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ROY F. WESTON, INC.
REGION II ALTERNATIVE REMEDIAL CONTRACTS STRATEGY (ARCS)
EPA CONTRACT NO. 68-W9-0022
FINAL DRAFT FOCUSED FEASIBILITY STUDY SECOND OPERABLE UNIT FOR THE CIRCUITRON CORPORATION SITE
EAST FARMINGDALE, NEW YORK

EPA Work Assignment No. 009-2LT3
Document Control No. 4200-15-ADVG

July 1994

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ROY F. WESTON, INC.

REGION II ALTERNATIVE REMEDIAL CONTRACTS STRATEGY (ARCS)
EPA CONTRACT NO. 68-W9-0022

FINAL DRAFT FOCUSED FEASIBILITY STUDY

SECOND OPERABLE UNIT

for the

CIRCUITRON CORPORATION SITE
East Farmingdale, New York

EPA Work Assignment No. 009-2LT3
Document Control No. 4200-09-ADVG

July 1994

VOLUME I

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REGION II ALTERNATIVE REMEDIAL CONTRACT STRATEGIES (ARCS)
EPA CONTRACT NO. 68-W9-0022

FINAL DRAFT FOCUSED FEASIBILITY STUDY FOR SECOND OPERABLE UNIT

for the

CIRCUITRON CORPORATION SITE
East Farmingdale, New York

EPA Work Assignment No. 009-2LT3
Document Control No. 4200-15-ADVG

July 1994

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EXECUTIVE SUMMARY

Roy F. Weston, Inc. (WESTON®) has prepared this Draft Focused Feasibility Study (FFS) for the Second Operable Unit (OU-2) representing off-property groundwater at the Circuitron Corporation Site in East Farmingdale, Suffolk County, New York. This work was performed for Work Assignment Number 015-2LIE under the United States Environmental Protection Agency (U.S. EPA) Alternative Remedial Contract Strategy (ARCS) Region II Contract Number 68-W9-0022. WESTON conducted a groundwater elevation monitoring program and Round 1 groundwater sampling of existing RI wells in May 1993. This was followed by a drive point groundwater field screening sampling program in August 1993; installation of two confirmatory monitoring wells; and Round 2 groundwater sampling in March 1994. These activities were performed to further delineate volatile organic groundwater contamination previously identified during the Remedial Investigation/Feasibility Study (RI/FS) completed by Ebasco Services Incorporated (Ebasco) in 1990.

The significant findings of the Ebasco RI/FS and WESTON drive point and groundwater sampling programs were that several on-property contamination source areas still exist at the Circuitron Corporation Site, and that both organic and inorganic contamination were evident in the groundwater in the Upper Glacial and Magothy aquifers. The groundwater contamination plume in the shallow Upper Glacial aquifer was determined to consist of elevated concentrations of organics (primarily 1,1,1-trichloroethane and 1,1-dichloroethene) and inorganics which have migrated up to at least 700 feet beyond the southern property line of the Circuitron Site. The site-related groundwater plume has an associated width of about 600 feet and extends vertically into the shallow portion (upper 40 saturated feet) of the Upper Glacial aquifer. Elevated concentrations of primarily organic contaminants were also present in the deeper portion of the Upper Glacial aquifer and the shallow Magothy aquifer, both upgradient and downgradient of the Circuitron Corporation Site.

The findings were based upon exceedances of New York State Drinking Water Standards and guidance values (Title 40 CFR-Part 141, 192) as well as the human health risk assessment. This assessment indicated that the contaminants in the groundwater in the shallow Upper Glacial aquifer at the Circuitron Corporation Site pose an elevated risk to human health. Although the shallow Upper Glacial aquifer is generally no longer used for public water supply in the area, remediation is warranted to protect the underlying Magothy aquifer from contamination present in the Upper Glacial aquifer. Two active public water supply wells draw water from the Magothy aquifer within a half-mile radius downgradient and adjacent of the Circuitron Corporation Site. The remedial investigation data and other data sources indicate that the two aquifers are hydraulically interconnected and no confining clay barriers exist between the two aquifers which would preclude the public supply pumping wells from inducing the downward migration of contamination into the Magothy aquifer.

Based upon the results of the field investigation, the focus of the Feasibility Study for off-property groundwater was on the contamination directly attributable to the Circuitron Corporation Site. Thus, it was focused on the shallow Upper Glacial aquifer.

The U.S. EPA and WESTON have determined that sufficient data exists regarding the contaminants in the shallow Upper Glacial aquifer (upper 40 feet of saturated thickness) to warrant a remedial action independent of the other contaminant concerns within the underlying deeper Upper Glacial and Magothy aquifers. This FFS does not address the groundwater contamination caused by any other facility/site, nor does it address the contamination present in the site soils, sludges, and/or sediment. The contamination sources at the Circuitron Corporation Site are presently being addressed as a separate operable unit (OU-1) under a Record of Decision dated March 4, 1991.

This Focused Feasibility Study (FFS) identifies and evaluates remedial alternatives that will facilitate remediation of contaminated groundwater present in the shallow portion of the Upper Glacial aquifer caused by past manufacturing and waste disposal practices at the Circuitron

Corporation Site. The remedial action objectives developed for the FFS include the remediation of the shallow Upper Glacial aquifer to meet ARAR requirements and further sampling of the groundwater in a downgradient direction to further define the extent of contamination. This FFS was prepared by WESTON, in accordance with the guidelines and format specified in the U.S. EPA 1988 document "Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA" under the supervision and guidance of U.S. EPA Region II.

Three potential remedial actions were evaluated in the FFS for remediation of groundwater in the Upper Glacial aquifer. The evaluation of the groundwater remedial alternatives is intended to lead to the selection of a groundwater remedial alternative by the U.S. EPA which will be in accordance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986. These remedial alternatives included:

GW-1	No Action/Institutional Action
GW-2:	Groundwater Pumping, Treatment using Aeration, Coagulation, Flocculation and Sedimentation/Air Stripping/Granular Activated Carbon/Reinjection using an Infiltration Gallery.
GW-3:	Air Sparging/Soil Vapor Extraction with Limited Groundwater Pumping for Hydraulic Containment and Groundwater Treatment using Aeration, Coagulation, Flocculation and Sedimentation/Air Stripping/Granular Activated Carbon and Either On or Off-Site Reinjection using an Infiltration Gallery.

Groundwater Remedial Action Alternatives GW-2 and GW-3 involve the pumping of contaminated groundwater from the Upper Glacial aquifer followed by their on-site treatment and subsequent reinjection. Alternative GW-3 includes only limited pumping for plume containment.

An analytical steady-state groundwater flow model (QUICKFLOW) was used to evaluate the location and pumping rates required to provide hydraulic containment of contaminated groundwater for Alternatives GW-2 and GW-3 in the Upper Glacial aquifer. The final simulation for hydraulic control of the contaminated groundwater plume involves the pumping of three recovery wells (RW-1 through RW-3) at a combined rate of up to 150 gallons per minute (gpm) for Alternative GW-2. Under Alternative GW-3, one extraction well (RW-3) will be pumped at 75 gpm for hydraulic control. Treated groundwater will be reinjected nearby crossgradient via infiltration galleries (approximate rate of 150 gpm and 75 gpm, respectively for GW-2 and GW-3) to be located either to the west or east of the northern (upgradient) property line of the Circuitron Corporation Site.

The three groundwater remedial action alternatives were subsequently evaluated against the criteria of:

- Overall Protection

  Alternatives GW-2 and GW-3 provide the greatest overall protection of human health through the containment of contaminated groundwater and the treatment of that groundwater. Alternative GW-2 and GW-3 are closed loop systems in which the Upper Glacial aquifer is recharged by the treated groundwater. Alternative GW-1, which offers no ground water or soil treatment, is the least protective alternative.

- Long Term Effectiveness and Permanence

  Alternatives GW-2 and GW-3 have good long-term effectiveness and permanence. Alternative GW-1 provides no treatment and is not considered to be effective.

- Reduction of Toxicity, Mobility, or Volume

Alternatives GW-2 and GW-3 reduce the mobility and toxicity of groundwater by the removal, treatment and destruction of volatile organic compounds and metals in the contaminated groundwater. Under Alternatives GW-2 and GW-3, the inorganic compounds will be separated and disposed off-site. Alternative GW-1 offers no treatment of the contaminated groundwater.

- Short-Term Effectiveness

Alternatives GW-2 and GW-3 in the short-term will halt the spread of contaminated groundwater in the Upper Glacial aquifer. Alternative GW-3 will address only the highest concentration portion of the volatile organic plume. Alternative GW-1 provides no treatment of groundwater and is not considered to be effective in the short-term because residual risks are not reduced.

- Implementability

Alternative GW-1 offers the greatest implementability followed by Alternative GW-2 which involves conventional technology with proven reliability. Alternative GW-3 involves the use of an innovative technology (i.e., air sparging and soil vapor extraction).

- Cost

Alternative GW-1, the no action alternative, has the lowest associated cost. Alternative GW-1 has a capital cost of about $5,000 and present worth of $5,000. Alternative GW-2 has a capital cost of about $1,963,100 and O&M costs of $675,000 per year for 10 years. The total present worth costs for Alternative GW-2 are $6,492,350. Alternative GW-3 has a capital cost of about $2,677,400 with associated O&M costs of $1,075,000 per year for 7 years. The total present worth costs for Alternative GW-3 are $8,274,170.

- Compliance with ARARs

  Alternative GW-1 does not comply with ARARs because no remedial actions take place. Alternatives GW-2 and GW-3 both comply with ARARs such as OSHA, RCRA and appropriate Clean Air and Water Acts. State and Federal ARARs pertaining to the reinjection of treated groundwater will be complied with during the remedial actions.

- State and Community Acceptance

  Issues pertaining to state and community acceptance will be addressed once comments are received.

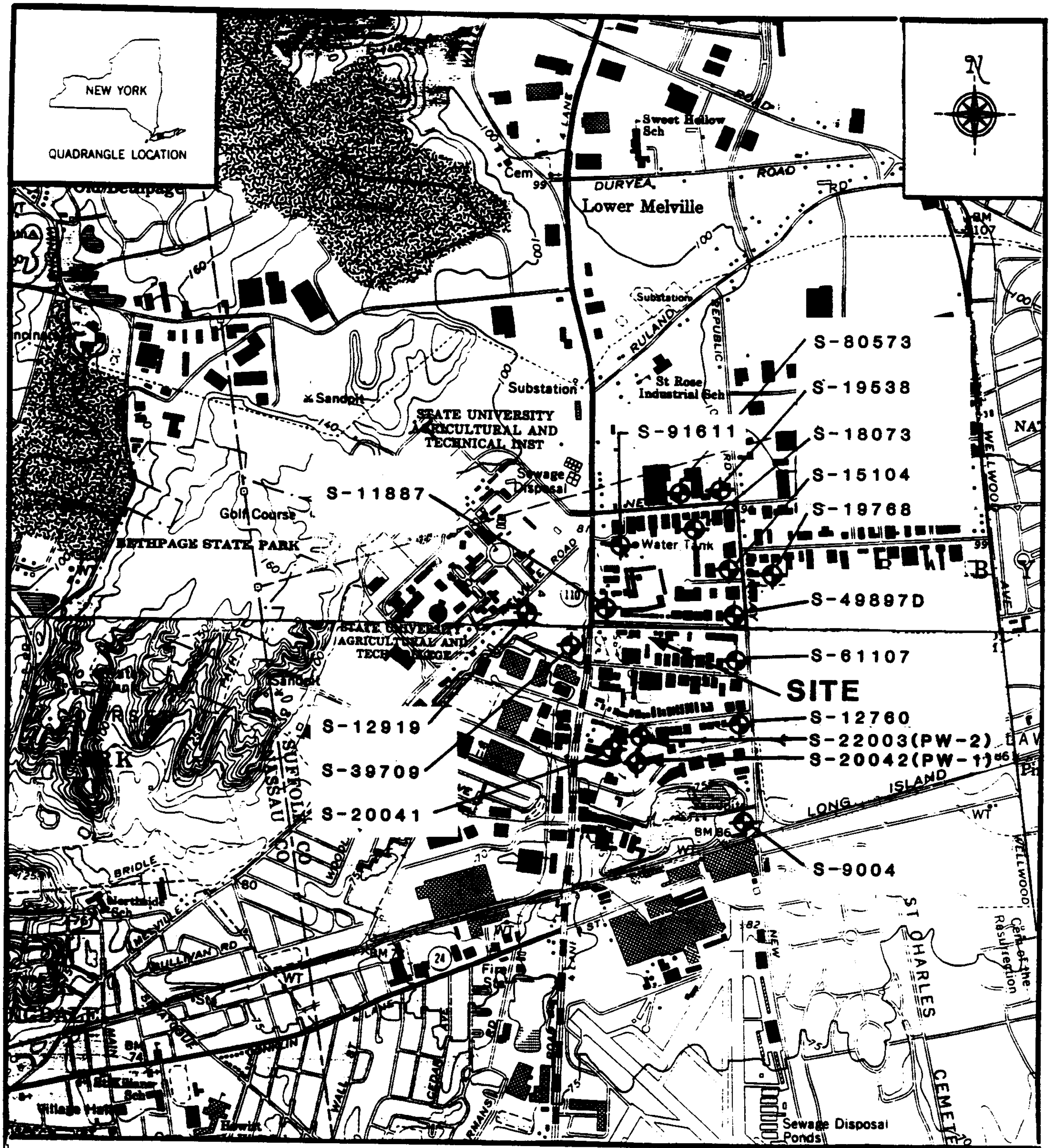
SECTION 1
SITE HISTORY AND PROJECT DEVELOPMENT

1.1 Introduction

Roy F. Weston, Inc. (WESTON®) has prepared this Draft Focused Feasibility Study (FFS) for the Second Operable Unit (OU-2) representing off-property groundwater at the Circuitron Corporation Site in East Farmingdale, Suffolk County, New York (Figure 1-1). This work was performed for Work Assignment Number 015-2LIE under United States Environmental Protection Agency (U.S. EPA) Alternative Remedial Contracts Strategy (ARCS) Region II Contract Number 68-W9-0022. This assignment requested WESTON to perform the following tasks as part of the preparation of a Focused Feasibility Study:

- Round 1 Groundwater Sampling
- Groundwater Elevation Measurements
- Drive Point Groundwater Sampling
- Monitoring Well Installation
- Round 2 Groundwater Sampling
- Hydrogeologic (Slug) Testing
- Long Term Groundwater Elevation Monitoring

WESTON conducted a Round 1 groundwater sampling of existing RI wells in May 1993. This was followed by a drive-point groundwater field screening sampling program in August 1993 to further delineate volatile organic groundwater contamination previously identified during the Remedial Investigation/Feasibility Study (RI/FS) completed by Ebasco Services Incorporated (Ebasco) in 1990. Two (2) confirmatory monitoring wells were installed by WESTON during this program and a second round of groundwater sampling of existing RI and confirmatory monitoring wells was completed in February 1994.



SOURCE: USGS 7.5 MINUTE SERIES AMITYVILLE AND HUNTINGTON QUADRANGLES (1979)

SCALE 1:24000

1 ½ 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

WESTON
MANAGERS DESIGNERS/CONSULTANTS

FIGURE 1-1
CIRCUITRON CORPORATION
SITE LOCATION MAP
EAST FARMINGDALE, NY

The significant findings of the Ebasco RI/FS and WESTON drive point and groundwater sampling programs were that several on-property contamination source areas still exist at the Circuitron Corporation Site, with organic and inorganic contamination evident in the groundwater in the Upper Glacial and Magothy aquifers.

The plume attributable to the Circuitron Corporation Site was determined to consist of elevated concentrations of both organics and inorganics which have migrated up to approximately 675 feet beyond the southern property line of the Circuitron Site. The organic chemicals are primarily 1,1,1-trichloroethane and 1,1-dichloroethene. The inorganic species present are primarily copper and chromium. The site-related groundwater plume has an associated width of about 600 feet and extends vertically into the shallow portion (upper 40 saturated feet) of the Upper Glacial aquifer. Elevated concentrations of organic contaminants were also present in the deeper portion of the Upper Glacial aquifer and the shallow Magothy aquifer, both upgradient and downgradient of the Circuitron Corporation Site. Based upon the results of the field investigation, the focus of the Feasibility Study for off-property groundwater was on the contamination directly attributable to the Circuitron Corporation Site.

The findings of elevated concentrations were based upon exceedances of New York State Drinking Water Standards and guidance values (Title 40 CFR-Part 141, 192) as well as the results of a human health risk assessment. This assessment indicated that contaminants in the groundwater in the shallow Upper Glacial aquifer at the Circuitron Corporation Site pose an elevated risk to human health. The remedial action objectives developed for the FFS include the remediation of the shallow Upper Glacial aquifer and further sampling of the groundwater in a downgradient direction to further define the extent of contamination.

1.1.1 Purpose of the Focused Feasibility Study

This Focused Feasibility Study (FFS) identifies and evaluates remedial alternatives that will facilitate remediation of contaminated groundwater present in the shallow portion of the Upper

Glacial aquifer caused by past manufacturing and waste disposal practices at the Circuitron Corporation Site. This FFS was prepared by WESTON, in accordance with the U.S. EPA's "Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA" (U.S. EPA, 1988) under the supervision and oversight of U.S. EPA Region II.

Although the Upper Glacial aquifer is generally no longer used for public water supply in the area, remediation is warranted to protect the underlying Magothy aquifer from contamination present in the Upper Glacial aquifer. The Magothy aquifer is the primary aquifer of use for public water supply in Suffolk County. Numerous public water supply well fields draw water from the Magothy aquifer in areas downgradient from the Circuitron Corporation Site. The remedial investigation data and other data sources indicate that the two aquifers are hydraulically interconnected and no confining clay barriers exist between the two aquifers which would preclude the public supply pumping wells from inducing the downward migration of contamination into the Magothy aquifer.

WESTON has found that the groundwater in the shallow Upper Glacial aquifer (WESTON, 1994) to contain inorganic compounds and volatile organic compounds above the New York State Drinking Water Quality Standards or Guidance Values for this class of groundwater (Class GA). The nature and extent of groundwater contamination is further discussed in Section 2. The U.S. EPA and WESTON have determined that sufficient data exists regarding the contaminants in the shallow Upper Glacial aquifer (upper 40 feet of saturated thickness) to warrant consideration of a remedial action independent of the other contaminant concerns within the underlying deeper Upper Glacial and Magothy aquifers.

The evaluation of the groundwater remedial alternatives presented in this FFS is intended to lead to the selection of a groundwater remedial action alternative in accordance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986.

Section 121 of CERCLA requires that remedial actions achieve a level of cleanup of hazardous substances that:

a. Protect human health and the environment, and

b. Meet all applicable standards promulgated by the U.S. EPA or the New York State Department of Environmental Conservation (NYSDEC) for any hazardous substances. In addition, the remedial action should be consistent with cleanup criteria and requirements that are relevant and appropriate under the circumstances of the release or threatened release of such hazardous substances or contaminants (CERCLA Section 121).

1.1.2 Focused Feasibility Study Approach

This FFS for OU-2 is intended to support U.S. EPA decision making regarding a remedial action for groundwater contamination present in the shallow Upper Glacial aquifer (upper 40 feet of saturated thickness) caused by past manufacturing and waste disposal practices at the Circuitron Corporation Site. It does not address the groundwater contamination caused by any other facility/site, nor does it address the contamination present in the site soils, sludges, and/or sediment. The contamination sources at the Circuitron Corporation Site are presently being addressed as a separate operable unit (OU-1) under a Record of Decision dated March 4, 1991.

The approach to conducting this FFS follows the guidelines outlined in the U.S. EPA 1988 "Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA," which reflect the emphasis and provisions of SARA. Accordingly, the Circuitron Corporation FFS evaluation of remedial action alternatives is divided into the following three sections:

- Section I - DEVELOPMENT OF REMEDIAL ACTION ALTERNATIVES
  - Identification of appropriate remedial action objectives.

  - Development of general response actions for each remedial action objective.
  - Determination of feasible technologies associated with each general response action.
  - Screening of each technology based on effectiveness, implementability and relative cost.
  - Assembling the technologies into remedial action alternatives.

- Section II - SCREENING OF REMEDIAL ACTION ALTERNATIVES

  - Description of each remedial action alternative and the basis for its development.
  - Screening of alternatives based on short-term and long-term analyses of effectiveness, implementability and cost.
  - Selection of alternatives for detailed evaluation and analysis.

- Section III - DETAILED ANALYSES OF ALTERNATIVES

  - Further definition of each remedial action alternative with respect to the volumes of hazardous substances to be addressed, the technologies to be used, and any performance requirements associated with those technologies.
  - Evaluation and comparison of alternatives with respect to the criteria of:

    - Overall protection of human health and the environment;
    - Compliance with Applicable or Relevant and Appropriate Requirements (ARARs);
    - Long-term effectiveness;
    - Reduction of toxicity, mobility or volume;

- Short-term effectiveness;
- Implementability;
- Cost;
- State acceptance; and
- Community acceptance.

Figure 1-2 outlines the three phases and the steps involved in completing the FFS process. In this FFS, Section 1.2 provides site background information regarding site location and description, site history and previous sampling activities, while Sections 1.3 and 1.4 provide the regulatory file review and the review of aerial photography. Section 2 presents the nature and extent of groundwater contamination, while Section 3 presents the conceptual site model. A baseline human health risk assessment is provided in Section 4. The FFS remedial alternative evaluations are provided in Sections 5, 6 and 7. Section 8 is a listing of references cited in this report.

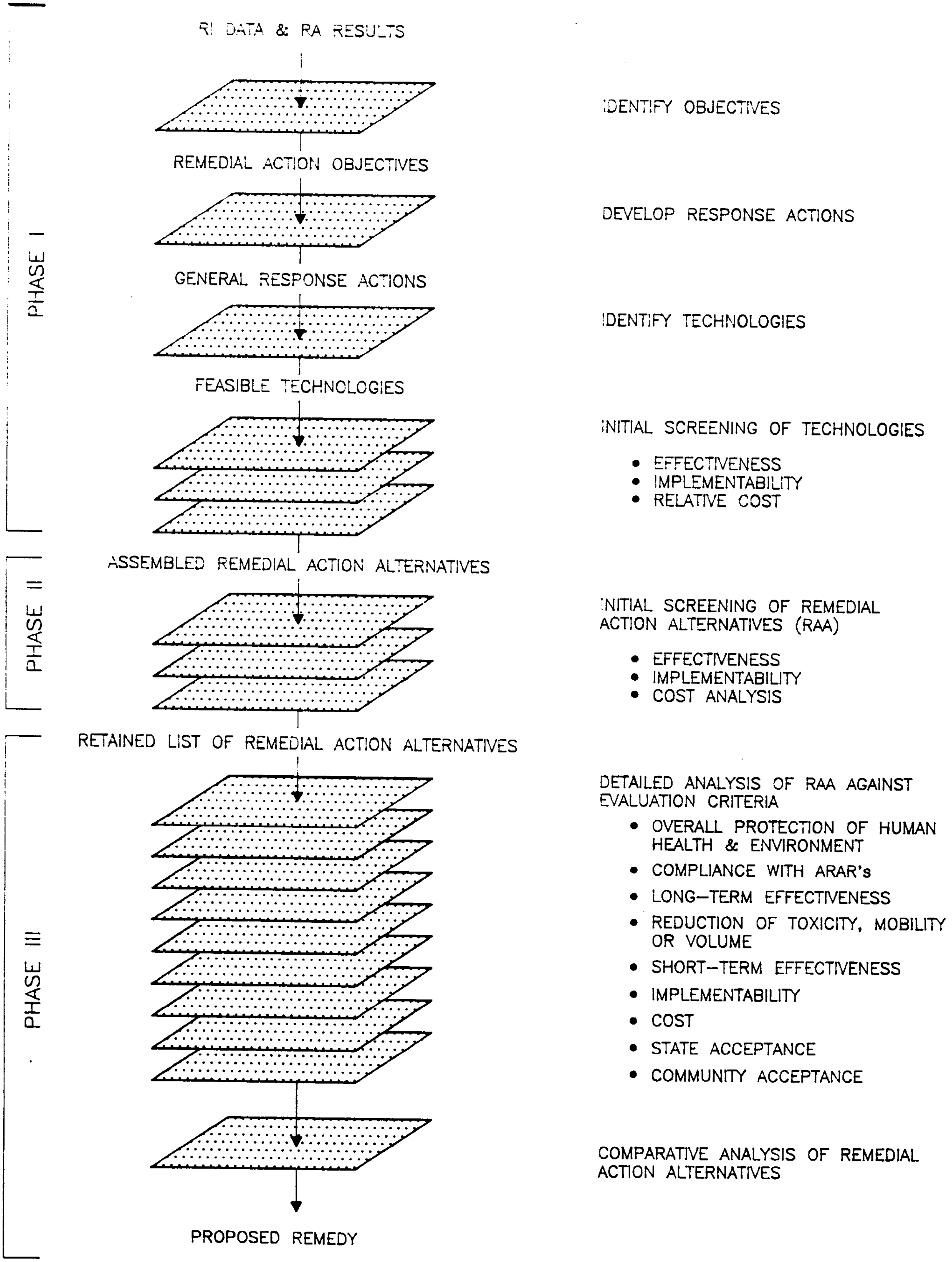
1.2 Site Background and Setting

1.2.1 Overview of Site Features

The Circuitron Corporation Site is located at 82 Milbar Boulevard in East Farmingdale, New York at Latitude 40°, 44' 58" north and Longitude of 73°, 25', 07" west (see Figure 1-1). This 0.9 acre site is situated in a densely populated industrial/commercial area just east of Route 110 and the State University of New York (SUNY). The site has been vacant since May or June of 1986.

A detailed site plan is presented in Figure 1-3. According to the RI report (Ebasco, 1990), at least two unauthorized leaching pools (LP-5 and LP-6) exist below the concrete floor in the plating room (see Figure 1-3). LP-5 is located slightly south of the middle of the plating room and LP-6 is near the southern corner of the plating room. Sunken areas in the concrete floor of the building near the middle and the front of the plating room indicate the presence of two

FIGURE 1-2
FOCUSED FEASIBILITY STUDY PROCESS
CIRCUITRON CORPORATION SITE, EAST FARMINGDALE, NEW YORK



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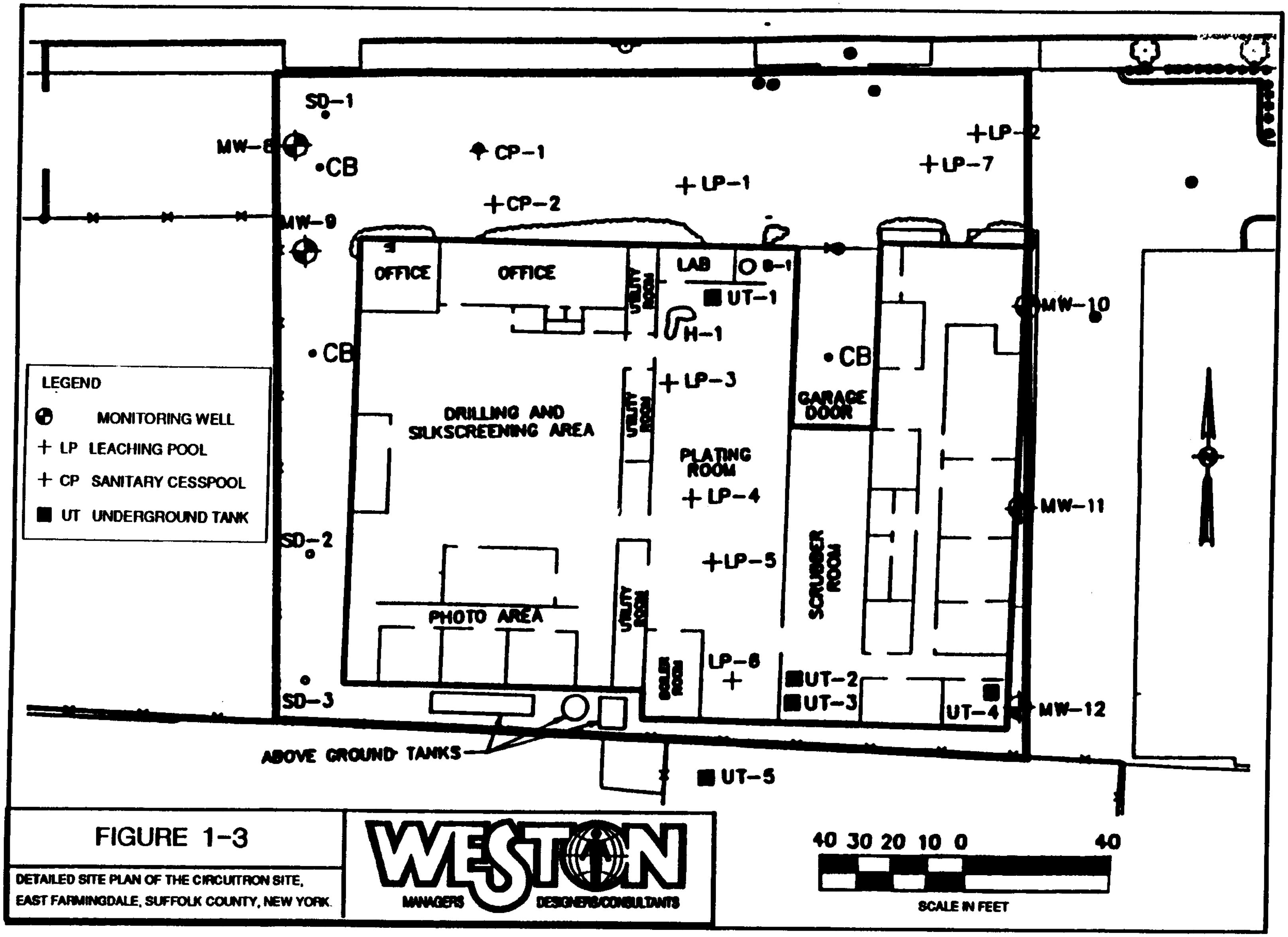

FIGURE 1-3

DETAILED SITE PLAN OF THE CIRCUITRON SITE, EAST FARMINGDALE, SUFFOLK COUNTY, NEW YORK.

additional unauthorized leaching pools (LP-3 and LP-4) (see Figure 1-3).

In addition, Figure 1-3 illustrates the presence of a hole in the floor (H-1) towards the northwest corner of the plating room, a wastewater treatment basin (B-1), an oil spill at the southeast corner of the scrubber room, and four underground tanks (UT-1 in the plating room, UT-2 and UT-3 by the oil spill in the scrubber room and UT-4 in the office area). Figure 1-3 also shows that a series of leaching pools underlies the parking lot in front of the building. There are two primary leaching pools which have been designated as LP-1 and LP-2. LP-1 has a permitted wastewater discharge (State Pollution Discharge Elimination System (SPDES) permit) located on the north side of the property in front of the laboratory, below a manhole.

LP-2 is located in the northeast corner of the site. LP-2 consists of a series of leaching pools beginning with a distribution chamber. The distribution chamber (LP-2) is approximately 5 feet deep. The distribution chamber is a concrete ring approximately 4 feet in diameter with a pipe from the building entering at the top, and three pipes at the bottom discharging to at least three separate leaching pools. The bottom of the distribution pool appears to be sand.

In addition to LP-1 and the LP-2 system, at least two sanitary cesspools (CP-1 and CP-2) have been documented to exist below the parking lot in front of the northwest corner of the building (see Figure 1-3). The sanitary cesspools were authorized to accept sanitary wastes only. However, Suffolk County Department of Health Services (SCDHS) sample analyses indicated that the cesspools may have received hazardous materials.

A line of interconnected storm drains exists on the western portion of the site (see Figure 1-3). The storm drain depths range from 10 feet to approximately 18 feet below grade. Two additional storm drains are located outside the building in an area between the plating room and the storage area in front of the garage door to the scrubber room.

1.2.2 Historical Site Use

A chronology of regulatory and historical events for the site is provided in Table 1-1. The Circuitron Corporation began operations in 1961 as a circuit board manufacturing facility. Processes in this industry include silk screening, circuit board etching, washing, rinsing, and painting. Chemicals used for this included acids, solvents, degreasers, and alkalies. Wastes resulting from the operations at Circuitron have historically been discharged into a number of unauthorized and unpermitted leaching pools, as well as onto an on-site storm drain. The original ownership was under the 82 Milbar Corporation, with Mario Lombardo and Julius D'Amato listed as the principle owners. The company was sold in 1983 to F.E.E. Industries, which in turn sold it to ADI Electronics, the current owner, in 1984. The site property is still owned by the 82 Milbar Corporation.

1.2.3 Regulatory History

The facility had an approved New York State Pollutant Discharge Elimination System (SPDES) permit to discharge industrial waste to leaching pools located under the parking lot to the north of the building. This permit, number NY-007-5655, was terminated in 1986 when the facility was vacated by the owners. Circuitron Corporation had a history of permit violations and warnings from the SCDHS and the New York State Department of Environmental Conservation (NYSDEC). The Circuitron Corporation installed five monitoring wells on the site during March and April of 1985. The locations were approved by the SCDHS, however, no records or well logs are available. The premises were vacated by the Circuitron Corporation sometime in May or June of 1986, leaving behind numerous containers and 55 gallon drums in and behind the building. These drums were subsequently removed as part of the U.S. EPA remedial investigation activities.

TABLE 1-1

CIRCUITRON CORPORATION SITE

CHRONOLOGY OF EVENTS AT THE CIRCUITRON CORPORATION SITE

1961	Circuitron Corporation begins operation at the site. The Corporation is owned by 82 Milbar Corporation, of which Julius D'Amato and Mario Lombardo are principal owners.
Approx. May 1981	An exchange of Circuitron Corporation stock takes place. Mario Lombardo gets 100 percent ownership of Circuitron Corporation, and Julius D'Amato gets 100 percent ownership of the property and 82 Milbar Corporation.
June 23, 1983	A fire at the facility destroys 95 percent of the east side of the building.
Unknown date, 1983	Circuitron Corporation is purchased by F.E.E. Industries.
November 16, 1983	SCDHS samples the SPDES industrial leaching pool LP-1. Analytical results indicate that permit violations have occurred.
February 2, 1984	SCDHS orders Circuitron Corporation to clean out the SPDES leaching pool.
Unknown date, 1984	ADI Electronics purchases Circuitron Corporation from F.E.E. Industries.
March 1984	The new owners discover that wastewater is being discharged to a storm drain in the southwest corner of the property and they notify SCDHS.
June 4, 1984	SCDHS Commissioner issues a 10-point Order of Consent for cleanup of illegal discharge (IW 84-46) (SCDHS, 1984).
June 27, 1984	Joseph Mignone, President of Circuitron Corporation, agrees to Order of Consent.

TABLE 1-1 (cont)

July 20, 1984	Circuitron Corporation cleans out the storm drain in the southwest corner as per Order of Consent.
November 1984	ADI Electronics discovers unauthorized leaching pool below the floor of the plating room and informs SCDHS.
December 12, 1984	SCDHS inspectors sample the unauthorized leaching pool. One of their inspectors collapses from solvent fumes emanating from the pool.
December 14, 1984	U.S. EPA requests the Field Investigation Team (FIT 2) to perform a Site Inspection/Preliminary Assessment on the site as a result of an article published in Newsday.
March 7, 1985	An Administrative Hearing is held, at which time Circuitron Corporation agrees to terms of a Stipulated Agreement.
March 14, 1985	SCDHS issues the Stipulated Agreement, DHS No. IW0885 (SCDHS, 1985).
March 25, 1985	The U.S. EPA FIT 2 contractor (NUS Corporation) submits PA/Site Evaluation Report to U.S. EPA, recommending that a groundwater study be conducted.
March 26 to April 5, 1985	SCDHS inspectors dye test the Circuitron Corporation's plumbing as per the Stipulated Agreement.
April 4, 1985	Samples collected indicate that unauthorized leaching pools were receiving discharges of toxic and hazardous materials.
April 1985	ADI Electronics informs SCDHS that Circuitron Corporation will vacate the premises and abandon operations at the site.
Approx. Mid-March Mid-April 1985	Circuitron Corporation installs five groundwater monitoring wells. The wells were never approved by SCDHS. There are no engineering reports or well installation reports available on the monitoring wells.

May 9, 1985	Former owner, Mario Lombardo, plead guilty to charges of unauthorized disposal of hazardous waste, N.Y.S. Environmental Conservation Law, Section 27 09-14. He is fined $50,000 and sentenced to 700 hours of community service.
May 31, 1985	SCDHS notifies Circuitron Corporation that an environmental cleanup of all toxic and hazardous materials and a groundwater quality study should be required, prior to abandoning the facility.
September 1, 1985	Circuitron Corporation allows their SPDES permit to expire. They continue to discharge to the SPDES leaching pool through March 31, 1986.
September 10, 1985	SCDHS samples the five on-site monitoring wells. Analytical results indicate the presence of 1,1,1-trichloroethane in the three downgradient wells.
October 29, 1985	NYSDEC samples the SPDES industrial leaching pool. Analytical results indicate the presence of phenols, 1,1,1-trichloroethane, and 1,1-dichloroethane in excess of N.Y.S. ambient water quality standards.
January 17, 1986	SCDHS samples SPDES leaching pool. Analytical results indicate the presence of methylene chloride.
Mid-May to End-June, 1986	Circuitron Corporation vacates the facility at some time during this period. They remove all equipment of value and leave various accumulated wastes at the facility.
May 28, 1986	Over a 12-month period covering 4/85-3/86, NYSDEC noted 104 SPDES permit violations.
July 1, 1986	NYSDEC inspects the Circuitron Corporation facility. They find the building vacated. Employees in neighboring buildings indicate that no one has been at the facility for at least a month. The SPDES industrial pool was dry, and eight 55-gallon drums with a strong solvent odor were left outside behind the building.

TABLE 1-1 (cont)

September 12, 1986	NYSDEC officially notifies Circuitron Corporation that it has deleted their SPDES permit based on the July 1, 1986, inspection indicating discharge ceased.
April 15, 1987	U.S. EPA directs NUS to conduct a Site Inspection at the Circuitron Corporation Site.
May 14, 1987	NUS conducts a site reconnaissance of the site for sampling to be conducted at a later date.
May 15, 1987	Based on conditions observed at the site, NUS recommends that U.S. EPA conduct an Emergency Response Action at the site.
May 16, 1987	U.S. EPA Emergency Response Team (ERT) and Technical Assistance Team (TAT) inspect the Circuitron facility.
May 18, 1987	ERT recommends a Removal Action at the site.
May 19, 1987	U.S. EPA directs NUS to conduct an Expanded Site Inspection (ESI) at the Circuitron Corporation Site. U.S. EPA requests NUS to complete the Site Inspection Report and Hazard Ranking Model for the site, based on existing state and county data.
May 28, 1992	Fencing of site and removal of debris found on site.
June 1987	A removal assessment by the Response and Prevention Branch (now Removal Branch) reveals approximately 380 containers of varying size within the building.
August 10, 1988	An Action Memorandum is signed authorizing Superfund Removal funds for the action. Sometime during the period of June 1987 to August 10, 1988, the PRP removes a substantial number of the containers left inside the building. Removal activities are halted due to a request from the U.S. EPA Office of Regional Counsel.

TABLE 1-1 (cont)

September 28, 1988	U.S. EPA awards Work Assignment 004-2L1E for performance of a Remedial Investigation/Feasibility Study to Ebasco Services Incorporated. The U.S. EPA Contract Number is 68-W8-0110.
October 14, 1988	U.S. EPA officials, Ebasco officials and Julius D'Amato inspect the Circuitron Corporation Site.
November 15, 1988	Ebasco Draft Work Plan submittal.
December 5, 1988	Ebasco Draft Field Operations Plan (FOP) submittal.
December 14 to December 16, 1988	U.S. EPA conducts initial sampling activities for compatibility and disposal.
February 17, 1989	Ebasco Final Work Plan submittal.
February 22 to February 23, 1989	U.S. EPA performs additional sampling including the underground structure.
February 24, 1989	Ebasco Final FOP submittal.
April 17 to May 10, 1989	U.S. EPA Emergency Response Actions remove 20 drums, clean out USTs, remove 3 above ground storage tanks and clean-up interior debris.
May 4, 1989	U.S. EPA performs wipe and air sampling.
May 18, 1989	Ebasco performs a geophysical survey at the Circuitron Corporation Site for the determination of the exact location of underground structures expected to exist below the parking lot and the ground at the rear of the building.
June 8, 1989	U.S. EPA approves the final Work Plan and FOP prepared by Ebasco.
June 13 through October 10, 1989	Ebasco conducts the field investigation activities at the at the Circuitron Corporation Site for the collection of data

	required for the performance of the Remedial Investigation/Feasibility Study.
December 11, 1989	Ebasco conducts one round of groundwater sampling of downgradient private well S-22003.
March 29, 1991	Record of Decision issued for site (OU-1).
June 24, 1991	Initiation of Record of Decision for OU-1.
May 28, 1992	Fencing of site and removal of debris found on site.
July - September 1992	U.S. EPA approves Final Work Plan and Sampling Analysis Plan for implementation of Focused Feasibility Study for the Second Operable Unit (OU-2) Groundwater by Roy F. Weston (WESTON).
February 1993	A Public Health Assessment was issued for the site by NYSDOH under a cooperative agreement with the Agency for Toxic Substance and Disease Registry.
March 1993	30% Remedial Design document submitted by ICF to U.S. EPA
March 29, 1993	60% Remedial Design document submitted by ICF to U.S. EPA for excavation and building demolition.
May 10 - 14, 1993	Round 1 Groundwater Sampling by WESTON under FFS.
August 16 - 24, 1993	Drivepoint Groundwater Sampling under FFS.
February 1994	Monitor Well Installations and Round 2 Groundwater Installation by WESTON under FFS.
March 9, 1994	Soil Vapor Extraction pump test completed by ICF.
April 14, 1994	U.S. EPA obtained clearance to demolish building.
May 1994	Submittal of Draft FFS by WESTON to U.S. EPA.

In December 1983, the SCDHS collected samples from the unauthorized leaching pools and the former SPDES permitted industrial leaching pool that indicated that the facility was discharging substances not covered by their SPDES permit. As a result of this activity, U.S. EPA directed its Field Investigation Team (FIT) to perform a Preliminary Assessment and Site Inspection. At a March 7, 1985 Administrative Hearing Circuitron Corporation agreed to terms of a Stipulated Agreement, DHS No. IW0885, subsequently issued on March 14, 1985. Additional sample collection and analysis revealed that toxic substances and hazardous wastes were being discharged without treatment, into unauthorized leaching pools and into a storm drain located in the southwest corner of the site. After informing the SCDHS in April 1985 that Circuitron Corporation would be abandoning the site, five unapproved monitoring wells were installed. SCDHS notified Circuitron in September that a cleanup of hazardous materials and a groundwater study would be required prior to abandoning the facility.

On May 9, 1985, the original owner, Mario Lombardo, pleaded guilty to charges of violating New York State Environmental Conservation Law Section 27 09-14, unauthorized disposal of hazardous waste. He was fined $50,000 and sentenced to 700 hours of community service.

Circuitron Corporation's SPDES permit expired in September of 1985, however, wastes were still discharged into the leaching pool until early 1986. As a result, Circuitron Corporation was sited for 104 SPDES violations as a result of those discharge. A series of samples collected from the leaching pools and monitoring wells revealed the presence of 1,1,1-trichloroethane, 1,1-dichloroethane, and methylene chloride. Circuitron Corporation abandoned the facility in mid-1986, without satisfactory compliance with the SCDHS Agreement.

1.2.4 Drainage and Surface Waters

Western Suffolk County lies within the glaciated portion of the Atlantic Coastal Plain physiographic province. Most of the land surface in the area is a gently rolling, slightly dissected southward-sloping plain with a grade of about 20 ft per mile. The relatively even surface is cut by very shallow valleys that contain streams or lakes. Most of the lakes are reaches of streams that have been ponded artificially for purposes of water supply or recreation. The area of the watershed is urban residential.

The Circuitron Corporation site is located on relatively flat ground at an elevation of approximately 85 ft above mean sea level (MSL), with a slight slope up to the south and east. The building and paved surfaces cover more than 90 percent of the site, making it nearly impermeable. After runoff from the pavement, virtually all the rainfall that does not evaporate or is not used by plants percolates quickly into the soil.

The headwaters of Amityville Creek are located approximately 4.5 miles south of the site. The headwaters of the east branch of Massapequa Creek are closer, approximately 3.5 miles to the southwest, but are not a part of the same drainage basin. Drainage from the site is primarily surface runoff into the storm sewers or leaching pools to the north and west of the site. Stormwater entering the storm drains goes to the County stormwater management system. Stormwater entering the leaching pools percolates directly to the water table, eventually resulting in groundwater seepage into the streams south of the site. These streams drain directly into the Atlantic Ocean.

1.2.5 Regional Geology and Hydrogeology

Western Suffolk County is underlain by a section of unconsolidated deposits ranging in age from Pleistocene to Cretaceous. These sediments form a wedge which ranges from a maximum thickness of 1700 feet offshore to approximately 850 feet in the vicinity of the site. This section discusses the glacial outwash deposits and marine clays of Pleistocene age and the Magothy Formation of Cretaceous age. Table 1-2 summarizes the stratigraphy of the area.

The Magothy Aquifer is the main aquifer of use in the area. Of the 19 water supply wells located within two miles of the site, 17 are screened in the Magothy. The closest supply wells located downgradient of the site are in the East Farmingdale Water District Wellfield #2 on Gazza Boulevard approximately 1500 feet south of the site (see Figure 1-1).

TABLE 1-2 SUMMARY OF THE STRATIGRAPHY AND WATER BEARING PROPERTIES OF THE DEPOSITS UNDERLYING WESTERN SUFFOLK COUNTY, NEW YORK

Series	Geologic Unit		Approximate Thickness (feet)	Depth from Land Surface to Top (feet)	Characters of Deposits	Water-Bearing Properties
Pleistocene	Upper Pleistocene Deposit	Outwash	80-140	0	Outwash consists mainly of brown fine to coarse sand gravel, stratified. In souther part interbedded with "20-foot" clay.	Sand and gravel part of outwash highly permeable; yields as much as 1,700 gpm per well reported. Specific capacities of wells as much as 109 gpm per ft. of drawdown. Water generally confined except beneath shallow clays in southern part of area. Water fresh except near shoreline.
		"20-foot" Clay	0-40	25-80	Clay and silt, gray and grayish green; some lenses of sand and gravel. Contains shells, Foraminifera, and peat. Altitude of top about 20 ft. below mean sea level. Interbedded with outwash in southern part of area.	Relatively impermeable confining unit.
	Gardiners Clay		65	55-160	Clay and silt, grayish-green; some lenses of sand and gravel. Contains lignitic material, shells, glauconite, Foraminifera, and diatoms. Interglacial deposit. Altitude of surface about 50 ft. or more below mean sea level.	Relatively impermeable confining layer.
Upper Cretaceous	Magothy Formation		30-1,000	40-350	Sand, fine to medium, gray; interfingered with lenses and coarse sand, sandy clay, silt, and solid clay. Generally contains gravel in lower 50 to 100 ft. Some sandy zones and beds of clay may be extensive. Lignite and pyrite abundant.	Moderately to highly permeable. Principal source for public supply. Yields large quantities of water from several zones. Individual wells yield as much as 2,200 gpm. Specific capacities as much as 80. Water contained under artesian pressure; some wells in southern part of area flow. Water generally is of excellent quality.

1.2.5.1 Outwash Deposits

The Pleistocene outwash sediments have a thickness of 80 to 140 feet in the vicinity of the site. They are composed of stratified beds of fine to coarse sand and gravel which consist chiefly of iron-stained quartz with some biotite, chlorite, hornblende, and fragments of igneous and metamorphic rocks. These constituents help distinguish Pleistocene sediments from those of the underlying Magothy Formation, which consists mainly of quartz with some lignite and muscovite and only about 2 to 3 percent heavy minerals. The lower contact is sharp where the outwash deposits overlie the Gardiners Clay, which is a silty and sandy clay.

The outwash deposits are highly permeable and contain large quantities of water. Individual wells are reported to yield as much as 1700 gallons per minute (gpm) and have a specific capacity of 109 gpm per foot of drawdown (Lockwood, Kessler and Bartlett, 1985). Data from aquifer tests indicate the average hydraulic conductivity of the outwash deposits is 1300 gallons per day per square foot (gpd/ft^2) and the storage coefficient is 0.24. Laboratory tests indicate an average porosity of 35 percent. The permeability of the deposits in the horizontal direction is estimated to be five to ten times greater than in the vertical direction, owing mainly to stratification of lenses of lower permeability silts and clays (Perlmutter and Geraghty, 1963). The groundwater in the outwash deposits underlying the site occurs mainly under water table conditions.

Recharge to the hydrologic system occurs from precipitation and subsurface inflow. Precipitation averages 45 inches per year. The groundwater reservoir is recharged additionally by infiltration of domestic and industrial liquid wastes from cesspools, seepage fields and disposal basins (Perlmutter and Geraghty, 1963).

1.2.5.2 20-Foot Clay

The name "20-foot clay" was assigned by Perlmutter and Geraghty to relatively thin beds of marine clay that occur at elevations of 20 to 35 feet below mean sea level (MSL) (Perlmutter and Geraghty, 1963). The clay ranges in thickness from 0 to 40 feet and consists of layers of fossiliferous gray and greenish gray silt and clay of shallow marine origin. These constituents contrast with clays of the Magothy Formation, which are described as generally light brown or tan in color and are composed of clay minerals, muscovite, and quartz.

The 20-foot clay is overlain by the outwash deposits described in the previous section. According to Perlmutter and Geraghty (1963), in most of southwestern Suffolk County, outwash also underlies this clay and separates it from the deeper Gardiners Clay. Perlmutter and Geraghty (1963) defined the northern limit of this clay as near the Southern State Parkway, thus the clay cannot be considered a confining layer in the area of the site (Perlmutter and Geraghty, 1963).

Little data is available regarding the permeability of the 20-foot clay, although its physical characteristics as reported in well logs suggests that it probably transmits water very slowly and that it acts as a confining layer.

1.2.5.3 Gardiners Clay

The Gardiners Clay is a gray and greenish gray clay and silt which is found at elevations of 50 to 120 ft below sea level. It was deposited in shallow bays and estuaries during an interglacial period and is distinguished from clays of the Magothy Formation by the presence of biotite, chlorite, glauconite, shell fragments and partly carbonized plant material. The upper interface with the outwash deposits and the lower interface with the Magothy Formation, are unconformable.

The northern limit of the Gardiners Clay in Suffolk County was tentatively defined as midway between the Sunrise Highway and the Southern State Highway, thus this clay cannot be considered a confining layer in the area of the site. The Gardiners Clay has a very low permeability and serves as a confining unit in southern Suffolk County. Up to 13 ft of head difference has been reported in places between the wells screened above and below the Gardiners Clay.

1.2.5.4 Magothy Formation

The Magothy Formation is a sequence of non-marine sediments which is approximately 700 feet thick in the vicinity of the site. Most of the sand of the Magothy Formation is gray or tan and fine to medium grained, contrasting with darker, coarser textured sand and gravel that comprise the Pleistocene outwash deposits. As mentioned in the previous sections, the Magothy clays are distinguished from clays of Pleistocene age by the absence of marine fossils and by color, which may be white, light and dark gray, yellow, tan or black. The upper contact of the formation, which is an erosional surface, can be recognized by differences in color, texture and composition between beds of the Magothy and the Pleistocene outwash deposits and clays.

The Magothy is the main aquifer of use in Suffolk County. The porosity is estimated between 28 and 35 percent and aquifer tests place transmissivity values between 50,000 and 250,000 gpd/ft. Large diameter wells, having screens as much as 60 feet in length, individually yield as much as 2200 gpm. Specific capacities of many such wells are on the order of 30 or 40 gpm per foot of drawdown. The ability of the Magothy Formation to yield substantial quantities of water year after year generally can be attributed to the large thickness of saturated material. The groundwater occurs under unconfined conditions.

Owing to interbedding of coarse and fine-grained materials, the permeability of the Magothy Formation is greatest in a direction parallel to bedding and least perpendicular to it. The average hydraulic conductivity of the Magothy Aquifer in the horizontal direction is estimated to be 500 gpd/ft^2 but the average hydraulic conductivity in the vertical direction may be less than 10 percent of that in the horizontal direction (Perlmutter and Geraghty, 1963).

1.2.6 Site Hydrogeology

Boring logs obtained from the 1990 RI report by Ebasco indicate that the uppermost 72 to 80 feet of sediments in the study area consist of moderately to poorly sorted sand and gravel outwash deposits that are probably of Pleistocene age. These sediments were underlain by well sorted, fine to medium grained quartzitic sand believed to be associated with the Magothy Formation. No discernable clay units that might be associated with the "20-foot clay" or Gardiners Clay were found and, therefore, there was no visible evidence of a local or regional confining unit separating the Pleistocene deposits and the lower Cretaceous sediments. The borings penetrated sediments to a depth of 100 feet. Based on observations made during the RI, groundwater in these two units occurs under unconfined conditions. According to the literature (Perlmutter and Geraghty, 1963), and RI data shallow groundwater flow in the area is horizontal except in local areas of recharge or discharge.

The depth to the water table in 1989 was approximately 23 to 27 feet below grade (62 - 63 feet above MSL) across the site. In 1993 - 1994, groundwater elevations had decreased to approximately 31 feet below grade (57 feet above MSL). Based on groundwater elevation data collected during the RI and the FFS, shallow groundwater flow is predominantly toward the south-southeast. A groundwater hydraulic gradient of 0.0026 ft/ft for the Upper Glacial deposits and 0.0015 ft/ft for the Magothy aquifer was measured during the report based on available field data. This hydraulic gradient was verified during the FFS, based upon water levels measured in the existing monitoring wells and the two new confirmatory wells. Using regional estimates for hydraulic conductivity, saturated thickness, and transmissivity derived from McClymonds and Franke (1972), Ebasco (1990) estimated groundwater velocities to be 1.6 ft/day in the outwash deposits and 0.5 ft/day in the Magothy aquifer. As part of the Round 2 groundwater sampling by WESTON for this FFS, slug tests were conducted at several of the shallow Upper Glacial aquifer monitoring wells. The results of slug testing are discussed in detail in Section 2.8. The results of slug testing confirmed that the regionally established values for hydraulic conductivity and transmissivity are representative of the Circuitron Corporation Site conditions.

Recharge to the hydrologic system beneath the site occurs from incident precipitation with infiltration to the water table and subsurface inflow of groundwater from upgradient areas. Discharge of groundwater beneath the site occurs through evapotranspiration and subsurface outflow. Most of the subsurface outflow from the outwash unit continues downgradient and ultimately discharges into the creeks approximately five miles south of the site.

An investigation of the stormwater drainage and recharge basins in the area of the Circuitron Corporation site was performed to identify areas of artificial recharge of stormwater to groundwater. The study of recharge locations included a review of aerial photos, and contacting the state, county, and local highway departments. The review of the aerial photos did not identify any nearby storm water drainage systems or recharge basins. The paved areas of the Circuitron site drain onto the street located to the north of the site, Milbar Boulevard. as shown on Figure 1-3. The Babylon Highway Department maintains four isolated recharge basins on Milbar Boulevard which are similar to dry wells. A closed leaching basin system with piping and seven basins also exist on Milbar Boulevard near Route 110 (Broad Hollow Road) located to the west of the site. The New York State Highway Department maintains a positive flow stormwater drainage system in the median of Route 110 at Milbar Boulevard. This system flows north of Milbar Boulevard approximately 2600 feet to a recharge basin on the west side of the highway. A flooding problem exists at the intersection of Route 110 and Adventureland Amusement Park to the north of the site which has caused the recharge system to have overcapacity on numerous occasions.

1.2.7 Public Water Supply

Nineteen (19) public water supply wells are located within two miles of the site, of which seventeen (17) are screened in the Magothy aquifer. There are eighteen (18) public supply wells, irrigation or commercial supply wells within a half-mile radius of the Circuitron Corporation Site as summarized on Table 1-3 and the closest wells are shown on Figure 1-1. The Magothy aquifer is the main aquifer of use within the half-mile radius. The closest public water supply wells located downgradient of the site are in the East Farmingdale Water District (EFWD) wellfield #2 on Gazza Boulevard approximately 1500 feet south of the site (see Figure 1-1). These two wells are tested on a quarterly basis and are completed within the Magothy aquifer at 191-268 and 524-585 feet below grade. The shallow well (S-20041) has been shut-in for several years due to the presence of low concentrations of volatile organic compounds such as trichloroethene (7 ug/l), tetrachloroethene (2 ug/l), 1,1,1-trichloroethane (2 ug/l), cis-dichloroethene (1 ug/l) and freon. At the deeper well (S-20042), only extremely low

TABLE 1-3

WATER SUPPLY WELLS WITHIN A HALF-MILE RADIUS OF THE CIRCUITRON CORPORATION SITE

NYSDEC Well Number	Completion Date	Depth of Screen (ft)	Aquifer Screened	Well Type	Owner and Location
S-9004	2/7/51	44 - 65	Upper Glacial	CS	JW Robinson & Sons
S-11887	5/4/54	32 - 42	Upper Glacial	CS	A.S. Marin
S-12760	1/6/55	60 - 65	Upper Glacial	CS	Mastrow Construction Co.
S-12919	6/3/55	60 - 72	Upper Glacial	CS	SUNY
S-15104	1/2/57	49 - 70	Upper Glacial	CS	Phillip Smith
S-17359	3/9/59	50 - 55	Upper Glacial	CS	M & S Company
S-18073	1/2/59	59 - 79	Upper Glacial	CS	W. Nohjel
S-19538	1/13/61	174 - 200	Magothy	CS	Electrical Fitting Corp.
S-19768	4/15/61	73 - 79	Upper Glacial	CS	L.I. Delivery
S-20041(4)	6/1/62	191 - 268	Magothy	PS	E. Farmingdale W.D.
S-20042	6/1/62	524 - 585	Magothy	PS	E. Farmingdale W.D.
S-22003	10/18/63	206 - 226	Magothy	CS	House of Plastics
S-39709	4/28/72	650 - 710	Magothy	PS	E. Farmingdale W.D.
S-41736	11/11/71	56 - 62	Upper Glacial	CS	171 Milbar Corporation
S-49897	10/3/73	60+-	Upper Glacial	CS	Monitor Boxart Co.
S-61107	4/27/77	52 - 55	Upper Glacial	CS	Canadian American Extruders
S-80573	9/13/85	165 - 200	Magothy	CS	Efcor, Inc.
S-91611(4)	1994	620 - 690	Magothy	PS	E. Farmingdale W.D.

Notes:

(1) See Figure 1-1 for well locations

(2) W.D. = Water District

(3) Well Type Abbreviations: PS = Public Supply, CS = Commercial Supply

(4) Not currently operational

concentrations (<0.5 ug/l) of volatile organics (trichloroethene), below New York State Drinking Water Standards, were reported. A new (not yet operational) deeper public water supply well has been installed by the EFWD at wellfield No. 2. This well (S-91611) is completed at a depth of 620 - 690 feet below grade and is not yet permitted for operation. Another East Farmingdale Water District public supply well (S-39709) is located cross gradient, to the east of the Circuitron Corporation Site, and is completed at a depth of 650-710 feet below grade.

The remaining fourteen (14) wells are all commercial supply wells and are typically used for non-contact cooling water purposes. No analytical data was available for any of these commercial supply wells with the exception of the House of Plastics wells (PW-2), also known as S-22003. This well is used as a commercial non-contact cooling water supply well and is located approximately 1,500 feet downgradient of the site. Because this well is located downgradient of the site, it was sampled during the 1989 RI and FFS. This well has reported elevated concentrations of volatile organic and inorganic compounds during past and current sampling. Although detailed information of the source of contamination to this well was not available, the House of Plastics site itself is under a SCDHS administrative order for violation of Article 7 regulations regarding improper discharge and storage of hazardous and toxic materials.

1.2.8 Climate

The Circuitron Corporation Site is located in Suffolk County, Long Island, New York, on the terminal moraine which marks the southern-most advance of the ice age sheet along the Atlantic Coast during the last ice age. The terrain is generally flat, with only a gradual rise in elevation from Long Island Sound on the northern shore and from the Atlantic Ocean on the southern shore toward the middle of the Island. No on-site historical meteorological data is available for the Circuitron Corporation Site. The nearest National Weather Service station is at MacArthur Airport in Islip, Long Island, approximately 19 miles to the east.

The majority of air masses affecting the area are continental in origin. However, the ocean has a pronounced influence on the climate of the area. A cool sea breeze blowing off the ocean during the summer months helps to alleviate the afternoon heat. There are an average of seven days between June and September when the afternoon temperature exceeds 90 degrees, while inland to the west of New York City there are typically 10 to 15 such days.

It is uncommon for the eye of a tropical storm to pass directly over Long Island. However, tropical weather systems moving along the Atlantic Coast are capable of producing episodes of heavy rain and strong winds in the late summer or fall.

The winter season is relatively mild, where below zero temperatures are reported on only one or two days in approximately half the winters. The seasonal snowfall averages about 29 inches, with almost all of this snow falling between December and March. Northeasters, coastal low pressure systems, are the principal source of this snow. These weather systems will occasionally produce a heavy snowfall. There are usually extended periods during the winter when the ground is bare of snow.

The National Climate Data Center (NCDC) annual average temperature (1984-1985) for Islip, New York is 51.8°F, with July being the warmest month (with an average temperature of 73.5°F) and January being the coldest (with an average of 29.5°F). The record average extremes temperatures are -7°F and 95°F during the reported six year period ending 1989.

Precipitation is uniform throughout the year and during the six year reported period (1984-1989). Islip averaged a total of 44.64 inches of precipitation and had 117 days per year with at least 0.01 inches of precipitation. Thunderstorms occurred on approximately 27 days per year.

In terms of the two major classification systems, Trewartha and Koppen, the following climate classifications define the area:

Trewartha: Dca, where;

d = Temperature group, where 4 to 7 months inclusive are over 50°F.

c = Continental type; cold month under 32° - 36°F.

a = Hot summer, with warmest months over 72°F.

Koppen: Cfa, where;

c = Mild temperature rainy climates; average temperature of coldest month below 64.4°F but above 26.6°F.

f = No distinct dry season; difference between the rainiest and driest months is less than for w and s, and the driest month of summer receives more than 1.2 inches.

s = Summer drought; at least three times as much rain in the wettest winter month as in the driest summer month. (Alternative definition: 70% or more of the average annual rainfall is received in the warmer 6 months.)

w = Winter drought; at least ten times as much rain in the wettest summer month as in the driest winter month. (Alternative definition: 70% or more of the average annual rainfall is received in the winter 6 months).

a = Hot summer, average temperature of warmest month over 71.6°F.

Based on a wind rose for Islip from 1984 to 1989, prevailing winds are generally from the west, with a south-southeasterly component during the warmer months and a north-northwesterly component in the colder months. Average wind speed was 9.3 mph during the six year period ending 1989.

1.2.9 Population and Land Use

The area immediately surrounding the Circuitron site consists of active businesses including small industrial and manufacturing facilities. Specifically, according to available tax maps, the Circuitron site is bordered on the north by Milbar Boulevard, to the east by "W.D.Equities", a 0.38 acre property; to the west by "Gazza, Joseph & Dorothy", a 0.63 acre property; and to the south by "Fenn, Wright & Manson Properties, Inc. " and "Milgray Electronics, Inc.", a 1-

acre and 2.99 acre property, respectively.

Within a mile of the site is a mixture of large institutional, industrial and commercial areas, cemeteries, an airport, amusement park (Adventureland) and a State park. The closest residential community is the Woodland Hills section of East Farmingdale located one mile southwest of the site. The State University Agricultural and Technical College at Farmingdale (SUNY-Farmingdale) is located approximately 1,500 feet west and northwest of the site at the intersection of Route 110 and Melville Road. The college serves a total student population of 8,700 which includes day and evening students, and has a residential dormitory of 700 students. The edge of Bethpage State Park is located 0.9 miles northwest of the site. East and southeast of the site are several cemeteries, the closest being the Pinelawn Cemetery which is located approximately 1,500 feet southeast of the site. The Republic Airport, servicing small aircraft and charter flights, is located 0.7 miles south of the site. An amusement park, "Adventureland 110", is located 800 feet north of the site on Route 110. Operating from March through October, it offers amusement park rides to the public.

East Farmingdale is an unincorporated hamlet in the Town of Babylon, Suffolk County. Babylon is comprised of eight hamlets and three incorporated villages, and is a densely populated area, with a 1993 population of 202,889. East Farmingdale is bordered on the east by the Hamlet of Wyandanch, and on the south by the Hamlet of North Amityville. It shares its northern border with the Town of Huntington, and its western border with the Village of Farmingdale, Town of Oyster Bay, which is in Nassau County.

East Farmingdale is predominantly an industrial area of the Town of Babylon. It is one of the most heavily industrialized sections of Suffolk County, and has been characterized frequently by problems associated with industrial pollution. The 1993 residential population of East Farmingdale was 5,395. The residential community of Woodland Hills, within East Farmingdale, located southwest of the Circuitron Corporation site, has a small civic association of 5 to 6 members, which has been vocal on the variety of issues pertaining to land use and the environment.

Prior to its use for industrial purposes, East Farmingdale was characterized largely by agriculture in the late 1950s. By the early 1970s, industrial manufacturing operations became the predominant land use.

1.3 Review of Aerial Photography of Site Vicinity

Aerial photographs of the area around the Circuitron Corporation site for three dates in 1966, 1977, and 1984 were reviewed. The aerial photographs cover an area of approximately 4000 by 4000 feet, at a scale of 1 inch equals approximately 150 feet, with the Circuitron Corporation Site approximately in the center of the photographs. The area examined by WESTON was between the property located north of Milbar Boulevard known as "Willow Park Court" (currently occupied by a Home Depot retail store and other commercial establishments) and the properties adjoining the south side of Schmitt Boulevard, and between Route 110 (Broad Hollow Road), located to the west and New Highway Road located to the east. The photos were specifically reviewed to determine whether above ground storage tanks were present as well as drum storage areas or apparent manufacturing operations. Copies of these photos with pertinent features are included as Figures 1-4, 1-5, and 1-6. The following is a discussion of the most significant site features at the Circuitron Corporation property and adjoining areas.

Aerial Photograph for May 5, 1966

In general, the industrial park surrounding the Circuitron Corporation site appears to be under construction. Approximately one-half of the buildings are either not completed or still empty lots or farm fields. There are several areas at the facilities reviewed on the 1966 aerial photograph that may relate to the storage and/or use of chemicals. A discussion of these site features shown in Figure 1-4 is given below.

- The Circuitron Corporation site shows two small buildings which are located in the place of the present day structure located on the eastern half of the property.

LEGEND

AST **ABOVE GROUND STORAGE TANK**

(85) STREET ADDRESS

0' 100' 200' 300' 400'

SCALE:

FIGURE 1-4
MAY 5, 1966
AERIAL PHOTOGRAPH

WESTON
MANAGERS DESIGNERS CONSULTANTS
Roy F. Weston of New York, Inc.

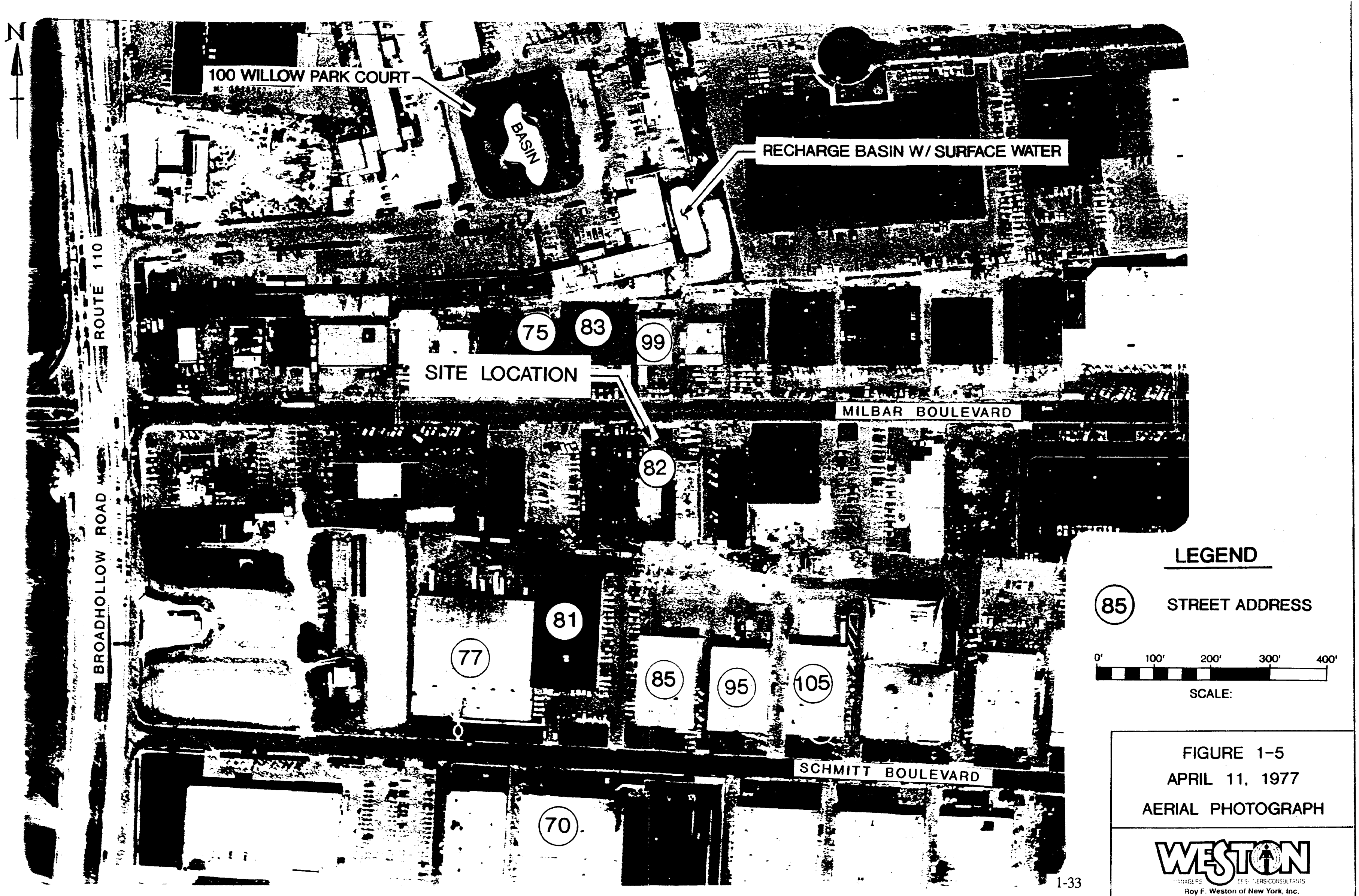

FIGURE 1-5
APRIL 11, 1977
AERIAL PHOTOGRAPH

WESTON
Roy F. Weston of New York, Inc.

FIGURE 1-6
MARCH 26, 1984
AERIAL PHOTOGRAPH

WESTON
Roy F. Weston of New York, Inc.

- Empty overgrown lots exist on the east and west side of the Circuitron site.

- Only a small recharge basin approximately one quarter the size of the 1984 size is present on the Willow Park Court property (currently Home Depot).

- No other surface water was observed in the air photo.

- The present day Milgray Electronics and Cangro Leather buildings (77, 81 and 85 Schmitt Boulevard, see Figure 1-4 for current location) are under construction at the time of the 1966 photo.

- In the area where Dubon Court is presently, there appears to be a 20-acre farm field.

- A facility on the east side of Broad Hollow Road appears to have a large number of possible pallets, crates, or drums organized in many rows. The building appears to be a manufacturing facility.

- The building located at 95 Schmitt Boulevard appears to have an above-ground storage tank (AST) at the northeast corner.

- South of the present day Home Depot site (Willow Park Court), many small rounded containers in rows appear next to a building. This area may be a drum storage area.

- Small rounded containers which are possible drums were visible on the south side of the building located on the south site of 70 Schmitt Blvd.

- A possible garbage pile containing drums was visible south of a Schmitt Boulevard property located to the east of 70 Schmitt Boulevard.

Aerial Photograph for April 11, 1977

In general, the industrial park surrounding the Circuitron Corporation site appears to be almost completed. There are several areas at facilities reviewed on the 1977 air photograph that may relate to storage and/or use of chemicals.

- The Circuitron site buildings have been completed to the present day construction, although no ASTs are visible on the south side of the building.
- The facility on the east side of Broad Hollow Road discussed in the 1966 review does not have as many pallets or crates, but some are still present in 1977.
- The other four potential storage areas identified in the 1966 review were not present in 1977.
- The surface water/recharge basin area at Willow Park Court is larger than 1966 but still smaller than 1984.
- A second surface water/recharge basin area is present south of the basin described above and due north of the Circuitron Corporation site.

Aerial Photograph for March 26, 1984

In general, the industrial park surrounding the Circuitron site appears to be completed and all buildings appear to be in use. There are several areas at facilities reviewed on the 1984 air photograph that may relate to storage and/or use of chemicals.

- The Circuitron site building appears the same in 1977. On the southwest side of the building there appears to be 1 or 2 ASTs.

- The facility building on the east side of Broad Hollow Road has been removed since 1977 and replaced with a small building and a parking lot. The eastern half of the site is an empty lot which appears to have a bare sandy surface. No storage of any materials is visible.

- There is surface water present on the south side of the building east of the Circuitron site.

- The recharge basin/surface water on the southeast side of Willow Park Court has a different texture than the 1977 photo. The water may be shallow, turbid, or not present in this area. The shape of the area is the same as in 1977.

1.4 Summary of Previous Groundwater Investigations

In early 1985, five monitoring wells (MW-8, 9, 10, 11 and 12) were installed on the site by Circuitron Corporation, at locations approved by the SCDHS (see Figure 1-3). These wells are screened at the water table according to documentation provided with the Site Inspection Report. The Circuitron Corporation sampled these wells in April 1985. No organic contaminants were found, but the concentration of cadmium ranged from 0.01 mg/1 in the upgradient samples to 0.65 mg/1 in the downgradient samples. The SCDHS sampled the wells in September, 1985. Analytical results indicate the presence of 1,1,1-trichloroethane at concentrations of 60 ug/1, 120 ug/1, and 520 ug/1 in MW-10, MW-11, and MW-12 respectively. No contaminants were reported in the two upgradient wells, MW-8 and MW-9.

Historical analytical data is available for two municipal wells and one private supply well located within 1,500 feet from the site. The East Farmingdale Water District (EFWD) well S-20042, located on Gazza Boulevard (see Figure 1-1) and screened at a depth of 585 feet below grade, is sampled quarterly by the Water District. The results of analyses performed between January, 1981 and December, 1984 did not indicate the presence of any contaminants (Ebasco, 1990) above the New York State Drinking Water regulations. This was confirmed by WESTON with a review of quarterly analytical test results for samples collected for 1992 in which only very low concentrations (<0.5 ug/l) of a volatile organic compound (trichloroethene) was reported. The EFWD shallower well (S-20041) completed at a depth of 268 feet has been shut-in due to low concentrations of volatile organics such as 1,2-dichloroethane (1 ug/l) and 1,1,1-trichloroethane (2 ug/l), trichloroethene (7 ug/l), tetrachloroethene (2 ug/l), cis-dichloroethene (1 ug/l) and freon.

The cooling water diffusion well S-22003 at the House of Plastics (see Figure 1-1), screened at a depth of 206 to 226.5 feet below grade, was sampled in January, 1979, and several volatile organic compounds were detected. These included 1,1,1-trichloroethane, methylene chloride, and 1,1-dichloroethene, which were detected at concentrations of 59 ug/1, 9 ug/1, and 5 ug/1, respectively. In addition, 1,1,1,2-tetrachloroethane, trichloroethene, and 1,1-dichloroethane were present at concentrations of 5 ug/l, 7 ug/l and 2 ug/l respectively. Cis-1,2-dichloroethene and 1,2-dichloroethane were also found, each at a concentration of 2 ug/1.

Seven additional well clusters were installed both on and off-site during the 1989 RI, and were designated MW-1 through MW-7. Each consisted of a deep well (screened interval of 90 to 100 feet) and a shallow well (screened interval of 25 to 35 feet). The locations of these wells are shown on Figure 1-3. For the purposes of the Ebasco remedial investigation, groundwater samples from all of the monitoring wells were analyzed for volatile and semivolatile organic compounds, pesticides, PCBs, inorganics and hexavalent chromium. Two off-site wells were also sampled; the East Farmingdale Water District municipal well S-20042, and the House of Plastics diffusion cooling water well S-22003. Both wells are located at an approximate distance of 1,500 feet down-gradient of the site (see Figure 1-1).

Groundwater sampling activities were performed by Ebasco during the RI throughout 1989. Existing wells MW-8 through MW-12 were sampled in July, 1989. MW-1 through MW-7 were the subject of two consecutive rounds of sampling, which took place during September and October of 1989, respectively. The municipal well S-20042 was also sampled in October 1989, while private well S-22003 was sampled in December 1989.

Table 1-4 summarizes the frequency of occurrence and concentration ranges of the volatile organics detected in the shallow monitoring wells during the Ebasco 1989 RI. Ten volatile organics were identified in the Round 1 samples (RAS analysis) while eighteen were identified in the Round 2 samples (SAS analysis for expanded volatiles). Review of Table 1-4 shows that of the eight volatile compounds present in both rounds, the frequency of occurrence and concentration ranges were fairly comparable. This would suggest that there is a constant input of contaminants to the groundwater such as from contaminated soil. The two compounds (benzene and 2-butanone) present only in the Round 1 samples were detected at low concentrations in on-site wells MW-3S and MW-2S. The remaining ten analytes in the Round 2 samples were expanded volatiles list analytes and were found infrequently (range: 4 to 13%) in the monitoring wells sampled. Two chlorofluorocarbon compounds (chlorodifluoromethane and dichlorofluoromethane) represented the dominant contaminants in this expanded list in terms of concentration. Most of the remaining contaminants in this group were present at concentrations less than 5 ug/1.

