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RI
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Remedial Investigation

Van Der Horst Plant No 1

ERM-Northeast

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LIST OF FIGURES

LIST OF FIGURES (continued)

LIST OF TABLES

EXECUTIVE SUMMARY

This report summarizes the findings and conclusions of Phases I, II and III of the RI study conducted at Van Der Horst Plant No. 1 between April 1989 and June 1991. Work done by ERM to develop the Phase II RI report included a field exploration program, a reduction and analysis of the field data, and ground water flow modeling. Specifically, field work completed during the RI included installation of 24 test borings, 27 monitoring wells, a surface geophysical survey, water level monitoring, in situ hydraulic testing of monitoring wells, an aquifer pumping test, and sampling and testing from various media including 242 soil samples, 7 storm sewer water/sediment samples, 16 surface water/sediment samples, 30 plant building surfaces, 6 on-site plating well water samples and 36 ground water samples. Laboratory testing, to aid in the evaluation of site conditions, was performed by Recra Environmental, Inc. The major findings of the RI Phases I, II and III are summarized below.

Environmental Conditions

The Van Der Horst Corporation of America Plant No. 1 is a former chrome-plating facility in the City of Olean, Cattaraugus County, New York. Plant No. 1 was founded in 1940 and has an areal extent of approximately 2 acres. Several environmental problems were identified at the site prior to ERM's RI/FS study, including:

- A discharge of 400 to 500 gallons of untreated chromic acid wastewater to the storm sewer in August, 1965. The sewer discharged into Olean Creek and resulted in a fish kill of over 10,000 fish.
- The periodic discharge on to the ground of waste fluids and filtered material from the chromic acid filtration system.
- A 1987 fine from NYSDEC due to improper emission control equipment to remove chromic acid from plant air emissions.
- The abandonment of numerous unsecured containers and vats of chemicals, after the R. G. Scott Corporation (the last owner of Plant No. 1) filed for bankruptcy in 1989.
- The abandonment of six "plating wells" used for plating Navy cannon barrels. The wells are 18" in diameter and 32 feet deep. Three of the wells were found to contain high levels of chromium.

Geologic Conditions

Ground water beneath Van Der Horst Plant No. 1 is present in two distinct and separate aquifers. Logs from shallow and deep monitoring wells indicate that the upper aquifer primarily consists of gravel and sand deposits with occasional cobbles. These deposits extend down to a depth of 90 feet.

The lower aquifer beneath the site was encountered during the drilling of monitoring well MW-5B. The lower aquifer is separated from the upper aquifer by a 19-foot thick layer (i.e., from 90 ft to 109 ft) of silty-clay. Lower aquifer sediments (i.e., > 109 ft) are typically composed of sand and gravel, based on the MW-5B well log. The top of the lower aquifer is at a depth of 109 feet, but the depth of the base of this lower aquifer is not presently known.

Ground Water Flow

Ground water flow in the shallow monitoring wells is primarily towards the southwest with an average lateral gradient of 0.0004. Ground water in the deep monitoring wells generally flows toward the southwest to west at an average lateral gradient of 0.0006. An average downward vertical gradient of 0.0005 (related to the head difference between shallow and deep wells) occurs within the uppermost aquifer southwest of the site however, larger values of both upward (+) or downward (-) vertical gradients occur at well pairs within the study area.

The upper aquifer near Plant No. 1 behaves like a semi-confined aquifer during static and low pumping conditions. Regionally, the upper aquifer is believed to be unconfined; however, clay lenses have been shown to locally exist within this aquifer, and may explain the aquifer's semi-confined behavior. The lower aquifer (i.e., > 109 ft below land surface) is confined by a 19-foot thick layer of silty clay, and is hydraulically separate from the upper aquifer, based on an average static head difference of greater than 1.0 ft, and that the aquifer did not respond to pumping of the upper aquifer.

The following average aquifer characteristics have been calculated or estimated from slug test and aquifer test data:

Parameter	Method	Value
Transmissivity	Pumping Test	193 ft^2/min
Hydraulic Cond.	Pumping Test	2.8 ft/min
Hydraulic Cond.	Shallow Well Slug Test	0.2 ft/min
Hydraulic Cond.	Deep Well Slug Test	0.10 ft/min
Hydraulic Cond.	Lower Aquifer Slug Test	0.12 ft/min
Storativity	Pumping Test	0.017
Specific Yield	Estimated Range	0.15 - 0.25

Public Health Risk Assessment

The public health risk assessment concluded that under current conditions there are carcinogenic effects from chromium in fugitive dust emissions and arsenic in residential soil (incidental ingestion by children). Under future conditions, if no remedial action is taken, the carcinogenic effects include PCE in drinking water, chromium in fugitive dust emissions and arsenic in residential soil. Additionally, the risk assessment concluded that noncarcinogenic effects under future conditions include chromium and lead in groundwater.

Based on the environmental risk assessment, no adverse effects to sensitive environmental resources are expected to occur as a result of the site contaminants. However, several of the contaminants found in sediment and surface water samples collected from Olean Creek are above SCGs and may be impacting benthic and aquatic life in this creek.

The following chromium cleanup levels were recommended in the final risk assessment: surface and subsurface soil (50 mg/Kg); ground water (50 ug/L). Surface and subsurface soil cleanup levels were determined from calculations of the leaching potential of chromium from soil to ground water. The ground water cleanup criterion was based on NYSDEC ground water standards. The soil cleanup level will also be used as the cleanup standard for sediment in Olean Creek and the storm sewer.

Delineation of Contamination

Soil

Four historical source areas (Areas A, B, C and D) were identified during the review of data from Phases I, II and III of the RI. These historical source areas were regions where specific plant activities have been identified as the cause of surface and subsurface soil contamination. All areas contain at least one subsurface soil sample which had chromium concentrations exceeding 1000 mg/Kg.

Area A is located along a series of chromium plating tanks within the main building of the plant. The tanks are believed to have leaked during plant operations. One subsurface saturated soil sample from this area had a chromium concentration of 30,500 mg/Kg or 3.05 percent. Area A is believed to be the primary source of ground water contamination at the site. Ground water from Area A monitoring well MW-17 had a chromium concentration of 264,000 ug/L.

Area B is located immediately west of the western plant wall and property fence. Chromium contamination in Area B is believed to have resulted from surface discharge of fluids from the plant chromic acid filters. Percent levels of chromium were detected in Area B surface soil. Chromium concentrations greater than 1000 mg/Kg were found in saturated subsurface soil beneath Area B.

Historical source Area C is northwest of the main plant building. Chromium contamination in this area may have resulted from former disposal practices or spillage from the nearby storage area within the building.

Area D is located in the courtyard surrounded by the plant buildings. The potential source of contamination in this area is the liquid contained in three of the six formerly operating plating wells. These wells extend below the water table and could be in hydraulic connection with the aquifer. Chromium concentrations of 700,000 ug/L, 22,900 ug/L, and 610 ug/L were respectively detected in wells A, B and D. Saturated and unsaturated soil surrounding these wells may also be a source of chromium contamination to ground water.

Ground Water

Chromium and PCE have been determined to be the principle ground water contaminants. PCE levels in Phase I, II and III ground water samples indicate that PCE contamination primarily occurs within the shallow wells beneath and adjacent to the Plant No. 1 building. Chromium contamination within the shallow monitoring wells has predominantly migrated south of the site. The extent of the shallow chromium plume appears to lie within the existing network of shallow monitoring wells. Chromium contamination in the deep monitoring wells has been transported to the southwest and west. Total chromium contamination extends beyond the deep monitoring wells.

Storm Sewer

The sediment and water samples collected from the storm sewer system that runs from the east side of the site to the Brookview outfall indicate that this system contains elevated levels of chromium and lead. Based on data collected during Phase II of the RI, it appears that the chromium concentrations are highest in water and sediment samples that were collected between the Van Der Horst storm sewer connection and Keating Street (i.e., down-flow from Plant No. 1).

Olean Creek

Chromium concentrations in Olean Creek sediment appear to be the highest near the Brookview storm-sewer outfall;

however, elevated chromium concentrations (i.e., chromium concentrations greater than 50 ppm) were measured in three of the bank-sediment samples downstream of the outfall. Based on a comparison of the chromium concentrations in sediment upstream and downstream of the outfall, it appears that this outfall was/is a source of the elevated chromium in Olean Creek.

Aluminum, iron and zinc were the only analytes detected above Class "C" surface water quality standards in surface water from Olean Creek during the Phase I and II RI sampling events. Thus, it appears that the surface water in Olean Creek is not being significantly impacted by the Brookview outfall (i.e., contaminants associated with the subject site migrating through the storm sewer) or the creek sediments (i.e., through suspension of contaminated sediments) at the time of the Phase II sampling event. Phase I concentrations of these metals were higher and may have been impacted by suspended sediment since the creek was relatively turbid during the time of sampling.

Remedial Action Objectives

The remedial action objectives are contingent upon current and future use of ground water by local residents and the potential for contaminant migration to public supply wells. This information has, in part, been collected by the NYSDOH during their residential well survey and the results, combined with the USGS records, are not conclusive that there is no active local withdrawal of ground water. However, assuming that there is some future exposure path for the contaminated ground water, the following remedial action objectives have been developed:

- Remediate identified areas of contaminated surface and subsurface soil to limit future migration of chromium, lead and PCE;
- Remediate ground water to acceptable risk levels for chromium, lead and PCE;
- Remediate the storm sewer system (i.e. lines between the site and Olean Creek) of residual contamination.
- Remediate the contaminated sediments in the vicinity of the Brookview outfall to Olean Creek; and
- Remediate on-site building structures (possibly including demolition of the plant building) if necessary.
- Remediate the plating well water and contaminated soil associated with the plating wells, if present.

Recommendations for the Remedial Action Program

Although the Phases I, II and III RI has provided extensive amount of information regarding the physical characteristics of the study area and the contaminants of interest, some additional study will be required for the remedial design programs. Some recommended studies for the initial phase of the remedial action program are summarized below:

wouldn't this be vertical extent

1) The horizontal extent of total chromium ground water contamination needs to be further delineated with additional deep monitoring wells southwest of the site. The existing ground water modeling data should be expanded to include the entire ground water plume, after the limits of total chromium in the deep monitoring well have been defined. Expanded ground water flow simulations which will be used to optimize the recovery of contaminated ground water from the entire plume. The following factors will be evaluated during modeling:

   - Numbers of recovery wells;
   - Recovery well locations; and
   - Recovery well pumping rates.

wasn't this done during pump test.

2) The area of subsurface soil contamination (see Figure 6-4) should be further defined vertically and horizontally to determine remedial action methodologies and cleanup costs. Although the approximate extent of contamination can be estimated in the unsaturated soil, no vertical limits have been determined for the vertical extent of chromium contamination in the saturated soil. Remedial measures for saturated soil can not presently be reliably determined since the vertical extent ~~is~~ unknown. Chromium contamination ~~limits in saturated soil are~~ particularly important, since this soil is in direct contact with ground water and is believed to be the primary source of ground water contamination at the site.

?

WHAT

WRONG

wouldn't saturated soil
be a factor of the G.W.
contamination.
Samples were ~~taken~~ during
MW installation
what happened to
these.

3) The southern extent of surface soil contamination on Conrail property east of the railroad tracks should be delineated. This delineation will involve contaminated soil (i.e., soil with chromium concentrations greater than 50 mg/Kg) as well as contaminated soil classified as hazardous (using TCLP analysis).

4) Water from plating wells A, B and D should be pumped out and properly disposed. Saturated and unsaturated subsurface soil near these wells should be sampled to

By EPA

R.R. tracks acts
as a boundary - reason
used in RI/FS W.P.

determine if these soils are also sources of contamination.

5) The limit of chromium contamination in Olean Creek sediment near the Brookview storm sewer outfall should be established. Additional creek sediment sampling would be necessary to accomplish this task. A chromium concentration of 50 mg/Kg would be used to delineate sediment contamination.

1.0 INTRODUCTION

This report presents and summarizes the results, findings and conclusions of ERM-Northeast's (ERM) Remedial Investigation (RI) conducted for the New York State Department of Conservation (NYSDEC) at the Van Der Horst Plant No. 1 chrome-plating facility in Olean, New York. The RI was conducted in three phases. Phase I and II information will be summarized within this report, since these data were previously included in documents submitted to NYSDEC in March 1990 and May 1991. Phase III data will be presented and discussed in detail. The conclusions presented in this final RI report will be based on information from all three phases. Supporting documentation for the Phase III RI is contained in the Phase III Remedial Investigation Field Data Report, submitted to NYSDEC in August 1991.

1.1 Purpose of RI Study

The purpose of the RI study was to assess the nature, extent and potential source(s) of contamination at the site. This process was conducted in three phases, beginning in April, 1989 and ending in June, 1991. It was the intent of the RI to compile sufficient data so that cost-effective and environmentally-sound long-term remedial actions could be developed during a Feasibility Study (FS).

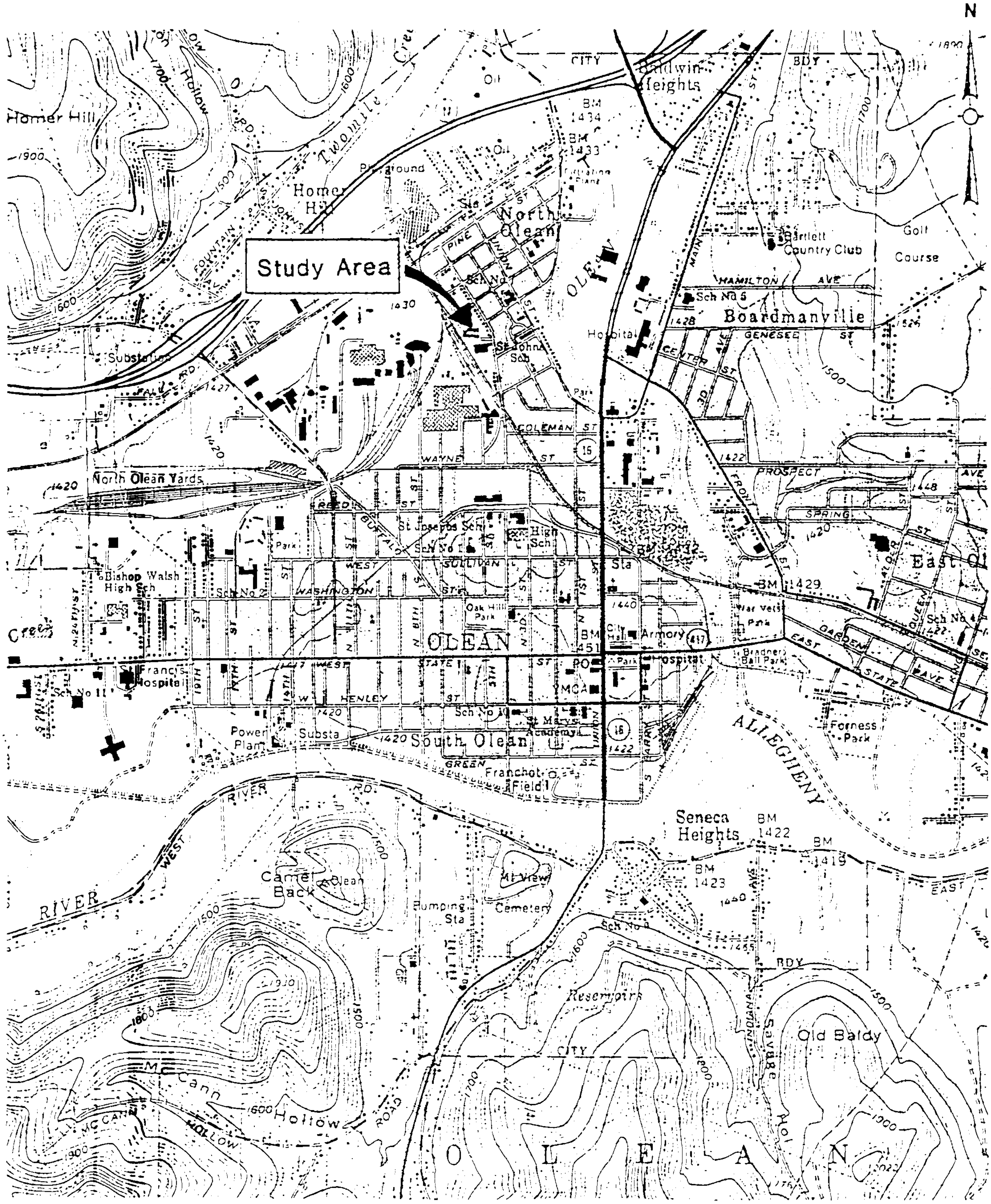
1.2 Background

1.2.1 Site Description

The former Van Der Horst Corporation of America Plant No. 1 chrome-plating facility is located at 314 Pennsylvania Avenue in the northern section of the City of Olean, Cattaraugus County, New York (see Figure 1-1). The subject site, defined for the purpose of this study as the fenced area at Van Der Horst Plant No. 1, has an areal extent of approximately 2 acres and lies within the valley of the Allegheny River Basin. Bordering the site to the north, east, and south are residential properties located along Pennsylvania Avenue, West Fourth Street, Spruce Street, and Vine Street (see Figure 1-2). Two sets of Conrail tracks border the site to the west and southwest, thereby separating the plant from the main industrial area of Olean.

Several other industrial facilities are located near Plant No. 1, and are shown on Figure 1-1. The larger

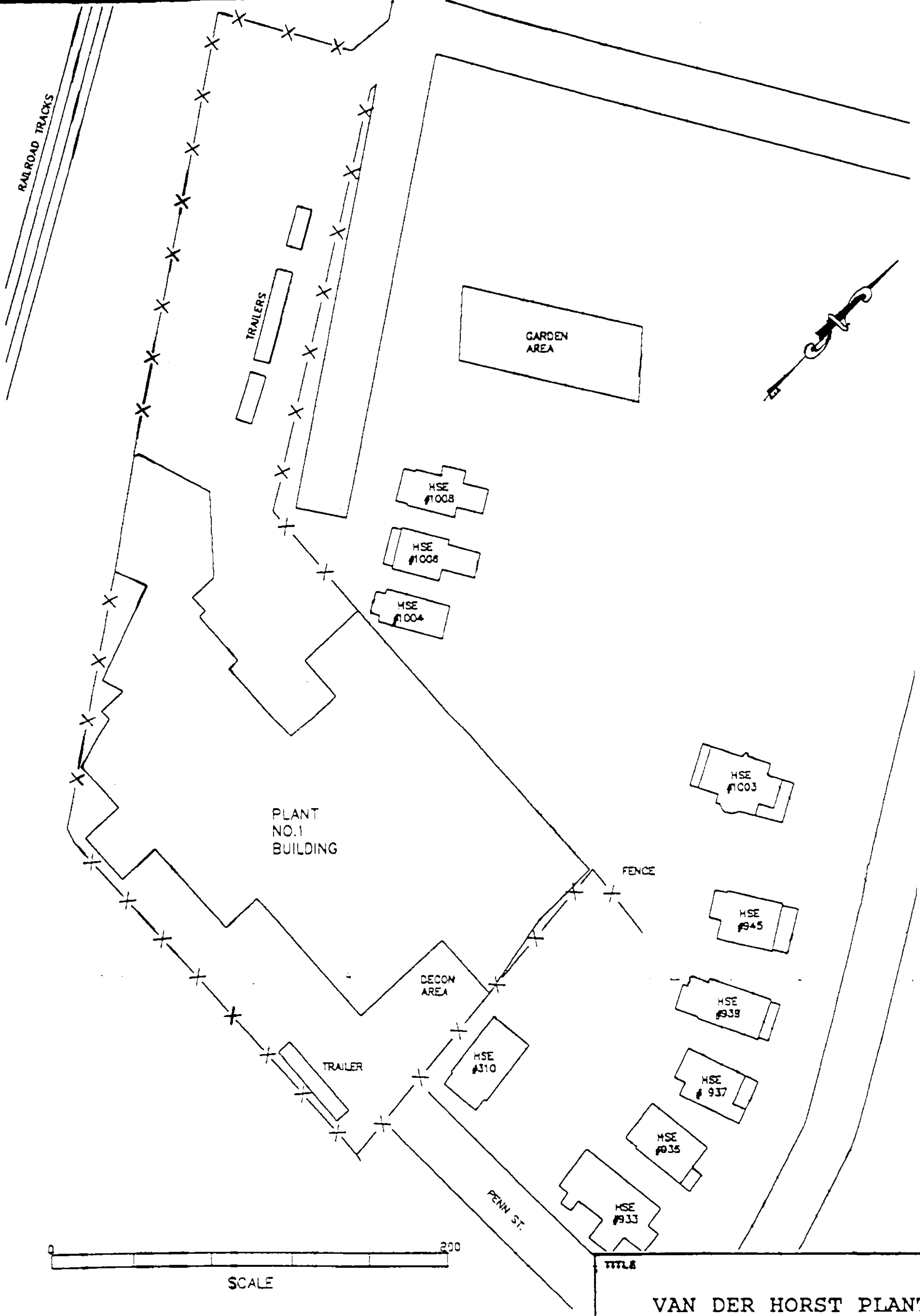
FIGURE 1-1
Site Location Map - Van Der Horst Company
RI/FS Plant No.1



Source: U.S.G.S. Quadrangle Map, Olean, N.Y.

Scale: 1"-2000'

ERM-Northeast
Environmental Resources Management



NOTES:

1) BASE MAP PROVIDED BY MILLARD & MAC KAY LAND SURVEYORS OF BUFFALO, NEW YORK.

TITLE

VAN DER HORST PLANT NO. 1

FACILITY PLAN

PREPARED FOR

ERM-Northeast
Environmental Resources Management

SCALE	FIGURE 1-2
DATE	

facilities include an Agway fertilizer plant (CONAP), two Dresser-Rand air compressor manufacturing plants, and a several acre tract of land owned by Felmont Oil Company formerly used for above-ground storage of their locally produced Pennsylvania-Grade crude oil. The building structures on this latter property have been razed and the entire tract is presently a vacant field. Prior to Felmont Oil ownership, this property was owned by the Socony-Vacuum Oil Company, the site of one of the country's first oil refineries. The refinery operated from 1861 to 1954, with a processing capacity of 7,000 barrels/day, mainly lubricating oils and greases.

1.2.2 Site History

Dr. Hendrik Van Der Horst founded the Van Der Horst Corporation in 1940 to service the local oil field industry and railroad companies. His first manufacturing operations were located in Olean at Plant No. 1, and consisted of the electrolytic deposition of hard-chrome plating on various types of customized metal parts. The corporation developed, patented, and utilized a specialized plating process called Porus-Krome™ during World War II. This process produced a "glass-smooth, diamond-hard, chromium-plated surface" that retained oil.

It was initially used to repair the worn cylinder linings in diesel engines of submarines, tugboats, and combat machines for the U.S. Navy.

The Van Der Horst Corporation opened a second plant (Plant No. 2) in 1951 on Connell Street in Olean. This plant was constructed to perform a new iron plating process (Vanderloy M™) that was designed and patented by the corporation. The iron-plating process was used to repair and restore the worn surfaces of mobile components of machinery (i.e., cylinders, crankshafts, etc.) for a cost that was less than that of purchasing new components.

In August, 1965, Plant No. 1 was responsible for an accidental discharge of 400 to 500 gallons of untreated chromic-acid wastewater that went directly into the storm sewer system. This resulted in a substantial fish kill of over 10,000 fish near the sewer's outfall in Olean Creek. At that time, the plant routinely disposed of its chromic acid waste through the storm sewer that led to the creek, and the standard operating procedure was to dilute and neutralize the Ph of the waste prior to discharge. No residual chromium contamination was detected in Olean Creek after the fish kill; however, thereafter the plant disposed of its waste into the sanitary sewer system.

In 1967, an industrial well field owned by Felmont Oil Co., located 500 feet west of Plant No. 1, was found to contain elevated concentrations of chromium (8.36 mg/l total and 0.54 mg/l trivalent) after being in operation for a single year. The City of Olean and the CCDOH expressed considerable concern about the contamination. Their main concern was for the 13,500 people living in the city and dependant upon the local water supply obtained from the Allegheny River Basin. At this time residents were cautioned, by the CCDOH, against the use of private supply wells for drinking purposes, and were encouraged to use municipal water. The CCDOH also required the Van Der Horst Corporation to pretreat any chromic acid waste prior to discharge into the city's sanitary sewer system. In March, 1968, a "chrome destruct" unit was installed at Plant No. 1 by the corporation to treat waste in accordance with the effluent limitation for hexavalent chromium.

Several manufacturing operations at Plant 1 may have resulted in the chromium contamination found in the ground water. During the 1940's and 1950's, chromic acid waste had allegedly been migrated into the ground water via exterior plating "wells". These "wells" are constructed of 20-inch diameter, PVC lined, steel casings with concrete bases. The "wells" extend to approximately 20 feet below grade and were used to refurbish cannon barrels during World War II and the Korean War. Other potential sources of contamination are the several chromic-acid plating tanks located inside the plant building. These tanks are situated approximately 20 feet below grade and set into subsurface concrete vaults. During production the tanks were reportedly lined and regularly checked for fluid retention but the concrete vaults were not.

An area where two chromic-acid filters were back flushed is another potential source area for chromium contamination. The two filters were located along the plant's western wall. Each cylindrical filter was approximately 4 feet high and 2.5 feet in diameter and use to remove suspended solids from used chromic acid during recirculation from the plating tanks. Approximately twice a day the filter became clogged and were back flushed under pressure. The chromic acid and filter cake were blown out of the plant building in the area were the MW-5 well cluster is installed.

In May, 1968, Van Der Horst Corporation of America was acquired by Unochrome to become a subsidiary of the largest chrome plating company in the world. However, the operations at Plant Nos. 1 and 2 remained essentially unchanged. Thereafter (in 1973), the Van Der Horst subsidiary was acquired by the R. G. Scott Corporation.

In 1984, the site was listed on the NYSDEC Registry of Suspected Hazardous Waste Sites. Soon after, the corporation installed emission control equipment. In 1986, the R. G. Scott Corporation received a proposed Order on Consent from the NYSDEC in reference to the Plant No. 1 facility's continued stack emissions. This consent order charged the corporation with "unreasonably interfering with the comfortable enjoyment of life and property". The action stemmed from the repeated complaints, and subsequent legal action, to the CCDOH by nearby residents stating that emissions from two points at Plant 1 were causing personal injury and property damages. In January, 1987, the corporation signed the consent order calling for a $5,000 fine, and modifications to the emission control equipment that would eliminate any future discharge of chromic acid into the air.

In June, 1987, Van Der Horst ceased all operations at their facilities after the employee's independent union rejected a contract proposal calling for benefit cuts and a 30% reduction in wages for all employees. The contract dispute was not settled and by October, 1987 the plant property was reportedly for sale. In August, 1988, the NYSDEC issued a proposed letter of consent to R. G. Scott Corporation for performing an RI/FS and in May, 1989 the corporation filed for bankruptcy.

The plant has been vacant since November 1988, and most of the production equipment has been removed from the interior of the building during salvage operations in 1988 and 1989. The property is surrounded by a chain link fence and numerous "keep out" signs have been posted. The three entrance gates, two on Penn Ave. and one on Vine Street, have been secured and access is limited.

The interior of the building had contained numerous containers and vats of chemicals left unsecured by the Van Der Horst Corporation. From January 1990 to February 1991 the USEPA conducted a removal operation of the unsecured chemicals.

In summary, previous investigations by the NYSDEC and the CCDOH have documented that chromium has migrated off-site via transport in surface water, ground water and air. This migration has resulted in the localized contamination of Olean Creek, the permanent closure of nearby industrial and residential ground water wells, and the deposition of chromium onto soil downwind of Van Der Horst Corporation's Plant No. 1.

1.2.3 Current Situation

The USEPA remediation of the plant interior, with respect to the removal of unsecured chemicals and process solutions, has been completed. No action to date has been taken as to the future of the plant building and interior structures.

Reports detailing the Phase I and Phase II RI and the Phase I and Phase II FS project have been submitted to the NYSDEC by ERM. The Phase I RI report was submitted in December 1989 and the Phase I and II FS report was submitted in February 1990. The Phase II RI Report was submitted in May 1991 and the draft Ground Water Flow Modeling Report was submitted in June 1991.

The Phase III Remedial Investigation Field Data was submitted in August 1991.

A Phase III Work Plan was submitted to the NYSDEC in February 1991 for the purpose of investigating the subsurface conditions beneath the building structure. Field operations for this phase commenced in April 1991 and were completed in June 1991.

1.3 Report Organization

This RI report presents the findings of the Phase III RI and a summary of data collected during the Phase I and II RIs. Conclusions are based on the results of the entire RI program. Work was conducted in general accordance with the NYSDEC and USEPA requirements and protocols. The report format is also in general accordance with the "USEPA Guidance for Conducting RI/FS Under CERCLA". The organization of this report is as follows:

Section 1.0 - Introduction
Section 2.0 - Remedial Investigation Program
Section 3.0 - Aquifer Characteristics and Hydraulic Testing
Section 4.0 - Overview of the RI Chemical Analyses
Section 5.0 - Public Health and Environmental Risk Assessment
Section 6.0 - Potential Sources and Extent of Plant No. 1 Contamination
Section 7.0 - Summary and Conclusions
Appendix - QA/QC Data Validation Report

2.0 REMEDIAL INVESTIGATION PROGRAM

2.1 Project Overview

The objective of ERM's RI field investigation program was to identify the extent of soil and ground water contamination in the vicinity of Van Der Horst Corporation's Plant No. 1 and to identify any residual contamination from the one time release of chromic acid to the storm sewer system. Emphasis was placed on identifying four possible environmental problems: 1) major on-site contaminant source areas; 2) the magnitude and extent of soil contamination in the local area adjacent to the Van Der Horst plant; 3) residual contamination present in the storm sewer system and Olean Creek; and 4) the lateral and vertical extent of ground water contamination.

The initial project task (Task 1) of the Phase I RI involved the preparation and submittal of a Work Plan, which included the QA/QC Plan (Appendix A), and the Health and Safety Plan, (Appendix B). The Work Plans for characterizing the site were an expansion of ERM's original RI/FS proposal. The QA/QC Plan contained the methodologies and protocols that were used when conducting the RI study while the Health-and-Safety Plan outlined the procedures for protection of on-site field personnel, as well as the surrounding community. All plans were submitted for review to the Division of Hazardous Waste Remediation, NYSDEC Central Office; and were reviewed by the NYSDEC (Central Office, Region 9 Office, and Olean sub-office), NYSDOH, and the CCDOH. The Phase I RI included the following tasks:

- A Literature Review
- Geophysical Survey
- Installation of Test Borings and Monitoring Wells
- On-site Soil Evaluation
- Monitoring Well Development
- Ground Water Sampling
- Evaluation of Hydraulic Properties of the Aquifer
- Off-site Soil Evaluation
- Olean Creek Sampling

Actual field work for Phase I commenced in April, 1989 and continued until December, 1989. The Phase I Remedial Investigation Report, which summarized the findings of the Phase I RI, and the associated appendices were submitted to the NYSDEC in December 1989. The Phase I and II Feasibility Study (FS) for the site was submitted to the NYSDEC in February 1990. This report identified the general response actions, evaluated the remedial technologies and formulated the remedial action alternatives based on the data generated during the Phase I RI. A detailed evaluation and design of the alternatives will be presented in the Phase III Feasibility Study.

The Phase II RI was conducted at the Van Der Horst Plant No. 1 between May 1990 and December 1990. Phase II was undertaken to further delineate the extent of surface soil, stream sediment and ground water contamination detected during the Phase I RI. The Phase II RI was also performed to better understand the aquifer properties, including ground water flow characteristics. The Phase II RI included the following tasks:

- Preparation of a Base Map and Site Topographic Map
- Installation of Monitoring Wells and Test Borings
- Monitoring Well Development
- Sampling of Ground Water Monitoring Wells
- Pumping Test and Ground Water Modeling
- Delineation of On-Site Soil Contamination
- Supplemental Evaluation of Off-Site Soils
- Additional Sampling at Olean Creek
- Sampling of Adjacent Storm-Sewer System
- Risk Assessment

Actual field work for Phase II commenced in June, 1990 and continued until December, 1990. The Phase II Remedial Investigation Report, which summarized the findings of the Phase II RI, and the associated appendices were submitted to the NYSDEC in May 1991. Ground water modeling results were submitted to NYSDEC in a separate draft report "Ground Water Flow Modeling Report" in June 1991.

Field work for the Phase III RI was conducted between May and June 1991. The purpose of this study was to: 1) assess the potential extent of contamination inside and beneath the plant buildings; 2) further delineate surface and subsurface soil contamination surrounding the plant; and 3) attempt to determine the source(s) of the ground water contamination. The Phase III RI included the following tasks:

- Review of existing facility and EPA data
- Sampling for asbestos containing materials
- Sampling of building interior surfaces
- Additional off-site surface and subsurface soil sampling
- Installation of test borings
- Installation/development of ground water monitoring wells
- Ground water sampling
- Surveying of Phase III RI monitoring well and sampling locations
- Final risk assessment

Field samples collected during the Phase III RI were analyzed for chemical parameters that reflected the facility's manufacturing and discharging history, and the results of previous sampling by the CCDOH and NYSDEC. Analytical parameters for each matrix are summarized on Table 2-1. The chemical analyses was performed by a laboratory that was technically acceptable by the NYSDEC. NYSDEC-mandated sampling, analytical procedures, QA/QC requirements, and sampling protocols were followed. These procedures are presented in the NYSDEC approved QA/QC Plan for this RI/FS.

TABLE 2-1

SUMMARY OF PHASE III RI SAMPLING PROGRAM

	Sampling Location	Analyses
OFF-SITE SOILS	SURFACE: SFS-1 through SFS-29	Total chromium
	SUBSURFACE: SB-20, through B-27 (23 samples)	Total chromium,
ON-SITE SOILS	SURFACE: SSPW-1 through SSPW-4	Total chromium, arsenic and lead
	SUBSURFACE: SB-10, SB-11, SB-14 through SB-17 (36 samples); B-28 (3 samples); SBPW-1 through SBPW-3 (7 samples); MW-15 through MW-17 (27 samples)	Total chromium, arsenic and lead
	SUBSURFACE: B-28 and MW-15 through MW-17	TAL metals
	SUBSURFACE: SB-10, SB-11, SB-14 and SB-17; B-28; MW-15 through MW-17	TCLP for RCRA metals
	SUBSURFACE: SB-10, SB-11, SB-13, SB-14 and SB-17 (10 samples); B-28; MW-15 through MW-17	TCL Volatiles
	SUBSURFACE: SB-17 (3 samples)	PCBs
	SUBSURFACE: SB-13 (2 samples)	PAHs
GROUND WATER	MW-15 through MW-17 and MW-19D	TCL Volatiles, TAL metals, hexavalent chromium
PLANT BUILDING	INSULATION/TILES: AS-1 through AS-20	Asbestos
	WIPE: W-1 through W-10 and W-12 through W-13	Total chromium, arsenic and lead
	SWEEP/SCRAPE: SCS-1 through SCS-16	Total chromium, arsenic and lead
	CORE: C-1 through C-2	Total chromium, arsenic and lead
PLATING WELL WATER	PLATING WELL A through PLATING WELL F	Total chromium, arsenic and lead

NOTE: Analyses were conducted at the lowest practical detection limit.

2.2 Review of Existing Facility and EPA Data

Concurrent with field studies, a record search of the Van Der Horst facility was conducted at the relevant federal, state and municipal offices. A list of the sources contacted for literature review is presented on Table 2-1 of the Phase I RI Report. During the course of the field studies, several persons familiar with conditions at Plant No. 1 were visited and interviewed. The individuals interviewed included: Mr. Gibbons, Olean Fire Chief; Mr. Helgas, CCDOH; Mr. Marcus, Olean DPW; Mr. Concannon, NYSDEC; and Gino Lorenzino, a former Van Der Horst employee. Site specific, local and regional background information collected under this task was presented in Section 1.0 of the Phase I RI report, and the associated Appendix A.

During Phase III of the RI, Mr. Jack Harmon of the USEPA was contacted with regards to analytical data from samples obtained by a USEPA subcontractor at the Plant 1 facility. This information was utilized to determine the location of many of the interior wipe and scrape samples that were collected during the Phase III RI. Furthermore, a file search was conducted at the plant facility to obtain information about underground storage tanks, air emission permits, and discharge points. The information gained during the file

DRAFT

FINAL REMEDIAL INVESTIGATION
PLANT NO. 1
VAN DER HORST CORPORATION SITE
SITE NO. 9-05-008
OLEAN, CATTARAUGUS COUNTY

TEXT
VOLUME I OF I

NOV 7 1991
[illegible] REMEDIATION

NOVEMBER 1991

SUBMITTED TO:

DIVISION OF HAZARDOUS WASTE REMEDIATION
NEW YORK STATE
DEPARTMENT OF ENVIRONMENTAL CONSERVATION
ALBANY, NEW YORK 12233

SUBMITTED BY:

ERM-NORTHEAST, INC.
5500 MAIN STREET
WILLIAMSVILLE, NEW YORK 14221

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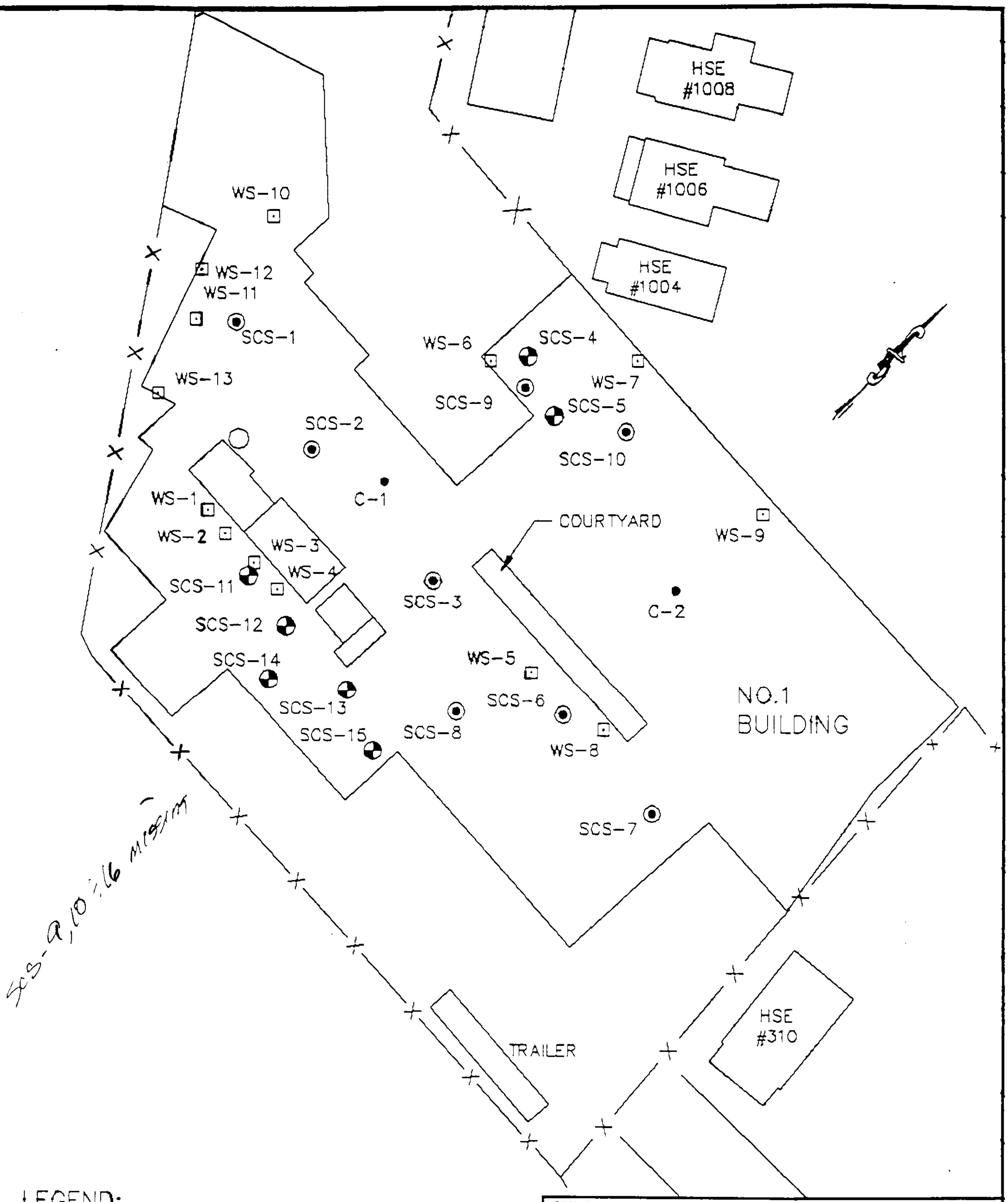
search was utilized in the location of several Phase III borings, monitoring wells and building samples.

2.3 Sampling for Asbestos Containing Materials

During the Phase III RI 20 grab samples were taken of pipe insulation, mudded elbow insulation, roofing materials and other materials suspected of containing asbestos. The samples provided an initial screening for asbestos containing materials on the building's two floors and lateral additions. Asbestos information will be necessary in the event that the building is demolished. The samples were analyzed using polarized-light microscopy for identification of the asbestos fibers. Asbestos containing material was identified in 18 of the 20 samples collected. The results of the analysis are presented on Table 4-12 and discussed in Section 4.6.3.

2.4 Sampling of Building Surfaces

Wipe, dust and scrape samples were also collected during the Phase III RI and analyzed to assess the extent of chemical contamination inside the plant building (see Figure 2-1). The samples provided an initial screening of the presence of contaminants and indicated where more detailed sampling will be required during the design phase of the FS. Twelve (12)



SCS-9,10 &16 missing

LEGEND:

- ⊡ Wipe Sample
- ◉ Floor Scrape Sample
- ◕ Roof Scrape Sample
- • Core Sample

GRAPHIC SCALE

25 0 25 50 100

(IN FEET)

TITLE

VAN DER HORST PLANT NO. 1
PHASE III WIPE, SCRAPE
AND CORE SAMPLE LOCATIONS

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Environmental Resources Management

SCALE	FIGURE
DATE	2-1

wipe samples were collected from various areas including: 1) inside the process tank exhaust ductwork; 2) the pit in the lead room located in the western section of the plant; and 3) in the north area of the plant near the chromic acid and caustic soda tanks. Sixteen (16) dust and scrape samples were collected from various areas including the roof, inside the air pollution control cyclones and the main work area floor. Two core samples were also obtained from fiberboard walls in the plant. All of the wipe (12) and dust (16) and core (2) samples were analyzed for total concentrations of chromium, arsenic and lead. The results of the wipe, scrape and core samples are presented in Tables 4-8 and 4-9 and are discussed in Section 4.6.1 and 4.6.2.

2.5 Off-site Soils

A total of one-hundred twenty-five (125) off-site soil samples were collected for chemical analysis during the three phases of the RI program. The term "off-site" was defined as the area outside the perimeter fence of the plant. The sample locations are shown on Figure 2-2 and 2-3. The analytical results for the Phase III samples are presented in Tables 4-1 and 4-2.

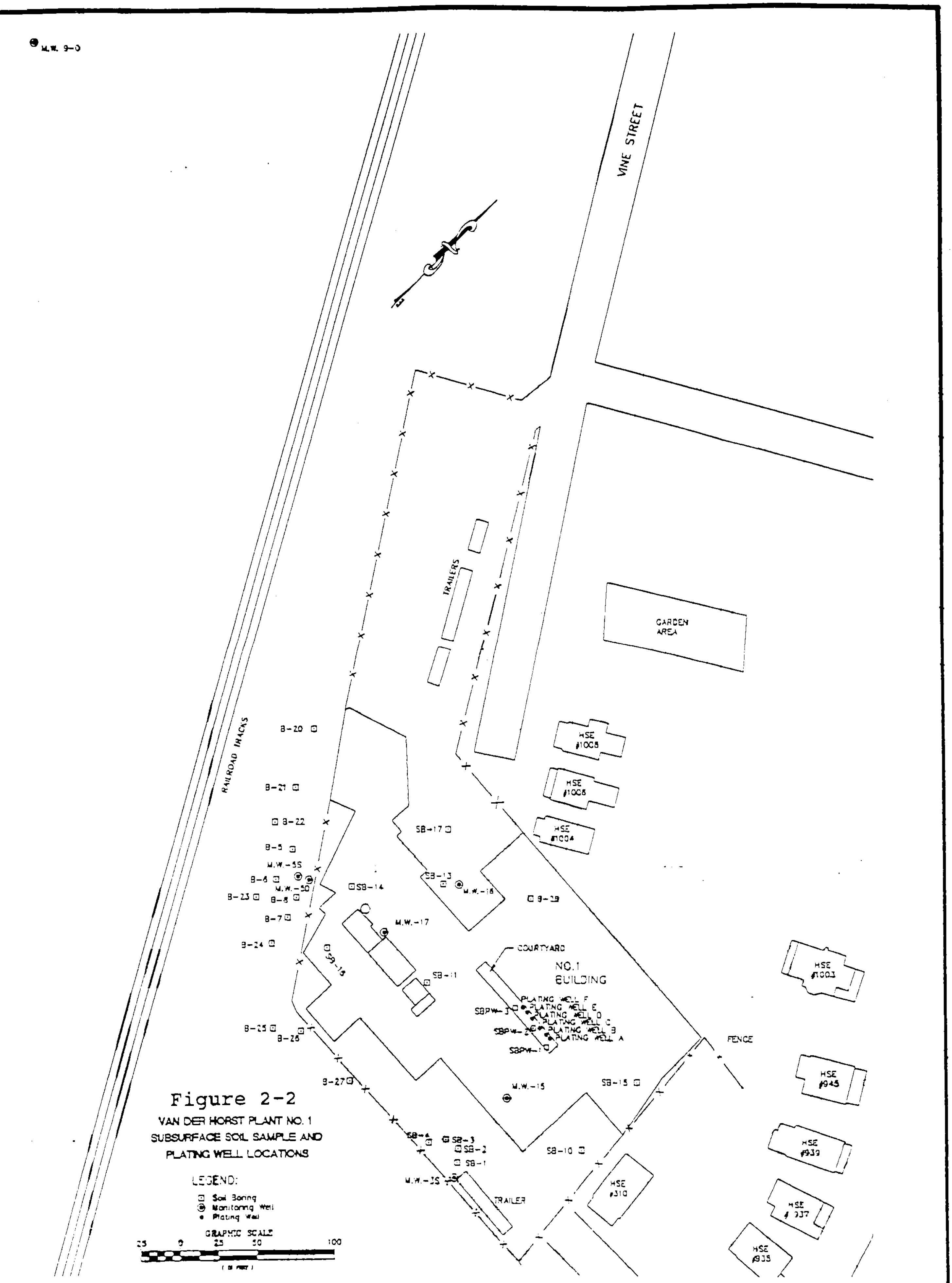

Figure 2-2

VAN DER HORST PLANT NO. 1
SUBSURFACE SOIL SAMPLE AND
PLATING WELL LOCATIONS

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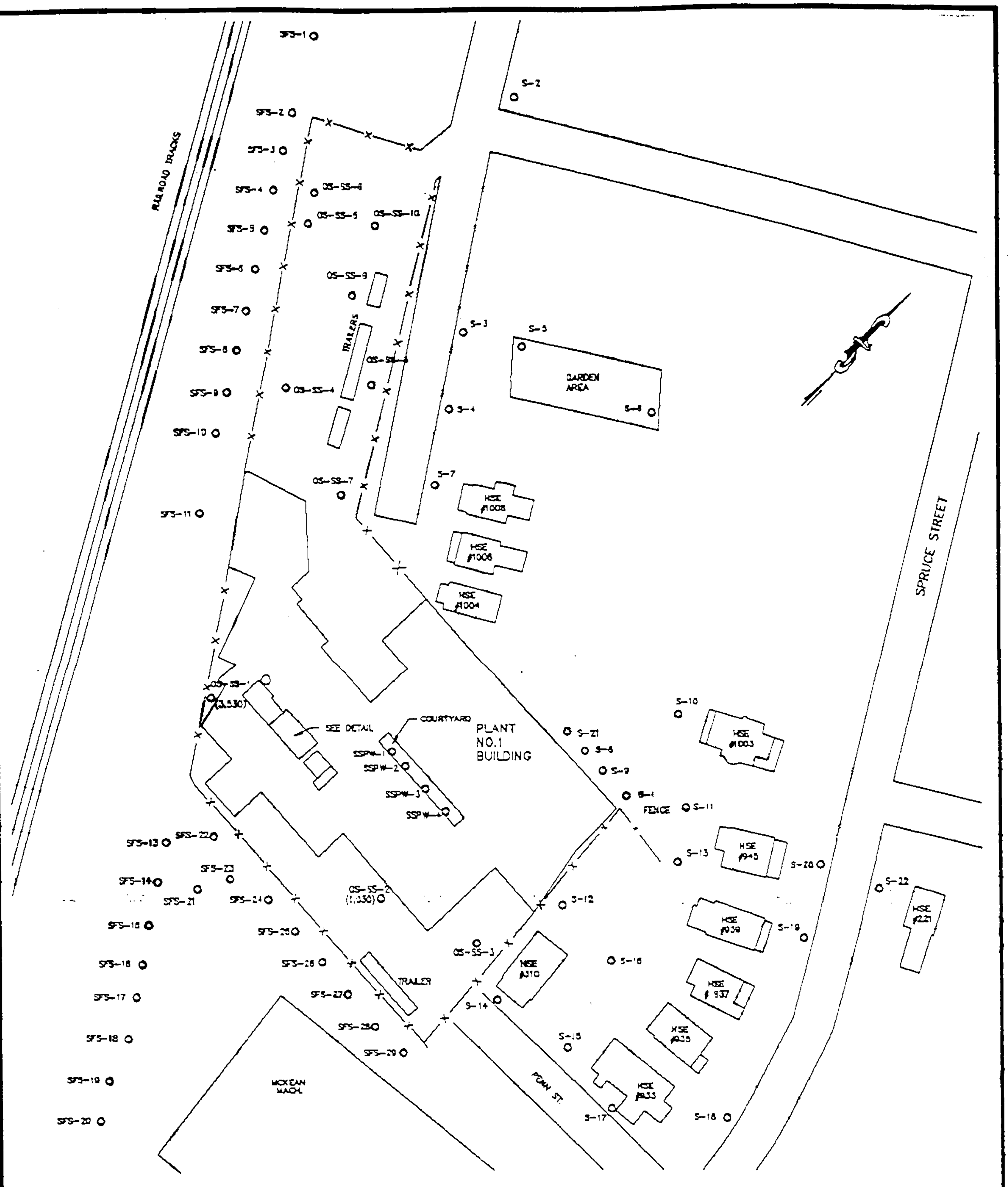

GRAPHIC SCALE

50 0 25 50 100 200

(IN FEET)

Figure 2-3

VAN DER HORST PLANT NO. 1
SURFACE SOIL SAMPLE LOCATIONS

LEGEND:

○ Surface Soil Sample

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During the Phase I RI, samples were collected to address complaints by the local residents that plant emissions were damaging house sidings and automobile finishes. This information was used to determine if plant emissions were responsible for depositing contaminants in the residential soil. These analytical data were also used to evaluate the short and long-term health risks associated with the soil.

