EPA WORK ASSIGNMENT NUMBER: 082-2N1E
ARCS II CONTRACT NUMBER: 68-W8-0110
EBASCO SERVICES INCORPORATED

FINAL WORK PLAN
REMEDIAL DESIGN
CIRCUITRON CORPORATION SITE
OPERABLE UNIT TWO
EAST FARMINGDALE
LONG ISLAND, NEW YORK

JUNE 1995

NOTICE

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EBASCO

June 16, 1995
ARCS II-95-082-005

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SUBJECT: ARCS II PROGRAM - EPA CONTRACT NO. 68-W8-0110
WORK ASSIGNMENT NO. 082-2N1E
CIRCUITRON CORPORATION SITE, OPERABLE UNIT TWO
EAST FARMINGDALE, LONG ISLAND, NEW YORK
FINAL WORK PLAN FOR REMEDIAL DESIGN

Dear Mr. Moncino and Dr. Fayon:

Ebasco Services Incorporated (Ebasco) is pleased to submit for your approval six (6) copies of the subject Work Plan. The Work Plan is finalized based on the EPA's comments dated May 3, 1995 and Ebasco's response to comments dated June 2, 1995.

If you have any questions please do not hesitate to contact me at (201) 842-7034 or K. Subburamu at (201) 842-7218.

Very truly yours,

M Kuo for

Dev R Sachdev, PhD, PE
ARCS II Program Manager

cc: D Butler (EPA)
L Lopez (EPA)
M Kuo
K Subburamu
Project File

June 16, 1995

Mr. Keith Moncino
Dr. A. M. Fayon

SUBJECT: ARCS II PROGRAM - EPA CONTRACT NO. 68-W8-0110
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EAST FARMINGDALE, LONG ISLAND, NEW YORK
FINAL WORK PLAN FOR REMEDIAL DESIGN

ACKNOWLEDGEMENT OF RECEIPT

Please acknowledge receipt of this Work Plan on the duplicate copy of this letter and return it to the sender. Thank you.

Signature

Date

D1350.LYN

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ARCS II CONTRACT NUMBER: 68-W8-0110
EBASCO SERVICES INCORPORATED

WORK PLAN
REMEDIAL DESIGN
CIRCUITRON CORPORATION SITE
OPERABLE UNIT TWO
EAST FARMINGDALE, LONG ISLAND, NEW YORK

JUNE 1995

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D1350.LYN

WORK PLAN
CIRCUITRON CORPORATION SITE REMEDIAL DESIGN

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Executive Summary

In response to the United States Environmental Protection Agency (USEPA) Work Assignment (WA) No. 082-2N1E under ARCS II Contract Number 68-W8-0110, Ebasco has prepared this Work Plan for the performance of Remedial Design (RD) for the Circuitron Corporation site. This Work Plan presents a description of the work elements required to complete the remedial design for the remedial alternatives selected in the Operable Unit 2 (OU-2, Groundwater Pump and Treatment) Record of Decision (ROD).

The Circuitron Corporation Site is a National Priorities List site which is located at 82 Milbar Boulevard, East Farmingdale, Suffolk County, New York. The site is situated near the Nassau County-Suffolk County border in central Long Island. The site encompasses approximately 1 acre in an industrial/commercial area just east of Route 110 and the State University of New York, Agricultural and Technical College campus in Farmingdale.

The Circuitron Corporation site consists of an abandoned 23,500 square foot building that was used between 1961 and 1986 for the manufacture of electronic circuit boards. Aside from the building, the site is primarily asphalt paved, with the exception of a small area in the rear of the building. At least two unauthorized leaching pools exist below the concrete floor inside the building. A circular depression in the concrete floor towards the front of the building indicates the presence of other unauthorized leaching pools. At least two sanitary cesspools have been documented to exist below the parking lot in front of the northwest corner of the building. The sanitary cesspools were authorized to accept sanitary wastes only. However, Suffolk County Department of Health Services (SCDHS) analyses indicated that the cesspools were used for disposal of hazardous materials.

Circuitron Corporation vacated the premises sometime within May and June of 1986. Prior to the onset of the remedial investigation and feasibility study (RI/FS), a removal action was conducted by USEPA at the site which consisted of sampling and removal of drum and tank contents which were abandoned on the site. The on-site removal activities were completed in May 1989. The RI/FS was initiated in September, 1988. A Record of Decision (ROD) for Operable Unit 1 was signed on March 29, 1991 and called for the in situ vapor extraction (SVE) of the contaminants from the contaminated soil, the excavation of contaminated sediments from leaching pits, the decontamination of the onsite building, and the repaving of the site area. However, due to the inclement weather during the 1992/1993 winter the building has deteriorated markedly. A decision was made by USEPA to demolish the building rather than restore it. A focused feasibility study (FFS) for a second operable unit (this operable unit) was initiated in December, 1991 to characterize the extent of groundwater contamination onsite as well as off-site from the Site. The FFS has been completed and a Record of Decision (ROD) for OU-2 was signed on September 30, 1994. The selected remedy consists of the removal of inorganics from the groundwater prior to air stripping and reinjection.

Major components of the remedy selected in the OU-2 ROD are:

- Extraction of the site-related groundwater contaminant plume present in the upper 40 feet of the saturated Upper Glacial aquifer;
- Treatment, via precipitation and air stripping, of contaminated groundwater to drinking water standards;

- o Reinjection of the treated groundwater into the Upper Glacial aquifer via an infiltration gallery; and

- o Disposal of treatment residuals at a RCRA Subtitle C facility.

The Circuitron Corporation site Remedial Design for OU-2 will be accomplished in two phases, the data collection phase and the remedial design phase. During data collection, supplemental chemical data will be collected to confirm the groundwater contamination and a Treatability Study/Pilot Testing will be conducted to determine the feasibility of treatment and reinjection and to collect system design parameters.

Remedial Design activities will begin as soon as all the supplemental data are collected, analyzed, validated and evaluated. The Circuitron Corporation site Remedial Design will culminate in the delivery to USEPA of designs at 30%, 90% and 100% completion. The design submittals will contain basis of design criteria, detailed specifications, drawings and engineer's cost estimate.

This Work Plan outlines the Tasks and Subtasks that must be performed to collect supplemental data and to develop the technical specifications and drawings required to solicit remedial action contractor to implement the ROD selected remedy. Based on the information presented in the RI/FS and FFS reports and the ROD, each of the 11 standard remedial design tasks in the USEPA ARCS II Program Management plan was reviewed and their applicability identified below.

Task		Applicability
Task 1	Project Planning	Yes
Task 2	Community Relations	Optional
Task 3	Data Acquisition	Yes
Task 4	Sample Analysis/Validation	Yes
Task 5	Data Evaluation	Yes
Task 6	Treatability Study/Pilot Test	Yes
Task 7	Preliminary Design (30%)	Yes
Task 8	Equipment/Services Procurement	No
Task 9	Intermediate Design (60%)	No
Task 10	Prefinal/Final Design (90-100%)	Yes
Task 11	Post Remedial Design Support	Yes

Task 8 - Equipment/Services Procurement and Task 9 - Intermediate Design (60%), are not included in this Work Plan.

The scope of activities anticipated for each of these tasks and subtasks are described in Section 4 of this Work Plan. Task 1, Project Planning, covers the activities associated with the initiation of this project, development of project schedule and cost, site visits, preparation of this work plan and a Brossman Work/QA Project Plan Short Form, and provision of ARAR support. For planning purposes, Ebasco has included under Optional Task 2, Community Relations, the scope of work for supporting USEPA in the planning of one small group public meeting.

Tasks 3 through 5 are the proposed supplemental data collection tasks to provide more specific data for the confirmation of the groundwater contamination, to update the existing groundwater modeling and to provide system design parameters. These data will also be used to support the

treatment system design effort. Task 3 Data Acquisition, includes mobilization and demobilization of field personnel and sampling equipment, performing groundwater confirmational sampling, and containment (drumming) and disposal of predesign investigation derived waste. Task 4 Data Evaluation, covers the activities associated with the sample analysis through Contract Laboratory Program (CLP), sample tracking and data validation. Task 5 Data Evaluation includes summarizing the collected data and performing groundwater modeling.

Task 6, Treatability Study/Pilot Testing will include contracting of a laboratory to perform the bench-scale treatability study to obtain information regarding the removal efficiencies and optimum operating conditions of the chemical precipitation and removal of metals and suspended solids. It will also include a field pilot testing of reinjection to determine the parametric design values such as aquifer transmissivity and optimal rate of aquifer reinjection.

Tasks 7, 9 and 10 define the various stages of the design effort for groundwater extraction, precipitation, filtration, air stripping, carbon adsorption and reinjection system. Task 7 is the 30% preliminary design which includes the completion of the Basis of Design Report, an outline of the specification and design sketches. Task 8 Equipment/Services Procurement will be performed during remedial action (construction phase). Task 9 usually is to bring the design to 60% completion; however, as directed by USEPA, this task is not included in the scope of work. Finally, Task 10 is the prefinal/final design (90-100%) that will complete the entire design effort. The final design submittal will contain technical specifications and drawings and engineers' cost estimate.

Task 11, Post Remedial Design Support, is to provide USEPA with any technical and engineering support that may be needed in the solicitation and engagement of contractors to implement the remedial action at the Circuitron Corporation site. The scope of supporting activity that is included in this scope of work as requested by USEPA includes the preparation of the Request for Proposal (RFP) Packages. Document printing, advertising and mailing, conduct of preproposal conferences, collection and evaluation of the proposals and recommendations for awarding the contracts are optional items and will be provided if requested by USEPA.

1.0 INTRODUCTION

This Work Plan presents descriptions of the work elements required for performing the remedial design for treatment of groundwater in the immediate vicinity at the Circuitron Corporation site in East Farmingdale, Suffolk County, Long Island, New York. It has been prepared at the request of the United States Environmental Protection Agency (USEPA) Region II Office under work Assignment Number 082-2N1E, USEPA Contract Number 68-W8-0110.

This Work Plan has been prepared by Ebasco Services Incorporated (Ebasco) in accordance with the guidance in the ARCS II Management Plan dated December 1988 (USEPA, 1988), the March 1987 Data Quality Objectives (DQO) guidance (USEPA, 1987), and the June 1986 Superfund Remedial Design and Remedial Action Guidance (USEPA, 1986); and in accordance with the USEPA's Statement of Work (SOW) dated February 1, 1995 and the discussions held during the kick-off meeting on February 22, 1995.

1.1 BACKGROUND AND ENFORCEMENT

BACKGROUND

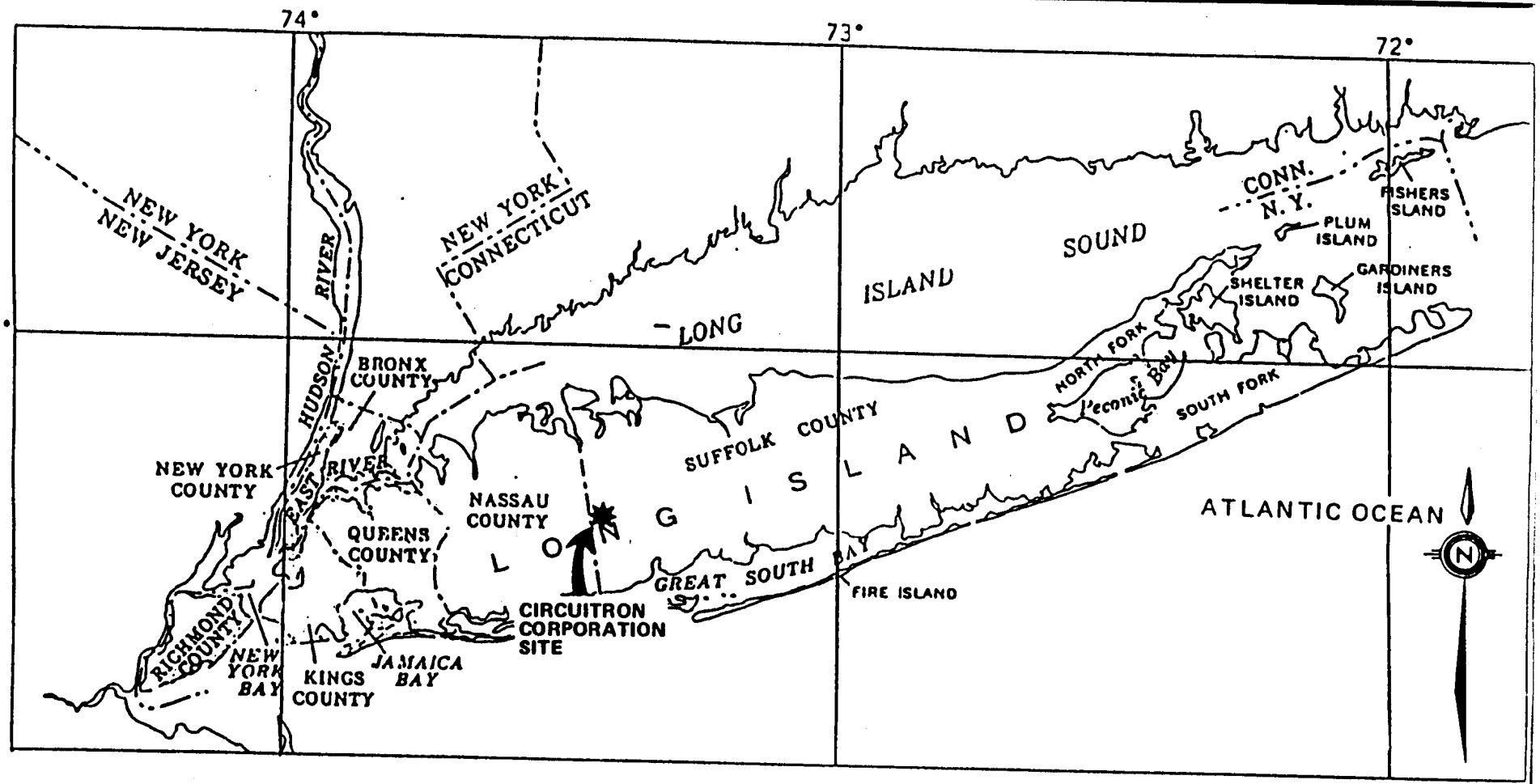
The Circuitron Corporation Site is a National Priorities List site which is located at 82 Milbar Boulevard, East Farmingdale, Suffolk County, New York. The site is situated near the Nassau County-Suffolk County border in central Long Island. The site encompasses approximately 1 acre in an industrial/commercial area just east of Route 110 and the State University of New York, Agricultural and Technical College campus in Farmingdale. The site is generally flat and has a slight slope up to the southeast of less than 1 percent. The site elevation is approximately 85 to 90 feet above mean sea level. Figures 1-1 and 1-2 present regional and detailed location maps for the Circuitron Corporation site. Figure 1-3 shows the site plan and the location of the above and below ground structures as existed before implementation of the Operable Unit 1 remedial action.

The Circuitron Corporation site consists of an abandoned 23,500 square foot building that was used between 1961 and 1986 for the manufacture of electronic circuit boards. Aside from the building, the site is primarily asphalt paved, with the exception of a small area in the rear of the building. The paved area in front of the building was used in the past as a parking lot for the employees of Circuitron Corporation and was later used for parking by employees of nearby companies. During the initial phases of the remedial design effort, the whole area was fenced and trespassing across property lines has ceased.

Circuitron Corporation is located in an industrial area surrounded by similar small manufacturers and is several miles away from any residential area. There are no schools or any recreational facilities in the immediate vicinity.

Approximately 15 municipal wells serving over 215,000 people are within 3 miles of the site, the nearest being approximately 1500 feet to the southeast of the site in the direction of groundwater flow. One shallow well in this field has been closed since 1978 due to organic chemical contamination from an unknown source.

Circuitron Corporation vacated the premises sometime within May and June of 1986.



