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BUREAU OF SOLID - HAZARDOUS WASTE MANAGEMENT

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION V

DATE: MAR 22 1988

SUBJECT: ON-SCENE COORDINATOR'S REPORT - Removal Action at the Wausau Groundwater Site, Wausau, Wisconsin (Site ID #N8)

FROM: Briand C. Wu, On-Scene Coordinator
Emergency Response Section

TO: Timothy Fields, Director
Emergency Response Division (WH-548B)

Grief

THRU: Basil G. Constantelos, Director
Waste Management Division

Attached please find the On-Scene Coordinator's report for the removal action taken at the Wausau Groundwater Site, Wausau, Wisconsin. The report follows the format outlined in the National Contingency Plan (NCP). The removal action was initiated on June 18, 1984, and concluded on January 3, 1985.

The site posed an imminent threat to human health and the environment, and met the criteria established in Section 300.65 of the NCP. The removal action was taken to alleviate the threat posed by volatile organic contamination of the Wausau community drinking water supply. The United States Environmental Protection Agency (U.S. EPA) installed a granular activated carbon filtration system in June of 1984, which operated for four months, until the Wausau community could install air strippers to maintain a clean drinking water supply. The U.S. EPA also conducted an extensive study to determine the extent of groundwater contamination and possible sources for the contamination. The study involved the installation of 20 monitoring wells, a seismic survey, an industrial users survey, a landfill survey, and sampling and analyses of river water, ground water, soils, and well water.

Costs under control of the On-Scene Coordinator totalled $402,851.64, of which $215,160.00 was for the Emergency Response Cleanup Services (ERCS) contractor costs. In addition, the indirect cost for the U.S. EPA was $56,866.50. The total project cost was $459,718.14.

This site is listed on the National Priorities List.

Attachment

cc: M. Giesfeldt, WDNR
B. Hamm, WH-548B

bcc: M. Elam/ F. Gomez, 5CS-TUB3
N. Niedergang/ C. Liszewski, 5HE-12
M. Guerriero, 5HR-11
J. Perrecone, 5PA-14
R. Freeman, 5RA-14
J. Oaks, 5HE-11

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Wausau Water Supply SF File

ON SCENE COORDINATOR'S REPORT

Region V

Waste Management Division

Emergency Response Section

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MAR 28 1988

BUREAU OF SOLID -
HAZARDOUS WASTE MANAGEMENT

ON-SCENE COORDINATOR'S REPORT

CERCLA IMMEDIATE REMOVAL PROJECT

WAUSAU GROUNDWATER

WAUSAU, WISCONSIN

DELIVERY ORDER NO. 6894-05-015

SITE ID#N8

REMOVAL DATES: JUNE 18, 1984 to JANUARY 3, 1985

Robert J Bowden for BCW — 3/22/88

BRIAND C. WU — Date

Emergency Response Section
United States Environmental Protection Agency
Region V

EXECUTIVE SUMMARY

On June 18, 1984, the United States Environmental Protection Agency (U.S. EPA) initiated a removal action at the Wausau Groundwater site in Wausau, Wisconsin. The City of Wausau's potable water supply was contaminated with trichloroethylene (TCE), tetrachloroethylene (PCE) and trans-1,2-dichloroethylene (DCE).

The U.S. EPA installed a granular activated carbon filtration system on one of the Wausau municipal wells in order to provide safe potable water for the city of Wausau (population of 32,000). The filtration system operated for over four months, until the City of Wausau completed the design and installation of air strippers to maintain a clean water supply. The U.S. EPA also conducted an extensive groundwater contamination source investigation, which involved the installation of 20 monitoring wells in order to monitor the groundwater, a seismic refraction study to help characterize the aquifer configuration, and an industrial users and landfill survey to help determine potential sources for the contamination.

The study was conducted at a cost of $402,851.64, which includes $215,160.00 for the Emergency Response Cleanup Services (ERCS) contractor. The removal was completed on January 3, 1985. The On-Scene Coordinator was Briand C. Wu.

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1.0 INTRODUCTION

1.1 Purpose and Scope

This report presents a summary of the actions taken by the United States Environmental Protection Agency (U.S. EPA), Emergency Response Section, in Wausau, Wisconsin, to mitigate public health threats from the City's contaminated public water supply. The mitigative and investigative activities described herein were conducted under the authorization of the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA).

The Federal action was taken in order to provide a safe and potable water supply for the City of Wausau, to characterize the extent of groundwater contamination and to determine potential sources. The scope of work included the following:

- The design and installation of a large scale granular activated carbon (GAC) filtration system capable of treating 1.8 million gallons per day (mgd) of water.

- Support and monitoring of the GAC system to assure effective contaminant removal.

- Characterization of the nature and extent of contamination at the affected well fields, definition of the site geology and hydrogeologic characteristics, and identification of potential sources.

- Recommendation of remedial alternatives.

1.2 Background

The City of Wausau has a population of approximately 32,000, and is located in central Wisconsin (Figure 1). The city spans both banks of the Wisconsin River. The Wausau metropolitan area includes the communities of Schofield, Rothschild and Weston.

The city provides potable municipal water from six wells (Figures 2, 3). The high yield wells (500-1,900 gallons per minute (gpm); Wells # 3, 4, 6, 7, 8 and 9) are positioned in alluvial deposits of the Wisconsin River flood plain. All the wells except #8 are connected directly to the water treatment plant. Well #8 is treated at the pump site and feeds directly into the distribution system.

Contamination of the municipal water supply was inadvertently discovered by personnel of Zimpro, Inc., a local analytical laboratory, in early 1982. During start-up and testing of new laboratory instrumentation, analysis of a Zimpro employee's residential water documented the occurrence of volatile organic contaminants (VOCs). The City of Wausau was notified, and in March of 1982 the City initiated testing of the six municipal wells for VOCs. At this time, VOCs were detected in City Wells #3 and #6 (Tables 1, 2). Well #3 was found to contain 100 parts per billion (ppb) tetra-

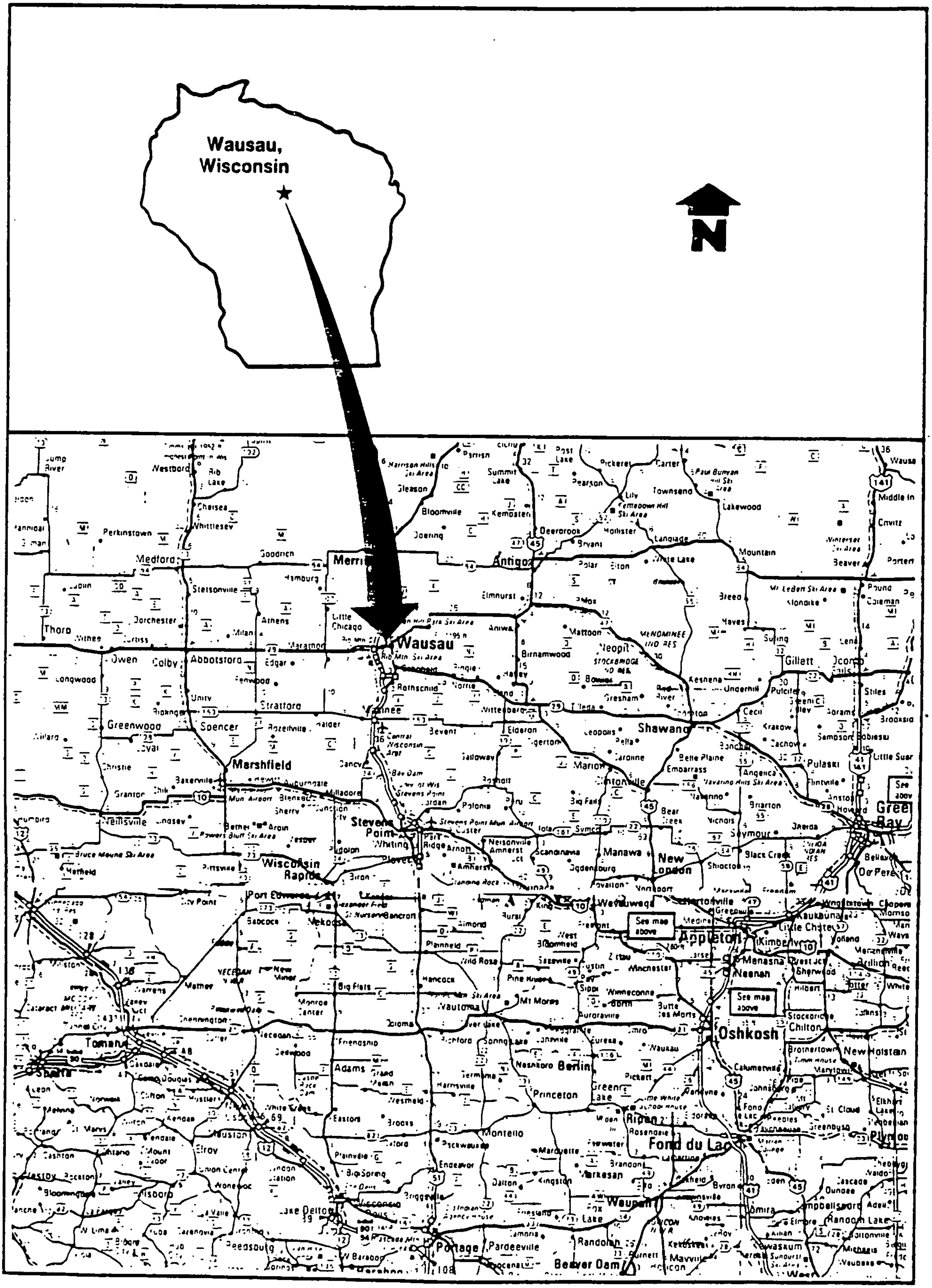


FIGURE 1 REGIONAL LOCATION MAP

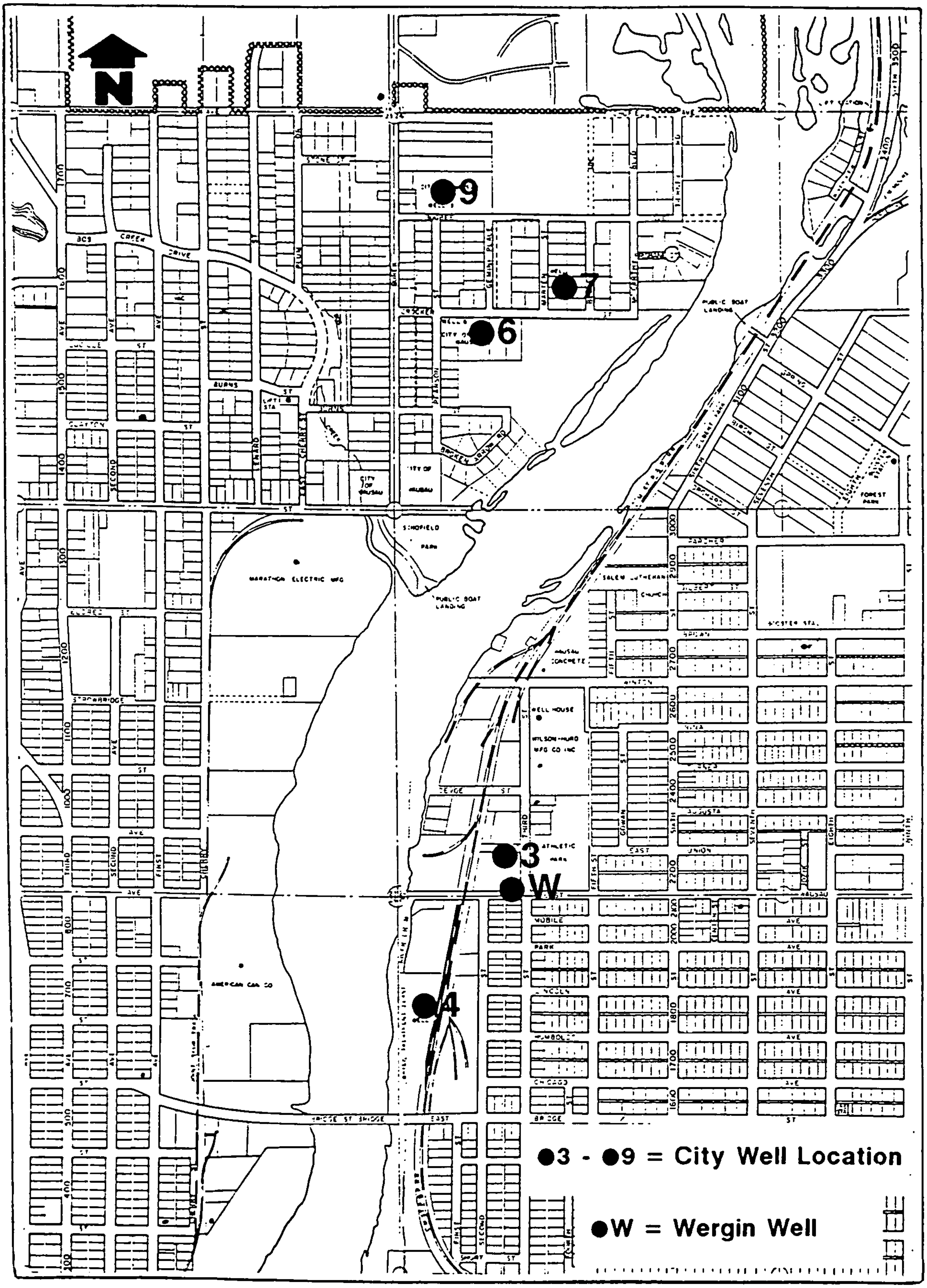


FIGURE 2 : Well Location Map - Wausau, Wisconsin

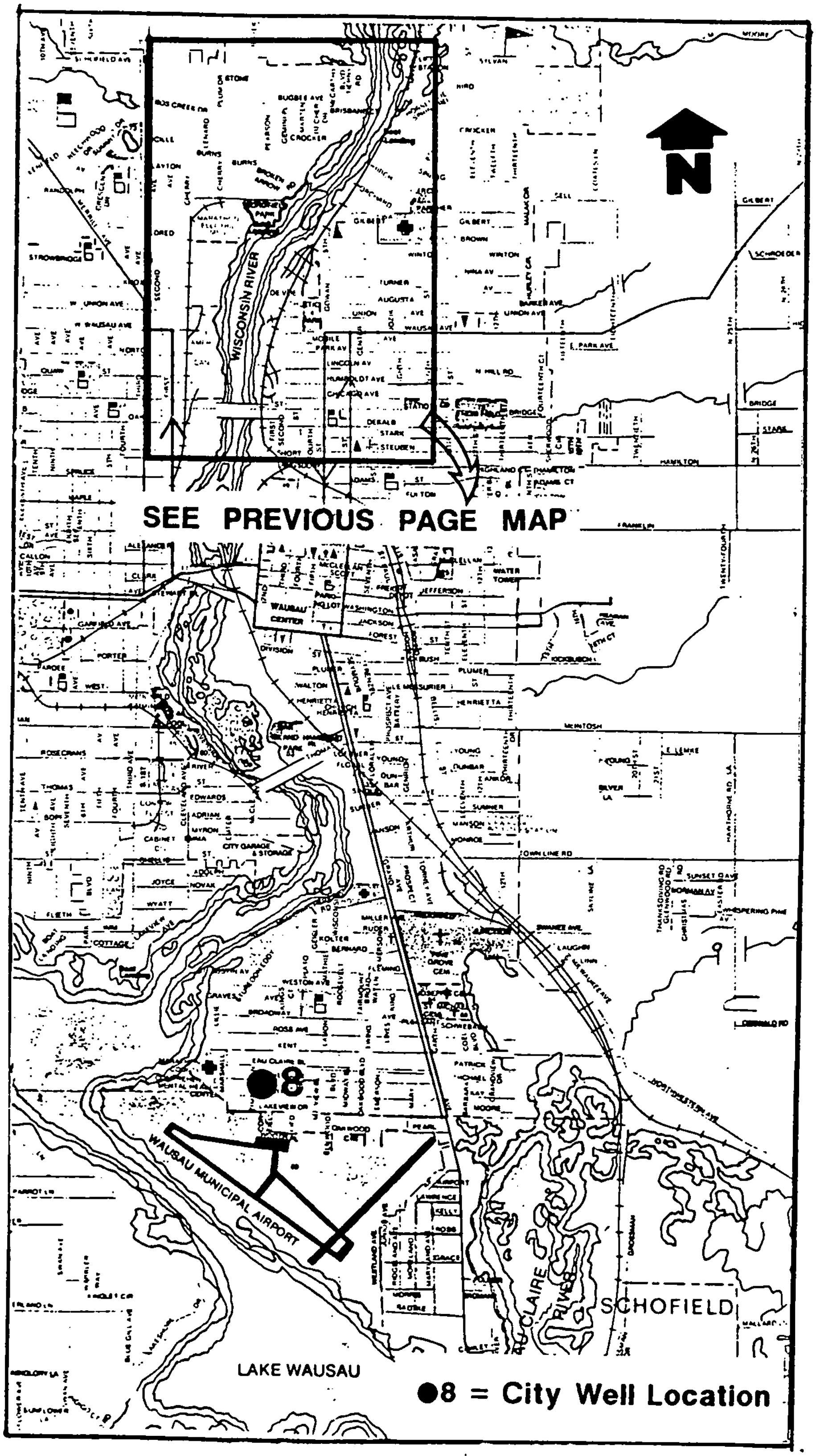


FIGURE 3 : Well Location Map - Wausau, Wisconsin

chloroethylene (PCE), 100 ppb trichloroethylene (TCE), and 40-50 ppb trans-1,2-dichloroethylene (DCE). Well #6 was found to contain only TCE at 75 ppb.

The City continued bi-weekly monitoring of the municipal wells, and found PCE at 50 ppb, TCE at 55 ppb, and DCE at 339 ppb in Well #4 in October, 1982 (Table 3). In response to the documented contamination levels, and due to the carcinogenic properties of the detected VOCs, Well #4 was taken off-line. Municipal water demand was met by blending water from uncontaminated Wells #7 and #9 with contaminated water from Wells #3 and #6. Although Well #8 tested clean for VOCs, it was used as a backup source only, due to its historically high iron contents.

In late 1982 and early 1983, the City undertook several investigative and mitigative studies. The City contracted for the installation of seven monitoring wells around Well #3 and a nearby, privately owned well (Wergin Well). The City also modified, on a pilot basis, one of their water treatment plant aerators in an attempt to volatilize the contaminants. This effort proved ineffective in removing VOCs from the municipal supply.

During 1983, contaminant levels in City Wells #3, #4 and #6 remained high. Concentration of TCE in Well #3 remained at approximately 100 ppb, while PCE and DCE concentrations decreased to insignificant levels. Well #4 remained contaminated with significant levels of PCE, TCE, DCE and toluene. TCE contamination in Well #6 exhibited a slight increase in concentration to the range 150-200 ppb.

The City, in an effort to develop a long-term resolution to the problem, applied for and was granted a U.S. EPA Cooperative Agreement (#CR81150), coordinated by Benjamin W. Lykins, Jr. of the U.S. EPA Office of Research and Development (ORD) Water Engineering Research Laboratory in Cincinnati, Ohio. EPA was to fund 90% and the City of Wausau was to fund the remaining 10% of the costs to design a VOC treatment system. The contract, awarded to Michigan Technical University (MTU), Houghton, Michigan, called for MTU to conduct pilot studies and design a treatment system. The research schedule specified that pilot scale testing start in May 1984, and if successful, ultimate construction of a large scale stripper would be completed by late summer 1984.

In early 1984, no adequate treatment system had been installed. The city continued to blend contaminated water from Wells #3 and #6 and clean water from Wells #7 and #9 to meet demand (Table 4). The existing water treatment systems could not reduce the VOC levels to a level consistently below the Health Advisory levels at all times. Water use through September of 1982 and 1983 was 4.68 and 5.54 million gallons per day (mgd). In addition, it was anticipated that the heavier water usage for summer of 1984 would strain the water distribution system even further, and would promote the use of the contaminated wells.

1.3 Threat to Public Health and the Environment

The National Academy of Sciences Carcinogen Assessment Group (CAG) established a draft Health Advisory concentration of 28 ppb for VOCs (10^{-5} excess cancer risk rate) during the time frame of the findings at Wausau. The Health Advisory for Wausau was 45 ppb for TCE prior to this time.

More recently, an Office of Solid Waste and Emergency Response Directive Interim Final Guidance on Removal Action Levels at Contaminated Drinking Water Sites (10-06-87) lists TCE as a VOC with a Maximum Contaminant Level (MCL) of 5 ppb. No established MCL exists for PCE and DCE. The Removal Action Levels (RALs) for TCE, PCE, and DCE are 128 ppb, 66 ppb, and 175 ppb respectively. Contaminant levels in the Wausau municipal Wells #3 and #6, respectively, were 70 and 260 ppb TCE, non-detectable and 100 ppb PCE; non-detectable and 110 ppb DCE. These wells supplied drinking water to a population of at least 30,000. Based on the TCE levels alone, the drinking water from the contaminated wells constituted an immediate and significant threat to human life and health, and met the criteria for a removal action as outlined in §300.65 of the National Contingency Plan (NCP).

1.4 Attempts to Obtain a Response from a Responsible Party

No potentially responsible parties (PRPs) could be specifically identified at the time of the action. Possible contaminant sources and PRPs are discussed in Section 4.

2.0 Actions Taken

In May 1984, the City of Wausau requested the help of the U.S. EPA removal program to avert a major water supply problem. A site assessment conducted by the U.S. EPA confirmed the potential threat to the residents dependent on the Wausau water supply. On June 18, 1984, the action memorandum was signed by the Regional Administrator, authorizing $290,000 to provide safe, potable drinking water to the City and to determine the sources of contamination at Wausau. A Delivery Order was issued to Pedco Environmental, Inc. (PEI), the primary Emergency Response Cleanup Services (ERCS) contractor to provide the required services.

2.1 Installation of Granular Activated Carbon System

The first objective of the U.S. EPA removal action was to provide an uninterrupted supply of uncontaminated water to the residents of Wausau until the air stripper, being developed by Michigan Technical University, could be installed. To meet the objective, the U.S. EPA removal program installed a Granular Activated Carbon (GAC) treatment system on municipal Well #6. Well #6 was selected because of its high yield capacity and its accessibility for GAC retrofitting. Calgon Corporation was selected as the subcontractor to provide the system, and Zimpro, Inc. was selected to provide all rapid turnaround analyses necessary during the installation.

The filtration system was comprised of two Calgon Model 20 Dual Adsorption Treatment Systems, each with two adsorption vessels (Figure 4), which operated in parallel. The four lined carbon steel adsorbers each contained 20,000 lbs. of granular-activated carbon. The system was capable of treating a maximum flow of 1,550 gallons per minute (gpm) of contaminated groundwater with concentrations of 100-250 ppb (micrograms per liter) of TCE and 1-10 ppb of DCE. Contaminated well water entered the top of each adsorber vessel, and treated water was collected in a pipe lateral system in the bottom of the vessels. The reduction in TCE levels from 250 to 1 ppb, and reduction of DCE levels from 10 pbb to 1 ppb utilized an estimated 0.13 to 0.26 lbs. of granular-activated carbon per 1,000 gallons of contaminated water.

