

***DRAFT***  
**PRE-DESIGN INVESTIGATION REPORT**

**AVM GOWANDA SITE**  
**OPERABLE UNIT 1**  
**TOWN OF PERSIA, CATTARAUGUS COUNTY, NEW YORK**

**(SITE REGISTRY NO. 9-05-025)**

**WORK ASSIGNMENT NO. D003600-38**

***Prepared for:***

**NEW YORK STATE DEPARTMENT  
OF ENVIRONMENTAL CONSERVATION**

***Prepared by:***

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**OCTOBER 2004**

**PRE-DESIGN INVESTIGATION REPORT  
AVM GOWANDA SITE  
OPERABLE UNIT 1**

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## **1.0 INTRODUCTION**

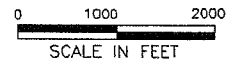
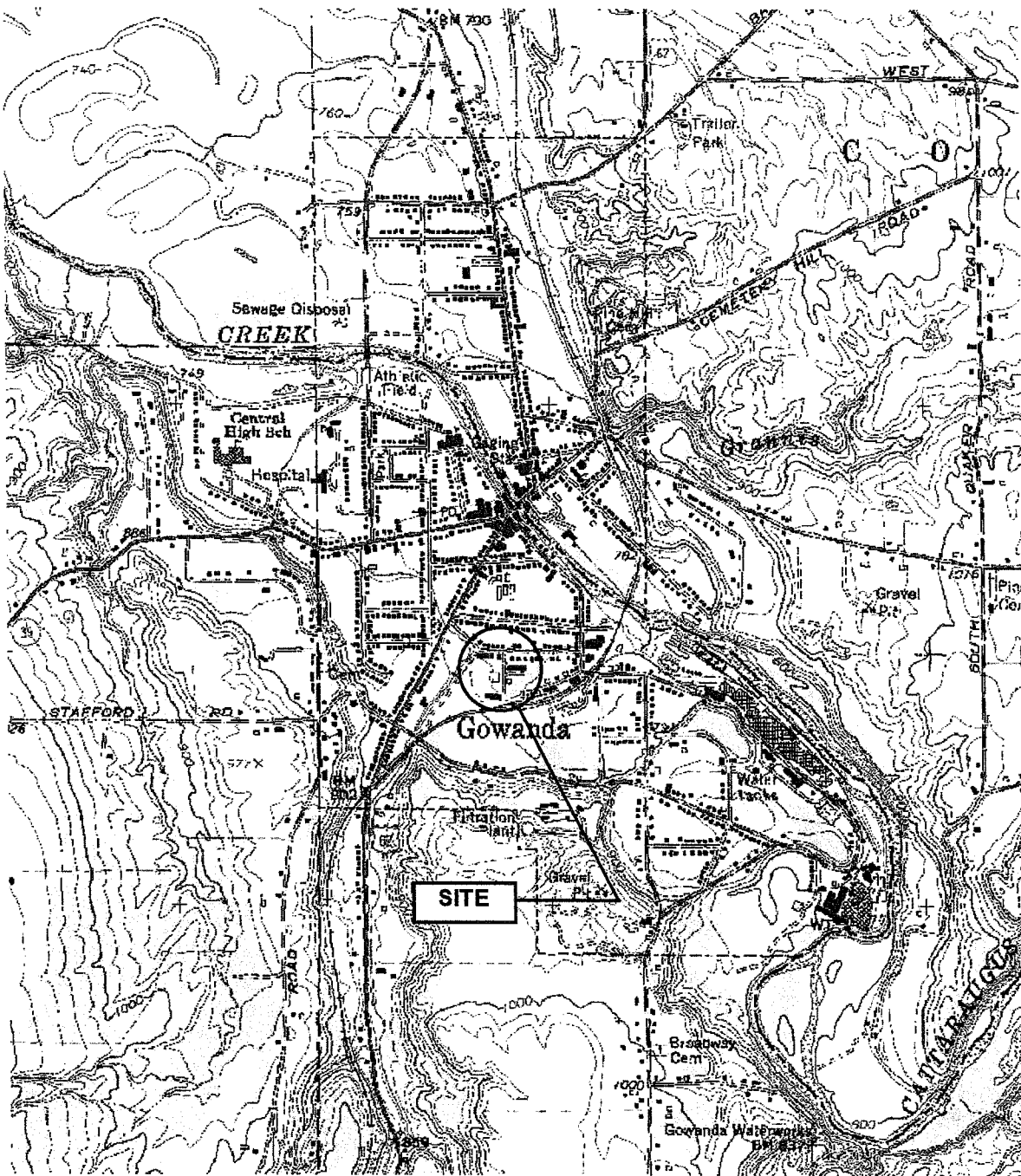
The Automatic Voting Machine Corporation (AVM) Gowanda Site, located in the Town of Persia, Cattaraugus County, New York (Figure 1-1), is a New York State Class 2 inactive hazardous waste disposal site, registry number 9-05-025. The New York State Department of Environmental Conservation (NYSDEC) has issued a Remedial Design (RD) Work Assignment to Dvirka and Bartilucci Consulting Engineers (D&B) under the State Superfund Standby Contract for the AVM Gowanda Site. The RD for this site is being performed with funds allocated under the New York State Superfund Program, as part of New York State's program to investigate and remediate hazardous waste sites.

### **1.1 Project Objective**

As part of New York State's program to investigate and remediate hazardous waste sites, the NYSDEC issued a work assignment to D&B for remedial design services for the AVM Gowanda Site, Operable Unit 1. The scope of work includes a pre-design investigation, preparation of an engineering design report, preparation of remedial design documents (plans and specifications) and providing pre-award services. The purpose of this report is to present a summary of the activities and findings of the pre-design investigation conducted at the site.

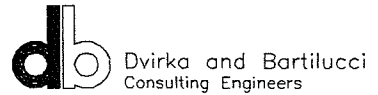
### **1.2 Site Location, Ownership and Access**

The AVM Gowanda Site is located at One Industrial Place in Gowanda, New York. The property is approximately 1.75 acres in area and includes two manufacturing buildings and two small storage sheds. The site is currently owned and occupied by the Gowanda Electronics Corporation, a small manufacturer of electrical components, such as inductors.



AVM GOWANDA SITE  
GOWANDA, NEW YORK

**SITE LOCATION MAP**



**FIGURE 1-1**

The site property is flat and largely covered with either paved parking areas or buildings. Surface drainage is provided via storm drains that discharge to Thatcher Brook and ultimately to Cattaraugus Creek. The site is bordered by residential property to the north and east, a railroad yard to the south and commercial industrial facilities to the west. Figure 1-2 presents the site and surrounding residential properties.

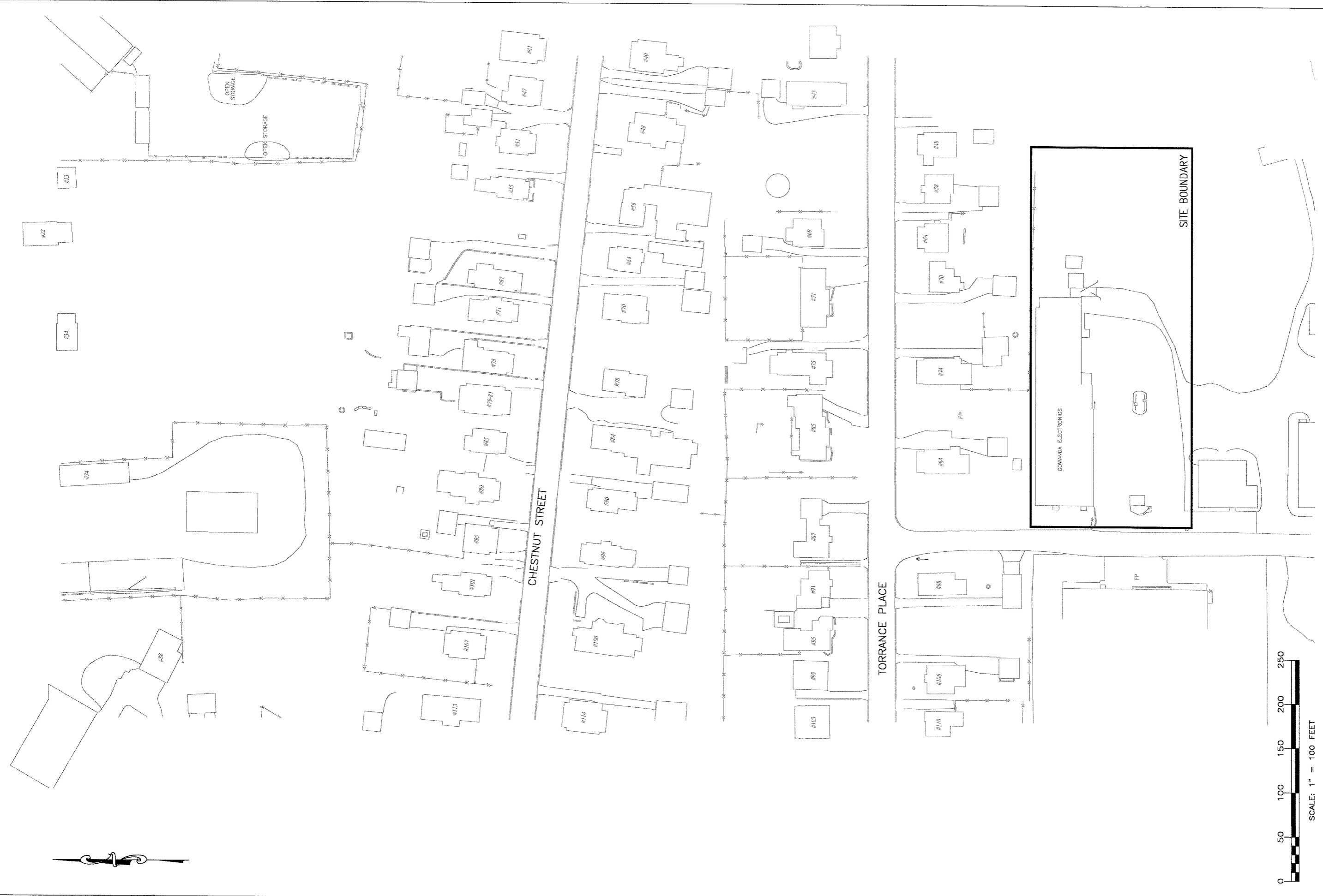
The site is located to the east of Industrial Place in a flat lying area within the Cattaraugus Creek valley. Upland areas to the east and west of the site are at elevations of approximately 1,300 and 1,600 feet above mean sea level, respectively. Topography in the area of the site generally slopes downward from south to north. Elevations in the immediate vicinity of the site range from approximately 765 to 780 feet above mean sea level.

Access to the site is obtained from Industrial Place through paved parking areas located at the south side of the Gowanda Electronics building. Access to the site is unrestricted.

### **1.3 Site History and Previous Investigations**

The AVM Gowanda Site has been used for industrial operations since the early 1930's. From World War II until 1979 the facility was used as a metal stamping/machine shop. Gowanda Electronics Corporation purchased the facility in 1979 from AVM and has since used the facility for the manufacture of electronics components.

Malcolm Pirnie, Inc., completed a Phase I and Phase II site investigation in the spring of 1994 for Gowanda Electronics Corporation. Analysis of surface soil samples showed elevated levels of various metals, total petroleum hydrocarbons (TPH) and trace levels of volatile organic compounds (VOCs) near the east end of the main building, along the northern property boundary. The company chose to excavate the surface soil for off-site disposal. The initial surface soil excavation program continued to a depth of approximately seven feet based on visual identification of stained soil and waste metal shavings, and resulted in the removal of 568 tons of



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contaminated soil and waste. This led to the discovery of elevated levels of VOCs, which increased in concentration as the depth of the excavation increased. VOCs from this area apparently had migrated to the water table, resulting in significant groundwater contamination. The excavation was backfilled and the company installed a groundwater extraction well (RW-1) with an air stripper for treatment. This system became operational in June 1996 and continues to operate under a Voluntary Cleanup Agreement (Index No. B9-0507-96-05) between the NYSDEC and the Gowanda Electronics Corporation. Groundwater is pumped at approximately 5 gallons per minute from RW-1 and treated water is discharged to the Village of Gowanda sanitary sewer system.

A NYSDEC Immediate Investigation Work Assignment (IIWA) was undertaken in 1995 to further investigate existing subsurface soil and groundwater conditions near the source area and to identify potential migration pathways from this source area. Field activities associated with the IIWA were conducted during late 1995, with a report issued by NYSDEC in January 1996. A significant groundwater contaminant plume was identified, migrating from the source area northward to Torrance Place. The data further suggested that the plume likely extended beyond Torrance Place.

The IIWA provided the basis for the site to be listed on the New York State Registry of Inactive Hazardous Waste Disposal Sites as a Class 2 site. A remedial investigation/feasibility study (RI/FS) was subsequently conducted to fully define the nature and extent of contamination, determine if any exposure pathways exist that pose a threat to human health or the environment, and if necessary, evaluate remedial alternatives to effectively address the contamination. The results of the RI were presented in a report prepared by NYSDEC dated July 1998 and the FS was presented in a report prepared by NYSDEC dated February 2000.

In March 2001, the NYSDEC issued a Record of Decision (ROD) for the AVM Gowanda Site. In order to eliminate or mitigate the significant threats to human health and the environment caused by the disposal of hazardous waste at the AVM Gowanda Site, the following remedy was selected:

- Undertake a remedial design program to verify the components of the conceptual design and prepare the plans and specifications necessary for the construction, operation and maintenance, and monitoring of the remedial system.
- Continue operation of the extraction well and air stripper currently in place at the Gowanda Electronics Corporation property by the volunteer.
- Installation of a groundwater extraction system consisting of pumping wells beneath Torrance Place and a collection trench midway between Torrance Place and Chestnut Street with conveyance of groundwater to the Gowanda Electronics Corporation property for treatment via an underground pipe.
- Construction of a treatment system consisting of an air stripping unit, air emissions treatment, and dense non-aqueous phase liquid (DNAPL) separator, housed in a separate sound dampened building constructed on the Gowanda Electronics Corporation property with discharge to Thatcher Creek.
- Installation of a reactive iron wall north of Chestnut Street, extending approximately 250 feet in length to intercept the leading edge of the contaminant plume.
- Implementation of a monitoring system to ensure the effectiveness of the remedy, including groundwater flow conditions, groundwater chemistry and indoor air quality.

## **2.0 PRE-DESIGN INVESTIGATION ACTIVITIES**

The purpose of the pre-design investigation was to evaluate existing conditions on-site and off-site and collect the information required for the design of the selected groundwater remedial alternatives. This section documents the field activities and techniques used to investigate the AVM Gowanda Site. The field investigation was conducted in accordance with the NYSDEC approved Remedial Design Project Management Work Plan (D&B, 2004).

Fieldwork was performed in five phases. The first phase was performed in April 2004 and consisted of the collection of indoor air samples and sub-slab soil vapor samples within and beneath residences, respectively, located within the limits of the groundwater contamination plume identified in the RI Report (NYSDEC, 1998). The second phase of the investigation was performed in May 2004 and consisted of advancing soil borings and the installation of groundwater monitoring wells at on-site and off-site locations. The third phase of the investigation was performed in June 2004 and consisted of the collection of ground water samples from existing wells and the new wells installed at the site during the second phase of site activities. The fourth phase of the investigation was performed in July 2004 and consisted of a groundwater pump test at an existing off-site well. The fifth phase of the investigation was performed in September 2004 and consisted of collection of a second round of groundwater samples and indoor air and sub-slab soil vapor samples within and beneath additional residences. The additional indoor air and sub-slab soil vapor samples were collected in houses which were not included in the April 2004 sampling event with the exception of two indoor air samples that were collected from houses that had been sampled in April 2004.