SOURCE: McCLYMONDS AND FRANKE

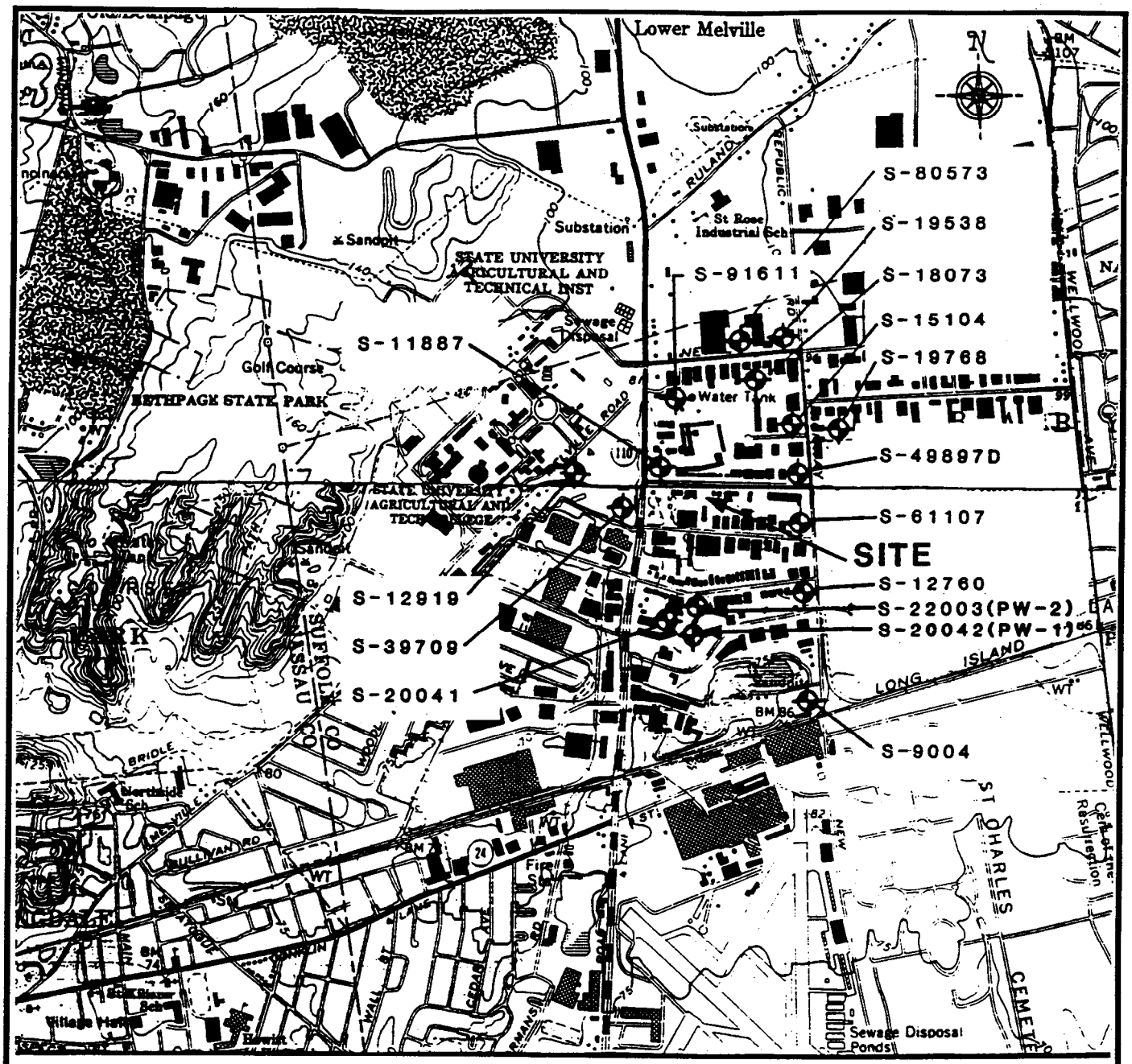
U.S. ENVIRONMENTAL PROTECTION AGENCY

CIRCUITRON CORPORATION SITE
OPERABLE UNIT 2, REMEDIAL DESIGN

FIGURE 1-1

REGIONAL LOCATION MAP

EBASCO SERVICES INCORPORATED



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

SCALE 1:24000

1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

S-11887 SUPPLY WELL

PW PRIVATE WELL

QUADRANGLE LOCATION

SOURCE: WESTON, FIG. 1-1

U.S. ENVIRONMENTAL PROTECTION AGENCY

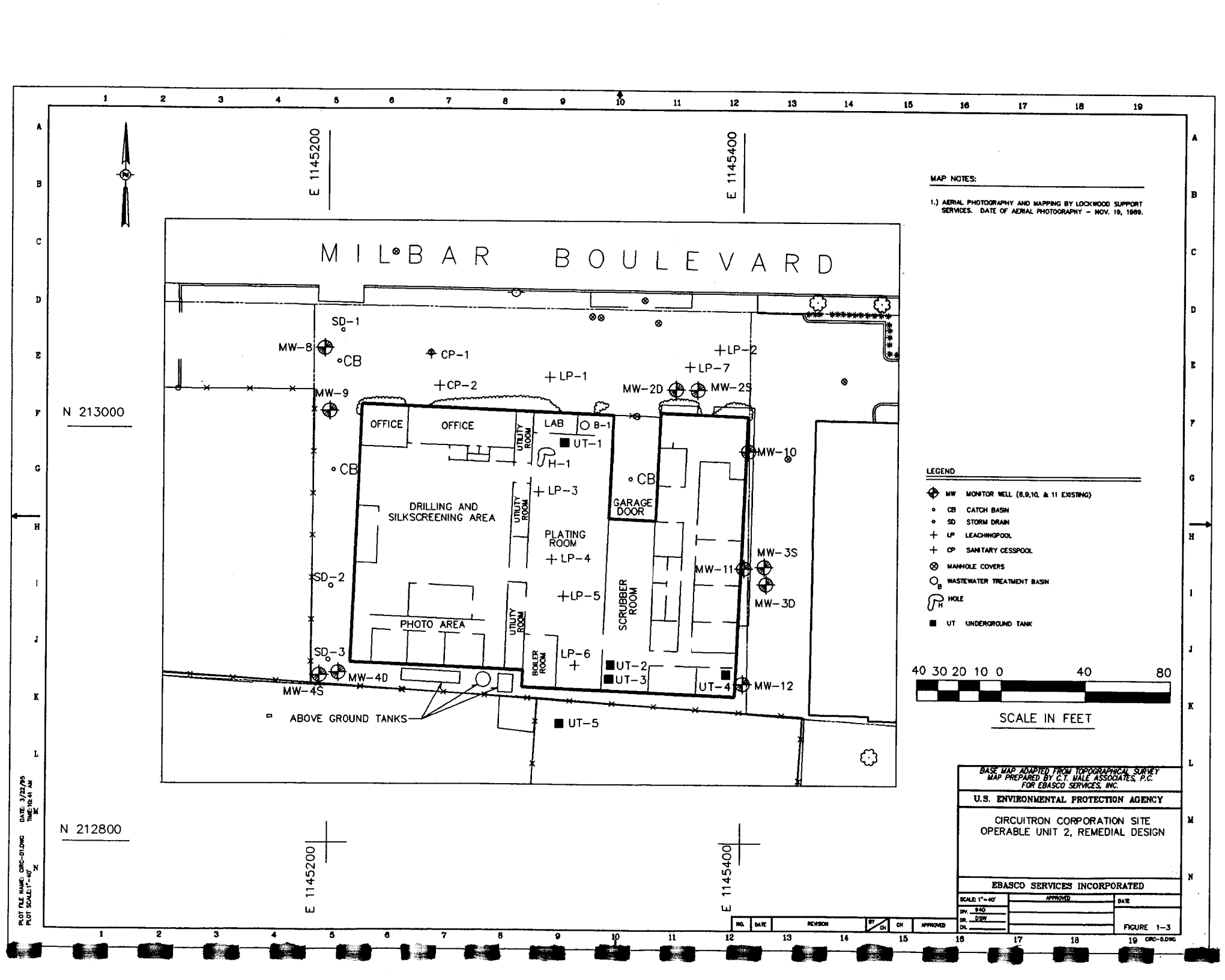
CIRCUITRON CORPORATION SITE
OPERABLE UNIT 2, REMEDIAL DESIGN

FIGURE 1-2

CIRCUITRON CORPORATION
SITE LOCATION MAP
EAST FARMINGDALE, NY

EBASCO SERVICES INCORPORATED

AFIG.DWG


MILBAR BOULEVARD
E 1145200
E 1145400
N 213000
N 212800
SD-1
MW-8
CB
CP-1
LP-2
LP-7
LP-1
CP-2
MW-9
MW-2D
MW-2S
OFFICE
OFFICE
UTILITY ROOM
LAB
B-1
UT-1
H-1
MW-10
CB
LP-3
CB
DRILLING AND SILKSCREENING AREA
UTILITY ROOM
GARAGE DOOR
PLATING ROOM
LP-4
MW-3S
MW-11
SD-2
LP-5
SCRUBBER ROOM
MW-3D
PHOTO AREA
UTILITY ROOM
SD-3
BOILER ROOM
LP-6
UT-2
UT-3
UT-4
MW-12
MW-4D
MW-4S
ABOVE GROUND TANKS
UT-5
MAP NOTES:
1.) AERIAL PHOTOGRAPHY AND MAPPING BY LOCKWOOD SUPPORT SERVICES. DATE OF AERIAL PHOTOGRAPHY - NOV. 19, 1989.
LEGEND
MW MONITOR WELL (8,9,10, & 11 EXISTING)
CB CATCH BASIN
SD STORM DRAIN
LP LEACHINGPOOL
CP SANITARY CESSPOOL
MANHOLE COVERS
WASTEWATER TREATMENT BASIN
H HOLE
UT UNDERGROUND TANK
40 30 20 10 0 40 80
SCALE IN FEET
BASE MAP ADAPTED FROM TOPOGRAPHICAL SURVEY MAP PREPARED BY C.T. MALE ASSOCIATES, P.C. FOR EBASCO SERVICES, INC.
U.S. ENVIRONMENTAL PROTECTION AGENCY
CIRCUITRON CORPORATION SITE OPERABLE UNIT 2, REMEDIAL DESIGN
EBASCO SERVICES INCORPORATED
FIGURE 1-3
PLOT FILE NAME: CIRC-01.DWG PLOT SCALE: 1"=40' DATE: 3/22/95 TIME: 10:41 AM

Prior to the onset of the remedial investigation and feasibility study (RI/FS), a removal action was conducted by USEPA at the site which consisted of sampling and removal of drum and tank contents which were abandoned on the site. The onsite removal activities were completed in May 1989. The RI/FS was initiated in September, 1988 and the field work started in May, 1989. The final RI/FS documents were completed in January, 1991.

A Record of Decision (ROD) for Operable Unit 1 (OU-1) was signed on March 29, 1991 and called for the in situ vapor extraction (SVE) of the contaminants from the contaminated soil, the excavation of contaminated sediments from leaching pits, the decontamination of the onsite building, and the repaving of the site area. The RD of OU-1 was initiated on June 24, 1991. A structural evaluation of the building on the property was performed, and the building was found to be structurally sound. However, due to the inclement weather during the 1992/1993 winter the building has deteriorated markedly. A decision was made by USEPA to demolish the building rather than restore it, since the former alternative will be more cost-effective. This change in the ROD for OU-1 was documented in the ROD for Operable Unit Two (OU-2).

A focused feasibility study (FFS) for OU-2 was initiated in December, 1991 to characterize the extent of groundwater contamination onsite as well as downgradient of the site. The findings of this investigation revealed that several onsite contamination source areas still exist at the site, and that both organic and inorganic contamination were evident in the Upper Glacial and Magothy aquifers. Elevated concentrations of organic contaminants (TCE, 1,1,1-TCA, PCE, DCE, etc.) were also present in the deeper portions of the Upper Glacial aquifer, both upgradient and downgradient of the site. The FFS has been completed and a ROD for OU-2 was signed on September 30, 1994. The selected remedy consists of the removal of inorganics from the groundwater prior to air stripping and reinjection.

The major components of the selected remedy in the ROD (September 1994) for the Second Operable Unit (groundwater) include the following:

- Extraction of the site-related groundwater contaminant plume present in the upper 40 feet of the saturated Upper Glacial aquifer;
- Treatment, via precipitation and air stripping, of contaminated groundwater to drinking water standards;
- Reinjection of the treated groundwater into the Upper Glacial aquifer via an infiltration gallery; and
- Disposal of treatment residuals at a RCRA Subtitle C facility.

ENFORCEMENT

The Circuitron Corporation filed for bankruptcy at the beginning of 1986. The bankruptcy proceeding was dismissed in 1988. A general notice letter was sent to the potentially responsible parties (PRPs) on August 15, 1988. No answer was received by the end of the moratorium period. It was determined therefore, that the PRPs did not intend to conduct the RI/FS for the first operable unit or cooperate with USEPA enforcement efforts to initiate remedial activities at the site and USEPA undertook the RI/FS in September, 1988.

General notice letters concerning the first operable unit were sent to several PRPs on March 29, 1991 offering them the opportunity to perform the Remedial Design/Remedial Action activities. All letters were returned unclaimed, with the exception of one. Additional general notice letters were hand-delivered to three PRPs on June 5, 1991 by an USEPA investigator. No responses were received from these PRPs and, therefore, USEPA decided to fund the remedial investigation and any subsequent remediation if it became necessary.

1.2 PURPOSE AND SCOPE

The purpose of this Work Plan is to describe the activities required to develop Technical Proposal Packages containing the necessary drawings and technical specifications to be used by the USEPA to solicit contractors to implement the selected remedy in the OU-2 ROD (September 1994). The drawings and specifications to be prepared under this Work Assignment will be submitted to USEPA at 30%, 90% and 100% RD completion.

The following activities are included in the scope of this remedial design Work Plan:

- Conduct water sampling and analysis including assessment of DQO to confirm the type and extent of contamination, perform treatability study/pilot testing to determine the design parameters for the groundwater treatment and reinjection system, and perform groundwater modeling to design the extraction and reinjection system,

- Prepare the subcontract bid package consists of technical specifications inclusive of specifying DQO for sampling during remedial action and drawings for the groundwater treatment system installation

The stated purpose and scope of the Work Plan are based on Ebasco's understanding of the previous investigations, USEPA's Statement of Work and the discussions with the USEPA at kick-off meetings.

1.3 PROJECT UNDERSTANDING

At the direction of the USEPA, Ebasco conducted the RI/FS investigation, and so is familiar with the physical setting of the Circuitron Corporation site. Circuitron Corporation site is located in an industrial area surrounded by similar small manufacturers and is several miles away from any residential areas. The whole site area is fenced currently and access to the site is restricted. US Army Corps of Engineer (USACE) and its Contractors on behalf of the USEPA has initiated the soil remedial action (Operable Unit 1) at the site. Ebasco will coordinate all field work activities through USEPA so that no interruption to field work occurs. In addition, Ebasco will incorporate the as-built conditions of the site resulting from the implementation of the Operable Unit 1 remedy into the groundwater remedial action design.

1.4 PROJECT APPROACH

The Ebasco approach to this Remedial Design Work Assignment is to identify in advance all the elements possible and to develop a coherent project schedule to systematically complete each of the work elements identified.

Immediately upon receipt of USEPA approval of this Work Plan, Ebasco will begin planning the field operations and sampling activities, including preparation of a Brossman Work/QA Project

Plan Short Form, bid packages for the procurement of a laboratory for conducting a groundwater treatability study; and arrangements for sample analysis and data validation. No new monitoring well installation or hydropunch sampling will be performed and only existing wells will be sampled. Since the scope of field work is limited to sampling of the existing Upper Glacial aquifer wells only, no Field Operation Plan will be prepared as directed by USEPA.

Upon completion of the procurement process and receipt of USEPA approval of the Work Plan and Brossman Work/QA Project Plan Short Form, Ebasco will proceed with field work activities. Collected groundwater samples will be sent to CLP Laboratories for analysis, and one large quantity groundwater sample will be sent to the laboratory selected for conducting treatability studies. In addition, a field pilot testing of reinjection will also be performed.

Initial development of the Basis of Design Report (BDR) will begin after completion of field sampling and testing activities as sample data gradually becomes available; however, Ebasco will complete the draft BDR for USEPA review only after the design bases are confirmed by the validated data and results of treatability study and groundwater modeling results. The 30% design package will include the BDR, an outline of specifications and drawings as well as design sketches.