The most abundant of the volatile organics detected in the shallow monitoring wells in 1989 in terms of concentration and frequency of occurrence were: 1,1-dichloroethane, 1,1-dichloroethane, trans-1,2-dichloroethene, chloroform, 1,1,1-trichloroethane, trichloroethene and tetrachloroethene. 1,1,1-Trichloroethane was present at the greatest concentrations relative to the other volatile organics analyzed.

Total volatile concentrations varied widely in the twelve shallow wells and between wells in close proximity (e.g., MW-8 and MW-9). The greatest total volatile concentrations in the wells located north of main Circuitron Corporation building (MW-1S, MW-2S, MW-8, MW-9 and MW-10) was in MW-1S (760 ug/1) which is located north of the property across Milbar Boulevard. This was an unexpected result since this well was located to represent the upgradient, off-site (and presumed uncontaminated) groundwater quality conditions. Among the four wells located on the eastern side of the Circuitron building (MW-3S, MW-10, MW-11 and MW-12), MW-12 had the highest volatile concentration (464 ug/1). The four remaining wells south of the building (see Figure 1-1) (MW-4S, MW-5S, MW-6S and MW-7S) included both

TABLE 1-4

VOLATILE ORGANICS IN GROUNDWATER DETECTED DURING BOTH ROUNDS OF EBASCO 1989 RI SAMPLING

COMPOUND	ROUND 1		ROUND 2	
	Frequency of Occurrence[1]	Concentration Range (ug/l)	Frequency of Occurrence	Concentration Range (ug/l)
1,1-Dichloroethene	0.67	0.6 - 12.0	0.70	0.8 - 23.0
1,1-Dichloroethane	0.67	0.4 - 17.0	0.70	0.6 - 11.0
Trans-1,2-dichloroethene	0.45	4.0 - 9.0	0.22	3.0 - 9.8
Chloroform	0.36	2.0 - 31.0	0.22	1.2 - 207.0
1,2-Dichloroethene	0.15	1.0 - 2.0	0.09	1.0 - 25.0
2-Butanone	0.08	1.0	0[2]	-
1,1,1-Trichloroethane	0.86	2.0 - 4600.0	0.87	2.0 - 1181.0
Trichloroethene	0.75	0.9 - 18.0	0.57	0.7 - 27.0
Benzene	0.09	3.0	0[2]	-
Tetrachloroethene	0.67	7.0 - 110.0	0.65	0.7 - 87.0

Notes:

[1] Frequency of occurrence is determined by dividing the number of wells at which a compound is detected by the total number of wells sampled.

[2] A frequency of zero indicates that the compound was not detected in this round.

the maximum total volatiles concentration of all wells (MW-4S, 4753 ug/1) and the only uncontaminated groundwater sample (MW-7S). The total volatiles analysis of the shallow wells suggests that while the site is contributing to groundwater contamination, it is not the only source of this contamination, since several of the contaminants detected on-site had lower concentrations than those in the upgradient and downgradient wells.

These analytical results indicate that the groundwater study performed during the 1989 RI was insufficient to fully evaluate the vertical and horizontal distribution of contaminants in the groundwater. The scope of the study did not include the identification of potential off-site sources. The aquifer hydraulic parameters required for a groundwater remediation feasibility study were also not verified. It was also determined that additional information was needed to further characterize the contribution of contaminants from upgradient, off-site sources and to evaluate the extent of the portion of the plume attributable to Circuitron Corporation. Since a Record of Decision (ROD) has already been issued for the soils and contamination at the site itself, the main objective of this FFS is to fully evaluate groundwater remedial alternatives.

1.5 Evaluation of Possible Additional Influences on Regional Groundwater Quality

In order to potentially locate off-property sources of volatile organic contamination, such as that previously reported in the upgradient monitoring well cluster MW-1S/1D (total volatile organics of 760 ug/l) during the 1989 Ebasco RI, environmental database information was reviewed, including data on National Priorities List (NPL) sites, CERCLIS sites, and discharges within a one-mile radius of the site. In an effort to identify other facilities with a potential for discharging hazardous materials, WESTON also consulted the Toxic Release Inventory (TRI), Facility Index System (FINDS), the RCRA Notifiers List, the Emergency Response Notification System (ERNS), the Hazardous Waste Data Management System (HWDMS) and the New York State Leaking Underground Storage Tank (LUST) Database and Bulk Petroleum Storage Division files examining again a one-mile radius around the Circuitron Corporation Site. The results of this evaluation are presented below, and supporting information is provided in Appendix A.

1.5.1 Environmental Database Review

Records maintained by the United States Environmental Protection Agency (U.S. EPA) and New York State Department of Environmental Conservation (NYSDEC) were obtained and reviewed to assess the potential for upgradient or off-property contamination. All such sites within a one mile radius of the site were identified as shown on Figure 1-7 and evaluated for their possible impact on groundwater upgradient and downgradient of the site.

Federal Environmental Databases

National Priorities List (NPL)

The NPL is EPA's database of the most serious uncontrolled or abandoned hazardous waste sites identified for priority remedial actions under the Superfund Program. These sites are determined to constitute an immediate threat to human health and environment. In general, sites listed on the NPL are considered to pose a significant risk to surrounding properties and potentially impacting property values.

Only one additional NPL site was identified within a one mile radius of the Circuitron Corporation Site. This site was Tronic Plating site located to the east of the FFS study area, far enough away that it is not expected to affect groundwater in areas upgradient or downgradient of Circuitron.

Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS)

CERCLIS is a compilation of known or suspected uncontrolled or abandoned hazardous waste sites which the EPA has investigated or is currently investigating for a release or threatened release of hazardous substances pursuant to the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980. These sites constitute a

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FAX: (703)836-0468

E R II S

Site Location
82 Milbar Blvd.
Farmingdale NY
Map Plotted: November 25, 1992

▽ CERCLA Information System
0 sites within 1.0 mile search radius

□ RCRIS Large Quantity Generator / TSD Facility
53 sites within 1.0 mile search radius

▵ Toxic Release Inventory
3 sites within 1.0 mile search radius

▽ SPILLS
17 sites within 1.0 mile search radius

⊠ Chemical Bulk Storage
3 sites within 1.0 mile search radius

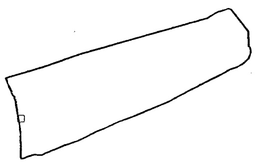
⊗ Hazardous Waste Manifest
83 sites within 1.0 mile search radius

☆ Leaking Storage Tanks
12 sites within 1.0 mile search radius

MAP LEGEND

✪ Point of Interest
Search Region
Highways
Other Roads
Railways
Water Features
County Boundary

SCALE (miles)
0 1



MAP LOCATION

FIGURE 1-7

potential threat to human health and environment. While it has been determined by the EPA that some CERCLIS sites require no action, others could well pose a real or perceived environmental threat to neighboring properties, thus impacting property values.

No CERCLIS sites not otherwise listed on the NPL exist upgradient or in close proximity downgradient of the Circuitron Site.

Toxic Release Inventory (TRI)

The TRI contains information on the annual estimated releases of toxic chemicals to the environment. TRI was mandated by Title III of the Superfund Amendments and Reauthorization Act (SARA) of 1986. Data includes the maximum amount of selected chemicals stored on site, the estimated quantity emitted into the air, discharged into bodies of water, injected underground, or released to land, as well as methods used in waste treatment and their efficiency, and data on transfer of chemicals off-site.

Six sites were reported as TRI facilities within a one-mile radius of the Circuitron Corporation site. All of these TRI facilities as summarized in Table 1-5, were either reported as air emission sources of release to the environment or reported due to the storage on-site of select chemicals. Poly-Pak Industries was the only TRI facility that reported the use of 1,1,1-trichloroethane, as an air emission source only, from both non-point and point sources.

Emergency Response Notification System (ERNS)

The ERNS contains information on reported spills (releases of oil and hazardous substances) made to federal authorities including the EPA, the US Coast Guard, National Response Center and Department of Transportation since 1987. The ERNS list identified several spills in the area surrounding Circuitron, but the releases were not halogenated volatile organics (U or F series waste) or were too remotely located from the site to contribute to

TABLE 1-5

LISTING OF TRI FACILITIES WITHIN A ONE-MILE RADIUS OF THE CIRCUITRON CORPORATION SITE

NAME	ADDRESS	EMISSION	CHEMICAL USED
Poly-Pak Industries	125 Spagnolia Rd	Air	1,1,1-trichloroethane
ESD-Raytheon	65 Marcus Dr	Air	Freon 113
Laribec Wire Co.	101 Central Ave	Air	Lead
Joel Meisner & Co. Inc.	115 Schmitt Blvd	None	Copper
Halbro Control Industries	2090 Route 110	Air	Glycol ethers
Atomergic Chemicals Corp.	222 Sherwood Ave	None	Antimony, cadmium, chromium, lead and nickel

the groundwater contamination identified in the vicinity of Circuitron.

Facility Index System (FINDS) and Resource Conservation and Recovery Act (RCRA) Notifiers List

FINDS is a compilation of any property or site which the EPA has investigated, reviewed or been made aware of in connection with its various regulatory programs, such as solid waste (RCRA), pesticides and toxic substances, water, and air and radiation.

The EPA's RCRA Program identifies and tracks hazardous waste from the point of generation to the point of disposal. The RCRA Notifiers are those sites which have filed notification forms with the EPA in accordance with the RCRA requirements regarding their hazardous waste activity. These sites include treatment storage and disposal facilities, transporters, and generators of hazardous waste regulated under RCRA. These sites are most significant if they are determined to be out of compliance with applicable regulations.

The RCRIS (Resource Conservation Recovery Act Information System) lists sites that comply with the regulations stipulated in the Resource Conservation Recovery Act. The PADS (PCB Activity Database System) lists facilities which handle or transport Polychlorinated Biphenyls. The listed sites are of concern if listed as non-compliant.

Under the summary of RCRIS Large Quantity Generators, at least 7 large scale generators were listed as using the contaminants of concern identified at Circuitron, however all were listed as RCRA compliant. Several small scale generators were identified but none that listed the site-related compounds of concern and none were reported out of compliance with RCRA.

There were 105 FINDS sites reported surrounding Circuitron, including 4 properties identified on Smith Street, several properties along Route 110 (Broadhollow Road) and 2 on Dubon Court as potential upgradient facilities, three (3) properties identified as potential cross gradient or downgradient facilities were located on Milbar and Schmitt Boulevards.

State Environmental Databases

A number of state databases list sites which have filed notification forms with the appropriate state agency regarding hazardous chemicals or hazardous waste management. States lists often include many more sites than the EPA RCRA notifiers list. However, sites which are in violation of applicable state regulations are mandated by law to report to the U.S. EPA. Therefore, all sites that are out of compliance from a state regulatory standpoint are included in the RCRA. The following is a description of the state databases.

New York Leaking Underground Storage Tank (LUST) Database/Spills Database

The New York LUST list consists of two parts: the list of tank test failures and the list of tank failures. Both of these lists include tanks that leak. However, the tank test failures list consists only of tanks that are below ground and the tank failures list consists of tanks that are both below and above ground.

The New York State LUST list indicated 17 sites in the area around Circuitron. Only numerous spills of a petroleum hydrocarbon had occurred or the spill was too far away to be a contributing factor to the contamination reported in the vicinity of Circuitron. None of the leaking tank sites were tanks containing liquids other than petroleum hydrocarbons.

Chemical Bulk Storage (CBS) Database

The New York CBS is a list of facilities that store regulated substances in above ground tanks with capacities greater than 185 gallons and or in underground tanks of any size.

One chemical bulk storage tank (above ground) was reported at 75 Milbar Boulevard (Price Driscoll).

Major Oil Storage Facilities (MOSF) Database

These facilities may be on shore facilities or vessels, with petroleum storage capacities of 400,000 gallons or more. No MOSFs were identified within a one mile radius.

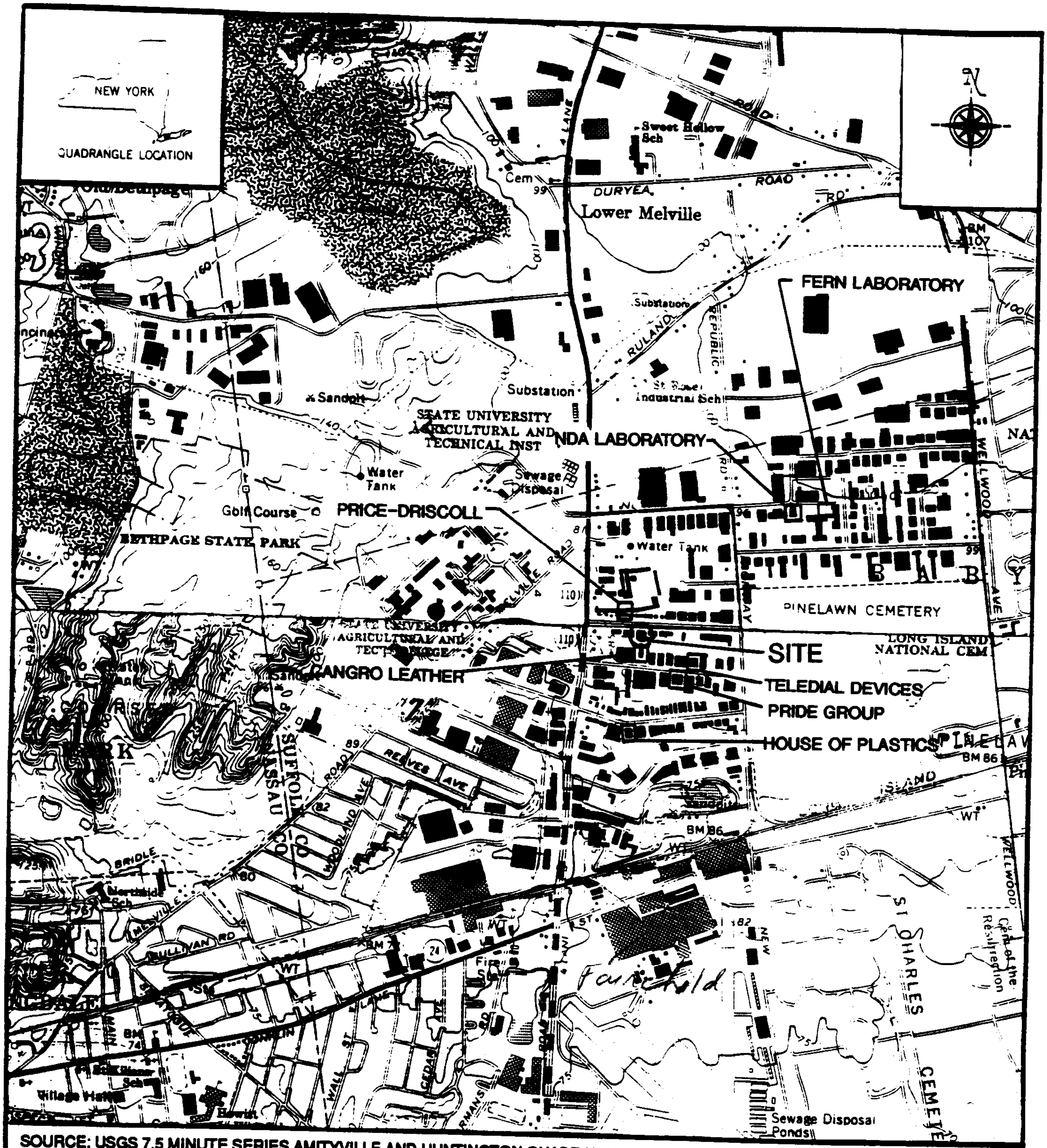
Solid Waste Facilities

A permitted solid waste facility is located approximately 1/2 mile to the northwest of the Circuitron Site. This solid waste facility is permitted only for construction and demolition debris and is known as the Route 110 Sand and Gravel Operation.

Local Regulatory FOIL Review

WESTON also performed a review of the New York State Department of Environmental Conservation (NYSDEC) and the Suffolk County Department of Health (SCDHS) files under the freedom of information law (FOIL) program in late 1992 and early 1993. A survey of the properties up and downgradient of the Circuitron Site was conducted and FOIL requests were submitted to NYSDEC and SCDHS in November 1992 for approximately 40 properties. The properties surveyed included those facilities upgradient of the Circuitron Site on Smith Street and Dubon Court and downgradient/crossgradient on Milbar and Schmitt Boulevards.

These files were reviewed to identify local spills, the underground storage of chemicals and other activities that might result in a release of volatile organics. The NYSDEC responded that no files were found for the list of properties provided by WESTON. The SCDHS identified 12 properties that had used solvents or possessed tanks or drum storage of chemicals. Of these 12 properties, 7 were confirmed to have had releases of chemicals and are shown on Figure 1-8. A further discussion of these properties is given below. Of these properties, only one (Price Driscoll) is located upgradient of the Circuitron Corporation Site at 75 Milbar Boulevard.



SOURCE: USGS 7.5 MINUTE SERIES AMITYVILLE AND HUNTINGTON QUADRANGLES (1979)

SCALE 1:24000

1 ½ 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

WESTON
MANAGERS DESIGNERS/CONSULTANTS

FIGURE 1-8
REGULATORY REVIEW SITES
SITE LOCATION MAP
EAST FARMINGDALE, NY

The following seven properties at the addresses indicated below were cited in the SCDHS files as having had a release of chemicals in the past.

Cangro Leather, 85 Schmitt Boulevard

In April 1992 approximately 1500 gallons of liquid and 25 drums of sludge were removed from the on-site cesspool system that showed elevated levels of Freon 113 (up to 43,000 ppm) with shallow underlying groundwater indicating low levels of halogenated organics (1,1,1-trichloroethane at 53 ug/l, 1,1-dichloroethane at 4 ug/l and tetrachloroethene at 3 ug/l).

Pride Group, 110 Schmitt Boulevard

A 20 gallon spill of an unknown chemical was reported into a storm drain, 890 gallons of liquid was removed and six 55 gallon drums of waste herbicide were removed. Analysis of removed materials indicated elevated concentrations of halogenated (tetrachloroethene) and non-halogenated organics.

Fern Laboratories, 280 Smith Street

From 1980 to 1983, a report from a New York State hearing indicated discharge of toxic or hazardous materials without a valid SPDES permit and non-compliance with SCDHS Article 12. Elevated inorganics were reported from discharges from the building.

NDA Laboratories, 260 Smith Street

Files indicate the potential for illegal discharges due to "dummy piping to sewer and site activities". Inorganics were reported as part of daily discharges from the laboratory and included zinc, mercury, copper sulfate, phenols and arsenic.

Price Driscoll Corporation, 75 Milbar Boulevard

This property contains an above ground 3792 gallon trichloroethene tank, on which there are no records of spills or violations. In 1985, a violation of SCDHS Article 12 occurred with a release of Dimethyl Poly Siloxane, which is not classified as either a hazardous or toxic compound.

Teledial Devices Inc., 125 Schmitt Boulevard

In 1982 the SCDHS files show the storage of Trichlorotrifluoroethane (TMS+) solvent at the property, with waste solvent in outdoor drum storage.

House of Plastics, Gazza Boulevard

A violation of the SCDHS Article 7 regulations were noted to have occurred which included the discharge and improper storage of toxic and hazardous materials.

In summary a review of surrounding up and downgradient properties indicates the high potential for the upgradient properties to have contributed to the identified regional groundwater contamination problem. However, the information review process did not identify any obvious upgradient volatile organic contamination sources based upon past releases.

SECTION 2
FOCUSED FEASIBILITY STUDY FIELD INVESTIGATION

2.1 Introduction

This section presents a summary of the tasks, methods and procedures employed by WESTON for the field investigation tasks of the focused feasibility study of groundwater contamination at the Circuitron Corporation Site. The field investigation was conducted from May 1993 to February 1994. It was performed in accordance with the U.S. EPA approved Draft Final Work Plan (July 1992) and Sampling and Analysis Plan (September 1992). The principal objectives of the field investigation program were to:

- Supplement the 1989 RI data and further delineate the horizontal and vertical extent of groundwater contamination downgradient of the Circuitron Corporation Site.
- Determine if there is a contribution of contamination from upgradient, off-property sources.
- Determine the aquifer hydraulic parameters required for evaluating groundwater remediation alternatives during the feasibility study analysis.

To achieve the objectives of the FFS, extensive groundwater sampling was performed both upgradient and downgradient of the Circuitron Corporation Site to further delineate volatile organic groundwater contamination previously identified during the RI/FS study by Ebasco in 1989. WESTON conducted two rounds of groundwater sampling and a drive-point program during this field investigation. Round 1 groundwater sampling of existing RI wells was conducted in May 1993. The drive-point groundwater field screening sampling program was performed in August 1993. The drive point groundwater sampling program was conducted primarily as a reconnaissance method and utilized quick turn-around halogenated VOC analytical testing to delineate the vertical and lateral extent of groundwater contamination on a real-time basis. Subsequently, two (2) confirmatory monitoring wells were installed. A confirmatory Round 2 groundwater sampling program at existing RI and new monitoring wells was completed in February 1994.

The Focused Feasibility investigatory program included the following tasks:

- Groundwater Elevation Measurements (May 1993, February and April 1994)
- Round 1 Groundwater Sampling (May 1993)
- Drive Point Groundwater Sampling (August 1993)
- Monitoring Well Installation (Two confirmatory wells in February 1994)
- Round 2 Groundwater Sampling (February 1994)
- Hydrogeologic (Slug) Testing (March 1994)
- Long Term Groundwater Elevation Monitoring (March 1994)

These tasks are discussed in the following sections. The procedures utilized during these field investigation tasks are presented first, followed by the results and conclusions of the field tasks.

2.2 Groundwater Elevation Measurements

A complete round of water level measurements from both on-property and off-property monitoring wells was made for further hydrogeologic evaluation of the groundwater flow direction and velocity. Groundwater level measurements were also made prior to sampling each well during both rounds of groundwater sampling and during April 1994. Long-term water level measurements were performed at MW-2S and MW-2D during March 15 to 21, 1994 to identify any effects on groundwater flow patterns due to nearby pumping supply wells. Depth to water was taken from a predetermined point at the top of the casing, which had been previously surveyed. This information, and all other relevant groundwater sampling field observations, were recorded in the field log book and groundwater sampling field data sheets. The results of groundwater elevation monitoring are discussed in Section 2.9 and detailed in Table 2-1.

2.3 Groundwater Sampling (Round 1 and 2)

2.3.1 Objectives and Monitoring Locations

To provide updated groundwater analytical data, the existing 1989 remedial investigation wells were resampled in May 1993 as the Round 1 groundwater sampling. These wells were sampled for Low Detection Level (LDL) Target Compound List (TCL) Volatile Organic Compounds (VOCs) and total and dissolved Target Analyte List (TAL) Metals. Table 2-2 details the monitoring well construction data for all of the existing RI wells sampled and the two new wells installed during the FFS. The existing RI wells included MW-2S/D, MW-3S/D, MW-4S/D, MW-8, MW-9, MW-10, MW-11 and MW-12 located on the Circuitron Corporation property. The remaining existing RI wells were located on adjacent properties included MW-1S/D, MW-5S/D, MW-6S/D and MW-7S/D. The "S"-designation indicates that the well is a water table well with a screened interval of approximately 25 - 35 feet below grade and is the shallow monitoring well of a two well couplet. The "D"-designation indicates that the well is the deeper well of the couplet, with a screened interval approximately 90 - 100 feet below grade.

One supply well was also sampled during Round 1. This well is a deep non-contact cooling water supply well (PW-2) located on the House of Plastics property, downgradient of the Circuitron Corporation Site.

A drive point groundwater sampling program was conducted in conjunction with quick turn-around laboratory analysis during August 1993 at the Circuitron Corporation Site and nearby upgradient and downgradient locations (Figure 2-1) as a reconnaissance method to delineate vertical and lateral volatile organic contamination. Groundwater samples were collected from locations along five (5) transects, located both upgradient and downgradient of the

TABLE 2-1

CIRCUITRON CORPORATION SITE

SUMMARY OF GROUNDWATER ELEVATION DATA

Well Number	Top of Well Casing Elevations (ft-MSL)	05/10/93 - 05/14/93		02/21/94 - 02/25/94		04/07/94	
		Depth to Water (ft below TOC)	Groundwater Elevation (ft-MSL)	Depth to Water (ft below TOC)	Groundwater Elevation (ft-MSL)	Depth to Water (ft Below TOC)	Groundwater Elevation (ft-MSL)
MW-1S	86.82	24.55	62.27	28.2	58.62	NA	NA
MW-1D	86.94	24.72	62.22	28.4	58.54	NA	NA
MW-2S	88.44	26.00	62.44	29.1	59.34	28.83	59.61
MW-2D	88.22	26.20	62.02	29.1	59.12	28.59	59.63
MW-3S	88.15	26.25	61.90	29.9	58.25	28.68	59.47
MW-3D	88.37	26.50	61.87	30.1	58.27	28.88	59.49
MW-4S	86.71	24.80	61.91	28.5	58.21	27.23	59.48
MW-4D	86.79	24.85	61.94	28.8	57.99	27.30	59.49
MW-5S	86.39	24.70	61.69	29.5	56.89	27.14	59.25
MW-5D	86.75	25.05	61.70	29.5	57.25	27.46	59.29
MW-6S	86.09	24.65	61.44	28.4	57.69	27.03	59.06
MW-6D	86.19	24.70	61.49	28.2	57.99	27.00	59.19
MW-7S	89.15	28.35	60.80	31.6	57.55	30.67	58.48
MW-7D	90.05	28.90	61.15	32.5	57.55	31.22	58.83
MW-8	86.16	24.18	61.98	27.6	58.56	26.61	59.55
MW-9	86.94	24.9	62.04	28.5	58.44	27.32	59.62
MW-10	88.68	26.75	61.93	DRY	NA	DRY	NA
MW-11	88.42	26.55	61.87	DRY	NA	28.90	59.52
MW-12	88.79	27.00	61.79	DRY	NA	29.35	59.44
MW-13	85.35	NA	NA	28.0	57.35	26.53	58.82
MW-14	85.28	NA	NA	28.5	56.78	27.46	57.82
PD-1	85.19	NA	NA	27.0	58.19	25.75	59.44
PD-2	85.61	NA	NA	NA	NA	25.97	59.64

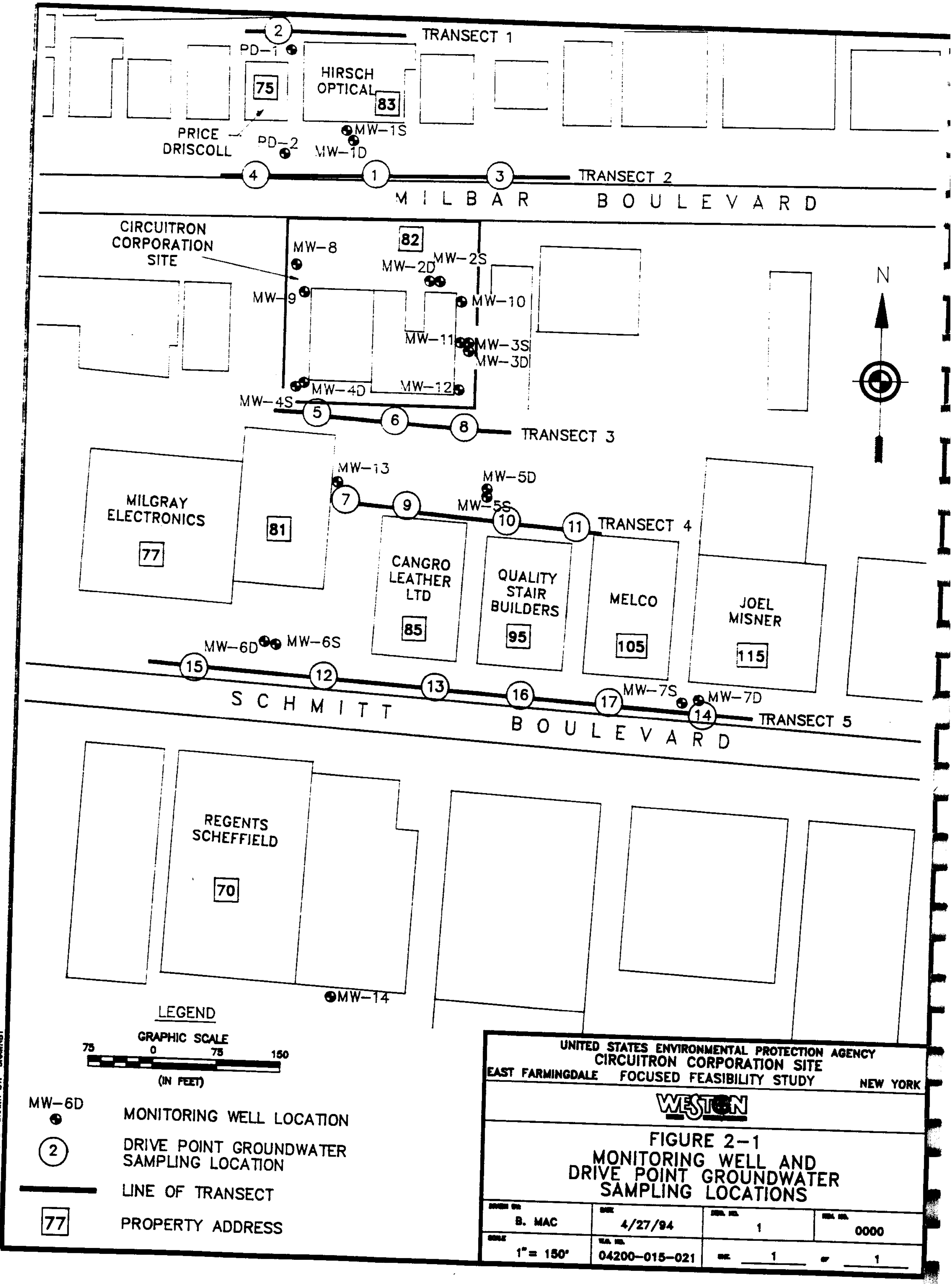
Notes:
1) MSL = Elevations referenced to Mean Sea Level
2) NA = Data Not Available
3) TOC = Top of Well Casing

TABLE 2-2

CIRCUITRON CORPORATION SITE
GROUNDWATER MONITORING WELL INSTALLATION DATA

Well Number	Top of Well Casing Elevation (ft-MSL)	Well Screen Depth (ft-BGS)	Well Screen Elevation (ft-MSL)	Aquifer Screened	Screen/Riser Type	Slot Size	Sand Pack
MW-1S	86.82	25.0-35.0	61.8-51.8	Upper Glacial	4" SS	20	#4 Q ROK
MW-1D	86.94	90.1-100.1	(-3.2)-(-13.2)	Magothy	4" SS	20	#4 Q ROK
MW-2S	88.44	25.1-35.1	63.3-53.3	Upper Glacial	4" SS	20	#4 Q ROK
MW-2D	88.22	90.5-100.5	(-2.3)-(-12.3)	Magothy	4" SS	20	#4 Q ROK
MW-3S	88.15	28.0-38.0	60.1-50.1	Upper Glacial	4" SS	20	#4 Q ROK
MW-3D	88.37	90.2-100.2	(-1.9)-(-11.9)	Magothy	4" SS	20	#4 Q ROK
MW-4S	86.71	23.7-33.7	63.0-53.0	Upper Glacial	4" SS	20	#4 Q ROK
MW-4D	86.79	90.2-100.2	(-3.5)-(-13.5)	Magothy	4" SS	20	#4 Q ROK
MW-5S	86.39	24.4-34.4	62.0-52.0	Upper Glacial	4" SS	20	#4 Q ROK
MW-5D	86.75	90.0-100.0	(-3.3)-(-13.3)	Magothy	4" SS	20	#4 Q ROK
MW-6S	86.09	24.0-34.0	62.1-52.1	Upper Glacial	4" SS	20	#4 Q ROK
MW-6D	86.19	89.5-99.5	(-3.4)-(-13.4)	Magothy	4" SS	20	#4 Q ROK
MW-7S	89.15	26.7-36.7	62.45-52.45	Upper Glacial	4" SS	20	#4 Q ROK
MW-7D	90.05	90.0-100.0	(-0.5)-(-10.5)	Magothy	4" SS	20	#4 Q ROK
MW-8	86.16	24.8-29.8	61.4-56.4	Upper Glacial	2" PVC	NA	NA
MW-9	86.94	24.1-29.1	62.9-57.9	Upper Glacial	2" PVC	NA	NA
MW-10	88.68	23.9-28.9	64.8-59.8	Upper Glacial	2" PVC	NA	NA
MW-11	88.42	25.0-30.0	63.4-58.4	Upper Glacial	2" PVC	NA	NA
MW-12	88.79	25.0-30.0	63.7-58.7	Upper Glacial	2" PVC	NA	NA
MW-13	85.35	32.0-42.0	53.4-43.4	Upper Glacial	4" SS	20	Morie #2
MW-14	85.28	33.0-43.0	52.3-42.3	Upper Glacial	4" SS	20	Morie #2
PD-1	85.19	22.0-32.0	63.2-53.2	Upper Glacial	2" PVC	NA	NA
PD-2	85.61	22.0-32.0	63.6-53.6	Upper Glacial	2" PVC	NA	NA

Notes:
1) MSL = Elevations referenced to Mean Sea Level
2) BGS = Depth referenced to feet below ground surface
3) PVC = Polyvinyl Chloride
4) NA = No Data Available



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
CIRCUITRON CORPORATION SITE
EAST FARMINGDALE FOCUSED FEASIBILITY STUDY NEW YORK

WESTON

FIGURE 2-1
MONITORING WELL AND
DRIVE POINT GROUNDWATER
SAMPLING LOCATIONS

B. MAC	4/27/94	1	0000
1"= 150'	04200-015-021	1	1

Circuitron Corporation Site, running generally perpendicular to the predominant groundwater flow direction to the south-southeast. Groundwater sampling locations were spaced along approximate 100 - 150 feet separation distances. Two upgradient and three downgradient transects were completed, for a total of seventeen (17) sampling locations. At these 17 sampling locations, a total of 48 groundwater samples were collected at varying depths within the Upper Glacial aquifer.

The groundwater samples were analyzed for halogenated volatile organic analysis by U.S. EPA Method 601 on a quick turn-around time basis. Generally, the groundwater samples were analyzed and reported within two hours of sample collection and delivery. During the drive point groundwater sampling program, 10% confirmatory samples were collected for off-site analysis for Target Compound List (TCL) organics using the Contract Laboratory Program (CLP).

Based upon the results of the drive point groundwater sampling, two (2) additional groundwater monitoring wells were installed to confirm the results of the drive point sampling program. One new monitoring well (MW-13) was located approximately center-line of the organic plume emanating from the southwest corner of the Circuitron Corporation facility 110 feet downgradient of the property line. The second new monitoring well (MW-14) was installed at a location 220 feet further downgradient of the southernmost existing monitoring well MW-6S. This well was installed at the southern portion of the 70 Schmitt Boulevard property to attempt to define the leading edge of the organic plume.

Round 2 groundwater sampling was performed in February 1994 and consisted of the sampling of the majority of the existing (RI) wells (MW-1S/D, MW-2S/D, MW-3S/D, MW-4S/D, MW-5S/D, MW-6S/D and MW-7S/D, two (2) newly installed confirmatory wells (MW-13 and MW-14), a private upgradient monitoring well (Price Driscoll property located at 75 Milbar Boulevard, designated as PD-1) and the House of Plastics well, PW-2. These wells were sampled for Low Detection Level TCL Volatile Organic Compounds and total and dissolved TAL Metals. In addition to these analytes, alkalinity, hardness, total dissolved solids (TDS) and total suspended solids (TSS) were also analyzed for at nine (9) monitoring wells.

Both Rounds 1 and 2 groundwater sampling events also included the measurement of groundwater elevations. Another round of groundwater elevation measurements was performed during April 1994 as well as a long term (six days) static water level measurement period in mid-March, 1994 was performed to determine if there are any apparent influences due to pumping supply wells in the area.

The procedures which were employed to sample the monitoring wells during both rounds of groundwater sampling are detailed below and are consistent with the procedures specified in the approved Final Draft SAP for this site. Any modifications to these procedures are discussed with the associated rationale for modification.

2.3.2 Groundwater Sampling Procedures

The groundwater sampling procedures followed by WESTON were designed to ensure that the groundwater samples are representative of the media they are intended to characterize. All purging, sampling and decontamination procedures were conducted in accordance with the approved Site Sampling and Analysis Plan as described below.

All monitoring wells were purged before sampling to ensure that stagnant water was removed from the well casing and that fresh formation water was induced into the well. Purging was conducted by first calculating the volume of water standing in the well (total depth of well minus depth to water) and then multiplying by 0.65 and 0.17 gallons per foot for a 4-inch and 2-inch well casing, respectively. Each well was purged until pH, conductivity, temperature and turbidity had stabilized and a minimum of three well volumes had been purged. Detailed data on the final field parameters taken during final purging conducted for Round 1 and 2 groundwater sampling are given in Table 2-3.

TABLE 2-3

CIRCUITRON CORPORATION SITE

SUMMARY OF THE FINAL GROUNDWATER FIELD PARAMETERS OF THE PURGED WATER FOR ROUND 1/ROUND 2 GROUNDWATER SAMPLING[1]

Well Number	Sampling Round	pH	Specific Conductance (umhos/cm)	Temperature (°C)	Turbidity (NTU)[2]
MW-1S	Round 1	6.7	442	16.8	>200
	Round 2	6.5	373	17.7	72
MW-1D	Round 1	7.1	163	14.0	10.2
	Round 2	6.3	135	11.8	28.6
MW-2S	Round 1	6.3	203	17.8	>200
	Round 2	6.6	221	14.8	>200
MW-2D	Round 1	7.0	170	20.5	6.51
	Round 2	6.2	137	13.0	NA
MW-3S	Round 1	6.3	177	19.0	>200
	Round 2	6.8	166	13.5	>200
MW-3D	Round 1	6.1	202	18.7	4.85
	Round 2	6.3	145	13.3	2.80
MW-4S	Round 1	6.3	217	22.0	15.5
	Round 2	6.6	187	13.0	37.8
MW-4D	Round 1	6.3	143	21.7	6.25
	Round 2	6.3	105	13.2	0.48
MW-5S	Round 1	6.2	197	19.2	99.4
	Round 2	6.6	171	12.3	10
MW-5D	Round 1	5.6	155	21.5	4.83
	Round 2	5.3	117	11.3	30
MW-6S	Round 1	7.1	143	14.0	21.5
	Round 2	6.3	139	11.7	2.8
MW-6D	Round 1	6.4	148	14.0	24.7
	Round 2	5.9	135	12.2	8.9
MW-7S	Round 1	6.7	130	15.0	5.60
	Round 2	6.8	173	12.5	>200
MW-7D	Round 1	8.6	135	15.0	6.79
	Round 2	6.6	115	11.8	9.0
MW-8	Round 1	6.6	243	17.3	122.2
	Round 2	NA	NA	NA	NA
MW-9	Round 1	6.8	213	17.3	103
	Round 2	NA	NA	NA	NA

TABLE 2-3

CIRCUITRON CORPORATION SITE

SUMMARY OF THE FINAL GROUNDWATER FIELD PARAMETERS OF THE PURGED WATER FOR ROUND 1/ROUND 2 GROUNDWATER SAMPLING[1]

Well Number	Sampling Round	pH	Specific Conductance (umhos/cm)	Temperature (°C)	Turbidity (NTU)[2]
MW-10	Round 1	7.1	160	13.8	>200
	Round 2	NA	NA	NA	NA
MW-11	Round 1	6.8	205	14.0	35.2
	Round 2	NA	NA	NA	NA
MW-12	Round 1	7.0	160	14.3	160.0
	Round 2	NA	NA	NA	NA
MW-13	Round 1	NA	NA	NA	NA
	Round 2	6.07	113	10.7	42
MW-14	Round 1	NA	NA	NA	NA
	Round 2	6.7	147	11.3	55.5
PD-1	Round 1	NA	NA	NA	NA
	Round 2	7.0	425	13.2	NA

Notes: 1) Data represents the mean value for the parameter for all volumes analyzed during that sampling round except for turbidity for which value of the final volume was reported.

2) NTU = Nephelometric Turbidity Units

NA - Not available

When purging was complete, most of the water levels recovered approximately to initial levels almost immediately, with the exception of some of the existing shallow RI wells. Several of the existing shallow water table RI wells were noted to contain only a few (2 to 3) feet of water at the bottom and were purged dry during the Round 2 groundwater sampling program. This correlates with the approximate six foot increase in depth to water measured since these wells were installed as part of the 1989 RI. These wells produced extremely turbid groundwater (>200 NTUs) which did not clear up during purging. Only a limited column of water was present to be removed from these wells and no additional techniques could be employed to remove the fines from the formation. Those wells noted as being dry during the Round 2 groundwater sampling program were not sampled (see Table 2-1).

Each of the monitoring wells was sampled within two hours after purging using laboratory decontaminated disposable teflon bailers with teflon-coated stainless steel haul cord. Groundwater samples were collected into the appropriate glassware, with volatile organic samples being collected first (field preserved), followed by total metals and then the filtered (dissolved) metals. Hydrochloric acid (HCL) was used to preserve the volatile organic samples. The amount of HCL was determined by first testing a separate 40 ml vial of groundwater to see how many drops of HCL were needed to alter the pH to two or less. After the amount of HCL was determined at each sampling location, the volatile organic sample bottles were pre-treated by adding the proper amount of HCL. Volatile organic samples were filled directly from the bailer. The remaining samples were placed directly into the appropriate sampling container from the bailer.

Where filtration was required (metals only), the collected sample was placed in a certified clean bottle and then passed through a dedicated disposable laboratory decontaminated filtration apparatus (QED Filters). The filtration apparatus consisted of a disposable polyethylene filter with a 0.45 micron cellulose-based nitrate filter. Dissolved and total metals were preserved with ultra-pure nitric acid. The pH of these two samples was adjusted in the field to a pH of two or less. The dissolved metals sample was preserved after being filtered. All samples were preserved and stored on ice in preparation for shipping. During Round 2 groundwater sampling, alkalinity, hardness, total dissolved solids and total suspended solids samples were also collected. These samples were collected after the metals, and were stored on ice to cool to 4° C. All of the groundwater samples were properly logged for transport. The chain-of-custody was completed and the cooler was custody-sealed and tagged for CLP analysis with the appropriate traffic reports. All samples were shipped to a CLP laboratory within 24 hours of sample collection. The monitoring wells were recapped and locked upon leaving the well location.

2.3.2.1 Sample Preservation

Acidification of Aqueous Volatile Organic Samples - The aqueous volatile organic samples were acidified by adjusting the pH to less than 2 prior to shipment to the assigned CLP laboratory. This was accomplished by adding 1:1 Hydrochloric acid (HCL) drop by drop to the required three 40 ml VOA vials. The amount of HCL was determined by first testing a separate 40 ml vial of groundwater to see how many drops of HCL were needed to alter the pH to two or less. If acidification caused effervescence, the sample was submitted without preservation, except for cooling to 4 C with the holding time reduced to 5 days from verified time of sample receipt (VTSR). No samples effervesced during acidification.

Addition of Nitric Acid ($HN0_3$) to Aqueous Metal and Hardness Samples - Aqueous samples for filtered and unfiltered metals and hardness analysis were acidified to a pH of less than 2 prior to shipment to the assigned CLP laboratory using ultra pure undiluted nitric acid.

Filtration of Aqueous Metal Samples - Aqueous metal samples were filtered in order to determine the concentration of dissolved inorganic constituents in the groundwater. Sample filtration was conducted in the field immediately after the sample was collected. Samples were filtered through a dedicated QED® Disposable filtration device made of polyethylene, and a cellulose-based membrane filter with a 0.45 micron nominal pore size. Samples were passed only once through the filtration device, and then were preserved with undiluted ultra-pure nitric acid to a pH of less than 2. The pH was immediately checked after preservation to ensure that the proper pH had been achieved.

All samples were placed on ice immediately after collection and shipped at a temperature of 4°C within 24 hours of sample collection.

2.3.2.2 Sampling of Monitoring Wells

As discussed above, existing on-property and off-property monitoring wells were sampled. The wells were purged using a decontaminated submersible pump and dedicated polyethylene tubing. All purge water was containerized on-property in holding tanks and will be disposed of in accordance with applicable regulations. The groundwater samples were collected using laboratory cleaned, dedicated disposable teflon bailers.

One shipment of samples was sent to the selected U.S. EPA CLP laboratories for analysis at the conclusion of each sampling day. QA/QC samples were collected and consisted of matrix spike/matrix duplicates (MS/MD) (only for TAL metals at a frequency of one in twenty samples); field rinsate blanks (field blanks); one field sample duplicate at a frequency of one in twenty samples; and a trip blank for volatile organic compounds analysis. The trip blanks accompanied the sample bottles throughout the field sampling activities. For each sampling event, the ratio of QA/QC samples to field samples was not less than 1:20. The appropriate preservatives were added to all QA/QC and field sample bottles. For VOC's three filled 40 milliliter (ml) teflon septum glass vials constituted a sample. These vials were enclosed in a plastic zip-lock bag. A WESTON Chain-of-Custody seal was applied to the bottles. Similarly, all other filled sample bottles were custody sealed and placed in zip-lock bags. While at the site, all filled sample bottles were stored on ice. Prior to shipment to the laboratory, all samples were documented in the field logbook and on a WESTON Chain-of-Custody form. A copy of the Chain-of-Custody form accompanied the sample shipment to the laboratory. The samples were shipped to the laboratory via overnight carrier within 24 hours of collection.

2.3.3 Groundwater Sampling Quality Assurance/Quality Control

2.3.3.1 Equipment Decontamination

All dedicated sampling equipment before use and all non-dedicated sampling equipment before and between use was decontaminated according to the following procedure:

- Wash and scrub with low phosphate detergent
- Tap water rinse
- Rinse with 10% ultra-pure nitric acid solution (1% for carbon steel spilt-spoons)
- Tap water rinse
- An acetone rinse only or a methanol followed by hexane rinse (pesticide grade or better)
- Thorough rinse with demonstrated analyte-free water*
- Air dry, and wrap sampling equipment in aluminum foil for transport

* The volume of water used during this rinse was at least five times the volume of the solvent used.

Heavy equipment such as the drill rig and geoprobe drive unit arrived on-site in a clean condition. Prior to the start and after completion of drilling, the drilling equipment along with any associated equipment (augers, drill bits, and tools or well materials) were steam-cleaned at an area on-site that had been prepared for this purpose. The equipment was steam cleaned before, between and after each monitoring well borehole location or drive point sample location to prevent cross-contamination. Decontamination fluids were segregated and stored on-site for later disposal.

2.3.3.2 Field Quality Control Samples

<u>Field Blanks</u> - One field (rinse) blank was collected for each type of sampling equipment used each day a decontamination event was carried out. The blanks consisted of pouring laboratory

documented analyte-free water over field decontaminated or laboratory decontaminated dedicated sampling equipment prior to sampling. Analysis of the rinse blank was performed for all analytes of interest. A rinse blank was collected on the dissolved metal filtration apparatus. Field blanks were taken as a check that the decontamination procedure had been adequately carried out and that no cross contamination of samples had occurred from the improper decontamination of equipment.

Trip Blanks - A trip blank consisting of demonstrated analyte free water sealed in a 40 ml teflon septum vial was taken into the field every day when volatile organics in an aqueous matrix were being collected. Trip blanks were used to determine if any on-site atmospheric contaminants seeped into the sample vial, or if any cross contamination of samples occurred during the handling, shipment or storage of the sample containers. The trip blanks accompanied the sample bottles throughout the field sampling activities.

Field Duplicates - To demonstrate the reproducibility of sampling technique field, duplicate samples are collected. Duplicate samples were taken at a frequency of five percent of the total number of groundwater samples.

Matrix Spike/Matrix Duplicates (MS/MD) - A Matrix Spike is an aliquot of a field sample that is fortified (spiked) with the analytes of interest, and is prepared and analyzed with the associated sample batch to monitor for any effects of the field sample matrix (matrix effects) on the analytical method. No Matrix Spike/Matrix Spike Duplicates samples are required for LDL volatiles. Matrix Spike/Matrix Duplicates samples are only required for TAL metals and were collected at a rate of 1 in 20 samples.

2.4 Drive-Point Groundwater Sampling

A drive point groundwater sampling program was conducted in conjunction with quick turn-around laboratory analysis at the Circuitron Corporation Site during August 16 to 24, 1993. The drive point groundwater sampling program was performed using a Geoprobe® Drive Point

Sampling System. The Geoprobe® Drive Point Sampling System is a truck mounted, hydraulically powered percussion hammer which depends on the weight of the vehicle and the percussion hammer to advance 1-inch steel probe rods into the ground. Groundwater samples were obtained by the driving of the 1-inch diameter decontaminated hardened steel rods from grade to preselected sampling depths within the aquifer. When the target depth in the aquifer is reached, the drive point sampling apparatus was retracted approximately two (2) feet and a groundwater sampling system (stainless steel screen and sampling chamber) was exposed in the borehole. Driven by the in-situ hydrostatic pressure, groundwater passes into the screen and then into the sampling chamber for collection.

Groundwater samples were collected during the Drive Point Sampling Program from dedicated teflon tubing lowered into the sampling chamber. The groundwater was lifted to the surface by oscillating the tubing which had a stainless steel check valve in the bottom. The groundwater sample was then carefully transferred into the appropriate glassware by pulling the tubing, removing the check valve and reversing the direction of flow of the water directly into the sample container. All sampling equipment was either laboratory decontaminated and dedicated or was decontaminated in the manner described above in Section 2.3.3.1.

After collection, the groundwater samples were transported by WESTON personnel to H2M Laboratories, an ELAP/CLP certified fixed based laboratory located approximately 1/4 mile from the site for halogenated volatile organic analysis by U. S. EPA Method 601 (non-CLP) on a quick-turn-around-time basis analysis. Trip and field blank samples were collected on a daily basis, with field duplicate samples collected for analysis at a rate of 1 in 20. Generally, the groundwater samples were analyzed and reported within two hours of sample collection and delivery.

During the drive point groundwater sampling program, WESTON also collected confirmatory samples for analysis for Target Compound List (TCL) organics using the CLP program, at an approximate rate of 10 percent of the total groundwater samples collected.

As detailed in the FFS Work Plan, groundwater samples were collected along transects located both upgradient and downgradient of the Circuitron Corporation Site, running generally perpendicular to the predominant groundwater flow direction to the south-southeast. Groundwater sampling locations were spaced along transects approximately 100 -150 feet apart, as shown on Figure 2-1. Two upgradient and three downgradient transects were completed, with a total of seventeen (17) sampling locations. The upgradient transect (Transect 1) included only one location due to property access constraints involving private landowners. The original Transect 1 included three locations at the property located at Willow Park Court. Because permission to drill could not be obtained, an alternative upgradient location (near PD-1) was accessed at the northernmost extent of 75 Milbar Boulevard. Transect 2, also upgradient, is located on the north side of Milbar Boulevard (within the Town of Babylon road right-of-way) and was sampled at three locations.

In general, the downgradient transects (Transects 3, 4 and 5) extended beyond the width of the Circuitron Corporation Site to allow a characterization of the width of the aquifer impacted by the site. Transect 3 was located adjacent to and parallel to the southern property line of the Circuitron facility and included three sampling locations. Transect 4 located approximately 150 feet to the south of Transect 3, included four sampling locations downgradient of Circuitron. Both Transects 3 and 4 were located on private property with the prior permission of the property owners. Transect 5 was located on the north side of Schmitt Boulevard (within the Town of Babylon right-of-way), approximately 320 feet south of the Circuitron southern property line and included six sampling locations. The eastern end of Transect 5 was extended to include monitoring well MW-7, because volatile organic compounds were quantified adjacent to drive point sample DP-17, located to the west. The western edge of Transect 5 was extended west of monitoring well location MW-6 because volatile organics were detected at elevated levels at MW-6S.

In the work plan, groundwater samples were proposed to be collected from the upper 10 foot and 20 - 25 foot zones of the Upper Glacial aquifer. A third or possibly deeper samples were proposed for collection at approximate 15-foot intervals below the second sample, at locations where volatile organics were found to be elevated in the second sample, until a vertical decrease in contaminant levels to regional or upgradient levels were obtained. Where possible, the groundwater data from the Round 1 groundwater sampling conducted at existing RI monitoring wells in May 1993 were used to supplement the drive point sampling data in determining when the decrease in contaminant levels occurred.

In May to August 1993, the depth to water at the Circuitron Corporation site and adjoining off-property locations was approximately six (6) feet deeper than that reported during the 1989 groundwater sampling activities. Therefore, the depth of the shallow drive point groundwater sample was increased by several feet to compensate for the drop in groundwater elevation. Depth to water at the site in August 1993 was approximately 32 feet below grade surface (bgs) versus approximately 26 feet bgs previously reported during the 1989 RI. Groundwater samples were collected primarily from three (3) sampling depths at each location which included a shallow (34'-36' bgs), medium (48'-52' bgs) and deeper zone (62'-68' bgs) within the Upper Glacial aquifer. The depths of sample collection at the various drive point sample locations are detailed on Table 2-4. Select drive point samples anticipated to be located along the center-line of the organic plume (DP-5, 6, 8, 9 and 13) were also sampled deeper (80'-82' bgs) to attempt to determine the vertical extent of the organic contamination into the underlying Magothy aquifer. One sampling location DP-14, was only sampled at one zone (42'-46'), to provide supplemental data to the nearby shallow/deep monitoring well couplet MW-7S/7D.

2.5 Monitoring Well Installation

2.5.1 Installation of MW-13 and MW-14

Based upon the results of the drive point groundwater sampling, two (2) groundwater monitoring wells were installed to confirm the extent of the contamination. The number and locations of wells were determined after implementation of the drive point program and in concurrence with the U.S. EPA. Monitoring well installation and development was conducted in accordance with the protocols detailed in the approved SAP.

TABLE 2-4

DRIVE POINT GROUNDWATER SAMPLING LOCATIONS

CIRCUITRON CORPORATION SITE
EAST FARMINGDALE, NEW YORK

AUGUST 16 - 24, 1993

DEPTH INTERVAL (feet below grade)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
34' - 36'	X	X	X	X	-	X	X	-	X	X	X	X	X	-	X	X	X
48' - 52'	X	X	X	X	X	X	X	X	X	X	X	X	X	-	X	X	X
62' - 68'	X	X	-	-	X	X	X	X	X	X	-	X	X	X	-	X	X
80' - 82'	-	X	-	-	X	X	-	X	X	-	-	-	X	-	-	-	-

X = Analyzed for halogenated volatile organic compounds EPA Method 601.

\- = Not sampled or analyzed

See Figure 2-1 for drive point locations.

Monitoring well boreholes were advanced using eight-inch (8") inside diameter hollow-stem augers. Split-spoon samples were collected according to ASTM D-1586 procedures in the selected well screen intervals for lithologic logging. To prevent cross-contamination, the drill rig, drilling tools, rods, bits, samplers, and casing were decontaminated by steam cleaning upon arriving on-site, after the completion of each well and with the completion of operations. Drill cuttings from all locations were containerized in drums and stored in a centralized staging area on the Circuitron Corporation site.

Table 2-2 summarizes the newly installed groundwater monitoring well data for MW-13 and MW-14. Monitoring well construction diagrams are presented in Appendix A. Monitoring wells were constructed of 4-inch inside diameter (ID), threaded, Schedule 304 stainless steel well material with continuous-wrap ten (10) foot long well screens of 0.02 inch slot. The well screens were 10 feet in length, set approximately 5 - 10 feet below the water table. A silicious sand pack of less than 5% calcareous material with a uniformity coefficient of 2.5 or less, such that the screen will retain 90% of the material, was emplaced around the screen. The augers were slowly withdrawn as sand was placed around the screen.

Approximately two feet of a granular bentonite pellet seal was emplaced above the sand pack in the annular space. A slow stream of potable water was added to the borehole during placement of the pellets to hydrate the bentonite pellets. The bentonite pellets were then allowed to hydrate for approximately 1 hour prior to placement of the grout. Class A or B Portland cement mixed with 2 to 4% bentonite and 6.5 to 7.8 gallons of potable water per 94 pound sack of cement was used to grout the remaining annular space. To complete monitoring well construction, a protective steel casing with a flush mount protective casing and a locking well compression cap supplied by the contractor was seated in a concrete cap. An elevation survey of the newly installed monitoring wells, as well as other private monitoring wells was also completed. Boring logs and well construction schematics for the two new monitoring wells are included in Appendix A.

2.5.2 Monitoring Well Development

After monitoring wells were installed, a minimum of 12 hours was allowed to pass prior to development of wells to ensure the grout had set. Pumping was performed with a submersible pump. Wells were developed by purging a minimum of five casing volumes and until pH, conductivity, turbidity and temperature had stabilized. The final three measurements were within 10 percent of one another. Well development was continued until the water was visually free of suspended materials and sediment. Final turbidity readings were less than 50 Nephelometric Turbidity Units (NTUs). All development equipment was decontaminated by steam cleaning before introduction into the well.

The Round 2 groundwater sampling of the newly installed monitoring wells was conducted after the new wells were allowed to stand for only 10 days (compared to 14 days specified in the SAP) with special permission from the U.S. EPA (Linda Ross, U.S. EPA February 1994). This is less than the 14 days specified in the SAP, the groundwater sampling program was expedited to accommodate the overall FFS schedule.

2.6 Round 2 Groundwater Sampling

A confirmatory round (Round 2) of groundwater sampling was performed during February 21 to 25 1994 consistent with the groundwater sampling procedures described in Section 2.3.2. In addition to the on-property and off-property monitoring wells, samples were collected from accessible public and private supply or monitoring wells as discussed above in Section 2.3.1. All protocols as described above for the Round 1 sampling event were adhered to during the Round 2 groundwater sampling program.

2.7 Hydrogeologic Testing

Slug tests were performed at a total of 4 selected shallow wells, including the 2 existing (MW-3S and MW-5S) wells, and the 2 new off-property monitoring wells (MW-13 and MW-14). The slug tests initially involved instantaneously raising the level in the well by inserting a solid cylinder, or slug, of known volume. The rate at which the newly created water level dropped back down to the static equilibrium level (falling head test) was then recorded. The slug was then removed, thereby lowering the water level, and the recovery of the water level over time was recorded. These data were then used to determine the hydraulic conductivity of the given screened interval. This procedure is used for wells with screens completely below the water table (MW-13 and 14). Modified procedures of these slug tests were used for wells partially completed in the unsaturated zone (MW-3S and 5S). The slug test data were recorded by an electronic data logger using the hydraulic pressure transducers. All field equipment exposed to potentially contaminated groundwater, except for the pressure transducers, was decontaminated according to procedures described in Section 2.3.3.1. Since the pressure transducer cables are soluble in nitric acid, this step was deleted from transducer decontamination procedures. To minimize the possibility of cross-contamination between wells, the pressure transducers were dedicated to each well for the duration of the slug tests. Upon completion of the tests, the data was down-loaded onto a personal computer for evaluation. The slug test data are discussed and evaluated in Section 2.10.

2.8 Nature and Extent of Contamination

This section discusses the range in concentrations and spatial distributions of the contaminants of concern identified during the groundwater field investigation tasks of the FFS at the Circuitron Corporation Site and adjoining off-property areas. The nature and extent of contamination was delineated in the groundwater on-property and at off-property locations within the underlying Upper Glacial aquifer. Limited groundwater quality data was also developed on the upper portion of the Magothy aquifer. The impact of potential sources of ongoing groundwater contamination identified at the Circuitron Corporation Site during the previous RI was further characterized during this FFS. The primary contaminants of concern analyzed for during the FFS were volatile organic and inorganic compounds. To allow an analysis of the nature and extent of contamination, summary analytical data tables were prepared that include all detected compounds as well as the non-detected compounds. The summary analytical tables are included at the end of each respective subsection on the Round 1 and Round 2 groundwater sampling and the drive point sampling.

The analytical data tables provide a complete explanation of the data qualifiers that appear on the tables and in the accompanying text in this section. Briefly, a "J" and "JN" qualifier indicates an estimated concentration. In addition, "ND" appearing in the text signifies a "non-detected" concentration. Any analysis marked with an "R" was rejected. Rejected analyses were not used to draw conclusions about contamination concentrations, and were not factored into calculated averages and means. The reason for rejecting an individual analysis is not reported here, but can be found in the validated data packages. Copies of the summary data analytical reports are provided in Appendix A.

To assess the significance of the detected compounds, a comparison was made to those potentially applicable or relevant and appropriate federal and state environmental and public health requirements (ARARs), site background conditions, upgradient versus downgradient relationships and spatial distribution of contamination. A detailed description of potential ARARs for this site is provided in Appendix B, with summary tables, which define the most stringent applicable criteria used to evaluate groundwater contamination. It should be noted that for this FFS, groundwater data was compared only to the New York State Drinking Water Standards and Guidance Values (Title 40 CFR - Part 141, 192) because they are more stringent than federal MCLs.

To delineate the extent of contamination, contaminant concentration isopleth maps were prepared to illustrate the vertical and horizontal extent of the primary contaminants of concern, halogenated volatile organic compounds. The inorganic compounds noted were not suitable for preparing similar isopleths because many of the inorganics at the older shallow RI wells were elevated due to excess turbidity and exhibited a wide range in concentrations. These concentration isopleth maps include the delineation of organic contamination within the shallow groundwater that is directly attributable to the Circuitron Corporation Site, with concentrations of compounds that exceed background concentrations or applicable standards (ARARs) being shown. The lateral extent of volatile organic contamination in groundwater was also delineated by the preparation of concentration isopleth maps in longitudinal cross-section and plan view showing specific contaminants of concern within the Upper Glacial aquifer. Total volatile organic concentrations were also plotted. The isopleths shown on these maps are based upon an interpretation of actual and estimated contaminant concentrations in the groundwater based upon the CLP Round 1 and 2 data, supplemented by the non-CLP drive point groundwater data. The concentration isopleths are shown in Figures 2-2 through 2-5. To define the lateral extent of the plume, plan views of the 1,1,1-trichloroethane and total volatile organics are presented as Figure 2-6 through 2-9.

2.8.1 Round 1 and Round 2 Groundwater Sampling Results

Groundwater samples were collected from a total of 20 wells in Round 1 and 18 wells in Round 2 conducted in May 1993 and February 1994, respectively. Groundwater samples were analyzed for Low Detection Limit (LDL) Target Compound List (TCL) volatile organics and Target Analyte List (TAL) metals (total and dissolved). During Round 2, nine wells were also sampled for alkalinity, hardness, total dissolved solids and total suspended solids. These wells (MW-1S, 3S, 4S, 5S, 6S, 7S, 13, 14 and PD-1) are located in the most representative portion of the shallow Upper Glacial aquifer (upper 40 saturated feet) being addressed during this FFS. Tables 2-5 to 2-12 provide a summary of the analytical testing results for Round 1 and Round 2 groundwater sampling for volatile organics and inorganics. For ease of review, all of the tables are presented at the end of Section 2.8.

Tables 2-5 and 2-7 provide the data summary for Rounds 1 and 2 volatile organic data. Tables 2-6 and 2-8 provide the data summary for Rounds 1 and 2 inorganic data. Table 2-9 provides a comparative analysis of the combined Rounds 1 and 2 organic data versus the 1989 RI Rounds 1 and 2 organic data specifically for 1,1,1-trichloroethane, (1,1,1-TCA) the volatile organic consistently detected in the highest concentrations. Table 2-10 (Round 1 and 2 with the Drive Point Data) provide an overall data summary with the mean concentrations and the frequency and range of detection of site-related chemicals detected and a comparison with background data. It should be noted that this analysis is confined to the shallow wells used to evaluate the effects of the Circuitron Site on the Upper Glacial aquifer. Table 2-11 provides the analytical test

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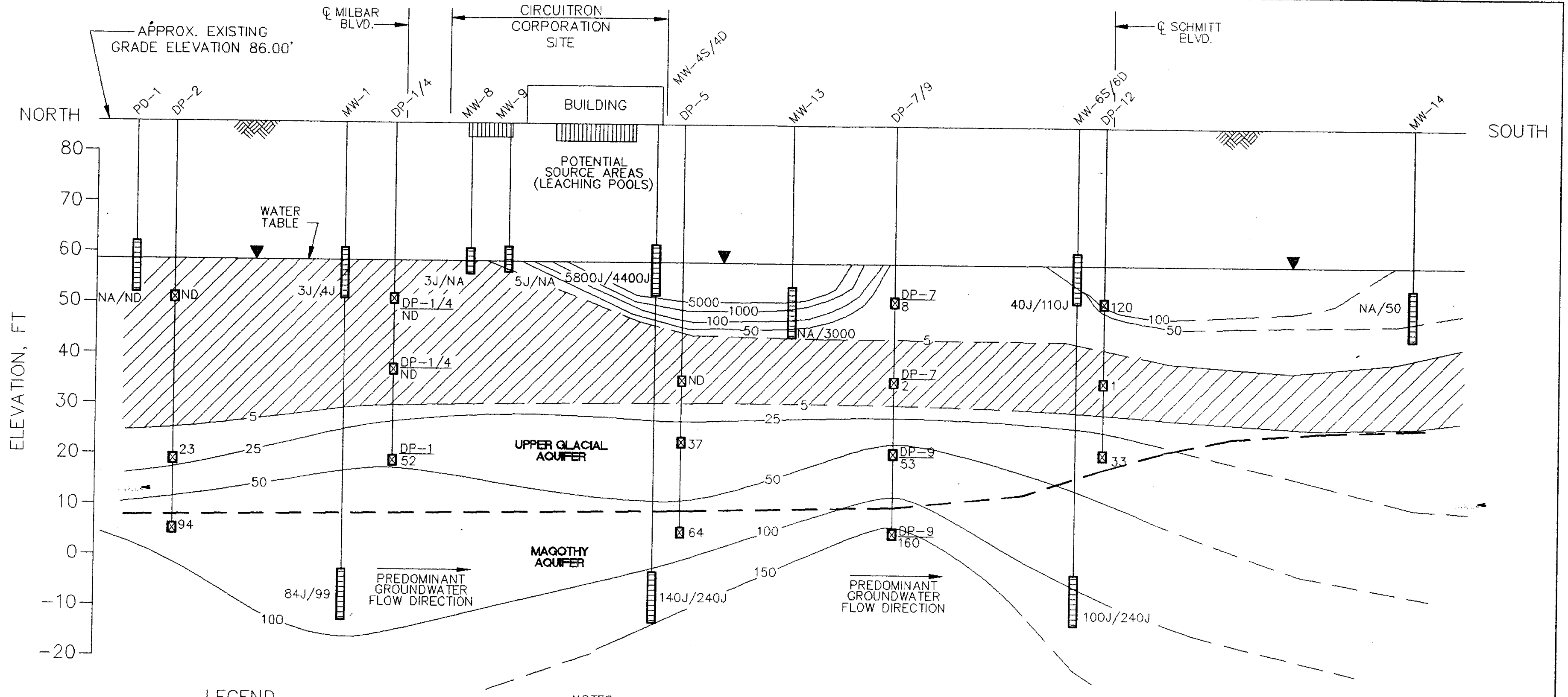
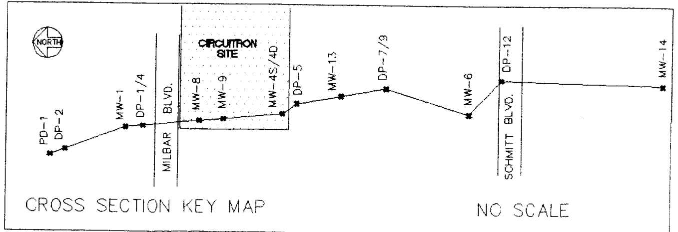


LEGEND

DP	DRIVE POINT GROUNDWATER SAMPLING LOCATION
—25—	CONCENTRATION ISOPLETH FOR 1,1,1-TCA IN ug/l
3J/ND	CONCENTRATION OF 1,1,1-TCA FOR ROUND 1/ROUND 2 GROUNDWATER SAMPLING
ND	ANALYTE NOT PRESENT ABOVE THE QUANTIFICATION LIMIT OF 1 ug/l FOR DRIVE POINT SAMPLES OR 0.5 ug/l FOR MONITORING WELLS
— — —	UNCONFORMABLE GEOLOGIC FORMATION CONTACT
▨	1,1,1-TCA LESS THAN 5 ug/l
▥	MONITORING WELL SCREENED INTERVAL
☒	DRIVE POINT SAMPLING SCREENED INTERVAL
NA	NOT SAMPLED OR ANALYZED

NOTES

1. ROUND 1 GROUNDWATER SAMPLING WAS PERFORMED DURING MAY 10-14, 1993; ROUND 2 GROUNDWATER SAMPLING WAS PERFORMED DURING FEBRUARY 21-25, 1994 ONLY ROUND 1 DATA AND DRIVE POINT DATA WAS USED FOR THE CONTOURING OF ISOCONCENTRATIONS WITH THE EXCEPTION OF MW-13 AND 14 ONLY SAMPLED DURING ROUND 2.
2. DRIVE POINT GROUNDWATER SAMPLING WAS PERFORMED DURING AUGUST 16-24, 1993.



CROSS SECTION KEY MAP

NO SCALE

80 0 80 160

HORIZONTAL SCALE - FEET

WESTON
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UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
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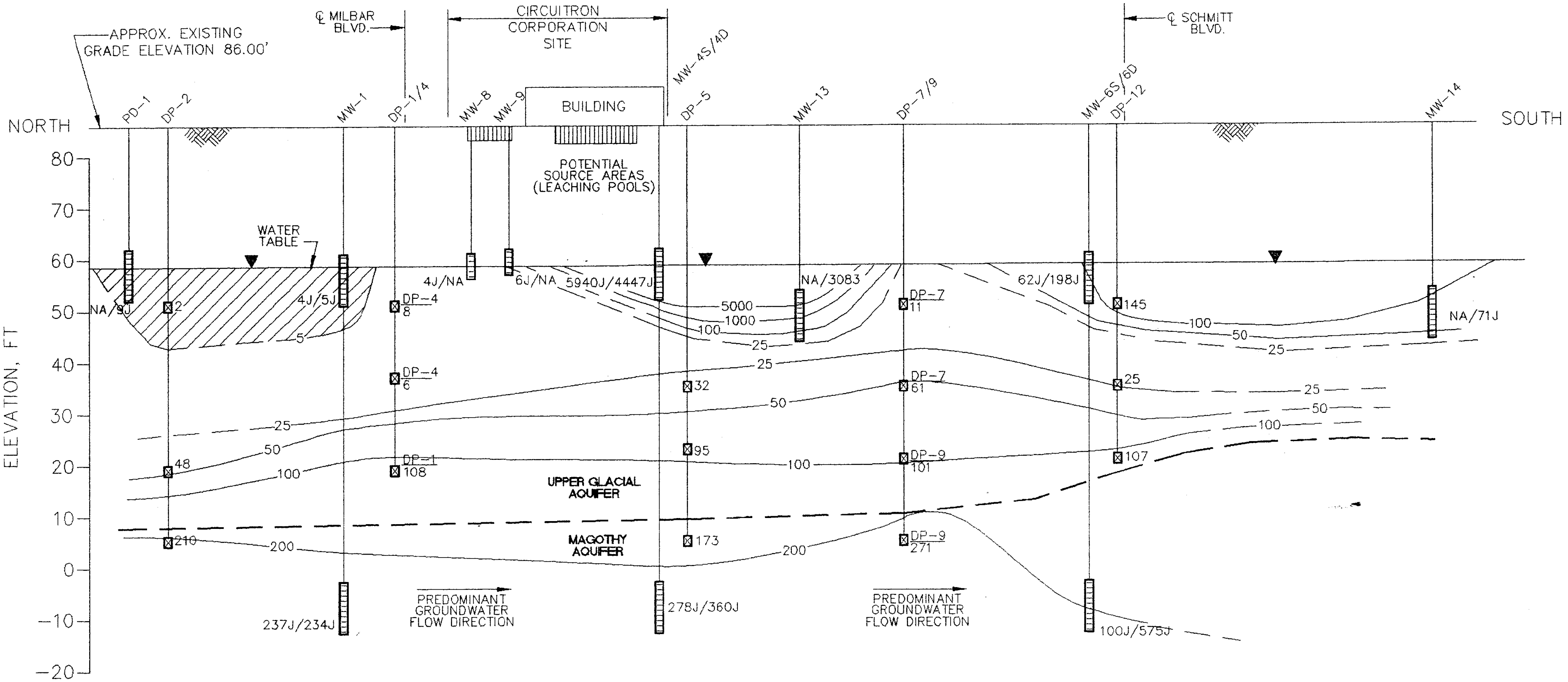
FOCUSED FEASIBILITY STUDY - OU2

FIGURE 2-2

CONCENTRATIONS OF 1,1,1-TCA IN GROUNDWATER, ug/l

MAY 1993, AUGUST 1993, AND FEBRUARY 1994



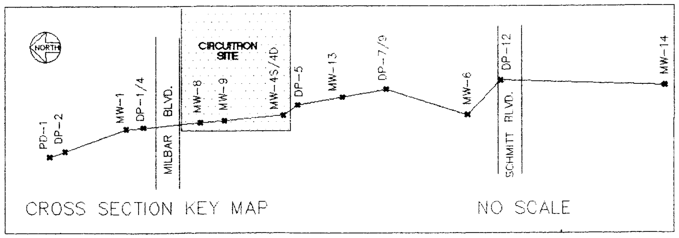
HORIZONTAL SCALE – FEET

LEGEND

DP	DRIVE POINT GROUNDWATER SAMPLING LOCATION
—25—	CONCENTRATION ISOPLETH FOR TOTAL VOLATILE ORGANICS IN ug/l
3J/ND	CONCENTRATION OF TOTAL VOLATILE ORGANICS FOR ROUND 1/ROUND 2 SAMPLING
ND	ANALYTE NOT PRESENT ABOVE THE QUANTIFICATION LIMIT OF 1 ug/l FOR DRIVE POINT SAMPLES OR 0.5 ug/l FOR MONITORING WELLS
— — —	UNCONFORMABLE GEOLOGIC FORMATION CONTACT
▨	TOTAL VOLATILE ORGANICS LESS THAN 5 ug/l
▥	MONITORING WELL SCREENED INTERVAL
☒	DRIVE POINT SAMPLING SCREENED INTERVAL
NA	NOT SAMPLED OR ANALYZED

NOTES

1. ROUND 1 GROUNDWATER SAMPLING WAS PERFORMED DURING MAY 10–14, 1993; ROUND 2 GROUNDWATER SAMPLING WAS PERFORMED DURING FEBRUARY 21–25, 1994 ONLY ROUND 1 DATA AND DRIVE POINT DATA WAS USED FOR THE CONTOURING OF ISOCONCENTRATIONS WITH THE EXCEPTION OF MW-13 AND 14 ONLY SAMPLED DURING ROUND 2.
2. DRIVE POINT GROUNDWATER SAMPLING WAS PERFORMED DURING AUGUST 16–24, 1993.