### **2.1 Base Map Development and Surveying**

A base map for the site was compiled from aerial photography and an on-site ground control survey. Site features on the map include roads, utilities, monitoring wells, surface water bodies and topography. Pre-existing monitoring wells and monitoring wells constructed for this

investigation were surveyed to the nearest 0.01 feet for location and elevation. The survey was prepared in the New York State Plane (NYSP) coordinate system (NAD 1983 and NAVD 1988).

The survey map shows the location of relevant site features and adjacent areas at a scale of 1-inch equals 100 feet. Topographic contours were plotted at 1-foot intervals. The map was constructed using AutoCad®.

Surveying for the base map and identification of investigation locations was conducted in several phases. A topographic map of the site was prepared first. The topographic map was prepared from aerial photographs prepared for Popli Consulting Engineers & Surveyors by LaFave, White & McGivern, LS, PC. The aerial photographs were taken in early spring of 2004 when there was a minimum of leaf cover, in order to maximize the visibility of site features. This phase also involved the establishment of control points at the site. The control points were used to orient aerial photography activities.

The second phase was conducted following the completion of the fieldwork. During this phase of surveying, the locations and elevations of monitoring wells (including water level measurement reference points), surface water locations, and other pertinent site features were surveyed and included on the base map.

A copy of the survey map is provided in a map pocket in Appendix A.

## **2.2 Indoor Air and Sub-Slab Soil Vapor Sampling**

Two rounds of indoor air and sub-slab soil vapor sampling were conducted during the pre-design investigation. Indoor air and sub-slab soil vapor samples were collected within and beneath houses overlying the groundwater contaminant plume identified in the RI Report (NYSDEC, 1998) in order to evaluate the need for permanent monitoring points and/or mitigation systems.

Initially a mailing was performed by the NYSDEC seeking permission from homeowners for access for the indoor air sampling and sub-slab soil vapor sampling. Only a small number of positive responses were received. Ultimately, for the first sampling round, performed in April 2004, access was obtained to a total of 12 houses. Identification numbers for the houses sampled, the dates sampling was performed and the type of samples collected in each house accessed are summarized on Table 2-1. As indicated on Table 2-1, as part of the April 2004 sampling event, an ambient air sample (outside) was collected on each day of indoor air sampling. The locations of the houses sampled as well as the ambient air sample locations are shown on Figure 2-1.

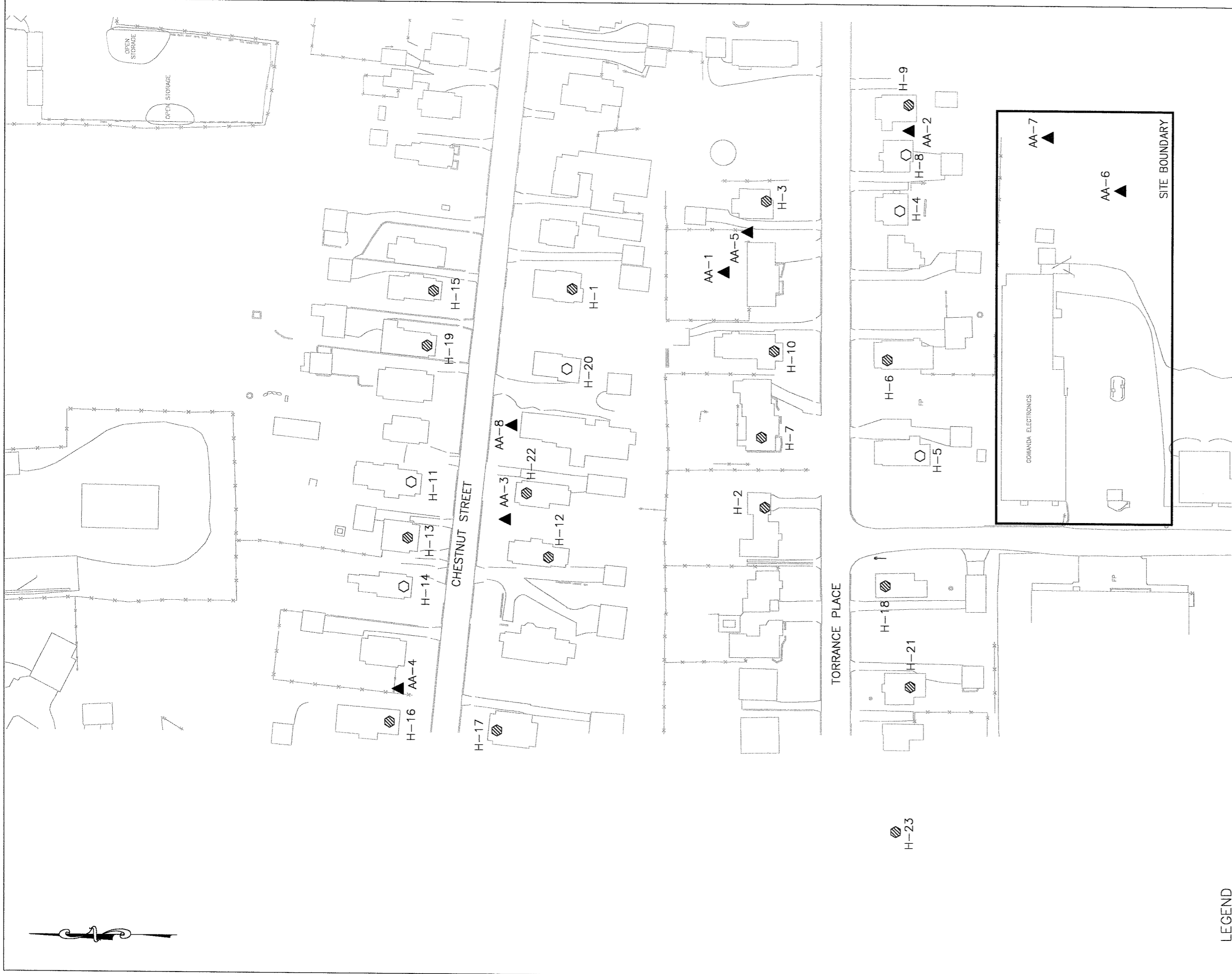
Based on the elevated levels of trichloroethene (TCE) detected in several indoor air samples collected during the first sampling round (NYSDOH suggested a preliminary screening value of 5 micrograms per cubic meter [ $\mu\text{g}/\text{m}^3$ ]), NYSDEC proceeded with installation of mitigation systems in four houses. In addition, a second round of mailings were sent out by the NYSDEC and telephone calls were made in an attempt to obtain access to additional houses for a second sampling round.

Based on the results of the follow up mailing and telephone calls, as well as soliciting access by going door to door, access was obtained to 11 additional houses for the second sampling round performed in September 2004. Also, as part of this second sampling round, indoor air was re-tested in three houses (H-3, H-6 and H-8) included in the first sampling round. H-3 was re-sampled to confirm the absence of TCE in the indoor air, since the results of the first sampling round indicated no TCE at that location. H-6 was re-sampled to evaluate the mitigation system which had been installed in that house after the first sampling round and H-8 was re-sampled to confirm concentrations of TCE in the indoor air, since the concentration of TCE detected during the first sampling round was close to the NYSDOH preliminary screening value of  $5 \text{ ug}/\text{m}^3$ .

**TABLE 2-1**  
**AVM GOWANDA SITE**  
**PRE-DESIGN INVESTIGATION**  
**INDOOR AIR AND SUB-SLAB SOIL VAPOR SAMPLE INFORMATION**

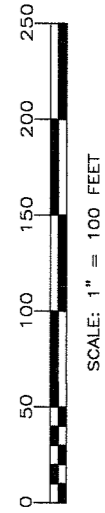
HOUSE/ LOCATION	SAMPLE DATE	SAMPLE IDENTIFICATION		
		INDOOR AIR	SUB-SLAB	AMBIENT AIR
H-1	4/5/04	A2	A1	
H-2	4/5/04	A4	A3	
H-3	4/5/04	A7	A6	
	9/22/04	A52		
H-4	4/5/04	A8		
H-5	4/6/04	A9		
H-6	4/6/04	A12	A11	
	9/22/04	A51		
H-7	4/6/04	A14	A13	
H-8	4/6/04	A15		
	9/20/04	A37		
H-9	4/6/04	A17	A16	
H-10	4/6/04	A19	A18	
H-11	4/7/04	A21		
H-12	4/7/04	A23	A22	
H-13	9/20/04	A25	A24	
H-14	9/20/04	A26		
H-15	9/20/04	A28	A27	
H-16	9/20/04	A30	A29	
H-17	9/20/04	A32	A31	
H-18	9/20/04	A39	A38	
H-19	9/22/04	A41	A40	
H-20	9/22/04	A42		
H-21	9/22/04	A44	A43	
H-22	9/22/04	A46	A45	
H-23	9/23/04	A54	A53	
AA-1	4/5/04			A5
AA-2	4/6/04			A10
AA-3	4/7/04			A20
AA-4	9/20/04			A33
AA-5	9/20/04			A34
	9/22/04			A48
AA-6	9/20/04			A35
	9/22/04			A50
AA-7	9/20/04			A36
	9/22/04			A49
AA-8	9/22/04			A47

Laboratory identifications have a prefix of AVM- and a suffix of -B for basement, -SS for sub-slab or -AA for ambient air.

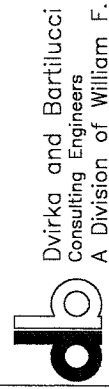


LEGEND

- H-8 INDOOR AIR SAMPLE LOCATION
- ◐ H-9 INDOOR AIR AND SOIL VAPOR SAMPLE LOCATION
- ▲ AA-4 AMBIENT AIR SAMPLE LOCATION



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A Division of William F. Cosulich Associates, P.C.

INDOOR AIR AND SOIL VAPOR SAMPLE LOCATIONS

During two days of the second sampling round, four ambient air samples were collected (see Table 2-1 and Figure 2-1). During the first day (September 20, 2004), the sampling was performed while the groundwater extraction and treatment system at the Gowanda Electronics Corporation site was shutdown. During the second day of sampling (September 22, 2004), the groundwater extraction and treatment system was operating in order to evaluate the potential effect of the treatment system's atmospheric exhaust on ambient air conditions.

All air samples were collected with 0.4-liter Minican<sup>®</sup> canisters and analyzed for chlorinated VOCs, benzene, toluene, ethylbenzene and xylene (BTEX) and methyl-tert-butyl ether (MTBE) by Method TO-15 using selective ion monitoring. Sample canisters were set up to collect air samples for two hours and removed within one day of placement.

During each sampling round indoor air samples were collected from the lowest living space (i.e., basement or first floor) in each house that was sampled. Sub-slab soil vapor samples were collect in houses with a lower permeability floor (e.g., concrete slab), when permission was granted by the owner. Sub-slab soil vapor samples were not collected in houses with an unfinished floor (i.e., soil) in the lowest level.

The indoor air samples were collected by placing a sample canister 2 to 4 feet above the floor and allowing it to fill. The sub-slab soil vapor samples were collected by drilling a  $\frac{9}{16}$ -inch diameter hole through the concrete basement floor to a depth of approximately 1.5 feet below grade. A Teflon<sup>™</sup> tube was placed in the hole, sealed with beeswax, connected to the sample canister and allowed to fill. Outside ambient air samples were collected by setting sample canisters approximately 1 foot above the ground surface and allowing them to fill.

An indoor air quality questionnaire and building inventory was completed for each house prior to sampling, as required by the Division of Environmental Health Assessment Bureau of Toxic Substance Assessment Indoor Air Sampling and Analysis Guidance Protocols, dated

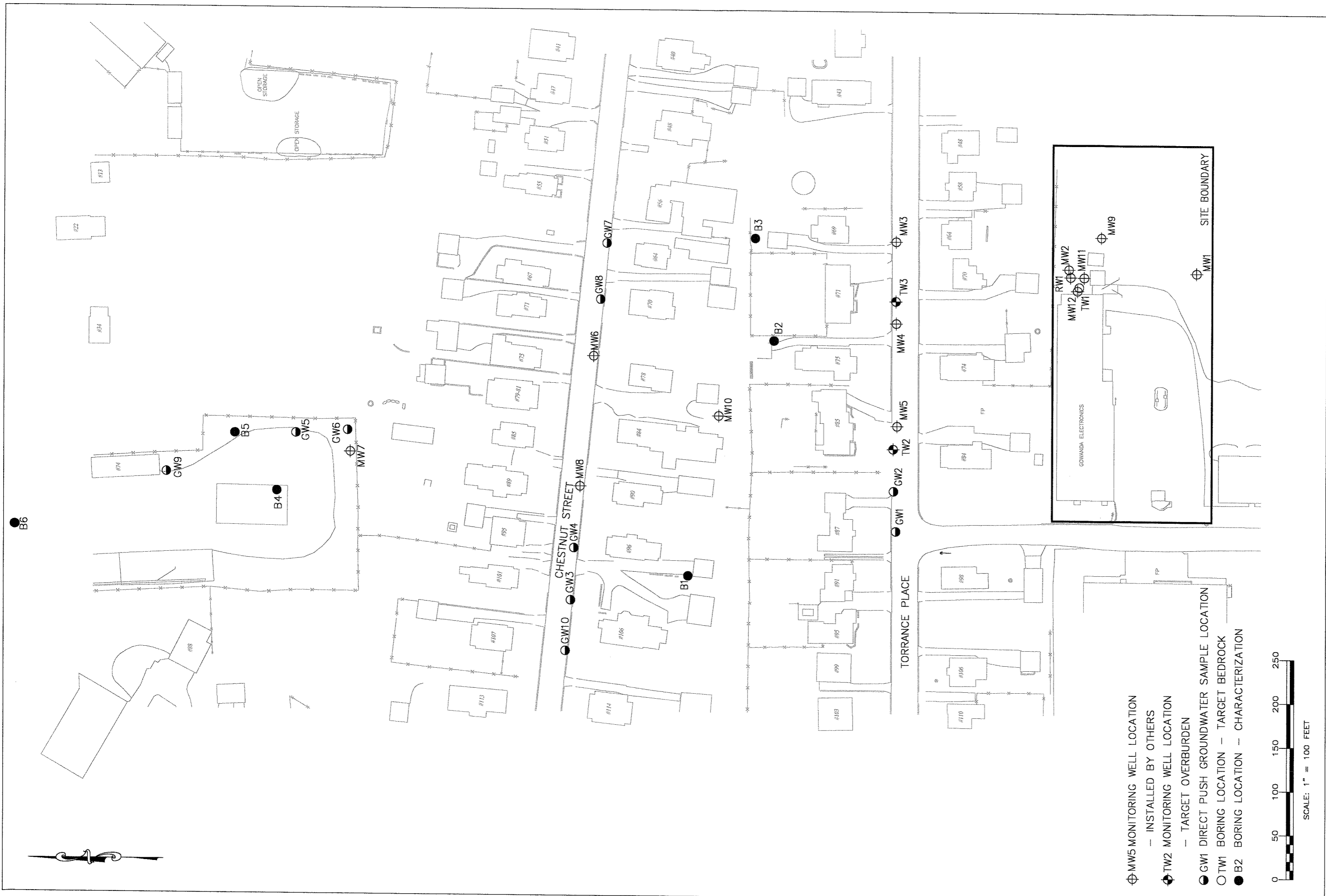


August 8, 2001. Copies of the completed indoor air quality questionnaires are included in Appendix B.