Following receipt of USEPA comments on the BDR, Ebasco will begin the preparation of the technical specifications for the groundwater treatment system. Technical specifications and drawings will be submitted at 90% and 100% completion. There will be no 60% design submittal as directed by USEPA.

1.5 WORK PLAN FORMAT

This Work Plan presents Ebasco's technical scope of work as well as an estimated effort and schedule for conducting the additional data acquisition and the treatability study/pilot testing to support the remedial design. This Work Plan also presents Ebasco's current understanding of the site conditions and the rationale for the technical approach selected.

This Work Plan contains five sections. Section 1 is this Introduction. Section 2, Summary of site Data, describes the location, features and history of the site, and discusses the nature and extent of contaminants found on site. Section 3, Scope of Remedial Design, presents the remedial design objectives, design approach and a preliminary list of Applicable or Relevant and Appropriate Requirements (ARARs). Section 4, Task Plan for Remedial Design, presents detailed discussions on the scope and approach for the applicable design tasks. Section 5, Project Management and Control, describes the project organization and schedule.

2.0 SUMMARY OF SITE DATA

This section presents a summary of the contamination data and information pertaining to the Circuitron Corporation site. The following summary is based on the information presented in the RI/FS Reports (Ebasco 1990), the Final Draft FFS Report (Roy F. Weston, Inc. July 1994) and OU-2 ROD (September 1994).

2.1 SITE LOCATION AND 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 as existed before implementation of the Operable Unit 1 remedial action 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 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) toward 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 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.

2.2 SITE HISTORY

A chronology of regulatory and historical events for the site is provided in Table 2-1. 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 alkaliés. 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.

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 USEPA remedial investigation activities.

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 discharge substances not covered by their SPDES permit. As a result of this activity, USEPA directed its Field Investigation Team (FIT) to perform a Preliminary Assessment and Site Inspection. At 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 discharges. A series of samples collected from the leach 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.

TABLE 2-1

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.
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.

TABLE 2-1 (Cont'd)

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. IWO885 (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 material 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.

TABLE 2-1 (Cont'd)

October 29, 1985	NYSDEC samples the SPDES industrial leaching pool. Analytical results indicate the presents 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.
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.

TABLE 2-1 (Cont'd)

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.
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.

TABLE 2-1 (Cont'd)

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 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 Remedial Design 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 of OU-1 submitted by ICF to U.S. EPA.
March 29, 1993	60% Remedial Design document of OU-1 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.

TABLE 2-1 (Cont'd)

July 1994	Submittal of Draft Final FFS by WESTON to U.S. EPA.
September 30, 1994	Record of Decision issued OU-2.
September 30, 1994	U.S. EPA Initiated OU-1 (soil) remedial action.
February 1, 1995	U.S. EPA Issued Design Work Assignment for OU-2.

2.4 PHYSICAL SETTING

2.4.1 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.

2.4.2 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.

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 (S-20041 and S-20042) located downgradient of the site which are screened in the Mogothy are located in the East Farmingdale Water District Wellfield #2 on Gazza Boulevard approximately 1500 feet south of the site (see Figure 1-2).

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 Bartless, 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).

20-Foot Clay

The name "20-foot clay" was assigned by Perlmutter and Geraghty to relatively thin beds of marine clay that occur at elevation 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.

Gardners 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.

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).

2.4.3 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 of 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 the FFS, slug tests were conducted at several of the shallow Upper Glacial aquifer monitoring wells. 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. 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 exists on Milbar Boulevard near Route 110 (Broad Hollow Road) located to the west of the site. The New York State Department of Transportation 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.

2.5 NATURE AND EXTENT OF GROUNDWATER CONTAMINATION

The nature and extent of groundwater contamination at the site as summarized in this section is based on data presented in the RI report (Ebasco, 1990), the FFS (WESTON, 1994) and the OU-2 ROD (1994).

The RI report concluded that the groundwater was contaminated in the shallow aquifer underlying the Site. The RI data also indicated the potential for the presence of upgradient sources for the groundwater contamination that was detected in the deeper Upper Glacial aquifer and the shallow Magothy aquifer. The groundwater contaminant levels that were detected in these aquifers upgradient and downgradient of the Site were of the same order of magnitude. As a result, USEPA concluded that additional groundwater and hydrogeological information was required before a remedy could be selected for the groundwater.

OU-2 investigation efforts under the FFS included: (1) groundwater elevation measurements and a first found of groundwater sampling of 20 existing first operable unit monitoring wells in May 1993; (2) a drive-point groundwater field screening sampling program in August 1993; (3) installation of two confirmatory monitoring wells in February 1994; (4) a second round of groundwater sampling of the existing RI monitoring wells and the two confirmatory monitoring wells, also in February 1994; (5) hydrogeologic (slug) testing in March 1994; and (6) initiation of a long-term groundwater elevation monitoring, also in March 1994.

A complete round of water level measurements from both on-site and off-site monitoring wells was made for hydrogeologic evaluation of the groundwater flow direction and velocity.

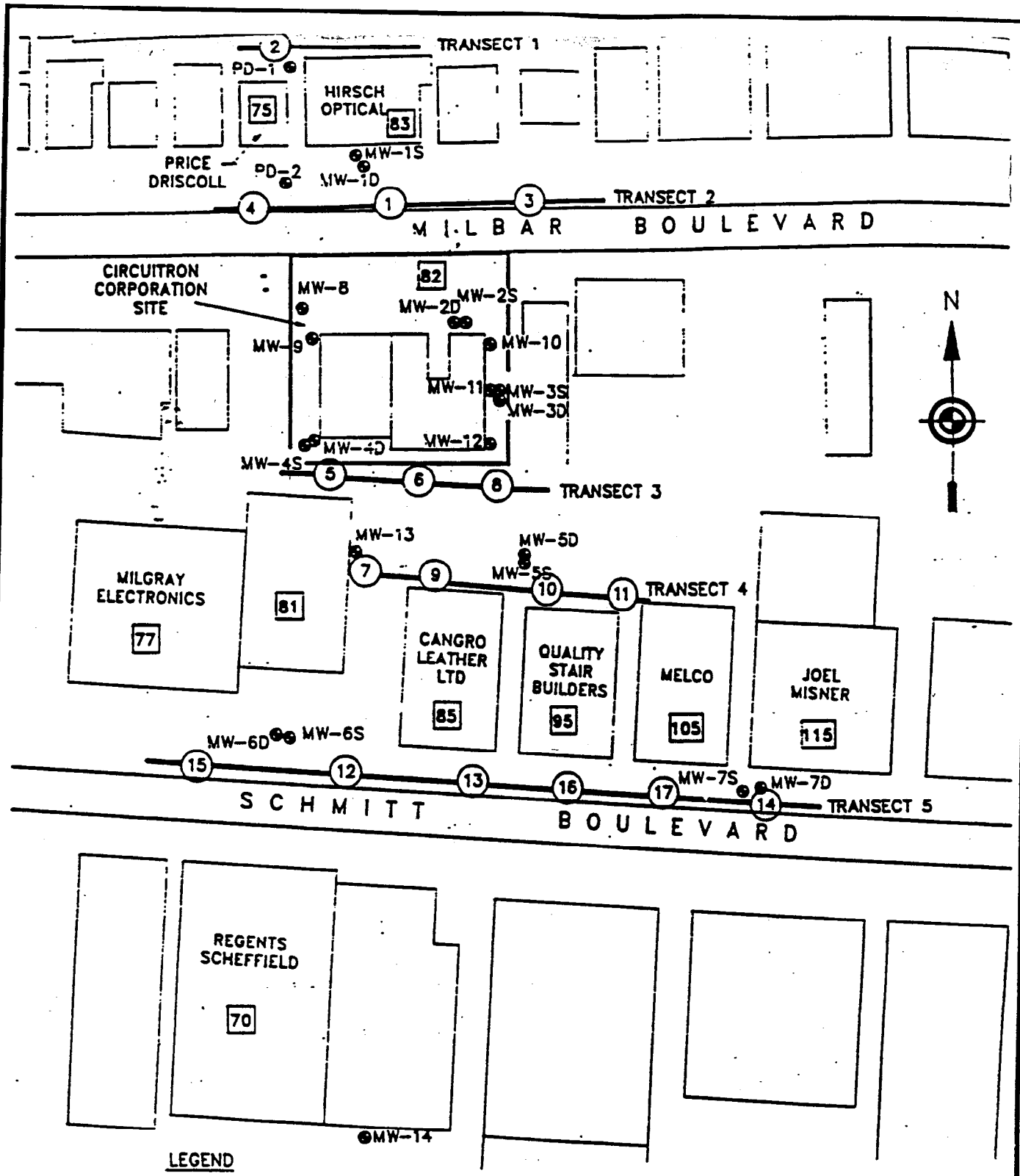
Groundwater level measurements were also made prior to both rounds of groundwater sampling and during April 1994. Long-term water level measurements were performed at MW-2S and MW-2D (see Figure 2-1) during March 15 to 21, 1994, to identify any effects on groundwater flow patterns due to pumping of nearby water supply wells. Groundwater flow direction was determined to be the south-southeast for both the Upper Glacial and Magothy aquifers. Average horizontal velocities of 1.84 feet/day and 0.25 feet/day were calculated for the Upper Glacial aquifer and the Magothy aquifer, respectively.

To provide updated groundwater analytical data, the existing 1989 RI monitoring wells were resampled in May 1993 as part of the Round 1 ground sampling event. These wells were sampled for Low Detection Level (LDL) Target Compound List (TCL) VOCs and total and dissolved Target Analyte List (TAL) Metals. 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 (see Figure 2-1). The remaining existing RI wells were located on adjacent properties and included MW-1S/D, MW-5S/D, MW-6S/D and MW-7S/D. The "S" indicated that the well is a water table well with a screened interval of approximately 25 to 35 feet below grade and is the shallow monitoring well of two collocated wells (couplet). The "D" indicates that the well is the deeper well of the couplet, with a screened interval approximately 90 to 100 feet below grade in the shallow Magothy aquifer. One supply well was also sampled during Round 1. This well is a deep noncontact cooling water supply well (PW-2) located on the House of Plastics property, downgradient of the Site (see Figure 1-2).

A drive-point groundwater sampling program was conducted in conjunction with quick turnaround laboratory analysis during August 1993 at the 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 Site, running generally perpendicular to the predominant groundwater flow direction to the south-southeast. Groundwater sampling locations were spaced at approximately 100 to 150 foot intervals along each transect. 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. During the drivepoint groundwater sampling program, 10% of the samples were collected for off-site analysis for TCL organics using of the Contract Laboratory Program (CLP) to confirm the results of the quick turnaround analysis performed by H_2M Laboratories (an ELAP/CLP certified).

Based upon the results of the drive-point 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 Site property, 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.

The round 2 groundwater sampling was performed in February 1994 and included the majority of the exiting RI monitoring 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 (PD-1 at Price Driscoll property, located at 75 Milbar Boulevard) and the House of Plastics well, PW-2. These wells were sampled for LDL TCL VOCs and total and dissolved TAL Metals. In addition to these analytes, alkalinity, hardness, total dissolved solids



U.S. ENVIRONMENTAL PROTECTION AGENCY

CIRCUITRON CORPORATION SITE
OPERABLE UNIT 2, REMEDIAL DESIGN

FIGURE 2-1

MONITORING WELL AND
DRIVE POINT GROUNDWATER
SAMPLING LOCATIONS

EBASCO SERVICES INCORPORATED

AFIG.DWG

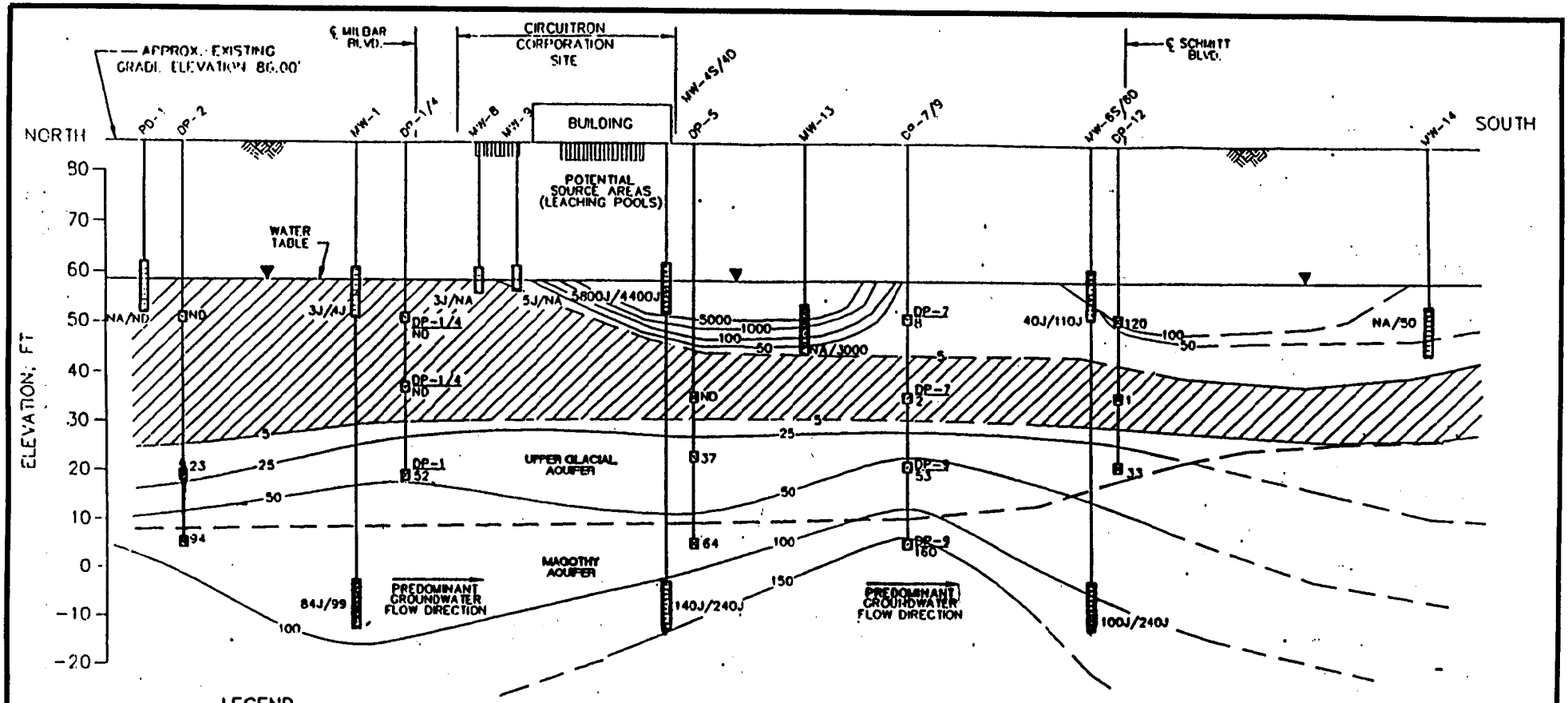
(TDS) and total suspended solids (TSS) were also analyzed for at nine (9) monitoring wells. The two rounds of groundwater VOC sampling results indicated elevated concentrations of several organic contaminants (ROD, 1994). The VOCs with the highest concentrations included: 1,1-dichloroethene (1,1-DCE) (58 parts per billion (ppb) at MW-6D), 1,1-dichloroethane (1,1-DCA) (52 ppb at MW-13), 1,1,1-trichloroethane (1,1,1-TCA) (5800 ppb at MW-4S), trichloroethane (TCE) (82 ppb at MW-1D), and tetrachloroethene (PCE) (63 ppb at MW-4D). These concentrations exceed their respective New York State Drinking Water Standards of 5 ppb.

For inorganic compounds, the first round of groundwater sampling results indicated elevated concentrations of arsenic, barium, chromium, copper, iron, lead and manganese. In the second round, only chromium, copper, iron, lead and manganese were reported in elevated concentrations. Of these compounds, it is believed that only arsenic, copper, lead and chromium are associated with past Site-related industrial process operations. These four inorganic compounds were also reported in elevated concentrations in Site soils and sediments during the first operable unit RI. These four inorganic compounds were detected at elevated concentrations (numbers in parentheses denote maximum concentrations) in the groundwater samples collected during the two rounds: arsenic (74 ppb at MW-2S), chromium (788 ppb at MW-7S), copper (14,600 ppb at MW-2S), and lead (55 ppb at MW-9). These concentrations exceed their respective New York State Drinking Water Standards of 25 ppb for arsenic, 100 ppb for chromium, 200 ppb for copper, and 15 ppb for lead.