The Phase II soil samples served to delineate the extent of the chromium contaminated areas not identified during the Phase I RI. The Phase II soil samples also provided further data for the evaluation of the health risks associated with the soil. The Phase III off-site samples served to further delineate the vertical and horizontal extent of soil contamination.

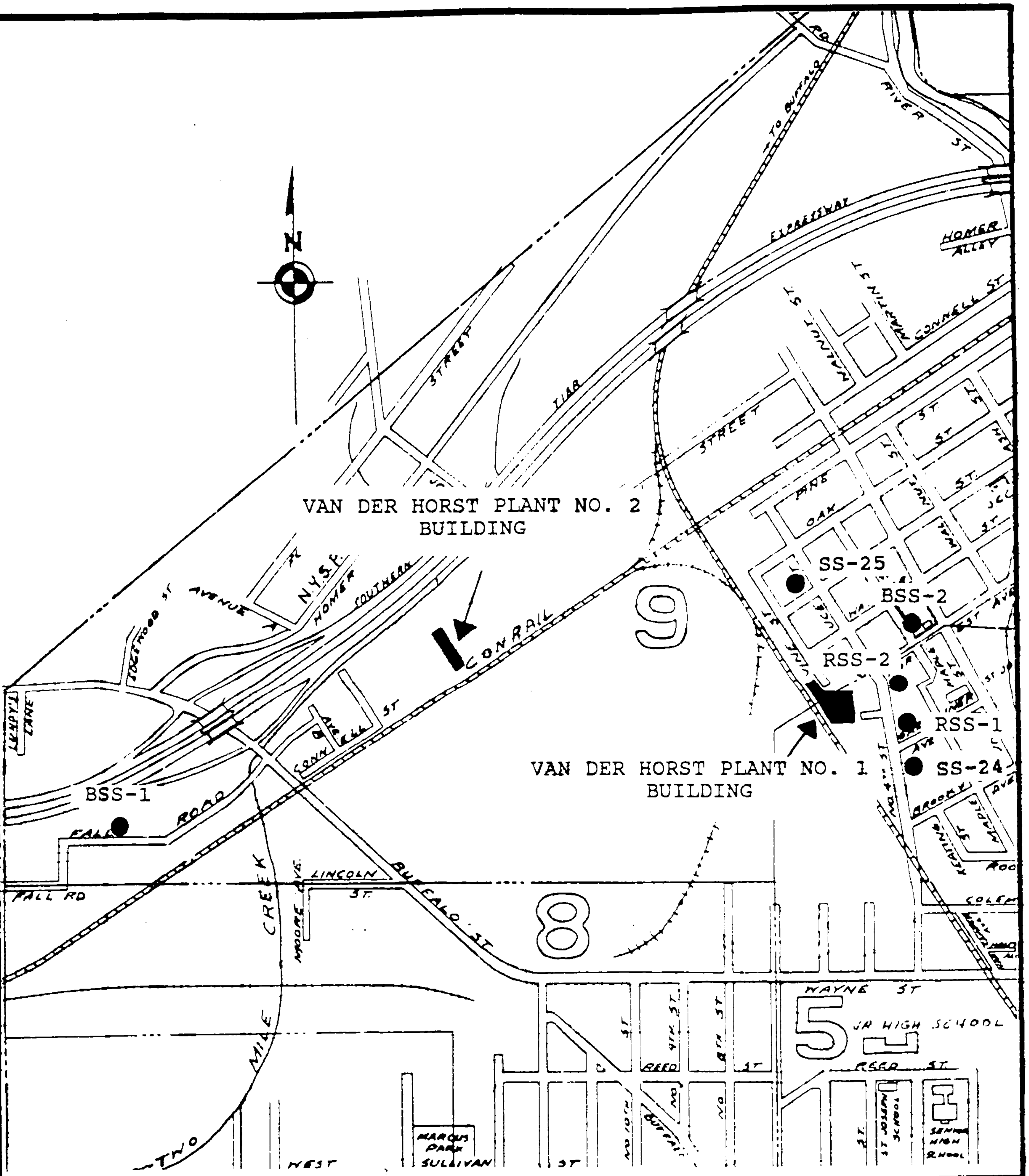
2.5.1 Surface Soil

During the Phase I RI forty-eight (48) samples of surface soil were collected from locations adjacent to the perimeter of the Van Der Horst property and from the public right-of-ways adjacent to Vine Street and Penn Avenue. The off-site soil samples were obtained from twoseparate depths: from 1 to 3 inches, and 3 to 6 inches. The location of these samples are shown on

Figure 2-3 and the analytical results are discussed in detail in the Phase I RI Report. Phase I surface sampling locations SS-24 and SS-25 are illustrated in Figure 2-4.

The Phase II RI off-site surface soil sample locations are presented on Figure 2-4. Sample BSS-1 was collected several hundred yard west of Plant No.1 to evaluate upwind background concentrations. Samples BSS-2, RSS-1 and RSS-2 were obtained to assess metal concentrations in residential areas. All four (4) Phase II off-site surface soil samples were tested for TAL metals. The analytical results of these samples are discussed in detail in the Phase II RI Report.

During the Phase III RI twenty-nine (29) off-site surface soil samples were collected to assess the horizontal extent of off-site contamination migration (see Figure 2-5). The samples were taken from the railroad right-of-way adjacent to the site's western perimeter and from McKean Machine property, adjacent to the site's southern perimeter. All Phase III off-site surface soil samples were analyzed only for total chromium.



● Soil Sample Location

Note: Sample BSS-1 is the upwind background sample.

TITLE

VAN DER HORST PLANT NO. 1

BACKGROUND AND RESIDENTIAL
SOIL SAMPLE LOCATIONS

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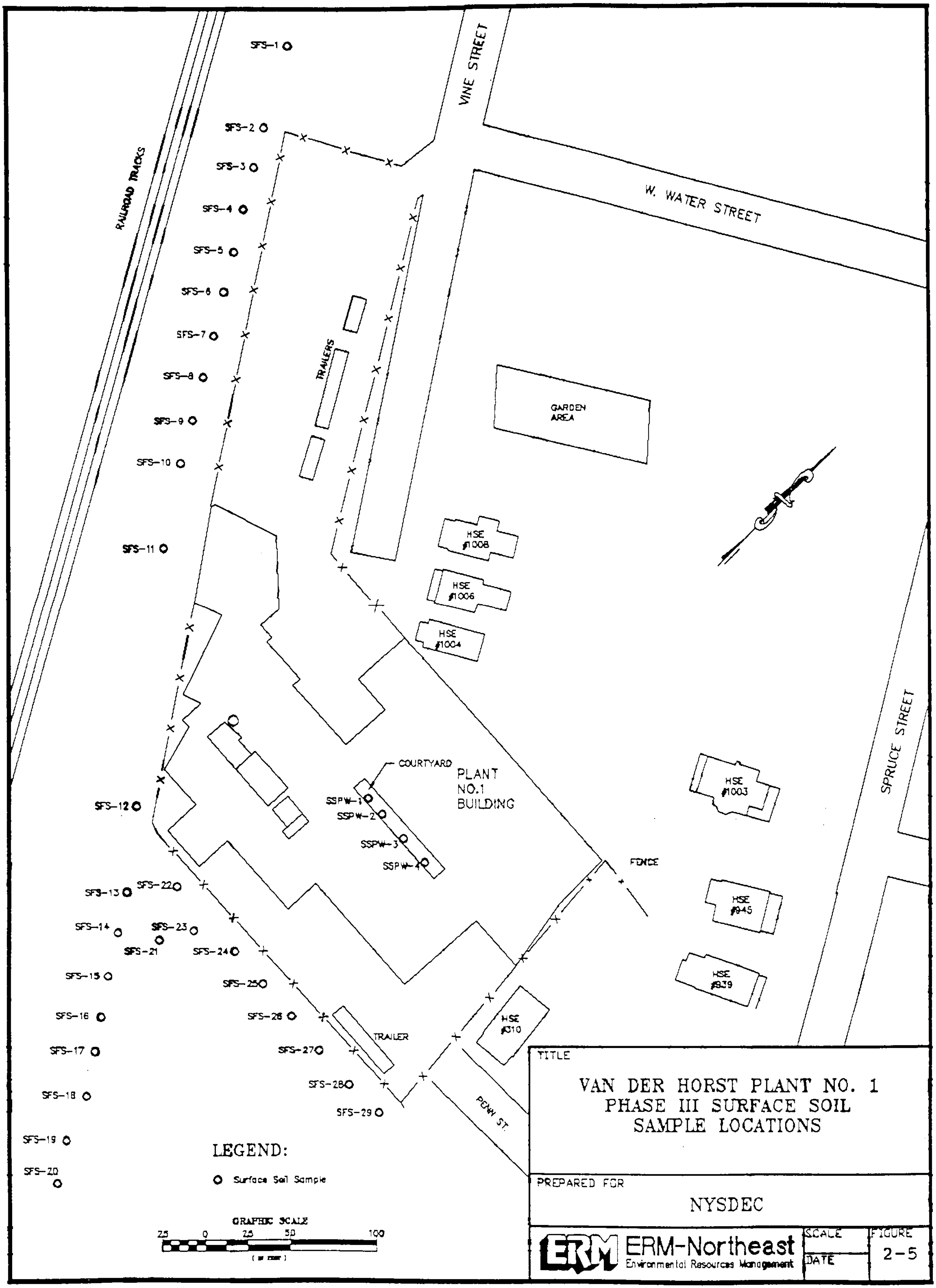
SCALE	FIGURE
DATE	2-4



TITLE

**VAN DER HORST PLANT NO. 1
PHASE III SURFACE SOIL
SAMPLE LOCATIONS**

PREPARED FOR

NYSDEC

ERM-Northeast
Environmental Resources Management

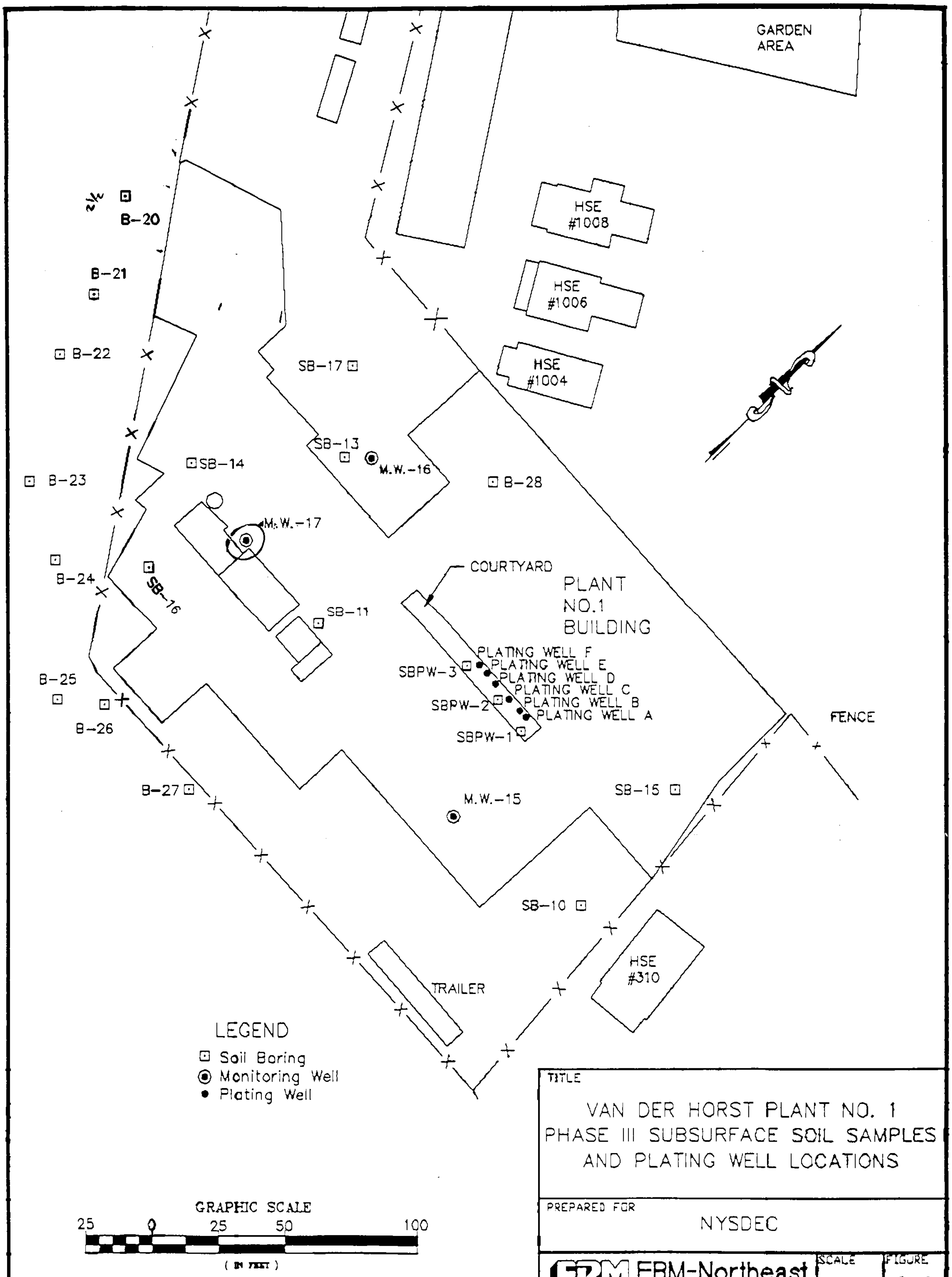
SCALE	FIGURE 2-5
DATE	

2.5.2 Subsurface Soil

During the Phase I RI three (3) off-site subsurface soil samples were collected for chemical analysis. These included MW-9D (5'-7') and MW-9D (15'-17'), and sample B-1 (3'-4').

During the Phase II RI nineteen (19) off-site subsurface soil samples were collected for chemical analysis. These samples were taken from test borings located along the facility's western perimeter and analyzed for total chromium, arsenic, and lead.

Twenty-two (22) off-site subsurface soil samples were collected for chemical analysis during the Phase III RI . The samples were collected to assess the vertical and horizontal extent of off-site contaminant migration. These samples were taken from soil borings B-20 through B-27. Two to four samples were obtained from each boring. The boring locations were sited along the railroad right-of-way adjacent to the site's western perimeter; or on McKean Machinery property, adjacent to the site's southern perimeter (see Figure 2-6). Samples were collected with a split-spoon sampler. All samples collected from the off-site borings were analyzed for total chromium.



TITLE

VAN DER HORST PLANT NO. 1
PHASE III SUBSURFACE SOIL SAMPLES
AND PLATING WELL LOCATIONS

PREPARED FOR

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Environmental Resources Management

SCALE	FIGURE
DATE	2-6

2.6 On-Site Soil Evaluation

One hundred seventeen (117) on-site soil samples were collected during the three phases of the RI. The locations are shown on Figures 2-2 and 2-3. Samples were collected from the land surface as well as from various underlying depths, so that the lateral and vertical extents of contamination could be determined

2.6.1 Surface Soil

During the Phase I RI one on-site surface soil sample was collected (S-26) and analyzed for PCBs (see Figure 2-3). This sample was collected to assess the area adjacent to the on-site transformer. The analytical results of this sample are presented and discussed in the Phase I RI Report.

During the Phase II RI, surface-soil samples were collected at 10 locations (SS-1 through SS-10) and analyzed for total chromium, arsenic, and lead. The sample locations are shown on Figure 2-3 and the analytical results are discussed in the Phase II RI Report.

During the Phase III RI four additional on-site surface soil samples were collected to assess the area adjacent to six former plating wells. The samples, SSPW-1 through SSPW-4, were collected from a depth of 1" to 3" below grade and analyzed for total chromium, lead, and arsenic. The sample locations are shown on Figure 2-5 and the analytical results are presented on Table 4-3.

2.6.2 Subsurface Soil

During the Phase I RI a total seven (7) on-site subsurface soil samples were collected and analyzed for chemical parameters to preliminarily identify potential on-site source areas. The soil sampling locations are indicated on Figure 2-2 and analysis results are presented in the Phase I RI Report.

The soil sampling program for the Phase II RI served to delineate the extent of the source areas identified during the Phase I RI, and the extent of chromium contamination at the ground surface on and near the perimeter of the site. Twelve (12) subsurface soil samples were collected from four on-site borings during the Phase II and submitted for chemical analysis. The Phase II RI on-site soil sampling locations are shown on

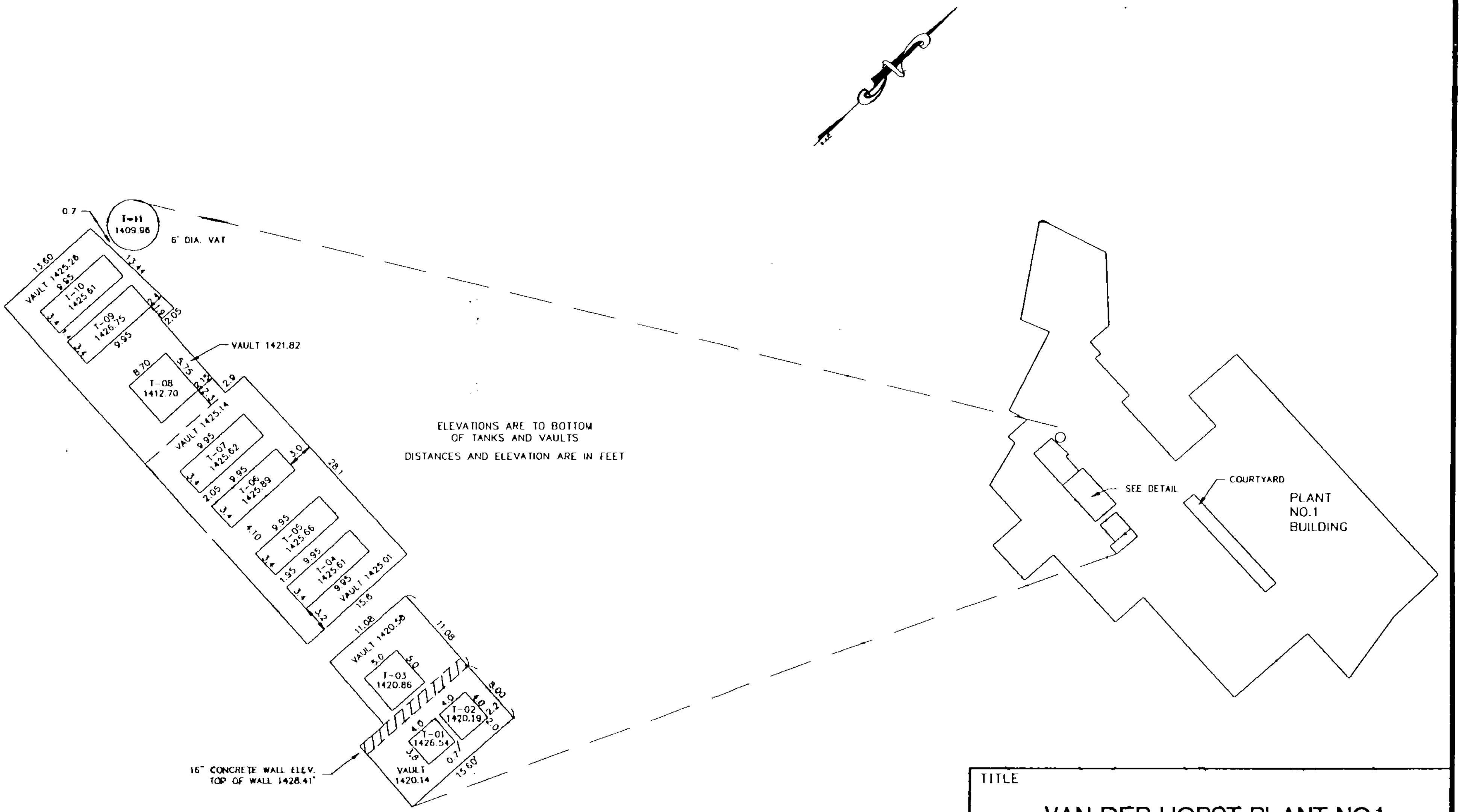
Figure 2-2 and the chemical analysis is presented in the Phase II RI Report.

Eighty-three (83) on-site subsurface soil samples were collected during the Phase III RI to further delineate the lateral and vertical extent of soil contamination beneath the plant building. Phase III subsurface soil sampling locations are presented in Figure 2-6. The samples were collected from borings drilled by hollow-stem auger to a depths varying from 2 to 20 feet below grade. Split-spoon samples were continuously collected during drilling and all borings were backfilled with grout upon completion. Site selection criteria for the soil borings are as follows:

1) SB-10 - to assess whether suspected spills in the loading dock area have contributed to soil and ground water contamination. Eight samples were collected from this location, all were analyzed for total chromium, arsenic and lead. Also, one was analyzed for TCLP metals and one was analyzed for TCL Volatile Organics.

2) SB-11 - to assess the horizontal and vertical extent of chromium contamination in the soil beneath the chromic acid plating tanks (see Figure 2-7). Eight samples were collected from this location, all were analyzed for total chromium, arsenic and lead. Also, one was analyzed for TCLP metals and one was analyzed for TCL Volatile Organics.

3) SB-13 - to assess potential contamination adjacent to the underground storage tank on the west side of the plant building. Two samples were obtained from



ELEVATIONS ARE TO BOTTOM
OF TANKS AND VAULTS

DISTANCES AND ELEVATION ARE IN FEET

TITLE

VAN DER HORST PLANT NO.1
PLATING TANK AND VAULT
DETAIL AND DIMENSIONS

PREPARED FOR

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Environmental Resources Management

DATE

FIGURE
2-7

this location and analyzed for TCL Volatile Organics and polyaromatic hydrocarbons.

4) SB-14 - to assess potential soil contamination levels adjacent to the "Lead Room". Nine samples were collected from this location, all were analyzed for total chromium, arsenic, and lead. Also, one was analyzed for TCLP metals and one was analyzed for TCL Volatile Organics.

5) SB-15 - to assess potential soil contamination in the degreasing area. One sample was collected from this location and analyzed for total chromium, arsenic, and lead.

6) SB-16 - to assess potential contamination levels in the soil beneath the former Chromium Recovery System. One sample was collected from this location and analyzed for total chromium, arsenic, and lead.

7) SB-17 - to assess potential soil contamination from an adjacent transformer and from a former exterior solvent storage area. Nine samples were collected from this location, all were analyzed for total chromium, arsenic, and lead. Also, one was analyzed for TCLP metals and TCL Volatile Organics, one was analyzed for PCB's, and two were analyzed for TCL Volatile Organics and PCB's.

8) B-28 - to assess whether two tanks, a chromic acid tank and a caustic soda tank, are a source of ground water and soil contamination. This location was originally the site of a monitoring well that was unable to be installed due to drilling rig inaccessibility. Four samples were collected at this location, all were analyzed for total chromium, arsenic, and lead. Also, of those four, one was analyzed for TCL Volatile Organics, one for TAL metals, and one for TCLP metals.

During the Phase III on-site soil evaluation, ERM was able to locate six (6) formerly operated plating wells within the narrow courtyard surrounded by the plant buildings (see Figure 2-6). These "plating wells" were used for chromium electroplating of navy cannon gun barrels. All wells were buried beneath 1 foot of soil fill material. Each well consisted of an 18-inch diameter, 32-foot long, concrete cylinder. The cylinders were installed vertically in the ground and were covered a steel plate. The interior of the wells was lined with PVC, but the integrity and effectiveness of the liners is not known. Water was sampled from each of the plating wells and shallow soil samples were collected within the courtyard.

Seven additional on-site subsurface soil samples were collected during the Phase III RI at locations indicated as SBPW-1 through SBPW-3 (see Figure 2-6). The samples were obtained with the use of a hand-held soil auger to assess the area adjacent to the above referenced six former plating wells. The samples were collected from shallow depths ranging to 3 feet below grade and analyzed for total chromium, arsenic, and lead. The locations for these samples are shown on Figure 2-6 and the analytical results are presented on Table 4-3.

2.7 Geophysical Study

A geophysical study was conducted at Van Der Horst Plant No. 1 during the Phase I RI. ERM performed the survey to locate potential on-site sources of chromium contamination and to search for an alleged injection well. The survey was done inside and outside the plant buildings along linear transects. Instruments used included a DM-22 magnetometer and a single-frequency electromagnetic instrument (EM-38). These less sensitive methods were chosen due to the presence of excessive background interference, caused mainly by metallic building components and stock-piles of scrap metal. The results of the geophysical survey are discussed in Section 3.3 of the Phase I RI Report.

2.8 Installation and Development of Ground Water Monitoring Wells

Twenty-seven (27) monitoring wells and four (4) piezometers were installed over the course of the three phases of the RI. Two wells (MW-6S and MW-6D) were damaged during Conrail operations and were only sampled during Phase I RI. Fifteen wells were installed during the Phase I RI, six were installed during the Phase II RI and four wells were installed during the Phase III RI. The four piezometers were also installed during the Phase II RI. The wells and piezometers were installed to evaluate subsurface conditions, the local direction of ground water flow, and the overall ground water quality in the vicinity of and beneath the plant building. Figure 2-8 presents the locations of the monitoring wells and

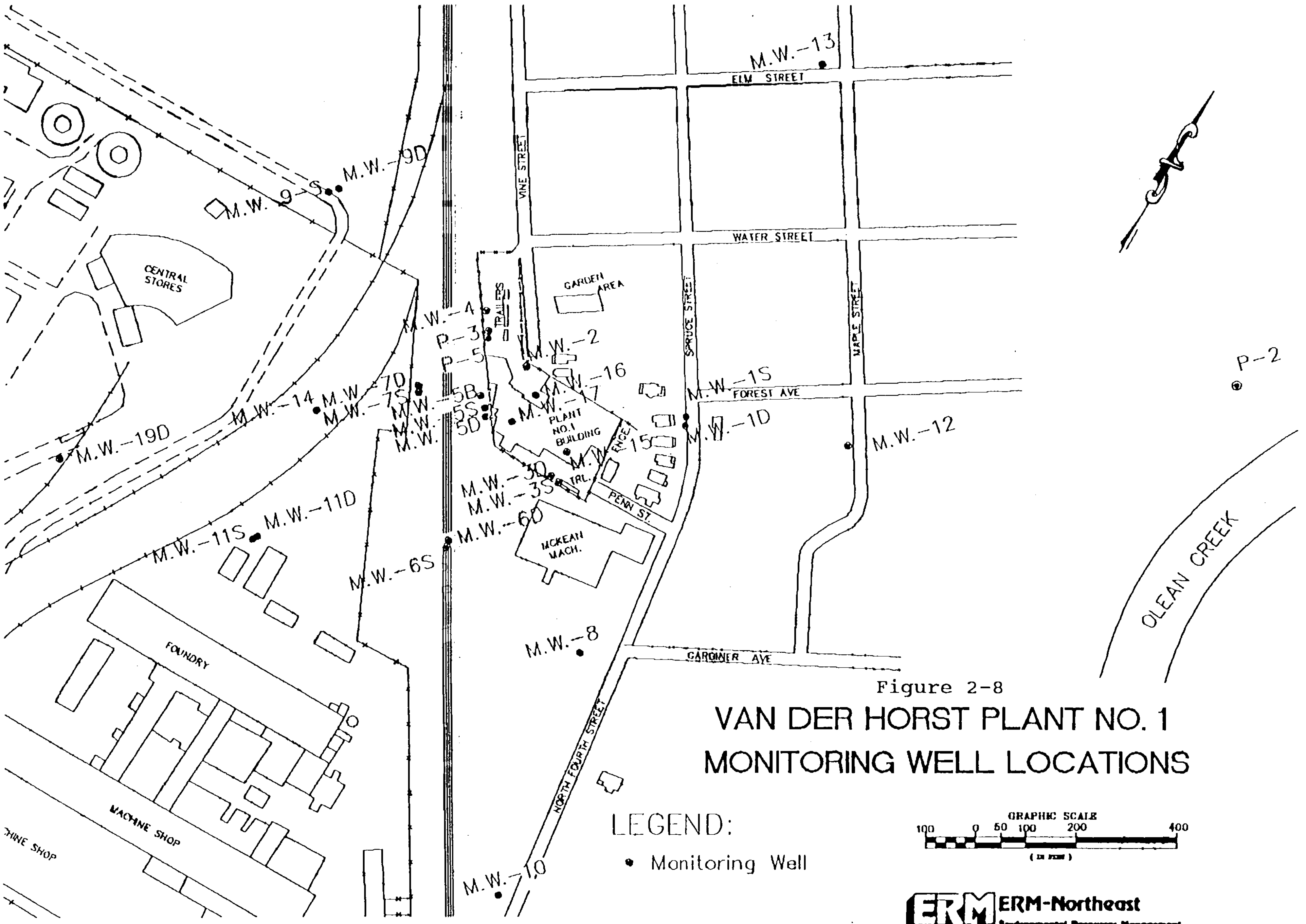


Figure 2-8

VAN DER HORST PLANT NO. 1
MONITORING WELL LOCATIONS

LEGEND:

● Monitoring Well

ERM-Northeast
Environmental Resources Management

piezometers. Table 2-2 summarizes the Plant 1 monitoring well construction data.

2.8.1 Well Locations

The well locations for all three phases of the RI were selected based on: 1) a site reconnaissance with NYSDEC field personnel; 2) anticipated directions of ground water flow and contaminant migration, and; 3) location accessibility for a drilling rig. The local direction of ground water flow was not certain at the start of the Phase I drilling program, since the only existing ground water contour maps were developed when the nearby Felmont industrial wells were in operation. Thus, the direction of ground water flow was originally estimated to be from northeast to southwest (NE to SW) based on local surface water conditions. After conducting the Phase I RI it was found that the inferred NE to SW direction of ground water flow was correct.

The Phase III RI concentrated on assessing the interior and the condition of soil and ground water beneath the plant building. Four (4) additional monitoring wells were installed during the Phase III RI.

TABLE 2-2

SUMMARY OF PLANT 1 MONITORING WELL DATA

Boring Number	Date Completed	Ground Surface Elevation (ft)	Monitoring Point Elevation (ft)	Depth of Boring (ft)	Bottom of Boring Elevation (ft)	Screened Interval Depth (ft)	Screened Interval Elevation (ft)	Sand Pack Depth (ft)	Sand Pack Elevation (ft)
PHASE I MONITORING WELLS									
MW-1S	06-1-89	1427.76	1427.35	31.0	1396.76	15.0-30.0	1412.76-1397.76	12.6-31.0	1415.16-1396.76
MW-1D	06-2-89	1427.73	1427.38	60.0	1367.73	50.0-55.0	1377.73-1372.73	51.0-60.0	1377.73-1367.73
MW-2	05-8-89	1430.14	1432.20	32.0	1399.14	16.0-31.0	1414.14-1399.14	14.9-32.0	1415.24-1398.14
MW-3S	05-3-89	1427.37	1429.54	30.0	1397.37	12.0-27.0	1415.37-1400.37	9.2-30.0	1418.17-1397.37
MW-3D	05-16-89	1427.53	1429.84	58.0	1369.53	51.0-56.0	1376.53-1371.53	49.0-58.0	1378.53-1369.53
MW-4	05-4-89	1430.92	1433.26	32.0	1398.92	16.0-31.0	1414.92-1399.92	14.9-32.0	1416.02-1398.92
MW-5S	05-12-89	1429.34	1432.42	32.0	1397.34	16.0-31.0	1413.34-1398.34	15.0-32.0	1414.34-1397.34
MW-5D	05-11-89	1429.32	1432.44	54.0	1375.32	47.0-52.0	1382.32-1377.32	45.0-54.0	1384.32-1375.32
MW-6S	05-18-89	1428.50	1430.16	33.0	1395.50	16.0-31.0	1412.50-1397.50	12.4-33.0	1416.10-1395.50
MW-6D	05-17-89	1428.58	1430.89	62.0	1366.58	54.0-59.0	1374.58-1369.58	52.0-62.0	1376.58-1366.58
MW-7S	05-16-89	1429.10	1431.42	36.0	1393.10	18.0-33.0	1411.10-1396.10	15.0-36.0	1414.10-1393.10
MW-7D	05-16-89	1429.04	1431.40	57.0	1372.04	48.0-53.0	1381.04-1376.04	45.0-57.0	1384.04-1372.04
MW-8	05-9-89	1429.00	1428.47	32.0	1397.92	16.0-31.0	1413.00-1398.00	13.4-32.0	1415.60-1397.00
MW-9S	07-7-89	1429.92	1433.50	32.0	1397.92	15.0-30.0	1414.92-1399.92	12.0-32.0	1417.92-1397.92
MW-9D	07-6-89	1429.84	1433.36	63.0	1366.84	55.0-60.0	1374.84-1369.84	53.0-63.0	1376.84-1366.84
PHASE II MONITORING WELLS									
MW-5B	08-7-90	1429.49	1431.57	118.9	1310.59	113.4-118.4	1315.09-1310.09	108.3-118.9	1299.99-1310.59
MW-10	07-7-90	1427.23	1429.70	35.0	1392.23	14.0-34.0	1413.23-1393.23	12.9-35.0	1414.33-1392.23
MW-11S	07-16-90	1428.92	1431.52	34.6	1394.32	18.6-33.6	1408.32-1393.32	18.5-34.6	1410.42-1394.32
MW-11D	07-13-90	1429.09	1431.58	60.0	1369.09	54.0-59.0	1373.09-1368.09	49.0-60.0	1380.09-1369.09
MW-13	07-18-90	1429.79	1429.81	33.0	1396.79	15.0-32.0	1412.79-1395.79	15.0-33.0	1414.79-1396.79
MW-14	07-17-90	1429.62	1431.47	34.0	1395.62	18.0-33.0	1411.62-1396.62	17.0-34.0	1413.62-1395.62
MW-12	07-26-90	1431.31	1431.24	34.0	1397.31	18.0-33.0	1413.31-1398.31	15.2-34.0	1416.11-1397.31
P-1	07-6-90	1428.54	1431.11	39.5	1389.04	23.5-38.5	1405.09-1390.04	20.5-39.5	1408.04-1389.04
P-2	07-19-90	1425.45	1425.51	44.7	1380.75	18.3-43.3	1407.15-1382.15	17.0-44.7	1408.45-1380.75
P-3	07-25-90	1430.74	1433.60	56.0	1374.74	15.0-55.0	1415.74-1375.74	10.0-56.0	1420.74-1374.74
P-5	11-5-90	1431.06	1432.64	60.0	1371.06	20.0-60.0	1411.06-1371.06	16.0-60.0	1415.06-1371.06
PHASE III MONITORING WELLS									
MW-15	05-9-91	1429.69	1429.22	33.0	1396.69	17.0-32.0	1412.69-1397.69	14.0-33.0	1415.69-1396.69
MW-16	05-8-91	1428.69	1428.30	34.0	1394.69	16.0-31.0	1412.69-1397.69	14.0-34.0	1414.69-1394.69
MW-17	05-14-91	1429.58	1429.16	33.8	1395.78	18.0-33.0	1411.58-1396.58	15.7-33.8	1413.88-1395.78
MW-19D	05-21-91	1426.93	1428.43	57.0	1369.93	46.0-56.0	1380.93-1370.93	42.5-57.0	1384.43-1369.93

The locations for those wells was determined based on the following rational:

- o MW-15 - to assess whether suspected spills in the loading dock area had contributed to ground water and soil contamination. This location is also upgradient of the exterior plating wells.
- o MW-16 - to assess whether exterior plating wells in the courtyard area are a source of ground water contamination.
- o MW-17 - to assess whether potential leakage from the chromic acid plating tanks has resulted in ground water and soil contamination.
- o MW-19D - to further delineate ground water contamination of chromium in the deep monitoring wells.

2.8.2 Shallow Monitoring Wells

In each shallow overburden well, a 15- to 20-foot section of slotted 2-inch I.D. PVC, NSF-approved well screen was installed. A riser casing of flush jointed, threaded, 2-inch I.D. PVC, NSF-approved pipe was extended from the screen to ground surface. The top of the well screen was positioned between one and three feet above the top of the water table. A sand filter pack was placed around the well screen extending two feet above the screen. The sand pack was overlain by a two foot seal of hydrolyzed bentonite pellets. The remainder of the annular space was filled with a cement/bentonite grout of the following ratio: 12 lbs. of cement, 1 lb.of bentonite, and 1 gallon of potable water. A locking, protective outer casing was cemented in place over the PVC riser pipe to secure each well. The concrete was mounded around the protective casing to promote drainage away from the monitoring wells. Monitoring well installation reports for each of the Phase III wells are included in the Phase III RI Field Data Report.

2.8.3 Deep Monitoring Wells

The deep monitoring wells were installed in the lower portion of the water table aquifer and were constructed using a 5-foot or 10-foot section of 2-inch PVC slotted screen. Approximately 10 feet of sand filter pack was placed around the well screen and the 2-inch PVC riser pipe above the screen. A thick bentonite slurry was set immediately above the sand pack. The remainder of the well construction was similar to the shallow wells.

2.8.4 Monitoring Well Development

The monitoring wells were left undisturbed for a several days following installation to allow the well construction materials to stabilize. Thereafter, the wells were developed by surging with a bailer and pumping to ensure that an effective hydraulic connection between the monitoring well and the aquifer. Some of the wells were initially bailed dry several times to remove silt which was clogging the well bottom and surrounding sand pack. Thereafter, the well screens were sufficiently cleared to allow sustained withdrawal using a centrifugal pump.

All of the ground water removed from the monitoring wells during development and pre-sample purging was containerized in 55-gallon drums and then transferred into several on-site holding tanks. The holding tanks were then emptied, after municipal approval, into Olean's sanitary sewer system.

During development, samples of the discharged ground water were periodically collected and analyzed for turbidity. All of the monitoring wells initially produced very turbid water, and well development was continued until the turbidity of the discharged water was visually sediment free and numerically less than 50 National Turbidity Units (NTU). The data collected during the Phase III well development are shown on Table 2-3.

TABLE 2-3

VAN DER HORST PLANT 1, PHASE III

MONITORING WELL SAMPLING INFORMATION

WELL	SAMPLING DATE	DEPTH TO WATER (ft)	WATER PURGED (gal)	NTU	pH	CONDUCTIVITY	TEMPERATURE (C)
MW-15	6/7/91	20.08	150	44	6	530	16.5
MW-16	6/7/91	20.68	325	25	6	300	10
MW-17	6/7/91	20.09	330	20	6	600	10
MW-19D	6/7/91	20.7	108	48	6	520	15.5

Development equipment (PVC bailers, polyethylene suspension cord, and PVC hosing) was dedicated to each well and was not reused. All spent equipment was containerized on-site in 55-gallon drums, with the exception of the bailers which were decontaminated for reuse.

2.8.5 Drilling Related Activities

All of the drilling equipment that was used to install the wells and piezometers were cleaned with a steam cleaner prior to use in the boring. Soil generated during the drilling of the wells, piezometers, and test borings is stored on-site and will be disposed of in accordance with applicable NYSDEC regulations, using TCLP analytical results.

Potential health and safety concerns (personnel and community) played an integral part in the well installation program. Protective clothing (Level D) was worn by all on-site personnel, and a field trailer with a telephone was maintained on-site. The air quality was continuously monitored during all drilling operations, and all exhumed soil and well water were immediately containerized and brought on-site to a secured storage area.

2.9 Ground Water Sampling

Following well development, unfiltered ground water samples were collected from all monitoring wells, using a bottom-loading PVC bailer with a polypropylene cord. Prior to well sampling, a minimum of three volumes of well water was pumped from each monitoring well with a centrifugal pump, using dedicated PVC hosing. Upon collection, the samples were immediately stored on ice in insulated coolers, and delivered within 24 hours to the analytical laboratory.

During the Phase I RI, samples from the fifteen wells were analyzed for all TLC parameters, hexavalent chromium, chlorides, nitrates, sulfates, total phenols, total hydrocarbons and pH. Sampling results are discussed in detail in the Phase I RI Report.

During the Phase II RI, samples from the recently installed twenty wells were analyzed for all TCL volatile organic compounds, TAL metals, hexavalent chromium, and pH. Sample analysis was performed at the lowest practical detection limit. Sampling results are discussed in detail in the Phase II RI Report.

During the Phase III RI samples from the four newly installed wells was analyzed for TCL volatile organics, TAL metals and hexavalent chromium. Water in six exterior plating "wells" was also sampled and analyzed for total chromium, arsenic and lead. The results of the Phase III ground water sample analysis is presented on Table 4-10 and discussed in Section 4-7 and 4-8.

2.10 Hydraulic Properties of the Aquifer

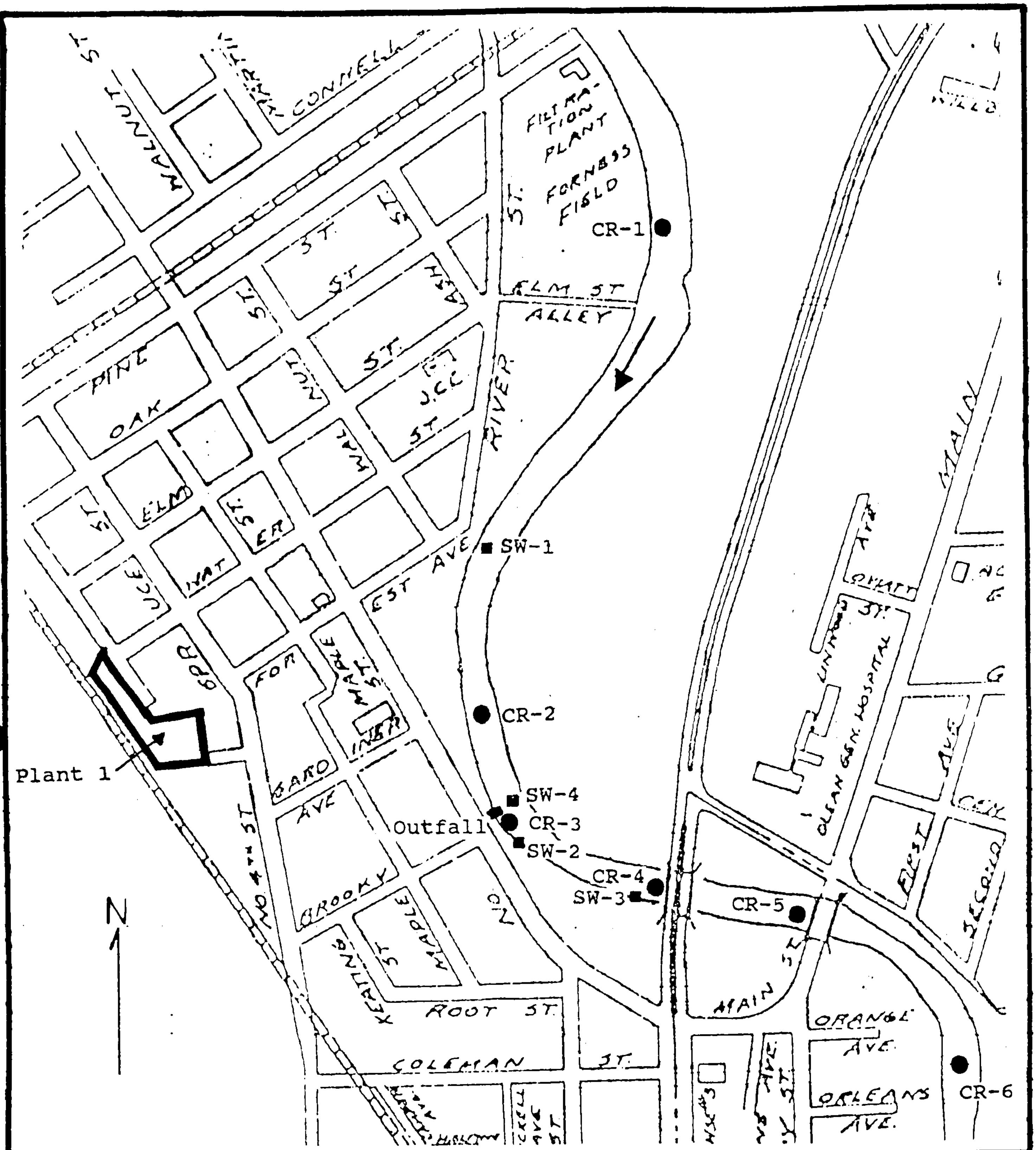
Hydraulic characteristics of the underlying aquifer have been obtained from reviewing the pumping test data generated by the USGS for nearby facilities, by conducting in-situ permeability tests in several of the monitoring wells and by performing an on-site pumping test. Data generated by the USGS pumping tests and slug test data that was collected during the Phase I RI is presented in Appendix A and Appendix F of the Phase I RI Report, respectively. The results of the Phase II pumping test are presented in the Ground Water Flow Modeling Report submitted to the NYSDEC in June 1991. The results of the slug tests performed during the Phase III RI are contained in the Phase III RI Field Data, submitted to the NYSDEC in August 1991.

Additionally, static ground water levels were synoptically measured in the monitoring wells on several events over the course of two years. The depths were measured to the nearest 0.01 feet with an electronic water level indicator. The data were used to generate ground water contour maps for each monitoring event. The maps are presented and discussed in Section 3.0

2.11 Olean Creek Sampling

During the Phase I RI four samples of surface water and three samples of stream sediment were collected from Olean Creek. The sampling locations are shown on Figure 2-9. This sampling was performed to determine if elevated metal concentrations were present in the stream bed and the surface water.

The above samples were collected adjacent to the sewer out-fall pipe connected to the on-site storm sewer system, as well as upstream and downstream of this outfall. A sample of storm water discharge was also collected directly from the storm-sewer discharge pipe at the outfall. The creek sediments were collected from the grassy banks of the creek in the vicinity of the outfall. All samples were collected, packaged, and delivered to the laboratory within 24 hours and were analyzed for TCL metals, chlorides, nitrates, sulfates, total phenols, and pH. The four water samples were also analyzed for hexavalent chromium. Analytical results of the sampling are presented in the Phase I RI Report.



