New York State Department of Environmental Conservation
Division of Environmental Remediation
Bureau of Hazardous Site Control

ADDITIONS/CHANGES TO REGISTRY: SUMMARY OF APPROVALS

SITE NAME: Bell Aerospace - Textron DEC I.D. NUMBER 932052

Current Classification 2 Volunteer Yes ___ No ___
Sign (7) below

Activity: ☐ Add as Class ___ ☑ Reclassify to 4 ☐ Delist Category ___ ☐ Modify ___

Approvals:

1. Regional Hazardous Waste Engineer	Yes	☑	No	☐	
2. BEEI of NYSDOH	Yes	☑	No	☐	
3. DEE	Yes	☑	No	☐	
4. ___ Remediation Action Bureau Director [Class 2]	Yes	n/a	No	☐	
5. BHSC - Investigation Section	Yes	☑	No	☐	
6. BHSC - O&M Section [Class 4]	Yes	☑	No	☐	

7. BPM - Brownfield & Voluntary Cleanup Section n/a Date ___
8. Site Control Section Robert Marion Date 5/5/98
9. Director [signature] Date 5/11/98

Completion Checklist for Registry Sites

		Completed By: Initials	Date
OWNER NOTIFICATION LETTER?	☑	___	6/4/98
ADJACENT PROPERTY OWNER NOTIFICATION LETTER?	☑	___	6/22/98
ENB/LEGAL NOTICE SENT? (For Deletion Only)	☐	___	___
COMMENTS SUMMARIZED/PLACE IN REPOSITORY	☐	___	___
FINAL NOTIFICATION SENT TO OWNER? (For Deletion Only)			

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DIVISION OF HAZARDOUS WASTE REMEDIATION

8/23/94

SITE INVESTIGATION INFORMATION

1. SITE NAME: Bell Aerospace - Textron	2. SITE NUMBER: 932052	3. TOWN/CITY/VILLAGE: Wheatfield (T)	4. COUNTY: Niagara

5. REGION: 09	6. CLASSIFICATION:	CURRENT 2:	PROPOSED: 4	MODIFY:

7. LOCATION OF SITE (Attach U.S.G.S. Topographic Map showing site location):

a. Quadrangle: Tonawanda West, N.Y.

b. Site Latitude: 46° 6' 1" Site Longitude 78° 55' 42"

c. Tax Map Number: 146 - 1 - 10

d. Site Street Address: Niagara Falls Boulevard and Walmore Road, Wheatfield, N Y 14240

8. BRIEFLY DESCRIBE THE SITE (Attach site plan showing disposal/sampling locations):

From 1948 to 1984, a pond constructed at the site was used by Bell Aerospace Textron to collect liquid wastes from rocket test cells at the facility. In accordance with a RCRA approved remediation plan, the pond was closed in 1988 by excavation to bedrock, backfilling with clean material and capping with a clayey soil. Investigations found that large plumes of contaminated groundwater existed in the overburden and bedrock both at the site and in adjacent offsite areas. NAPL was also found in the upper zone of the fractured bedrock at the site. Under the RCRA program, corrective action measures to address the groundwater and NAPL contamination were selected and implemented. These measures include long term groundwater pump and treat with phase separation for NAPL removal. On site, six groundwater extraction wells and a wastewater treatment facility were installed and put in operation in 1994. The off site system consisting of five groundwater extraction wells became operational in 1993.

a. Area: 0.5 acre b. EPA ID Number NYD002106276

c. Projects Completed ( )Phase I ( )Phase II ( ) PSA ( )RI/FS ( )PA/SI (x)Other RCRA Facility Investigation, Corrective Action Study;

9. HAZARDOUS WASTE DISPOSED:

Liquid wastes having various contaminants including Trichlorothylene: 668,000 mg/l, 1,1,1- Trichloroethane: 106,000 mg/l, PCB 1254: 352 mg/l, PCB 1260: 102 mg/l, etc.

10. ANALYTICAL DATA AVAILABLE:

a. ( )Air (x)Groundwater ( )Surface Water ( )Sediment (x)Soil ( )Waste (x)Leachate (x)EPTox ( )TCLP

b. Contravention of Standards or Guidance Values: The wastes disposed contravene the ground water standards.

11. STATEMENT OF CONCLUSION:

Installation of the RCRA corrective measure for this site is complete and the ground water pump and treat system is in operation. In accordance with the RCRA Post Closure permit O&M and Summary Performance reports for the system are submitted to the Department on a regular basis. Based on these reports, the remedial system is performing as intended. Long term operation and maintenance of the system will continue. Therefore reclassification of the site to Class 4 is in order.

12. SITE IMPACT DATA:

a. Nearest Surface Water: Distance: 0 feet	Direction: SW	Classification:	
b. Nearest Groundwater: Depth: 10 feet	Flow Direction: S	( )Sole Source ( )Primary (x)Principal ( ) Perched	
c. Nearest Water Supply: Distance: 4 miles	Direction: SW	Active: (x) Yes ( ) No	
d. Nearest Building: Distance: 0 feet	Direction:	Use: Industrial	
e. In State Economic Development Zone?	( )Y (x)N	i. Controlled Site Access?	(x)Y ( )N
f. Are crops or livestock on site?	( )Y (x)N	j. Exposed hazardous	( )Y (x)N
g. Documented fish or wildlife mortality?	( )Y (x)N	k. HRS Score:	
h. Impact on special status fish or wildlife resource?	( )Y (x)N	l. For Class 2: Priority Category:	

13. SITE OWNER'S NAME:	14. ADDRESS:	15. TELEPHONE NUMBER:
Textron Inc.	40 Westminister Street, Providence, Rhode Island 02903	

16. PREPARER:	17. APPROVED:
Abul Barkat (cons) 2/17/98	5/11/98
Signature Date	Signature Date
Abul Barkat, Environmental Engr. II, Div. of Env. Rem.	Earl H. Barcomb, Director, BHSC, DER
Name, Title, Organization	

Tony

STATE OF NEW YORK
DEPARTMENT OF HEALTH

II University Place Albany, New York 12203

Barbara A. DeBuono, M.D., M.P.H.
Commissioner of Health

Dennis P. Whalen
Executive Deputy Commissioner

April 17, 1998

Mr. Earl Barcomb, P.E., Director
Bureau of Hazardous Site Control
Division of Environmental Remediation
NYS Department of Environmental Conservation
50 Wolf Road, Room 252
Albany, New York 12233

Re: Classification Package
Bell Aerospace-Textron
Site #932052
(T) Wheatfield, Niagara County

Dear Mr. Barcomb:

My staff reviewed the Classification Package for the referenced site. I concur with the proposed classification change from 2 to 4. I understand that through a RCRA corrective action program, remedial actions to address soil and groundwater contamination from past rocket testing and manufacturing activities have been implemented. The source of contamination, a former liquid waste lagoon, was excavated, backfilled and capped. On-site and off-site groundwater contamination is being addressed through a pump and treatment system that went into operation in 1993 and has been upgraded and modified to achieve additional plume control. Hydraulic barriers ("clay stops") were installed in the backfill of the sanitary sewer trench along Walmore Road adjacent to the facility. The remedial systems are performing as designed and are now under long-term operation and maintenance.

The signed decision form is enclosed. If you have any questions, please contact me or Mark VanValkenburg at (518) 458-6310.

Sincerely,

G. Anders Carlson

G. Anders Carlson, Ph.D., Director
Bureau of Environmental Exposure
Investigation

New York State Department of Environmental Conservation
270 Michigan Avenue, Buffalo, New York 14203-2999
(716) 851-7220

John P. Cahill
Commissioner

TO: Bob Marino, DER-Albany
FROM: Dan King, DER-9
SUBJECT: Bell Aerospace - Textron
Site No. 932052

DATE: February 17, 1998

Enclosed for review and processing is a Site Investigation Information form and supporting documentation for reclassification of the Bell Aerospace - Textron site (No. 932052) from Class 2 to Class 4.