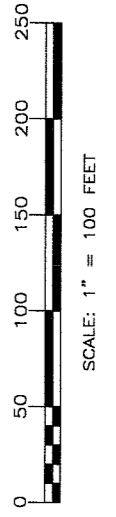
### **2.3 Soil Boring and Monitoring Well Installations**

Nineteen soil borings were drilled during the pre-design investigation to evaluate hydrogeologic and groundwater quality conditions on-site and off-site and obtain information required for the design of a groundwater remediation system. Ten of the soil borings (plume confirmation borings) were advanced solely for the collection of groundwater samples to determine the limits of contamination. Six of the soil borings (characterization borings) were advanced to provide hydrogeologic data for the design of the remediation system. Two of the soil borings (target well borings) were advanced for the purpose of installing additional monitoring wells in the overburden at the site. One of the soil borings (target well boring for bedrock) was advanced for the purpose of installing a monitoring well in bedrock at the site; however, as discussed further below, a well was not installed at this boring. The locations of the borings are presented on Figure 2-2. A discussion of drilling results and observations is presented in Section 3.0. Boring logs are presented in Appendix C.

Plume confirmation borings GW-1 and GW-2 were installed near the southwest limits of the groundwater contamination plume illustrated in the ROD (NYSDEC, 2001). Plume confirmation borings GW-3, GW-4 and GW-10 were installed near the northwest limits of the groundwater contamination plume illustrated in the ROD. Plume confirmation borings GW-5, GW-6 and GW-9 were installed near the northern limits of the groundwater contamination plume illustrated in the ROD. Plume confirmation borings GW-7 and GW-8 were installed near the northeast limits of the groundwater contamination plume illustrated in the ROD. The purpose of these borings was to establish the current limits of groundwater contamination. These borings were advanced to the first occurrence of groundwater.



- ⊕ MW5 MONITORING WELL LOCATION
- INSTALLED BY OTHERS
- ⊕ TW2 MONITORING WELL LOCATION
- TARGET OVERBURDEN
- GW1 DIRECT PUSH GROUNDWATER SAMPLE LOCATION
- TW1 BORING LOCATION — TARGET BEDROCK
- B2 BORING LOCATION — CHARACTERIZATION



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Characterization borings B-1, B-2 and B-3 were installed in the vicinity of the planned groundwater collection trench illustrated in the ROD. Characterization borings B-4, B-5 and B-6 were installed in the vicinity of the planned permeable reactive barrier wall illustrated in the ROD. The purpose of these borings was to characterize the overburden layers and hydrogeologic properties of the overburden. These borings were drilled to the top of the clay and silt unit.

Monitoring wells TW-2 and TW-3 were installed at off-site locations to characterize the overburden layers, confirm groundwater flow information and establish current chemistry. The monitoring wells were installed at target locations identified in the geophysical study (Resolution Resources, Inc., 2000). The wells were installed and screened immediately above the clay and silt unit. Table 2-2 lists the monitoring well depths and construction specifications.

One soil boring (TW-1) was installed on-site, near the east side of the Gowanda Electronics Corporation building. This location is targeted in the geophysical study report (Resolution Resources, Inc., 2000) to investigate whether non-aqueous phase liquids is present. Additionally, the purpose of this boring was to characterize the bedrock geology and groundwater chemistry. Based on the geophysical study, the estimated depth to the top of bedrock was 75 to 95 feet below ground surface. However, bedrock was not encountered after drilling to a depth of 155 feet below grade. Therefore, after drilling to a depth of 155 feet, the borehole was abandoned and a well was not installed.

All soil borings and monitoring wells were installed by Nothnagle Drilling, Inc. using a truck-mounted CME 85 drill rig, except for soil boring B-3 which was drilled using a Geoprobe 6610 DT. Drilling equipment was steam cleaned before the start of work at a temporary decontamination area located to the southeast of the Gowanda Electronics Corporation building. Downhole drilling tools were steam cleaned after the completion of each boring and monitoring well with the exception of the split spoon samplers and MacroCores™. Split spoons and MacroCores™ were washed and rinsed at the borehole between each use. Decontamination wastewater was collected in the decontamination pad and subsequently disposed of off-site (see Section 2.8).

**TABLE 2-2**  
**AVM GOWANDA SITE**  
**PRE-DESIGN INVESTIGATION**  
**SUMMARY OF WELL CONSTRUCTION DETAILS**

Well ID	Date Installed	Well Diameter (inches)	Well Material	Total Depth (feet)	Screened Formation	Screen			Elevation (feet above mean sea level)*				LOCATION*	
						Top (feet bgs)	Bottom (feet bgs)	Length (feet)	Casing Top	Ground Surface	Screen Top	Screen Bottom	Northing (feet)	Easting (feet)
MW-1	6/9/97	2	PVC	30.0	S&G	6.0	16.0	10.0	779.74	777.10	771.10	761.10	895599.66	1053568.24
MW-2	6/10/97	2	PVC	20.5	S&G	10.0	20.0	10.0	775.15	776.00	766.00	756.00	895745.31	1053571.79
MW-3	6/11/97	2	PVC	24.0	S&G	8.0	23.0	15.0	775.48	775.95	767.95	752.95	895941.95	1053601.64
MW-4	6/12/97	2	PVC	22.5	S&G	7.0	22.0	15.0	775.24	775.67	768.67	753.67	895941.49	1053508.25
MW-5	6/12/97	2	PVC	18.5	silt & S&G	8.0	18.0	10.0	774.79	775.28	767.28	757.28	895940.39	1053391.14
MW-6	6/13/97	2	PVC	24.0	silt & S&G	5.5	10.5	5.0	770.63	771.26	765.76	760.76	896286.82	1053468.76
MW-7	6/16/97	2	PVC	16.5	S&G	11.0	16.0	5.0	766.39	764.30	753.30	748.30	896563.68	1053357.42
MW-8	6/16/97	2	PVC	12.0	silt & S&G	5.5	10.5	5.0	770.05	770.29	764.79	759.79	896302.06	1053320.17
MW-9	12/8/97	2	SS	22.0	S&G	5.0	20.0	15.0	775.55	776.00	771.00	756.00	895708.32	1053608.25
MW-10	12/9/97	2	PVC	16.0	S&G	5.0	15.0	10.0	773.67	774.20	769.20	759.20	896144.15	1053401.41
MW-11	12/10/97	2	SS	16.0	S&G	4.0	14.0	10.0	775.81	776.30	772.30	762.30	895727.99	1053562.59
MW-12	12/10/97	2	SS	16.0	S&G	4.5	14.5	10.0	775.74	776.10	771.60	761.60	895735.46	1053547.48
RW-1	unkwn	6	CS	unkwn	unkwn	unkwn	unkwn	unkwn	775.23	776.10	776.10	776.10	895743.30	1053563.03
TW-2	6/2/04	2	SS	27.0	silt & S&G	17.0	27.0	10.0	774.78	775.09	758.09	748.09	895944.74	1053364.90
TW-3	6/3/04	2	SS	21.0	silt & S&G	11.0	21.0	10.0	775.44	775.74	764.74	754.74	895942.09	1053533.56

Notes: \* - Data from survey completed by Popli Consulting Engineers & Surveyors in 2004 (NAD 83/92, NAVD 88)

- unkwn - unknown
- PVC - poly vinyl chloride
- SS - stainless steel
- CS - carbon steel
- S&G - sand and gravel
- bgs - below ground surface

Monitoring wells TW-2 and TW-3 were completed using 4¼-inch inside diameter hollow stems augers and split spoon samples or MacroCores™ were generally collected continuously to the bottom of the borings. All borehole construction and monitoring well installations were logged and documented by a geologist. Boring logs, presented in Appendix C, include the depths of stratigraphic changes, descriptions of samples using the Modified Burmeister Classification System, details of drilling techniques and total ionizable vapor measurements obtained with a Photovac Model 2020 photoionization detector (PID).

Monitoring wells TW-2 and TW-3 were constructed using 10 foot long 2-inch inside diameter (ID) stainless steel wire wrapped 0.010-inch slot well screens and 2-inch ID stainless steel riser pipe. Well screens were installed at the bottom of the boreholes. Sand pack was placed in the annulus between the borehole wall and the well screen extending from the well bottom to at least 2 feet above the top of the screen and at least 2 feet of bentonite seal was placed above the sand pack. Lockable expansion caps were installed on the well riser pipes and flush-mount protective steel casings were installed in concrete surface pads. Well construction specifications are provided on Well Construction Logs presented in Appendix D.

## **2.4 Monitoring Well Development**

The two new (TW-2 and TW-3) and twelve existing monitoring wells (MW-1 through MW-12) were developed by surging and evacuating groundwater using submersible pumps and dedicated tubing. Water was not removed from the new wells until at least one day after well completion to allow the grout and concrete surface seals to cure, thereby minimizing the potential for surface water cross-contamination. Well development water was monitored for field parameters (pH, temperature, specific conductance and turbidity). Well development was continued until at least 8 well volumes of groundwater were removed or the field parameters equilibrated. Well development water was pumped from the wells and containerized for off-site disposal (see Section 2.13). Details of well development are provided on the Well Development Logs presented in Appendix E.

## **2.5 Water Level Monitoring**

Over the course of the field investigation water levels were periodically measured at the monitoring wells. Water level rounds were conducted at times of relatively stable weather conditions and within as short a period as possible in order to provide a synoptic view of groundwater conditions. In general, water level measurements were completed in less than one hour. Depth to water measurements and topographic survey data were used to calculate groundwater elevations and to prepare water table maps.

## **2.6 In Situ Hydraulic Conductivity Testing**

Hydraulic conductivity tests were performed on each of the new monitoring wells (TW-2 and TW-3) and on six of the existing monitoring wells (MW-3, MW-4, MW-7, MW-8, MW-10 and MW-11). Slug tests were conducted by lowering a 1-inch diameter aluminum bar into each well, causing a sudden rise in water level, and recording head change over time using an In-Situ, Inc. miniTroll<sup>®</sup> data logger. For each monitoring well, when groundwater returned to the pre-test level, a bail test was performed by quickly removing the aluminum bar causing a sudden drop in water level. The water level recovery was then monitored using an In-Situ, Inc. miniTroll<sup>®</sup> data logger.

Data collected from the slug (falling head) and bail (rising head) tests were analyzed using the Bouwer and Rice (1976) technique for hydraulic conductivity determination. The results of the calculations for hydraulic conductivity are summarized in Section 3.0.

## **2.7 Pump Test**

A pump test was performed at a selected well (MW-4) at the AVM Gowanda Site during the week of July 26, 2004. The purpose of the pump test at MW-4 was to determine the influence of pumping on the shallow groundwater aquifer and estimate aquifer hydraulic conductivity.

MW-4 was pumped at four successively higher pumping rates throughout the test. Water was pumped from MW-4 using a Grundfos Redi-Flo 2™ submersible pump to temporary polyethylene holding tanks and then transferred to a 20,000 gallon holding tank for subsequent disposal off-site (see Section 2.13).

The pump test at MW-4 was initiated on July 27, 2004 at 7:20 a.m. and the well was initially pumped at a rate of 1.4 gallons per minute for a period of 12 hours. After 12 hours of pumping the flow rate was increased to 1.9 gallons per minute for 12 hours. After 24 hours of pumping the flow rate was increased to 2.9 gallons per minute for 12 hours. After 36 hours of pumping the flow rate was increased to 3.8 gallons per minute for 12 hours. The pump was then shut off and groundwater recovery was monitored for 24 hours.

During the pump test and recovery test, water levels were monitored to the nearest 0.01 foot using dedicated pressure transducers (i.e., Mini-Troll® and Hermit 3000® data loggers) and a hand held water level measurement instrument (i.e., Solinst® water level indicator). The water level data was recorded using data loggers and field notebooks.

Two sets of groundwater samples were collected from MW-4 during the pump test. The samples were collected at different stages of the pump test in order to evaluate groundwater quality variations under different pumping conditions. The results of the sampling will be used to design the groundwater treatment system. The groundwater samples collected from the pump discharge were analyzed for Target Compound List (TCL) VOCs, TCL semivolatile organic compounds (SVOCs), TCL pesticides/PCBs, Target Analyte List (TAL) inorganics and cyanide.

Pump test data were evaluated to determine aquifer characteristics including aquifer continuity and transmissivity. Transmissivity of the hydrogeologic units were calculated using time drawdown analyses and curve matching. Pump test results are discussed in Section 3.2.

## 2.8 Groundwater Sampling

Five groundwater sampling events were conducted during the pre-design investigation. Fifteen samples were collected during the first sampling event in May/June 2004 from soil borings advanced during the pre-design investigation for the purpose of plume limit delineation. The second sampling round included fourteen samples collected in June 2004 from the twelve existing monitoring wells and two new monitoring wells installed during the pre-design investigation for plume characterization. The third round consisted of collection of two samples during the pump test in July 2004 to characterize groundwater for treatment system design. A fourth round included samples collected in July 2004 from seven groundwater monitoring wells for design parameters. A fifth round of samples was collected in September 2004 and included the wells that were sampled during the second round of sampling to confirm plume characterization data and identify seasonal variations, if present.

Groundwater samples were collected for chemical analysis at direct push probe locations GW-1 through GW-10 and from boreholes B-1 and B-3 through B-6, during the May/June 2004 sampling event. All of the samples were analyzed for TCL VOCs.

Samples for chemical analysis were collected from wells MW-1, MW-2, MW-3, MW-4, MW-5, MW-6, MW-7, MW-8, MW-9, MW-10, MW-11, MW-12, TW-2 and TW-3 as part of the second and fifth groundwater sampling events in June and September 2004. Each well was purged of at least three volumes of groundwater before sample collection using a new disposable polyethylene bailer. All of the samples were analyzed for TCL VOCs and the samples collected from monitoring wells MW-4, TW-2 and TW-3 were also analyzed for TCL SVOCs, TCL pesticides/PCBs, TAL inorganics and cyanide.

Groundwater samples were collected for chemical analysis from well MW-4 during the pump test (the third sampling event). The samples were collected at various times during the pump test to detect changes in groundwater chemistry during pumping. One sample was collected on July 28, 2004 after 24 hours of pumping and one sample was collected on July 29,



2004 after 48 hours of pumping. Groundwater samples were collected directly from the pump discharge tubing and analyzed for TCL VOCs, TCL SVOCs, TCL pesticides/PCBs, TAL inorganics, cyanide, cations (barium, calcium, iron, magnesium, manganese, potassium and sodium), anions (bromide, chloride, fluoride, sulfate and nitrate), dissolved organic carbon, total organic carbon, alkalinity, total dissolved solids and total suspended solids (the “design parameters”).