The FFS groundwater sampling results, in conjunction with the results from the first operable unit RI, confirmed that several on-property contamination source areas exist at the Site, as organic and inorganic contamination is evident in the groundwater in both the Upper Glacial and shallow Magothy aquifers. The drive-point data indicated that a groundwater contaminant plume attributed to the Site exists in the Upper Glacial aquifer extending to an approximate depth of 70 feet below grade (upper 40 feet of the saturated Upper Glacial aquifer). The volatile organic contaminant levels found in upgradient and downgradient samples collected from drive-point installations located in the deep Upper Glacial and monitoring wells located in the shallow Magothy aquifers were of approximately the same order of magnitude, and, therefore, indicate approximately the same order of magnitude, and, therefore, indicate that the groundwater contamination that has been detected beneath the Upper Glacial aquifer, beginning at a depth of approximately 70 feet below grade, is attributed to upgradient sources.

The potential for the presence of upgradient sources is also supported by the vertical distribution of 1,1,1-TCA, shown in Figure 2-2, which is considered to be a fingerprint contaminant for the Site and is indicative of the vertical extent of groundwater contamination that is attributed to the Site. This distribution indicates a zone where 1,1,1-TCA was not detected between the heavily contaminated shallow Upper Glacial and the deep Upper Glacial aquifer. The absence of 1,1,1-TCA in this zone suggests that the Site-related contaminant plume in the shallow Upper Glacial aquifer is separate and distinct from the 1,1,1-TCA-contaminated groundwater in the deep Upper Glacial and shallow Magothy aquifers, and that there are other sources contributing to the contamination in the deep Upper Glacial and shallow Magothy aquifers.

In the Upper Glacial aquifer, the groundwater contaminant plume attributable to the Site contained elevated concentrations of both organics and inorganics which have migrated to approximately 700 feet beyond the southern property line of the Site. The main organic contaminants were 1,1,1-TCA and 1,1-DCE and the main inorganic contaminants were copper and chromium. The Site-related groundwater contaminant plume has a width of about 600 feet and extends vertically into the shallow portion (upper 40 saturated feet) of the Upper Glacial aquifer.



LEGEND

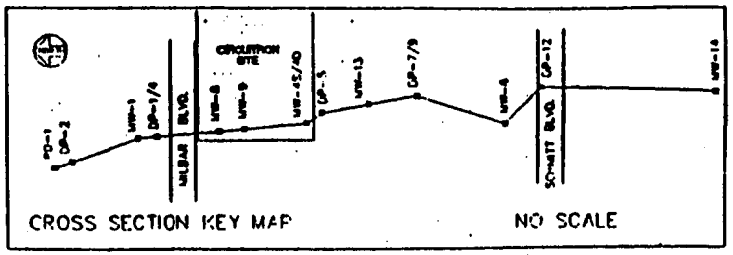
DP	DRIVE POINT GROUNDWATER SAMPLING LOCATION
—25—	CONCENTRATION ISOPLETH FOR 1,1,1-TCA IN ug/l
3J/ND	CONCENTRATION OF 1,1,1-TCA FOR ROUND 1/ROUND 2 GROUNDWATER SAMPLING
ND	ANALYTE NOT PRESENT ABOVE THE QUANTIFICATION LIMIT OF 1 ug/l FOR DRIVE POINT SAMPLES OR 0.5 ug/l FOR MONITORING WELLS
— — —	UNCONFORMABLE 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.

80 0 80 160

HORIZONTAL SCALE - FEET



SOURCE: WESTON, FIGURE 4 OF ROD

U.S. ENVIRONMENTAL PROTECTION AGENCY

CIRCUITRON CORPORATION SITE
OPERABLE UNIT 2, REMEDIAL DESIGN

FIGURE 2-2

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

MAY 1993, AUGUST 1993 AND FEBRUARY 1994

EBASCO SERVICES INCORPORATED

3.0 SCOPE OF REMEDIAL DESIGN

An OU-2 ROD documenting the rationale for the selection of a preferred remedy (Alternative GW-2 of the FFS) for groundwater contamination was issued on September 30, 1994.

The scope of this RD is to design the remedy selected in the OU-2 ROD. This operable unit represents the final remedy planned for the Circuitron Corporation site. It addresses the treatment of site related contaminated groundwater in the immediate vicinity (beneath and downgradient) of the property.

The USEPA's Statement of Work (SOW) dated February 1, 1995 and the discussions and directives given by USEPA during the kick-off meeting held on February 22, 1995 provide the major activities that are to be performed. The following sections describe the design objectives, design approach and Applicable or Relevant and Appropriate Requirements (ARARs).

3.1 DESIGN OBJECTIVES

Consistent with the declaration in the OU-2 ROD issued on September 30, 1994, the Remedial Design Objective is to employ the most cost effective design approach for the remedy selected such that upon implementation, this design would achieve the remedial objectives set out in the ROD. The remedial objectives defined in the OU-2 ROD for the Circuitron Corporation site are:

- Prevent potential future ingestion of site-related contaminated groundwater;
- Restore the quality of the groundwater contaminated from the site-related activities to levels consistent with the State and Federal drinking water and groundwater quality standards; and
- Mitigate the off-site migration of the site-related contaminated groundwater.

3.2 DESIGN APPROACH

The Circuitron Corporation site Remedial Design will be accomplished in two phases, the data collection phase and the remedial design phase.

Data Collection

During data collection, Ebasco will conduct field activities to collect additional site-specific chemical data and will conduct a bench-scale treatability study and field pilot testing to obtain the treatment process and reinjection design parameters. The collected site-specific chemical data and design parameters will be used for the following:

- Confirm the presence of inorganic and organic contamination
- Preparation of a detailed design for the installation of a groundwater treatment and reinjection system.

Ebasco will, to the degree appropriate, adopt or amend the existing RI/FS Health and Safety Plan for field operation. Ebasco will prepare a Brossman Work/QA Project Plan Short Form for the planning including assessment of DQO, collection, analysis and validation of groundwater sample and no sampling plan will be prepared as directed by USEPA.

Remedial Design

The Circuitron Corporation Site Remedial Design effort will culminate in the delivery to USEPA the following design documents:

- o Basis of Design Report (30% design completion),
- o Prefinal and final (90% and 100% completion) design specifications inclusive of specifying DQO for sampling during remedial action and drawings for the installation of a groundwater pumping and treatment system, and
- o Preliminary, prefinal and final Engineer's Cost Estimate.

The Basis of Design Report will document the technical rationale and performance requirements for the design of the groundwater treatment system. The groundwater treatment system may include groundwater extraction and collection, precipitation and clarification, filtration, air stripping, carbon adsorption, and reinjection components. Preparation of the Basis of Design Report will begin as the preliminary data becomes available. A draft Basis of Design Report will be completed and submitted for USEPA review and comment. Upon completion of USEPA review, Ebasco will submit a final Basis of Design Report incorporating USEPA comments for approval.

Data collected from the previous investigations as well as from the pre-design sampling and pilot testing program will be analyzed and groundwater modelling will be performed to determine the design flow rate for the Groundwater Treatment System. Data collected during the treatability study will be used to develop and optimize system parameters, such as chemical addition dosages for metals removal.

Based on the established design basis, technical specifications and drawings will be prepared for installation and testing of the entire treatment system and supporting equipment and structures. These documents will be included in a bid package that will enable a Construction Contractor to prepare a detailed construction documents and install and test the treatment system. In addition to the technical specifications and drawings, other procurement documents such as Terms and Conditions, will be prepared and assembled.

It is expected that the groundwater treatment system will be implemented after completion of the soil remediation efforts that are initiated for the implementation of the OU-1. The remedial design of the groundwater system will be based on the assumptions that no new sources of contamination will be added to increase the present levels of contamination and that the latest groundwater database will be utilized for the system design influent levels in the 30% design submittals.

3.3 PRELIMINARY IDENTIFICATION OF APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)

Remedial activities at the Circuitron Corporation site must be conducted in compliance with all federal, state and local statutes, regulations, codes and environmental policies. To achieve this objective, comprehensive sections on regulatory compliance requirements for appropriate design documents will be developed to ensure that regulatory considerations are factored into all stages of the remedial design. Specifically, Applicable Relevant and Appropriate Requirements (ARARs) for the site will be confirmed and properly utilized during development of the remedial design.

This section provides a preliminary determination of the federal and New York State environmental and public health requirements that are potentially applicable or relevant and appropriate to the site. In addition, this section presents an identification of other federal and state criteria, advisories and guidance (i.e., to be considered) that could be used when ARARs do not exist for the particular chemical or remedial activity or when the existing ARARs are not protective of human health or the environment.

3.3.1 Definition of ARARs

The requirements identified below have been categorized as "applicable or relevant and appropriate requirements" (ARARs) and "to be considered" (TBC) material, based upon the revised National Contingency Plan, 40 CFR 300. ARARs are defined as:

- Any standard, requirement, criterion, or limitation under any federal environmental law; and

- Any promulgated standard, requirement, criterion, or limitation under a state environmental or facility siting law that is more stringent than any equivalent federal standard, requirement, criterion, or limitation.

The purpose of this definition is to ensure that CERCLA responses are consistent with both federal and state environmental requirements.

Within these jurisdictional boundaries, ARARs are further defined according to the activity, contaminants, or location they are expected to affect. ARARs that relate to the level of pollutant allowed are called contaminant-specific; ARARs that relate to the presence of a specific geographic or archaeological resource are called location-specific; and ARARs that relate to a method of remedial response are called action-specific.

3.3.2 Consideration of ARARs During Remedial Design

All pertinent documents will be reviewed to identify and confirm the ARARs and TBCs which shall be used to guide remedial design.

3.3.3 Identification of ARARs and TBCs

3.3.3.1 Applicable or Relevant and Appropriate Requirements

The National Contingency Plan (NCP) (40 CFR 300) and the CERCLA/SARA Compliance Policy guidance define applicable requirements as the federal and state requirements for hazardous

substances, which would be legally binding at the site, if site response were to be undertaken regardless of CERCLA Section 104. Relevant and appropriate requirements are defined as those federal and state requirements that, while not directly applicable, apply to facilities or problems similar to those encountered at this site, so that their use is well suited. In other words, requirements may be relevant and appropriate if they would be applicable except for jurisdictional restrictions associated with the requirements. With respect to the implementation of remedial action, relevant and appropriate requirements are to be afforded the same weight and consideration as applicable requirements.

Below is a list of potential federal and state ARARs and criteria, advisories, and guidelines to be considered (TBCs) during the design and implementation of this remedial action at the Circuitron Corporation site, Operable Unit 2. It should be noted that this list is considered an informal compilation, and may be subject to modification during the design as appropriate.

1) Contaminant-Specific

Federal

- o Resource Conservation and Recovery Act (RCRA) Groundwater Protection Standards and Maximum Concentration Levels (40 CFR, Subpart F)
- o National Ambient Air Quality Standards (NAAQS) (40 CFR 50)
- o Safe Drinking Water Act, Maximum Contaminant Levels (MCLs) (40 CFR 141.11-.16)

New York State

- o New York General Prohibitions for Air Pollution (6 NYCRR 211)
- o New York Ambient Air Quality Standards (6 NYCRR 257-6)
- o New York Groundwater Quality Standards and Groundwater Effluent Standards (6 NYCRR 703)
- o New York Safe Drinking Water Act Maximum Contaminant Levels (MCLs) (10 NYCRR 5)
- o New York State RCRA Groundwater Protection Standards (6 NYCRR 373-2.6(e))

2) Location-Specific

Federal

There are no federal location-specific ARARs pertinent to the remediation of the Circuitron Corporation site.

New York State

There are no New York State location-specific ARARs pertinent to the remediation of the Circuitron Corporation site.

3) Action-Specific

Federal

- o RCRA General Regulations for Hazardous Waste Management (40 CFR 260)
- o RCRA Hazardous Waste Treatment Facility Design and Operating Standards for Miscellaneous Treatment and Disposal Systems (40 CFR 264 Subpart X)
- o RCRA Generator Requirements (40 CFR 262)
- o RCRA Subtitle C Closure and Post-Closure Standards (40 CFR 264, Subpart G)
- o RCRA Air Emission Standards for Equipment Leaks (40 CFR 264, subpart BB)
- o RCRA Groundwater Monitoring and Protection Standards (40 CFR 264, Subpart F)
- o RCRA Air Emission Standards for Process Vents (40 CFR 264 Subpart AA)
- o RCRA Transporter Requirements for Off-Site Disposal (40 CFR 263)
- o RCRA Identification and Listing of Hazardous Waste (40 CFR 261)
- o RCRA Land Disposal Restrictions (40 CFR 268)
- o DOT Rules for Hazardous Materials Transport (49 CFR 107, 171.1-171.500)
- o Occupational Safety and Health Standards for Hazardous Responses and General Construction Activities (29 CFR 1904, 1910, 1926)
- o Safe Drinking Water Act, Underground Injection Control Requirements (40 CFR 144 and 146)

New York State

- o New York State General RCRA Standards for Hazardous Waste Facilities (6 NYCRR 370-372)
- o New York State RCRA Closure and Post-Closure Standards (Clean Closure and Waste-in-Place Closures) (6 NYCRR 373-2.7)
- o New York State RCRA Generator and Transporter Requirements for Manifesting Waste for Off-Site Disposal (6 NYCRR 364 and 372)
- o New York State Air Emission Standards (6 NYCRR 200-212 and 231).
- o New York State Guidelines for Soil Erosion and Sediment Control
- o New York State Pollution Discharge Elimination System (SPDES) Requirements (Standards for Stormwater Runoff and Groundwater Discharges) (6 NYCRR 750-757)

- New York Industrial Code Rule #53, Notification Requirements for Buried Pipeline (12 NYCRR 753)

3.3.3.1 Potential "To Be Considered" Material

When ARARs do not exist for a particular chemical or remedial activity or when the existing ARARs are not protective of human health or the environment, other criteria, advisories and guidance may be useful in designing and selecting a remedial alternative. The following criteria, advisories and guidance were developed by the EPA and other federal and New York State agencies and are to be considered during the performance of Superfund remedial activities:

1) Federal

- OSWER Directive 9355.0-28 - Guidance for Air Stripper Emissions
- USEPA Health Effects Assessment (HEAs)
- Toxicological Profiles, Agency for Toxic Substances and Disease Registry, U.S. Public Health Service
- Cancer Assessment Group (National Academy of Science) Guidance
- USEPA Drinking Water Health Advisories
- TSCA Health Data
- Safe Drinking Water Act, National Primary Drinking Water Regulations, Maximum Contaminant Level Goals (MCLGs)

New York State

- New York State Air Guidelines for the Control of Toxic Ambient Air Contaminants (New York State Air Guide 1, 1994)
- New York State Underground Injection/Recirculation at Groundwater Remediation Sites (Technical Operating Guidance (TOG) Series 7.1.2)
- New York State Ambient Water Quality Standards and Guidance Values (Technical Operating Guidance (TOG) Series 1.1.1)

3.3.4 Local Regulations

All local regulations, codes and standards will be considered during remedial design.

4.0 TASK PLAN

Ebasco has reviewed the 11 standard tasks in the ARCS II Program Management Plan, and identified 8 as applicable and 1 as optional to this remedial design effort. These tasks are listed below:

Task		Applicability
Task 1	Project Planning	Yes
Task 2	Community Relations	Optional
Task 3	Data Acquisition	Yes
Task 4	Sample Analysis/Validation	Yes
Task 5	Data Evaluation	Yes
Task 6	Treatability Study/Pilot Test	Yes
Task 7	Preliminary Design (30%)	Yes
Task 8	Equipment/Services Procurement	No
Task 9	Intermediate Design (60%)	No
Task 10	Prefinal/Final Design (90-100%)	Yes
Task 11	Post Remedial Design Support	Yes

The above applicable tasks are further divided into subtasks, as required, to enhance the management and cost control of the project. Based on the scope outlined in the SOW and the discussions held during the kick-off meetings, Task 8 - Equipment/Services Procurement and Task 9 - Intermediate Design (60%) are not included in this Work Plan as directed by USEPA.