PHASE I SAMPLING LOCATION ■
PHASE II SAMPLING LOCATION ●

Note: Duplicate sample CR-7 was also collected at CR-3

TITLE

VAN DER HORST PLANT NO. 1
SURFACE WATER AND SEDIMENT
SAMPLING LOCATIONS IN
OLEAN CREEK

PREPARED FOR

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ERM-Northeast
Environmental Resources Management

SCALE

DATE

FIGURE
2-9

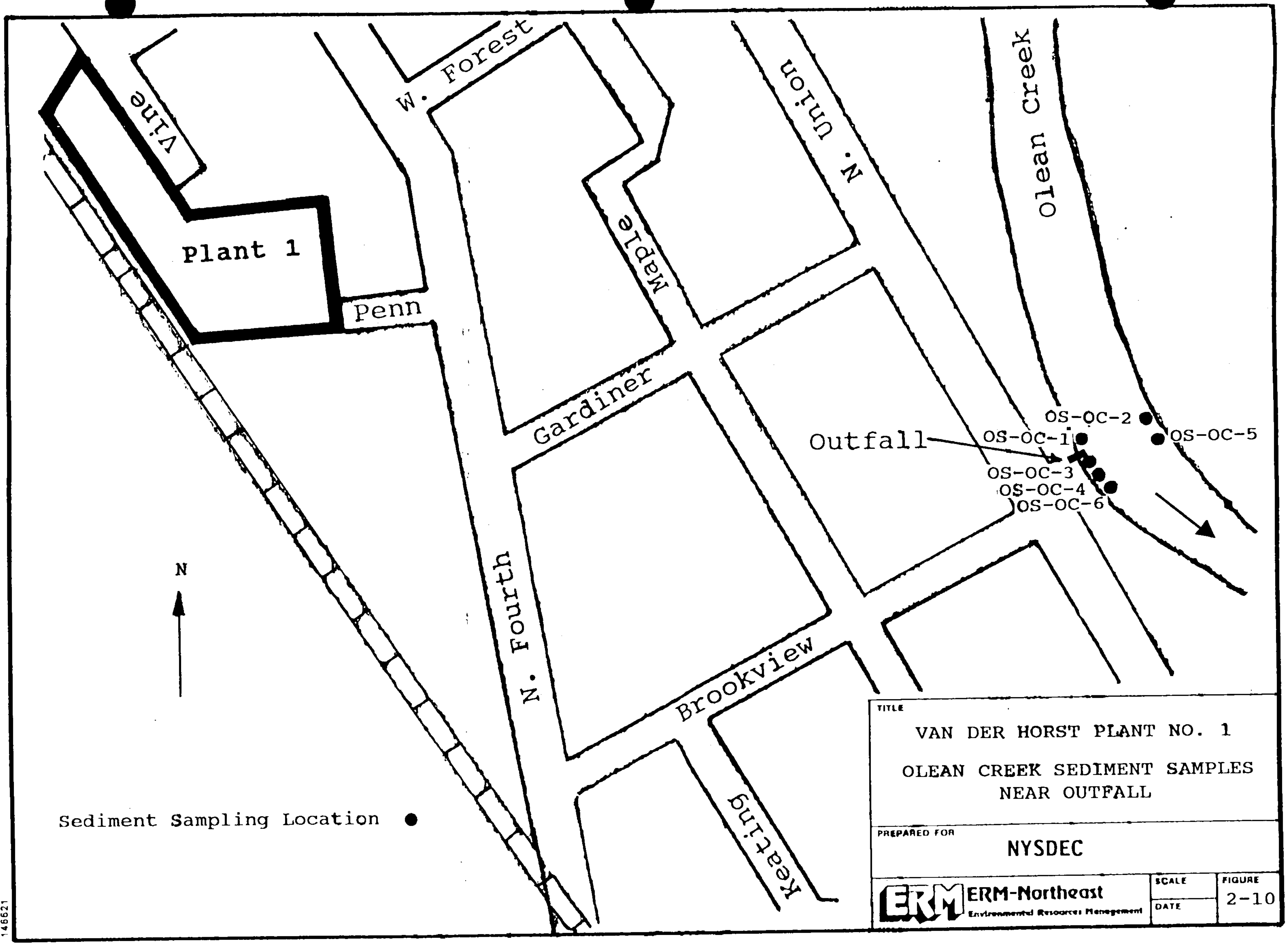
139839

During the Phase II RI creek bed sediment, bank sediment and surface water were sampled from Olean Creek to determine if residual chromium was present. The specific sampling sites were selected based on the following criteria:

- Past and present stream morphology;
- Historical dredging activities;
- Potential areas of contaminant deposition; and
- Previous sampling locations within Olean Creek.

Olean Creek Phase II sampling locations are shown on Figure 2-8. All surface water was tested for total chromium, arsenic, lead, hexavalent chromium and pH. Sediment samples were tested for TAL metals.

Following the initial Phase II creek sampling, six additional sediment samples (OS-OC-1 through OS-OC-6) were collected adjacent to the storm sewer outfall associated with the Van Der Horst Plant 1 site (see Figure 2-10). Sample locations were adjacent to: 1) the sewer outfall pipe, 2) upstream of the outfall, and 3) downstream of the outfall. The creek sediments were tested for TAL metals or TCLP metals. Analytical results of these samples are presented in the Phase II RI Report. No further stream sampling was performed during the Phase III RI.



TITLE

VAN DER HORST PLANT NO. 1

OLEAN CREEK SEDIMENT SAMPLES
NEAR OUTFALL

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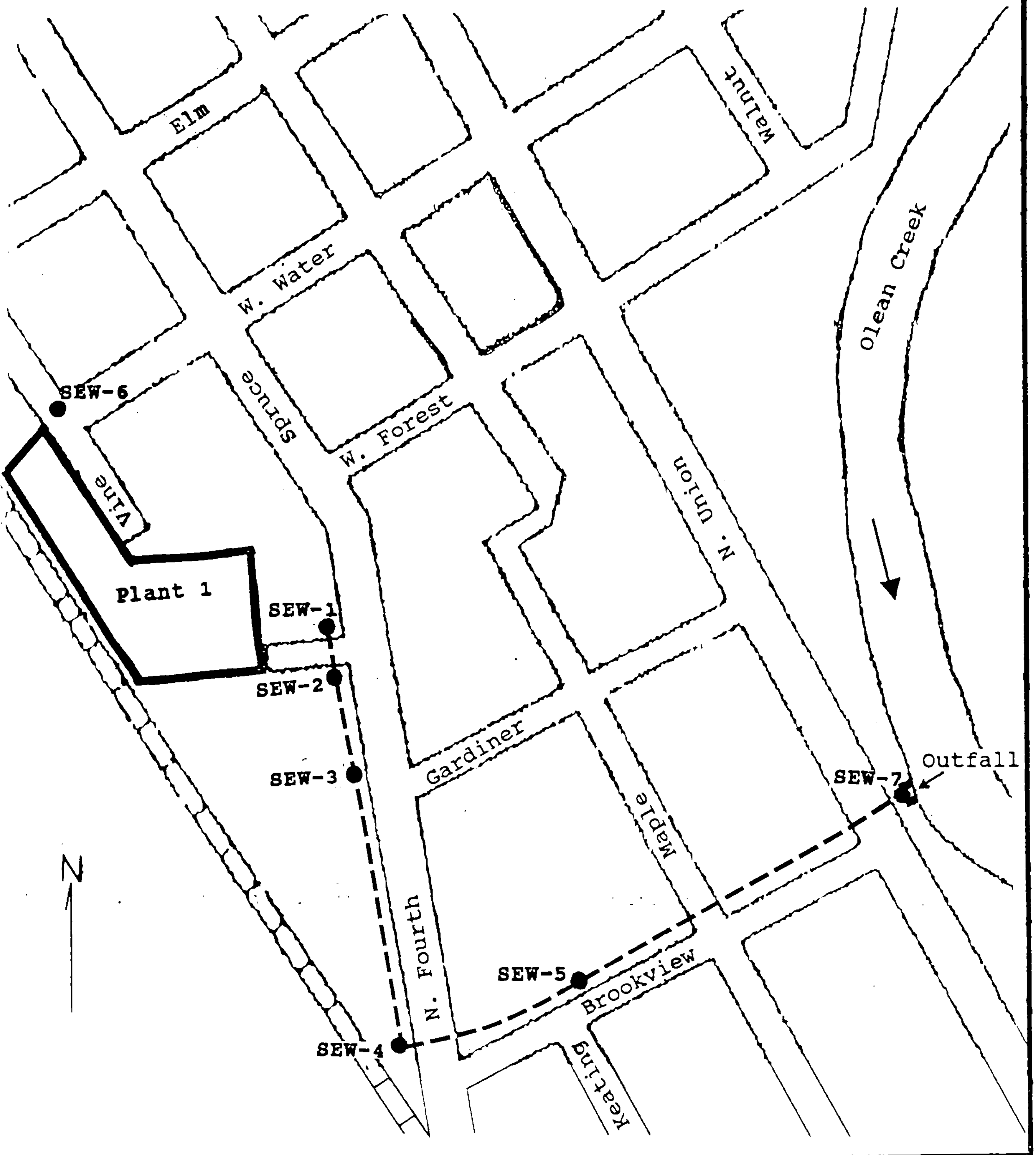
SCALE	FIGURE
DATE	2-10

2.12 Sampling of Adjacent Storm-Sewer System

During the Phase II RI, storm-sewer water and sediment samples were collected from seven (7) accessible manholes at a one-time event. Figure 2-11 presents the storm sewer sampling locations. Sample SEW-1 was collected at the manhole immediately upgradient of the Van Der Horst junction to the sewer. A "background" storm sewer sample (SEW-6) was collected from another storm sewer north of site. This storm sewer discharges to Olean Creek, north of the outfall shown at sample location SEW-7. Storm-sewer sediment samples were analyzed for total chromium, arsenic, and lead. The storm-sewer water samples were analyzed for the same three metals, plus hexavalent chromium and pH. Analysis results of these samples are presented in the Phase I RI Report.

2.13 Survey of Local Ground-Water Usage

A water well survey was conducted to determine the type and amount of ground water use in the vicinity of the Plant 1 facility. This information, in combination with that obtained from the USGS Water Resources Investigations Report 85-4082 and the USGS DESPOOL Ground Water Tables for Cattaraugus County indicated that there are numerous ground water wells within 1 mile downgradient of the Plant 1 site.



Sewer sampling location ●

Storm sewer line — — — —

TITLE

VAN DER HORST PLANT NO. 1
SEWER SAMPLE LOCATIONS

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Environmental Resources Management

SCALE	FIGURE 2-11
DATE	

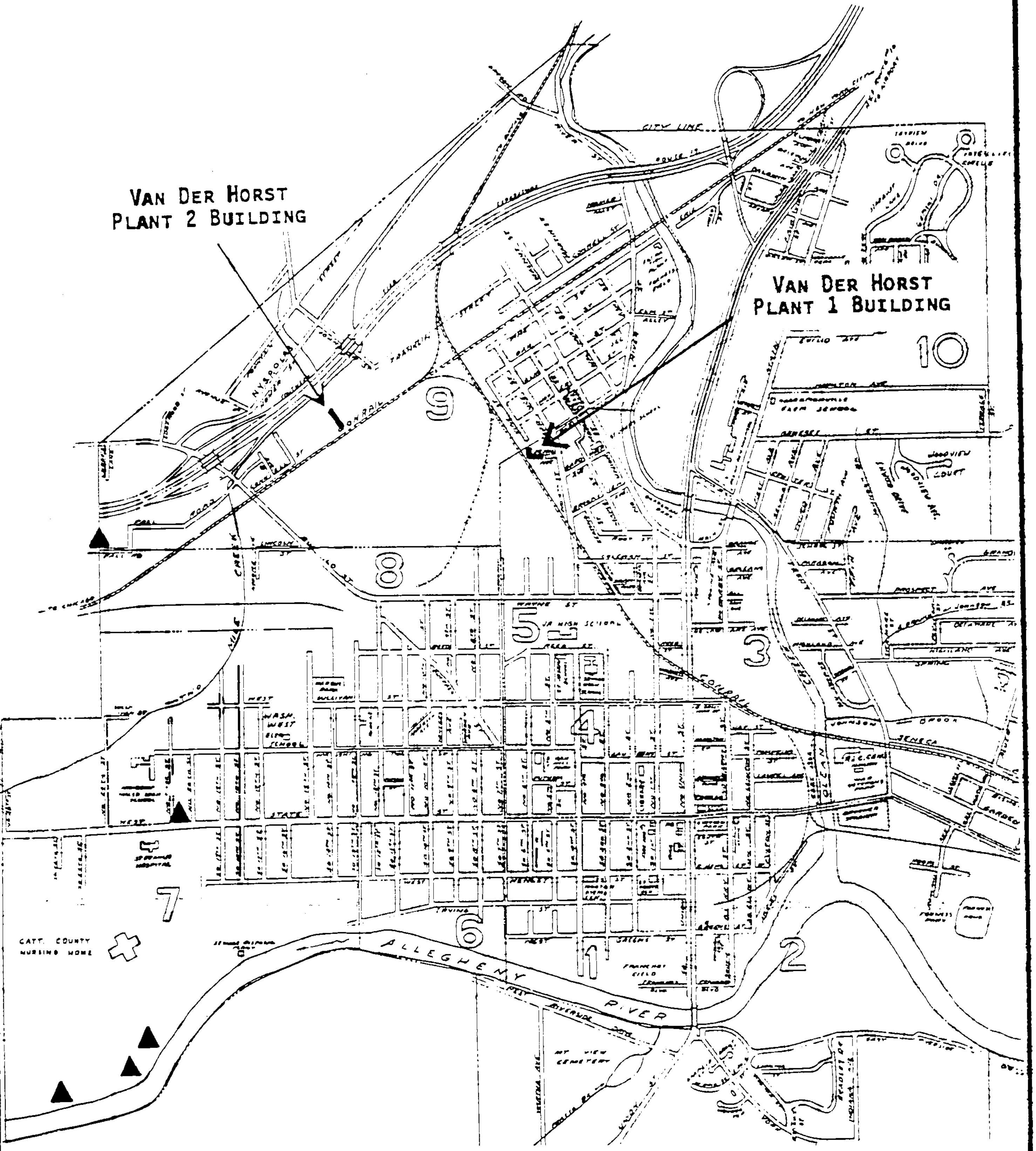
The types of water wells include: 1) public/domestic wells, 2) commercial/industrial/institutional wells, and; 3) ground water observation wells. ERM does not know of any downgradient water wells within one mile of the Plant No. 1 site that are presently in use. Locations of these wells are shown on the following Figures 2-12 through 2-14.

2.14 Ground Water Modeling

Ground water flow modeling was conducted during the Phase II RI to aid in the selection of a contaminant recovery-well system (i.e., well numbers, locations and pumping rates). This information was presented in the "Ground Water Flow Modeling Report" and will be used in the final FS. A summary of ground water modeling results is discuss in section 3.7 of this report.

2.15 Preparation of a Base Map and a Site Topographic Map

A land surveyor, licensed in the State of New York, was contracted to prepare base map of the study area and a topographic map of the site and surrounding area. The land surveyor used aerial photography and ground-control survey techniques to generate a site topographic map with a scale of one inch equals fifty feet, and with one-foot contour intervals.



▲ DENOTES PUBLIC/DOMESTIC SUPPLY WELL LOCATION

SOURCES: USGS WATER-RESOURCES INVESTIGATIONS REPORT 85-4082, 1987; USGS DESPOOL GROUND WATER TABLES, CATTARAUGUS COUNTY, NEW YORK.

TITLE

LOCATION OF PUBLIC/DOMESTIC
WELLS IN THE OLEAN AREA

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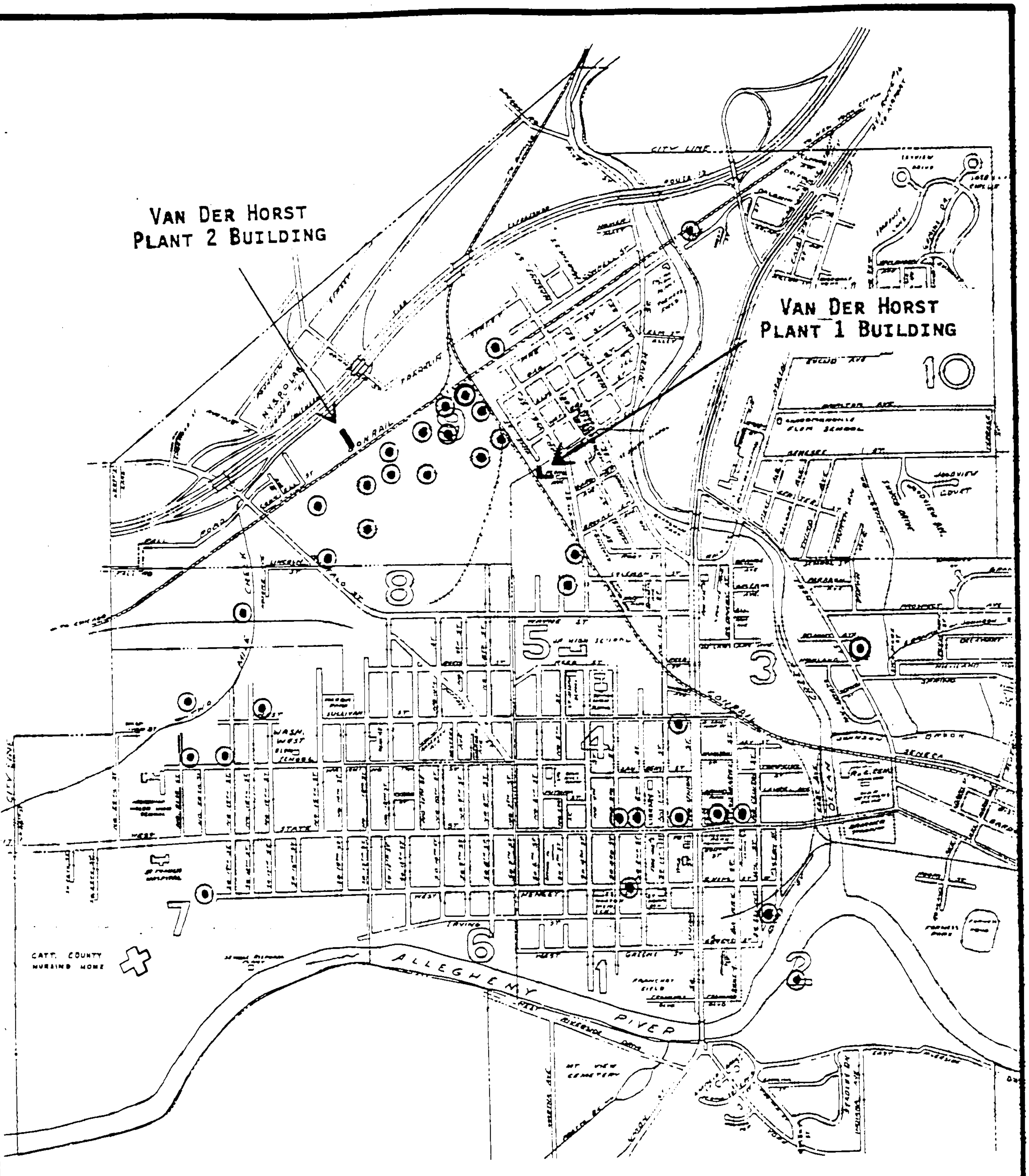
Environmental Resources Management

SCALE	FIGURE
DATE	2-12



● DENOTES INDUSTRIAL/COMMERCIAL/INSTITUTIONAL WELL LOCATION

SOURCES: USGS WATER-RESOURCES INVESTIGATIONS REPORT 85-4082, 1987; USGS DESPOOL GROUND WATER TABLES, CATTARAUGUS COUNTY, NEW YORK.

TITLE

LOCATION OF COMMERCIAL/
INDUSTRIAL/INSTITUTIONAL WELLS
IN THE OLEAN AREA

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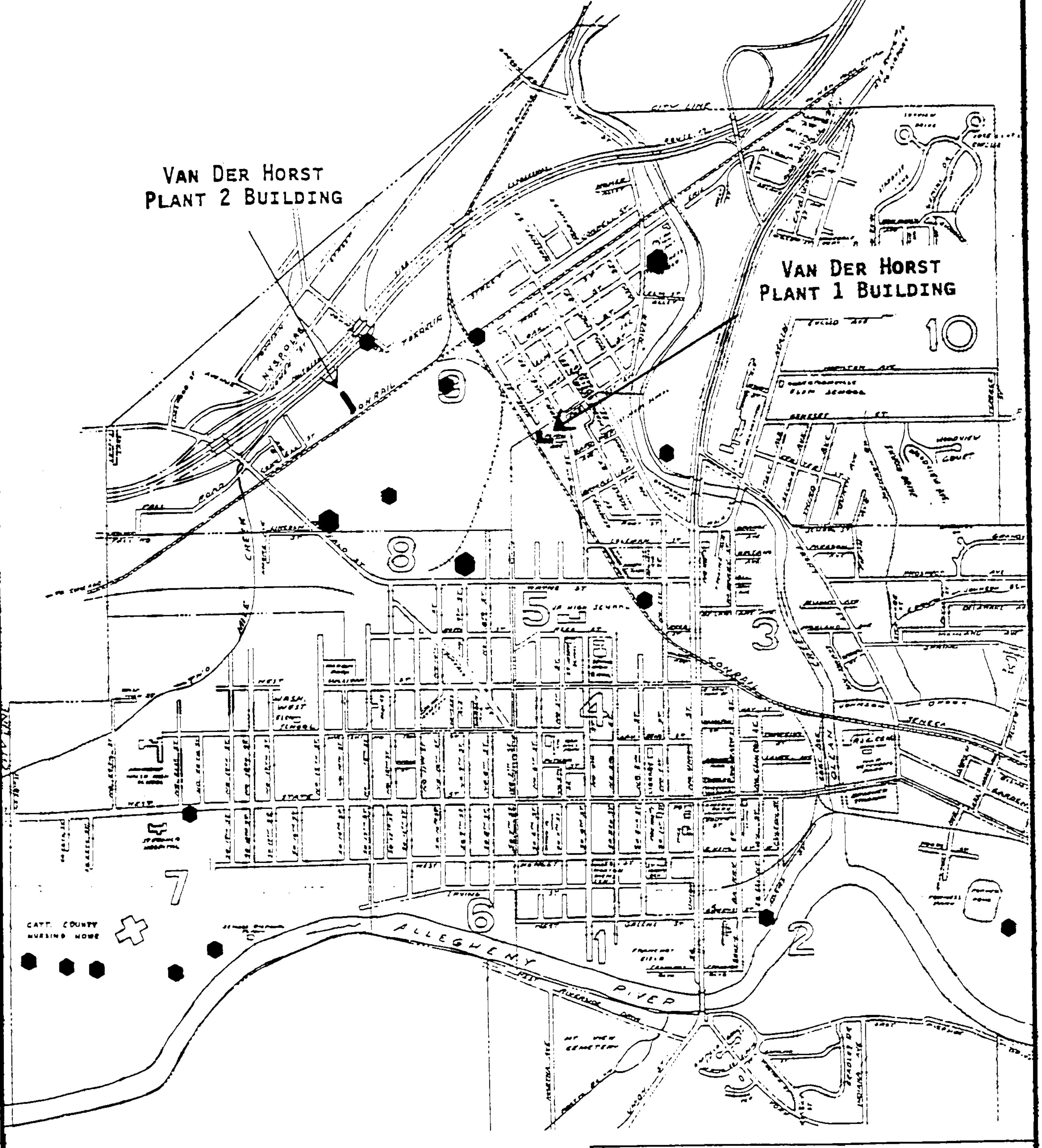
Environmental Resources Management

SCALE

DATE

FIGURE
2-13



● DENOTES **USGS** OBSERVATION WELL LOCATION

SOURCES: USGS WATER-RESOURCES INVESTIGATIONS REPORT 85-4082, 1987; USGS DESPOOL GROUND WATER TABLES, CATTARAUGUS COUNTY, NEW YORK.

TITLE

LOCATION OF OBSERVATION WELLS
IN THE OLEAN AREA

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Environmental Resources Management

SCALE	FIGURE
DATE	2-14

A second map was generated at a scale of 1 inch = 200 feet. This map included the study areas for both Van Der Horst Plant 1 and Plant 2. Cultural features on the base map include city streets, houses, railroad tracks, fences, etc. All Plant 1 monitoring wells, piezometers, test borings and surface soil samples were surveyed and plotted on the map. Computer files of the base map and the topographic map, compatible with AutoCad Version 10, were created to facilitate subsequent figure generation.

2.16 Final Risk Assessment

A baseline risk assessment was conducted as part of the Phase I RI. The baseline risk assessment was modified during the Phase II RI, based on the results of the Phase II analytical data. The final risk assessment, in Section 5.0 of this document, incorporates all of the analytical data generated in the three phases or the RI. The final risk assessment includes information on baseline risks and recommendations for source area cleanup levels, based on USEPA and NYSDEC health risk criteria.

3.0 AQUIFER CHARACTERISTICS AND HYDRAULIC TESTING

3.1 Regional Geology

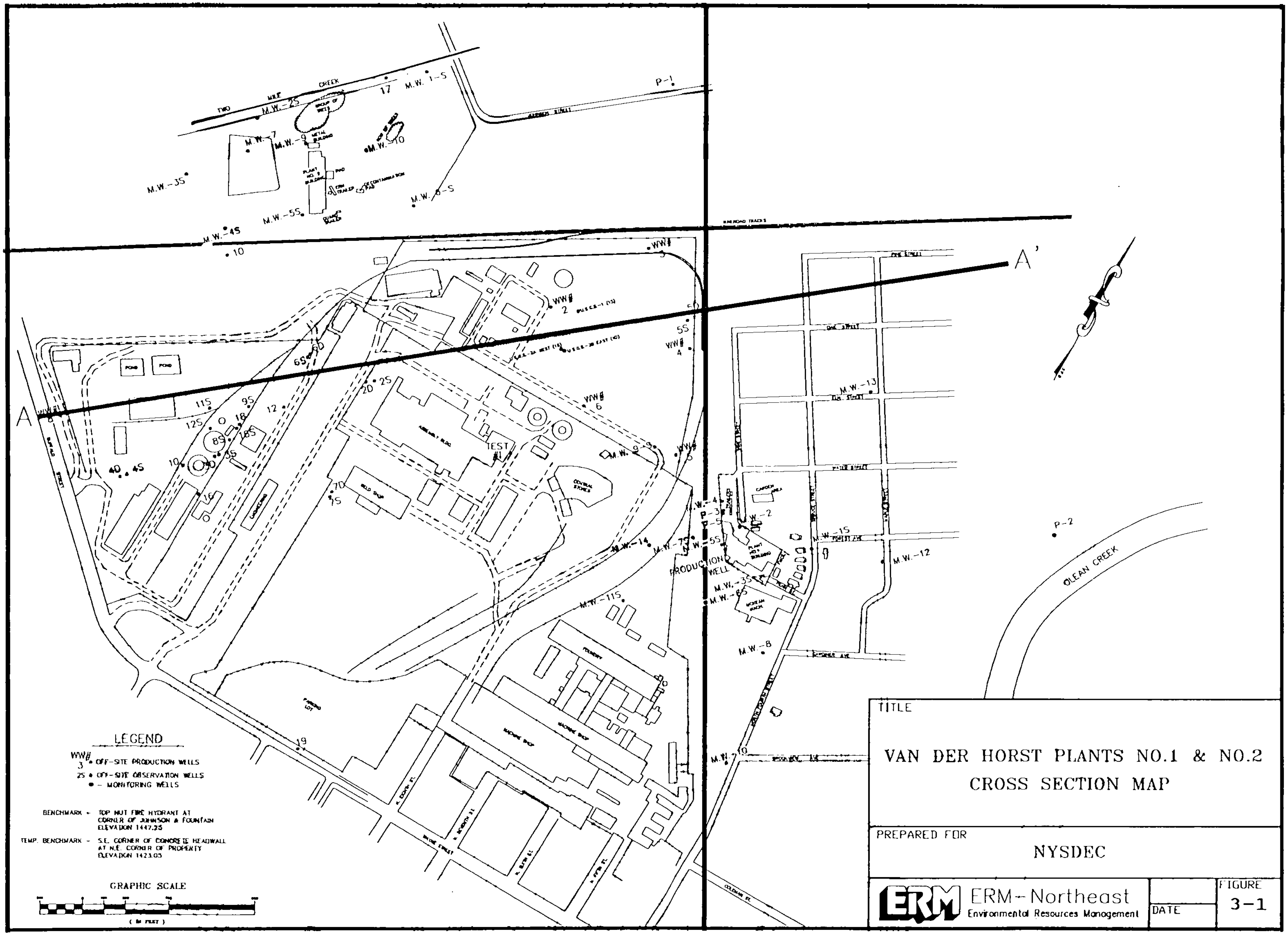
The City of Olean is located within the Allegheny River Basin of the Appalachian Plateau Physiographic Province. The glaciated Allegheny River valley trends east to west and has been eroded several hundred feet into bedrock. Bedrock outcrops can be seen on the steep hills forming the north and south sides of the valley, while bedrock on the valley floor is covered by up to three hundred feet of sediment, consisting mainly of glaciofluvial outwash. These surficial glacial deposits are present at the Van Der Horst Plant No. 1 site and overlie the Upper Devonian shale and siltstone bedrock.

Previous geological studies (USGS, 1987b; USGS, 1988) have concluded that the overlying surficial material locally consists of unconsolidated glacial and fluvial deposits, ranging from 150 to 300 feet in thickness. The underlying material consists of unconsolidated sediments which have tentatively been identified as predominately lacustrine clays and silts. Such sediments are deposited in glacial lakes and locally can range up to 150 feet in thickness (USGS, 1988). Shallower sediments consist of till and stratified drift which were deposited by a former glacial ice tongue which extended down Olean Creek. The post-glacial deposits generally consist of well sorted sand-and-gravel alluvium overlain by silt, and these range from 10 to 30 feet in thickness.

The surficial soils in the valleys are classified as Recent alluvium and exhibit a wide range of sediment grain size. These deposits are made up of gravelly silt loams which may range in thickness from 10 to 30 feet in some areas of the valleys.

A valley fill deposit of fluvial sands and gravels generally occurs beneath the Recent alluvium. The fluvial deposits are typically 40 to 60 feet thick and extend to an average depth of 80 feet below land surface. This deposit of fluvial sands and gravels constitutes the major aquifer in the Olean area and is saturated at depths of 15 - 20 feet below grade. Clay lenses have been documented to occur within the valley fill deposit.

A map of the area surrounding the site is presented in Figure 3-1. Line A - A' is the location of a cross section which passes through the modelled area. Figure 3-2 illustrates the aquifer cross section along A - A'.



TITLE

VAN DER HORST PLANTS NO.1 & NO.2
CROSS SECTION MAP

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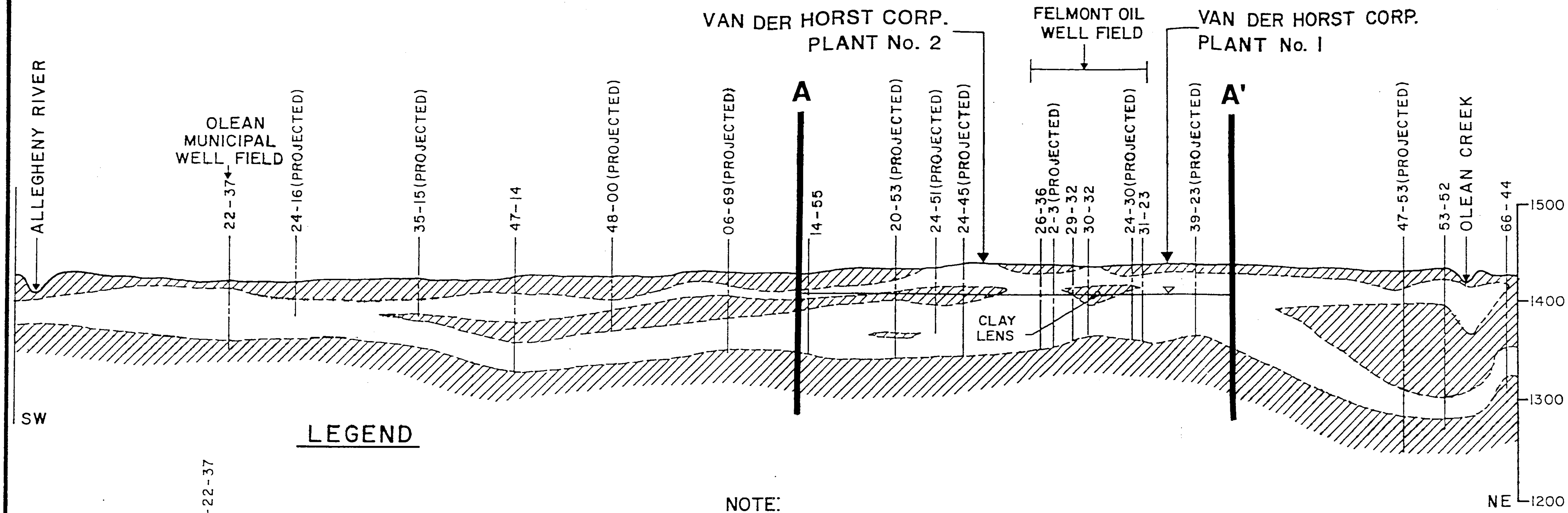
DATE

FIGURE
3-1



LEGEND

22-37 — WELL LOCATION AND NUMBER (LATITUDE AND LONGITUDE)

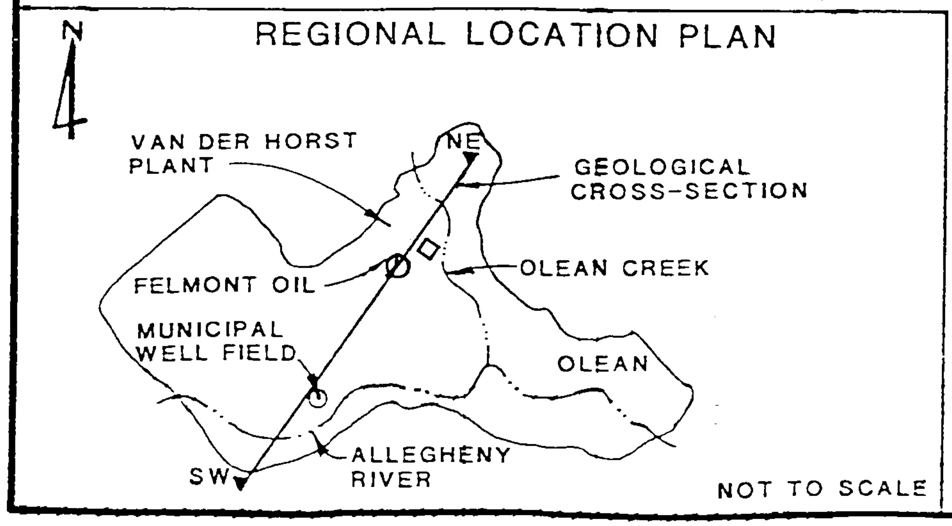
▨ DEPOSITS OF SILTS AND CLAYS (GLACIOLACUSTRINE OR ALLUVIAL)

☐ FLUVIAL DEPOSITS OF SAND AND GRAVEL

NOTE:

GROUND WATER FLOWS FROM THE NORTHEAST TO THE SOUTHWEST. CONSEQUENTLY, THE CLAY LENS BENEATH THE FELMONT OIL FACILITY MUST BE CONSIDERED WHEN INSTALLING DOWNGRADIENT WELLS.

REGIONAL LOCATION PLAN



HORIZONTAL SCALE: 1"= 1,000'
VERTICAL SCALE: 1"= 100'
VERTICAL EXAGGERATION: 10X
(SOURCE: U.S.G.S., 1985)

TITLE

VAN DER HORST RI/FS
GEOLOGICAL CROSS-SECTION

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Environmental Resources Management

SCALE	FIGURE
DATE	3-2

3.2 Site Hydrogeology

Local hydrogeologic conditions at Plant No. 1 have been found to be somewhat different than those of earlier studies. The thickness of Recent alluvial deposits is approximately 10 feet. The top of the upper aquifer at Plant No. 1 is at a depth of about 20 feet. The base of the upper aquifer occurs at a depth of 90 feet (at well MW-5B), and lies above a 19-foot thick, silty clay aquitard. Beneath this aquitard is a semi-confined lower aquifer of unknown thickness. Both the upper and lower aquifers are within sand and gravel deposits. The lower aquifer at Plant No. 1 is not in good hydraulic connection with the upper aquifer, based on pumping test results.

3.3 Ground Water Flow

3.3.1 Regional Ground Water Flow

Static ground water levels were measured twenty-one times at monitoring wells during the period of July 1989 through July 1991. Water levels were measured to the nearest 0.01 feet with an electronic water level indicator. These data are presented in Table 3-1.

Table 3-1

VAN DER HORST PLANT 1
MONITORING WELL WATER LEVELS

LOCATION	MONITORING POINT ELEVATION (FEET)	PARAMETER	10-Jul-89	12-Jul-89	13-Jul-89	17-Jul-89	7-Aug-89	30-Aug-89	7-Dec-89	22-Jan-90	8-Mar-90	2-Apr-90	18-May-90	20-Jun-90	7-Aug-90	2-Oct-90	1-Nov-90	13-Dec-90	4-Jan-91	7-Feb-91	1-Mar-91	3-Apr-91	18-Jul-91
MW-1S	1427.35	Depth to Water (FT.)	14.75	15.05	15.15	15.67	17.35	18.65	18.78	17.70	15.69	16.42	15.94	16.87	17.98	17.27	15.29	16.11	14.03	16.06	16.14	16.07	19.40
		Static Water Level (FT)	1412.60	1412.30	1412.20	1411.68	1410.00	1408.70	1408.57	1409.65	1411.66	1410.93	1411.41	1410.48	1409.37	1410.08	1412.06	1411.24	1413.32	1411.29	1411.21	1411.28	1407.95
MW-1D	1427.38	Depth to Water (FT.)	14.80	15.11	15.25	15.73	17.42	18.71	18.86	17.77	15.77	16.50	16.02	16.94	18.06	17.34	15.35	16.18	14.10	16.15	16.24	16.13	19.50
		Static Water Level (FT)	1412.58	1412.27	1412.13	1411.65	1409.96	1408.67	1408.52	1409.61	1411.61	1410.88	1411.36	1410.44	1409.32	1410.04	1412.03	1411.20	1413.28	1411.23	1411.14	1411.25	1407.88
MW-2	1432.20	Depth to Water (FT.)	19.63	19.94	20.07	20.57	22.33	23.65	23.83	22.77	20.69	21.42	21.07	21.89	22.79	22.32	20.27	21.11	19.04	21.16	21.20	21.13	24.52
		Static Water Level (FT)	1412.57	1412.26	1412.13	1411.63	1409.87	1408.55	1408.37	1409.43	1411.51	1410.78	1411.13	1410.31	1409.41	1409.88	1411.93	1411.09	1413.16	1411.04	1411.00	1411.07	1407.68
MW-3S	1429.54	Depth to Water (FT.)	17.00	17.28	17.45	17.94	19.64	20.94	21.10	20.03	18.00	18.73	18.28	19.17	20.28	19.60	17.55	18.43	16.39	18.43	18.45	16.40	21.73
		Static Water Level (FT)	1412.54	1412.26	1412.09	1411.60	1409.90	1408.60	1408.44	1409.51	1411.54	1410.81	1411.26	1410.37	1409.26	1409.94	1411.99	1411.11	1413.15	1411.11	1411.09	1413.14	1407.81
MW-3D	1429.84	Depth to Water (FT.)		17.58	17.70	18.22	19.91	21.21	21.36	20.27	18.23	18.91	18.52	19.42	20.55	19.84	17.84	18.67	16.60	18.66	18.72	18.64	21.99
		Static Water Level (FT)		1412.26	1412.14	1411.62	1409.93	1408.63	1408.48	1409.57	1411.61	1410.93	1411.32	1410.42	1409.29	1410.00	1412.00	1411.17	1413.24	1411.18	1411.12	1411.20	1407.85
MW-4	1433.26	Depth to Water (FT.)	20.63	20.96	21.07	21.59	23.35	24.67	24.84	23.77	21.63	22.37	22.03	22.85	23.99	23.29	21.22	22.08	20.00	22.10	22.14	22.11	25.51
		Static Water Level (FT)	1412.63	1412.30	1412.19	1411.67	1409.91	1408.59	1408.42	1409.49	1411.63	1410.89	1411.23	1410.41	1409.27	1409.97	1412.04	1411.18	1413.26	1411.16	1411.12	1411.15	1407.75
MW-5S	1432.42	Depth to Water (FT.)	19.87	20.17	20.32	20.82	22.59	23.92	24.08	23.00	20.84	21.60	21.24	22.08	23.26	22.52	20.44	21.29	19.20	21.28	21.32	21.25	24.67
		Static Water Level (FT)	1412.55	1412.25	1412.10	1411.60	1409.83	1408.50	1408.34	1409.42	1411.58	1410.82	1411.18	1410.34	1409.16	1409.90	1411.98	1411.13	1413.22	1411.14	1411.10	1411.17	1407.75
MW-5D	1432.44	Depth to Water (FT.)	19.64	20.16	20.30	20.79	22.54	23.86	24.02	22.94	20.83	21.57	21.18	22.04	23.22	22.48	20.43	21.27	19.19	21.26	21.30	21.23	24.62
		Static Water Level (FT)	1412.80	1412.28	1412.14	1411.65	1409.90	1408.58	1408.42	1409.50	1411.61	1410.87	1411.26	1410.40	1409.22	1409.96	1412.01	1411.17	1413.25	1411.18	1411.14	1411.21	1407.82
MW-5B	1431.57	Depth to Water (FT.)													23.62	22.78	20.67	21.52	19.40	21.45	21.44	21.45	25.03
		Static Water Level (FT)													1407.95	1408.79	1410.90	1410.05	1412.17	1410.12	1410.13	1410.12	1406.54
MW-6S	1430.16 1429.62	Depth to Water (FT.)	17.71	18.03	18.15	18.61										19.76	17.72	18.56	16.47	18.55	18.58	16.51	21.90
		Static Water Level (FT)	1412.45	1412.13	1412.01	1411.55										1409.86	1411.90	1411.06	1413.15	1411.07	1411.04	1413.11	1407.72
MW-6D	1430.89 1429.46	Depth to Water (FT.)	18.40	18.70	18.80	19.33										19.53	17.47	18.32	16.24	? 2.44	18.25	18.15	21.65
		Static Water Level (FT)	1412.49	1412.19	1412.09	1411.56										1409.93	1411.99	1411.14	1413.22	1427.02	1411.21	1411.31	1407.81
MW-7S	1431.42	Depth to Water (FT.)	18.86	19.16	19.37	19.79	21.55	22.88	23.03	21.96	19.82	20.57	20.21	21.04	22.21	21.48	19.42	20.27	18.19	20.27	20.31	20.24	23.64
		Static Water Level (FT)	1412.57	1412.26	1412.05	1411.63	1409.87	1408.54	1408.39	1409.46	1411.60	1410.85	1411.21	1410.38	1409.21	1409.94	1412.00	1411.15	1413.23	1411.15	1411.11	1411.18	1407.78
MW-7D	1431.40	Depth to Water (FT.)	18.82		19.28	19.78	21.53	22.86	23.04	21.99	19.87	20.62	20.26	21.09	22.26	21.51	19.45	20.30	18.23	20.34	20.37	20.31	23.71
		Static Water Level (FT)	1412.58		1412.12	1411.62	1409.87	1408.54	1408.36	1409.41	1411.53	1410.78	1411.14	1410.31	1409.14	1409.89	1411.95	1411.10	1413.17	1411.06	1411.03	1411.09	1407.69
MW-8	1428.47	Depth to Water (FT.)		16.27	16.40	16.88	18.48	19.76	19.48	18.78	16.88	17.60	17.02	18.03	19.14	18.42	16.50	17.30	15.23	17.19	17.31	17.24	20.49
		Static Water Level (FT)		1412.20	1412.07	1411.59	1409.99	1408.71	1408.99	1409.69	1411.59	1410.87	1411.45	1410.44	1409.33	1410.05	1411.97	1411.17	1413.24	1411.25	1411.16	1411.23	1407.98
MW-9S	1433.50	Depth to Water (FT.)	20.84	21.26	21.37	20.90	23.72	25.09	25.10	24.19	21.93	22.69	22.44	23.19	24.39	23.66	21.53	22.43	20.32	22.44	22.43	22.22	25.85
		Static Water Level (FT)	1412.66	1412.24	1412.13	1412.60	1409.78	1408.41	1408.40	1409.31	1411.57	1410.81	1411.06	1410.31	1409.11	1409.84	1411.97	1411.07	1413.18	1411.06	1411.07	1411.28	1407.65
MW-9D	1433.36	Depth to Water (FT.)	20.75	21.11	21.24	21.75	23.57	24.92	25.27	24.03	21.77	22.53	22.28	23.03	24.23	23.51	21.28	22.25	20.16	22.26	22.27	22.38	25.71
		Static Water Level (FT)	1412.61	1412.25	1412.12	1411.61	1409.79	1408.44	1408.09	1409.33	1411.59	1410.83	1411.08	1410.33	1409.13	1409.85	1412.08	1411.11	1413.20	1411.10	1411.09	1410.98	1407.65

Table 3-1 (continued)
VAN DER HORST PLANT 1
MONITORING WELL WATER LEVELS

LOCATION	MONITORING POINT ELEVATION (FEET)	PARAMETER	10-Jul-89	12-Jul-89	13-Jul-89	17-Jul-89	7-Aug-89	30-Aug-89	7-Dec-89	22-Jan-90	8-Mar-90	2-Apr-90	18-May-90	20-Jun-90	7-Aug-90	2-Oct-90	1-Nov-90	13-Dec-90	4-Jan-91	7-Feb-91	1-Mar-91	3-Apr-91	18-Jul-91
MW-10	1429.70	Depth to Water (FT.)													20.39	19.65	17.78	18.57	16.49	18.43	18.55	18.48	21.62
		Static Water Level (FT)													1409.31	1410.05	1411.92	1411.13	1413.21	1411.27	1411.15	1411.22	1408.08
MW-11S	1431.52	Depth to Water (FT.)													22.52	21.76	19.69	20.56	18.46	20.55	20.53	20.47	23.92
		Static Water Level (FT)													1409.00	1409.76	1411.83	1410.96	1413.06	1410.97	1410.99	1411.05	1407.60
MW-11D	1431.58	Depth to Water (FT.)													22.44	21.86	19.77	20.64	18.55	20.63	20.62	20.56	24.02
		Static Water Level (FT)													1409.14	1409.72	1411.81	1410.94	1413.03	1410.95	1410.96	1411.02	1407.56
MW-12	1431.24	Depth to Water (FT.)													21.40	21.10	19.17	19.97	17.89	19.86	19.95	19.91	23.20
		Static Water Level (FT)													1409.84	1410.14	1412.07	1411.27	1413.35	1411.38	1411.29	1411.33	1408.04
MW-13	1429.81	Depth to Water (FT.)													20.40	19.72	17.65	18.50	16.41	18.53	18.55	18.47	21.97
		Static Water Level (FT)													1409.41	1410.09	1412.16	1411.31	1413.40	1411.28	1411.26	1411.34	1407.84
MW-14	1431.47	Depth to Water (FT.)													22.33	21.58	19.50	20.37	18.28	20.37	20.37	20.31	23.73
		Static Water Level (FT)													1409.14	1409.89	1411.97	1411.10	1413.19	1411.10	1411.10	1411.16	1407.74
P-1	1431.11	Depth to Water (FT.)													19.54	19.26	16.94	17.62	16.13	17.55	17.57	17.64	21.50
		Static Water Level (FT)													1411.57	1411.85	1414.17	1413.49	1414.98	1413.56	1413.54	1413.47	1409.61
P-2	1425.51	Depth to Water (FT.)													15.53	14.95	13.30	14.00	11.97	13.67	14.02	13.96	16.85
		Static Water Level (FT)													1409.98	1410.56	1412.21	1411.51	1413.54	1411.84	1411.49	1411.55	1408.66
P-3	1433.60	Depth to Water (FT.)													24.08	23.64	21.56	22.41	20.33	22.39	22.42	22.36	25.77
		Static Water Level (FT)													1409.52	1409.96	1412.04	1411.19	1413.27	1411.21	1411.18	1411.24	1407.83
P-5	1432.64	Depth to Water (FT.)																21.53	19.44	21.51	21.54	21.48	24.87
		Static Water Level (FT)																1411.11	1413.20	1411.13	1411.10	1411.16	1407.77
USGS-1	1433.80	Depth to Water (FT.)															21.85	22.75	20.70	22.81	22.78	22.76	26.30
		Static Water Level (FT)															1411.95	1411.05	1413.10	1410.99	1411.02	1411.04	1407.50
USGS-2A	1432.44	Depth to Water (FT.)															20.49	21.33	19.31	21.40	21.37	21.35	24.96
		Static Water Level (FT)															1411.95	1411.11	1413.13	1411.04	1411.07	1411.09	1407.48
USGS-2B	1431.69	Depth to Water (FT.)															19.73	20.67	18.58	20.68	20.65	20.36	24.18
		Static Water Level (FT)															1411.96	1411.02	1413.11	1411.01	1411.04	1411.33	1407.51
VDH (PROD)	1430.33	Depth to Water (FT.)															18.56	19.41	17.33	19.38	19.42	19.35	22.75
		Static Water Level (FT)															1411.77	1410.92	1413.00	1410.95	1410.91	1410.98	1407.58
MW-15	1429.22	Depth to Water (FT.)																					21.53
		Static Water Level (FT)																					1407.69
MW-16	1429.89	Depth to Water (FT.)																					22.16
		Static Water Level (FT)																					1407.73
MW-17	1429.16	Depth to Water (FT.)																					21.58
		Static Water Level (FT)																					1407.58
MW-19D	1428.43	Depth to Water (FT.)																					22.26
		Static Water Level (FT)																					1406.17

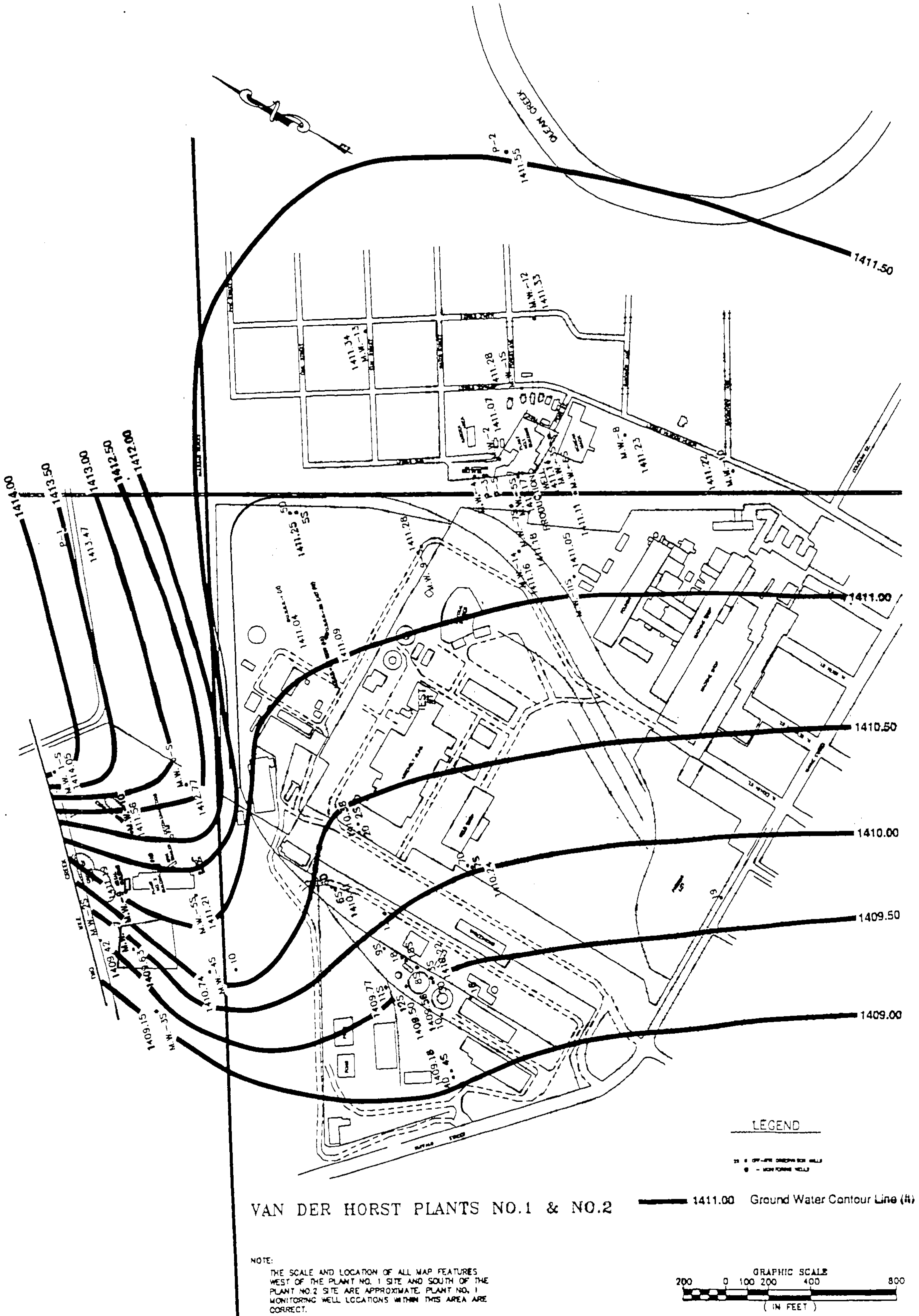
Figure 3-3 presents the April 3, 1991 regional ground water flow in shallow wells within the modelled area. Ground water flow on this date is believed to be representative of typical regional flow conditions. The direction of flow downgradient of Plant No. 1 was towards the southwest. The hydraulic gradient in Figure 3-3 ranged from 0.00025 at Plant No. 1 to 0.005 at Plant No. 2.