During the fourth sampling round, in July 2004, groundwater samples were collected for chemical analysis from monitoring wells MW-7, MW-10, MW-11, TW-2 and TW-3. Each well was purged of at least three volumes of groundwater before sample collection using a new disposable polyethylene bailer. The samples were analyzed for cations (barium, calcium, iron, magnesium, manganese, potassium and sodium), anions (bromide, chloride, fluoride, sulfate and nitrate), dissolved organic carbon, total organic carbon, alkalinity, total dissolved solids and total suspended solids (the “design parameters”).

In the case of groundwater samples collected from permanent monitoring wells during sampling events in June and September, field parameters, including pH, specific conductance, turbidity and temperature, were monitored during sampling using a Horiba U-10 instrument. Wells with groundwater exhibiting turbidity of greater than 50 NTUs were allowed to settle for several hours prior to collecting samples for total metals. Purge water was containerized and later disposed of off-site (see Section 2.12). Results are discussed in Section 4.0 and chain of custody forms and sample information records are presented in Appendix F.

## **2.9 Ambient Air Monitoring**

Air monitoring for organic vapors and particulates was conducted throughout the drilling portions of the investigation in accordance with the site-specific Health and Safety Plan. Air monitoring was conducted using a Photovac 2020<sup>®</sup> PID and MIE personalDataRam<sup>®</sup>. The exclusion zone action levels of 5 ppm for the PID or 2.5 mg/m<sup>3</sup> of particulate in the breathing zone were not exceeded during the performance of work. In addition, at no time during the

investigation were the perimeter action levels of 5 ppm for the PID or 2.5 mg/m<sup>3</sup> for the dust meter exceeded. Air monitoring data are presented in Appendix G.

## **2.10 Health and Safety Program**

A site-specific Health and Safety Plan (HASP) was prepared in accordance with the requirements of the Occupational Health and Safety Administration (OSHA) for the work conducted for this investigation. The HASP was prepared to provide site-specific health and safety information, and provide for worker and community protection. The Health and Safety Plan was dated May 17, 2004 and was reviewed by NYSDEC. Activities conducted as part of the field investigation were conducted in accordance with the HASP.

## **2.11 Quality Assurance/Quality Control Program**

A site-specific Quality Assurance/Quality Control Plan (QA/QC) dated May 2004 was developed for the site. Work performed during the field investigation was performed in accordance with procedures described in the QA/QC Plan. The QA/QC Plan was designed to maximize the quality and validity of the data collected during the field investigation. The QA/QC Plan describes detailed sampling and analytical procedures, as well as necessary QA/QC sampling and analyses for each sampling matrix investigated. Adherence to QA/QC protocols allowed for data validation and usability analyses. In accordance with the QA/QC Plan, chain of custody forms and sample information records were completed for each sample collected and are presented along with shipping records in Appendix F.

## **2.12 Investigation Derived Waste Sampling and Disposal**

Investigation derived waste generated during the pre-design investigation included soil cuttings from soil borings, water from decontamination activities and groundwater from well development, well purging and the pump test. Investigation derived waste was staged at the

Gowanda Electronics Corporation property and subsequently disposed of off-site. Disposal manifests, bills of lading, and disposal receipts are included in Appendix H.

Drill cuttings were staged on-site in 55 gallon steel drums and characterized for off-site disposal. Two soil samples (TW1DRUMS and AVM-SC) were collected during the pre-design investigation for the purpose of characterizing drill cuttings for off-site disposal. Soil sample TW1DRUMS consisted of a composite sample from drill cuttings generated during the installation of soil boring TW-1. Soil sample AVM-SC consisted of a composite sample from drill cuttings generated during the installation of soil borings TW-2 and TW-3. The soil samples were both analyzed for Toxicity Characteristic Leaching Procedure (TCLP) VOCs and TCLP metals. Soil sample TW1DRUMS was also analyzed for cyanides, reactivity, pH and ignitability. The soil was also subjected to a paint filter test to determine if it contained any free liquid. Soil sample AVM-SC was also analyzed for TCL VOCs. Results are discussed in Section 4 and chain of custody forms are presented in Appendix F. On September 7, 2004 approximately 5 tons of soil staged in 23 drums were shipped to CWM Chemical Services, LLC in Model City, New York for disposal.

Decontamination water was pumped from the decontamination pad to 55-gallon drums and subsequently transferred to a 20,000 gallon holding tank. Well development and purge water was removed from the wells, transferred to 55 gallon drums and subsequently transferred to the 20,000 gallon holding tank. Groundwater from the pump test conducted at MW-4 was pumped to temporary polyethylene holding tanks and then transferred to the 20,000 gallon holding tank. The 20,000 gallon holding tank was later evacuated with two vacuum tankers and transported for disposal off-site. On September 7, 2004, 7,193 gallons of water (including decontamination water, well development water, purge water and pump test water) was shipped to E.I. DuPont de Nemours, Company, Inc. in Deepwater, New Jersey for disposal.

## 2.13 Data Validation

Air and soil vapor analytical work was performed by Centek Laboratories, LLC, which is certified under the New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP) for analytical testing of air samples. Soil and groundwater analytical work was performed by Mitkem Corporation Inc., a NYSDOH ELAP laboratory certified in all categories of Contract Laboratory Protocol (CLP) and Solid and Hazardous Waste analytical testing. A Data Usability Summary Report was prepared and is included in Section 4.4. Category B deliverables were provided by the laboratories and have been retained in the project files. The deliverables are available for full data validation by a qualified independent third party, if required.

### **3.0 PHYSICAL CHARACTERISTICS OF STUDY AREA**

#### **3.1 Site Geology**

Unconsolidated deposits at the site have been mapped as recent deposits (Cadwell, et. al., 1988). Recent deposits consist of fine-grained sands to gravels and may be overlain by silt in larger valleys. These deposits are associated with floodplains within valleys and are subject to frequent flooding. The deposits are generally oxidized and non-calcareous and the thickness is variable (3 to 30 feet).

The description of site geology is based on observations made during advancement of 19 soil borings throughout this investigation, which ranged from 8 to 155 feet in depth. An uppermost unit consisting of medium to dark yellowish brown silts and fine- to coarse-grained sands was observed from grade (or near grade at paved areas) to depths of 4 to 9 feet below grade. This unit was underlain by a medium brown fine- to coarse-grained sand and gravel unit, which was present to depths of 11 to 17 feet below grade. The sand and gravel unit was underlain by brownish gray to olive gray fine-grained sands and silts, which extended to depths of 16 to 31 feet below grade. The lowermost unit consisted of a brownish gray to olive gray clay and silt unit, which was observed to a depth of 155 feet at the deepest boring advanced at the site (TW-1). A geologic cross-section, taken through the study area in the north-south direction (Figure 3-1), which depicts the observations recorded during the pre-design investigation, is presented in Figure 3-2.

Generally, the geology observed at the site and in the vicinity of the site during this investigation was consistent with the descriptions presented in the RI report (NYSDEC, 1998). However, findings during this investigation did not support the interpretations presented in the geophysical study (Resolution Resources, Inc., 2000). Specifically, the geophysical report indicated that bedrock was 75 to 95 feet below ground surface near the east side of the Gowanda Electronics Corporation building and boring TW-1 was advanced to 155 feet below grade without encountering bedrock. The site geology presented in the RI report describes three



geologic units consisting of uppermost flood plain deposits, which overlies an alluvial sand and gravel overlying a clay and silt unit. The RI identifies the lowermost unit of clay and silt as a glacial lodgement till, however, observations during this investigation (such as varves) suggest that the clay and silt are of lacustrine origin and somewhat less dense than anticipated. In addition, a fourth unit appears to be present between the alluvial sand and gravel unit and the clay and silt unit, which consists of fine-grained sands and silts.

Bedrock geology in the vicinity of the site has been mapped as the Machias formation of the Canadaway Group (Fisher and Rickard, 1970). The Machias formation is Upper Devonian in age, and is composed of shale and siltstone of the Rushford Sandstone; Caneadea, Canisteo, and Hume Shales; Canaseraga sandstone; South Wales and Dunkirk Shales. The deepest boring advanced during this investigation was terminated at a depth of 155 feet below grade. Bedrock was not encountered during this investigation or previous investigations at the site.

### **3.2 Site Hydrogeology**

Groundwater flow characteristics at the AVM Gowanda Site were assessed using several techniques. These included observations of soil characteristics during drilling, installation of groundwater monitoring wells, sieve analyses, hydraulic conductivity tests (slug tests), pump test, groundwater sampling and measurement of water level depths to determine groundwater elevations.

Water levels were measured in the groundwater monitoring wells on eight occasions during the investigation. Water level measurements were used with topographic survey data to calculate groundwater elevations. These data were then used to prepare groundwater table surface elevation maps. Groundwater elevation data is presented in Table 3-1 and groundwater table surface elevation maps are presented in Appendix I.

**TABLE 3-1  
AVM GOWANDA SITE  
PRE-DESIGN INVESTIGATION  
WATER LEVEL MEASUREMENT SUMMARY**

WELL	GROUND SURFACE ELEVATION (ft MSL)	REFERENCE ELEVATION (ft MSL)	TOP OF SCREEN (ft BGS)	SCREEN BOTTOM (ft BGS)	DATE											
					1/23/98		4/7/04		5/24/04		5/26/04		6/2/04			
					DTW	ELEV	DTW	ELEV	DTW	ELEV	DTW	ELEV	DTW	ELEV		
MW-1	777.1	779.74	6.0	16.0	5.90	773.84	4.67	775.07	3.72	776.02	4.42	775.32	5.44	774.30		
MW-2	776.0	775.15	10.0	20.0	10.75	764.40	4.68	770.47	3.43	771.72	3.41	771.74	3.97	771.18		
MW-3	776.0	775.48	8.0	23.0	7.73	767.75	5.28	770.20	4.38	771.10	4.88	770.60	5.29	770.19		
MW-4	775.7	775.24	7.0	22.0	7.65	767.59	5.01	770.23	4.22	771.02	4.57	770.67	5.01	770.23		
MW-5	775.3	774.79	8.0	18.0	9.00	765.79	7.49	767.30	7.08	767.71	6.96	767.83	7.87	766.92		
MW-6	771.3	770.63	5.5	10.5	6.38	764.25	5.27	765.36	4.83	765.80	5.01	765.62	5.56	765.07		
MW-7	764.3	766.39	11.0	16.0	10.04	756.35	10.00	756.39	9.24	757.15	9.44	756.95	10.64	755.75		
MW-8	770.3	770.05	5.5	10.5	NM	NM	5.28	764.77	4.96	765.09	5.10	764.95	5.34	764.71		
MW-9	776.0	775.55	5.0	20.0	9.35	766.20	4.57	770.98	3.17	772.38	3.58	771.97	4.18	771.37		
MW-10	774.2	773.67	5.0	15.0	8.39	765.28	7.10	766.57	6.35	767.32	6.51	767.16	7.47	766.20		
MW-11	776.3	775.81	4.0	14.0	10.50	765.31	5.09	770.72	3.82	771.99	4.03	771.78	4.59	771.22		
MW-12	776.1	775.74	4.5	14.5	10.27	765.47	4.62	771.12	3.14	772.60	3.78	771.96	NM	NM		
RW-1	776.1	775.23	NM	NM	10.66	764.57	5.22	770.01	3.79	771.44	3.42	771.81	3.97	771.26		
TW-2	775.1	774.78	17.0	27.0	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI		
TW-3	775.7	775.44	11.0	21.0	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI		
TB-dam	NM	778.35	NA	NA	NM	NM	0.89	777.46	0.66	777.69	0.95	777.40	1.08	777.27		
TB-cmr	NM	777.93	NA	NA	NM	NM	11.99	765.94	11.87	766.06	12.35	765.58	12.52	765.41		

ft MSL - feet above mean sea level (NAVD 88).

ft BGS - feet below ground.

DTW - depth to water in feet relative to reference elevation.

ELEV - groundwater elevation in feet above mean sea level.

NI - Not installed.

NM - Not measured.

TB-dam - Thatcher Brook at dam.

TB-cmr - Thatcher Brook at corner of Industrial Street and Torrance Place.



**TABLE 3-1 (CONTINUED)**  
**AVM GOWANDA SITE**  
**PRE-DESIGN INVESTIGATION**  
**WATER LEVEL MEASUREMENT SUMMARY**

WELL	GROUND SURFACE ELEVATION (ft MSL)	REFERENCE ELEVATION (ft MSL)	TOP OF SCREEN (ft BGS)	SCREEN BOTTOM (ft BGS)	DATE							
					6/14/04		7/26/04		7/30/04		9/7/04	
					DTW	ELEV	DTW	ELEV	DTW	ELEV	DTW	ELEV
MW-1	777.1	779.74	6.0	16.0	6.98	772.76	6.30	773.44	6.48	773.26	7.34	772.40
MW-2	776.0	775.15	10.0	20.0	6.12	769.03	4.55	770.60	4.55	770.60	7.10	768.05
MW-3	776.0	775.48	8.0	23.0	6.22	769.26	5.81	769.67	5.75	769.73	6.93	768.55
MW-4	775.7	775.24	7.0	22.0	6.08	769.16	5.51	769.73	5.55	769.69	6.93	768.31
MW-5	775.3	774.79	8.0	18.0	8.84	765.95	8.79	766.00	8.85	765.94	9.33	765.46
MW-6	771.3	770.63	5.5	10.5	6.08	764.55	6.05	764.58	6.11	764.52	6.38	764.25
MW-7	764.3	766.39	11.0	16.0	11.96	754.43	12.00	754.39	12.17	754.22	12.62	753.77
MW-8	770.3	770.05	5.5	10.5	5.61	764.44	6.58	763.47	5.63	764.42	5.78	764.27
MW-9	776.0	775.55	5.0	20.0	6.18	769.37	4.88	770.67	4.85	770.70	7.18	768.37
MW-10	774.2	773.67	5.0	15.0	8.36	765.31	8.27	765.40	8.38	765.29	8.76	764.91
MW-11	776.3	775.81	4.0	14.0	6.57	769.24	5.20	770.61	5.16	770.65	7.53	768.28
MW-12	776.1	775.74	4.5	14.5	6.28	769.46	5.11	770.63	5.09	770.65	7.36	768.38
RW-1	776.1	775.23	NM	NM	6.61	768.62	NM	NM	4.54	770.69	7.69	767.54
TW-2	775.1	774.78	17.0	27.0	9.04	765.74	9.13	765.65	9.15	765.63	9.32	765.46
TW-3	775.7	775.44	11.0	21.0	6.25	769.19	5.64	769.80	5.69	769.75	7.09	768.35
TB-dam	NM	778.35	NA	NA	1.03	777.32	1.00	777.35	1.07	777.28	1.06	777.29
TB-crmr	NM	777.93	NA	NA	12.64	765.29	12.55	765.38	12.70	765.23	12.80	765.13

ft MSL - feet above mean sea level (NAVD 88).

ft BGS - feet below ground.

DTW - depth to water in feet relative to reference elevation.

ELEV - groundwater elevation in feet above mean sea level.

NI - Not installed.

NM - Not measured.

TB-dam - Thatcher Brook at dam.

TB-crmr - Thatcher Brook at corner of Industrial Street and Torrance Place.

The first occurrence of groundwater or saturated conditions is in the overburden layer above bedrock. Water level monitoring of the wells indicates that the depth of groundwater in the overburden wells averages 6.9 feet below ground surface, with a range of 3.1 feet below ground surface to 12.6 feet below ground surface. Precipitation falling in the vicinity of the site runs to the municipal storm water system and streams or infiltrates downward through the unconsolidated materials. Shallow groundwater in the vicinity of the site flows in a north-northwest direction.