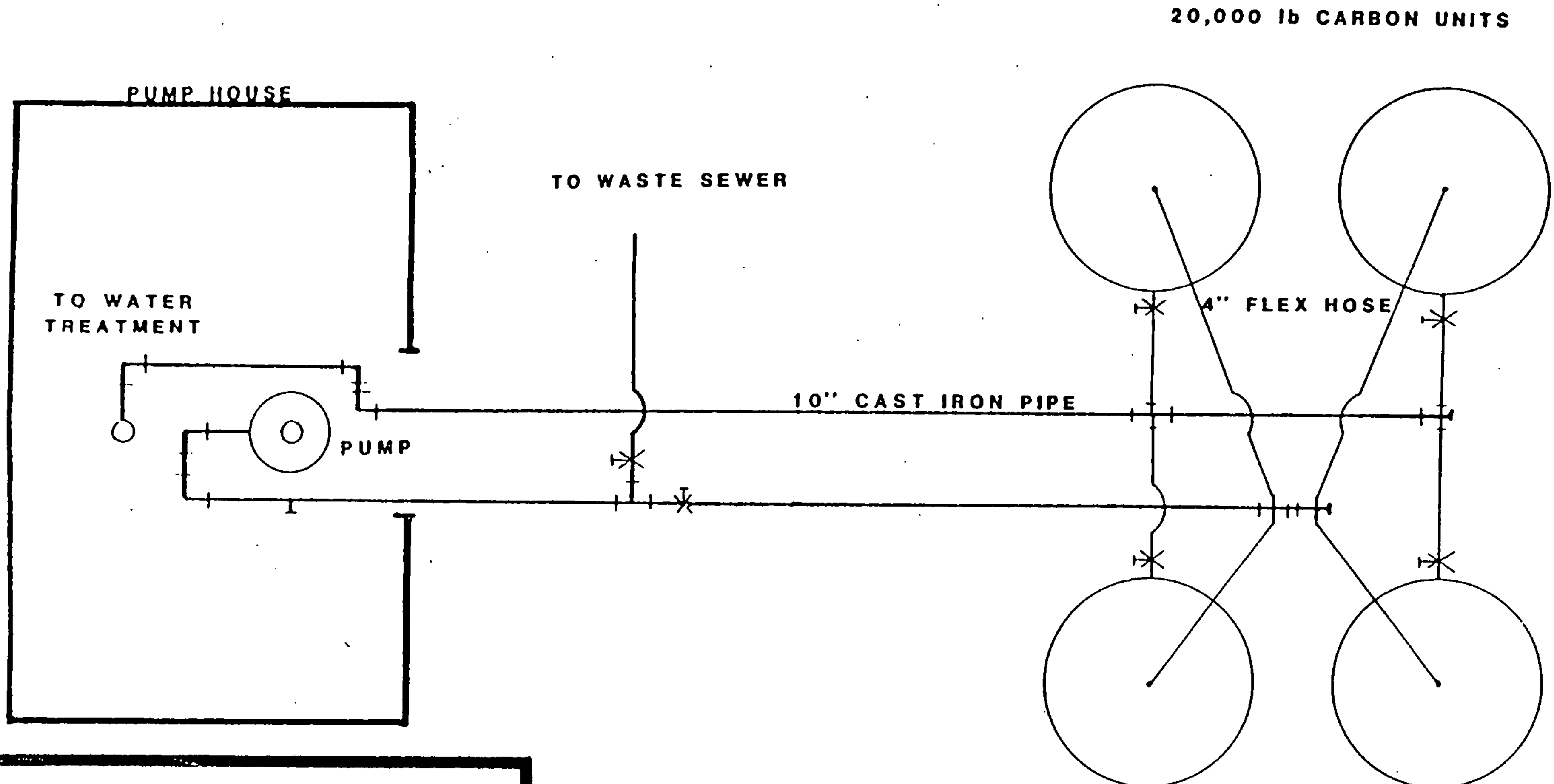


FIGURE 4

CARBON FILTRATION UNIT SITE SKETCH

Under maximum flow, approximately 22,500 lbs. of carbon were consumed per month (24 hours per day operation). A detailed manufacturer's description of the system and its operation is provided in Appendix NN, and the result of a carbon adsorption (carbon isotherm) study are provided in Appendix OO.

The system installation started on June 20, 1984. The City of Wausau provided manpower and equipment for the hookup from the pumphouse to the GAC filtration vessels. The first two vessels were in operation by June 28, 1984. On June 29, samples of treated water were analyzed by Zimpro and were found to meet drinking water criteria. The final two vessels arrived on-site on June 29, 1984, and were immediately installed. All four carbon units were on-line by July 2, 1984. The units successfully operated until October 29, 1984, (containment levels for water from Well #6 as a result of filtration are shown in Table 5); the air stripper designed by MTU and installed by the Wausau Water and Sewerage Utilities began operation in August 1984.

2.2 Investigation of the Wausau Groundwater Contamination

The second objective under the removal action was to characterize the extent of groundwater contamination, identify the potential contamination sources, and evaluate groundwater rehabilitation alternatives. In order to meet these objectives, an investigation by the U.S. EPA, in conjunction with the City and State agencies, was initiated on June 20, 1984, which consisted of the following items.

- Preliminary test well installation.
- A seismic refraction survey.
- Installation of monitoring wells.
- Sample surveys of sediments, soils, groundwater, and Wisconsin River water.
- An industrial users' survey.
- A landfill survey and minor historical research.

2.2.1 Test Well Installation

The investigation was initiated with the drilling and installation of a test well (MW-#1A) to bedrock (Figure 5). The test well was initially proposed to fulfill the following objectives:

- To provide a bedrock depth measurement as a preliminary to the geophysical (seismic) survey.
- To measure the water table surface elevation.
- To supplement information on stratigraphic control.
- To define the vertical stratification of the contamination.

Exploration Technology, Inc., of Madison, Wisconsin, was contracted by Roy F. Weston, Inc., under a TAT Special Project TDD, to perform the drilling and installation of the test well. Soil samples were collected at 5-foot intervals from the surface to bedrock using a split-spoon sampler to provide additional geological information in the area west of the

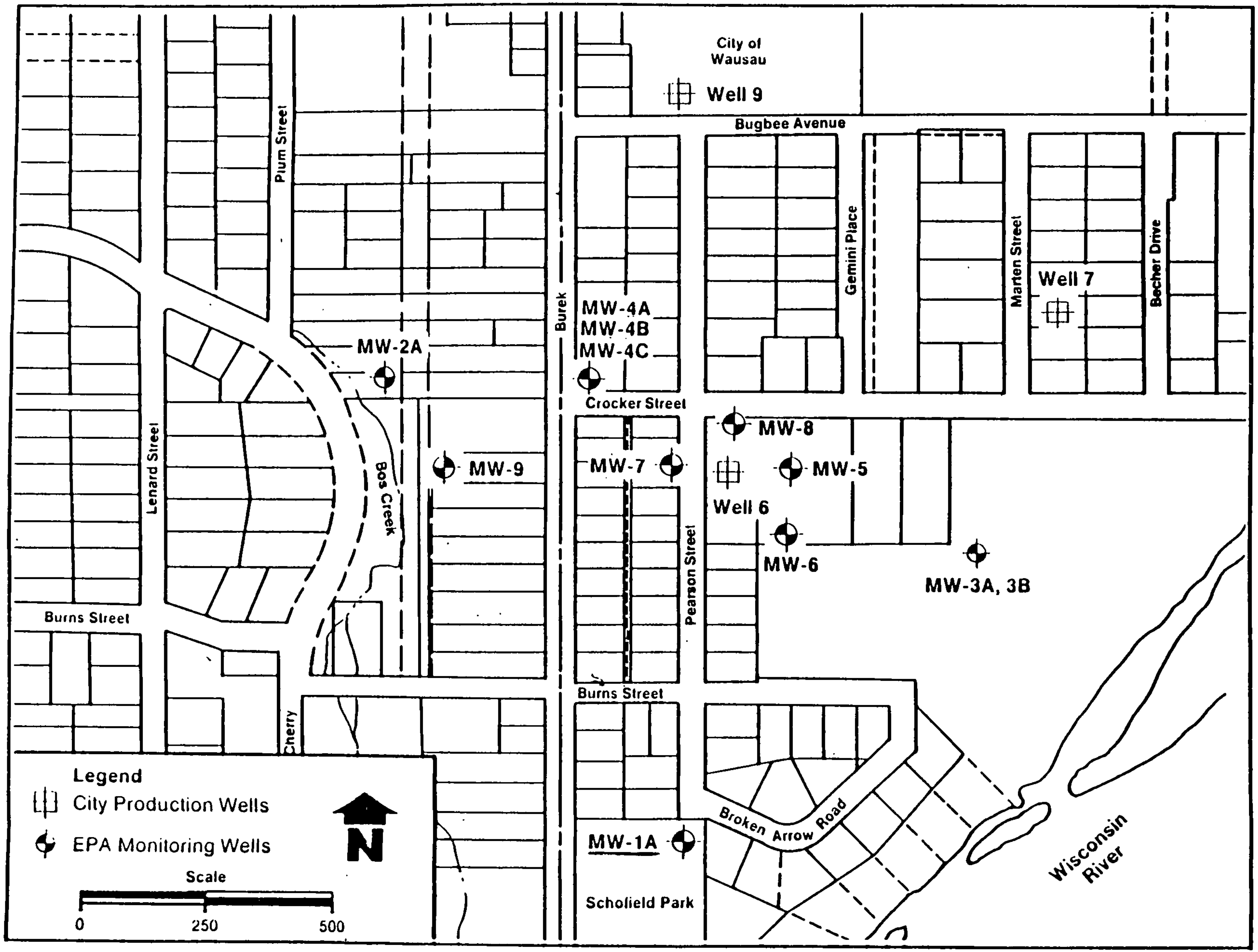


FIGURE 5 **WEST STUDY AREA WELL LOCATION MAP**

Wisconsin River (western study area). Water samples and soil samples were obtained as the boring was advanced. A galvanized well point was initially employed as a vertical sampling point; however, the subsoils were extremely well consolidated (penetration values, N, generally greater than 25), which made advancement and retrieval of the well point impossible. Consequently, a section of NW gauge hollow drill stem was substituted as a well point by slotting the stem with a band saw and fitting one end with a heavy duty steel point. The heavy duty slotted drill stem was then successfully employed.

Water samples were taken at 10 foot intervals from the water table down to bedrock. The well point was developed at each level by jetting the well with filtered compressed air in order to remove sediment and provide a hydraulic connection between the well and aquifer prior to bailing the well for sampling purposes. Following the jetting procedures, the well was bailed to remove a minimum of two casing volumes before water samples were taken (it should be noted that the jetting method of developing well points potentially can reduce VOC concentrations through volatilization of these compounds).

The actual volume of purge water removed was dependent upon the depth. At depths of less than 70 feet, four case volumes were removed before VOC samples were taken. In the intermediate sample zone, 70 to 100 feet, three volumes were removed; and at depths greater than 100 feet, two casing volumes were removed before sample collection. Samples were placed in precleaned, 40 ml septum vials and analyzed for VOCs by Zimpro Laboratories.

2.2.2 Seismic Refraction Survey for Bedrock Mapping

A seismic refraction study was undertaken to provide a data base for mapping the bedrock configuration. The survey assisted in characterizing the configuration of the aquifer and allowed strategic placement of monitoring wells for a comprehensive monitoring program. The survey also identified bedrock features that could affect contaminant distribution and movement. The data would also facilitate the City of Wausau's search for another water well field by providing pertinent hydrogeologic information which would optimize the placement and yield of future production wells.

The seismic refraction technique was the most applicable seismic method for this residential setting. The technique produced reliable data and was cost effective.

The survey was conducted by the Technical Assistance Team (TAT) and E.A. Hickok and Associates, Inc., of Wayzata, Minnesota, from July 15 to August 2, 1984. Seismic data was gathered using a single geophone Bison Signal Enhancement Seismograph, Model 1570B. A total of 56 sounding sites were used during the survey. The majority of the sounding points required 300-foot traverses to determine the depth to bedrock. The remainder of the sounding points used 400 foot traverses with one point requiring a 500-foot traverse. The offset hammer stations were located at 10- and 20-foot intervals along a 300- to 500-foot measuring tape originating at the geophone. The energy source used to generate the compressional waves was a 10-pound sledge hammer with an inertia closing switch. The energy was detected by the geophone and amplified and recorded on the seismograph as a wave form. The raw data consisted of travel times and distances which were converted into the format of seismic velocity variations with depth (Table 6). Data were collected until a trend of refracted primary wave interval times indicated seismic velocities characteristic of bedrock.

At 2 of the 56 sounding locations, bedrock depths exceeded 125 feet, generally considered to be the depth limitation of the equipment used. Two of the deep seismic traverses proved extremely accurate when correlated with nearby boring records. Seismic Station #2 indicated bedrock to be 167 feet below land surface. Monitoring well #1A, located 200 feet updip of the seismic station, encountered bedrock at 159.5 feet below land surface. Seismic Station #7 indicated bedrock to lie 158 feet below land surface. Monitoring well #3A was drilled less than 30 feet from seismic Station #7 and confirmed bedrock at 151 feet below land surface. The correlation of data indicated that the seismic approach was valid for the mapping of the bedrock surface at the site.

The majority of the 56 sounding stations identified three separate velocity layers. The first and second velocity layers were typical of unconsolidated sand and gravel outwash deposits with the two layers indicating a change in consolidation. The first layer was characterized by velocities less than 1,500 ft/second and the second layer by less than 6,000 feet/second. The third layer velocities were significantly higher, generally greater than 15,000 ft/second, and indicated a much greater density.

Based on the calculated velocities and hammer station distances, the depth to variation in velocity was determined. A reverse profile was conducted at each sound station to check accuracy. At the sounding stations where the arrival times were equal, an averaging of the data was used to determine a representation of true bedrock depth. At sounding locations where the reverse profiles did not have equal arrival times, depth determinations were made averaging the profiles and correlating the values with other nearby profiles.

Based on monitoring wells completed to bedrock and structural boring records, the seismic refraction method proved to be very accurate in characterizing bedrock and was cost effective compared to conventional drilling methods.

2.2.3 Survey and Sampling Program

In addition to sampling undertaken by the U.S. EPA, the WDNR initiated a survey and sampling program which was coordinated with the U.S. EPA,and designed to provide data for the identification of contaminant sources and to assist the U.S. EPA in the placement of monitoring wells.

All existing municipal and monitoring wells in the Wausau area were sampled simultaneously on October 1, and November 8 and 29, 1984. The samples were analyzed by ERT's mobile lab in Niles, Michigan (Table 7).

Sediment and water of the Wisconsin River was sampled to determine if the river was a source of contamination. Samples were collected on June 20 and September 25, 1984, (sample locations - Figures 6, 7). Analytical results are listed in Tables 8a-8d. Data for the previous decade was provided by the WDNR and reviewed (Appendix Z).

A limited soil sampling program was initiated for the east bank of the river (sample locations - Figure 8). Results are listed in Table 9.

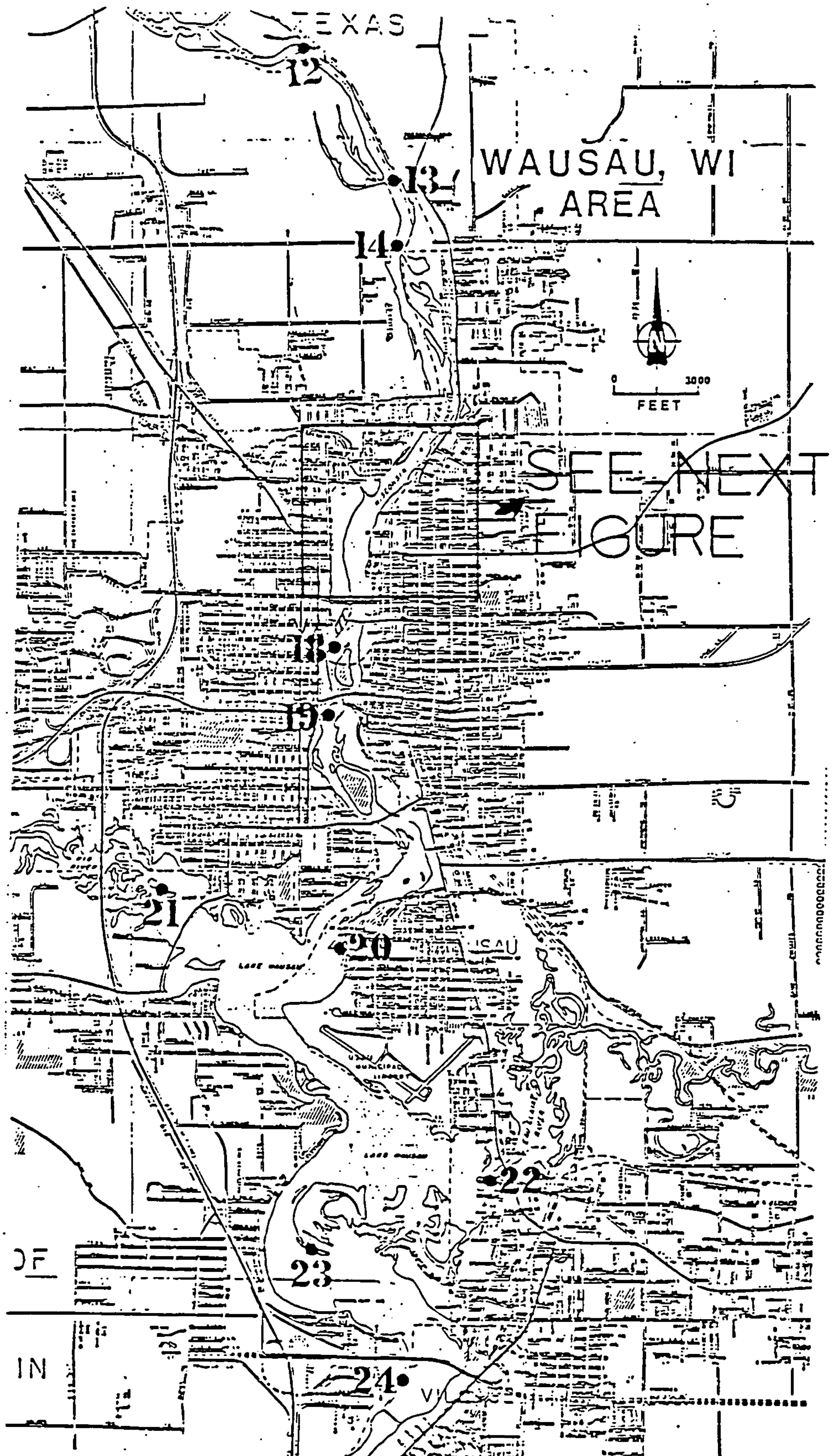
2.2.4 Monitoring Well Installation

Based partly on the results of the sampling studies, a total of 20 monitoring wells were constructed and installed by the U.S. EPA in Wausau. The drilling was initiated on September 13, 1984, and completed on December 1, 1984. Twelve monitoring wells were located west of the Wisconsin River, and eight were placed east of the river (Figure 5).

The monitoring wells were installed by Exploration Technology, Inc., of Madison, Wisconsin. To expedite the drilling program, Exploration Technology subcontracted Wisconsin Test Drill of Schofield, Wisconsin. Bore holes were advanced with a truck-mounted Central Mine Equipment 55 or 750 drilling rig. Four-inch hollow stem augers were used to drill monitoring wells to depths less than 75 feet. A NW gauge drill stem fitted with a 3 7/8" tri-cone bit was used to reach depths greater than 75 feet. The monitoring wells were constructed of 2-inch (I.D.) flush threaded joint PVC (Schedule 40) with a wall thickness of 0.154 inches. Most of the well casings terminated with a 10-foot continuous wrap screen (#60 slot size), except for MW #12 and MW #9 which utilized 20-foot and 15-foot screens, respectively. The annular space around the screens was packed with Number 30 flint filter sand. The filter sand was emplaced with a 3/4-inch PVC drop pipe to approximately two feet above the top of the screen. A 2-foot seal of bentonite pellets was placed atop the sand; the remainder of the annular space was pressure-grouted with a 6:1 bentonite/cement grout mixture.

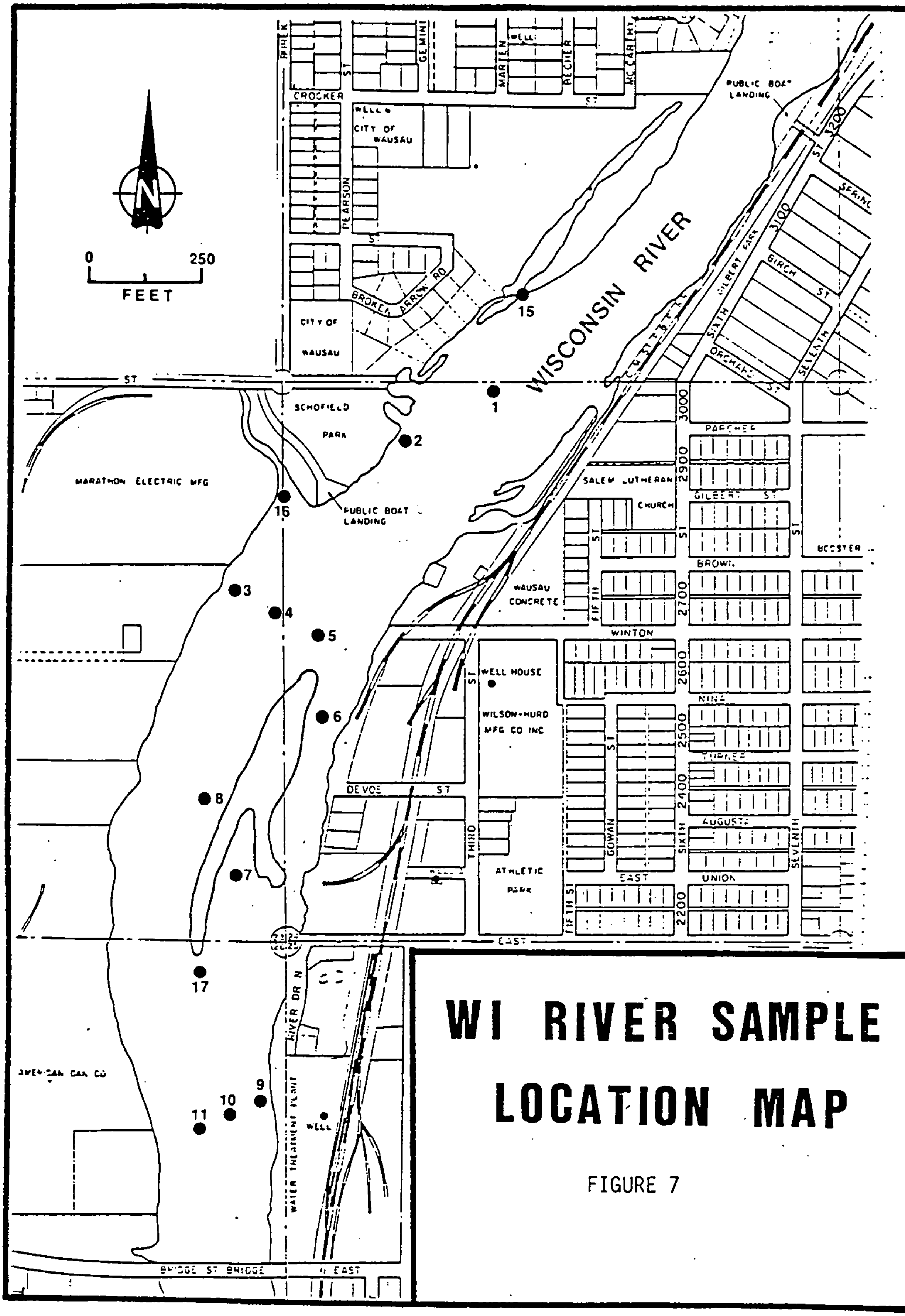
To provide security for each well, a 3-inch nominal diameter steel protector pipe with locking cap was set around the well casing. Casehardened steel padlocks were attached to each well. The protector pipe was sunk three feet into a portland cement mixture with a two-foot extension of pipe above the surface. At the surface, a mounded concrete pad was constructed around the riser pipe to inhibit infiltration and enhance runoff (Figure 9). To minimize the visibility of the monitoring wells in the residential settings, a water-tight valve box cover was used to complete the well at land surface. Tables 10 and 11 provide a summary of monitoring well measurements.