Through the RCRA corrective action program, remedial actions to address soil and groundwater contamination from past rocket testing activities have been implemented. The source of contamination, a former liquid waste lagoon, was excavated, backfilled and capped in 1988. On site and off site groundwater contamination is being addressed through a pump and treatment system that went into operation in 1993/94. The system is performing as intended and is now considered in long term O&M.

Should you have any questions regarding the enclosed package, please contact Abul Barkat of this Office.

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
Division of Hazardous Waste Remediation
Inactive Hazardous Waste Disposal Report

Site Name: Bell Aerospace - Textron | Site Code: 932052
Class Code: 4 | Region: 9 | County: Niagara | EPA Id: NYD002106276
Address: Niagara Falls Boulevard and Walmore Road | City: Wheatfield | Zip: 14240
Latitude: 43° 6' 1" | Longitude: 78° 55' 42"
Site Type: | Estimated Size: .5 Acres

Site Owner/Operator Information:
Current Owner(s) Name: Bell Aerospace Textron
Current Owner(s) Address: PO Box 1 | Niagara Falls | NY 14240
Owner(s) during disposal: Bell Aircraft - Allied Signal Corp.
Operator(s) during disposal: Bell Aerospace Textron
Stated Operator(s) Address: PO Box 1 | Niagara Falls | NY 14240
Hazardous Waste Disposal Period: From 1948 To 1984

Site Description:
This site was a pond for collecting runoff and wash-down from test cells for rocket engine testing. Monitoring of the flow and pH of the pond was done before discharge into sanitary sewers. A comprehensive hydrogeologic investigation was completed at this site. An interim report of the results of the investigation was submitted by Bell's consultant, Golder Associates, in 1987. More work was done in 1988-89 that included additional off-site investigation, investigation of the local sewer trenches, potential for soil gas migration, survey of private wells in the area, and a pump test to define aquifer characteristics for use in evaluating the potential remedial measures. The neutralization pond was physically closed in 1988 in accordance with an approved closure plan. The investigation was completed and a Corrective Measures Study (CMS) has been approved. The CMS includes a remediation plan for off-site and on-site areas and a health risk/environmental risk study. The NYCRR Part 373 permit has been issued for post-closure care and corrective action. The off-site corrective action system which consists of five extraction wells, became operational in March 1993. The on-site corrective action system became operational in late 1994 and consists of six extraction wells and treatment of groundwater. A waste water treatment plant has been built on plant property for this purpose. The groundwater from the off-site extraction wells is treated at the Publicly Owned Treatment Works (POTW).

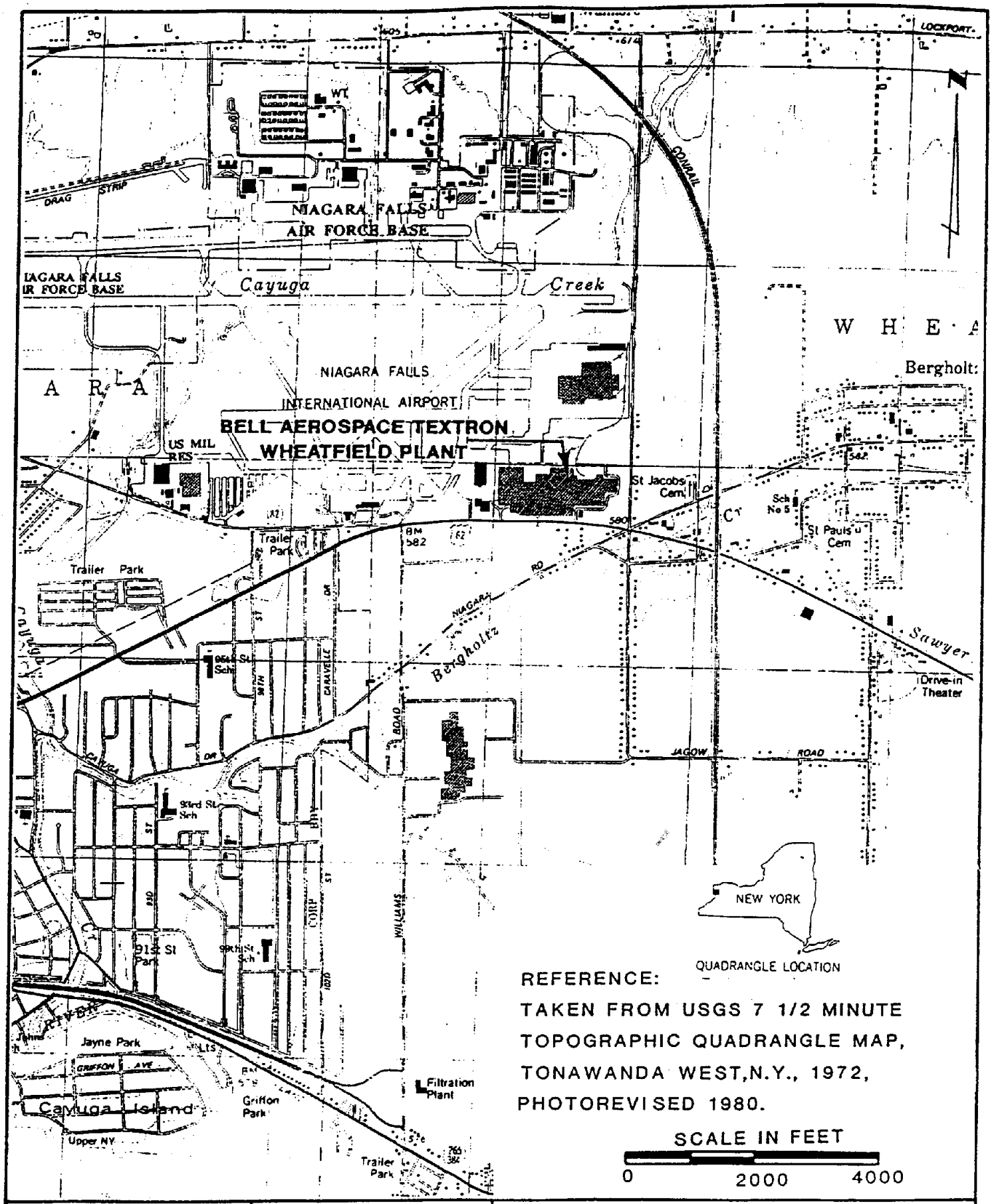
Confirmed Hazardous Waste Disposal:	Quantity:
Chlorinated Solvents	Unknown
Spilled or residues from rocket fuel	
Miscellaneous Chemicals	

Analytical Data Available for: Groundwater Soil
Applicable Standards Exceeded in: Groundwater
Geotechnical Information:
Soil/Rock Type: Fill(2')Clay-Silt(1.5")Varied clay(3'-4')silt, sand, clay
Depth to Groundwater: 10' below grd-Bottom of pond

Legal Action: Type: State Post Closure Permit Status: Order Signed
Remedial Action: Completed Nature of action: Groundwater Pump and Treat

Assessment of Environmental Problems:
Groundwater contaminated with various halogenated organics. The implementation of corrective measures, which has required pumping and treating the contaminated groundwater, along with other remedial measures, is addressing the environmental problems at this site.

Assessment of Health Problems:
The pond is closed and site access is restricted so exposures on-site are not expected. Groundwater is contaminated at the site. However, exposures via drinking water are not expected as all area homes are connected to public water. The potential exists for Public Works employees to be exposed to chemicals migrating within sewer trenches near the Plant site. Exposures to low level chemicals in creek sediments and waters are possible.