In general, the ground water flow direction in the shallow wells located along the railroad tracks between Plants No. 1 and No. 2, is to the southeast. This southeastern component of ground water flow is believed to result from the much lower hydraulic conductivity of the shallow sediments northwest of Johnson Street. The gradient in the shallow wells of this area is not believed to be representative of the overall regional flow direction of the aquifer.

Figure 3-4 presents the regional ground water flow in the deep wells. The flow direction in the deep wells throughout the modelled area is to the southwest, and the hydraulic gradient ranges from 0.0003 at Plant No. 1 to 0.0009 southwest of Plant No. 1. The direction and magnitude of the hydraulic gradient in the deep

Figure 3-3

Ground Water Contours for Shallow Monitoring Wells on April 3, 1991



NOTE:
THE SCALE AND LOCATION OF ALL MAP FEATURES WEST OF THE PLANT NO. 1 SITE AND SOUTH OF THE PLANT NO.2 SITE ARE APPROXIMATE. PLANT NO. 1 MONITORING WELL LOCATIONS WITHIN THIS AREA ARE CORRECT.

Figure 3-4

Ground Water Contours for Deep Monitoring Wells on April 3, 1991

1411.00 Ground Water Contour Line (ft)

VAN DER HORST PLANTS NO.1 & NO.2

NOTE:
THE SCALE AND LOCATION OF ALL MAP FEATURES WEST OF THE PLANT NO. 1 SITE AND SOUTH OF THE PLANT NO.2 SITE ARE APPROXIMATE. PLANT NO. 1 MONITORING WELL LOCATIONS WITHIN THIS AREA ARE CORRECT.

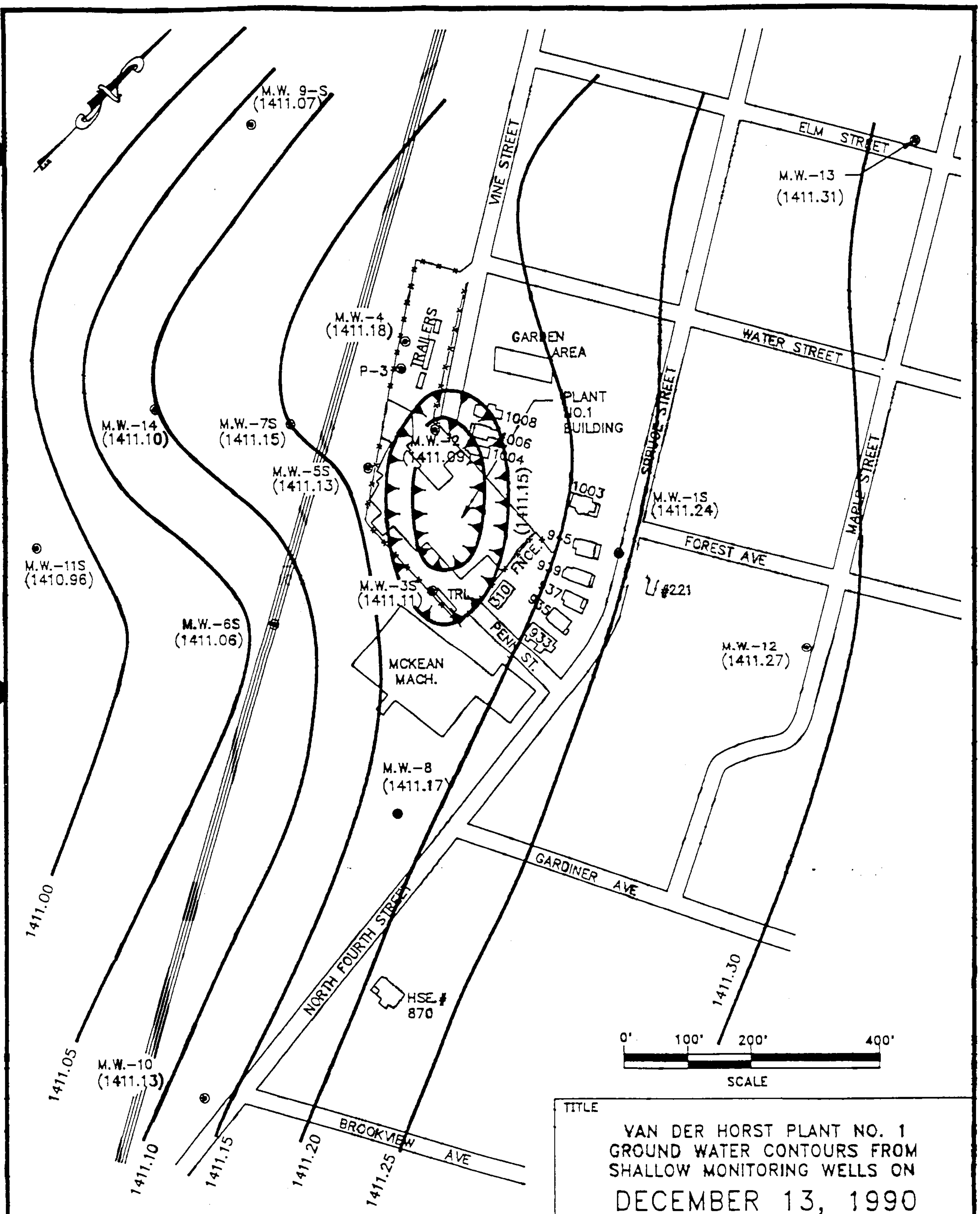
monitoring wells is believed to be representative of the predominant flow characteristics of that portion of the aquifer.

3.3.2 Ground Water Flow at Plant No. 1

Shallow Wells

Water level data were also plotted on the Plant No. 1 base map and used to generate local ground water contour maps. Ground water contours for shallow and deep monitoring wells, generated from water level data obtained on December 13, 1990, are presented in Figures 3-5 and 3-6. The contours in these figures are representative of the general pattern of ground water flow beneath the site. Other ground water contour maps generated for Plant No. 1 are presented in Appendix F of the Phase II RI.

The general direction of ground water flow in the shallow wells of the upper aquifer is to the southwest, although flow direction has ranged from due south to due west during some measuring events. This range in direction of flow could be a result of the low flow gradient. The average horizontal hydraulic gradient in



TITLE

VAN DER HORST PLANT NO. 1
GROUND WATER CONTOURS FROM
SHALLOW MONITORING WELLS ON
DECEMBER 13, 1990

PREPARED FOR

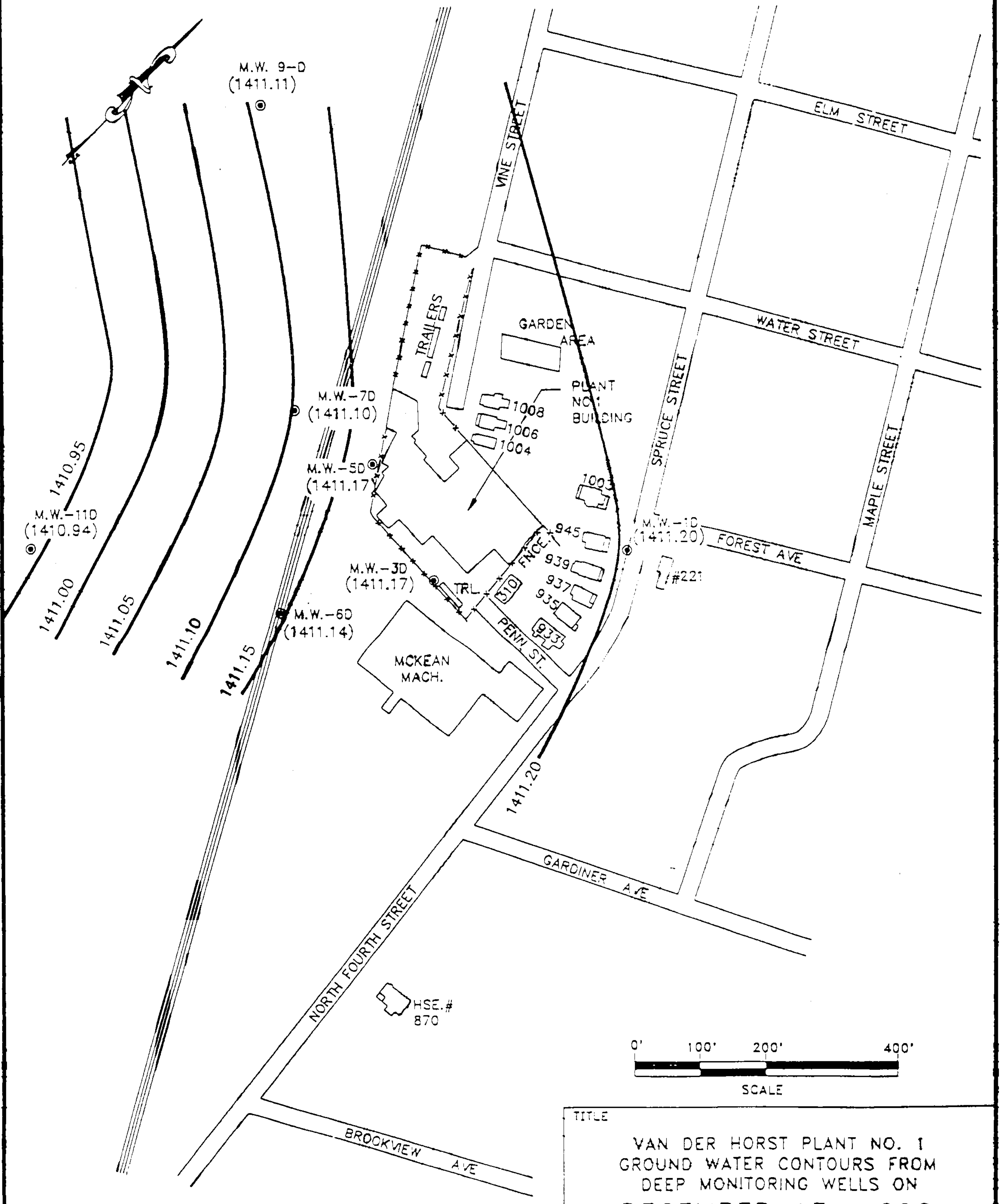
NYSDEC

ERM-Northeast
Environmental Resources Management

SCALE	FIGURE
AS NOTED	3-5
DATE	

LEGEND

1411.00 ——— GROUND WATER CONTOURS (FT.)
1410.95 ▲▲▲▲ GROUND WATER DEPRESSION CONTOURS (FT.)
(1410.88) GROUND WATER ELEVATIONS (FT.)



LEGEND

1411.00 ———— GROUND WATER CONTOURS (FT.)

(1410.88) GROUND WATER ELEVATIONS (FT.)

TITLE

VAN DER HORST PLANT NO. I
GROUND WATER CONTOURS FROM
DEEP MONITORING WELLS ON
DECEMBER 13, 1990

PREPARED FOR

NYSDEC

ERM-Northeast
Environmental Resources Management

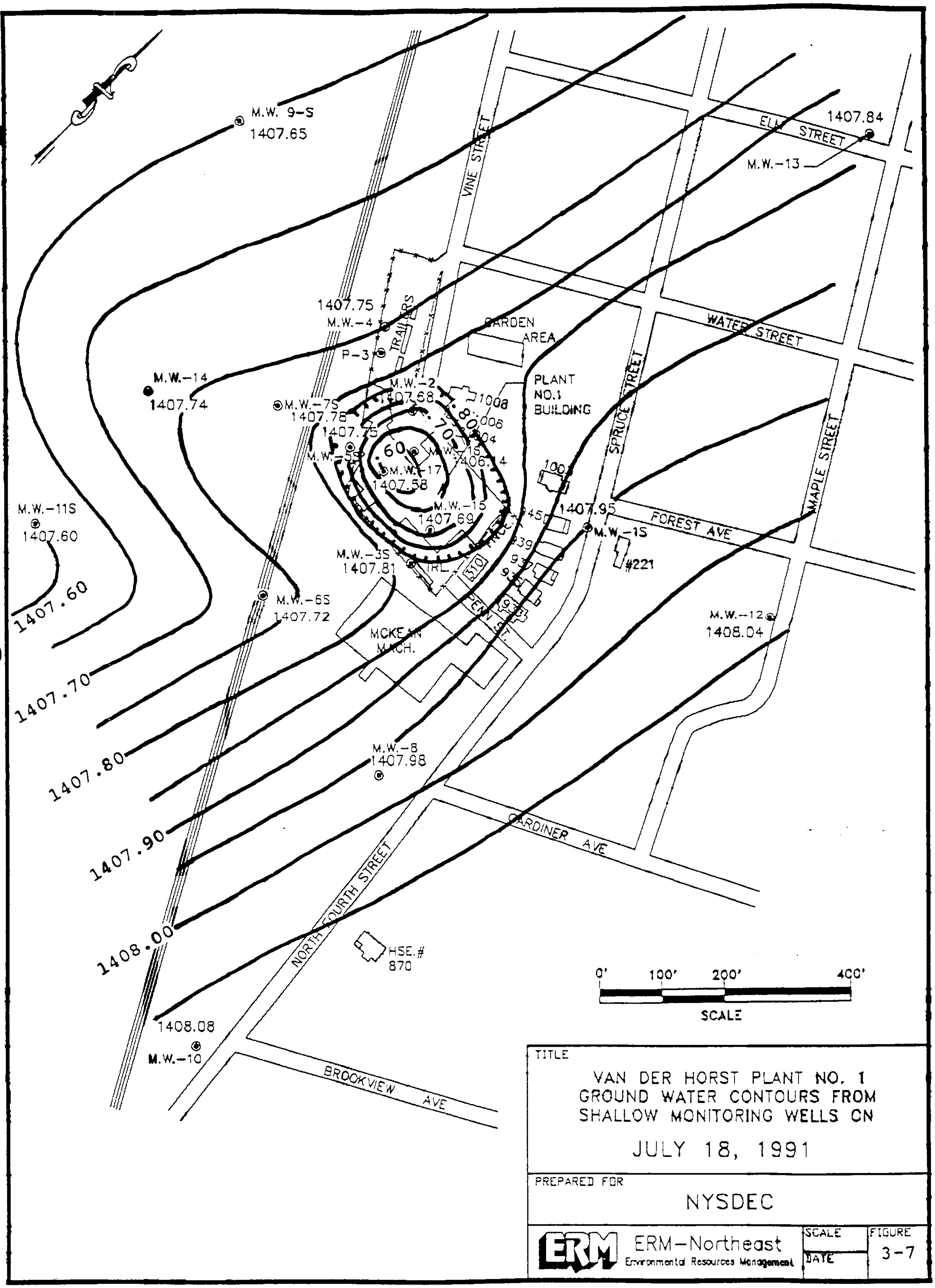
SCALE	FIGURE
AS NOTED	3-6
DATE	

the shallow wells down-flow of the site was 0.0004 and, to date, has ranged from 0.0003 to 0.0006.

A depression in the potentiometric surface beneath part of the Plant No. 1 building and the area immediately north of the building, has been indicated on all shallow well ground water contour maps. The depth and size of the depression were more accurately defined with the July 18, 1991 water level data due to additional Phase III monitoring wells MW-15, MW-16 and MW-17. A ground water contour map of shallow monitoring wells on July 18, 1991 is presented in Figure 3-7. The depth of the depression on this date was approximately 0.20 feet. This depression may have resulted from localized decreased rainwater infiltration beneath the Plant No. 1 building.

Deep Wells

The typical ground water flow direction in the deep wells of the upper aquifer was towards the southwest. The deep well flow direction exhibited a greater range than that of the shallow wells and varied from southeast to northwest. The average horizontal hydraulic gradient down-flow of the site was 0.0006 and fluctuated between 0.0002 and 0.0010.



TITLE

VAN DER HORST PLANT NO. 1
GROUND WATER CONTOURS FROM
SHALLOW MONITORING WELLS ON

JULY 18, 1991

PREPARED FOR

NYSDEC

ERM-Northeast
Environmental Resources Management

SCALE	FIGURE
DATE	3-7

Vertical Gradient

Ground water within the upper aquifer was also found to have a vertical flow component. The average vertical hydraulic gradient within the upper aquifer was calculated at each of the shallow and deep well pairs. Average vertical hydraulic gradient was calculated by dividing the average water level difference between the shallow and deep wells by the vertical distance between the bottom of the shallow well borehole and the top off the deep well sand pack. Negative values indicate a downward vertical gradient. Average vertical gradients are listed below for all monitoring well pairs:

Monitoring Wells	Average Water Level Difference Between Deep and Shallow Wells (ft)	Average Vertical Gradient
MW-1S & 1D	-0.04	-0.002
MW-3S & 3D	0.05	0.003
MW-5S & 5D	0.05	0.004
MW-6S & 6D	0.09	0.004
MW-7S & 7D	-0.05	-0.005
MW-9S & 9D	-0.02	0.001
MW-11S & 11D	-0.01	-0.001

Although the vertical gradient is small within the upper aquifer, this component of ground water flow is significant at the Plant No. 1 site. The vertical gradient is approximately 10 times greater than the horizontal gradient.

The average vertical hydraulic gradient was also calculated between the upper and lower aquifers beneath the site. Well MW-5B is the only well that penetrates the 19-foot thick aquitard separating the two aquifers. The average water level difference between MW-5B (1409.99) and MW-5D (1411.12 feet) was -1.13 feet. The vertical gradient between these two aquifers was -0.06.

Water Level Fluctuation

The seasonal rising and falling trends of the aquifer are believed to be in response to variations in precipitation and above freezing temperatures in the winter. The highest ground water levels measured during the study occurred in January 1991. Accumulated snow melted during month due to above freezing temperatures. Relatively low water levels have been recorded during winter months when the temperature has been below freezing. The lowest water levels were measured in July 1991, which was a month of little precipitation. The water level difference between these two dates was approximately 5.45 feet.

The depth range of ground water below the ground surface has been measured as shallow as 14.44 feet in MW-1S and as deep as 23.27 feet in MW-4.

3.4 Hydraulic Properties of the Aquifer

The following average aquifer characteristics have been calculated or estimated during RI Phases I and II from slug test and aquifer test data at Plant No. 1:

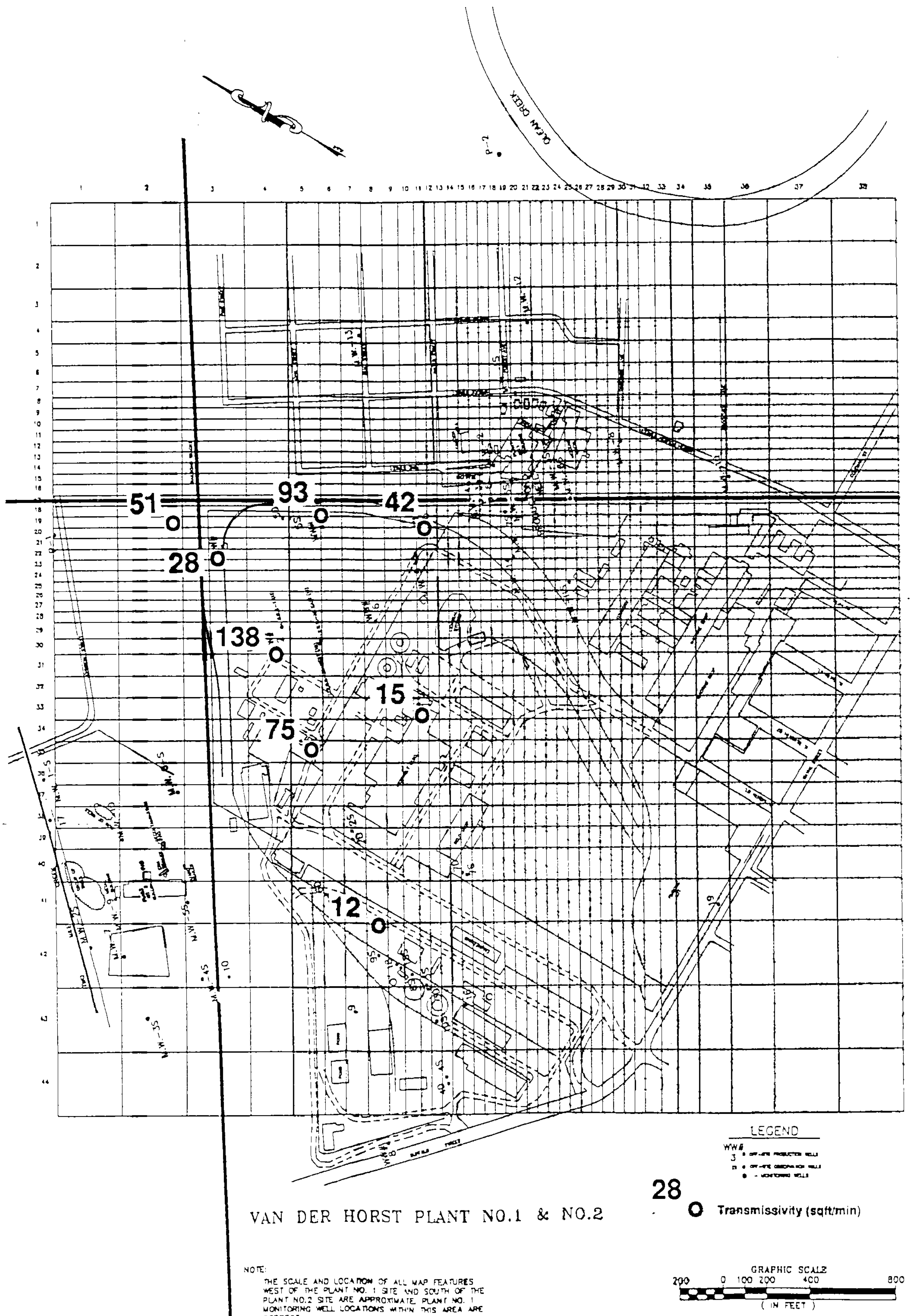
Parameter	Method	Value	
Transmissivity	P-5 Pumping Test	193 ft^2/min	
Hydraulic Cond.	P-5 Pumping Test	2.8 ft/min	K
Hydraulic Cond.	Shallow Well Slug Tests	0.2 ft/min	
Hydraulic Cond.	Deep Well Slug Tests	0.10 ft/min	
Storativity	Pumping Test	0.017	
Specific Yield	Estimated Range	0.15 - 0.25	

Transmissivity was calculated by the USGS from specific capacity tests or pumping tests of industrial pumping wells downgradient of the Plant No. 1 area. These transmissivities ranged from 12 to 138 ft^2/min and are presented in Figure 3-8.

The Plant No. 1 pumping test and USGS specific capacity and pumping test results appear to provide the best data for

Figure 3-8

USGS Transmissivity Calculations from Specific Capacity



VAN DER HORST PLANT NO.1 & NO.2

NOTE:
THE SCALE AND LOCATION OF ALL MAP FEATURES WEST OF THE PLANT NO. 1 SITE AND SOUTH OF THE PLANT NO.2 SITE ARE APPROXIMATE. PLANT NO. 1 MONITORING WELL LOCATIONS WITHIN THIS AREA ARE CORRECT.

estimating the transmissivity distribution within the regional aquifer. Plant No. 1 slug tests did not appear to sufficiently stress the aquifer to achieve representative results for hydraulic parameter estimation.

The range of specific yield was estimated to be between 0.15 and 0.25, based on geological characteristics of the aquifer material (USGS Water-Supply Paper 1662-D, 1967; and USGS Open-File Report 78-304, 1978).

3.5 Slug Testing

Slug tests were performed in selected Phase I and II monitoring wells to estimate the hydraulic conductivity of the aquifer material surrounding the well screen. Water level fluctuations within the well were initiated by rapidly introducing a solid PVC slug into the water column and measuring the rate that the displaced well water fell and returned to equilibrium (falling head). The second step of the test was to remove the PVC slug and measure the rate at which the water level rose and returned to equilibrium (rising head). The induced water level changes were recorded with an In-Situ Data Logger, Model SE-1000B in combination with a 15-psi pressure transducer. A summary of the slug test results is presented in Table 3-2.

Table 3-2

Slug Test Hydraulic Conductivity for Plant No. 1 Wells

Well	Falling Head Hydraulic Conductivity (ft/min)	Falling Head Hydraulic Conductivity (cm/sec)	Rising Head Hydraulic Conductivity (ft/min)	Rising Head Hydraulic Conductivity (cm/sec)
MW-1S	0.294	0.149	0.288	0.146
MW-1D	0.029	0.015	0.114	0.058
MW-2	0.336	0.171	0.258	0.131
MW-3D	0.072	0.037	0.162	0.082
MW-4	0.222	0.113	0.126	0.064
MW-5S	0.420	0.213	0.288	0.146
MW-5D	0.042	0.021	0.013	0.007
MW-5B	0.132	0.058	0.086	0.044
MW-7S	0.072	0.037	0.072	0.037
MW-7D	0.108	0.055	0.174	0.088
MW-8	0.294	0.149	0.312	0.158
MW-9S	0.108	0.055	0.162	0.082
MW-9D	0.126	0.064	0.162	0.082
MW-15	0.153	0.078	0.046	0.023
MW-16	0.097	0.049	0.171	0.087
MW-17	0.066	0.034	0.146	0.074
MW-19D	0.048	0.024	0.060	0.030

Slug test were conducted in a similar manner for Phase III monitoring wells MW-15, MW-16, MW-17 and MW-19D. The rapid recovery of the water level during slug testing required that only selected water level versus time data be used for analysis of the Phase III wells. These test data were analyzed and plotted using the AQTESOLV™ program. The Bouwer and Rice slug test evaluation method (1976) was used in AQTESOLV™ since all of the monitoring wells partially penetrate the aquifer. Computer plots and AQTESOLV™ data analysis equations were included in the Phase III RI Field Data Report.

Average hydraulic conductivities calculated from Phase III slug test were approximately half of the values calculated from the Phase I wells. The average hydraulic conductivity for shallow Phase III wells was 0.1 ft/min. The average hydraulic conductivity for Phase III deep well MW-19D was 0.05 ft/min. Average Phase I hydraulic conductivities were 0.2 ft/min for shallow wells and 0.1 ft/min for deep wells.

3.6 Pumping Test

3.6.1 Pumping Test Objectives

ERM conducted a pumping test at the Van Der Horst Plant No. 1 Site during the Phase II RI, and presented the results in Phase II RI Report. Between the dates of December 5 and 7, 1990, pumping well P-5 was pumped and then allowed to recover. A total of 17 monitoring wells were measured for water level fluctuations. The objectives of this testing were as follows:

- Calculate the hydraulic characteristics of the upper aquifer beneath the Plant No. 1 site for usage during ground water modeling;
- Determine the hydraulic relationship between the lower and upper aquifers;
- Estimate an optimum discharge for a contaminated ground water recovery well at Plant No. 1;
- Estimate if the on-site production well location could be acceptable for the recovery of contaminated ground water.

The P-5 pumping test began at 8:30 AM on December 5, 1990. The well was pumped at a relatively constant average rate of 256 gpm. On December 6, at 8:30 AM the pump in P-5 was shut off. Recovery measurement was immediately initiated after the pump was turned off, and was continued until 8:30 AM on December 7.

Pumped water was discharged directly into the sanitary sewer at the south end of Vine Street. A tap was installed in the discharge line near the well head for water sampling of hexavalent chromium, pH and specific conductivity during the pumping test.

3.6.2 Aquifer Parameter Calculation

Transmissivity, average hydraulic conductivity, and storativity, were calculated from pumping test drawdown and recovery data in seven monitoring wells at Plant No. 1. The Theis, Jacob, Distance-Drawdown, and Neuman methods were used to calculate these values from drawdown data. The Theis Recovery method was used to obtain transmissivity, average hydraulic conductivity, and storativity from recovery data. The following average aquifer parameter values were calculated from P-5 pumping test data:

Transmissivity	193 ft^2/min
Hydraulic Conductivity	2.8 ft/min
Storativity	0.017

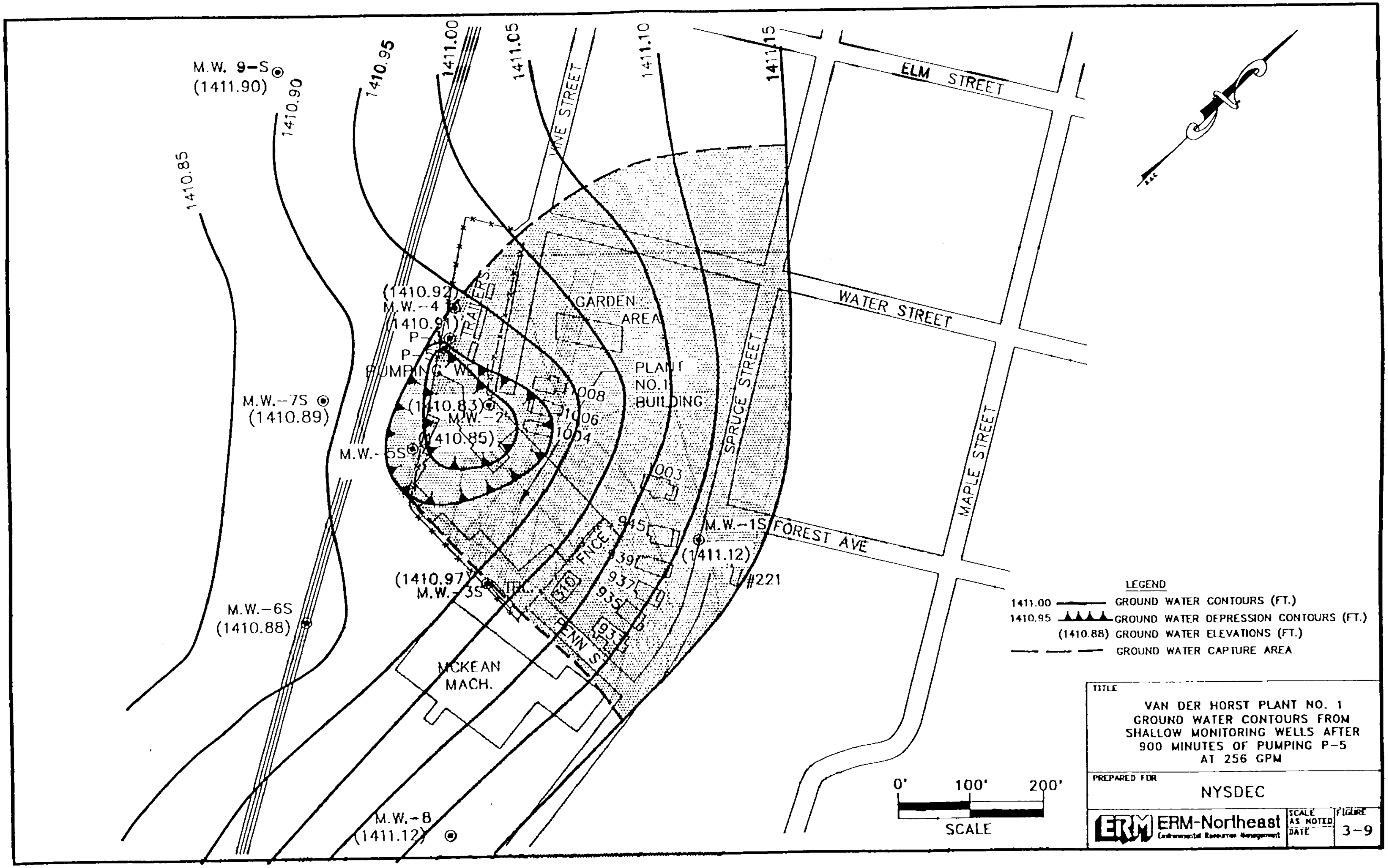
The time versus drawdown plots which were used to determine aquifer parameters are presented in Appendix H of the Phase II RI Report.

3.6.3 Ground Water Capture Area During Test

The ground water capture area for P-5 was evaluated after pumping 256 gpm for 900 minutes. The pumping time of 900 minutes was selected since this was the approximate time of maximum drawdown during the 24-hour pumping period. Contour maps of ground water elevations at 900 minutes of pumping are provided in Figures 3-9 and 3-10. The ground water capture area is shaded on each of these figures.

3.6.4 Conclusions

One of the primary objectives of the pumping test was to obtain aquifer parameters required for subsequent ground water modeling. Aquifer parameter values for transmissivity, storativity, and average hydraulic conductivity were able to be calculated from pumping test data. Specific yield could not be determined from pumping test data for the following reasons:



LEGEND

1411.00 ——— GROUND WATER CONTOURS (FT.)

1410.95 ▲▲▲▲ GROUND WATER DEPRESSION CONTOURS (FT.)

(1410.88) GROUND WATER ELEVATIONS (FT.)

— — — GROUND WATER CAPTURE AREA

TITLE

VAN DER HORST PLANT NO. 1
GROUND WATER CONTOURS FROM
SHALLOW MONITORING WELLS AFTER
900 MINUTES OF PUMPING P-5
AT 256 GPM

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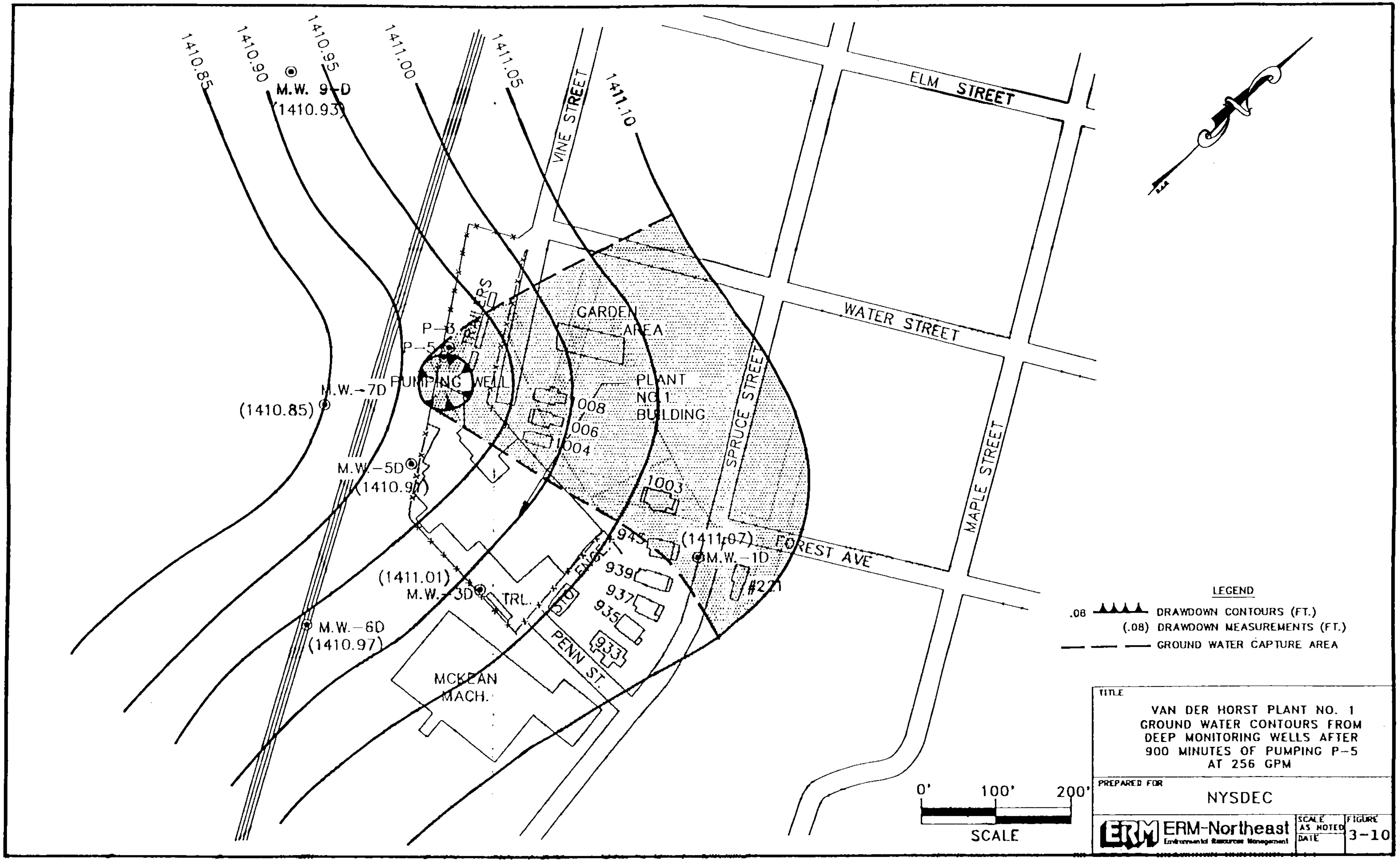
SCALE	FIGURE
AS NOTED	3-9
DATE	



TITLE
VAN DER HORST PLANT NO. 1
GROUND WATER CONTOURS FROM
DEEP MONITORING WELLS AFTER
900 MINUTES OF PUMPING P-5
AT 256 GPM

PREPARED FOR
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Environmental Resources Management

SCALE AS NOTED
DATE
FIGURE 3-10

- The length of the pumping test was shortened due to water level fluctuation related to barometric pressure changes;
- The pumping test only mildly stressed the aquifer. Greater discharge was not possible due to the size restrictions on the diameter of the pump and the well;
- The drawdown data were not effected by delayed drainage from dewatered portions of the aquifer. Delayed drainage effects on drawdown are used to calculate specific yield.

Based on geological characteristics of the aquifer, the specific yield is estimated between 0.15 and 0.25 (USGS Water-Supply Paper 1662-D, 1967; and USGS Open-File Report 78-304, 1978).

The lower aquifer beneath the site appears to be confined or semi-confined. Water levels in MW-5B were unaffected by the pumping of P-5, but seemed to be directly influenced by barometric pressure changes.

The upper aquifer in the vicinity of Plant No. 1 behaves as a semi-confined aquifer during static and low stress pumping conditions. This conclusion was based on the response of ground water levels to barometric pressure changes during the pumping test. The upper aquifer is believed to be regionally unconfined.

A ground water discharge of 256 gpm may be an acceptable rate for a recovery well at Plant No. 1. A recovery well pumping at this rate could be sited to capture the most highly contaminated ground water at the plant.

3.7 Ground Water Flow Modeling

3.7.1 Introduction

The primary goal of ground water modeling at Van Der Horst Plant No. 1 was to aid in the selection of recovery wells for potential remediation of chromium contamination in the underlying ground water. The model was used to evaluate the effect of well placement, number, and discharge on the well capture area relative to the estimated area of chromium contamination.

3.7.2 Selection of Modelled Area

Selection of the area to be modelled in this study was based on an estimated distribution of total chromium contamination within the aquifer beneath Plant No. 1. Although the extent of chromium contamination has been approximated to the north and east of the site, the extent of contamination southwest (downgradient) of Plant

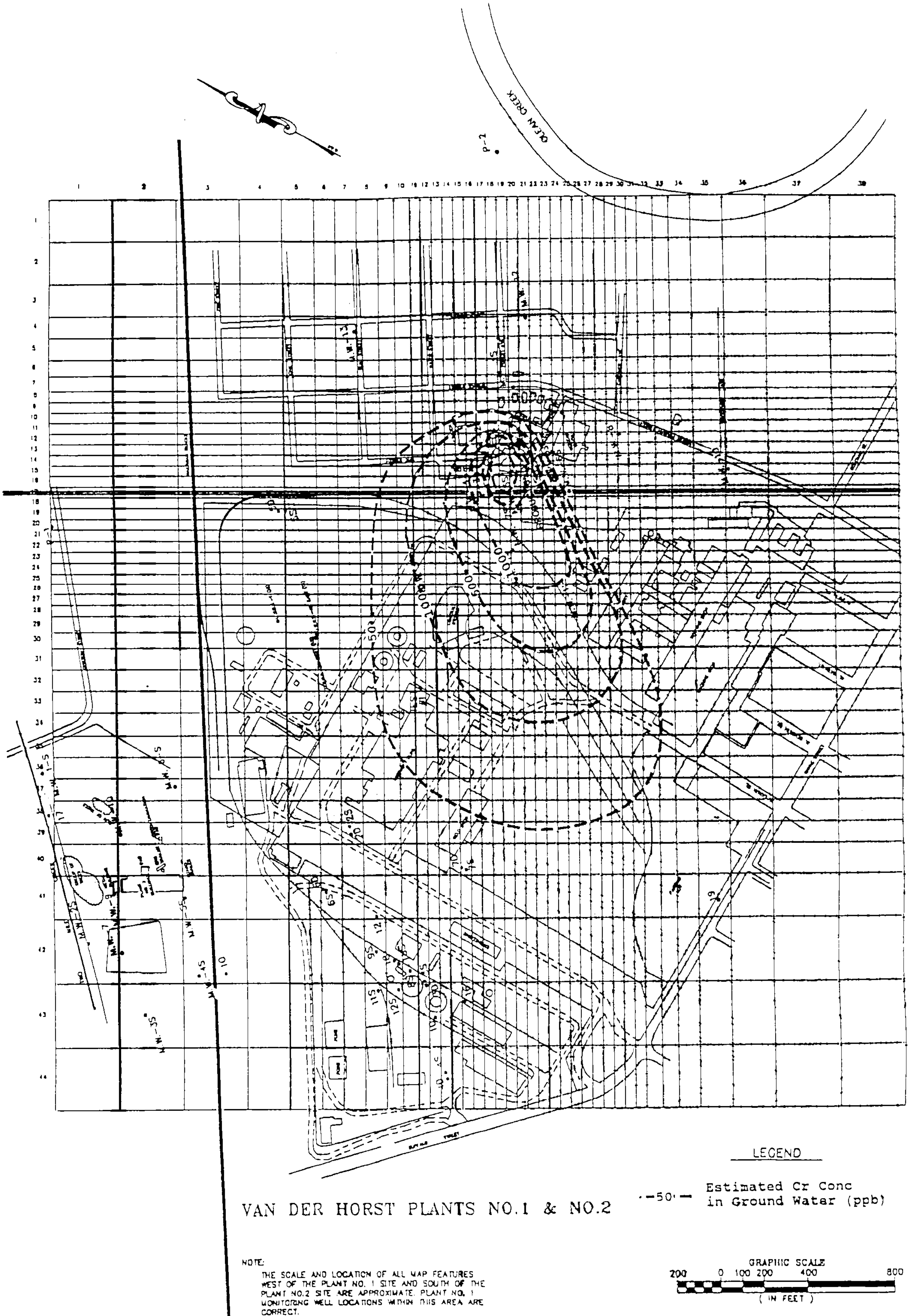
No. 1 has not yet been delineated. An estimate of chromium distribution southwest of monitoring well MW-11D was made based on ground water flow direction and an extrapolation of the observed Phase I and II concentrations near the site. The rate of chromium migration is believed to be slower than the ground water flow velocity, due to the sorptive properties of the aquifer. Figure 3-11 illustrates the estimated distribution of chromium within the aquifer. It should be noted that this estimate is based on limited data and may not represent the exact boundary of the chromium plume.

3.7.3 Model Description

Numerical modeling was completed using the USGS (McDonald and Harbaugh, 1988) modular, 3-D finite-difference ground water flow model (MODFLOW). Two dimensional (1-layer) ground water modeling was conducted using steady-state or transient ground water flow and confined aquifer conditions. Discretization of the modeled aquifer area was carried out by dividing the area into 44 rows and 38 columns of rectangular nodes (Figure 3-12).