In order to minimize cross-contamination or introduction of contamination during well installation, rigorous decontamination procedures were used to remove surface grease, oil, gasoline and/or organic contaminants from all equipment and machinery. Prior to all drilling activities, a high pressure steam cleaner was utilized to decontaminate the drill rig, flight augers, equipment, and well construction materials. In addition to steam cleaning, the drill rig, well construction materials and split-spoon barrels were cleaned with a methanol wash, followed by several clear water rinses (water provided by the fire department which was analyzed and found to be uncontaminated) and allowed to dry. This procedure was conducted at every well site prior to drilling activity.



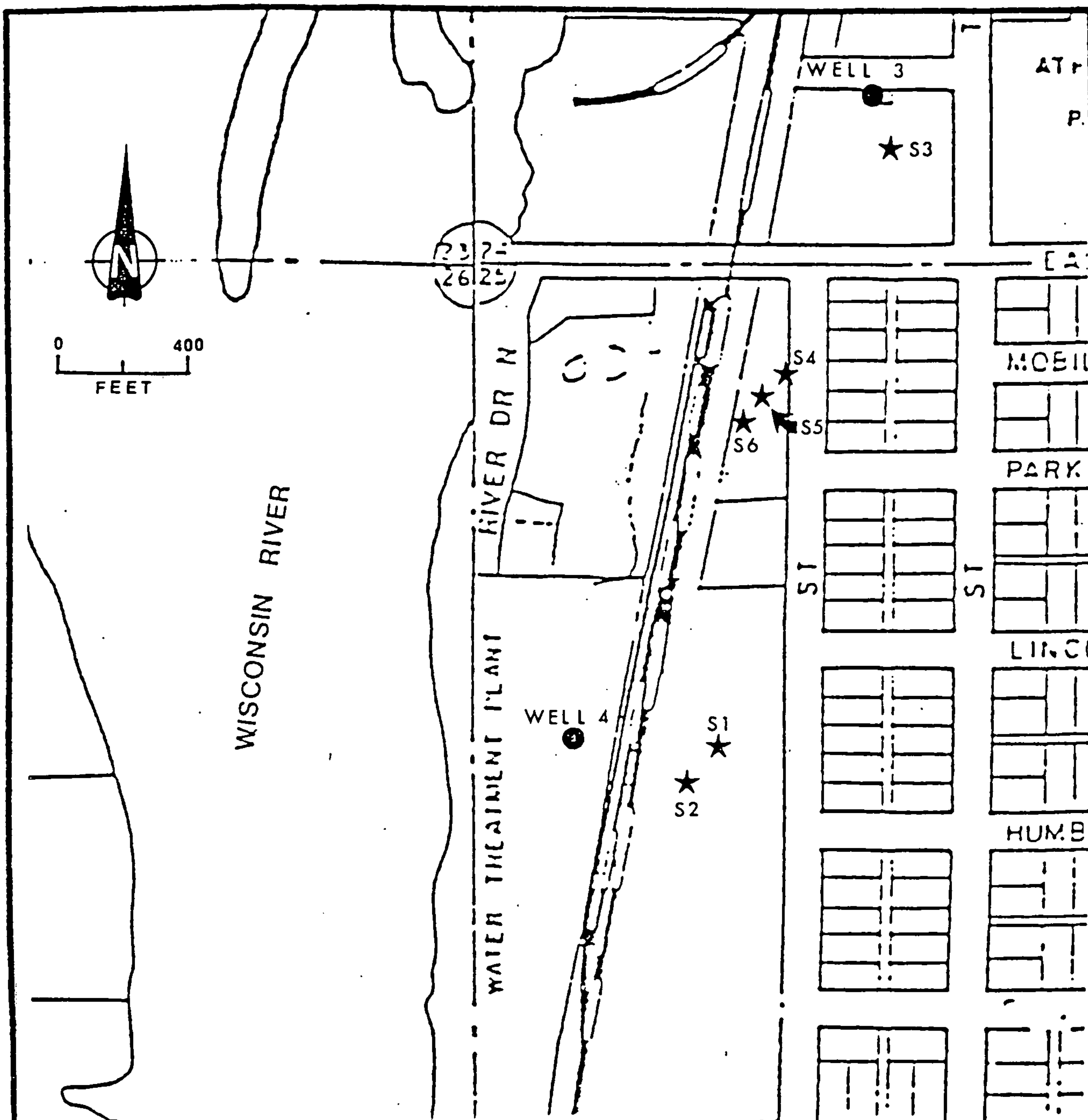
WI RIVER SAMPLE LOCATION MAP

FIGURE 6



WI RIVER SAMPLE LOCATION MAP

FIGURE 7



SOIL SAMPLE LOCATION MAP

WAUSAU, WI

FIGURE 8

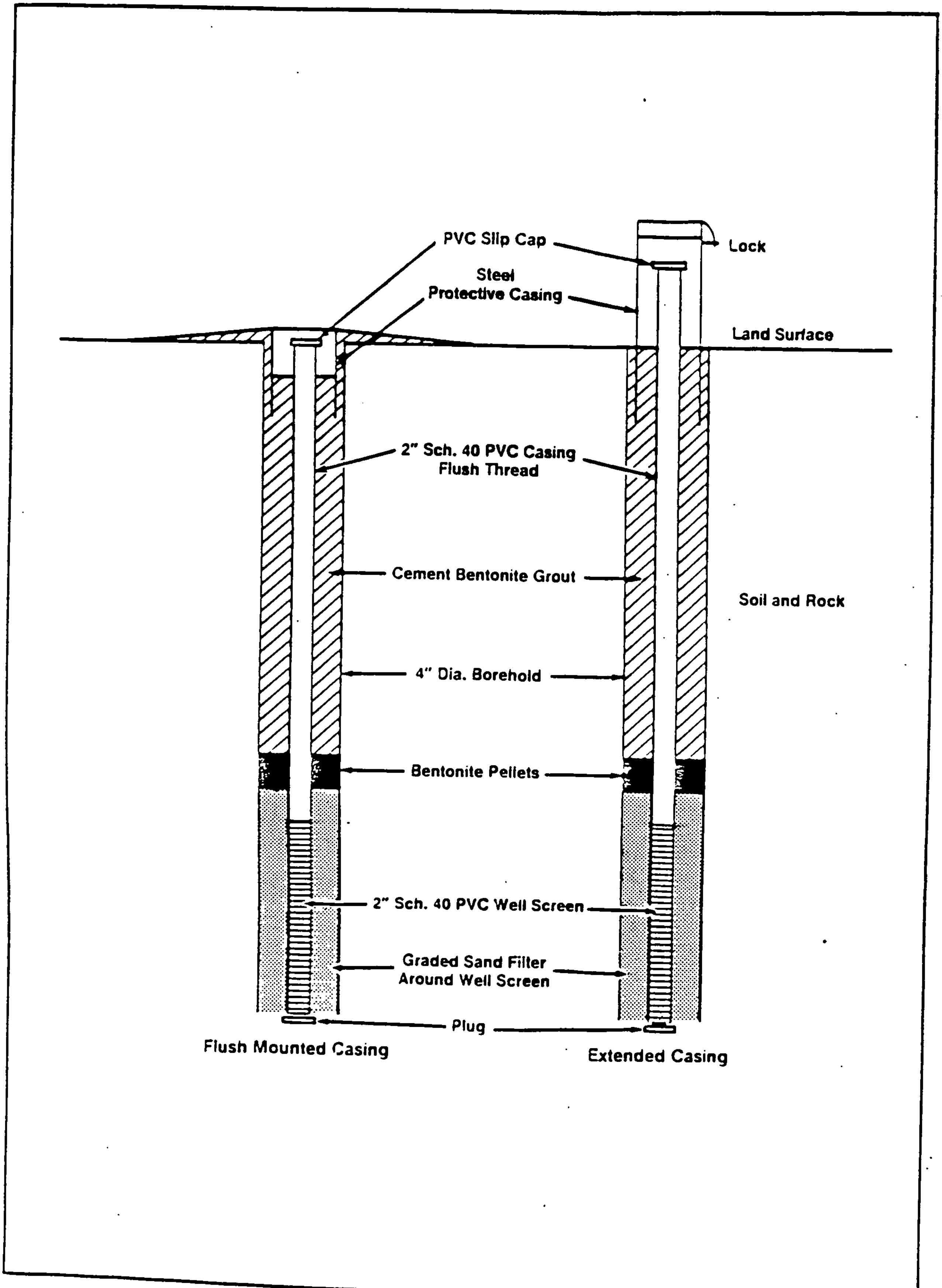


FIGURE 9 SCHEMATIC OF MONITORING WELL CONSTRUCTION

2.2.5 Soil Borings, Survey, Sampling and Analysis

Split-spoon sampling was conducted during installation of six of the monitoring wells. The sampling was undertaken in accordance with ASTM D-1586 protocols. A 2-inch (O.D.) splitspoon sampler was driven by a 140 pound weight, free falling approximately 30 inches Blow counts were recorded for each sample location and used to determine penetration resistance. All samples were placed in 8-oz glass jars and used for lithologic descriptions.

A 4.5-foot carbide core barrel was utilized at monitoring well #2A for the recovery of a bedrock sample The sample was identified in the field and then shipped to the University of Wisconsin-Oshkosh for detailed lithologic identification and research purposes.

The City of Wausau's Engineering Department surveyed all the monitoring wells after the completion of the drilling program. Elevations were taken at the land surface and top of the well casing. The elevation of four river gauging stations were also measured by the City's engineering department.

Groundwater was sampled at the newly installed monitoring wells and at the monitoring wells installed by the City of Wausau. A dedicated permanent evacuation pipe was fitted on each well. The evacuation pipe consisted of a 3/4 inch check valve attached to a portion of Schedule 80 PVC pipe. The length of the pipe was determined by the depth to the water table. The monitoring wells with water levels less than 30 feet were evacuated by a 3/4 horsepower pump connected to a 90° elbowed nipple which was attached to the evacuation pipe.

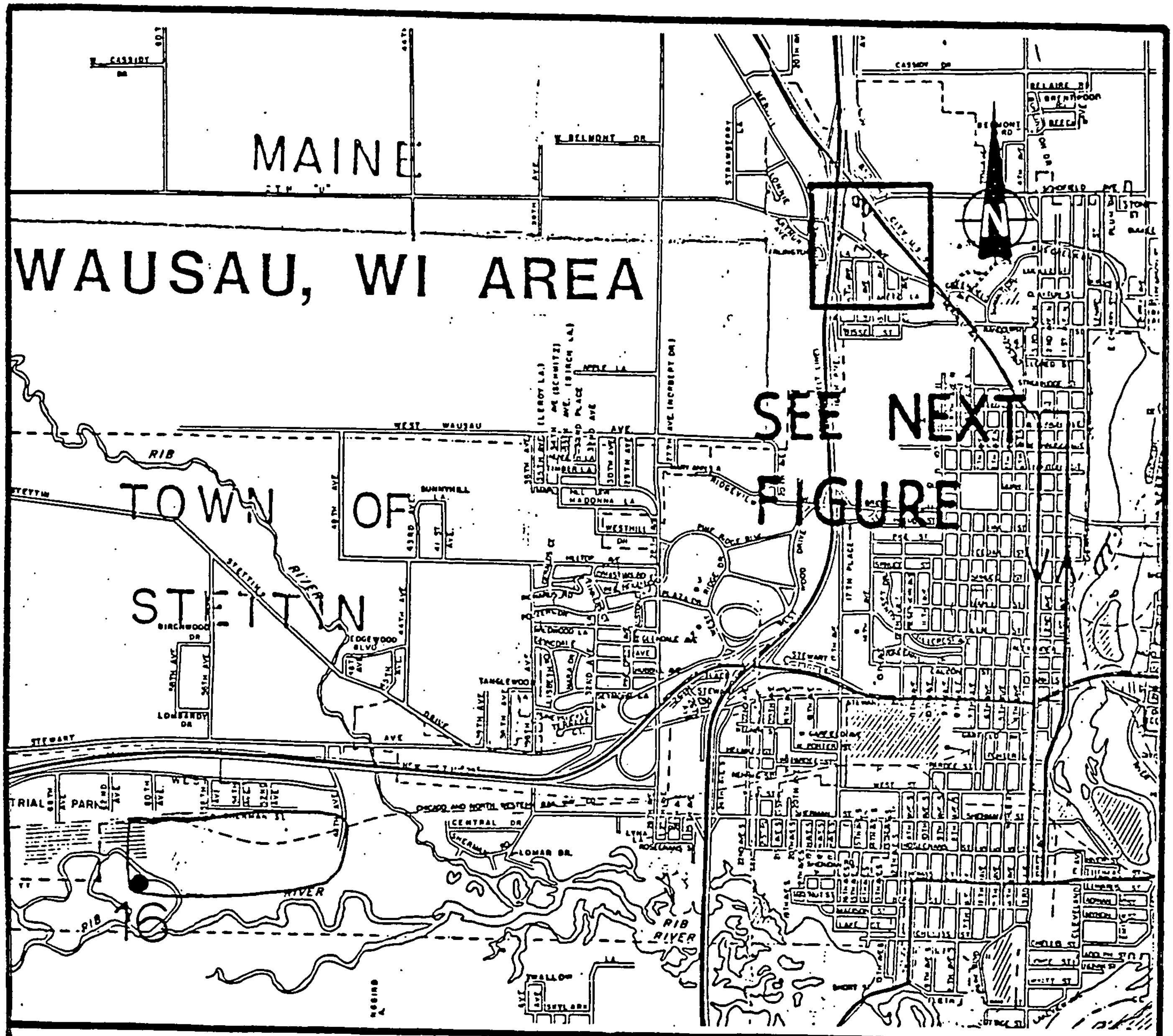
Following the evacuation, a minimum of six volumes of standing water in the well were retrieved using a decontaminated stainless steel or Teflon bailer prior to sampling. The bailers were decontaminated between samples with laboratory grade methanol and several clean water rinses. Samples were placed in 40 ml septum vials and preserved with ice in coolers for transport to Zimpro Laboratories in Rothschild, Wisconsin, or shipment to the U.S. EPA Environmental Response Team (ERT) mobile laboratory in Niles, Michigan. Chain of custody was maintained on all samples. All samples were analyzed for PCE, TCE and DCE. Duplicate, blank and spike samples were used for quality control and quality assurance.

2.2.6 Industrial User Survey

Files of all industrial users were obtained from the U.S. EPA RCRA program, the WDNR and the City of Wausau. Over 150 potential users of TCE and PCE were identified. In conjunction with the WDNR, the identified facilities were inspected; inspection forms and facility files are in Appendices II-MM.

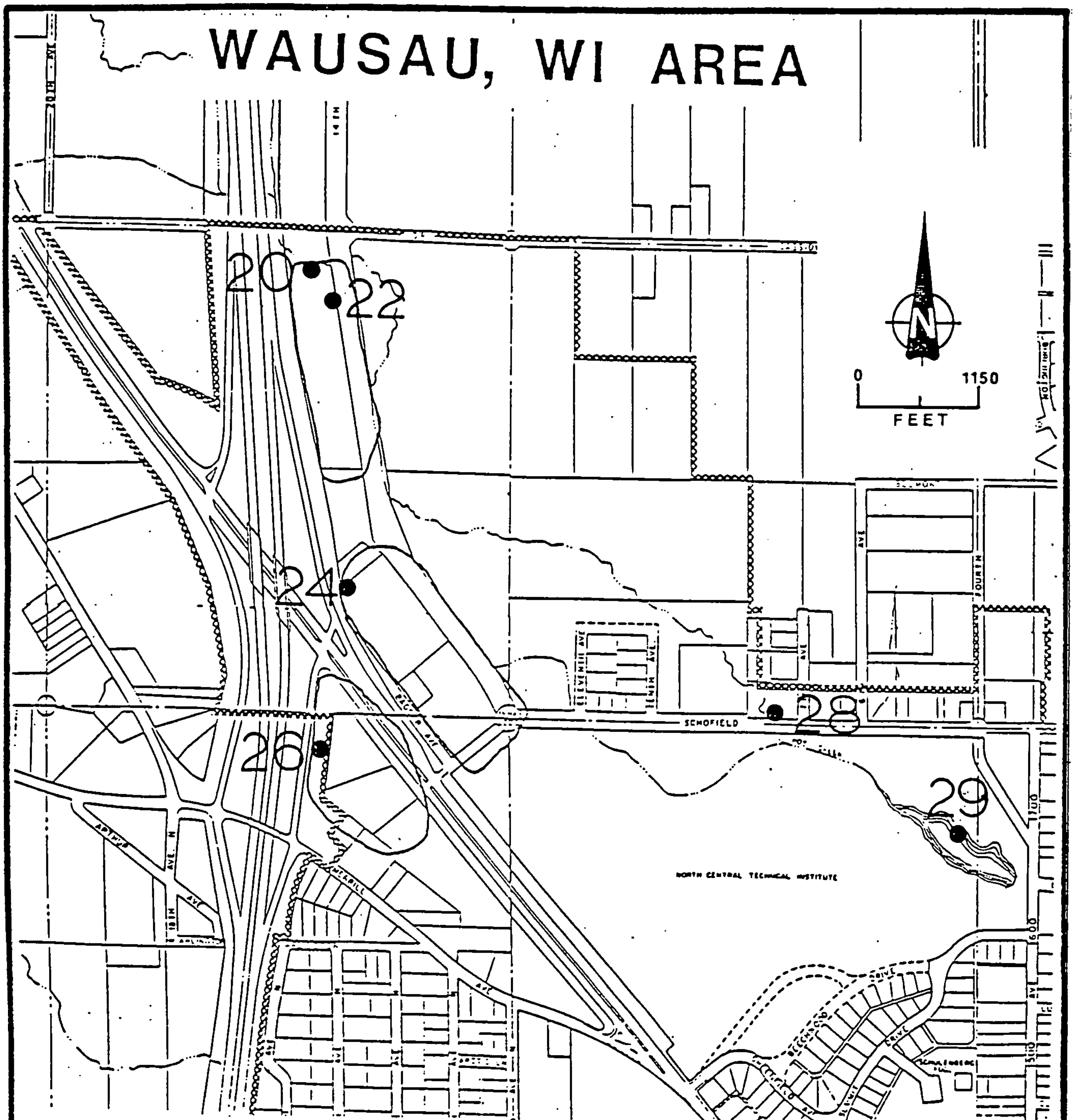
2.2.7 Landfill Survey

All existing and old landfills in the Wausau vicinity were inspected. Landfill location maps are shown in Figures 10 and 11. Analytical results of runoff water are listed in Table 12. Landfill inspection details can be found in Appendix HH.



LANDFILL SAMPLE LOCATION MAP

FIGURE 10



LANDFILL SAMPLE LOCATION MAP

FIGURE 11

3.0 RESULTS OF INVESTIGATION - GEOLOGICAL SETTING

The test well, seismic refraction survey and monitoring well information contributed to the interpretation of the geological setting of the Wausau area presented below.

3.1 Surficial Geology

Wausau is situated in a complex array of Pleistocene glacial deposits overlying predominantly Precambrian igneous and metamorphic bedrock. The Wausau topography is typified by gently rolling plains which are the remnant deposits of outwash sand and gravel carried into the Wisconsin River Valley by the Rib and Eau Claire Rivers. Local areas exhibit a marked increase in relief as a result of downcutting by the Wisconsin River and its tributaries.

The Pleistocene outwash deposits provide the major source of ground water in the area. Present knowledge of the surficial geology has indicated that the area has been inundated three and possibly four times by glacial advances in the Pleistocene epoch.

3.2 Bedrock Geology

The bedrock geology was studied extensively by LaBerge and Myers (1983) to determine the potential for mineral exploration of the Precambrian rock. Two major lithic units, both volcanic in origin, dominate the regional bedrock geology. Two syenite plutons exist in the Wausau area on the western side of the Wisconsin River. The plutons are concentric ovals that consist mainly of syenite, quartz syenite and a semi-circular ring of large quartzite xenoliths. The east side of the Wisconsin River exhibits regionally extensive felsic volcanic rock (rhyolites). The contact between these two lithic bodies in the Wausau area is believed to lie beneath the Wisconsin River. In the Wausau study area, the river exhibits an unusually linear reach which is attributed to the fault line between the two lithologies (LaBerge, Klasner, pers. comm., July 16, 1984.)

It has been surmised that the bedrock topography appears to be controlled by erosion. The less resistant syenite (the West Well Field) exhibits dramatic relief changes; the more resistant rhyolite of the East Well Field exhibits subtle relief features.

3.3 Hydrogeology

Ground water in the Wausau area is contained within two distinct lithologies; an upper lithologic unit in the unconsolidated Pleistocene glacial outwash deposits and a lower zone in the underlying bedrock. The outwash deposits are quite extensive and exhibit excellent hydrogeologic properties for yielding large quantities of water. The waterbearing character of the deposits is, in part, a function of depositional regime and location within the buried bedrock valleys. The highest yields within the deposits are generally found in the deep valley axis, where coarser sediments occur. All of the municipal wells in Wausau are screened in the outwash deposits, but do not extend to the bedrock surface. Yields range from 500 to 2,000 gallons per minute (gpm) and are sufficient to provide the City with an adequate water supply.

Preliminary investigations indicate that the groundwater in the glacial deposits receives recharge from direct infiltration through the land surface and discharges as base flow to the Wisconsin River and its tributaries. Bedrock may also contribute somewhat to the recharge of the overlying deposits. Induced infiltration from the Wisconsin River has occured in areas as a direct result of pumping from the municipal wells. The resulting gradient reversal is a function of the pumping scheme employed by the City of Wausau, and may also be related to the level of the Wisconsin River.

The bedrock aquifer is utilized, to a limited extent, as a potable water source for residential wells where glacial deposits are thin. These wells are generally greater than 75 feet in depth and yields are usually less than 50 gpm. Groundwater movement in the bedrock is controlled by fracture planes, and actual groundwater yields in wells are a function of fracture density and intersection.

3.4 Test Well Results

The test well, monitoring well (MW) #1, was positioned in the northeast corner of Marathon County's Schofield Park for several reasons: 1) the location was expected to be within the radial cone of influence of City Well #6; 2) the site had previously been the location of a lumber company disposal area, where the company had landfilled wood and production wastes; and 3) the site had been noted by several senior citizens as a neighborhood dump. The actual volume, dimensions and content of the landfilled material is unknown. In addition, a nearby industry, Marathon Electric Manufacturing Company (location - Figure 2), had been identified as a potential contaminant source. The company was suspected to have used trichloroethylene in the manufacture of various electrical components.