Task 1 covers the planning effort required to initiate the work process in response to the USEPA work assignment. This includes the work assignment kick-off meeting, review background information, preparation of this Work Plan, and the Brossman Work/QA Plan Short Form and site visits. Optional Task 2 covers planning and attend for one small group public meeting. Tasks 3, 4 and 5 are the tasks required to plan, collect, validate and analyze site-specific data used for the design effort including groundwater modeling. Task 6 involves the conduct of groundwater treatability studies and field pilot testing of reinjection.

Task 7 involves the preparation of the Basis of Design Report, and will include design criteria, preliminary drawings, specification outline, results of groundwater modeling, results of treatability study and field testing of infiltration, preliminary construction schedule and cost estimate. Following resolution of comments and responses or upon USEPA approval of the Basis of Design Report, Ebasco will proceed with Task 10, preparation of prefinal design (90% completion), specifications, drawings and Engineer's cost estimate for the groundwater treatment system. After USEPA and state agency review and acceptance of the responses to the review comments, Ebasco will proceed to incorporate USEPA and state agency comments and to bring the draft design to 100% completion. The deliverables will include final drawings, technical specifications, construction schedule and engineer's cost estimate. A description of each of the tasks is described below. Task 11 includes the preparation of remedial action procurement documents such as Terms and Conditions and the completion of a bid package.

4.1 TASK 1 - PROJECT PLANNING

The objective of this task is to define and control the technical scope, cost, schedule and management approach for the project. The expected planning activities and the subtasks required are described below:

Kick-off Meeting

Ebasco will hold a kick-off meeting with USEPA (meeting was held on February 22, 1995) to discuss the latest development at the Circuitron Corporation site and to discuss the project scope outlined in the USEPA's Statement of Work. In this meeting, Ebasco's understanding of the Scope of Work and technical approach for the remedial design was presented. A meeting minutes dated March 1, 1995 was submitted to USEPA. The USEPA comments and suggestions have been incorporated in this document.

Site Access

The responsibility of obtaining access to and use of the Circuitron Corporation site and affected properties, as well as all right-of-way and easements necessary to implement this remedial design and subsequent construction activities will lie with USEPA.

Site Visit

The purpose of the site visit is to obtain first-hand understanding of the current physical condition of the site. A one-day site reconnaissance is planned to familiarize the Ebasco project team with details of the site layout and surroundings. It is noted that the current physical condition of the site will be somewhat altered due to the implementation of the Operable Unit 1 soil remedy. The USEPA may also participate in the site visit. The site visit will be conducted before pre-design investigation or during the initiation of preliminary design.

Acquisition of Existing Data

The existing data for this site were presented in the Ebasco RI and FS Reports for the site, Roy F. Weston Focused Feasibility study report and the OU-2 ROD for the groundwater contamination. These existing data will be utilized in the remedial design effort to the extent practicable. As defined in the Statement of Work and direction provided by USEPA during the kick-off meeting, Ebasco will utilize the existing data as much as possible and only limited groundwater sampling will be performed during the predesign data collection activities.

Plan Preparation

This Work Plan has been prepared by Ebasco for performing the remedial design activities for the Circuitron Corporation site, Operable Unit 2. This Work Plan was prepared in response to the Work Assignment Number 082-2N1E under contract Number 68-W8-0110. In addition, a Brossman Work/QA Project Plan Short Form will be prepared for the predesign data collection. Due to limited predesign data collection activities (i.e., one round of Upper Glacial aquifer groundwater sampling) no sampling and analysis plan will be prepared as directed by USEPA. The existing Health and Safety Plan will be used (or modified if required) for groundwater sampling activities.

ARARs Compliance Review

Under this subtask, Ebasco will initiate review and provide regulatory support to provide the remedial design. Section 3.3 of this Work Plan presents a preliminary list of ARARs and TBCs identified. This preliminary list of ARARs will be further refined during the design. At that time, Ebasco will determine which ARARs trigger permit application or permit application equivalency submittals to Federal, State or Local regulatory agencies. This determination is necessary to ensure that sufficient site and remedial action related information exists to develop the submittals if required and to allow its identification in the Basis of Design document and other deliverables of the remedial design efforts.

4.2 TASK 2 - COMMUNITY RELATIONS (OPTIONAL)

As discussed during the February 22, 1995 kick-off meeting, no community relations plan or fact sheets will be specifically developed for this Remedial Design. Community Relations Plan originally developed during the RI/FS will be used during the design phase. However, for planning purposes, Ebasco will include the coordination and attendance for one public meeting in this scope of work. This task is an optional item and will be initiated only when requested by USEPA.

4.3 TASK 3 - DATA ACQUISITION

This task incorporates all actions related to the data acquisition for remedial design purposes at the Circuitron Corporation site. This includes implementation of supplemental field and analytical investigations required for the confirmation of groundwater contamination and also for Treatability Studies/Pilot Testing (Task 6).

Overall Objective

Field activities (Confirmational Groundwater Sampling [Subtask 3.2]) associated with the Remedial Design are planned to obtain additional chemical data to confirm/supplement data collected during the RI/FS and FFS. The following subsections summarize the objectives, methods, materials to be used, and sampling activities to be undertaken.

Mobilization and Demobilization (Subtask 3.1)

This subtask will consist of field personnel orientation, equipment mobilization, identification of sampling wells and demobilization. Each field team member will attend an on-site orientation meeting to become familiar with the history of the site, and the site-specific health and safety requirements and field procedures.

Equipment mobilization will entail the ordering, purchase, and if necessary, fabrication, of all sampling equipment needed for the field investigation. Ebasco will try to use equipment excessed by other ARCS Contractors as practical as possible to help increase the Government Furnished Equipment (GFE) utilization rate and at the same time minimize costs to the Government. A complete inventory of available equipment will be conducted prior to initiating field activities to ensure against delay-causing omissions. Any additional equipment required will be secured.

Equipment will be demobilized upon completion of field activities. Equipment demobilization may include (but will not be limited to) sampling equipment, health and safety decontamination equipment, organic vapor screening and monitoring equipment (OVA/HNu) and the field support facilities.

Confirmational Groundwater Sampling (Subtask 3.2)

It was noted that the analytical testing for inorganic compounds during the FFS reported sporadic elevated concentrations of these compounds detected at isolated locations on- and off-site 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 Nephelometric Turbidity units (NTUs). Therefore, additional groundwater sampling for the inorganic compounds present in groundwater, independent of the influence of high turbidity, would be obtained.

Because of concerns about turbidity in the wells and the effects on metals sampling results, Ebasco proposes to use the low-flow purge and sample method.

The low flow purge and sample method consists of using a submersible pump to purge the well at a very low flow rate (0.1 liter/minute). The pump intake is set approximately in the middle of the well screen, with a stagnant water column over the top of the pump. The well is purged at the low flow rate until the field parameters (such as temperature, pH, specific conductivity, turbidity, dissolved oxygen, Eh) have stabilized and turbidity is less than 50 NTUs. The sample is then collected directly from the pump discharge at a low flow rate. If the low flow purging can yield a unfiltered sample of less than 5 NTUs, then no filtered samples will be collected.

Equipment/Instrument Requirements

- o adjustable rate stainless steel submersible pump (e.g., Grundfos Redi-Flo2 with converter or equivalent)
- o generator
- o teflon-lined polyethylene tubing
- o filtration apparatus with 0.45 um filter (in-line disposable filters preferred)
- o polyethylene sheeting
- o monitoring instrument for measuring pH, turbidity, dissolved oxygen, conductivity, temperature (pH-alternate-narrow range paper)
- o Eh (oxidation potential) meter (Orion or equivalent)
- o large, wide-mouth beakers for measuring field parameters
- o photoionization detector (PID) or flame ionization detector (FID) or equivalent
- o electronic water level indicator or equivalent (marked in 0.01 foot increments)
- o nylon stay-ties
- o logbook(s)
- o sampling gloves
- o decontamination supplies
  - eight - 5 gallon buckets
  - potable water supply
  - alconox
  - methanol (if needed)
  - di-ionized water

- o sample bottles and preservatives specified in the Bossman Work/QA Short Form
- o labels and shipping products specified in the Brossman Work/QA Short Form
- o personal protective equipment specified in site Health and Safety Plan

Groundwater samples will be collected from onsite wells and off-site wells screened in the Upper Glacial aquifer. The wells located in the most representative portion of the shallow Upper Glacial aquifer (Upper 40 saturated feet) are MW-1S, 3S, 4S, 5S, 6S, 7S, 13, 14 and PD-1 (Figure 2-1). These samples will be analyzed for TCL volatiles, TCL extractables and TAL metal (filtered, if required, and total). As directed by EPA during kick-off meeting (refer to minutes of Kick-off Meeting March 1, 1995) only limited sampling effort for the TCL extractables is proposed in the Work Plan. Therefore, the TCL extractables analysis will be performed only on those samples collected from five monitoring wells which are located upstream (MW-1S), and in site related groundwater contamination (MW-4S, 5S, 6S and 14) to determine the level of semivolatile contaminants.

Containment and Disposal of Predesign Investigation Derived Waste

Predesign investigation derived waste will include decontamination water, well development (if required) and purge water, and disposable personnel protective equipments. It is estimated to be less than 10-55 gallon drums. Ebasco, upon completion of all field activities, will procure a Subcontractor to remove and dispose the drummed waste appropriately. Ebasco will procure the Subcontractor through telephone solicitation (from three (3) bidders) and will comply with all procedures and documentation required for the removal and disposal.

4.4 TASK 4 - SAMPLE ANALYSIS/VALIDATION

All environmental samples collected as part of Task 3 (Section 4.3) will be subjected to a laboratory testing and data validation program. The data validation portion of the program will verify that the analytical results are of sufficient quality to be relied upon to support the Remedial Design.

4.4.1 Sample Analysis

All sample analyses will be conducted via the USEPA CLP (routine analytical services (RAS)) program. A summary of the groundwater analytical program is provided in Table 4-1. Sample collection and analytical protocols are presented in Table 4-2.

Groundwater analyses for TCL volatiles; TCL semivolatiles (base-neutral/acid extractables only) and TAL metals (filtered and unfiltered) will correspond to those of USEPA Data Quality Object (DQO) Level IV as specified in "Data Quality Objectives for Remedial Response Activities" (EPA 540/G-87/003, OSWER Directive 9355.0-7B), March 1987.

4.4.2 Sample Tracking

Sample tracking consists of the arrangements for allocating testing with the CLP laboratories and all documentation activities associated with sample collection and shipment, analysis, and receipt of data. The task includes assuring proper documentation and transport of field samples to the laboratories, correspondence with organizations dealing with the sampling, and assembly of analytical results as they are received. All Task 3 samples will be tracked following ARCS II Field Technical Guidelines and USEPA Region II procedures for utilization of the USEPA CLP program.

TABLE 4-1

CIRCUITRON CORPORATION SITE
SUMMARY OF GROUNDWATER FIELD SAMPLING PROGRAM

Sample Type	Matrix	TCL Volatiles	TCL Base-Neutral/ Acid Extractables Only	Total TAL Metals	Dissolved TAL Metals
Existing Monitoring Wells:					
1. Monitoring Wells	Groundwater	9	5	9	9
Duplicate Samples	Groundwater	1	1	1	1
QA/QC Blanks:					
1. Distilled Water Blanks	Water	1	1	1	-
2. Field Blanks	Water	4	4	4	-
3. Filtering Apparatus Blanks	Water	-	-	4	-
4. Trip Blanks	Water	4	-	-	-
	Totals	19	11	19	10

Notes:

- Number of samples are estimated.
- Number of field, filtering apparatus and trip blanks are estimated.
- No filtered samples and filtering apparatus blanks are required to obtain, if the turbidity of low flow rate purge groundwater (unfiltered) is less than 5 NTUs
- TCL = USEPA Target Compound List
- TAL = USEPA Target Analyte List.

TABLE 4-2

CIRCUITRON CORPORATION SITE
SAMPLING AND ANALYSIS PROTOCOLS

Sample Type	Number of Samples	Matrix	Sampling Device	Parameter	Sample Container	Sample Preservation	Analytical Method	Method Detection Limits	Holding Time
Groundwater	10*	Water	Direct fill of bottles from low flow submersible pump	TCL Volatiles	(3)-40 ml VOA vials w/Teflon lined septum	1:1 HCL to pH <2; Cool to 4°C	OLM01.9 or most recent version	Compound Specific (10 ug/l)	10 days
	6*			TCL Extractables	(4) 1-L amber glass w/Teflon lined cap	Cool to 4°C	OLM01.9 or most recent version	Compound Specific (0.01-20 ug/l)	5 days extract; 40 days analyze
	10*			TAL Metals (unfiltered)	(1) 1-L polyethylene	Conc. HNO3 to pH; <2 Cool to 4°C	ILM03.0 or most recent version	Element Specific (0.2-5000 ug/l)	6 months (Hg-26 days)
	10*			TAL Metals (filtered)	(1) 1-L polyethylene	Filter in field w/0.45 um filter, then conc. HNO_3 to pH <2;	ILMO3.0 or most recent version	Element Specific (0.2-5000 ug/l)	6 months (Hg-26 days)
Field Blank	4	Water	Collected Rinsate Passed Over Sampling Equipment	TCL Volatiles	(3) 40 ml VOA vials w/Teflon lined septum	1:1 HCL to pH <2;Cool to 4°C	OLMO1.9 or most recent version	Compound Specific (10 ug/l)	10 days
	4			TCL Extractables	(4) 1-L amber glass w/Teflon lined cap	Cool to 4°C	OLMO1.9 or most recent version	Compound Specific (0.01-20 ug/l)	5 days extract; 40 days analyze
	4			TAL Metals (unfiltered)	(1) 1-L polyethylene	Conc. HNO_3 to pH <2; Cool to 4°C	ILM03.0 or most recent version	Element Specific (0.2-5000 ug/l)	6 months (Hg-26 days)
Filtering Apparatus Blank	4	Water	Collected Rinsate Passed through filtering apparatus	TAL Metals (unfiltered)	(1) 1-L polyethylene	Conc. HNO_3 to pH <2; Cool to 4°C	ILMO3.0 or most recent version	Element Specific (0.2-5000 ug/l)	6 months (HG-26 days)
DI Blank	1	Water	Direct Fill of Bottles	TCL Volatiles	(3) 40 ml VOA vials w/Teflon lined septum	1:1 HCL to pH <2; Cool to 4°C	OLM01.9 or most recent version	Compound Specific (10 ug/l)	10 days
	1			TCL Extractables	(4) 1-L amber glass w/Teflon lined cap	Cool to 4°C	OLM01.9 or most recent version	Compound Specific (0.01-20 ug/l)	5 days extract; 40 days analyze
	1			TAL Metals (unfiltered)	(1) 1-L polyethylene	Conc. HNO_3 to pH <2; Cool to 4°C	ILM03.0 or most recent version	Element Specific (0.2-5000 ug/l)	6 months (Hg-26 days)
Trip Blank	4	Water	Direct Fill of Bottles	TCL Volatiles	(3) 40 ml VOA vials w/Teflon lined septum	1:1 HCL to pH <2;Cool to 4°C	OLM01.9 or most recent version	Compound Specific (10 ug/l)	10 days

Notes: All holding times listed are from Verified Time of Sample Receipt. The number in parentheses in the "Sample Container" column denotes the number of containers needed. The number of Field, Filtering Apparatus, Trip and DI water blanks are estimated.
ILM03.0 = USEPA Contract Lab Program Statement of Work for Inorganics
OLM01.9 = USEPA Contract Lab Program Statement of Work for Organics

All sample bottles will be obtained from Eagle-Picher and comply with OSWER Directive #9240.0-05A; "Specifications and Guidance for obtaining Contaminant - Free Sample Containers, EPA 540/R-93/051. (December, 1992)"

For TCL organics, triple volume is required for matrix spike/matrix spike duplicate (MS/MSD) analysis.

* - The number of samples indicated includes one duplicate sample.