REFERENCE:
TAKEN FROM USGS 7 1/2 MINUTE TOPOGRAPHIC QUADRANGLE MAP, TONAWANDA WEST,N.Y., 1972, PHOTOREVISED 1980.

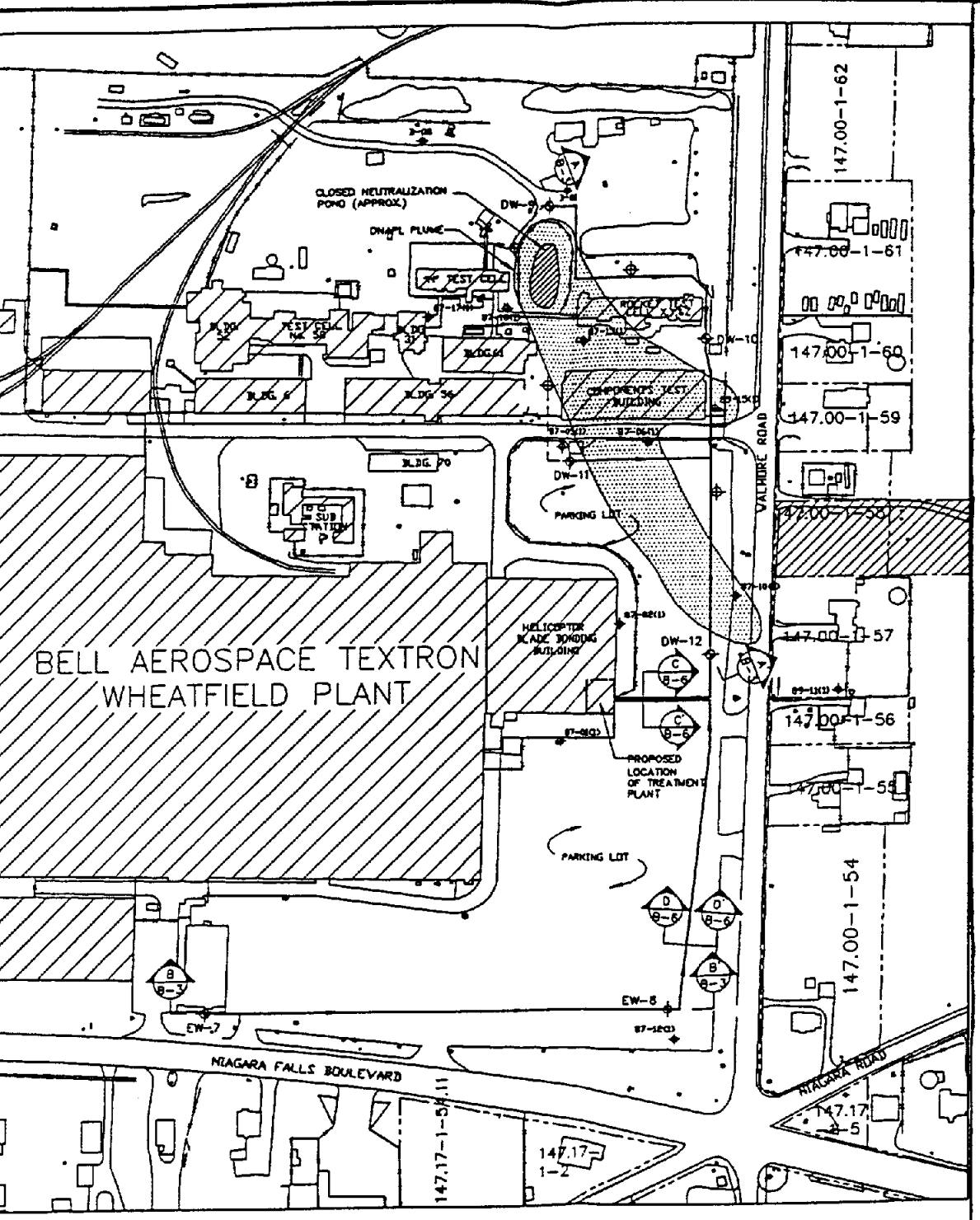
SCALE IN FEET

0 2000 4000

JOB No.: 914-1014	SCALE: AS SHOWN	SITE LOCATION MAP	
DRAWN: EAH	DATE: 8/20/91		
CHECKED: ACL	DWG. No.: 8		
Golder Associates		BELL AEROSPACE TEXTRON	FIGURE 1

158896

BUF/FILE # 9141014



LEGEND

- EXISTING MONITORING WELL LOCATION
- DNAPL WELL
- EXTRACTION WELL
- PROPOSED LOCATION OF ADDITIONAL EXTRACTION WELL (IF NECESSARY)
- BURIED PIPELINE
- PIPELINE EXTENSION (IF NECESSARY)
- INDICATES DIRECTION OF FLOW
- INTERPRETED ZONE 1 DNAPL PLUME
- DETAIL/CROSS SECTION DESIGNATION
- DWG. No. WHERE DETAIL/CROSS SECTION IS

NOTES

1.) THE ACTUAL CONSTRUCTION LOCATIONS AND DETAILS MAY VARY FROM THE DESIGN SHOWN AS A RESULT OF MINOR FIELD VARIATIONS AND WILL BE SHOWN IN "AS BUILT" DRAWINGS.

2.) DESIGN DETAIL MODIFICATIONS ARE SUBJECT TO PRIOR A OF THE OWNER OR APPROVED REPRESENTATIVE.