The test well was designed to provide stratigraphic information, water table elevations, actual depth to bedrock for seismic calibration, and, possibly, data on the depth and concentration of the VOC plume. Penetration values recorded during the sampling generally ranged between 25 and 50 blows for the final 12 inches of the sample recovery. Water table elevation was determined to be at 1,186.81 feet above Mean Sea Level (27 feet below land surface). The water level was monitored under various municipal pumping regimes and measurements indicated a static water level fluctuation of 6 to 12 inches directly attributable to the pumping of City Well #6; water level fluctuations occurred within one hour of pumping at City Well #6.

The bedrock surface was encountered at 159.5 feet below land surface. With knowledge of the depth of the bedrock surface and the degree of consolidation of overlying sediments, the seismic survey was extremely useful in mapping the bedrock topography.

Water samples were collected at 10-foot intervals and analyzed for VOCs. Laboratory analysis found no significant levels of volatile organic compounds at any of the intervals sampled (Table 13).

3.5 Bedrock Topography

The bedrock surface contour maps were constructed from the geophysical survey and well borings (Figures 12, 13). The contour maps depict the

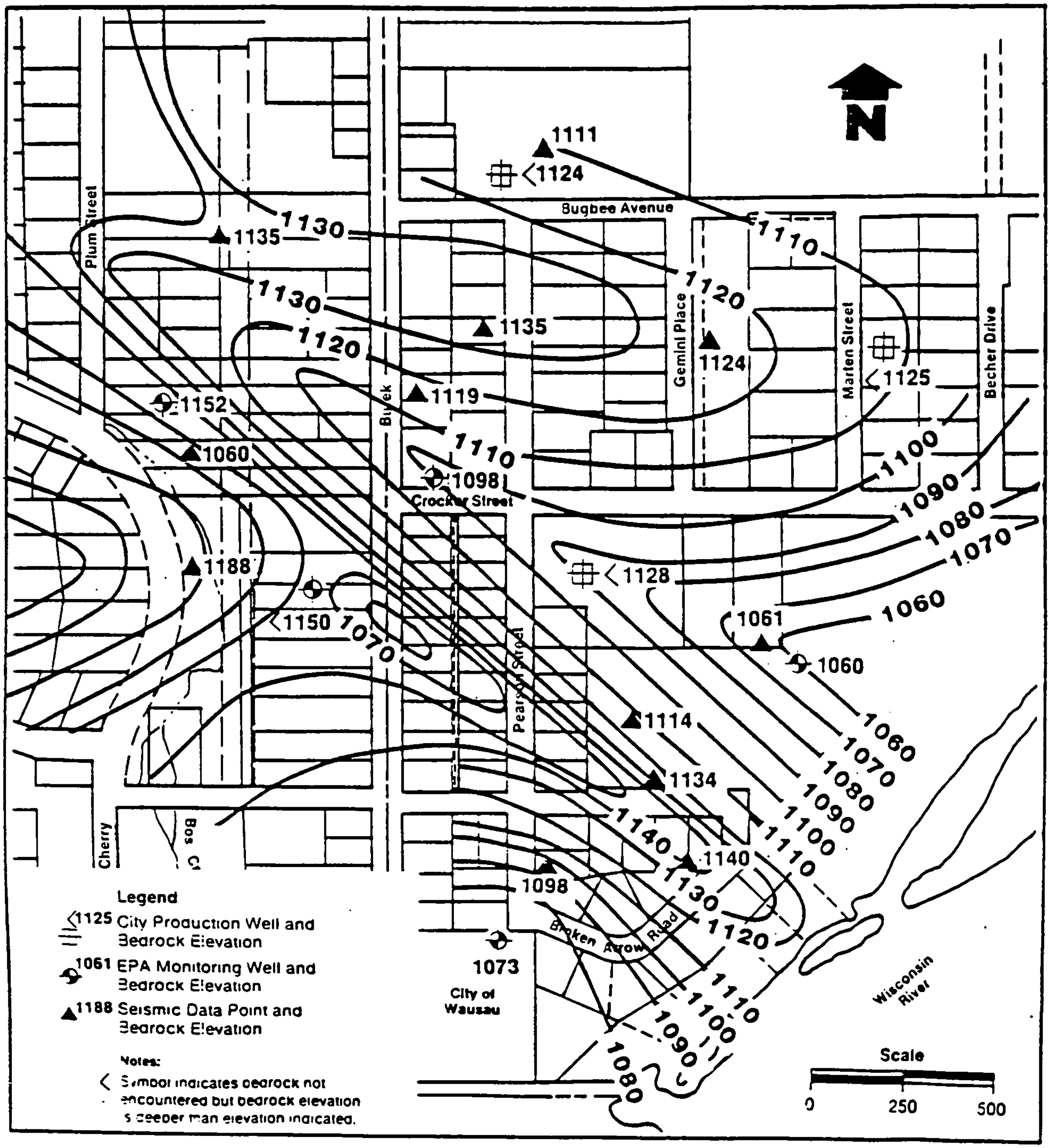


FIGURE 12 **WEST STUDY AREA - BEDROCK TOPOGRAPHY MAP**

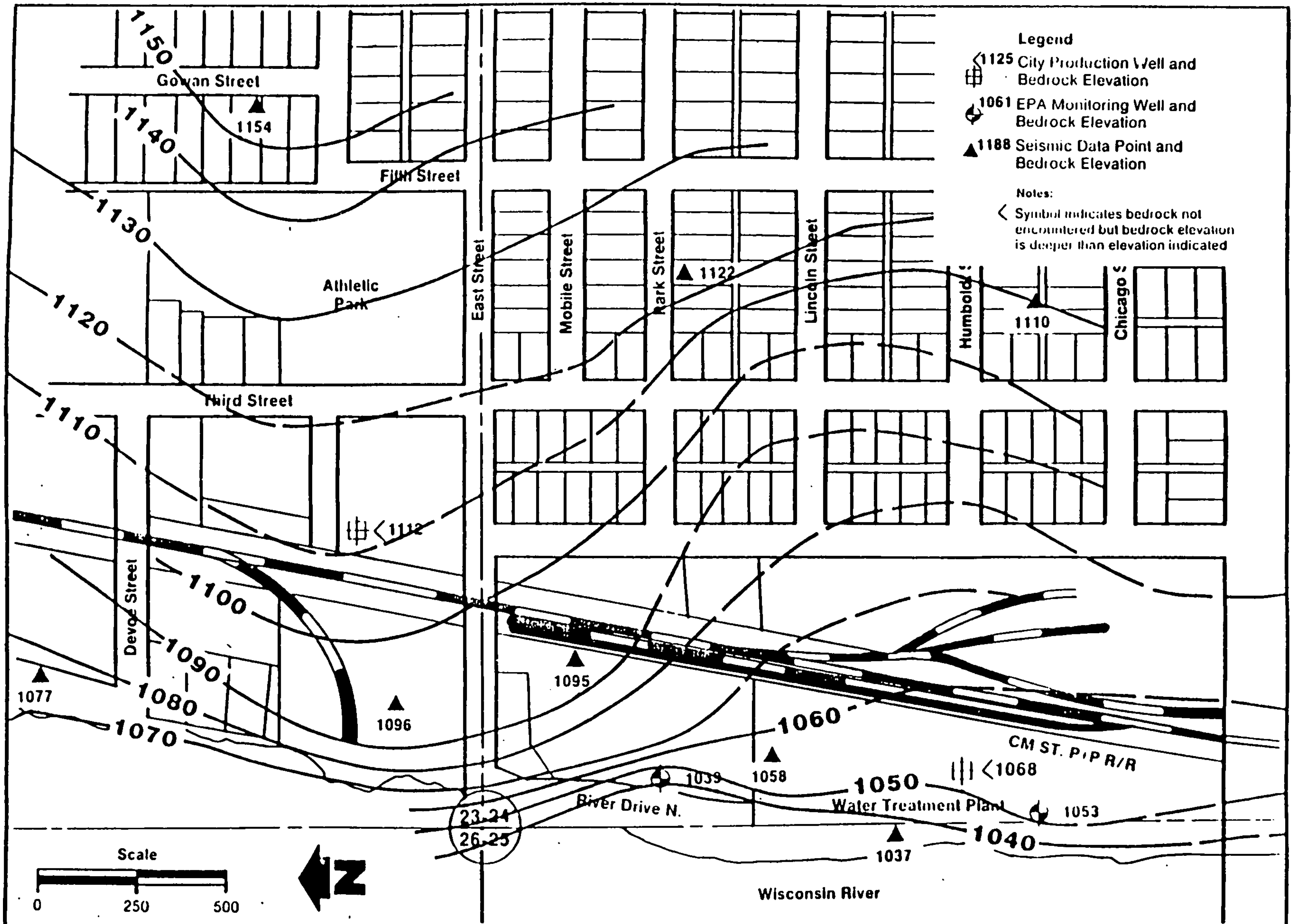


FIGURE 13 EAST STUDY AREA - BEDROCK TOPOGRAPHY MAP

effects of differential erosion rates attributed to differences in lithology. The rhyolite east of the river exhibited subtle, uniform erosional surface. In contrast, the west side of the Wisconsin River expressed a sharply contrasting relief indicative of less resistant syenite bedrock.

3.6 West Well Field

Preliminary data indicated the presence of two significant buried bedrock valleys in the western study area. One valley originates near the intersection of Campus Drive and Schofield Avenue and trends northwest to southeast to City Well #6. This bedrock valley parallels Bos Creek and appears to be very narrow and deep (approximately 100 ft). The second buried valley generally trends east-west in the vicinity of Bugbee Avenue. City Well #9 is situated within the confines of this valley. The second buried valley appears to extend from Campus Drive at Fourth Avenue to City Well #9. City Well #7 is believed to be located upon the axis of a buried ridge that divides the two valleys. The ridge appears to be sloping towards the Wisconsin River where the alluvial deposits increase in thickness.

Preliminary data also indicated the presence of an elongated ridge on Burke Avenue which trends northwest-southwest. The ridge expressed significant relief and created the eastern half of a saddle feature. It appeared as if Bos Creek has been rerouted along the axis of this saddle feature indicating the possibility of a ground water and surface water divide.

3.7 East Well Field

The eastern study area's bedrock topography expressed subtle relief changes with little direct influence on the city production wells. A gently sloping valley trends in a general east-west direction, parallel to Lincoln Avenue. This valley was more apparent outside of the alluvial deposits where it outcrops on east Wausau Avenue.

4.0 DISCUSSION OF CONTAMINANT SOURCES

The information provided by the industrial user's survey, combined with data provided by the sampling of the monitoring wells, is discussed below with implications regarding sources of the water contamination.

A brief comment regarding the characteristics of the contaminants may be useful at this point. It should be noted that PCE or TCE may undergo biodegradational transformation in anaerobic subsurface environments (Parsons, et al., 1982 1984). PCE, the parent compound, degrades to TCE, which subsequently degrades to the cis- and trans- isomers of 1,2-DCE, and eventually to vinyl chloride as the end product. A greater proportion of the cis- isomer relative to the trans-isomer of DCE is generated. The significance of this process to the following discussion is that the TCE and DCE present in contaminated water may be derived from a single specific parent compound.

In addition, the specific gravity for PCE, TCE and DCE is 1.63, 1.46, and 1.26-1.28, respectively. The high specific gravity values of these compounds, combined with their low solubility, indicate that these compounds should sink to the bottom of an aquifer. Xylene and toluene, on the other hand, have specific gravity values of 0.86 and 0.87, respectively, and would tend to float on the water surface, although low concentrations and vertical gradients suspending compounds in the upper aquifer zone may inhibit this phenomenon. Thus samples from shallow monitoring wells could miss the heavier contaminants, and deep wells could miss the lighter contaminants.

4.1 East Well Field Monitoring Wells

4.1.1 City Well #4

City Well #4 was constructed in July 1966 as a supplemental supply well to accomodate seasonal demand. The well is located approximately 100 feet east from the Wisconsin River and 200 feet south of Wausau's water treatment plant (Figure 14). The well was completed at 132 feet below land surface and was sized with a 40 foot section of stainless steel shutter screen. The casing diameter is 30 inches and the screen diameter is 20 inches. After construction, the well was tested at 2,000 gpm for a duration of 12 hours. The well had 36 feet of drawdown and has a specific capacity of 55.6 gpm/ft (Layne-Northwestern, 1966). Due to the well's proximity to the river, a significant proportion of its recharge is from induced infiltration from the river; such induced infiltration could dilute contaminants in the groundwater, thus lowering the VOC concentrations.

Historical well chemistry data indicate relatively low concentrations of PCE and TCE, but significant levels of DCE (Figure 15). The original detection of VOCs occurred in October 1982. Later sampling results have also indicated trace levels of toluene and xylene. During 1982 and 1983, concentrations fluctuated dramatically. As of May 1984, individual contaminant levels were under 110 ppb.

Potential Contaminant Sources - City Well #4

Several sources warranted evaluation during the early stages of the source investigation:

- Wausau Chemical Company,
- Marathon Box Company,
- A strip of property owned by the Chicago, Milwaukee, St. Paul and Pacific (CMSPP) Railroad located between City Well #4 and Marathon Box Company,
- The Wisconsin River, and
- An unidentified upgradient source (east of Marathon Box).

The Wausau Chemical Company was identified as a possible source since part of its operation includes distribution of bulk solvents for the dry cleaning and other industries. Additionally, it is located near City Wells #3 and #4, and it has had a history of solvent spills.

In May of 1975, during excavation at the Wausau Chemical Company for the expansion of the City of Wausau's water treatment plant, strong odors were emanating from the excavated ground. Soil samples analyzed by Zimpro Laboratory were found to contain 31.5 ppm PCE, 25.6 ppm TCE, 247 ppm toluene, and 7.1 ppm xylene. Subsequently, the WDNR requested that Wausau Chemical remove the contaminated soil from the property, implement a groundwater surveillance program, and install a forty foot monitoring well to define the lateral extent of contamination. The monitoring well was installed, but there is no known record of monitoring efforts or of contaminated soil removal. The Wausau Chemical Company reported two spills of PCE in 1983.

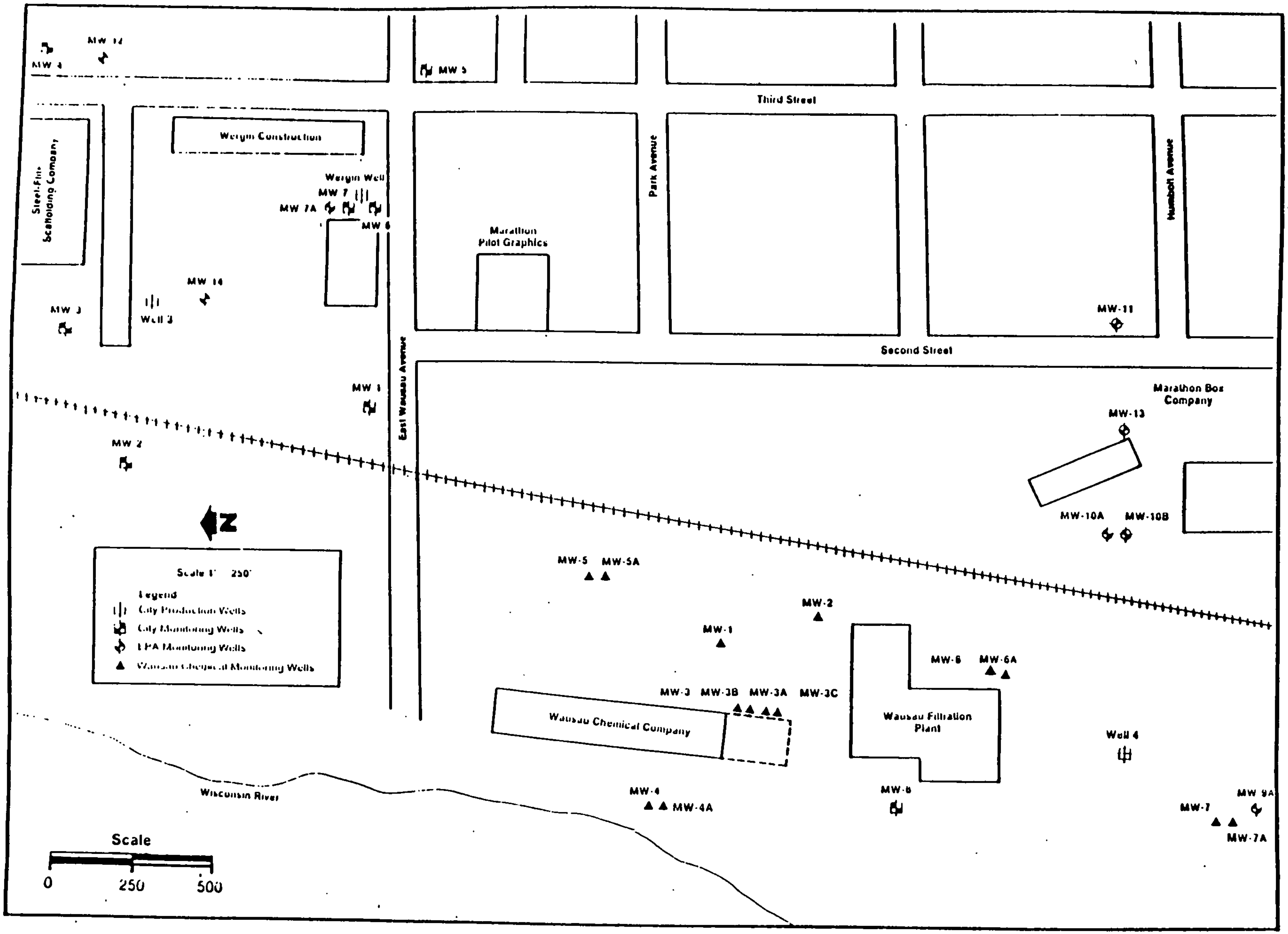


FIGURE 14 **EAST STUDY AREA WELL LOCATION MAP**
- Well locations are approximate.

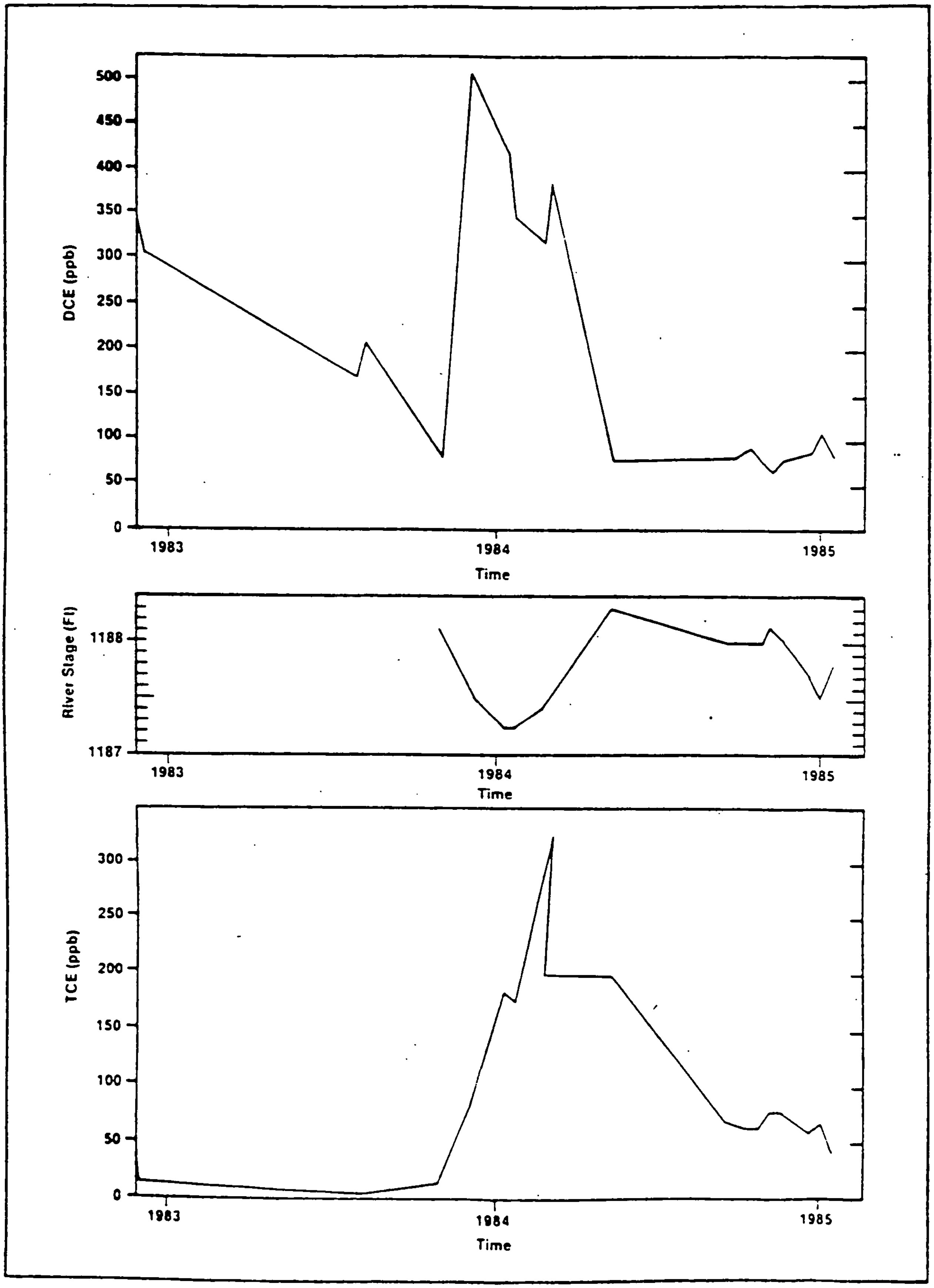
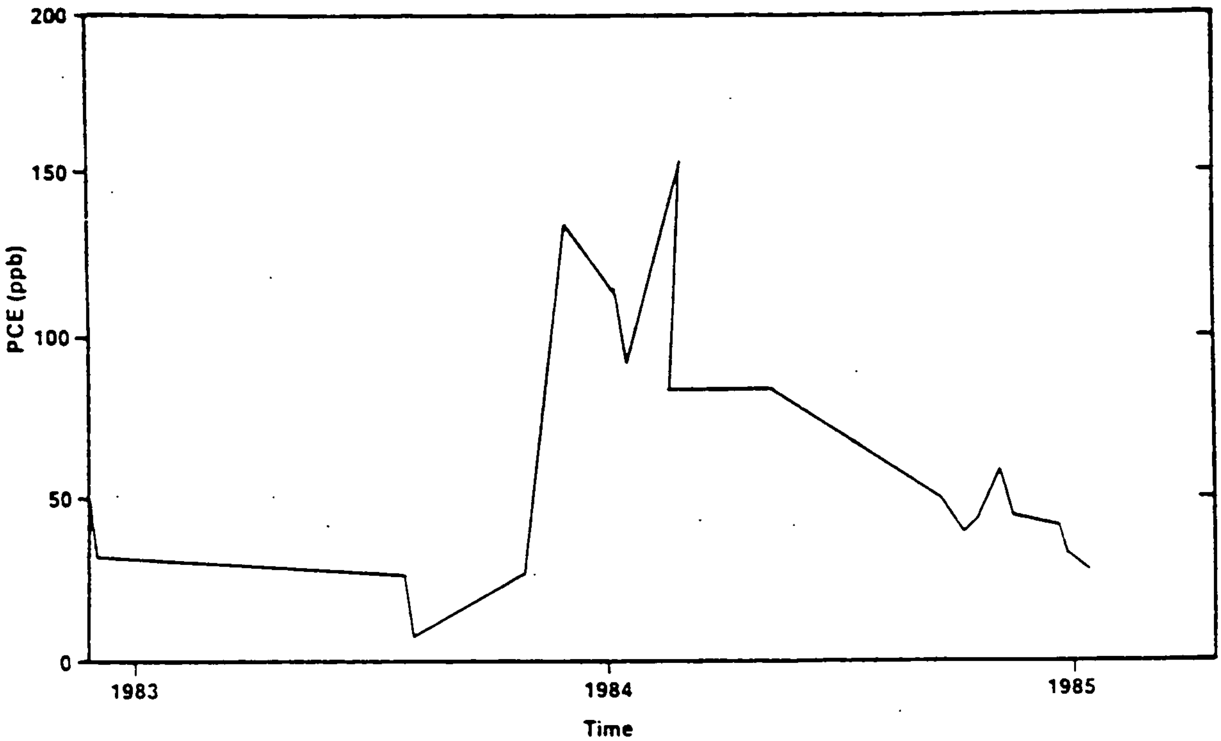