CROSS SECTION KEY MAP

NO SCALE

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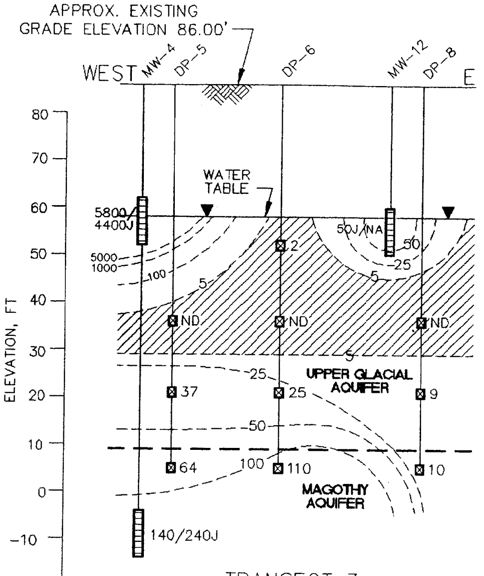
FIGURE 2-3

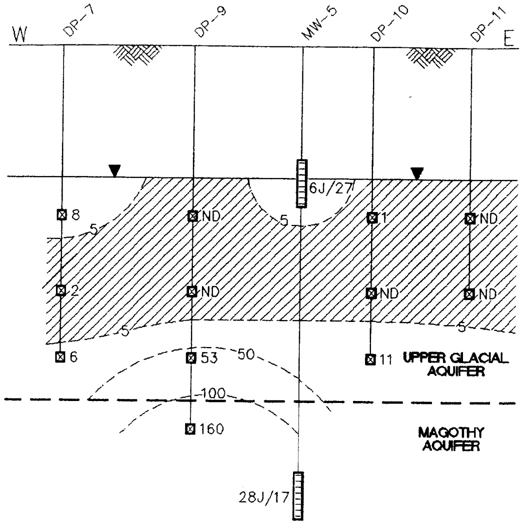
CONCENTRATIONS OF TOTAL VOLATILE ORGANICS IN GROUNDWATER, ug/l

MAY 1993, AUGUST 1993, AND FEBRUARY 1994

File name: C:\ACAD\PROJECT\CIRCUIT\42001503.DWG Last edited: 94/05/17 @ 16:47



TRANSECT 3



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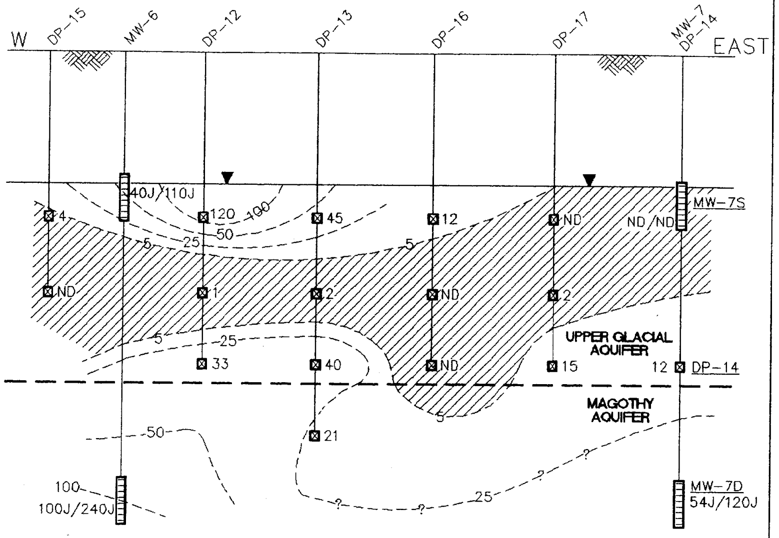
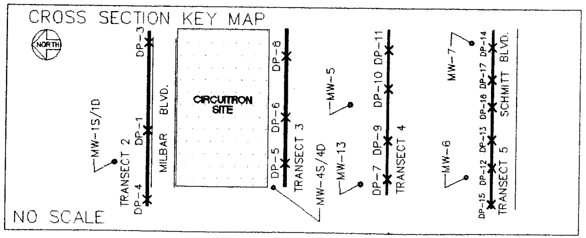
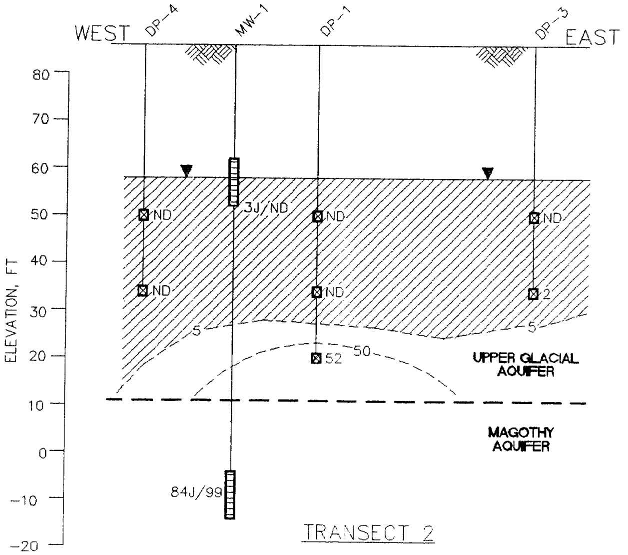


TRANSECT 5

LEGEND

DP	DRIVE POINT GROUNDWATER SAMPLING LOCATION
—25—	CONCENTRATION ISOPLETH FOR 1,1,1-TCA IN ug/l
3J/ND	CONCENTRATION OF 1,1,1-TCA FOR ROUND 1/ROUND 2 SAMPLING
ND	ANALYTE NOT PRESENT ABOVE THE QUANTIFICATION LIMIT OF 1 ug/l FOR DRIVE POINT SAMPLES OR 0.5 ug/l FOR MONITORING WELLS
— — —	UNCONFORMABLE GEOLOGIC FORMATION CONTACT
▨	1,1,1-TCA LESS THAN 5 ug/l
▯	MONITORING WELL SCREENED INTERVAL
☒	DRIVE POINT SAMPLING SCREENED INTERVAL
NA	NOT SAMPLED OR ANALYZED





TRANSECT 2

NOTES

1. ROUND 1 GROUNDWATER SAMPLING WAS PERFORMED DURING MAY 10–14, 1993; ROUND 2 GROUNDWATER SAMPLING WAS PERFORMED DURING FEBRUARY 21–25, 1994 ONLY ROUND 1 DATA AND DRIVE POINT DATA WAS USED FOR THE CONTOURING OF ISOCONCENTRATIONS WITH THE EXCEPTION OF MW-13 AND 14 ONLY SAMPLED DURING ROUND 2.
2. DRIVE POINT GROUNDWATER SAMPLING WAS PERFORMED DURING AUGUST 16–24, 1993.

HORIZONTAL SCALE – FEET

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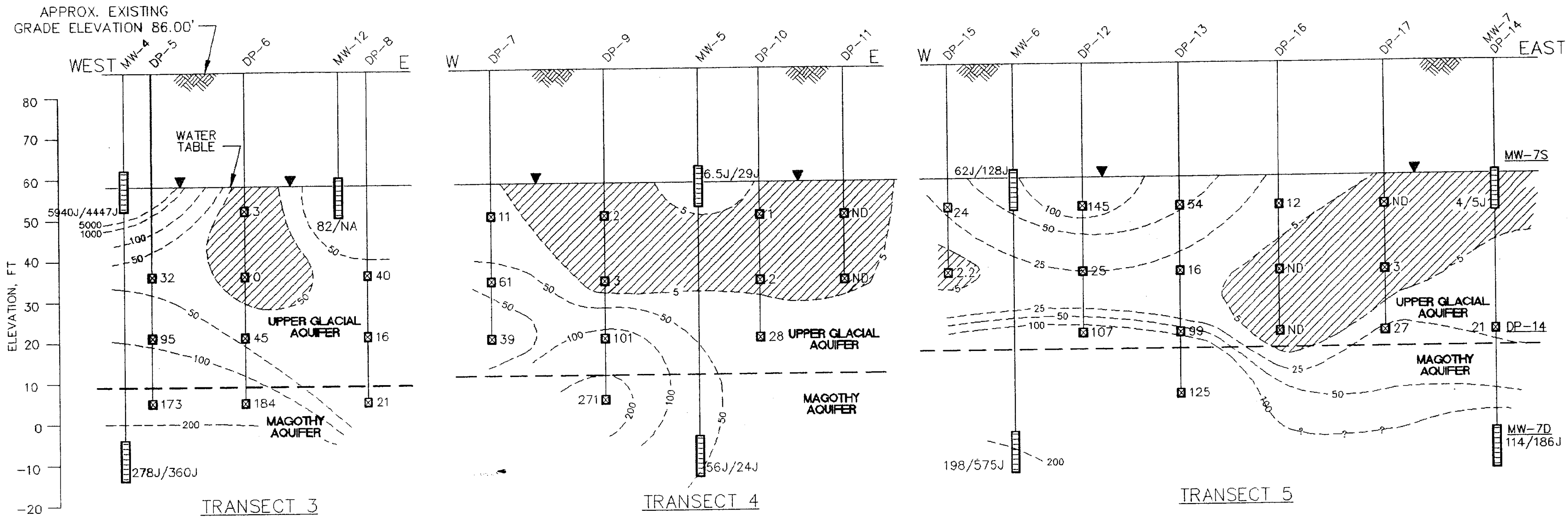
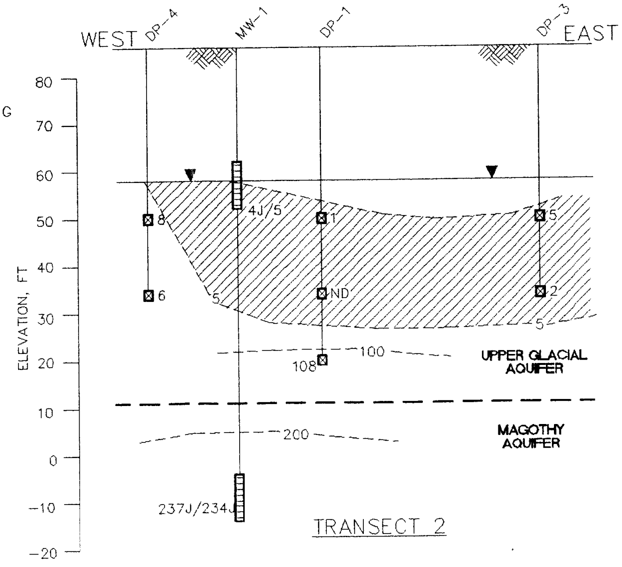
FIGURE 2-4

CONCENTRATIONS OF 1,1,1-TCA
IN GROUNDWATER, ug/l

MAY 1993, AUGUST 1993, AND FEBRUARY 1994

File name: C:\ACAD\PROJECT\CIRCUIT\42001504.DWG Last edited: 94/05/17 @ 17:11

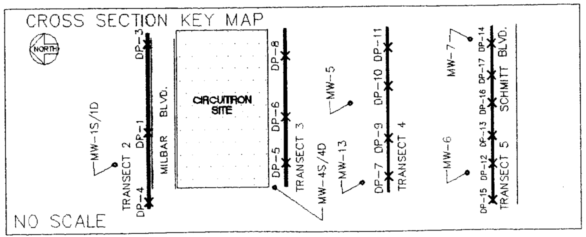




LEGEND

DP DRIVE POINT GROUNDWATER SAMPLING LOCATION
—25— CONCENTRATION ISOPLETH FOR TOTAL VOLATILE ORGANICS IN ug/l
3J/ND CONCENTRATION OF TOTAL VOLATILE ORGANICS FOR ROUND 1/ROUND 2 SAMPLING
ND ANALYTE NOT PRESENT ABOVE THE QUANTIFICATION LIMIT OF 1 ug/l FOR DRIVE POINT SAMPLES OR 0.5 ug/l FOR MONITORING WELLS
— — — UNCONFORMABLE GEOLOGIC FORMATION CONTACT
▨ TOTAL VOLATILE ORGANICS LESS THAN 5 ug/l
▯ MONITORING WELL SCREENED INTERVAL
☒ DRIVE POINT SAMPLING SCREENED INTERVAL
NA NOT SAMPLED OR ANALYZED

CROSS SECTION KEY MAP



NO SCALE

NOTES

1. ROUND 1 GROUNDWATER SAMPLING WAS PERFORMED DURING MAY 10-14, 1993; ROUND 2 GROUNDWATER SAMPLING WAS PERFORMED DURING FEBRUARY 21-25, 1994 ONLY ROUND 1 DATA AND DRIVE POINT DATA WAS USED FOR THE CONTOURING OF ISOCONCENTRATIONS WITH THE EXCEPTION OF MW-13 AND 14 ONLY SAMPLED DURING ROUND 2.
2. DRIVE POINT GROUNDWATER SAMPLING WAS PERFORMED DURING AUGUST 16-24, 1993.

100 0 100 200

HORIZONTAL SCALE - FEET

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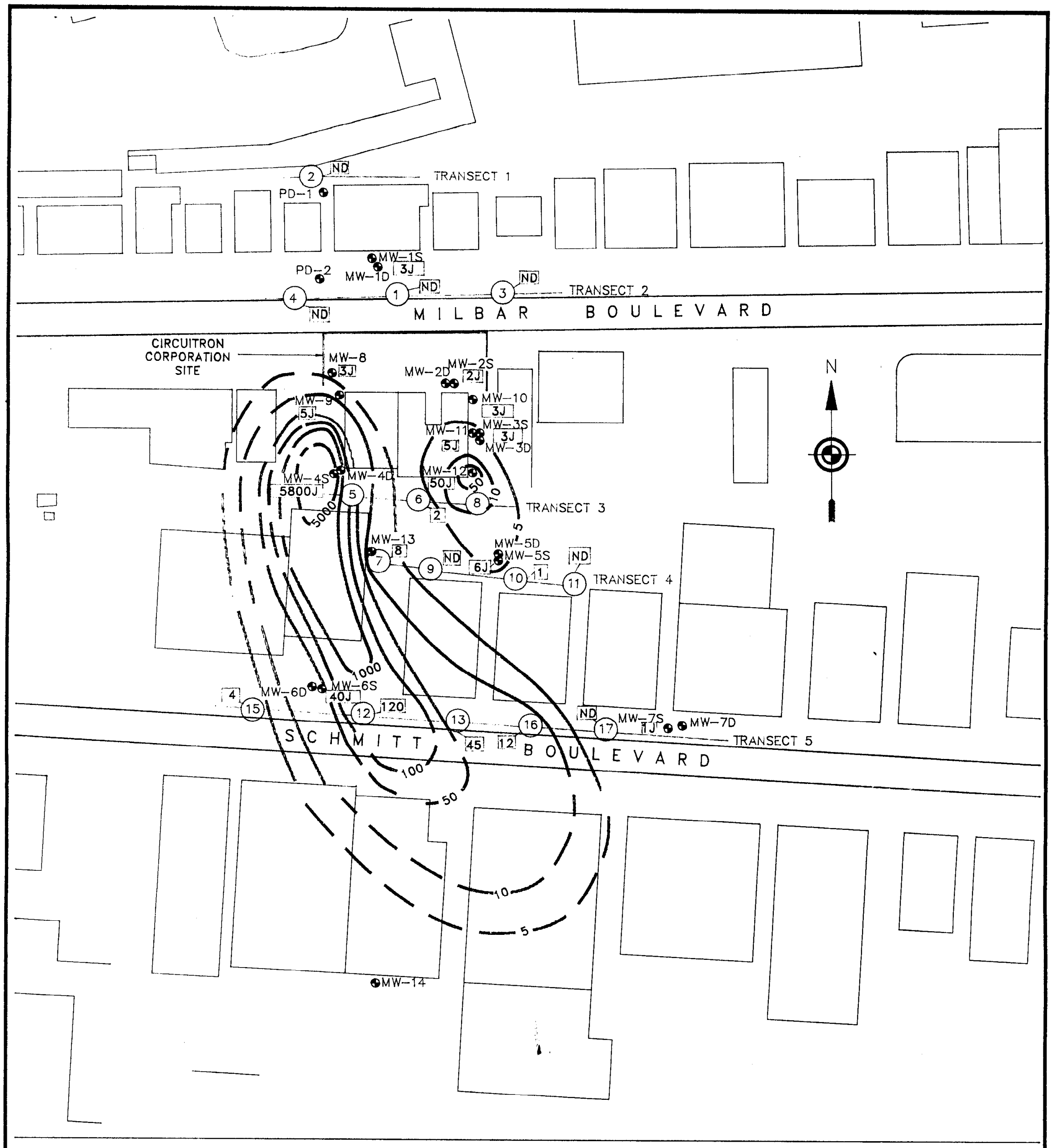
FIGURE 2-5

CONCENTRATIONS OF TOTAL VOLATILE ORGANICS IN GROUNDWATER, ug/l

MAY 1993, AUGUST 1993, AND FEBRUARY 1994



LEGEND

GRAPHIC SCALE
75 0 75 150
(IN FEET)

(2) SHALLOW DRIVE POINT SAMPLING LOCATION (34–36FT)

MW-6S UPPER GLACIAL AQUIFER MONITORING WELL LOCATION

127.86 1,1,1 – TCA CONCENTRATION IN UG/L

ND DENOTES NOT DETECTED

J DENOTES ESTIMATED VALUE

—10— ISOCONCENTRATION LINE IN UG/L (DASHED WHERE INFERRED)

DATA PRESENTED INCLUDES THE SHALLOW DRIVE POINT GROUNDWATER SAMPLING AND ROUND I GROUNDWATER DATA

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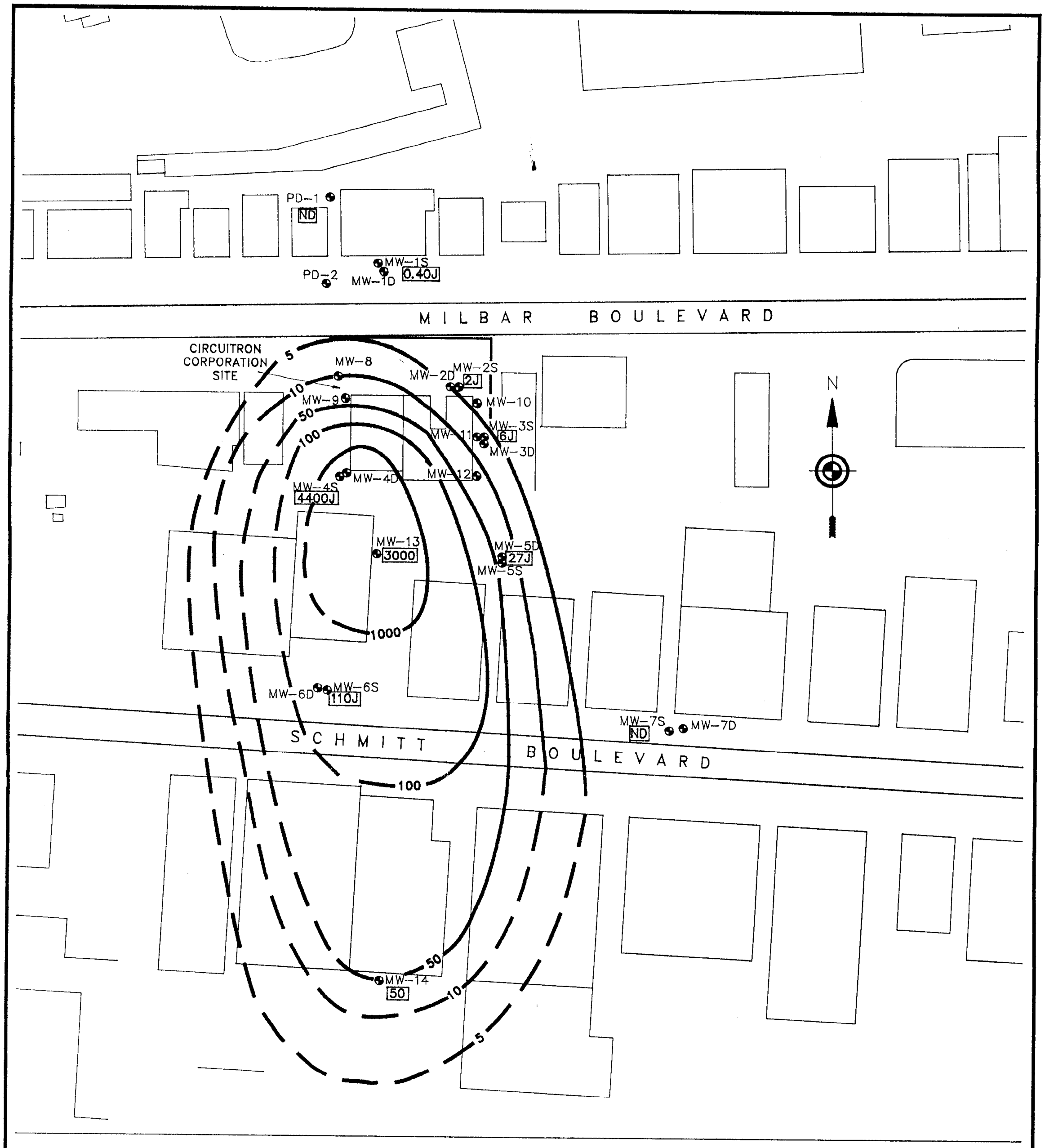
FIGURE 2–6
LATERAL DISTRIBUTION OF
1,1,1 – TCA
MAY/ AUGUST 1993

DRAWN BY	DATE	DWG. NO.	REV. NO.
B. MAC	5/10/94	1	0000
SCALE	W.O. NO.		
1"= 150'	04200-015-021	SHT. 1 OF 1	

REVISION # 001 DATE: 5/9/94
FILE NAME: 2-6_B.DWG DRAWN BY: B. MAC



LEGEND

GRAPHIC SCALE
75 0 75 150
(IN FEET)

MW-6D ⊕ (110J)	MONITORING WELL DESIGNATION AND 1,1,1 TCA CONCENTRATIONS IN UG/L
ND	DENOTES NOT DETECTED
J	DENOTES ESTIMATED VALUE
50 ———	ISOCONCENTRATION LINE (DASHED WHERE INFERRED)

DATA PRESENTED ARE THE ROUND II GROUNDWATER DATA.

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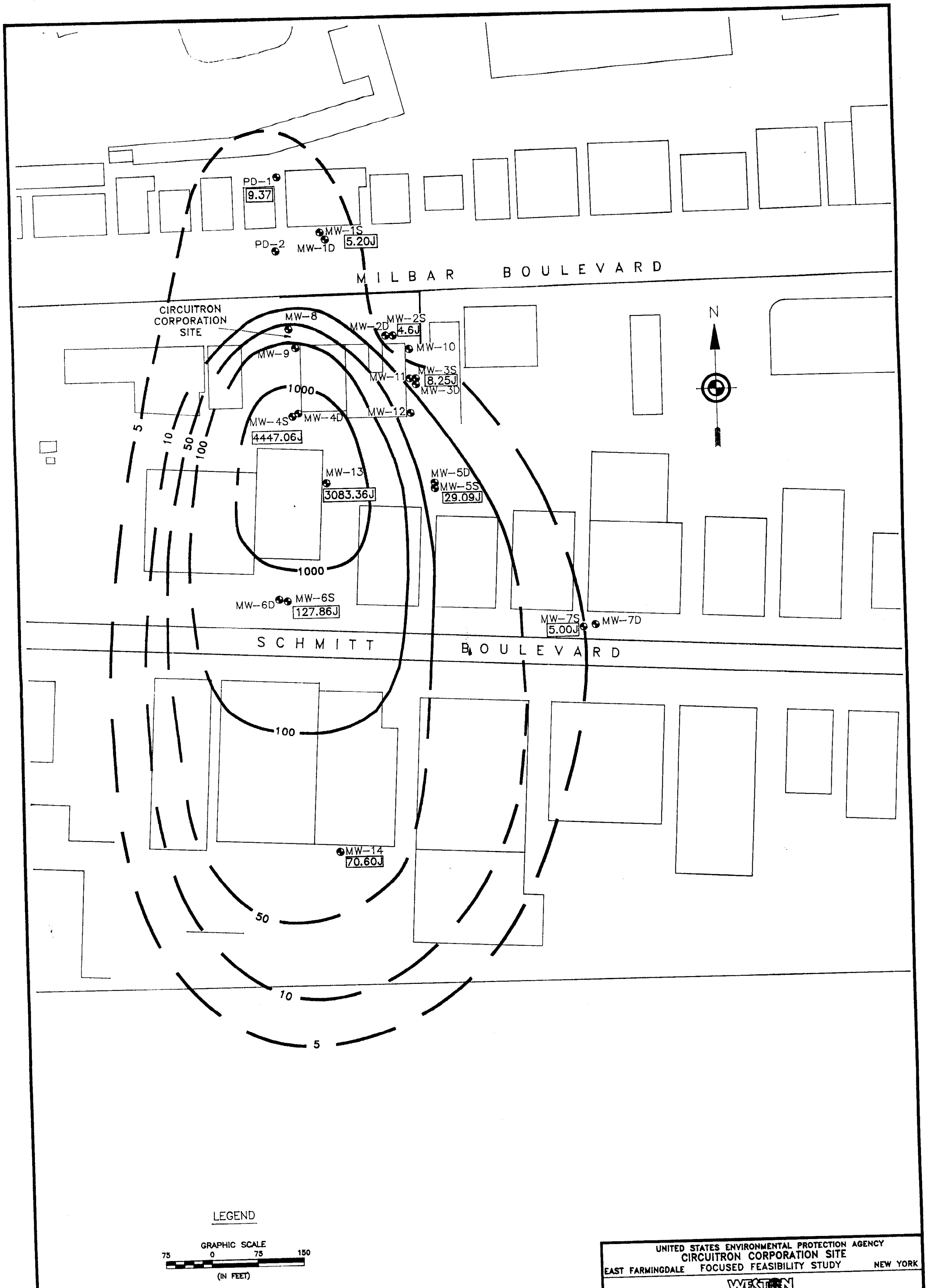
FIGURE 2-8
LATERAL DISTRIBUTION OF
1,1,1 - TCA
FEBRUARY 1994

DRAWN BY: B. MAC	DATE 5/5/94	DWG. NO. 1	REV. NO. 0000
SCALE 1" = 150'	W.O. NO. 04200-018-021	SHT. 1 OF	

REVISION # 000 DATE: 5/10/94 DRAWN BY: B. MAC
FILE NAME: 2-8.DWG



LEGEND

MW-6S ● 127.86J MONITORING WELL DESIGNATION AND THE TOTAL VOLATILE ORGANIC CONCENTRATIONS IN UG/L

J DENOTES ESTIMATED VALUE

—10— ISOCONCENTRATION LINE IN UG/L (DASHED WHERE INFERRED)

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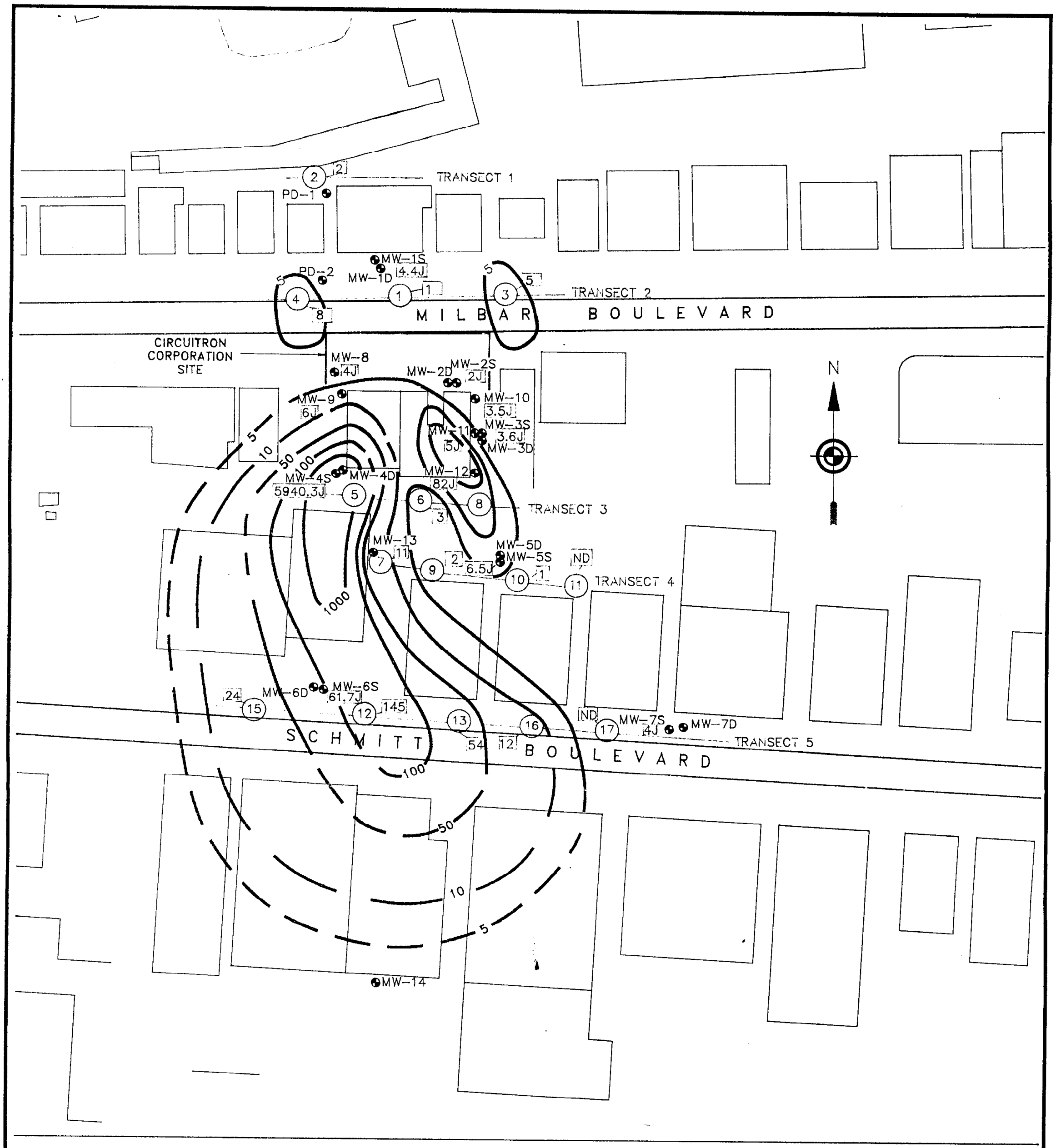
FIGURE 2-9
LATERAL DISTRIBUTION OF TOTAL VOLATILE ORGANIC CONCENTRATIONS, UPPER GLACIAL AQUIFER
FEBRUARY 1994

DRAWN BY	DATE	DWG. NO.	REV. NO.
B. MAC	4/20/94	1	0000
SCALE 1" = 150'	W.O. NO. 04200-015-021	SHT. 1	OF 1

REVISION # 001 DATE: 5/10/94
FILE NAME: 2-9.DWG DRAWN BY: B. MAC



LEGEND

GRAPHIC SCALE
75 0 75 150
(IN FEET)

②	SHALLOW DRIVE POINT SAMPLING LOCATION (34–36FT)
MW–6S ●	UPPER GLACIAL AQUIFER MONITORING WELL LOCATION
127.86	TOTAL VOLATILE ORGANIC CONCENTRATION IN UG/L
ND	DENOTES NOT DETECTED
J	DENOTES ESTIMATED VALUE
▬ 10 ▬	ISOCONCENTRATION LINE IN UG/L (DASHED WHERE INFERRED)

DATA PRESENTED INCLUDES THE SHALLOW DRIVE POINT GROUNDWATER SAMPLING AND ROUND I GROUNDWATER DATA

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CIRCUITRON CORPORATION SITE
EAST FARMINGDALE FOCUSED FEASIBILITY STUDY NEW YORK

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FIGURE 2–7
LATERAL DISTRIBUTION OF TOTAL VOLATILE ORGANIC CONCENTRATIONS, UPPER GLACIAL AQUIFER
MAY/ AUGUST 1993

DRAWN BY	DATE	DWG. NO.	REV. NO.
B. MAC	5/10/94	1	0000
SCALE	W.O. NO.	SHT. 1	OF 1
1"= 150'	04200–015–021		

REVISION #: 001 DATE: 5/9/94
FILE NAME: 2–8_8.DWG DRAWN BY: B. MAC

results for alkalinity, hardness, total dissolved solids and total suspended solids. Table 2-12 provides a listing of the New York State Drinking Water Standards (Title 40 CFR - Part 141, 192) for the same constituents analyzed for comparison purposes.

The results of the analytical testing is provided in detail below, with a separate discussion provided for the volatile organic (Rounds 1 and 2 sampling and the drive-point program) and inorganic analyses.

2.8.1.1 Volatile Organic Results

Up to seventeen (17) volatile organic compounds from the Target Compound List were quantified at the on-property and off-property monitoring wells during the Round 1 and Round 2 groundwater sampling for LDL volatiles. Those volatile organic compounds present in concentrations exceeding the New York State Drinking Water Standards of 5 ug/l for principal organic compounds were several of the chlorinated (halogenated) organics. The highest concentration volatile organics for both Round 1 and Round 2 included 1,1-dichloroethene (1,1-DCE) (up to 58E ug/l at MW-6D), 1,1-dichloroethane (1,1-DCA) (up to 52 ug/l at MW-13), 1,1,1-trichloroethane (up to 5800E/4400J ug/l at MW-4S (Rounds 1/2)), trichloroethene (TCE) (82 ug/l at MW-1D) and tetrachloroethene (PCE) (up to 63J ug/l at MW-4D). Concentrations of acetone (18J ug/l at MW-12 and 2800J ug/l at PW-2) were reported but were not considered to be site-related. Low concentrations of methylene chloride, carbon disulfide and chloroform were also reported but were also not considered site-related. Low level concentrations of non-halogenated volatile organics such as benzene (0.4J ug/l), 1,4-dichlorobenzene (0.4J ug/l) and styrene (up to 0.07J ug/l) were also reported below the New York State Drinking Water Standards at several of the wells.

The low level concentrations of incidental volatile organics (methylene chloride, chloroform and acetone) reported during groundwater sampling were also present in the trip, rinse and or bailer blank water. These volatile organic compounds are common laboratory contaminants and were present only in low level concentrations, similar to the blank samples, therefore, the presence of these compounds can be attributed to induced contamination from field procedures or laboratory analysis.

To determine if the concentrations of volatile organic compounds were elevated, a comparison was made to the New York State Drinking Water Standards and Guidance Values. The volatile organics present in concentrations elevated above the New York State Standards or Guidance Values at the monitoring well locations and their associated Round 1/Round 2 concentrations are indicated below. The designation of "NA" means that monitoring well was not sampled or analyzed during that round of sampling.

The highest concentration volatile organics included 1,1-dichloroethene at the following wells and concentrations: 31J/24 ug/l at MW-1D, 6J/3 ug/l at MW-2D, 6J/9 ug/l at MW-3D, 44J/36 ug/l at MW-4D, 9J/2 ug/l at MW-5D, 22J/58E ug/l at MW-6D, 14J/22 ug/l at MW-7D, and NA/6 ug/l at MW-13. 1,1-Dichloroethane was quantified at the following wells and concentrations for Round 1/2 sampling: 4J/6 ug/l at MW-1D, 42J/18 ug/l at MW-4S, 2J/11 ug/l at MW-4D, 10J/13 ug/l at MW-6S, NA/52 ug/l at MW-13 and NA/14 ug/l at MW-14.

The most elevated halogenated volatile organic compound 1,1,1-trichloroethane was reported at the following wells and concentrations during the Round 1/2 sampling: 84J/99 ug/l at MW-1D, 25J/23J ug/l at MW-2D, 3J/6J ug/l at MW-3S, 35J/37J ug/l at MW-3D, 5800J/4400J ug/l at MW-4S, 140J/240J ug/l at MW-4D, 6J/27 ug/l at MW-5S, 28J/17 ug/l at MW-5D, 40J/110J ug/l at MW-6S, 100J/420J ug/l at MW-6D, 54J/120 ug/l at MW-7D, 5J/NA ug/l at MW-9, 5J/NA ug/l at MW-11, 50J/NA ug/l at MW-12, NA/3,000 ug/l at MW-13 and NA/50 ug/l at MW-14. Trichloroethene was reported at the following wells and concentrations: 76J/82 ug/l at MW-1D, 5J/7 ug/l at MW-2D, 4J/17 ug/l at MW-3D, 22J/23 ug/l at MW-4D, 19J/43 ug/l at MW-6D, 10J/16 ug/l at MW-7D and 21J/0.1J ug/l at PW-2.

Tetrachloroethene was reported at the following wells and concentrations: 38J/18 ug/l at MW-1D, 6J/4 ug/l at MW-2D, 10J/7 ug/l at MW-3D, 21J/22 ug/l at MW-4S, 63/38 ug/l at MW-4D, 7J/3 ug/l at MW-5D, 31J/37 ug/l at MW-6D and 30J/23 ug/l at MW-7D, 5J/NA ug/l at MW-12, NA/18 ug/l at MW-13 and 7J/ND ug/l at PW-2. Cis-1,2-dichloroethene was reported at the MW-6S at a concentration of ND/1 ug/l during Round 1/2 sampling.

Only low level concentrations of volatile organics were noted in the shallow background or upgradient groundwater samples. Severely elevated concentrations (greater than 4 parts per million range concentration) of the halogenated organics, specifically 1,1,1-trichloroethane were reported at the shallow Circuitron Corporation Site wells (MW-4S) and the shallow water table wells located directly downgradient of the property. This indicates a direct relationship with site-related volatile organics and their movement in the shallow Upper Glacial aquifer, downgradient to the south-southeast. Although severely elevated, the concentrations of 1,1,1-trichloroethane do not support that pure product phase is present.

The deeper wells ("D" series) also reported elevated halogenated volatile organics present, consistent with an increase in volatile organic concentrations seen with depth during the drive point groundwater sampling program discussed in Section 2.8.2. These elevated volatile organics are present in the same relative concentrations in the upgradient locations (MW-1D and drive point data) as the downgradient locations.

The ratio of concentration of primary organic compounds (1,1,1-TCA and trichloroethene) to daughter degradation products (1,1,-DCE and 1,1-DCA) was calculated for the "D" wells completed in the upper Magothy aquifer. Substantially higher concentrations of primary organics were noted with respect to lower concentrations of daughter products in the "D" wells. Round 1 volatile organic data indicated that 1,1,1-trichloroethane represented greater than 50% of total volatile organics compound concentration reported. Concentrations of trichloroethene ranged from 10% to 30% of the total volatile organics concentrations reported in the deep wells. Daughter product volatile organics ranged from approximately 10% to 16% comparatively.

Tentatively identified compounds (TICs) were also quantified at 12 out of 20 wells sampled in Rounds 1 and 10 out of 18 wells sampled in Round 2, although TICs over 50 ug/l were noted only at MW-1S (69JN/81.3JN ug/l), MW-4S (250J/24.4JN ug/l), MW-8 (55J/NA ug/l), MW-9 (71J/NA ug/l), PD-1 (NA/54.9JN) and MW-13 (NA/257JN ug/l). The majority of the volatile

TICs were unknown compounds and chlorofluorocarbon-type contaminants. The source of these chlorofluorocarbons are not site-related considering that these unknowns were not detected in most of the site groundwater samples.

2.8.1.2 Inorganics Results

Groundwater samples for Rounds 1 and 2 were analyzed for both total and dissolved (filtered) inorganics. The following discussion only includes the analytical testing results of the total inorganic analysis and the shallow water table wells that are reflective of the Circuitron Site. A separate discussion is provided on a comparison of the total versus dissolved inorganic concentrations in Section 2.8.1.3. The following inorganic compounds were detected in the groundwater samples during Round 1 and Round 2 sampling at the range of concentrations indicated in parentheses: aluminum (133 to 4,800.0 ug/l), arsenic (2.6 to 81.2 ug/l), barium (27.0 to 1,390.0 ug/l), beryllium (0.25 to 0.51 ug/l), cadmium (ND to 4.0 ug/l), calcium (13,100.0 to 84,000.0 ug/l), chromium (4.2 to 788.0 ug/l), cobalt (3.8 to 18.4 ug/l), copper (4.2 to 14,600.0 ug/l) iron (55.7 to 467,000.0 ug/l), lead (2.2 to 55.0 ug/l), magnesium (2,700.0 to 7,190.0 ug/l), manganese (108.0 to 4,400.0 ug/l), nickel (7.0 to 72.0 ug/l), potassium (2,500.0 to 7,120.0 ug/l), selenium (ND to 1.4 ug/l), silver (4.1 to 28 ug/l), sodium (7,780.0 to 26,800.0 ug/l), vanadium (2.9 to 46.0 ug/l), zinc (4.9 to 281.0 ug/l).

To determine the significance of the concentrations of quantified inorganic compounds indicated above, comparisons were made to the New York State Drinking Water Quality Standards and Guidance Values, upgradient versus downgradient well locations, and frequency of detection.

The following inorganics were reported above their New York State Standard or Guidance Value indicated in parentheses: arsenic (25 ug/l), barium (1,000 ug/l), cadmium (10 ug/l), chromium (50 ug/l), copper (200 ug/l), iron (300 ug/l), lead (15 ug/l), manganese (300 ug/l), sodium (20,000 ug/l) and zinc (300 ug/l). Both the Round 1 and 2 data are summarized below.

Arsenic was quantified above its associated New York State Standard (25 ug/l) and site background concentration at MW-2S at a concentration of 73.8JN only during the Round 1 sampling. Barium was reported at a concentration of 1,390.0J ug/l, 155.0BJ ug/l and 111.0BJ ug/l at MW-2S, MW-6S and MW-6D, respectively only during the Round 1 sampling.

Chromium was reported above the New York State Standard of 50 ug/l and the background concentration (MW-1S at 19 ug/l) at MW-3D (R/75.20J), MW-4S (597.0J/282.0J ug/l), MW-4D (73.3J/72.20J ug/l), MW-6S (186.0J/70.90 ug/l), MW-6D (437.0J/69.40 ug/l), MW-7S (25.40/788.0 ug/l). Copper was reported at a concentration of 14,600.0J/2550.0 ug/l at MW-2S, 17.48J/21.5B ug/l at MW-2D, 262.0J/992.0 ug/l at MW-3S, 125.0J/108.0 ug/l at MW-4S and R/218.0 ug/l at MW-5S. Lead was reported at 54.9J ug/l at MW-9, and 22.3J ug/l at MW-12 during Round 1 groundwater sampling. During Round 2, lead was reported above the New York State Drinking Water Standard at 28.70 ug/l only at MW-2D.

Iron and manganese were reported above their respective standards of 300 ug/l at the majority of the monitoring wells sampled. Although included in the New York State Drinking Water Regulations, standards for iron and manganese are secondary standards. Secondary standards are related to the condition of the water supply in terms of aesthetics or nuisance compounds versus being a standard based on human health toxicity. Therefore, concentrations of these two naturally occurring compounds were reviewed with respect to these secondary standards. Both of these inorganics were noted as severely elevated in the background samples with concentrations of iron of 66,600/42,400 ug/l and manganese of 806/815 ug/l. Elevated concentrations of iron and manganese are noted as a very common condition on Long Island. Based upon a comparison with background conditions for iron, the following groundwater samples were noted to be elevated: MW-2S (467,000.0J/136,000.0 ug/l) and MW-3S (42,200.0J/327,000.0 ug/l). Based upon a comparison with background conditions for manganese, the following groundwater sampling locations were noted to be elevated: MW-1S, MW-2S, MW-3S, MW-3D, MW-4S, MW-4D, MW-5S, MW-6S, MW-6D, MW-7S, MW-7D, MW-13 and MW-14.

Upon review of the turbidity data (Table 2-3) and a comparative analysis with the filtered samples (Section 2.8.1.3), it is apparent that the inorganic sample analytical data for many of the inorganic compounds such as iron and manganese were strongly influenced by the digestion and subsequent analysis of suspended solids that occurs in the analysis of total inorganic samples with excess turbidity. In many of the existing shallow RI wells, excess turbidity (>200 NTUs) was present. The excess turbidity was noted particularly at MW-1S (Round 1 only), MW-2S, MW-3S, MW-5S (99 NTUs), MW-7S (Round 2 only), MW-8 (122 NTUs), MW-9 (103 NTUs), MW-10 and MW-12 (160 NTUs). As discussed in Section 2.3.2, many of the existing shallow 1989 RI wells were noted to have only a few feet of water or were purged dry during the Round 2 groundwater sampling program. This was correlated with the approximate six-foot increase in depth to water measured since these wells were installed. Only a reduced portion of the well was screened below the water table and the groundwater samples were noted to be extremely turbid. The excess turbidity (>200 NTUs) did not clear up during purging, as only a limited column of water was present or could be removed from these wells.

In summary, the highest concentrations of primary site-related inorganic contamination (copper and chromium) were reported at MW-2S, 3S, 4S, 5S, 6S, 6D, 7S and 12. Other potentially site-related inorganics such as lead were only identified at three well locations during Round 1 sampling only, and one location during Round II sampling. Arsenic was reported elevated above the NYS Drinking Water Standards at one location during Round I only. Elevated concentrations of iron and manganese were also reported but are known to be elevated under naturally occurring conditions on Long Island, and were present in upgradient wells at elevated concentrations.

2.8.1.3 Total Versus Dissolved Inorganics

Groundwater samples were collected for TAL inorganic analysis as both unfiltered (total) and filtered (dissolved) to identify the effects of suspended or colloidal material in the samples on contaminant concentrations. A comparison of the total and filtered analytical results was made to evaluate the likelihood for the inorganic species to be present in a dissolved versus suspended phase, and hence their persistence and overall mobility in the groundwater. For the purposes of data evaluation in this FFS, comparison of only the total (unfiltered) analytical results is made to the New York State Drinking Water Standards.

Table 2-13 provides a comparison between the total and filtered concentrations for the Round 1 and Round 2 samples for the primary reported inorganic contaminants of concern (copper and chromium). Filtered copper and chromium concentrations were all significantly less than the total concentrations, or comparable to the concentrations detected above the instrument detection limit but below the contract required detection limit. For those wells at which total copper and chromium was present above the New York State Drinking Water Standard of 100 and 50 ug/l, respectively, filtration did reduce the concentrations below the applicable New York State Standard.

In general, the comparison between the filtered and unfiltered data indicates that inorganics such as iron, manganese and to some degree copper and chromium have an attraction to the colloidal or suspended phase in the groundwater samples as indicated by the low concentration of the two compounds in the filtered samples. Based upon the elevated recorded turbidity in some of the groundwater samples (in some cases higher than 200 NTUs) and the generally low anticipated clay fraction of the aquifer, it is likely that suspended solids are the primary factor in the cases where lower filtered concentrations were reported. Based upon this evidence, it is probable that copper and chromium will not exist as dissolved contaminants in groundwater and in general are not readily available for transport within the aquifer. These inorganic compounds will tend to be locally transported in the groundwater, with removal by adsorption or precipitation. The significance of this conclusion is discussed further in the fate and transport section (Section 3.0) of the FFS.

2.8.1.4 Summary of Monitoring Well Sampling Results

In summary, the combined Rounds 1 and 2 volatile organic groundwater sampling results indicated elevated concentrations of the following halogenated volatile organic compounds: 1,1,1-trichloroethane, trichloroethene and tetrachloroethene with associated daughter degradation products such as 1,1-dichloroethene (1,1-DCE) and 1,1-dichloroethane (1,1-DCA) with tetrachloroethene representing less than 10 percent of total volatile organic concentrations. The concentration and ratio of primary organic compounds (>50% for 1,1,1-TCA and trichloroethene) to daughter degradation products (10% - 20% of 1,1-DCE and 1,1-DCA) was noted in the upper Magothy aquifer.

For inorganic compounds, the Round 1 inorganic groundwater sampling results indicated elevated concentrations of arsenic, barium, chromium, copper, iron, lead and manganese above the New York State Standards. During Round 2, only chromium, copper, iron and manganese were reported in concentrations elevated above the New York State Standards. Of these compounds, only arsenic, copper, lead and chromium may be associated to past site-related industrial process operations or were present in elevated concentrations in site-soils as reported in the 1989 RI data.

2.8.2 Drive Point Groundwater Analytical Results

A summary of the results of the drive point groundwater sampling analytical data is given in Table 2-14. Table 2-15 presents the analytical results of the 10% TCL off-site CLP confirmatory groundwater samples collected during the drive point groundwater sampling program. The TCL validated CLP confirmatory groundwater sample data were noted to show good correlation with the groundwater samples analyzed during the drive point groundwater sampling, and was within the range of analytical error. Figure 2-1 illustrates the drive point groundwater sampling locations.

Elevated concentrations of several halogenated volatile organic compounds such as 1,1,1-trichloroethane, trichloroethene and tetrachloroethene with associated daughter degradation products such as 1,1-dichloroethene and 1,1-dichloroethane were quantified during the groundwater sampling. 1,1,1-TCA was reported in most samples as the volatile organic present in the highest concentrations during the drive point sampling, followed generally by trichloroethene; the daughter compounds 1,1-DCE and 1,1-DCA; and tetrachloroethene in descending order of measured concentrations. Low level concentrations of other volatile organics such as acetone, methylene chloride and chlorobenzene were also reported and were considered to be either not site-related or insignificant due to their low concentration or limited occurrence.

As discussed in Section 2.4, groundwater samples were collected from shallow, intermediate and deep zones within the Upper Glacial aquifer as well as in the upper portion of the underlying Magothy aquifer, at select locations. To depict the nature and extent of the volatile organic contamination quantified during the drive point groundwater sampling and May 1993/February 1994 Round 1/2 groundwater sampling, longitudinal cross sections were prepared to illustrate the concentration of 1,1,1-TCA and total volatile organic compound distribution throughout the portion of the Upper Glacial and Magothy aquifers sampled. These longitudinal sections, included as Figures 2-2 and 2-3, were contoured to depict equal concentrations (isopleths) of contaminants and therefore the approximated distribution of these compounds within the aquifers. Cross sections depicting the lateral distribution of the 1,1,1-TCA and total volatile organic contamination identified were also prepared and are included as Figures 2-4 and 2-5. These lateral cross sections are coincident with the orientation and length of the drive point sampling transect lines. To further define the lateral extent of the plume, plan views of the 1,1,1-TCA and total volatile organic plume were generated and are included as Figures 2-6 and 2-9.

Shallow Zone of Upper Glacial Aquifer (34'-36' and 48'-52' bgs)

As shown in Figures 2-2 and 2-3, the concentrations of 1,1,1-TCA and total volatile organic compounds are the most elevated in the shallow groundwater, specifically that portion of the aquifer underlying the southwestern corner of the Circuitron Corporation Site. In this area, a direct relationship exists between the elevated concentrations of halogenated volatile organics present in the shallow groundwater (Monitoring Well MW-4S) and apparent ongoing discharges from known source areas (leaching pool structures) at the Circuitron Corporation Site. Another area of elevated concentrations of halogenated volatile organics at sampling locations MW-6/DP-12, occurs directly downgradient of the elevated volatile organics reported at MW-4S. This area may represent a "slug" of contamination released from the Circuitron Site source areas.

As shown in Figures 2-2 and 2-3, underlying and surrounding these "hot spots" of elevated organic contamination is a "cleaner" (significantly lower volatile organic concentrations) portion of the aquifer. Within this zone, 1,1,1-TCA was generally below the instrument detection limits with concentrations of total volatile organic compounds ranging between 5 ug/l and 61 ug/l. Below this zone, concentrations of total volatile organics were observed to increase with depth, from approximately 61 ug/l at 20 feet below the water table to concentrations in excess of 200 ug/l in the upper zone of the Magothy aquifer. Generally, at most drive point locations, the ratio of daughter degradation volatile organics (1,1-DCA and 1,1-DCE) to 1,1,1-TCA in the shallow and intermediate zones of the Upper Glacial aquifer was greater than 50 percent.

Deeper Upper Glacial Aquifer (62'-68' bgs)

Underlying the zone of lower concentrations of halogenated volatile organics in the shallow and intermediate (34' - 52' bgs) of the Upper Glacial aquifer, is the deeper Upper Glacial aquifer, which exhibited an increase in the concentrations of volatile organics. In general, concentrations of 1,1,1-TCA increased substantially with depth into this zone and represented the largest contribution of organic contamination in the deeper Upper Glacial aquifer. Proportionally 1,1,1-TCA consistently ranged from 40 to 60 percent of the total volatile organic concentration as compared to associated daughter degradation compounds, which dropped down to consistently 15 to 20 percent of the total concentrations.

The volatile organic contamination quantified in the deeper Upper Glacial aquifer was also reported upgradient, at the furthest upgradient transect location (DP-2), at the same order of magnitude concentrations as that reported downgradient, at the three other series of transect locations. At Transect 3, oriented along the downgradient (southern property boundary) edge of the Circuitron Corporation Site, concentrations of volatile organics were reported at slightly higher concentrations than that noted in the upgradient locations at a comparable depth within the aquifer. The lateral cross sections, Figures 2-4 and 2-5, show that the organic contamination is most elevated directly beneath and downgradient of the Circuitron Corporation Site.

The concentrations of volatile organics reported at MW-14 to the south of Schmitt Boulevard, as shown in Figures 2-6 and 2-9, indicate that concentrations of volatile organic compounds decrease substantially in the shallow Upper Glacial aquifer, with increasing distance from the Circuitron Corporation Site. However, 1,1,1-TCA was reported at 50 ug/l and total volatile organics at 70J ug/l at this location, indicating that the leading edge of this plume may be several hundred feet further downgradient to the south-southeast.

Shallow Magothy Aquifer (80'-82'bgs)

The samples collected from the upper portion of the Magothy aquifer during the drive point sampling and Round 1/2 sampling, indicate a relative increase in concentration compared to the overlying groundwater in the Upper Glacial aquifer. Total volatile organic concentrations of 278J/360J ug/l at MW-4S/4D and 100J/575J ug/l at MW-6S/6D (Round 1/Round 2), were reported underlying and downgradient, respectively of the Circuitron Corporation Site. The relative increase in concentration of 1,1,1-trichloroethane in the shallow Magothy aquifer is consistent in both the upgradient (94 ug/l at DP-2, 84J/99 ug/l at MW-1D) and downgradient sampling locations. The volatile organic contamination appears to be emanating from a source located upgradient of the Circuitron Corporation Site. However, since the Circuitron Corporation Site overlies the most elevated portion of the deep contamination, some of this deeper contamination may be site-related.

TABLE 2-5
CIRCUITRON CORPORATION SITE
ROUND I DATA
FOCUSED FEASIBILITY STUDY - GROUNDWATER SAMPLING
MONITORING WELLS
VOLATILE ORGANICS ANALYTICAL RESULTS (ug/l)

NYS Drinking Water Quality Standards	Sample Number Screened Interval (ft) Date Collected	MW-2D 90-100 5/10/93	Field Blank - 5/10/93	MW-2S 25-35 5/11/93	MW-2S-DUP 25-35 5/11/93	MW-3S 28-38 5/11/93	MW-4S 24-34 5/11/93	MW-4D 90-100 5/11/93
-	Chloromethane	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	Bromomethane	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
2	Vinyl Chloride	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	Chloroethane	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	Methylene Chloride	2.00 UJ	2.00 R	2.00 UJ	2.00 UJ	2.00 UJ	2.00 J	1.00 UJ
-	Acetone	5.00 R	5.00 J	5.00 R	5.00 R	5.00 R	2.00 UJ	2.00 R
-	Carbon Disulfide	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	5.00 R	5.00 R
5	1,1-Dichloroethene	6.00 J	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	1,1-Dichloroethane	1.00 J	1.00 UJ	1.00 UJ	1.00 UJ	0.60 J	66.00 [illegible] 42.00 X1	144.00 [illegible]
5	cis-1,2-Dichloroethene	2.00 J	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	2.00 J	2.00 J
5	trans-1,2-Dichloroethene	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	5.00 J
7	Chloroform	1.00 UJ	4.00 J	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	1,2-Dichloroethane	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	2.00 UJ
-	2-Butanone	5.00 R	5.00 R	5.00 R	5.00 R	5.00 R	1.00 UJ	1.00 J
-	Bromochloromethane	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	5.00 R	5.00 R
5	1,1,1-Trichloroethane	25.00 J	1.00 UJ	2.00 J	2.00 J	3.00 J	1.00 UJ	1.00 UJ
5	Carbon Tetrachloride	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	5800.00 X2J	[illegible]
5	Bromodichloromethane	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	1,2-Dichloropropane	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	cis-1,3-Dichloropropene	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	Trichloroethene	5.00 J	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
-	Dibromochloromethane	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	3.00 J	22.00 J
5	1,1,2-Trichloroethane	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
0.7	Benzene	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	3.00 J	1.00 J
5	trans-1,3-Dichloropropene	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
-	Bromoform	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
-	4-Methyl-2-Pentanone	5.00 UJ	5.00 UJ	5.00 UJ	5.00 UJ	5.00 UJ	1.00 UJ	1.00 UJ
-	2-Hexanone	5.00 R	5.00 R	5.00 R	5.00 R	5.00 R	5.00 UJ	5.00 UJ
5	Tetrachloroethene	6.00 J	1.00 UJ	1.00 UJ	1.00 UJ	1.00 U	5.00 R	5.00 R
5	1,1,2,2-Tetrachloroethane	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 U	21.00 J	63.00 X1
-	1,2-Dibromoethane	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	Toluene	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 U	1.00 UJ	1.00 UJ
5	Chlorobenzene	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 U	0.70 J	1.00 UJ
5	Ethylbenzene	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 U	0.60 J	1.00 UJ
5	Styrene	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 U	1.00 UJ	1.00 UJ
5	Xylenes(total)	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 U	1.00 UJ	1.00 UJ
4.7	1,3-Dichlorobenzene	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 U	1.00 UJ	1.00 UJ
4.7	1,4-Dichlorobenzene	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 U	1.00 UJ	1.00 UJ
4.7	1,2-Dichlorobenzene	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 U	1.00 UJ	1.00 UJ
5	1,2-Dibromo-3-chloropropane	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 U	1.00 UJ	1.00 UJ
	Total VOCs	45.00 J	9.00 J	2.00 J	2.00 J	3.60 J	5940.30 J	278.00 J
	Total TICs	0.00	0.00	0.00	0.00	0.00	1.00	0.00
	Total TIC Concentration	0.00	0.00	0.00	0.00	0.00	250.00 J	0.00

Notes:
Concentrations above the New York State Drinking Water Standards referenced in Table 2-12 are highlighted
- = No standard available
U= Analyte was not detected at the instrument detection limit given
B= Reported value is between the instrument detection limit and the contract required detection limit
E= Value is estimated due to interferences
J= Estimated value
R= Rejected during data validation
X1=1:5 Dilution
X2=1:12.5 Dilution
JN=Presumptive evidence for presence of analyte; estimated quantity

TABLE 2-5
CIRCUITRON CORPORATION SITE
ROUND I DATA
FOCUSED FEASIBILITY STUDY - GROUNDWATER SAMPLING
MONITORING WELLS
VOLATILE ORGANICS ANALYTICAL RESULTS (ug/l)

NYS Drinking Water Quality Standards	Sample Number	Field Blank	Trip Blank	MW-1S	MW-3D	MW-5S	MW-5D	MW-8
	Screened Interval (ft)	-	-	25-35	90-100	24-34	90-100	24.8-29.8
	Date Collected	5/11/93	5/11/93	5/12/93	5/12/93	5/12/93	5/12/93	5/12/93
-	Chloromethane	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	Bromomethane	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
2	Vinyl Chloride	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	Chloroethane	1.00 UJ	1.00 UJ	1.00 U	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	Methylene Chloride	1.00 J	4.00 J	2.00 R	2.00 R	2.00 UJ	2.00 UJ	2.00 UJ
-	Acetone	5.00 R	5.00 R	5.00 R	5.00 R	5.00 R	6.00 J	5.00 R
-	Carbon Disulfide	1.00 J	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	1,1-Dichloroethene	1.00 UJ	1.00 UJ	1.00 UJ	6.00 J	1.00 UJ	9.00 J	1.00 UJ
5	1,1-Dichloroethane	1.00 UJ	1.00 UJ	0.80 J	0.90 J	0.50 J	1.00 J	1.00 J
5	cis-1,2-Dichloroethene	1.00 UJ	1.00 UJ	1.00 UJ	0.90 J	1.00 UJ	1.00 J	1.00 UJ
5	trans-1,2-Dichloroethene	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
7	Chloroform	4.00 J	1.00 J	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	1,2-Dichloroethane	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
-	2-Butanone	5.00 R	5.00 R	5.00 R	5.00 R	5.00 R	5.00 R	5.00 R
-	Bromochloromethane	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	1,1,1-Trichloroethane	1.00 UJ	1.00 UJ	3.00 J	35.00 J	6.00 J	28.00 X1J	3.00 J
5	Carbon Tetrachloride	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	Bromodichloromethane	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	1,2-Dichloropropane	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	cis-1,3-Dichloropropene	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	Trichloroethene	1.00 UJ	1.00 UJ	1.00 UJ	4.00 J	1.00 UJ	4.00 J	1.00 UJ
-	Dibromochloromethane	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	1,1,2-Trichloroethane	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
0.7	Benzene	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	trans-1,3-Dichloropropene	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
-	Bromoform	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 R
-	4-Methyl-2-Pentanone	5.00 UJ	5.00 UJ	5.00 UJ	5.00 UJ	5.00 UJ	5.00 R	5.00 R
-	2-Hexanone	5.00 R	5.00 R	5.00 R	5.00 R	5.00 R	5.00 R	5.00 R
5	Tetrachloroethene	1.00 UJ	1.00 UJ	1.00 UJ	10.00 J	1.00 UJ	7.00 J	1.00 UJ
5	1,1,2,2-Tetrachloroethane	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
-	1,2-Dibromoethane	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	Toluene	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	Chlorobenzene	1.00 UJ	1.00 UJ	0.60 J	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	Ethylbenzene	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	Styrene	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	Xylenes(total)	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
4.7	1,3-Dichlorobenzene	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 R
4.7	1,4-Dichlorobenzene	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 R
4.7	1,2-Dichlorobenzene	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 R
5	1,2-Dibromo-3-chloropropane	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 R
	Total VOCs	6.00 J	5.00 J	4.40 J	56.80 J	6.50 J	56.00 J	4.00 J
	Total TICs	0.00	0.00	2.00	0.00	1.00	0.00	1.00
	Total TIC Concentration	0.00	0.00	69.00 JN	0.00	4.00 JN	0.00	55.00 J

Notes:
Concentrations above the New York State Drinking Water Standards referenced in Table 2-12 are highlighted
- = No standard available
U= Analyte was not detected at the instrument detection limit given
B= Reported value is between the instrument detection limit and the contract required detection limit
E= Value is estimated due to interferences
J= Estimated value
R= Rejected during data validation
X1=1:5 Dilution
X2=1:12.5 Dilution
JN=Presumptive evidence for presence of analyte; estimated quantity

TABLE 2-5
CIRCUITRON CORPORATION SITE
ROUND I DATA
FOCUSED FEASIBILITY STUDY - GROUNDWATER SAMPLING
MONITORING WELLS
VOLATILE ORGANICS ANALYTICAL RESULTS (ug/l)

NYS Drinking Water Quality Standards	Sample Number Screened Interval (ft) Date Collected	MW-9 24.1-29.1 5/12/93	Field Blank - 5/12/93	Trip Blank - 5/12/93	MW-1D 90-100 5/13/93	MW-6S 24.8-34.8 5/13/93	MW-10 23.9-28.9 5/13/93	MW-11 25.1-30.1 5/13/93
-	Chloromethane	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	Bromomethane	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
2	Vinyl Chloride	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	Chloroethane	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	Methylene Chloride	2.00 UJ	3.00 J	3.00 J	2.00 R	2.00 UJ	2.00 UJ	2.00 UJ
-	Acetone	5.00 R	5.00 R	5.00 R	5.00 R	8.00 J	5.00 R	5.00 R
-	Carbon Disulfide	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	1,1-Dichloroethene	1.00 UJ	1.00 UJ	1.00 UJ	31.00 J	3.00 J	1.00 UJ	1.00 UJ
5	1,1-Dichloroethane	1.00 J	1.00 UJ	1.00 UJ	4.00 J	10.00 J	0.50 J	1.00 UJ
5	cis-1,2-Dichloroethene	1.00 UJ	1.00 UJ	1.00 UJ	4.00 J	1.00 UJ	1.00 UJ	1.00 UJ
5	trans-1,2-Dichloroethene	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
7	Chloroform	1.00 UJ	1.00 J	1.00 J	3.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	1,2-Dichloroethane	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
-	2-Butanone	5.00 R	5.00 R	5.00 R	5.00 R	5.00 UR	5.00 R	5.00 R
-	Bromochloromethane	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	1,1,1-Trichloroethane	5.00 J	1.00 UJ	1.00 UJ	84.00 J	40.00 X1J	3.00 J	5.00 J
5	Carbon Tetrachloride	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	Bromodichloromethane	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	1,2-Dichloropropane	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	cis-1,3-Dichloropropene	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	Trichloroethene	1.00 UJ	1.00 UJ	1.00 UJ	76.00 J	1.00 UJ	1.00 UJ	1.00 UJ
-	Dibromochloromethane	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	1,1,2-Trichloroethane	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
0.7	Benzene	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	trans-1,3-Dichloropropene	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
-	Bromoform	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
-	4-Methyl-2-Pentanone	5.00 UJ	5.00 R	5.00 R	5.00 UJ	5.00 UJ	5.00 UJ	5.00 UJ
-	2-Hexanone	5.00 R	5.00 R	5.00 R	5.00 R	5.00 R	5.00 R	5.00 R
5	Tetrachloroethene	1.00 UJ	1.00 UJ	1.00 UJ	38.00 J	0.70 J	1.00 UJ	1.00 UJ
5	1,1,2,2-Tetrachloroethane	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
-	1,2-Dibromoethane	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	Toluene	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	Chlorobenzene	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	Ethylbenzene	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	Styrene	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	Xylenes(total)	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
4.7	1,3-Dichlorobenzene	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
4.7	1,4-Dichlorobenzene	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
4.7	1,2-Dichlorobenzene	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	1,2-Dibromo-3-chloropropane	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
	Total VOCs	6.00 J	4.00 J	4.00 J	237.00 J	61.70 J	3.50 J	5.00 J
	Total TICs	1.00	0.00	0.00	1.00	1.00	1.00	1.00
	Total TIC Concentration	71.00 J	0.00	0.00	3.00 JN	5.00 J	4.00 JN	4.00 JN

Notes:

Concentrations above the New York State Drinking Water Standards referenced in Table 2-12 are highlighted

- = No standard available

U= Analyte was not detected at the instrument detection limit given

B= Reported value is between the instrument detection limit and the contract required detection limit

E= Value is estimated due to interferences

J= Estimated value

R= Rejected during data validation

X1=1:5 Dilution

X2=1:12.5 Dilution

JN=Presumptive evidence for presence of analyte; estimated quantity

TABLE 2-5
CIRCUITRON CORPORATION SITE
ROUND I DATA
FOCUSED FEASIBILITY STUDY - GROUNDWATER SAMPLING
MONITORING WELLS
VOLATILE ORGANICS ANALYTICAL RESULTS (ug/l)

NYS Drinking Water Quality Standards	Sample Number	MW-12	Field Blank	Trip Blank	MW-6D	MW-7S	MW-7D	PW-2
	Screened Interval (ft)	25-35	-	-	90-100	27-37	90-100	216.3-226.3
	Date Collected	5/13/93	5/13/93	5/13/93	5/14/93	5/14/93	5/14/93	5/14/93
-	Chloromethane	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	Bromomethane	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
2	Vinyl Chloride	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	Chloroethane	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	Methylene Chloride	2.00 UJ	2.00 J	3.00 J	2.00 UJ	2.00 UJ	2.00 UJ	2.00 UJ
-	Acetone	18.00 J	5.00 R	5.00 R	4.00 J	3.00 J	3.00 J	4.00 J
-	Carbon Disulfide	1.00 UJ	1.00 J	1.00 UJ	1.00 J	1.00 UJ	1.00 UJ	1.00 UJ
5	1,1-Dichloroethene	2.00 J	1.00 UJ	1.00 UJ	22.00 J	1.00 UJ	14.00 J	2.00 J
5	1,1-Dichloroethane	1.00 J	1.00 UJ	1.00 UJ	2.00 J	1.00 UJ	2.00 J	1.00 UJ
5	cis-1,2-Dichloroethene	1.00 UJ	1.00 UJ	1.00 UJ	6.00 J	1.00 UJ	1.00 J	11.00 J
5	trans-1,2-Dichloroethene	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
7	Chloroform	1.00 UJ	1.00 J	1.00 J	12.00 J	1.00 UJ	1.00 UJ	1.00 UJ
5	1,2-Dichloroethane	1.00 UJ	1.00 UJ	1.00 UJ	1.00 J	1.00 UJ	1.00 UJ	2.00 J
-	2-Butanone	6.00 J	5.00 R	5.00 R	5.00 R	5.00 R	5.00 R	5.00 R
-	Bromochloromethane	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	1,1,1-Trichloroethane	50.00 X1J	1.00 UJ	1.00 UJ	100.00 X1J	1.00 JN	54.00 X1J	10.00 [illegible]
5	Carbon Tetrachloride	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	Bromodichloromethane	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	1,2-Dichloropropane	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	cis-1,3-Dichloropropene	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	Trichloroethene	1.00 UJ	1.00 UJ	1.00 UJ	19.00 J	1.00 UJ	10.00 J	2[illegible]
-	Dibromochloromethane	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	1,1,2-Trichloroethane	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
0.7	Benzene	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	trans-1,3-Dichloropropene	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
-	Bromoform	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
-	4-Methyl-2-Pentanone	5.00 R	5.00 R	5.00 R	5.00 R	5.00 R	5.00 R	5.00 R
-	2-Hexanone	5.00 R	5.00 R	5.00 R	5.00 R	5.00 R	5.00 R	5.00 R
5	Tetrachloroethene	5.00 J	1.00 UJ	1.00 UJ	31.00 X1J	1.00 UJ	30.00 X1J	7.00 [illegible]
5	1,1,2,2-Tetrachloroethane	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
-	1,2-Dibromoethane	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	Toluene	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	Chlorobenzene	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	Ethylbenzene	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	Styrene	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	Xylenes(total)	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
4.7	1,3-Dichlorobenzene	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
4.7	1,4-Dichlorobenzene	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
4.7	1,2-Dichlorobenzene	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	1,2-Dibromo-3-chloropropane	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
	Total VOCs	82.00	4.00	4.00	198.00	4.00	114.00	57.00
	Total TICs	0.00	0.00	0.00	1.00	0.00	0.00	1.00
	Total TIC Concentration	0.00	0.00	0.00	5.00 JN	0.00	0.00	10.00 R

Notes:

Concentrations above the New York State Drinking Water Standards referenced in Table 2-12 are highlighted

- = No standard available

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J= Estimated value

R= Rejected during data validation

X1=1:5 Dilution

X2=1:12.5 Dilution

JN=Presumptive evidence for presence of analyte; estimated quantity

TABLE 2-5
CIRCUITRON CORPORATION SITE
ROUND I DATA
FOCUSED FEASIBILITY STUDY - GROUNDWATER SAMPLING
MONITORING WELLS
VOLATILE ORGANICS ANALYTICAL RESULTS (ug/l)

NYS Drinking Water Quality Standards	Sample Number	Field Blank	Trip Blank
	Screened Interval (ft)	-	-
	Date Collected	5/14/93	5/14/93
-	Chloromethane	1.00 UJ	1.00 UJ
5	Bromomethane	1.00 UJ	1.00 UJ
2	Vinyl Chloride	1.00 UJ	1.00 UJ
5	Chloroethane	1.00 UJ	1.00 UJ
5	Methylene Chloride	3.00 J	3.00 J
-	Acetone	5.00 R	5.00 R
-	Carbon Disulfide	1.00 UJ	1.00 UJ
5	1,1-Dichloroethene	1.00 UJ	1.00 UJ
5	1,1-Dichloroethane	1.00 UJ	1.00 UJ
5	cis-1,2-Dichloroethene	1.00 UJ	1.00 UJ
5	trans-1,2-Dichloroethene	1.00 UJ	1.00 UJ
7	Chloroform	1.00 J	1.00 J
5	1,2-Dichloroethane	1.00 UJ	1.00 UJ
-	2-Butanone	5.00 R	5.00 R
-	Bromochloromethane	1.00 UJ	1.00 UJ
5	1,1,1-Trichloroethane	1.00 UJ	1.00 UJ
5	Carbon Tetrachloride	1.00 UJ	1.00 UJ
5	Bromodichloromethane	1.00 UJ	1.00 UJ
5	1,2-Dichloropropane	1.00 UJ	1.00 UJ
5	cis-1,3-Dichloropropene	1.00 UJ	1.00 UJ
5	Trichloroethene	1.00 UJ	1.00 UJ
-	Dibromochloromethane	1.00 UJ	1.00 UJ
5	1,1,2-Trichloroethane	1.00 UJ	1.00 UJ
0.7	Benzene	1.00 UJ	1.00 UJ
5	trans-1,3-Dichloropropene	1.00 UJ	1.00 UJ
-	Bromoform	1.00 UJ	1.00 UJ
-	4-Methyl-2-Pentanone	5.00 R	5.00 R
-	2-Hexanone	5.00 R	5.00 R
5	Tetrachloroethene	1.00 UJ	1.00 UJ
5	1,1,2,2-Tetrachloroethane	1.00 UJ	1.00 UJ
-	1,2-Dibromoethane	1.00 UJ	1.00 UJ
5	Toluene	1.00 UJ	1.00 UJ
5	Chlorobenzene	1.00 UJ	1.00 UJ
5	Ethylbenzene	1.00 UJ	1.00 UJ
5	Styrene	1.00 UJ	1.00 UJ
5	Xylenes(total)	1.00 UJ	1.00 UJ
4.7	1,3-Dichlorobenzene	1.00 UJ	1.00 UJ
4.7	1,4-Dichlorobenzene	1.00 UJ	1.00 UJ
4.7	1,2-Dichlorobenzene	1.00 UJ	1.00 UJ
5	1,2-Dibromo-3-chloropropane	1.00 UJ	1.00 UJ
	Total VOCs	4.00	4.00
	Total TICs	1.00	0.00
	Total TIC Concentration	3.00 JN	0.00

Notes:
Concentrations above the New York State Drinking Water Standards referenced in Table 2-12 are highlighted
- = No standard available
U= Analyte was not detected at the instrument detection limit given
B= Reported value is between the instrument detection limit and the contract required detection limit
E= Value is estimated due to interferences
J= Estimated value
R= Rejected during data validation
X1=1:5 Dilution
X2=1:12.5 Dilution
JN=Presumptive evidence for presence of analyte; estimated quantity

TABLE 2-6
CIRCUITRON CORPORATION SITE
ROUND I DATA
FOCUSED FEASIBILITY STUDY - GROUNDWATER SAMPLING
EXISTING MONITORING WELLS
INORGANICS ANALYTICAL RESULTS (ug/l)

Sample Number Analysis Screened Interval (ft) Date Collected	MW-2D Total 90-100 5/10/93	MW-2D Dissolved 90-100 5/10/93	MW-2S Total 25-35 5/11/93	MW-2S Dissolved 25-35 5/11/93	MW-2S-DUP Total 25-35 5/11/93	MW-2S-DUP Dissolved 25-35 5/11/93	MW-3S Total 28-38 5/11/93	MW-3S Dissolved 28-38 5/11/93	MW-4S Total 24-34 5/11/93	NYS Drinking Water Quality Standards
Aluminum	180.00 BJ	31.00 B	652.00 R	25.10 R	436.00 R	31.30 R	193.00 BJ	31.40 R	1,510.00 R	-
Antimony	24.30 BJ	17.90 U	17.90 UJ	17.90 UJ	17.90 UJ	17.90 UJ	17.90 UJ	17.90 UJ	17.90 UJ	-
Arsenic	2.30 UJWN*	3.50 UJW	73.80 JN*	3.50 UJW	81.20 JSN*	3.50 UJ	16.00 JN*	3.50 UJ	2.30 UJN*	25.00
Barium	100.00 BJ	82.70 B	1,390.00 J	72.40 BJ	1,010.00 J	51.70 BJ	40.00 BJ	5.20 BJ	61.70 BJ	1,000.00
Beryllium	0.50 UJ	0.50 U	0.50 UJ	0.50 UJ	0.50 UJ	0.50 UJ	0.50 UJ	0.50 UJ	0.50 UJ	-
Cadmium	1.70 UJN	1.70 U	1.70 UJN	1.70 UJ	1.70 UJN	1.70 UJ	1.70 UJN	1.70 UJ	1.70 UJN	10.00
Calcium	15,400.00 J	11,000.00	39,700.00 J	29,000.00 J	38,600.00 J	27,800.00 J	22,200.00 J	19,200.00 J	31,700.00 J	-
Chromium	42.90 J	29.70	38.70 J	5.80 UJ	173.10 J	5.80 UJ	11.70 J	5.80 UJ	597.00 J	50.00
Cobalt	3.80 UJ	3.80 U	4.60 BJ	3.80 UJ	3.80 UJ	3.80 UJ	3.80 UJ	3.80 UJ	3.80 UJ	-
Copper	17.40 BJ	9.40 B	14,600.00 J	18.80 BJ	10,500.00 J	34.70 J	262.00 J	18.90 BJ	125.00 J	200.00
Iron	885.00 J	62.50 B	467,000.00 J	714.00 J	230,000.00 J	515.00 J	42,200.00 J	1,150.00 J	6,210.00 J	300.00
Lead	7.10 J	2.60 R	8.50 J	1.90 R	5.30 J	2.90 R	6.30 J	1.50 R	10.90 J	15.00
Magnesium	2,560.00 BJ	2,290.00 B	4,340.00 BJ	3,930.00 BJ	4,540.00 BJ	3,970.00 BJ	3,290.00 BJ	2,900.00 BJ	3,350.00 BJ	35,000.00
Manganese	159.00 J	84.70	1,790.00 J	402.00 J	1,400.00 J	397.00 J	467.00 J	370.00 J	458.00 J	300.00
Mercury	0.10 UJN	0.10 U	0.10 UJN	0.10 UJ	0.10 UJN	0.10 UJ	0.10 UJN	0.10 UJ	0.10 UJN	2.00
Nickel	14.10 BJ	6.10 U	7.00 BJ	6.10 UJ	20.70 BJ	6.10 UJ	6.10 UJ	6.10 UJ	23.80 BJ	-
Potassium	15,900.00 J	16,700.00 J	5,570.00 J	5,840.00 J	5,730.00 J	5,100.00 J	7,120.00 J	7,490.00 J	4,350.00 BJ	-
Selenium	3.30 R	2.90 UJW	16.50 R	2.90 UJ	16.50 R	2.90 UJ	3.30 R	2.90 UJ	3.30 R	10.00
Silver	3.80 UJ	3.80 U	27.70 J	3.80 UJ	17.40 J	3.80 UJ	3.80 UJ	3.80 UJ	3.80 UJ	50.00
Sodium	20,200.00 J	20,600.00 J	10,100.00 J	10,400.00 J	10,800.00 J	9,920.00 J	15,200.00 J	14,200.00 J	9,250.00 J	20,000.00
Thallium	1.20 UJW	1.20 UJWN	1.20 UJ	1.20 UJWN	1.20 UJ	1.20 UJWN	1.20 UJ	6.00 UJN	1.20 UJW	-
Vanadium	3.30 UJ	3.30 U	46.20 BJ	3.30 UJ	29.20 BJ	3.30 UJ	7.10 BJ	3.30 UJ	6.90 BJ	-
Zinc	80.90 JE	61.90	281.00 JE	3.40 UJ	209.00 JE	9.00 BJ	28.20 JE	30.20 J	81.90 JE	300.00

Notes:

Concentrations above the New York State Drinking Water Quality Standards referenced in Table 2-12 are highlighted

- = No standard available
U= Analyte was not detected at the instrument detection limit given
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N= Spiked sample recovery was not within control limits
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TABLE 2-6
CIRCUITRON CORPORATION SITE
ROUND I DATA
FOCUSED FEASIBILITY STUDY - GROUNDWATER SAMPLING
EXISTING MONITORING WELLS
INORGANICS ANALYTICAL RESULTS (ug/l)

Sample Number Analysis Screened Interval (ft) Date Collected	MW-4S Dissolved 24-34 5/11/93	MW-4D Total 90-100 5/11/93	MW-4D Dissolved 90-100 5/11/93	Field Blank Total Pump 5/11/93	Field Blank Total Bailer 5/11/93	Field Blank Dissolved Filter 5/11/93	MW-1S Total 25-35 5/12/93	MW-1S Dissolved 25-35 5/12/93	MW-3D Total 90-100 5/12/93	NYS Drinking Water Quality Standards
Aluminum	23.50 UJ	373.00 R	27.00 R	604.00 J	426.00 J	23.50 UJ	254.00	30.10 B	104.00 B	-
Antimony	17.90 UJ	17.90 UJ	17.90 UJ	17.90 UJ	17.90 UJ	17.90 UJ	17.90 U	17.90 U	17.90 U	-
Arsenic	3.50 UJ	2.30 UJWN*	3.50 UJ	2.30 UJN	2.30 UJN*	3.50 UJ	7.50 BJN*	6.10 B	2.30 UJN*	25.00
Barium	56.90 BJ	21.70 BJ	82.70 BJ	2.50 UJ	2.50 UJ	2.50 UJ	217.00	164.00 B	100.00 B	1,000.00
Beryllium	0.50 UJ	0.50 UJ	0.50 UJ	0.50 UJ	0.50 UJ	0.50 UJ	0.50 U	0.50 U	0.50 U	-
Cadmium	1.70 UJ	1.70 UJN	1.70 UJ	1.70 UJN	1.70 UJN	1.70 UJ	1.70 UJN	1.70 U	1.70 UJN	10.00
Calcium	30,700.00 J	18,300.00 J	9,890.00 J	710.00 BJ	458.00 BJ	97.50 BJ	80,700.00	76,200.00	14,500.00	-
Chromium	36.00 J	173.30 J	5.80 UJ	5.80 UJ	5.80 UJ	5.80 UJ	19.10	5.80 U	81.90 R	50.00
Cobalt	3.80 UJ	3.80 UJ	3.80 UJ	3.80 UJ	3.80 UJ	3.80 UJ	6.40 B	3.90 B	19.80 B	-
Copper	31.80 J	5.60 BJ	9.40 BJ	9.10 BJ	5.50 BJ	4.20 UJ	38.50	4.80 B	8.30 B	200.00
Iron	[illegible] J	603.00 J	18.90 BJ	116.00 J	41.60 BJ	8.20 BJ	66,600.00	21,300.00	528.00	300.00
Lead	1.90 R	3.10 J	1.50 R	3.90 JW	2.20 BJ	6.70 J	7.10	2.60 R	7.30 R	15.00
Magnesium	2,910.00 BJ	2,580.00 BJ	2,840.00 BJ	160.00 BJ	114.00 BJ	46.40 UJ	5,920.00	5,580.00	2,830.00 B	35,000.00
Manganese	[illegible] J	257.00 J	17.40 J	17.80 J	11.50 BJ	1.80 UJ	806.00	783.00	1,970.00	300.00
Mercury	0.10 UJ	0.10 UJN	0.10 UJ	0.10 UJN	0.10 UJN	0.10 UJ	0.10 UJN	0.10 U	0.10 UJN	2.00
Nickel	37.30 BJ	39.30 BJ	6.10 UJ	6.10 UJ	6.10 UJ	6.10 UJ	7.50 B	7.10 B	22.90 B	-
Potassium	4,230.00 BJ	2,390.00 R	6,420.00 R	188.00 UJ	188.00 UJ	188.00 UJ	13,900.00	12,400.00 J	4,950.00 B	-
Selenium	2.90 UJ	3.30 R	2.90 UJ	3.30 R	3.30 R	2.90 UJ	3.30 R	2.90 UJW	3.30 R	10.00
Silver	4.60 BJ	3.80 UJ	4.00 BJ	3.80 UJ	3.80 UJ	3.80 UJ	3.80 U	3.80 U	3.80 U	50.00
Sodium	9,040.00 J	12,000.00 J	16,700.00 J	434.00 BJ	135.00 BJ	66.20 UJ	18,600.00	17,100.00	21,100.00	20,000.00
Thallium	1.20 UJWN	1.20 UJW	1.20 UJWN	1.20 UJ	1.20 UJ	1.20 UJN	1.20 UJW	1.20 UJWN	1.20 UJW	-
Vanadium	3.30 UJ	3.30 UJ	3.30 UJ	3.30 UJ	3.30 UJ	3.30 UJ	12.00 B	3.30 U	3.30 U	-
Zinc	48.00 J	70.90 JE	17.00 BJ	16.00 BJE	7.70 BJE	3.40 UJ	133.00 JE	38.40 J	23.40 JE	300.00

Notes:
Concentrations above the New York State Drinking Water Quality Standards referenced in Table 2-12 are highlighted
- = No standard available
U= Analyte was not detected at the instrument detection limit given
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N= Spiked sample recovery was not within control limits
*= Duplicate analysis was not within control limits
J= Estimated value
R= Rejected during data validation
M=Duplicate injection precision criteria was not met.
S=Determined by Method of Standard Addition (MSA).