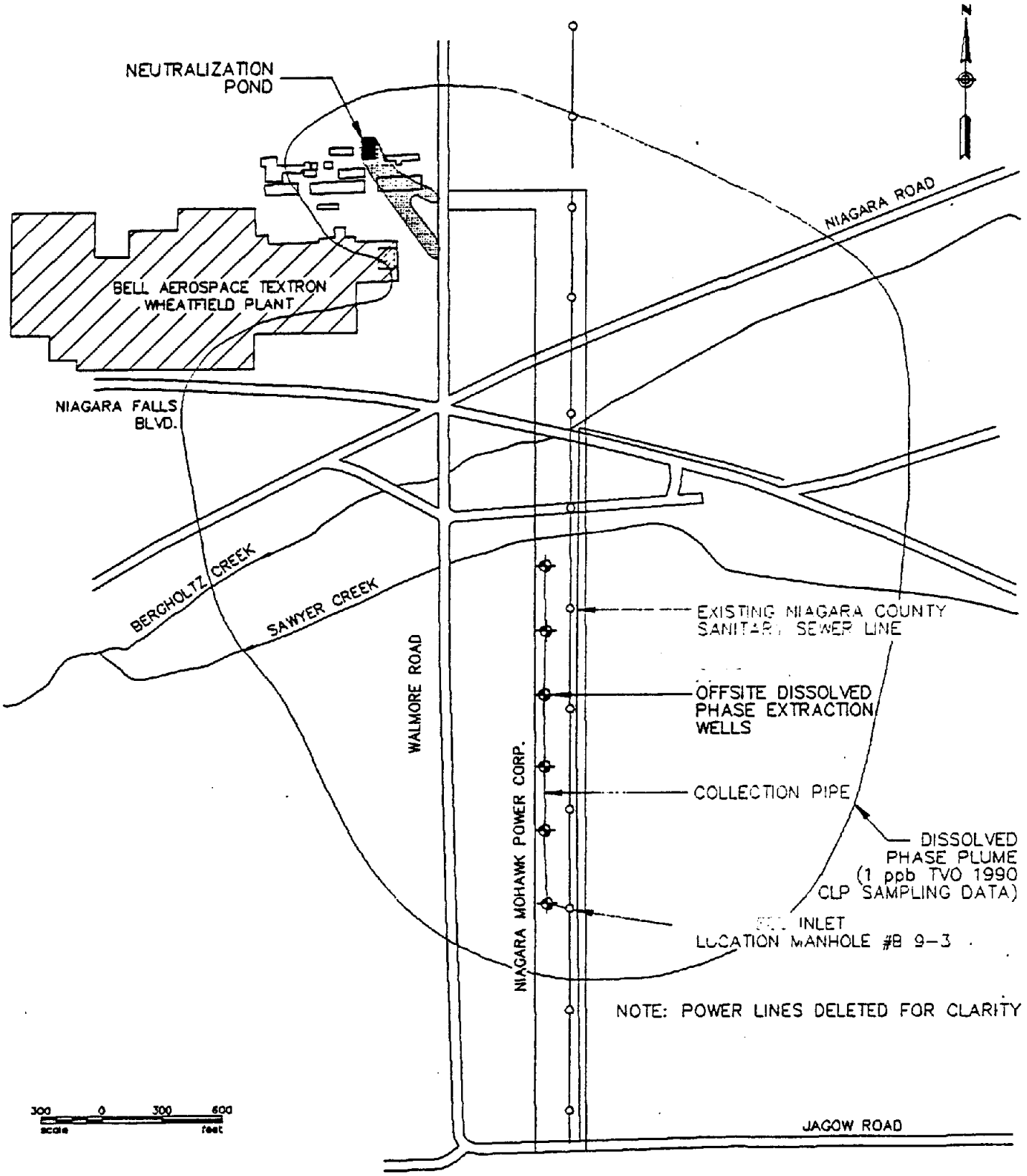
1 / B-2 ONSITE EXTRACTION SYSTEM

Scale: 100 0 100 200 feet

DESCRIPTION	DR BY
AS SHOWN	PROJECT: Bell Aerospace TEXTRON WHEATFIELD, NEW YORK
923-9055	
DR 02/17/92	SHEET TITLE: ONSITE GROUNDWATER EXTRACTION SYSTEM PLAN
CH 02/17/92	
PM 3/12/93	
AM 3/12/93	

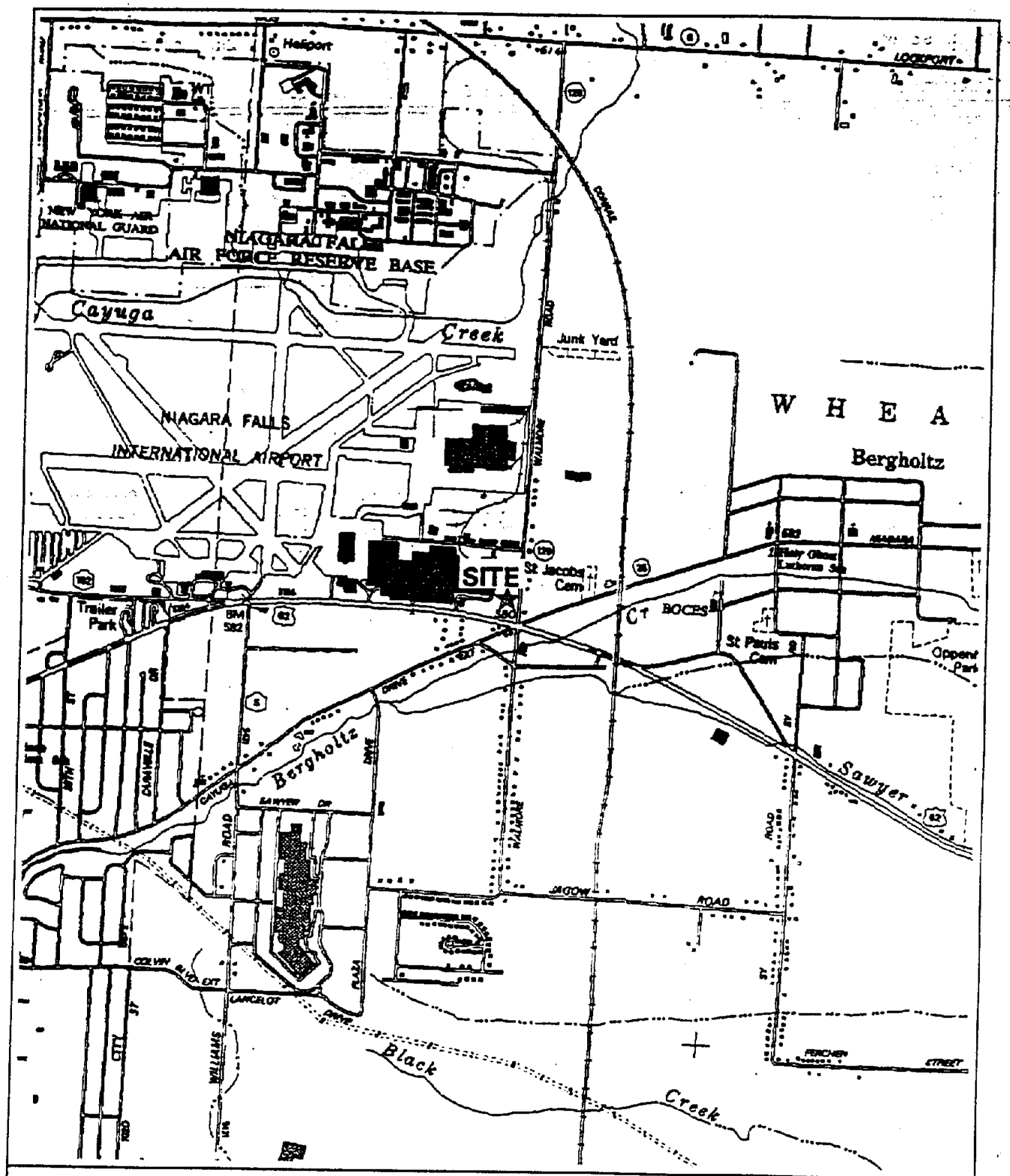
Golder Associates
Buffalo, New York

SHEET OF
FILE No. NY01-25
B-2



JOB No.: 913-9014	SCALE: AS SHOWN	**OFFSITE CORRECTIVE MEASURES**	
DRAWN: MJZ	DATE: 08/14/91		
CHECKED:	DWG. No.: NY01-275		
Golder Associates		BELL AREOSPACE TEXTRON	FIGURE 2

188698



Site Location Map

932052 Bell Aerospace - Textron

NYSDOT Planimetric Quadrangle(s):

N

0 500 1000 1500 2000

FEET

Scale 1:24,000

March 16, 1996

Golder Associates Inc.

2221 Niagara Falls Boulevard, L.P.O. Box 4069
Niagara Falls, NY USA 14304-8069
Telephone (716) 731-1560
Fax (716) 731-1652

Golder Associates

REPORT ON

APRIL 1997 QUARTERLY AND SEMI-ANNUAL GROUNDWATER MONITORING EVENT AND SUMMARY OF OFF-SITE AND ON-SITE GROUNDWATER EXTRACTION SYSTEM OPERATION TEXTRON REALTY OPERATIONS (WHEATFIELD) INC. FACILITY WHEATFIELD, NEW YORK

Submitted to:

Textron Inc.
40 Westminster Street
Providence, Rhode Island, 02903-6028

DISTRIBUTION:

8 Copies - Ms. Leslie Alden; Textron Inc.; Providence, Rhode Island
1 Copy - Golder Associates Inc.; Buffalo, New York

July 1997

973-9158

1. INTRODUCTION

This report represents the annual summary and system performance report for the Off-Site Groundwater Extraction System and the On-Site Groundwater Extraction System (Off-Site System and On-Site System, respectively) located at the Textron Realty Operations (Wheatfield) Inc.'s (TRO's) facility in Wheatfield, New York, for the 12-month period March 1996 through February 1997. This report is submitted in accordance with TRO's New York State Department of Environmental Conservation (NYSDEC) Title 6 New York Code of Rules and Regulations (6NYCRR) Part 373 Post Closure Permit, effective September 14, 1992 (Permit No. 9-2940-00001/00079-0). Included herein is a summary of the previous twelve months of operation including groundwater quality results, groundwater hydraulic monitoring results, and system operation information. In addition, this report presents proposed changes to TRO's current groundwater monitoring program (GWMP) and recommendations for future operations for the Off-Site System (based on the first 48 months of operation) and the On-Site System (based on the first 24 months of operation).