Figure 3-11

Estimated Distribution of Chromium Contamination in Ground Water



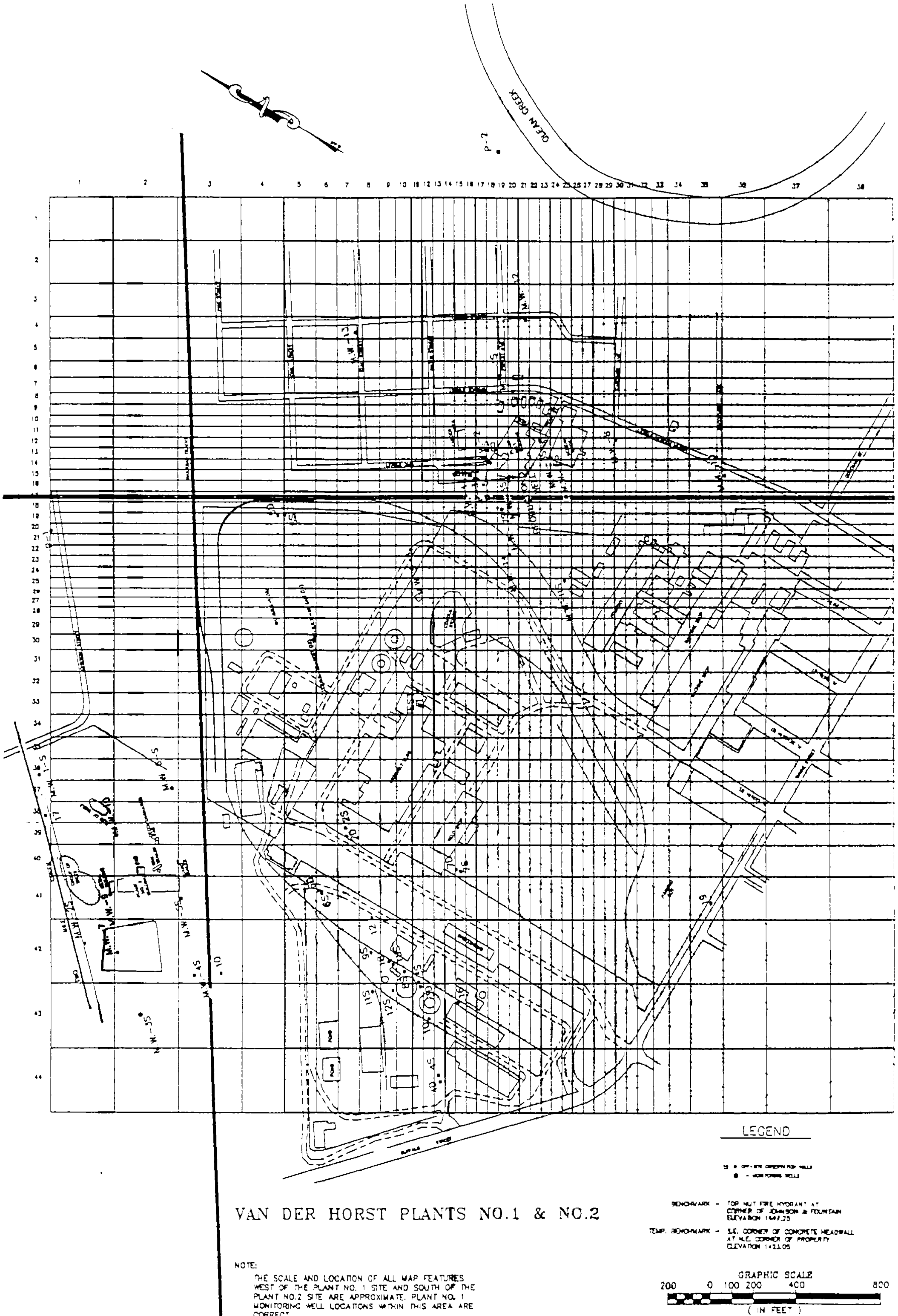
VAN DER HORST PLANTS NO.1 & NO.2

-50- Estimated Cr Conc in Ground Water (ppb)

NOTE:
THE SCALE AND LOCATION OF ALL MAP FEATURES WEST OF THE PLANT NO. 1 SITE AND SOUTH OF THE PLANT NO.2 SITE ARE APPROXIMATE. PLANT NO. 1 MONITORING WELL LOCATIONS WITHIN THIS AREA ARE CORRECT.

Figure 3-12

Modeling Grid Map



NOTE:
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3.7.4 Model Calibration

The Plant No. 1 ground water flow model was calibrated to April 3, 1991 water elevations from Plant 1 and 2 monitoring wells and USGS observations wells within the modelled area. The model was calibrated by systematically varying aquifer transmissivity. Transmissivity varied from 20 to 250 ft^2/min (see Figure 3-13), but was primarily based on the transmissivity distribution from the USGS specific capacity tests (Figure 3-8) and the ERM pumping test. Recharge was held constant in the steady state calibrations and recharge and storativity were constants in the 900-minute pumping test calibration. Transmissivity was adjusted until the ground water levels in the model were within an acceptable range (+/- 0.05 feet) of the monitoring well data.

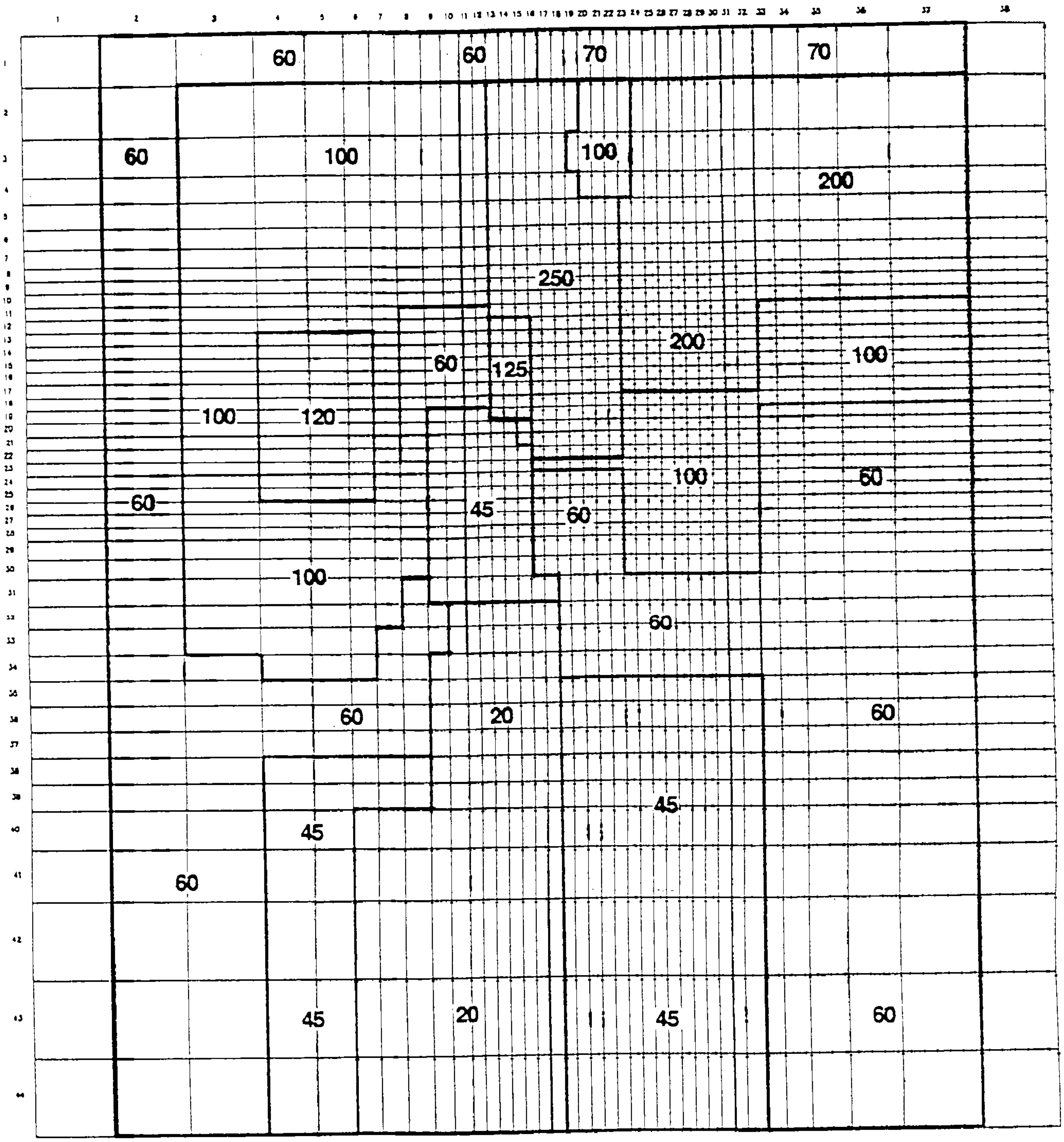
3.7.5 Sensitivity Analysis

General Methodology

Sensitivity analysis was conducted on the model calibrations to evaluate the relative effect of input parameters on predicted water levels or drawdown. One

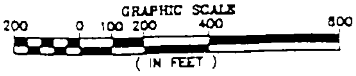
Figure 3-13

Transmissivity Distribution in Final Model Calibration



Legend

60 Transmissivity (sq ft/min)



input parameter was changed for each sensitivity run. Transmissivity and recharge were adjusted to test parameter sensitivity for steady state calibrations. Transmissivity, recharge and storativity were adjusted for transient flow calibrations.

The sensitivity of the following four calibrations was analyzed:

- Steady State - Constant Head - No Pumping;
- Steady State - Upgradient Constant Flux - No Pumping;
- Transient Flow - Constant Head - No Pumping; and
- Transient Flow - Constant Head - 900-Minute Pumping Test

3.7.6 Recovery Well Simulations

Ground water recovery well simulations were performed by modifying the calibrated pumping test simulation. The simulation length was extended to 1 year and different combinations of recovery wells were evaluated. Four recovery well simulations, employing 1, 3, 4 and 5 wells, were presented in the June 1991 Ground Water Flow Modeling Report. The 4 and 5 well scenarios have been selected for review in this report. A 256 gpm pumping rate was used for each of the wells in the ground water recovery simulations. The ground water capture area and recovery well drawdown for each simulation are illustrated in Figures 3-14 to 3-17.

Ground water capture areas were estimated by the ground water elevations produced from the recovery well simulations. Capture area delineation employed the basic premise that ground water flow is perpendicular to ground water elevation contours. Ground water contours were not included in the capture area figures so that the estimated ground water chromium concentration contours could be easily compared with the capture area.

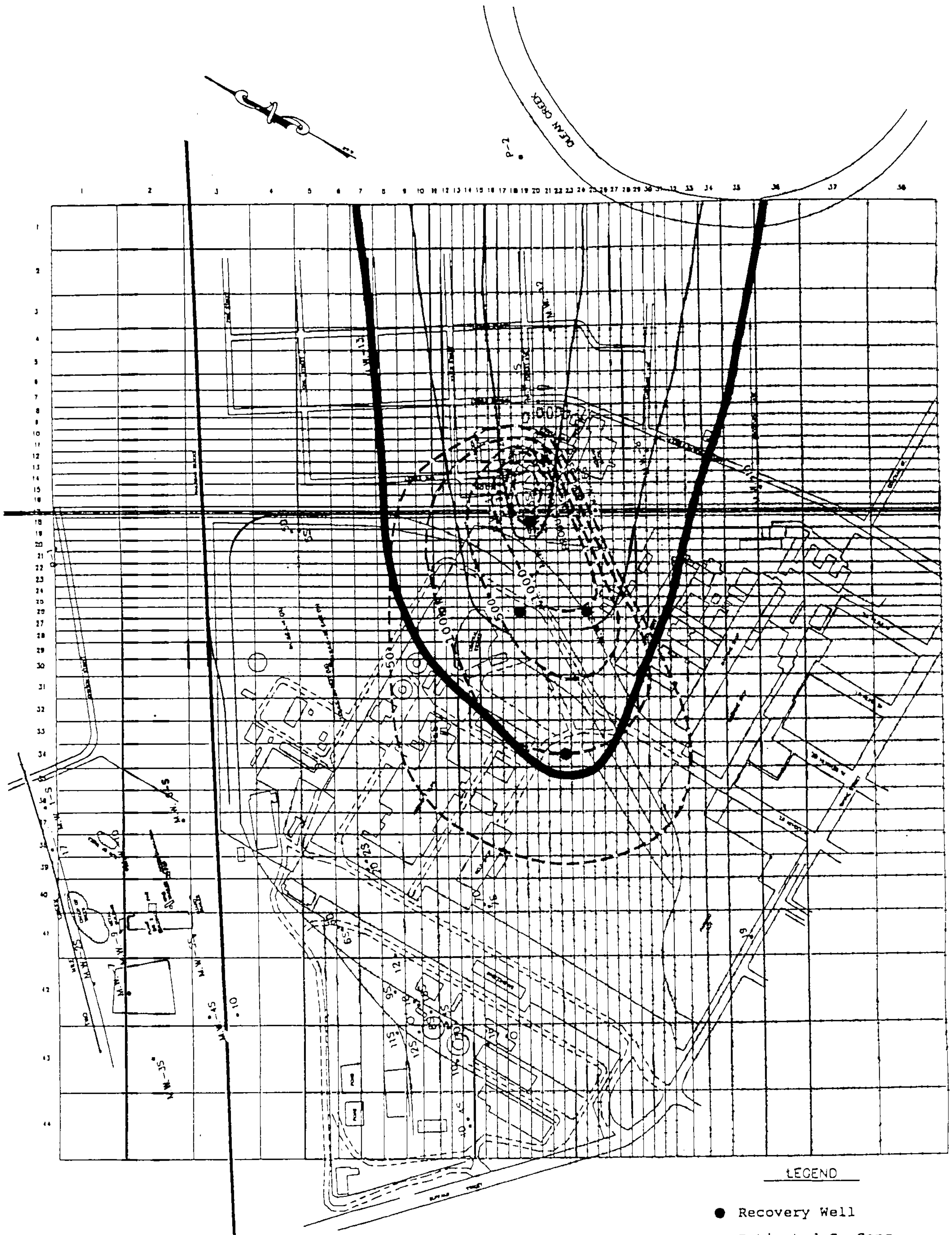
3.7.7 Modeling Conclusions and Recovery Well Recommendations

Modeling Conclusions

The USGS ground water model MODFLOW was used to predict the capture area of several patterns of recovery wells around the Van Der Horst Plant No. 1 site. The model was initially calibrated to non-pumping steady state conditions and also to a 900 minute pumping test at Plant No. 1. Calibration was conducted by changing aquifer transmissivity until the difference between the modelled heads and the field-measured heads was

Figure 3-14

Estimated Ground Water Capture Area for 4 Wells Pumping at 256 gpm for 1 Year



● Recovery Well

·-50·— Estimated Cr Conc in Ground Water (ppb)

▬ Ground Water Capture Zone

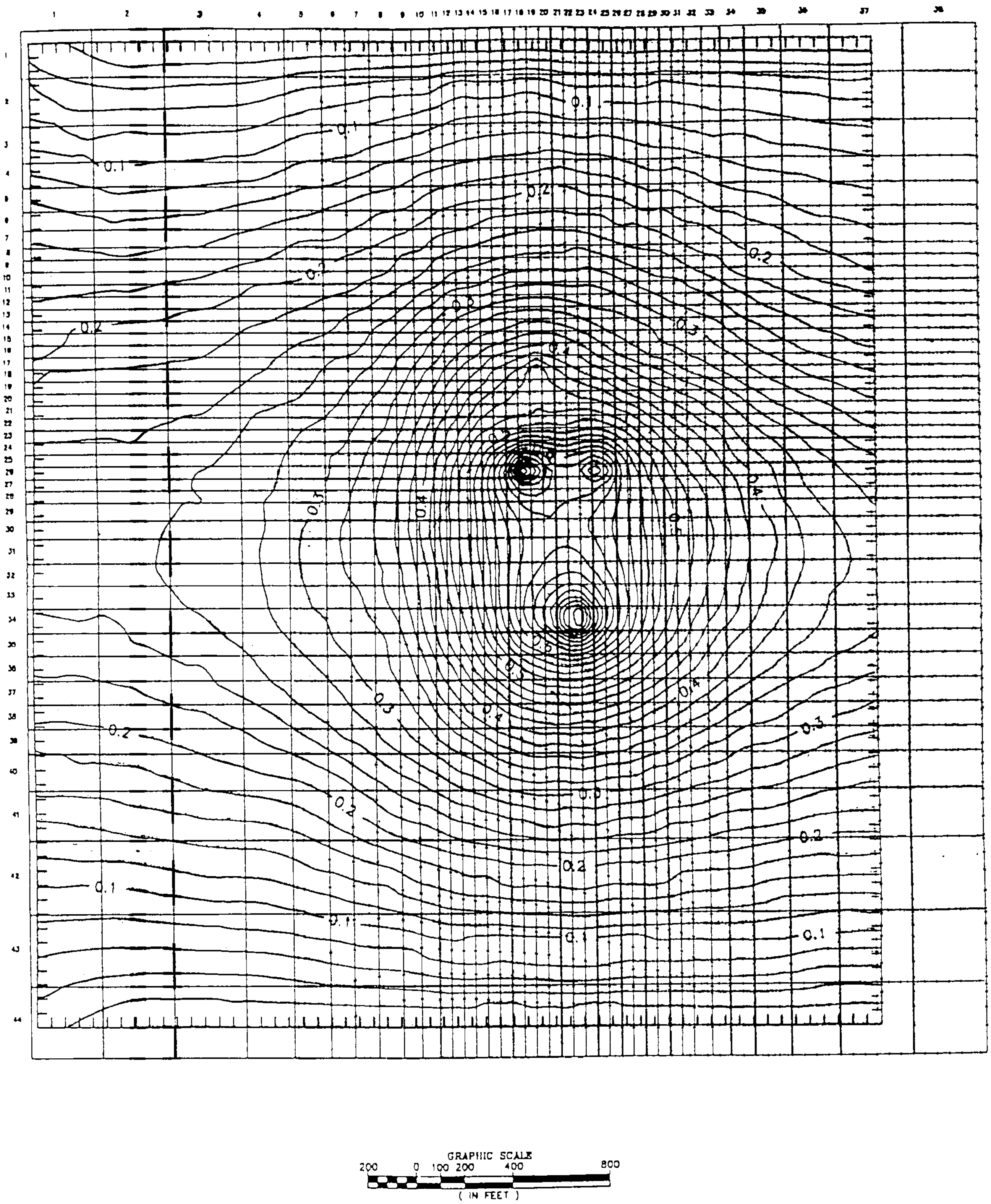
VAN DER HORST PLANTS NO.1 & NO.2

NOTE:
THE SCALE AND LOCATION OF ALL MAP FEATURES WEST OF THE PLANT NO. 1 SITE AND SOUTH OF THE PLANT NO.2 SITE ARE APPROXIMATE. PLANT NO. 1 MONITORING WELL LOCATIONS WITHIN THIS AREA ARE CORRECT.

GRAPHIC SCALE
200 0 100 200 400 800
(IN FEET)

Figure 3-15

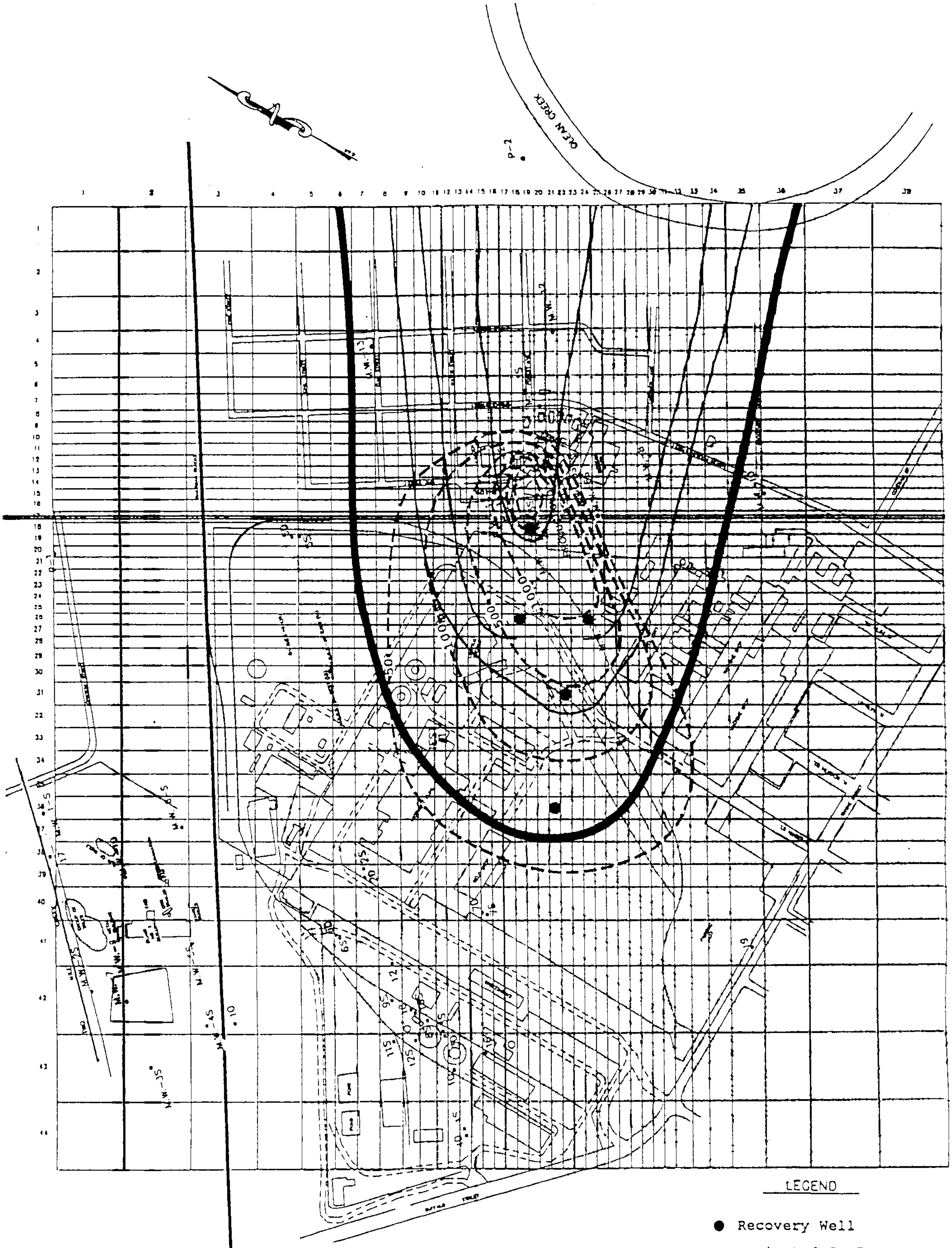
Estimated Drawdown for 4 Wells Pumping at 256 gpm for 1 year



– 0.02 – Recovery Well Drawdown (ft)

Figure 3-16

Estimated Ground Water Capture Area for 5 Wells Pumping at 256 gpm for 1 Year



VAN DER HORST PLANTS NO.1 & NO.2

● Recovery Well

·—50·— Estimated Cr Conc in Ground Water (ppb)

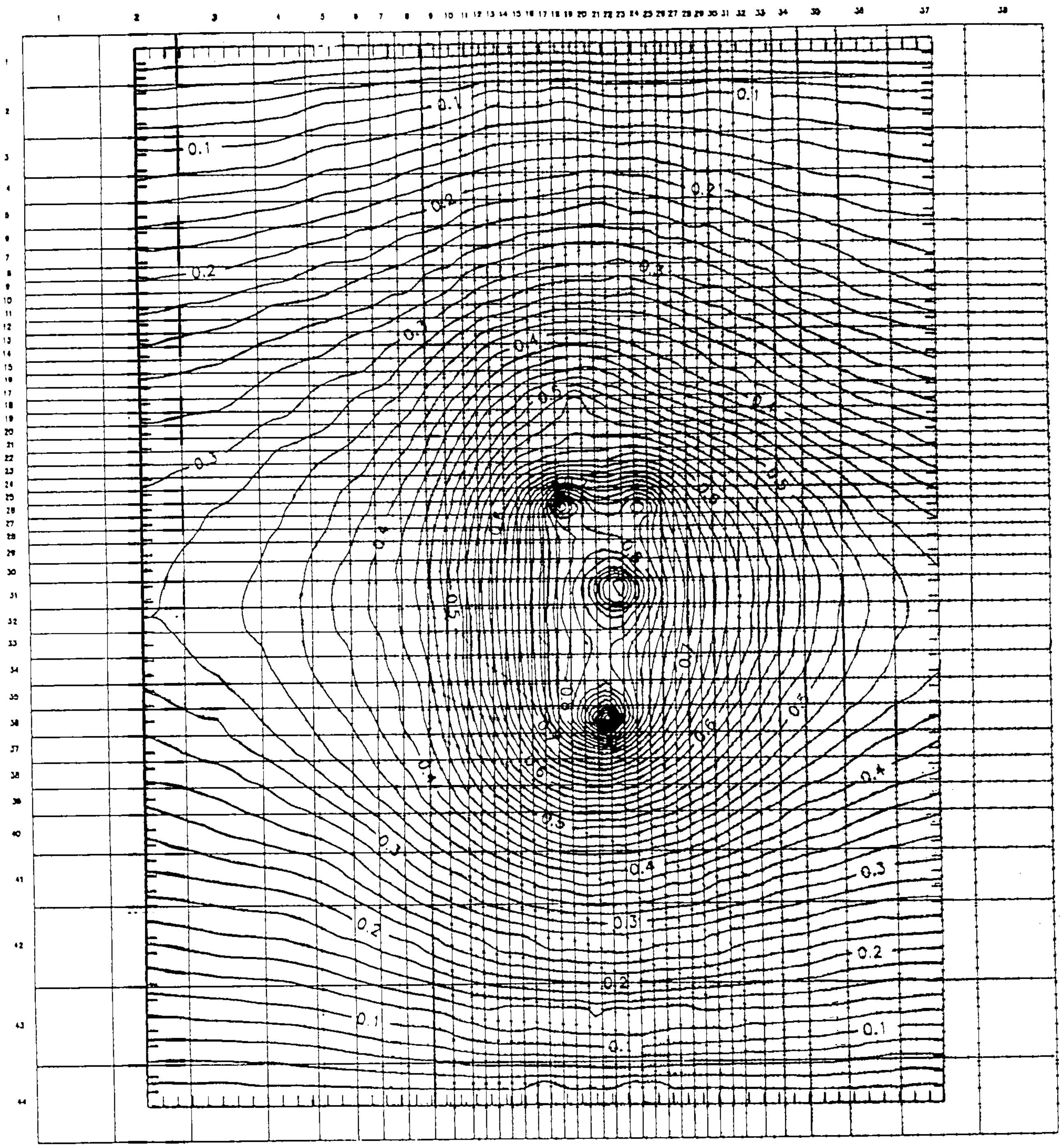
▬ Ground Water Capture Zone

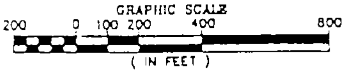
GRAPHIC SCALE
200 0 100 200 400 800
(IN FEET)

NOTE:
THE SCALE AND LOCATION OF ALL MAP FEATURES WEST OF THE PLANT NO. 1 SITE AND SOUTH OF THE PLANT NO.2 SITE ARE APPROXIMATE. PLANT NO. 1 MONITORING WELL LOCATIONS WITHIN THIS AREA ARE CORRECT.

Figure 3-17

Estimated Drawdown for 5 Wells Pumping at 256 gpm for 1 year





- 0.02 - Recovery Well Drawdown (ft)

acceptable. The general distribution and magnitude of aquifer transmissivity was based on USGS specific capacity tests in production wells and a pumping test in well P-5 at Plant No. 1.

The model was calibrated using constant head or constant flux upgradient boundaries; however, final calibrations were made only with constant head boundaries. The constant flux calibrations produced unrealistic drawdown for ground water pumping simulations.

Sensitivity analysis of calibrations revealed the following tendencies in the model:

- Parameter changes in constant flux calibrations produced greater head differences than in constant head calibrations.
- Constant head calibrations were most greatly affected by changes in transmissivity and recharge. Storativity changes for transient flow calibrations had little effect on the predicted head.
- Parameter sensitivity was fairly similar for both steady state and transient flow calibrations with constant head boundaries.

Recovery well simulations were evaluated for 1, 3, 4 and 5 well systems. Drawdown from recovery wells was found to extend beyond the model boundaries.

Recovery Well Recommendations

Based on predicted recovery well capture areas and the estimated extent of chromium contamination in the aquifer, a four or five recovery well system is recommended for ground water remediation at Plant No. 1. Each well in the system would be pumped at a rate of approximately 250 gpm. Although several other pumping rates were used for recovery well simulations, an approximate rate of 250 gpm was found to be the best discharge for optimizing the ground water capture area.

The estimated capture area for a four recovery well system appears to capture almost all of the suspected chromium contamination greater than 100 ppb. Ground water with chromium levels between 50 and 100 ppb could be allowed to attenuate naturally by the sorptive properties of the aquifer. The NYSDEC ground water standard for chromium is 50 ppb.

The total ground water recovery rate of the four well system would be 1,000 gpm. At this rate of recovery, roughly 2.5 times the estimated volume of chromium contaminated water would be pumped annually.

Based on the model-predicted ground water capture area results, a five recovery well system is recommended if it is necessary to capture most of the ground water with chromium levels between 50 and 100 ppb. Each recovery well in this system would also be pumped at a rate of 250 gpm.

4.0 OVERVIEW OF THE REMEDIAL INVESTIGATION CHEMICAL ANALYSIS

4.1 General

The following media were sampled and tested during the three phases of the RI study:

- Surface and subsurface soil from on and off-site locations;
- Surface water from Olean Creek;
- Sediment from Olean Creek;
- Ground water from on and off-site monitoring wells;
- Water and sediment from the adjacent sewer system;
- Water from the plating wells in the plant courtyard; and
- building samples from walls, floors, roofs and equipment surfaces at the plant facility.

Analytical results of the samples collected during the Phase III RI will be presented as summary tables within associated subsection of Section 4.0. Analytical data summary table for RI Phase I and II samples have been included in the Phase I and Phase II reports and will not be presented here. The summary of the Phase III RI sampling program is presented on Table 2-1. Phase III sampling locations are shown on Figures 2-2 through 2-4. These data were reviewed and validated by an ERM QA/QC specialist and a copy of ERM's QA/QC data validation is provided in the Appendix.

Presented below is a summary and overview of the Phase III analytical sampling results. This is followed by a final risk assessment (Section 5.0) which used data from all phases of the RI to evaluate risks to human health and the environment. Section 6.0 discusses the potential sources and extent of contamination, and graphically shows the distribution of contaminants relative to Plant No. 1.

4.2 Off-Site Surface Soils

Table 4-1 presents the analytical results for the 29 surface soil samples (SFS-1 through SFS-29) collected from areas adjacent to the plant facilities. These samples were analyzed for total chromium content only, in an attempt to delineate the areal extent of chromium contamination in the surface soil near Plant 1 (see Figure 2-5 for sampling locations).

Total chromium in off-site surface soil samples ranged from 20.7 mg/Kg (SFS-10) to 12,200 mg/Kg (SFS-12) with 25 of the 29 samples exhibiting levels of total chromium in excess of 50 mg/Kg. Furthermore, 11 of the 29 samples exhibited total chromium levels of over 1000 mg/Kg. Background samples collected in previous phases of the RI exhibited a range for

Table 4-1

Van Der Horst Plant 1 Phase 3
Surface Soil - Chromium

SAMPLE NUMBER		SFS-1, 0"-3"	SFS-2, 0"-3"	SFS-3, 0"-3"	SFS-4, 0"-3"	SFS-5, 0"-3"	SFS-6, 0"-3"	SFS-7, 0"-3"	SFS-8, 0"-3"
MATRIX		Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
DATE SAMPLED		15-May-91	15-May-91	15-May-91	15-May-91	15-May-91	15-May-91	15-May-91	15-May-91
UNITS		mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
ANALYTE	**CAS Number**								
Total Chromium	7440-47-3	33.5 J	25.5 J	91.4 J	116 J	76.9 J	87.7 J	61.4 J	184 J

SAMPLE NUMBER		SFS-9, 0"-3"	SFS-10, 0-3"	SFS-11, 0-3"	SFS-12, 0-3"	SFS-13, 0-3"	SFS-14, 0-3"	SFS-15, 0-3"	SFS-16, 0-3"
MATRIX		Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
DATE SAMPLED		15-May-91	15-May-91	15-May-91	15-May-91	15-May-91	15-May-91	15-May-91	15-May-91
UNITS		mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
ANALYTE	**CAS Number**								
Total Chromium	7440-47-3	80.2 J	20.7 J	394 J	12200 J	1930 J	3860 J	1360 J	388 J

SAMPLE NUMBER		SFS-17, 0-3"	SFS-18, 0-3"	SFS-19, 0-3"	SFS-20, 0-3"	SFS-21, 0-3"	SFS-22, 0-3"	SFS-23, 0-3"	SFS-24, 0-3"
MATRIX		Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
DATE SAMPLED		15-May-91	15-May-91	15-May-91	15-May-91	15-May-91	16-May-91	16-May-91	16-May-91
UNITS		mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
ANALYTE	**CAS Number**								
Total Chromium	7440-47-3	1300 J	1590 J	3520 J	1180 J	1280 J	4400	1180	83.5

SAMPLE NUMBER		SFS-25, 0-3"	SFS-26, 0-3"	DUP-50	SFS-27, 0-3"	SFS-28, 0-3"	SFS-29, 0-3"
MATRIX		Soil	Soil	Soil	Soil	Soil	Soil
DATE SAMPLED		16-May-91	16-May-91	16-May-91	16-May-91	16-May-91	16-May-91
UNITS		mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
ANALYTE	**CAS Number**						
Total Chromium	7440-47-3	585	515	463	45.3	75.5	117

Qualifier Codes:
B: Indicates a value greater than or equal to the instrument detection limit but less than the CRDL.
J: This result should be considered a quantitative estimate.
ND: This analyte was not detected

total chromium of 13.0 mg/Kg (S-23 and S-25) to 16.4 mg/Kg (S-24).

4.3 Off-Site Subsurface Soils

Thirty off-site subsurface samples, obtained from eight locations, were collected during the Phase III RI and analyzed for total chromium (see Figure 2-6). The samples were collected to better delineate the vertical extent of chromium contamination migration in the soil adjacent to the plant property. Total chromium for the off-site subsurface soils ranged from 5.8 mg/Kg (B-23, 0'-2') to 3860 mg/Kg (B-24, 0'-2'). Analytical results are presented in Table 4-2. These results indicate that off-site chromium contamination generally decreases with depth.

4.4 On-site Surface Soils

Table 4-3 also presents the analytical results for the four surface soil samples collected from on-site locations (see Figure 2-5). These samples, SSPW-1 through SSPW-4, were collected from a courtyard between the plant buildings to assess soil conditions where former plating wells are located. The samples were analyzed for total chromium, arsenic and lead.

Table 4-2

Van Der Horst Plant 1 Phase 3
Subsurface Soil Samples - As, Cr & Pb

SAMPLE NUMBER		SB-10, 0'-2'	SB-10, 2'-4'	SB-10, 4'-6'	SB-10, 6'-8'	SB-10, 8'-10'	SB-10, 12-14'	SB-10, 14-16'	SB-10, 16-18'
MATRIX		Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
DATE SAMPLED		8-May-91	8-May-91	8-May-91	8-May-91	8-May-91	8-May-91	8-May-91	8-May-91
UNITS		mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
ANALYTE	**CAS Number**								
Arsenic	7440-38-2	17.2 JB	17.5 JB	38.9 J	19.7 J	12.6 J	9.2 J	6.3 J	4 J
Chromium	7440-47-3	101	145	327	274	30.6	25.4	7.8	8.9
Lead	7439-92-1	388 J	383 J	823 J	627 J	39.3 J	47.3 J	13.5 J	10.2 J

SAMPLE NUMBER		SB-11, 0'-2'	SB-11, 2'-4'	SB-11, 4'-6'	SB-11, 6'-8'	SB-11, 10-12'	SB-11, 14-16'	SB-11, 16-18'	SB-11, 18-20'
MATRIX		Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
DATE SAMPLED		10-May-91	10-May-91	10-May-91	10-May-91	10-May-91	10-May-91	10-May-91	10-May-91
UNITS		mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
ANALYTE	**CAS Number**								
Arsenic	7440-38-2	8.8 J	8.3 J	8 J	8.4 J	8 J	7 J	7.2 J	7.9 J
Chromium	7440-47-3	958	494	159	75.9	860	239	821	985
Lead	7439-92-1	21.8	20.8 J	18.6	17.5	15.1	11.7	11.2	17.4

SAMPLE NUMBER		SB-14, 0'-2'	SB-14, 2'-4'	SB-14, 4'-6'	SB-14, 6'-8'	SB-14, 10-12'	SB-14, 12-14'	DUP-4
MATRIX		Soil	Soil	Soil	Soil	Soil	Soil	Soil
DATE SAMPLED		14-May-91	14-May-91	14-May-91	14-May-91	14-May-91	14-May-91	14-May-91
UNITS		mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
ANALYTE	**CAS Number**							
Arsenic	7440-38-2	12.1	7.9	9.5	8.5	6.2	4.2	6 J
Chromium	7440-47-3	2660	1880	176	41.8	67	73.8	61.7 J
Lead	7439-92-1	533 J	43.5	79.5	18.4	15.7 J	9.7	9.7 J

Qualifier Codes:
B: Indicates a value greater than or equal to the instrument detection limit but less than the CRDL.
J: This result should be considered a quantitative estimate.
ND: This analyte was not detected

Table 4-2 (con't)

Van Der Horst Plant 1 Phase 3
Subsurface Soil Samples - As, Cr & Pb

SAMPLE NUMBER		SB-14,14-16'	DUP-2	SB-14,16-18'	SB-14,18-20'	SB-15, 3'-5'	SB-16, 0'-2'	SB-17, 0'-2'	SB-17, 2'-4'
MATRIX		Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
DATE SAMPLED		14-May-91	14-May-91	14-May-91	14-May-91	16-May-91	16-May-91	8-May-91	8-May-91
UNITS		mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
ANALYTE	**CAS Number**								
Arsenic	7440-38-2	4.9	5.9 J	6.4	6	45.9 J	17.9 J	17.5 JB	9.6 J
Chromium	7440-47-3	144	114 J	89.9	819	3750	2860	5570	504
Lead	7439-92-1	8.2	9.7 J	25.7	17.9	1910 J	249 J	1700 J	262 J

SAMPLE NUMBER		SB-17, 4'-6'	SB-17, 6'-8'	SB-17, 8'-10'	SB-17,10-12'	SB-17,12-14'	SB-17,14-16'	SB-17,18-20'
MATRIX		Soil	Soil	Soil	Soil	Soil	Soil	Soil
DATE SAMPLED		8-May-91	8-May-91	8-May-91	8-May-91	8-May-91	8-May-91	8-May-91
UNITS		mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
ANALYTE	**CAS Number**							
Arsenic	7440-38-2	36.4 J	10.7 J	7.6 J	7.6 J	5.1 J	6.6 J	5.2 J
Chromium	7440-47-3	177	192	1770	1200	33.6	33.1	44.5
Lead	7439-92-1	60.3 J	264 J	23 J	141 J	7.7 J	9.7 J	9.7 J

Qualifier Codes:

B: Indicates a value greater than or equal to the instrument detection limit but less than the CRDL.

J: This result should be considered a quantitative estimate.

ND: This analyte was not detected

Table 4-2 (con't)

Van Der Horst Plant 1 Phase 3

Subsurface Soil Samples - As, Cr & Pb

SAMPLE NUMBER		B-20, 0'-2'	B-20, 2'-4'	B-20, 4'-6'	B-21, 0'-2'	B-21, 2'-4'	B-21, 4'-6'	B-22, 0'-2'	B-22, 2'-4'
MATRIX		Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
DATE SAMPLED		16-May-91	16-May-91	16-May-91	16-May-91	16-May-91	16-May-91	16-May-91	16-May-91
UNITS		mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
ANALYTE	**CAS Number**								
Arsenic	7440-38-2	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	7440-47-3	11.9 J	14.6 J	13.5 J	39.8 J	21.1 J	12.5 J	9.4 J	25.2 J
Lead	7439-92-1	NA	NA	NA	NA	NA	NA	NA	NA

SAMPLE NUMBER		B-22, 4'-6'	B-22, 6'-8'	B-22, 8'-10'	B-23, 0'-2'	B-23, 2'-4'	B-23, 4'-6'	B-24, 0'-2'	B-24, 2'-4'
MATRIX		Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
DATE SAMPLED		16-May-91	16-May-91	16-May-91	16-May-91	16-May-91	16-May-91	16-May-91	16-May-91
UNITS		mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
ANALYTE	**CAS Number**								
Arsenic	7440-38-2	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	7440-47-3	17 J	26.1 J	11.7	5.8 J	17.4 J	10.9 J	3860 J	97.9 J
Lead	7439-92-1	NA	NA	NA	NA	NA	NA	NA	NA

SAMPLE NUMBER		B-24, 4'-6'	B-25, 0'-2'	DUP-51	B-25, 4'-6'	B-26, 0'-1'	B-26, 1'-2'	DUP-8
MATRIX		Soil	Soil	Soil	Soil	Soil	Soil	Soil
DATE SAMPLED		16-May-91	16-May-91	16-May-91	16-May-91	24-May-91	24-May-91	24-May-91
UNITS		mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
ANALYTE	**CAS Number**							
Arsenic	7440-38-2	NA	NA	NA	NA	NA	NA	NA
Chromium	7440-47-3	41.6 J	764 J	743 J	1260 J	2120	266	450
Lead	7439-92-1	NA	NA	NA	NA	NA	NA	NA

SAMPLE NUMBER		B-27, 0'-2'	B-27, 2'-4'	B-28, 2'-4'	DUP-6	B-28, 4'-6'	B-28, 6'-8'	DUP-7
MATRIX		Soil	Soil	Soil	Soil	Soil	Soil	Soil
DATE SAMPLED		24-May-91	24-May-91	16-May-91	16-May-91	16-May-91	16-May-91	16-May-91
UNITS		mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
ANALYTE	**CAS Number**							
Arsenic	7440-38-2	NA	NA	10.3 J	7.4 J	7.6	5.4 J	7.7 J
Chromium	7440-47-3	2090	1140	97.8	101	108	45.4	44.6
Lead	7439-92-1	NA	NA	17.5 J	40.2 J	31.5	7.3 J	13 J

Qualifier Codes:
B: Indicates a value greater than or equal to the instrument detection limit but less than the CRDL.
J: This result should be considered a quantitative estimate.
ND: This analyte was not detected.
NA: This analyte was not analyzed.

Table 4-2 (con't)

Van Der Horst Plant 1 Phase 3
Subsurface Soil Samples - As, Cr & Pb

SAMPLE NUMBER		MW-15, 0-2'		MW-15, 2-4'	MW-15, 4-6'		MW-15, 6-8'		MW-15, 8-10'		MW-15,10-12'		MW-15,12-14'		MW-15,16-18'	
MATRIX		Soil		Soil	Soil		Soil		Soil		Soil		Soil		Soil	
DATE SAMPLED		10-May-91		10-May-91	10-May-91		10-May-91		10-May-91		10-May-91		10-May-91		10-May-91	
UNITS		mg/Kg		mg/Kg	mg/Kg		mg/Kg		mg/Kg		mg/Kg		mg/Kg		mg/Kg	
ANALYTE	**CAS Number**															
Arsenic	7440-38-2	13	J	11	10.6	J	9.5	J	8.6	J	23.7	J	5.8	J	6.6	J
Chromium	7440-47-3	15.7		10.3	16		17.5		14.3		19.2		13.5		8.5	
Lead	7439-92-1	46.1		39.4	25.9		24.4		19.5		20.1		27.2		19.1	

SAMPLE NUMBER		MW-15,18-20'		MW-15,25-27'		MW-16, 0-2'	MW-16, 2-4'		MW-16, 4-6'	MW-16, 6-8'	MW-16, 8-10'	MW-16,10-12'
MATRIX		Soil		Soil		Soil	Soil		Soil	Soil	Soil	Soil
DATE SAMPLED		10-May-91		10-May-91		8-May-91	8-May-91		8-May-91	8-May-91	8-May-91	8-May-91
UNITS		mg/Kg		mg/Kg		mg/Kg	mg/Kg		mg/Kg	mg/Kg	mg/Kg	mg/Kg
ANALYTE	**CAS Number**											
Arsenic	7440-38-2	5.6	J	7	J	7.9	13.3	JB	15.3	6.7	5.9	5.6
Chromium	7440-47-3	43.7		41.8		278	551		515	50.7	35.7	39.1
Lead	7439-92-1	17.1		14.3		231	160	J	254	29.3	194	32.5

SAMPLE NUMBER		MW-16,12-14'	MW-16,14-16'	MW-16,18-20'	MW-16,22-24'
MATRIX		Soil	Soil	Soil	Soil
DATE SAMPLED		8-May-91	8-May-91	8-May-91	8-May-91
UNITS		mg/Kg	mg/Kg	mg/Kg	mg/Kg
ANALYTE	**CAS Number**				
Arsenic	7440-38-2	7.1	5.2	6.3	5.2
Chromium	7440-47-3	12.1	16.5	74.7	611
Lead	7439-92-1	12.5	10.6	12	9.9

Qualifier Codes:

B; Indicates a value greater than or equal to the instrument detection limit but less than the CRDL.

J; This result should be considered a quantitative estimate.

ND: This analyte was not detected

Table 4-2 (con't)

Van Der Horst Plant 1 Phase 3
Subsurface Soil Samples - As, Cr & Pb

SAMPLE NUMBER		MW-17, 2-4'	MW-17, 4-6'	DUP-3	MW-17, 6-8'	MW-17, 8-10'	MW-17,10-12'
MATRIX		Soil	Soil	Soil	Soil	Soil	Soil
DATE SAMPLED		14-May-91	14-May-91	14-May-91	14-May-91	14-May-91	14-May-91
UNITS		mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
ANALYTE	**CAS Number**						
Arsenic	7440-38-2	10.3	6.1	8.2 J	8.4	4.7	9.3
Chromium	7440-47-3	1780	1890	1710 J	2140	3150	3280
Lead	7439-92-1	483	22.2	46.1	27.2	9.8	14

SAMPLE NUMBER		MW-17,12-14'	DUP-1	MW-17,16-18'	MW-17,18-20'	MW-17,24-26'
MATRIX		Soil	Soil	Soil	Soil	Soil
DATE SAMPLED		14-May-91	14-May-91	14-May-91	14-May-91	14-May-91
UNITS		mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
ANALYTE	**CAS Number**					
Arsenic	7440-38-2	4.9	5.2	5.5	6.5	~~22.6~~
Chromium	7440-47-3	885	857	977	1610	30500
Lead	7439-92-1	7.5	9.5	22.3	15.1 J	57.5 J

Qualifier Codes:

B: Indicates a value greater than or equal to the instrument detection limit but less than the CRDL.

J: This result should be considered a quantitative estimate.

ND: This analyte was not detected

Table 4-3

Van Der Horst Plant 1 Phase 3
Plating Well Soil

Subsurface Soil

SAMPLE NUMBER		SBPW-1,0'-1'		SBPW-1,1'-2'		SBPW-2,0'-1'		SBPW-2,1'-2'		SBPW-2,2'-3'		SBPW-3,0'-1'		SBPW-3,1'-2'	
MATRIX		Soil		Soil		Soil		Soil		Soil		Soil		Soil	
DATE SAMPLED		28-May-91		28-May-91		28-May-91		28-May-91		28-May-91		28-May-91		28-May-91	
UNITS		mg/Kg		mg/Kg		mg/Kg		mg/Kg		mg/Kg		mg/Kg		mg/Kg	
ANALYTE	**CAS Number**														
Arsenic	7440-38-2	41.1	J	24.1	J	61.5	J	66.8	J	46.4	J	73.5	J	21.6	J
Chromium	7440-47-3	2330		1700		1070		648		1430		172		63.7	
Lead	7439-92-1	984		686		456		135		90.1		725		201	

Surface Soil

SAMPLE NUMBER		SSPW-1		SSPW-2		SSPW-3		SSPW-4	
MATRIX		Soil		Soil		Soil		Soil	
DATE SAMPLED		28-May-91		28-May-91		28-May-91		28-May-91	
UNITS		mg/Kg		mg/Kg		mg/Kg		mg/Kg	
ANALYTE	**CAS Number**								
Arsenic	7440-38-2	23	J	20.7	J	10	J	21.7	J
Chromium	7440-47-3	446		369		413		7490	
Lead	7439-92-1	2520		10100		395		3870	

EPTOX LEAD FAILURE MOST LIKELY

Qualifier Codes:
B: Indicates a value greater than or equal to the instrument detection limit but less than the CRDL.
J: This result should be considered a quantitative estimate.
ND: This analyte was not detected.