FIGURE 15 HISTORIC VARIATION IN RIVER STAGE AND CONTAMINANT CONCENTRATIONS IN CITY WELL 4



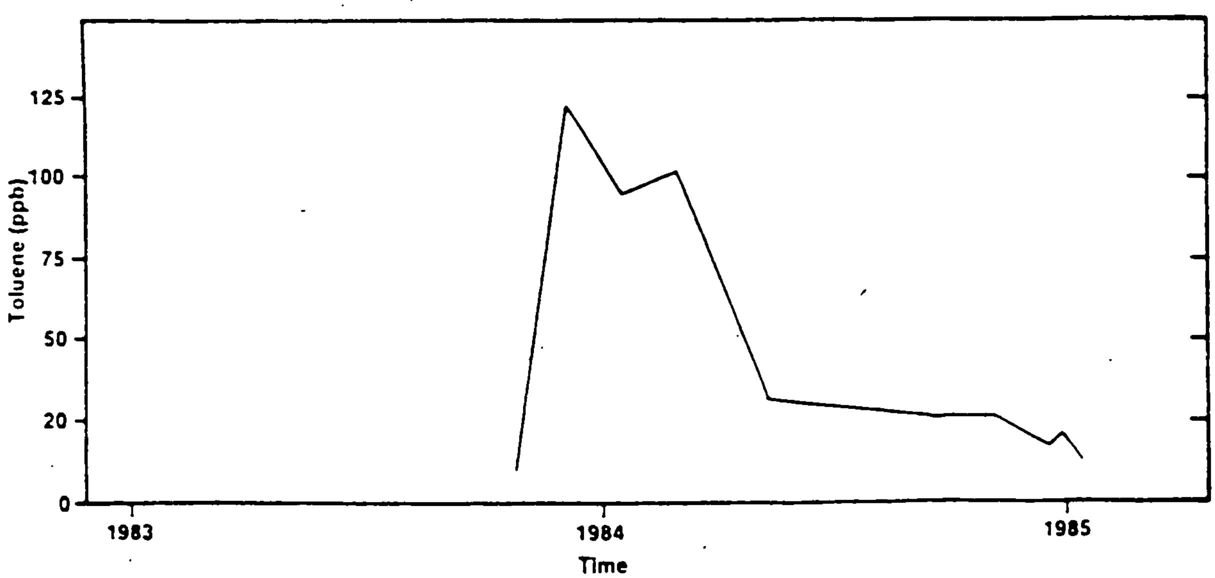


FIGURE 15 **HISTORIC VARIATION IN RIVER STAGE AND CONTAMINANT CONCENTRATIONS IN CITY WELL 4 (CONTINUED)**

The first spill occurred on February 15, 1983, when a valve broke on a delivery truck during off-loading. At least 135 gallons were discharged from this incident, based on information gathered from the TAT Spill Prevention Control & Countermeasures (SPCC) report. On December 19, 1983, a second PCE spill occurred, releasing in excess of 500 gallons.

Remedial measures of an undetermined effectiveness were taken in an attempt to limit the environmental impact of these 1983 spills. The measures consisted of absorbing the spilled liquid with absorbant materials and excavating the contaminated soil.

Additionally, inspections revealed that the facility's bulk storage tanks and diked perimeter appeared to be structurally inadequate. Visual observations by the U.S. EPA identified stained soils from a drum storage area located behind the facility.

Because of its history of contamination problems, including the spills in 1983, the Wausau Chemical Company installed 14 monitoring wells at the request of WDNR. Wausau Chemical contracted Soil Testing Services, Inc., (STS) to install the wells and to interpret the results.

Groundwater analysis of the Wausau Chemical monitoring wells indicated significant PCE and other contaminant levels in wells #1, #2, #3A, #3C, #5A, and #6A. It is apparent that a substantial amount of the contamination is concentrated at the southern end of the facility. Additionally, sampling from monitoring well #5A, located at the north end of the facility, has shown increased PCE concentrations. This would indicate possible contaminant movement toward City Wells #3 and #4, emanating from the facility. Preliminary data indicates that the contaminant appears to be concentrated in the upper part of the aquifer (Table 14).

A second possible industrial source, the Marathon Box Company, warranted investigation because of its upgradient location and usage of various chemicals for wood treatment and a common cleaning solvent to clean machinery.

Contaminant sources upgradient (east) of City Well #4 were investigated by installation of four U.S. EPA monitoring wells, MW-#10A, MW-#10B, MW-#11, and MW-#13. Samples from the nested well set (#10A, #10B), located at the western half of the Marathon Box property, contained concentrations of VOCs in proportions similar to VOCs in City Well #4. Monitoring Well #10A, screened at 60-70 feet, contained concentrations of PCE and TCE that ranged from less than 10 ppb to 120 ppb PCE and 580 ppb TCE (Table 15). Well #10B, screened from 25 feet to 35 feet, exhibited much greater DCE concentrations (580 ppb) than the MW-#10A (less than 10 ppb) and suggested a nearby surface soil contamination source.

To define the eastern boundary of the contamination, a shallow 35-foot monitoring well (MW-#11) was constructed further upgradient, near the corner of Second Street and Humboldt Avenue. Only nondetectable to trace levels of contamination were found, suggesting that the loading source was located between monitoring well nest #10A/#10B and monitoring well #11. As a result, a fourth well, MW-#13, was constructed between the two locations which confirmed groundwater contamination with DCE, TCE and PCE at concentrations of 30 ppb, 20 ppb and 50 ppb, respectively, beneath the Marathon Box property (Table 15).

As noted previously, the strip of property owned by the CMSPP Railroad was also considered a possible source area. The Wausau Chemical Company has received bulk shipments of chemical solvents via rail, and spillage or leakage may have occurred at this area during transfer of materials. However, due to the necessarily limited scope of this preliminary investigation, no data was collected in the present study to either confirm or refute this property as a source, and the railyard merits investigation in any future studies. Furthermore, based on the data collected, it was not possible to segregate potential source areas on the railroad right-of-way from contamination documented on Wausau Chemical and beneath Marathon Box properties.

Potential contaminant sources between the Wisconsin River and City Well #4 were investigated through sampling of U.S. EPA monitoring well #9A and by sampling Wausau Chemical's monitoring wells #7 and #7A. Monitoring wells located between the Wisconsin River and City Well #4 documented that contaminants were neither migrating westward past City Well #4 nor derived from the Wisconsin River through induced infiltration.

Groundwater movement in the eastern study area was observed to be greatly altered by drawdown during pumping of City Wells #3 and #4. Under static conditions (i.e., no pumping), groundwater flows west towards the Wisconsin River, contributing to base river flow. Pumping of City Wells #3 and #4, however, reversed this flow direction along the river recharge zone (Figure 16). City Well #4's cone of influence extends west to the Wisconsin River where it receives a significant portion of its recharge. The cone also extends eastward, upgradient, possibly encompassing the entire Marathon Box property and extends further east to a point beyond Second Street.

The size of City Well #4's cone of influence is a function of river stage and pumping regime An inverse relationship is believed to exist between the elevation of the recharge boundary and the size of the cone of influence. As the river stage declines, the size of the cone of influence increases to maintain hydraulic equilibrium. The interaction between pumping rates and the fluctuating elevation of the river recharge boundary is believed to be a significant factor affecting groundwater contaminant concentrations and contaminant movement in the eastern study area wells Specifically, when the Wisconsin River stage is increased, the hydraulic head along the recharge boundary is increased Under these conditions, the volume extracted from the river is increased. As a result of this increased recharge, contaminants are diluted within City Well #4's cone of influence. Conversely, a decrease in river stage reduces the hydraulic head along the recharge boundary and the volume extracted from the river is decreased. The net result of this inverse relationship is an increase in contaminant concentration when the river stage is lowered. Additionally, contaminant movement will be enhanced or retarded to varying degrees depending on the combined effects of river stage, pumping pattern and pumping volume.

Based on results of analyses of water samples collected from the Wausau Chemical wells, city monitoring wells, and newly installed U.S. EPA monitoring wells, it is apparent that at least two sources have impacted City Well #4. Monitoring wells upgradient to the east of City Well #4 indicated

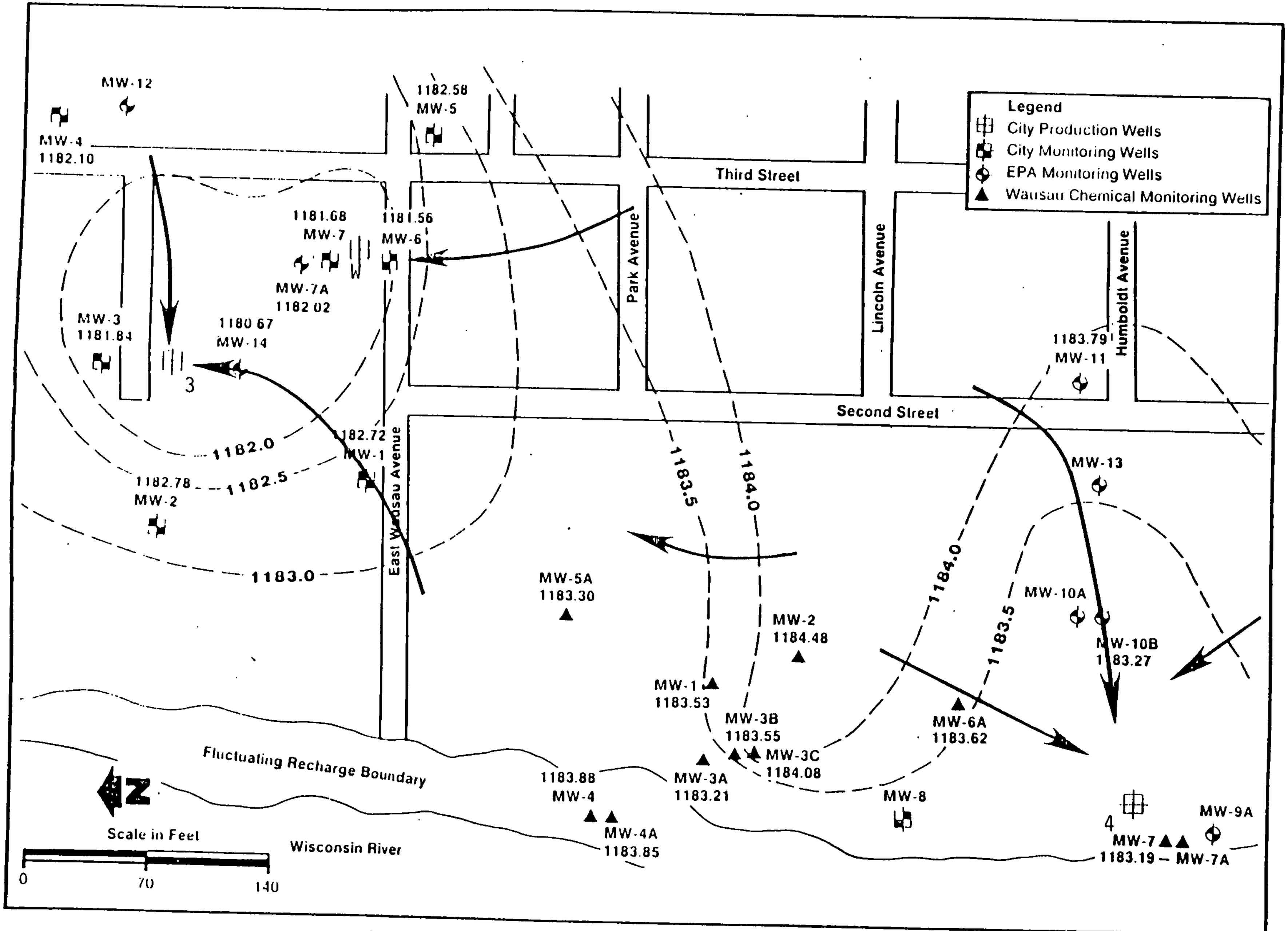


FIGURE 16 **EAST STUDY AREA WATER TABLE CONFIGURATION**
- Well locations are approximate.

that a source area exists either along the railroad tracks adjacent to Marathon Box, or on Marathon Box property proper, or both. It is also apparent that Wausau Chemical Company is contributing to the contamination in City Well #4. Monitoring wells installed on and around Wausau Chemical Company have clearly demonstrated high contaminant concentrations in the ground water, particularly in the shallower monitoring wells, which also occur in City Well #4. Total VOCs on the order of several thousand ppb are also found in ground water between Wausau Chemical and City Well #4 confirming migration toward the city well. In addition to the high levels of chlorinated organics observed in the ground water, soil samples obtained from the Wausau Chemical property indicated significant levels of PCE, TCE, DCE, toluene and xylenes. Again, these contaminants are being detected at City Well #4.

The cones of depression attributed to City Well #4 and City Well #3 both appear to extend to the Wausau Chemical property. As depicted on Figure 16, ground water within the southern boundary of the property tends to flow toward City Well #4 whereas within the northern confines of the property, ground water tends to flow northeast as influenced by City Well #3, when the city wells are operational. Flow directions are further influenced by the variation in river recharge as affected by fluctuations in base river flow.

4.1.2 City Well #3 and Wergin Well

City Well #3 was drilled and completed in the spring of 1961. The well is located approximately 300 feet north of East Wausau Avenue and 250 feet south of Third Street. It is 91 feet deep and 18 inches in diameter with an initial boring of 48 inches. The well's construction is consistent with standard methods, and includes a 40-foot screened interval. Pump tests have not been documented and they are not on file with any state or local agency. The well's maximum yield is 1,500 gpm and draws its recharge from surface infiltration, the bedrock uplands, and the Wisconsin River. TCE has been the persistent contaminant at about 100 to 200 ppb. PCE and DCE, which occurred previously in high concentrations, have diminished to only trace levels of less than or equal to 10 ppb.

The Wergin Construction Company's well is located approximately 280 feet southeast of City Well #3. The well is 70 feet deep and 6 inches in diameter. It yields approximately 75 gpm and is designed for nonconsumptive use in noncontact cooling water which is subsequently discharged to the municipal sewer system. The well was initially tested in July 1982. Analysis identified 2,100 ppb DCE, 230 ppb TCE, and 110 ppb PCE in the groundwater samples. Between October 1982 and November 1984, total VOC concentrations steadily declined to the order of 100 ppb (Table 16).

Potential Contaminant Sources - City Well #3 and Wergin Well

At the onset of the investigation, City Well #3 was one of the City's main supply wells. The well was first shut down on April 22, 1982, due to contamination. Several suspected contaminant sources exist in the vicinity of the well. Wausau Chemical Company, for the historical reasons noted above in 4.1.1, was believed to be a likely source area.

Water levels indicated that City Well #3's cone of depression extends over a large area. The well draws recharge from the Wisconsin River and from surrounding areas. As previously described in relation to City Well #4, the size of City Well #3's cone of depression, rate of groundwater movement, and dilutional effects are a function of river stage, pumping volume and pumping scheme. During low base river flow periods, the cone of influence from City Well #3 extends south and west into the Wausau Chemical Company property. This relationship appears to be controlling the ground water movement on the northern half of the Wausau Chemical property. When Well #3 is pumped, the native gradient appears to be reversed to some degree, possibly enhancing contaminant movement as suggested by the increasing levels of PCE at Wausau Chemical MW #5A.

The U.S. EPA and the WDNR conducted an industrial survey which identified three additional facilities as potential source areas: Wilson-Hurd, Steel-Flite Scaffolding, and Marathon Pilot Graphics.

Wilson-Hurd is a manufacturer of name plates, located approximately 1,000 feet northeast of City Well #3. The plant engineer, Bill Siebecker, supplied the U.S. EPA with their material safety data sheets which listed the use of aromatic hydrocarbons. The engineer indicated that they used approximately 165 gallons of unspecified aromatic hydrocarbons per month and the residual wastes are collected and transported by Wausau Chemical Company to Waste Research and Reclamation in Eau Claire, Wisconsin. Based on this information, it appears possible that Wilson-Hurd may be considered a potential source of contamination.

Steel Flite Scaffolding Company, located directly north of City Well #3, was identified as another possible source. The industrial survey indicated that the products in question were not used in large quanitities on site and all wastewater was discharged to the city sanitary sewer system. Based on the above facts and the fact that Steel Flite does not utilize large quantities of solvent in their manufacturing process, they are considered a minor potential source of contamination.

Marathon Pilot Graphics (Marathon Press Company, Inc.), located directly south of Well #3, was also identified as a possible source. During the industrial survey, the president of the company was interviewed and he indicated that the company uses several solvents and cleaners but had no material safety data sheets. He agreed to contact the manufacturers and forward data sheets to the U.S. EPA. The firm disposed of used solvents in the city sanitary sewer. The survey also noted that press cleaners were applied with rags and that no excess liquid was generated. Due to the limited information on the industry's disposal methods and in-house products, they remain a possible source area.

The property upon which City Well #3 was constructed was also a suspected source due to previous land use. Records and conversations with local residents indicated that the property was used as a maintenance garage by the City of Wausau prior to the early 1960's. Actual documentation of the products used and disposal practices are not known to exist. It is, however, possible that chlorinated hydrocarbons were used as degreasing/ cleaning agents.

Prior to this investigation, seven monitoring wells were constructed by the City. These wells were intended to define the direction from which contamination was migrating to City Well #3. In addition, monitoring wells installed by Wausau Chemical Company aided study efforts. To further augment data from the City of Wausau and the Wausau Chemical Company's wells, U.S. EPA installed three monitoring wells: two (MW #7A and MW #12) as piezometers adjacent to existing City of Wausau monitoring wells MW #7 and MW #4, respectively; and due to the past land use near the city production well, MW #14 was constructed in the equipment yard, 60 feet south of City Well #3. Monitoring Well #14 was intended to either intercept the plume or document on-site loading.

Monitoring wells #1 and #14, positioned between City Well #3 and Wausau Chemical Company, did not detect any contamination that would suggest a plume in the shallow ground water attributable to Wausau Chemical Company. Monitoring well #1, installed by the City of Wausau, was screened at a depth of 40 feet, and quite possibly was too shallow to detect the contaminant plume. Monitoring well #14 was installed close to City Well #3 to document local contaminant loading, and was, therefore, screened at a shallow depth (35 to 45 feet). This well also was possibly too shallow to detect a plume from Wausau Chemical Company. To confirm the existance of a possible plume of contaminants from Wausau Chemical Company, it apparently would be necessary to install and sample well(s) screened at depths of greater than 50 feet.

The contaminant trends observed at City Well #3 indicated PCE and DCE concentrations have diminished. This would suggest a discrete spill or loading episodes involving PCE and DCE. Consistent occurrence of TCE at the 150-210 ppb range suggests continual loading of this contaminant and therefore indicates possible additional sources. To date, any additional source areas are unknown and upgradient sources north of City Well #3 should be investigated.

In addition to the increasing PCE levels observed at Wausau Chemical's MW #5A, it appears that City Well #3's cone of influence is enhancing contaminant movement emanating from the Wausau Chemical facility. As previously mentioned, a second plume that impacted the Wergin well may have had some influence on City Well #3. This plume was first detected in city monitoring wells #5 and #6 and in the Wergin wells in September and October 1982. Since the 1982 analysis, concentration trends suggest that a plume has migrated past city monitoring well #5 and has been intercepted and/or drawn to the Wergin well. Current analysis has indicated a decrease in contaminant levels (Table 16). Based on this information, it is believed that VOC levels once observed in these wells were the result of at least one discrete loading episode which migrated as a slug. Furthermore, the Wergin well may have acted as a barrier well, minimizing the impact of the plume on City Well #3.

4.2 West Well Field Monitoring Wells

4.2.1 City Well #6

City Well #6 is located on the west side of the Wisconsin River at the corner of Pierson Street and Crocker Avenue The well was drilled by Lane Northwestern in 1951 and was completed at 100 feet below land surface. The well was fitted with 38.5 feet, 24 inch diameter well screen and packed gravel. The well tested at 3600 gpm, yielding a specific capacity of 130 gpm/ft. Maximum pumping rate is 2,000 gpm; however, the city usually pumps the well at 1,550 gpm. The well yields large volumes of low iron water and it has been desirable for the City to use this well to its fullest potential.

Contamination was first detected in City Well #6 in March 1982, when 75 ppb of TCE was reported. Since the initial detection, TCE concentrations have been fluctuating between 100 ppb and 250 ppb (Figure 17). Trace levels of DCE have also been observed. TCE and DCE may be attributable to biodegradation of a PCE source, and DCE may result in part from biodegradation of a possible TCE source (as discussed in Section 4.0).

Potential Contaminant Sources - City Well #6

Due to the residential setting, lack of historical information, and absence of industries in the immediate vicinity, potential contamination source(s) at City Well #6 were not immediately apparent. Three potential sources were identified early in the study:

° Marathon Electric Company;

° Fill material along Bos Creek;

° Marathon County Park.

Marathon Electric Company and the Schofield Park are situated on adjoining parcels of land, approximately 1,500 feet southwest of City Well #6. As noted in the industrial user survey (Attachment JJ), Marathon Electric Company reported they had used chlorinated organics in their manufacturing process.

Earthen backfill lines the east and west banks of Bos Creek from Plum Drive to Burns Avenue. The source(s) and chemistry of the fill material were unknown.

Schofield Park was reported to be the site of a lumber company's former disposal area based on conversations with City employees and neighboring residents, but no details about area of disposal or waste materials are available. Monitoring well MW-#1A is located between these potential sources and City Well #6. Ground water was sampled at 10 foot intervals during drilling in an attempt to detect any VOC contamination. Contaminants were not detected at significant levels in any of the 11 samples from monitoring well MW-#1A when analyzed for the full volatile priority pollutant scan by gas chromatography/mass spectrometry (GC/MS).