2. BACKGROUND

The Off-Site System consists of six Zone 1 bedrock groundwater extraction wells (EW-1 through EW-6), connected by a subsurface double-containment pipeline that discharges the extracted groundwater to the Niagara County Sewer District (NCSD) Publicly Owned Treatment Works (POTW). Figure 1 presents a site layout showing the locations of the extraction wells and the groundwater monitoring points. The Off-Site System has been operating since March 1993. Extraction well EW-1 was taken out of service during system start-up in March 1993, based on the hydraulic response observed during system start-up. EW-6 was taken off-line on April 11, 1996 in an attempt to reduce the constituent concentration at the southern boundary of the dissolved phase plume in the area of EW-6. The cessation of pumping at EW-6 should allow EW-5 to draw the dissolved phase plume boundary (as of October 1996, just to the south of EW-6) to the north toward EW-5.

The On-Site System consists of six Zone 1 bedrock groundwater extraction wells (EW-7, EW-8, and DW-9 through DW-12) connected by a subsurface double-containment pipeline that delivers the extracted groundwater to the On-Site Pre-Treatment Plant. At the Pre-Treatment Plant, the water is stripped of volatile organic compounds (VOCs), the VOCs are thermally destroyed, and the water ultimately is discharged to the NCSD POTW. Figure 1 presents a site layout showing the locations of the extraction wells and the groundwater monitoring points. Construction of the system was initiated on September 20, 1993, and was substantially completed by late 1994. Start-up of the system began in February 1995.

3. SUMMARY OF GROUNDWATER MONITORING

3.1 General

Groundwater quality and hydraulic monitoring of the Off-Site and On-Site Systems were performed pursuant to TRO's GWMP and the data for the past year were presented in individual Quarterly Groundwater Monitoring Reports (Golder Associates, June 1996, October 1996, January 1997a, and March 1997). Groundwater quality monitoring was conducted in April 1996, July 1996, October 1996, and January 1997. Hydraulic monitoring was conducted on a quarterly basis, corresponding with the quarterly groundwater quality monitoring events.

A summary of the operations associated with the Off-Site System during each quarter, including a discussion of the groundwater quality and hydraulic monitoring data collected during the representative quarter, is presented in detail in each of the aforementioned Quarterly Reports. The following sections present some general trends that are noted in the data collection during the past year.

3.2 Chemical Monitoring

Table 1 presents the monitoring points included in TRO's GWMP and the monitoring locations are shown on Figure 1. Groundwater quality monitoring was conducted on a quarterly basis (April 1996, July 1996, October 1996, and January 1997) with additional monitoring points included during the semi-annual events (April 1996 and October 1996) and the annual event (October 1996). These monitoring events include the analysis for VOCs only, for each monitoring point. Tables 2, 3, 4, and 5 present a quarterly summary of the detected compounds from the groundwater analytical data. Appendix A presents a database of all analyzed compounds for the past three years for each monitoring point.

A review of the analytical data collected from the monitoring wells indicates that the detection and concentration of VOCs in most monitoring wells were comparable from quarter to quarter throughout the year.

Due to the complex groundwater flow regime and the variability in concentrations of contaminants in Zone 1, a variability in total volatile organic compounds (TVOC) concentrations is observed in groundwater from some monitoring wells over time. These wells are generally located within the interior of the Zone 1 plume and between the On-Site and Off-Site System's extraction wells. This variability in TVOC concentrations is well illustrated by the TVOC concentration versus time plot of analytical results from monitoring well 87-20(1) (located north of the Off-Site System), as shown on Figure 2.

Continuing downward chemical trends were observed in monitoring wells 87-02(1) and 89-15(1). These on-site monitoring wells appear to have a downward chemical trend (see Figures 3 and 4 for TVOC concentration versus time plots), for all monitoring events after the start of the On-Site System in February 1995. This apparent reduction of TVOC concentrations may be attributed to the pumping of the Zone 1 aquifer by the On-Site System.

Figure 5 presents the approximate limit of the dissolved phase plume in the Zone 1 bedrock aquifer, based upon the groundwater quality monitoring data collected during the October 1996 annual monitoring event (Golder Associates, January 1997a). The extent of the dissolved phase plume in Zone 1 has remained relatively constant throughout the year, as anticipated, with the exception of the estimated boundary on the east side of the plume. In this area the plume boundary has been extended slightly further east beyond monitoring well 89-04(1) (located east of the TRO facility), due to low level detections of VOCs in groundwater obtained from this well during the October 1996 sampling event. This well had no detections in the January 1996 annual monitoring event, thus the plume boundary was thought to be located west of monitoring well 89-04(1), as previously shown in the

January 1996 monitoring event report (Golder Associates, March 1996). However, the lack of detections during the January 1996 annual monitoring event appears to have been a transient condition.

3.3 Hydraulic Monitoring

3.3.1 General

Tables 6 through 9 present a quarterly summary of the past year's hydraulic monitoring data. Figures 5, 7, 9, and 11 present groundwater elevation contour maps for each quarter for both the On-Site and Off-Site area together and Figures 6, 8, 10, and 12 present more detailed quarterly groundwater elevation contour maps of just the On-Site area.

3.3.2 Off-Site System

Groundwater equipotential maps of the Zone 1 bedrock aquifer in the vicinity of the On-Site and Off-Site Systems for all four quarters are presented on Figures 5, 7, 9, and 11. These maps show there is a consistent and significant overlap of the cone-of-depression and the contaminant plume in the off-site area, which is one of the design goals of the system. The hydraulic response to pumping of the Off-Site System has remained reasonably consistent since system startup in March 1993, although precipitation is shown to have a significant impact on the overall elevation of the cone-of-depression. Precipitation events tend to raise the elevation of all the wells in the off-site area, however, an inward hydraulic gradient toward the Off-Site System has always been observed.

Groundwater flow directions, as shown by the arrows on Figures 5, 7, 9, and 11, have remained relatively consistent within the developed cone-of-depression. The flow direction is generally towards the four pumping extraction wells (i.e. EW-2 through EW-5) of the Off-Site System. The horizontal hydraulic gradient in the area immediately north of the Off-Site System during October 1996 was approximately 0.006 feet/feet (ft/ft), as determined from water levels recorded in wells 87-20(1) and EW-2 in October 1996 (see

Figure 5). This figure is in good agreement with the horizontal gradient between these two wells of 0.007 ft/ft measured in January 1996 (Golder Associates, March 1996).

The flow rate, or average linear velocity of groundwater, can be calculated from hydraulic gradient data. To calculate this flow rate (V_s), the average Zone 1 hydraulic conductivity (K) of 2×10^{-3} centimeters per second (cm/sec), an effective porosity (n_e) value of 3-percent, as presented in the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) for the TRO facility (Golder Associates, June 1991), and the calculated hydraulic gradient (i) as recorded during January 1996 were used. The formula is:

$$V_s = -K/n_e \times i$$

The flow rate in the area immediately north of the Off-Site System during October 1996 was approximately 1.13 feet per day (ft/day), based on the hydraulic gradient of 0.006 ft/ft. The flow rate in this area has decreased slightly from a flow rate of 1.32 ft/day noted for January 1996 (Golder Associates, March 1996), due to reduced drawdown at EW-2, at the time of measurement. The flow rates are comparable from year to year.