Analytical results for total chromium ranged from 369 mg/Kg (SSPW-2) to 7490 mg/Kg (SSPW-4) with SSPW-1 and SSPW-3 exhibiting values of 446 mg/Kg and 413 mg/Kg, respectively. Arsenic concentrations ranged from 10 mg/Kg (SSPW-3) to 23 mg/Kg (SSPW-1) with SSPW-2 and SSPW-4 exhibiting values of 20.7 mg/Kg and 21.7 mg/Kg, respectively. Lead was detected at concentrations that ranged from 395 mg/Kg (SSPW-3) to 10,100 mg/Kg (SSPW-2), with SSPW-1 and SSPW-4 exhibiting values of 2520 mg/Kg and 3870 mg/Kg, respectively.

4.5 On-Site Subsurface Soils

A total of 80 on-site subsurface soil samples were collected during the Phase III RI (see Figure 2-6). These samples were analyzed for a variety of different parameters. The results of the analyses are shown on Tables 4-2 to 4-7.

4.5.1 Inorganics

Seventy-five of the samples were tested for total chromium, arsenic and lead. Sampling locations are illustrated in Figure 2-6. Total chromium concentration in these samples ranged from 7.8 mg/Kg in SB-10 (14'-16') to 30,500 mg/Kg in MW-17 (24'-26'). Forty-five of the seventy-five samples exhibited total chromium

Table 4-4

Van Der Horst Plant 1 Phase 3
Subsurface Soil - TAL Metals

SAMPLE NUMBER		B-28, 4'-6'		MW-15, 2-4'		MW-16, 0-2'		MW-17,16-18'	
MATRIX		Soil		Soil		Soil		Soil	
DATE SAMPLED		16-May-91		10-May-91		8-May-91		14-May-91	
UNITS		mg/Kg		mg/Kg		mg/Kg		mg/Kg	
ANALYTE	**CAS Number**								
Aluminum	7429-90-5	8670		9370		5200		4030	J
Antimony	7440-36-0	ND	J	ND	J	ND		ND	J
Arsenic	7440-38-2	7.6	J	11	J	7.9		5.5	
Barium	7440-39-3	46.4	J	43.2	B	73.6		35.7	B
Beryllium	7440-41-7	ND	J	ND		ND		ND	
Cadmium	7440-43-9	ND	J	5.9		6.8	J	7.3	
Calcium	7440-70-2	1910		2480		46300		51700	
Chromium	7440-47-3	108	J	10.3		278		977	
Cobalt	7440-48-4	ND	J	ND		4.5	B	ND	
Copper	7440-50-8	28.5	J	16.8		38.5		33.5	
Iron	7439-89-6	17100		13200		14300		12600	
Lead	7439-92-1	31.5	J	39.4		231	J	9.8	
Magnesium	7439-95-4	2250		1690		5470		6150	
Manganese	7439-96-5	743		483		469		521	J
Mercury	7439-97-6	ND		ND		ND		ND	
Nickel	7440-02-0	24.1	J	17.2		24.6		16.9	J
Potassium	7440-09-7	1170		586	B	381	B	566	B
Selenium	7782-49-2	R		R		ND	J	R	
Silver	7440-22-4	ND	J	ND		3		1.8	B
Sodium	7440-23-5	342		92.6	B	119	B	435	B
Thallium	7440-28-0	ND	J	ND		ND	J	ND	
Vanadium	7440-62-2	16.9	J	11.7		9.7	B	8.2	B
Zinc	7440-66-6	90.2	J	49.8		65		54.3	J

Qualifier Codes:
B: Indicates a value greater than or equal to the instrument detection limit but less than the CRDL.
J: This result should be considered a quantitative estimate.
ND: This analyte was not detected.
R: Analytical result was rejected

Table 4-5

Van Der Horst Plant 1 Phase 3
Subsurface Soil - TCLP Metals

SAMPLE NUMBER		SB-10, 4'-6'	SB-11,16-18'	SB-14,10-12'	SB-17, 2'-4'	MW-17, 6-8'	B-28, 2'-4'	DUP-6	MW-15, 4-6'	MW-16, 6-8'
MATRIX		Water	Water	Water	Water	Water	Water	Water	Water	Water
DATE SAMPLED		7-May-91	10-May-91	13-May-91	7-May-91	14-May-91	16-May-91	16-May-91	9-May-91	7-May-91
UNITS		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
ANALYTE	**EPA LIMITS FOR TCLP ANALYSIS (µg/L)**									
Aresenic	5000	ND	ND J	ND	ND	ND	ND J	ND J	ND J	ND
Barium	100000	410	303	290	450	32	316 J	326 J	818	227
Cadmium	1000	ND	ND	ND	10	15	ND	ND	ND	ND
Chromium	5000	ND	83.3	17	730	3800	2140 J	1760 J	17.6	44
Lead	5000	ND	ND	2400	450	ND	ND	ND	ND	ND
Mercury	200	ND	ND	0.3	ND	ND	ND	0.48	ND	ND
Selenium	1000	ND	ND J	ND	ND	ND	R	R	R	ND
Silver	5000	ND	ND	11	ND	ND	ND J	ND J	ND	ND

Qualifier Codes:
- B: Indicates a value greater than or equal to the instrument detection limit but less than the CRDL.
- J: This result should be considered a quantitative estimate.
- ND: This analyte was not detected.
- ▨: This concentration exceeds EPA TCLP limits.
- R Analytical result was rejected

Table 4-6

Van Der Horst Plant 1 Phase 3
Subsurface Soil - PCBs

SAMPLE NUMBER		SB-17, 4'-6'	SB-17, 6'-8'	SB-17, 8-10'
MATRIX		Soil	Soil	Soil
DATE SAMPLED		8-May-91	8-May-91	8-May-91
UNITS		µg/Kg	µg/Kg	µg/Kg
ANALYTE	**CAS Number**			
Aroclor 1016	12674-11-2	ND	ND	ND
Aroclor 1221	11104-28-2	ND	ND	ND
Aroclor 1232	11141-16-5	ND	ND	ND
Aroclor 1242	53469-21-9	ND	ND	ND
Aroclor 1248	12672-29-6	ND	ND	ND
Aroclor 1254	11097-69-1	ND	ND	ND
Aroclor 1260	11096-82-5	ND	ND	ND

QUALIFIER CODES

B: This result is qualitatively invalid because the compound was also detected in a blank at a similar concentration

J: This result should be considered a quantitative estimate.

NA: This parameter not analyzed for this sample.

ND: This parameter was not detected.

Table 4-7

Van Der Horst Plant 1 Phase 3
Subsurface Soil - TCL Volatiles

SAMPLE NUMBER		SB-10, 2'-4'	SB-10, 4'-6'	SB-10, 6'-8'	SB-11,18-20'	SB-13,14-16'	SB-13,18-20'	SB-14,18-20'
MATRIX		Soil	Soil	Soil	Soil	Soil	Soil	Soil
DATE SAMPLED		7-May-91	7-May-91	7-May-91	10-May-91	8-May-91	8-May-91	13-May-91
UNITS		µg/Kg	µg/Kg	µg/Kg	µg/Kg	µg/Kg	µg/L	µg/Kg
COMPOUND	**CAS Number**							
methylene chloride	75-09-2	ND	ND	ND	ND	ND	ND	ND
acetone	67-64-1	ND	ND	ND	ND	ND	8 BJ	ND
1,1,1-trichloroethane	71-55-6	ND	ND	ND	18 J	ND	ND	ND
trichloroethene	79-01-6	38	8	2 J	23 J	ND	0.6 J	ND
tetrachloroethene	127-18-4	23	7	0.7 J	12 J	ND	2 J	5 J
toluene	108-88-3	ND	ND	ND	6 J	ND	ND	ND

SAMPLE NUMBER		SB-17, 2'-4'	SB-17, 4'-6'	SB-17, 6'-8'	B-28, 6"-2'	DUP-5	MW-15,18-20'	MW-16,22-24'	MW-17, 0-2'
MATRIX		Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
DATE SAMPLED		7-May-91	7-May-91	7-May-91	16-May-91	16-May-91	9-May-91	7-May-91	14-May-91
UNITS		µg/Kg	µg/Kg	µg/Kg	µg/Kg	µg/Kg	µg/Kg	µg/Kg	µg/Kg
COMPOUND	**CAS Number**								
methylene chloride	75-09-2	ND	ND	ND	ND	ND	3 BJ	ND	ND
acetone	67-64-1	ND	ND	ND	ND	ND	ND	67 JB	ND
1,2-Dichloroethene(total)	540-59-0	1 J	ND	ND	ND	ND	ND	ND J	ND
1,1,1-trichloroethane	71-55-6	ND	ND	ND	6	8	4 J	ND J	ND
trichloroethene	79-01-6	22	4 J	8	43	45	ND	ND J	17
benzene	71-43-2	ND	ND	ND	ND	ND	ND	2 J	ND
tetrachloroethene	127-18-4	26	5 J	25	ND	ND	ND	ND J	43
toluene	108-88-3	0.3 J	ND	ND	ND	ND	ND	ND J	ND

Qualifier Codes:

B: This result is qualitatively invalid because the analyte was also detected in a blank at a similar concentration.

J: This result should be considered a quantitative estimate.

ND: This compound was not detected.

concentrations greater than 50 mg/Kg. Arsenic levels ranged from 4 mg/Kg in SB-10 (16'-18') to 45.9 mg/Kg in SB-15 (3'-5'). The concentration of lead in these samples varied from 7.3 mg/Kg in B-28 (6'-8') to 1910 mg/Kg in SB-15 (3'-5').

Four of the on-site subsurface soil samples were also analyzed for TAL Metals. The results of these analyses are presented on Table 4-5.

Ten of the on-site subsurface soil samples were analyzed for TCLP Metals. Barium was detected in nine of the ten samples at levels that ranged from 32 ug/L in MW-17 (6'-8') to 818 ug/L in MW-15 (4'-6'). Cadmium was detected in two of the ten samples, SB-17 (2'-4') at 10 ug/L and MW-17 (6'-8') at 15 ug/L. Chromium was detected in eight of the ten samples with levels that ranged from 17 ug/L in SB-14 (10'-12') to 3800 ug/L in MW-17 (6'-8'). Lead was found in two of the ten samples, SB-14 (10'-12') at 2400 ug/L and SB-17 (2'-4') at 450 ug/L. Mercury was detected in one sample, SB-14 (10'-12') at 0.3 ug/L. Silver was also detected in SB-14 (10'-12') at 11 ug/L.

4.5.2 PCBs

Three on-site subsurface soil samples, SB-17 (4'-6'), (6'-8') and (8'-10'), were analyzed for PCBs. Although each sample was analyzed for seven types of Aroclor, no PCBs were detected. The results of these analyses are presented on Table 4-6.

4.5.3 Volatile Organics

Fourteen on-site subsurface soil samples were analyzed for TCL Volatile Organics. Methylene chloride was detected in all samples, at levels which ranged from 0.8 ug/Kg in SB-13 (14'-16') to 20 ug/Kg in SB-10 (2'-4'). Acetone was also detected in all samples, but the results were considered to be qualitatively invalid since it was also detected in a blank at similar concentrations. 1,2-Dichloroethene was found in one sample, SB-17 (2'-4') at 1 ug/Kg. 1,1,1-trichloroethane was measured in 4 samples, at levels that ranged from 4 ug/Kg in MW-15 (18'-20') to 18 ug/Kg in SB-11 (18'-20'). Trichloroethene was detected in 11 samples, with levels that varied between 0.6 ug/Kg in SB-13 (18'-20') to 43 ug/Kg in B-28 (0'-2'). Benzene was detected in one sample, MW-16 (22'-24') at a level of 2 ug/Kg.

Tetrachloroethene was found in 11 samples at concentrations that ranged between 0.7 ug/Kg in SB-10 (6'-8') to 43 ug/Kg in MW-17 (0'-2'). Toluene was detected in 2 samples, SB-11 (18'-20') at 6 ug/Kg and SB-17 (2'-4') at 0.3 ug/Kg. Results of the volatiles analyses are presented on Table 4-7.

4.6 Building Interior Samples

4.6.1 Wipe Samples

Table 4-8 includes a summary of the analytical results for the twelve (12) wipe samples obtained from the interior of the plant building (see Figure 2-1). These samples were analyzed for total chromium, arsenic and lead. Arsenic was detected in three of the samples, exhibiting levels that ranged from 5 ug/Kg in W-9 to 69 ug/Kg in W-12. Chromium was found in all samples at levels between 226 ug/Kg in W-5 to 352,000 ug/Kg in W-3. Lead was also detected in all samples, at concentrations that varied from 55 ug/Kg in W-5 to 14,000 ug/Kg in W-12.

Table 4-8

Van Der Horst Plant 1 Phase 3
Wipe Samples

SAMPLE NUMBER		W-1	W-2	W-3	W-4	W-5	W-6
MATRIX		Wipe	Wipe	Wipe	Wipe	Wipe	Wipe
DATE SAMPLED		29-May-91	29-May-91	29-May-91	29-May-91	29-May-91	29-May-91
UNITS		µg/L/wipe	µg/L/wipe	µg/L/wipe	µg/L/wipe	µg/L/wipe	µg/L/wipe
ANALYTE	**CAS Number**						
Arsenic	7440-38-2	ND J	ND J	ND J	ND J	ND J	ND J
Chromium	7440-47-3	14400	45900	352000	175000	226	2390
Lead	7439-92-1	240	1300	2000	3800	55 J	450

SAMPLE NUMBER		W-7	W-8	W-9	W-10	W-12	W-13
MATRIX		Wipe	Wipe	Wipe	Wipe	Wipe	Wipe
DATE SAMPLED		29-May-91	29-May-91	29-May-91	29-May-91	29-May-91	29-May-91
UNITS		µg/L/wipe	µg/L/wipe	µg/L/wipe	µg/L/wipe	µg/L/wipe	µg/L/wipe
ANALYTE	**CAS Number**						
Arsenic	7440-38-2	ND J	ND J	5 JB	ND J	69 J	60 J
Chromium	7440-47-3	2320	473	46300	694	2700	2880
Lead	7439-92-1	3200	360	1300	470	14000	10400

Qualifier Codes:

B: This result is qualitatively invalid because the analyte was also detected in a blank at a similar concentration.

J: This result should be considered a quantitative estimate.

ND: This analyte was not detected.

4.6.2 Scrape Samples

Sixteen scrape samples, designated SCS-1 through SCS-16, were collected from various locations through the plant building (see Figure 2-1). These samples were obtained to assess the extent of contamination throughout the building interior and roof. All samples were analyzed for total chromium, arsenic and lead. The results of the analyses are presented on Table 4-9.

Arsenic, chromium and lead were detected in all of the scrape samples. Arsenic concentrations ranged from 11.7 mg/Kg in SCS-3 to 94 mg/Kg in SCS-16. Chromium levels varied between 1100 mg/Kg in SCS-16 to 144,000 mg/Kg in SCS-4. Lead concentrations ranged between 574 mg/Kg in SCS-14 to 280,000 mg/Kg in SCS-16.

Location
not shown
Fig. 16

Two samples of wood building material were also obtained during the collection of the scrape samples. These samples are designated C-1 and C-2 and were analyzed for total chromium, arsenic, and lead. The results of the analyses for these samples is also presented on Table 4-9.

Table 4-9

Van Der Horst Plant 1 Phase 3
Scrape and Core Samples

SAMPLE NUMBER		SCS-1	SCS-2	SCS-3	SCS-4	SCS-5	SCS-6
MATRIX		Soil	Soil	Soil	Soil	Soil	Soil
DATE SAMPLED		29-May-91	29-May-91	29-May-91	29-May-91	29-May-91	29-May-91
UNITS		mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
ANALYTE	**CAS Number**						
Arsenic	7440-38-2	30.3 J	25 J	11.7 J	15.2 J	23 J	28.7 J
Chromium	7440-47-3	4850	10300	8780	144000	7700	11900
Lead	7439-92-1	11800	131000	9940	1100	1580	10400

SAMPLE NUMBER		SCS-7	SCS-8	SCS-9	SCS-10	SCS-11	SCS-12
MATRIX		Soil	Soil	Soil	Soil	Soil	Soil
DATE SAMPLED		29-May-91	29-May-91	29-May-91	29-May-91	29-May-91	29-May-91
UNITS		mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
ANALYTE	**CAS Number**						
Arsenic	7440-38-2	12.9 J	17.8 J	13.3 J	18.6 J	30 J	24.4 J
Chromium	7440-47-3	11400	19100	4750	14200	80000	6400
Lead	7439-92-1	8770	11600	19900	19900	8810	10300

SAMPLE NUMBER		SCS-13	SCS-14	SCS-15	SCS-16	DUP- 9
MATRIX		Soil	Soil	Soil	Soil	Soil
DATE SAMPLED		29-May-91	29-May-91	29-May-91	29-May-91	29-May-91
UNITS		mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
ANALYTE	**CAS Number**					
Arsenic	7440-38-2	35.7 J	13.5 J	32.3 J	94 J	80.4 J
Chromium	7440-47-3	8160	17100	8320	1100	5950
Lead	7439-92-1	16800	574	8210	280000	224000

SAMPLE NUMBER		C-1	C-2
MATRIX		Soil	Soil
DATE SAMPLED		29-May-91	29-May-91
UNITS		mg/Kg	mg/Kg
ANALYTE	**CAS Number**		
Arsenic	7440-38-2	ND J	529 J
Chromium	7440-47-3	204 J	25.3
Lead	7439-92-1	5780	75.8

Qualifier Codes:

B: This result is qualitatively invalid because the analyte was also detected in a blank at a similar concentration.

J: This result should be considered a quantitative estimate.

ND: This analyte was not detected.

4.6.3 Asbestos Samples

Twenty-two (22) samples, suspected of containing asbestos, were collected from various areas inside the plant building. These samples were obtained to assess the amount of asbestos containing materials in the building and to estimate costs for removal, if necessary.

Eighteen of the twenty-two samples collected exhibited the presence of asbestos when analyzed under polarized light microscopy. Chrysotile was the only form of asbestos detected, and ranged in concentration from 5% in AS-17 to 87% in AS-5. The results of the microscopy analysis for all asbestos containing samples are presented on Table 4-10.

4.7 Ground Water Samples

Table 4-11 presents the analytical results for the ground water samples tested during the Phase III RI study. Samples from the four newly installed ground water monitoring wells were tested for TAL Metals, hexavalent chromium and TCL volatile organics. Well locations are presented in Figure 2-8.

TABLE 4-10

Van Der Horst Plant 1 Phase 3
Results of Sample Analysis for Asbestos

	ASBESTOS	NONASBESTOS				
Sample No.	Chrysotile	Cellulose	Mineral Wood	Fibrous Glass	Other Fibers	Nonfibrous Material
AS-1	75	2				23
AS-2	40	10				50
AS-3	18	5	20	30	25	2
AS-4	87	3				10
AS-5	73	15				12
AS-6	20	5	30	40		5
AS-7	18	5	20	50		7
AS-8	23	3	20	30	18	6
AS-9	47	3	10	20		20
AS-10	55	2	3	10		30
AS-11	25	3	15	35	15	7
AS-12	23	2	12	25	10	28
AS-13		3				97
AS-14	70	5				25
AS-15	25	10	13	35	10	7
AS-16	50	<1				49
AS-17	5	2				98
AS-18	46	2			5	47
AS-19	70	<1				29
AS-20		<1				99

NOTE: Results were generated through the use of polarized light microscopy and analyzed in accordance with the EPA Interim Method, 40 CFR Pt 763 Subpart F, App A (7-1-87).

Table 4-11

Van Der Horst Plant 1 Phase 3
Ground Water

TAL Metals:

SAMPLE NUMBER		MW-15-W	DUP-10	MW-16-W	MW-17-W	MW-19D
MATRIX		Water	Water	Water	Water	Water
DATE SAMPLED		7-Jun-91	7-Jun-91	7-Jun-91	7-Jun-91	7-Jun-91
UNITS		µg/L	µg/L	µg/L	µg/L	µg/L
ANALYTE	**NYSDEC GROUND WATER QUALITY STANDARDS (µg/L)**					
Aluminum	---	44600	10100	9640	19000	21600
Antimony	3	ND	ND	ND	45 B	ND
Arsenic	25	74	14	27	8 B	25
Barium	1000	610	443	229	730	565
Beryllium	3	ND	ND	ND	ND	ND
Cadmium	10	ND J	ND J	ND J	187 J	ND J
Calcium	---	347000	231000	127000	364000	157000
Chromium	50	846	198	4070	284000	851
Cobalt	---	45.1 B	ND	ND	51.3	28.8 B
Copper	200	261	61.5	75.9	4250	113
Iron	300	80200 J	19600 J	21400 J	83300 J	43600 J
Lead	25	214	50.3	93.3	145	206
Magnesium	35000	108000	36900	30500	59600	25400
Manganese	300	6800	4110	1310	4070	5090
Mercury	2	ND	0.5	ND	29.3	0.6
Nickel	---	625 J	165 J	64.8 J	143 J	112 J
Potassium	---	12400	5340	4030 B	5240	7240
Selenium	20	R	R	R	R	R
Silver	50	7 B	12	ND	28	ND
Sodium	---	27300	26700	16200	48100	32900
Thallium	4	ND	ND	ND	ND	ND
Vanadium	---	65.7	ND	ND	101	ND
Zinc	300	580 J	162 J	177 J	518 J	293 J
Hexavalent Chromium	50	17	104	18	167000	56

QUALIFIER CODES

B: Indicates a value greater than or equal to the instrument detection limit but less than the CRDL.
J: This result should be considered a quantitative estimate.
NA: This parameter not analyzed for this sample.
ND: This parameter was not detected.
▨ This result exceeds NYSDEC ground water quality standards.

TCL Volatiles:

SAMPLE NUMBER		MW-15-W	DUP-10	MW-16-W	MW-17-W	MW-19D
MATRIX		Water	Water	Water	Water	Water
DATE SAMPLED		7-Jun-91	7-Jun-91	7-Jun-91	7-Jun-91	7-Jun-91
UNITS		µg/L	µg/L	µg/L	µg/L	µg/L
ANALYTE	**NYSDEC GROUND WATER QUALITY STANDARDS (µg/L)**					
vinyl chloride	2	ND J	ND J	ND J	ND J	ND J
acetone	50	ND J	ND J	2 J	6 J	8 J
carbon disulfide	50	ND J	ND J	ND J	ND J	ND J
1,2-Dichloroethene(total)	5	ND J	ND J	15 J	1 J	ND J
chloroform	100	ND J	ND J	0.3 J	0.4 J	ND J
bromodichloromethane	50	ND J	ND J	ND J	ND J	ND J
trichloroethene	5	ND J	ND J	12 J	0.1 J	ND J
tetrachloroethene	0.7	ND J	ND J	0.8 J	0.3 J	ND J
toluene	5	ND J	ND J	ND J	0.1 J	ND J
total xylenes	5	ND J	ND J	ND J	2 J	ND J

QUALIFIER CODES

B: This result is qualitatively invalid because the compound was also detected in a blank at a similar concentration.
J: This result should be considered a quantitative estimate.
NA: This parameter not analyzed for this sample.
ND: This parameter was not detected.
▨ This result exceeds NYSDEC ground water quality standards.

4.7.1 Organics

TCL volatile organics detected in the ground water samples include acetone, tetrachloroethene, toluene, total xylenes, TCE, 1,2-dichloroethene (total) and chloroform. Acetone was detected in three wells, at concentrations that ranged from 2 ug/L in MW-16 to 8 ug/L in MW-19D. Total Xylenes were detected in one well, MW-17 at a level of 2 ug/L. TCE was found in two wells, MW-16 at a concentration of 12 ug/L and in MW-17 at 0.1 ug/L. 1,2-dichloroethene (total) was detected in MW-16 at a concentration of 15 ug/L and in MW-17 at 1 ug/L. Chloroform was found at a concentration of 0.3 ug/L in MW-16 and 0.4 ug/L in MW-17. Tetrachloroethene was detected in MW-16 and MW-17 at levels of 0.8 ug/L and 0.3 ug/L, respectively.

4.7.2 Inorganics

Inorganics were detected in all ground water samples collected. Those inorganics measured at concentrations exceeding NYSDEC Class "GA" drinking water standards include: 1) arsenic, detected in MW-15 (74 ug/L) and MW-16 (27 ug/L); 2) cadmium, detected in MW-17 (187 ug/L); 3) chromium, found in all wells, concentrations ranged from 848 ug/L in MW-15 to 264,000 ug/L in MW-17; 4) copper, detected in MW-15 (261 ug/L) and MW-17 (4250 ug/L); 5) iron, measured in all 4 wells at concentrations between 21,400 ug/L (MW-16) and 93,300 ug/L (MW-17); 6) manganese, detected in all 4 wells at concentrations that ranged from 1310 ug/L (MW-16) to 6,900 ug/L (MW-15); 7) lead, found in all four wells with levels that ranged from 93.3 ug/L in MW-16 to 214 ug/L in MW-15; 8) magnesium, measured in two wells, MW-15 (108,000 ug/L) and MW-17 (59,600 ug/L); and 9) hexavalent chromium, detected in MW-19D (56 ug/L), and MW-17 (167,000 ug/L).

4.8 Plating Well Water Samples

Water samples were also obtained from six former plating wells located in a courtyard surrounded by the plant buildings (see Figure 2-2). These wells were used by Van-Der Horst as part of the process of plating cannon barrels for Navy ships. Samples were collected to determine whether these wells may have contributed to the ground water contamination at the site. The samples were analyzed for total chromium, arsenic and lead. Analytical results are presented on Table 4-12, with the samples designated as Plating Well A through Plating Well F.

Table 4-12

Van Der Horst Plant 1 Phase 3
Plating Well Water

SAMPLE NUMBER		PLATING WELL A	PLATING WELL B	PLATING WELL C	PLATING WELL D	PLATING WELL E	PLATING WELL F
MATRIX		Water	Water	Water	Water	Water	Water
DATE SAMPLED		16-May-91	16-May-91	16-May-91	16-May-91	16-May-91	16-May-91
UNITS		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
ANALYTE	**CAS Number**						
Arsenic	7440-38-2	ND J	ND J	ND J	ND J	ND J	ND J
Chromium	7440-47-3	700000	22900	54 J	610	25	57
Lead	7439-92-1	147 J	211 J	70.9 J	21.6 J	47 J	86 J

Qualifier Codes:

B: Indicates a value greater than or equal to the instrument detection limit but less than the CRDL.

J: This result should be considered a quantitative estimate.

ND: This analyte was not detected.

Chromium and lead were detected in all six wells. Chromium levels ranged from 25 ug/L in Tank E to 700,000 ug/L in Tank A. Lead concentrations varied between 21.6 ug/L in Tank D to 211 ug/L in Tank B. Arsenic was not detected in any of the plating wells.

4.9 QA/QC Samples

QA/QC field samples were used to assess the quality of the analytical data by identifying and quantifying any external sources of contamination to which the samples may have been exposed. The types of field QA/QC samples analyzed are described below.

4.9.1 Trip Blanks

Trip blanks consist of laboratory grade water that is taken to the field in sealed volatile organics vials. The vials remain sealed and are returned to the laboratory with a sample shipment. Analysis of trip blanks identifies any sources of contamination resulting from preparation and transport of the sample bottles. The results of the trip blank analysis is presented on Table 4-13.

Table 4-13

Van Der Horst Plant 1 Phase 3
Trip Blanks

SAMPLE NUMBER		TB-3	TB-5		TB-6	
MATRIX		Water	Water		Water	
DATE SAMPLED		16-May-91	7-Jun-91		12-Jun-91	
UNITS		µg/L	µg/L		µg/L	
COMPOUND	**CAS Number**					
chloromethane	74-87-3	ND	ND	J	ND	
bromomethane	74-83-9	ND	ND	J	ND	
vinyl chloride	75-01-4	ND	ND	J	ND	
chloroethane	75-00-3	ND	ND	J	ND	
methylene chloride	75-09-2	ND	1	J	1	J
acetone	67-64-1	ND	ND	J	ND	
carbon disulfide	75-15-0	ND	ND	J	ND	
1,1-Dichloroethene	75-35-4	ND	ND	J	ND	
1,1-Dichloroethane	75-34-3	ND	ND	J	ND	
1,2-Dichloroethene(total)	540-59-0	ND	ND	J	ND	
chloroform	67-66-3	ND	ND	J	ND	
1,2-Dichloroethane	107-06-2	ND	ND	J	ND	
2-Butanone	78-93-3	ND	ND	J	ND	
1,1,1-trichloroethane	71-55-6	ND	ND	J	ND	
carbon tetrachloride	56-23-5	ND	ND	J	ND	
vinyl acetate	108-05-4	ND	ND	J	ND	
bromodichloromethane	75-27-4	ND	ND	J	ND	
1,2-dichloropropane	78-87-5	ND	ND	J	ND	
cis-1,3-Dichloropropene	10061-01-5	ND	ND	J	ND	
trichloroethene	79-01-6	ND	ND	J	ND	
dibromochloromethane	124-48-1	ND	ND	J	ND	
1,1,2-Trichloroethane	79-00-5	ND	ND	J	ND	
benzene	71-43-2	ND	ND	J	ND	
trans-1,3-Dichloropropene	10061-02-6	ND	ND	J	ND	
bromoform	75-25-2	ND	ND	J	ND	
4-Methyl-2-Pentanone	108-10-1	ND	ND	J	ND	
2-Hexanone	591-78-6	ND	ND	J	ND	
tetrachloroethene	127-18-4	ND	ND	J	ND	
1,1,2,2-Tetrachloroethane	79-34-5	ND	ND	J	ND	
toluene	108-88-3	ND	ND	J	ND	
chlorobenzene	108-90-7	ND	ND	J	ND	
ethylbenzene	100-41-4	ND	ND	J	ND	
styrene	100-42-5	ND	ND	J	ND	
total xylenes	1330-20-7	ND	ND	J	ND	

Qualifier Codes:
B: This result is qualitatively invalid because the compound was also detected in a blank at a similar concentration.
J: This result should be considered a quantitative estimate.
ND: This compound was not detected.
NA: This analyte was not analyzed.

SAMPLE NUMBER		TB-4	
MATRIX		Water	
DATE SAMPLED		29-May-91	
UNITS		µg/L	
ANALYTE	**CAS Number**		
Arsenic	7440-38-2	NA	
Chromium	7440-47-3	6	B
Lead	7439-92-1	12	

Qualifier Codes:
B: Indicates a value greater than or equal to the instrument detection limit but less than the CRDL.
J: This result should be considered a quantitative estimate.
ND: This analyte was not detected
NA: This analyte was not analyzed.

4.9.2 Field Blanks

Field blanks consist of laboratory grade water that is taken to the field and contacts sampling equipment. This is done to identify if there is any possibility that contamination found in the samples is the result of sampling or decontamination procedures. Field blanks were analyzed for the same parameters as the samples collected on that day. The results of the analysis for the field blanks is presented on Table 4-14.

Table 4-14

Van Der Horst Plant 1 Phase 3
Field Blanks

SAMPLE NUMBER		FB-1	FB-3	FB-8
MATRIX		Water	Water	Water
DATE SAMPLED		8-May-91	16-May-91	7-Jun-91
UNITS		µg/L	µg/L	µg/L
COMPOUND	**CAS Number**			
toluene		ND	1 J	ND J
vinyl chloride	75-01-4	ND	ND	ND J
acetone	67-64-1	ND	ND	6 J
carbon disulfide	75-15-0	ND	99	ND J
1,2-Dichloroethene(total)	540-59-0	ND	ND	ND J
1,2-Dichloropropane	78-87-5	ND	1 J	1 J
chloroform	67-66-3	ND	ND	ND J
bromodichloromethane	75-27-4	ND	ND	ND J
trichloroethene	79-01-6	ND	ND	ND J
tetrachloroethene	127-18-4	ND	ND	ND J
chlorobenzene	108-90-7	35	32	27 J
total xylenes	1330-20-7	ND	0.5 J	ND J

Qualifier Codes:

B. This result is qualitatively invalid because the compound was also detected in a blank at a similar concentration.

J: This result should be considered a quantitative estimate.

ND: This compound was not detected.

▨: This result exceeds the NYSDEC ground water quality standards.

SAMPLE NUMBER		FB-1	FB-2	FB-3	FB-4	FB-5	FB-6	FB-7	FB-8	FB-50
MATRIX		Water	Water	Water	Water	Water	Water	Water	Water	Water
DATE SAMPLED		8-May-91	14-May-91	16-May-91	23-May-91	23-May-91	28-May-91	28-May-91	7-Jun-91	15-May-91
UNITS		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
ANALYTE	**CAS Number**									
Aluminum	7429-90-5	ND	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	7440-36-0	ND J	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	7440-38-2	ND J	ND	ND J	NA	NA	ND J	ND J	NA	NA
Barium	7440-39-3	ND	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	7440-41-7	ND	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	7440-43-9	ND	NA	NA	NA	NA	NA	NA	NA J	NA
Calcium	7440-70-2	234 B	NA	NA	NA	NA	NA	NA	417 B	NA
Chromium	7440-47-3	ND	6 B	100	ND	ND	5 B	ND	20.4	ND
Cobalt	7440-48-4	ND	NA	NA	NA	NA	NA	NA	NA	NA
Copper	7440-50-8	ND	NA	NA	NA	NA	NA	NA	NA	NA
Iron	7439-89-6	118	NA	NA	NA	NA	NA	NA	31.8 JB	NA
Lead	7439-92-1	ND	11	45 J	NA	NA	3.2	5	3	NA
Magnesium	7439-95-4	ND	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	7439-96-5	ND	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	7439-97-6	ND	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	7440-02-0	ND	NA	NA	NA	NA	NA	NA	ND J	NA
Potassium	7440-09-7	ND	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	7782-49-2	R	NA	NA	NA	NA	NA	NA	R	NA
Silver	7440-22-4	ND	NA	NA	NA	NA	NA	NA	NA	NA
Sodium	7440-23-5	643 B	NA	NA	NA	NA	NA	NA	862 B	NA
Thallium	7440-28-0	ND	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	7440-62-2	ND	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	7440-66-6	10.3 B	NA	NA	NA	NA	NA	NA	19.3 JB	NA
Hexavalent Cr		NA	NA	NA	NA	NA	NA	NA	12	NA

Qualifier Codes:

B: Indicates a value greater than or equal to the instrument detection limit but less than the CRDL.

J: This result should be considered a quantitative estimate.

ND: This analyte was not detected.

NA: This analyte was not analyzed.

R: This analytical value was rejected

Figure 4-14 (con't)

Van Der Horst Plant 1 Phase 3
TCLP Field Blanks

SAMPLE NUMBER		**FB-3**	
MATRIX		Water	
DATE SAMPLED		16-May-91	
UNITS		µg/L	
ANALYTE	**EPA LIMITS FOR TCLP ANALYSIS (µg/L)**		
Aresenic	5000	ND	J
Barium	100000	ND	
Cadmium	1000	ND	
Chromium	5000	67	J
Copper	___	ND	
Lead	5000	69.2	
Mercury	200	ND	
Nickel	___	ND	
Selenium	1000	R	
Silver	5000	ND	J

Qualifier Codes:

B: Indicates a value greater than or equal to the ins
detection limit but less the the CRDL.

J: This result should be considered a quantitative e

ND: This analyte was not detected.

▨: This concentration exceeds EPA TCLP limits.

R: Analytical result was rejected

5.0 PUBLIC HEALTH AND ENVIRONMENTAL RISK ASSESSMENT

A baseline public health and environmental risk assessment was prepared and submitted as part of the Phase I RI report. Following the Phase II RI, analytical data were reviewed to assess whether changes or additions to the baseline risk assessment were necessary (ERM, 1991). In this section, analytical data from the Phase III RI are similarly reviewed (Section 5.1). Based on the results of the baseline risk assessment and the evaluation of Phase II and Phase III data, a final risk assessment for the site was prepared. Section 5.2 summarizes the final risk assessment. Using the results of this risk assessment, cleanup levels for those chemicals and media at the site which present unacceptable risks to human health and the environment were derived (Section 5.3).

5.1 Evaluation of Phase III Data

The purpose of the Phase III RI was to collect additional field data required to complete the delineation of contamination at the site and to provide information necessary for the feasibility study. As described in the preceding sections, the Phase III RI involved additional sampling of plating well water, building surfaces, surface and subsurface soils, and ground water. In this section, the additional data are reviewed in terms of the previously conducted risk assessment to assess whether of the conclusions presented in earlier submittals are valid or require further evaluation. A summary of the conclusions of the Phase I and Phase II risk assessments is provided in Table 5-1.

5.1.1 Review of Phase III Soil Data

In the Phase III RI, surface and subsurface soil samples were collected from the site and from the area immediately to the southwest of the site outside of the fenced area. As described in the preceding sections, most of these samples were analyzed for arsenic, chromium, and lead. Four samples were analyzed for full TAL metals and a number of off-site samples were analyzed for volatile organics. Potential exposure routes for analytes in soil identified and evaluated in the previously submitted baseline risk assessment include: (1) inhalation of volatilized organics from the soil; (2) inhalation of fugitive dust emissions; and (3) direct contact with soil. Each of these exposure routes is reevaluated below, taking into account the Phase III RI data.

TABLE 5-1

SUMMARY OF CHEMICALS FOR WHICH PROJECTED INTAKES EXCEED ACCEPTABLE INTAKES BASED ON PHASE I AND PHASE II DATA

	Noncarcinogenic Effects	Carcinogenic Effects
Current Conditions	• No adverse effects	• Chromium in fugitive dust emissions • Arsenic in residential soils (incidental ingestion by children)
Future Conditions	• Chromium in ground water • Lead in ground water	• Chromium in fugitive dust emissions • Arsenic in residential soils (incidental ingestion by children) • Tetrachloroethene in ground water

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5.1.1.1 Inhalation of Volatilized Organics

In the baseline risk assessment, two chemicals of concern were identified for exposures via inhalation of volatilized organics from site soils: trichloroethene and tetrachloroethene. Volatilization was assumed to occur in all areas of the plant which are not covered by pavement. The concentrations detected in soil in the baseline risk assessment did not result in unacceptable risks to human health via inhalation.

In the Phase III RI, the maximum concentration of trichloroethene detected in unpaved areas of the site was less than the concentration used to evaluate risk in the baseline risk assessment. Therefore, trichloroethene is not expected to pose an unacceptable risks to human health. The maximum concentration of tetrachloroethene detected in unpaved areas of the site in the Phase III RI was approximately four times higher than the concentration used to evaluate risk in the baseline risk assessment (26 ug/kg vs. 6 ug/kg). The risk associated with inhalation of tetrachloroethene as calculated in the baseline risk assessment was more than 4 orders of magnitude lower than the acceptable risk (1×10^{-6}). Therefore the marginally higher concentrations of tetrachloroethene detected in the Phase III RI are not expected to result in any unacceptable risks.

5.1.1.2 Fugitive Dust Emissions

Fugitive dust emissions from contaminated surface soils in unpaved areas of the site were quantitatively evaluated for each of the chemicals of concern in the baseline risk assessment (arsenic, barium, cadmium, chromium, lead, cyanide, PCBs, and 8 PAHs). Of these chemicals, only chromium resulted in unacceptable risks to human health. In the Phase III RI, a number of surface and near-surface soil samples (0-2 ft) were analyzed for arsenic, chromium, and lead. In addition, one near-surface sample was analyzed for full TAL metals.

The average concentrations of the chemicals of concern detected in surface and near-surface soils in the Phase III RI were, in all cases, less than the average site-wide concentrations used to evaluate fugitive dust emissions in the baseline risk assessment. Since that evaluation identified only chromium as posing an unacceptable risk, concentrations of inorganics other than chromium in site soil are not expected to pose any unacceptable risks to human health via fugitive dust emissions.

5.1.1.3 Direct Contact

In the baseline risk assessment, incidental soil ingestion resulting from direct contact with on- and off-site soils was quantitatively evaluated. For on-site soils, hypothetical future short-term construction workers were assumed to be the exposed population of concern. For off-site soils, nearby residents were assumed to be the exposed population of concern.

In the baseline risk assessment, incidental ingestion resulting from direct contact with on-site soils by hypothetical future short-term construction workers did not result in any unacceptable risks. As is the case with fugitive dust emissions, this evaluation was based on chemical concentrations in the top two feet of soil. As described in Section 5.1.1.2, the average concentrations of the chemicals of concern in surface and near-surface soils in the Phase III RI were, in all cases, less than the average site-wide concentrations used to evaluate incidental ingestion by construction workers in the baseline risk assessment. Therefore, incidental ingestion of soils by future construction workers is not expected to pose an unacceptable risk.

Off-site soils, to which nearby residents may be exposed, were analyzed only for chromium in the Phase III RI. These samples were taken in the immediate vicinity of the plant, but outside of the fenced area. The average concentration of chromium in off-site surface and near-surface soil samples in the Phase III RI (1209 mg/Kg) was significantly higher than the value used in the baseline risk assessment (62 mg/Kg). Therefore, potential risk associated with incidental ingestion of off-site soil by nearby residents based on the Phase III data were evaluated.

Average daily intakes of chromium resulting from incidental soil ingestion for children and adults in the vicinity were calculated using the Phase III RI sampling data and the same methodology as was used in the baseline risk assessment. Table 5-2 summarizes the results of this calculation. As indicated in this table, even with the conservative assumption that all chromium in off-site soil is present in the more toxic hexavalent form, the presence of chromium in off-site soils does not pose a

TABLE 5-2

EVALUATION OF RISK ASSOCIATED WITH INCIDENTAL SOIL INGESTION BY NEARBY RESIDENTS USING PHASE III DATA

Average Concentration of Chromium in Off-Site Soil (Phase III) (mg/kg)	Projected Average Daily Intake by Children (mg/kg/day)	Projected Average Daily Intake for by Adults (mg/kg/day)	Total Average Daily Intake (mg/kg/day)	Acceptable Daily Intake (mg/kg/day)	Hazard Index
1209	1.99×10^{-3}	2.27×10^{-5}	2.01×10^{-3}	1.0(1) 5×10^{-3} (2)	0.002(1) 0.40(2)

(1) Acceptable daily intake and resulting hazard index for trivalent chromium.
(2) Acceptable daily intake and resulting hazard index for hexavalent chromium.

significant risk to nearby residents (hazard index less than 1.0).

5.1.2 Review of Phase III Ground Water Data

Three new on-site wells were installed as part of the Phase III RI. Samples from these wells were analyzed for TAL metals and volatile organics. In addition, ground water samples from the six on-site plating wells were analyzed for arsenic, chromium, and lead. In the baseline risk assessment, although no domestic wells were identified in the site vicinity, it was conservatively assumed that ground water in the vicinity of the site could be used in the future for drinking water. Based on the previous analysis of Phase I and Phase II data, concentrations of chromium, lead, and tetrachloroethene in ground water could pose unacceptable risks if the water were to be ingested. Therefore, since these analytes (chromium, lead, and tetrachloroethene) have already been identified as potentially requiring remediation, no further evaluation of the Phase III data for these chemicals was performed.

Table 5-3 compares the average concentration of the chemicals of concern in on-site wells based on the Phase

TABLE 5-3

COMPARISON OF AVERAGE ON-SITE CONCENTRATIONS OF THE CHEMICALS OF CONCERN IN GROUND WATER WITH RELEVANT STANDARDS AND GUIDANCE VALUES

Chemical	Phase I - Average On-Site Concentration (mg/l)	Phase I, II and III - Average On-Site Concentration (mg/l)	Current MCL (mg/l)	Current MCLG (mg/l)	Final MCL[1] (mg/l)	Final MCLG[1] (mg/l)	NYSDOH MCL (mg/l)	New York State Ground Water Quality Standards
Barium	0.12	0.232	1		2	2	1	1
✓ Cadmium	0.015	0.027	0.01		0.005	0.005	0.01	0.01
✓ Copper	0.057	0.421			1.3[2]	1.3[2]		0.200
Nickel	0.063	0.101						
✓ Silver	0.0041	0.053	0.05				0.05	0.05
Trichloroethene	0.0022	0.0045	0.005	Zero			0.005	0.005

(1) Final MCLs and MCLGs become effective July 1992. At that time, the current MCLs cease to be effective.

(2) Action level applicable at the tap (U.S. EPA, 1991)

I, II and III data to the average concentrations used in the baseline risk assessment. In addition, Table 5-3 shows applicable federal and New York State standards and guidelines. As shown in this table, the average concentrations of all of the chemicals of concern (barium, cadmium, copper, nickel, silver, and trichloroethene) are higher based on analytical results from all three phases of the RI, rather than just the average concentrations for the baseline risk assessment. Therefore, projected health impacts associated with ingestion of site ground water were evacuated using the average concentrations from all three RI phases.

The average daily intakes of barium, cadmium, copper, nickel, silver, and trichloroethene resulting from ingestion of ground water in the site vicinity were calculated based on analytical results from the three phases of the RI, using the same methodology and exposure assumptions as were used in the baseline risk assessment. Table 5-4 presents the resulting projected average daily intakes and hazard indices or risk levels.

As indicated in Table 5-4, concentrations of barium, nickel, silver, and trichloroethene do not result in unacceptable risks. Therefore, remediation of these

TABLE 5-4
EVALUATION OF RISK ASSOCIATED WITH
INGESTION OF GROUND WATER BASED ON PHASE I,II & III RESULTS

Noncarcinogens	Average Concentration in On-Site Ground Water (mg/l)	Projected Average Daily Intake (mg/kg/day)	Acceptable Daily Intake (Rfd) (mg/kg/day)	Hazard Index
Barium	0.232	6.63×10^{-3}	5×10^{-2}	0.13
Cadmium	0.027	7.71×10^{-4}	5×10^{-4}	1.54
Copper	0.421	1.20×10^{-2}	---(1)	---
Nickel	0.10	2.89×10^{-3}	2×10^{-2}	0.144
Silver	0.053	1.51×10^{-3}	3×10^{-3}	0.49

Carcinogens	Average Concentration in On-Site Ground Water (mg/l)	Projected Average Daily Intake (mg/kg/day)	Potency Factor $(mg/kg/day)^{-1}$	Risk
Trichloroethene	0.0045	5.14×10^{-5}	1.1×10^{-2}	5.6×10^{-7}

(1) None Available.

chemicals is not considered necessary. The U.S. EPA has not developed a reference dose for copper; therefore, copper cannot be evaluated in the same manner as the other chemicals. However, the average concentration (0.421 mg/l) exceeds the New York State ground water quality standard of 0.200 mg/l. Therefore, copper has been added to the list of chemicals in ground water for which remediation may be necessary. The average concentration of cadmium (0.027 mg/l) results in a hazard index of greater than one and, as shown in Table 5-3, exceeds applicable federal and state standards and guidelines. Therefore, cadmium has also been added to the list of chemicals in ground water for which remediation may be necessary based on the Phase III data.

5.2 Final Risk Assessment

As described in Section 5.1, a full baseline public health and environmental risk assessment was conducted as part of the Phase I RI. Two additional rounds of sampling (Phase II and Phase III) were later performed. The data from these latter two rounds were reviewed to assess whether changes or additions to the baseline risk assessment were necessary. In this section, a summary of the final risk assessment for the site is presented. The final risk assessment incorporates data from all three phases of the RI.

The purpose of the risk assessment is to establish the degree of hazard posed by existing conditions. The risk assessment is then used to develop and evaluate remedial alternatives in the feasibility study. The risk assessment was performed in accordance with relevant U.S. EPA and NYSDEC guidance documents, including the Superfund Public Health Evaluation Manual (SPHEM; U.S. EPA, 1986), Risk Assessment Guidance for Superfund - Volume I (Human Health Evaluation Manual) and Volume II (Environmental Evaluation Manual) (U.S. EPA, 1989a; 1989b), and NYSDEC Habitat Based Assessment (NYSDEC, 1989). The methodology and results for the public health and environmental risk assessment are summarized in the following sections.

5.2.1 Public Health Risk Assessment

The public health risk assessment was divided into the following five steps: 1) selection of indicator chemicals, 2) identification of exposure routes, 3) quantification of potential exposures, 4) toxicity assessment and 5) risk characterization. Each of these steps is described below.

At hazardous wastes sites where a number of chemicals have been detected, U.S. EPA guidance suggests reducing the number of chemicals that warrant a complete and thorough evaluation through the selection of indicator chemicals or chemicals of concern. The criteria used in the selection of indicator chemicals include chemical toxicity information, site concentration data, and environmental mobility. The indicator chemicals thus selected are expected to include those chemicals which present the greatest risk to public health. Media sampled in the three phases of the RI to which significant human exposure could occur include **soil**, ground water, and surface water (Olean Creek). The indicator chemicals selected for each of these media are presented in Table 5-5.