Sieve analyses were conducted on eight soil samples collected from borings advanced during the investigation. Four samples were collected from the clay and silt unit at the site (B-1, 24 to 28 feet; B-3, 29 to 36 feet; B-4, 20 to 24 feet and B-5, 20 to 24 feet). Two samples were collected from the fine-grained sand and silt unit (B-3, 17 to 22 feet and B-4, 12 to 20 feet) and two samples were collected from the sand and gravel unit (B-2, 8 to 16 feet and B-5, 12 to 16 feet). Results of the sieve analyses are consistent with the field descriptions and indicate that the site soils are heterogeneous. Sieve analysis data is presented in Appendix J.

Hydraulic conductivity tests were performed on monitoring wells MW-3, MW-4, MW-7, MW-8, MW-10, MW-11, TW-2 and TW-3. Slug tests consisted of falling head and rising head tests which were analyzed using the Bouwer and Rice (1976) technique. The data and results of the calculations for hydraulic conductivity are presented in Appendix K. The average of overburden well hydraulic conductivity values is  $3.37 \times 10^{-3}$  centimeters per second (cm/s). The range of values is  $2.86 \times 10^{-4}$  to  $7.12 \times 10^{-2}$  cm/s.

A groundwater pump test was performed at monitoring well MW-4. Water level measurements were obtained from nearby wells throughout the pump test using data loggers. The existing groundwater recovery system (RW-1) located at the Gowanda Electronics Corporation property was shut down prior to initiating the pump test at MW-4. Raw data collected during the pump test is presented in Appendix L.

The pump test at MW-4 was initiated on July 27, 2004 at 7:20 a.m. and the well was initially pumped at a rate of 1.4 gallons per minute (gpm) for a period of 12 hours. After 12 hours of pumping, the flow rate was increased to 1.9 gpm, for 12 hours. After 24 hours of pumping, the flow rate was increased to 2.9 gpm, for 12 hours. After 36 hours of pumping, the flow rate was increased to 3.8 gpm, for 12 hours. The pump was then shut off and groundwater recovery was monitored for 24 hours. Water levels were monitored in select monitoring wells for the duration of the test. The pump was shut off on July 29, 2004 at 7:20 a.m., and water in the pumping well (MW-4) recovered within a half foot of the pre-test level in 45 minutes.

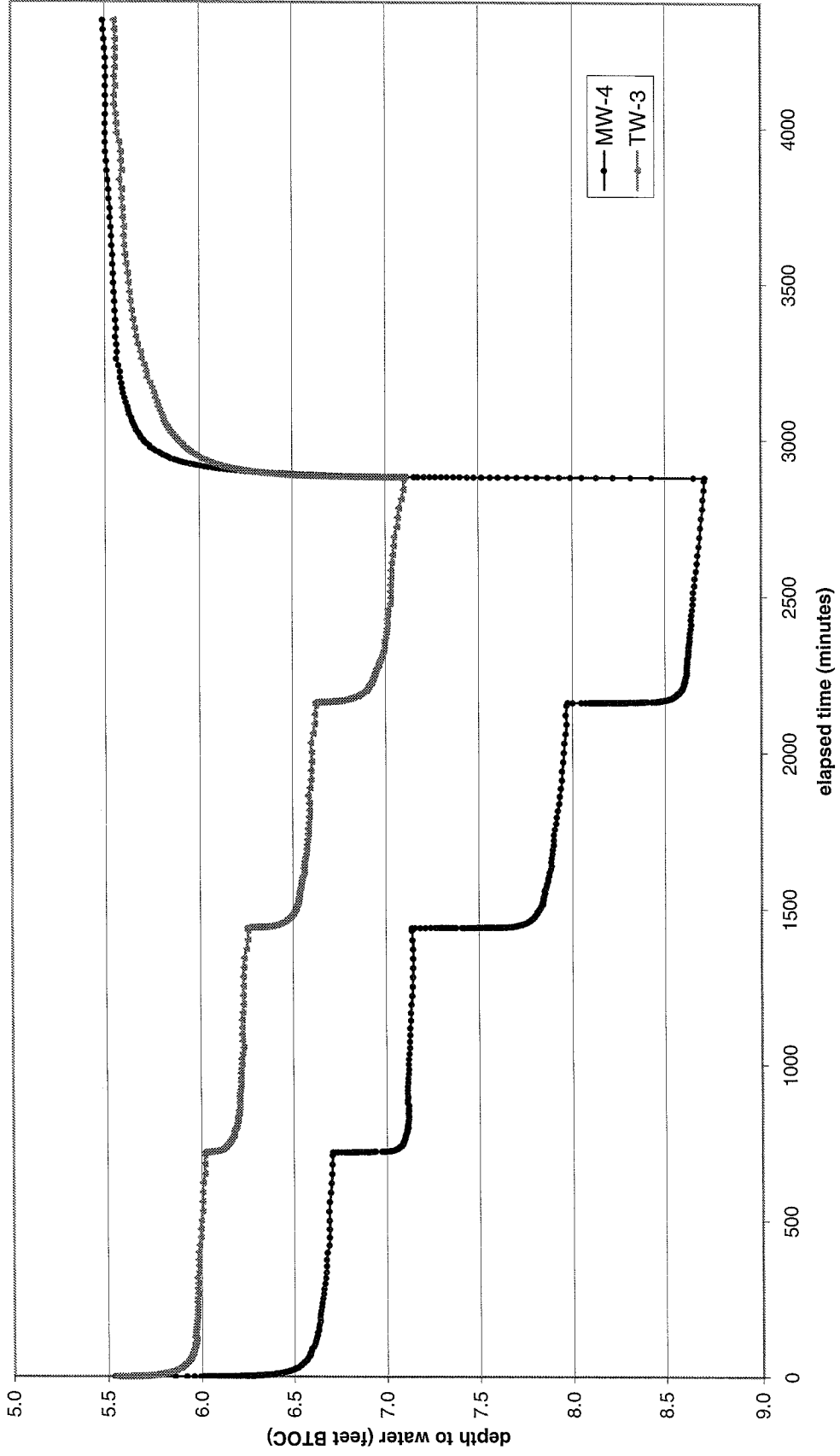
As indicated in Table 3-2, the maximum drawdown observed in MW-4 during the pump test was 3.28 feet, which occurred 48 hours into the test at an extraction rate of 3.8 gpm. During the pump test, water levels in several of the nearby monitoring wells responded to changes in the pumping well. Responses to pumping at MW-4 were observed at wells MW-3, MW-5, TW-2 and TW-3 with maximum drawdowns of 0.60 feet, 0.08 feet, 0.06 feet and 1.56 feet, respectively, as shown in Table 3-2. Figure 3-3 shows water table level elevations measured in the pumping well and observation well TW-3 during the pump test. Each of the wells had nearly recovered to its pre-test water level within one hour of the end of pumping.

Monitoring of well MW-10, located approximately 229 feet from MW-4, indicated no observable influence from pumping at well MW-4 for 48 hours. Water level fluctuations in this well were less than 0.05 feet and could not be discerned from typical fluctuations due to precipitation, barometric pressure variations or typical diurnal variations. The maximum drawdown observed at TW-2, located 144 feet from MW-4, was 0.06 feet, which occurred 48 hours into the test at an extraction rate of 3.8 gpm. The relationship between distance and drawdown measured in the observation wells during each step of the pump test is shown in Figure 3-4.

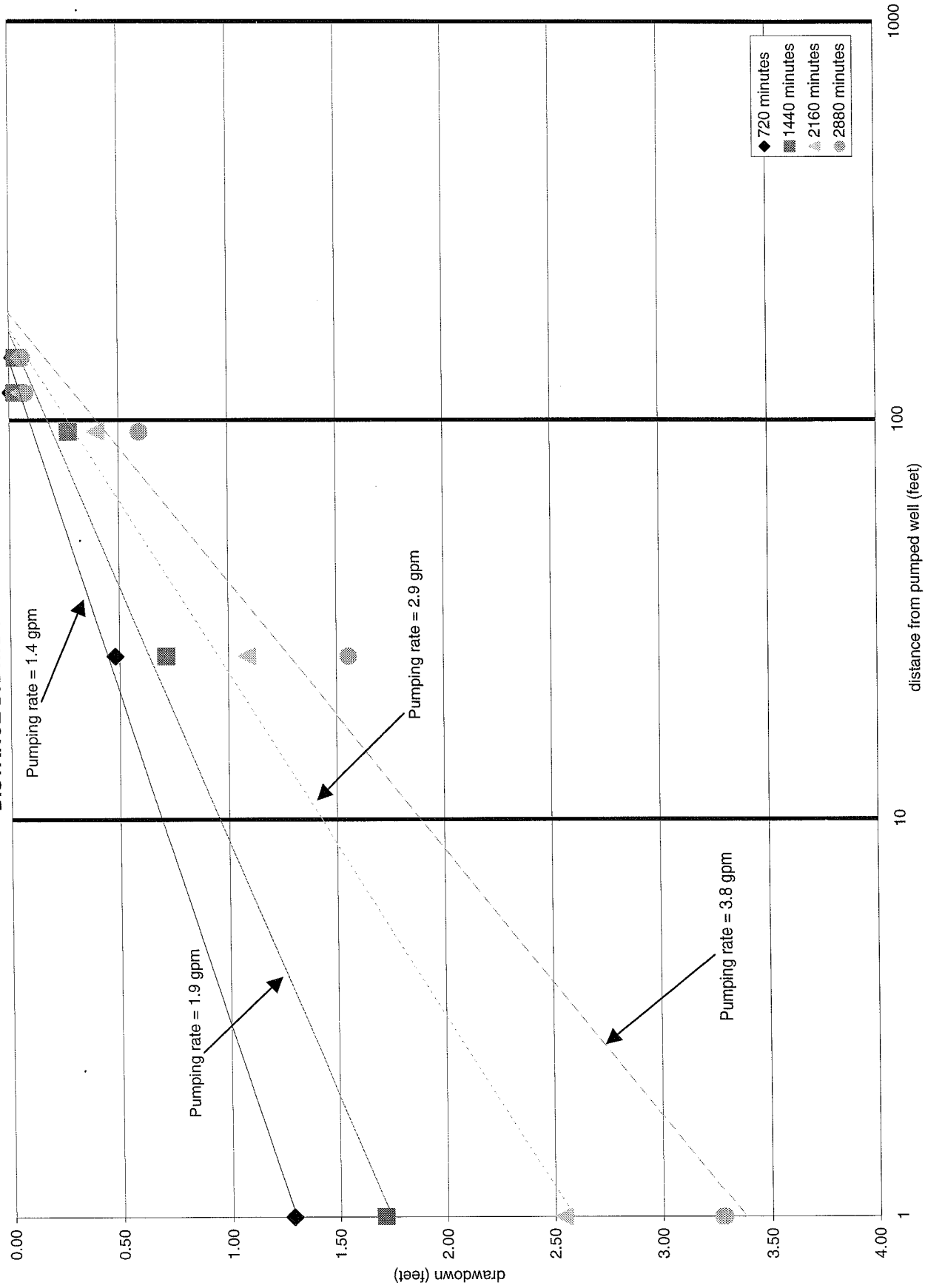
**TABLE 3-2  
AVM GOWANDA  
PRE-DESIGN INVESTIGATION  
PUMP TEST RESULTS SUMMARY**

Pumping Test Step No.	Withdrawal Rate (gpm)	Observation Well ID	Distance from MW-4 (feet)	Maximum Drawdown (feet)
1	1.4	MW-4	---	1.28
		TW-3	26	0.48
		MW-3	94	0.15
		MW-5	117	0.01
		TW-2	144	0.02
		MW-10	229	0.00
2	1.9	MW-4	---	1.72
		TW-3	26	0.71
		MW-3	94	0.27
		MW-5	117	0.03
		TW-2	144	0.03
		MW-10	229	0.00
3	2.9	MW-4	---	2.54
		TW-3	26	1.09
		MW-3	94	0.40
		MW-5	117	0.05
		TW-2	144	0.05
		MW-10	229	0.00
4	3.8	MW-4	---	3.28
		TW-3	26	1.56
		MW-3	94	0.60
		MW-5	117	0.07
		TW-2	144	0.06
		MW-10	229	0.02

**FIGURE 3-3  
AVM GOWANDA SITE  
PRE-DESIGN INVESTIGATION  
PUMP TEST WATER LEVELS**



**FIGURE 3-4  
AVM GOWANDA SITE  
PRE-DESIGN INVESTIGATION  
DISTANCE DRAWDOWN RESULTS**



Pump test data was analyzed using the Theis (1935) solution for unconfined aquifers. The data and results of the calculations for the pump test are presented in Appendix K. The transmissivity calculated for the site based on the pump test at MW-4 is  $3.72 \text{ cm}^2/\text{s}$  and the storativity is 0.001. Based on an aquifer thickness of 16.6 feet, this would equate to a hydraulic conductivity of  $7.37 \times 10^{-3} \text{ cm/s}$ .

## **4.0 RESULTS OF ENVIRONMENTAL SAMPLING**

The purpose of this section is to discuss the results of the environmental sampling conducted during the pre-design investigation at the AVM Gowanda Site. The results are compared to standards, criteria and guidance (SCGs) selected for the site to determine potential impacts on human health and the environment. The nature and extent of contamination found at, and in the vicinity of the site during the investigation is described below.

The results of the environmental sampling performed at the AVM Gowanda Site are presented below for each environmental media. The discussion for each environmental media is organized by analyte group. The results of analyses for VOCs are discussed first, followed by SVOCs, pesticides, PCBs, metals and cyanide. Tabulated results are presented in Appendix M.

### **4.1 Indoor Air and Sub-Slab Soil Vapor**

During Work Plan development, The New York State Department of Health (NYSDOH) requested that sampling and analysis of indoor air in houses adjacent to the AVM Gowanda Site be incorporated into the investigation. Accordingly, two rounds of indoor air and sub-slab soil vapor samples were collected during the pre-design investigation. The first round was conducted in April 2004 and consisted of 23 samples including 12 indoor air samples (basement/first floor living space) collected from 12 houses, 8 sub-slab soil vapor samples collected from beneath 8 houses and 3 ambient air samples collected outside. The second round was conducted during September 2004 and consisted of 31 samples including 14 indoor air samples (basement/first floor living space) collected from 14 houses, 9 sub-slab soil vapor samples collected from beneath 9 houses and 8 ambient air samples collected outside. Each round of samples was analyzed for chlorinated VOCs, BTEX and MTBE. The results of the indoor air and sub-slab soil vapor analyses are presented in Tables 1a and 2a in Appendix M, and discussed below.