3.3.3 On-Site System

The hydraulic response of the On-Site System through this year has reached the design expectations of establishing a zone of groundwater capture over the DNAPL plume; establishing a groundwater zone of capture along the southern property boundary of the TRO facility; maintaining an upward gradient between the Zone 3 and Zone 1 aquifers; and maintaining a downward gradient between the overburden and the Zone 1 aquifer.

A groundwater capture zone has been created by operation of the On-Site System, in the Zone 1 aquifer, over the DNAPL plume. An examination of the Zone 1 equipotential maps for the quarterly monitoring in April 1996 (Figure 8) and in July 1996 (Figure 10) show that for the first two quarters of this year, the capture zone of the On-Site System

did not extend over 100% of the DNAPL plume. However, examination of the Zone 1 equipotential maps for October 1996 and January 1997 monitoring events, Figures 6 and 12, respectively, illustrate that the operation of the On-Site System is producing a hydraulic capture zone in Zone 1 over essentially all of the DNAPL plume. As shown on Figure 12, during the January 1997 monitoring event, groundwater flowing through Zone 1 over the area of the DNAPL plume is not migrating off-site. In addition, groundwater flowing on-site that is not captured by extraction wells DW-9 through DW-12 (adjacent to the DNAPL plume) is subsequently captured by either On-Site extraction wells EW-7 and EW-8 or by the capture zone created by the Off-Site System.

The quarterly monitoring events in April 1996, July 1996, and October 1996, (see Figures 6, 8, and 10), show a groundwater capture zone developed in Zone 1 along the southern boundary of the on-site area south of Niagara Falls Boulevard but it did not extend entirely across the area between EW-7 and EW-8. Based on these conditions, a small portion of the groundwater that flows between EW-7 and EW-8 was not being captured by these two extraction wells. However, review of the data gathered in the January 1997 monitoring event indicates that a capture zone has been established between extraction wells EW-7 and EW-8, thereby capturing the southerly groundwater flow between EW-7 and EW-8, as illustrated on Figure 12.

The horizontal hydraulic gradient in the Zone 1 bedrock at the on-site area have been measured from two locations, as determined from water levels recorded between monitoring well 87-02(1) and extraction well DW-12; and between monitoring well 87-01(1) and extraction well EW-8. A horizontal hydraulic gradient of 0.012 ft/ft was calculated between wells 87-02(1) and DW-12 and a horizontal hydraulic gradient of 0.031 ft/ft was calculated between wells 87-01(1) and EW-8. The on-site groundwater flow rate, using a hydraulic conductivity value of 2×10^{-3} cm/sec and an effective porosity value of 3-percent (the same parameters as used for the off-site area), is 5.67 ft/day, based

on a gradient of 0.031 ft/ft between 87-01(1) and EW-8; and 2.27 ft/day, based on a gradient of 0.012 ft/ft between 87-02(1) and DW-12.

Data from every quarter (presented in their respective quarterly reports) indicate that the desired upward gradients, between Zones 3 and 1, and downward gradients, between the overburden and Zone 1, are present in every well cluster measured. Figure 13 presents a plot of water table elevations versus time for on-site monitoring wells 87-04(1) (a Zone 1 well) and 87-04(3) (a Zone 3 well) collected with automatic data loggers. The plot shows that an upward gradient from Zone 3 to Zone 1 has been continuously maintained in these wells for almost two years (March 15, 1995 through January 14, 1997), with only brief exceptions, due to precipitation events and/or on-site "rocket test cooling water" discharge events (from Atlantic Research Corporation (ARC)). Please note that a data logger battery failure in early February 1996 prevented the collection of data from well 87-04(1) until July 5, 1996. In addition, preventative maintenance in the data logger in well 87-04(3) prevented the collection of data from February 26, 1996 to July 5, 1996.

Table 10 presents a summary of vertical hydraulic gradients between Zones 1 and 3 based on the past year's hydraulic monitoring data. The data indicate that the hydraulic gradients range from 0.15 to 0.85 ft/ft, in every case the flow direction is upwards from Zone 3 to Zone 1 which is the desired direction.

Figure 14 presents an on-site groundwater elevation contour map for the Zone 3 bedrock aquifer as measured in October 1996. It indicates that groundwater flow in the Zone 3 aquifer is generally in a southeasterly direction, which is similar to its flow direction prior to the On-Site System's operation.

Improvements in the on-site hydraulic capture zone over the DNAPL plume and between extraction wells EW-7 and EW-8 observed during the past year is attributed in part to the two ancillary measures installed in the on-site area in 1996 (Golder Associates, January

1997b). TRO has completed the implementation of the following ancillary measures in the past year, consistent with their Part 373 Post-Closure Permit, in an attempt to enhance the drawdown of the On-Site System:

- Installation of a pipeline system on-site, which extends to the existing Walmore Road storm sewer, to hydraulically isolate the "rocket test cooling water" (discharged on-site by TRO tenant Atlantic Research Corporation (ARC)) and on-site stormwater from entering Zone 1; and

- Installation of hydraulic barriers ("clay stops") in the backfill of the sanitary sewer trench along Walmore Road adjacent to the TRO facility to minimize induced water infiltration from the Walmore Road sewer backfill to the On-Site System.

In addition, improvements to the On-Site System's pumping capacity (see Section 4) and the nearly continuous operation of the On-Site System throughout the past year have improved hydraulic conditions in the on-site area.

3.4 Routine Operations and Maintenance

During each monitoring event, personnel performed a standard general operations and maintenance (O&M) check of each well sampled. The following is a summary of the results of the O&M check and activity completed, per monitoring event:

April 1996

- Monitoring wells 87-02(1), 87-20(0), 89-04(1), and B-14(1) were missing caps on the riser pipe;
- Monitoring wells 87-22(0), 89-02(1), and 89-02(3) had cracked cement/bentonite surface seals; and
- Data loggers in monitoring wells 87-04(1) and 87-04(3) were taken out of service for repairs (in March 1996).

July 1996

New caps were installed on the riser pipes of monitoring wells 87-02(1), 87-20(0), 89-04(1), and B-14(1) and new hydrated bentonite and layer of crushed stone was placed on the cracked cement/bentonite surface seals of monitoring wells 87-22(0), 89-02(1), and 89-02(3) (as identified during the April 1996 monitoring event). In addition, the reconditioned data loggers were re-installed at well 87-04(1) and 87-04(3).

Upon completion of the maintenance activity described above, the O&M check during the July 1996 monitoring event did not indicate any additional problems, and all monitoring wells and extraction wells sampled appeared to be functional and in good working condition.

October 1996

The O&M check during the October 1996 monitoring event did not indicate any problems as all monitoring wells and extraction wells sampled appeared to be functional and in good working condition.

January 1997

During the January 1997 O&M check, the following problems were noted:

- Monitoring well 94-02(1) was rendered unserviceable because of damage to the protective casing and riser due to being struck by a vehicle;
- Monitoring well 89-02(1) showed signs of damage to the riser pipe from frost heave; and
- Monitoring well 87-14(1) was noted as having a loose protective casing hinged cap.

TRO will repair the riser and protective casings on monitoring wells 94-02(1) and 89-02(1) and repair the cap on monitoring well 87-14(1) prior to the April 1997 monitoring event.

4. SUMMARY OF SYSTEM OPERATIONS

4.1 Off-Site System

Off-Site System operations during the past year involved general maintenance and improving the resistance of the flow and level controllers to electrical damage. The flow and level controllers in several of the vaults of the Off-Site System have been damaged on more than one occasion, apparently due to lightning strikes in the vicinity of the power line right-of-way adjacent to the Off-Site System. Data line circuit protectors were installed in all operational Off-Site System vaults during the second quarter to reduce the potential for lighting strike damage to the pump controllers. The circuit protectors seem to have been effective, as no new lightning-induced problems have occurred since the second quarter. No unscheduled down time was noted for the Off-Site System this year.