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4.4.3 Quality Assurance Samples and Data Validation

The proposed analytical program listed in Table 4-1 and Table 4-2 includes QA/QC samples. Duplicate samples will be analyzed at a minimum frequency of 5% (1 in 20 samples). Additionally, matrix spike/matrix spike duplicate (MS/MSD) samples are to be collected at triple the standard volume at a rate of one per CLP assigned case or one per 20 samples, whichever is greater, for extractable organic and volatile fractions in order to allow for Matrix Spike (MS) and Matrix Spike Duplicate (MSD) analyses. Field and filtering apparatus blanks will be taken on each sampling day for each sampling procedure that groundwater sampling equipment is used. One distilled water blank sample will be collected during the Task 3 activities. Distilled water and field blanks will be analyzed for TCL volatiles, TCL extractables and total TAL metals (unfiltered) only. Duplicate samples will be analyzed for the same parameters as the original samples. Filtering apparatus blanks will be analyzed for total TAL metals (unfiltered) only. Trip blanks, collected at a frequency of one per cooler of volatile samples shipped per day, will accompany each groundwater sample batch requiring analysis for TCL volatiles and will be analyzed for TCL volatiles only.

All samples obtained by Ebasco and analyzed through the CLP, will be subjected to data validation by Ebasco personnel using the most current revision of the USEPA Region II procedures provided in SOP HW-2 (Revision 11) and HW-6 (Revision 9). Further guidance is provided in ARCS II Validation Guideline LS-4. All Ebasco personnel performing data validation tasks will be certified by USEPA Region II in the discipline pertinent to the analysis performed. The results of the data validation will be discussed within the 30% Remedial Design report.

4.5 TASK 5 - DATA EVALUATION

Data collected during prior sampling programs and data from this predesign investigation will be assembled, reviewed and carefully evaluated to satisfy the objectives of the Remedial Design. Whenever possible, the data evaluation task will be performed concurrently with Tasks 3 and 4, with the goal of preparing the Basis of Design Report. The scope of data evaluation will also include groundwater modeling.

The data collected to support the Remedial Design will be organized and analyzed to confirm previous analytical data, provide parameter input for groundwater modeling, and enable design specifications for groundwater treatment systems to be developed. Appropriate groundwater modeling and statistical analytical methods will be employed. Field data and data resulting from laboratory analysis will be entered into a data base. Previous water level elevations and water level elevations measured during the predesign sampling wells will be used to develop plots of the piezometric surface in the aquifer. Both the horizontal and vertical hydraulic gradients will be determined as appropriate. Pumping rates and locations will be evaluated for the extraction and reinjection system.

Maps and/or figures of the data will be prepared for groundwater sampling to assist in the analysis. Tables summarizing the results of the investigations will be prepared and evaluated. All data results, evaluations and interpretations will be presented and discussed in the Basis of Design Report.

Groundwater modeling will be used to support the design of the groundwater extraction and injection system, and to simulate the long-term performance of the system. Initial estimates for recovery wells and infiltration gallery flow rates, locations and specific details presented in the

FFS performed by QUICKFLOW groundwater flow model will be refined via the MODFLOW/EM groundwater model based upon existing information and new information acquired in the data acquisition phase of the Remedial Design.

MODFLOW/EM, is a three-dimensional finite difference model developed by McDonald and Harbaugh (1988) for the United States Geological Survey. The model is capable of solving steady and nonsteady groundwater flow in nonhomogeneous and anisotropic aquifers. Input parameters to the model include hydraulic conductivity, aquifer thickness, transmissivity, storativity and net precipitation. Output of the model includes water table elevation, from which flow directions and flow rates can be evaluated. The flow region of the model can be of irregular shape and with complex boundary conditions. The model can also simulate confined, unconfined or leaky conditions.

The use of the more sophisticated finite-difference model is proposed due to the fact that primary assumptions inherent to analytical models are not valid at this site. The depth of the base of the Upper Glacial aquifer (i.e., the unconformable contact between the Upper Glacial and Magothy aquifer) is not constant and is observed to decrease to the south of Schmitt Boulevard. The Upper Glacial aquifer appears to be somewhat non-homogenous based upon slug test and horizontal hydraulic gradient information. The aquifer also appears to be somewhat anisotropic based upon regional information (Pluhauski and Kantrowitz, 1964). This modeling effort is particularly critical in this case, since no aquifer pumping test will be performed.

A modeling memorandum will be prepared and submitted detailing initial model input parameters with references. The memorandum will detail the proposed model calibration process which will include statistical comparison of model simulated heads and concentrations with observed along with the presentation of scatter plots of model simulated versus observed heads. The memorandum will also specify that particle tracking on a finite difference model grid which will be used to delineate the capture zone realized by the extraction/reinjection system simulated.

The MODFLOW/EM model will be applied by constructing a mesh of cells and defined boundaries for the model domain. The mesh will be finer in areas where extraction and reinjection are anticipated. Calibration of the model will be performed assuming steady flow and utilizing site-specific aquifer parameters and available regional data of similar hydrogeological conditions. The calculated heads will be compared to the measured water levels in the monitoring wells. The aquifer parameters will be adjusted until good agreement as defined in the modeling memorandum is obtained between the calculated and the measured water levels.

The calibrated model will be used to simulate the performance of the groundwater extraction and injection system. The model will be particularly useful to assess the cumulative effect of pumping and injecting on the local aquifer. The model will delineate capture zones of extraction wells and area of influence of the injection system on the groundwater table. The location of the extraction well relative to the injection will be evaluated and computer simulation will also provide an estimate of the pumping rate required to achieve a sufficient capture zone to extract the groundwater contamination.

4.6 TASK 6 - TREATABILITY STUDY/PILOT TESTING

The objectives of the treatability study/pilot test task are to determine the feasible and cost-effective treatment process and techniques and the system design parameters for removal of contaminants in order to achieve requirements stated in the ROD.

The activities to be performed for bench-scale treatability testing will include:

- o Prepare bid specifications for treatability subcontract;
- o Procure subcontract laboratory services;
- o Mobilize subcontractor and collect groundwater sample;
- o Conduct bench-scale tests; and
- o Prepare treatability study summary report for inclusion in the 30% design submittal.

Based on the results of the treatability studies outlined in the subsections below, Ebasco will select the most cost-effective and appropriate equipment design parameters for use in the system design.

Bench-scale testing is recommended for groundwater treatment systems and would be performed for metals removal. Due to the proven nature of the air stripping and carbon adsorption processes, no tests are required for these operational units. In addition, a pilot test of an injection technique will also be performed to obtain design parameters for the reinjection system.

4.6.1 Bench-Scale Testing

The treatability study will entail the performance of bench-scale tests. The tests will be designed to obtain information regarding the removal efficiencies and optimum operating conditions of the chemical precipitation of metals and suspended solids removal. Chemical precipitation is a process in which an acid or a base is added to groundwater to adjust its pH to the point where the lowest solubility of the contaminants to be removed is reached. Following similar principles, other precipitation agents such as lime, sodium sulfide or ferric chloride may be added for the removal of metals in groundwater. Following precipitation, flocculating agents such as alum and flocculent aids such as polymers would be added to flocculate agglomerate and settle precipitated contaminants. After heavy metals are precipitated, flocculated and removed, the supernate would be neutralized to meet discharge standards. The elevated levels of metals in the groundwater must be removed because they are above ARARs and would adversely affect the performance of the air stripper. Bench-scale testing will be necessary to evaluate the effectiveness of the metals removal process, to determine chemical requirements and to select equipment operating parameters. Based on the performance of chemical precipitation and removal, tests for ion exchange may or may not be required. All bench-scale tests will be conducted using a subcontractor laboratory facility.

4.6.2 Pilot-Scale Testing - Water Treatment

The objectives of a pilot-scale test would be to develop design criteria for the full-scale treatment plant. Based on the data collected from bench-scale tests, a pilot-scale treatment system could be installed by combining each of the unit processes into a single treatment train. However, for this design, because of the use of conventional and proven treatment and equipment and their well known performance standards, no pilot-scale test will be performed.

4.6.3 Pilot-Scale Testing - Reinjection

Information to select extraction rates for wells is available and will be evaluated during the groundwater modeling effort. However, data to evaluate recharge rates in the unsaturated zones for injection galleries are not available. To evaluate recharge rates, a pilot recharge test will be performed. One recharge well or trench will be installed, to measure the performance of a recharge system at the site. The test will be performed using potable water, or water generated during well development.

The purpose of the pilot testing is to determine the parametric design values such as aquifer transmissivity and optimal rate of aquifer reinjection. A pilot boring will be drilled using the hollow stem auger within the unsaturated zone near the potential location for the reinjection well/galleries. Continuous split spoon sampling to depth within the boring will be conducted for subsequent grain size analyses to be used in the selection of optimum screen intervals, screen slot size and sand pack size to be used in the injection well/galleries. A temporary well casing will be installed within the completed borehole and a 72-hour groundwater reinjection test will be conducted measuring the amount of water reinjected and the rising water level, or mounding due to the reinjected water.

4.7 REMEDIAL DESIGN

The design will address various aspects of the selected remedy consisting of installation and testing of a groundwater extraction, treatment (precipitation, clarification, filtration, air stripping, carbon adsorption, etc.) and reinjection system and off-site disposal of any treatment residuals generated as a result of treatment.

The technical request for proposal packages prepared for the groundwater remediation will contain the applicable drawings, technical specifications and other supporting documents which will enable a contractor to prepare detailed construction drawings and implement the remedial actions described in the OU-2 ROD.

The design will include the following major components:

- Design Calculations and Analyses
- Drawings
- Technical Specifications
- Engineer's Cost Estimate
- Preliminary Construction Schedule

Generally, under Design Calculations and Analyses, design documentation, including criteria resulting from site investigations, laboratory analysis, and other available data and design calculations will be summarized for record purposes. This material will cover the design elements of the selected remedy (Alternative GW-2 of FFS) as identified in the OU-2 ROD. This design will be reflected in the drawings and/or technical performance specifications. Additionally, working drawings/sketches will be developed for the purpose of material quantification to enable Ebasco to prepare an engineer's cost estimate at 30%, 90% and 100% design completion. Regulatory compliance and permitting issues also will be addressed under this work effort.

Under Drawings, Ebasco will produce a drawing that establishes existing site conditions and other drawings which provide design/construction requirements, suggested layouts, typical sections and

details, and the general construction approach to implement the design. The following is a preliminary list of proposed drawings:

- CGW-01 - Cover Sheet

  This drawing will indicate the project name, the USEPA Contract number and will also include a Key Plan and Regional Site Location Map.

- CGW-02 - Site Plan

  This drawing will show the site plan including limits of the contract work area with respect to existing property, buildings, and easement lines; access to the site and suggested locations of site facilities. This drawing will be developed from the as built drawings prepared for the OU-1 source control (soil) remedy. The USEPA is responsible for providing one set of the OU-1 as built drawings.

- CGW-03 - Existing Conditions - Groundwater

  This drawing will show the hydrogeological cross-section, the lateral and vertical extent of the groundwater contamination. In addition, this drawing will also show some of the existing conditions, property and easement lines, buildings, streets, roadways, existing utilities, etc., locations of monitoring wells, and other similar details as appropriate.

- CGW-04 GW Treatment System - General Arrangement

  This drawing will consist of several sheets. Sheet 01 will show the locations of extraction and injection system with capture zone realized, groundwater treatment unit, and piping. Details of the extraction and injection system will be shown in Sheets 02 and 03.

- CGW-05 GW Treatment System - Piping and Instrumentation Diagram

  This drawing will show the flow diagram to be utilized for implementation of the groundwater treatment system. This drawing will consist of several sheets.

- CGW-06 GW Treatment System - Electrical Details

  This drawing will show a schematic and one line diagram of the electrical system for the groundwater treatment system.

- CGW-07 GE Treatment System - Mechanical Details

  This drawing will show typical mechanical details of various components involved in the treatment system.

- o CGW-08 GW Treatment System - Building Details

  This drawing will show a architectural plan, sections and details of the structure housing the groundwater treatment system and associated security fence, access, parking, drainage, grading, etc. This drawing will consist of several sheets.

Under Technical Specifications, Ebasco will produce technical specifications based on the design, which will form the technical provisions of selected remedy. The specifications will be prepared according to the Construction Specifications Institute (CSI) format and subdivided into the applicable divisions. The specifications will cover groundwater extraction, treatment and reinjection; off-site transportation, treatment, if required, and disposal of contaminated residuals generated during the remediation activities. The proposed bench-scale treatability study results would be used to determine whether the sludge resulting from metals removal treatment would be hazardous or nonhazardous.

A preliminary identification of the applicable divisions of the CSI format is as follows:

Division	Description	Applicability
1	General Requirements	Yes
2	Site Work	Yes
3	Concrete	Yes
4	Masonry	Will Not Be Used
5	Metals: Structural and Miscellaneous	Will Not Be Used
6	Carpentry	Will Not Be Used
7	Moisture Protection	Will Not Be Used
8	Doors, Windows and Glass	Will Not Be Used
9	Finishes	Yes
10	Specialties	Will Not Be Used
11	Equipment	Yes
12	Furnishing	Yes
13	Special Construction	Yes
14	Conveying System	Will Not Be Used
15	Mechanical	Yes
16	Electrical	Yes

Due to the simple nature (less equipment arrangement) of the remedial action, the structure housing the groundwater treatment system, will be covered as part of the Special Construction (Division 13).

Each Division will be divided into independent Sections which will be numbered in accordance with the CSI format. Table 4-3 present preliminary lists of specifications and drawings for the groundwater treatment system.

TABLE 4-3

CIRCUITRON CORPORATION SITE
PRELIMINARY LIST OF SPECIFICATIONS AND DRAWINGS FOR A GROUNDWATER TREATMENT SYSTEM

DIVISION 1 - GENERAL

Section No.	Description
01000	Specification Outline
01005	Definitions, Codes and Abbreviations
01010	Summary of Work
01011	Site Description
01015	Subcontractor's Use of Site
01025	Measurement and Payment
01050	Field Engineering
01060	Regulatory Requirements
01065	Health and Safety Requirements
01210	Pre-Construction and Pre-Work Conferences
01220	Project Progress Meetings
01300	Submittals
01305	Letters of Commitment
01311	Network Analysis System
01380	Project Photographs and Videotape
01400	Site-Specific Quality Management Plan
01410	Construction Quality Assurance
01420	Chemical Quality Assurance
01430	Chemical Testing Laboratory Services
01505	Mobilization/Demobilization
01510	Temporary Site Facilities and Utilities
01540	Security
01560	Temporary Controls/Environmental Protection
01562	Dust Control
01563	Erosion and Sediment Control
01564	Spill Control
01600	Equipment and Material Handling
01640	Off-Site Transportation and Disposal
01700	Project Closeout
01720	Project Record Documents
01725	Project Record Drawings
01730	Operating and Maintenance Manuals

DIVISION 2 - SITEWORK

02110	Clearing
02672	Extraction Wells
02673	Injection Gallary
02674	Extraction Wells and Injection Gallary piping

TABLE 4-3 (Cont'd)

CIRCUITRON CORPORATION SITE
PRELIMINARY LIST OF SPECIFICATIONS AND DRAWINGS FOR A GROUNDWATER TREATMENT SYSTEM

DIVISION 3 - CONCRETE

03110	Concrete

DIVISION 9 - FINISHES

09870	Coating Systems for Steel
09880	Protective Coatings for Concrete
09900	Painting

DIVISION 11 - EQUIPMENT

11211	Extraction Well Pumps
11212	Sump Pumps
11213	Air Blowers
11214	Groundwater Collection and Equalization System
11374	Filtration System
11375	Chemical Precipitation System
11376	Packed Column Air Stripper System
11377	Carbon Adsorption System
11378	Chemical Addition System
11379	Sludge Handling System

DIVISION 12 - FURNISHINGS

12345	Laboratory Tops, Sinks and Accessories

DIVISION 13 - SPECIAL CONSTRUCTION

13120	Pre-Engineered Structures

DIVISION 15 - MECHANICAL

15050	Basic Mechanical Materials and Methods
15060	Pipes and Pipe Fittings
15100	Valves
15850	Air Handling
15890	Duct Work

DIVISION 16 - ELECTRICAL

16050	Basic Electrical Materials and Methods
16500	Lighting
16850	Electrical Resistance Heating

TABLE 4-3 (Cont'd)

CIRCUITRON CORPORATION SITE
PRELIMINARY LIST OF SPECIFICATIONS AND DRAWINGS FOR A
GROUNDWATER TREATMENT SYSTEM

Drawings

CGW-01	Cover Sheet
CGW-02	Site Plan
CGW-03	Existing Conditions - Groundwater
CGW-04	GW Treatment System - General Arrangement
CGW-05	GW Treatment System - Piping and Instrumentation Diagram
CGW-06	GW Treatment System - Electrical Details
CGW-07	GW Treatment System - Mechanical Details
CGW-08	GW Treatment System - Building Details

Under the final Engineer's Cost Estimate, Ebasco will determine the estimated quantities, to an accuracy of +15 to -10 percent, based on the available information and data at the time. Unit prices and lump sum prices will be developed based on Ebasco's experience on similar projects and quotations from suppliers. In cases where quotations are used, attempts will be made to obtain three quotations without releasing any particular information about the site that would preclude the quoters from proposing on this package during the remedial action procurement process.