#### 4.1.1 April 2004 Samples

VOCs detected in at least one of the 12 indoor air samples collected during the April 2004 sampling event included benzene, 1,1-dichloroethane, cis-1,2-dichloroethene, ethylbenzene, MTBE, toluene, 1,1,1-trichloroethane, trichloroethene, m-xylene, o-xylene and p-xylene. Benzene was detected in 10 samples at concentrations ranging from 0.210 parts per billion volume (ppbv) (A4) to 1.57 ppbv (A23). 1,1-Dichloroethane was detected in 1 sample at a concentration of 0.270 ppbv (A12). Cis-1,2-dichloroethene was detected in 7 samples at concentrations ranging from 0.210 ppbv (A2) to 2.80 ppbv (A14). Ethylbenzene was detected in 4 samples at concentrations ranging from 0.200 ppbv (A7) to 0.580 ppbv (A14). MTBE was detected in 1 sample at a concentration of 0.250 ppbv (A17). Toluene was detected in 12 samples at concentrations ranging from 0.210 ppbv (A15) to 7.20 ppbv (A14). 1,1,1-Trichloroethane was detected in 5 samples at concentrations ranging from 0.250 ppbv (A4) to 15.8 ppbv (A14). Trichloroethene was detected in 9 samples at concentrations ranging from 0.370 ppbv (A15) to 27.2 ppbv (A21). m-Xylene was detected in 11 samples at concentrations ranging from 0.230 ppbv (A17) to 1.45 ppbv (A14). p-Xylene was detected in 2 samples at concentrations of 0.220 ppbv (A19) and 0.430 ppbv (A14). o-Xylene was detected in 8 samples at concentrations ranging from 0.200 ppbv (A9) to 0.590 ppbv (A14). VOCs that were not detected in any of the 12 indoor air samples included 1,2-dichloroethane, 1,1-dichloroethene, trans-1,2-dichloroethene, 1,1,2,2-tetrachloroethane, tetrachloroethene, 1,1,2-trichloroethane and vinyl chloride.

VOCs detected in at least one of the 8 sub-slab soil vapor samples collected during the April 2004 sampling event included benzene, 1,1-dichloroethane, 1,1-dichloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, ethylbenzene, MTBE, tetrachloroethene, toluene, 1,1,1-trichloroethane, 1,1,2-trichloroethane, trichloroethene, m-xylene, o-xylene and p-xylene. Benzene was detected in 8 samples at concentrations ranging from 1.79 ppbv (A1) to 414 ppbv (A18). 1,1-dichloroethane was detected in 5 samples at concentrations ranging from 0.570 ppbv (A3) to 88.4 ppbv (A22). 1,1-dichloroethene was detected in 3 samples at concentrations ranging from 1.82 ppbv (A13) to 23.3 ppbv (A22). Cis-1,2-dichloroethene was detected in 6 samples at

concentrations ranging from 0.450 ppbv (A3) to 420 ppbv (A13). Trans-1,2-dichloroethene was detected in 5 samples at concentrations ranging from 1.47 ppbv (A1) to 10.2 ppbv (A13). Ethylbenzene was detected in 8 samples at concentrations ranging from 0.330 ppbv (A1) to 11.9 ppbv (A18). MTBE was detected in 2 samples at concentrations of 0.290 ppbv (A1) and 0.810 ppbv (A3). Tetrachloroethene was detected in 3 samples at concentrations ranging from 0.450 ppbv (A3) to 0.800 ppbv (A22). Toluene was detected in 8 samples at concentrations ranging from 2.07 ppbv (A18) to 56.2 ppbv (A6). 1,1,1-Trichloroethane was detected in 7 samples at concentrations ranging from 0.710 ppbv (A1) to 273 ppbv (A11). 1,1,2-trichloroethane was detected in 2 samples at concentrations of 0.620 ppbv (A22) and 0.750 ppbv (A11). Trichloroethene was detected in 7 samples at concentrations ranging from 1.19 ppbv (A16) to 3140 ppbv (A13). m-Xylene was detected in 8 samples at concentrations ranging from 0.700 ppbv (A1) to 17.8 ppbv (A6). o-Xylene was detected in 8 samples at concentrations ranging from 0.680 ppbv (A11) to 7.00 ppbv (A6). p-Xylene was detected in 8 samples at concentrations ranging from 0.270 ppbv (A1) to 4.40 ppbv (A6). VOCs that were not detected in any of the 8 sub-slab soil vapor samples included 1,2-dichloroethane, 1,1,2,2-tetrachloroethane and vinyl chloride.

VOCs detected in at least one of the 3 ambient air samples collected during the April 2004 sampling event included benzene, cis-1,2-dichloroethene, MTBE, toluene, trichloroethene and o-xylene. Benzene was detected in 2 samples at concentrations of 0.270 ppbv (A10) and 0.300 ppbv (A20). Cis-1,2-dichloroethene was detected in 1 sample at a concentration of 0.520 ppbv (A5). MTBE was detected in 1 sample at a concentration of 0.270 ppbv (A10). Toluene was detected in 3 samples at concentrations ranging from 0.220 ppbv (A5) to 0.950 ppbv (A10). Trichloroethene was detected in 2 samples at concentrations of 0.510 ppbv (A20) and 3.01 ppbv (A5). o-Xylene was detected in 1 sample at a concentration of 0.530 ppbv (A10). VOCs that were not detected in any of the 3 ambient air samples included 1,1-dichloroethane, 1,2-dichloroethane, 1,1-dichloroethene, trans-1,2-dichloroethene, ethylbenzene, 1,1,2,2-tetrachloroethane, tetrachloroethene, 1,1,1-trichloroethane, 1,1,2-trichloroethane, vinyl chloride, m-xylene and p-xylene.

#### 4.1.2 September 2004 Samples

VOCs detected in at least one of the 14 indoor air samples collected during the September 2004 sampling event included benzene, 1,2-dichloroethane, cis-1,2-dichloroethene, ethylbenzene, MTBE, tetrachloroethene, toluene, 1,1,1-trichloroethane, trichloroethene, m-xylene, o-xylene and p-xylene. Benzene was detected in 12 samples at concentrations ranging from 0.280 parts per billion volume (ppbv) (A46) to 12.0 ppbv (A30). 1,2-dichloroethane was detected in 1 sample at a concentration of 0.210 ppbv (A25). Cis-1,2-dichloroethene was detected in 6 samples at concentrations ranging from 0.270 ppbv (A25) to 2.65 ppbv (A42). Ethylbenzene was detected in 11 samples at concentrations ranging from 0.220 ppbv (A46) to 8.50 ppbv (A30). MTBE was detected in 1 sample at a concentration of 1.11 ppbv (A25). Tetrachloroethene was detected in 2 samples at concentrations of 0.200 ppbv (A30) and 0.260 ppbv (A54). Toluene was detected in 14 samples at concentrations ranging from 0.490 ppbv (A37) to 53.2 ppbv (A30). 1,1,1-Trichloroethane was detected in 2 samples at concentrations of 0.260 ppbv (A30) and 0.710 ppbv (A28). Trichloroethene was detected in 9 samples at concentrations ranging from 0.240 ppbv (A32) to 4.70 ppbv (A42). m-Xylene was detected in 14 samples at concentrations ranging from 0.230 ppbv (A37) to 23.8 ppbv (A30). o-Xylene was detected in 13 samples at concentrations ranging from 0.200 ppbv (A28) to 11.0 ppbv (A30). p-Xylene was detected in 9 samples at concentrations ranging from 0.230 ppbv (A25) to 11.0 ppbv (A30). VOCs that were not detected in any of the 14 indoor air samples included 1,1-dichloroethane, 1,1-dichloroethene, trans-1,2-dichloroethene, 1,1,2,2-tetrachloroethane, 1,1,2-trichloroethane and vinyl chloride.

VOCs detected in at least one of the 9 sub-slab soil vapor samples collected during the September 2004 sampling event included benzene, 1,1-dichloroethane, 1,1-dichloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, ethylbenzene, tetrachloroethene, toluene, 1,1,1-trichloroethane, 1,1,2-trichloroethane, trichloroethene, m-xylene, p-xylene and o-xylene. Benzene was detected in 9 samples at concentrations ranging from 1.87 ppbv (A53) to 28 ppbv (A45). 1,1-dichloroethane was detected in 6 samples at concentrations ranging from 0.480 ppbv (A38) to 120 ppbv (A45). 1,1-dichloroethene was detected in 1 sample at a concentration of 24.0 ppbv (A45). Cis-1,2-dichloroethene was detected in 6 samples at concentrations ranging from

0.470 ppbv (A38) to 740 ppbv (A45). Trans-1,2-dichloroethene was detected in 3 samples at concentrations ranging from 6.90 ppbv (A31) to 36.3 ppbv (A53). Ethylbenzene was detected in 9 samples at concentrations ranging from 0.770 ppbv (A24) to 13.1 ppbv (A45). Tetrachloroethene was detected in 8 samples at concentrations ranging from 0.240 ppbv (A27) to 2.90 ppbv (A38). Toluene was detected in 9 samples at concentrations ranging from 4.50 ppbv (A53) to 41 ppbv (A45). 1,1,1-Trichloroethane was detected in 9 samples at concentrations ranging from 0.230 ppbv (A27) to 68 ppbv (A45). 1,1,2-trichloroethane was detected in 2 samples at concentrations of 0.210 ppbv (A43) and 0.960 ppbv (A45). Trichloroethene was detected in 9 samples at concentrations ranging from 9.70 ppbv (A43) to 3200 ppbv (A45). m-Xylene was detected in 9 samples at concentrations ranging from 2.07 ppbv (A24) to 32.6 ppbv (A27). o-Xylene was detected in 9 samples at concentrations ranging from 1.12 ppbv (A24) to 20.1 ppbv (A45). p-Xylene was detected in 8 samples at concentrations ranging from 0.800 ppbv (A24) to 15.1 ppbv (A45). VOCs that were not detected in any of the 9 sub-slab soil vapor samples included 1,2-dichloroethane, MTBE, 1,1,2,2-tetrachloroethane and vinyl chloride.

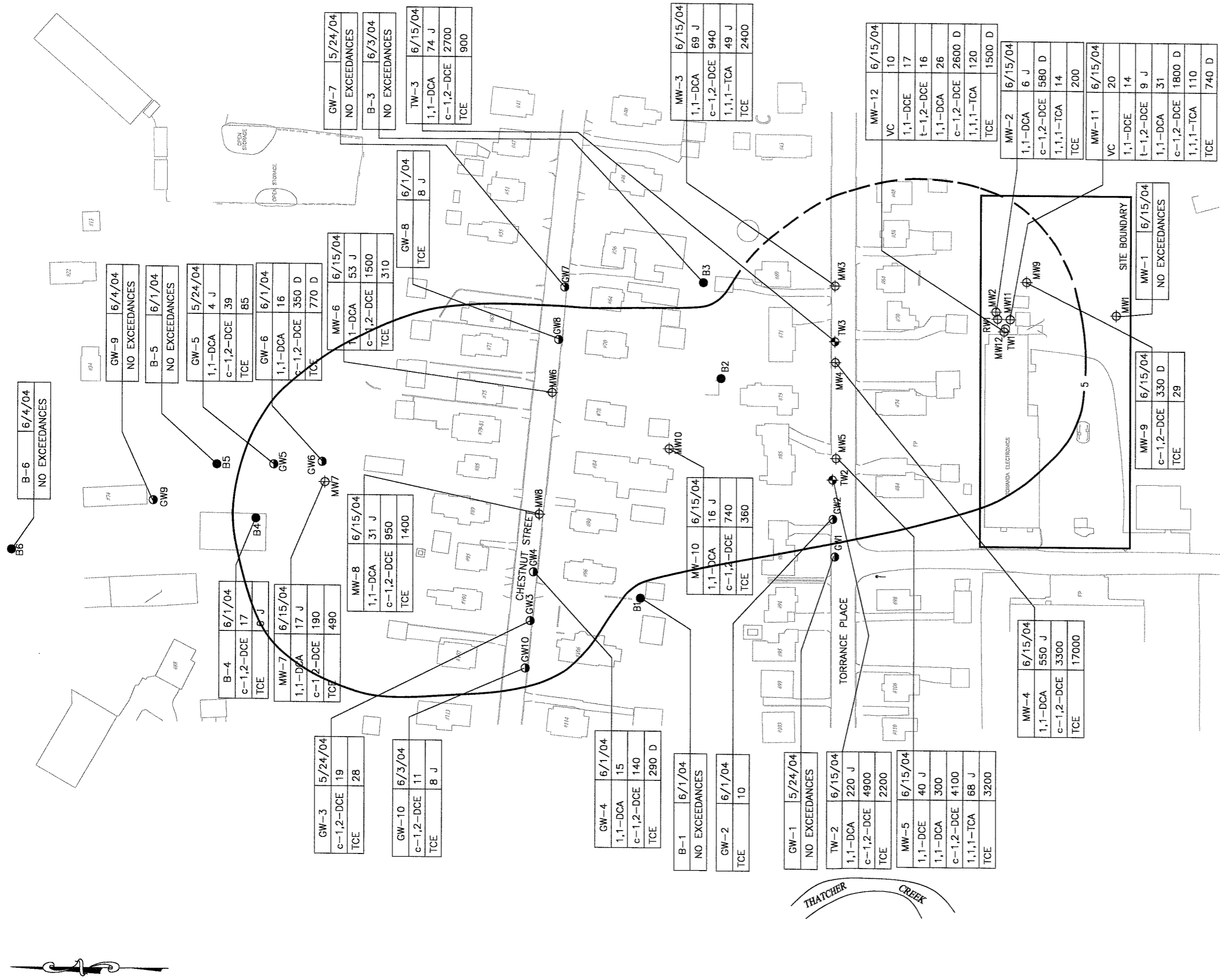
VOCs detected in at least one of the 8 ambient air samples collected during the September 2004 sampling event included benzene, ethylbenzene, toluene, trichloroethene, m-xylene, o-xylene and p-xylene. Benzene was detected in 8 samples at concentrations ranging from 0.200 ppbv (A49) to 0.390 ppbv (A47). Ethylbenzene was detected in 3 samples at concentrations ranging from 0.200 ppbv (A48) to 0.340 ppbv (A47). Toluene was detected in 8 samples at concentrations ranging from 0.460 ppbv (A50) to 3.48 ppbv (A33). Trichloroethene was detected in 3 samples at concentrations ranging from 0.630 ppbv (A50) to 3.84 ppbv (A35). m-Xylene was detected in 8 samples at concentrations ranging from 0.200 ppbv (A50) to 1.50 ppbv (A47). o-Xylene was detected in 7 samples at concentrations ranging from 0.200 ppbv (A34) to 1.16 ppbv (A47). p-Xylene was detected in 3 samples at concentrations ranging from 0.220 ppbv (A49) to 0.660 ppbv (A47). VOCs that were not detected in any of the 8 ambient air samples included 1,1-dichloroethane, 1,2-dichloroethane, 1,1-dichloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, MTBE, 1,1,2,2-tetrachloroethane, tetrachloroethene, 1,1,1-trichloroethane, 1,1,2-trichloroethane, and vinyl chloride.

## 4.2 Groundwater

Five rounds of groundwater samples were collected during the pre-design investigation. The first round of groundwater samples were collected in May and June 2004 from direct push soil borings. The second round of groundwater samples were collected from all 16 monitoring wells in June 2004. The third round of groundwater samples were collected from monitoring well MW-4 during the pump test performed at that well in July 2004. The fourth round of groundwater samples were also collected in July 2004 from seven wells and analyzed for the design parameters. The fifth round of groundwater samples were collected in September 2004 from the 16 monitoring wells sampled during the second round of groundwater sampling.

Each round of groundwater samples, except the fourth, was analyzed for TCL VOCs. Three of the second round (MW-4, TW-2 and TW-3) and two of the fifth round samples (MW-4 and TW-3) as well as both of the third round samples were also analyzed for TCL SVOCs, TCL pesticides/PCBs, TAL inorganics and cyanide. The fourth round of samples was analyzed for cations, anions, dissolved organic carbon, total organic carbon, alkalinity, total dissolved solids and total suspended solids (the “design parameters”).