Specific pump flow settings, implementation dates, and operational adjustments have been previously presented in the Quarterly System Operation Reports (Golder Associates, June 1996, October 1996, January 1997a, and March 1997). However, a review of the Off-Site System's performance and major operations adjustments are provided:

- Total flow rate for the Off-Site System ranged from a monthly average of approximately 56,500 gallons per day (gpd) to approximately 92,500 gpd during the second quarter (July 1996) of operation; and

- During the year the flow rate of individual off-site extraction wells ranged from approximately 16 gallons per minute (gpm) to 25 gpm for EW-2; from approximately 8 gpm to 12.5 gpm for EW-3 through EW-5; and from approximately 6 gpm to 10 gpm for EW-6 up to the point it was taken off-line on April 11, 1996.

4.2 On-Site System

On-Site System operations this past year have concentrated on general maintenance and improving the rate of system influent processing. Two unscheduled down time events totaling approximately 136 hours occurred during the third quarter (Golder Associates, January 1997a).

During this past year, the approximate average flow rates for the on-site extraction wells were from 4 gpm to 10 gpm per well. The total average flow rate for the On-Site System, including maintenance down time, ranged from a monthly average of approximately 58,000 gpd (40 gpm) to 60,480 gpd (42 gpm). Instantaneous flow rates of up to 50 gpm have been observed.

During the past year, TRO installed higher capacity pumps and made other modifications to the pre-treatment system to improve the efficiency of the system. Due to these improvements, the On-Site System influent processing rate is able to continuously process a maximum of approximately 40 gpm, approximately a 60% increase from the previous year's average flow rate of approximately 25 gpm. The various modifications made to the pre-treatment system throughout the year were discussed in detail in the Quarterly System Operation Reports (Golder Associates, June 1996, October 1996, January 1997a, and March 1997).

5. RECOMMENDATIONS FOR FUTURE GROUNDWATER MONITORING AND SYSTEM OPERATIONS

This section presents recommendations for future groundwater monitoring of the On-Site and Off-Site Systems as well as recommendations for future operations of the Systems. TRO proposes the following recommendations:

- Permanently decommission vault EW-1 of the Off-Site System;
- Discontinue the continuous datalogger recordings of monitoring wells 87-04(1) and 87-04(3);
- Remove sewer trench well SW-89(1) and monitoring wells 87-04(1), 87-12(1) and 87-18(1) from the proposed On-Site and Off-Site effectiveness monitoring program;
- Analyze all VOCs using method 8260; and
- Proposed future monitoring frequency, in accordance with the GWMP.

Extraction well EW-1 of the Off-Site System was taken out of service (the pumps removed and the borehole capped) in March 1993 because of its hydraulic response during the start-up phase of the system. The performance of the Off-Site System without EW-1 has been consistently satisfactory since this date, thus it is unlikely that EW-1 will be required again and therefore, TRO proposes to decommission EW-1. A proposed decommissioning plan will be submitted to the NYSDEC for review and approval.

Data loggers have recorded the groundwater elevations in on-site monitoring wells 87-04(1) and 87-04(3) since March 1995. Figure 13 presents a plot of these water table elevations versus time. The plot shows that an upward gradient from Zone 3 to Zone 1 has been continuously maintained in these wells for almost two years (March 15, 1995 through January 14, 1997), with only brief exceptions, due to precipitation events and/or on-site "rocket test cooling water" discharge events (from ARC). TRO proposes to discontinue monitoring these two wells with the data loggers (hydraulic monitoring will continue as per the GWMP) as the satisfactory performance of the On-Site System with

respect to the upward vertical gradients has been consistently demonstrated over the past two years.

Sewer trench well SW-89(1) is currently scheduled to be sampled on an annual basis. At no scheduled sampling event for this well since groundwater monitoring for the Off-Site System began in April 1993 has this well contained enough water to allow it to be sampled. TRO proposes to remove sewer trench well SW-89(1) from the On-Site and Off-Site Effectiveness Monitoring Program, as reflected in Table 11. Hydraulic monitoring will not be affected and will be continued according to the GWMP.

Monitoring wells 87-04(1), 87-12(1) and 87-18(1) are all within tens of feet of On-Site System extraction wells DW-10, EW-8, and EW-7, respectively. Because these three monitoring wells are each within the cones of depression generated by the pumping of a nearby extraction well, groundwater chemistry as determined at the pumping wells should be generally representative of the groundwater chemistry at the monitoring wells. An examination of historical data for these pairs indicates that, for a particular sampling event, the compounds detected in each pumping/monitoring well pair are almost without exception the same and the concentrations within an order of magnitude of one another. As such, as long as extraction wells DW-10, EW-8, and EW-7 are pumped and sampled, sampling of the associated nearby monitoring well amounts to redundancy. TRO proposes to remove monitoring wells 87-04(1), 87-12(1) and 87-18(1) from the On-Site and Off-Site Effectiveness Monitoring Program, as reflected in Table 11. Hydraulic monitoring will not be affected and will be continued according to the GWMP.

TRO's existing monitoring schedule indicates that the analytical methods listed in Table 1 include USEPA Methods 8240 and 8260 for VOCs (USEPA, November, 1990), depending on the sampling point location. TRO proposes to use Method 8260 at all proposed sampling locations, as listed on Table 11. The operation of the Off-Site and On-Site Systems continues to reduce overall VOC constituent concentrations, thus Method

8260, with its lower detection limits, is more appropriate at this time. Method 8260 is the same as Method 8240 in all other aspects.

TRO's existing monitoring schedule indicates that the monitoring frequencies listed in Table 1 will be reduced after one and two years of the On-Site System operation. The On-Site System has been in operation since February 1995, although modifications have been made to the system in 1996 that have enhanced the system's performance. Therefore, TRO proposes to continue short term monitoring, as defined in Table 1, through 1997. Starting in 1998, TRO will conduct semi-annual sampling (April and October) and annual sampling (October) through 1998, and then annual sampling thereafter, as outlined in Table 11.

6. SUMMARY

The Off-Site System has been operating since start-up of the system in March 1993. Sixteen quarterly monitoring events have been performed during the past four years of operation of the Off-Site System. The data collected from these monitoring events indicates that the Off-Site System is operating as intended as a cone-of-depression has developed in the Zone 1 aquifer which sufficiently overlaps the dissolved phase contamination in the off-site area. Therefore, TRO will continue to operate the Off-Site System based on its current mode of operation. The temporary suspension of pumping of EW-6 will continue as before.

The hydraulic response of the On-Site System has met the design expectations of establishing a zone of groundwater capture over the DNAPL plume; maintaining an upward gradient between the Zone 3 and Zone 1 aquifers; maintaining a downward gradient between the overburden and the Zone 1 aquifer; and establishing a groundwater zone of capture along the southern property boundary of the TRO facility, between extraction wells EW-7 and EW-8. On-Site Pre-Treatment System modifications and on-site ancillary measures have been implemented during 1996 and have improved the hydraulic containment performance of the On-Site System. Therefore, TRO will continue to operate the On-Site System based on its current mode of operation.