4.7.1 Task 7 - Basis of Design Report (30% Completion)

The Basis of Design Report will discuss the existing data on site features, and the nature and extent of site contamination with regard to developing the technical bid package that will satisfy the requirements of the ROD. They will include a discussion of the data and conclusions presented in the RI/FS, the FFS, the ROD, and the additional data collected during the site investigations including the results of treatability study, field pilot testing and groundwater modeling results to support the design.

A section of the Basis of Design Report will address the project site, presenting a detailed description of the site location, extent of contamination, soil description, and site features, including buildings, utilities and roads, with respect to potential impact on remedial activities. A discussion of the pertinent site geology, topography, hydrology, geohydrology, and groundwater modeling relative to the remedial design will also be presented.

Specific data and design criteria will be presented for the principal components of the remedial design as follows:

a) Design data and criteria will be developed for evaluating the Groundwater Treatment System including evaluation of the extraction well system, pumping equipment, air stripper, metal precipitation unit, the treatment process flow diagram (PFD), discharge points and off-site transportation and disposal of treatment residuals. The PFD will show all major components of the process equipment and the important elements of process instrumentation and control.

   The extraction well design will be based on the calculated pumping rate and the groundwater modeling results. The location of the extraction well will be identified as well as specification of the diameter of the well, the depth of the well, the screen size and the pumping rate. Similarly, the injection system will be defined as to what type of system will be used to reinject the treated groundwater (reinjection well/gallery). The locations, number and spacing of the injection system components will be given. The reinjection system will be based on the data collected during the field pilot testing of reinjection. Also the configuration of the injection system (the type, size and depth) will be specified. In addition, figures depicting the capture zone realized by the specified extraction/reinjection system simulated in the model will be included.

4.7.2 Task 9 - Intermediate Design (60%) (omitted)

This task includes efforts necessary to prepare plans and specifications, to a point of approximately 60% completion, which will be submitted for review and comment. Included in this task is the incorporation of comments on the Basis of Design Report, preparation of lists of key

submittals, implementation of Value Engineering analyses, preparation of preliminary plans of operation, and development of an intermediate budget level cost estimate of +30 percent to -30 percent accuracy.

Based on scope outlined in the Scope of Work and the direction given during the kick-off meeting by USEPA, this task is not included in this work assignment.

4.7.3 Task 10 - Prefinal/Final Design (90-100% Completion)

In this phase of the project, the Basis of Design Report (Task 7) approved by the USEPA will be utilized for the preparation of the Prefinal Design documents. These documents will be submitted to the USEPA for review and comment. Any comments will be incorporated and the design will then be brought to 100 percent completion. The prefinal design will include the following:

Design Calculations
Drawings
Technical Specifications
Engineer's Cost Estimate
Construction Schedule
Constructibility Review

4.7.3.1 Design Calculations

Design calculations will be prepared for major aspects of the design. This involves making estimates of performance, size and cost. Where detailed calculations are not warranted, a calculation sheet will be prepared and will clearly state the basis of the design data and references. All calculations will be checked by a qualified person other than the originator.

Calculations will be performed for a number of major design parameters including, but not limited to:

- groundwater extraction and reinjection systems
- precipitation unit, chemical feed, and mass balance including sludge production
- air stripping tower
- filtration unit
- carbon adsorption unit
- electrical conductor/breaker sizing
- pumps, motors, blowers, etc.
- piping and valve/actuator sizing
- other ancillary equipment
- preliminary civil design calculation

4.7.3.2 Drawings

Project drawings will be submitted at 90% completion and will be brought to 100% after the USEPA's review comments are resolved and incorporated. The drawings will provide sufficient detail to establish the pre-remediation site conditions and provide design requirements including the general construction approach to the remediation, suggested layouts and typical sections and details. Detailed drawings based on the performance specifications necessary for the implementation of the selected remedy will be prepared. The as-built drawings depicting the

constructed facility will be prepared by the Contractor at the completion of construction. It is estimated that at least eight drawings will be produced for this project, however, the exact number cannot be established until the preliminary design phase has begun. These drawings would include those identified in Subsection 4.7.

4.7.3.3 Technical Specifications

The Technical Specifications will be near completion (90 %) for submittal to the USEPA for review and comments. All review comments received on the Basis of Design Report will have been resolved and incorporated.

The specifications will be detail design for groundwater treatment system. The specifications may define the project components by manufacturer's name, brand name, model number, type designation, or other unique characteristics. However, alternatives or substitutes for the specified products of equal quality will be allowed. Whenever a product is specified by using a proprietary name or the name of a particular manufacturer or vendor, the specific item mentioned shall be understood as establishing type, function, dimension, appearance and quality desired. Other manufacturer or vendor products will be accepted provided sufficient information is submitted to allow the Remedial Action Contractor to determine that the proposed products are equivalent to those specified.

4.7.3.4 Engineer's Cost Estimate

The cost estimate developed for this submittal will be prefinal type estimate, of +15 to -10 percent accuracy and will show equipment, construction, and operating and maintenance costs and other indirect costs. This estimate will be further refined in the Final Design phase.

4.7.3.5 Construction Schedule

A schedule for the construction phase of the project will be prepared based on the drawings and technical specifications completed for the Prefinal Design. Each activity will be defined relative to its prerequisite and corequisite activities and the durations for each activity will then be estimated.

4.7.3.6 Constructibility Review

Ebasco will conduct an internal review prior to the prefinal design submittal using experienced construction personnel to ensure that assumptions and methods used in the design are reasonably constructible and within an acceptable budget.

4.7.3.7 Final Design

Included in this task are all efforts necessary to bring the plans and specifications to 100% completion. Also in this phase of the project, the USEPA and NYSDEC comments and recommendation regarding the Prefinal Design will be incorporated.

Calculations required to finalize the technical specifications and drawings will be performed in this phase of the project. In addition, a cover sheet and table of contents will be prepared for the calculation package and attached for ease of identification. Calculations will be kept in the project files for future reference.

A draft final design package at 100% completion will be submitted for USEPA approval. After incorporating USEPA and state comments, the design will be considered final. The drawings and technical specifications will be reviewed, signed and sealed by an Ebasco New York State Registered Professional Engineer.

The final (engineer's) cost estimate will be based on final drawings and specifications of 100% design. The estimate will be carefully prepared and will refine the estimate from the prefinal design phase to a +15 to -10 percent accuracy as permissible by the details of the specification. The estimate will evaluate the costs for construction, equipment, operation and maintenance of the complete site work.

4.8 TASK 8 - EQUIPMENT/SERVICES PROCUREMENT (OMITTED)

This task includes efforts necessary to produce or initiate procurement of long lead time equipment and/or services identified during the preliminary design phase. Efforts may include preparation of necessary plans and specifications, advertisement, evaluation of bids, etc.. However, upon reviewing the work involved in this work assignment, Ebasco finds no need for long lead time equipment and/or services and therefore, no work is proposed under this task.

4.9 VALUE ENGINEERING DURING DESIGN

Value Engineering is a specialized cost control technique which uses a systematic and creative approach to and focus on unnecessarily high cost in the project in order to arrive at a cost savings without sacrificing the reliability of efficiency of the Remedial Design. Ebasco will informally perform initial Value Engineering (VE) during the 30% design to identify any potential cost savings using the data collected during the predesign investigation and the results of treatability study and groundwater modeling. Based on the informal VE, Ebasco will devise the most cost-effective engineering alternative which will be presented in the 30% design document to address the OU-2 ROD.

4.10 TASK 11 - POST REMEDIAL DESIGN SUPPORT

This task consists of all efforts required to prepare Contract Request for Proposal (RFP) documents, which include printing, advertising, mailing, conducting pre-bid meetings, preparation of necessary addenda, conducting bid opening, tabulation of bids, and contract award.

The entire scope of this task is not presently included in this work assignment, but is identified here as part of the optional plan of execution and will be performed in its entirety if the USEPA selects Ebasco to execute the construction management effort.

However, as currently identified in the USEPA's Statement of Work, Ebasco will prepare a bid package for remedial action subcontract procurement documents for use in the solicitation of bids by general subcontractor to provide the necessary construction and associated services for implementation of the remedial actions.

The request for bid package may include, as a minimum, the following:

- Background information
- Definitions
- Bidder information

- o General Terms and Conditions (per USEPA requirements)
- o Scope of work
- o Technical specifications
- o Contract drawings
- o Special conditions (including Construction Value Engineering Contractor Proposal [VECP])
- o Attachments

As an optional portion of this task, Ebasco could provide all ancillary services required to support the contract procurement process. These services would include, but not be limited to:

1. Advertise for invitation to bid
2. Mail out packages
3. Conduct site visits
4. Conduct Bidder's meeting
5. Answer technical questions
6. Issue addenda as required
7. Accept and open bids
8. Prepare abstracts of bids
9. Evaluate bids and make purchase recommendation
10. Document process

These services will be performed in accordance with applicable USEPA regulations and guidelines.

5.0 PROJECT MANAGEMENT AND CONTROL

This section presents the project organization and project schedule.

5.1 PROJECT ORGANIZATION

Ebasco's management objective on the ARCS II Program is to ensure that USEPA receives well-managed, cost effective and timely services. The project organization for this project is shown on Figure 5-1 with the key responsibilities identified. The designated Site Manager, K. Subburamu will be the focal point of contact with USEPA for the overall conduct of this work assignment. Mr. Subburamu will report to the USEPA WAM and will be responsible to the Ebasco ARCS II Program Manager for the successful completion of the work.

The key personnel involved in the performance of this remedial design work assignment include the Site Manager, the Remedial Design Leader (RDL) and the Field Operations Leader (FOL). In addition to these individuals, the project will be supported by a multi-discipline team of specialists who will lead or coordinate the various project subtasks, as required, under the direction of the Site Manager.

The Site Manager has primary responsibility for plan development and the implementation of the Remedial Design Work Plan, including coordination among the project leaders and support staff, development of bid packages, acquisition of engineering or specialized technical support, and all other aspects of the day-to-day activities associated with the project. The Site Manager identifies staff requirements, directs and monitors project progress, ensures implementation of quality procedures and compliance with applicable codes and regulations, and is responsible for performance within the established budget and schedule.

The Remedial Design Leader (RDL) reports to, and will work directly with, the Site Manager to develop the Project Plans as appropriate, and will be responsible for the implementation of the analysis, interpretation and presentation of data acquired relative to the site, and preparation of the Basis of Design Report and Prefinal/Final Design. The RDL will also direct the activities of the required engineering disciplines working on the project.

The Field Operation Leader (FOL) will be responsible for on-site management for the duration of all site operations, including the activities conducted by Ebasco such as sampling, and the work performed by subcontractors, such as drum removal. The FOL will provide consultation and decide on factors relating to sampling activities and changes to the field sampling program.

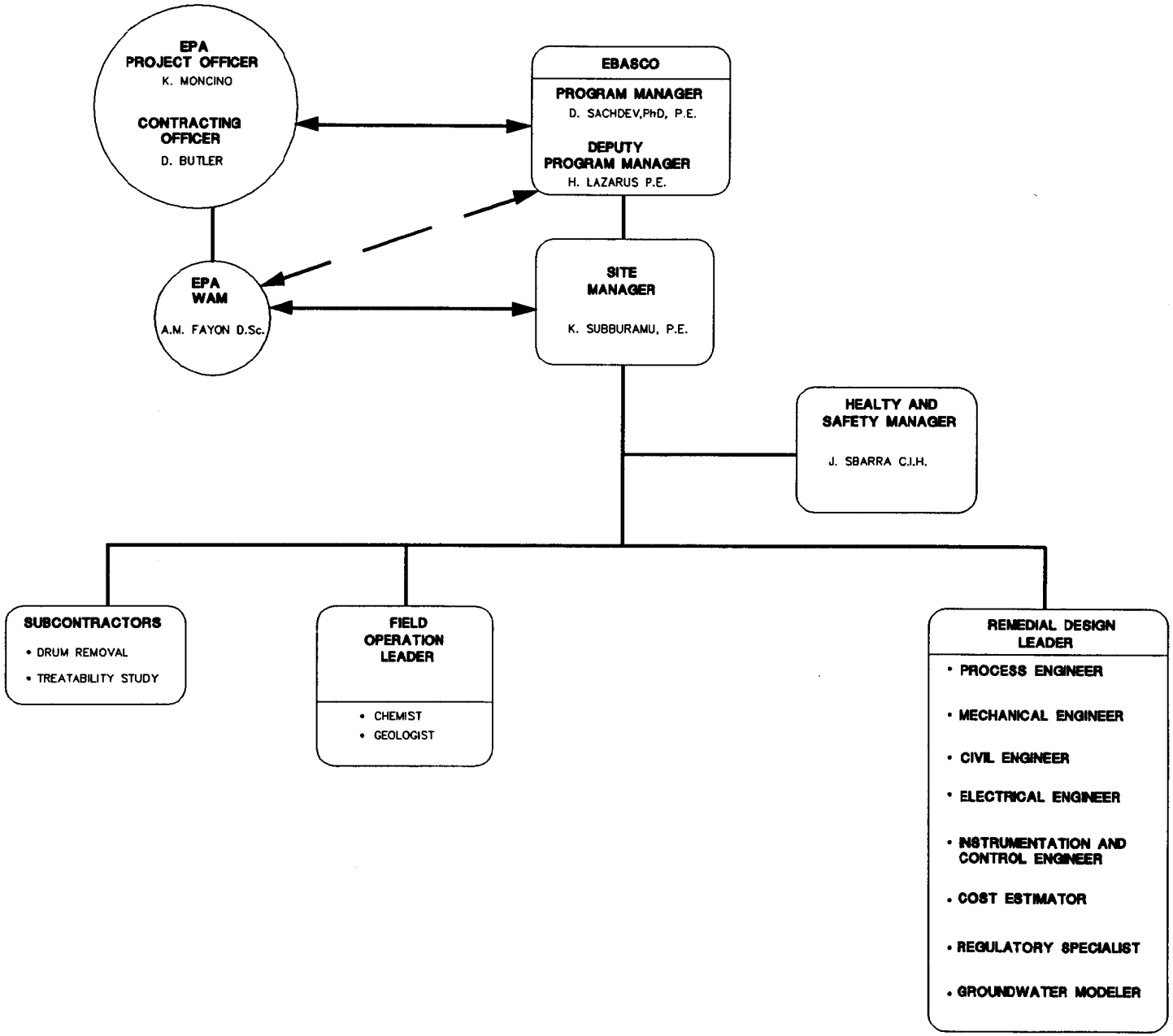
5.2 PROJECT SCHEDULE

It is estimated that the duration of this remedial design assignment will be approximately 15 months from the date of the kick-off meeting . Figure 5-2 is the project baseline schedule showing the starting and completion dates for each of the work elements.