TABLE 2-6
CIRCUITRON CORPORATION SITE
ROUND I DATA
FOCUSED FEASIBILITY STUDY - GROUNDWATER SAMPLING
EXISTING MONITORING WELLS
INORGANICS ANALYTICAL RESULTS (ug/l)

Sample Number Analysis Screened Interval (ft) Date Collected	MW-3D Dissolved 90-100 5/12/93	MW-5S Total 24-34 5/12/93	MW-5S Dissolved 24-34 5/12/93	MW-5D Total 90-100 5/12/93	MW-5D Dissolved 90-100 5/12/93	MW-8 Total 24.8-29.8 5/12/93	MW-8 Dissolved 24.8-29.8 5/12/93	MW-9 Total 24.1-29.1 5/12/93	MW-9 Dissolved 24.1-29.1 5/12/93	NYS Drinking Water Quality Standards
Aluminum	30.60 B	133.00 BJ	45.10 B	350.00 J	128.00 BJ	1,270.00 J	23.50 UJ	2,700.00 J	109.00 B	-
Antimony	17.90 U	17.90 UJ	17.90 U	17.90 UJ	17.90 UJ	17.90 UJ	41.60 BJ	17.90 UJ	17.90 U	-
Arsenic	3.50 U	2.30 UJN*	3.50 U	2.30 UJWN*	3.50 UJW	5.00 BJN*	3.50 UJ	2.60 BJN*	3.50 U	25.00
Barium	31.00 B	93.30 BJ	31.00 B	35.00 BJ	32.70 BJ	80.00 BJ	72.40 BJ	88.30 BJ	56.90 B	1,000.00
Beryllium	0.50 U	0.51 BJ	0.50 U	0.50 UJ	0.50 UJ	0.50 UJ	0.50 UJ	0.50 UJ	0.50 U	-
Cadmium	1.70 U	1.70 UJN	1.70 U	2.70 BJN	1.70 UJ	1.70 UJN	1.70 UJ	1.70 UJN	1.70 U	10.00
Calcium	15,100.00	11,400.00 R	25,900.00 R	9,060.00 J	9,260.00 J	29,000.00 J	32,800.00 J	32,900.00 J	30,400.00	-
Chromium	216.00 R	[illegible]	5.80 U	5.80 UJ	5.80 UJ	5.80 UJ	5.80 UJ	5.80 UJ	9.00 B	50.00
Cobalt	3.80 U	3.80 UJ	4.50 B	3.80 UJ	3.80 UJ	3.80 UJ	3.80 UJ	5.80 BJ	3.80 U	-
Copper	10.30 B	4.60 R	34.90 R	110.00 J	108.00 J	23.80 BJ	23.90 BJ	57.90 J	15.00 B	200.00
Iron	92.10 B	467.00 R	1,980.00 R	368.00 J	34.90 BJ	13,500.00 J	3,510.00 J	9,550.00 J	93.80 B	300.00
Lead	24.80 R	3.90 JM	2.10 R	7.70 JW	1.40 R	25.00 J	2.70 R	54.90 J	4.60 R	15.00
Magnesium	2,890.00 B	3,400.00 BJ	2,780.00 B	1,630.00 BJ	1,740.00 BJ	3,780.00 BJ	3,770.00 BJ	4,470.00 BJ	3,620.00 B	35,000.00
Manganese	[illegible]	23.30 R	441.00 R	49.10 J	51.60 J	207.00 J	229.00 J	305.00 J	30.10	300.00
Mercury	0.10 U	0.10 UJN	0.10 U	0.10 UJN	0.10 UJ	0.10 UJN	0.10 UJ	0.10 UJN	0.10 U	2.00
Nickel	15.90 B	15.40 R	53.60 R	7.00 BJ	9.60 BJ	6.10 UJ	6.10 UJ	10.10 BJ	6.10 U	-
Potassium	4,750.00 B	5,010.00 J	5,570.00 J	3,840.00 BJ	4,120.00 BJ	5,690.00 J	7,460.00 J	5,420.00 J	5,000.00 BJ	-
Selenium	2.90 U	3.30 R	2.90 U	16.50 R	2.90 UJ	3.30 R	2.90 UJ	3.30 R	2.90 U	10.00
Silver	3.80 U	3.80 UJ	3.80 U	3.80 UJ	3.80 UJ	3.80 UJ	3.80 UJ	3.80 UJ	3.80 U	50.00
Sodium	19,400.00	16,500.00 J	12,700.00	9,470.00 J	10,900.00 J	26,800.00 J	26,500.00 J	19,200.00 J	18,600.00	20,000.00
Thallium	1.20 UJWN	1.20 UJW	1.20 UJWN	1.20 UJW	1.20 UJWN	1.20 UJW	1.20 UJWN	1.20 UJW	1.20 UJWN	-
Vanadium	3.30 U	5.00 BJ	3.30 U	6.20 BJ	3.30 UJ	7.40 BJ	3.30 UJ	7.90 BJ	3.30 U	-
Zinc	34.80 J	22.50 JE	9.90 B	33.80 JE	20.40 J	19.60 BJE	7.00 BJ	33.30 JE	20.00 BJ	300.00

Notes:
Concentrations above the New York State Drinking Water Quality Standards referenced in Table 2-12 are highlighted
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TABLE 2-6
CIRCUITRON CORPORATION SITE
ROUND I DATA
FOCUSED FEASIBILITY STUDY - GROUNDWATER SAMPLING
EXISTING MONITORING WELLS
INORGANICS ANALYTICAL RESULTS (ug/l)

Sample Number Analysis Screened Interval (ft) Date Collected	Field Blank Total Pump 5/12/93	Field Blank Dissolved Filter 5/12/93	MW-1D Total 90-100 5/13/93	MW-1D Dissolved 90-100 5/13/93	MW-6S Total 24.8-34.8 5/13/93	MW-6S Dissolved 24.8-34.8 5/13/93	MW-10 Total 23.9-28.9 5/13/93	MW-10 Dissolved 23.9-28.9 5/13/93	MW-11 Total 25.1-30.1 5/13/93	NYS Drinking Water Quality Standards
Aluminum	23.50 U	23.50 BJ	264.00	45.00 BJ	615.00 J	119.00 B	3,460.00 J	40.80 BJ	1,910.00 J	-
Antimony	17.90 U	17.90 UJ	17.90 U	17.90 UJ	17.90 UJ	17.90 U	17.90 UJ	17.90 UJ	17.90 UJ	-
Arsenic	2.30 UJN*	3.50 UJ	2.30 UJN*	3.50 UJ	2.30 UJWN*	3.50 U	2.30 UJN*	3.50 UJ	2.30 UJN*	25.00
Barium	2.50 U	2.50 UJ	103.00 B	68.90 BJ	155.00 BJ	20.70 B	26.70 BJ	5.20 BJ	30.00 BJ	1,000.00
Beryllium	0.51 B	0.50 UJ	0.50 U	0.50 UJ	0.50 UJ	0.50 U	0.50 UJ	0.50 UJ	0.50 UJ	-
Cadmium	1.70 UJN	1.70 UJ	1.70 UJN	1.70 UJ	1.70 UJN	1.70 U	1.70 UJN	1.70 UJ	1.70 UJN	10.00
Calcium	44.60 B	101.00 BJ	13,600.00	12,100.00 J	28,500.00 J	17,100.00	22,600.00 J	21,800.00 J	32,700.00 J	-
Chromium	5.80 U	5.80 UJ	31.40	16.20 J	186.00 J	161.00	5.80 UJ	5.80 UJ	5.80 UJ	50.00
Cobalt	3.80 U	3.80 UJ	3.80 U	3.80 UJ	4.60 BJ	3.80 U	5.20 BJ	3.80 UJ	3.80 UJ	-
Copper	7.30 B	5.60 BJ	16.50 B	5.60 BJ	222.00 J	11.30 B	347.00 J	53.30 J	137.00 J	200.00
Iron	93.80 B	4.80 UJ	659.00	15.50 BJ	11,100.00 J	660.00	6,560.00 J	9.70 BJ	2,450.00 J	300.00
Lead	3.10 J	2.20 R	16.40	2.10 R	8.90 J	1.50 R	14.80 J	2.40 R	7.70 J	15.00
Magnesium	103.00 B	46.40 UJ	2,980.00 B	1,400.00 BJ	3,020.00 BJ	2,390.00 B	4,520.00 BJ	3,760.00 BJ	5,470.00 J	35,000.00
Manganese	1.80 U	1.80 UJ	31.20	10.30 BJ	503.00 J	237.00	158.00 J	10.00 BJ	108.00 J	300.00
Mercury	0.10 UJN	0.10 UJ	0.10 UJN	0.10 UJ	0.10 UJN	0.10 U	0.10 UJN	0.10 UJ	0.10 UJN	2.00
Nickel	6.10 U	6.10 UJ	10.60 B	6.10 UJ	71.90 J	108.00 J	7.90 BJ	6.10 UJ	6.10 UJ	-
Potassium	188.00 U	188.00 UJ	5,370.00 J	7,830.00 J	5,600.00 J	2,440.00 B	4,170.00 BJ	4,190.00 BJ	4,090.00 BJ	-
Selenium	3.30 R	2.90 UJW	3.30 R	2.90 UJ	3.30 R	2.90 U	3.30 R	2.90 UJ	3.30 R	10.00
Silver	3.80 U	3.80 UJ	3.80 U	3.80 UJ	3.80 UJ	3.80 U	3.80 UJ	3.80 UJ	3.80 UJ	50.00
Sodium	974.00 B	66.20 UJ	19,700.00	18,300.00 J	13,200.00 J	11,600.00	14,000.00 J	13,900.00 J	13,500.00 J	20,000.00
Thallium	1.20 U	1.20 UJN	1.20 UJW	1.20 UJWN	1.20 UJW	1.20 UJWN	1.20 UJW	1.20 UJWN	1.20 UJW	-
Vanadium	4.10 B	3.30 UJ	3.30 U	3.30 UJ	4.50 BJ	3.30 U	6.60 BJ	3.30 UJ	4.50 BJ	-
Zinc	7.10 BE	3.40 UJ	35.50 JE	27.30 J	28.30 R	62.30 R	47.50 JE	23.90 J	29.90 JE	300.00

Notes:
Concentrations above the New York State Drinking Water Quality Standards referenced in Table 2-12 are highlighted
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TABLE 2-6
CIRCUITRON CORPORATION SITE
ROUND I DATA
FOCUSED FEASIBILITY STUDY - GROUNDWATER SAMPLING
EXISTING MONITORING WELLS
INORGANICS ANALYTICAL RESULTS (ug/l)

Sample Number Analysis Screened Interval (ft) Date Collected	MW-11 Dissolved 25.1-30.1 5/13/93	MW-12 Total 25.1-30.1 5/13/93	MW-12 Dissolved 25-35 5/13/93	Field Blank Total Pump 5/13/93	Field Blank Dissolved Filter 5/13/93	MW-6D Total 90-100 5/14/93	MW-6D Dissolved 90-100 5/14/93	MW-7S Total 27-37 5/14/93	MW-7S Dissolved 27-37 5/14/93	NYS Drinking Water Quality Standards
Aluminum	45.70 B	3,700.00 J	431.00	23.50 UJ	39.50 B	82.30 BJ	23.50 UJ	309.00 J	23.50 UJ	-
Antimony	17.90 U	18.60 UJ	17.90 U	17.90 UJ	17.90 U	18.60 UJ	17.90 UJ	18.60 U	17.90 UJ	-
Arsenic	3.50 U	2.30 UJ	3.50 U	2.30 UJN*	3.50 U	2.30 UJ	3.50 UJ	2.30 UJW	3.50 UJ	25.00
Barium	22.40 B	48.20 BJ	25.80 B	2.50 UJ	2.50 U	111.00 BJ	77.80 BJ	54.30 B	18.20 BJ	1,000.00
Beryllium	0.50 U	0.38 BJ	0.50 U	0.50 UJ	0.50 U	0.30 UJ	0.50 UJ	0.30 U	0.50 UJ	-
Cadmium	1.70 U	1.40 UJ	1.70 U	1.70 UJN	1.70 U	1.40 UJ	1.70 UJ	1.40 U	1.70 UJ	10.00
Calcium	31,700.00	26,900.00 J	26,500.00	42.30 UJ	87.20 B	21,800.00 J	12,000.00 J	16,600.00	15,500.00 J	-
Chromium	5.80 U	6.30 BJ	5.80 U	5.80 UJ	5.80 U	437.00 J	336.00 J	25.40	5.80 UJ	50.00
Cobalt	3.80 U	7.80 BJ	3.80 U	3.80 UJ	3.80 U	2.90 UJ	3.80 UJ	2.90 U	3.80 UJ	-
Copper	47.70	327.00 J	119.00	6.40 BJ	4.70 B	9.70 BJ	4.20 UJ	4.20 B	7.10 BJ	200.00
Iron	4.80 U	[illegible]	106.00	90.30 BJ	11.60 B	898.00 J*	4.80 UJ	249.00 *	4.80 UJ	300.00
Lead	3.40 R	[illegible]	7.20	2.80 BJ	2.40 R	4.30 J	2.10 BJW*	3.50 J	1.80 BJW*	15.00
Magnesium	5,300.00	4,840.00 BJ	4,130.00 B	68.50 BJ	46.40 U	1,500.00 BJ	311.00 BJ	3,420.00 B	3,210.00 BJ	35,000.00
Manganese	4.70 B	235.00 JN	9.70 B	1.80 UJ	1.80 U	32.70 JN	1.80 UJ	1,720.00 JN	1.80 UJ	300.00
Mercury	0.10 U	0.10 UJ	0.10 U	0.10 UJN	0.10 U	0.10 UJ	0.10 UJ	0.10 U	0.10 UJ	2.00
Nickel	8.40 B	9.80 BJ	6.10 U	6.10 UJ	6.10 U	57.20 J	6.10 UJ	15.90 B	6.10 UJ	-
Potassium	3,780.00 B	2,960.00 BJ	2,670.00 B	188.00 UJ	227.00 B	14,200.00 J	14,700.00 J	2,500.00 B	2,530.00 BJ	-
Selenium	2.90 U	3.30 UJWN	2.90 U	3.30 R	2.90 U	3.30 UJN	2.90 UJ	16.50 UJWN	2.90 UJ	10.00
Silver	3.80 U	3.30 UJ	3.80 U	3.80 UJ	3.80 U	3.30 UJ	3.80 UJ	3.30 U	3.80 UJ	50.00
Sodium	13,000.00	7,780.00 J	7,630.00	148.00 BJ	67.10 B	31,900.00 J	32,400.00 J	7,860.00	7,600.00 J	20,000.00
Thallium	1.20 UJWN	1.20 UJW	1.20 UJWN	1.20 UJ	1.20 UJN	1.20 UJW	1.20 UJWN	1.20 UJW	1.20 UJWN	-
Vanadium	3.30 U	5.00 BJ	3.30 U	3.30 UJ	3.30 U	2.70 BJ	3.30 UJ	2.10 U	3.30 UJ	-
Zinc	23.60 J	32.80 J	24.00 J	4.30 BJE	5.10 BJ	33.60 J	3.40 UJ	4.90 B	5.70 BJ	300.00

Notes:
Concentrations above the New York State Drinking Water Quality Standards referenced in Table 2-12 are highlighted
- = No standard available
U= Analyte was not detected at the instrument detection limit given
B= Reported value is between the instrument detection limit and the contract required detection limit
E= Value is estimated due to interferences
N= Spiked sample recovery was not within control limits
*= Duplicate analysis was not within control limits
J= Estimated value
R= Rejected during data validation
M=Duplicate injection precision criteria was not met.
S=Determined by Method of Standard Addition (MSA)

TABLE 2-6
CIRCUITRON CORPORATION SITE
ROUND I DATA
FOCUSED FEASIBILITY STUDY - GROUNDWATER SAMPLING
EXISTING MONITORING WELLS
INORGANICS ANALYTICAL RESULTS (ug/l)

Sample Number Analysis Screened Interval (ft) Date Collected	MW-7D Total 90-100 5/14/93	MW-7D Dissolved 90-100 5/14/93	PW-2 Total 216.3-226.3 5/14/93	PW-2 Dissolved 216.3-226.3 5/14/93	Field Blank Total Pump 5/14/93	Field Blank Dissolved Filter 5/14/93	NYS Drinking Water Quality Standards
Aluminum	237.00 J	23.50 UJ	36.50 B	28.60 BJ	32.00 B	23.50 UJ	-
Antimony	18.60 U	17.90 UJ	18.60 U	20.10 BJ	18.60 U	17.90 UJ	-
Arsenic	2.30 UJW	3.50 UJW	2.30 UJW	3.50 UJ	2.30 U	3.50 UJ	25.00
Barium	88.30 B	77.80 BJ	33.80 B	34.00 BJ	1.10 U	2.50 UJ	1,000.00
Beryllium	0.30 U	0.50 UJ	0.30 U	0.50 UJ	0.30 U	0.50 UJ	-
Cadmium	1.40 U	1.70 UJ	1.40 U	1.70 UJ	1.40 U	1.70 UJ	10.00
Calcium	13,400.00	11,000.00 J	4,990.00 B	4,820.00 BJ	109.00 B	42.30 UJ	-
Chromium	22.00	5.80 UJ	3.30 U	5.80 UJ	58.50 [illegible]	5.80 UJ	50.00
Cobalt	2.90 U	3.80 UJ	2.90 U	3.80 UJ	2.90 U	3.80 UJ	-
Copper	5.90 B	4.20 UJ	462.00	203.00 J	2.70 U	4.20 UJ	200.00
Iron	[illegible] J	4.80 UJ	55.70 B*	29.50 BJ	275.00 *	4.80 UJ	300.00
Lead	5.10 J	2.00 BJW*	14.60	11.70 J*	3.30 J	1.70 BJ*	15.00
Magnesium	3,640.00 B	3,350.00 BJ	2,290.00 B	2,230.00 BJ	31.20 B	46.40 UJ	35,000.00
Manganese	21.00 JN	10.90 BJ	28.30 JN	28.20 J	6.00 BJN	1.80 UJ	300.00
Mercury	0.10 U	0.10 UJ	0.10 U	0.10 UJ	0.10 U	0.10 UJ	2.00
Nickel	13.30 B	6.10 UJ	4.20 U	6.10 UJ	30.00 B	6.10 UJ	-
Potassium	3,120.00 B	2,940.00 BJ	1,390.00 B	1,140.00 BJ	93.60 U	188.00 UJ	-
Selenium	3.30 UJWN	2.90 UJ	3.30 UJWN	2.90 UJ	3.30 UJN	2.90 UJ	10.00
Silver	3.30 U	3.80 UJ	3.30 U	3.80 UJ	3.30 U	3.80 UJ	50.00
Sodium	11,400.00	11,100.00 J	7,130.00	7,080.00 J	172.00 B	66.20 UJ	20,000.00
Thallium	1.20 UJW	1.20 UJWN	1.20 UJW	1.20 UJN	1.20 U	1.20 UJN	-
Vanadium	2.10 U	3.30 UJ	2.10 U	3.30 UJ	2.10 U	3.30 UJ	-
Zinc	25.70	9.30 BJ	89.20	43.30 J	4.80 U	3.40 UJ	300.00

Notes:
Concentrations above the New York State Drinking Water Quality Standards referenced in Table 2-12 are highlighted
- = No standard available
U= Analyte was not detected at the instrument detection limit given
B= Reported value is between the instrument detection limit and the contract required detection limit
E= Value is estimated due to interferences
N= Spiked sample recovery was not within control limits
*= Duplicate analysis was not within control limits
J= Estimated value
R= Rejected during data validation
M=Duplicate injection precision criteria was not met.
S=Determined by Method of Standard Addition (MSA)

TABLE 2-7
CIRCUITRON CORPORATION SITE
ROUND II DATA
FOCUSED FEASIBILITY STUDY - GROUNDWATER SAMPLING
MONITORING WELLS
VOLATILE ORGANICS ANALYTICAL RESULTS (ug/l)

NYS Drinking Water Quality Standards	Sample Number Depth Interval (ft) Date Collected	MW-2D 90-100 2/24/94	MW-2S 25-35 2/22/94	MW-3S 28-38 2/22/94	MW-4S 24-34 2/21/94	MW-4D 90-100 2/21/94	Field Blank - 2/22/94	Trip Blank - 2/21/94	MW-1S 25-35 2/22/94	MW-3D 90-100 2/22/94
-	Chloromethane	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
5	Bromomethane	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
2	Vinyl Chloride	1.00 U	1.00 U	1.00 U	0.20 J	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
5	Chloroethane	1.00 U	1.00 U	1.00 U	2.00	1.00 U	1.00 U	1.00 U	0.20 J	1.00 U
5	Methylene Chloride	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	2.00	3.00	2.00 U	2.00 U
-	Acetone	5.00 J	2.00 J	3.00 R	5.00 R	5.00 R	5.00 R	3.00 J	3.00 J	5.00 R
-	Carbon Disulfide	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
5	1,1-Dichloroethene	3.00	1.00 U	1.00 U	2.00	[illegible]	1.00 U	1.00 U	1.00 U	[illegible]
5	1,1-Dichloroethane	1.00	0.50 J	2.00	8.00	11.00	1.00 U	1.00 U	0.70 J	4.00
5	cis-1,2-Dichloroethene	3.00	1.00 U	1.00 U	1.00	6.00	1.00 U	1.00 U	1.00 U	1.00
5	trans-1,2-Dichloroethene	1.00 U	1.00 U	1.00 U	1.00 U	0.20 J	1.00 U	1.00 U	1.00 U	1.00 U
7	Chloroform	2.00	1.00 U	1.00 U	1.00 U	3.00	0.10 J	0.20 J	1.00 U	1.00 U
5	1,2-Dichloroethane	1.00 U	1.00 U	1.00 U	1.00 U	2.00	1.00 U	1.00 U	1.00 U	1.00 U
-	2-Butanone	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U
5	1,1,1-Trichloroethane	[illegible]	2.00 J	[illegible]	[illegible]	[illegible]	1.00 UJ	1.00 UJ	0.40 J	[illegible]
5	Carbon Tetrachloride	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
5	Bromodichloromethane	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
5	1,2-Dichloropropane	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
5	cis-1,3-Dichloropropene	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
5	Trichloroethene	7.00	1.00 U	0.05 J	1.00	[illegible]	1.00 U	1.00 U	1.00 U	[illegible]
5	Dibromochloromethane	1.00 U	1.00 UJ	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
5	1,1,2-Trichloroethane	1.00 U	1.00 U	1.00 U	1.00 U	0.70 J	1.00 U	1.00 U	1.00 U	1.00 U
5	1,2-Dibromoethane	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
0.7	Benzene	1.00 U	1.00 U	1.00 U	0.10 J	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
5	trans-1,3-Dichloropropene	1.00 U	1.00 U	1.00 U	1.00 UJ	1.00 UJ	1.00 U	1.00 UJ	1.00 U	1.00 U
-	Bromoform	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
-	4-Methyl-2-Pentanone	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U
-	2-Hexanone	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U
5	Tetrachloroethene	4.00	1.00 U	0.20 J	[illegible]	[illegible]	1.00 U	1.00 U	1.00 U	[illegible]
➢	Bromochloromethane	1.00 UJ	1.00 U	1.00 UJ	1.00 U	1.00 U	1.00 UJ	1.00 U	1.00 UJ	1.00 UJ
5	1,1,2,2-Tetrachloroethane	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
5	Toluene	1.00 U	1.00 U	1.00 U	0.06 J	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
5	Chlorobenzene	1.00 U	1.00 U	1.00 U	0.70 J	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
5	Ethylbenzene	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	0.70 J	1.00 U
5	Styrene	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
4.7	1,2-Dichlorobenzene	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	0.07 J	1.00 U	1.00 U	1.00 U
5	Xylenes(total)	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	0.08 J	1.00 U	1.00 U	1.00 U
4.7	1,3-Dichlorobenzene	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
4.7	1,4-Dichlorobenzene	1.00 U	0.10 J	1.00 U	0.10 J	1.00 U	1.00 U	1.00 U	0.20 J	0.10 J
5	1,2-Dibromo-3-chloropropane	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
	Total VOC's	48.00 J	4.60 J	8.25 J	4447.06 J	359.90 J	2.25 J	6.20 J	5.20 J	75.10 J
	Total TICs	0	0	0	5	2	0	0	3	0
	Total TIC Concentration	0.00	0.00	0.00	24.37 JN	7.70 JN	0.00	0.00	81.30 JN	0.00

Concentrations above the New York State Drinking Water Standards referenced in Table 2-12 are highlighted
- = No standard available
U= Analyte was not detected at the instrument detection limit given
B= Reported value is between the instrument detection limit and the contract required detection limit
E= Value is estimated due to interferences
J= Estimated value
JN = Presumptive evidence for presence of analyte, estimated quantity
R= Rejected during data validation
X1=1.5 Dilution
X2=1.250 Dilution

TABLE 2-7
CIRCUITRON CORPORATION SITE
ROUND II DATA
FOCUSED FEASIBILITY STUDY - GROUNDWATER SAMPLING
MONITORING WELLS
VOLATILE ORGANICS ANALYTICAL RESULTS (ug/l)

NYS Drinking Water Quality Standards	Sample Number	MW-5S	MW-5D	Field Blank	Trip Blank	MW-1D	MW-6S	Field Blank	Trip Blank	MW-6D
	Depth Interval (ft)	24-34	90-100	-	-	90-100	24.8-34.8	-	-	90-100
	Date Collected	2/23/94	2/23/94	2/23/94	2/23/94	2/23/94	2/24/94	2/24/94	2/24/94	2/24/94
-	Chloromethane	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
5	Bromomethane	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
2	Vinyl Chloride	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
5	Chloroethane	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
5	Methylene Chloride	2.00 U	2.00 U	3.00	3.00	2.00 U	2.00 U	2.00	2.00	2.00 U
-	Acetone	5.00 R	5.00 R	5.00 R	3.00 J	5.00 R	5.00 R	5.00 R	5.00 R	5.00 R
-	Carbon Disulfide	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
5	1,1-Dichloroethene	1.00 U	2.00	1.00 U	1.00 U	24.00	0.60 J	1.00 U	1.00 U	[illegible]
5	1,1-Dichloroethane	1.00	0.40 J	1.00 U	1.00 U	6.00	13.00	1.00 U	1.00 U	4.00
5	cis-1,2-Dichloroethene	1.00 U	0.40 J	1.00 U	1.00 U	4.00	1.00	1.00 U	1.00 U	[illegible]
5	trans-1,2-Dichloroethene	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	0.30 J
7	Chloroform	1.00 U	1.00 U	0.30 J	0.30 J	1.00 U	1.00 U	0.30 J	0.20 J	2.00
5	1,2-Dichloroethane	1.00 U	1.00 U	1.00 U	1.00 U	0.50 J	1.00 U	1.00 U	1.00 U	2.00
-	2-Butanone	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U
5	1,1,1-Trichloroethane	27.00	17.00	1.00 U	1.00 U	99.00	110.00	1.00 UJ	1.00 UJ	[illegible]
5	Carbon Tetrachloride	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
5	Bromodichloromethane	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
5	1,2-Dichloropropane	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
5	cis-1,3-Dichloropropene	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
5	Trichloroethene	0.09 J	1.00	1.00 U	1.00 U	82.00	0.70 J	1.00 U	1.00 U	[illegible]
5	Dibromochloromethane	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
5	1,1,2-Trichloroethane	1.00 U	1.00 U	1.00 U	1.00 U	0.70 J	1.00 U	1.00 U	1.00 U	1.00
5	1,2-Dibromoethane	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
0.7	Benzene	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
5	trans-1,3-Dichloropropene	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 U	1.00 U	1.00 U	1.00 U
-	Bromoform	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
-	4-Methyl-2-Pentanone	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U
-	2-Hexanone	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U
5	Tetrachloroethene	1.00	3.00	1.00 U	1.00 U	18.00	2.00	1.00 U	1.00 U	[illegible]
-	Bromochloromethane	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
5	1,1,2,2-Tetrachloroethane	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
5	Toluene	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	0.10 J	1.00 U
5	Chlorobenzene	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	0.50 J	1.00 U	1.00 U	1.00 U
5	Ethylbenzene	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
5	Styrene	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
4.7	1,2-Dichlorobenzene	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
5	Xylenes(total)	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
4.7	1,3-Dichlorobenzene	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
4.7	1,4-Dichlorobenzene	1.00 U	0.06 J	1.00 U	1.00 U	1.00 U	0.06 J	1.00 U	1.00 U	0.03 J
5	1,2-Dibromo-3-chloropropane	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 U	1.00 U	1.00 U	1.00 U
	Total VOC's	29.09 J	22.86 J	3.30 J	6.30 J	234.20 J	127.86 J	2.30 J	2.30 J	575.33 J
	Total TICs	0	0	0	0	3	2	0	0	2
	Total TIC Concentration	0.00	0.00	0.00	0.00	6.80 JN	33.90 JN	0.00	0.00	1.95 JN

Concentrations above the New York State Drinking Water Standards referenced in Table 2-12 are highlighted
- = No standard available
U= Analyte was not detected at the instrument detection limit given
B= Reported value is between the instrument detection limit and the contract required detection limit
E= Value is estimated due to interferences
J= Estimated value
JN = Presumptive evidence for presence of analyte, estimated quantity
R= Rejected during data validation
X1=1.5 Dilution
X2=1.250 Dilution

TABLE 2-7
CIRCUITRON CORPORATION SITE
ROUND II DATA
FOCUSED FEASIBILITY STUDY - GROUNDWATER SAMPLING
MONITORING WELLS
VOLATILE ORGANICS ANALYTICAL RESULTS (ug/l)

NYS Drinking Water Quality Standards	Sample Number Depth Interval (ft) Date Collected	MW-7S 27-37 2/24/94	MW-7D 90-100 2/23/94	Trip Blank - 2/22/94	PW-2-02 216.3-226.3 2/22/94	MW-3D-DUP 90-100 2/22/94	PD-1-02 17-32 2/24/94	Trip Blank - 2/25/94	MW-13 31-41 2/25/94	MW-14 33-43 2/25/94
-	Chloromethane	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
5	Bromomethane	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
2	Vinyl Chloride	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 UJ	0.50 J	1.00 U
5	Chloroethane	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	0.10 J	1.00 U	0.40 J	1.00 U
5	Methylene Chloride	2.00 U	2.00 U	3.00	2.00 U	2.00 U	2.00 U	3.00	2.00 U	2.00 U
-	Acetone	5.00 J	5.00 R	5.00 R	2800.00 J	5.00 R	5.00 J	5.00 R	5.00 R	5.00 R
-	Carbon Disulfide	1.00 U	1.00 U	1.00 U	2.00	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
5	1,1-Dichloroethene	1.00 U	22.00	1.00 U	1.00 U	8.00	1.00 U	1.00 U	6.00	1.00
5	1,1-Dichloroethane	1.00 U	2.00	1.00 U	1.00 U	4.00	0.30 J	1.00 U	52.00	[illegible]
5	cis-1,2-Dichloroethene	1.00 U	2.00	1.00 U	0.30 J	1.00	0.08 J	1.00 U	2.00	0.90 J
5	trans-1,2-Dichloroethene	1.00 U	0.05 J	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
7	Chloroform	1.00 U	1.00 U	0.20 J	1.00 U	1.00 U	1.00 U	0.30 J	1.00 U	1.00 U
5	1,2-Dichloroethane	1.00 U	0.50 J	1.00 U	0.10 J	0.10 J	1.00 U	1.00 U	1.00 U	1.00 U
-	2-Butanone	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U
5	1,1,1-Trichloroethane	1.00 UJ	120.00	1.00 UJ	6.00 J	34.00 J	1.00 UJ	1.00 U	3000.00	[illegible]
5	Carbon Tetrachloride	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
5	Bromodichloromethane	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
5	1,2-Dichloropropane	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
5	cis-1,3-Dichloropropene	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
5	Trichloroethene	1.00 U	16.00	1.00 U	0.10 J	16.00	1.00 U	1.00 U	4.00	3.00
5	Dibromochloromethane	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
5	1,1,2-Trichloroethane	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
5	1,2-Dibromoethane	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
0.7	Benzene	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	0.40 J	1.00 U	0.06 J	0.30 J
5	trans-1,3-Dichloropropene	1.00 U	1.00 UJ	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
-	Bromoform	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
-	4-Methyl-2-Pentanone	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U
-	2-Hexanone	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U
5	Tetrachloroethene	1.00 U	21.00	1.00 U	1.00 U	7.00	1.00 U	1.00 U	18.00	1.00
-	Bromochloromethane	1.00 UJ	1.00 U	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 U	1.00 U	1.00 U
5	1,1,2,2-Tetrachloroethane	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
5	Toluene	1.00 U	1.00 U	1.00 U	0.10 J	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
5	Chlorobenzene	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	3.00	1.00 U	1.00 U	1.00 U
5	Ethylbenzene	1.00 U	1.00 U	1.00 U	0.09 J	1.00 U	1.00 U	1.00 U	0.40 J	0.40 J
5	Styrene	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
4.7	1,2-Dichlorobenzene	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
5	Xylenes(total)	1.00 U	1.00 U	1.00 U	0.70 J	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
4.7	1,3-Dichlorobenzene	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	0.09 J	1.00 U	1.00 U	1.00 U
4.7	1,4-Dichlorobenzene	1.00 U	1.00 U	1.00 U	1.00 U	0.10 J	0.4 J	1.00 U	1.00 U	1.00 U
5	1,2-Dibromo-3-chloropropane	1.00 U	1.00 UJ	1.00 U	1.00 U	1.00 U	1 U	1.00 U	1.00 U	1.00 U
	Total VOC's	5.00 J	185.55 J	3.20 J	2809.39 J	70.20 J	9.37 J	3.30 J	3083.36 J	70.60 J
	Total TICs	0	0	0	1	0	2	0	2	2
	Total TIC Concentration	0.00	0.00	0.00	3.1 J	0.00	54.90 JN	0.00	257.00 JN	11.19 JN

Concentrations above the New York State Drinking Water Standards referenced in Table 2-12 are highlighted
- = No standard available
U= Analyte was not detected at the instrument detection limit given
B= Reported value is between the instrument detection limit and the contract required detection limit
E= Value is estimated due to interferences
J= Estimated value
JN = Presumptive evidence for presence of analyte, estimated quantity
R= Rejected during data validation
X1=1.5 Dilution
X2=1.250 Dilution

TABLE 2-8
CIRCUITRON CORPORATION SITE
ROUND II DATA
FOCUSED FEASIBLILITY STUDY
MONITORING WELLS
INORGANICS ANALYTICAL RESULTS (ug/l)

Sample Number Analysis Depth Interval (ft) Date Collected	MW-2D Total 90-100 2/24/94	MW-2D Dissolved 90-100 2/24/94	MW-2S Total 25-35 2/21/94	MW-2S Dissolved 25-35 2/22/94	MW-3S Total 28-38 2/22/94	MW-3S Dissolved 28-38 2/22/94	MW-4S Total 24-34 2/21/94	MW-4S Dissolved 24-34 2/21/94	MW-4D Total 90-100 2/21/94	MW-4D Dissolved 90-100 2/21/94	NYS Drinking Water Quality Standards
Aluminum	460.00 J	20.80 U	172.00 B	20.80 U	553.00 J	20.80 U	598.00 J	20.80 U	691.00 J	20.80 U	-
Antimony	28.30 U	28.30 U	28.30 U	28.30 U	28.30 UJ	28.30 UJ	28.30 UJ	28.30 UJ	28.30 UJ	28.30 U	-
Arsenic	1.30 U	1.30 U	R	1.30 UJN	R	1.30 UJN	R	1.30 UJN	R	1.30 UJN	25.00
Barium	81.80 B	62.70 B	355.00	58.10 B	177.00 B	11.10 B	91.00 B	91.40 B	105.00 B	96.90 B	1,000.00
Beryllium	0.20 U	0.20 U	0.20 U	0.20 U	0.25 B	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	-
Cadmium	3.60 B	2.70 U	2.70 U	2.70 U	2.70 U	2.70 U	2.90 B	2.70 U	2.70 U	2.70 U	10.00
Calcium	13,600.00	11,700.00	39,400.00	39,700.00	31,500.00	29,200.00	35,400.00 J	39,000.00 J	15,200.00	15,200.00	-
Chromium	17.80	2.60 U	4.20 B	2.60 U	40.90 J	2.60 U	242.00 J	2.60 U	72.20 J	2.60 U	50.00
Cobalt	2.90 U	2.90 U	6.30 B	2.90 B	18.40 B	2.90 U	4.20 B	6.30 B	5.40 B	5.00 B	-
Copper	21.50 B	5.50 B	3,550.00	17.60 B	992.00	8.10 B	108.00	9.90 B	12.30 B	3.90 B	200.00
Iron	[illegible]	[illegible]	[illegible]	1,360.00	[illegible]	4,940.00	10,800.00	9,060.00	2,750.00	178.00	300.00
Lead	[illegible]	3.40	3.20 JWN	R	6.60 JWN		3.70 JWN	R	5.40 JWN	R	15.00
Magnesium	2,800.00 BE	2,290.00 BE	3,980.00 B	4,270.00 B	3,450.00 B	3,380.00 B	3,330.00 B	3,590.00 B	3,480.00 B	3,480.00 B	35,000.00
Manganese	[illegible]	260.00	[illegible]	546.00	877.00	620.00	602.00	650.00	244.00	220.00	300.00
Mercury	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	2.00
Nickel	16.20 B	10.80 U	10.80 U	10.80 U	13.30 B	10.80 U	14.40 B	10.80 U	25.20 B	10.80 U	-
Potassium	3,220.00 B	3,000.00 B	6,630.00	7,040.00	5,180.00	5,160.00	5,490.00	5,990.00	5,950.00	6,410.00	-
Selenium	1.20 BJW	1.10 U	1.10 U	1.10 U	1.10 U	1.10 U	1.10 U	1.10 U	1.10 U	1.10 U	10.00
Silver	2.80 U	2.80 U	9.90 B	2.80 U	21.60	2.80 U	2.80 U	2.80 U	2.80 U	2.80 U	50.00
Sodium	13,300.00	13,100.00	13,700.00	14,700.00	11,400.00	11,900.00	12,500.00	13,600.00	16,500.00	17,100.00	20,000.00
Thallium	1.50 BJW	1.20 BJW	R	1.00 UJWN	R	1.00 UJWN	R	1.10 BJWN	R	1.20 BJWN	-
Vanadium	2.30 U	2.30 U	2.90 B	2.30 U	6.60 B	2.30 U	3.40 B	2.30 U	3.10 B	2.30 U	-
Zinc	256.00 J	170.00 J	76.80	5.80 B	178.00	10.70 B	20.50	8.30 B	48.80	22.30	300.00

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TABLE 2-8
CIRCUITRON CORPORATION SITE
ROUND II DATA
FOCUSED FEASIBLILITY STUDY
MONITORING WELLS
INORGANICS ANALYTICAL RESULTS (ug/l)

Sample Number Analysis Depth Interval (ft) Date Collected	Field Blank Total - 2/22/94	Field Blank Dissolved - 2/22/94	Field Blank Dissolved - 2/22/94	MW-1S Total 25-35 2/22/94	MW-1S Dissolved 25-35 2/22/94	MW-3D Total 90-100 2/22/94	MW-3D Dissolved 90-100 2/22/94	MW-3D-DUP Total 90-100 2/22/94	MW-3D-DUP Dissolved 90-100 2/22/94	MW-3S Total 24-34 2/23/94	NYS Drinking Water Quality Standards
Aluminum	20.80 U	20.80 U	20.80 U	175.00 B	20.80 U	71.90 B	20.80 U	60.10 B	20.80 U	201.00	-
Antimony	28.30 U	28.30 U	28.30 U	28.30 U	28.30 U	28.30 U	28.30 U	28.30 U	28.30 U	28.30 UJ	-
Arsenic	N	1.30 UJN	1.30 UJN	R	9.80 BJN	R	1.30 UJN		1.30 UJN	2.60 BJW	25.00
Barium	0.80 U	0.80 U	0.80 U	193.00 B	163.00 B	154.00 B	156.00 B	154.00 B	142.00 B	139.00 B	1,000.00
Beryllium	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	-
Cadmium	2.70 U	2.70 U	2.70 U	2.70 U	2.70 U	2.90 BJ	2.70 U	2.70 U	2.70 U	2.70 U	10.00
Calcium	26.40 B	70.40 B	70.40 B	75,100.00	77,600.00	13,700.00	14,500.00	13,700.00	14,300.00	31,700.00	-
Chromium	2.60 U	2.60 U	2.60 U	7.70 B	2.60 U	75.20 J	3.40 B	73.40 J	3.60 B	45.80	50.00
Cobalt	2.90 U	2.90 U	2.90 U	5.90 B	2.90 B	26.40 B	21.80 B	26.80 B	19.70 B	2.90 U	-
Copper	2.40 B	2.40 U	2.40 U	17.80 B	5.50 B	10.70 B	5.80 B	13.20 B	9.20 B	218.00	200.00
Iron	28.90 B	6.10 U	6.10 U	52,600.00 E	23,200.00 J	687.00	189.00	661.00 J	184.00	9,790.00	300.00
Lead	0.60 UN	0.60 UN	0.60 UN	2.90 BJWN		9.50 N	R	8.60 JWN	R	3.00 BJW	15.00
Magnesium	26.80 U	26.80 U	26.80 U	5,230.00	5,580.00	2,600.00 B	2,800.00 B	2,620.00 B	2,700.00 B	3,540.00 BE	35,000.00
Manganese	1.70 U	1.70 U	1.70 U	714.00	629.00	2,680.00	2,290.00	2,610.00 J	2,270.00 J	682.00	300.00
Mercury	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	2.00
Nickel	10.80 U	10.80 U	10.80 U	10.80 U	10.80 U	22.60 B	10.80 U	16.40 B	11.70 B	18.40 B	-
Potassium	348.00 U	348.00 U	348.00 U	11,100.00	15,300.00 J	6,170.00	6,440.00	6,300.00	6,420.00	4,970.00 B	-
Selenium	1.10 U	1.10 U	1.10 UJW	1.10 UJW	1.10 U	1.10 U	1.10 U	1.10 U	1.10 U	1.10 U	10.00
Silver	2.80 U	2.80 U	2.80 U	2.80 U	2.80 U	2.80 U	2.80 U	2.80 U	2.80 U	2.80 U	50.00
Sodium	33.70 B	37.80 B	129.00 B	19,200.00 J	23,000.00 J	15,700.00 J	17,300.00 J	15,600.00	16,500.00	13,500.00	20,000.00
Thallium	*	1.00 UN	1.00 UN	R	1.30 BJWN	R	1.00 UJWN	R	1.30 UJWN	1.00 U	-
Vanadium	2.30 U	2.30 U	2.30 U	5.00 B	2.30 U	2.30 U	2.30 U	2.30 U	2.30 U	2.30 U	-
Zinc	3.10 U	3.10 U	3.10 U	21.50	5.00 B	67.90	33.10	62.10	46.40	11.30 B	300.00

Concentrations above the NYS Drinking Water Quality Standards referenced in table 2-12 are highlighted
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R= Rejected during data validation
M=Duplicate injection precision criteria was not met.

TABLE 2-8
CIRCUITRON CORPORATION SITE
ROUND II DATA
FOCUSED FEASIBLILITY STUDY
MONITORING WELLS
INORGANICS ANALYTICAL RESULTS (ug/l)

Sample Number Analysis Depth Interval (ft) Date Collected	MW-5S Dissolved 24-34 2/23/94	MW-5D Total 90-100 2/23/94	MW-5D Dissolved 90-100 2/23/94	Field Blank Total - 2/23/94	Field Blank Dissolved - 2/21/94	MW-1D Total 90-100 2/23/94	MW-1D Dissolved 90-100 2/23/94	MW-6S Total 24.8-34.8 2/24/94	MW-6S Dissolved 24.8-34.8 2/24/94	MW-6D Total 90-100 2/24/94	NYS Drinking Water Quality Standards
Aluminum	20.80 U	89.50 B	20.80 U	20.80 U	20.80 U	223.00 J	20.80 U	298.00 J	98.00 B	306.00 J	-
Antimony	28.30 UJ	28.30 U	28.30 U	28.30 U	28.30 U	28.30 UJ	28.30 UJ	28.30 U	28.30 U	28.30 UJ	-
Arsenic	1.30 UJW	1.30 UJW	1.30 U	1.30 UJW	1.30 UJN	1.30 UJW	1.30 UJW	1.30 UJW	1.30 U	1.30 UJW	25.00
Barium	43.10 B	25.30 B	20.50 B	0.80 U	0.80 U	117.00 B	105.00 B	39.30 B	36.40 B	120.00 B	1,000.00
Beryllium	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	-
Cadmium	2.70 U	5.50	4.80 B	2.70 U	2.70 U	4.30 B	2.70 U	2.70 U	3.40 B	2.70 U	10.00
Calcium	30,400.00	8,990.00	8,840.00	23.10 U	106.00 B	13,100.00	12,600.00	20,900.00	20,500.00	25,800.00	-
Chromium	2.60 U	10.40	2.60 U	2.60 U	2.60 U	36.20	6.40 B	70.90	2.60 U	**69.40**	50.00
Cobalt	2.90 U	2.90 U	2.90 U	2.90 U	2.90 U	2.90 U	2.90 U	2.90 U	2.90 U	2.90 U	-
Copper	29.70	44.80	20.30 B	2.40 U	2.40 U	9.00 B	5.00 B	2.40 U	2.40 U	8.00 B	200.00
Iron	[illegible]	[illegible]	49.40 B	13.80 B	6.10 U	**621.00**	37.70 B	**647.00**	69.30 B	**1,110.00**	300.00
Lead	3.10 JW	11.20	2.10 B	1.10 B	R	5.30 JW	2.70 BJW	3.30 W	1.70 B	5.30 JW	15.00
Magnesium	3,450.00 BE	911.00 BE	917.00 BE	26.80 UE	26.80 U	4,010.00 BE	3,890.00 BE	2,700.00 BE	2,660.00 BE	4,360.00 BE	35,000.00
Manganese	[illegible]	65.40	34.80	1.70 U	1.80 B	60.10	53.00	238.00	213.00	73.70	300.00
Mercury	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	2.00
Nickel	10.80 B	10.80 U	11.40 B	10.80 U	10.80 U	94.40	80.50	33.30 B	24.90 B	104.00	-
Potassium	4,830.00 B	4,460.00 B	4,660.00 B	348.00 U	348.00 U	7,110.00	7,260.00	3,220.00 B	3,610.00 B	1,600.00 B	-
Selenium	1.10 U	1.10 U	1.10 UJW	1.10 U	1.10 U	1.10 U	1.10 U	1.10 U	1.10 U	1.10 U	10.00
Silver	2.80 U	2.80 U	2.80 U	2.80 U	2.80 U	2.80 U	2.80 U	2.80 U	2.80 U	2.80 U	50.00
Sodium	13,200.00	6,280.00	6,360.00	56.10 B	40.50 B	**20,500.00**	**20,300.00**	12,700.00	12,800.00	16,500.00	20,000.00
Thallium	1.00 U	1.00 U	1.00 U	1.00 U	1.00 BJWN	1.00 U	1.00 U	1.20 BJW	1.00 UJW	1.00 UJW	-
Vanadium	2.30 U	2.30 U	2.30 U	2.30 U	2.30 U	2.30 U	2.30 U	2.30 U	2.30 U	2.30 U	-
Zinc	7.50 B	89.30	51.40 J	5.90 B	3.10 U	114.00 J	88.30 J	15.90 B	11.70 B	48.50 J	300.00

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MONITORING WELLS
INORGANICS ANALYTICAL RESULTS (ug/l)

Sample Number Analysis Depth Interval (ft) Date Collected	MW-6D Dissolved 90-100 2/24/94	MW-7S Total 27-37 2/24/94	MW-7S Dissolved 27-37 2/24/94	MW-7D Total 90-100 2/23/94	MW-7D Dissolved 90-100 2/23/94	PW-2-02 Total 216.3-226.3 2/22/94	PW-2-02 Dissolved 216.3-226.3 2/22/94	Field Blank Total - 2/24/94	Field Blank Dissolved - 2/23/94	Field Blank Dissolved - 2/23/94	NYS Drinking Water Quality Standards
Aluminum	20.80 U	222.00 J	20.80 U	393.00 J	20.80 U	20.80 U	20.80 U	20.80 U	20.80 U	20.80 U	-
Antimony	28.30 U	28.30 U	28.30 U	28.30 U	28.30 U	28.30 U	28.30 U	28.30 U	28.30 U	28.30 U	-
Arsenic	1.30 U	1.30 U	1.30 U	1.30 UJW	1.30 U	R	1.30 UJN	1.30 UJN	1.30 U	1.30 U	25.00
Barium	95.30 B	84.80 B	19.00 B	91.10 B	85.50 B	40.70 B	40.40 B	0.80 U	0.80 U	0.80 U	1,000.00
Beryllium	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	-
Cadmium	3.70 B	4.00 B	3.20 B	3.70 B	2.70 U	2.70 U	2.70 U	2.70 UJ	2.70 U	2.70 U	10.00
Calcium	15,500.00	13,100.00	12,600.00	12,900.00	12,800.00	5,260.00 J	5,830.00 J	37.50 B	63.10 B	72.10 B	-
Chromium	10.90	[illegible]	5.40 B	5.00 B	2.60 U	2.60 U	2.60 U	2.60 U	2.60 U	2.60 U	50.00
Cobalt	2.90 U	2.90 U	2.90 U	2.90 U	2.90 U	3.80 B	2.90 U	2.90 U	2.90 U	2.90 U	-
Copper	2.40 U	16.10 B	2.40 U	2.40 U	2.40 U	88.90	71.90	2.40 U	2.40 U	2.40 U	200.00
Iron	57.10 B	[illegible]	10.50 B	371.00 [illegible]	26.40 B	174.00	10.10 B	10.80 B	89.80 B	20.50 B	300.00
Lead	0.94 B	2.20 B	1.10 B	3.80 JW	2.90 B	8.10 N	R	0.60 UN	1.70 BJW	1.60 B	15.00
Magnesium	3,490.00 BE	2,760.00 BE	2,690.00 BE	3,470.00 BE	3,110.00 BE	2,420.00 B	2,590.00 B	26.80 U	26.80 UE	26.80 UE	35,000.00
Manganese	38.50	[illegible]	2.70 B	14.90 B	9.80 B	22.90	22.90	1.70 U	1.70 U	1.70 U	300.00
Mercury	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	2.00
Nickel	38.00 B	52.00	10.80 U	11.60 B	10.80 U	41.40	10.80 U	10.80 U	10.80 U	10.80 U	-
Potassium	1,670.00 B	4,420.00 BJ	5,070.00 J	2,410.00 B	2,490.00 B	1,450.00 B	1,610.00 B	348.00 U	348.00 U	348.00 U	-
Selenium	1.10 UJW	1.10 UJW	1.10 UJW	1.10 U	1.10 U	1.10 U	1.10 UJW	1.10 UJN	1.10 U	1.10 U	10.00
Silver	2.80 U	2.80 U	2.80 U	2.80 U	2.80 U	2.80 U	2.80 U	2.80 U	2.80 U	2.80 U	50.00
Sodium	15,500.00	9,600.00	9,420.00	11,600.00	11,500.00	7,670.00	8,440.00	66.00 B	99.30 B	143.00 B	20,000.00
Thallium	1.00 UJW	1.20 BJW	1.00 UJW	1.00 U	1.50 BJW		1.00 UN	1.20 B	1.00 U	1.00 U	-
Vanadium	2.30 U	2.30 U	2.30 U	2.30 U	2.30 U	2.30 U	2.30 U	2.30 U	2.30 U	2.30 U	-
Zinc	28.50	16.70 B	6.70 B	37.90 J	11.00 B	360.00 [illegible]	42.90	5.30 B	4.20 B	11.00 B	300.00

Concentrations above the NYS Drinking Water Quality Standards referenced in table 2-12 are highlighted
- = No standard available
U= Analyte was not detected at the instrument detection limit given
B= Reported value is between the instrument detection limit and the contract required detection limit
E= Value is estimated due to interferences
N= Spiked sample recovery was not within control limits
*= Duplicate analysis was not within control limits
J= Estimated value
W= Post-digestion spike for Furnace AA analysis out of control limits, while sample absorbance is less than 50% of spike absorbance
R= Rejected during data validation

M=Duplicate injection precision criteria was not met

TABLE 2-8
CIRCUITRON CORPORATION SITE
ROUND II DATA
FOCUSED FEASIBLILITY STUDY
MONITORING WELLS
INORGANICS ANALYTICAL RESULTS (ug/l)

Sample Number Analysis Depth Interval (ft) Date Collected	PD-1 Dissolved 17-32 2/24/94	PD-1 Total 17-32 2/24/94	Field Blank Dissolved - 2/24/94	Field Blank Dissolved - - 2/24/94	MW-13 Total 31-41 2/25/94	MW-13 Dissolved 31-41 2/25/94	MW-14 Total 33-43 2/25/94	MW-14 Dissolved 33-43 2/25/94	Field Blank Dissolved - 2/25/94		NYS Drinking Water Quality Standards
Aluminum	262.00 J	3,240.00	20.80 U	20.80 U	4,800.00	20.80 U	1,840.00	113.00 B	20.80 U		-
Antimony	28.30 UJ	28.30 U	33.10- B	28.30 U	28.30 U	28.30 U	28.30 U	39.40 B	28.30 U		-
Arsenic	4.00 BW	4.70 BJWN	1.30 UJN	1.30 UJN	1.30 UJN	1.30 UJN	1.30 UJN	1.30 UJN	1.30 UJN		25.00
Barium	230.00	234.00	0.80 U	0.80 U	81.80 B	45.40 B	33.50 B	23.00 B	0.80 U		1,000.00
Beryllium	0.20 U	0.29 B	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U		-
Cadmium	3.90 B	2.70 UJ	2.70 UJ	2.70 UJ	2.70 U	2.70 UJ	2.70 UJ	2.70 UJ	2.70 UJ		10.00
Calcium	84,100.00	84,000.00	56.20 B	74.90 B	29,300.00	24,700.00	23,400.00	22,600.00	65.60 B		-
Chromium	2.60 U	10.50	2.60 U	2.60 U	17.60	3.70 B	14.30	2.80 B	2.90 B		50.00
Cobalt	2.90 U	4.90 B	2.90 U	2.90 U	12.10 B	8.50 B	5.80 B	2.90 U	4.00 B		-
Copper	2.90 B	11.20 B	2.40 U	2.40 U	40.00 J	6.10 B	9.80 B	2.40 U	2.40 U		200.00
Iron	27,200.00	32,100.00	14.00 B	11.60 B	20,600.00	4,760.00	3,880.00	289.00	9.10 B		300.00
Lead	7.00 JW	8.90 JWN	0.60 UN	0.60 UN	11.90 JWN	1.40 BJN	3.80 JN	0.90 BJN	0.60 UJWN		15.00
Magnesium	6,850.00 EJ	7,190.00	44.20 B	26.80 U	4,110.00 B	2,600.00 B	3,040.00 B	2,710.00 B	38.00 B		35,000.00
Manganese	[illegible]	815.00	2.00 B	1.70 U	681.00	520.00	319.00	243.00	1.70 U		300.00
Mercury	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U		2.00
Nickel	10.80 U	10.80 U	10.80 U	10.80 U	35.40 B	13.30 B	10.80 U	10.80 U	10.80 U		-
Potassium	10,600.00	11,400.00 J	348.00 U	348.00 U	4,800.00 B	3,990.00 B	2,820.00 B	2,420.00 B	348.00 U		-
Selenium	1.10 U	1.10 UJWN	1.10 UJN	1.10 UJN	1.40 BJWN	1.10 UJWN	1.10 UJWN	1.10 UJN	1.10 UJN		10.00
Silver	2.80 U	4.10 B	2.80 U	2.80 U	4.50 B	2.80 U	4.10 B	2.80 U	2.80 U		50.00
Sodium	50,500.00	41,600.00	101.00 B	96.30 B	12,300.00	11,000.00	15,800.00	15,200.00	105.00 B		20,000.00
Thallium	1.40 BJW	1.10 BJW	1.00 U	1.60 B	1.10 BJW	1.00 U	1.00 U	1.00 BJW	1.00 U		-
Vanadium	2.30 U	11.60 B	2.30 U	2.30 U	10.10 B	3.50 B	4.30 B	2.30 U	2.70 B		-
Zinc	11.80 B	29.70	3.10 U	3.10 U	68.10	23.60	14.00 B	6.10 B	3.10 U		300.00

Concentrations above the NYS Drinking Water Quality Standards referenced in table 2-12 are highlighted

- = No standard available

U= Analyte was not detected at the instrument detection limit given

B= Reported value is between the instrument detection limit and the contract required detection limit

E= Value is estimated due to interferences

N= Spiked sample recovery was not within control limits

*= Duplicate analysis was not within control limits

J= Estimated value

W= Post-digestion spike for Furnace AA analysis out of control limits, while sample absorbance is less than 50% of spike absorbance

R= Rejected during data validation

M=Duplicate injection precision criteria was not met

TABLE 2-9

CIRCUITRON CORPORATION SITE
1,1,1-Trichloroethane Quantified during 1989 RI and Round 1/Round 2 FFS Groundwater Sampling

Well No.	Round 1/Round 2 1989 RI Sampling	Round 1/Round 2 FFS Sampling[1]
MW-1S	760/1181J	3J/0.4J
MW-1D	28J/23	84J/99
MW-2S	2J/5.4	2J/2J
MW-2D	33/5/42 (Dup)	25J/23J
MW-3S	8J/78	3J/6J
MW-3D	38J/61	35J/37J
MW-4S	4600/ND	5800J/4400J
MW-4D	8/19	140J/240J
MW-5S	91J/115J	6J/27
MW-5D	ND/6.6	28J/17
MW-6S	95J/97	40J/110J
MW-6D	12/19	100J/420J
MW-7S	ND/ND	1J/ND
MW-7D	37J/19	54J/120
MW-8	110J/NA	3J/NA
MW-9	2/NA	5J/NA
MW-10	20/NA	3J/NA
MW-11	43J/NA	5J/NA
MW-12	380J/NA	50J/NA
MW-13	-	-/3000
MW-14	-	-/50
PW-2 (House of Plastics)	7/NA	10J/6J
PD-1	-	NA/ND

Concentrations in ug/l J = Estimated Value NA = Not Analyzed
ND - Not detected - = Not Installed

Notes:
[1] Round 1 groundwater sampling was performed May 1993; Round 2 groundwater sampling was performed in February 1994. New York State Drinking Water Standards (Title 40 CFR - Part 141, 192) for the same constituents analyzed for comparison purposes.

Table 2-10
CIRCUITRON CORPORATION SITE
CHEMICALS DETECTED IN GROUNDWATER (UPPER 40 FEET OF THE SATURATED AQUIFER)
ROUND I AND ROUND II DATA

Chemical	Round I			Round II		
	Frequency of Detection [a]	Range of Detected Concentrations (g/L)	Mean Concentration [b] (g/L)	Frequency of Detection [a]	Range of Detected Concentrations (g/L)	Mean Concentration [b] (g/L)
Organics						
Acetone	3/3	3 - 18	9.67	2/2	2 - 5	3.5
Benzene	ND	ND	ND	3/8	0.06 - 0.3	0.37
2-Butanone	1/1	6	6	ND	ND	ND
Chlorobenzene	2/24	0.6 - 3	0.539	4/8	0.4 - 0.7	0.5
Chloroethane	1/24	2	0.563	2/8	0.4 - 2	0.675
Chloroform	3/24	1 - 3	0.604	ND	ND	ND
1,4-Dichlorobenzene	ND	ND	ND	3/8	0.06 - 0.1	0.345
1,1-Dichloroethane	16/24	0.5 - 42	4.93	7/8	0.5 - 52	12.6
1,1-Dichloroethene	14/24	1 - 66	4.4	4/8	0.6 - 6	1.45
cis-1,2-Dichloroethene	8/24	1 - 10	1.2	4/8	0.9 - 2	0.863
Tetrachloroethene	14/24	0.7 - 21	1.95	6/8	0.2 - 22	5.65
Toluene	1/11	0.7	0.518	1/8	0.06	0.445
1,1,1-Trichloroethane	23/24	1 - 5,800	253	7/8	2 - 4,400	949
1,1,2-Trichloroethane	1/24	3	0.604	ND	ND	ND
Trichloroethene	12/24	1 - 43	4.08	6/8	0.05 - 4	1.23
Vinyl Chloride	ND	ND	ND	2/8	0.2 - 0.5	0.463
Inorganics						
Aluminum	9/9	133 - 3,700	1,590	8/8	172 - 4,800	1,090
Arsenic	4/11	2.6 - 81	9.92	1/5	2.6	1.04
Barium	11/11	27 - 1,390	171	8/8	33.5 - 355	125
Beryllium	2/11	0.36 - 0.51	0.275	1/8	0.25	0.119
Cadmium	ND	ND	ND	2/8	2.9 - 4	1.88
Calcium	10/10	16,600 - 39,700	28,200	8/8	13,100 - 39,400	28,100
Chromium	7/11	6.3 - 597	84.9	8/8	4.2 - 788	158
Cobalt	5/11	4.6 - 7.8	3.42	5/8	4.2 - 18.4	6.39
Copper	10/10	4.2 - 14,600	1,410	7/8	9.8 - 2,550	492
Iron	10/10	249 - 467,000	47,200	8/8	647 - 327,000	64,000
Lead	11/11	3.5 - 55	15	8/8	2.2 - 11.9	4.71
Magnesium	11/11	3,020 - 5,470	4,000	8/8	2,700 - 4,110	3,360
Manganese	10/10	108 - 1,790	576	8/8	238 - 4,400	1,100
Nickel	7/10	^7 - 72	16.2	6/8	13.3 - 52	22.2
Potassium	11/11	2,500 - 7,120	4,780	8/8	2,820 - 6,630	4,690
Selenium	ND	ND	ND	1/8	1.4	0.656
Silver	1/11	^17 - 28	3.73	4/8	4.1 - 21.6	5.71
Sodium	11/11	7,780 - 26,800	14,000	8/8	9,600 - 15,800	12,700
Thallium	ND	ND	ND	3/5	1.1 - 1.2	0.9
Vanadium	10/11	4.5 - 46	8.51	5/8	2.9 - 10.1	3.84
Zinc	10/10	4.9 - 281	54.6	8/8	11.3 - 178	50.2

ND = Not Detected.

[a] Number of sampling locations at which the chemical was detected compared with the total number of sampling locations.

[b] Arithmetic mean.

TABLE 2-11

CIRCUITRON CORPORATION SITE

Alkalinity, Hardness, Total Dissolved Solids (TDS) and Total Suspended Solids (TSS), mg/L

Well No.	Alkalinity	Hardness	TDS	TSS
MW-1S	240	218	284	90
MW-3S	68	125	123	370
MW-4S	120	122	162	39
MW-5S	64	96.2	176	10
MW-6S	42	74.9	130	ND
MW-7S	2	50.9	107	6.0
PD-1	230	273	514	131
MW-13	72	89.2	134	113
MW-14	64	72	138	50
FB022294-01	ND	ND	ND	ND
FB022394-01	ND	ND	7	ND
FB022494-01	ND	ND	7	ND

Notes:

ND - Indicates that the parameter was not detected at or above the reported limit.

TABLE 2-12

NYS DRINKING WATER QUALITY STANDARDS FOR GROUNDWATER

Parameters	Groundwater Conc. (mg/l)
Aluminum (ionic)	-
Arsenic	.025
Barium	1
Benzene	ND
Beryllium	.003
Boron	.05
Cadmium	0.01
Calcium	-
Carbon Tetrachloride	.005
Chloride	.250
Chlorobenzene	.005
Chloroform	.007
Chromium (total)	.05
Chromium VI	.05
Cobalt	-
Copper	.2
Dichlorobenzenes	.0047
1,1-Dichloroethane	.005
1,2-Dichloroethane	.005
1,2-Dichloroethene (total)	.005
1,2 - Dichloropropane	.005
Dibromochloromethane	.005
Ethylbenzene	.005
2-Hexanone	.05
Iron	.3
Iron & Manganese	.5

TABLE 2-12 (Continued)

NYS DRINKING WATER QUALITY STANDARDS FOR GROUNDWATER

Parameters	Groundwater Conc. (mg/l)
Lead	.025
Manganese	.3
Magnesium	35
Mercury	.002
Methoxychlor	.035
Methylene Chloride	.005
Nickel	-
Potassium	-
Selenium	.01
Silver	.05
Sodium	20
Styrene	.005
Tetrachloroethene	.005
1,1,1-trichloroethane	.005
1,1,2-trichloroethane	.005
Trichloroethene	.005
Toluene	.005
Thallium	.004
Trichlorobenzenes	.005
Vanadium	-
Vinyl Chloride	.002
Xylenes (each isomer)	.005
Zinc	.3
Unspecified Organic Contaminant	.05
Principal Organic Contaminant	.005

<u>Reference</u>:

New York State Drinking Water Standards (Title 40 CFR - Part 141, 192)
New York State Department of Environmental Conservation, November 1991.
Division of Water Technical and Operational Guidance Series (1.1.1) Ambient Water Quality Standards and Guidance Values.
NYSDEC, Division of Water 6 NYCRR Parts 700-705 Effective September 1991

TABLE 2-13

CIRCUITRON CORPORATION SITE
COMPARISON OF TOTAL VERSUS DISSOLVED CONCENTRATIONS
ROUNDS I/II COPPER AND CHROMIUM DATA, UG/L

Monitoring Point Designation	Copper		Chromium	
	Total	Dissolved	Total	Dissolved
MW-1S	38.5/17.80 B	4.80 B/5.50 B	19.10/7.70 B	5.80 U/2.60 U
MW-1D	16.50 B/9.00 B	5.60 BJ/5.00 B	31.40/36.20	16.20 J/6.40 B
MW-2S	14,600.00 J/2,500.00	18.80 BJ/17.60 B	38.70 J/4.20 B	5.80 UJ/2.60 U
MW-2S-DUP	10,500.00 J/NA	34.70 J/NA	73.10 J/NA	5.80 UJ/NA
MW-2D	17.40 BJ/21.50 B	9.40 B/5.50 B	42.90 J/17.80	29.70/2.60 U
MW-3S	262.00 J/992.00	18.90 BJ/8.10 B	11.70 J/40.90 J	5.80 UJ/2.60 U
MW-3D	8.30 B/10.70 B	10.30 B/5.80 B	81.90 R/75.20 J	216.00 R/3.40 B
MW-3D-DUP	NA/13.20 B	NA/9.20 B	NA/73.40 J	NA/3.60 B
MW-4S	125.00/108.00	31.80 J/9.90 B	597.00 J/282.00 J	36.00 J/2.60 U
MW-4D	5.60 BJ/12.30 B	9.40 BJ/3.90 B	73.30 J/72.20 J	5.80 UJ/2.60 U
MW-5S	4.60 R/218.00	34.90 R/29.70	40.00 J/45.80	5.80 UJ/2.60 U
MW-5D	110.00 J/44.80	108.00 J/20.30 B	5.80 UJ/10.40	5.80 UJ/2.60 U
MW-6S	220.00 J/2.40 U	11.30 B/2.40 U	186.00 J/70.90	161.00/2.60 U
MW-6D	9.70 BJ/8.00 B	4.20 UJ/2.40 U	437.00 J/69.40	336.00 J/10.90
MW-7S	4.20 B/16.10 B	7.10 BJ/2.40 U	25.40/788.00	5.80 UJ/5.40 B
MW-7D	5.90 B/2.40 U	4.20 UJ/2.40 U	22.00/5.00 B	5.80 UJ/2.60 U
MW-8	23.80 UJ/NA	23.90 BJ/NA	5.80 UJ/NA	5.80UJ/NA

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TABLE 2-13 (CONTINUED)

CIRCUITRON CORPORATION SITE
COMPARISON OF TOTAL VERSUS DISSOLVED CONCENTRATIONS
ROUNDS I/II COPPER AND CHROMIUM DATA, UG/L

Monitoring Point Designation	Copper		Chromium	
	Total	Dissolved	Total	Dissolved
MW-9	57.90 J/NA	15.00 B/NA	5.80 UJ/NA	9.00 B/NA
MW-10	347.00 J/NA	53.30 J/NA	5.80 UJ/NA	5.80 UJ/NA
MW-11	137.00/NA	47.70/NA	5.80 UJ/NA	5.80 UJ/NA
MW-12	327.00 J/NA	119.00/NA	6.30 UJ/NA	5.80 U/NA
MW-13	NA/40.00 J	NA/6.10 B	NA/17.60	NA/3.70 B
MW-14	NA/9.80 B	NA/2.40 U	NA/14.30	NA/2.80 B
PD-1	NA/11.20 B	NA/2.90 B	NA/10.50	NA/2.60 U
PW-2	462.00/88.90	203.00 J/71.90	3.30 U/2.60 U	5.80 UJ/2.60 U

Notes:

Concentrations are presented in ug/l.
Concentrations are presented as Round I groundwater sampling data/Round II groundwater sampling data.
NA denotes not sampled.
U denotes analyte was not detected at the instrument detection limit given.
B denotes the reported value is between the instrument detection limit and the contract required detection limit.
J denotes estimated value.