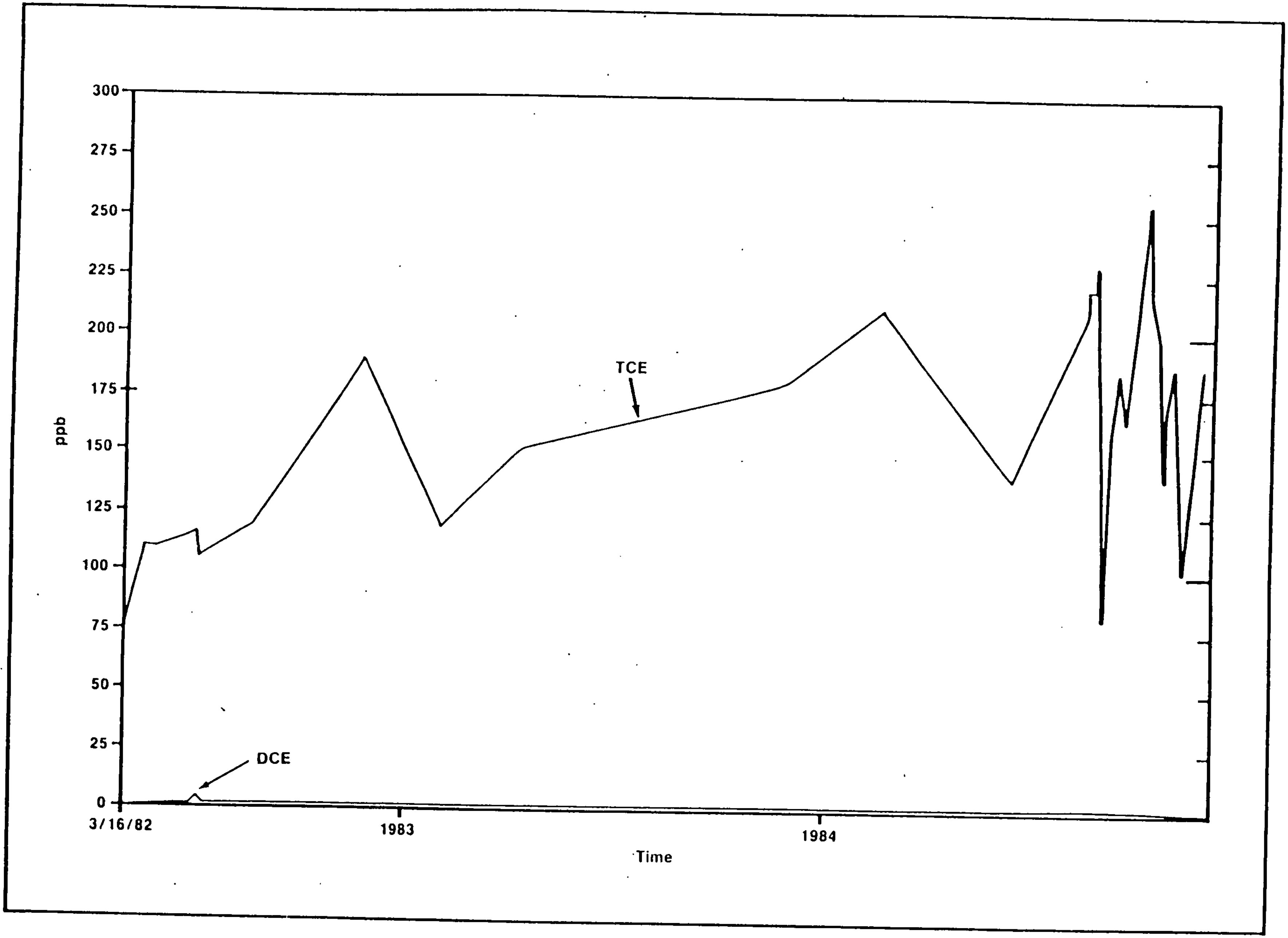


FIGURE 17 **CITY WELL 6 CONTAMINENT TRENDS**

Following installation of MW #1A, the seismic survey was conducted as a means of identifying aquifer morphometry in positioning additional well sites. The survey suggested that City Well #6 was situated within a buried bedrock valley trending approximately east-west. Monitoring well MW #2A was constructed in this bedrock valley approximately 750 feet west of City Well #6. The well was situated near the backfilled area adjacent to Bos Creek.

This well further refined understanding of bedrock morphometry and allowed positioning of two additional nested well sets within the bedrock valley. Nested wells MW #4A, #4B, and #4C were located directly upgradient in the axis of the bedrock valley containing City Well #6. Nested wells MW #3A and MW #3B were located east of City Well #6 in the same bedrock valley. No volatile organics were found in water samples collected from any of these wells. MW #2A, #3A, #3B, #4A, #4B, and #4C were all positioned to detect potential contaminant sources within the bedrock valley. Because no contaminants were found in these wells, the positioning of additional wells concentrated on detection of sources in the immediate vicinity of City Well #6. MW #5, #6, #7, and #8 were thus installed and screened at shallow depths to detect nearby potential sources. These four monitoring wells were located approximately north, south, east and west of City Well #6 at distances ranging from 110 to 150 feet from the well. The monitoring wells were initially constructed to shallow depths with the intention of drilling nested well sets if necessary. Again, sample analysis of these shallow wells failed to detect any volatile organics. As a final step, MW #9 was installed approximately 650 feet west of City Well #6, in an area that had been backfilled with unknown materials along Bos Creek. Samples from this shallow well contained no detectable levels of volatile organic contaminants.

The cone of depression from City Well #6 is believed to extend over 1,000 feet radially away from the well (Figure 18). The combined pumping of City Wells #6, #7, and #9 depresses a much greater area. The actual area is unknown due to lack of water level data around the uncontaminated city wells. Groundwater movement and flow velocity are controlled, in part, by the pumping schedule of the city wells. Under static conditions, ground water movement is toward the Wisconsin River (east) where it is discharged as base flow. When City Wells #7 and #9 are pumped and City Well #6 is off, flow is to the north and east (Figure 19). City Well #6 creates a large cone of depression and intersects the cones generated by Wells #7 and #9. Using field data collected at City Well #6 and U.S. EPA monitoring wells, maximum groundwater velocity has been estimated to be on the order of 1 foot per day. Measurement of water levels in well nests indicates the flow is nearly horizontal.

A bedrock feature was suggested by the seismic survey in the area southwest of City Well #6. This possible bedrock high, if present, may be influencing groundwater flow in that the horizontal gradient in this vicinity appears significantly less than the horizontal gradient observed northeast of City Well #6.

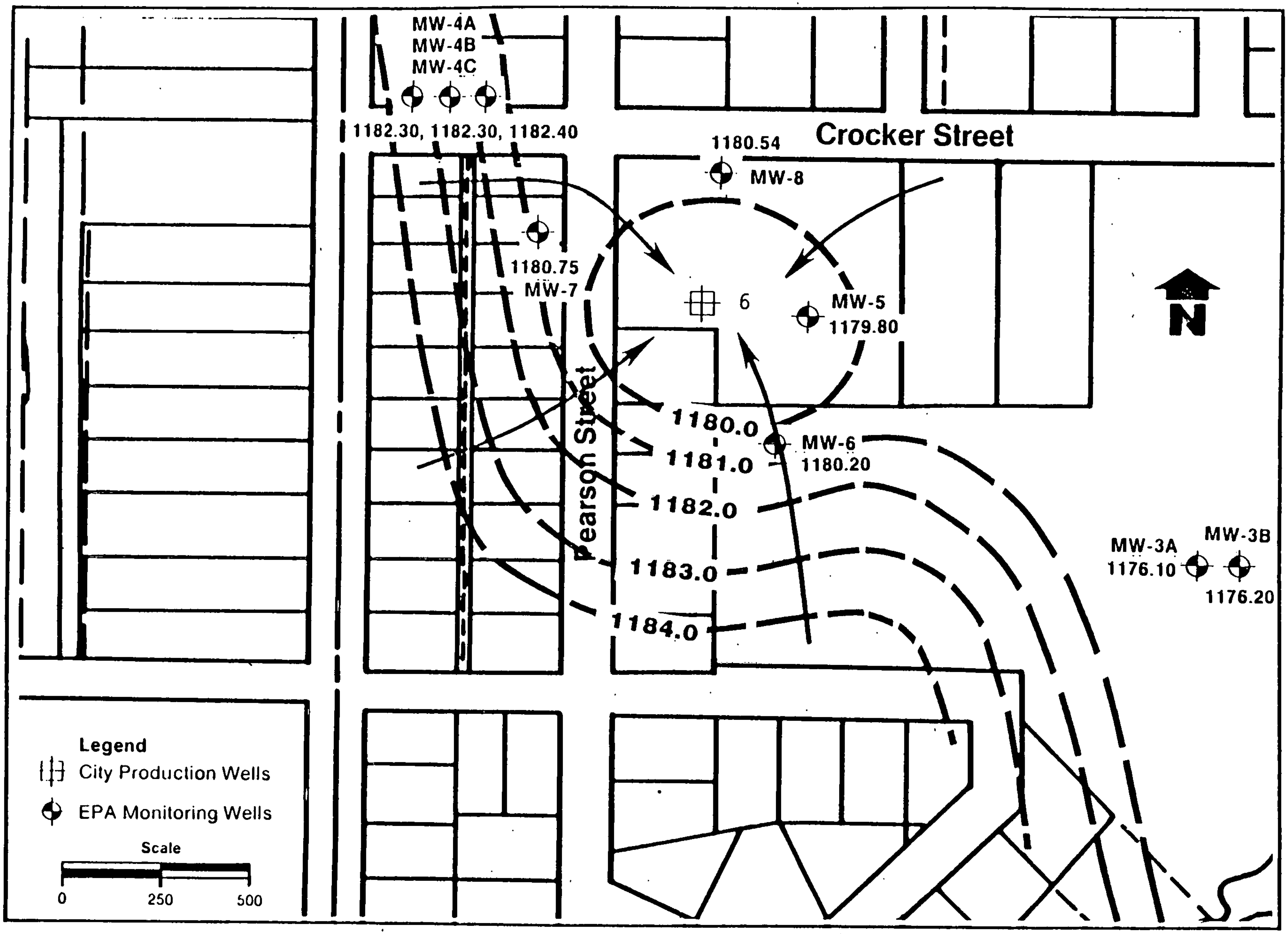


FIGURE 18 **WEST STUDY AREA WATER TABLE ELEVATION WITH CITY WELL PUMPING**

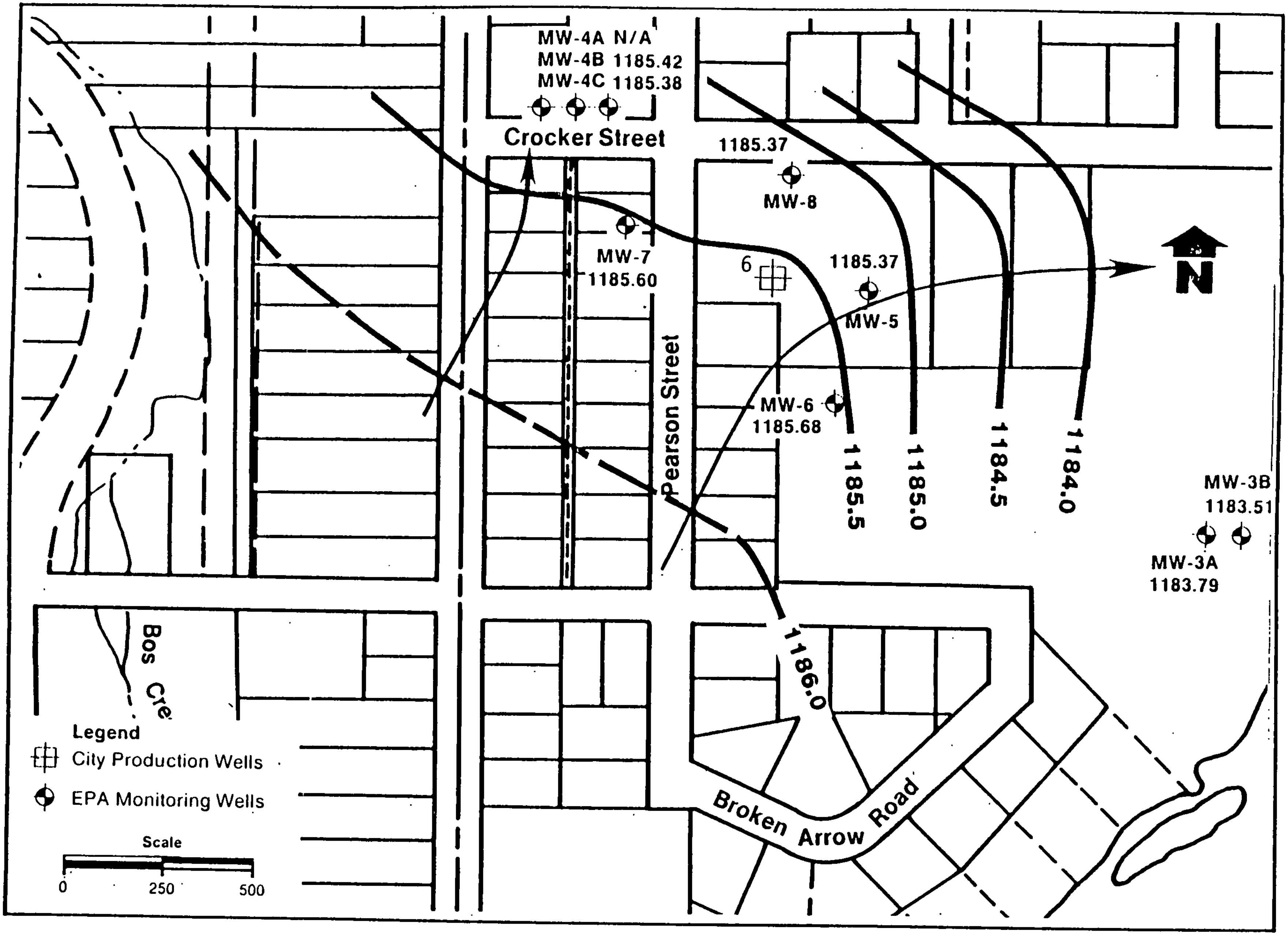


FIGURE 19 **WEST STUDY AREA WATER TABLE ELEVATION WITH CITY WELL 6 NOT PUMPING**

Data gathered herein suggests several possible explanations for the contaminants documented in City Well #6. The contaminant concentration and continued persistence suggests a large volume source. It is estimated that since the discovery of contamination an excess of 300 gallons of TCE have been pumped from City Well #6. The estimate is based on an average production volume (1.8 mgd), and an assumed concentration of 200 ppb. The estimate does not include TCE lost, dispersed, attenuation and volatilization. This estimate is based on the data collected at City Well #6 since its contamination was discovered in March 1982. Due to high flow velocities in the study area, the plume configuration may be very narrow and may have been missed by the U.S. EPA monitoring wells, passing either between or beneath the shallow wells.

If the contaminant is loaded within relatively close proximity of City Well #6, dispersion may be limited and the plume narrow due to convergence of flow lines toward the city well, making source detection through monitoring wells difficult. As a cost effective consideration, the proximal monitoring wells (MW #5, #6, #7 and #8) were completed at shallow depths, with the possiblity of drilling deeper wells at a later date. The deeper wells were contingent upon the analytical results. Therefore, if study efforts continue, nested monitoring wells should be considered at this location to evaluate the presence of contaminants entering the city well at depth.

Finally it is conceivable that the TCE source could be the result of contaminated soil and/or bulk volumes, and that a small leak on the order of a half gallon of pure product per day could go unnoticed and cause the levels of contamination observed at City Well #6. It is apparent that such a volume and persistence would merit further investigation.

5.0 CONCLUSIONS

The Wausau emergency removal action consisted of two major objectives: 1) to secure a safe and potable water supply in sufficient quantities to satisfy public demand, and 2) to conduct a hydrogeologic investigation to characterize the groundwater contamination problem and pinpoint possible contaminant sources.

The first objective was accomplished by the installation of four large, granular activated carbon units on City Well #6. These units successfully secured a safe and potable water supply for the city of Wausau.

The hydrogeologic investigation objectives, methods and results have been presented in detail. As a result of the investigation the following conclusions may be made.

5.1 Eastern Study Area

5.1.1 City Well #4

° Regional ground water movement under static conditions is generally toward the Wisconsin River where it is discharged as base flow. When pumped, City Well #4 extracts a majority of its recharge from the

Wisconsin River by induced infiltration. Additionally, pumping of Well #4 apparently reverses the groundwater flow direction and velocity of groundwater movement in the well's cone of influence. The river stage appears to influence the contaminant concentrations observed in the eastern study area. An inverse relationship has been identified between the contaminant concentrations at City Well #4 and the stage of the Wisconsin River. This inverse relationship reflects dilution of contaminants as a result of increased recharge from the Wisconsin River at increased stage heights.

- At least three different sources may have contaminated City Well #4: Wausau Chemical, Marathon Box Company, and the CMSPP Railroad. Monitoring wells clearly indicated a contamination plume emanating from the Wausau Chemical Company's property to City Well #4. Concentrations observed in the Wausau Chemical wells indicate the compounds are present and have impacted the local groundwater.

- Groundwater samples taken from monitoring wells located on the Marathon Box Company property indicate groundwater contamination beneath the facility. The contaminated groundwater emanating from beneath this property is potentially adversely impacting City Well #4. The CMSPP Railroad adjoins the Marathon Box property and may have been an area where spills commonly occurred. Without additional data it was not possible to determine if the Railroad is an additional contaminant source.

5.1.2 <u>City Well #3</u>

- A significant portion of City Well #3 recharge is derived from the Wisconsin River. The cone of influence apparently encompasses a large radial area and includes the Wausau Chemical property.

- City Well #3 and the Wergin well have been contaminated by more than one source. It was apparent that at least one short-term release of VOCs occurred upgradient of these wells. The release produced a pulse type of contaminant slug that appears to have emanated from a source upgradient in a east-southeast direction from the property. The Wergin well may have acted as a barrier well and minimized the impact of the contamination event on City Well #3 by intercepting the majority of the plume.

- Wausau Chemical Company may be partially responsible for the groundwater contamination impacting City Well #3 and the Wergin well as indicated by the increasing contaminant concentrations at MW #5A.

- The Wergin well may be receiving contamination from a source south and/or southwest of the well, possibly the Marathon Pilot Graphic facility or the Wausau Chemical Company; however, this plume has not been characterized.

- Due to the persistence in TCE concentrations observed at City Well #3, it is apparent that one or more significant sources are loading the system at a consistent rate.

5.2 Western Study Area

5.2.1 City Well #6

- Due to the detection of only one contaminant (TCE) and its constant concentration, it appears that City Well #6 has been contaminated by at least one source. The source of ground water contamination was not positively identified Two possible scenarios were presented. One scenario involves a distal source such as a bulk storage tank with a slow leak, or the earthen landfilled materials along Bos Creek that may be tainted with TCE. The plume may have bypassed the monitoring well configuration due to the convergence of the flow lines, or may be entering Well #6 at a depth beneath that of the monitoring wells. A second scenario involves an intensely localized source.

- The Wausau sewer tiles should be selectively checked for leaks in the vicinity of suspected contaminant sources and contaminated wells.

6.0 RECOMMENDATIONS

The following recommendations are provided in order to facilitate future study efforts.

- Groundwater samples should be taken periodically from all monitoring wells. Sample collection should continue and the results should be evaluated by a hydrogeologist to monitor contaminant transport and fate.

- The expansion of monitoring well control in the two study areas is required to further identify suspected sources impacting the east and west study areas. To this end, an expansion of MWs #5, 6, 7 and 8 to nested sets may facilitate plume identification. A nested well site is suggested for the eastern study area to delineate the impact of the railroad property, Wausau Chemical Company, Steel Flite Scaffolding, and Marathon Pilot Graphics. At least four nested well sets would be required.

- Locate and delineate plume migration from Wausau Chemical toward City Well #3 by locating several wells at or near East Wausau Avenue and the north end of the chemical facility. Furthermore, the clustering of City MW #1 may identify a plume at a depth greater than the present monitoring well is capable of intersecting.

- Due to the impact that the Wausau Chemical facility apparently has had on City Wells #4 and #3, Federal, State, and local officials should remove and restrict the facility's drum storage area. Surface water runoff from the facility should be strictly controlled and operational practices should be monitored closely.

- The three dimensional extent of soil contamination on the Wausau Chemical, Marathon Box, and railroad properties should be defined. Subsequently, treatment or removal of the soils should be evaluated.

- The railroad's handling procedures of the hazardous substances should be evaluated to prevent the possibility of future spills.

- The Wausau sewer tiles should be selectively checked for leaks in the vicinity of the suspected contaminant sources and contaminated wells.

- The City of Wausau should consider siting another production well near the corner of Bugbee and Tierney Avenue, possibly 100 ft north of this intersection. A second possible location would be near the north corner of Plum Drive and Stone Street. The alluvial deposits at these locations are estimated to be over 120 feet thick and may yield sufficient quantities of water to justify the exploration expenditure. It should be noted that past land use in the area should be researched.

7.0 SUMMARY OF EXPENDITURES

PEI, the prime ERCS contractor, under delivery order number 6894-05-015, awarded Calgon the subcontract for installation of the carbon filters. The groundwater investigation phase was performed under TAT special projects.

A summary of all costs incurred during this removal action is presented below:

EPA EXPENDITURES

EPA PAYROLL - Regional	$ 16,560.75
EPA TRAVEL - Regional	4,185.26
EPA INDIRECT COSTS - Regional	56,866.50
EPA MISCELLANEOUS COSTS	15.19
EPA CONTRACT - PEI	215,160.00
TAT CONTRACT - Weston (68-01-6669)	149,408.00
EERU CONTRACT - IT Corp.	17,522.44
TOTAL EPA EXPENDITURES	$459,718.14

This cost summary reflects only costs related to the emergency removal activity. This cost summary was prepared on February 2, 1986, and revised on October 27, 1987, by the U.S. EPA.

8.0 EFFECTIVENESS OF REMOVAL ACTIONS

8.1 Responsible Parties

As stated above, no PRPs were identified prior to the removal action.

8.2 State and Local Agencies

The City of Wausau provided extensive field support, equipment, and site information, and was actively involved in investigating the contaminant sources through the installation of seven monitoring wells. The City had also successfully applied for a grant from the U.S. EPA to develop air strippers for the wells, and installed the strippers within five months of the time that the U.S. EPA GAC filter had been installed, thus relieving the U.S. EPA removal program from providing any direct aid to the area.

Local government agencies were very cooperative and were an asset to the removal.

8.3 Federal Agencies

Other Federal agencies involved with the action included the Center for Disease Control (CDC), the U.S. EPA Environmental Response Team (ERT), and the U.S. Geological Survey (USGS). The U.S. EPA Environmental Research Laboratory in Cincinnati, Ohio, and the Michigan Technical University research group were very cooperative and helpful prior to and during the removal action.

8.4 Contractors and Subcontractors

The TAT contractor, R.F. Weston, the ERCS contractor, PEI, and the subcontractors listed below provided efficient, quality services throughout the action: E.A. Hickok and Associates, Inc., Exploration Technology, Inc., Wisconsin Test Drill, Calgon Co. and Zimpro Laboratories.

9.0 PROBLEMS ENCOUNTERED

Several problems were encountered during the Wausau removal action. On the Federal level, a prolonged time period was required to procure permission from the Department of Transportation to transport the oversized carbon filtration systems across state lines. Subzero temperatures, typical to the Wausau area during October and November, slowed the drilling process and extended the completion date of the wells installation.

10.0 SUBSEQUENT ACTIONS

Following the removal action, a remedial investigation/field study (RI/FS) was initiated by the Site Management Section of the U.S. EPA. The RI/FS is ongoing as of the completion of this report. Margaret Guerriero is the remedial response manager for the site.