In the second step of the risk assessment, pathways by which human exposure to contaminants in soil, ground water, and surface water were identified. Figure 5-1 presents a diagram outlining the major potential routes of contaminant exposure. Exposure routes under both existing conditions and projected future conditions were identified. Currently, the site is inactive and is fenced to restrict access. Because the site is industrially zoned and because it is bordered by

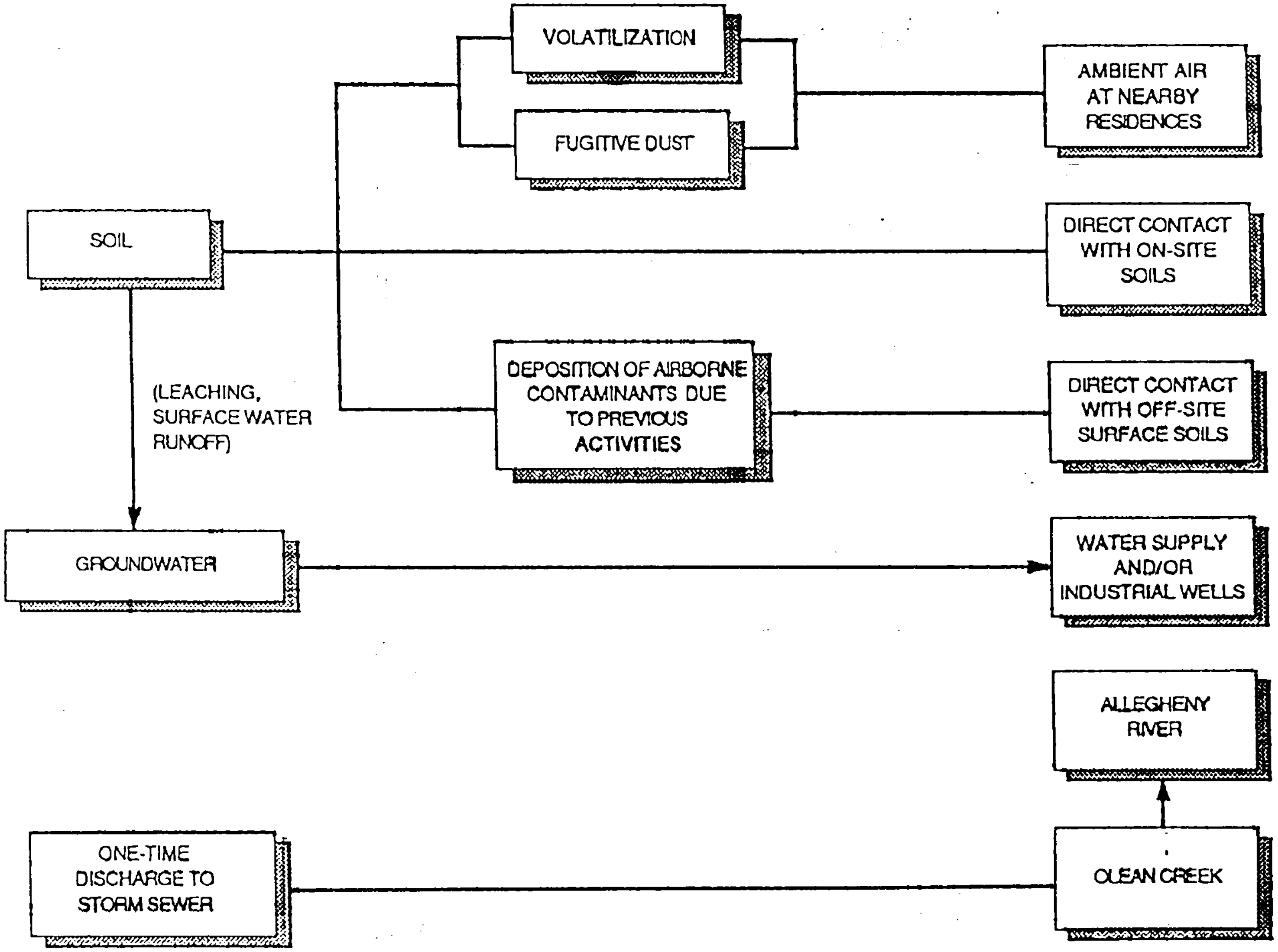
TABLE 5-5

INDICATOR CHEMICALS EVALUATED IN THE RISK ASSESSMENT

Soil	Ground Water	Surface Water
Arsenic	Barium	Chromium
Barium	alpha-BHC	Copper
Cadmium	Cadmium	Vanadium
Chromium	alpha-Chlordane	Zinc
Cyanide	Chromium	
Lead	Copper	
PAHs:	Cyanide	
Benzo(a)anthracene	Lead	
Benzo(a)pyrene	Nickel	
Benzo(b)fluoranthene	Silver	
Benzo(k)fluoranthene	Tetrachloroethene	
Chrysene	Trichloroethene	
Fluoranthene		
Phenanthrene		
Pyrene		
PCBs		
Tetrachloroethene		
Trichloroethene		

16400401.305

FIGURE 5-1
POTENTIAL EXPOSURE PATHWAYS



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industrial properties to the south and west, it was assumed that the site would be used for industrial purposes in the future. Residential areas are located immediately adjacent to the site to the east and to the north. Potential exposures which were quantitatively evaluated include:

1. Inhalation of fugitive dust emissions from on-site surface soils.
2. Inhalation of volatilized organics from site soils.
3. Direct contact with off-site soils by nearby residents. (These soils may have been impacted by previous emissions from the site.
4. Direct contact with on-site soils by hypothetical future construction workers.
5. Ingestion of water from a future hypothetical domestic well situated in the vicinity of the site. (Based on available data, there are no active public or domestic water wells within approximately 1 mile of the site. However, because the aquifer underlying the site is hydrogeologically suitable for water supply, it was conservatively assumed that such a well is installed in the future).
6. Ingestion of fish from Olean Creek.

In the third step, potential exposures for each of the pathways identified above were quantitatively evaluated. For each potential exposure route, exposure point concentrations of each of the indicator chemicals were compiled from monitoring data or calculated using environmental fate models. The exposure point concentrations were then compared to New York State Standards, Criteria, & Guidance Values (SCGs), where available, or other criteria. Table 5-6 summarizes the applicable SCGs. Chromium was the only chemical for which projected concentrations in ambient air exceeded corresponding guideline concentrations. Lead exceeded the U.S. EPA guidance cleanup level for soil in several on-site locations (U.S. EPA, 1989c). The average concentrations of several inorganics (cadmium, chromium, copper and lead) and tetrachloroethene in on-site ground water exceeded corresponding SCGs. The ambient water quality criteria for the protection of human health via ingestion of fish were never exceeded for the chemicals of concern in Olean Creek. Because SCGs do not exist for all chemicals in all media, average daily intakes are calculated for each exposure route based on the exposure point concentrations in accordance with U.S. EPA guidance. These average daily intakes were then compared to acceptable daily intakes and resulting risks were calculated.

The fourth step consisted of a toxicity assessment of the indicator chemicals. In this step, health-based acceptable daily intakes (for noncarcinogens) and potency factors (for carcinogens) were compiled and derived in order to evaluate the average daily intakes projected in

TABLE 5-6
NEW YORK STATE STANDARDS CRITERIA AND GUIDANCE VALUES (SCGs) USED IN THE HUMAN HEALTH RISK ASSESSMENT

Medium	SCGs
Air	• National Ambient Air Quality Standards (NAAQS) • New York State Ambient Guideline Concentrations (AGCs)
Soil	• U.S. EPA Interim Guidance Cleanup Level for Lead in Soil
Ground Water	• U.S. EPA Maximum Contaminant Levels (MCLs) • NYSDOH MCLs • NYSDEC Ground Water Quality Standards
Surface Water	• U.S. EPA Ambient Water Quality Criteria for the Protect Human Health (Ingestion of Fish)

Step 3. In addition, detailed toxicological profiles of each of the indicator chemicals were prepared.

The fifth step, risk characterization, used projected average daily intakes and health-based acceptable daily intakes and potency factors to quantitatively evaluate and characterize the risk to human health associated with the site. In order to evaluate the site on a worst-case basis, it was assumed that under current conditions a nearby resident could potentially be exposed to site contaminants by the following routes of exposure: incidental ingestion of soil (both as children and as adults), consumption of fish from Olean Creek, inhalation of fugitive dust emissions, and inhalation of volatile organics from site soils. Under future conditions, it was assumed that, in addition to the above exposure routes, a nearby resident could potentially be exposed to site contaminants from a hypothetical drinking water well in the site vicinity and through incidental ingestion of on-site soils during construction or landscaping activities at the site.

Noncarcinogenic risks were evaluated by comparing the total average daily intake (chronic daily intake) with acceptable chronic intakes for that exposure route.

A Hazard Index was then calculated for each chemical. A Hazard Index value greater than 1.0 (unity) indicates the possibility of a health hazard to the exposed population.

For potential carcinogens, risks are estimated as probabilities. The excess cancer risk due to exposure to each chemical via ingestion or inhalation was estimated as follows:

$$\begin{array}{c} \text{Added Lifetime} \\ \text{Cancer Risk} \end{array} = \begin{array}{c} \text{PF} \\ (\text{mg/Kg/day})^{-1} \end{array} \times \begin{array}{l} \text{Estimated Lifetime} \\ \text{Average Daily} \\ \text{Intake (mg/Kg/day)} \end{array}$$

The PF (EPA's carcinogen potency factor) is an upper 95% confidence limit on the probability of response per unit intake of a chemical over a lifetime. EPA's target risk range is 10^{-7} to 10^{-4} (U.S. EPA, 1986). A risk of one in a million (1×10^{-6}) is considered to be an acceptable or de minimis risk.

Table 5-7 presents a summary of those chemicals and exposure routes for which calculated chronic daily intakes exceed acceptable intakes or result in unacceptable risks and for which remediation may be necessary. As indicated in this table, under current and future conditions, the risk associated with chromium in

TABLE 5-7

SUMMARY OF CHEMICALS TO BE EVALUATED FOR REMEDIATION IN THE FEASIBILITY STUDY - FINAL RISK ASSESSMENT

	Noncarcinogenic Effects	Carcinogenic Effects
Current Conditions	• No adverse effects	• Chromium in fugitive dust emissions
Future Conditions	• Cadmium, chromium, copper and lead in ground water	• Chromium in fugitive dust emissions • Tetrachloroethene in ground water

site soils due to inhalation of fugitive dust emissions exceeds the acceptable or de minimis risk. This calculation assumes that all chromium present at the site occurs as hexavalent chromium. Under ambient conditions, hexavalent chromium is reduced to trivalent chromium in soils; therefore, it is unlikely that all chromium is present as hexavalent chromium. Current laboratory techniques are not adequate to distinguish between hexavalent and the less toxic and noncarcinogenic trivalent chromium in soils. Under future conditions, consumption of ground water from the site could result in adverse health effects due to the presence of cadmium, copper, chromium, lead, and tetrachloroethene. Therefore, remediation of ground water for these chemicals is evaluated in the feasibility study.

The presence of arsenic in residential soils presents a risk which marginally exceeds the de minimis risk due to incidental ingestion. It should be noted, however, that this evaluation is conservative for two reasons. First, the potency factor for arsenic is currently under review, and there are some indications that this number may be too high (too conservative). Second, the concentrations of arsenic in soil in residential areas are well within typical background concentrations. The maximum concentration reported in residential soils (48.7 ppm) is approximately two-thirds of the maximum background concentration reported for typical soils (73 ppm) (Shacklette and Boerngen, 1984). Therefore, remediation of soils for arsenic is not considered necessary.

As noted above, lead was detected in a number of on-site soil samples in concentrations in excess of the U.S. EPA guidance cleanup level. However, areas with elevated concentrations of lead also contain elevated concentrations of chromium. Since these areas will be remediated because of the presence of chromium, no further evaluation of lead in soil was performed.

5.2.3 Environmental Risk Assessment

The purpose of the environmental assessment was to assess whether contaminants present at the site pose a current or potential future threat to ecological resources. The assessment was performed in accordance with NYSDEC draft guidance on Habitat Based Assessment (HBA) (NYSDEC, 1989) and the U.S. EPA guidance manual on environmental risk assessment entitled "Risk Assessment Guidance for Superfund - Environmental Evaluation Manual

(U.S. EPA, 1989b). The environmental assessment consists of four steps: 1) site description; 2) resource characterization; 3) hazard threshold identification; and 4) risk characterization. A summary of the findings is provided below.

No adverse impacts to sensitive environmental resources are expected to occur as a result of site contamination based on a review of fish and wildlife-related SCGs (freshwater wetlands, regulated streams, navigable waterbodies, and significant habitats/endangered and threatened species).

A review of the surface water and sediment data from Olean Creek suggests that adverse impacts due to previous discharges from the site may still be occurring, although the data are somewhat conflicting due to the presence of contamination in the creek from other sources. The presence of chromium and lead in sediments in elevated concentrations is probably due to at least in part to discharges from the site. Relevant NYSDEC sediment guidelines for both chemicals were exceeded at downstream locations. Therefore, adverse impacts to benthic life may be occurring as a result of previous discharges. Other chemicals were also detected at higher concentrations in downstream (versus upstream) locations. However, because many of these chemicals were not identified as chemicals of concern at the site, and because the storm drain continues to collect and discharge runoff from the town of Olean, the site's contribution to contamination of these sediments is uncertain.

Only three chemicals (copper, vanadium and zinc) were consistently detected in surface water in greater concentrations downstream than upstream. Relevant guidelines for the protection of aquatic life for all of these chemicals were exceeded. Of these chemicals, only copper was identified as a chemical of concern at the site. Results from the Phase I RI indicated that hexavalent chromium in Olean Creek surface waters may pose some risk to aquatic life. However, data from the Phase II RI did not confirm these results. As noted above, the storm sewer system continues to collect and discharge runoff from the town of Olean. Therefore, the site's contribution to elevated concentrations of chemicals in surface water is not certain.

5.3 Development of Site Remediation Goals

Based on the results of the final risk assessment, the only chemical in soil for which remediation is considered necessary due to risks to human health and the environment is chromium. For ground water, chemicals which resulted in unacceptable risks include cadmium, chromium, copper, lead, and tetrachloroethene. Site remediation goals for these chemicals in soil and ground water are developed in Sections 5.3.1 and 5.3.2, respectively.

5.3.1 Development of Soil Remediation Goals (Chromium)

In general, remediation goals or cleanup levels are based on New York State Standards, Criteria, and Guidance Values (SCGs), wherever possible. However, no such standard was identified for chromium in soil. Therefore, the cleanup level for chromium in soil was developed using risk assessment methodology. The cleanup level derived in this manner represents a level determined to be fully protective of human health and the environment based on current and expected future uses of the site. The cleanup goal was derived in accordance with guidance provided in the U.S. EPA Human Health Evaluation Manual (Part A) (U.S. EPA, 1989a).

As described in Section 5.2, the final risk assessment found that chromium in soil poses a potentially unacceptable risk to human health and the environment as a result of exposures via inhalation of fugitive dust emissions. In addition, that study found that if ground water in the site vicinity were to be used for potable water in the future, the concentrations of chromium present would result in unacceptable risks. Chromium in soil is expected to be a source of chromium contamination in ground water. Therefore, two route-specific cleanup goals were developed for chromium in soils: (1) a risk-based cleanup goal based on inhalation of fugitive dust emissions; and (2) a risk-based cleanup goal based on ingestion of ground water at the site which has been contaminated by chromium leached from site soils. The lower of the two cleanup goals was then adopted as the site cleanup level for soil.

5.3.1.1 Fugitive Dust Emissions

A health-based soil cleanup goal for chromium based on fugitive dust emissions is determined by "back-calculating" from the established acceptable daily intake. This process is essentially the same process as was used in the baseline risk assessment, but the calculations are performed in reverse order. In the baseline risk assessment, projected intakes via inhalation of fugitive dusts were calculated from measured concentrations of chromium in soil in three steps: (1) estimation of fugitive dust emissions using the Cowherd model (U.S. EPA, 1985); (2) calculation of resulting ambient levels using the Near-Field Box Model; and (3) calculation of projected average daily intakes using standard U.S. EPA exposure assumptions. The calculated average daily intake was then compared to the acceptable daily intake. In calculating cleanup levels, the acceptable daily intake is used as the starting point and an acceptable concentration in soil is "back-calculated" from the acceptable intake using the same modelling steps and exposure assumptions.

The equation used to calculate average daily intakes via inhalation in the baseline risk assessment is (U.S. EPA, 1989a):

$$\text{Average Daily Intake (mg/Kg/day)} = \frac{IR \times C \times YR}{BW \times AT}$$

where:

IR = Inhalation rate (m^3/day)
C = Projected concentration of chromium in air (mg/m^3)
YR = Total years of exposure (yrs)
BW = Body weight (kg)
AT = Averaging time (yr).

In order to calculate an acceptable concentration in air, this equation is rearranged and the average daily intake is replaced by the acceptable daily intake (AI), as shown below:

$$\text{Acceptable Concentration in Air} = \frac{AI \times BW \times AT}{IR \times YR}$$

An acceptable daily intake for carcinogens (such as chromium) is calculated by dividing an acceptable risk level ($1\text{x}10^{-6}$) by the relevant potency factor. In performing this calculation, it was conservatively assumed that all chromium at the site is present as hexavalent chromium. Thus, the acceptable daily intake is given by $1\text{x}10^{-6}/41$ or $2.44\text{x}10^{-8}$ mg/Kg/day where 41 $(\text{mg/Kg/day})^{-1}$ is the inhalation potency factor for hexavalent chromium. The assumptions used in assigning values to the remaining variables in the above equation are the same as those used in the baseline risk assessment. The resulting acceptable concentration of chromium in air is $2.16\text{x}10^{-4}$ ug/m^3.

The calculated acceptable ambient concentration of chromium in air is then used as an endpoint and the first two modelling steps described above (estimation of emissions and calculation of resulting ambient levels) are performed iteratively to determine what initial concentration of chromium in soil would result in an ambient concentration of chromium in air which is equal to or less than the derived acceptable concentration. The assumptions used in these two modelling steps are the same as those used in the baseline risk assessment. Further details on the models can be found in the baseline risk assessment.

Based on health risk calculations for fugitive dust, the maximum acceptable level of chromium in the surface soil is 265 mg/Kg.

5.3.1.2 Leaching of Chromium in Soil to Ground Water

In developing a soil cleanup level for chromium based on leaching, it was conservatively assumed that ground water in the site vicinity could be used for domestic water in the future. Therefore, it was concluded that soils should be cleaned up to a level such that leaching from residual contamination would not result in an exceedence of the New York drinking water or ground water standard for chromium (0.05 mg/l) being exceeded in site ground water.

The soil cleanup level for chromium based on leaching was "back-calculated" from the New York State drinking water standard using the soil/water partition coefficient. In using this model, it is assumed that residual contamination in soil in the unsaturated zone leaches out in percolating rainfall to the maximum extent predicted by the soil/water partition coefficient. The contaminated rainfall then discharges to ground water. Based on the low organic content of the soil and the low gradient of the water table at this site, it was conservatively assumed that chromium leaches downward without retardation and without significant dilution at the water table.

The equation used to calculate the soil cleanup level for chromium using the soil/water partition coefficient is given by:

$$Cs = Kd \times Cw$$

where:

Cs = Allowable concentration of chromium in soil (mg/Kg)
Kd = Soil/water partition coefficient (ml/g)
Cw = New York State drinking water standard (mg/l)

This equation is the same equation recommended by the NYSDEC for development of cleanup levels for petroleum-contaminated soil (NYSDEC, 1990). The soil/water partition coefficient (Kd) is equal to the product of fraction of total organic carbon (f) and the organic carbon partition coefficient (Koc), as cited in that guidance document.

The mean soil/water partition coefficients for a variety of soils for trivalent and hexavalent chromium are 2200 ml/g and 37 ml/g, respectively (Baes and Sharp, 1983). Assuming that half of the chromium present in soil at the site is present as hexavalent chromium, an average soil/water partition coefficient of (2200 + 37) / 2 or 1119 ml/g was calculated for use in this equation. The resulting allowable concentration in soil is given by 1119 ml/g x 0.05 mg/l = 56 mg/Kg or approximately 50 mg/Kg.

5.3.1.3 Selection of Site Soil Cleanup Level

The soil cleanup level for chromium based on exposures to fugitive dust emissions is 265 mg/Kg. The soil cleanup level based on exposures to ground water receiving contaminated leachate from overlying soils is 50 mg/Kg. Therefore, the lowest cleanup level, 50 mg/Kg, is selected as the site cleanup level. Because of the conservative assumptions used in these calculations, cleanup of soils to 50 mg/Kg is expected to be fully protective human health and the environment via all potential exposure pathways (fugitive dust, direct contact by neighboring children, and leaching of contamination to ground water).

5.3.2 Selection of Ground Water Cleanup Levels

As described above, the contaminants which pose unacceptable risks to human health and the environment based on ingestion of ground water in the immediate site vicinity include cadmium, chromium, copper, lead, and tetrachloroethene. New York State Standards, Criteria, and Guidance Values (SCGs) have been established for all of these chemicals; therefore, risk-based cleanup levels were not developed. Applicable SCGs include the NYSDOH drinking water standards and the NYSDEC ground water quality standards. The lower of these two standards was selected as the site cleanup level for each chemical. Table 5-8 presents the resulting cleanup levels for the chemicals potentially requiring remediation in ground water at the site.

TABLE 5-8
GROUND WATER CLEANUP LEVELS

Chemical	NYSDOH MCL[1] (ug/l)	NYSDEC Ground Water Quality Standard[2] (ug/l)	Site Cleanup Level (ug/l)
Cadmium	10	10	10
Chromium	50	50	50
Copper	1300[3]	200	200
Lead	50	25	25
Tetrachloroethene	5	5	5

(1) NYSDOH Primary Maximum Contaminant Level (State Sanitary Code Part 5 - Drinking Water Supplies

(2) NYSDEC, 1991

(3) Federal Primary Maximum Contaminant Level (Action Level)

6.0 POTENTIAL SOURCES AND EXTENT OF CONTAMINATION

6.1 Introduction

This section identifies the source areas at the site and summarizes the extent and magnitude of contamination. Although this section focuses on the recently obtained Phase III RI data, the analytical results from all three phases of investigation have been used for the purpose of delineating the extent of contamination within the soil, sediment and ground water.

The final Risk Assessment (Section 5.0) identified sixteen (16) separate indicator chemicals found within either the soil/sediment, ground water and/or surface water during the RI. These indicator chemicals were selected based on their concentrations, toxicity, mobility and frequency of occurrence in the study area. Of these indicator chemicals, the following four were identified as posing a risk to human health or the environment: chromium, lead, arsenic and PCE.

Based on the past activities at Van Der Horst Plant No. 1 and the sampling data, it appears that the chromium measured in the study area is: 1) the result of past disposal/discharge activities at the site; and 2) the inorganic indicator chemical detected most frequently above background concentrations. PCE is the organic indicator chemical that appears to be the result of past site activities and was measured most frequently above background concentrations. The petroleum hydrocarbons and various other volatile organic and semi-volatile organic indicator chemicals encountered off-site in the area of the MW-9 monitoring well cluster appear to be confined to the Felmont Oil facility and are not associated with past operations at the Van Der Horst Plant. TCE and 1,2-DCE were also detected above drinking water standards in some monitoring wells, but were not consistently found at these levels in all three sampling rounds. Additionally, arsenic, although identified in Section 5.0 as an indicator chemical of concern, does not appear to be associated with past operations at the plant. Thus, this section addresses the identification of potential sources at Plant No. 1 and the extent of contamination, based on the chromium and PCE concentrations measured in the soil, sediment, surface water and ground water.

6.2 Extent of Contamination

This section summarizes the extent of the contamination detected during the RI sampling within: 1) surface and subsurface soil; 2) the storm sewer system (surface water and sediment); 3) Olean Creek (surface water and sediment); and 4) groundwater in the study area. The analytical data discussed in this section are presented in Tables 4-1 through 4-12.

The Phase II and III RI data indicate the existence of a ground water plume with contaminant concentrations that diminish away from the site. However, ground water samples collected from the perimeter wells along the southwestern side of the study area contained contaminants above drinking water standards, so that the southwestern extent of ground water contamination presently remains unknown. Additional study (i.e., primarily to the southwest of the site) is necessary to delineate the extent of ground water contamination; however, for the purpose of this discussion ERM has attempted to approximate the area associated with the primary contaminants of concern (i.e. chromium and PCE).

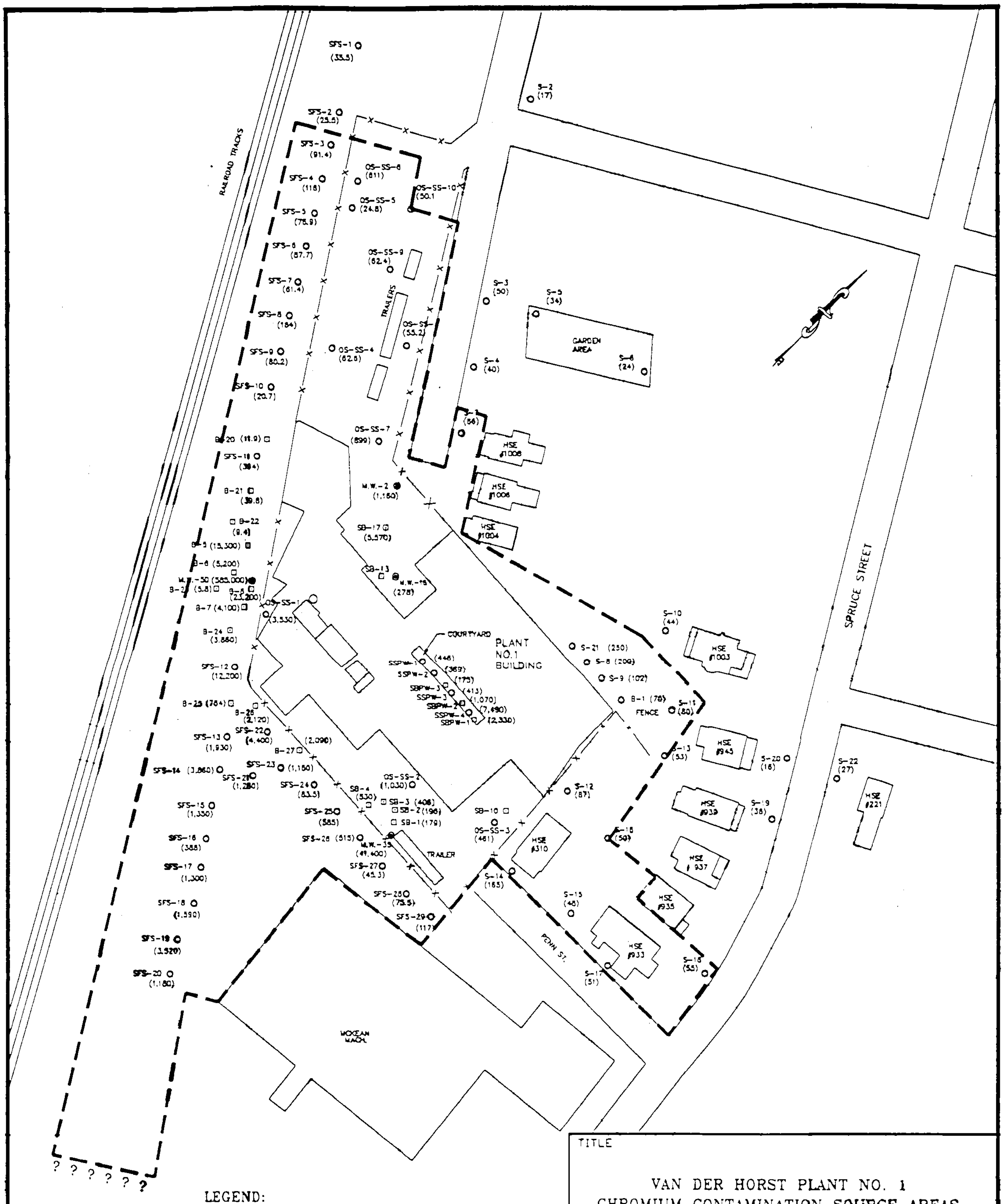
A soil/sediment clean-up level of 50 mg/Kg has been used to delineate the extent of chromium contamination. This cleanup level was selected on the basis of leachability calculations with TCLP analysis of on-site soil samples (see Section 5._). Additionally, a ground water clean-up level of 50 ug/L for hexavalent and total chromium has been selected to delineate the extent of ground water contamination, based on

New York State Ground Water Quality standards, and a surface water clean-up level of 11 ug/L for hexavalent and total chromium has been selected to delineate the extent of surface water contamination, based on New York State Class "C" Surface Water Quality standards.

6.2.1 Surface Soil

The objective of the Phase III RI surface soil sampling program was to delineate the extent of surficial chromium, lead and arsenic concentrations beyond the fenced area of the site. The parameters selected for analysis and the surface soil sampling locations were chosen based on data needs identified by the Phase I and II RI reports.

Figure 6-1 and 6-2 present the total chromium concentrations measured in the surface soil samples collected during the entire RI and Phase III RI, respectively. Based on these figures, it appears that the area of surface soil chromium contamination (assuming a 50 mg/Kg clean-up level is used) includes:



LEGEND:

- ○ Surface Soil Sample
- ▣ Soil Boring
- ● Monitoring Well
- (51) Chromium Concentration (mg/Kg)
- ▬ ▬ Estimated Boundary of Surface Soil Contamination Source Area (> 50 mg/Kg)

GRAPHIC SCALE

50 0 25 50 100 200

(IN FEET)

TITLE

VAN DER HORST PLANT NO. 1
CHROMIUM CONTAMINATION SOURCE AREAS
IN SURFACE SOIL

PREPARED FOR

NYSDEC

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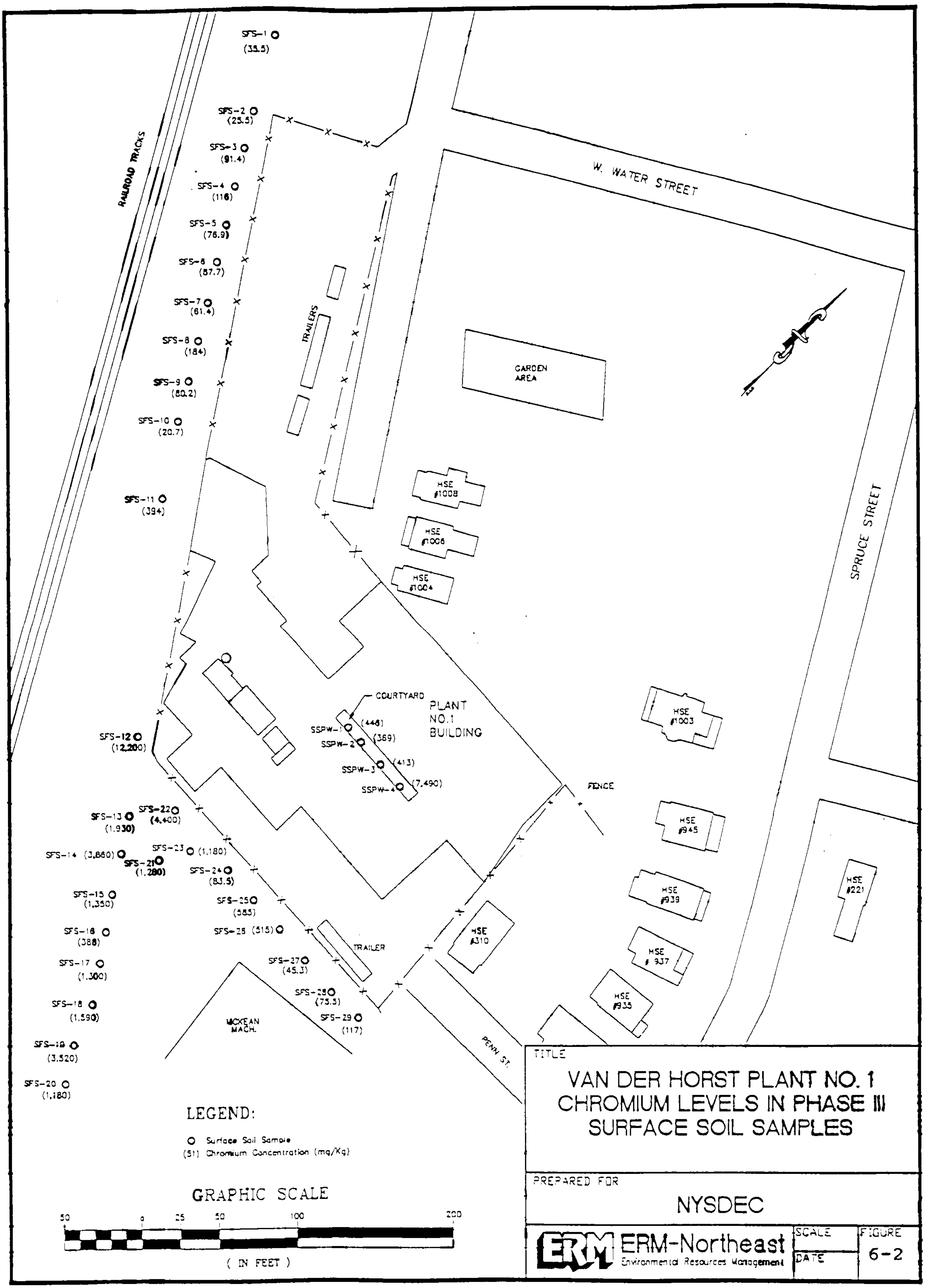
SCALE

DATE

FIGURE
6-1



TITLE

VAN DER HORST PLANT NO. 1
CHROMIUM LEVELS IN PHASE III
SURFACE SOIL SAMPLES

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DATE

FIGURE
6-2

- The majority of the surface soil within the fenced-in confines of the site;
- An area outside the fence (i.e., approximately 50 feet beyond the fence to the east and north); Figure 6-1 An area from Penn St. to about 100 ft north of Penn St;
- McKean Machinery property south of Plant No. 1;
- The area between the railroad tracks and the southwest property fences for Plant No. 1 and McKean Machinery; and
- The courtyard area surrounded by the Plant No. 1 buildings.

The extent of surface soil contamination at the southern most portion of the outlined region was notdelineated by the RI programs and is labelled with question marks on Figure 6-1. Surface water runoff from Plant No. 1 appears to have carried chromium contamination south of sample SFS-20.

Lead concentrations measured in the on-site surface soil samples were in a number of cases higher than the concentrations measured in the background samples. Additionally, elevated lead concentrations detected in Phase I and II surface soil samples appear to correspond with the occurrence of the elevated chromium concentrations (i.e., where the lead concentrations are above background levels the chromium concentrations are also generally above background levels). Elevated lead concentrations appear to be a result of the former on-site activities and are associated with the areas of surface soil chromium contamination; though chromium contamination is more extensive.

Arsenic concentrations measured in all but one of the 45 Phase I and Phase II soil samples were below or slightly above the levels in background soil sample (BSS-1). Phase II on-site surface soil sample OS-SS-6 had an arsenic concentration of 499 mg/kg. These data indicate that arsenic concentrations measured in on-site and off-site surface soil samples are <u>not</u> from an on-site source and thus, should not be addressed as part of this RI program. The one localized anomalous on-site occurrence of a high arsenic level (i.e, OS-SS-06) may be the result of a surface deposit of one of the many commonly used products that contain arsenic (e.g., rat poison, paint, leather goods, insecticides, weed killers, etc.). This one sample location does not appear to constitute an on-site source area. The area surrounding sample OS-SS-06 may be remediated for chromium contamination since chromium was detected at 611 mg/Kg in this sample.

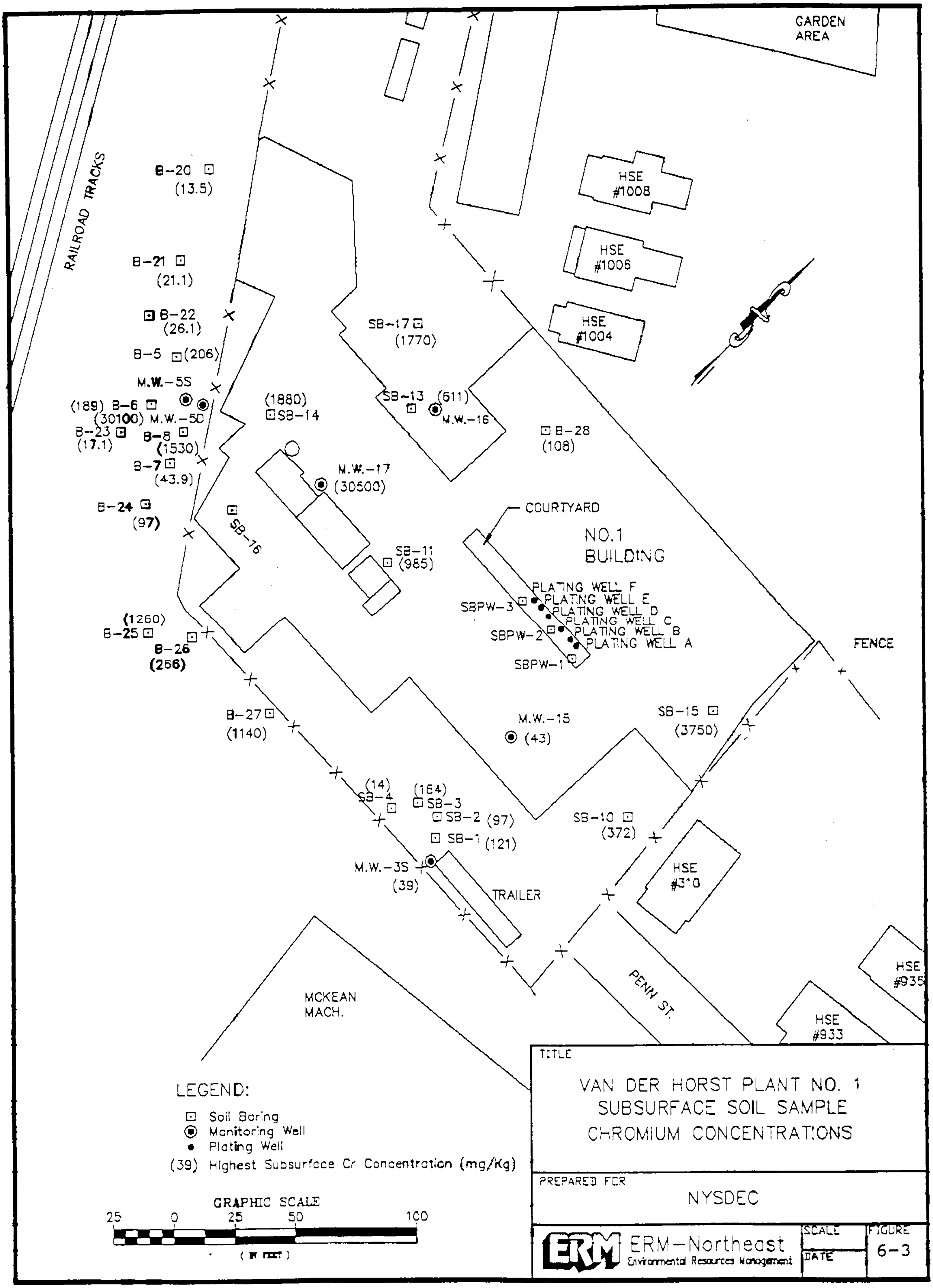
6.2.2 Subsurface Soil

Subsurface soil samples were collected at soil borings and monitoring wells within and adjacent to the

Plant No. 1 building to evaluate chromium lead and arsenic levels. Chromium concentrations were generally found to be the highest of these three metals. Areas with high lead levels generally had high chromium concentrations, and chromium contamination was found in many soil samples with only low-levels of lead. Elevated levels of arsenic were only observed in the subsurface samples within the Plant No. 1 courtyard. Some courtyard samples had arsenic levels above background concentrations.

Figure 2-4 presents the locations of the Phase III subsurface samples, while Figure 6-3 summarizes the sampling locations where elevated chromium has been detected. Figure 6-4 shows the area at and surrounding the site which contains chromium levels in subsurface soil which are greater than 50 mg/Kg. This area encompasses almost the entire fenced property southeast of the northwest addition to the building. The area also includes the Conrail property between the Plant No. 1 west property fence and the railroad tracks.

Subsurface profiles were developed from soil boring and monitoring well data to evaluate the depth of chromium contamination in the soil. Figure 6-5 shows the



TITLE

VAN DER HORST PLANT NO. 1
SUBSURFACE SOIL SAMPLE
CHROMIUM CONCENTRATIONS

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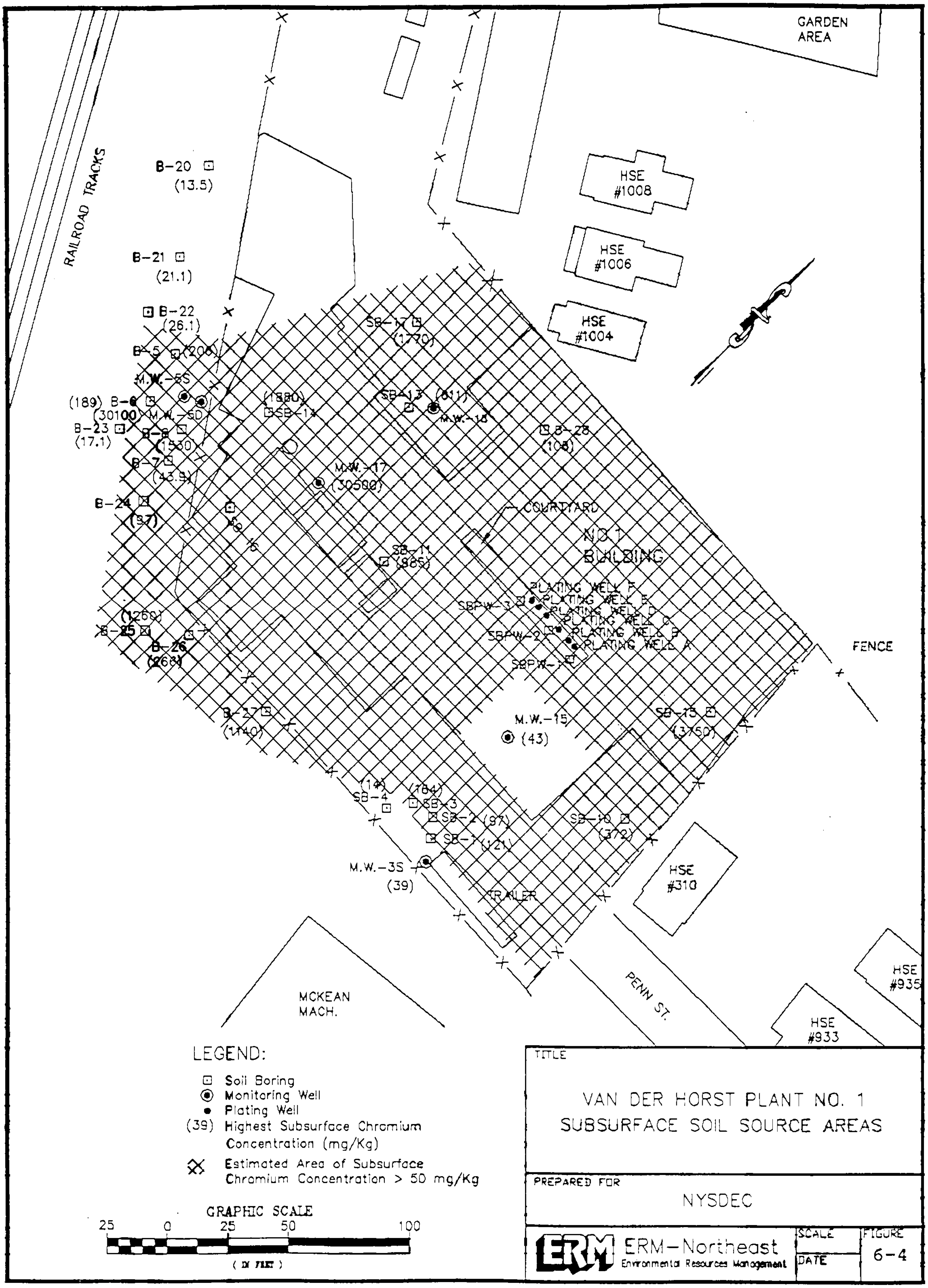
SCALE

DATE

FIGURE
6-3



TITLE

VAN DER HORST PLANT NO. 1
SUBSURFACE SOIL SOURCE AREAS

PREPARED FOR

NYSDEC

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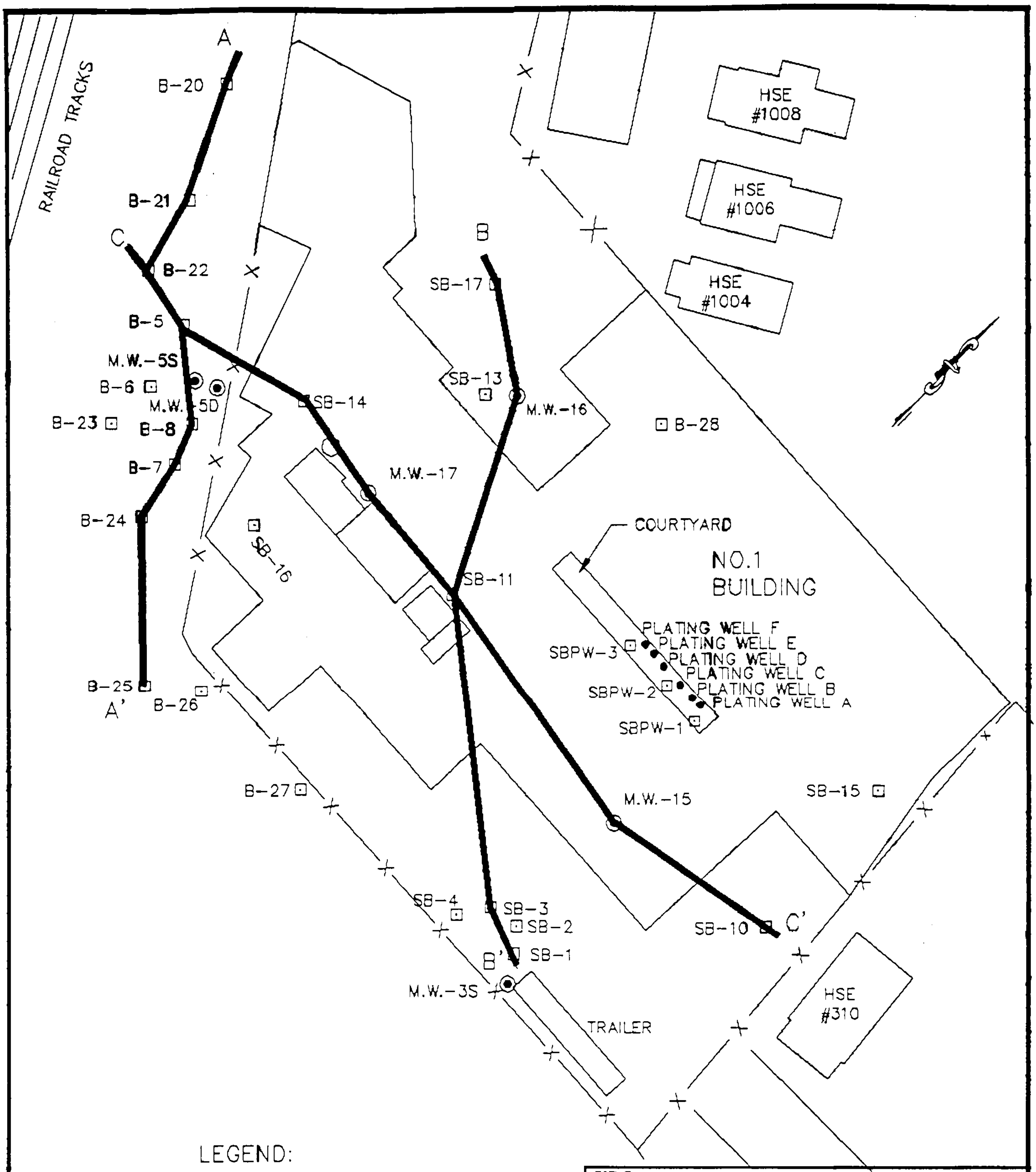
Environmental Resources Management

SCALE	FIGURE
DATE	6-4



TITLE

VAN DER HORST PLANT NO. 1

SUBSURFACE SOIL

PROFILE LOCATIONS

PREPARED FOR

NYSDEC

ERM-Northeast
Environmental Resources Management

SCALE	FIGURE
DATE	6-5

locations of profiles A - A', B - B' and C - C', while the chromium concentrations along these profiles are illustrated, respectively, in Figures 6-6, 6-7 and 6-8.