TABLE 2-14
CIRCUITRON CORPORATION SITE
FOCUSED FEASIBILITY STUDY
DRIVEPOINT GROUNDWATER SAMPLING
VOLATILE ORGANICS ANALYTICAL RESULTS (ug/l)

Sample Number Sample Type Depth Interval (ft) Date Collected	DP1-34-36 Groundwater 34-36 08/16/93	DP1-48-50 Groundwater 48-50 08/16/93	DP1-66-68 Groundwater 66-68 08/16/93	DP2-34-36 Groundwater 34-36 08/16/93	DP2-66-68 Groundwater 66-68 08/16/93	DP3-34-36 Groundwater 34-36 08/16/93	DP3-50-52 Groundwater 50-52 08/16/93	DP-PW-081693 Decon water - 08/16/93	DP-FB-081693 Field Blank - 08/16/93
Chloromethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Vinyl Chloride	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Bromomethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Chloroethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Fluorotrichloromethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethene	1 U	1 U	12	1 U	5	5	1 U	1 U	1 U
Methylene Chloride	1 U	1 U	8	1 U	1 U	1 U	1 U	1 U	1 U
trans-1,2-Dichloroethene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethane	1 U	1 U	3	1 U	2	1 U	1 U	1 U	1 U
cis-1,2-Dichloroethene	1 U	1 U	1	1 U	1 U	1 U	1 U	1 U	1 U
Chloroform	1 U	1 U	3	1 U	2	1 U	1 U	1 U	1 U
1,1,1-Trichloroethane	1 U	1 U	52	1 U	23	1 U	2	1 U	1 U
Carbon Tetrachloride	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloroethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Trichloroethene	1 U	1 U	25	1 U	13	1 U	1 U	1 U	1 U
1,2-Dichloropropane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Bromodichloromethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
trans-1,3-Dichloropropene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
cis-1,3-Dichloropropene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2-Trichloroethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Tetrachloroethene	1 U	1 U	4	1 U	3	1 U	1 U	1 U	1 U
Chlorodibromomethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Chlorobenzene	1	1 U	1 U	2	1 U	1 U	1 U	1 U	1 U
Bromoform	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2,2-Tetrachloroethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
M-Dichlorobenzene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
P-Dichlorobenzene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
O-Dichlorobenzene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U

Notes:
U= Analyte was not detected at the instrument detection limit given
B= Reported value is between the instrument detection limit and the contract required detection limit
E= Value is estimated due to interferences
J= Estimated value
W= Post-digestion spike for Furnace AA analysis out of control limits, while
R= Rejected during data validation
X1=1.5 Dilution
X2=1.250 Dilution

TABLE 2-14
CIRCUITRON CORPORATION SITE
FOCUSED FEASIBILITY STUDY
DRIVEPOINT GROUNDWATER SAMPLING
VOLATILE ORGANICS ANALYTICAL RESULTS (ug/l)

Sample Number Sample Type Depth Interval (ft) Date Collected	DP-TB-081693 Trip Blank - 08/16/93	DP4-34-36 Groundwater 34-36 08/17/93	DP4-50-52 Groundwater 50-52 08/17/93	DP5-50-52 Groundwater 50-52 08/17/93	DP5-62-64 Groundwater 62-64 08/17/93	DP5-80-82 Groundwater 80-82 08/17/93	DP6-34-36 Groundwater 34-36 08/17/93	DP6-50-52 Groundwater 50-52 08/17/93	DP6-64-66 Groundwater 64-66 08/17/93
Chloromethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Vinyl Chloride	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Bromomethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Chloroethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Fluorotrichloromethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethene	1 U	1 U	1 U	3	10	17	1 U	1 U	5
Methylene Chloride	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
trans-1,2-Dichloroethene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethane	1 U	1 U	4	16	9	5	1	1 U	2
cis-1,2-Dichloroethene	1 U	1 U	1 U	3	2	4	1 U	1 U	1 U
Chloroform	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1,1-Trichloroethane	1 U	1 U	1 U	1 U	37	64	2	1 U	25
Carbon Tetrachloride	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloroethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Trichloroethene	1 U	1 U	2	10	34	78	1 U	1 U	11
1,2-Dichloropropane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Bromodichloromethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
trans-1,3-Dichloropropene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
cis-1,3-Dichloropropene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2-Trichloroethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Tetrachloroethene	1 U	1 U	1 U	1 U	3	5	1 U	1 U	2
Chlorodibromomethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Chlorobenzene	1 U	8	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Bromoform	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2,2-Tetrachloroethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
M-Dichlorobenzene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
P-Dichlorobenzene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
O-Dichlorobenzene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U

Notes:
U= Analyte was not detected at the instrument detection limit given
B= Reported value is between the instrument detection limit and the contract required detection limit
E= Value is estimated due to interferences
J= Estimated value
W= Post-digestion spike for Furnace AA analysis out of control limits, while
R= Rejected during data validation
X1=1.5 Dilution
X2=1.250 Dilution

TABLE 2-14
CIRCUITRON CORPORATION SITE
FOCUSED FEASIBILITY STUDY
DRIVEPOINT GROUNDWATER SAMPLING
VOLATILE ORGANICS ANALYTICAL RESULTS (ug/l)

Sample Number Sample Type Depth Interval (ft) Date Collected	DP-FB-081793 Field Blank - 08/17/93	DP-TB-081793 Trip Blank - 08/17/93	DP6-80-82 Groundwater 80-82 08/18/93	DP7-34-36 Groundwater 34-36 08/18/93	DP7-50-52 Groundwater 50-52 08/18/93	DP8-50-52 Groundwater 50-52 08/18/93	DP8-64-66 Groundwater 64-66 08/18/93	DP8-80-82 Groundwater 80-82 08/18/93	DP9-34-36 Groundwater 34-36 08/18/93
Chloromethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Vinyl Chloride	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Bromomethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Chloroethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Fluorotrichloromethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethene	1 U	1 U	23	1 U	5	1 U	1	2	1 U
Methylene Chloride	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
trans-1,2-Dichloroethene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethane	1 U	1 U	3	3	22	2	1 U	2	2
cis-1,2-Dichloroethene	1 U	1 U	3	1 U	10	1 U	1 U	1 U	1 U
Chloroform	1 U	1 U	2	1 U	1 U	1 U	1 U	1 U	1 U
1,1,1-Trichloroethane	1 U	1 U	110	8	2	1 U	9	10	1 U
Carbon Tetrachloride	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloroethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Trichloroethene	1 U	1 U	23	1 U	21	2	5	5	1 U
1,2-Dichloropropane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Bromodichloromethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
trans-1,3-Dichloropropene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
cis-1,3-Dichloropropene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2-Trichloroethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Tetrachloroethene	1 U	1 U	20	1 U	1	1 U	1	2	1 U
Chlorodibromomethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Chlorobenzene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Bromoform	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2,2-Tetrachloroethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
M-Dichlorobenzene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
P-Dichlorobenzene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
O-Dichlorobenzene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U

Notes:
U= Analyte was not detected at the instrument detection limit given
B= Reported value is between the instrument detection limit and the contract required detection limit
E= Value is estimated due to interferences
J= Estimated value
W= Post-digestion spike for Furnace AA analysis out of control limits, while
R= Rejected during data validation
X1=1.5 Dilution
X2=1.250 Dilution

TABLE 2-14
CIRCUITRON CORPORATION SITE
FOCUSED FEASIBILITY STUDY
DRIVEPOINT GROUNDWATER SAMPLING
VOLATILE ORGANICS ANALYTICAL RESULTS (ug/l)

Sample Number	DP9-50-52	DP9-64-66	DP9-80-82	DP-TB-081893	DP-FB-081893	DP7-64-66	DP2-80-82	DP10-34-36	DP10-50-52
Sample Type	Groundwater	Groundwater	Groundwater	Trip Blank	Field Blank	Groundwater	Groundwater	Groundwater	Groundwater
Depth Interval (ft)	50-52	64-66	80-82	-	-	64-66	80-82	34-36	50-52
Date Collected	08/18/93	08/18/93	08/18/93	08/18/93	08/18/93	08/19/93	08/19/93	08/19/93	08/19/93
Chloromethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Vinyl Chloride	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Bromomethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Chloroethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Fluorotrichloromethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethene	1 U	14	48	1 U	1 U	1	23	1 U	1 U
Methylene Chloride	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
trans-1,2-Dichloroethene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethane	2	3	7	1 U	1 U	12	5	1 U	1
cis-1,2-Dichloroethene	1 U	1	5	1 U	1 U	6	3	1 U	1 U
Chloroform	1 U	3	1	1 U	1 U	1 U	1	1 U	1 U
1,1,1-Trichloroethane	1 U	53	160	1 U	1 U	6	94	1	1 U
Carbon Tetrachloride	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloroethane	1 U	1 U	1	1 U	1 U	1 U	1 U	1 U	1 U
Trichloroethene	1	22	22	1 U	1 U	14	78	1 U	1
1,2-Dichloropropane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Bromodichloromethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
trans-1,3-Dichloropropene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
cis-1,3-Dichloropropene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2-Trichloroethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Tetrachloroethene	1 U	5	27	1 U	1 U	1 U	6	1 U	1 U
Chlorodibromomethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Chlorobenzene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Bromoform	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2,2-Tetrachloroethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
M-Dichlorobenzene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
P-Dichlorobenzene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
O-Dichlorobenzene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U

Notes:
U= Analyte was not detected at the instrument detection limit given
B= Reported value is between the instrument detection limit and the contract required detection limit
E= Value is estimated due to interferences
J= Estimated value
W= Post-digestion spike for Furnace AA analysis out of control limits, while
R= Rejected during data validation
X1=1.5 Dilution
X2=1.250 Dilution

TABLE 2-14
CIRCUITRON CORPORATION SITE
FOCUSED FEASIBILITY STUDY
DRIVEPOINT GROUNDWATER SAMPLING
VOLATILE ORGANICS ANALYTICAL RESULTS (ug/l)

Sample Number Sample Type Depth Interval (ft) Date Collected	DP10-64-66 Groundwater 64-66 08/19/93	DP11-34-36 Groundwater 34-36 08/19/93	DP11-50-52 Groundwater 50-52 08/19/93	DP-FB-081993 Field Blank - 08/19/93	DP-TB-081993 Trip Blank - 08/19/93	DP12-34-36 Groundwater 34-36 08/20/93	DP12-50-52 Groundwater 50-52 08/20/93	DP12-64-66 Groundwater 64-66 08/20/93	DP13-34-36 Groundwater 34-36 08/20/93
Chloromethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Vinyl Chloride	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Bromomethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Chloroethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Fluorotrichloromethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethene	3	1 U	1 U	1 U	1 U	1 U	1 U	10	1 U
Methylene Chloride	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
trans-1,2-Dichloroethene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethane	3	1 U	1 U	1 U	1 U	21	17	13	9
cis-1,2-Dichloroethene	1 U	1 U	1 U	1 U	1 U	1 U	1	3	1 U
Chloroform	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1,1-Trichloroethane	11	1 U	1 U	1 U	1 U	120	1	33	45
Carbon Tetrachloride	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloroethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Trichloroethene	9	1 U	1 U	1 U	1 U	1	2	43	1 U
1,2-Dichloropropane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Bromodichloromethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
trans-1,3-Dichloropropene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
cis-1,3-Dichloropropene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2-Trichloroethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Tetrachloroethene	2	1 U	1 U	1 U	1 U	3	1	5	1 U
Chlorodibromomethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Chlorobenzene	1 U	1 U	1 U	1 U	1 U	1 U	3	1 U	1 U
Bromoform	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2,2-Tetrachloroethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
M-Dichlorobenzene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
P-Dichlorobenzene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
O-Dichlorobenzene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U

Notes:
U= Analyte was not detected at the instrument detection limit given
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E= Value is estimated due to interferences
J= Estimated value
W= Post-digestion spike for Furnace AA analysis out of control limits, while
R= Rejected during data validation
X1=1.5 Dilution
X2=1.250 Dilution

TABLE 2-14
CIRCUITRON CORPORATION SITE
FOCUSED FEASIBILITY STUDY
DRIVEPOINT GROUNDWATER SAMPLING
VOLATILE ORGANICS ANALYTICAL RESULTS (ug/l)

Sample Number Sample Type Depth Interval (ft) Date Collected	DP13-50-52 Groundwater 50-52 08/20/93	DP13-64-66 Groundwater 64-66 08/20/93	DP13-80-82 Groundwater 80-82 08/20/93	DP14-64-66 Groundwater 64-66 08/20/93	DP-TB-082093 Trip Blank - 08/20/93	DP-FB-082093 Field Blank - 08/20/93	DP15-34-36 Groundwater 34-36 08/24/93	DP15-50-52 Groundwater 50-52 08/24/93	DP16-34-36 Groundwater 34-36 08/24/93
Chloromethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Vinyl Chloride	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Bromomethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Chloroethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Fluorotrichloromethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethene	1	10	5	2	1 U	1 U	1 U	1 U	1 U
Methylene Chloride	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
trans-1,2-Dichloroethene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethane	8	8	5	1 U	1 U	1 U	4	1 U	1 U
cis-1,2-Dichloroethene	4	2	6	1 U	1 U	1 U	9	2.2	1 U
Chloroform	1 U	1	52	2	1 U	1 U	1 U	1 U	1 U
1,1,1-Trichloroethane	2	40	21	12	1 U	1 U	4	1 U	12
Carbon Tetrachloride	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloroethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Trichloroethene	1	36	21	4	1 U	1 U	3	1 U	1 U
1,2-Dichloropropane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Bromodichloromethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
trans-1,3-Dichloropropene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
cis-1,3-Dichloropropene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2-Trichloroethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Tetrachloroethene	1 U	2	15	1	1 U	1 U	4	1 U	1 U
Chlorodibromomethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Chlorobenzene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Bromoform	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2,2-Tetrachloroethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
M-Dichlorobenzene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
P-Dichlorobenzene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
O-Dichlorobenzene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U

Notes:
U= Analyte was not detected at the instrument detection limit given
B= Reported value is between the instrument detection limit and the contract required detection limit
E= Value is estimated due to interferences
J= Estimated value
W= Post-digestion spike for Furnace AA analysis out of control limits, while
R= Rejected during data validation
X1=1.5 Dilution
X2=1.250 Dilution

TABLE 2-14
CIRCUITRON CORPORATION SITE
FOCUSED FEASIBILITY STUDY
DRIVEPOINT GROUNDWATER SAMPLING
VOLATILE ORGANICS ANALYTICAL RESULTS (ug/l)

Sample Number Sample Type Depth Interval (ft) Date Collected	DP16-50-52 Groundwater 50-52 08/24/93	DP16-64-66 Groundwater 64-66 08/24/93	DP17-34-36 Groundwater 34-36 08/24/93	DP17-50-52 Groundwater 50-52 08/24/93	DP17-64-66 Groundwater 64-66 08/24/93	DP-TB-082493 Trip Blank - 08/24/93	DP-FB-082493 Field Blank - 08/24/93
Chloromethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Vinyl Chloride	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Bromomethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Chloroethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Fluorotrichloromethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethene	1 U	1 U	1 U	1 U	3	1 U	1 U
Methylene Chloride	1 U	1 U	1 U	1 U	1 U	1 U	1 U
trans-1,2-Dichloroethene	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U
cis-1,2-Dichloroethene	1 U	1 U	1 U	1	1	1 U	1 U
Chloroform	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1,1-Trichloroethane	1 U	1 U	1 U	2	15	1 U	1 U
Carbon Tetrachloride	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloroethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Trichloroethene	1 U	1 U	1 U	1 U	7	1 U	1 U
1,2-Dichloropropane	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Bromodichloromethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U
trans-1,3-Dichloropropene	1 U	1 U	1 U	1 U	1 U	1 U	1 U
cis-1,3-Dichloropropene	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2-Trichloroethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Tetrachloroethene	1 U	1 U	1 U	1 U	1	1 U	1 U
Chlorodibromomethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Chlorobenzene	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Bromoform	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2,2-Tetrachloroethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U
M-Dichlorobenzene	1 U	1 U	1 U	1 U	1 U	1 U	1 U
P-Dichlorobenzene	1 U	1 U	1 U	1 U	1 U	1 U	1 U
O-Dichlorobenzene	1 U	1 U	1 U	1 U	1 U	1 U	1 U

Notes:
U= Analyte was not detected at the instrument detection limit given
B= Reported value is between the instrument detection limit and the contract required detection limit
E= Value is estimated due to interferences
J= Estimated value
W= Post-digestion spike for Furnace AA analysis out of control limits, while
R= Rejected during data validation
X1=1.5 Dilution
X2=1.250 Dilution

TABLE 2-15

CIRCUITRON CORPORATION SITE
EAST FARMINGDALE, NEW YORK
CONFIRMATORY GROUNDWATER SAMPLES FROM THE DRIVE POINT GROUNDWATER SAMPLING PROGRAM
AUGUST 16 - 24, 1993

PARAMETERS, ug/l	DRIVE POINT LOCATIONS														
	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
	TB	DP-1 48'-50'	FB	DP-5 50'-52'	FB	TB	DP-8 80'-82'	FB	DP-10 34'-36'	FB	TB	DP-12 64'-66'	DP-12 64'-66'	FB	DP-13 80'-83'
Acetone	ND	ND	ND	ND	ND	ND	22J	ND	ND	3BJ	ND	ND	ND	0.5BJ	ND
Methylene Chloride	2BJ	ND	3BJ	ND	1BJ	4BJ	ND	4BJ	ND	ND	5BJ	ND	ND	ND	ND
Carbon Disulfide	ND	ND	ND	ND	2	ND	ND	1	ND	ND	ND	ND	ND	ND	ND
1,1-dichloroethene	ND	ND	ND	3	ND	ND	4	ND	ND	ND	ND	12	ND	ND	7
1,1-dichloroethane	ND	ND	ND	13	ND	ND	3	ND	ND	ND	ND	15	ND	ND	6
1,2-dichloroethene	ND	ND	ND	2	ND	ND	ND	ND	ND	ND	ND	3	ND	ND	7
Trichloroethene	ND	ND	ND	8	ND	ND	6	ND	ND	ND	ND	36	ND	ND	22
Tetrachloroethene	ND	ND	ND	0.7J	ND	ND	ND	3	ND	ND	ND	4	ND	ND	20
1,1,1-Trichloroethane	ND	ND	ND	ND	ND	ND	13	ND	ND	ND	ND	37	ND	ND	23
Bromochloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.7J	ND	ND	ND	ND	ND
1,1,2-Trichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1	ND	ND
Toluene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.8J	ND	ND
Chlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1	ND	ND
Chloroform	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	56
Tentatively Identified Compounds	ND	ND	ND	100J	ND	ND	ND	R	ND	ND	ND	143J	ND	ND	5J
Dates	8/16	8/16	8/16	8/17	8/17	8/18	8/18	8/18	8/19	8/19	8/20	8/20	8/20	8/20	8/20

Notes:

J = Estimated Value
DUP = Duplicate Sample
ND = Analyte was not detected above the instrument detection limit
R = Rejected Value
B = Analyte present in blank sample
TB = Trip Blank
FB = Field Blank

2.9 Results of Groundwater Elevation Monitoring

2.9.1 Groundwater Elevation Data

Groundwater elevation data was generated for May 1993, February and April 1994 as part of the FFS field activities. Figures 2 - 10 and 2 - 11 depict lines of equal groundwater elevations (equipotential) within the Upper Glacial aquifer downgradient of the Circuitron Corporation Site for May 1993 and April 1994, respectively. As illustrated by these figures, the groundwater flow direction for the Circuitron Corporation Site and downgradient areas is south-southeast. Based upon this elevation data, the hydraulic gradient of the Upper Glacial aquifer was calculated as approximately 0.002 feet/feet to 0.003 feet/feet for May 1993 and April 1994, respectively.

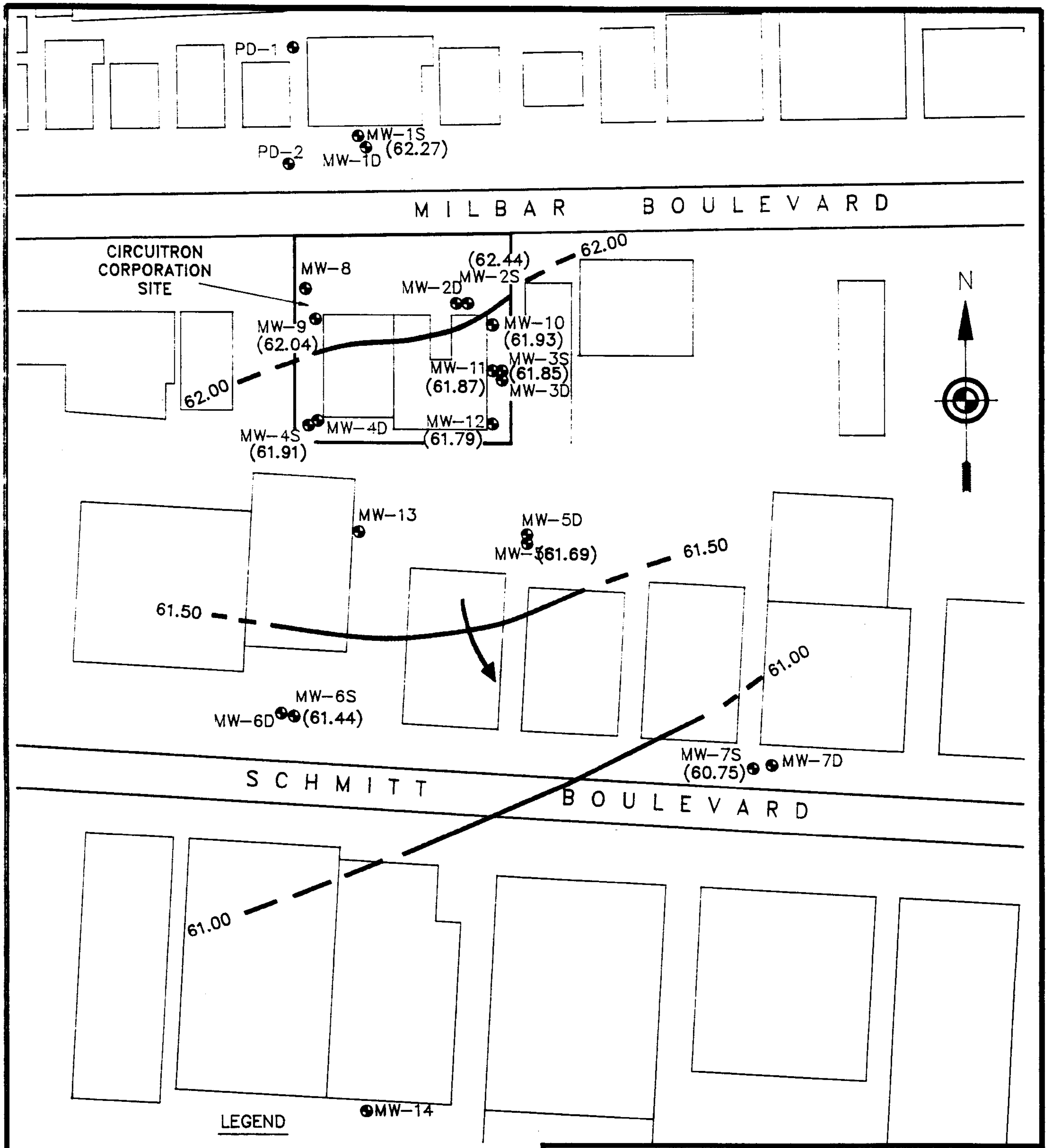
Figures 2-12 and 2-13 depict equipotential lines within the shallow Magothy aquifer for May 1993 and April 1994, respectively. Groundwater flow direction is also noted to be to the south-southeast, within this deeper aquifer. The hydraulic gradient within this aquifer for these measurement dates is approximately 0.0013 feet/feet and 0.0012 feet/feet for May 1993 and April 1994, respectively.

These values of hydraulic gradient measured and calculated during the FFS are consistent with the data generated during the 1989 RI and published literature values for these two aquifers.

Based upon those measured site-specific hydraulic gradient and average hydraulic conductivities discussed in Section 1.2.6, an estimation of groundwater flow velocities in both aquifers can be made. The general equation for groundwater velocity is presented below:

$$V = \frac{Ki}{n}$$

V = Groundwater velocity (ft/day)
K = hydraulic conductivity (ft/day)
i = hydraulic gradient (ft/ft)
n = effective porosity



LEGEND

GRAPHIC SCALE
75 0 75 150
(IN FEET)

CONTOUR INTERVAL IS 0.5 FEET

——►	DIRECTION OF GROUNDWATER FLOW
MW-6S ● (61.44)	UPPER GLACIAL AQUIFER MONITORING WELL DESIGNATION AND WATER LEVEL ELEVATION, IN FT. ABOVE M.S.L.
61.00 ━━━	EQUIPOTENTIAL LINE (DASHED WHERE INFERRED)

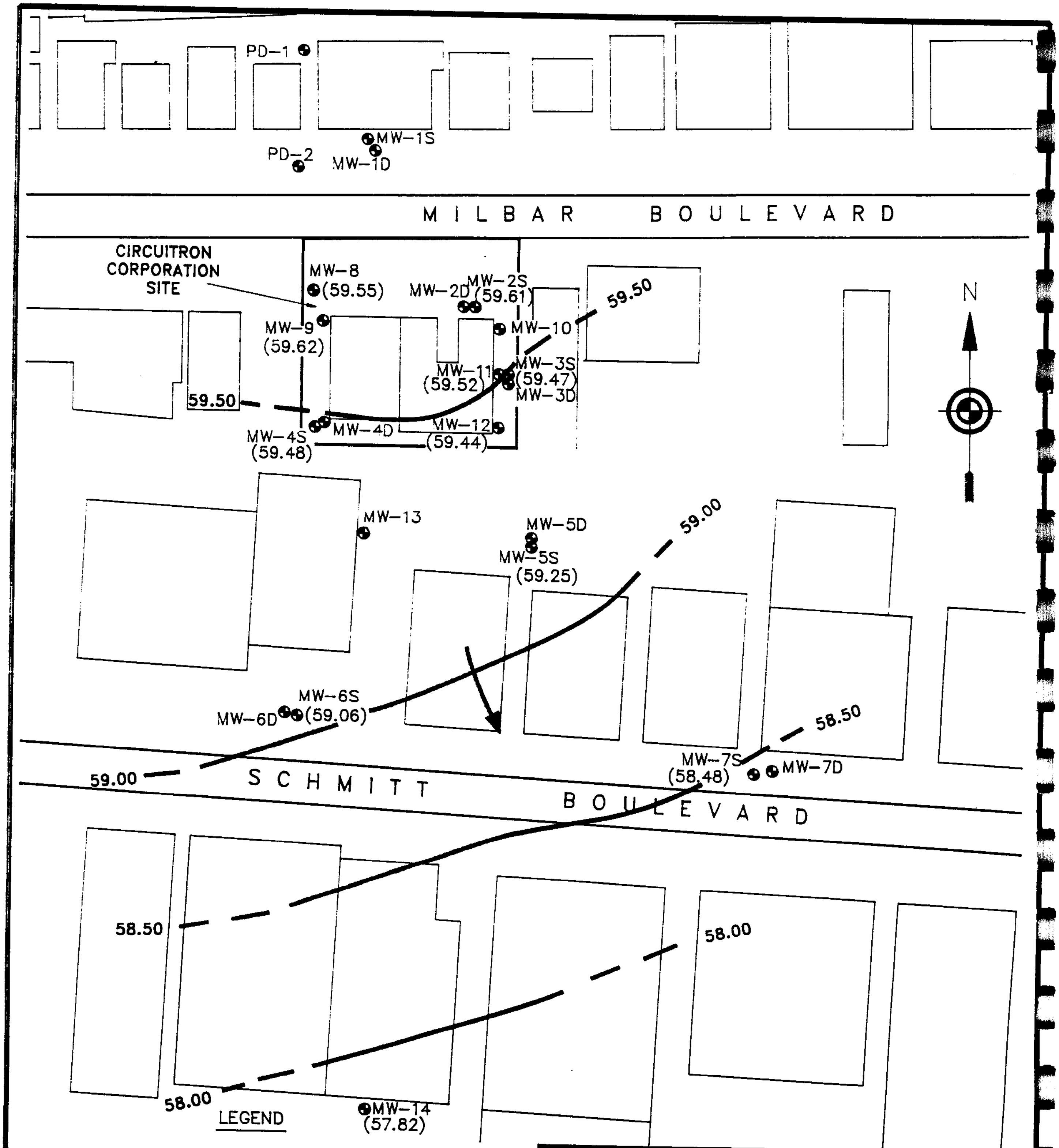
REVISION #: 001 DATE: 5/10/94 PLOT NAME:
FILE NAME: BASE.DWG DRAWN BY: B.MAC

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
CIRCUITRON CORPORATION SITE
EAST FARMINGDALE FOCUSED FEASIBILITY STUDY NEW YORK

WESTON

FIGURE2-10
UPPER GLACIAL AQUIFER GROUNDWATER
ELEVATION CONTOUR MAP
MAY 1993

B. MAC	5/10/94	1	0000
1"= 150'	04200-015-021	1	1



LEGEND

GRAPHIC SCALE

75 0 75 150

(IN FEET)

CONTOUR INTERVAL IS 0.5 FEET

DIRECTION OF GROUNDWATER FLOW

MW-6S (59.06) MAGOTHY AQUIFER MONITORING WELL DESIGNATION AND WATER LEVEL ELEVATION, IN FT. ABOVE M.S.L.

58.00 EQUIPOTENTIAL LINE (DASHED WHERE INFERRED)

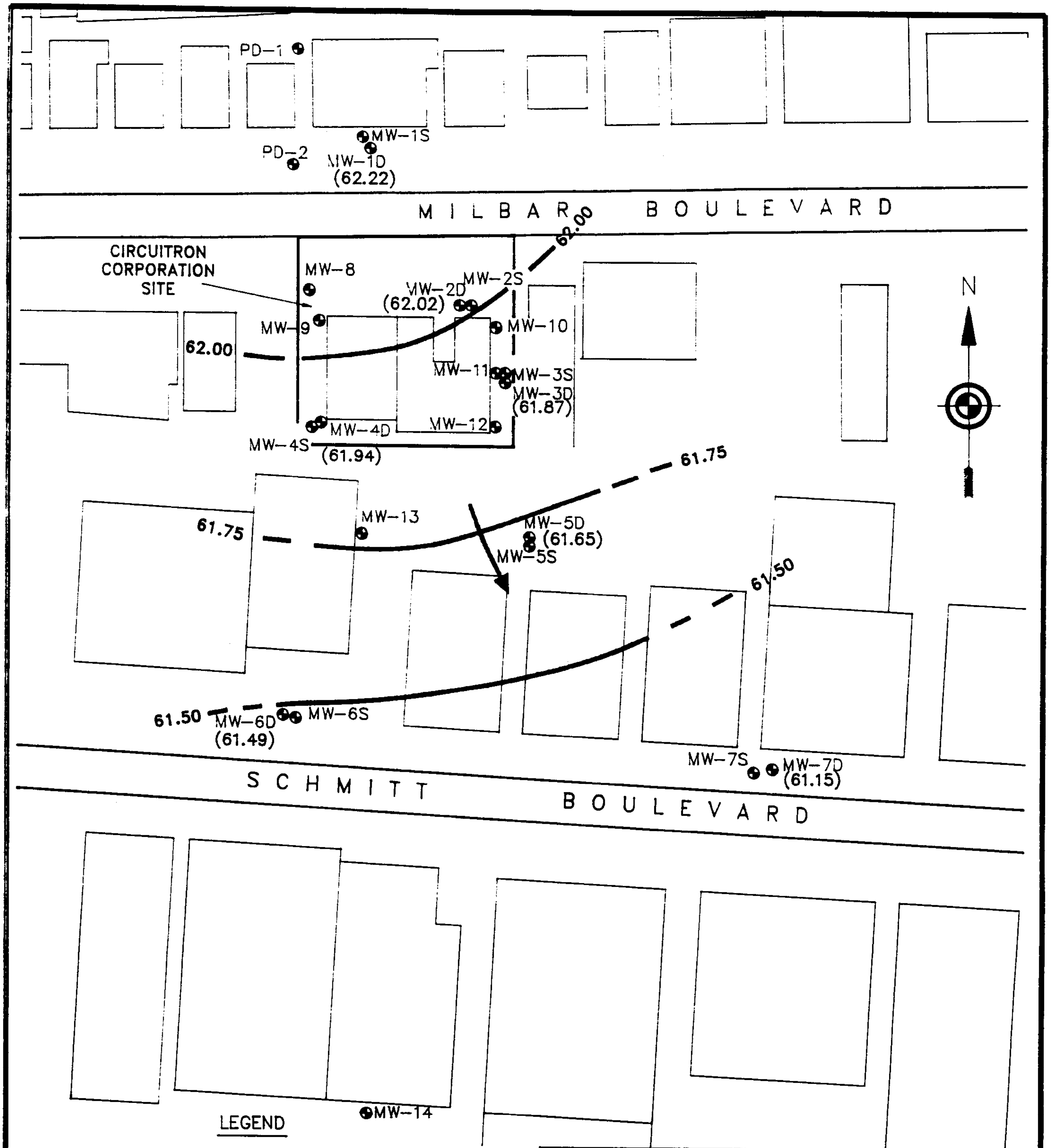
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
CIRCUITRON CORPORATION SITE
EAST FARMINGDALE FOCUSED FEASIBILITY STUDY NEW YORK

WESTON

FIGURE 2-11
UPPER GLACIAL AQUIFER GROUNDWATER ELEVATION CONTOUR MAP
APRIL 1994

B. MAC	5/10/94	1	0000
1" = 150'	04200-015-021	1	1

REVISION #: 001 DATE: 5/10/94 PLOT NAME:
FILE NAME: BASE.DWG DRAWN BY: B.MAC



LEGEND

GRAPHIC SCALE

75 0 75 150

(IN FEET)

CONTOUR INTERVAL IS 0.25 FEET

⟶	DIRECTION OF GROUNDWATER FLOW
MW-6D ⊕ (61.49)	MAGOTHY AQUIFER MONITORING WELL DESIGNATION AND WATER LEVEL ELEVATION, IN FT. ABOVE M.S.L.
61.50 ━━	EQUIPOTENTIAL LINE (DASHED WHERE INFERRED)

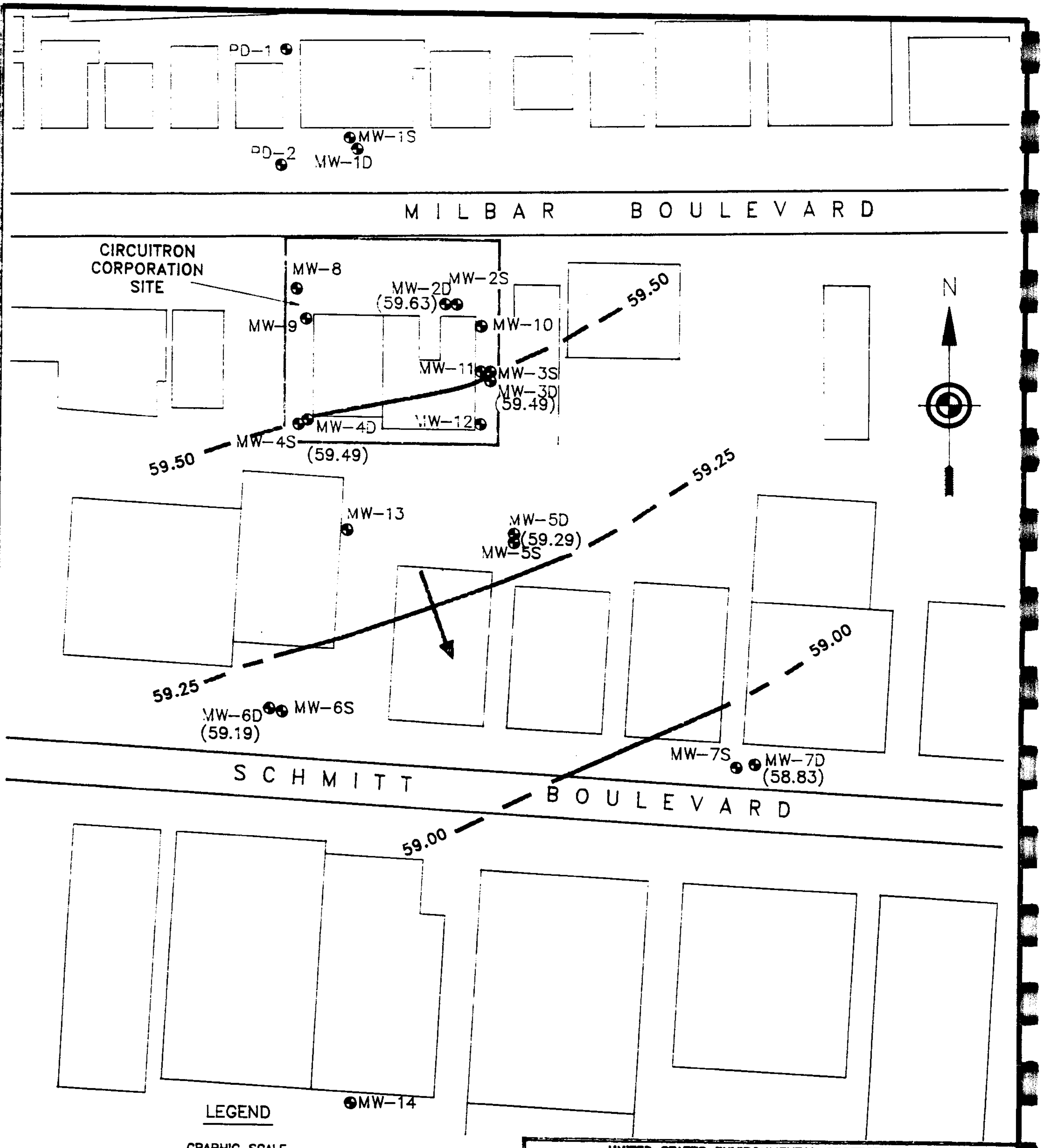
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
CIRCUITRON CORPORATION SITE
EAST FARMINGDALE FOCUSED FEASIBILITY STUDY NEW YORK

WESTON

FIGURE2-12
MAGOTHY AQUIFER GROUNDWATER
ELEVATION CONTOUR MAP
MAY 1993

B. MAC	5/10/94	1	0000
1"= 150'	04200-015-021	1	1

REVISION #: 001 DATE: 5/10/94 PLOT NAME:
FILE NAME: BASE.DWG DRAWN BY: B.MAC



LEGEND

GRAPHIC SCALE
75 0 75 150
(IN FEET)

CONTOUR INTERVAL IS 0.25 FEET

→ DIRECTION OF GROUNDWATER FLOW

MW-6D ● (61.19) MAGOTHY AQUIFER MONITORING WELL DESIGNATION AND WATER LEVEL ELEVATION, IN FT. ABOVE M.S.L.

59.00 ▬ EQUIPOTENTIAL LINE (DASHED WHERE INFERRED)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
CIRCUITRON CORPORATION SITE
EAST FARMINGDALE FOCUSED FEASIBILITY STUDY NEW YORK

WESTON

FIGURE2-13
MAGOTHY AQUIFER GROUNDWATER ELEVATION CONTOUR MAP
APRIL 1994

B. MAC	5/10/94	1	0000
1"= 150'	04200-015-021	1	1

REVISION #: 001 DATE: 5/10/94 PLOT NAME:
FILE NAME: BASE.DWG DRAWN BY: B.MAC

An average horizontal velocity of 1.84 feet/day for the Upper Glacial aquifer was calculated based upon an average hydraulic gradient of 0.0025 feet/feet and an average porosity and hydraulic conductivity of 0.30 and 221 feet/day, respectively. An average horizontal velocity of 0.25 feet/day for the Upper Magothy aquifer was calculated based upon an average hydraulic gradient of 0.0012 feet/feet and average physical characteristics for hydraulic conductivity (50 feet/day) and porosity (0.25).

The vertical hydraulic gradient between the two aquifers was calculated by comparing the measured groundwater elevation data at the shallow and deep wells of each couplet. In general, the elevation data indicated only small elevation change with depth. A predominantly higher elevation head was noted to be present in the Magothy aquifer, indicating a potential for upward flow into the Upper Glacial aquifer. A range in vertical hydraulic gradient of .0003 feet/feet to .0006 feet/feet was calculated.

2.9.2 Long Term Groundwater Elevation Monitoring

Groundwater levels were monitored continuously in monitor wells 2S and 2D for six days during March 15 - 21, 1994 to identify any effects caused by large capacity pumping wells in the vicinity of the Circuitron Corporation site. The water levels were measured with an In-Situ, Inc. Hermit 2000 Digital Datalogger and a 10 psi pressure transducer in each well. The datalogger and transducers were installed in the same manner as with the slug testing. Groundwater levels were measured at 10 minute intervals in monitor wells 2S and 2D during the six days to identify any effects caused by large capacity pumping wells in the vicinity of the site. Monitor well MW-2S is screened in the Upper Glacial aquifer and monitor well MW-2D is screened in the Magothy aquifer. The graph of groundwater elevation (feet) vs. time (minutes) included in Appendix A for MW-2S shows a very small gradual increase in the elevation of approximately .07 feet over the six day measuring period. The graph of groundwater elevation versus time for MW-2D showed a small gradual increase in the elevation of approximately 0.15 feet over the six day monitoring period. No significant short term changes in the groundwater elevations were recorded in either of the wells monitored.

The results of the long term water level monitoring for both the Upper Glacial and the Magothy aquifers at the Circuitron Corporation site illustrate that there are currently no large capacity pumping well(s) in the vicinity of the site, which may be locally influencing groundwater flow direction or contaminant plume migration. The small gradual rise in the water level elevations may be due to a combination of barometric, temperature, or precipitation changes.

2.10 Results of Hydrogeologic Slug Testing

On March 14, 1994, in-situ permeability tests or "slug tests" were conducted at four (4) monitor well locations to allow an estimation of the hydraulic conductivity of the Upper Glacial aquifer. All four of the monitor wells tested were screened across or directly below the groundwater table within the Upper Glacial aquifer.

The "slugs" consisted of solid cylinders of PVC which were 5 feet long by 2.5 inches in diameter, suspended on stainless steel or teflon-coated stainless steel cable. The cable was attached to the slugs with stainless steel fittings. Before the start of each test, static water levels were measured with an electronic water level indicator. Water levels were measured during the test with an In-Situ Inc., Hermit 2000 Digital Datalogger equipped with a 10 psi downhole pressure transducer. Since the water levels were expected to change quickly during the beginning of the test, the datalogger was programmed to record the early test data more frequently that the later test data.

The water level recovery in the wells were measured and recorded at the intervals shown below on Table 2-16.

Initially, "falling head" tests were performed by lowering the slug into the water column, thereby raising the water level, and then monitoring the water level drop to the original static level. "Rising head" tests were subsequently performed by removing the slug from the water column, lowering the water level, and monitoring the water level rise to the original level. The water levels were monitored for several minutes after full recovery. For each of the tests the

TABLE 2-16

SLUG TEST DATA FOR MW-3S, MW-5S, MW-13 AND MW-14 CIRCUITRON CORPORATION SITE

March 14, 1994

Time Since Start of Test (seconds)	Time Interval Between Measurements (seconds)
0 - 20	0.5
20 - 60	1.0
60 - end of test	12

water levels were fully recovered in approximately 15 seconds or less. As a quality control check, the slug test procedure was repeated at the first well location (MW-14).

The field data were downloaded from the data logger onto a computer file at the end of the field effort. The slugs and downhole pressure transducers were decontaminated between each well by using the approved procedures.

The slug test method of analysis developed by Bouwer (1989) and Bouwer and Rice (1976) permits the measurement of saturated hydraulic conductivity (K) of aquifer materials with a single well using the following equation.

$$K = \frac{(r_c)^2 \ln (R_e/r_w)}{2L_e} \frac{1}{t} \ln (\frac{Y_o}{Y_t})$$

Where:

r_c = inside radius of the casing
R_e = effective radius over which y is dissipated
r_w = radial distance between the undisturbed aquifer and well center
L_e = length of screen
y = vertical distance between water level in well and equilibrium water table in aquifer
y_0 = y at time 0 of the test
y_t = y at time t of the test
t = time interval corresponding to y_t

The slug test analysis for the four wells at the Circuitron Corporation Site was performed with a spreadsheet program developed by WESTON to calculate and display the Bouwer and Rice method results. Since two of the four of the monitoring wells tested were screened partially in the unsaturated zone, only the "rising head" tests were analyzed. The analysis results are summarized in Table 2-17 and are included in Appendix A. The slug test procedure was repeated at MW-14. Each data set at MW-14 was analyzed as a quality control check. The hydraulic conductivity results of the two tests at MW-14 were within 5% of each other, illustrating the repeatability of the data.

The water transmitting properties of the Upper Glacial aquifer on Long Island have been extensively studied which allows a reliable estimation of aquifer characteristics in the study area. Regional values for these properties have been calculated using specific capacity data from many test and supply wells. Published references for the vicinity of the site, report the Upper Glacial aquifer average hydraulic conductivity to be 270 ft/day and the average saturated thickness to be 75 feet, and the average transmissivity of the aquifer calculated to be 150,000 gpd/ft (McClymonds and Franke, 1972).

The hydraulic conductivity of the Upper Glacial aquifer varies depending on the heterogeneity of the aquifer material. The coarse outwash deposits of the Upper Glacial aquifer have slightly lower hydraulic conductivity in the vertical direction due to anisotropy at a given location within the aquifer. The average value for the horizontal hydraulic conductivity as stated above is 27 ft/day and the average vertical hydraulic conductivity is 27/ft/day with a ratio of about 10:1 (Pluhowski and Kantrowitz, 1964).

The slug tests were performed during the FFS for four wells according to the procedures outlined above. The hydraulic conductivities or in-situ permeabilities calculated at the four wells (MW-3S, MW-5S, MW-13, and MW-14) ranged from 118 - 229 ft/day. Table 2-17 presents the results of the in-situ permeability testing. The results are within the range of values for the regional horizontal hydraulic conductivity of the Upper Glacial aquifer. The well specifications, graphical plots, and calculation results are presented in Appendix A.

TABLE 2-17

SLUG TEST RESULTS FOR MW-3S, MW-5S, MW-13 AND MW-14 CIRCUITRON CORPORATION SITE

MARCH 14, 1994

Parameter \ Well	MW-3S	MW-5S	MW-13	MW-14	MW-14 (2)
Hydraulic Conductivity (ft/day)	137	118	217	217	229
Effective Radial Distance (ft)	2.3	2.1	2.8	2.8	2.8

2.11 Conclusions of Groundwater Sampling Programs

2.11.1 Conclusions

Only low level concentrations of volatile organics were noted in the shallow background upgradient groundwater samples. Elevated concentrations of the halogenated organics, specifically 1,1,1-trichloroethane were reported at the shallow "S" Circuitron Corporation Site wells (MW-4S) and shallow wells (MW-13 and MW-14) located directly downgradient of potential source areas on the property. This data indicated a direct relationship between site-related discharges of volatile organic compounds and their movement in the shallow Upper Glacial aquifer, downgradient to the south-southeast of the site. On this basis, the FFS was focused on the upper 40 feet of saturated aquifer that is clearly impacted by continuing discharges of volatile organic compounds from the Circuitron Corporation Site. Although significantly elevated above the New York State Drinking Water standards, the highest concentrations of volatile organics found at on-property wells are not of sufficient concentration to be present in a pure product phase known as a Dense Phase Non-Aqueous Phase Liquid (DNAPL). On this basis, no evidence exists that a DNAPL was released at the Circuitron Corporation Site.

The deeper monitoring wells ("D") also reported halogenated volatile organics present, showing an increase in volatile organic concentrations with depth, consistent with that reported during the drive point groundwater sampling program. The elevated volatile organics were reported in the "D" wells at the same relative concentrations at upgradient locations (MW-1D and drive point data) as the downgradient locations. The predominant groundwater flow pathway in the Upper Glacial aquifer is horizontal, therefore contamination would most likely flow along the existing horizontal pathway. This suggests an upgradient source of contamination contributing to regional groundwater contamination. This contaminant flow path is supported by the pattern of contamination for 1,1,1-trichloroethane which indicates a relatively clean zone underlying the most severely impacted zone in the shallow Upper Glacial aquifer. This indicates a low probability for vertical migration of these compounds to have occurred. A recent long term (6 days) groundwater elevation monitoring program did not show evidence of any nearby pumping wells inducing vertical migration.

The ratio of the primary volatile organic compounds reported (1,1,1-trichloroethane and trichloroethene) to associated daughter degradation products such as 1,1-dichloroethene and 1,1-dichloroethane, was significantly different in the shallow and intermediate zone within the Upper Glacial aquifer, than that noted in the deep Upper Glacial and shallow Magothy aquifer. The above information suggests that an additional source(s) of volatile organic contamination exists; that it emanates from an upgradient location(s); and that it has contributed to regional groundwater contamination. The volatile organic contamination increases with depth and based upon the limited vertical delineation provided under this FFS, concentrations may increase further with depth below 100 feet below grade.

The highest concentrations of site-related inorganic contamination (copper and chromium) were reported at MW-2S, MW-3S, MW-4S, MW-5S, MW-6S, MW-6D, MW-7S and MW-12. Elevated concentrations of iron and manganese were also reported upgradient as well as downgradient and are known to be elevated under naturally occurring conditions on Long Island.

SECTION 3

CONTAMINANT FATE AND TRANSPORT

This section discusses the fate and transport of contaminants emanating from the Circuitron Corporation Site. An understanding of the specific fate and transport processes at work at the Circuitron Corporation Site and the physical/chemical properties of the contaminants of concern is essential to evaluate contaminant migration, and the potential for exposure at concentrations that pose human health or environmental risks. Two of the most significant factors affecting the fate and transport of a specific contaminant is its mobility and persistence in the environment within the different media that it encounters.

The data used to develop contaminant fate and transport information for the contaminants of concern were compiled primarily from the U.S. EPA 1985 "Chemical, Physical and Biological Properties of Compounds Present at Hazardous Waste Sites", prepared by Clement Associates, and the Superfund Public Health Evaluation Manual, EPA 540/1-86/060, Office of Emergency and Remedial Response, October 1986, and other sources listed in Section 8.0, References.

3.1 Site Characteristics Affecting Contaminant Fate and Transport

3.1.1 Subsurface and Hydrogeologic Conditions

Subsurface characteristics and site specific hydrogeologic conditions were identified through field work and literature review. Data acquired by Ebasco during the 1989 Remedial Investigation was supplemented with additional data acquired by WESTON during their 1993 and 1994 investigative activities.

During the remedial investigation performed by Ebasco, test borings, monitoring well installation and groundwater sampling were performed. During this investigation, Ebasco also performed a literature review to identify characteristics of the aquifers beneath the site, and to correlate site specific geologic and hydrogeologic conditions into the regional framework.

WESTON supplemented the data compiled by Ebasco through monitoring well installation, groundwater sampling and drive point groundwater sampling during their 1993 and 1994 investigative activities. WESTON's activities focused on identifying the nature and extent of groundwater contamination attributed to previous site activities.

The following is a summary of the significant findings of Ebasco's Remedial Investigation and WESTON's investigative tasks. A more in depth presentation of Ebasco's findings are presented in the Final Remedial Investigation Report - Circuitron Corporation Site (Ebasco, 1990). The groundwater drive point sampling and groundwater sampling activities performed by WESTON are presented in greater detail in Section 2.0.

As discussed in the site background, the Circuitron Corporation Site is located in Suffolk County, New York upon a sequence of unconsolidated deposits ranging in thickness of up to 2,000 feet. Geologic units investigated within the study area correlate regionally to Glacial Deposits of the Upper Pleistocene Epoch and the Magothy Formation of the Cretaceous Period.

The surficial geologic unit beneath the site, which is the Upper Glacial deposits, consist of predominantly tan, moderately to poorly sorted sand with an appreciable amount of gravel. This unit is present from ground surface to approximately 70 to 80 below grade. The poorly graded sand unit underlying the glacial deposits is the Magothy Formation. This unit is similar in composition to the glacial deposits, but is distinguished from the overlying glacial deposits by differences in grain size distribution and sorting.

Groundwater is present at approximately 30 feet below grade in regionally extensive aquifers, known as the Upper Glacial Aquifer and the Magothy Aquifer.

During WESTON's investigatory activities, the Upper Glacial Aquifer was divided into three separate zones for sampling purposes: the shallow zone (34 to 36 feet below grade), medium zone (48 to 52 feet below grade), and the deep zone (62 to 68 feet below grade). WESTON established these zones to identify the vertical distribution of chemical constituents (specifically halogenated volatile organic compounds) within this aquifer.

Synoptic rounds of groundwater level measurements were made during the 1989 Remedial Investigation and WESTON's 1993 and 1994 investigative studies. These field measurements were used in the construction of groundwater equipotential maps and to estimate groundwater flow direction and gradient. As a result of these measurements, groundwater flow beneath the site was determined to be principally horizontal with a horizontal groundwater flow gradient of approximately 0.002 ft/ft to the south-southeast. Literature review provided estimates of hydraulic conductivity and transmissivity for each aquifer. In addition, WESTON performed slug tests at selected monitoring wells to provide a site-specific range for the hydraulic conductivity and transmissivity of the Upper Glacial Aquifer.

Groundwater is the primary source of water supply on Long Island. Within a 2-mile radius of the site, it is the sole source of water supply through the development of the Magothy and Upper Glacial Aquifers. There are 19 commercial and public water supply wells within a 3-mile radius of the site. Of these, all but two of the wells are screened in the Magothy aquifer.

3.1.2 Surface Water Drainage and Hydrology

No surface water bodies are in the immediate vicinity of the site. The nearest stream is approximately three miles to the south. As a result, surface water conditions have not been impacted by activities performed exclusively at the site and surface water bodies are not functioning as a mechanism of transport for chemical constituents emanating from the Circuitron Corporation Site.

3.2 Fate and Transport Processes

An evaluation of the fate and transport, or migration, of contamination emanating from the Circuitron Corporation Site is important in determining the potential for exposure to these contaminants. Migration of contaminants that have been previously or may continue to be released from the site is influenced by environmental factors such as the hydrogeological characteristics of the aquifer, site soil conditions, the characteristics of the contaminant source areas, and the physical/chemical characteristics of the contaminants themselves. Ultimately, the two major factors that affect the fate and transport of a contaminant are the contaminant's mobility and its persistence in the different environmental media.

Mobility is a measure of the tendency for a chemical compound to be transported in the environment and is predominantly affected by the physical and chemical characteristics of the media and the contaminant. Some defined characteristics are: solubility in water, volatilization, sorption, hydrolysis, photolysis, and oxidation potential. Persistence, or the amount of time a chemical will remain at measurable concentrations in the environment once introduced, is influenced by many of the same chemical and physical characteristics listed above. However, persistence is also a function of other processes in the environment such as biodegradation. Factors and processes that control the mobility and persistence of contaminants, in addition to the above factors, are the site physical characteristics such as the composition of site soils and aquifer properties and also include advection and hydrodynamic dispersion. Contaminants may exist in the gas phase, aqueous phase, or solid phase. The ultimate fate of these contaminants is controlled by a combination of the aforementioned factors.

The migration of contaminants is controlled by various transport and attenuation processes. Processes that tend to disperse contamination include surface water runoff and groundwater movement (which includes the movement of dissolved and suspended contaminants), facilitated transport, and leaching by dissolution or desorption from soils. Contaminants can be transported in the dissolved phase in one of two ways: advection or hydrodynamic dispersion. Advection involves transport of the contaminant with the flowing groundwater and migrating with the mean velocity of the solute (groundwater plus dissolved contaminant). Hydrodynamic dispersion has two components: molecular diffusion and mechanical dispersion. Molecular diffusion is the process by which ionic or molecular constituents move under the influence of concentration gradients. Dispersion is related to the varying pore fluid velocities and path lengths of the intergranular flow paths of the aquifer.

3.3 Physical and Chemical Properties that Influence Migration and Persistence

The physical and chemical properties of contaminants greatly influence their fate and migration in various media. The importance of these properties for the contaminant's fate and migration in the environment is discussed below.

- The water solubility of a substance is a critical property affecting environmental fate, and is a measure of the amount of the substance that will totally dissolve in water. Highly soluble chemicals readily dissolve in water, can rapidly leach from wastes and soils and are generally mobile. The solubilities of the contaminants of concern at the Circuitron Site range from 1.5×10^2 mg/L (tetrachloroethene) to 8.62×10^3 mg/L (1,2-dichloroethane). Highly soluble compounds remain in solution as compared to low solubility compounds which tend to adsorb to solids or form non-polar phases. The solubility of chemicals that are not readily soluble in water may become enhanced in the presence of organic solvents which themselves are more soluble in water.

- Volatilization is the physical process whereby a chemical goes from the surface of a liquid or solid to a gas or vapor phase. Volatilization of a compound depends on its vapor pressure, water solubility, and diffusion coefficient. Highly water soluble compounds generally have lower volatilization rates than water unless they also have high vapor pressures. Vapor pressure is a relative measure of the volatility of chemicals in their pure state. Volatilization from an aqueous solution can be predicted based upon the values of the compound's Henry's Law Constant, which is also a measure of chemical volatility. The Henry's Law Constant is particularly useful for estimating the release of the compounds from contaminated water.

- Adsorption and desorption are the physical processes whereby a chemical binds to and releases from (respectively) the surface of a solid matrix. Different materials will adsorb to varying degrees thus resulting in a distribution of the material in both the solid and aqueous phases. This partitioning is typically described using numerical partition coefficients.

The organic carbon partition coefficient, (K_{oc}), is a measurement of the sorption potential for organic materials, especially for aqueous pathways. This value relates to the tendency of organic chemicals to be adsorbed, which is also dependent upon soil particles. The normal range of K_{oc} is from 1 to 10^7 with the higher K_{oc} indicating greater sorption potential. For groundwater, low K_{oc} values indicate faster leaching from soils and relatively rapid transport through an aquifer (limited retardation of the chemical). High K_{oc} values in groundwater indicate a higher retardation of movement of that chemical. Site-related contaminant of concern K_{oc} values range from 14 l/kg (1,2-Dichloroethane) to 1,700 l/kg (1,4-Dichlorobenzene). A low K_{oc} in soil indicates that a compound may be released to groundwater in the future.

The soil-water partition coefficient (Kd) is the ratio of the chemical concentration in the solid and aqueous phases. The Kd values are constant for inorganic analytes but are dependent upon the organic carbon content of the solid phase for organic compounds in aqueous environments.

Although adsorption is generally modelled as a fully reversible process, there is evidence that there is a partially irreversible component related to the amount of time that the chemical has been adsorbed. It has been established that the less polar a chemical is, the greater the adsorption will be to the solid matrix. After adsorption, volatilization and other fate processes are limited.

The octanol-water partition coefficient (Kow) is a measure of the chemical concentration in octanol to that in water at equilibrium conditions. This is useful in predicting the fate of organic compounds in aqueous environments.

- Oxidation is a chemical reaction which involves the removal of electrons from a metal or other chemical. In reduction reactions, electrons are added to chemical substrates. Both oxidation and reduction reactions are significant in the mobility and fate of chemicals in different media. Oxidized and reduced forms of the same chemical in the environment may also exhibit unique chemical, ecological and/or toxicological properties.

- Photolysis is a chemical decomposition process caused by an energy source such as sunlight. The rate of chemical decomposition from photolysis depends on a compounds molecular structure, the proximity and nature of the light source and the presence of other reactant compounds.

- Hydrolysis is the reaction of a chemical with hydrogen ions (H+) and hydroxyl radicals (OH-) resulting in the degradation of the chemical in the environment. A chemical's hydrolytic reactivity depends on both the pH (acidity/alkalinity) of the environment and the molecular structure of the specific compound.

- Biotransformation/Biodegradation is a process whereby microorganisms and biota found in the environment can metabolically change contaminants to something that may not be as toxic as the original compound. Biotransformation includes a variety of enzyme-catalyzed reactions such as oxidation and reduction.

- Bioconcentration occurs due to the accumulation of a chemical plants or animals as a result of an environmental exposure. The potential for bioconcentration is described by a bioconcentration factor (BCF) which is the concentration ratio of the contaminant in the animal or plant tissue and the concentration in the environmental medium. Organic chemicals with large BCFs such as pesticides generally are lipophilic and will tend to accumulate in animal fat tissues. Some heavy metals such as mercury are known to be bioconcentrated. Literature BCF values most commonly pertain to fish species. The BCF is important in determining human intakes via the aquatic food ingestion route. Bioaccumulation is different in that it is the accumulation of a contaminant from both the water and through the food chain. Therefore utilizing BCFs alone tends to underestimate the potential contaminant concentrations in the organism if the food chain is also affected.

3.4 Fate and Transport Data

This section provides a summary of the chemical characteristics and the available environmental fate and transport data for the contaminants of concern detected in groundwater both on and off property at the Circuitron Site. The contaminants detected are generally grouped into two types: organic and inorganic compounds. The organic constituents consist of volatile organic compounds. A discussion of the major fate and transport characteristics of each type of contaminant of concern identified during WESTON investigation's is given below. A summary of the most important fate and transport data such as Henry's Law Constants and vapor pressures are given in Table 3-1 for specific volatile organic compounds.

3.4.1 Organic Contaminants in Groundwater

As discussed in the preceding sections, volatile organic compounds were detected in groundwater at the Circuitron Corporation Site and in adjoining areas. A discussion is given below identify the physical characteristics of volatile organic compounds in groundwater.

The following volatile organic compounds were detected in groundwater during the 1993 and 1994 Focused Feasibility Study and determined to be of significance because of their presence in concentrations above New York State standards or guidance values. These volatile organic compounds primarily include: 1,1-dichloroethane; 1,1-dichloroethene, 1,1,1-trichloroethane; trichloroethene; tetrachloroethene; and chloroform. Summary data for environmental fate and transport parameters for these materials are given in Table 3-1.

TABLE 3-1

CIRCUITRON CORPORATION SITE
PHYSICAL CHARACTERISTICS AFFECTING THE ENVIRONMENTAL FATE AND TRANSPORT OF SPECIFIC VOLATILE ORGANIC CONTAMINANTS

	Water Solubility[(1)] (mg/l)	Specific Gravity	Vapor Pressure[(1)] (mm/Hg)	Henry's Law Constant (atm-m^3/mol)	Volatility	K_{oc}[(1)] (l/kg)	Log K_{ow}[(1)]	Sorption[(3)]	Susceptible to Photolysis[(2)]	Susceptible to Hydrolysis[(2)]	Mobility
CHLORINATED VOLATILE ORGANIC COMPOUNDS											
Chlorobenzene	4.66×10^{2}	1.11	1.17×10^{1}	3.72×10^{-3}	High	330	2.84	M	Negligible	No	Moderate
1,2-Dichlorobenzene	1.00×10^{2}	1.31	1.00×10^{0}	1.93×10^{-3}	High	1,700	3.60	MS	Negligible	Negligible	Moderate
1,1-Dichloroethane	5.50×10^{3}	1.18	1.82×10^{2}	4.31×10^{-3}	Moderate	30	1.79	M	Negligible	Negligible	Moderate
1,2-Dichloroethane	8.52×10^{3}	1.25	6.40×10^{1}	9.78×10^{-4}	Moderate	14	1.48	M	Negligible	Negligible	Moderate
1,1-Dichloroethene	2.25×10^{3}	1.21	6.00×10^{2}	3.40×10^{-2}	High	65	1.85	M	Negligible	No	High
Trichloroethene	1.10×10^{3}	1.46	5.79×10^{1}	9.10×10^{-3}	Moderate	126	2.38	M	Negligible	No	Moderate
Tetrachloroethane	1.50×10^{2}	1.62	1.78×10^{1}	2.59×10^{-2}	High	364	2.66	MS	Negligible	Negligible	Moderate
1,1,1-Trichloroethane	1.50×10^{3}	1.44	1.23×10^{2}	1.44×10^{-2}	High	152	2.5	M	Negligible	Negligible	Moderate
1,2-Dichloroethene	2.25×10^{3}	1.27	6.0×10^{2}	3.40×10^{-2}	Moderate	65	1.84	M	Negligible	Negligible	Moderate
1,4-Dichlorobenzene	4.9×10^{1}	1.25	1.18×10^{0}	2.89×10^{-3}	High	1,700	3.60	MS	-	-	Low
Chloroform	8.00×10^{3}	1.49	1.60×10^{2}	--	--	--	1.97	--	--	--	High
Tetrachloroethene	1.50×10^{2}	1.63	1.46×10^{1}	--	--	--	2.88	--	--	--	High

Notes:

(1) - U.S. EPA, 1986; Reference 58
(2) - Clement Associates (1985), Reference 57
(3) -

Sorption Qualifiers

VW - Very weakly sorbed, W - Weak, M - Moderate, S - Strong, VS - Very strong

Solubility/Density

As summarized on Table 3-1, the elevated volatile organic compounds contaminants of concern at the Circuitron Corporation Site are primarily the chlorinated (halogenated) organics. They tend to be water soluble, ranging from 1.50 x 10^2 mg/1 (tetrachloroethene) to 8.00 x 10^3 mg/1 (chloroform). The high solubilities for these compounds are due to their small molecular size, low molecular weights and high polarity. Because of the soluble nature of these compounds in water, these compounds tend to leach out of soil and move into groundwater. Transportation of volatile organic compounds carried by groundwater as it moves is the predominant environmental transport and fate process for this category of material. In general, these volatile organic compounds have low to medium partition (sorption) coefficients, high mobility and densities greater than water (i.e. specific gravity > 1.0).

Volatilization

Volatile organic compounds readily migrate into the atmosphere from surficial soils and water when in contact with the atmosphere depending on such factors such as vapor pressure and temperature. For the volatile organic compounds of concern, vapor pressures (in mm mercury) range from 1.40 x 10^1 (tetrachloroethene) to 6.0 x 10^2 (1,1-dichloroethene) and Henry's Law Constants range from 1.44 x 10^{-2} m^3/mol for 1,1,1-trichloroethane to 9.78 x 10^{-4} m^3/mol for 1,2-Dichloroethane. Therefore, volatilization from the surface soils and shallow subsurface soils could be a major environmental fate process for volatile organic compounds present at the site However, site specifically, this fate process is of limited concern because of the presence of a almost site-wide covering of blacktop and buildings, and depth to water of approximately thirty feet.

Adsorption/Desorption

Adsorption/Desorption is not considered a significant fate/transport process for the most elevated site volatile organics as evidenced by values for K_{oc} ranging from 14 to 364 l/kg. This implies that volatile organics present in the site soils are leachable and have the potential to be a source of groundwater contamination.

Bioconcentration and Bioaccumulation

Volatile organics associated with site pose an insignificant bioconcentration or bioaccumulation hazard since there is no surface waterbodies within approximately three miles.

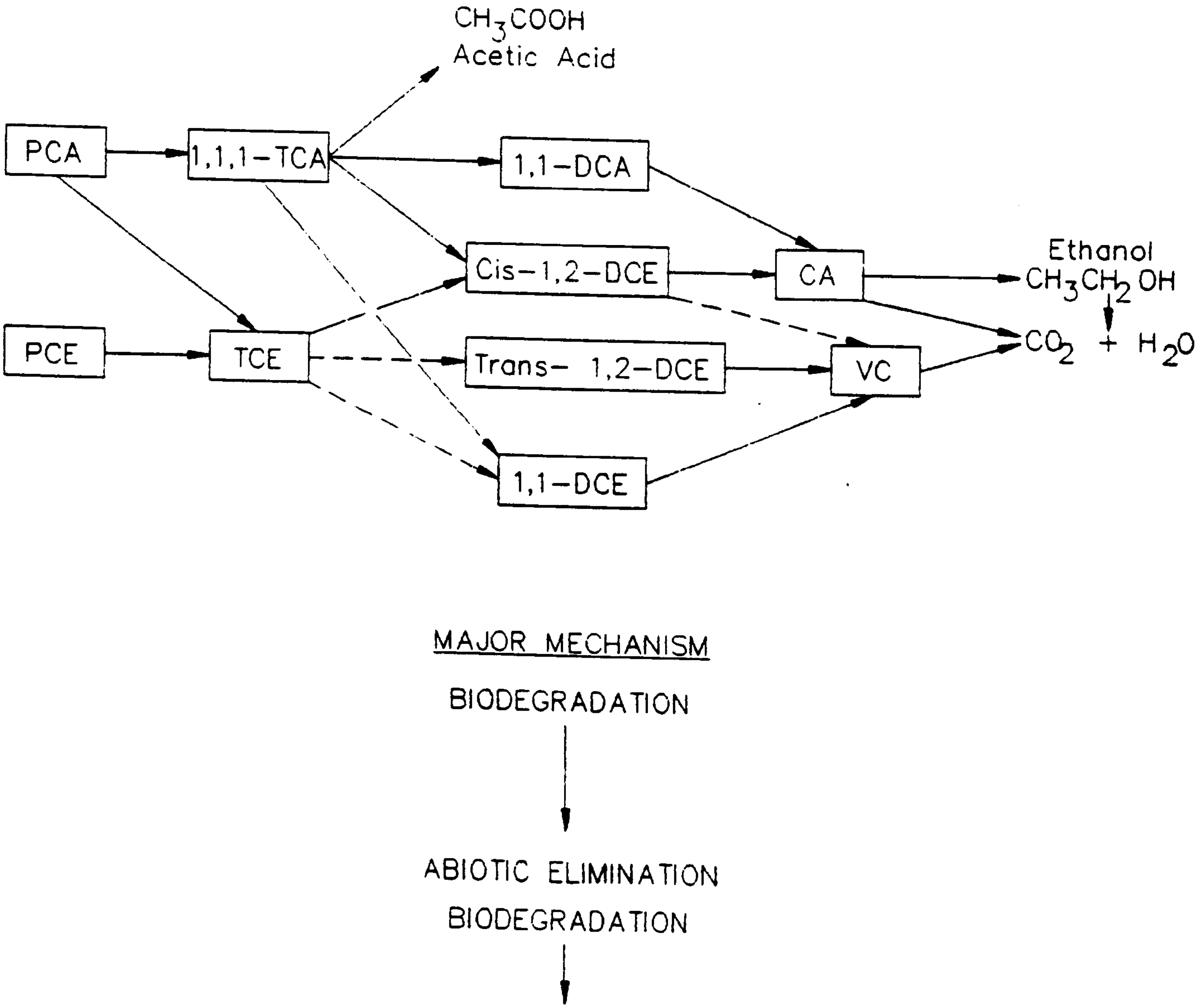
Biodegradation/Biotransformation

The body of research on the biodegradation/biotransformation of volatile organic compounds is not extensive. The biodegradation of volatile organic compounds is known to be a slow process (EPA, 1979) particularly for chlorinated materials. However, biodegradation generally occurs faster than abiotic degradation such as photolysis.

Progressive dechlorination of chlorinated volatile compounds under anaerobic conditions can be a significant transformation pathway. For example, 1,1,1-trichloroethane, which is the prevalent volatile organic compound of concern at the Circuitron Corporation site, can be dechlorinated to 1,1-dichloroethane as shown on Figure 3-1. Biodegradation of the non-chlorinated volatile organic compounds occurs via microbial processes or metabolic pathways of higher organisms under reduced conditions in the aquifer soils.

Hydrolysis/Photolysis

The chemical hydrolysis of chlorinated volatile compounds as shown on Table 3-2 occurs relatively quickly with half-lives ranging from approximately 0.5 to 1.0 year. The data shown on this table reveals that the chlorinated ethenes are hydrolyzed some what slower than the chlorinated ethanes. Photolytic degradation of volatile organic compounds is not a significant removal mechanism for these compounds unless they become airborne, and are not expected to oxidize in the atmosphere. Photolysis would not occur unless the volatile organic compounds discharge with groundwater into local streams.



FOOTNOTES

— — — MINOR PATHWAY

Cis-1,2-DCE GENERATED AT APPROXIMATELY 30 TIMES THE CONCENTRATION OF Trans-1,2-DCE AND BY A FACTOR OF 25:1

PCA = TETRACHLOROETHANE
1,1,1-TCA = 1,1,1-TRICHLOROETHANE
1,1 DCA = 1,1-DICHLOROETHANE
Cis-1,2-DCE = Cis-1,2-DICHLOROETHENE
CA = CHLOROETHANE
PCE = TETRACHLOROETHENE
TCE = TRICHLOROETHENE
Trans-1,2-DCE = Trans-1,2-DICHLOROETHENE
VC = VINYL CHLORIDE
1,1-DCE = 1,1-DICHLOROETHENE

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WESTON
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FIGURE 3-1
TRANSFORMATIONS OF
CHLORINATED ALIPHATIC HYDROCARBONS

REFERENCE: HAZARDOUS MATERIAL CONTROL, JULY/AUGUST 1990

TABLE 3-2

HALF-LIVES OF SELECTED ORGANICS IN SOILS AND GROUNDWATER[1.]

Compound	Hydrolysis or Dehalogenation Half-Life (months)	Biodegradation Half-Life (days)
1,2-dichloroethene (total)	-	>88 - 339
1,1-dichloroethane	-	>60
1,1,1-Trichloroethane	6	17 yr. → 1,1-DCE
1,1-Dichloroethene	12	81 - 173
Trichloroethene	10.7	33 - 230
Tetrachloroethene	8.8	34 - 230

Note:

1. Complete references available from the reference cited below.

Reference

Olsen, R.L. and Davis A., "Predicting the Fate and Transport of Organic Compounds in Groundwater", Parts 1 and 2, Hazardous Material Control, May/June 1990 and July/August 1990.

Oxidation

Direct oxidation of chlorinated and non-chlorinated volatile organic compounds is generally an insignificant fate process in water and soil environments. Volatile organic compounds detected in the groundwater are not expected to become airborne. This fate process is of limited concern at the Circuitron Corporation Site.

Summary

In general, volatile organic compounds are very leachable and mobile in the environment, principally due to their high volatility, low adsorption to soils and high water solubility. Due to the high mobility of volatile organic compounds, the concentrations will tend to decrease with time, as long as there are no ongoing continuing sources of organic contamination.

3.4.2 Inorganic Compounds in Groundwater

Several of the TAL metals were detected in groundwater samples collected from on-property and off-property wells adjoining the Circuitron Corporation site. Many of these inorganic compounds are naturally occurring in aqueous media because of leaching from soil. However, due to the previous environmental history of the Circuitron Corporation Site, several site-related inorganics were detected at concentrations in excess of guidance values. These site-related inorganics have been identified to primarily include chromium and copper, although not site-related, iron and manganese were also reported in elevated concentrations. An overview of the important characteristics affecting the environmental fate of the inorganic compounds detected in groundwater is presented in this section. This overview was compiled from U.S. EPA (1986) and Clement Associates (1985) and are presented below.

Solubility/Aqueous Chemical Speciation

As a group, the aqueous speciation of metals primarily depends upon the relative stability of individual valance states, oxygen content, pH and Eh conditions, and the presence of available complexing agents. The distribution of these species is commonly expressed on Eh-pH diagrams for the metal. In order to determine the potential for an inorganic to exist on-site in an aqueous dissolved form or an immobile form and the oxidation state of the element, a set of geochemical equilibrium equations needs to be developed for that element. However, a qualified assessment of the distribution of the inorganic species can be conducted by superimposing the site specific Eh and pH on an existing Eh-pH diagram if the conditions associated with the specific diagram are similar with the site conditions. Because there is a wide variation in aqueous speciation for different inorganics, inorganic-specific descriptions are provided after a description of the fate and transformation processes.

Volatilization

In general, the volatilization of the inorganic compounds of concern detected at the site does not occur with the exception of arsenic. Arsenic is capable of being biomethylated and the methylated derivatives of this metals can volatilize. While limited volatilization of arsenic can occur, volatilization of this compound is considered an insignificant environmental fate process because the elevated concentrations are found in groundwater in excess of thirty feet below ground.

Photolysis

In general, photolytic reactions do not occur for the majority of the site-related inorganic compounds quantified during the Focus Feasibility Study. Therefore, photolysis would be an insignificant environmental fate process.

Adsorption/Desorption

In general, inorganic compounds are known to readily adsorb to most mineral surfaces and organics. Adsorption for most metals is highly pH-dependent, with desorption being favored at low pH and adsorption dominating at higher pH conditions. In general, the underlying aquifer lithology consists of fine to coarse sands which possess low adsorptive capacity. It will be the presence of any clay and associated surface area in the environment that determines the extent of any adsorption.

Complexation

In the environment, the inorganic compounds of concern in groundwater associated with the Circuitron Corporation Site form numerous inorganic and organic complexes. In general, organo-metallic complexes are readily formed, especially with naturally occurring organic acids (e.g., humic and fulvic acids). Some of the inorganic compounds may also form metallo-inorganic complexes with other inorganic compounds present such as carbonates, chlorides, and sulfates. For inorganics such as arsenic, metallo-organic complex formation is usually favored over metallo-inorganic complexes. The complexation described above alters the solubilities of the inorganics in water. Due to this fact, complexation with various organic and inorganic liquids is a significant environmental fate process for the inorganics of concern at the Circuitron Corporation Site.

Precipitation/Coprecipitation

At the Circuitron Corporation Site, important removal mechanisms of dissolved aqueous inorganic species are precipitation and/or coprecipitation. Coprecipitation with hydrous iron, manganese, and/or aluminum oxides may occur for arsenic, copper, particularly under non-reducing conditions.

Cationic Exchange

All the inorganics compounds of concern are capable of undergoing isomorphic substitution with cations present in the soils. However, because the clay content of the aquifer underlying the site is low, cationic exchange represents a minor removal mechanism.

Biotransformation/Biodegradation

Biotransformation of arsenic can occur to a limited extent in the environment. The other inorganics are not susceptible to biotransformation mechanisms. This environmental fate process of biotransformation/biodegradation is of limited significant in groundwater.

3.4.2.1 Descriptions of Specific Inorganic Characteristics

Arsenic

It will typically be associated with the suspended particulate rather than be in a dissolved form, or complexed with dissolved organic compounds within the aqueous phase. Arsenic is generally mobile because it is associated with this particulate. The degree of mobility is related to its chemical form and properties of the surrounding media.

Copper

Most copper in aqueous solution is in a complexed form with organic and/or inorganic liquids and are expected to be the predominant dissolved aqueous species of copper in groundwater. Copper may also exist in water as the hydrated divalent cupric ion. Copper is one of the more mobile metals in the environment, with the formation of complexes, sorption and bioaccumulation comprising the major fate process.

Chromium

Chromium in natural waters occurs in a +3 and +6 oxidation (valence) state. Chromium occurs as a variety of aqueous species including both cationic [$Cr(+3)$, $Cr(OH)^{2+}$, $Cr(OH)_2^{+}$, and less commonly $Cr_2(OH)_2^{4+}$ and [$Cr_3(OH_4)^{5+}$] and anionic [$Cr(OH)_4$ and CrO_4^{2-} species]. Both pH and oxidation potential (Eh) affect the chromium species present in groundwater. Trivalent chromium (Cr^{+3}) is thermodynamically stable at moderate pH and Eh (pH 2 to 8, Eh-5 to +5). Hexavalent chromium (Cr^{+6}) is stable in more oxidizing environments ($Eh > 10$) in three principal anionic species ($HCrO_4^-$, CrO_4^{2-}, and less importantly $Cr_2O_7^{2-}$).

Iron

The behavior of iron, including its solubility, is dependent largely on the oxidation potential and the pH of the aquifer. Iron can form inorganic complexes with chloride, fluoride, sulfate, phosphate, and OH(-). Adsorption is significant on ferric oxyhydroxide compounds, which may impact the concentrations of other constituents.

Manganese

Manganese occurs most commonly as +2 and +4 oxidation states in aquatic systems. Its mobility depends primarily on pH, dissolved oxygen and whether complexing agents are present. The solubility of manganese is increased at low pH and under reducing conditions.

Summary

As detailed above, inorganics compounds of concern were identified in exceedance of standards in the groundwater. Their presence is related to mechanisms such as precipitation, cationic exchange and adsorption, which decrease mobility of a compound. Chemical speciation of inorganics in the environment can result in concentrations of inorganics in both soils and water media or limit the presence of the inorganic entirely to one media. However, the fate reactions and the behavior of these inorganics under the site geochemical conditions may lead to an increase and/or decrease in their relative concentration in any given media.

3.5 Conceptual Model

3.5.1 Potential Routes of Migration

Considering the distribution and concentrations of contaminants in the underlying groundwater, contaminants may migrate via several principal routes from the source areas identified during the 1990 RI at the Circuitron Corporation Site. These include: leaching of contaminants from the contaminated site soils by rainwater and transport into the underlying groundwater surface; and subsurface flow within the aquifer to downgradient areas. All of the Circuitron Corporation Site is occupied by buildings or is paved with asphalt. This limits additional contaminant transport migration routes including: surface water runoff; airborne transport via volatilization or entrained dust; direct contact; and downwards leaching of contaminants except where openings in the paved cover exist and contaminated soils are exposed to infiltrating rainwater. The potential routes of contaminant migration in the environment are discussed in more detail below and are summarized in Table 3-3.