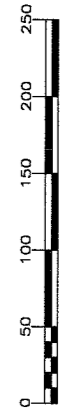
Tabulated results of the analyses of the groundwater samples are presented in Appendix M. The first round sample results are presented in Table 3a. The second round sample results are presented in Tables 4a, 4b, 4c and 4d. The third round sample results are presented in Tables 5a, 5b, 5c and 5d. The fourth round sample results are presented in Table 6a. The fifth round sample results are presented in Tables 7a, 7b, 7c and 7d. The results of the analyses of the groundwater samples have been compared to the Class GA groundwater standards and guidance values in NYSDEC TOGS 1.1.1, “Ambient Water Quality Standards and Guidance Values”. Figure 4-1 illustrates exceedances of SCGs in groundwater for VOCs and Figure 4-2 illustrates isopleth contours for TCE in groundwater.



ABBREV.	COMPOUND	STANDARD
VC	VINYL CHLORIDE	2
1,1-DCE	1,1-DICHLOROETHENE	5
t-1,2-DCE	trans-1,2-DICHLOROETHENE	5
1,1-DCA	1,1-DICHLOROETHANE	5
c-1,2-DCE	cis-1,2-DICHLOROETHENE	5
1,1,1-TCA	1,1,1-TRICHLOROETHANE	5
TCE	TRICHLOROETHENE	5

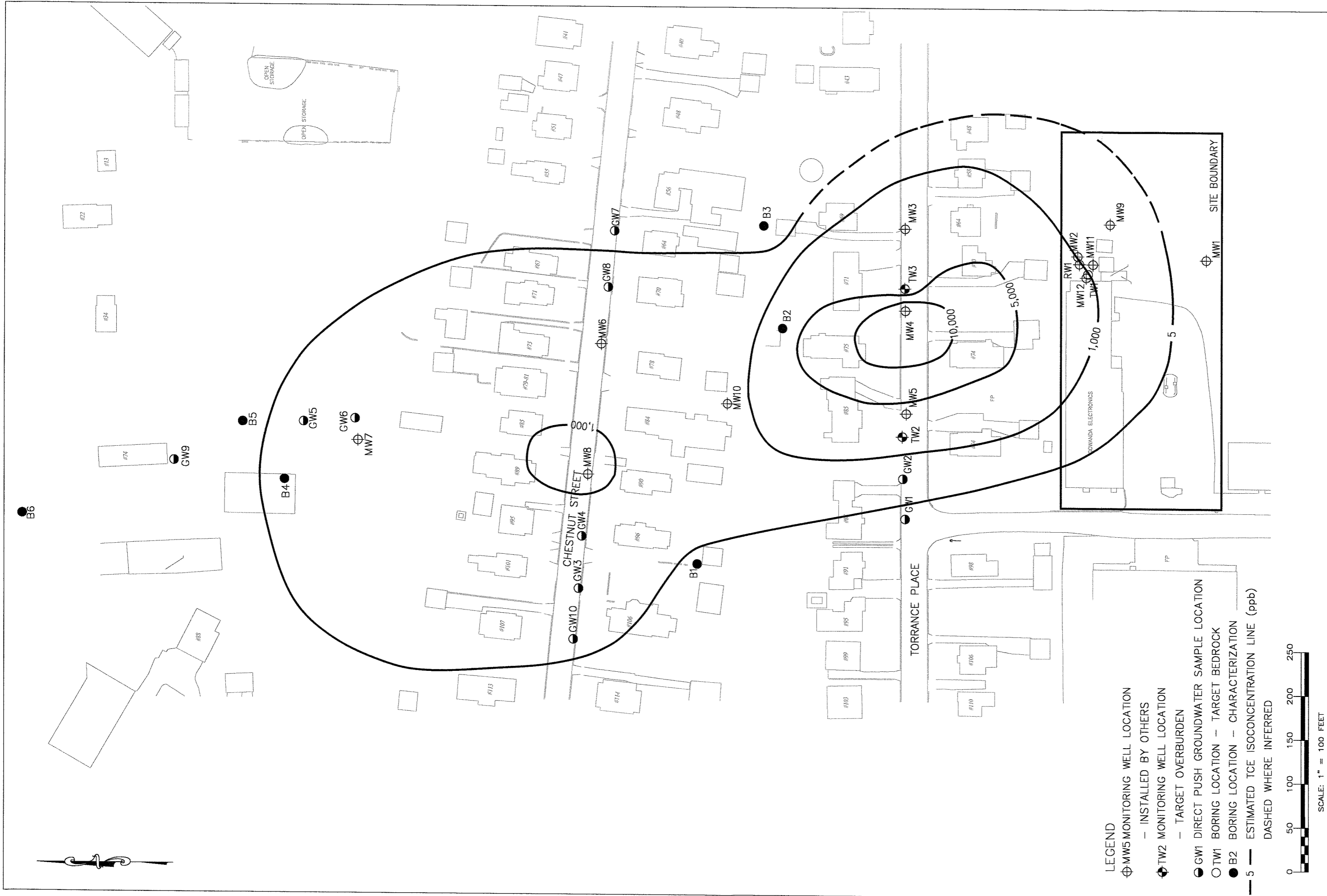
CONCENTRATIONS IN MICROGRAMS PER LITER (ug/l)

- LEGEND**
- ⊕ MW5 MONITORING WELL LOCATION
  - INSTALLED BY OTHERS
  - ⊕ TW2 MONITORING WELL LOCATION
  - TARGET OVERBURDEN
  - GW1 DIRECT PUSH GROUNDWATER SAMPLE LOCATION
  - TW1 BORING LOCATION - TARGET BEDROCK
  - B2 BORING LOCATION - CHARACTERIZATION
  - 5 ESTIMATED TCE ISOCONCENTRATION LINE (ppb)
  - - - DASHED WHERE INFERRED



AVM GOWANDA SITE  
GOWANDA, NEW YORK

SCG EXCEEDANCES IN GROUNDWATER - VOCS



AVM GOWANDA SITE  
GOWANDA, NEW YORK

TCE ISOPLETH MAP — GROUNDWATER

**db** Dvirka and Bartilucci  
Consulting Engineers  
A Division of William F. Cosulich Associates, P.C.

#### 4.2.1 Direct Push Groundwater Samples

SCGs were exceeded for the VOCs 1,1-dichloroethane, cis-1,2-dichloroethene and trichloroethene in the samples collected from direct push soil borings in May/June 2004. 1,1-Dichloroethane was detected above its SCG of 5 micrograms per liter ( $\mu\text{g/l}$ ) in three of the 15 samples at concentrations ranging from 4  $\mu\text{g/l}$  (GW-5) to 16  $\mu\text{g/l}$  (GW-6). Cis-1,2-dichloroethene was detected above its SCG of 5  $\mu\text{g/l}$  in six of the 15 samples at concentrations ranging from 11  $\mu\text{g/l}$  (GW-10) to 350  $\mu\text{g/l}$  (GW-6). Trichloroethene was detected above its SCG of 5  $\mu\text{g/l}$  in eight of the 15 samples at concentrations ranging from 6  $\mu\text{g/l}$  (B-4) to 770  $\mu\text{g/l}$  (GW-6).

#### 4.2.2 June 2004 Permanent Well Groundwater Samples

SCGs were exceeded for the VOCs 1,1-dichloroethane, 1,1-dichloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, 1,1,1-trichloroethane, trichloroethene and vinyl chloride in the samples collected from the monitoring wells during the June 2004 round of groundwater sampling. 1,1-Dichloroethane was detected above its SCG of 5  $\mu\text{g/l}$  in 12 samples at concentrations ranging from 6  $\mu\text{g/l}$  (MW-2) to 550  $\mu\text{g/l}$  (MW-4). 1,1-Dichloroethene was detected above its SCG of 5  $\mu\text{g/l}$  in three samples at concentrations ranging from 14  $\mu\text{g/l}$  (MW-11) to 40  $\mu\text{g/l}$  (MW-5). Cis-1,2-dichloroethene was detected above its SCG of 5  $\mu\text{g/l}$  in 13 samples at concentrations ranging from 190  $\mu\text{g/l}$  (MW-7) to 4,900  $\mu\text{g/l}$  (TW-2). Trans-1,2-dichloroethene was detected above its SCG of 5  $\mu\text{g/l}$  in two samples at concentrations of 9  $\mu\text{g/l}$  in MW-11 and 16  $\mu\text{g/l}$  in MW-12. 1,1,1-Trichloroethane was detected above its SCG of 5  $\mu\text{g/l}$  in five samples at concentrations ranging from 14  $\mu\text{g/l}$  (MW-2) to 120  $\mu\text{g/l}$  (MW-12). Trichloroethene was detected above its SCG of 5  $\mu\text{g/l}$  in 13 samples at concentrations ranging from 29  $\mu\text{g/l}$  (MW-9) to 17,000  $\mu\text{g/l}$  (MW-4). Vinyl chloride was detected above its SCG of 2  $\mu\text{g/l}$  in two samples at concentrations of 10  $\mu\text{g/l}$  in MW-12 and 20  $\mu\text{g/l}$  in MW-11.



SVOCs, pesticides and PCBs were not detected above SCGs in any of the three groundwater samples (MW-4, TW-2 and TW-3) collected during the June 2004 sampling event and tested for these parameters.

SCGs were exceeded for the metals antimony, iron, manganese and sodium in the samples collected during the June 2004 round of groundwater sampling. Antimony was detected above its SCG of 3 µg/l in two samples at concentrations of 3.2 µg/l in MW-4 and 4.1 µg/l in TW-2. Iron was detected above its SCG of 300 µg/l in each of the three samples at concentrations ranging from 3,170 µg/l (MW-4) to 13,300 µg/l (TW-2). Manganese was detected above its SCG of 300 µg/l in each of the three samples at concentrations ranging from 591 µg/l (MW-4) to 3,210 µg/l (TW-2). Sodium was detected above its SCG of 20,000 µg/l in each of the three samples at concentrations ranging from 35,800 µg/l (MW-4) to 70,400 µg/l (TW-2).

#### 4.2.3 Pump Test Groundwater Samples

SCGs were exceeded for the VOCs 1,1-dichloroethane, 1,1-dichloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, trichloroethene and vinyl chloride in the samples collected during the pump test. 1,1-Dichloroethane was detected above its SCG of 5 µg/l in both samples at concentrations of 720 µg/l (MW4 PT24) and 650 µg/l (MW4 PT48). 1,1-Dichloroethene was detected above its SCG of 5 µg/l in both samples at concentrations of 150 µg/l (MW4 PT24) and 130 µg/l (MW4 PT48). Cis-1,2-dichloroethene was detected above its SCG of 5 µg/l in both samples at concentrations of 4,800 µg/l (MW4 PT24) and 4,400 µg/l (MW4 PT48). Trans-1,2-dichloroethene was detected above its SCG of 5 µg/l in both samples at concentrations of 29 µg/l (MW4 PT24) and 25 µg/l (MW4 PT48). Trichloroethene was detected above its SCG of 5 µg/l in both samples at concentrations of 29,000 µg/l (MW4 PT24) and 28,000 µg/l (MW4 PT48). Vinyl chloride was detected above its SCG of 2 µg/l in both samples at concentrations of 41 µg/l (MW4 PT24) and 36 µg/l (MW4 PT48).

SVOCs, pesticides and PCBs were not detected above SCGs in either of the two groundwater samples collected during the July 2004 pump test sampling event.

SCGs were exceeded for the metals iron, manganese and sodium in the samples collected during the pump test. Iron was detected above its SCG of 300 µg/l in both samples at concentrations of 9,100 µg/l (MW4 PT24) and 8,850 µg/l (MW4 PT48). Manganese was detected above its SCG of 300 µg/l in both samples at concentrations of 623 µg/l (MW4 PT24) and 591 µg/l (MW4 PT48). Sodium was detected above its SCG of 20,000 µg/l in both samples at concentrations of 36,800 µg/l (MW4 PT24) and 37,900 µg/l (MW4 PT48).

#### 4.2.4 Design Parameter Groundwater Samples

SCGs were exceeded for the metals iron, manganese and sodium in the samples collected during the pump test and from monitoring wells MW-7, MW-10, MW-11, TW-2 and TW-3 in July 2004. Iron was detected above its SCG of 300 µg/l in each of the seven samples at concentrations ranging from 1,680 µg/l (TW-3) to 139,000 µg/l (MW-10). Manganese was detected above its SCG of 300 µg/l in each of the seven samples at concentrations ranging from 591 µg/l (MW4 PT48) to 3,600 µg/l (MW-10). Sodium was detected above its SCG of 20,000 µg/l in six of the seven samples at concentrations ranging from 33,200 µg/l (MW-11) to 78,000 µg/l (TW-2).

Bromide was detected in two of the samples at concentrations of 0.13 mg/l in MW-11 and 0.27 mg/l in TW-2. Chloride was detected in each of the seven samples at concentrations ranging from 16 mg/l (MW-11) to 66 mg/l (TW-2). Fluoride was detected in one sample, TW-2, at a concentration of 0.26 mg/l. Sulfate was detected in each of the seven samples at concentrations ranging from 19 mg/l (MW-10) to 86 mg/l (TW-2). Nitrate was detected in four samples at concentrations ranging from 0.069 mg/l (TW-2) to 2.7 mg/l (MW-10). Dissolved organic carbon was not detected in any of the seven samples. Total organic carbon was detected in one sample, TW-2, at a concentration of 11 mg/l. Alkalinity was detected in each of the seven samples at concentrations ranging from 140 mg/l (MW-10) to 320 mg/l (TW-2). Total dissolved

solids were detected in each of the seven samples at concentrations ranging from 230 mg/l (MW-10) to 560 mg/l (TW-2). Total suspended solids were detected in each of the seven samples at concentrations ranging from 11 mg/l (TW-3) to 1,600 mg/l (MW-10).

#### 4.2.5 September 2004 Permanent Well Groundwater Samples

To be completed.

### 4.3 Soil

Two soil samples (TW1DRUMS and AVM-SC) were collected during the pre-design investigation for the purpose of characterizing investigation derived waste for off-site disposal. The soil samples were both analyzed for TCLP VOCs and TCLP metals. Soil sample TW1DRUMS was also analyzed for cyanides, reactivity, pH and ignitability. In addition, the soil was subjected to a paint filter test. Soil sample AVM-SC was also analyzed for TCL VOCs. Tabulated results of the soil analyses are presented in Appendix M on Tables 8a, 8b, 8c and 8d.

VOCs, metals, flashpoint, cyanides, sulfides and pH were not detected above regulatory limits in the soil samples.

### 4.4 Data Validation and Usability

#### 4.4.1 Indoor Air and Sub-Slab Soil Vapor Samples

Twenty-three indoor air and sub-slab soil vapor samples were collected in basements and beneath the sub-slabs of residences, respectively, on April 5, 6 and 7, 2004. One ambient air sample was collected each day to establish background conditions. The samples were analyzed for chlorinated VOCs, BTEX and MTBE. Sample analysis was performed by Centek Laboratories, LLC (Centek).