TABLE 1

SUMMARY OF SELECTED VOLATILE ORGANIC CONTAMINANT
CONCENTRATIONS IN CITY WELL #3
MARCH 1982 - NOVEMBER 1984

Collection Date	Concentration-ppb*		
	PCE	TCE	DCE
3-16-82	100	100	50
4-07-82	90	140	110
4-15-82	80	130	90
6-14-82	40	80	-
6-14-82	50	20	80
6-14-82	60	120	40
6-16-82	50	70	60
7-13-82	60	110	70
8-09-82	60	90	50
9-09-82	20	190	20
9-24-82	30	130	20
9-27-82	20	140	30
9-28-82	30	100	30
10-28-82	20	90	10
2-07-83	10	80	10
5-03-83	10	100	10
6-30-83	10	80	10
6-30-83	10	70	10
7-06-83	10	70	10
11-30-83	10	120	10
1-10-84	10	90	10
1-17-84	10	100	10
2-06-84	10	130	10
2-20-84	10	150	10
5-07-84	<10	140	<10
9-17-84	10	150	20
10-01-84	0	150	10
10-03-84	<10	160	10
10-17-84	0	110	0
11-08-84	0	210	10

* Reported values have been rounded to two significant figures
\- Non-Detectable Concentration
\+ Less than 10 ppb

TABLE 2

SUMMARY OF SELECTED VOLATILE ORGANIC CONTAMINANT
CONCENTRATIONS IN CITY WELL #6
MARCH 1982 - OCTOBER 1984

Collection Date	Concentration-ppb*		
	PCE	TCE	DCE
3-16-82	-	80	-
4-07-82	-	110	-
4-15-82	-	110	+
6-14-82	-	120	+
6-14-82	-	70	+
6-14-82	-	140	+
6-16-82	-	110	+
8-09-82	-	120	+
11-15-82	-	190	-
2-07-83	-	120	-
5-03-83	+	150	+
11-30-83	+	180	+
2-20-84	+	210	+
5-07-84	+	140	+
6-30-84	-	210	+
7-03-84	-	220	+
7-04-84	-	220	+
7-05-84	-	220	+
7-06-84	-	220	+
7-07-84	-	220	+
7-08-84	-	230	+
7-11-84	-	190	+
7-18-84	-	80	+
7-26-84	-	160	+
8-02-84	-	180	+
8-08-84	-	170	-
8-15-84	-	190	+
8-22-84	-	220	+
8-30-84	-	260	+
9-05-84	-	220	+
9-12-84	-	200	-
9-17-84	-	140	-
9-19-84	-	170	-
9-25-84	-	170	-
9-26-84	-	190	-
10-01-84	-	110	-
10-17-84	-	190	-
10-24-84	-	150	-

* Reported values have been rounded to two significant figures

\- Non-Detectable Concentration

\+ Less than 10 ppb

TABLE 3

SUMMARY OF SELECTED VOLATILE ORGANIC CONTAMINANT
CONCENTRATIONS IN CITY WELL #4
MARCH 1982 - JANUARY 1985

Collection Date	Concentration-ppb*				
	PCE	TCE	DCE	Toluene	Xylene
3-16-82	-	-	-	-	#
4-15-82	-	-	-	-	#
6-14-82	-	+	-	-	#
6-14-82	-	-	-	-	#
6-16-82	-	-	-	-	#
10-28-82	50	60	340	-	#
11-02-82	30	10	300	-	#
6-30-83	20	+	160	-	#
6-30-83	20	+	200	-	#
7-06-83	10	+	200	-	#
10-30-83	20	+	80	10	#
11-30-83	130	80	500	120	#
1-10-84	110	180	410	-	#
1-17-84	90	170	340	90	#
2-20-84	80	190	210	-	#
2-27-84	150	320	380	100	#
5-07-84	80	90	80	30	#
9-17-84	50	70	80	30	#
10-01-84	40	60	90	30	#
10-17-84	40	60	70	-	#
10-29-84	60	70	70	30	#
11-08-84	40	80	70	-	#
12-11-84	40	60	80	20	#
12-19-84	30	70	110	20	#
1-02-85	30	40	80	10	#

* Reported values have been rounded to two significant figures

- Non-Detectable Concentration

+ Less than 10 ppb

Less than 20 ppb

TABLE 4

SUMMARY OF SELECTED VOLATILE ORGANIC CONTAMINANT CONCENTRATIONS IN THE CITY DISTRIBUTION SYSTEM USING BLENDED WATERS

All Results in ppb*

Date of Sample	Location	PCE in ug/l	TCE in ug/l	DCE in ug/l
03-02-82	Water Treatment Plant	+	60	30
03-16-82	WTP - Effluent	60	100	30
04-07-82	City Hall	20	30	30
04-15-82	Mary Gardens Apt.	+	10	+
04-15-82	Art Museum	20	20	20
04-15-82	City Hall	+	+	+
04-15-82	WWTP	+	10	10
04-15-82	UW Marathon	10	30	10
04-15-82	Mount View Manor	+	50	10
04-15-82	Employers Regional	+	50	+
04-15-82	Ground Reservoir	10	40	10
04-15-82	NCTI	10	20	10
05-03-82	WTP - Effluent	-	10	-
05-03-82	City Hall	-	20	-
05-03-82	Airport	-	+	-
05-06-82	Water Treatment Plant	-	30	-
05-06-82	Water Treatment Plant	-	20	-
05-06-82	Water Treatment Plant	-	40	-
06-14-82	City Hall	-	20	-
06-14-82	City Hall	-	20	-
06-14-82	Airport	-	+	-
06-14-82	Airport	-	+	-
10-28-82	City Hall	+	70[1]	60[1]
10-28-82	Airport	+	60[1]	70[1]
12-30-82	Water Treatment Plant	10	50	-
02-07-83	Fire Station	+	30	+
02-07-83	Bob Johnson's Chevy	+	40	+
05-03-83	Holiday Inn	+	50	+
05-03-83	City Hall	+	30	+

[1] Values the result of city well #4's contamination and was immediately taken off line.

TABLE 4 (Continued)

Date of Sample	Location	PCE in ug/l	TCE in ug/l	DCE in ug/l
06-13-83	Marathon County Health Care	-	70	-
06-13-83	Holiday Inn	-	80	-
06-13-83	Central Fire Station	-	80	-
06-13-83	City Hall	-	80	-
11-14-83	Holiday Inn	-	+	-
12-28-83	City Hall	+	60	-
12-28-83	Marathon County Health Care	+	30	-
01-25-84	Health Care Center	+	50	+
01-25-84	City Hall	+	20	+
02-06-84	McDonalds	+	50	-
02-13-84	Holiday Inn	+	30	-
02-13-84	Health Care Center	+	20	-
02-13-84	City Hall	-	10	-
04-02-84	Health Care Center	+	40	-
04-02-84	City Hall	+	30	-

TABLE 4 (Continued)

Date of Sample	Location	PCE in ug/l	TCE in ug/l	DCE in ug/l
05-07-84	Water Treatment Plant	-	40	-
05-07-84	City Hall	+	60	-
05-07-84	North Central Health Care	+	50	-
05-07-84	Holiday Inn	+	50	-
05-07-84	Central Fire Station	+	50	-
05-30-84	Wausau Child Care Center	+	30	-
05-30-84	John Muir Middle School	+	10	-
05-30-84	North Central Technical Institute	+	+	-

All results are from the Wisconsin State Laboratory.

* Reported values have been rounded to two significant figures
- Non-Detectable Concentration
+ Less than 10 ppb

TABLE 5

WAUSAU WELL #6 RESULTS: GAC FILTRATION SYSTEM

VOC ANALYSIS (ppb) - JUNE, 1984 to OCTOBER 1984

	DATE	TCE	PCE	DCE	Benzene	Toluene	Ethyl-benzene	Xylenes	1,1,1-Tri-chloroethene	Chloro-form
Influent	6/29/84*	210	-	1.8	-	0.2	-	-	-	-
Effluent	6/29/84*	-	-	-	-	0.5	-	-	-	0.1
Effluent, Unit A	6/29/84*	-	-	-	-	1.2	-	-	-	0.1
Eff. Units A & B	6/29/84*	-	-	-	-	1.2	-	-	-	0.1
Eff. Units A & B	6/29/84*	-	-	-	-	0.2	-	-	-	0.1
Influent	6/30/84*	210	-	1.8	-	-	-	-	-	-
Effluent	6/30/84*	-	-	-	-	-	-	-	-	-
Influent	7/ 3/84*	220	-	1.2	-	0.7	-	-	-	-
Effluent	7/ 3/84*	-	-	-	0.1	0.4	-	-	-	-
Influent	7/ 4/84*	220	-	1.6	-	-	-	-	-	-
Effluent	7/ 4/84*	0.3	-	-	0.1	-	-	-	-	-
Influent	7/ 5/84*	220	-	1.4	-	1.4	-	-	-	-
Effluent	7/ 5/84*	0.4	-	-	0.1	0.9	-	-	-	-
Influent	7/ 6/84*	220	-	1.7	-	-	-	-	-	-
Effluent	7/ 6/84*	0.6	-	-	0.2	-	-	-	-	-
Influent	7/ 7/84*	220	-	1.7	0.5	-	-	-	-	-
Effluent	7/ 7/84*	0.9	-	-	0.1	-	-	-	-	-
Influent	7/ 8/84*	230	0.1	1.7	0.2	-	-	-	-	-
Effluent	7/ 8/84*	-	-	-	0.2	-	-	-	-	0.5

* Analysis by Zimpro, all others by PEI

\- Not Detected

TABLE 5 (continued)

	DATE	TCE	PCE	DCE	Benzene	Toluene	Ethyl-benzene	Xylenes	1,1,1-Tri-chloroethene	Chloro-form
Influent	7/11/84	190	-	1.7	-	-			-	-
Effluent	7/11/84	-	-	-	-	-			-	-
Backwash	7/11/84	19.6	-	-	-	-			-	-
Backwash	7/11/84	19.4	-	-	-	-			-	-
Influent	7/18/84	181	-	0.8	-	0.6			-	-
Effluent	7/18/84	-	-	-	-	-			-	1.2
Influent	7/26/84	168	-	1.8	-	-			-	-
Effluent	7/26/84	-	-	-	-	-			-	-
Influent	8/ 2/84	183	-	1.6	-	-			-	-
Effluent	8/ 2/84	-	-	-	-	-			-	-
Influent	8/ 8/84	167	-	-	-	-			-	-
Effluent	8/ 8/84	-	-	-	-	-			-	-
Influent	8/15/84	185	-	1.3	-	-			-	-
Effluent	8/15/84	-	-	-	-	-			-	-
Influent	8/22/84	218	-	1.4	-	-			-	-
Effluent	8/22/84	0.5	-	-	-	-			-	-
Influent	8/30/84	255	-	1.3	-	-			-	-
Influent	8/30/84	241	-	1.2	-	-			-	-
Effluent	8/30/84	1.1	-	-	-	-			-	-

* Analysis by Zimpro, all others by PEI

\- Not Detected

Blank - Analysis Not Performed

TABLE 5 (continued)

	DATE	TCE	PCE	DCE	Benzene	Toluene	Ethyl-benzene	Xylenes	1,1,1-Tri-chloroethene	Chloro-form
Influent	9/ 5/84	218	-	1.4	-	-			-	-
Effluent	9/ 5/84	1.7	-	-	-	-			-	0.5
Influent	9/12/84	230	1.3	-	-	-			-	-
Effluent	9/12/84	3.4	-	-	-	-			-	-
Influent	9/12/84*	198								
Effluent	9/12/84*	2.0								
Eff. Unit A	9/12/84*	0.1								
Eff. Unit B	9/12/84*	-								
Eff. Unit C	9/12/84*	0.1								
Eff. Unit D	9/12/84*	0.2								
Influent	9/19/84	171	-	-	-	-			-	-
Influent	9/19/84	164	-	-	-	-			-	-
Effluent	9/19/84	-	-	-	-	-			-	-
Influent	9/26/84	187	-	-	-	-			-	-
Effluent	9/26/84	-	-	-	-	-			-	-
Influent	10/ 3/84	184	-	-	-	-			-	-
Effluent	10/ 3/84	3.3	-	-	-	-			-	-
Influent	10/10/84	160	-	0.7	-	-			-	-
Effluent	10/10/84	3.7	-	-	-	-			-	-

* Analysis by Zimpro, all others by PEI

\- Not Detected

Blank - Analysis Not Performed

TABLE 5 (continued)

		TCE	PCE	DCE	Benzene	Toluene	Ethyl-benzene	Xylenes	1,1,1-Tri-chloroethene	Chloro-form
Influent	10/17/84	188	-	-	-	-			-	-
Effluent	10/17/84	7.8	-	-	-	-			-	-
Influent	10/24/84	152	-	-	-	-			-	-
Effluent	10/24/84	7.5	-	-	-	-			-	-

* Analysis by Zimpro, all others by PEI

\- Not Detected

Blank - Analysis Not Performed

TABLE 6

WAUSAU WISCONSIN - SEISMIC SOUNDING DATA

Seismic Sounding No.	Velocity Range ft/sec	ft/sec	ft/sec	Depth to 1st Layer (ft)	Surface Elevation (1)	1st Layer Elevation (1)	Depth to Bedrock (ft)	Surface Elevation (1)	Bedrock Elevation (1)
1	1450	2500	-	17	1213	1196	-	1213	-
2	1600	2600	20,500	16	1213	1197	167	1213	1046
3	1350	3850	22,500	10	1193	1183	136	1193	1058
4	900	4250	22,500(2)	10	1195	1185	158	1195	1037
5	1200	3000	35,000	6	1217	1211	80	1217	1137
6	1450	3750	15,000	45	1221	1176	121	1221	1111
7	1600	2800	30,000	9	1219	1210	158	1219	1061
8	1025	3900	25,000(2)	11	1199	1188	180	1199	1019
9	1100	20,000	--	15	1121	1206	15	1221	1204
10	1250	6150	26,000	14	1209	1195	124	1209	1085
11	1500	3500	30,000	21	1214	1193	137	1214	1077
12	1100	25,000	--	12	1255	1243	12	1255	1243
13	1250	2650	10,000	12	1215	1203	95	1215	1120
14	1450	5750	25,000(2)	40	1220	1180	120	1220	990
15	1425	7950	--	23	1223	1200	23	1223	1200 (3)
16	1200	4250	21,250	9	--	--	53	--	--
17	1250	5500	25,000	11	1224	1213	74	1224	1121
18	1400	20,000	--	7	1242	1235	7	1242	1235
19	950	13,000	--	80	1196	1116	80	1196	1116
20	1350	18,250	--	17	1200	1183	17	1200	1182
21	1300	4350	16,500	6	1212	1206	75	1212	1137
22	1250	3750	19,000	12	1206	1194	68	1206	1138
23	In landfill; very slow velocities, questionable data								
24	1450	13,500	--	30	1225	1195	30	1225	1195
25	1475	12,500	--	14	1202	1188	14	1202	1188
26	1450	25,000	--	15	1246	1231	15	1246	1231

TABLE 6 (continued)

Seismic Sounding No.	Velocity Range ft/sec	ft/sec	ft/sec	Depth to 1st Layer (ft)	Surface Elevation (1)	1st Layer Elevation (1)	Depth to Bedrock (ft)	Surface Elevation (1)	Bedrock Elevation (1)
27	1400	15,000	--	26	1216	1190	26	1216	1190
28	1800	21,000	--	85	1219	1134	85	1219	1134
29	1350	2240	17,000	5	1218	1213	104	1218	1114
30	1450	2050	7,000	6	1220	1214	80	1220	1140
31	1400	2950	17,000	14	1215	1201	117	1215	1098
32	1360	2250	13,000	4	1218	1214	94	1218	1124
33	1625	25,000	--	85	1220	1135	85	1220	1135
34	1500	2800	11,000	17	1208	1191	95	1208	1113
35	1150	22,500	--	20	1224	1204	140	1224	1084
36	1325	2825	12,000	8	1216	1208	49	1216	1167
37	1200	3250	12,000	9	1216	1207	83	1216	1133
38	1075	2125	12,000	7	1220	1213	85	1220	1135
39	1175	4500	23,500	11	1199	1188	65	1199	1134
40	1225	3650	16,000	14	1196	1182	101	1196	1095
41	1075	3250	17,500	5	1199	1194	103	1199	1086
42	1175	2725	15,000	5	1213	1208	59	1213	1154
43	1150	2262	21,000	15	1216	1201	97	1216	1119
44	1188	3125	16,500	8	1200	1192	40	1200	1160
45	1250	5850	20,000	13	1214	1201	105	1214	1109
46	1050	4250	17,500	7	1216	1209	78	1216	1138
47	1375	4500	11,500	42	1195	1153	115	1195	1080
48	1300	2750	20,000	6	1216	1210	125	1216	1091
49	1650	20,000	--	15	1262	1247	15	1262	1247
50	1350	3250	15,000	10	1195	1185	118	1195	1077
51	1410	2625	18,500	9	1210	1201	88	1210	1122
52	1125	2200	20,000	35(2)	1217	1182	200	1217	1017
53	1550	3725	20,000	13	1202	1189	82	1202	1120

TABLE 6 (continued)

Seismic Sounding No.	Velocity Range ft/sec	ft/sec	ft/sec	Depth to 1st Layer (ft)	Surface Elevation (1)	1st Layer Elevation (1)	Depth to Bedrock (ft)	Surface Elevation (1)	Bedrock Elevation (1)
54	1350	2850	20,000	5	1209	1204	99	1209	1110
55	1200	3250	25,000	15	1208	1193	66	1208	1142
56	1750	5250	20,000	30	1217	1187	85	1217	1132

(1) Elevations above mean sea level
(2) Assumed bedrock velocity
(3) Probable error in depth determination due to profile crossing deep and narrow alluvial valley

TABLE 7

ANALYTICAL RESULTS FOR THE SIMULTANEOUS SAMPLING PROGRAM
WAUSAU, WISCONSIN

All results in ppb*

MW #1	PCE	TCE	DCE
07-13-82	-	-	-
07-21-82	-	-	-
09-17-84	-	-	-
10-01-84	-	-	-
10-17-84	-	-	-
11-08-84	-	-	-
MW #2			
07-13-82	-	-	-
09-17-84	-	-	-
10-01-84	-	-	-
10-17-84	-	-	-
11-08-84	-	-	-
MW #3			
07-13-82	-	-	-
09-17-84	-	-	-
10-01-84	-	-	-
10-17-84	-	-	
11-08-84	-	-	-
MW #4			
07-13-82	-	-	-
10-01-84	-	-	-
10-17-84	-	-	-
11-08-84	-	-	-
City MW #5			
10-23-82	+	+	+
09-17-84	-	-	-
10-01-84	-	-	-
10-17-84	-	-	-
11-08-84	-	-	-

TABLE 7 (continued)

City MW #6	PCE	TCE	DCE
09-09-82	190	150	440
09-27-82	230	240	2910
10-28-82	280	260	140
09-17-84	+	-	+
10-01-84	20	-	+
10-17-84	20	+	+
11-08-84	+	+	+
City MW #7			
09-09-82	310	110	370
09-27-82	790	220	1140
10-28-82	220	120	520
09-17-84	20	+	+
10-01-84	+	+	+
10-17-84	30	+	+
Wergin Well			
07-13-82	110	230	2100
07-21-82	130	200	1260
09-09-82	800	150	620
09-24-82	530	90	520
09-27-82	390	110	2020
10-28-82	520	130	960
05-03-83	370	60	550
02-20-84	270	20	80
City #3			
09-17-84	+	150	20
10-01-84	+	150	+
10-17-84	-	110	+
11-08-84	-	210	+
City #4			
09-17-84	50	70	80
10-01-84	40	60	90
10-17-84	40	60	70
11-08-84	40	80	70
City #6			
09-17-84	-	140	+
09-25-84	-	170	-
10-01-84	-	150	+
10-17-84	-	130	-
11-08-84	-	130	-

TABLE 7 (continued)

City #7	PCE	TCE	DCE
09-17-84	-	-	-
10-01-84	-	-	-
10-17-84	-	-	-
11-08-84	-	-	-
City #8			
09-17-84	-	-	-
10-01-84	-	-	-
10-17-84	-	-	-
11-08-84	-	-	-
City #9			
09-17-84	-	-	-
10-01-84	-	-	-
10-17-84	-	-	-
11-08-84	-	-	-
EPA MW #1A			
10-01-84	-	-	-
10-17-84	-	-	-
11-08-84	-	-	-
11-29-84	-	-	-
EPA MW #2A			
09-25-84	-	-	-
10-01-84	-	-	-
10-17-84	-	-	-
11-08-84	-	-	-
11-29-84	-	-	-
EPA MW #3A			
10-01-84	-	-	-
10-17-84	-	-	-
11-08-84	-	-	-
11-29-84	-	-	-
EPA MW #3B			
10-01-84	-	-	-
10-17-84	-	-	-
11-08-84	-	-	-
11-29-84	-	-	-

TABLE 7 (continued)

EPA MW #4B	PCE	TCE	DCE
10-01-84	-	-	-
10-17-84	-	-	-
11-08-84	-	-	-
11-29-84	+	-	-
EPA MW #4C			
10-31-84	+	+	-
11-01-84	-	+	-
11-08-84	-	-	-
11-29-84	-	-	-
EPA MW #5			
11-08-84	-	-	-
11-09-84	-	-	-
11-29-84	-	-	-
EPA MW #6			
11-08-84	-	+	-
11-09-84	+	+	+
11-29-84	-	-	-
EPA MW #7			
11-28-84	-	+	-
EPA MW #7A			
10-01-84	+	-	-
10-17-84	+	-	-
11-08-84	-	-	-
EPA MW #8			
11-29-84	-	-	-
EPA MW #9			
12-03-84	-	+	-

TABLE 7 (continued)

EPA MW #9A	PCE	TCE	DCE
10-01-84	-	+	-
10-17-84	-	+	+
11-08-84	-	+	-
EPA MW #10A			
10-01-84	40	+	+
10-17-84	60	+	-
11-08-84	+	+	30
EPA MW #10B			
10-01-84	120	70	580
10-17-84	120	70	480
11-08-84	70	50	380
EPA MW #11			
10-31-84	+	+	-
11-01-84	+	+	+
11-08-84	+	+	+
EPA MW #12			
11-05-84	-	-	-
11-08-84	-	-	-
EPA MW #13			
11-29-84	50	20	30
EPA MW #14			
11-30-84	+	+	-

* Reported values have been rounded to two significant figures.