TABLE 3-3

CIRCUITRON CORPORATION SITE
CHARACTERIZATION OF IDENTIFIED PATHWAYS OF MIGRATION FOR CONTAMINANTS OF CONCERN

Contaminant Group	Migration Pathway					
	Percolation into Groundwater	Migration within Groundwater	Direct Contact	Migration in Surface Water/Sediments	Site Surface Runoff	Atmospheric Transport
Volatile Organics	X	X	Insignificant	Insignificant	Insignificant	Insignificant
Metals	X	X	Insignificant	Insignificant	Insignificant	Insignificant

3.5.2 Percolation into Groundwater

As rainwater percolation through contaminated soil, it desorbs inorganic and organic constituents which can readily move to the groundwater underlying the site. The contaminants present in the soils at the Circuitron Corporation Site, principally 1,1,1-trichloroethane, clearly have migrated into the Upper Glacial aquifer underlying the site as demonstrated by comparing site related soil contamination gathered during the 1990 RI, with those contaminants present in groundwater. In addition, these same contaminants have migrated into the underlying Magothy Aquifer as well, although the source of these contaminants are currently unknown. It should be noted that many of the same of the contaminants were detected in upgradient background wells or drive point locations at elevated concentrations, in both the Upper Glacial and shallow Magothy aquifers.

The leachability of a compound from soils is determined by the characteristics of the soil (cation exchange capacity and total organic carbon content) and the characteristics of the compound including its solubility, for inorganics and organics, and the organic carbon partition coefficient (K_{oc}) for organics only. The contaminants of concern all have properties which favor their migration into groundwater as discussed previously.

3.5.3 Migration in Groundwater

<u>Contaminant Migration Velocities</u>

Compounds which reach the groundwater system are transported with the groundwater in the prevailing flow direction which is to the south-southeast from the Circuitron Corporation Site. In general, most compounds are transported at a rate slower than groundwater due to the effect of partitioning of the compounds between the mobile aqueous phase and the stationary soil particles that are in contact with the groundwater. This partitioning process results in the retardation, or attenuation, of the rate of a compound's transport. As these contaminants move further downgradient with the Upper Glacial aquifer's groundwater, their concentrations will tend to decrease due to the physio/chemical processes described previously.

The movement of organic contaminants in groundwater can be estimated by utilizing literature values for K_{oc}, calculating the Kd and Rd (retardation factor) values, and then using the retardation factors to calculate the contaminant migration velocity. Predicted migration rates for selected organics are given on Table 3-4.

Compared to other organic compounds, the volatiles in Table 3-4 have relatively high solubilities in water and low K_{oc} values indicating a high mobility in groundwater with a low capacity for retardation. The Rd values were calculated using the following equation:

$Rd = 1 + Kd\,(p/n)$ where

Kd = Soil-water partition coefficient from
$Kd = K_{oc}f_{oc}$, where f_{oc} is the organic carbon fraction of the soil and equals 0.00058
p = Soil bulk density = 2.0 g/cm^3
n = Aquifer total porosity = 0.35

The values of f_{oc} and n are literature values for local Upper Glacial aquifer soils (Ebasco, Inc., August 1990). The soil bulk density, p, is also a literature estimate (Sowers, G.F., 1979). The contaminant migration velocity is then calculated from equation:

$Vc = V/Rd$, where

Vc = Retarded contaminant velocity
V = Average linear velocity of groundwater estimated to be about 1.84 ft/day.

TABLE 3-4

CIRCUITRON CORPORATION SITE

MIGRATION RATES FOR SELECTED VOLATILE ORGANICS FOUND IN GROUNDWATER

Compound	K_{oc} (l/kg)	Kd (l/kg)	Rd	Migration Velocity (ft/day)[1]
1,1-Dichloroethane	30	0.017	1.10	1.67
1,1-Dichloroethene	65	0.038	1.22	1.51
Trichloroethene	126	0.073	1.42	1.29
Tetrachloroethene	364	0.211	2.20	0.84
1,1,1-Trichloroethane	152	0.088	1.50	1.23

Notes:

(1) The calculated velocity of groundwater in the Upper Glacial aquifer is 1.84 ft/day.
(2) K_{oc} values from Table 3-1.

The contaminant migration rates for these five organics range from 0.84 ft/day for tetrachloroethene to 1.51 ft/day for 1,1-dichloroethene. All of the organics are retarded compared to the average groundwater flow velocities. The other organic compounds found in groundwater will migrate at significantly slower rates than these volatiles because of their much higher K_{oc} values.

Metals migration velocities cannot be evaluated using the same methods as organics because they do not have a strong affinity for the organic carbon present in the aquifer. The use of Kd and Rd values for inorganics is generally not reliable because metals mobility is complex and is controlled by a wide range of physical and chemical characteristics such as Eh and pH conditions, metal valence states, dissolved oxygen content, and precipitation reactions, as well as adsorption/desorption reactions.

The present volatile organic plume in the Upper Glacial aquifer does not exhibit any segmented characteristics but is rather a continuous plume from the site sources to the estimated leading edge.

3.5.4 Migration into Air

Contaminants that are found in unsaturated soils may either volatilize to the air directly or become suspended in the air on soil particles entrained in the atmosphere during dry, windy days or as a result of soil disturbance by ongoing site activities. Airborne transport at the Circuitron Corporation Site by direct volatilization for volatile organic compounds, and transport in particulate form for metals compounds detected in the site's soil is negligible due to the covering of the site by paving and buildings.

3.5.5 Surface Water Runoff from the Circuitron Corporation Site

This mechanism is of limited significance at the site because of the presence of blacktop. The blacktop serves as a "barrier" keeping surface water runoff, generated during rain events, from contact with chemically impacted soils. Leaching pool structures that contain contaminated soil will be sources of contamination should surface water runoff enter and percolate through these soils.

3.5.6 Migration of Groundwater Contaminants into Surface Water

No surface water bodies are in the immediate vicinity of the Circuitron Corporation Site. The nearest stream is approximately three miles to the south. As a result, surface water conditions have not been impacted by activities performed exclusively at the site and these surface water bodies are not functioning as a mechanism of transport for chemical constituents from the Circuitron site.

SECTION 4
RISK ASSESSMENT

4.1 INTRODUCTION

The Circuitron Corporation Site is currently on the U.S. Environmental Protection Agency's (EPA's) National Priority List (NPL). This human health risk assessment was prepared as part of the Focused Feasibility Study (FFS) for a Second Operable Unit (OU-2) which represents off-property groundwater.

In accordance with the National Oil and Hazardous Substances Contingency Plan (NCP), a baseline risk assessment should evaluate the potential human health and environmental impacts associated with a site under no-action alternative [i.e., in the absence of remedial (corrective) action]. For this risk assessment, the no-action alternative was assumed for both present and potential future uses of the site; the scope of the risk assessment includes an evaluation of both current and potential future human health risks associated with chemicals in on-property and off-property groundwater in the upper 40 feet of the saturated aquifer (i.e., up to a depth of 70 feet below the grade surface (bgs) in the Upper Glacial aquifer). The following subsections provide a description of the objectives and the technical components involved in the risk assessment process.

4.1.1 Objectives and Components of the Risk Assessment Process

4.1.1.1 Objectives

The purpose of this risk assessment is to evaluate the potential for adverse human health effects posed by the presence of chemical contaminants in groundwater (the upper 40 feet of the saturated aquifer) resulting from previous activities at the Circuitron Corporation Site. The primary objective of the human health risk assessment for the Circuitron Corporation Site is to characterize the potential human health risks to on-property and off-property residents (child and adult) based on current and potential future uses of groundwater in the upper 40 feet of the saturated aquifer.

The risk assessment primarily focuses on the evaluation of the reasonable maximum exposure (RME) scenario as recommended in the NCP (EPA, 1990a). However, the central tendency exposure (CTE) has also been evaluated for those receptors for which the total carcinogenic risk from all exposure routes and all chemicals combined was greater than 1 in 10,000 (1E-04), or for which the total noncarcinogenic hazard index was greater than 1. The CTE evaluation is presented in the uncertainty analysis subsection of the risk assessment (Subsection 4.6).

The technical direction for the performance of the risk assessment comes primarily from several documents, including the *Risk Assessment Guidance for Superfund (RAGS), Volume I - Human Health Evaluation Manual, Part A* (EPA, 1989a), *Human Health Evaluation Manual, Supplemental Guidance* (EPA, 1991a), and the *Exposure Factors Handbook* (EPA, 1989b). In addition to these primary guidances, other document reports and information were used in the development of this risk assessment and are provided in the references to the human health risk assessment. The following subsection defines the technical components of the risk assessment.

4.1.1.2 Components of the Risk Assessment

This risk assessment consists of four main components:

- Data evaluation and reduction
- Exposure assessment
- Toxicity assessment
- Risk characterization

These components, which are briefly described below, are addressed in Subsections 4.2 through 4.5 of this report. Every component of the risk assessment process involves numerous assumptions, each of which contributes to uncertainty in the ultimate estimate of risk. Consequently, in addition to the four principal components, an uncertainty analysis of the four components is presented in Subsection 4.6. The relationship of the components of the risk assessment process is illustrated in Figure 4-1.

Data Evaluation

The data used in this risk assessment were obtained from the May 1993 Round I groundwater sampling of existing Remedial Investigation (RI) monitoring wells and the August 1993 drive point groundwater sampling program at the Circuitron Corporation Site. Data from groundwater samples in the upper 40 feet of the saturated aquifer (i.e., up to a depth of 70 feet bgs in the Upper Glacial aquifer) were used in this assessment. Subsection 4.2 of this report reviews and summarizes the guidelines used for evaluation of the available sampling data. A screening of all the chemicals detected in groundwater is conducted to focus the effort of the risk assessment on the site-related chemicals which pose the greatest potential risk to human health. The screening process involves the development of summary statistics, comparison with background, and evaluation of inherent chemical toxicity. Section 2 of this document contains the tables presenting the analytical data used in conducting this risk assessment.

Exposure Assessment

Subsection 4.3 of this report presents the exposure assessment. The objective of the exposure assessment is to estimate the chemical doses received by potential human receptors. In this section, local land and water uses are characterized and the pathways through which chemicals may migrate from the site are identified. Based

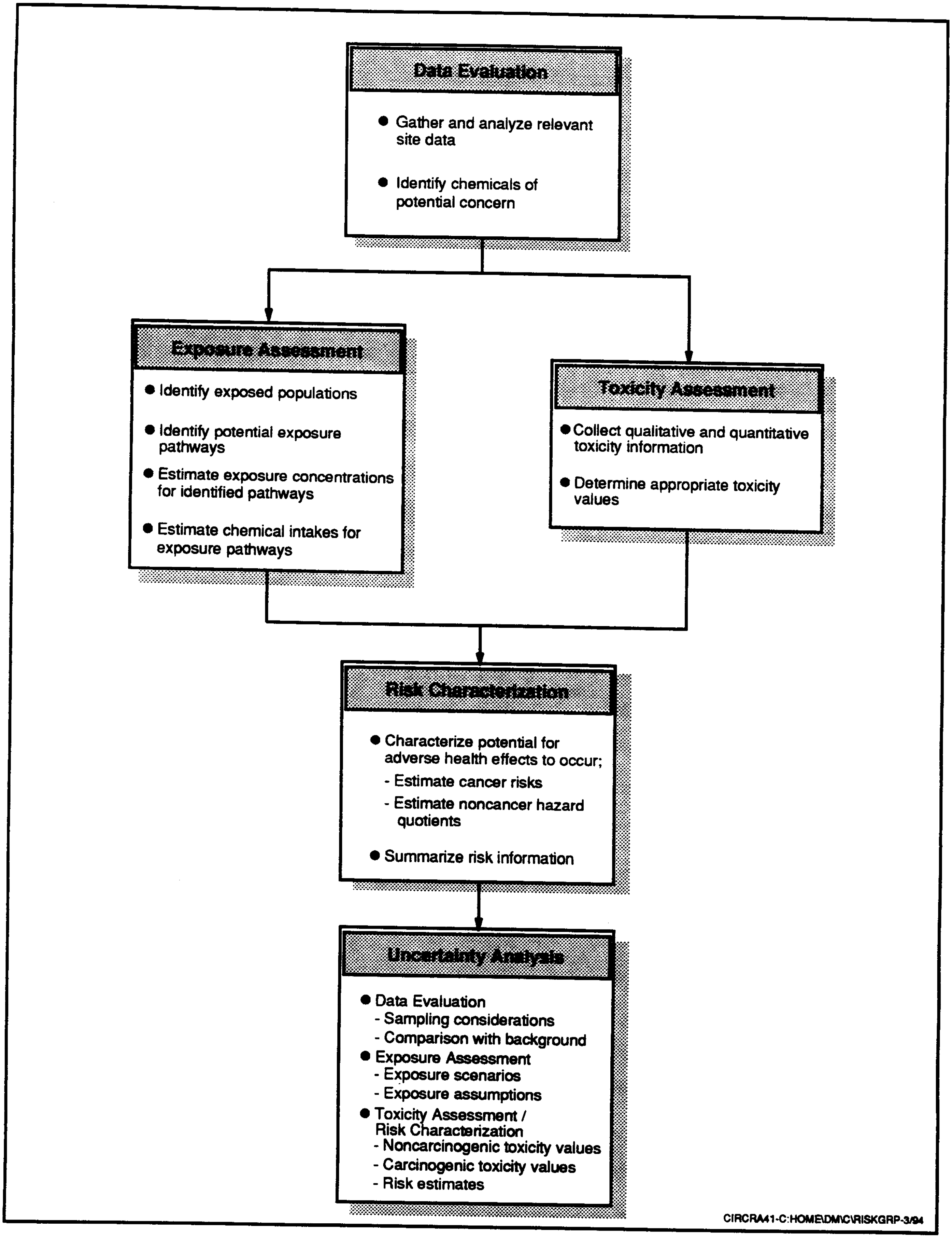


FIGURE 4-1 SCHEMATIC OF THE HUMAN HEALTH RISK ASSESSMENT PROCESS CIRCUITRON CORPORATION SITE

on this information, potentially exposed populations and potential exposure routes are discussed and exposure scenarios are developed. The exposure concentrations are determined for the chemicals of potential concern. The models used to calculate chemical doses and the exposure assumptions developed for all potential receptors through all potential exposure routes are presented. The doses calculated using these models are tabulated and summarized in tables.

Toxicity Assessment

Subsection 4.4 of this report presents the toxicity assessment. Applicable human toxicity values, namely reference doses (RfDs) and slope factors (SFs), are identified for the chemicals of potential concern for all relevant exposure routes. The reference doses were used to estimate noncarcinogenic risks, and the slope factors were used to estimate carcinogenic risks.

Risk Characterization

Subsection 4.5 of this report presents the risk characterization. In the risk characterization, the results of the exposure assessment and toxicity assessment are integrated to evaluate the potential carcinogenic and noncarcinogenic risks to humans. Based on the exposure doses calculated in the exposure assessment and the toxicity values identified in the toxicity assessment, potential risks are quantitatively evaluated for each chemical through each exposure route and for all chemicals through all exposure routes combined.

Uncertainty Analysis

Subsection 4.6 of this report presents an uncertainty analysis of this risk assessment. There is uncertainty associated with the components of the risk assessment process. The exposure models can produce varying results unless all standardized assumptions are used and the possible variation in other site-specific assumptions is clearly understood. Similarly, toxicological assumptions also introduce uncertainty to the risk assessment process (e.g., extrapolating from animal studies to humans). Uncertainty in a risk assessment may arise from many sources, including:

- environmental chemistry sampling and analysis;
- misidentification or failure to be all-inclusive in hazard identification;
- choice of models and input parameters in exposure assessment and fate and transport modeling;
- choice of models or evaluation of toxicological data in dose-response quantification; and
- assumptions concerning exposure scenarios and population distributions.

The variation of any factor used in the calculation of the exposure concentration will have an impact on the total carcinogenic and noncarcinogenic risk. The uncertainty analysis qualitatively discusses non-site and site-specific factors that may produce uncertainty in the human health risk assessment. These factors may include key exposure model assumptions, exposure factors, assumptions inherent in the development of toxicological end points, and spatio-temporal variance in sampling.

The following subsection on data evaluation describes the approaches used in evaluating the analytical data for the risk assessment. The procedures used to select the chemicals of potential concern for the risk assessment are outlined in this subsection.

4.2 DATA EVALUATION AND REDUCTION

4.2.1 Introduction

The objectives of the data evaluation and reduction are:

- To review and summarize the analytical data for groundwater sampled in the upper 40 feet of the saturated aquifer on-site and downgradient of the site.
- To select the chemicals of potential concern to be evaluated in the risk assessment.

The following subsections provide a description of the data used in the risk assessment and the guidelines used for data evaluation and selection of chemicals of potential concern.

4.2.2 Site-related and Background Data for Groundwater

In the selection of data to be included in the risk assessment, the objective was to characterize as accurately as possible the extent to which the groundwater on-property is contaminated and the potential migration of the contaminants to off-property groundwater. The data used in this risk assessment for groundwater are presented in Section 2 and are described in the following paragraphs.

A summary of the tasks, methods and procedures employed for the on-property and off-property groundwater sampling are presented in Section 2. The locations of the on-property and off-property groundwater monitoring wells and drive point sampling locations are presented in Figure 2-1 (Section 2). Analytical data were obtained from the May 1993 Round I groundwater sampling of existing Remedial Investigation

(RI) monitoring wells and the August 1993 drive point groundwater sampling program conducted at the Circuitron Corporation Site. Results reviewed for use in this risk assessment were from on-property and off-property groundwater samples in the upper 40 feet of the saturated aquifer (up to a depth of 70 feet bgs in the Upper Glacial aquifer).

The chemicals analyzed during the Round I groundwater sampling of existing RI monitoring wells include volatile organic compounds (VOCs) and inorganics. The data from the Round I groundwater sampling were validated. The chemicals analyzed during the drive point groundwater sampling program included only halogenated VOCs as targeted fingerprint contaminants as discussed in Section 2. The data from the drive point sampling program were not validated. The drive point sampling program was primarily a reconnaissance method to delineate the highest concentrations of downgradient site-related groundwater contamination, potentially targeted for remediation. During the drive point sampling program, 10 percent of the total samples were collected for confirmatory analysis using the Contract Laboratory Program (CLP) guidelines. A review of the validated confirmatory CLP groundwater data showed good correlation with the groundwater samples analyzed during the drive point groundwater sampling. Also, the nonvalidated data from the drive point groundwater sampling program were consistent with the validated data from the May 1993 Round I groundwater sampling. The data from the RI monitoring wells and the drive point sampling locations were combined for use in this risk assessment.

All residents in the vicinity of the Circuitron Corporation Site obtain potable water from public supply wells. For future use, it was assumed that groundwater on-property and off-property will potentially be used for household purposes (drinking, showering etc.). Therefore, data from the on-property and off-property monitoring wells were used to assess future use of groundwater. This is a conservative scenario considering that there are no current household uses of on- or off-property groundwater.

Data from drive point groundwater sampling locations and monitoring wells in the on-property areas and downgradient off-property areas were used as site-related data. Upgradient well MW-1S and upgradient drive point sampling locations DP-1 through DP-4 were used as background locations for comparison purposes to screen the groundwater data.

4.2.3 Guidelines for Data Evaluation and Reduction

The following guidelines for data evaluation were used to produce the data summaries for groundwater.

- If a chemical was not positively identified in any sample, because it was reported as a nondetect ("U" value) or because of blank contamination, it was not addressed in the data summary tables (EPA, 1989a, 1990b).

- "J" values are estimated concentrations reported below the minimum confidence quantitation limit for a chemical. Data with J qualifiers were assumed to be positive identifications (EPA, 1989a, 1990b).

- If a chemical was reported as a non-detect in a sample, it was assumed to be present at one-half of the sample quantitation limit for that sample in the calculation of the mean of the background data and the upper 95 percent confidence limit concentrations (EPA, 1989a, 1990b).

- Duplicate samples from the same sampling round were considered as one data point in calculating the frequency of detection, mean, and upper 95 percent confidence limit concentrations. The values reported for the duplicate samples were averaged, and the average concentration was assumed as the concentration for that sampling round. However, the range of detected concentrations (minimum and maximum detected concentrations) was reported considering individual duplicate samples.

- The results for groundwater samples from multiple depths at a single drive point or monitoring well location were averaged to get an average concentration for that individual location. These averaged concentrations obtained at individual locations were used to calculate the frequency of detection and the exposure point concentrations.

- Only total chromium data were available from sampling results for groundwater. In the absence of speciation data for chromium III and chromium VI, a 6:1 ratio of chromium III:chromium VI was assumed based on discussion with EPA Region II on another project (Baseline Risk Assessment for the Liberty Industrial Finishing site). The total chromium results were split into 86% of trivalent chromium and 14% of hexavalent chromium in this risk assessment.

- The arithmetic mean was calculated for the background data to get a central tendency estimate of the background data. It was used to compare the background data with the site-related data.

Preliminary data summaries containing "positively identified" chemicals were prepared for groundwater using the above guidelines and the data summaries are presented in Table 4-1. The preliminary summaries include the frequency of detection and the range of detected concentrations. In addition, background data are presented for the identified chemicals, if available. The information provided in the

Table 4–1
Chemicals Detected in Groundwater (On–Property and Off–Property Wells)
Circuitron Corporation Site

Chemical	Site–Related Data		Background Data [a]		Reason for Elimination as a Chemical of Potential Concern (if applicable)
	Frequency of Detection [b]	Range of Detected Concentrations (μg/L)	Range of Detected Concentrations (μg/L)	Mean Concentration [c] (μg/L)	
Organics					
Acetone	3/3	3 – 18	ND	ND	
2–Butanone	1/1	6	ND	ND	
Chlorobenzene	2/24	0.6 – 3	0.6 – 8	1.5	
Chloroethane	1/24	2	ND	ND	FOD
Chloroform	3/24	1 – 3	2 – 3	0.82	
1,1–Dichloroethane	16/24	0.5 – 42	0.8 – 4	1.2	
1,1–Dichloroethene	14/24	1 – 66	5 – 12	2.2	
cis–1,2–Dichloroethene	8/24	1 – 10	1	0.53	
Tetrachloroethene	14/24	0.7 – 21	3 – 4	0.98	
Toluene	1/11	0.7	ND	ND	
1,1,1–Trichloroethane	23/24	1 – 5,800	2 – 52	6.8	
1,1,2–Trichloroethane	1/24	3	ND	ND	
Trichloroethene	12/24	1 – 43	2 – 25	3.5	
Inorganics					
Aluminum	9/9	133 – 3,700	254	254	
Arsenic	4/11	2.6 – 81	7.5	7.5	
Barium	11/11	27 – 1,390	217	217	
Beryllium	2/11	0.36 – 0.51	ND	ND	
Calcium	10/10	16,600 – 39,700	80,700	80,700	BB
Chromium	7/11	6.3 – 597	19	19	
Cobalt	5/11	4.6 – 7.8	6.4	6.4	AB
Copper	10/10	4.2 – 14,600	39	39	
Iron	10/10	249 – 467,000	66,600	66,600	Low Toxicity
Lead	11/11	3.5 – 55	7.1	7.1	
Magnesium	11/11	3,020 – 5,470	5,920	5,920	BB
Manganese	10/10	108 – 1,790	806	806	
Nickel	7/10	7 – 72	7.5	7.5	
Potassium	11/11	2,500 – 7,120	13,900	13,900	BB
Silver	1/11	17 – 28	ND	ND	
Sodium	11/11	7,780 – 26,800	18,600	18,600	Low Toxicity
Vanadium	10/11	4.5 – 46	12	12	
Zinc	10/10	4.9 – 281	133	133	

AB = Eliminated based on concentrations slightly above background.
BB = Eliminated based on concentrations below background.
FOD = Eliminated based on a frequency of detection < 5%.
ND = Not detected.

[a] Upgradient sampling locations DP–1 through DP–4 and MW–1S were used as background.

[b] Number of sampling locations at which the chemical was detected compared with the total number of sampling locations.

[c] Arithmetic mean.

preliminary summary tables was used to select the chemicals of potential concern using the criteria listed in the following subsection.

4.2.4 Selection of Chemicals of Potential Concern

The objective of this screening step is to evaluate the preliminary data summaries and identify the chemicals of potential concern at the site. For example, although numerous chemicals may be detected in the groundwater samples, they may be unrelated to site activities (i.e., they may be naturally occurring at the levels observed), or they may be of little concern toxicologically (e.g., iron, magnesium, calcium, potassium and sodium).

The chemicals of potential concern were selected using the criteria listed below. A substance was eliminated as a chemical of potential concern for one or more of the following reasons:

- The substance was detected in less than 5% of the samples, and:
    - The substance was not reported at unusually high concentrations at any location.
    - The substance is not a carcinogen.
- The substance was not detected above background concentrations. Only naturally occurring inorganic substances were considered for elimination based on comparison with background data. If the maximum detected concentration at the site was lower than or comparable to the mean background concentration, then the contaminant was not considered a chemical of potential concern.

- Chemicals or essential nutrients such as calcium, iron, magnesium, potassium and sodium, which are of little concern toxicologically, were eliminated as chemicals of potential concern for the human health risk assessment.

The preliminary summary table (Table 4-1) identifies the chemicals eliminated from consideration as chemicals of potential concern for the risk assessment, along with the justification for the decision. The substances that were chosen as chemicals of potential concern in groundwater and the final data summaries for these chemicals are presented in Table 4-2. Table 4-2 includes the frequency of detection, the range of sample quantitation limits, and the range of detected concentrations for the chemicals of potential concern.

4.3 EXPOSURE ASSESSMENT

4.3.1 Introduction

Exposure assessment is the estimation of the magnitude, frequency, duration, and route of exposure. The objectives of the exposure assessment are:

- Characterization of the exposure setting.

- Identification of the actual or potential exposure pathways.

- Determination of the extent of exposure through the identified exposure pathways.

The key elements of the exposure assessment are:

- Definition of local land and water uses.
- Identification of the potentially exposed human populations.

Table 4-2
Chemicals of Potential Concern in Groundwater (On-Property and Off-Property Wells) Circuitron Corporation Site

Chemical	Frequency of Detection [a]	Range of Sample Quantitation Limits (µg/L)	Range of Detected Concentrations (µg/L)
Organics			
Acetone	3/3	10 [b]	3 – 18
2-Butanone	1/1	10 [b]	6
Chlorobenzene	2/24	1	0.6 – 3
Chloroform	3/24	1	1 – 3
1,1-Dichloroethane	16/24	1	0.5 – 42
1,1-Dichloroethene	14/24	1	1 – 66
cis-1,2-Dichloroethene	8/24	1	1 – 10
Tetrachloroethene	14/24	1	0.7 – 21
Toluene	1/11	1	0.7
1,1,1-Trichloroethane	23/24	1	1 – 5,800
1,1,2-Trichloroethane	1/24	1	3
Trichloroethene	12/24	1	1 – 43
Inorganics			
Aluminum	9/9	200 [b]	133 – 3,700
Arsenic	4/11	2.3	2.6 – 81
Barium	11/11	200 [b]	27 – 1,390
Beryllium	2/11	0.3 – 0.5	0.36 – 0.51
Chromium	7/11	5.8	6.3 – 597
Copper	10/10	25 [b]	4.2 – 14,600
Lead	11/11	3 [b]	3.5 – 55
Manganese	10/10	15 [b]	108 – 1,790
Nickel	7/10	6.1	7 – 72
Silver	1/11	3.3 –3.8	17 – 28
Vanadium	10/11	2.1	4.5 – 46
Zinc	10/10	20 [b]	4.9 – 281

[a] Number of sampling locations at which the chemical was detected compared with the total number of sampling locations.

[b] The contract required quantitation limit (CRQL) is indicated.

- Identification of exposure scenarios and exposure routes.
- Estimation of exposure point concentrations.
- Identification of the exposure models and assumptions.
- Estimation of doses.

The following narrative discusses each of the key elements in relation to the Circuitron Corporation Site.

4.3.2 Land and Water Uses

This step of the assessment includes a description of the current and potential future uses of the Circuitron Corporation Site and the land and water uses in the neighboring areas. The Circuitron Corporation Site is located in an industrial area surrounded by small manufacturers and is several miles away from any residential area. There are no schools or in the immediate vicinity. Currently, the Circuitron Corporation Site is covered by the former Circuitron Corporation building and the asphalt-covered parking lot. The building structure on the site is abandoned.

Approximately 15 municipal wells serving over 215,000 people are within 3 miles of the site, the nearest being approximately 1,500 feet to the southeast of the site in the direction of groundwater flow. There are two major water-bearing zones in the region: the Upper Glacial and the Magothy aquifers. The predominant direction of groundwater flow is to the southeast. The focus of this risk assessment and of the FFS is the contamination in the upper 40 feet of the saturated aquifer clearly attributable to the Circuitron Corporation Site.

4.3.3 Potentially Exposed Human Populations

This step of the assessment involves the definition of the activity patterns of potentially exposed populations and the selection of the current and future receptors under the reasonable maximum exposure (RME) scenario.

4.3.3.1 Current Receptors

Groundwater underlying the site in the Upper Glacial aquifer is not currently used for household purposes. The residents in the area are on public water supply from supply wells completed into the deeper Magothy aquifer. On this basis, no receptors were evaluated under current use conditions in this risk assessment.

4.3.3.2 Potential Future Receptors

Based on discussions with EPA Region II, it was assumed that the site and the neighboring areas will be developed for residential use in the future (EPA, 1994). A conservative assumption was made that groundwater from the upper 40 feet of the saturated aquifer will be used for household purposes in the future. Hence, a future resident (child and adult) was evaluated for exposure to on-property and off-property groundwater under the RME scenario.

The future resident (child and adult) was assumed to be exposed to groundwater on a daily basis, year-round. A year-round exposure frequency of 350 days/year was assumed (EPA, 1991a). The total exposure duration for the future resident under the RME scenario was assumed to be 30 years based on an estimate of the national upper 90th percentile of time spent at one residence (EPA, 1991a). This residential exposure was divided into two age groups: a 6-year duration was evaluated for young children including ages 1 through 6 and a 24-year exposure duration was evaluated for adults.

4.3.4 Identification of Exposure Routes

The potential exposure pathways, scenarios, and routes evaluated in this risk assessment are presented in Table 4-3. The following discussion briefly describes the exposure routes evaluated for the groundwater pathway.

Table 4-3
Potential Exposure Pathways/Routes
Circuitron Corporation Site

Exposure Pathway	Scenario	Receptor	Exposure Routes
Groundwater[a] On-property and off-property Wells			
	Current	None - Not used for household purposes	
	Future	Resident (1-6 yr old child and adult)	1. Ingestion 2. Noningestion uses (showering, washing etc.)

[a]Groundwater data from the upper 40 feet of the saturated aquifer was used.

Ingestion of water and noningestion uses of groundwater (showering, bathing, cooking etc.) are the two exposure routes evaluated under future residential use in this risk assessment. The mathematical models used to estimate intakes from these exposure routes and the exposure assumptions used in calculating the intakes for ingestion of groundwater and noningestion uses of groundwater are presented in Subsection 4.3.6.

4.3.5 Exposure Point Concentrations

Exposure point concentrations are the concentrations of chemicals that are contacted over the exposure period at the points of potential contact between a receptor and the chemicals. Data from sampling events conducted by WESTON as discussed in Subsection 4.2 were used to estimate exposure point concentrations for the chemicals of potential concern in groundwater.

In accordance with EPA guidance (EPA, 1992a) for estimating exposure point concentrations, the upper 95 percent confidence limit concentrations for chemicals of potential concern in groundwater were calculated using the log-transformed data sets. The upper 95 percent confidence limit concentrations based on log-transformed data are more conservative than those based on normally distributed data sets.

The following formula was used to determine the upper 95% confidence limit (UCL) based on the arithmetic mean of the log-transformed data (EPA, 1992a):

$$UCL = e^{\left(\bar{x}_i + 0.5\,S^2 + \frac{SH}{\sqrt{n-1}}\right)}$$

Where:

e = constant (natural log)
$\bar{x}_i$ = arithmetic mean of the log-transformed data for contaminant i

S = standard deviation of the log-transformed data

$$\left(S = \sqrt{\frac{\sum_{i=1}^{n} (x_i - \bar{x}_i)^2}{n-1}} \right)$$

H = statistic determined by the standard deviation and sample size
n = sample size for contaminant in the particular media set

The upper 95 percent confidence limit concentration based on the log-transformed data was used as the exposure point concentration for the reasonable maximum exposure scenario if it was lower than the maximum detected concentration for the chemical. In some instances, the calculated upper 95 percent confidence limit concentration can be higher than the maximum detected concentration for a chemical for one or more of the following reasons: high sample quantitation limits, limited number of samples, and large variation in the data set. If the calculated upper 95 percent confidence limit concentration exceeded the maximum detected concentration for a chemical, the maximum detected concentration was used as the exposure point concentration to estimate risks (EPA, 1992a). Table 4-4 presents the exposure point concentrations for the chemicals of potential concern in groundwater (on-property and off-property wells).

4.3.6 Identification of Exposure Models and Assumptions

This step of the assessment describes the mathematical models used to calculate intakes (i.e., the doses for each receptor through the applicable exposure routes). These models are presented in Tables 4-5 and 4-6. Each table defines the variables for the exposure route and includes the assumptions (i.e., exposure parameters) used in the model for the RME scenario and the central tendency exposure (CTE) scenario. The CTE exposure variables were used to evaluate average risks for a receptor. The discussion of the CTE evaluation and the corresponding results are presented in Subsection 4.6.

Table 4–4
Exposure Point Concentrations for Chemicals of Potential Concern in Groundwater (On–Property and Off–Property Wells) Circuitron Corporation Site

Chemical	Upper 95 Percent Confidence Limit Concentration (μg/L)	Maximum Detected Concentration (μg/L)	Exposure Point Concentration [a] (μg/L)
Organics			
Acetone	19,400	18	18
2–Butanone	NA	6	6
Chlorobenzene	0.58	3	0.58
Chloroform	0.67	3	0.67
1,1–Dichloroethane	11	42	11
1,1–Dichloroethene	5.8	66	5.8
cis–1,2–Dichloroethene	1.6	10	1.6
Tetrachloroethene	2.4	21	2.4
Toluene	0.56	0.7	0.56
1,1,1–Trichloroethane	181	5,800	181
1,1,2–Trichloroethane	0.67	3	0.67
Trichloroethene	9.7	43	9.7
Inorganics			
Aluminum	10,500	3,700	3,700
Arsenic	47	81	47
Barium	374	1,390	374
Beryllium	0.33	0.51	0.33
Chromium	1,565	597	597
Copper	54,300	14,600	14,600
Lead	31	55	31
Manganese	1,417	1,790	1,417
Nickel	47	72	47
Silver	5.9	28	5.9
Vanadium	17	46	17
Zinc	157	281	157

NA = Not applicable. An upper 95 percent confidence limit concentration cannot be calculated based on one sample.

[a] Represents the upper 95 percent confidence limit concentration if it is lower than the maximum detected concentration. If the upper 95 percent confidence limit concentration exceeds the maximum detected concentration, the exposure point concentration equals the maximum detected concentration.

Table 4-5
Model for Calculating Intakes from Ingestion of Groundwater
Circuitron Corporation Site

$$\text{Intake from Groundwater Ingestion (mg/kg-day)} = \frac{CW \times CF \times IR \times EF \times ED}{BW \times AT}$$

Where:

CW = Chemical concentration in groundwater (μg/L)
CF = Conversion factor (10^{-3} mg/μg)
IR = Ingestion rate (L/day)
EF = Exposure frequency (days/year)
ED = Exposure duration (years)
BW = Body weight (kg)
AT = Averaging time (days)

Exposure Assumptions for the Reasonable Maximum Exposure (RME) Scenario (Future Child and Adult Residents) and the Central Tendency Exposure (CTE) Scenario (5-13 Year Old Future Resident - Including Ages 5 Through 13):

CW = Upper 95% confidence limit concentration in groundwater.

IR = RME - 2 liters/day for the future adult resident (EPA, 1991a).
= RME - 1 liter/day for the future child resident (assumed to be one half of the adult ingestion rate).
= CTE - 1.2 liters/day for a 5-13 year old future resident (estimated).

EF = RME and CTE - 350 days/year for the future child, adult and 5-13 year old residents (EPA, 1991a).

ED = RME - 6 years for the future child resident (EPA, 1991a).
= RME - 24 years for the future adult resident (EPA, 1991a).
= CTE - 9 years for a 5-13 year old future resident based on the 50th percentile of time spent at a residence (EPA, 1989b).

BW = RME - 15 kg for the future child resident (EPA, 1991a).
= RME - 70 kg for the future adult resident (EPA, 1991a).
= CTE - 31 kg for a future 5-13 year old resident. It represents an average weight of a 5-13 year old male (EPA, 1989b).

AT = RME and CTE - Exposure duration (years) x 365 days/year for evaluating noncarcinogenic risk.
= RME and CTE - 70 years x 365 days/year for evaluating carcinogenic risk.

Table 4-6
Model for Calculating Intakes from Noningestion Uses of Groundwater
Circuitron Corporation Site

$$\text{Intake from Noningestion Groundwater Use (mg/kg-day)} = \frac{CW \times CF \times NIE \times EF \times ED}{BW \times AT}$$

Where:

CW = Chemical concentration in groundwater (μg/L)
CF = Conversion factor (10^{-3} mg/μg)
NIE = Noningestion exposure equivalent (L/day)
EF = Exposure frequency (days/year)
ED = Exposure duration (years)
BW = Body weight (kg)
AT = Averaging time (days)

Exposure Assumptions for the Reasonable Maximum Exposure (RME) Scenario (Future Child and Adult Residents) and the Central Tendency Exposure (CTE) Scenario (5-13 Year Old Future Resident - Including Ages 5 Through 13):

CW = Upper 95% confidence limit concentration in groundwater.

NIE = RME - 4 liters/day for the future adult resident (McKone and Knezovich, 1991).
= RME - 2 liters/day for the future child resident (assumed one half of the adult ingestion equivalent).
= CTE - 1.8 liters/day for a 5-13 year old future resident (estimated).

EF = RME and CTE - 350 days/year for the future child, adult and 5-13 year old residents (EPA, 1991a).

ED = RME - 6 years for the future child resident (EPA, 1991a).
= RME - 24 years for the future adult resident (EPA, 1991a).
= CTE - 9 years for a 5-13 year old future resident based on the 50th percentile of time spent at a residence (EPA, 1989b).

BW = RME - 15 kg for the future child resident (EPA, 1991a).
= RME - 70 kg for the future adult resident (EPA, 1991a).
= CTE - 31 kg for a future 5-13 year old resident. It represents an average weight of a 5-13 year old male (EPA, 1989b).

AT = RME and CTE - Exposure duration (years) x 365 days/year for evaluating noncarcinogenic risk.
= RME and CTE - 70 years x 365 days/year for evaluating carcinogenic risk.

Most of the exposure parameters that were used are standard values recommended by EPA (EPA, 1989a; EPA, 1991a). When available, site-specific exposure data were used. The following subsections discuss the key exposure assumptions for the RME scenario and the rationale behind these assumptions.

4.3.6.1 Ingestion of Groundwater

Ingestion of groundwater was considered a potential exposure route for the future child and adult residents. The equation and assumptions that were used to calculate doses from the ingestion of groundwater are presented in Table 4-5. Some of the key exposure assumptions for evaluating ingestion of groundwater are discussed in the following paragraph.

A drinking water ingestion rate of 2 L/day was used for the future adult resident (EPA, 1991a), representing the 90th percentile water ingestion rate for adults. A value of 1 L/day, half the drinking water ingestion rate for adults, was assumed to be the ingestion rate for a child resident.

4.3.6.2 Noningestion Uses of Groundwater

Noningestion uses of groundwater (e.g., showering, bathing, cooking) was also considered a potential exposure route for the child and the adult residents. The equation and assumptions that were used to calculate intakes through noningestion groundwater uses are presented in Table 4-6.

Currently, there is no validated method for quantifying the risk associated with the use of household water for noningestion purposes (EPA, 1989a). Therefore, it was assumed based on available literature, that exposure to volatile organics through inhalation in showers could be equivalent to an ingestion contact of 1 to 4 L/day for an adult (McKone and Knezovich, 1991). The upper end value of 4 liters/day was used to represent exposure through noningestion household water use by an adult resident. A drinking water equivalent of 2 L/day, half the adult ingestion equivalent, was assumed for noningestion household water use for the child resident.

Only volatile organic chemicals were evaluated through this exposure route. A volatile organic chemical was considered for this risk assessment as any organic compound for which Henry's Law Constant is greater than 10^{-5} atm-m^3/mole, and its molecular weight is less than 200 (EPA, 1991b). The Henry's Law Constants and the molecular weights of the organic chemicals of potential concern in groundwater are presented in Table 4-7.

4.3.7 Estimation of Doses

Two types of exposure doses or intakes were calculated. One type, which was averaged over the actual exposure duration (e.g., 6 years for child and 24 years for adult) is defined as the average daily dose (ADD). ADDs were used to evaluate the potential for noncarcinogenic health effects for the child and adult resident. The other type which was averaged over a 70-year lifetime is defined as the lifetime average daily dose (LADD). LADDs were combined for the child and adult resident under the RME scenario to evaluate the potential lifetime carcinogenic risk. The exposure doses were expressed as intakes in milligrams of contaminant per kilogram of body weight per day (mg/kg-day). The doses calculated for the groundwater pathway for the RME scenario are presented in Tables 4-8 through 4-10.

4.4 TOXICITY ASSESSMENT

4.4.1 Introduction

The purpose of the toxicity assessment is to identify slope factors and reference doses to evaluate the potential carcinogenic and noncarcinogenic health risks posed by the

Table 4–7
Henry's Law Constant and Molecular Weight for Organic Chemicals of Potential Concern in Groundwater
Circuitron Corporation Site

Chemical	Henry's Law Constant (atm–m^3/mole)	Molecular Weight (g/mole)	Evaluated By Inhalation Pathway [a]
Organics			
Acetone	4.28E–05 [b]	58.08 [c]	Yes
2–Butanone	4.66E–05 [b]	72.12 [c]	Yes
Chlorobenzene	3.58E–03 [d]	112.56 [c]	Yes
Chloroethane	1.48E–01 [d]	64.62 [c]	Yes
Chloroform	3.20E–03 [d]	119.38 [c]	Yes
1,1–Dichloroethane	4.26E–03 [d]	98.96 [c]	Yes
1,1–Dichloroethene	3.52E–01 [d]	96.94 [c]	Yes
cis–1,2–Dichloroethene	4.08E–03 [b]	96.94 [c]	Yes
Tetrachloroethene	1.50E–02 [d]	165.83 [c]	Yes
Toluene	6.60E–03 [d]	92.00 [c]	Yes
1,1,1–Trichloroethane	3.00E–02 [d]	133.40 [c]	Yes
1,1,2–Trichloroethane	7.42E–04 [d]	133.40 [c]	Yes
Trichloroethene	9.10E–03 [d]	131.38 [c]	Yes

[a] Chemical was evaluated by the inhalation pathway (noningestion uses of groundwater) if its Henry's law constant was greater than 1E–05 and molecular weight was less than 200 (EPA, 1991b).

[b] EPA, 1992b.

[c] Toxicological, Occupational Medicine and Environmental Series (TOMES) Database.

[d] EPA, 1987.

Table 4-8
Future Resident (child and adult combined) - RME
Estimated Daily Intakes Through All Exposure Routes
Over a Lifetime (70 years)
(Groundwater - On-Property and Off-Property Wells)
Based on Upper 95 Percent Confidence Limit Concentration

Chemical	Ingestion of Groundwater (mg/kg-day)	Noningestion Uses of Groundwater (mg/kg-day)
ORGANICS		
Chloroform	7.34E-06	1.47E-05
1,1-Dichloroethane	1.21E-04	2.41E-04
1,1-Dichloroethene	6.36E-05	1.27E-04
Tetrachloroethene	2.63E-05	5.26E-05
1,1,2-Trichloroethane	7.34E-06	1.47E-05
Trichloroethene	1.06E-04	2.13E-04
INORGANICS		
Arsenic	5.15E-04	NC
Beryllium	3.62E-06	NC
Lead	3.40E-04	NC

NC = Chemical is not of concern through this exposure route.

Table 4–9
Future Child Resident (1–6 yr old) – RME
Estimated Daily Intakes Through All Exposure Routes
Over a 6–Year Duration
(Groundwater – On–Property and Off–Property Wells)
Based on Upper 95 Percent Confidence Limit Concentration

Chemical	Ingestion of Groundwater (mg/kg–day)	Noningestion Uses of Groundwater (mg/kg–day)
ORGANICS		
Acetone	1.15E–03	2.30E–03
2–Butanone	3.84E–04	7.67E–04
Chlorobenzene	3.71E–05	7.42E–05
Chloroform	4.28E–05	8.57E–05
1,1–Dichloroethane	7.03E–04	1.41E–03
1,1–Dichloroethene	3.71E–04	7.42E–04
cis–1,2–Dichloroethene	1.02E–04	2.05E–04
Tetrachloroethene	1.53E–04	3.07E–04
Toluene	3.58E–05	7.16E–05
1,1,1–Trichloroethane	1.16E–02	2.31E–02
1,1,2–Trichloroethane	4.28E–05	8.57E–05
Trichloroethene	6.20E–04	1.24E–03
INORGANICS		
Aluminum	2.37E–01	NC
Arsenic	3.00E–03	NC
Barium	2.39E–02	NC
Beryllium	2.11E–05	NC
Chromium (III)	3.28E–02	NC
Chromium (VI)	5.37E–03	NC
Copper	9.33E–01	NC
Lead	1.98E–03	NC
Manganese	9.06E–02	NC
Nickel	3.00E–03	NC
Silver	3.77E–04	NC
Vanadium	1.09E–03	NC
Zinc	1.00E–02	NC

NC = Chemical is not of concern through this exposure route.

Table 4–10
Future Adult Resident – RME
Estimated Daily Intakes Through All Exposure Routes
Over a 24–Year Duration
(Groundwater – On–Property and Off–Property Wells)
Based on Upper 95 Percent Confidence Limit Concentration

Chemical	Ingestion of Groundwater (mg/kg–day)	Noningestion Uses of Groundwater (mg/kg–day)
ORGANICS		
Acetone	4.93E–04	9.86E–04
2–Butanone	1.64E–04	3.29E–04
Chlorobenzene	1.59E–05	3.18E–05
Chloroform	1.84E–05	3.67E–05
1,1–Dichloroethane	3.01E–04	6.03E–04
1,1–Dichloroethene	1.59E–04	3.18E–04
cis–1,2–Dichloroethene	4.38E–05	8.77E–05
Tetrachloroethene	6.58E–05	1.32E–04
Toluene	1.53E–05	3.07E–05
1,1,1–Trichloroethane	4.96E–03	9.92E–03
1,1,2–Trichloroethane	1.84E–05	3.67E–05
Trichloroethene	2.66E–04	5.32E–04
INORGANICS		
Aluminum	1.01E–01	NC
Arsenic	1.29E–03	NC
Barium	1.02E–02	NC
Beryllium	9.04E–06	NC
Chromium (III)	1.41E–02	NC
Chromium (VI)	2.30E–03	NC
Copper	4.00E–01	NC
Lead	8.49E–04	NC
Manganese	3.88E–02	NC
Nickel	1.29E–03	NC
Silver	1.62E–04	NC
Vanadium	4.66E–04	NC
Zinc	4.30E–03	NC

NC = Chemical is not of concern through this exposure route.

doses that were estimated in the Exposure Assessment (Subsection 4.3). In evaluating potential health risks, both carcinogenic and noncarcinogenic health effects must be considered. Excessive exposure to any chemical can potentially produce noncarcinogenic health effects, while the potential for carcinogenic effects is limited to exposure to chemicals that are known or suspected carcinogens. Subsequently, noncarcinogenic toxicity values (i.e., reference doses) are identified and selected for each of the chemicals selected for evaluation while carcinogenic toxicity values (i.e., slope factors) are identified and selected only for those chemicals that have evidence of carcinogenicity.

The toxicity values used in this risk assessment were obtained from three sources: *Integrated Risk Information System* (IRIS) (IRIS, 1994), *Health Effects Assessment Summary Tables* (HEAST) (EPA, 1993), and the Environmental Criteria and Assessment Office (ECAO) (ECAO, 1992;1994). The established toxicity values are conservative and take into account variations in sensitivity between individuals in the population. IRIS was used as the initial source for the most current EPA-approved values. If a toxicity value for a certain chemical was not available in IRIS, HEAST was reviewed. For chemicals which did not have values in either IRIS or HEAST, an attempt was made to obtain a value from ECAO. Chemicals which don't have IRIS, HEAST or ECAO toxicity values were not evaluated quantitatively in this risk assessment.

4.4.2 Slope Factors

Slope factors are the toxicity values used to evaluate the potential for carcinogenic health effects. A slope factor is a plausible upper-bound estimate of the probability of a response per unit intake of a chemical over a lifetime (EPA, 1989a). The chemicals evaluated for potential carcinogenic risk are classified as carcinogens by EPA (Groups A, B, or C) and/or the International Agency for Research on Cancer (IARC) (Groups 1, 2A, or 2B) (CIS, 1988; EPA, 1993). These chemicals and their

EPA and IARC carcinogenicity classifications are presented in Table 4-11. The interpretation and explanation of the EPA and IARC carcinogenicity classification systems are presented in Table 4-12.

The slope factors that are used in the evaluation of carcinogenic risks in Subsection 4.5 have been developed by EPA. In developing slope factors, EPA assumes that there is no threshold for cancer development and that the risk of cancer is linearly related to dose. So if laboratory animals developed cancer at relatively high doses, EPA assumes that the high doses can be extrapolated down to extremely small doses with some risk of cancer always remaining.

In the derivation of slope factors, EPA uses a linearized multistage model and the slope factor usually reflects the upper-bound limit of the chemical's cancer potency. As a result, the calculated carcinogenic risk is likely to represent a plausible upper limit to the risk. Because EPA's model uses upper-bound carcinogenic limits, actual carcinogenic risk values are likely to be lower than the predicted risk (EPA, 1986; 1989a). Actual risk may even be as low as zero.

The carcinogenic potency of a substance depends on its route of entry into the body (e.g., oral or inhalation). In some cases, a carcinogen may produce tumors only at or near a specific natural route of entry (e.g., nasal passages) and may not produce carcinogenic effects through other exposure routes. Several of the carcinogenic metals (chromium VI and nickel) produce carcinogenicity only through inhalation exposure; therefore, slope factors are developed and classified according to the route of administration. EPA has developed oral and/or inhalation slope factors for several carcinogens (IRIS, 1994; EPA, 1993).

Although lead is classified as a Group B2 carcinogen, EPA recommends that its carcinogenicity should not be quantitated in risk assessments. There are currently no EPA-derived slope factors for lead. In addition, EPA has stated that lead does

Table 4–11
Carcinogenicity Classification
Circuitron Corporation Site

Chemical	EPA Classification	IARC Classification
Organics		
Chloroform	B2	2B
1,1–Dichloroethane	C	NCL
1,1–Dichloroethene	C	NCL
Tetrachloroethene	C–B2	2B
1,1,2–Trichloroethane	C	3
Trichloroethene	NCL	3
Inorganics		
Arsenic	A	1
Beryllium	B2	2A
Chromium [a,b]	A	1
Lead	B2	2B
Nickel [a]	A	1

NCL = Not classified.

[a] Considered a carcinogen through the inhalation route only. Inorganics are not of concern through the inhalation route for the groundwater pathway. Therefore, chromium and nickel were not evaluated as carcinogens in this risk assessment.

[b] Carcinogenic classification based on chromium as chromium VI.

Table 4-12
EPA and IARC Categorizations of Carcinogens Based on Human and Animal Evidence
Circuitron Corporation Site

EPA Categorization of Carcinogens (EPA, 1986)

Human Evidence	Animal Evidence				
	Sufficient	Limited	Inadequate	No Data	No Evidence
Sufficient	A	A	A	A	A
Limited	B1	B1	B1	B1	B1
Inadequate	B2	C	D	D	D
No Data	B2	C	D	D	D
No Evidence	B2	C	D	D	E

<u>Key:</u>

Group A	Human carcinogen (sufficient evidence from epidemiological studies).
Group B1	Probable human carcinogen (at least limited evidence of carcinogenicity to humans).
Group B2	Probable human carcinogen (a combination of sufficient evidence in animals and inadequate data in humans).
Group C	Possible human carcinogen (limited evidence in animals in the absence of human data).
Group D	Not classified (inadequate animal and human data).
Group E	No evidence for carcinogenicity (no evidence for carcinogenicity in at least two adequate animals tests in different species, or in both epidemiological and animal studies).

IARC Categorization of Carcinogenicity (WHO, 1987)

Group 1	Human carcinogen (sufficient evidence of carcinogenicity in humans).
Group 2A	Probable human carcinogen (at least limited evidence of carcinogenicity in humans and sufficient evidence of carcinogenicity in experimental animals).
Group 2B	Possible human carcinogen (limited evidence of carcinogenicity in humans and insufficient evidence of carcinogenicity in experimental animals; insufficient evidence of carcinogenicity in humans and sufficient evidence of carcinogenicity in experimental animals; or insufficient evidence of carcinogenicity in humans and limited evidence of carcinogenicity in experimental animals with supporting evidence from other relevant data).
Group 3	Not classifiable (substances in this category do not fall into any other category).
Group 4	Probably not carcinogenic to humans.

not appear to be a potent carcinogen and that at low doses "the non-cancer effects of lead are of greatest concern for regulatory purposes" (EPA, 1988). Consequently, lead was not evaluated quantitatively based on its potential carcinogenic risk. Lead is further discussed in the Risk Characterization Section (Subsection 4.5). The slope factors for the carcinogenic chemicals of potential concern are presented in Table 4-13 and are discussed, by exposure route, in the following subsections.

4.4.2.1 Oral Slope Factors

The carcinogenic potency through the oral route can be presented as a slope factor expressed in units of $(mg/kg/day)^{-1}$, or a unit risk factor, expressed in units of $(\mu g/L)^{-1}$. EPA guidance recommends that when an oral slope factor is unavailable, a unit risk factor can be used to calculate the slope factor. A unit risk is converted to a slope factor by using a drinking water ingestion rate of 2 L/day and an adult body weight of 70 kg for this calculation (EPA, 1993).

4.4.2.2 Inhalation Slope Factors

The carcinogenic potency through the inhalation route can be presented as a slope factor expressed in units of $(mg/kg/day)^{-1}$, or as a unit risk factor expressed in units of $(\mu g/m^3)^{-1}$. These values can be converted by using the inhalation rate of 20 m^3 of air/day and an adult body weight of 70 kg (EPA, 1993).

4.4.3 Reference Doses

Reference doses (RfDs) are the toxicity values used to evaluate the potential for noncarcinogenic health effects. Unlike the approach used in evaluating carcinogenic risk, it is assumed that a threshold dose exists below which there is no potential for noncarcinogenic health effects. The term RfD was developed by EPA to refer to a daily intake of a chemical to which an individual can be exposed without any

Table 4–13
Slope Factors
Circuitron Corporation Site

Chemicals	Oral Slope Factor (mg/kg/day)$^{-1}$	Source	Inhalation Slope Factor (mg/kg/day)$^{-1}$	Source
Organics				
Chloroform	6.1E−03	IRIS, 1994	8.1E−02	EPA, 1993
1,1−Dichloroethane	NTV	−−	NTV	−−
1,1−Dichloroethene	6E−01	IRIS, 1994	1.2E+00	EPA, 1993
Tetrachloroethene	5.2E−02	ECAO,1992	2E−03	ECAO,1992
1,1,2−Trichloroethane	5.7E−02	IRIS, 1994	5.7E−02	EPA, 1993
Trichloroethene	1.1E−02	ECAO,1992	6E−03	ECAO,1992
Inorganics				
Arsenic	1.8E+00	IRIS, 1994	NC	−−
Beryllium	4.3E+00	IRIS, 1994	NC	−−
Lead	NTV	−−	NC	−−

NC = Chemical is not of concern through this exposure route.
NTV = No toxicity value was available.

expectation of adverse health effects occurring (e.g., organ damage, biochemical alterations, birth defects) even for sensitive individuals.

RfDs, like slope factors, are developed for specific exposure routes and have been derived to evaluate chronic exposure (defined by EPA as seven years or longer) (EPA, 1989a). In this risk assessment, chronic RfDs were used to evaluate all the scenarios. Chronic RfDs have been derived by EPA for a number of chemicals for the oral and/or inhalation routes. The RfDs that are used in this evaluation are presented in Table 4-14 and are discussed, by exposure route, in the following subsections.

4.4.3.1 Oral Reference Doses

Chronic oral RfDs were available for the majority of the chemicals being evaluated through the oral exposure route. The oral RfD is usually derived from a NOAEL (no-observed-adverse-effect level) or LOAEL (lowest-observed-adverse-effect level) by the application of uncertainty factors of 10 each, and an additional modifying factor of up to 10 which accounts for a professional assessment of scientific uncertainties in the available data (EPA, 1989a).

4.4.3.2 Inhalation Reference Dose

Chronic inhalation reference concentrations (RfCs) were available for a few organic chemicals evaluated through the inhalation route for the groundwater pathway. The reasons for the unavailability of RfCs for a majority of the chemicals include: the evolving nature of the methodology used, availability of limited inhalation toxicity data, and complexity of applying dosimetric conversions in extrapolating from animal to human data. The RfC is usually derived from a NOAEL or LOAEL which is adjusted for continuous exposure (i.e., from 6 hours/day, 5 days/week to 24 hours/day, 7 days/week) and corrects for various parameters that differ between

Table 4-14
Reference Doses (RfDs)
Circuitron Corporation Site

Chemical	Oral Reference Dose (mg/kg/day)	Source	Inhalation Reference Dose (mg/kg/day)	Source
Organics				
Acetone	1E-01	IRIS, 1994	NTV	--
2-Butanone	6E-01	IRIS, 1994	1E+00	IRIS, 1994
Chlorobenzene	2E-02	IRIS, 1994	5E-03	EPA, 1993
Chloroform	1E-02	IRIS, 1994	NTV	--
1,1-Dichloroethane	1E-01	EPA,1993	1E-01	EPA, 1993
1,1-Dichloroethene	9E-03	IRIS, 1994	NTV	--
cis-1,2-Dichloroethene	1E-03	EPA, 1993	NTV	--
Tetrachloroethene	1E-02	IRIS, 1994	NTV	--
Toluene	2E-01	IRIS, 1994	4E-01	IRIS, 1994
1,1,1-Trichloroethane	NTV	--	2.9E-01	ECAO, 1994
1,1,2-Trichloroethane	4E-03	IRIS, 1994	NTV	--
Trichloroethene	6E-03	ECAO, 1992	NTV	--
Inorganics				
Aluminum	NTV	--	NC	--
Arsenic	3E-04	IRIS, 1994	NC	--
Barium	7E-02	IRIS, 1994	NC	--
Beryllium	5E-03	IRIS, 1994	NC	--
Chromium III	1E+00	IRIS, 1994	NC	--
Chromium VI	5E-03	IRIS, 1994	NC	--
Copper	3.7E-02	EPA, 1993	NC	--
Lead	NTV	--	NC	--
Manganese	5E-03	IRIS, 1994	NC	--
Nickel	2E-02	IRIS, 1994	NC	--
Silver	5E-03	IRIS, 1994	NC	--
Vanadium	7E-03	EPA, 1993	NC	--
Zinc	3E-01	IRIS, 1994	NC	--

NC = Chemical is not of concern through this exposure route.
NTV= No toxicity value was available.

animals and humans. A RfC can be converted to a RfD by multiplying by an inhalation rate of 20 m^3 of air per day and dividing by an adult body weight of 70 kg (EPA, 1993).

4.5 RISK CHARACTERIZATION

4.5.1 Introduction

The objective of the risk characterization is to integrate the information developed in the exposure assessment (Subsection 4.3) and the toxicity assessment (Subsection 4.4) into an evaluation of the potential current and future health risks associated with the chemicals of potential concern at the Circuitron Corporation Site. Risk characterization is an analysis of the nature and degree of health risk posed to the potential receptor populations described in the exposure assessment (Subsection 4.3).

Human health risks are discussed independently for carcinogenic and noncarcinogenic effects of chemicals because of the different toxicological endpoints, varying exposure durations, and methods employed in characterizing risk. The potential for carcinogenic effects is evaluated only for those chemicals classified as carcinogens, while the potential for noncarcinogenic effects is evaluated for all the chemicals of potential concern at the Circuitron Corporation Site. The approaches to determining carcinogenic and noncarcinogenic risks are presented in the following subsection.

4.5.2 Risk Evaluation - Approaches and Acceptable Levels

4.5.2.1 Carcinogenic Risk Evaluation Approach

Carcinogenic risk is calculated by multiplying the estimated daily dose that is averaged over a lifetime [lifetime-averaged daily dose (LADD)] by a compound and exposure route-specific (oral, inhalation) slope factor (SF). The calculation of carcinogenic risk, assuming a low-dose, linear relationship is illustrated by the following equation:

$$\text{Cancer risk} = \text{LADD} \times \text{SF}$$

Where:

Cancer risk = Lifetime carcinogenic risk (expressed as a probability).

LADD = Lifetime average daily dose (averaged over 70 years) (mg/kg-day).

SF = Slope factor $(\text{mg/kg-day})^{-1}$.

The linear equation is valid only at low risk levels (i.e., below estimated risks of 1E-02 or 0.01). The lifetime average daily doses are presented in Table 4-8. The slope factors for the oral and inhalation routes of exposure are presented in Table 4-13.

The combined potential upper bound cancer risk for a particular exposure route is estimated by summing the risk estimates for all the chemicals of potential concern for that route. This approach is in accordance with the U.S. EPA guidelines on chemical mixtures, in which risks associated with carcinogens are considered additive (EPA, 1986). This approach assumes independence of action by the chemicals (i.e., that there are no synergistic or antagonistic interactions), and that all of the chemicals have the same toxicological endpoint (i.e., cancer). The total potential upper bound cancer risk to an individual member of a receptor population is estimated by summing the combined carcinogenic risks from all relevant exposure routes. For the future residents (child and adult), doses and risks are summed to provide an estimate of total lifetime carcinogenic risk.

4.5.2.2 Noncarcinogenic Risk Evaluation Approach

Noncarcinogenic risks are evaluated by comparing calculated chemical daily intakes, which were averaged over the period of exposure [i.e., average daily doses (ADD)], to reference doses (RfDs). This is accomplished by the calculation of hazard quotients and hazard indices. A hazard quotient for a particular chemical is the ratio between the estimated daily dose through a given exposure route and the applicable RfD, as illustrated by the following equation:

$$HQ = ADD/RfD$$

Where:

HQ = Hazard quotient.

ADD = Average daily dose (averaged over the exposure period) (mg/kg-day).

RfD = Reference dose (mg/kg-day).

The daily doses averaged over the period of exposure are presented in Tables 4-9 and 4-10. The reference doses for the oral and inhalation routes of exposure are presented in Table 4-14.

The hazard quotients determined for each chemical of potential concern by exposure pathway and age group are summed within an exposure scenario to obtain a hazard index (HI). The HI is an expression of the additivity of noncarcinogenic health effects. The principle of additivity assumes that similar organ systems and health endpoints are affected by the chemicals of potential concern. However, the RfDs determined for the multiple chemicals in a given exposure scenario usually represent effects to a range of target organs or systems.

4.5.2.3 Acceptable Carcinogenic and Noncarcinogenic Risk Levels

In assessing the carcinogenic risks posed by a site, the NCP establishes an excess cancer risk of 1E-06 as a "point of departure" for establishing remedial goals. Excess cancer risks lower than 1E-06 are not addressed by the NCP. Excess cancer risks in the range of 1E-04 to 1E-06 may or may not be considered acceptable depending on site-specific factors such as the potential for exposure, technical limitations to remediation, and data uncertainties.

The acceptable risk range was clarified further in an April 1991 OSWER Directive (9355.0-30) from the EPA Assistant Administrator to Regional Directors that when reasonable maximum exposures for both current and future land use result in carcinogenic risks less than 1E-04, action is generally not warranted, unless there are adverse environmental impacts. However, it should be noted that the same directive indicates that the risk manager may decide that risk less than 1E-04 is unacceptable due to site-specific issues.

The methodology used to evaluate noncarcinogenic risk, unlike the methodology used in the evaluation of carcinogenic risk, is not a measure of quantitative risk. The hazard quotient or hazard index is not a mathematical prediction of incidence of effects or severity of those effects. If a hazard quotient or hazard index exceeds "one" (>1), it simply indicates that there is a potential for noncarcinogenic health effects under the defined exposure conditions. However, the degree to which the HQ or HI exceeds 1 does provide some measure of the likelihood of an adverse effect. Consequently, an HI of 100 would suggest a greater concern than an HI of 5. Conversely, a hazard quotient or index of less than or equal to one (<1) indicates that it is unlikely for even sensitive populations to experience adverse noncarcinogenic health effects.

4.5.3 Risk Results

The following narrative presents the risk results for the receptors evaluated under reasonable maximum exposure scenarios at the Circuitron Corporation Site. The risk results for the central tendency evaluation are presented in the uncertainty analysis (Subsection 4.6).

4.5.3.1 Carcinogenic Risk

Future Resident [child (1-6 year old) and adult]

Total carcinogenic risks are summarized in Table 4-15 by exposure pathway for the future resident (child and adult exposure combined). The carcinogenic risks are presented by chemical and exposure route in Table 4-16. The percent distribution of these risks by chemical and exposure route is presented in Table and 4-17.

The total excess incremental carcinogenic risk to the future resident from exposure to groundwater was 1 in 1,000 (1.1E-03). The majority (86%) of the total carcinogenic risk was contributed by the ingestion of groundwater. Arsenic and 1,1-dichloroethene contributed 98% of the total carcinogenic risk. The carcinogenic risk for arsenic was 9E-04 through ingestion of groundwater. The upper 95 percent confidence limit concentration for arsenic (47 μg/l), used to calculate the carcinogenic risk, is lower than its maximum contaminant level (MCL) of 50 μg/l. The carcinogenic risk for 1,1-dichloroethene was 1.9E-04 primarily through noningestion uses of groundwater. Other chemicals which exceeded a carcinogenic risk of 1E-06 are included in Table 4-15.

EPA regulates maximum carcinogenic risks in the range 1E-06 to 1E-04. The total carcinogenic risk calculated for the future resident (child and adult) from exposure to groundwater is higher than the regulatory risk range of 1E-06 to 1E-04. These

Table 4-15
Summary of Carcinogenic Risks by Exposure Pathway, Receptor, and Chemical – RME Scenario
Circuitron Corporation Site

Exposure Pathway	Receptor	Total Carcinogenic Risk	Chemicals with a Carcinogenic Risk > or = 1E–06		
			Chemical	Carcinogenic Risk	% Contribution To Total Carcinogenic Risk
Groundwater	Resident (child & adult combined)	Total Carcinogenic Risk = 1.1E–03 * carcinogenic risk from ingestion uses = 9.6E–04 * carcinogenic risk from noningestion uses = 1.6E–04	Arsenic	9E–04	81%
			1,1–Dichloroethene	1.9E–04	17%
			Beryllium	1.6E–05	1%
			Trichloroethene	2.4E–06	0.2%
			Tetrachloroethene	1.5E–06	0.1%
			1,1,2–Trichloroethane	1.3E–06	0.1%
			Chloroform	1.2E–06	0.1%

Table 4-16
Future Resident (child and adult combined) - RME
Potential Carcinogenic Risk Through All Exposure Routes
(Groundwater - On-Property and Off-Property Wells)
Based on Upper 95 Percent Confidence Limit Concentration

Chemical	Ingestion of Groundwater	Noningestion Uses of Groundwater	Total
ORGANICS			
Chloroform	4.48E-08	1.19E-06	1.23E-06
1,1-Dichloroethane	NTV	NTV	NA
1,1-Dichloroethene	3.81E-05	1.53E-04	1.91E-04
Tetrachloroethene	1.37E-06	1.05E-07	1.47E-06
1,1,2-Trichloroethane	4.19E-07	8.37E-07	1.26E-06
Trichloroethene	1.17E-06	1.28E-06	2.44E-06
INORGANICS			
Arsenic	9.01E-04	NC	9.01E-04
Beryllium	1.56E-05	NC	1.56E-05
Lead	NTV	NC	NA
TOTAL	9.58E-04	1.56E-04	1.11E-03

NA = Not applicable.
NC = Chemical is not of concern through this exposure route.
NTV = No toxicity value was available.

Table 4-17
Future Resident (child and adult combined) - RME
Distribution of Lifetime Carcinogenic Risk as Percent of Total Risk
(Groundwater - On-Property and Off-Property Wells)
Based on Upper 95 Percent Confidence Limit Concentration

Chemical	Ingestion of Groundwater	Noningestion Uses of Groundwater	Total
ORGANICS			
Chloroform	0.00	0.11	0.11
1,1-Dichloroethane	NTV	NTV	NA
1,1-Dichloroethene	3.42	13.69	17.12
Tetrachloroethene	0.12	0.01	0.13
1,1,2-Trichloroethane	0.04	0.08	0.11
Trichloroethene	0.10	0.11	0.22
INORGANICS			
Arsenic	80.91	NC	80.91
Beryllium	1.40	NC	1.40
Lead	NTV	NC	NA
TOTAL	86.00	14.00	100.00

0.00 = Contribution is less than 0.01 percent.
NA = Not applicable.
NC = Chemical is not of concern through this exposure route.
NTV = No toxicity value was available.

56 (through all chemicals and all exposure routes) overestimates the potential for toxic effects.

If a hazard quotient or hazard index exceeds "one" (>1), it indicates that there may be a potential for noncarcinogenic health effects under the defined exposure conditions. The total hazard index calculated for the future child resident from exposure to groundwater is greater than one. These results indicate a potential for adverse noncarcinogenic health effects to the future child resident from exposure to groundwater for the RME scenario.

Future Adult Resident

Total hazard quotients and indices are summarized in Table 4-18 by exposure pathway for the future adult resident. The hazard quotients and indices are presented by chemical and exposure route in Table 4-21. The percent distribution of these hazard quotients and indices by chemical and exposure route is presented in Table 4-22.

The total hazard index for the future adult resident from exposure to groundwater was 24. More than 99% of the total hazard index was contributed by ingestion of groundwater. Copper, manganese, and arsenic contributed 96% of the total hazard index. The hazard indices for copper, manganese, and arsenic were 11, 7.8, and 4.3 respectively, through ingestion of groundwater. The upper 95 percent confidence limit concentration for arsenic (47 μg/l), used to calculate the hazard index for arsenic, is lower than its MCL of 50 μg/l.

The critical toxic endpoints for copper and manganese are gastrointestinal irritation and central nervous system effects, respectively. The critical toxic endpoints for arsenic include keratosis (skin effects), hyperpigmentation (skin effects), and possible vascular problems. Consequently, the calculated hazard indices for copper,

Table 4-21
Future Adult Resident – RME
Hazard Quotients and Indices Through All Exposure Routes
(Groundwater – On-Property and Off-Property Wells)
Based on Upper 95 Percent Confidence Limit Concentration

Chemical	Ingestion of Groundwater	Noningestion Uses of Groundwater	Total
ORGANICS			
Acetone	4.93E-03	NTV	4.93E-03
2-Butanone	2.74E-04	3.29E-04	6.03E-04
Chlorobenzene	7.95E-04	6.36E-03	7.15E-03
Chloroform	1.84E-03	NTV	1.84E-03
1,1-Dichloroethane	3.01E-03	6.03E-03	9.04E-03
1,1-Dichloroethene	1.77E-02	NTV	1.77E-02
cis-1,2-Dichloroethene	4.38E-02	NTV	4.38E-02
Tetrachloroethene	6.58E-03	NTV	6.58E-03
Toluene	7.67E-05	7.67E-05	1.53E-04
1,1,1-Trichloroethane	NTV	3.42E-02	3.42E-02
1,1,2-Trichloroethane	4.59E-03	NTV	4.59E-03
Trichloroethene	4.43E-02	NTV	4.43E-02
INORGANICS			
Aluminum	NTV	NC	NA
Arsenic	4.29E+00	NC	4.29E+00
Barium	1.46E-01	NC	1.46E-01
Beryllium	1.81E-03	NC	1.81E-03
Chromium (III)	1.41E-02	NC	1.41E-02
Chromium (VI)	4.60E-01	NC	4.60E-01
Copper	1.08E+01	NC	1.08E+01
Lead	NTV	NC	NA
Manganese	7.76E+00	NC	7.76E+00
Nickel	6.44E-02	NC	6.44E-02
Silver	3.23E-02	NC	3.23E-02
Vanadium	6.65E-02	NC	6.65E-02
Zinc	1.43E-02	NC	1.43E-02
TOTAL	2.38E+01	4.70E-02	2.38E+01

NA = Not applicable.
NC = Chemical is not of concern through this exposure route.
NTV = No toxicity value was available.

results indicate significant potential carcinogenic risk to the future resident through the groundwater pathway for the RME scenario.

4.5.3.2 Noncarcinogenic Risk

__Future Child Resident__

Total hazard quotients and indices are summarized in Table 4-18 by exposure pathway for the future child resident. The hazard quotients and indices are presented by chemical and exposure route in Table 4-19. The percent distribution of these hazard quotients and indices by chemical and exposure route is presented in Table 4-20.

The total hazard index for the future child resident from exposure to groundwater was 56. More than 99% of the total hazard index was contributed by the ingestion of groundwater. Copper, manganese, and arsenic contributed 96% of the total hazard index. The hazard indices for copper, manganese, and arsenic were 25, 18, and 10 respectively, through ingestion of groundwater. The upper 95 percent confidence limit concentration for arsenic (47 μg/l), used to calculate the hazard index for arsenic, is lower than its MCL of 50 μg/l. Other chemicals which exceeded a hazard index of one are presented in Table 4-18.

The critical toxic endpoints for copper and manganese are gastrointestinal irritation and central nervous system effects, respectively. The critical toxic endpoints for arsenic include keratosis (skin effects), hyperpigmentation (skin effects), and possible vascular problems. Consequently, the calculated hazard indices for copper, manganese, and arsenic are not additive because each chemical results in varying critical toxic endpoints or effects. Therefore, the total hazard index is equal to 25 (hazard index for copper) which represents the maximum of the hazard indices calculated for copper, manganese, and arsenic. The calculated total hazard index of

Table 4-18
Summary of Hazard Indices by Exposure Pathway, Receptor, and Chemical – RME Scenario
Circuitron Corporation Site

Exposure Pathway	Receptor	Total Hazard Index	Chemicals with Hazard Index > or = 1		
			Chemical	Hazard Index	% Contribution To Total Hazard Index
Groundwater	Child Resident	Total Hazard Index = 56 * hazard index from ingestion uses = 56 * hazard index from noningestion uses = 0.1	Copper Manganese Arsenic Chromium VI	25 18 10 1.1	45% 33% 18% 2%
	Adult Resident	Total Hazard Index = 24 * hazard index from ingestion uses = 24 * hazard index from noningestion uses = 0.05	Copper Manganese Arsenic	11 7.8 4.3	45% 33% 18%

Table 4−19
Future Child Resident (1−6 yr old) − RME
Hazard Quotients and Indices Through All Exposure Routes
(Groundwater − On−Property and Off−Property Wells)
Based on Upper 95 Percent Confidence Limit Concentration

Chemical	Ingestion of Groundwater	Noningestion Uses of Groundwater	Total
ORGANICS			
Acetone	1.15E−02	NTV	1.15E−02
2−Butanone	6.39E−04	7.67E−04	1.41E−03
Chlorobenzene	1.85E−03	1.48E−02	1.67E−02
Chloroform	4.28E−03	NTV	4.28E−03
1,1−Dichloroethane	7.03E−03	1.41E−02	2.11E−02
1,1−Dichloroethene	4.12E−02	NTV	4.12E−02
cis−1,2−Dichloroethene	1.02E−01	NTV	1.02E−01
Tetrachloroethene	1.53E−02	NTV	1.53E−02
Toluene	1.79E−04	1.79E−04	3.58E−04
1,1,1−Trichloroethane	NTV	7.98E−02	7.98E−02
1,1,2−Trichloroethane	1.07E−02	NTV	1.07E−02
Trichloroethene	1.03E−01	NTV	1.03E−01
INORGANICS			
Aluminum	NTV	NC	NA
Arsenic	1.00E+01	NC	1.00E+01
Barium	3.42E−01	NC	3.42E−01
Beryllium	4.22E−03	NC	4.22E−03
Chromium (III)	3.28E−02	NC	3.28E−02
Chromium (VI)	1.07E+00	NC	1.07E+00
Copper	2.52E+01	NC	2.52E+01
Lead	NTV	NC	NA
Manganese	1.81E+01	NC	1.81E+01
Nickel	1.50E−01	NC	1.50E−01
Silver	7.54E−02	NC	7.54E−02
Vanadium	1.55E−01	NC	1.55E−01
Zinc	3.35E−02	NC	3.35E−02
TOTAL	5.55E+01	1.10E−01	5.56E+01

NA = Not applicable.
NC = Chemical is not of concern through this exposure route.
NTV = No toxicity value was available.