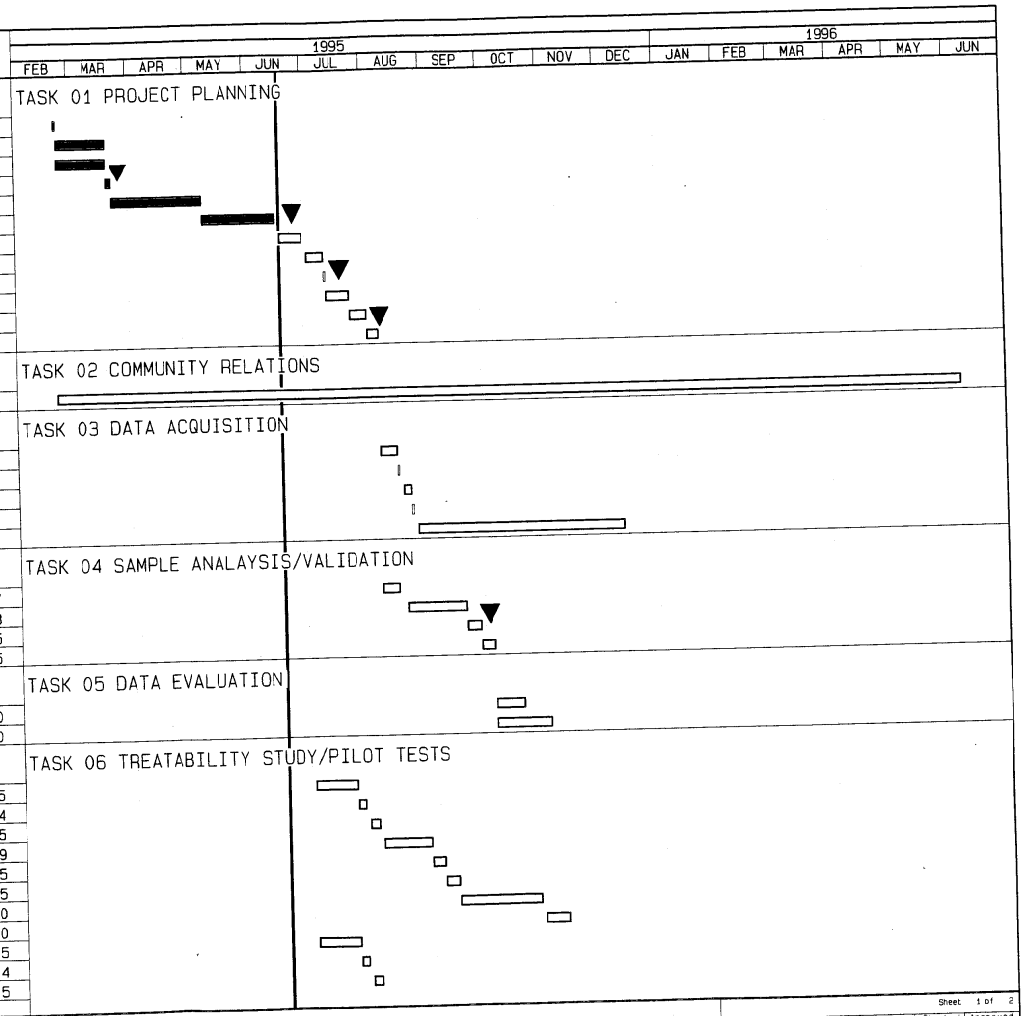
The project schedule is predicted on the following assumptions:

- Four week review period for the draft Work Plan and a two week approval period for the Final Work Plan. However, the Figure 5-2 Project Schedule is updated incorporating the actual date as of today for the completed activities.

FIGURE 5-1
CIRCUITRON CORPORATION SITE, OPERABLE UNIT 2
REMEDIAL DESIGN ORGANIZATION CHART



ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH	ORIG DUR
TASK 01 PROJECT PLANNING			
WORK ASSIGNMENT START & KICK-OFF MEETING	22FEB95A	22FEB95A	1
EXISTING DATA ACQUISITION	23FEB95A	20MAR95A	18
PREPARATION OF DRAFT WORK PLAN	23FEB95A	20MAR95A	18
QC REVIEW DRAFT WORK PLAN	21MAR95A	23MAR95A	3
EPA REVIEW DRAFT WORK PLAN	24MAR95A	9MAY95A	33
FINALIZE WORK PLAN	10MAY95A	16JUN95A	27
EPA APPROVAL OF FINAL WORK PLAN	19JUN95	30JUN95	10
PREPARATION OF DRAFT BROSSMAN	3JUL95	11JUL95	6
QC REVIEW OF DRAFT BROSSMAN	12JUL95	12JUL95	1
EPA REVIEW OF DRAFT BROSSMAN	13JUL95	24JUL95	8
FINALIZE BROSSMAN	25JUL95	2AUG95	7
EPA APPROVAL OF FINAL BROSSMAN	3AUG95	8AUG95	4
TASK 02 COMMUNITY RELATIONS			
COMMUNITY RELATIONS SUPPORT (OPTIONAL)	22FEB95A	7JUN96	303
TASK 03 DATA ACQUISITION			
PROCURE SAMPLE BOTTLES & EQUIPMENT	9AUG95	17AUG95	7
FIELD MOBILIZATION	18AUG95	18AUG95	1
GROUNDWATER SAMPLING	21AUG95	24AUG95	4
DEMOBILIZATION	25AUG95	25AUG95	1
DRUM REMOVAL	28AUG95	13DEC95	76
TASK 04 SAMPLE ANALAYSIS/VALIDATION			
PROCUREMENT OF LAB ANALYSIS - CLP	9AUG95	17AUG95	7
SAMPLE ANALYSIS	22AUG95	21SEP95	23
DATA VALIDATION	22SEP95	28SEP95	5
EPA APPROVAL OF DATA VALICATION	29SEP95	5OCT95	5
TASK 05 DATA EVALUATION			
DATA REDUCTION AND ANALYSIS	6OCT95	20OCT95	10
GROUNDWATER MODELING	6OCT95	3NOV95	20
TASK 06 TREATABILITY STUDY/PILOT TESTS			
PREPARE TREATABILITY STUDY - (TS) SPECIFICATIONS	3JUL95	24JUL95	15
QC REVIEW OF TS SPEC.	25JUL95	28JUL95	4
ISSUE INQUIRY - TS	31JUL95	4AUG95	5
RECEIVE BIDS - TS	7AUG95	31AUG95	19
EVALUATE BIDS - TS	1SEP95	7SEP95	5
AWARD CONTRACT - TS	8SEP95	14SEP95	5
PERFORM TREATABILITY TEST	15SEP95	27OCT95	30
TREATABILITY SUMMARY REPORT	30OCT95	10NOV95	10
PREPARE PILOT TEST - (PT) SPECIFICATIONS	3JUL95	24JUL95	15
QC REVIEW OF PT SPEC.	25JUL95	28JUL95	4
ISSUE INQUIRY - PT	31JUL95	4AUG95	5



Project Start 22FEB95
Project Finish 7JUN95 *
(c) Primavera Systems, Inc.

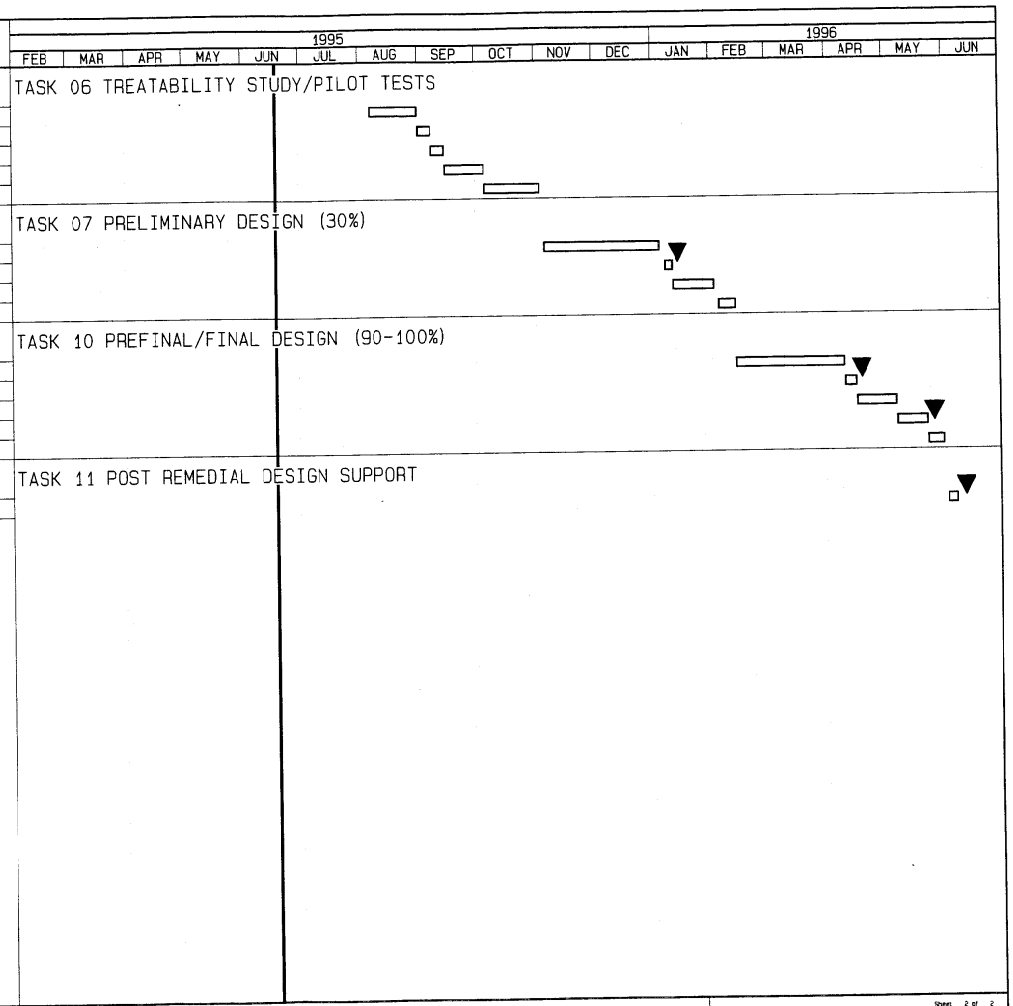
Activity Bar
A — EPA Deliverable
Actual Date

FIGURE 5 - 2
PROJECT SCHEDULE
CIRCUITRON CORPORATION SITE

Sheet 1 of 2

Date	Revision	Checked	Approved

ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH	ORIG DUR
RECEIVE BIDS - PT	7AUG95	31AUG95	19
EVALUATE BIDS - PT	1SEP95	7SEP95	5
AWARD CONTRACT - PT	8SEP95	14SEP95	5
PERFORM PILOT TEST	15SEP95	5OCT95	15
PILOT TEST SUMMARY REPORT	6OCT95	3NOV95	20
PREPARE DRAFT BASIS OF DESIGN (30%)	6NOV95	4JAN96	42
QC REVIEW - 30% DESIGN	8JAN96	11JAN96	4
EPA REVIEW - 30% DESIGN	12JAN96	2FEB96	16
FINALIZE 30% DESIGN	5FEB96	13FEB96	7
PREPARE 90% DESIGN SUBMITTAL	14FEB96	1OAPR96	40
QC REVIEW - 90% DESIGN	11APR96	16APR96	4
EPA REVIEW - 90% DESIGN	17APR96	7MAY96	15
PREPARE 100% DESIGN SUBMITTAL	8MAY96	23MAY96	12
EPA REVIEW AND APPROVAL 100% DESIGN	24MAY96	31MAY96	5
PREPARE CONTRACT DOCUMENTS	3JUN96	7JUN96	5



Project Start 22FEB95
Project Finish 7JUN95 *
(c) Primavera Systems, Inc.

Activity Bar
A — Actual Date
EPA Deliverable

FIGURE 5 - 2
PROJECT SCHEDULE
CIRCUITRON CORPORATION SITE

Sheet 2 of 2

Date	Revision	Checker	Approved

- o No delays in approval of the Work Plan, Brossman Work/QA Project Plan Short Form and Optional Form 60 (project budget and expenditure limit)

- o No delays in the field sampling including obtaining access, sample collection and sample analysis (due to weather or laboratory error).

- o Laboratory analysis data collected for design purposes (treatability study) is conducted at analytical level DQO 3 (i.e., full CLP validation is not required except for initial and final data of the selected approach). Ebasco will validate the initial and final data of the selected approach.

- o Data validation of samples will be performed within two weeks.

- o Formal Value Engineering is not required for this "simple" design.

- o No separate submittals are required for data analysis and evaluation, modeling results, treatability study, pilot testing and value engineering. These analyses and findings will be included in the 30% design submittals.

- o The review comments received on the 30% and 90% design submittals will be addressed by response letters and incorporated in the following design submittals.

The major deliverables for this Work Assignment are identified below.

Task 1 - Project Planning

- o Draft and Final Work Plan
- o Draft and Final Brossman Work/QA Project Plan Short Form

Task 2 - Community Relations

- o Fact Sheets (as required)

Task 3 - Data Acquisition

- o None (Initial data package will be included in Basis of Design Report)

Task 4 - Sample Analysis/Validation

- o None (Validated data package will be included in Basis of Design Report)

Task 5 - Data Analysis

- o None (Data analyses and groundwater modeling results will be included in the Basis of Design Report)

Task 6 - Treatability Study/Pilot Test

- o None (Laboratory treatability report and field pilot study results will be included in the Basis of Design Report)

Task 7 - Remedial Design (30%)

- o Draft Basis of Design Report
- o Final Basis of Design Report (will be submitted with 90% design submittal)

Task 10 - Remedial Design (90-100%)

- o Draft and Final Specification and Drawings
- o Draft and Final Cost Estimate Reports
- o Draft and Final Preliminary Construction Schedule

Task 11 - Post RD Support

- o Subcontract Bid Package

5.3 QUALITY ASSURANCE AND DOCUMENT CONTROL

The site-specific quality assurance requirements will be in accordance with the most recent Quality Assurance Project Plan for the ARCS II Program as submitted to USEPA.

Data management aspects of the program pertain to controlling and filing documents. Ebasco has developed a program filing system (Administrative and Guideline Number PA-5) that conforms to the requirements of the USEPA to ensure that the documents are properly stored and filed. This guideline will be implemented to control and file all data associated with the remedial design for this site. The system includes document receipt control procedures, a file review and inspection system, and security measures.

REFERENCES

Ebasco Services Incorporated, 1990. Final Remedial Investigation Report, Circuitron Corporation Site, East Farmingdale, New York.

Ebasco Services Incorporated, 1991. Draft Final Feasibility Study Report, Circuitron Corporation Site, East Farmingdale, New York.

Ebasco Services Incorporated, 1995, Minutes of Kick-off Meeting dated March 1, 1995, Circuitron Corporation Site, East Farmingdale, New York.

Geraghty and Miller, Inc., September 1991, Quick Flow Analytical 2D Groundwater Flow Model Version 1.0.

McClymonds, N.E., and Franke, O.L., 1972, Water-Transmitting Properties of Aquifers on Long Island, New York, U.S. Geological Survey Professional Paper 627-E.

M.G. McDonald and A.W. Harbaugh, 1988. A Modular Three-Dimensional Finite-Difference Groundwater Flow Model. TWRI of USGS, Book 6/A1.

Lockwood, Kessler and Bartless, Inc. 1985, Remedial Investigation Report, Former Site or Liberty Industrial Finishing Corporation, Farmingdale, New York.

Perlmutter, N.M. and J.J. Geraghty, 1963, Geology and Groundwater Conditions in Southern Nassau and Southeastern Queens Counties, Long Island, New York: U.S. Geological Survey Water Supply Paper 1613-A.

Pluhowski, E.J. and Kantrowitz, J.H., 1964, Hydrogeology of the Babylon-Islip Area, U.S. Geological Survey Water Supply Paper 1768.

Roy F. Weston, Inc. 1994. Final Draft Focused Feasibility Study Report, Operable Unit 2, Circuitron Corporation Site, East Farmingdale, New York.

USEPA 1986. Superfund Remedial Design and Remedial Action Guidance (OSWER Directive 9355.0-4A), June 1986.

USEPA 1987. Data Quality Objectives for Remedial Response Activities (EPA 540/G-87/003, OSWER Directive 9355.0-7B), March 1987.

USEPA 1994. Record of Decision, Operable Unit 2, Circuitron Corporation Site, East Farmingdale, New York.

USEPA 1995. Statement of Work, Operable Unit 2, Circuitron Corporation Site, East Farmingdale, New York; Work Assignment Number 082-2N1E; Contract Number 68-W8-0110.