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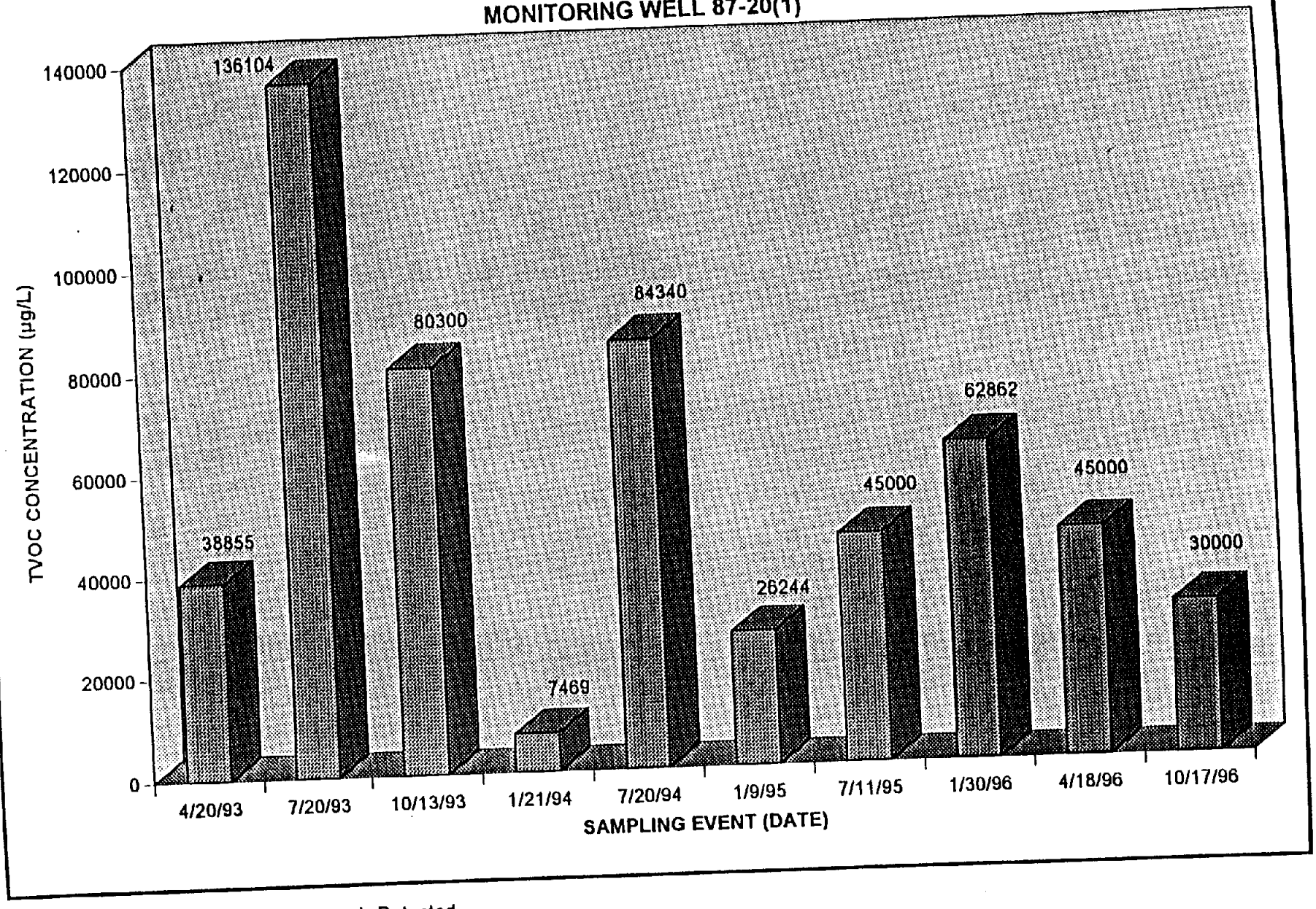
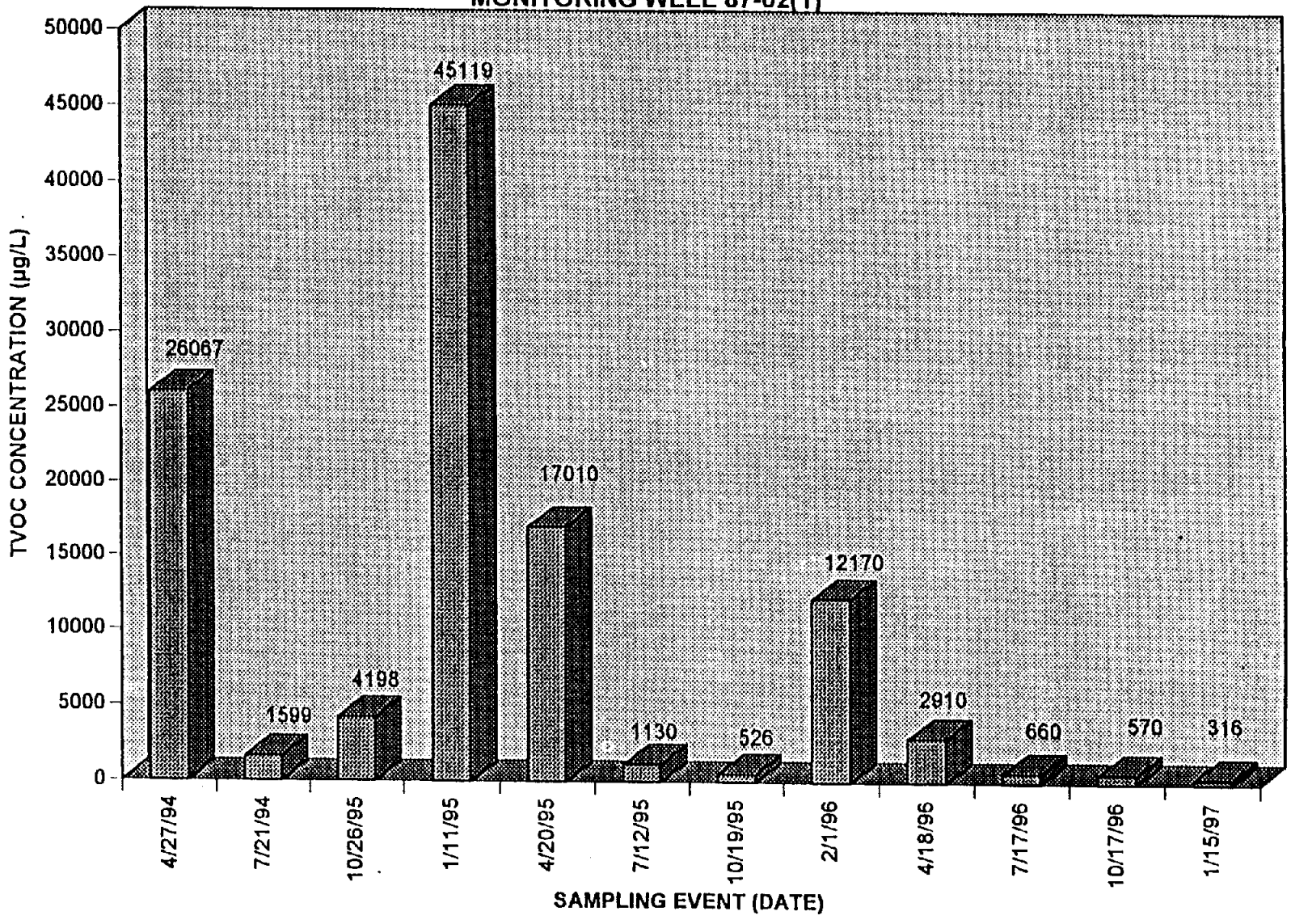
DCW/ALG:dml
F/N: 3RDANN.DOC

FIGURE 2
TVOC CONCENTRATIONS VS. TIME
MONITORING WELL 87-20(1)



TVOC = Total Volatile Organic Compounds Detected

FIGURE 3
TVOC CONCENTRATIONS VS. TIME
MONITORING WELL 87-02(1)



TVOC = Total Volatile Organic Compounds Detected