\- Non-Detectable Concentration

\+ Less than 10 ppb

TABLE 8a

WISCONSIN RIVER SEDIMENT SAMPLING PROGRAM - 20 JUNE 1984

Map Location #	Zimpro's Analytical #	Location
1	4766 (Water)	300° from City Well #6 - center of the river
2	4768 (Water 4768 (Soil)	Wisconsin River trib. - Schofield Park
3	4769 (Water) 4770 (Soil)	100 yards below Schofield Park - west sample
4	4771 (Soil)	100 yards below Schofield Park - middle sample
5	4772 (Soil)	100 yards below Schofield Park - east sample
8	4773 (Soil)	off well #3 - west sample
7	4774 (Soil) 4776 (Water) 4784 (Soil)	off well #3 - middle sample
6	4775 (Soil)	off well #3 - east sample
9	4778 (Soil) 4777 (Water)	off well #4 - east sample
10	4779 (Soil)	off well #4 - middle sample
11	4780 (Soil)	off well #4 - west sample

TABLE 8a (continued)

WISCONSIN RIVER SEDIMENT PROGRAM - (9/25/84)
ANALYSIS BY ERT'S MOBILE LAB

All results in ppb
Detection limit for liquid = 1 ppb   Detection limit for soil = 5 ppb
- Not detected

Location Number	Location	DCE	TCE	PCE
12	NW 1/4, SE 1/4, Sec. 2, T29N R7E	-	-	-
13	NW, SW, Sec. 12, T29N R7E	-	-	-
14	NW, NW, Sec. 13, T29N R7E	-	-	-
15	SW, NW, Sec. 24, T29N R7E	-	-	-
16	NE, SE, Sec. 23, T29N R7E	-	-	-
17	SE, SE, Sec. 23, T29N R7E	-	-	-
18	NW, SE, Sec. 26, T29N R7E	-	-	-
19	NW, NE, Sec. 35, T29N R7E	-	-	-
20	NE, SE, Sec. 2, T28N R7E	-	-	-
21	NW, NE, Sec. 3, T28N R7E	-	-	-
22	NW, NE, Sec. 13, T28N R7E	-	63.5	-
23	NW, SE, Sec. 14, T28N R7E	-	-	-
24	300 Yards above the Rothschild Dam	-	-	-

TABLE 8b

WISCONSIN RIVER SEDIMENT SAMPLING RESULTS
VOC ANALYSIS - 20 JUNE 1984

WATER SAMPLES (ppb)

	Detection Limit	Field Blank	1	2	3	7	9
Benzene	0.1	x	x	x	x	x	x
Bromoform	0.5	x	x	x	x	x	x
Bromomethane	1.0	x	x	x	x	x	x
Carbon Tetrachloride	0.1	x	x	x	x	x	x
Chlorobenzene	0.1	x	x	x	x	x	x
Chloroethane	1.0	x	x	x	x	x	x
2-Chloroethylvinyl Ether	2.0	x	x	x	x	x	x
Chloroform	0.1	x	0.2	0.2	0.2	0.6	0.6
Chloromethane	6.0	x	x	x	x	x	x
Dibromochloromethane	0.1	x	x	x	x	x	x
1,2-Dichlorobenzene	0.3	x	x	x	x	x	x
1,3-Dichlorobenzene	0.3	x	x	x	x	x	x
1,4-Dichlorobenzene	0.3	x	x	x	x	x	x
Dichlorobromomethane	0.1	x	x	x	x	x	x
1,1-Dichloroethane	0.1	x	x	x	x	x	x
1,2-Dichloroethane	0.3	x	x	x	x	x	x
1,1-Dichloroethylene	0.5	x	x	x	x	x	x
1,2-Dichloroethylene	0.3	x	x	x	x	x	x
Dichloromethane	0.2	0.2	x	x	x	x	x
1,2-Dichloropropane	0.5	x	x	x	x	x	x
cis-1,3-Dichloropropene	0.3	x	x	x	x	x	x
trans-1,3-Dichloropropene	1.0	x	x	x	x	x	x
Ethylbenzene	0.2	x	x	x	x	x	x
1,1,2,2-Tetrachloroethane	0.1	x	x	x	x	x	x
Tetrachloroethylene	0.1	x	x	x	x	x	x
Toluene	0.1	x	x	x	x	x	x
1,1,1-Trichloroethane	0.1	x	x	x	x	x	x
1,1,2-Trichloroethane	0.1	x	x	x	x	x	x
Trichloroethylene	0.1	x	x	x	x	x	x
Vinyl Chloride	0.1	x	x	x	x	x	x
Zimpro Analytical No.		4765	4766	4767	4769	4776	4777

X = Not Detected

TABLE 8c

SOIL SAMPLE (ppm)

	2	3	4	5	8	7
Benzene	<0.2	<0.3	<0.2	<0.2	<0.2	<1.0
Bromoform	<0.7	<1.5	<0.7	<0.7	<0.7	<5.0
Bromomethane	<2.0	<3.0	<2.0	<2.0	<2.0	<10.0
Carbon Tetrachloride	<0.2	<0.3	<0.2	<0.2	<0.2	<1.0
Chlorobenzene	<0.2	<0.3	<0.2	<0.2	<0.2	<1.0
Chloroethane	<2.0	<3.0	<2.0	<2.0	<2.0	<10.0
2-Chloroethylvinyl Ether	<3.0	<6.0	<3.0	<3.0	<3.0	<20.0
Chloroform	<0.2	<0.3	<0.2	<0.2	<0.2	<1.0
Chloromethane	<9.0	<18.0	<9.0	<9.0	<10.0	<60.0
Dibromochloromethane	<0.2	<0.3	<0.2	<0.2	<0.2	<1.0
1,2-Dichlorobenzene	<0.5	<0.9	<0.5	<0.5	<0.5	<3.0
1,3-Dichlorobenzene	<0.5	<0.9	<0.5	<0.5	<0.5	<3.0
1,4-Dichlorobenzene	<0.5	<0.9	<0.5	<0.5	<0.5	<3.0
Dichlorobromomethane	<0.2	<0.3	<0.2	<0.2	<0.2	<1.0
1,1-Dichloroethane	<0.2	<0.3	<0.2	<0.2	<0.2	<1.0
1,2-Dichloroethane	<0.5	<0.9	<0.5	<0.5	<0.5	<3.0
1,1-Dichloroethylene	<0.7	<1.5	<0.7	<0.7	<0.7	<5.0
1,2-Dichloroethylene	<0.5	<0.9	<0.5	<0.5	<0.5	<3.0
Dichloromethane	<0.3	0.9	<0.3	0.4	<0.3	5.9
1,2-Dichloropropane	<0.7	<1.5	<0.7	<0.7	<0.7	<5.0
cis-1,3-Dichloropropene	<0.5	<0.9	<0.5	<0.5	<0.5	<3.0
trans-1,3-Dichloropropene	<2.0	<3.0	<2.0	<2.0	<2.0	<10.0
Ethylbenzene	<0.3	<0.6	<0.3	<0.3	<0.3	<2.0
1,1,2,2-Tetrachloroethane	<0.2	<0.3	<0.2	<0.2	<0.2	<1.0
Tetrachloroethylene	<0.2	<0.3	<0.2	<0.2	<0.2	<1.0
Toluene	<0.2	<0.3	<0.2	<0.2	<0.2	<1.0
1,1,1-Trichloroethane	<0.2	<0.3	<0.2	<0.2	<0.2	<1.0
1,1,2-Trichloroethane	<0.2	<0.3	<0.2	<0.2	<0.2	<1.0
Trichloroethylene	<0.2	<0.3	<0.2	<0.2	<0.2	<1.0
Vinyl Chloride	<0.2	<0.3	<0.2	<0.2	<0.2	<1.0
Zimpro Analytical No.	4768	4770	4771	4772	4773	4774

< - Less than the Detection Limit

TABLE 8c (continued)

SOIL SAMPLES (ppm)

	6	9	10	11
Benzene	<0.2	<0.2	<0.2	<0.2
Bromoform	<0.9	<0.7	<0.7	<0.7
Bromomethane	<2.0	<2.0	<2.0	<2.0
Carbon Tetrachloride	<0.2	<0.2	<0.2	<0.2
Chlorobenzene	<0.2	<0.2	<0.2	<0.2
Chloroethane	<2.0	<2.0	<2.0	<2.0
2-Chloroethylvinyl Ether	<4.0	<3.0	<3.0	<3.5
Chloroform	<0.2	<0.2	<0.2	<0.2
Chloromethane	<11.0	<9.0	<9.0	<10.0
Dibromochloromethane	<0.2	<0.2	<0.2	<0.2
1,2-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5
1,3-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5
1,4-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5
Dichlorobromomethane	<0.2	<0.2	<0.2	<0.2
1,1-Dichloroethane	<0.2	<0.2	<0.2	<0.2
1,2-Dichloroethane	<0.5	<0.5	<0.5	<0.5
1,1-Dichloroethylene	<0.9	<0.7	<0.7	<0.9
1,2-Dichloroethylene	<0.5	<0.5	<0.5	<0.5
Dichloromethane	<0.4	0.6	<0.6	<0.4
1,2-Dichloropropane	<0.9	<0.7	<0.7	<0.9
cis-1,3-Dichloropropene	<0.5	<0.5	<0.5	<0.5
trans-1,3-Dichloropropene	<2.0	<2.0	<2.0	<2.0
Ethylbenzene	<0.4	<3.0	<3.0	<0.4
1,1,2,2-Tetrachloroethane	<0.2	<0.2	<0.2	<0.2
Tetrachloroethylene	<0.2	<0.2	<0.2	<0.2
Toluene	<0.2	<0.2	<0.2	<0.2
1,1,1-Trichloroethane	<0.2	<0.2	<0.2	<0.2
1,1,2-Trichloroethane	<0.2	<0.2	<0.2	<0.2
Trichloroethylene	<0.2	<0.2	<0.2	<0.2
Vinyl Chloride	<0.2	<0.2	<0.2	<0.2
Zimpro Analytical No.	4775	4778	4779	4790

< - Less than the Detection Limit

TABLE 8d

WISCONSIN RIVER SEDIMENT SAMPLING RESULTS - 20 JUNE 1984

ELEMENTAL ANALYSIS BY ZIMPRO

Sample #7, Zimpro # 4784

ELEMENT	CONCENTRATION (ug/g)
Ag	< 1.0
As	< 12.0
Be	1.9
Cd	5.3
Cr	43.0
Cu	58.0
Hg	0.14
Ni	22.0
Pb	< 20.0
Sb	< 20.0
Se	< 30.0
Tl	33.0
Zn	210.0
Phenol	14.0
CN	81.0

TABLE 9

SOIL SAMPLE RESULTS - WAUSAU, EAST BANK
VOC ANALYSIS BY ZIMPRO (ppm): 11/27/84-11/29/84

Date	Location	Location #	DCE	TCE	PCE	Benzene	Toluene	Ethyl-benzene	Xylene
		Detection Limit	0.3	0.1	0.1	0.3	0.3	0.3	0.5
11/27/84	EPA MW #13, Marathon Box, 3.5'-5'	S-1	-	-	-	-	-	-	-
11/27/84	EPA MW #13, 8.5'-10'	S-1	-	-	-	-	-	-	-
11/27/84	EPA MW #13, 13.5'-15'	S-1	-	-	-	-	-	-	-
11/29/84	Marathon Box by drums 0.5'-1.0'	S-2	-	-	-	-	8.4	-	41.8
11/27/84	EPA MW #14, Wergin Const., 3.5'-5'	S-3	-	-	-	-	0.4	-	-
11/27/84	EPA MW #14, 8.5'-10'	S-3	-	-	-	-	-	-	-
11/27/84	EPA MW #14, 13.5'-15'	S-3	-	-	-	-	-	-	-
11/29/84	Wausau Energy, east 1.0'-2.0'	S-4	-	-	-	-	-	-	8.9
11/29/84	Wausau Energy, middle 1.0'-2.0'	S-5	-	-	-	-	4.5	1.2	18.2
11/29/84	Wausau Energy, west 1.0'-2.0'	S-6	-	-	-	-	-	-	1.3

- Not Detected

TABLE 10

SUMMARY OF WEST SIDE MONITORING WELL ELEVATIONS AND DEPTHS

Monitoring Well	Elevation and Land Surface	Elevation of Top of Casing	Well Depth	Screen
1A	1214.15	1215.92	141.0	10.0
2A	1200.10	1202.59	48.0	10.0
3A	1221.14	1223.67	141.0	10.0
3B	1221.16	1223.37	75.0	10.0
4A	1215.63	1215.63	100.0	10.0
4B	1215.53	1215.53	60.5	10.0
4C	1215.50	1215.50	40.0	10.0
5	1219.08	1219.08	45.0	10.0
6	1218.93	1218.93	45.0	10.0
7	1219.10	1219.10	45.0	10.0
8	1217.55	1217.55	45.0	10.0
9	1201.98	1201.98	50.0	15.0
Cty Wl 6	N/A	1221.00		
Cty Wl 7	N/A	1225.66		
Cty Wl 9	N/A	1224.56		

TABLE 11

SUMMARY OF EAST SIDE MONITORING WELL ELEVATIONS AND DEPTHS

Monitoring Well	Elevation and Land Surface	Elevation of Top of Casing	Well Depth	Screen
EPA 7A	1198.90	1201.11	69.5	10.0
EPA 9A	1194.25	1196.82	141.0	10.0
EPA 10A	1204.50	1206.63	76.5	10.0
EPA 10B	1204.50	1206.41	35.0	10.0
EPA 11	1209.92	1209.92	35.0	10.0
EPA 12	1200.06	1200.06	70.0	20.0
EPA 13	1211.10	1211.10	45.0	10.0
EPA 14	1197.40	1197.40	45.0	10.0
W.Chem.B1	1195.03	1197.03	23.0	10.0
W.Chem.B2	1195.94	1197.94	24.0	10.0
W.Chem.B3	1196.16	1198.16	161.0	3.0
W.Chem.B3A	1195.81	1197.81	65.0	3.0
W.Chem.B3B	1195.94	1197.94	24.0	10.0
W.Chem.B3C	N/A	1198.94	29.0	10.0
W.Chem.B4	N/A	1196.56	60.0	3.0
W.Chem.B4A	N/A	1196.39	30.0	10.0
W.Chem.B5	N/A	1196.53	70.0	3.0
W.Chem.B5A	N/A	1196.49	30.0	10.0
W.Chem.B6	N/A	1198.00	70.0	3.0
W.Chem.B6A	N/A	1198.48	30.0	10.0
W.Chem.B7	N/A	1196.79	60.0	3.0
W.Chem.B7A	N/A	1196.60	30.0	10.0
City MW 1	N/A	1198.32	40.0	5.0
City MW 2	N/A	1202.97	40.0	5.0
City MW 3	N/A	1201.61	40.0	5.0
City MW 4	N/A	1202.06	40.0	5.0
City MW 5	N/A	1210.02	37.0	5.0
City MW 6	N/A	1200.37	41.0	5.0
City MW 7	N/A	1200.61	48.0	5.0
City MW 8	N/A	1198.66	23.5	10.5
City Wl 3	N/A	1203.40	91.0	41.0
City Wl 4	N/A	1200.79	132.0	40.0

TABLE 12

WAUSAU LANDFILL RUNOFF RESULTS
VOC ANALYSIS BY ZIMPRO (ppb): 9/84-10/84

Location	Location #	DCE	TCE	PCE	Benzene	Toluene	Ethyl-benzene	Xylene
	Detection Limit	0.3	0.1	0.1	0.3	0.3	0.3	0.5
Sherman &56 th Ave.	16	-	-	-	5.9	1.0	-	-
Cassidy & 14 th - Pond	20	-	-	-	-	-	-	-
Cassidy & 14 th - Swamp	22	-	-	-	-	-	-	-
14 th & Campus Ave. - Swamp	24	-	-	-	-	0.9	-	-
Hwy. 51 & Campus Ave. - Creek	26	-	-	-	-	-	-	-
North Central Technical Inst. (NCTI) - Basin	27	-	-	-	-	-	-	-
Retention Pond North of Campus Ave.	28	-	-	-	-	0.6	-	-

- Not Detected

TABLE 13

SUMMARY OF VOLATILE ORGANIC CONTAMINANT CONCENTRATIONS
FROM THE VERTICAL SAMPLING OF
U.S. EPA MONITORING WELL #1A

	35-40 ft	45-50 ft	55-60 ft	64.5-69.5 ft	73.5-78.5 ft	83.5-88.5 ft	93.5-98.5 ft	103.5-108.5 ft	113.5-118.5 ft	Blank H_2O	123.5-128.5 ft	133.5-138.5 ft
Benzene	+	+	+	+	+	+	-	-	+	-	+	+
Bromoform	-	-	-	-	-	-	-	-	-	-	-	-
Bromomethane	-	-	-	-	-	-	-	-	-	-	-	-
Carbon Tetrachloride	-	-	-	-	-	-	-	-	-	-	-	-
Chlorobenzene	-	-	-	-	-	-	-	-	-	-	-	+
Chloroethane	-	-	-	-	-	-	-	-	-	+	-	-
2-Chloroethylvinyl Ether	-	-	-	-	-	-	-	-	-	-	-	-
Chloroform	-	-	-	-	-	-	-	-	-	-	-	-
Chloromethane	-	-	-	-	-	-	-	-	-	+	+	+
Dibromochloromethane	-	-	-	-	-	-	-	-	-	-	-	-
1,2-Dichlorobenzene	-	-	-	-	-	-	-	-	-	-	-	+
1,3-Dichlorobenzene	-	-	-	-	-	-	-	-	-	-	-	-
1,4-Dichlorobenzene	-	-	-	-	-	-	-	-	-	-	-	-
Dichlorobromomethane	-	-	-	-	-	-	-	-	-	-	-	-
1,1-Dichloroethane	-	-	-	-	-	-	-	-	-	-	-	+
1,2-Dichloroethane	-	-	-	-	-	-	-	-	-	-	-	-
1,1-Dichloroethylene	-	-	-	-	-	-	-	-	-	-	-	-
1,2-Dichloroethylene	-	-	-	-	-	-	-	-	-	-	-	-
Dichloromethane	-	-	-	-	-	+	-	-	-	-	-	-
1,2-Dichloropropane	-	-	-	-	-	-	-	-	-	-	-	-
Cis-1,3-Dichloropropene	-	-	-	-	-	-	-	-	-	-	-	-
Trans-1,3-Dichloropropene	-	-	-	-	-	-	-	-	-	-	-	-

TABLE 13 (continued)

	35-40 ft	45-50 ft	55-60 ft	63.5-68.5 ft	73.5-78.5 ft	83.5-88.5 ft	93.5-98.5 ft	103.5-108.5 ft	113.5-118.5 ft	Blank H_2O	123.5-128.5 ft	133.5-138.5 ft
Ethyl Benzene	+	+	+	+	+	-	-	-	-	-	-	-
1,1,2,2-Tetrachloroethane	-	-	-	-	-	-	-	-	-	-	-	-
Tetrachloroethylene	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	+	+	+	+	+	-	-	-	-	-	+	-
1,1,1-Trichloroethane	-	-	-	-	+	+	+	+	+	-	-	+
1,1,2-Trichloroethane	-	-	-	-	-	-	-	-	-	-	-	-
Trichloroethylene	-	-	-	-	-	-	-	-	-	-	-	-
Vinyl Chloride	-	-	-	-	-	-	-	-	-	-	-	-
EPA Tag No.	545151	545152	545154	545155	544853	544854	544855	545156	545157	545163	545164	545167
Zippro Analytical No.	4867	4868	4892	4893	4896	4946	4947	4948	4950	4967	4968	5007

\- Not detected (less than 0.1 ppb)
\+ less than 10 ppb

TABLE 14

SUMMARY OF SELECTED VOLATILE ORGANIC CONTAMINANTS AT THE WAUSAU CHEMICAL COMPANY

All results in ppb*

MW #B-1	PCE	TCE	DCE
05-16-84	180	30	20
10-01-84	200	150	90
10-17-84	120	70	80
11-08-84	30	20	30
MW #B-2			
05-04-84	490	50	20
09-17-84	540	170	70
10-01-84	330	210	100
10-17-84	170	90	70
11-09-84	80	80	30
MW #B-3			
05-16-84	+	+	+
05-31-84	+	+	+
09-17-84	-	+	-
10-01-84	+	+	+
10-17-84	-	+	+
11-08-84	-	+	+
MW #B-3A			
05-16-84	3200	2600	630
05-31-84	4300	4800	680
09-17-84	2300	2700	3100
10-01-84	6480	4860	3300
10-17-84	870	1502	2100
11-08-84	1260	1120	920
MW #B3-C			
10-17-84	-	3330	750
11-08-84	+	100	-
MW #B-4			
10-01-84	+	-	-
10-17-84	-	-	-
11-08-84	-	-	-

TABLE 14 (continued)

MW #B4-A	PCE	TCE	DCE
10-01-84	-	-	-
10-17-84	-	-	-
11-08-84	-	-	-
MW #B-5			
10-01-84	+	-	-
10-17-84	-	-	-
11-08-84	+	-	-
MW #B5-A			
10-01-84	170	+	-
10-17-84	380	10	+
11-08-84	2600	40	+
MW #B-6			
10-01-84	-	-	+
10-17-84	-	-	-
11-08-84	-	-	+
MW #B6-A			
10-01-84	1920	880	310
10-17-84	790	1100	570
11-08-84	3930	2040	730

TABLE 14 (continued)

MW #B-7	PCE	TCE	DCE
10-01-84	10	+	-
10-17-84	-	-	-
11-08-84	+	-	-
MW #B7-A			
10-01-84	+	+	-
10-17-84	-	-	-
11-08-84	-	-	-
EPA MW #9			
10-01-84	-	+	-
10-17-84	-	+	+
11-08-84	-	+	-
CITY MW #8			
05-16-84	30	+	+
09-17-84	40	+	-
10-01-84	30	+	-
10-17-84	+	-	-
11-08-84	+	-	-

* Reported values have been rounded to two significant figures.
- Non-Detectable Concentration
+ Less than 10 ppb

TABLE 15

SUMMARY OF SELECTED VOLATILE ORGANIC CONTAMINANTS AT THE MARATHON BOX FACILITY

All Results Reported in ppb*

EPA MW #10A	PCE	TCE	DCE
10-01-84	40	+	+
10-17-84	60	+	-
11-08-84	+	+	30
EPA MW #10B			
10-01-84	120	70	580
10-17-84	120	70	480
11-08-84	70	50	380
EPA MW #11			
10-31-84	+	+	-
11-01-84	+	+	+
EPA MW #13			
11-29-84	50	20	30

* Reported values have been rounded to two significant figures.
- Non-Detectable Concentrations
+ Less than 10 ppb

TABLE 16

SUMMARY OF SELECTED VOLATILE ORGANIC CONTAMINANT CONCENTRATIONS
IN THE WERGIN CONSTRUCTION COMPANY WELL
JULY 1982 - OCTOBER 1984

Collection Date	Concentration-ppb*		
	PCE	TCE	DCE
7-13-82	110	230	2090
7-21-82	130	200	1260
9-09-82	800	150	620
9-24-82	530	90	520
9-27-82	390	110	2020
10-28-82	520	130	960
5-03-83	370	60	550
2-20-84	270	20	80
8-23-84	70	+	+
9-17-84	70	+	10
10-01-84	50	+	10
10-17-84	110	+	40
11-08-84	70	+	40

* Reported values have been rounded to two significant figures.
\+ Less than 10 ppb

REFERENCES CITED

LaBerge, L.G., and S.J. Klasner. Personal Communication, July 16, 1984, Wausau, Wisconsin.

LaBerge, L.G., and E.P. Meyers, 1983. Precambrian Geology of Marathon County, Wisconsin. Information Circular Number 45. University of Wisconsin Extension, Geological and Natural History Survey.

Parsons, F., G. Lage, R. Rice M. Astraskis and R. Nassar, 1982. Behavior and Fate of Hazardous Organic Chemicals in Contamination Ground Water - Final Report. State of Florida STAR GRANT 81-022, Dr. R. DeHan, Project Officer, Florida Dept. Environ. Regulation.

Parsons, F., P.R. Wood and J. DeMarco, 1984 Transformations of Tetrachloroethene and Trichloroethene in Microcosms and Ground Water. Journal American Water Works Association, February, pp. 56-59.