Category B deliverable data packages submitted by Centek have been reviewed for completeness and compliance with the analytical method stipulated on the chain of custody. The findings of the review process are summarized below:

- All samples were analyzed within 7-days of collection.
- All surrogate recoveries were within QC limits.
- All tunes and instrument calibrations met QC requirements.
- No compounds were found in any of the method blanks associated with the samples.
- Several samples had area counts outside QC limits, however the samples were reanalyzed at secondary dilutions and all area counts were within limits. Qualification of the data was not required.
- Several compound results exceeded the instrument calibration range and the samples were reanalyzed at secondary dilutions. The results taken from the diluted analysis have been qualified with a 'D' on the data summary tables.
- Several sample results have been qualified as estimated, possibly biased high based on the results of the ambient (background) air samples. The results that have been qualified are those concentrations that were equal to or less than the concentration detected in the ambient sample and have been flagged 'J\*' on the data summary tables.

There were no other problems found with the sample results and all data is deemed valid and usable for environmental assessment purposes.

#### 4.4.2 Direct Push Groundwater Samples

Fifteen direct push probe and soil boring groundwater samples were collected on May 24, 2004, June 1, 2004, June 3, 2004 and June 4, 2004 and submitted for analyses with three trip blanks. Samples were collected from probe locations in the vicinity of the AVM Gowanda Site. All of the samples were analyzed for TCL VOCs. Sample analysis was performed by Mitkem Corporation.

Category B deliverable data packages submitted by Mitkem Corporation have been reviewed for completeness and compliance with the analytical methods stipulated in the project work plan. The findings of the review process are summarized below:

- All samples were analyzed within the method specified holding times.
- All surrogate recoveries were within QC limits.
- All tunes and instrument calibrations met QC requirements.
- All blanks (trip and method) were clean; therefore qualification of the sample results was not required.
- Several compound results exceeded the instrument calibration range in samples GW-4 and GW-6. These samples were reanalyzed at secondary dilutions. The results for the affected compounds have been taken from the diluted analysis and are qualified with a 'D' on the data summary tables.

There were no other problems found with the sample results and all data is deemed valid and usable for environmental assessment purposes.

#### 4.4.3 June 2004 Permanent Well Groundwater Samples

Fourteen groundwater samples were collected on June 15, 2004 and June 16, 2004 and submitted for analysis with one trip blank. Samples were collected from the permanent wells comprising the AVM Gowanda sampling network. All of the samples were analyzed for TCL VOCs, and three of the samples were also analyzed for TCL SVOCs, TCL pesticides/PCBs, TAL inorganics and cyanide. Sample analysis was performed by Mitkem Corporation.

Category B deliverable data packages submitted by Mitkem Corporation have been reviewed for completeness and compliance with the analytical methods stipulated in the project work plan. The findings of the review process are summarized below:

- All samples were analyzed within the method specified holding times.
- All surrogate recoveries were within QC limits.
- All tunes and instrument calibrations met QC requirements.
- The trip blank (TB040615) contained cis-1,2-dichloroethene and trichloroethene at concentrations of 3 µg/l and 2 µg/l, respectively. These compounds were qualified in sample AVM-MW-1 due to blank contamination since the sample concentrations were the same as that in the blank. The concentrations of these compounds in the other

samples were greater than 5 times that of the blank. Therefore, qualification of the data was not required.

- Several compound results exceeded the instrument calibration range and the samples were reanalyzed at secondary dilutions. The results taken from the diluted analysis have been qualified with a 'D' on the data summary tables.

There were no other problems found with the sample results and all data is deemed valid and usable for environmental assessment purposes.

#### 4.4.4 Pump Test Groundwater Samples

Two groundwater samples and one trip blank were collected on July 28 and July 29, 2004. Samples were collected from MW-4 during the pump test and analyzed for TCL VOCs, TCL SVOCs, TCL Pesticides/PCBs, TAL inorganics, cyanide and select general chemistry parameters. Sample analysis was performed by Mitkem Corporation.

Category B deliverable data packages submitted by Mitkem Corporation have been reviewed for completeness and compliance with the analytical methods stipulated in the project work plan. The findings of the review process are summarized below:

- All samples were analyzed within the method specified holding times.
- All surrogate recoveries were within QC limits.
- All tunes and instrument calibrations met QC requirements.
- Bis-(2-ethylhexyl)phthalate has been qualified as non-detect in samples MW4PT24 and MW4PT48 due to blank contamination. That is the method blank associated with the samples also contained bis(2-ethylhexyl)phthalate and the sample concentrations were less than 5 times that found in the blank.
- Several VOC results exceeded the instrument calibration range in samples MW4PT24 and MW4PT48. These samples were reanalyzed at 1:200 dilutions. The results for the affected compounds have been taken from the diluted analysis and are qualified with a 'D' on the data summary tables.

There were no other problems found with the sample results and all data is deemed valid and usable for environmental assessment purposes.

#### 4.4.5 Design Parameter Groundwater Samples

Five groundwater samples were collected on July 29, 2004 and analyzed for select metals and general chemistry parameters. Sample analysis was performed by Mitkem Corporation.

Category B deliverable data packages submitted by Mitkem Corporation have been reviewed for completeness and compliance with the analytical methods stipulated in the project work plan. The findings of the review process are summarized below:

- All samples were analyzed within the method specified holding times.
- All surrogate recoveries were within QC limits.
- All tunes and instrument calibrations met QC requirements.

There were no other problems found with the sample results and all data is deemed valid and usable for environmental assessment purposes.

#### 4.4.6 September 2004 Permanent Well Groundwater Samples

To be completed following receipt of analytical data.

## 5.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the AVM Gowanda site pre-design investigation, the following conclusions have been established.

### Geology/Hydrogeology:

- Soil encountered in the study area can be described as follows:

Depth	Description
Ground surface to 4 to 9 feet	Medium to dark yellowish brown silts and fine- to coarse-grained sands
Bottom of overlying unit to 11 to 17 feet	Medium brown fine- to coarse-grained sand and gravel
Bottom of overlying unit to 16 to 31 feet	Brownish gray to olive gray fine-grained sands and silts
Bottom of fine-grained sand and silt unit to 155 feet	Brownish gray to olive gray clay and silt

- Vertical migration of groundwater contamination below the sand and silt unit (i.e., below approximately 31 feet) is expected to be minimal because of the presence of the underlying clay and silt unit encountered throughout the study area. Additionally, it is anticipated that the clay and silt unit will serve as an adequate confining unit to key the proposed permeable reactive barrier wall into, as described in the Record of Decision.
- Although top of bedrock was anticipated at a depth of 75 to 95 feet based on previous reports, bedrock was not encountered in a boring advanced to 155 feet below ground surface on the east side of the Gowanda Electronics Corporation building.
- Based on water table elevation measurements, depth to groundwater was observed to average approximately 7 feet below ground surface, the pre-dominant direction of groundwater flow in the study area was determined to be to the north-northwest, and the hydraulic gradient was calculated to range from 0.011 to 0.035, with the steepest apparent gradient found in the



northern part of the study area near monitoring wells MW-7 and MW-8 (consistent with steep ground surface topography in this area).

- Based on the results of slug tests performed in eight monitoring wells in the study area, the average hydraulic conductivity was calculated to be  $3.4 \times 10^{-3}$  centimeters per second (cm/s).
- An average hydraulic conductivity of  $7.37 \times 10^{-3}$  cm/sec was calculated based on the results of the aquifer pump test. During the last step of the pump test, groundwater was extracted at a rate of 3.8 gallons per minute from MW-4 (a 2-inch diameter well screened from 7 to 22 feet below ground surface) and a maximum drawdown of 3.28 feet was recorded in MW-4. At the groundwater extraction rate of 3.8 gpm, the influence of pumping was observed up to 144 feet from MW-4 in monitoring well TW-1, where a maximum drawdown of 0.06 feet was recorded.
- Based on the lack of significant variability in geology observed across the study area during the pre-design investigation, it is anticipated that the characteristics of the aquifer would be reasonably consistent.

#### Indoor Air and Soil Vapor

- The following VOCs were detected in soil vapor samples collected from beneath houses which are within the estimated limits of the groundwater contamination plume: benzene, 1,1-dichloroethane, 1,1-dichloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, ethylbenzene, MTBE, tetrachloroethene, toluene, 1,1,1-trichloroethane, 1,1,2-trichloroethane, trichloroethene, m-xylene, o-xylene and p-xylene. Of these compounds, 1,1-dichloroethane, 1,1-dichloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, 1,1,1-trichloroethane and trichloroethene were also detected in groundwater above Class GA standards. The highest concentrations of volatile organic compounds were found in soil vapor samples collected from the house located at 90 Chestnut Street. Estimated depth to groundwater below the basement floor slab at this location is approximately 2 feet.
- The following VOCs were detected in soil vapor samples collected from houses which are located outside of the estimated limits of the groundwater contamination plume: benzene,

1,1-dichloroethane, cis-1,2-dichloroethene, trans-1,2-dichloroethene, ethylbenzene, MTBE, tetrachloroethene, toluene, 1,1,1-trichloroethane, 1,1,2-trichloroethane, trichloroethene, m-xylene, o-xylene and p-xylene.

- The following VOCs were detected in indoor air samples collected from houses which are located within the estimated limits of the groundwater contamination plume: benzene, 1,1-dichloroethane, 1,2-dichloroethane, cis-1,2-dichloroethene, ethylbenzene, MTBE, tetrachloroethene, toluene, 1,1,1-trichloroethane, trichloroethene, m-xylene, o-xylene and p-xylene. Of these compounds, 1,1-dichloroethane, cis-1,2-dichloroethene, 1,1,1-trichloroethane and trichloroethene were also detected in groundwater above Class GA standards. The highest concentrations of volatile organic compounds were found in indoor air samples collected from the house located at 85 Torrance Place and, as a result, a mitigation system has been installed in the house. This house also overlies the highest concentrations of groundwater contamination detected. Estimated depth to groundwater below the basement floor slab at this location is approximately 2 feet.
- The following VOCs were detected in indoor air samples collected from houses which are located outside of the estimated limits of the groundwater contamination plume: benzene, cis-1,2-dichloroethene, ethylbenzene, tetrachloroethene, toluene, 1,1,1-trichloroethane, trichloroethene, m-xylene, o-xylene and p-xylene.
- Background ambient air sampling (outside) indicated potential upwind sources of the compounds detected in indoor air samples.
- Inventories of materials present in houses investigated in the study area did not reveal any sources which would be expected to contribute to the trichloroethene encountered in indoor air and soil vapor samples.
- Based on inspection of accessible areas of the houses tested, there were several potential vapor intrusion pathways (e.g., severe cracks in foundation walls or floors, active sumps, basement flooding, etc.) observed as indicated in the questionnaires in Appendix B.

Groundwater Quality:

- In general, groundwater contaminant concentrations were found to be lower than reported in the July 1998 RI Report. Presented below is a comparison of the results:

Volatile Organic Compound <sup>1</sup>	Pre-Design Investigation (2004)		Remedial Investigation (1998)	
	Highest Concentration Detected (ug/l)	Location of Highest Detected Concentration	Highest Concentration Detected (ug/l)	Location of Highest Detected Concentration
cis-1,2-Dichloroethene	4,900	TW-2	5,400	GW-29B
1,1-Dichloroethane	550	MW-4	8,100	MW-4
1,1-Dichloroethene	40	MW-5	1,600	MW-4
trans-1,2-Dichloroethene	16	MW-12	45,000	MW-4
Trichloroethene	17,000	MW-4	170,000	MW-4
Vinyl chloride	20	MW-11	130	MW-4

- Elevated levels of site contaminants were detected in the discharge from MW-4 during the pump test as follows: cis-1,2-dichloroethene at 4,800 µg/l, 1,1-dichloroethane at 720 µg/l, 1,1-dichloroethene at 150 µg/l, trans-1,2-dichloroethene at 29 µg/l, trichloroethene at 29,000 µg/l and vinyl chloride at 41 µg/l. These results will be considered in design of the groundwater treatment system.
- The estimated limits of the groundwater contaminant plume, based on the results of the pre-design investigation, are approximately consistent with the limits shown in the RI Report, and although using the data from the pre-design investigation certain portions of the plume limits are inferred (as shown on Figure 4-1), the plume has been adequately delineated to advance the design of the selected groundwater remediation technologies. The plume was

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<sup>1</sup> Table includes compounds detected above Class GA groundwater standards during the pre-design investigation. The results of the samples collected during the aquifer pump test are not included.

found to be oriented consistent with the direction of groundwater flow (north-northwest), and based upon the estimated limits of 5 ppb of trichloroethene, the plume is approximately 1,100 feet long, and approximately 500 feet across (at its widest).

- Free phase liquid (light and dense non-aqueous phase) was not encountered during the pre-design investigation.
- The results of the pre-design investigation do not indicate any specific limitations to the technologies identified in the Record of Decision for remediation of the groundwater contamination encountered. However, iron and manganese were detected in groundwater samples at concentrations of up to 9.1 mg/l and 0.6 mg/l in the pump test discharge and 139 mg/l and 3.6 mg/l in other groundwater samples, respectively and, therefore, consistent with previous reports, removal of iron and manganese will be required prior to treatment of extracted groundwater for volatile organic compounds via air stripping.

### **Recommendations**

The pre-design investigation has provided the information required to proceed with the engineering design studies and remedial design tasks identified in the April 2004 Remedial Design Project Management Work Plan for the AVM Gowanda Site. Accordingly, there are no additional pre-design investigation activities recommended at this time with respect to remediation of groundwater contamination.

## 6.0 REFERENCES

- Cadwell, et. al., 1988. Surficial Geologic Map of New York, Niagara Sheet. New York State Museum – Geological Survey, Map and Chart Series #40.
- D&B, 2004, Remedial Design Project Management Work Plan – AVM Gowanda Site, Operable Unit 01. Site Registry No. 9-05-025. April 2004.
- NYSDEC, 1994. Determination of Soil Cleanup Objectives and Cleanup Levels. Division of Hazardous Waste Remediation Technical and Administrative Guidance Memorandum (TAGM) HWR-94-4046. January 24, 1994.
- NYSDEC, 1998. Remedial Investigation Report, AVM-Gowanda Site. July 1998.
- NYSDEC, 1998. Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations. Division of Water Technical and Operational Guidance Series (TOGS) 1.1.1. June 1998 (April 2000 addendum).
- NYSDEC, 2001. Record of Decision, AVM-Gowanda Site, Persia (T), Cattaraugus County, New York, Site Registry No. 9-05-025. March 2001.
- Resolution Resources, Inc., 2000. Fracture Trace Analysis and 3D High Resolution Seismic Reflection Imaging, AVM-Gowanda Site, Final Report Revision 2, February 2000.
- Rickard and Fisher, 1970. Geologic Map of New York, Niagara Sheet. New York State Museum and Science Service, Map and Chart Series #15.
- New York State Department of Environmental Conservation, 1980. Administrative Order on Consent between General Electric Company and the NYSDEC, September 23, 1980 by J. Francis Doyle, General Electric Company, Turbine Business Group, and Robert F. Flacke, NYSDEC Commissioner, 27pp.
- United States Environmental Protection Agency, 1981. Remedial Actions at Hazardous Waste Sites: Survey and Case Studies, Section 4, Site C: Anonymous Waste Disposal Company Dumpsite East-Central New York. EPA 430/9-81-05 SW-910, Solid and Hazardous Waste Research Division MERI, Cincinnati, Ohio, p. 65-94.