Table 4-20
Future Child Resident (1-6 yr old) - RME
Distribution of Hazard Quotient and Indices as Percent of Total Hazard Index
(Groundwater - On-Property and Off-Property Wells)
Based on Upper 95 Percent Confidence Limit Concentration

Chemical	Ingestion of Groundwater	Noningestion Uses of Groundwater	Total
ORGANICS			
Acetone	0.02	NTV	0.02
2-Butanone	0.00	0.00	0.00
Chlorobenzene	0.00	0.03	0.03
Chloroform	0.01	NTV	0.01
1,1-Dichloroethane	0.01	0.03	0.04
1,1-Dichloroethene	0.07	NTV	0.07
cis-1,2-Dichloroethene	0.18	NTV	0.18
Tetrachloroethene	0.03	NTV	0.03
Toluene	0.00	0.00	0.00
1,1,1-Trichloroethane	NTV	0.14	0.14
1,1,2-Trichloroethane	0.02	NTV	0.02
Trichloroethene	0.19	NTV	0.19
INORGANICS			
Aluminum	NTV	NC	NA
Arsenic	18.00	NC	18.00
Barium	0.61	NC	0.61
Beryllium	0.01	NC	0.01
Chromium (III)	0.06	NC	0.06
Chromium (VI)	1.93	NC	1.93
Copper	45.34	NC	45.34
Lead	NTV	NC	NA
Manganese	32.57	NC	32.57
Nickel	0.27	NC	0.27
Silver	0.14	NC	0.14
Vanadium	0.28	NC	0.28
Zinc	0.06	NC	0.06
TOTAL	99.80	0.20	100.00

0.00 = Contribution is less than 0.01 percent.
NA = Not applicable.
NC = Chemical is not of concern through this exposure route.
NTV = No toxicity value was available.

Table 4-22
Future Adult Resident - RME
Distribution of Hazard Quotient and Indices as Percent of Total Hazard Index
(Groundwater - On-Property and Off-Property Wells)
Based on Upper 95 Percent Confidence Limit Concentration

Chemical	Ingestion of Groundwater	Noningestion Uses of Groundwater	Total
ORGANICS			
Acetone	0.02	NTV	0.02
2-Butanone	0.00	0.00	0.00
Chlorobenzene	0.00	0.03	0.03
Chloroform	0.01	NTV	0.01
1,1-Dichloroethane	0.01	0.03	0.04
1,1-Dichloroethene	0.07	NTV	0.07
cis-1,2-Dichloroethene	0.18	NTV	0.18
Tetrachloroethene	0.03	NTV	0.03
Toluene	0.00	0.00	0.00
1,1,1-Trichloroethane	NTV	0.14	0.14
1,1,2-Trichloroethane	0.02	NTV	0.02
Trichloroethene	0.19	NTV	0.19
INORGANICS			
Aluminum	NTV	NC	NA
Arsenic	18.00	NC	18.00
Barium	0.61	NC	0.61
Beryllium	0.01	NC	0.01
Chromium (III)	0.06	NC	0.06
Chromium (VI)	1.93	NC	1.93
Copper	45.34	NC	45.34
Lead	NTV	NC	NA
Manganese	32.57	NC	32.57
Nickel	0.27	NC	0.27
Silver	0.14	NC	0.14
Vanadium	0.28	NC	0.28
Zinc	0.06	NC	0.06
TOTAL	99.80	0.20	100.00

0.00 = Contribution is less than 0.01 percent.
NA = Not applicable.
NC = Chemical is not of concern through this exposure route.
NTV = No toxicity value was available.

manganese, and arsenic are not additive because each chemical results in varying critical toxic endpoints or effects. Therefore, the total hazard index is equal to 11 (hazard index for copper) which represents the maximum of the hazard indices calculated for copper, manganese, and arsenic. The calculated total hazard index of 24 (through all chemicals and all exposure routes) overestimates the potential for toxic effects.

If a hazard quotient or hazard index exceeds "one" (>1), it indicates that there is a potential for noncarcinogenic health effects under the defined exposure conditions. The total hazard index calculated for the future adult resident from exposure to groundwater is greater than one. These results indicate a potential for adverse noncarcinogenic health effects to the future adult resident from exposure to groundwater for the RME scenario.

4.5.3.3 Evaluation of Risk from Lead

Due to the uncertainty and unavailability of toxicity values for lead, it was not quantitatively evaluated in this risk assessment. To evaluate the potential of lead posing significant risks, the exposure concentration in groundwater was compared to the action level recommended by EPA. The exposure concentration for lead of 31 ppb exceeded the action level of 15 ppb recommended by EPA for groundwater. Therefore, lead may be of potential concern through the groundwater pathway.

4.6 UNCERTAINTY ANALYSIS

4.6.1 Introduction

Many steps in the risk assessment process involve making assumptions. Any assumptions made and limitations on the accuracy and precision of analytical methods contribute to uncertainty in the risk evaluation. In this risk assessment, an effort was made to use assumptions that are conservative, yet realistic. It is likely, therefore, that the net effect of all the assumptions was a conservative estimate of overall risk.

Uncertainty plays a part in each of the principal components of the risk assessment, including data evaluation and reduction, the exposure assessment, the toxicity assessment, and the risk characterization. All of the assumptions made in the risk assessment have been mentioned and discussed in the applicable subsections. Rather than repeat all of the specific assumptions and uncertainties associated with these assumptions, this discussion is limited to the uncertainties associated with the chemicals and exposure pathways which contributed most significantly to the calculated risk. In general, the focus is on those chemicals and exposure pathways that pose a potential carcinogenic risk of greater than 1E-06 or were calculated to pose a potential noncarcinogenic risk (i.e., have a hazard index of greater than one). The health risks posed by these chemicals and exposure pathways have been discussed in Subsection 4.5.

4.6.2 Uncertainties Associated with Data Evaluation and Reduction

Some of the uncertainties associated with data evaluation and reduction are presented below.

- In this risk assessment, unvalidated data from the drive point sampling locations were used along with validated data from the May 1993 sampling of RI monitoring wells. Use of unvalidated data may introduce an uncertainty associated with the quality of data from the drive point sampling locations. However, validated confirmatory CLP data showed good correlation and minimizes the uncertainty associated with the data from the drive point sampling locations.

- Total metals data (unfiltered metals data) were used for groundwater in this risk assessment. Many of the inorganic compounds (metals) were present at elevated concentrations. The groundwater samples collected from many shallow wells were noted to have high turbidity (> 200 NTUs). The maximum concentrations of copper (14,600 μg/l), manganese (1,790 μg/l), and arsenic (81.2 μg/l based on total metals data from Round I groundwater sampling were found in well MW-2S. MW-2S was noted to have turbidity levels greater than 200 NTUs. The corresponding concentrations for copper, manganese, and arsenic, based on filtered data from well MW-2S were 402 μg/l, 18.8 μg/l, and 3.5U μg/l. Wells MW-2S, MW-3S, and MW-7S were noted to have turbidity greater than 200 NTUs in the Round II groundwater sampling. An elevated concentration of copper (2,550 μg/l based on total metal data as compared to 17.6 μg/l based on filtered metal data) was reported in MW-2S in the Round II groundwater sampling. Maximum concentrations of manganese (4,400 μg/l based on total metal data, 2.7 μg/l based on filtered metal data) and chromium (788 μg/l based on total metal data, 5.4 μg/l based on filtered metal data) were found in MW-7S in the Round II groundwater sampling.

  Based upon a comparison of total versus filtered samples, it is apparent that the analytical results may have been influenced by the presence of suspended solids in the total inorganic samples. Therefore, there is uncertainty associated with the use of total metals data for evaluating risks through the groundwater pathway since these data may overestimate potential risks contributed by some metals.

- The results of this risk assessment are based on the analytical data obtained from the 1993 Round I groundwater sampling of existing RI monitoring wells and drive point sampling locations. Subsequently, additional data were obtained from the February 1994 Round II groundwater sampling. A comparison of the Round I and Round II results is presented in Table 2-10 (Section 2).

The Round II groundwater sampling results were consistent with the Round I groundwater sampling results. The chemicals not detected in Round I but detected in Round II include: benzene, 1,4-dichlorobenzene, vinyl chloride, cadmium, selenium, and thallium. The maximum detected concentration for these chemicals was below the MCL. The maximum detected concentration for manganese from Round II results was 2.5 times higher than the respective concentration from Round I results. Incorporation of Round II results for manganese in the calculation of hazard index will result in numbers higher than those calculated in the risk assessment.

- Chromium VI posed a hazard index of 1.1 through the groundwater pathway. However, there is uncertainty associated with the chromium VI levels in groundwater. Only total chromium results were available for groundwater. In the absence of speciation data for chromium III and chromium VI, a 6:1 ratio was assumed for chromium III : chromium VI. Therefore, the risks due to chromium VI may have been underestimated or overestimated depending on the actual speciation in groundwater at the Circuitron Corporation Site.

- Several organic compounds (e.g., 1,1-dichloroethene, 1,1,1-trichloroethane, trichloroethene, etc.) were detected in the sampling locations upgradient of the site. These upgradient locations were used as background locations for screening the inorganic chemicals of potential concern. Detection of volatile organic compounds in the upgradient locations indicates upgradient sources of groundwater contamination.

There is uncertainty associated with the contribution of the Circuitron Corporation Site to the risks calculated in this risk assessment. There may be other potential sources which contribute to the groundwater contamination. A portion of the calculated risks may be due to background regional groundwater contamination.

4.6.3 Uncertainties Associated with Exposure Assessment

Some of the uncertainties associated with the exposure assessment are presented below.

- The exposure assumptions directly influence the calculated doses (daily intakes), and ultimately the calculation of risk. In general, conservative exposure assumptions were made in calculating exposure doses such as the selection of exposure routes and scenarios, and the exposure input factors (e.g., ingestion rate, exposure frequency, and exposure duration) used to estimate exposure doses. Actual exposures may vary from the assumed conservative estimates. In most cases, these overestimates of actual exposures overestimate risk.

- Several variables that determine the exposure dose for the RME are based on upper-bound (typically 90th percentile or greater) estimates. These are:

    - The 95 percent upper confidence limit of the mean concentration for the chemical used to calculate the exposure dose.

- Intake/contact rate (IR) (upper-bound value).

- Exposure frequency (EF) (upper-bound value).

- Exposure duration (ED) (upper-bound value).

Therefore, the calculated exposure dose for any given chemical, which results from integration of all of these variables, represents an upper-bound estimate of the probable exposure dose. The use of these upperbound exposure parameters, coupled with conservative estimates of toxicity, in turn yield risk results that represent an upper-bound estimate of the occurrence of carcinogenic and noncarcinogenic health effects.

- In this exposure assessment, it was assumed that the concentration of 1,1-dichloroethene and other volatile and/or degradable chemical substances in the groundwater would remain unchanged for a lifetime of exposure. This is unrealistic as volatilization and/or degradation of these chemicals will likely occur over the lifetime of the resident. Therefore, the adjusted groundwater concentration of 1,1-dichloroethene and other volatile substances over a lifetime of exposure (i.e., 30 years) will probably be lower than the exposure point concentration used in this risk assessment. Carcinogenic risks through the groundwater pathway may have been overestimated.

- There is uncertainty associated with the model used for estimation of inhalation risks during noningestion uses of groundwater (Subsection 4.3.6.2). It was assumed that exposure to volatile organics through inhalation in showers is equivalent to an ingestion contact of 1 to 4 L/day for an adult (McKone and Knezovich, 1991). Use of the upper end value of 4 liters/day for the adult and 2 liters/day for the child may have potentially overestimated the risks through noningestion uses of groundwater.

4.6.4 Uncertainties Associated with Toxicity Assessment/Risk Characterization

Some of the uncertainties associated with the toxicity assessment include:

- In developing cancer slope factors, EPA assumes that there is no threshold for cancer development and that the risk of cancer is linearly related to dose. This means that even if cancer was noted in laboratory animals at relatively high doses, it is conservatively assumed that these high doses can be extrapolated down to extremely small doses with some risk of cancer remaining until the dose is zero. The slope factors are usually derived by EPA using a linearized multistage model and usually reflect an upper-bound limit of the potency of the chemical. As a result, the calculated cancer risk is likely to represent a plausible upper limit to the risk. The actual risk is unknown, but is likely to be lower than the predicted risk (EPA, 1986; EPA, 1989a) and may be even as low as zero.

- Arsenic posed a carcinogenic risk of greater than 1E-04 through the groundwater pathway. There has been considerable controversy regarding the oral slope factor for arsenic. Some of the controversy has stemmed from questions regarding the possibility of other unidentified contributory factors (e.g., race, nutritional status) associated with the epidemiological study on which the oral slope factor is based. According to a memo from the EPA Administrator, "The uncertainties associated with ingested arsenic are such that estimates could be modified downwards as much as an order of magnitude relative to risk estimates associated with most other carcinogens" (IRIS, 1994). Therefore, the carcinogenic risk due to arsenic may have been overestimated. Also, the upper 95 percent confidence limit concentration for arsenic (47 μg/l), used to calculate the carcinogenic risk, is lower than its MCL of 50 μg/l.

- The chemicals not quantitatively evaluated in the risk assessment as a consequence of lack of toxicity values represent a source of uncertainty in the final risk estimates. Specifically, 1,1,1-trichloroethane, although detected at the highest concentrations amongst all VOCs, was not quantitatively evaluated through the ingestion of groundwater due to the unavailability of an oral reference dose. The total risk may have been underestimated as a result of lack of toxicity information for several chemicals.

- Risk/dose estimates were assumed to be additive for a receptor through all applicable exposure routes in the absence of information on synergistic and antagonistic effects for chemicals. Also, in adding the hazard quotients for different chemicals, the assumption made is that all of the chemicals have the same toxic endpoint by the same mechanism of action which is usually not the case. Therefore, the assumed additivity of hazard quotients for different chemicals leads to uncertainty in calculating hazard indices for exposure pathways through all exposure routes combined. These factors may have resulted in overestimation or underestimation of the risks depending on the toxic endpoints and the presence of synergistic or antagonistic effects.

4.6.5 Central Tendency Evaluation

The central tendency exposure (CTE) was evaluated for those receptors for which, the total risk under reasonable maximum exposure (RME) from all exposure routes and all chemicals combined was greater either than 1E-4 for cancer effects or a hazard index of 1 for noncarcinogenic effects. The future resident scenario (child and adult exposure) meet these criteria. The objective of the central tendency evaluation was to estimate the average risks for receptors evaluated at the Circuitron Corporation Site. A 5-13 year old future resident was chosen for the central tendency evaluation (EPA, 1994).

In the CTE scenario, the upper 95 percent confidence limit concentration was still used as exposure concentration, but average, rather than reasonable maximum estimates were used for some exposure parameters (e.g., exposure frequency, exposure duration). The exposure parameters and the receptor evaluation for the central tendency evaluation are presented in Tables 4-5 and 4-6. The doses calculated for the future resident under the CTE scenario are presented in Tables 4-23 (lifetime average daily doses) and 4-24 (average daily doses). The following subsection presents the results of the central tendency evaluation.

4.6.5.1 Risk Results

Carcinogenic Risk

Total carcinogenic risks are summarized in Table 4-25 by exposure pathway for the 5-13 year old future resident for the CTE scenario. The carcinogenic risks are presented by chemical and exposure route in Table 4-26. The percent distribution of these risks by chemical and exposure route is presented in Table 4-27.

The total excess incremental carcinogenic risk for the 5-13 year old future resident from exposure to groundwater was 5 in 10,000 (4.7E-04). The majority (89%) of the

Table 4-23
Future Resident (5-13 yr old) - CTE
Estimated Daily Intakes Through All Exposure Routes
Over a Lifetime (70 years)
(Groundwater - On-Property and Off-Property Wells)
Based on Upper 95 Percent Confidence Limit Concentration

Chemical	Ingestion of Groundwater (mg/kg-day)	Noningestion Uses of Groundwater (mg/kg-day)
ORGANICS		
Chloroform	3.20E-06	4.80E-06
1,1-Dichloroethane	5.25E-05	7.87E-05
1,1-Dichloroethene	2.77E-05	4.15E-05
Tetrachloroethene	1.15E-05	1.72E-05
1,1,2-Trichloroethane	3.20E-06	4.80E-06
Trichloroethene	4.63E-05	6.94E-05
INORGANICS		
Arsenic	2.24E-04	NC
Beryllium	1.57E-06	NC
Lead	1.48E-04	NC

NC = Chemical is not of concern through this exposure route.

Table 4-24
Future Resident (5-13 yr old) - CTE
Estimated Daily Intakes Through All Exposure Routes
Over a 9-Year Duration
(Groundwater - On-Property and Off-Property Wells)
Based on Upper 95 Percent Confidence Limit Concentration

Chemical	Ingestion of Groundwater (mg/kg-day)	Noningestion Uses of Groundwater (mg/kg-day)
ORGANICS		
Acetone	6.68E-04	1.00E-03
2-Butanone	2.23E-04	3.34E-04
Chlorobenzene	2.15E-05	3.23E-05
Chloroform	2.49E-05	3.73E-05
1,1-Dichloroethane	4.08E-04	6.12E-04
1,1-Dichloroethene	2.15E-04	3.23E-04
cis-1,2-Dichloroethene	5.94E-05	8.91E-05
Tetrachloroethene	8.91E-05	1.34E-04
Toluene	2.08E-05	3.12E-05
1,1,1-Trichloroethane	6.72E-03	1.01E-02
1,1,2-Trichloroethane	2.49E-05	3.73E-05
Trichloroethene	3.60E-04	5.40E-04
INORGANICS		
Aluminum	1.37E-01	NC
Arsenic	1.74E-03	NC
Barium	1.39E-02	NC
Beryllium	1.22E-05	NC
Chromium (III)	1.90E-02	NC
Chromium (VI)	3.12E-03	NC
Copper	5.42E-01	NC
Lead	1.15E-03	NC
Manganese	5.26E-02	NC
Nickel	1.74E-03	NC
Silver	2.19E-04	NC
Vanadium	6.31E-04	NC
Zinc	5.83E-03	NC

NC = Chemical is not of concern through this exposure route.

Table 4–25
Summary of Carcinogenic Risks by Exposure Pathway, Receptor, and Chemical – CTE Scenario
Circuitron Corporation Site

			Chemicals with a Carcinogenic Risk > or = 1E–06		
Exposure Pathway	Receptor	Total Carcinogenic Risk	Chemical	Carcinogenic Risk	% Contribution To Total Carcinogenic Risk
Groundwater	5–13 Year Old Resident	Total Carcinogenic Risk = 4.7E–04 * carcinogenic risk from ingestion uses = 4.2E–04 * carcinogenic risk from noningestion uses = 5.1E–05	Arsenic	3.9E–04	84%
			1,1–Dichloroethene	6.6E–05	14%
			Beryllium	6.8E–06	1%

Table 4-26
Future Resident (5-13 yr old) - CTE
Potential Carcinogenic Risk Through All Exposure Routes
(Groundwater - On-Property and Off-Property Wells)
Based on Upper 95 Percent Confidence Limit Concentration

Chemical	Ingestion of Groundwater	Noningestion Uses of Groundwater	Total
ORGANICS			
Chloroform	1.95E-08	3.88E-07	4.08E-07
1,1-Dichloroethane	NTV	NTV	NA
1,1-Dichloroethene	1.66E-05	4.98E-05	6.64E-05
Tetrachloroethene	5.96E-07	3.44E-08	6.30E-07
1,1,2-Trichloroethane	1.82E-07	2.73E-07	4.56E-07
Trichloroethene	5.09E-07	4.17E-07	9.26E-07
INORGANICS			
Arsenic	3.93E-04	NC	3.93E-04
Beryllium	6.77E-06	NC	6.77E-06
Lead	NTV	NC	NA
TOTAL	4.17E-04	5.09E-05	4.68E-04

NA = Not applicable.
NC = Chemical is not of concern through this exposure route.
NTV = No toxicity value was available.

Table 4-27
Future Resident (5-13 yr old) - CTE
Distribution of Lifetime Carcinogenic Risk as Percent of Total Risk
(Groundwater - On-Property and Off-Property Wells)
Based on Upper 95 Percent Confidence Limit Concentration

Chemical	Ingestion of Groundwater	Noningestion Uses of Groundwater	Total
ORGANICS			
Chloroform	0.00	0.08	0.09
1,1-Dichloroethane	NTV	NTV	NA
1,1-Dichloroethene	3.55	10.64	14.19
Tetrachloroethene	0.13	0.01	0.13
1,1,2-Trichloroethane	0.04	0.06	0.10
Trichloroethene	0.11	0.09	0.20
INORGANICS			
Arsenic	83.85	NC	83.85
Beryllium	1.45	NC	1.45
Lead	NTV	NC	NA
TOTAL	89.12	10.88	100.00

0.00 = Contribution is less than 0.01 percent.
NA = Not applicable.
NC = Chemical is not of concern through this exposure route.
NTV = No toxicity value was available.

total carcinogenic risk was contributed by the ingestion of groundwater. Arsenic and 1,1-dichloroethene contributed 98% of the total carcinogenic risk. The carcinogenic risk for arsenic was 3.9E-04 through the ingestion of groundwater. The upper 95 percent confidence limit concentration for arsenic (47 μg/l), used to calculate the carcinogenic risk, is lower than its MCL of 50 μg/l. The carcinogenic risk for 1,1-dichloroethene was 6.6E-05 primarily through noningestion uses of groundwater.

Other chemicals which exceeded a carcinogenic risk of 1E-06 are presented in Table 4-25.

EPA regulates maximum carcinogenic risks in the range 1E-04 to 1E-06. The total carcinogenic risk calculated for the 5-13 year old future resident from exposure to groundwater is higher than the regulatory risk range of 1E-06 to 1E-04. These results indicate significant potential carcinogenic risk to the 5-13 year old future resident through the groundwater pathway for the CTE scenario.

Noncarcinogenic Risk

Noncancer hazard quotients and total hazard indices are summarized in Table 4-28 by exposure pathway for the 5-13 year old future resident for the CTE scenario. The hazard quotients and indices are presented by chemical and exposure route in Table 4-29. The percent distribution of these hazard quotients and indices by chemical and exposure route are presented in Table 4-30.

The total hazard index for the 5-13 year old future resident from exposure to groundwater was 32. More than 99% of the total hazard index was contributed by ingestion of groundwater. Copper, manganese, and arsenic contributed 96% of the total hazard index. The hazard indices for copper, manganese, and arsenic were 15, 11, and 6 respectively, through ingestion of groundwater. The upper 95 percent confidence limit concentration for arsenic (47 μg/l), used to calculate the hazard

Table 4–28
Summary of Hazard Indices by Exposure Pathway, Receptor, and Chemical – CTE Scenario
Circuitron Corporation Site

Exposure Pathway	Receptor	Total Hazard Index	Chemicals with Hazard Index > or = 1		
			Chemical	Hazard Index	% Contribution To Total Hazard Index
Groundwater	5–13 Year Old Resident	Total Hazard Index = 32 * hazard index from ingestion uses = 32 * hazard index from noningestion uses = 0.05	Copper Manganese Arsenic	15 11 6	45% 33% 18%

Table 4-29
Future Resident (5-13 yr old) - CTE
Hazard Quotients and Indices Through All Exposure Routes
(Groundwater - On-Property and Off-Property Wells)
Based on Upper 95 Percent Confidence Limit Concentration

Chemical	Ingestion of Groundwater	Noningestion Uses of Groundwater	Total
ORGANICS			
Acetone	6.68E-03	NTV	6.68E-03
2-Butanone	3.71E-04	3.34E-04	7.05E-04
Chlorobenzene	1.08E-03	6.46E-03	7.54E-03
Chloroform	2.49E-03	NTV	2.49E-03
1,1-Dichloroethane	4.08E-03	6.12E-03	1.02E-02
1,1-Dichloroethene	2.39E-02	NTV	2.39E-02
cis-1,2-Dichloroethene	5.94E-02	NTV	5.94E-02
Tetrachloroethene	8.91E-03	NTV	8.91E-03
Toluene	1.04E-04	7.79E-05	1.82E-04
1,1,1-Trichloroethane	NTV	3.48E-02	3.48E-02
1,1,2-Trichloroethane	6.22E-03	NTV	6.22E-03
Trichloroethene	6.00E-02	NTV	6.00E-02
INORGANICS			
Aluminum	NTV	NC	NA
Arsenic	5.82E+00	NC	5.82E+00
Barium	1.98E-01	NC	1.98E-01
Beryllium	2.45E-03	NC	2.45E-03
Chromium (III)	1.90E-02	NC	1.90E-02
Chromium (VI)	6.24E-01	NC	6.24E-01
Copper	1.46E+01	NC	1.46E+01
Lead	NTV	NC	NA
Manganese	1.05E+01	NC	1.05E+01
Nickel	8.72E-02	NC	8.72E-02
Silver	4.38E-02	NC	4.38E-02
Vanadium	9.01E-02	NC	9.01E-02
Zinc	1.94E-02	NC	1.94E-02
TOTAL	3.22E+01	4.77E-02	3.23E+01

NA = Not applicable.
NC = Chemical is not of concern through this exposure route.
NTV = No toxicity value was available.

Table 4-30
Future Resident (5-13 yr old) - CTE
Distribution of Hazard Quotient and Indices as Percent of Total Hazard Index
(Groundwater - On-Property and Off-Property Wells)
Based on Upper 95 Percent Confidence Limit Concentration

Chemical	Ingestion of Groundwater	Noningestion Uses of Groundwater	Total
ORGANICS			
Acetone	0.02	NTV	0.02
2-Butanone	0.00	0.00	0.00
Chlorobenzene	0.00	0.02	0.02
Chloroform	0.01	NTV	0.01
1,1-Dichloroethane	0.01	0.02	0.03
1,1-Dichloroethene	0.07	NTV	0.07
cis-1,2-Dichloroethene	0.18	NTV	0.18
Tetrachloroethene	0.03	NTV	0.03
Toluene	0.00	0.00	0.00
1,1,1-Trichloroethane	NTV	0.11	0.11
1,1,2-Trichloroethane	0.02	NTV	0.02
Trichloroethene	0.19	NTV	0.19
INORGANICS			
Aluminum	NTV	NC	NA
Arsenic	18.01	NC	18.01
Barium	0.61	NC	0.61
Beryllium	0.01	NC	0.01
Chromium (III)	0.06	NC	0.06
Chromium (VI)	1.93	NC	1.93
Copper	45.37	NC	45.37
Lead	NTV	NC	NA
Manganese	32.58	NC	32.58
Nickel	0.27	NC	0.27
Silver	0.14	NC	0.14
Vanadium	0.28	NC	0.28
Zinc	0.06	NC	0.06
TOTAL	99.85	0.15	100.00

0.00 = Contribution is less than 0.01 percent.
NA = Not applicable.
NC = Chemical is not of concern through this exposure route.
NTV = No toxicity value was available.

index for arsenic, is lower than its MCL of 50 μg/l. Other chemicals which exceeded a hazard index of one are presented in Table 4-28.

The critical toxic endpoints for copper and manganese are gastrointestinal irritation and central nervous system effects, respectively. The critical toxic endpoints for arsenic include keratosis (skin effects), hyperpigmentation (skin effects), and possible vascular problems. Consequently, the calculated hazard indices for copper, manganese, and arsenic are not additive because each chemical results in varying critical toxic endpoints or effects. Therefore, the total hazard index is equal to 15 (hazard index for copper) which represents the maximum of the hazard indices calculated for copper, manganese, and arsenic. The calculated total hazard index of 32 (through all chemicals and all exposure routes) overestimates the potential for toxic effects.

If a hazard quotient or hazard index exceeds "one" (>1), it indicates that there is a potential for noncarcinogenic health effects under the defined exposure conditions. The total hazard index calculated for the 5-13 year old future resident from exposure to groundwater is greater than one. These results indicate a potential for adverse noncarcinogenic health effects to the 5-13 year old future resident from exposure to groundwater for the CTE scenario.

4.7 SUMMARY OF THE RISK ASSESSMENT RESULTS

The following narrative presents a discussion of the major pathways of exposure and chemicals which contributed the highest risks on-property and off-property under the reasonable maximum exposure (RME) scenario. The results should be interpreted keeping in perspective the key uncertainties associated in the various steps of the risk assessment.

There are currently no receptors to the groundwater contamination identified in the Upper Glacial aquifer in this FFS. All residents in the vicinity of the Circuitron

Corporation Site obtain potable water from monitored public supply wells. In this risk assessment, for future land use conditions, a resident (child and adult) was evaluated for exposure to on-property and off-property groundwater in the upper 40 feet of the saturated aquifer. This is a conservative scenario considering no current household uses of on-property or off-property groundwater exist.

The results show significant carcinogenic risk (total excess carcinogenic risk of 1 in a population of 1,000). The majority of the carcinogenic risk was contributed by arsenic through ingestion of groundwater and 1,1-dichloroethene primarily through noningestion uses of groundwater. The noncarcinogenic risk results show a potential for adverse noncarcinogenic health effects to occur to the future child and adult resident (calculated hazard indices were greater than one). The majority of the noncarcinogenic risk was contributed by copper, manganese, and arsenic through ingestion of groundwater. It should be noted that, although arsenic contributed significant carcinogenic and noncarcinogenic risks, the upper 95 percent confidence limit concentration for arsenic, used to calculate the carcinogenic and noncarcinogenic risks, is lower than its MCL of 50 μg/l. Since this risk assessment uses the combination of reasonable maximum exposure estimates and conservative toxicity values, the results represent upper-bound or conservative estimates of carcinogenic and noncarcinogenic risks.

1,1,1-Trichloroethane was detected at highest concentrations amongst the volatile organic chemicals in groundwater. 1,1,1-Trichloroethane was used as the fingerprint contaminant to depict distribution of contamination in the Upper Glacial and Magothy aquifers. However, the noncarcinogenic risk due to 1,1,1-trichloroethane through ingestion of groundwater could not be calculated due to lack of an oral reference dose. Therefore, the total noncarcinogenic risk through the groundwater pathway may have been underestimated.

SECTION 5

DEVELOPMENT OF REMEDIAL ACTION ALTERNATIVES

Based upon the results of the field investigation and the human health risk assessment described in Sections 1 to 4, the off-property groundwater contaminated by the Circuitron Corporation Site warrants further consideration for remediation. The U.S. EPA and WESTON have determined that sufficient data exists regarding the contaminants in the shallow Upper Glacial aquifer (upper 40 feet of saturated thickness) to warrant the consideration of a remedial action independent of the other contaminant concerns within the underlying deeper Upper Glacial and Magothy aquifers. The shallow Upper Glacial groundwater contamination plume was determined to consist of elevated concentrations of organics (primarily 1,1,1-trichloroethane and 1,1-dichloroethene) and inorganics (primarily chromium and copper), which have migrated at least 700 feet beyond the southern property line of the Circuitron Corporation Site, with a width of about 600 feet. This plume extends vertically approximately 40 feet into the upper saturated zone of the Upper Glacial aquifer.

The risk assessment presented in Section 4 indicated that the contaminants in the groundwater in the shallow Upper Glacial aquifer at the Circuitron Corporation Site pose an elevated risk to human health for both carcinogenic and noncarcinogenic materials. It indicated that remediation is warranted to both protect future users of the shallow aquifer as well as to protect the underlying Magothy aquifer from contamination present in the Upper Glacial aquifer.

The remedial action objectives developed for the FFS include the remediation of the shallow Upper Glacial aquifer and further sampling of the groundwater in a downgradient direction to further define the extent of contamination. This FFS does not address the groundwater contamination caused by any other facility/site, nor does it address the contamination present in the site soils, sludges, and/or sediment. The contamination sources at the Circuitron Corporation Site are presently being addressed as a separate operable unit (OU-1) under a Record of Decision dated March 4, 1991.

5.1 OVERVIEW OF FFS PHASE I

This section addresses the first phase of the FFS screening process as presented in U.S. EPA's RI/FS Guidance Manual (1988). The FFS is a progressive screening process which occurs in three phases: Phase 1 - the development of remedial action alternatives, Phase 2 - the screening of remedial action alternatives, and Phase 3 - the detailed analysis or evaluation of the selected remedial action alternatives.

Phase 1 consists of the identification and evaluation of remedial technologies, the elimination of unsuitable remedial technologies, and assembly of the remaining technologies into remedial alternatives for further review. The six steps of this phase 1 screening process are:

Step 1 - Development of remedial action objectives;

Step 2 - Identification of general response actions for each remedial action objective;

Step 3 - Determination of media to which general response actions might be applied;

Step 4 - Identification of appropriate feasible technologies and process options applicable to each general response action;

Step 5 - Evaluation of technology process options based on the criteria of effectiveness, implementability, and cost;

Step 6 - Assembling feasible technology process options into remedial action alternatives, representing a range of treatment and containment combinations.

Appropriate remedial action objectives consisting of environmental media-specific goals for the protection of human health and the environment are identified in the first step. Remedial action objectives specify the constituents of concern, potential exposure routes and receptors, and acceptable constituent concentrations or ranges of concentrations for each potential exposure route.

In the second step, appropriate general response actions are determined which involve either the identification of measures that could provide a remedy or the incorporation of measures into a coordinated remedy. General response actions identify those actions which, by themselves, or in conjunction with other general response actions, satisfy the remedial action objectives.

The third step identifies the media to which the general response actions can be applied. The physical/chemical characteristics of the site and the cleanup requirements identified in the remedial action objectives are considered in applying the general response actions.

The fourth step addresses the identification of feasible remedial technologies and technology process options existing within each general response action. Technology types are general categories of technologies (e.g., thermal treatment), while technology process options are specified processes within a technology (e.g., rotary kiln incineration). During this step, technology types and technology process options are screened on the basis of the site and waste characteristics and technical implementability.

In the fifth step, technology process options considered to be implementable are further assessed based on the screening criteria of effectiveness, implementability, and cost.

Feasible technology process options not eliminated in the fifth step can be assembled into remedial alternatives for the subsequent evaluation in Phases II and III of the FFS.

5.2 DEVELOPMENT OF REMEDIAL ACTION OBJECTIVES

As part of this FFS, groundwater-specific remedial action objectives were established to facilitate the development of remedial alternatives protective of human health and the environment. The remedial alternatives developed will protect human health and the environment by reducing concentrations of the contaminants of concern and potential exposures to these contaminants, as well as mitigating migration pathways. The remedial action objectives established below are applicable to the Circuitron Corporation Site and address the contaminants of concern present in the groundwater in the shallow Upper Glacial aquifer.

- Reduce the concentration of groundwater contaminants due to the Circuitron Corporation Site and present in the shallow Upper Glacial aquifer (upper 40 feet of saturated thickness) to NYS Drinking Water Standards, and

- Control the downgradient migration of contaminated groundwater.

Analytical testing for inorganic compounds during the FFS reported only sporadic elevated concentrations of these compounds detected at isolated locations on and off-property during the two rounds of groundwater sampling. A review and comparison of the turbidity data with the filtered groundwater data indicates that the concentration of many of the inorganic compounds were strongly influenced by the presence of turbidity in excess of 200 NTUs.

Additional groundwater sampling for the inorganic compounds present in groundwater, independent of that influenced by excess turbidity, will be obtained. These groundwater sampling activities will be performed early during the design phase for the selected remedial alternative, prior to finalization of the required inorganic groundwater treatment program.

5.3 IDENTIFICATION OF APPROPRIATE GENERAL RESPONSE ACTIONS

General response actions are those remedial actions which will satisfy the remedial objectives. The environmental media of concern to be remediated will be the contaminated groundwater present in the shallow Upper Glacial aquifer (upper 40 feet of saturated thickness) beneath and downgradient of the Circuitron Corporation Site. The groundwater in the shallow Upper Glacial Aquifer has been identified by WESTON (WESTON, 1994) to contain metals (inorganics) and volatile organic compounds above NYS Drinking Water Standards. The U.S. EPA and WESTON have determined that sufficient data exist regarding the contaminants in the shallow Upper Glacial aquifer attributable to Circuitron to perform a remedial action independent of the contamination in the deeper Upper Glacial and Magothy aquifers.

The principal objectives of this remedial action are to reduce the level of contaminants in the shallow Upper Glacial aquifer to concentrations which comply with the NYS Drinking Water Standards and control the continued downgradient migration of the contaminated groundwater. All of the other contaminated media (soil/sediment, sludges and miscellaneous artifacts and debris) present on-site are presently being addressed under a separate operable unit, OU-1. Additionally, the downgradient extent of contamination in the shallow Upper Glacial aquifer will be further defined during the groundwater remedial design phase through the installation of additional monitoring wells to determine the downgradient extent of groundwater contamination.

The following general response actions are considered to be appropriate and applicable for addressing the contamination of groundwater in the shallow Upper Glacial aquifer:

- No Action/Institutional Controls

  Under this response action, no remedial actions will be attempted on the groundwater. This response action is required to be considered by the NCP to provide a baseline for other general response actions. Institutional controls which prohibit future groundwater usage and exposure to contaminants will be implemented under this action.

- Containment

  Under this response action, remedial action will take the form of reducing or eliminating contaminant flow by installing subsurface barriers. While subsurface barriers are not effective in removing the contaminants of concern from the environment, they can be effective in controlling their areal distribution and protecting downgradient receptors from becoming impacted, thereby protecting human health and the environment from the further spread of an existing contaminant plume.

- Groundwater Collection

  A collection response action removes or collects the contaminants from the environment without altering either the physical state or the chemistry of the contaminants. In the case of remediation of groundwater contaminant plumes, the collection response action is coupled with either treatment or disposal response actions for the overall remedial strategy.

- Treatment

  This response action alters the chemistry of the groundwater plume to render the contaminants less toxic, less mobile, or of reduced volume. Treatment actions may be performed in-situ, or, when coupled with collection response actions, ex-situ. The treatment response action encompasses physical, chemical, biological or thermal treatment technologies.

- Disposal

  This response action addresses the ultimate location of contaminants, treated media, and treatment residuals. It generally encompasses on-site recharge of treated groundwater, off-site discharge (either to groundwater, surface water or publicly owned treatment works) of treated and/or pretreated groundwater, and off-site disposal of treatment residuals such as treatment plant sludges and exhausted treatment media (i.e., activated carbon, ion exchange resins, etc.)

5.4 GROUNDWATER CHARACTERISTICS AFFECTING TREATMENT SYSTEM DESIGN

As previously described, the volatile organic and inorganic contamination plume present in the shallow Upper Glacial aquifer and due to the operations at the Circuitron Corporation Site are present at least 700 feet and extends up to 1,000 feet downgradient of the site. Table 5-1 summarizes the maximum concentrations of contaminants present in the groundwater in the shallow Upper Glacial aquifer (present in monitoring wells MW-1S, MW-2S, MW-3S, MW-4S, MW-5S, MW-6S, MW-7S, PD-1, MW-13 and MW-14) during the WESTON February 1994 sampling episode.

Assuming worst case concentrations present during the WESTON February 1994 groundwater sampling episode for wells screened in the shallow Upper Glacial aquifer, the volatile organic compounds attributable to the Circuitron Corporation Site and present above NYS Drinking Water Standards include 1,1,1-trichloroethane (4,400 ug/l), 1,1-dichloroethene (58 ug/l), 1,1-dichloroethane (52 ug/l) and tetrachloroethene (38 ug/l). The inorganics present above NYS Drinking Water Standards in the shallow Upper Glacial aquifer include arsenic (74 ug/l), iron (327,000 ug/l), manganese (4,400 ug/l), copper (2,550 ug/l), chromium (282 ug/l), lead (55 ug/l) and barium (355 ug/l).

TABLE 5-1

GROUNDWATER CHARACTERISTICS AFFECTING TREATMENT SYSTEM DESIGN

Groundwater Characteristics	Maximum Concentrations (ug/l)
Inorganics	
Chromium (total)	282
Iron	327,000
Manganese	4,400
Copper	2,550
Organics	
Trichloroethene	.1
1,1,1-Trichloroethane	4,400
1,1-Dichloroethane	52
1,1-Dichloroethene	6
Tetrachloroethene	22
Miscellaneous Parameters	
pH	5.3 - 8.6
TDS	107 - 514
Turbidity	.48 - >200
Temperature	10.7 - 21.7°C
Alkalinity	2 - 240
Hardness	50.9 - 273
TSS	ND - 370

The ranges for the groundwater characteristics which could affect treatment system design include pH (5.3 - 8.6 units), total dissolved solids (107 - 514 mg/l), temperature (10.7 - 21.7 degrees centigrade), alkalinity (2 - 240), hardness (50.9 - 273), total suspended solids (ND - 370), and turbidity (.48 - >200).

Assuming that the length of contaminated groundwater plume is approximately 1,000 feet, associated width of 600 feet and soil porosity of 0.3, the volume of groundwater to be remediated in the shallow Upper Glacial Aquifer (upper 40 feet of saturated thickness) is approximately:

$$40 \times 0.3 \times 1000 \times 600 \times 7.48 = 5.3856 \times 10^7 \text{ gallons}$$

5.5 IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLOGIES AND TECHNOLOGY PROCESS OPTIONS

The remedial technologies and technology process options applicable to each general response action for the groundwater in the contaminated shallow Upper Glacial aquifer are identified below. A summary of the remedial technologies types and process options is presented in Table 5-2.

During the initial screening step, process options and remedial technologies are removed from further consideration if they failed a screening for technical implementability. The remedial technology screening is specific and was performed using information gained from the remedial investigations conducted at the site (Ebasco, 1990; WESTON, 1993 and 1994). The remedial technology process options identified in Table 5-2 are described below.

5.5.1 No Action/Institutional Controls

Description: Under this response action, no remedial action will be taken to address concerns due to the contaminated groundwater. The no action alternative is required to be considered by the NCP to provide a baseline against which all other alternatives may be compared. In

TABLE 5-2

INITIAL SCREENING OF TECHNOLOGIES FOR REMEDIATION OF CONTAMINATED GROUNDWATER AT CIRCUITRON CORPORATION SITE EAST FARMINGDALE, SUFFOLK COUNTY, NEW YORK

General Response Action	Remedial Technology	Process Option	Description	Screening Comments & Site Applicability
No Action/Institutional Controls	None	Not Applicable, deed restrictions	No action; deed restrictions on future groundwater use	Required for consideration by National Contingency Plan.
Containment	Subsurface Barriers	Slurry Walls	Low permeability subsurface cut-off walls to contain areas of direct groundwater flows	Not applicable due to the absence of a confining layer beneath the Site.
		Sheet Piling	Install sheet piling to contain/divert groundwater/surface water flows/soil sediment	Questionable containment integrity; applicable for temporary barriers only.
		Grout Curtains	Pressure injection of grout in a regular pattern of drilled holes to contain contamination and/or divert groundwater flows	Not applicable. Questionable integrity due to presence of unconsolidated sediments.
		Diaphragm Walls	Barriers composed of reinforced concrete panels emplaced by slurry trenching techniques	Not applicable for the site due to the absence of a confining layer beneath the Site.
Groundwater Collection	Pumping Systems	Well Point Dewatering Systems	Well point systems consist of a group of closely spaced wells connected to a header pipe and pump.	For maximum operating efficiency, lift attainable by pump is about 22 feet. Does not meet lift requirements. Not applicable.

TABLE 5-2 (CONTINUED)

INITIAL SCREENING OF TECHNOLOGIES FOR REMEDIATION OF CONTAMINATED GROUNDWATER AT CIRCUITRON CORPORATION SITE EAST FARMINGDALE, SUFFOLK COUNTY, NEW YORK

General Response Action	Remedial Technology	Process Option	Description	Screening Comments & Site Applicability
		Ejector Wells	Groundwater is extracted by bubbling air through well casings, forming a corresponding rise in water levels.	Very low operating efficiencies. Well design is for high-lift, low-flow conditions. Not applicable.
		Pumping Wells	Series of conventional groundwater wells used to extract contaminated groundwater	Potentially applicable.
	Subsurface Drains	French Drains	A drainage system of tiles or perforated pipe backfilled with permeable media to intercept and collect contaminated groundwater	Generally limited to shallow depths (1-20 feet). Not applicable.
Treatment - Groundwater	Physical	Aeration, coagulation, flocculation and sedimentation	Aeration, coagulation and settling out of particles in groundwater	Potentially applicable.
		Filtration	Using porous materials in a filter bed to separate particles in groundwater/surface water.	Potentially applicable.
		Granular Activated Carbon	Adsorption of contaminants into activated carbon columns.	Potentially applicable.
		Ion Exchange	Exchange of constituent ions when groundwater/surface water passed through resin beds.	Potentially applicable.
		Air Stripping	Mass transfer process in which volatile contaminants are evaporated into the air.	Potentially applicable.

TABLE 5-2 (CONTINUED)

INITIAL SCREENING OF TECHNOLOGIES FOR REMEDIATION OF CONTAMINATED GROUNDWATER AT CIRCUITRON CORPORATION SITE EAST FARMINGDALE, SUFFOLK COUNTY, NEW YORK

General Response Action	Remedial Technology	Process Option	Description	Screening Comments & Site Applicability
		Steam Stripping	A continuous fractional distillation process using steam to evaporate volatile contaminants from aqueous waste.	Not applicable for wastes containing low concentrations of organics.
		Critical Fluid Extraction	Extraction of contaminants from aqueous streams using carbon dioxide at its critical point under high pressure.	Not applicable for wastes containing low concentrations of contaminants.
		Reverse Osmosis	Use of high pressures to force aqueous waste streams through semi-permeable membranes.	Potentially applicable.
		Oil-Water Separation	Removing oil and grease from aqueous waste stream by utilizing the difference in terminal velocities existing between substances of different densities.	Not applicable because of the absence of floating product in the shallow Upper Glacial aquifer.
		Air Sparging/Soil Vapor Extraction	Two physical treatment processes that address the remediation of volatile organic groundwaters and soil.	Potentially applicable.
		Thickening/Dewatering	A process used to increase the solids content of sludges.	Potentially applicable.
	Chemical	Neutralization	Introduction of dilute acids and bases into aqueous waste stream to bring the pH to 7.0	Potentially applicable.

TABLE 5-2 (CONTINUED)

INITIAL SCREENING OF TECHNOLOGIES FOR REMEDIATION OF CONTAMINATED GROUNDWATER AT CIRCUITRON CORPORATION SITE EAST FARMINGDALE, SUFFOLK COUNTY, NEW YORK

General Response Action	Remedial Technology	Process Option	Description	Screening Comments & Site Applicability
		Chemical Precipitation	Changing the chemical equilibrium of aqueous streams to reduce constituent mobility and enhance removal by settling or other physical means.	Potentially applicable.
		Ultraviolet/Hydrogen Peroxide	Uses a simultaneous application of ultraviolet light and ozone for the oxidation of contaminants in aqueous waste streams.	Potentially applicable.
	Biological	Suspended Growth - Activated Sludge	Aerobic degradation of organics using suspended microorganisms in completely mixed reactors.	The presence of the inorganics may be harmful to the microorganisms. Not applicable.
		Fixed Film Growth - Rotating Biological Contractor, Trickling filters, etc.	Aerobic degradation of organics using microorganisms attached to a fixed medium.	Potentially applicable.
		Bio-reclamation	In-situ treatment of groundwater using either injection/extraction wells or subsurface drains.	Feasible only for treatment of non-halogenated organics which are not significant contaminants of concern at the Circuitron Site. Not applicable.
	Thermal	Rotary-Kiln Incineration	On-site unit will use high temperature oxidation under controlled conditions to destroy organic constituents in aqueous waste streams.	Not suitable for treating aqueous waste streams having high concentrations of inorganics.

TABLE 5-2 (CONTINUED)

INITIAL SCREENING OF TECHNOLOGIES FOR REMEDIATION OF CONTAMINATED GROUNDWATER AT CIRCUITRON CORPORATION SITE EAST FARMINGDALE, SUFFOLK COUNTY, NEW YORK

General Response Action	Remedial Technology	Process Option	Description	Screening Comments & Site Applicability
		Liquid Injection Incineration	On-site unit will use high temperature oxidation under controlled conditions to destroy organic constituents in aqueous waste streams.	Burners are susceptible to clogging. Not suitable for treating waste streams having high concentrations of inorganics.
		Pyrolysis	Destroys organics in aqueous wastes by pyrolyzing them into combustible gases.	Not suited for inorganics. Also certain chlorinated organics produce hazardous PIPs.
		Wet Air Oxidation	Aqueous-phase oxidation process brought about when an organic and/or oxidizable inorganic-containing aqueous waste stream is mixed with oxygen.	Not suitable for inorganics or for wastes containing low concentrations of organics.
Disposal - Groundwater/ Wastewater Sludges	Off-Site	Discharge to Local POTW	Discharge raw, partially treated or treated groundwater to local POTW	Not applicable because the POTW will not accept any groundwater discharges.
		Disposal to Off-Site TSD	Off-site disposal to approved TSD.	Extremely large volumes of groundwater makes this option infeasible.

TABLE 5-2 (CONTINUED)

INITIAL SCREENING OF TECHNOLOGIES FOR REMEDIATION OF CONTAMINATED GROUNDWATER AT CIRCUITRON CORPORATION SITE EAST FARMINGDALE, SUFFOLK COUNTY, NEW YORK

General Response Action	Remedial Technology	Process Option	Description	Screening Comments & Site Applicability
	On-Site/Off-Site	Discharge to Surface Water	Discharge raw, partially treated or treated groundwater to surface waters; re-discharge partially treated or treated surface waters back to specific downgradient surface water body.	Not applicable because the stormwater flows do not flow into a nearby surface water body. Rather they are routed to injection galleries operated by East Farmingdale who will not accept any new discharges into these lines.
		Reinjection	Discharge treated groundwater upgradient or crossgradient of existing groundwater plume.	Potentially applicable.

addition, institutional controls such as perimeter fencing to restrict site access, deed restrictions to limit future land use, groundwater restrictions for potable water use to prevent future groundwater usage and exposure to contaminants will be instituted.

Initial Screening: SARA requires the consideration of a no action alternative during the FFS to serve as a basis for comparison with the other alternatives. Therefore, the no action option has been retained for further evaluation as required under 40 CFR 300.68(f). Since the contaminated shallow Upper Glacial aquifer is a source of further contamination to the deeper Upper Glacial and Magothy aquifers at the Circuitron Corporation Site, the no action option will be combined with the institutional controls option to provide better site control. The no action/institutional controls option will hence be retained for further evaluation.

5.5.2 Containment

5.5.2.1 Subsurface Barriers

Subsurface containment barriers are low-permeability cut-off or diversion walls installed to minimize or contain contaminant migration in groundwater both on-site and off-site.

5.5.2.1.1 Slurry Walls

Description: Soil/bentonite and cement/bentonite slurry walls are used for long-term containment with groundwater diversion and control. Slurry wall construction typically entails the excavation and backfilling of a trench with either a soil/bentonite or cement/bentonite slurry mixture. Soil/bentonite slurry walls are more flexible, achieve low hydraulic conductivities, and are cheaper than cement/bentonite slurry walls. Where superior strengths are required, cement/bentonite slurry walls can be constructed. To prevent underflow of contaminated groundwater, the slurry walls are typically keyed into underlying confining clay layers within an aquifer.

Initial Screening: Slurry walls are high performance containment barriers applicable to site remediation and can be used with various technologies and process options to achieve site closure. Chemical compatibility studies of the slurry mix with the groundwater would be a necessity. This option was not retained for further consideration because of the absence of a competent and laterally continuous clay confining layer beneath the Circuitron Corporation Site.

5.5.2.1.2 Sheet Piling

Description: Sheet pile barrier walls are formed by driving interlocking sheet piles constructed of wood, concrete, or steel to achieve short-term groundwater containment and diversion, as well to achieve structural stability of soil masses.

Initial Screening: Unpredictable wall integrity and costs make the use of sheet piling viable only for short-term containment, diversion control and structural stability. This option will only be retained for further evaluation for the construction of the expected groundwater collection and treatment remedy as necessary.

5.5.2.1.3 Grout Curtains

Description: Grout curtains are fixed, subsurface barriers formed by the pressure injection of grout in a regular pattern of drilled holes. Typically, the grout is injected into pipes arranged in a pattern of two or three adjacent rows. The injected grout fills open pore spaces and sets or gels in the soil voids reducing the permeability of the grouted area.

Initial Screening: Grout curtains are only applicable in fractured bedrock geologic conditions. This process option was not considered further.

5.5.2.1.4 Diaphragm Walls

Description: Diaphragm walls are barriers composed of reinforced concrete panels emplaced by slurry trenching techniques. They may be cast-in-place or pre-cast and are capable of supporting heavy loads. Diaphragm walls can only be expected to have permeabilities comparable to cement/bentonite walls if the joints between the cast panels are made correctly.

Initial Screening: The absence of a continuous clay confining layer beneath the site precludes the effectiveness of this option. This process option is hence not applicable for the Circuitron Corporation Site and was not retained for further evaluation.

5.5.3 Groundwater Collection

Groundwater pumping techniques actively manipulate groundwater in order to contain or remove a plume or to adjust groundwater levels to prevent the migration of a plume. Well types used in the groundwater collection system may include well points, ejector wells, and pumping wells, with the selection of the appropriate well type depending on the depth of contamination and the hydrogeologic characteristics of the aquifer.

5.5.3.1 Well Point Dewatering Systems

Description: A well point dewatering system consists of an array of well points (constructed of steel pipes with perforated tips) which are driven into the aquifer and connected at the surface by a manifold hooked to a vacuum system.

Initial Screening: Well point dewatering systems are best suited for shallow aquifers where extraction is not needed below 22 feet. At the Circuitron Corporation Site, the groundwater contamination is present at deeper depths and hence, well point dewatering systems were not retained for further evaluation.

5.5.3.2 Ejector Wells

Description: Ejector well construction specifications are similar to those of well points. Pumping and extraction of groundwater is achieved by bubbling air upward through the well casing and allowing the air pressure to lift the groundwater to the surface. Ejector wells are applicable for high-lift, low-flow conditions.

Initial Screening: Ejector wells are applicable to high-lift, low-flow conditions. These conditions are not consistent with the requirements or hydrogeology at the Circuitron Corporation Site and hence, were not further evaluated.

5.5.3.3 Pumping Wells

Description: Pumping wells are similar to traditional monitoring wells and are installed in a boring consisting of riser casing, well screen and sand filter pack. The wells can be installed at regular intervals to allow for the overlapping of the cones of depression (capture zones) created by simultaneous pumping to achieve the collection of contaminated groundwater and halt the migration of a plume.

Initial Screening: Pumping wells will be retained for further evaluation.

5.5.3.4 Subsurface Drains

Subsurface drains include any type of buried conduit used to convey and collect groundwater by gravity flow. They function like an infinite line of extraction wells, creating a continuous zone of influence enabling groundwater within these zones to flow toward the drain.

5.5.3.4.1 French Drains

Description: French drains installed at regular intervals across a site are constructed by the excavation of trenches in the aquifer of concern, placement of a perforated drainage pipe in the base of the trench, and backfilling the trench with aggregate. The individual drain pipes subsequently drain into a collection sump which can be emptied periodically.

Initial Screening: French drains are most effective to shallow depths of less than 20 feet. At the Circuitron Site, the groundwater contamination is also present at deeper depths, and hence, french drains were not retained for further evaluation.

5.5.4 Treatment - Groundwater

5.5.4.1 Physical

5.5.4.1.1 Aeration, Coagulation, Flocculation and Sedimentation

Description: Aeration, coagulation, flocculation and sedimentation are the combination of four processes for the removal of inorganics and solids in water. The aeration process induces the oxidation of dissolved inorganics like iron and manganese. Sedimentation is the separation of suspended particles that are heavier than water by gravitational settling. Coagulation is a technique directed towards the destabilization of colloidal particles in the water into larger particles which can settle out, while flocculation is a slow mixing technique which promotes the agglomeration of the destabilized particles to precipitate out of the water.

Initial Screening: Aeration, coagulation, flocculation and sedimentation are an integral part of any aqueous treatment alternative and are used specifically for the removal of dissolved inorganics and suspended solids. Reduction of organics and dissolved inorganics will also require treatment via other physical or chemical processes. This treatment technology will be considered for further evaluation.

5.5.4.1.2 Filtration

Description: Filtration is the separation and removal of suspended solids from a liquid brought about by passing the liquid through a porous medium comprised of a fibrous fabric, a screen, or a bed of granular material. To aid filtration, ground cellulose or diatomaceous earth is commonly added to the filter medium. Fluid flow through the filter media may be accomplished by gravity by inducing a partial vacuum on one side of the medium, or by exerting a mechanical pressure on a dewatered sludge enclosed by filter media.

Initial Screening: Filtration is used primarily to remove any residual suspended solids remaining in the water following coagulation/sedimentation. This treatment technology will be retained and considered.

5.5.4.1.3 Granular Activated Carbon

Description: Chemical contaminants can be removed from water by the physical and chemical adsorption of organics onto the surface of carbon particles. Wastewater is pumped through a bed of granular activated carbon where close contact with carbon particles promotes adsorption of contaminants. Carbon adsorption removes a broad range of organic contaminants and a select number of inorganic contaminants. Adsorption is reversible, so the exhausted carbon must be removed for disposal or regeneration.

Initial Screening: The technology is very effective and achieves a high level of contaminant removal. Operational guidelines for this technology are that contaminant concentrations should be less than 10,000 ppm with suspended solids less than 50 ppm (U.S. EPA, 1985). The process will be retained and evaluated for the Circuitron Site.

5.5.4.1.4 Ion Exchange

Description: Ion exchange is a process by which ions of a given species are displaced from an insoluble exchange material by ions of a different species in solution. Ion exchangers can be operated in either a batch or a continuous mode. Spent resin is usually regenerated by exposing it to a very concentrated solution of the original exchange ion, enabling a reverse exchange to take place, resulting in regenerated resin and a concentrated solution of the removed ion which can then be processed for recovery and reuse.

Initial Screening: The process is used to treat metal-containing wastes including cations and anions. Limitations to the ion exchange process are compound selectivity/competition, pH, and suspended solids. High solids concentrations sometimes lead to resin blinding. However, the treatability parameters of the Circuitron Site do not effect the use of this technology. The ion exchanges an evaluation process will be considered for further evaluation.

5.5.4.1.5 Air Stripping

Description: Air stripping is a mass transfer process in which volatile contaminants in water are transferred into the air. Air stripping is frequently accomplished in a packed tower equipped with an air blower. The factors important in the removal of organics from water include Henry's Law constants, temperature, pressure, air-to-water ratios and the surface area available for mass transfer. The recovery of volatilized hazardous gases by means of emission control apparatuses may be required for subsequent treatment to preclude air pollution concerns.

Preliminary Screening: The process is temperature dependent resulting in changing of the stripping efficiencies with the variation of temperatures. Air stripping is most effective for the removal of volatile organics as a pretreatment step prior to activated carbon. The process will be retained for further evaluation.

5.5.4.1.6 Steam Stripping

Description: Steam stripping uses steam to evaporate volatile organics from aqueous waste streams. Steam stripping is essentially a continuous fractional distillation process carried out in a packed or tray tower. Clean steam provides direct heat to the column in which gas flows from the bottom to the top of the tower. The resulting residuals are contaminated steam condensate, recovered solvent and stripped effluent. The organic vapor, and the bottoms would require further treatment.

Preliminary Screening: Steam stripping will treat less volatile and more soluble wastes than will air stripping and can handle concentrations from less than 100 ppm to about 10 percent organics. Because of the relatively lower concentrations of volatile organic compounds in the shallow Upper Glacial Aquifer, steam stripping was not considered further.

5.5.4.1.7 Critical Fluid Extraction

Description: Critical fluid extraction involves solvent extraction of the aqueous constituents and subsequent separation of the solvent and organics with the reuse of the solvent. The aqueous stream enters near the top of an extractor, while the solvent is fed countercurrently into the bottom. At or near the critical point of the gas, the organics in the aqueous stream dissolve into the solvent. Organic-laden extract can then be removed from the top of the column while clean water exits from the bottom. The extract then goes to a separator, where the temperature and pressure are decreased, causing the organics to separate from the solvent which is recycled and returned to the extractor.

Initial Screening: Critical fluid extraction can remove chlorinated hydrocarbons, phenols, benzene and its derivatives, alcohols, ketones, acids, oil and greases. The relatively low concentrations of these compounds precludes the usefulness of this technology at this site and hence is not considered further.

5.5.4.1.8 Reverse Osmosis

Description: Reverse osmosis uses a semipermeable membrane which will allow the passage of only certain components of a solution and a driving force to separate these components at a useful rate. The membrane is permeable to the solvent (groundwater), but impermeable to most dissolved organics and inorganics.

Initial Screening: Reverse osmosis may be used to concentrate dilute solutions of many inorganic and some organic solutes. Reprocessing may be necessary to optimize pH, remove strong oxidants, and filter out suspended solids. The process will be considered for further evaluation.

5.5.4.1.9 Oil-Water Separation

Description: Gravitational forces are used to separate two or more immiscible liquids having sufficiently different densities. Flow rates in continuous processes are kept low to enable liquid/liquid separation when the liquid mix is allowed to settle. Floating product/oil can be skimmed off the top using a skimmer, while the water flows out of the lower portion of the chamber. Acids may be used to break an oil/water emulsion and enhance separation to allow for greater removal efficiencies.

Initial Screening: Oil-water separation is usually a pretreatment process the effectiveness of which is influenced by the aqueous waste stream's rate of flow, temperature, and pH. The absence of floating product in the groundwater at the Circuitron Corporation Site precludes the usefulness of this technology. The process will hence not be considered for further evaluation.

5.5.4.1.10 Thickening/Dewatering

Description: Thickening/Dewatering is a process used to increase the solids content of sludge by removing a portion of the liquid fraction by such unit processes as centrifugation or filtration, etc.

Initial Screening: The process is generally proposed for water treatment sludges and will be considered for further evaluation.

5.5.4.1.11 Air Sparging/Soil Vapor Extraction

Description: Air Sparging and Soil Vapor Extraction are two physical treatment processes that address the remediation of volatile organic contaminated groundwaters and soils. Air sparging involves the injection of air below the groundwater surface to promote the volatilization of volatile organics from the groundwater into the vadose zone, which can then be removed via the soil vapor extraction (SVE) technology. SVE is an in-situ remediation technique whereby soil gas within the unsaturated contaminated soil zone is extracted using an applied vacuum at one or more extraction wells or trenches.

Initial Screening: The process is applicable to the Circuitron Corporation Site and will be considered for further evaluation.

5.5.4.2 Chemical

5.5.4.2.1 Neutralization

Description: Neutralization is the interaction of an acid with a base to enable the adjustment of the pH to 7.0, at which level the concentrations of hydrogen and hydroxyl ions are equal. The primary products of the reaction are salt and water. Neutralization is used to treat waste acids and alkalis in order to eliminate or reduce their reactivity and corrosivity.

Initial Screening: Neutralization will be retained for further consideration.

5.5.4.2.2 Chemical Precipitation

Description: Chemical precipitation is widely used for the removal of heavy metals wherein the chemical equilibrium of a waste is changed through the addition of an acid or alkali to reduce the solubility of the undesired components. This causes them to precipitate out of solution in the form of colloidal or solid particulates.

Initial Screening: The process is limited in that not all metals have a common pH at which they precipitate. Chelating and complexing agents can interfere with the precipitation process. Chemical precipitation will be retained for further evaluation.

5.5.4.2.3 Ultraviolet/Hydrogen Peroxide

Description: Ultraviolet radiation is electromagnetic radiation which has a wave length shorter than visible light but longer than x-ray radiation. Ultraviolet radiation causes the re-arrangement of molecular structures resulting in the formation of new chemical compounds. Hydrogen peroxide is an unstable, highly reactive oxidizing agent which when coupled with the ultraviolet radiation has been shown to be successful in the degradation of certain organic compounds in aqueous solutions.

Conventional ultraviolet/hydrogen peroxide techniques utilize a liquid-phase reaction wherein hydrogen peroxide is bubbled through the aqueous wastewater. The mixture is then exposed to ultraviolet radiation in a mixing tank leading to the degradation of the contaminants, and the splitting of the peroxide into free oxygen which causes further oxidation of the contaminant.

Initial Screening: Ultraviolet/hydrogen peroxide is generally restricted to waters with a one percent or lower concentration of hazardous contaminants. The process will be considered for further evaluation.

5.5.4.3 Biological

5.5.4.3.1 Suspended Growth - Activated Sludge

Description: The activated sludge process only treats aqueous organic waste streams having less than one percent suspended solids content. During the process, organic contaminants in the aqueous wastes are broken down through the activity of aerobic microorganisms which metabolize biodegradable organics. The treatment includes conventional activated sludge processes, as well as modifications such as sequencing batch reactors. The aeration process includes pumping the aqueous waste into an aeration tank where the biological treatment occurs. This is followed by the stream being sent to a clarifier where the treated water is separated from the sludge biomass.

Initial Screening: Activated sludge processes are not suitable for removing highly chlorinated organics, aliphatics, amines and aromatic compounds from an aqueous waste stream. In addition, some heavy metals and organic chemicals can be harmful to the microorganisms. The process will hence not be further evaluated.

5.5.4.3.2 Fixed Film Growth - Rotating Biological Contractor, Trickling Filters, Etc.

Description: Rotating biological contactors employ microorganisms attached to a fixed medium which is rotated through the aqueous waste stream in a closed reactor. In a trickling filter, the influent wastewater is distributed over a fixed media that serve as a substrate for the microbes. The fixed film growth systems aerobically treat aqueous waste streams containing alcohols, phenols, phthalates, cyanide, and ammonia.

Initial Screening: The fixed film growth systems are essentially applicable to the same waste streams as the activated sludge treatment process. The process will be further evaluated.

5.5.4.3.3 Bioreclamation

Description: Bioreclamation is used to treat contaminated media through the use of aerobic microbial degradation. The basic concept involves altering environmental conditions to enhance microbial catabolism or cometabolism of organic contaminants, leading to the breakdown and detoxification of those contaminants. It may be accomplished by in-situ treatment using injection/extraction wells. Extracted groundwater, is oxygenated, nutrients and bacteria are added and the liquids reinjected into the ground.

Initial Screening: The treatment has been successfully applied only to biodegradable non-halogenated organics, which are not significant contaminants of concern at the Circuitron Corporation Site. The process will not be retained for further evaluation.

5.5.4.4 Thermal

5.5.4.4.1 Rotary Kiln Incineration

Description: A rotary kiln incinerator consists of two combustion chambers. The primary chamber is the main combustion chamber for oxidizing organics, while the secondary combustion chamber or afterburner provides additional retention time for the destruction of organic vapors which may have escaped the primary unit before the complete oxidation. The capacity of these units are approximately 15 million BTU per hour, with waste residence time ranging from 30 to 60 minutes when burning sediment/soil. The primary chamber operates within the range of 1,800 to 3,000 degrees Fahrenheit, while the secondary chamber operates above 2,000 degrees. Energy for both the chambers is supplied using gas or oil.

Initial Screening: These units are normally used for waste/soil/sediment treatment and not contaminated groundwater. The throughput capacity of these units is not adequate for the treatment of large volumes of groundwater which could cause tremendous difficulties in maintaining suitable combustion conditions for destruction of the organic contaminants. Aqueous wastes with high inorganic salt content and/or heavy metals require special treatment. This process will not be considered further.

5.5.4.4.2 Liquid Injection Incineration

Description: Liquid injection incinerators are usually cylindrical refractory secondary combustors for low-calorific materials. Liquid wastes are introduced to the combustion chamber by means of specially designed nozzles which mix with air and fuel as needed. The resulting gases, following combustion, are collected and treated to remove particulates and to neutralize acid gases. Pretreatment may be required for feeding some aqueous wastes to specific nozzles to provide efficient mixing with the oxygen source and to maintain a continuous waste flow.

Initial Screening: The burners are susceptible to clogging by particulates or caked material at the nozzles. Heavy metal wastes and wastes having high inorganic contents are not suitable for treatment. The process will not be considered for further evaluation.

5.5.4.4.3 Pyrolysis

Description: Pyrolysis is the chemical decomposition of wastes accomplished in an oxygen deficient atmosphere. The system involves the use of two chambers. The separation of the volatile components from the non-volatile components and ash is achieved in the primary chamber (pyrolyzer). In the secondary combustion chamber, volatile components are burned under proper operating conditions to destroy any remaining hazardous components. Temperatures in the pyrolyzer range from 1,000 to 1,300° F.

Initial Screening: Pyrolysis is only applicable to wastes containing pure organics. Systems are usually designed for specific wastes and are not readily adaptable to a variety of wastes. In addition, pyrolysis of chlorophenols can lead to the formation of chlorodibenzofurans and chlorodibenzo-p-dioxins. The process will not be retained for further evaluation.

5.5.4.4.4 Wet Air Oxidation

Description: Wet air oxidation uses high temperature oxidation under controlled conditions to destroy dissolved or suspended organic waste constituents, oxidizable inorganics and wastes not readily amenable to biological treatment. Aqueous phase oxidation of organic constituents are achieved at temperatures between 350 to 650°F and pressures ranging from 300 to 3,000 psi. Liquid wastes are pumped into the system and are mixed with compressed air or oxygen. The air-waste mixture then passes through a heat exchanger before entering the reactor, where the oxygen in the air reacts with organic constituents in the waste. The gas and liquid phase are separated following oxidation.

Initial Screening: Wet air oxidation is not suitable for inorganics or for media containing low concentrations of organics. The process will not be considered further.

5.5.5 Disposal - Groundwater/Wastewater Sludges

5.5.5.1 Off-Site Disposal

5.5.5.1.1 Discharge to Local Publicly Owned Treatment Works (POTW)

Description: In this option, groundwater would be routed to a nearby POTW following pretreatment to comply with the facility's pretreatment standards.

Initial Screening: At present, this option is not feasible because the POTW will not accept any groundwater discharges. This option will not be retained for further evaluation.

5.5.5.1.2 Disposal to Off-Site Treatment, Storage and Disposal Facility (TSD)

Description: This option entails off-site hauling of groundwater treated to the levels necessary for acceptance at an approved off-site TSD facility.

Initial Screening: This option is not applicable because of the large volumes of groundwater to be treated and hence, will not be retained.

5.5.5.2 On-Site Disposal

5.5.5.2.1 Discharge to Surface Water

Description: In this disposal option, groundwater treated to NYS Drinking Water standards would be directly discharged to the storm sewer at the site.

Initial Screening: This disposal option is not feasible because the storm sewers at the site are routed to injection galleries located adjacent to the site. In addition, the town of East Farmingdale will not accept any discharge of groundwater into the stormwater lines. This option will not be retained for further evaluation.

5.5.5.2.2 Reinjection

Description: Reinjection involves recharge of treated groundwater to the subsurface for plume recovery.

Initial Screening: Reinjection for plume recovery must occur outside the plume boundaries to be the most effective. This option will be retained for further evaluation.

5.6 EVALUATION OF TECHNOLOGY PROCESS OPTIONS

The technology process options considered to be technically implementable were then further evaluated in greater detail. The objective of this screening step is to reduce the number of representative process options for each remedial technology type to simplify the subsequent development and evaluation of alternatives without limiting flexibility during the remedial design.

The representative process selected provides a basis for developing performance specifications during the preliminary design stage; however, specific unit process(s) and unit operations actually used in the implementation of the remedial action at the site may not actually be selected until the remedial design phase.

The process options are evaluated using the criteria of effectiveness, implementability, and cost. An important distinction made at this point is that these criteria are applied only to the remedial technologies and the general response actions they are intended to satisfy, and not to the site as a whole. In addition, the evaluation focuses on the effectiveness criterion, with lesser emphasis directed towards the implementability and cost criteria.

The technology process evaluation criteria are summarized as follows:

- Effectiveness

  Specific technology process options identified are evaluated relative to other processes within the same technology type. The evaluation focuses on:

  1. The potential effectiveness of the process options in handling the contaminated groundwater and in meeting the remediation goals identified in the remedial action objectives.
  2. Potential impacts to human health and the environment during the construction and implementation stages.
  3. Proven performance and reliability of the technology with respect to the constituents and conditions at the site.

- Implementability

  Implementability encompasses both the technical and institutional feasibility of implementing the technology process options and addressing the treatment of contaminated groundwater at the Circuitron Site. Emphasis is placed on the institutional aspects of implementability, such as the ability to obtain necessary permits for on-site/off-site actions and the availability of necessary equipment and services.

- Cost

  Cost plays a limited role in the screening of the process options. Detailed cost estimates are not generated for each technology. Relative costs based on engineering judgement are instead used for comparing technologies that are able to achieve similar remediation objectives.

Table 5-3 provides a summary of the technology process options and their screening evaluations for the remediation of contaminated groundwater at the Circuitron Corporation Site.

As mandated by the U.S. EPA, the "No Action/Institutional Controls" option remains for baseline comparison. None of the "containment" general response actions relating to subsurface barriers have been retained because of unfavorable hydrogeologic conditions. Pumping wells have been retained under the "groundwater collection" general response action since this is both feasible and necessary for implementation of the other general response action.

Several treatment technologies have been retained under the "treatment-groundwater" general response action due to the complexity of the groundwater matrix which will require more than one treatment technology (i.e., to remove organics and inorganics). The high concentrations of inorganics necessitates the requirement for inorganics treatment for all groundwater pump and

TABLE 5-3

DETAILED SCREENING OF TECHNOLOGY TYPES AND PROCESS OPTIONS FOR REMEDIATION OF CONTAMINATED GROUNDWATER AT THE CIRCUITRON CORPORATION SITE
EAST FARMINGDALE, SUFFOLK COUNTY, NEW YORK

General Response Action	Technology Type	Process Options	Screening Criteria			Retain	Reason for Elimination
			Effectiveness	Implementability	Cost		
No Action/Institutional Controls	None	Not Applicable, Deed Restrictions	Does not achieve remedial action objectives; useful for documenting conditions; no contaminant reduction.	Implementable	Low capital, low O&M.	Yes*	----
Groundwater Collection	Pumping Systems	Pumping Wells	Effective and reliable; proven performance.	Implementable	Low capital; low O&M	Yes	---
Treatment - Groundwater	Physical	Aeration, Coagulation, Flocculation, and Sedimentation	Effective and reliable; used as a pre-treatment step for many chemical processes.	Implementable	Low capital, moderate O&M	Yes	---
		Filtration	Effective; used for particulate removal in pretreatment; preceded by sedimentation in most cases; may remove suspended metals from solution in conjunction with chemical precipitation.	Implementable; may be subject to clogging; requires frequent backwashing.	Low capital, moderate O&M	Yes	---
		Granular Activated Carbon	Effective and reliable; requires disposal/regeneration of spent carbon; may remove metals.	Implementable	Moderate capital, high O&M	Yes	----

TABLE 5-3 (CONTINUED)
DETAILED SCREENING OF TECHNOLOGY TYPES AND PROCESS OPTIONS FOR REMEDIATION OF CONTAMINATED GROUNDWATER AT THE CIRCUITRON CORPORATION SITE
EAST FARMINGDALE, SUFFOLK COUNTY, NEW YORK

General Response Action	Technology Type	Process Options	Screening Criteria			Retain	Reason for Elimination
			Effectiveness	Implementability	Cost		
		Ion Exchange	Not suitable for removal of high concentrations of exchangeable ions; pretreatment necessary in order to prevent adversely affecting the resin.	Implementable; certain aromatics may become irreversibly sorbed by the resin.	Moderate capital, very high O&M	No	Presence of high concentrations of exchangeable ions.
		Air stripping	Effective and reliable; requires further off-gas treatment; does not remove metals or non-volatile organics.	Implementable	Moderate capital, high O&M	Yes	---
		Critical Fluid Extraction	Pilot-test required to determine effectiveness and reliability; does not remove metals.	Implementable; requires organic-laden extract disposal.	High capital, high O&M	No	The relatively low concentrations of contaminants precludes the usefulness of this process option.
		Reverse Osmosis	Pretreatment may be necessary; reliable.	Implementable	High capital, high O&M	No	Low concentrations of metals precludes usefulness.
		Thickening/ Dewatering	Effective and reliable for groundwater treatment sludges.	Implementable	Low capital, high O&M	Yes	---
		Air Sparging/Soil Vapor Extraction	Effective and reliable for volatile organics	Implementable	Moderate capital, moderate O&M	Yes	---

TABLE 5-3 (CONTINUED)
DETAILED SCREENING OF TECHNOLOGY TYPES AND PROCESS OPTIONS FOR REMEDIATION OF CONTAMINATED GROUNDWATER AT THE CIRCUITRON CORPORATION SITE
EAST FARMINGDALE, SUFFOLK COUNTY, NEW YORK

General Response Action	Technology Type	Process Options	Screening Criteria			Retain	Reason for Elimination
			Effectiveness	Implementability	Cost		
	Chemical	Neutralization	Effective and reliable	Implementable	Low capital, low O&M	Yes	----
		Chemical Precipitation	Effective and reliable conventional technology for metals/solids removal only.	Implementable, requires sludge treatment and disposal.	Low capital, high O&M	Yes	----
		Ultraviolet/ Hydrogen Peroxide	Pilot test may be required to test effectiveness and reliability; does not remove metals.	Implementable	High capital, high O&M	Yes	---
	Biological	Fixed Film Growth	Susceptible upsets due to inhibitory compounds; ineffective on highly chlorinated organics, aliphatics, amines, and aromatics; pilot test required to determine reliability and effectiveness; heavy metals potentially harmful to microbes.	Implementability; requires sludge treatment and disposal.	High capital, moderate O&M	No	Presence of concentrations of metals precludes the usefulness of this process option.

TABLE 5-3 (CONTINUED)
DETAILED SCREENING OF TECHNOLOGY TYPES AND PROCESS OPTIONS FOR REMEDIATION OF CONTAMINATED GROUNDWATER AT THE CIRCUITRON CORPORATION SITE
EAST FARMINGDALE, SUFFOLK COUNTY, NEW YORK

General Response Action	Technology Type	Process Options	Screening Criteria			Retain	Reason for Elimination
			Effectiveness	Implementability	Cost		
Disposal - Groundwater/Waste Water Sludges		Disposal to off-site TSD	TSD acceptance criteria to govern effectiveness and reliability; testing of water and sludges required prior to manifesting and off-site disposal.	Requires manifesting and transportation of extremely large volumes of water; land disposal ban may prevent implementation of sludge disposal.	Low capital, high O&M	Yes	Process option will be retained only for the disposal of wastewater sludges.
	On-Site/Off-Site	Reinjection	Effective and reliable, SPDES permit required.	Implementable	Moderate capital, moderate O&M	Yes	—

Note:

* No action retained for baseline comparison as required by U.S. EPA, 1988.

treat alternatives to preclude the fouling of other treatment processes (air strippers, etc.) The retained treatment technologies include:

Aeration, Coagulation, Flocculation and Sedimentation
Filtration
Granular Activated Carbon
Air Stripping
Oil-Water Separation
Thickening/Dewatering
Neutralization
Chemical Precipitation
Ultraviolet/Hydrogen Peroxide
Air Sparging/Soil Vapor Extraction.

Under the "disposal-groundwater/wastewater sludges" general response action, only the on-site reinjection option has been retained. The POTW has advised WESTON that it will not accept a groundwater discharge from the Circuitron Corporation Site. The offsite disposal via a TSD has been retained only for the wastewater sludges as the extremely large volumes of pumped groundwater preclude the cost-effectiveness of this option.

5.7 DEVELOPMENT OF GROUNDWATER REMEDIAL ACTION ALTERNATIVES

5.7.1 General

In this section, the technologies/process options identified previously and retained are grouped into potential remedial action alternatives for the groundwater. Based upon the initial screening and implementability analysis, the potential remedial alternatives for remediation of the groundwater in the shallow Upper Glacial aquifer are listed below and summarized in Table 5-4.

GW-1: No Action/Institutional Controls

GW-2: Groundwater Pumping, Treatment using Aeration, Coagulation, Flocculation and Sedimentation/Air Stripping/Granular Activated Carbon/On-Site/Off-site Reinjection using an Infiltration Gallery

GW-3: Air Sparging/Soil Vapor Extraction/Limited Groundwater Pumping for Hydraulic Containment/Treatment using Aeration, Coagulation, Flocculation and Sedimentation/ Air Stripping/Granular Activated Carbon/On-Site/Off-site Reinjection using an Infiltration Gallery.

Only groundwater remedial action alternatives GW-2 and GW-3 involve the pumping of contaminated groundwater from the shallow Upper Glacial aquifer followed by their on-site treatment and subsequent disposal. Alternative GW-3 involves the air sparging of the contaminated groundwater within the shallow Upper Glacial aquifer followed by the soil vapor extraction of the volatilized organic compounds and their capture on vapor phase carbon. For the purposes of this FFS, the remedial alternatives (GW-1, GW-2 and GW-3) will be further screened in Section 6.0.

TABLE 5-4

GROUNDWATER REMEDIAL ALTERNATIVES
CIRCUITRON CORPORATION SITE
EAST FARMINGDALE, SUFFOLK COUNTY, NEW YORK

Technology Process Option	Remedial Alternatives		
	GW-1	GW-2	GW-3
No Action/Institutional Controls	X		
Groundwater Monitoring		X	X
Pumping Wells		X	X
Air Sparging/Soil Vapor Extraction			X
Thickening/Dewatering		X	X
Neutralization		X	X
Granular Activated Carbon		X	X
Air Stripping		X	X
Aeration, Coagulation, Flocculation, and Sedimentation		X	X
Filtration		X	X
On-Site/Off-Site Reinjection		X	X
Off-Site Sludge Disposal		X	X
Air Emissions Control		X	X

Note:

X - Technology process option for evaluation in screening of alternative.

SECTION 6.0

INITIAL SCREENING OF REMEDIAL ACTION ALTERNATIVES

6.1 Introduction

In this section, the feasible technologies for the treatment of the groundwater in the shallow Upper Glacial aquifer which were identified and grouped into remedial action alternatives in Section 5.0, are further screened on the basis of effectiveness and implementability. The purpose of this screening exercise (Phase 2 of the FFS) is to eliminate alternatives identified in Section 5.0 which are either unable to provide a sufficient degree of clean up or are impractical to implement. Effectiveness will be evaluated considering the ability of the alternative to reduce the toxicity of the contamination, the mobility of the contaminants, and the volume of the contaminated media in both the short and long term. This evaluation will also examine the ability of each remedial action alternative to meet ARARs.

The implementability evaluation is used to assess the technical and administrative feasibility of constructing, operating and maintaining each remedial action alternative. In addition, the availability of the pertinent components for the technologies necessary for the remedial action alternative is considered.

Section 6.2 and Appendix B discuss ARARs relevant to this project. Subsequent sections provide additional descriptions of the remedial action alternatives identified in Section 5.0 and evaluate them against the screening criteria.

6.2 Use of ARARs in Remedial Alternative Evaluation

Section 121 of SARA designates state requirements as ARARs whenever they are promulgated and identified in a timely manner, and are as strict or stricter than equivalent federal ARARs. SARA also requires the attainment of Water Quality Criteria or Maximum Contaminant Levels

(MCLs) if they are "relevant and appropriate". On August 27, 1987 the U.S. EPA issued an Interim Guidance document addressing the new ARAR provisions (52 Federal Register 32496).

The role of ARARs in the FS process involves evaluating a remedial action alternative to characterize the performance level and compliance with regulatory standards of which it is capable of achieving. Each remedial action alternative must be assessed to evaluate whether it attains or exceeds federal and state ARARs.

Two types of ARARs exist: "applicable" and "relevant and appropriate" requirements of federal and state laws. An applicable requirement is any standard or limitation that is legally binding on a CERCLA-site based on the contaminant, remedial action, or location of the site. That is, "applicable" requirements are those requirements that would apply to response actions even if actions were not taken pursuant to CERCLA. A "relevant and appropriate" requirement is any standard or limitation that, while not applicable to the hazardous substance action, or location at a CERCLA site, does address problems or situations sufficiently similar to those encountered at the CERCLA site for which its use is intended. When establishing performance goals for remedial alternative selection, relevant and appropriate requirements are given equal weight and consideration as applicable requirements.

If no ARAR exists for a CERCLA site, other federal and state criteria, advisories, guidance, or proposed rules may be considered for developing remedial alternative performance goals. These "To Be Considered" (TBCs) are not legally binding, but may provide useful information or recommended procedures that explain or amplify the content of the ARARs. If no ARAR addresses a particular situation, or if existing ARARs do not ensure protection of human health and the environment at the Circuitron Corporation Site, the TBCs should be further evaluated for use.

Each type of ARAR can be characterized further as:

- Contaminant-specific

- Action-specific
- Location-specific

A contaminant-specific ARAR sets health and risk-based concentration limits in various environmental media for specific hazardous substances or contaminants. An action-specific ARAR sets performance, design, or other similar action-specific criteria on particular remedial activities. A location-specific ARAR sets restrictions for conducting activities in particular locations, such as wetlands, flood-plains, national historic districts, and others. ARARs applicable to the Circuitron Site are included in Appendix B.

6.3 Capture Zone Analysis for Hydraulic Containment of Contaminated Groundwater Plume for Alternatives GW-2 and GW-3

Groundwater models are simplified representations of groundwater conditions which occur at a particular study area. After the model is developed, it can be used to predict how the groundwater flow and contaminant concentrations may change at a site if conditions such as pumping locations are altered. This process is typically a quick and cost-effective way of evaluating the efficiency of groundwater remediation scenarios involving pumping. However, due to the simplistic nature of these groundwater models, they are based on several assumptions which depend on the model used, the site conditions and the data available.

For the Circuitron Corporation Site, an analytical steady-state groundwater flow model - QUICKFLOW (Geraghty & Miller, Inc., 1991) was selected and used to evaluate the location and pumping rates required to provide hydraulic containment of contaminated groundwater in the shallow Upper Glacial Aquifer. QUICKFLOW is designed to solve two-dimensional groundwater flow problems in a horizontal plane using analytical functions developed by Stack (1989). Each module uses the principle of superposition to evaluate the effects from multiple analytical functions (extraction wells, etc.) in a uniform regional flow field.

The steady-state module simulates the effects of the following analytic elements in two-dimensional confined or unconfined flow: uniform recharge, circular recharge/discharge areas, and line/point sources and sinks. The unconfined option was utilized for this project. The model depicts the flow field using streamlines, particle traces and contours of hydraulic head.

6.3.1 Model Design and Calibration

To simulate the saturated groundwater flow conditions in the Upper Glacial aquifer at the site, a DXF site map file was imported into the QUICKFLOW model. This accurately provided the locations of important site features, such as monitor wells, buildings and the property line.

After the model area was established, aquifer parameters such as top, bottom, groundwater gradient and flow direction, hydraulic conductivity, effective porosity and the reference head, were entered into the model. Because the Upper Glacial aquifer is unconfined the top of the model domain was set to 65 feet MSL, which is an elevation above the water table. The bottom of the model was set to 10 feet MSL, which is the elevation of the bottom of the Upper Glacial aquifer. The groundwater gradient was set at 0.0022 ft./ft. and the groundwater flow direction was set to the southeast (282 degrees). The average hydraulic conductivity of the Upper Glacial aquifer was set at 220 ft/day, which was the average of the slug tests conducted at the site. This is a similar value to those reported for regional values for the area encompassing the Circuitron Corporation site. The effective porosity was estimated to be 30%.

A constant reference elevation was located cross-gradient of the site, far enough away so that it wouldn't be within the area of influence of the pumping centers at the site. The only input parameter adjusted during calibration was the location and elevation of the reference head which were adjusted slightly until the model output water levels closely matched the measured water levels. The non-pumping model output water levels which were compared with the measured water levels, indicated that the model output water levels closely match the measured water levels and that the model adequately represents the groundwater flow conditions at the site.

MODEL ASSUMPTIONS AND LIMITATIONS

Groundwater models are simplified representations of groundwater flow conditions which occur at a particular area of interest. After the model is developed it can be used to predict how the groundwater flow may change at a site if conditions such as pumping centers are altered. This process is typically a much more cost effective method for evaluating environmental management decisions than simply implementing changes in the field on a trial and error basis. However, due to the simplifying nature of groundwater models they are based on several assumptions which depend on the model code used, the site conditions and the data available. It is important to consider the limiting assumptions upon which the model is based.

The six primary assumptions inherent to the model used for this FFS are:

- Groundwater flow is predominantly horizontal, and the horizontal extent of the aquifer is infinite;
- The aquifer is isotropic and homogeneous;
- The base of the aquifer is horizontal and fixed at a given elevation;
- The reference head is constant during all model simulations;
- All pumping rates and line sink/source fluxes are constant through time;
- All wells are assumed to fully penetrate the aquifer and be perfectly efficient, and all line sink/sources are in perfect hydraulic communication with the aquifer.

Because of the conceptual nature of the remedial action alternatives in the FFS, the estimates for recovery well and infiltration gallery flow rates and locations will need to be evaluated with more sophisticated numerical flow modeling and/or long-term pump tests conducted during a remedial design phase.

The principal water bearing units of concern in this investigation are the Upper Glacial and Magothy aquifers, the latter of which is predominantly used for public water supply. The groundwater in the Upper Glacial aquifer is unconfined, whereas, partially confined conditions exist in the Magothy aquifer where clay deposits are present. The Upper Glacial aquifer consists of permeable sand and gravel while the Magothy unit consists of less permeable, finer grained sand with interbedded silt and clay lenses. Regional horizontal hydraulic conductivity values for the Upper Glacial and Magothy aquifers in the area of the site are estimated to be approximately 267 and 53 feet per day respectively. The five-fold difference in horizontal hydraulic conductivity between the two water bearing units indicates a significant difference in the hydrogeology of these two units.

The geologic cross-sections presented in Section 2 show that the Upper Glacial and Magothy aquifers are relatively flat and are continuous across the area of investigation with an unconformable contact between the two units occurring at an elevation of approximately 10 feet above MSL (upper 40 feet of saturated thickness). As previously described, only the contamination down to a depth of approximately 25 feet MSL is attributed to the Circuitron Corporation Site. All other contamination present below that depth is attributed to regional contamination and is not addressed under this FFS.

Hydraulic containment of contaminated groundwater was evaluated by simulating particle movement through the area requiring remediation. Well locations and pumping rates selected for modeling were chosen to ensure that the contaminated groundwater were within capture zones delineated by the particle flowpaths. (A capture zone is the portion of the aquifer affected by pumpage that actually yields water to the extraction well.) The recovery wells were located such that the respective capture zones would encompass the portions of the aquifer delineated as containing the highest concentrations of inorganics and organics during the FFS. Based upon an evaluation of several remediation scenarios, the goals of the remediation scenario included containing the plume at its southern-most extent, and also recovering groundwater at the two highly contaminated areas near wells MW-4S and MW-6S.

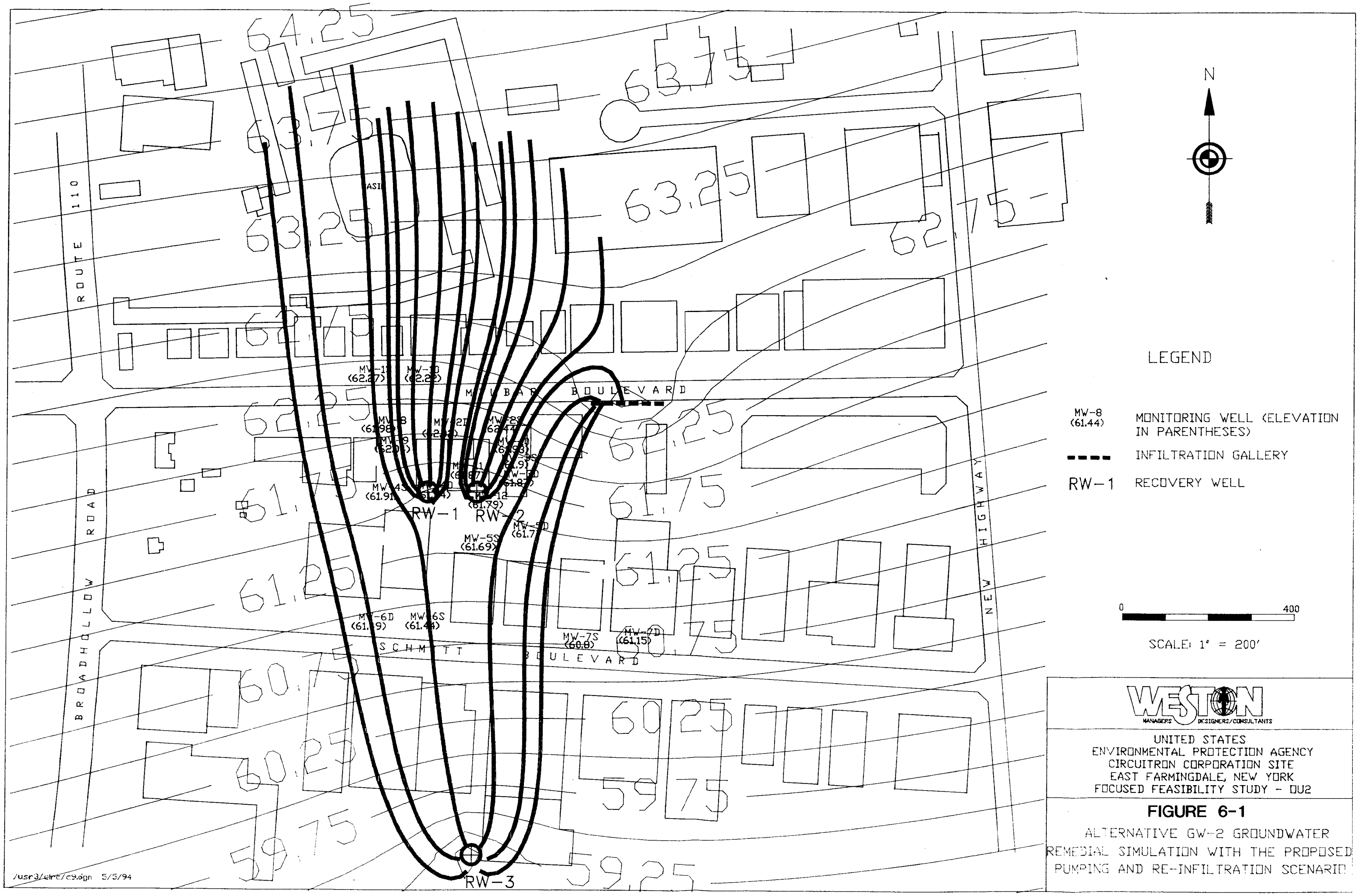
Figures from Section 2 show the simulation indicating that the plume has migrated at least 700 feet south of the Circuitron Site. The figure also indicates the presence of two areas of relatively higher concentrations of contaminants near wells MW-4S and MW-6S, at the southwestern corner of the site.

The final and most effective groundwater remediation simulation shown on Figure 6-1 includes the pumping of three recovery wells (RW-1, RW-2 and RW-3) at a combined rate of 135 gallons per minute (gpm). Recovery wells RW-1 and RW-2, located closest to the site, will recover the most contaminated groundwater and provide the hydraulic control of the downgradient end of the plume to the site. Recovery wells RW-1 and RW-2 will be designed as site source control wells pumping at respective rates of 30 gpm, while, RW-3 located at the furthermost downgradient extent of the plume, will be the migration control well, pumping at a rate of 75 gpm.

The groundwater treatment system to be located on-property will hence be designed for a higher combined flow rate of 150 gpm (excess capacity of 15 gpm) to accommodate any variations in flow rate required to effect sufficient capture zones in the shallow Upper Glacial Aquifer.

Treated groundwater will be reinjected off-site via a 170 foot long infiltration gallery to be located approximately 250 feet east of the site along Milbar Boulevard. Figure 6-1 depicts the proposed extraction wells which have been designed to effectively capture the groundwater contaminants attributable to the Circuitron Corporation Site as well as control plume migration. It also includes the recharge (reinfiltration) of the extracted groundwater back into the shallow Upper Glacial aquifer.

Two of three groundwater alternatives (GW-2 and GW-3) involve the pumping and treatment of contaminated groundwater from the shallow Upper Glacial aquifer. Alternative GW-2 incorporates the final and most effective groundwater remediation simulation discussed previously and depicted in Figure 6-1. This alternative involves the pumping of three recovery wells (RW-1, RW-2, and RW-3) at a combined pumping rate of 135 gpm followed by their on-



WESTON
MANAGERS DESIGNERS/CONSULTANTS

UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
CIRCUITRON CORPORATION SITE
EAST FARMINGDALE, NEW YORK
FOCUSED FEASIBILITY STUDY - OU2

FIGURE 6-1

ALTERNATIVE GW-2 GROUNDWATER
REMEDIAL SIMULATION WITH THE PROPOSED
PUMPING AND RE-INFILTRATION SCENARIO

property treatment within a groundwater treatment facility, to be constructed at the Circuitron Corporation Site. In addition to addressing the near-site contamination, this alternative also provides for the hydraulic control of the downgradient end of the plume. The conceptual design of the groundwater treatment system has been included in Section 6.4.1.

Alternative GW-3 involves a combination of air sparging/SVE followed by a limited groundwater pump and treat program. Groundwater will be pumped from one recovery well (RW-3) located at the furthermost downgradient extent of the plume, at a rate of 75 gpm. This alternative focuses on the hydraulic containment of the downgradient end of the plume and provides the additional benefit of inorganics treatment as well as the recovery of volatile organic compounds from the gases and groundwater.

6.4 Conceptual Groundwater Treatment Systems

As previously discussed in Section 5.6, the complexity of the contamination in groundwater at the Circuitron Corporation Site (elevated organic and inorganic compounds) necessitates that the groundwater alternatives GW-2 and GW-3 include the following technologies:

- Aeration, Coagulation, Flocculation and Sedimentation
- Neutralization
- Chemical Precipitation
- Filtration
- Air Stripping, and
- Granular Activated Carbon (Liquid Phase and Vapor Phase)

6.4.1 Conceptual Groundwater Treatment Systems for Alternatives GW-2 and GW-3

The groundwater treatment system for Alternatives GW-2 and GW-3 should be designed for the "Life Cycle" of the project to address:

- Worst case influent concentrations that will occur during the earlier stages of the groundwater remediation as summarized in Table 5-1, and

- Lower groundwater influent concentrations present during the subsequent stages of the remediation.

The contaminants of concern present in the groundwater include volatile organic and inorganic compounds. The volatile organic compounds will be removed from the groundwater by utilizing conventional treatment technologies like air stripping coupled with vapor and liquid phase carbon. The inorganic compounds will be removed from the groundwater by utilizing aeration, pH adjustment, flocculation, sedimentation, clarification and filtration. The primary inorganics of concern in the groundwater at the Circuitron Corporation Site include chromium, copper, iron and manganese. Although the concentrations of chromium and copper exceed NYS Drinking Water Standards, they are present at concentrations lower than that of iron and manganese. Iron and manganese are present at severely elevated concentrations in the groundwater at the Circuitron Corporation Site. For the groundwater sampling conducted in February 1994, iron concentrations ranged up to 327,000 ug/l (total) and 27,200 ug/l (dissolved); while corresponding manganese concentrations ranged up to 4,400 ug/l (total) and 894 ug/l (dissolved). The elevated iron and manganese concentrations measured may be biased due to precipitation of inorganic oxides caused by the aeration of the groundwater samples or excess turbidity during sampling activities.

The concentrations of iron and manganese present in the groundwater at the Circuitron Corporation Site can cause staining of clothes and plumbing fixtures, impart color and objectionable turbidity and through deposition, cause fouling of air stripping towers and decrease the carrying capacity of water mains. With iron, operational difficulties arise when the dissolved concentrations reach approximately 300 ug/l, while with manganese typically problems arise when dissolved concentrations exceed 50 ug/l. An American Water Works Association (AWWA) Task Group (AWWA, 1962) suggested limits of 50 ug/l for iron, and 10 mg/l for manganese for an "ideal" quality water suitable for public use.

While both iron and manganese are normally present in highly insoluble forms, these constituents are brought into solution when anaerobic conditions prevail and carbon dioxide is present in the water phase. For the Circuitron Corporation Site, the highest concentration of iron was found in on-site monitoring well MW-3S (327,000 ug/l). Upgradient concentrations of iron in the shallow Upper Glacial aquifer in the area were also comparable and ranged from 52,600 ug/l in monitoring well MW-1S to 32,100 ug/l in monitoring well PD-1. Off-property and downgradient concentrations in the farthest downgradient well MW-14 was 3880 ug/l. The highest concentrations of manganese were found in off-property monitoring well MW-7S (4400 ug/l) located approximately 450 feet southeast of the Circuitron Corporation Site. Upgradient and off-property manganese concentrations ranged from 714 ug/l in monitoring well MW-1S to 915 ug/l in monitoring well PD-1.

The reduction of iron and manganese concentrations will be necessary as a prerequisite to any groundwater treatment involving the extraction of groundwater for treatment (Alternatives GW-2 and GW-3).

The reduction of iron and manganese to acceptable levels by water treatment may be accomplished by:

- Converting to insoluble ferric and manganic compounds and mechanical removal (sedimentation and filtration), or filtration alone, of these precipitates, or
- Removal by substitution in the reduced soluble form (ion exchange).

The actual mechanics of removal of these compounds involves the use of conventional water treatment procedures. Soluble ferrous iron has to be oxidized to the insoluble ferric state. In the ferric state, iron is not soluble above a pH of 7. Oxidation occurs readily at pH 7.0 to 7.5. The water must simply be aerated within this pH range and ferrous iron will convert to ferric iron. Diffused air aerators are one means of providing oxygen to the water. Amounts of air used vary from 0.04 to 1.5 m^3/m^3 of water. A reaction time of up to 30 minutes is normally allowed.

Passage of the water through a bed of filter media is necessary in all cases of iron and manganese removal. These filters may be either gravity or pressure type. Filter rates through sand are usually at rates of 3-4 gpm per square foot of filter surface area. Wash water application rates for sand beds in service average 10-12 gpm per square foot, with these rates applied for 5-10 minutes.

The reduction in the concentrations of the iron and manganese to NYS Drinking Water Standards is imperative to ensure continuous and effective operation of the water treatment facility.

6.4.2 Conceptual Groundwater Treatment System for Alternative GW-3 Air Sparging/Soil Vapor Extraction

One of the other alternatives considered for the Circuitron Corporation Site involves the use of an innovative technology (Air Sparging/Soil Vapor Extraction (SVE)) to address the volatilization of the organic compounds from groundwater.

Soil vapor extraction has been demonstrated to be a successful and cost-effective remedial technology for removing volatile organics from vadose zone soils. This technology involves the controlled application of an air pressure gradient to induce an air flow through volatile organic contaminated soils. As soil gas is drawn towards the vacuum source (vapor extraction well), the equilibrium between the volatile organic phases (free product, adsorbed, vapor and dissolved) is upset, causing enhanced partitioning into the vapor phase. Volatile organics in the vapor phase are subsequently removed from the subsurface and treated using one of the several off-gas treatment systems. One of the limitations of SVE is that it does not adequately address remediation of contaminated soil below the water table.

A number of techniques have been developed and employed to expand the SVE process to include effective remediation of volatile organics in saturated zone soils. One such innovative approach is the application of an in-situ air sparging technology, also referred to as soil/groundwater aeration, to inject a hydrocarbon-free gaseous medium (typically air) into the saturated zone below or within the areas of contamination. With air sparging, the volatile organics dissolved in the groundwater and sorbed onto the soil particles, partition into the advective gaseous phase, effectively simulating an in-situ, saturated zone air stripping system. The stripped contaminants are subsequently transported via the air phase through the vadose zone, within the radius of influence of an operating SVE system. The contaminated vapors are drawn through the vadose zone to the vapor extraction wells and are treated using a standard vapor extraction off-gas treatment system. A schematic depicting a typical air-sparging system configuration is presented in Section 7.0.

6.4.2.1 Air Sparging System Design Criteria

The methodologies that are typically applied in the design of air sparging systems are empirically based. The following discussion focuses on a number of the major design parameters that require consideration:

- Site Geology

  Site geology is considered the most important design parameter. Air sparging is generally more effective in coarse grained soils which typically have lower air entry pressures and provide a medium for more even air distribution, allowing for better mass transfer efficiencies and more effective VOC removals. Fine grained soils require higher air entry pressures and are more likely to cause the formation of significant gas pockets, which may impede air sparging effectiveness and also cause significant lateral displacement of groundwater contaminants and spreading of the contaminant plume if groundwater control is not used.

- Contaminant Type

As air sparging is essentially a physical/chemical treatment process (with potential biological enhancements), the compounds that are amenable to remediation are those that are easily removed from contaminated groundwater through traditional air stripping towers (volatile organics). Correspondingly, those chemicals that do not strip well from aqueous streams have limited potential for using air sparging (except those that could be biologically degraded). Additionally, the choice of sparging gas should be based on the potential geochemical changes that may occur in the subsurface environment. The precipitation of dissolved minerals through changes in redox potential is one of the most obvious potential interactions. The compounds that are most amenable to air sparging are the lighter petroleum compounds (C_3 - C_8) and low molecular weight halogenated organics.

- Bubble Geometry and Gas Channeling

Theoretically, a large number of small bubbles will provide better mass transfer characteristics for the removal of VOCs from the aqueous soil phase than will a smaller number of large bubbles or channels. Air diffusers may be used at the sparging point to inject small bubbles into a coarse grained formation. However, any sand pack around the sparging point should have a grain size that will prevent coalescing of the small bubbles prior to entry into the formation.

- Gas Flow Rate

As air sparging is essentially an in-situ air stripping process, it is necessary to provide a sufficient air-to-water flow ratio to produce the desired contaminant mass removal in a given soil/water volume. Air flow rates that are typically used range from 3 to 10 standard cubic feet per minute (scfm) per sparge point. Pulsing of the air flow into the sparge points is considered to provide an energy efficient and cost effective approach to remediation.

- Gas Injection Pressure

  Gas injection pressures are governed by the static water head above the sparge point, the air entry pressure of the saturated soils, and the gas injection operating flow rate. In the design process, the lowest effective air injection pressure will correspond to the pressure required to maintain the minimum gas flow rate that will achieve the desired stripping efficiency. Higher pressures will produce higher air injection flow rates, and may be necessary to provide a more uniform gas channeling distribution in heterogeneous soils due to the range of air entry pressures associated with differing grain size distributions in adjacent soil units. In addition, the higher air injection pressures could cause the formation of gas pockets due to fractures in the sparging well annular seal or along weak joints in the soil, also resulting in a loss of system efficiency.

- Injection Point Interval

  The injection point interval encompasses:
  - the injection well screen interval, and
  - the depth of the screened interval with respect to the static water table.

Short screened intervals on the order of 1 - 3 feet, are generally used in air sparging wells because most of the air exits through the top of the screened interval where the pressure head is at a minimum. Use of longer screened intervals does not add to the effectiveness of the process.

In uniform homogeneous soils, injecting at greater depths with respect to the water table tends to increase the radius of influence of an injection point, but also requires higher air pressures at the well to achieve and maintain the gas flow.

- Radius of Injection Point Influence

  The radius of influence of a sparging well can be highly variable, especially in heterogeneous or stratified soils. In coarser soils in which vertical channel distribution is more controllable and predictable, the injected air tends to follow an almost parabolic path to the vadose zone. Under these conditions, the radius of influence will increase with the depth of the sparging point. Radii of influence from 5 feet to 20 feet have been observed in coarse materials. The radius of influence is evaluated based on observed increases in soil gas volatile organic concentrations in vadose zone monitoring points above the sparging point location, recorded increases in dissolved oxygen levels in saturated zone monitoring points, and localized water table mounding observed above gas injection points. Under ideal conditions, the achievable radius of influence is limited by the operating pressures that will produce short circuiting of the air flow through the formation and/or an excessively turbulent air flow regime.

6.4.2.2 Air Sparging System Requirements

The design of an air sparging system involves selecting the well configuration, blower and compressor sizes, well design and vapor treatment systems. In addition to the placement of the process equipment, proper gauges and instrumentation are crucial for monitoring the effectiveness of the process and making adjustments as needed. For the Circuitron Corporation Site, the performance of a long-term pilot test (1-3 months) is crucial to determine the effectiveness of the air sparging technology. For the purposes of conceptual screening and in the absence of pilot-plant data for Alternative GW-3, the following system is assumed:

- The installation of 20 two-inch air sparging wells screened at depths of 70 - 73 feet below grade.

- The installation of 15 two-inch vacuum extraction wells screened from approximately 10 - 25 feet below grade.

- Installation of approximately 5,000 feet of buried trenching connecting the air injection wells to the air delivery system and the vacuum extraction wells to the vacuum extraction and gaseous treatment system at the Circuitron Corporation Site.

6.5 Screening and Evaluation of Remedial Action Alternatives

6.5.1 Alternative GW-1, No Action/Institutional Controls

The No Action/Institutional Controls alternative would not require any remedial activities to be completed for the contaminated groundwater in the shallow Upper Glacial aquifer at the Circuitron Corporation Site. The NCP requires that this alternative be considered to provide a baseline against which all other alternatives may be compared. Deed restrictions would be imposed to restrict future uses of the groundwater in the shallow Upper Glacial aquifer at and downgradient of the Circuitron Corporation Site. Additional institutional controls could involve the long-term monitoring of the groundwater in the shallow Upper Glacial aquifer. This alternative could be implemented in approximately 1 to 2 months.

6.5.1.1 Effectiveness

The No Action/Institutional Controls alternative does not satisfy the remedial action objectives for the groundwater present at the Circuitron Corporation Site. In addition, this alternative provides no reduction in the toxicity, mobility or volume for the contaminants of concern contained within the shallow Upper Glacial aquifer. The No Action/Institutional Controls strategy does not inhibit or control the migration of contaminants present in the shallow Upper

Glacial aquifer to other hydraulically connected media.

This alternative also presents the possibility of long-term unacceptable risks to potential human and/or other receptors through the migration of contaminants to other environmental media (soil/groundwater). Although long-term groundwater monitoring could be provided to assess contaminant migration mechanisms, it may not identify possible contaminant migration through other transport media.

In summary, the No Action/Institutional Controls alternative is not appropriate since there would be existing, unacceptable risks to human health and the environment including the potential for adverse human health effects due to the continued migration of contaminants in the shallow Upper Glacial aquifer.

6.5.1.2 Implementability

This alternative is easy to implement.

6.5.2 Alternative GW-2, Groundwater Pumping/Treatment using Aeration, Coagulation, Flocculation and Sedimentation/Air Stripping/Granular Activated Carbon/Re-injection using an Infiltration Gallery

This alternative involves the capture of the contaminated groundwater in the shallow Upper Glacial aquifer through the installation of three groundwater recovery wells capable of pumping up to a total rate of 150 gpm; the on-site treatment of the contaminated groundwater and reinjection of the water following treatment. This alternative would also involve the quarterly sampling of selected monitoring wells to monitor groundwater cleanup and the sampling of the effluent from the groundwater treatment plant to monitor treatment effectiveness. The installation of the groundwater treatment system for this alternative could be completed within approximately six months to one year. It is estimated that groundwater treatment will be required for approximately ten years based upon volume of groundwater and contaminant concentrations.

6.5.2.1 Effectiveness

Alternative GW-2 satisfies the remedial action objectives for the groundwater in the shallow Upper Glacial aquifer. In addition, this alternative provides for a reduction in the toxicity, mobility and/or volume for the contaminants of concern contained within the shallow Upper Glacial Aquifer through their removal, on-site treatment and reinjection.

The removal, treatment and reinjection of treated groundwater helps to reduce the long-term risks to potential human and/or other receptors through the migration of contaminants contained within the shallow Upper Glacial aquifer to other environmental media. The short-term risks associated with the installation of the groundwater recovery, treatment and reinjection system during the implementation phase are acceptable.

6.5.2.2 Implementability

This alternative is easy to implement. All equipment and personnel necessary to complete the installation of the groundwater recovery, treatment and reinjection operations are readily available. The use of conventional organic and inorganic treatment processes assures long-term effectiveness of this alternative.

6.5.3 Alternative GW-3: Air Sparging/Soil Vapor Extraction/Limited Groundwater Pumping for Hydraulic Containment/Groundwater Treatment using Aeration, Coagulation, Flocculation and Sedimentation/Air Stripping/Granular Activated Carbon/On-Site or Off-Site Reinjection using an Infiltration Gallery

This alternative involves the installation of an air sparging/SVE treatment system to recover the contaminated volatile organic compounds from the shallow Upper Glacial aquifer. This is in addition to groundwater recovery from recovery well (RW-3) located at the farthest downgradient extent of the groundwater plume to provide hydraulic containment. This alternative addresses the recovery of the inorganics and organics present in the groundwater which are attributable to the Circuitron Corporation Site.

The groundwater will be treated in an on-site treatment unit at the Circuitron Corporation Site before being reinjected back into the aquifer. This alternative would also involve the quarterly sampling of selected monitoring wells to monitor groundwater cleanup and the sampling of the off-gases from the air sparging/SVE process and the groundwater treatment plant to monitor treatment effectiveness. The installation of the groundwater treatment system for this alternative could be implemented in approximately six months to one year, although access for installation activities on private property may be problematic. Based upon the volume of groundwater, and the contaminant concentrations, the duration of groundwater treatment is estimated at 7 years.

6.5.3.1 Effectiveness

Alternative GW-3 satisfies the remedial action objectives for the groundwater in the shallow Upper Glacial aquifer. In addition, this alternative provides for the remediation of the toxicity, reduction in the mobility and volume of the organic and inorganic contaminants of concern present in the groundwater in the shallow Upper Glacial aquifer. It will also serve to retard the movement of the shallow contamination into the deeper aquifer.

6.5.3.2 Implementability

As previously discussed, the alternative is implementable and the equipment and personnel necessary for installation of the recovery and treatment systems are readily available. A long-term pilot plant test is necessary to determine effectiveness of the air sparging/SVE process.

6.6 Summary

All of the three alternatives are implementable. They will have some technical challenges to remove iron and manganese to prevent the fouling of water treatment equipment (Alternatives GW-2 and GW-3) and to tailor the air sparging system design to site conditions (Alternative GW-3). For the purposes of this FFS, the three groundwater alternatives have been retained for further evaluation in Section 7.0.

SECTION 7.0

DETAILED EVALUATION OF REMEDIAL ACTION ALTERNATIVES
(PHASE III)

7.1 INTRODUCTION

This section provides a description, detailed evaluation and comparative analysis of each of the remedial action alternatives which passed the initial screening of alternatives (Phase II). Each alternative will be assessed against the specific SARA requirements listed below:

- Protectiveness of human health and the environment;
- Attainment of ARARs (or provide justification for invoking a waiver);
- Cost-effectiveness;
- Permanence of solutions and use of alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and
- Satisfaction of the preference for treatment that reduces toxicity, mobility, or volume.

In addition, SARA emphasizes evaluating each of the remedial alternatives on long-term effectiveness and related considerations. These statutory considerations include:

- The long-term uncertainties associated with land disposal;
- The goals, objectives, and requirements of the Solid Waste Disposal Act;
- The persistence, toxicity, and mobility of hazardous substances and their constituents, and their propensity to bioaccumulate;
- Short-term and long-term potential for adverse health effects resulting from potential human exposure;
- The potential for future remedial action costs if the alternative remedial action in question were to fail;

- The potential threat to human health and the environment associated with excavation, transportation, redisposal, or containment (CERCLA Section 121); and
- Long-term maintenance costs.

7.2 OVERVIEW OF EVALUATION CRITERIA

Nine criteria have been developed by the U.S. EPA in its RI/FS Guidance Document (October 1988) to address the SARA requirements and considerations listed in Section 7.1. The criteria to be evaluated are:

- Overall protection of human health and the environment;
- Compliance with ARARs;
- Long-term effectiveness;
- Reduction of toxicity, mobility, or volume;
- Short-term effectiveness;
- Implementability;
- Cost;
- State acceptance; and
- Community acceptance.

A description of each criterion is provided in the following sections:

7.2.1 Overall Protection of Human Health and the Environment

This criterion provides a final check to assess whether the alternatives are protective of human health and the environment. The overall assessment of protectiveness is based on a combination of factors assessed under the evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

7.2.2 Compliance with ARARs

This criterion will evaluate the compliance of each alternative with the ARARS identified and listed in Appendix B. (See Section 6.2 for a discussion of ARARs).

7.2.3 Long-Term Effectiveness and Permanence

This criterion involves the evaluation of the long-term effectiveness of alternatives for protecting human health and the environment after the response objectives have been completed. The primary focus of this evaluation is the extent and effectiveness of the controls that may be required to manage the potential risks posed by treatment residuals and/or untreated wastes. The following components will be addressed under this criterion:

- Magnitude of Remaining Risk - Evaluates the residual risk remaining from untreated waste or treatment residuals at the conclusion of remedial activities.

- Adequacy and Reliability of Controls - Considers the adequacy and suitability of controls, if any, that are used to manage treatment residuals or untreated wastes that remain at the site. It also determines if these controls are sufficient to ensure that any possible exposure to human and environmental receptors is within protective limits. In addition, it also evaluates the long-term reliability of controls for providing continued protection from residual contamination.

- Reliability of Controls - Evaluates the long-term reliability of management controls for providing continued protection from residuals.

7.2.4 Reduction of Toxicity, Mobility, or Volume

The assessment of this criterion evaluates the anticipated performance of specific treatment technologies. This evaluation criterion addresses the statutory preference for selecting remedial actions that employ treatment technologies to permanently and significantly reduce toxicity, mobility, or volume of wastes.

This criterion focuses on the following factors:

- The amount of hazardous materials that will be destroyed or treated, including how principal threats will be addressed.
- Irreversibility of treatment.
- The type and quantity of residuals that will remain following treatment.
- The treatment processes the remedy will employ, and the materials they will treat.
- The degree of expected reduction in toxicity, mobility, or volume measured as a percentage of reduction (or order of magnitude).
- Whether or not the alternative would satisfy the statutory preference for treatment as a principal element.

7.2.5 Short-Term Effectiveness

This criterion examines the effectiveness of alternatives for protecting human health and the environment during the construction and implementation period until the response objectives have been met. The following factors will be addressed under this criterion:

- Protection of the Community during Remedial Actions - Addresses the potential risks to human health from implementation of the proposed remedial action (i.e. fugitive dust emissions from excavation activities, etc.)

- Protection of On-site Workers during Remedial Actions - Assesses potential risks to on-site workers as well as the effectiveness and reliability of protective measures to reduce worker exposure.

- Environmental Impacts - Addresses the potential adverse environmental impacts that may result from implementation of an alternative and evaluates the effectiveness of available mitigative measures to prevent or reduce impacts.

- Time until Remedial Response Objectives are Achieved - Estimates the time required to achieve protection for either the entire site or for individual elements associated with specific threats.

7.2.6 Implementability

The implementability criterion addresses the technical and administrative feasibility of implementing an alternative and the availability of various services and materials required during implementation. This criterion involves the analysis of the following factors:

7.2.6.1 Technical Feasibility

- Construction and Operation - Relates to the technical difficulties and unknowns associated with a technology.

- Reliability of Technology - Focuses on the likelihood that technical problems associated with implementation will lead to scheduling delays.

- Ease of Undertaking Additional Remedial Actions - Discusses the types, if any, of future remedial actions which may be undertaken and the difficulty of implementing such additional actions.

- Monitoring Considerations - Addresses the ability to monitor the effectiveness of a remedy, and includes an evaluation of the potential risks from exposure should monitoring be insufficient to detect a system failure.

7.2.6.2 Administrative Feasibility

- Related to the activities needed to coordinate with other offices and agencies (eg. obtaining permits for off-site activities).

7.2.6.3 Availability of Services and Materials

- Availability of adequate off-site treatment, storage capacity, and disposal services.
- Availability of necessary equipment and specialists to ensure any necessary additional resources.
- Availability of prospective technologies.
- Availability of services and materials, including the potential for obtaining competitive bids.

7.2.7 Cost

Cost evaluation of each alternative includes consideration of capital costs and annual costs. The accuracy provided by these cost estimates is reflected by using a contingency of 15%. A present worth analysis is also conducted, allowing all remedial action alternatives to be compared on the basis of a single cost. The three components are discussed below:

- Capital Costs - Consist of direct (i.e. construction) and indirect (i.e. overhead) costs. Direct costs include expenditures for the equipment, labor, and materials necessary to complete the necessary remedial actions. Indirect costs include expenditures for engineering, financial, and other services that are not part of the actual remedial activities but are required to complete the remedial alternative.

- Annual Costs - Operating and Maintenance These include post-construction costs necessary to ensure the continued effectiveness of a remedial action.

- Present Worth Analysis - After completion of the cost estimate, an economic analysis considering the time value of money is conducted to allow comparison of alternatives through a present worth analysis. Expenditures that occur over different time periods are evaluated by discounting future costs to the current year (1994). This figure represents the amount of money that, if invested in the base year and disbursed as needed, would be sufficient to cover all costs associated with the remedial action over its planned life.

Costs for each alternative are presented with the evaluation of that alternative. Detailed breakdowns of the cost estimates are provided in Appendix C.

7.2.8 State Acceptance

This criterion evaluates the technical and administrative issues and concerns that the State may have regarding each of the alternatives. As the State has not yet been provided with a formal opportunity to review the detailed analysis of the remedial alternatives, no formal comments from the State are currently available for evaluation of this criterion. It is anticipated that the formal comments from the State will be provided during the public comment period. These comments will then be addressed in the Final FFS Report or in the Responsiveness Summary Section of the Record of Decision (ROD).

7.2.9 Community Acceptance

This criterion incorporates public comments into the evaluation of the remedial alternatives. As the public has not yet been provided with a formal opportunity to review the detailed analysis of the remedial alternatives, no formal comments from the public are currently available for evaluation of this criterion. It is anticipated that the formal comments from the public will be provided during the public comment period on this FS report. These comments will then be addressed in the Responsiveness Summary Section of the ROD.

7.3 DESCRIPTION AND DETAILED ANALYSIS OF ALTERNATIVES

7.3.1 Alternative GW-1 - No Action/Institutional Controls

7.3.1.1 Description of Alternative

The No Action/Institutional Controls alternative is required by the NCP to provide a baseline to which all other alternatives may be compared. Under the No Action alternative, no additional remedial actions would be initiated. The proposed institutional actions would include deed and site restrictions to prevent use of the groundwater from the Upper Glacial aquifer.

7.3.1.2 Overall Protection of Human Health and the Environment

This alternative prevents neither the degradation of groundwater in the Upper Glacial Aquifer underlying and downgradient of the Circuitron Corporation Site, nor the degradation of other hydraulically connected media. The groundwater contaminants would continue to migrate into as yet uncontaminated portions of the Upper Glacial aquifer. An unacceptable risk to human health and the environment would exist relative to the future use of the Upper Glacial aquifer.

The existing unacceptable risk to human health from incidental ingestion of contaminated groundwater will continue to exist. Additionally, the potential for the migration of the groundwater plume into deeper portions of the Upper Glacial aquifer and the Magothy aquifer will continue to exist.

7.3.1.3 Compliance with ARARs

The No Action/Institutional Controls alternative will leave contaminated groundwater in the Upper Glacial aquifer and will not achieve ARARs for the groundwater.

7.3.1.4 Long-Term Effectiveness and Permanence

This alternative does not prevent the continued degradation of groundwater in the Upper Glacial aquifer nor the degradation of other hydraulically connected media. Contaminants in the groundwater could be expected to remain at hazardous levels for decades to come.

7.3.1.5 Reduction of Toxicity, Mobility or Volume

There is no reduction in toxicity, mobility, or volume since no remedial action is employed in this alternative. Groundwater contaminants will be left to naturally attenuate.

7.3.1.6 Short-Term Effectiveness

The No Action/Institutional Actions alternative will not prevent the continued migration of contaminated groundwater in the shallow Upper Glacial aquifer. Since no remedial activities would occur on-site, this alternative does not pose an unacceptable short-term risk to on-site workers or the surrounding community.

7.3.1.7 Implementability

This criterion is not applicable as no additional remedial actions will be implemented under this alternative.

7.3.1.8 State Acceptance

Comments from the New York State agencies received in response to this alternative will be incorporated in either the final FFS Report and/or the Responsiveness Summary Section of the ROD. It is anticipated that this alternative will not be acceptable since it does not reduce groundwater contamination to meet the NYS Drinking Water Standards.

7.3.1.9 Community Acceptance

Following the receipt of public comments regarding this alternative, they will be included in the Responsiveness Summary Section of the ROD. It is anticipated that this alternative will not meet with community acceptance because it does not reduce toxicity or the extent of groundwater contamination, and it does nothing to prevent possible migration of contaminants to other hydraulically connected media.

7.3.1.10 Cost

The estimated costs for the No Action/Institutional Controls alternative are provided in Table 7-1. The estimated capital cost for this alternative is $5,000. The total present worth costs of the No Action/Institutional Controls alternative is $5,000.

TABLE 7-1

COST ESTIMATE - ALTERNATIVE GW-1
NO ACTION/INSTITUTIONAL CONTROLS
CIRCUITRON CORPORATION SITE
EAST FARMINGDALE, SUFFOLK COUNTY, NEW YORK

Item	Installed Cost
CAPITAL COSTS	
Deed and Site Restrictions	$5,000
Installation of 4 Monitoring Wells	
Total Direct Construction Costs (TDCC)	$5,000
Estimated Installed Capital Costs	**$5,000**
OPERATION AND MAINTENANCE COSTS	
Estimated Total O&M Costs Assuming 8% Compounded Annually over 30 years	**$0**
TOTAL PRESENT WORTH COSTS	**$5,000**

7.3.2 Alternative GW-2: Groundwater Pumping, Treatment Using Aeration, Coagulation, Flocculation and Sedimentation/Air Stripping/Granular Activated Carbon/ Reinjection using an Infiltration Gallery

7.3.2.1 Description of Alternative

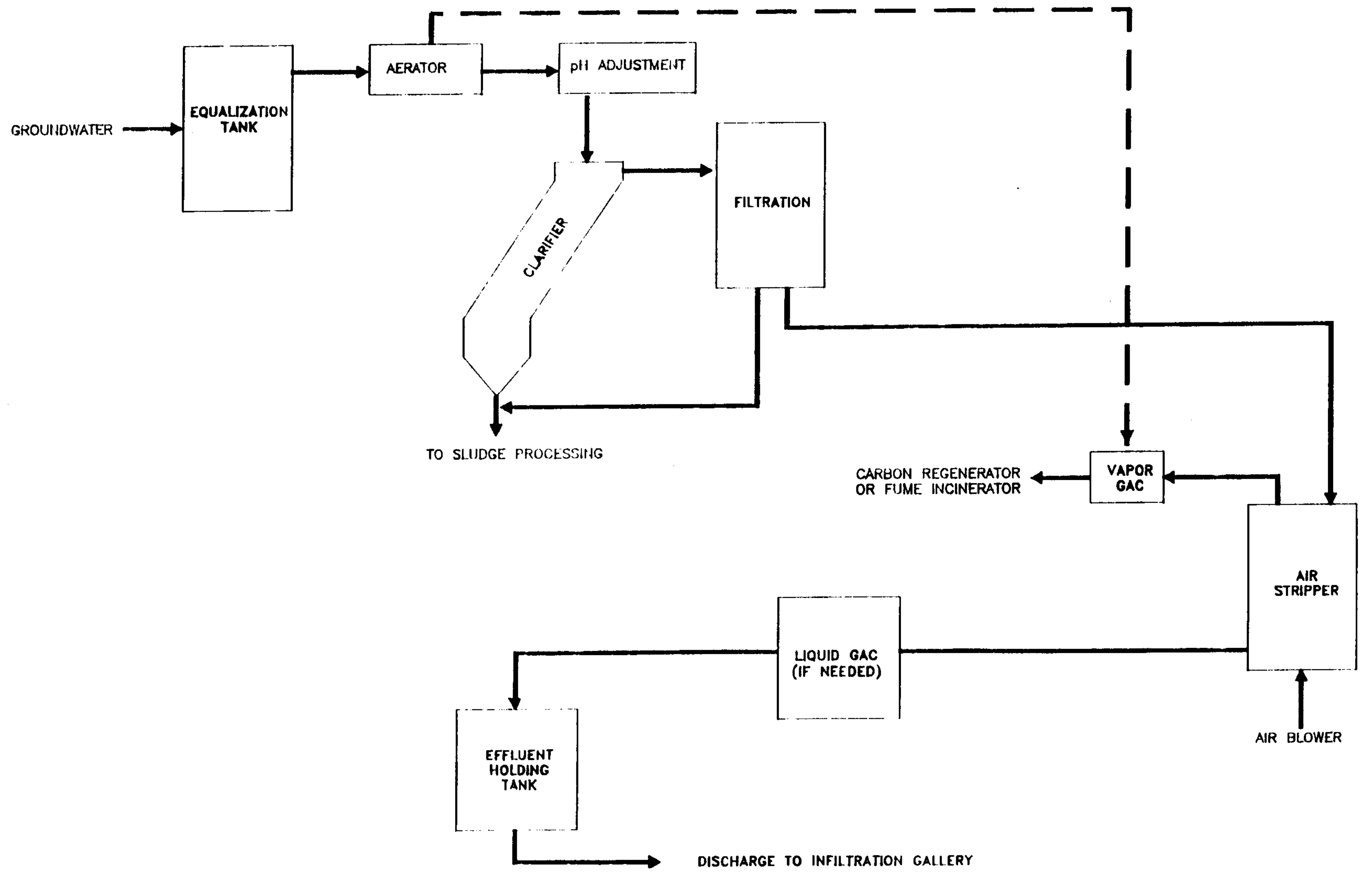
The major components of this alternative are as follows:

- Installation of an on-site groundwater treatment system capable of handling flows up to 150 gpm. The on-site groundwater treatment system is illustrated in Figure 7-1.
- Drilling of three eight-inch recovery wells (RW-1 through RW-3) at locations illustrated in Figure 6-1. The wells will be screened across the top 40 feet of shallow Upper Glacial aquifer (approximately 70 feet deep).
- Installation of approximately 2000 feet of buried trenching connecting the recovery wells to the on-site groundwater treatment system.
- Installation of an Infiltration Gallery along the northern boundary of the site on Milbar Boulevard.
- Monitoring on-site/off-site groundwater, and providing O&M services.

Figure 7-1 illustrates the proposed groundwater recovery and treatment system. The three ten-inch wells (RW-1 through RW-3) screened across the top 40 feet of the Upper Glacial aquifer will be connected to ten-inch piping installed within trenches.

The groundwater treatment system as depicted in Figure 7-1 will involve flow equalization, aeration, pH adjustment, clarification, filtration, and air stripping coupled to liquid and vapor phase carbon for the removal of volatile organics. The vapor phase carbon units will be

FIGURE 7–1
MAJOR COMPONENTS FOR ALTERNATIVE GW–2 GROUNDWATER TREATMENT via METALS PRECIPITATION/AIR STRIPPING/GRANULAR ACTIVATED CARBON CIRCUITRON CORPORATION SITE, EAST FARMINGDALE, NEW YORK



REVISION #: REV# DATE: DATE
FILE NAME: DWG-NAME.DWG DRAWN BY: DRAWNBY

designed to be regenerable. The filter cake from the metals treatment will be disposed off-site as a hazardous waste. The treatment system will be designed to handle flows up to 150 gpm (incorporating an excess of 15 gpm) in order to accommodate variability in future pumping requirements. Based upon the volume of groundwater to be pumped and treated under this alternative, a treatment time of 10 years has been assumed. The treated groundwater will be directed towards the infiltration gallery to be located along the northern property boundary and along Milbar Boulevard.

7.3.2.2 Overall Protection of Human Health and the Environment

This alternative provides good overall protection of human health and the environment as it prevents the further degradation of the Upper Glacial and Magothy aquifers and other hydraulically connected media. The proposed long-term groundwater monitoring program will monitor effectiveness over the duration of the cleanup. During the remediation activities, public health would be adequately protected through the restricted use of the groundwater.

7.3.2.3 Compliance with ARARs

It is assumed that the inorganic and organic treatment processes will be operated in accordance with Federal and New York hazardous waste treatment facility requirements. As the extracted groundwater would be treated to below NYS Drinking Water Standards, it can be assumed that the delisting requirements would be met, and thus RCRA Land Disposal Regulations (LDRs) would not be applicable. The treated effluent would meet the permit effluent limitations for the contaminants of concern. Based upon this analysis, Alternative GW-2 is expected to comply with identified ARARs and TBCs, so long as contaminant-specific ARARs are achieved at the end of the remediation period. Groundwater monitoring will be executed in compliance with all applicable U.S. EPA and NYSDEC requirements.

7.3.2.4 Long-Term Effectiveness and Permanence

The major benefits associated with this treatment option include the reduction of the inorganic and organic groundwater contaminants to NYS Drinking Water Standards. A long-term risk posed by the treatment of the contaminated groundwater includes the potential exposure to 1,1,1-trichloroethane and other volatile organic contaminated emissions from the air stripping tower. This risk would be minimized by the inclusion of the vapor phase carbon adsorption units which would reduce volatile organic concentrations to levels meeting air emission standards.

Sludge generated from the groundwater treatment process would be hauled off-site by a licensed contractor to a RCRA TSD facility where treatment could incorporate any number of viable technologies (for the purpose of this FFS, it is assumed that stabilization would be used). RCRA landfilling of the treated sludge would take place once RCRA LDR standards are met. Overall, long-term effectiveness and permanence of this alternative is expected to be acceptable as long as adequate monitoring and maintenance are continued.

7.3.2.5 Reduction of Toxicity, Mobility or Volume

The recovery of groundwater from the shallow Upper Glacial aquifer will substantially reduce the toxicity and mobility of the groundwater contaminants. As the groundwater contaminants are removed, the volume of groundwater with contaminant concentrations remaining above the ARARs will decrease. It is expected that the treated groundwater would meet delisting requirements, and can be discharged back into the aquifer.

Groundwater treatment using aeration, pH adjustment, clarification, filtration, air stripping and carbon adsorption allows for the removal of the existing groundwater contaminants. Treatment residuals will be disposed off-site. The quality of the treated groundwater should enable to be beneficially reused off-site. For the purpose of this FFS, only off-site reinjection via an infiltration gallery has been addressed. This is based upon retaining the option for beneficial reuse of groundwater in a sole-source aquifer area like Long Island.

7.3.2.6 Short-Term Effectiveness

In the short-term, the proposed groundwater remedial action will halt the migration of the contamination plume in the shallow Upper Glacial aquifer. A short-term risk to the workers exists from exposure to the groundwater contaminants during the construction of the off-site groundwater recovery wells and the associated trenching activities. Proper personnel protective equipment would be required during construction. The groundwater treatment facility would be an above-ground system, thus requiring minimal excavation for the foundation. Construction activities would generate airborne particulate matter which poses a potential threat of inhalation of contaminated soil to the public. This threat would be minimized through the use of dust suppression procedures. A short-term environmental impact posed by this treatment option includes the change of site land use to accommodate the treatment facility.

The time of construction for the treatment system is estimated to range from 6 months to one year. The short-term effects during the installation of this remedial facility could be minimized by utilizing appropriate protection and control measures.

7.3.2.7 Implementability

Installation of the groundwater treatment and recovery system are readily implementable. The technologies involved are proven and reliable. The existing network of monitoring wells should be sufficient to monitor the effectiveness of the remedy with several additional monitoring wells to be installed during the Remedial Design Stage to monitor the leading edge of the plume. Sufficient number and capacity of off-site TSD facilities exist for the treatment and/or disposal of the groundwater treatment residues. In addition, the equipment to be used in the treatment and recovery system is readily available.

Extensive institutional management would be required to ensure the proper operation, maintenance and overall execution of this treatment option. Long-term monitoring of the treated effluent would be required to measure the performance of the treatment system. Although complicated and time consuming, the tasks associated with coordinating the management of this treatment option are nonetheless feasible and implementable.

7.3.2.8 State Acceptance

Comments from the New York State agencies received in response to this alternative will be incorporated into either the Final FFS Report or the Responsiveness Summary Section of the ROD. It is expected that this alternative will meet with state acceptance because of its control of contaminant migration and eventual reduction of contaminants to levels complying with the NYS Drinking Water Standards.

7.3.2.9 Community Acceptance

Public comments received in response to this alternative will be incorporated in the Responsiveness Summary Section of the ROD. It is expected that this alternative will meet with public approval because of its control of contaminant migration and its eventual reduction of contaminants to levels complying with the NYS Drinking Water Standards.

7.3.2.10 Cost

The estimated costs for this alternative are provided in Table 7-2. The estimated capital costs for this alternative is $1,963,100. Estimated annual O&M costs for this alternative are $675,000 per year. Using a present worth analysis of eight percent interest compounded annually over 10 years, the total present worth cost estimated is for this alternative $6,492,350.

TABLE 7-2

COST ESTIMATE - ALTERNATIVE GW-2 GROUNDWATER PUMPING/TREATMENT USING AERATION, COAGULATION, FLOCCULATION AND SEDIMENTATION/OIL-WATER SEPARATION/AIR STRIPPING/GRANULAR ACTIVATED CARBON/REINJECTION USING AN INFILTRATION GALLERY
CIRCUITRON CORPORATION SITE
EAST FARMINGDALE, SUFFOLK COUNTY, NEW YORK

Item		Installed Cost
<u>CAPITAL COSTS</u>		
Installation of Groundwater Treatment System		$ 637,585
Installation of Support Facilities and Instrumentation		$ 259,516
Installation of Recovery Wells and Infiltration Gallery		$ 340,585
Other Project Costs		$ 179,500
Project/Construction Contract Costs		$ 289,800
Total Direct Construction Costs (TDCC)	**Subtotal**	**$1,707,000**
Contingency at 15%		$ 256,100
Estimated Installed Capital Costs		**$1,963,100**
<u>OPERATION AND MAINTENANCE COSTS</u>		
Quarterly Site Inspections, Groundwater Sampling (25 wells) and Reporting		$ 275,000 per year
Carbon Regeneration, Sludge Disposal and Permitting		$ 400,000 per year
Estimated O&M costs per year		$ 675,000
Estimated Total O&M Costs Assuming 8% Compounded Annually over 10 years		**$4,529,250**
TOTAL PRESENT WORTH COSTS		**$6,492,350**

7.3.3 Alternative GW-3 - Air Sparging/Soil Vapor Extraction/Limited Groundwater Pumping for Hydraulic Containment/Groundwater Treatment using Aeration, Coagulation, Flocculation and Sedimentation/Air Stripping/Granular Activated Carbon/Reinjection using an Infiltration Gallery

7.3.3.1 Description of Alternative

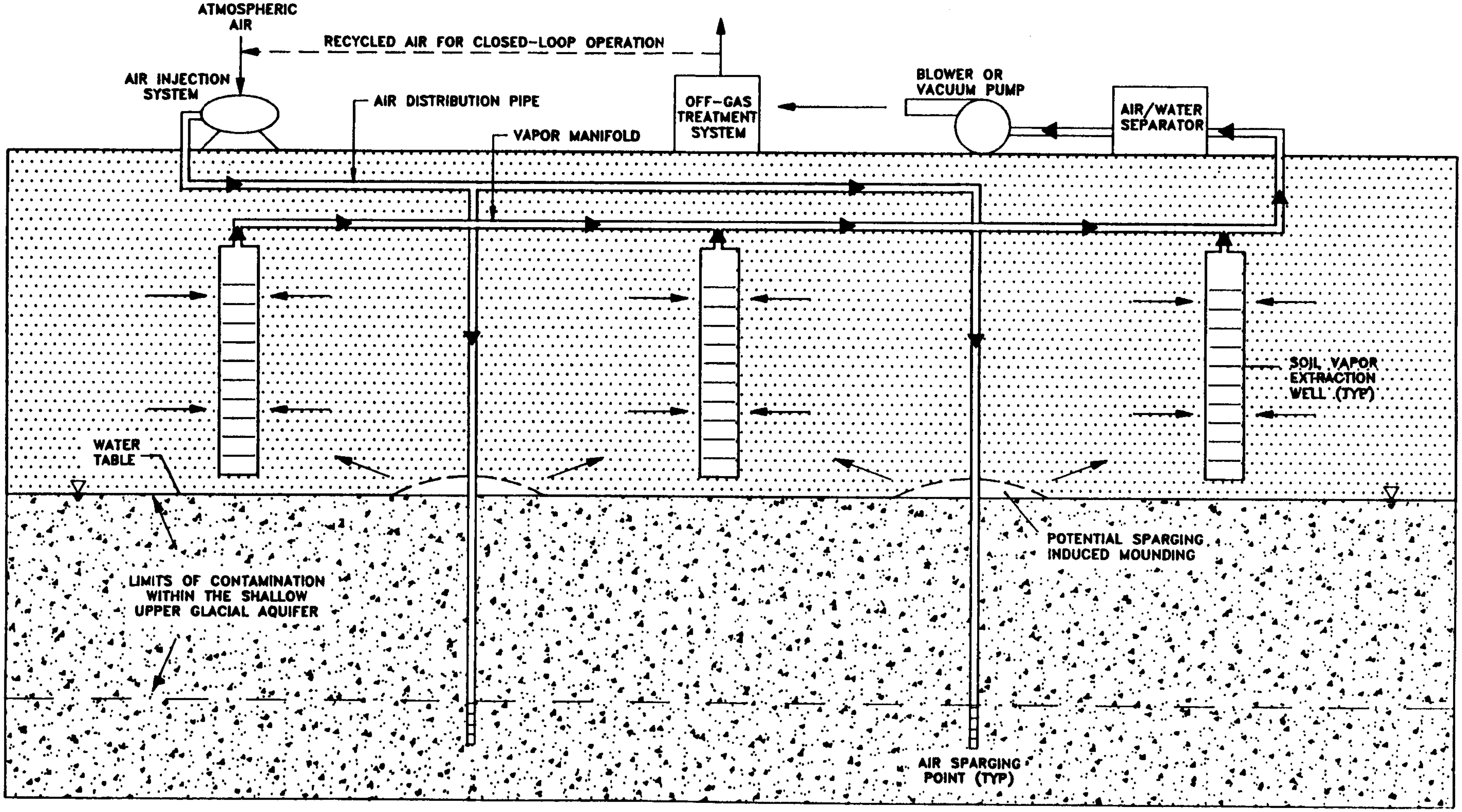
The major components of this alternative are as follows:

- Installation of an air sparging and soil vapor extraction system capable of addressing the on-site and off-site volatile organic contamination in the shallow Upper Glacial aquifer. A schematic showing the major components for Alternative GW-3 is illustrated on Figure 7-2.

- Drilling of approximately twenty 2-inch air sparging wells at locations to be determined based on pilot-plant testing to be conducted prior to Remedial Design activities. The wells will be screened at depths of 70-73 feet below grade. Drilling of approximately fifteen 2 to 4 inch vacuum extraction wells at locations to be determined, based on pilot-plant testing to be conducted prior to Remedial Design activities. The extraction wells will be screened from approximately 10-25 feet below grade (groundwater elevations are approximately 30 feet below grade).

- Drilling of eight-inch recovery well (RW-3) at the location illustrated on Figure 6-1. The well will be screened across the upper 40 feet of the shallow Upper Glacial aquifer (approximately 70 feet deep) and will provide for hydraulic containment of the farthest downgradient extent of the plume attributable to the Circuitron Corporation Site.

FIGURE 7–2
MAJOR COMPONENTS FOR ALTERNATIVE GW–3
TYPICAL AIR SPARGING SYSTEM CONFIGURATION
CIRCUITRON CORPORATION SITE, EAST FARMINGDALE, NEW YORK



- Installation of an on-site groundwater treatment system capable of handling flows up to 75 gpm. The on-site groundwater treatment system is similar to that described for Alternative GW-2 and is illustrated on Figure 7-1.

- Installation of approximately 5,000 feet of buried trenching connecting the air injection wells to the air delivery system, the vacuum extraction wells to the vacuum extraction system, the groundwater recovery well (RW-3) to the groundwater treatment system and the injection gallery.

- Installation of an Infiltration Gallery along the northern boundary of the site on Milbar Boulevard.

- Monitoring on-site and off-site groundwater and providing O & M services.

This alternative addresses the remediation of the volatile organic and inorganic contaminants present in the shallow Upper Glacial aquifer. Based upon the volume of groundwater to be pumped and treated under this alternative in conjunction with additional treatment of volatile organics by air sparging, a treatment time of seven years has been assumed.

7.3.3.2 Overall Protection of Human Health and the Environment

This alternative provides good overall protection to human health and the environment as it prevents the further degradation of the shallow Upper Glacial aquifer and other hydraulically connected media. The proposed long-term groundwater monitoring program would monitor treatment effectiveness over the duration of the groundwater cleanup. In addition, public health would be adequately protected during the remediation activities.

7.3.3.3 Compliance with ARARs

It is assumed that the aqueous inorganic and organic and the air sparging/soil vapor extraction treatment processes will be operated in accordance with Federal and New York hazardous waste treatment facility requirements. As the extracted groundwater would be treated to below NYS Drinking Water Standards, it is assumed that the delisting requirements would be met, and thus RCRA Land Disposal Regulations (LDRs) would not be applicable. The treated effluent (vapors and water) would meet the permit effluent limitations for the contaminants of concern, and applicable air pollution control emission standards. Based upon this analysis, alternative GW-3 is expected to comply with all identified ARARs and TBCs, so long as contaminant-specific ARARs are achieved at the end of the remediation period. Groundwater monitoring will be executed in compliance with all applicable NYSDEC requirements and can be recharged into the aquifer.

7.3.3.4 Long-Term Effectiveness and Permanence

The major benefits associated with this treatment option include the reduction of the inorganic and organic groundwater contaminants to NYS Drinking Water Standards. A long-term risk posed by the treatment of the contaminated groundwater includes the potential exposure to 1,1,1-trichloroethane and other volatile organic contaminated emissions from the air stripping tower and the SVE processes. This risk would be minimized by the inclusion of the vapor phase carbon adsorption units which would reduce volatile organic concentrations to levels meeting air emission standards.

Sludge generated from the groundwater treatment process would be hauled off-site by a licensed contractor to a RCRA TSD facility where treatment could incorporate any number of viable technologies (for the purpose of this FFS, it is assumed that stabilization would be used). RCRA landfilling of the treated sludge would take place once RCRA LDR standards are met. Overall, long-term effectiveness and permanence of this alternative is expected to be acceptable as long as adequate monitoring and maintenance are continued.

7.3.3.5 Reduction of Toxicity, Mobility or Volume

The recovery of organic and inorganic contaminated groundwater and volatile organic contaminated vapors from the shallow Upper Glacial aquifer will substantially reduce the toxicity of the contaminated groundwater. As the groundwater contaminants are removed, the volume of groundwater with contaminant concentrations remaining above NYS Drinking Water Standards will decrease. It is expected that the treated groundwater would meet delisting requirements, and can be recharged into the aquifer.

Groundwater treatment using aeration, pH adjustment, chemical coagulation and flocculation, clarification, filtration, air stripping and carbon adsorption allows for the removal of the existing groundwater contaminants. Treatment residuals will be disposed off-site. The quality of the treated groundwater should enable to be beneficially reused off-site. For the purpose of this FFS, only off-site reinjection via the infiltration gallery has been addressed. This is based upon retaining the option for beneficial reuse of groundwater on Long Island.

7.3.3.6 Short-Term Effectiveness

In the short-term, the proposed limited groundwater remedial action will halt the migration of the contamination plume in the shallow Upper Glacial aquifer. A short-term risk to the workers exists from exposure to the groundwater contaminants during the construction of the off-site groundwater recovery air sparging and SVE wells and the associated trenching activities. Proper personnel protective equipment would be required during construction. The groundwater treatment and the SVE facility would be an above-ground system, thus requiring minimal excavation for the foundation. Construction activities would generate airborne particulate matter which poses a potential threat of inhalation of contaminated soil to the public. This threat would be minimized through the use of dust suppression procedures. A short-term environmental impact posed by this treatment option includes the change of site land use to accommodate the treatment facility.

The time of construction for the treatment system is estimated to range from 6 months to one year. The short-term effects during the installation of this remedial facility could be minimized by utilizing appropriate protection and control measures.

7.3.3.7 Implementability

Installation of the air sparging/SVE and groundwater treatment and recovery system are implementable. The groundwater treatment technologies involved are proven and reliable. The air sparging/SVE system while less proven generally, has been chosen for the Circuitron site for the remediation of contaminated soils under OU-1. The existing network of monitoring wells should be sufficient to monitor the effectiveness of the remedy with several additional monitoring wells required during the Remedial Design Stage to monitor the leading edge of the plume after suitable detailed design and treatability studies. Sufficient number and capacity of off-site TSD facilities exist for the treatment and/or disposal of the groundwater treatment residues. In addition, the equipment to be used in the treatment and recovery system is readily available.

Extensive institutional management would be required to ensure the proper operation, maintenance and overall execution of this treatment option. Long-term monitoring of the treated effluent would be required to measure the performance of the treatment system. Although complicated and time consuming, the tasks associated with coordinating the management of this treatment option are nonetheless feasible and implementable.

7.3.3.8 State Acceptance

Comments from the New York State agencies received in response to this alternative will be incorporated into either the Final FFS Report or the Responsiveness Summary Section of the ROD. It is expected that this alternative will meet with state acceptance because of its control of contaminant migration and eventual reduction of contaminants to levels complying with the NYS Drinking Water Standards.

7.3.3.9 Community Acceptance

Public comments received in response to this alternative will be incorporated in the Responsiveness Summary Section of the ROD. It is expected that this alternative will meet with public approval because of its control of contaminant migration and its eventual reduction of contaminants to levels complying with the NYS Drinking Water Standards.

7.3.3.10 Cost

The estimated costs for this alternative are provided in Table 7-3. The estimated capital costs for this alternative is $2,677,400. Estimated annual O&M costs for this alternative are $1,075,000 per year. Using a present worth analysis of eight percent interest compounded annually over 7 years, the total present worth costs for this alternative is $8,274,170.

7.4 COMPARATIVE ANALYSIS OF ALTERNATIVES

A comparative analysis of the three alternatives against the nine evaluation criteria is presented in Table 7-4 and is discussed below.

7.4.1 Overall Protection of Human Health and the Environment

Alternatives GW-2 and GW-3 provide the greatest overall protection of human health through treatment of groundwater. Alternative GW-2 is a closed loop system in which the shallow Upper Glacial aquifer is recharged by the treated groundwater. Alternative GW-3 is a closed loop system for both the extracted groundwater and the contaminated vapors. Alternative GW-1, which offers no groundwater treatment, is the least protective alternative.

TABLE 7-3

COST ESTIMATE - ALTERNATIVE GW-3
AIR SPARGING/SOIL VAPOR EXTRACTION
LIMITED GROUNDWATER PUMPING/TREATMENT USING AERATION, COAGULATION, FLOCCULATION AND SEDIMENTATION/OIL-WATER SEPARATION/AIR STRIPPING/GRANULAR ACTIVATED CARBON/REINJECTION USING AN INFILTRATION GALLERY
CIRCUITRON CORPORATION SITE
EAST FARMINGDALE, SUFFOLK COUNTY, NEW YORK

Item	**Installed Cost**
CAPITAL COSTS	
Installation of Groundwater Treatment System	$ 585,706
Installation of Soil Venting Treatment System	$ 429,700
Installation of Support Facilities and Instrumentation	$ 273,516
Installation of Recovery Well, Air Sparging Wells, Vacuum Extraction Wells and Infiltration Gallery	$ 399,305
Other Project Costs	$ 244,700
Project/Construction Contract Costs	$ 395,300
Total Direct Construction Costs (TDCC)	**$2,328,227**
Contingency at 15%	$ 349,200
Estimated Installed Capital Costs	**$2,677,400**
OPERATION AND MAINTENANCE COSTS	
Quarterly Site Inspections, Groundwater Sampling (25 wells) and Reporting	$ 275,000 per year
Carbon Regeneration, Sludge Disposal and Permitting	$ 800,000 per year
Estimated O&M costs per year	$1,075,000
Total O&M Costs Assuming 8% Compounded Annually over 7 years	**$5,596,770**
TOTAL PRESENT WORTH COSTS	**$8,274,170**

TABLE 7-4

COMPARATIVE ANALYSIS FOR SITE ALTERNATIVES
CIRCUITRON CORPORATION SITE
EAST FARMINGDALE, SUFFOLK COUNTY, NEW YORK

Alternatives	Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction of Toxicity Mobility or Volume	Short-Term Effectiveness	Implementa-bility	State and Community Acceptance	Cost ($)		
								Capital Costs	Operation and Maintenance Costs	Total Present Worth Costs
GW-1 No Action/Institutional Controls	None	No	None	No	None	High	Not available	5,000	0	5,000
GW-2 Groundwater Pumping/Treatment using Aeration, Coagulation, Flocculation and Sedimentation/Air Stripping/Granular Activated Carbon Reinjection using an Infiltration Gallery	High	Full	High	Toxicity, Mobility, Volume	High	High	Not available	1,963,100	4,529,250(1)	6,492,350
GW-3 Air Sparging/Soil Vapor Extraction/ Limited Groundwater Pumping/Treatment using Aeration, Coagulation, Flocculation and Sedimentation/Air Stripping/Granular Activated Carbon/Reinjection using an Infiltration Gallery	Moderate to High	Full	High	Toxicity, Mobility, Volume	High	High	Not Available	2,677,400	5,596,770(2)	8,274,170

(1)10 years operations and maintenance cost projected
(2)7 years operations and maintenance cost projected

7.4.2 Long-Term Effectiveness and Permanence

Alternatives GW-2 and GW-3 provide the best combination long-term effectiveness and permanence as contaminant reduction is achieved and plume migration is halted. Alternative GW-1 provides no treatment and is not considered to be effective.

7.4.3 Reduction of Toxicity, Mobility, or Volume

Alternatives GW-2 and GW-3 reduce the mobility and toxicity of groundwater by the treatment of the volatile organic and inorganic compounds present in the contaminated shallow Upper Glacial aquifer groundwater. Alternative GW-2 provides treatment of a larger portion of the groundwater plume than Alternative GW-3. The inorganic compounds will be separated and disposed of off-site. Alternative GW-1 offers no treatment of the contaminated groundwater.

7.4.4 Short-Term Effectiveness

Alternatives GW-2 and GW-3 in the short-term will halt the spread of volatile organic and inorganic contaminants in the shallow Upper Glacial aquifer, and will also retard the migration of the contaminants into the deeper Upper Glacial and Magothy Aquifers. Alternative GW-1 provides no treatment of groundwater and is not considered to be effective in the short-term because residual risks are not reduced.

7.4.5 Implementability

Alternative GW-1 is the most readily implementable followed by Alternative GW-2 which involves conventional technologies with proven reliability. Alternative GW-3 involves the use of an innovative technology (i.e., air sparging/SVE) with a lesser degree of demonstration on Superfund sites similar to that of the Circuitron Corporation Site. SVE has been selected for use on the Circuitron Corporation Site for the remediation of volatile-organic contaminated soils under Operable Unit 1.

7.4.6 Cost

A comparative analysis of cost for the site alternatives is presented in Table 7-4. Alternative GW-1, the no action/institutional controls alternative, has the lowest associated cost. The capital costs for GW-1 are \$5,000 with the present worth costs of \$5,000 per year. Alternative GW-2 has a capital cost of about \$1,963,100 and O&M costs of \$675,000 per year. The total present worth costs for Alternative GW-2 are \$6,492,350. Alternative GW-3 has a capital cost of about \$2,677,400 with associated O&M cost of \$1,075,000 per year. The total present worth costs for Alternative GW-3 are \$8,274,170.

7.4.7 Compliance with ARARs

Alternative GW-1 does not have to comply with ARARs because no remedial actions take place. Alternatives GW-2 and GW-3 comply with ARARs such as OSHA, RCRA and appropriate Clean Air and Water Acts. State and Federal ARARs pertaining to the reinjection of treated groundwater and long term monitoring for Alternatives GW-2 and GW-3 will also be addressed and will be complied with during the remedial actions. The air emissions relating to Alternatives GW-2 and GW-3 would comply with USEPA and NYSDEC Clean Air requirements.

7.4.8 State and Community Acceptance

Issues pertaining to state and community acceptance will be addressed once comments are received.

SECTION 8

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