Chromium contamination in the unsaturated subsurface soil appears as the shaded area above the seasonal high aquifer surface in profiles A, B and C. The vertical distribution of chromium contamination in unsaturated soil typically follows a pattern of: 1) High levels near the surface; 2) Decreasing concentrations with depth, and; 3) Increasing concentrations near the water table. Nearly all of the unsaturated soil beneath the Plant No. 1 building is believed to have chromium levels greater than 50 mg/Kg.

The three profiles also indicate that chromium contamination greater than 50 mg/Kg extends beneath the water table at B-8, SB-11, SB-14, MW-16 and MW-17. At all of these locations, chromium levels beneath the water table were greater than most of the soil above the water table. This trend was most evident in MW-17, where the 25' - 27' sample (which was below the water table) had a chromium concentration of 30,500 mg/Kg (see Figure 6-9).

Figure 6-6

Subsurface Soil Chromium Levels Along Cross Section A

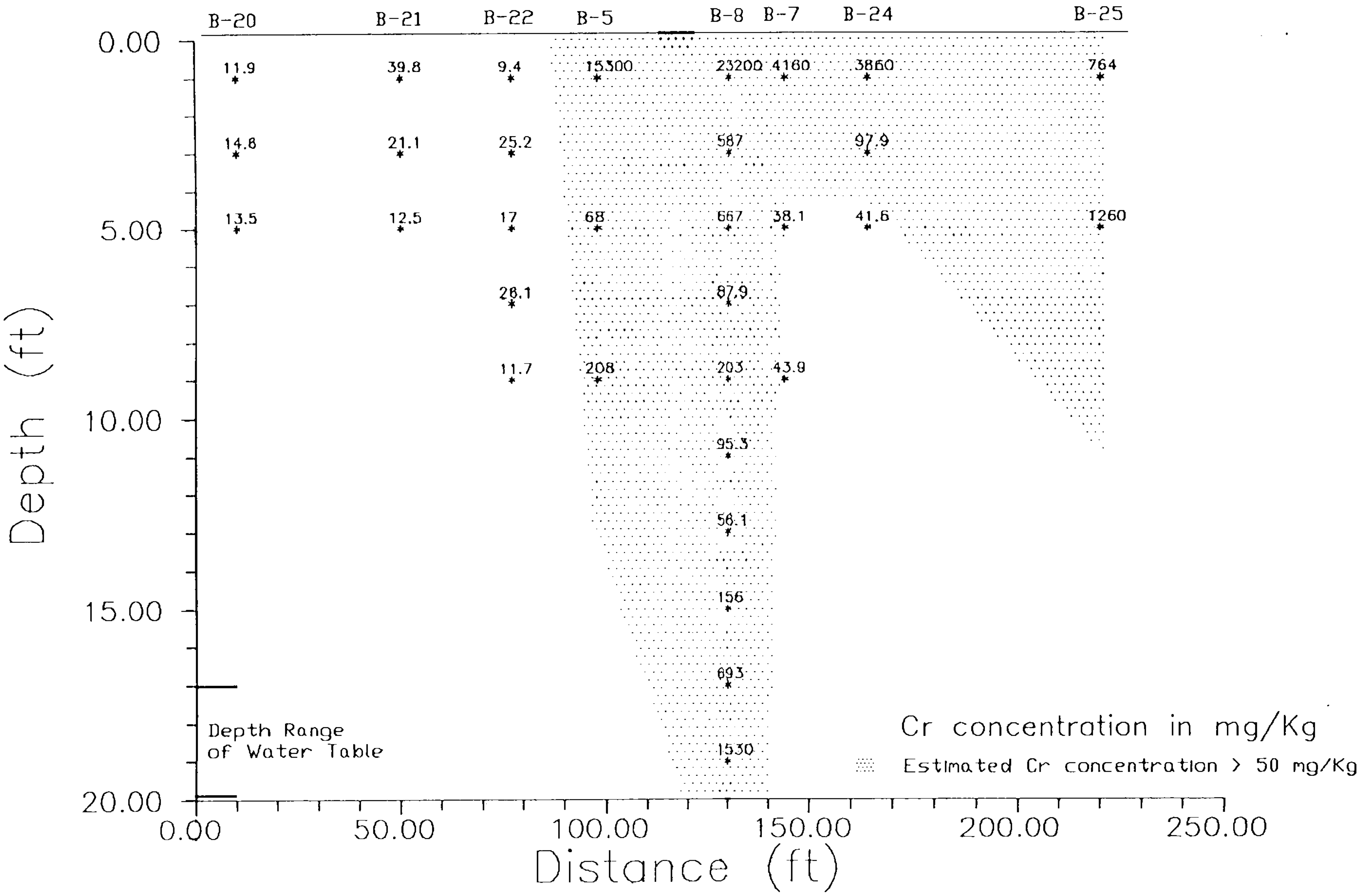


Figure 6-7

Subsurface Soil Chromium Levels Along Cross Section B

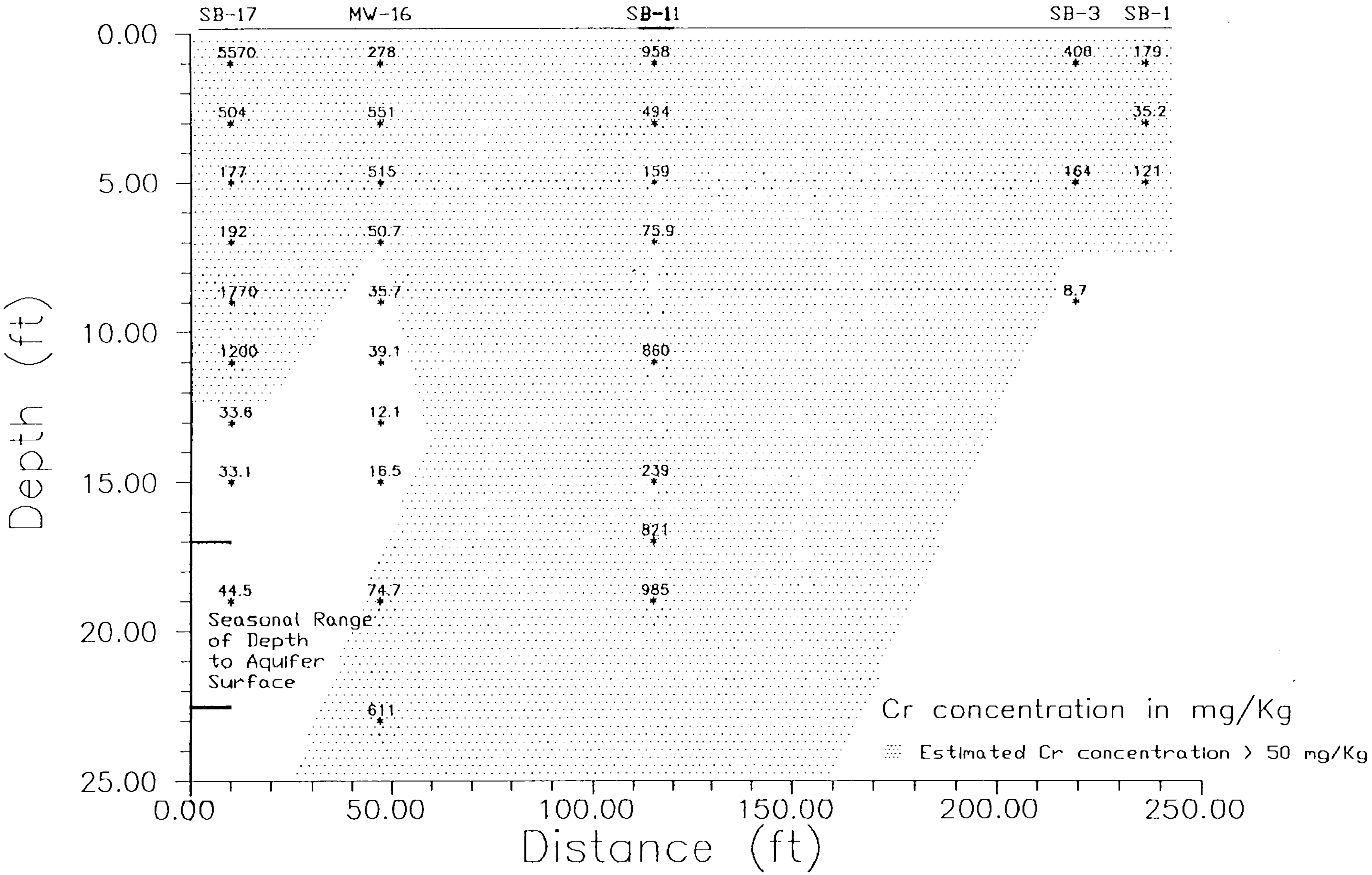


Figure 6-8

Subsurface Soil Chromium Levels Along Cross Section C

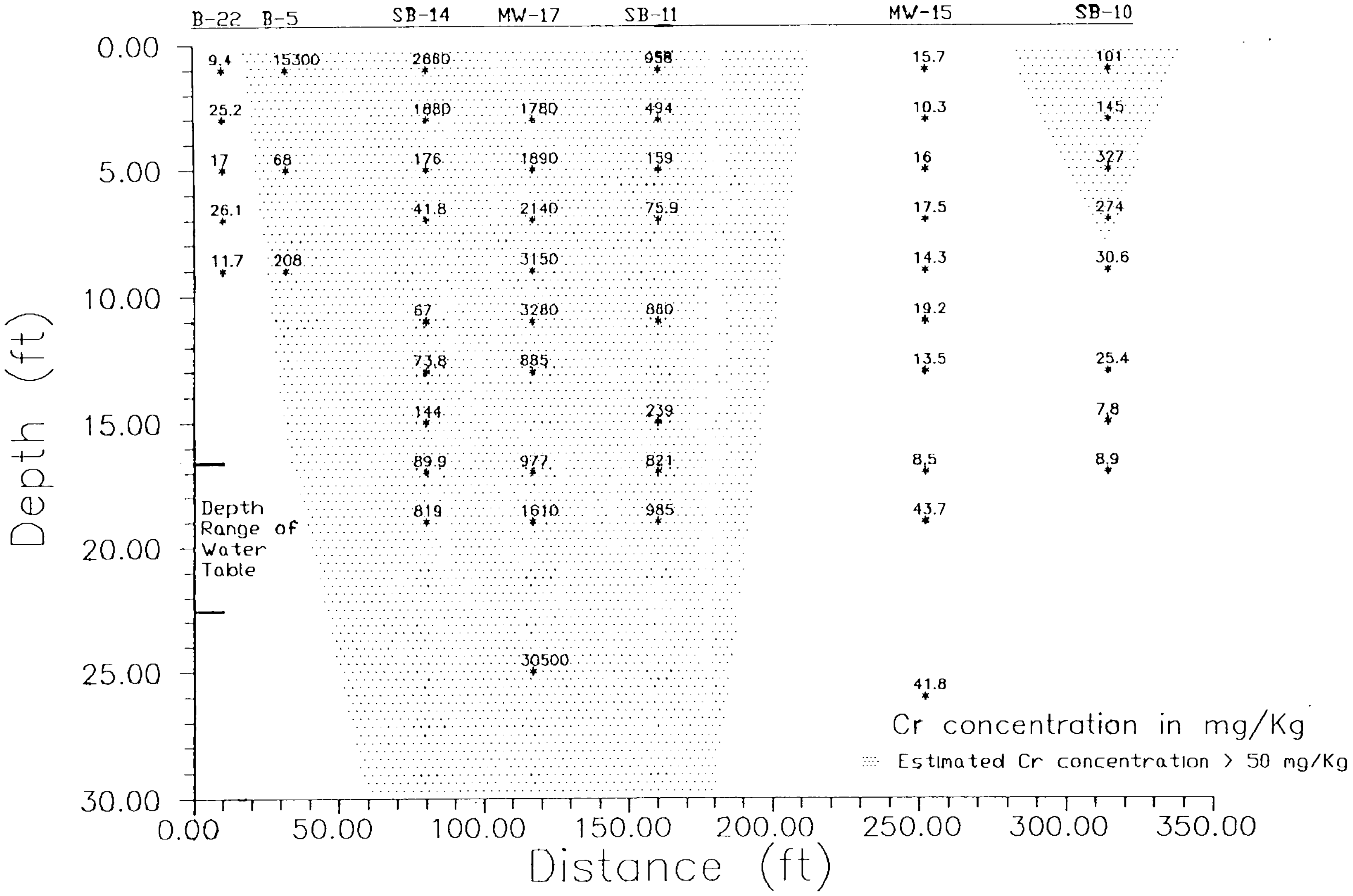
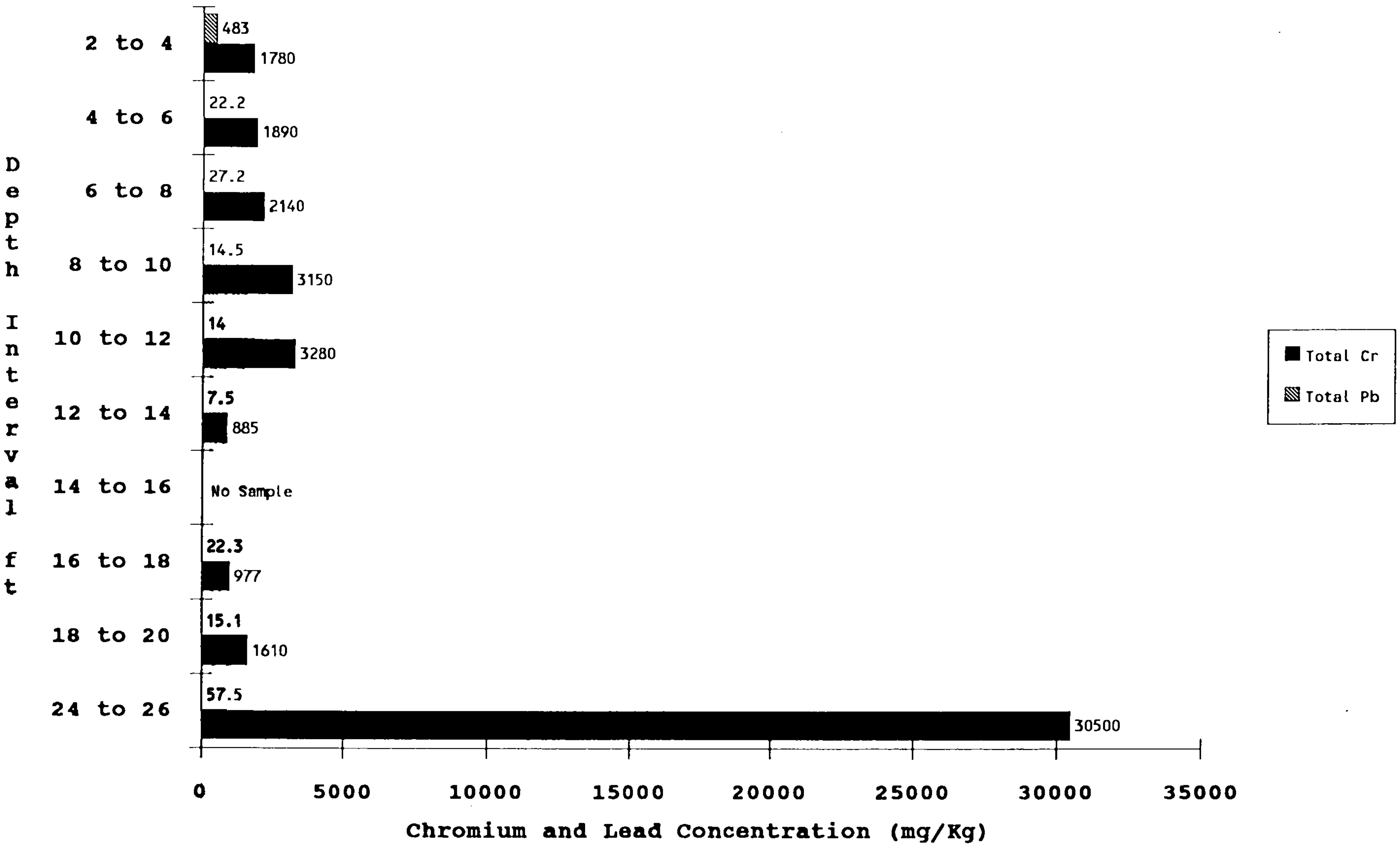


Figure 6-9

Total Chromium and Lead Levels in Soil from Monitoring Well MW-17

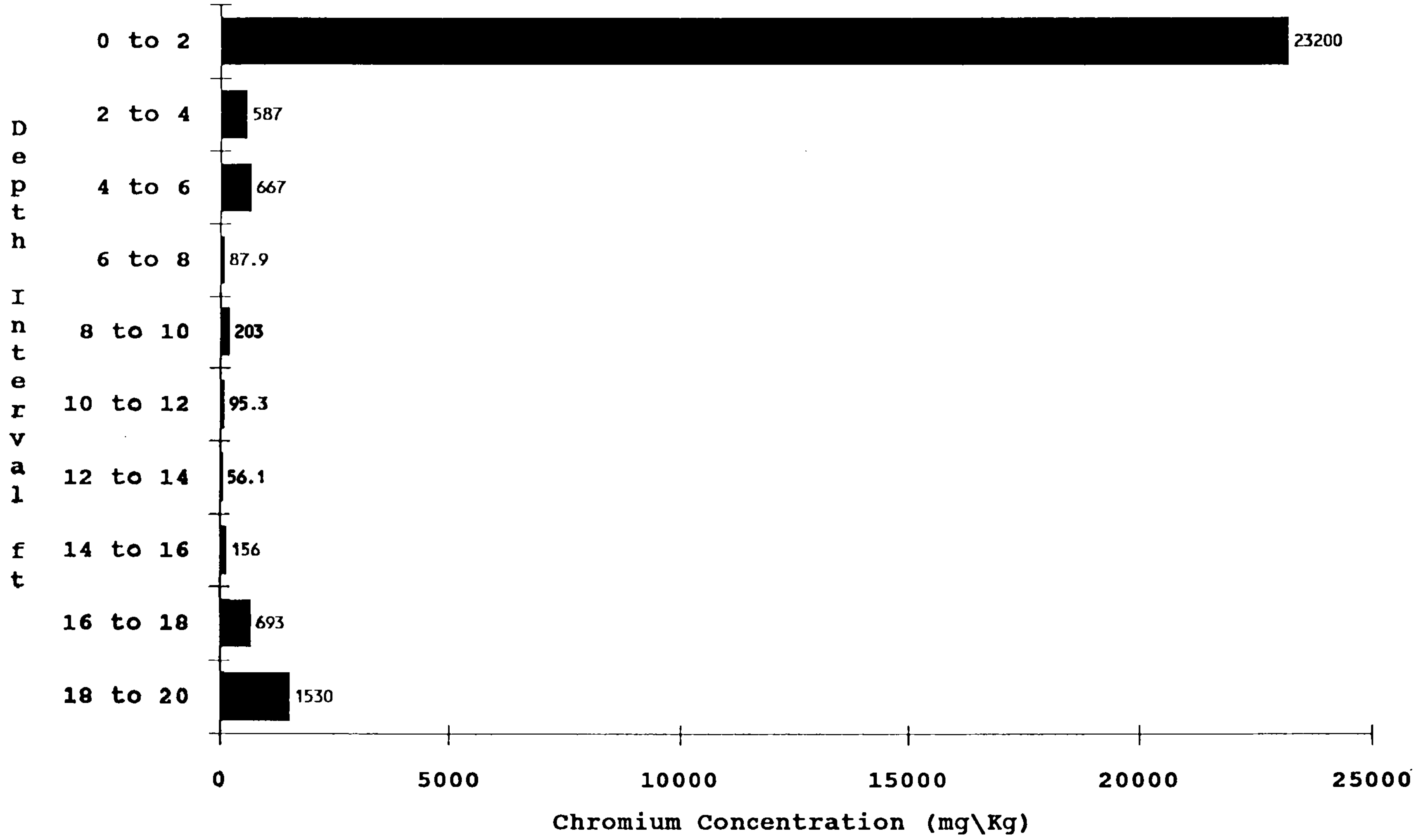


Phase II sampling data from soil boring B-8 indicated that most chromium contamination in the subsurface soil was not transported to the ground water. B-8 was sited within an area where the plant formerly discharged backwash-water from their chromic acid filtration system. Figure 6-10 illustrates that there was a sharp difference between the very high concentration of chromium from 0' - 2' (23,200 mg/Kg) and the concentration at 2' - 4' (586 mg/Kg). The amount of chromium in subsurface soil did not significantly increase until the 16' - 18' sample (693 mg/Kg) and the 18' - 20' sample (1530 mg/Kg), which were collected below the water table than in unsaturated soils. These results indicate that chromium has a much higher mobility in the subsurface soil beneath the water table. The high levels of chromium in the 16' - 18' and 18' - 20' samples appear to have originated by sorption of chromium from contaminated ground water onto the subsurface soil.

The high concentration of chromium in the 25' - 27' soil sample from MW-17 may have been caused by leakage from a series of exterior plating tanks (Figure 2-7). This monitoring well was emplaced as close to the plating tanks as access would allow. It is presently believed that leakage of chromic acid from the tanks, combined

Figure 6-10

Total Chromium Concentrations in Soil Boring SB-8



perhaps with surface spillage has resulted in the high levels of chromium within the soil beneath the water table. It is also presently believed that these plating tanks were the source area for chromium contamination within the ground water, and that the resulting contamination of soil (saturated and perhaps unsaturated) presently acts as a source area for ground water contamination.

Total chromium was detected at 264,000 ug/L (or 264 mg/L) in ground water from MW-17. This is the highest level of chromium found in ground water at the site, however the soil sample from 25' - 27' has a much higher concentration than the ground water. Saturated soil with chromium concentrations of this magnitude would continuously release high levels of chromium to ground water. The saturated soil around MW-17 is believed to be the primary source of contamination at Plant No. 1, due to the continuous release of high levels of chromium to ground water.

High levels of chromium in the saturated soil can probably not be effectively remediated by pump and treat methodologies. Chromium would continue to desorb from the aquifer material until equilibrium is reached between the soil and the ground water. Many years of pumping would be necessary before equilibrium conditions would reach an acceptable level of chromium contamination in ground water (i.e. less than 50 ug/L).

Though an extensive amount of surface and subsurface soil has been found to be contaminated with chromium, all but one of the soil samples have been classified as non-hazardous (Phase II and III TCLP analyses). Only one surface soil sample (SB-8, 0-2') failed the TCLP criteria.

6.2.3 Plating Wells

During the Phase III RI field investigation, ERM discovered six (6) "Plating Wells" in the Plant No. 1 Courtyard (see Figure 2-4). These "plating wells" were used for chromium electroplating of navy cannon gun barrels. Water was sampled from each of the plating wells and shallow soil samples were collected within the courtyard. The initial process of locating the plating well was difficult since the top of each well was buried beneath 1 foot of soil fill material.

Each well was found to consist of an 18-inch diameter, 32-foot long, concrete cylinder. The cylinders were installed vertically in the ground and were covered with a steel plate. The interior of the wells was lined with PVC piping, though the integrity and effectiveness of the liners in not known. It is also not known as to how long this existing PVC piping has served as a liner.

All soil samples from the courtyard had chromium levels greater than 50 mg/Kg (ranging from 63.7 to 7490 mg/Kg) and lead levels greater than background. Slightly elevated levels of arsenic were also found in some samples. Chromium concentrations and soil sampling locations are presented in Figure 6-2.

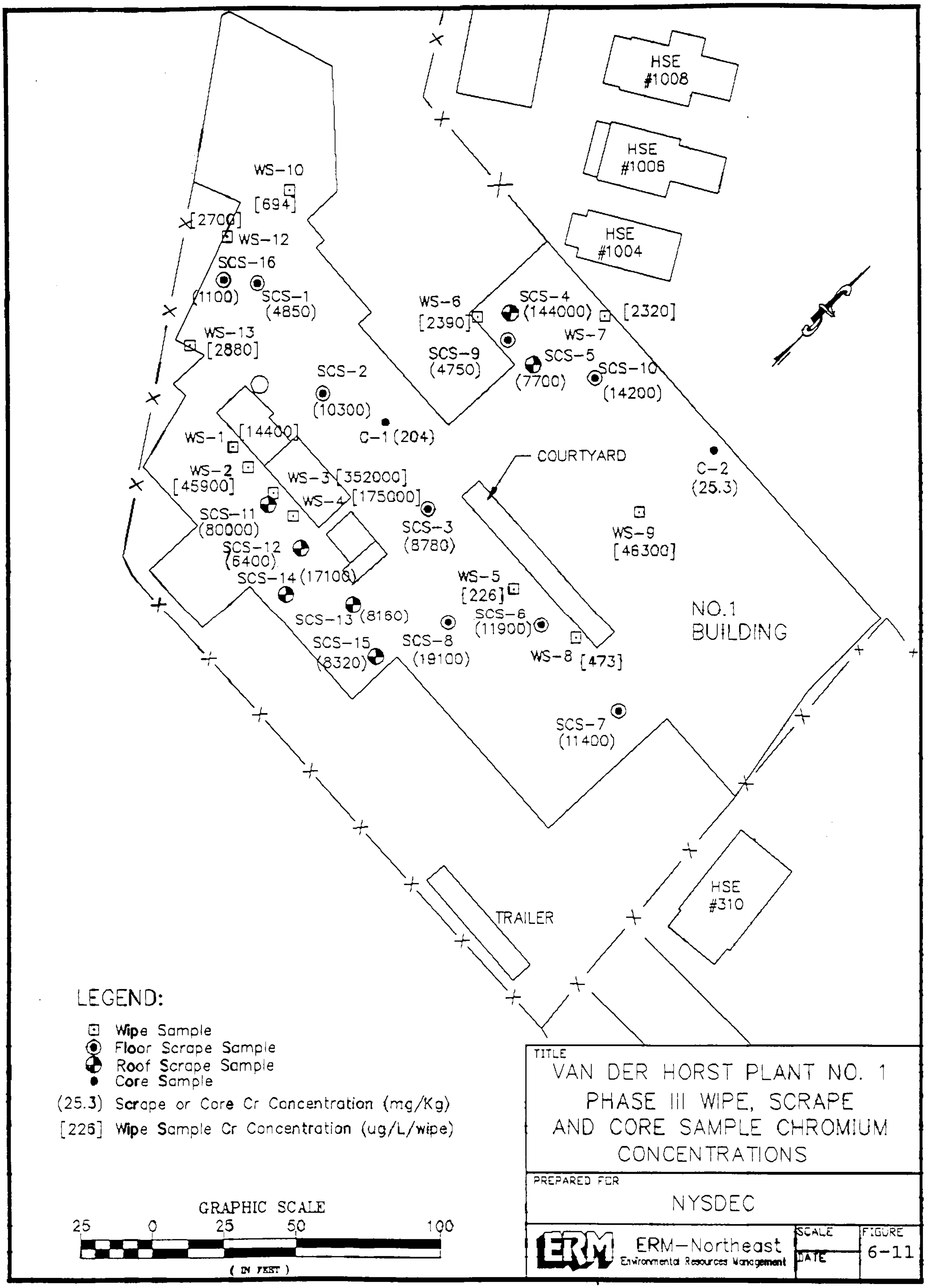
Chromium was the primary contaminant in the plating well water. Chromium levels in plating wells A (700,000 ug/L), B (22,900 ug/L) and D (610 ug/L) were significantly above the NYSDEC ground water standard of 50 ug/L. Chromium concentrations in wells C, E and F were found to be near or below the ground water standard. Water in five of the wells also contained lead levels greater than NYSDEC ground water limits. Arsenic was not detected in any of the water samples.

The water found in plating wells A, B, and D could represent a present source of chromium contamination to ground water at the site. These plating wells extend below the water table and could be in hydraulic connection with the aquifer.

6.2.4 Wipe, Scrape and Core Building Samples

Chromium was the primary contaminant detected in most of the samples collected from the building structures. Chromium concentrations at all building sample locations are shown in Figure 6-11. Relatively high levels of chromium were found in all of the Phase III wipe samples. The highest chromium concentrations (ranging from 14,400 to 352,000 ug/L/wipe) were detected in samples collected from the plating tank exhaust vents (samples W-1 through W-4) and on the wall north of the parts storage area (sample W-9).

Elevated levels of chromium were also measured in all scrape samples that were collected. The highest concentrations of chromium were detected in scrape samples collected on the roof near exhaust vents (SCS-4: 144,000 mg/Kg, and SCS-11: 80,000 mg/Kg). The



LEGEND:

- ⊡ Wipe Sample
- ◉ Floor Scrape Sample
- ⊕ Roof Scrape Sample
- ● Core Sample

(25.3) Scrape or Core Cr Concentration (mg/Kg)

[226] Wipe Sample Cr Concentration (ug/L/wipe)

TITLE

VAN DER HORST PLANT NO. 1
PHASE III WIPE, SCRAPE
AND CORE SAMPLE CHROMIUM
CONCENTRATIONS

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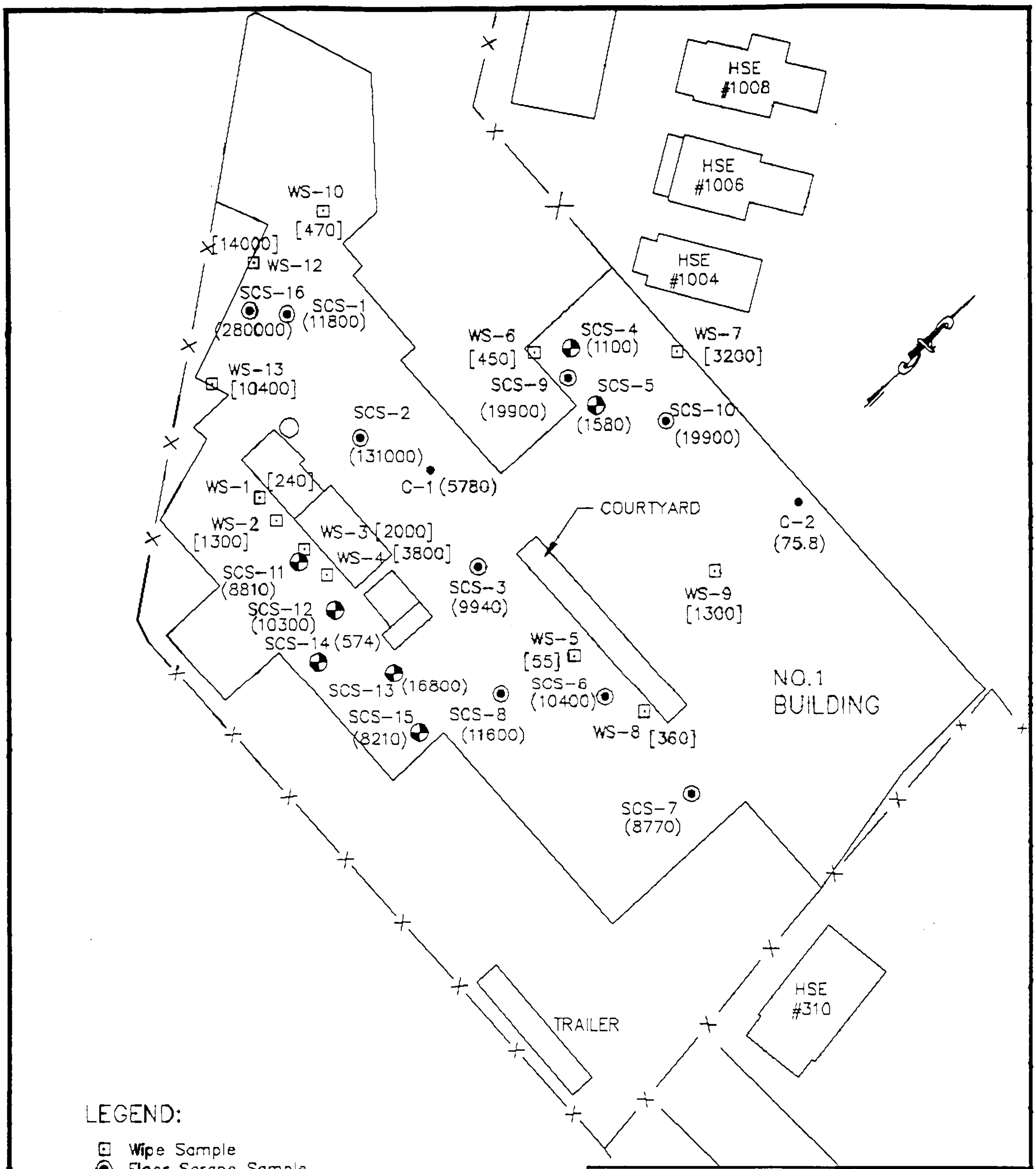
SCALE	FIGURE
DATE	6-11

fiberboard wall core samples had relatively low concentrations of chromium.

Lead was also a major contaminant in many of the samples, as shown in Figure 6-12. Samples W-12 and W-13 had the highest lead levels of the wipe samples (14,000 and 10,400 ug/L/wipe, respectively). Both samples were located in the "lead room", which was used for lead operations at the plant. Most of the scrape samples had lead concentrations which were greater than 1000 mg/Kg. The highest concentrations of lead within the scrape samples occurred on the lead room floor (SCS-16: 280,000 mg/Kg) and north of the chromium plating tanks (SCS-2: 131,000 mg/Kg). Wall core sample C-1 contained lead at a concentration of 5780 mg/Kg.

Based upon the overall results from the Phase III building samples and the previously collected EPA building samples (submitted to NYSDEC April 3, 1991), most of the floors, walls and equipment are contaminated with chromium and lead. Arsenic was not detected at elevated concentrations within the building samples.



GRAPHIC SCALE

25 0 25 50 100

(IN FEET)

TITLE
VAN DER HORST PLANT NO. 1
PHASE III WIPE, SCRAPE
AND CORE SAMPLE LEAD
CONCENTRATIONS

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Environmental Resources Management

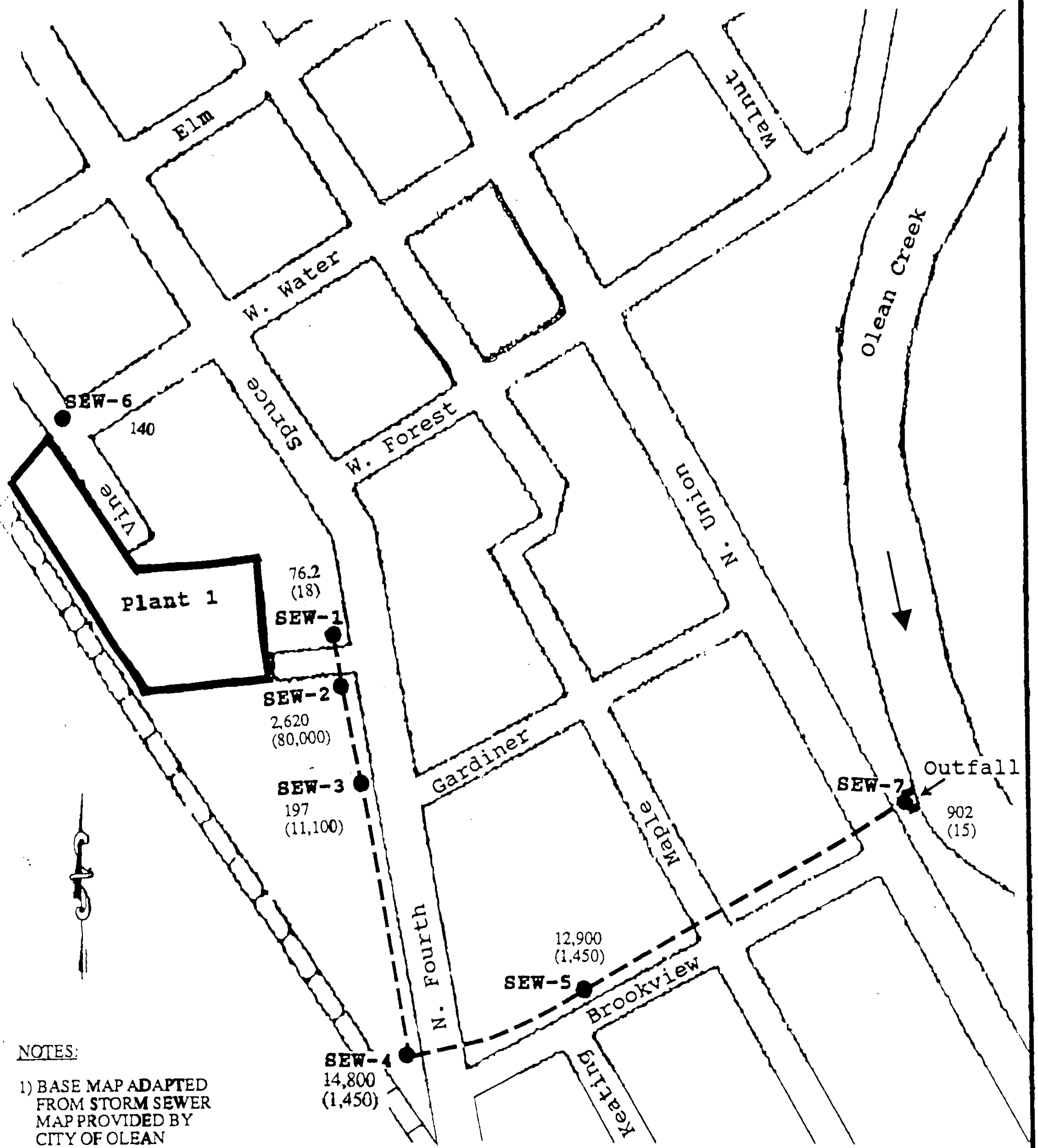
SCALE

DATE

FIGURE
6-12

6.2.5 Storm Sewer System

The sediment and water samples collected from the storm sewer system that runs from the east side of the site to the Brookview outfall indicate that this system contains elevated levels (i.e., above background levels) of chromium and lead (Figure 6-13). Based on these data, it appears that the chromium concentrations are highest, in both water and sediment, between SEW-2 and SEW-5. The highest sediment concentration was measured in the sample from SEW-4 which was collected from the junction manhole for flow coming from the south and the north. Thus, the chromium detected at and downstream of SEW-4 may not be entirely from the subject site, and could instead be from other industries (former and present) that discharged into the storm sewer. The highest chromium concentration in water was measured in the sample from SEW-2, which is approximately 300 feet downgradient of the site. All of the samples collected from the down stream reaches of the sewer system contained higher concentrations of chromium than that found in upstream sample SEW-1.



NOTES:

1) BASE MAP ADAPTED FROM STORM SEWER MAP PROVIDED BY CITY OF OLEAN ENGINEERING DEPT.

2) ANALYTICAL DATA PROVIDED BY RECRA ENVIRONMENTAL, INC.

LEGEND:

● SEWER SAMPLING LOCATION

– – – STORM SEWER LINE

12,900 TOTAL CHROMIUM CONCENTRATION IN SEDIMENT (mg/Kg)

(1,450) TOTAL CHROMIUM CONCENTRATION IN WATER (ug/L)

TITLE

VAN DER HORST PLANT NO. 1
TOTAL CHROMIUM CONCENTRATIONS
IN STORM SEWER SYSTEM

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SCALE

DATE

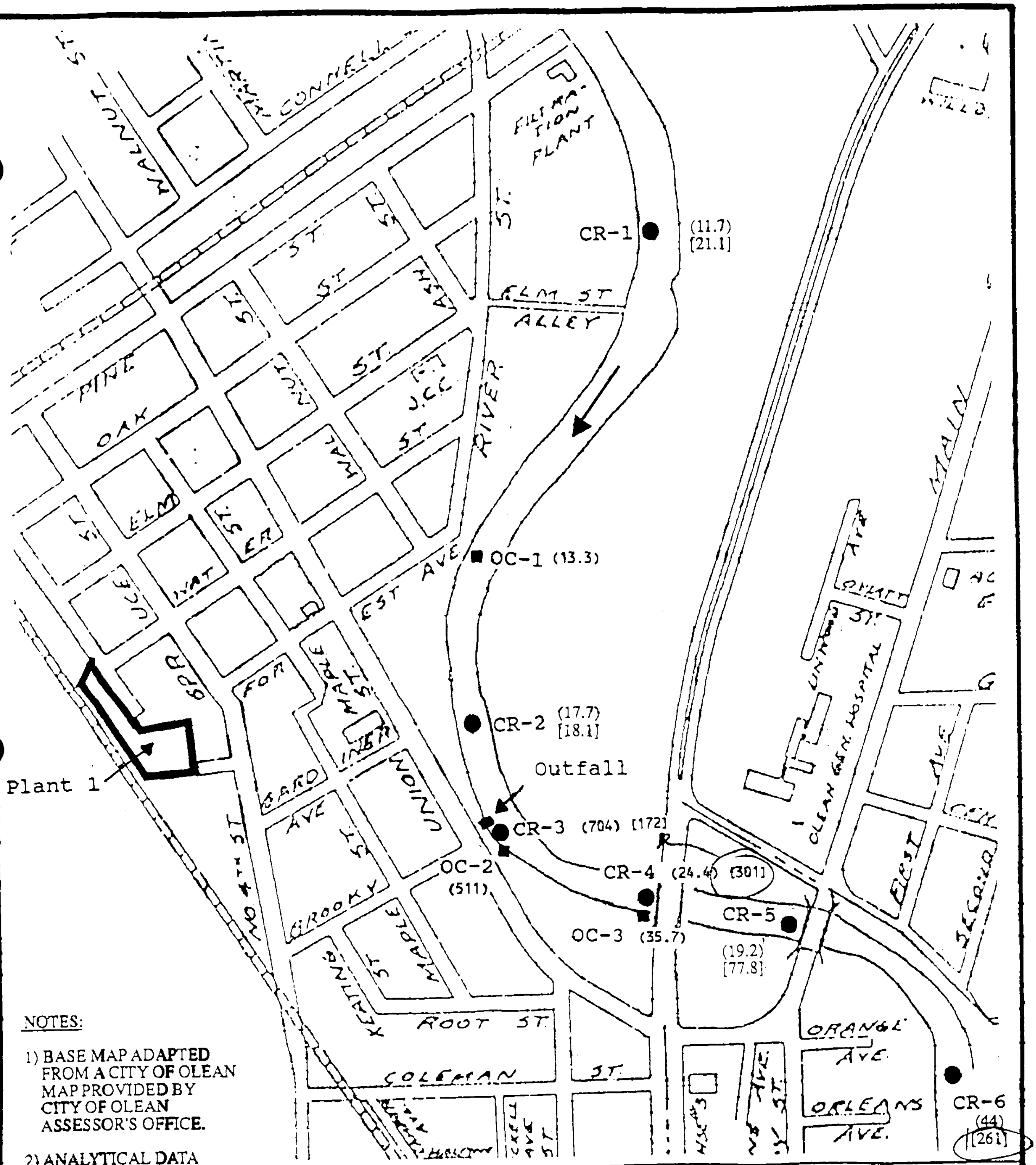
FIGURE
6-13

6.2.6 Olean Creek

Sediment

Figure 6-14 presents the chromium concentrations in Phase I and II sediment samples collected from the banks and channel bottom of Olean Creek. Chromium concentrations within the sediments appear to be highest near the Brookview storm-sewer outfall; however, elevated chromium concentrations (i.e., chromium concentrations greater than 50 mg/Kg) were measured in three bank samples (i.e., CR-4, CR-5 and CR-6) downstream of the outfall.

Based on a comparison of the chromium concentrations in sediment upstream and downstream of the outfall, it appears that this outfall was/is a source of the elevated levels of chromium that have been detected in Olean Creek. This trend is further indicated by the fact that the chromium concentrations in sediment samples collected immediately downstream of the Brookview outfall (OS-OC-3 and OS-OC-4; see Figure 6-15) are over 100 times higher than the concentrations in sediment samples collected immediately upstream of the outfall (OS-OC-1 and OS-OC-2).



NOTES:

1) BASE MAP ADAPTED FROM A CITY OF OLEAN MAP PROVIDED BY CITY OF OLEAN ASSESSOR'S OFFICE.

2) ANALYTICAL DATA PROVIDED BY RECRA ENVIRONMENTAL, INC.

LEGEND:

■	PHASE I SEDIMENT SAMPLING LOCATION
●	PHASE II SEDIMENT SAMPLING LOCATION
(11.7)	TOTAL CHROMIUM CONCENTRATION IN CREEK SEDIMENT (mg/Kg)
[21.1]	TOTAL CHROMIUM CONCENTRATION IN BANK SEDIMENT (mg/Kg)

TITLE

CHROMIUM CONCENTRATIONS IN OLEAN CREEK SEDIMENT

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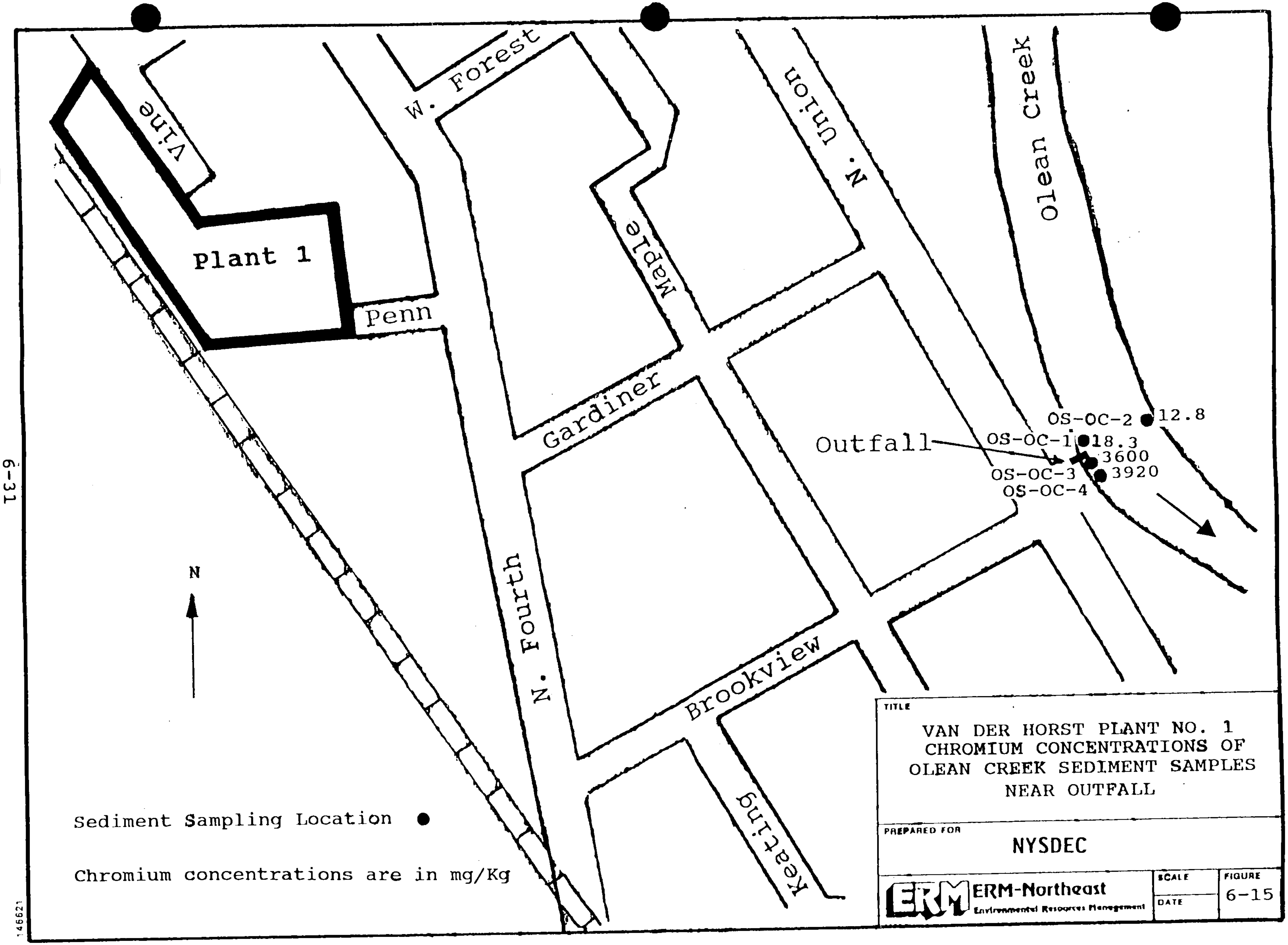
SCALE

DATE

FIGURE 6-14



Sediment Sampling Location ●

Chromium concentrations are in mg/Kg

TITLE

VAN DER HORST PLANT NO. 1
CHROMIUM CONCENTRATIONS OF
OLEAN CREEK SEDIMENT SAMPLES
NEAR OUTFALL

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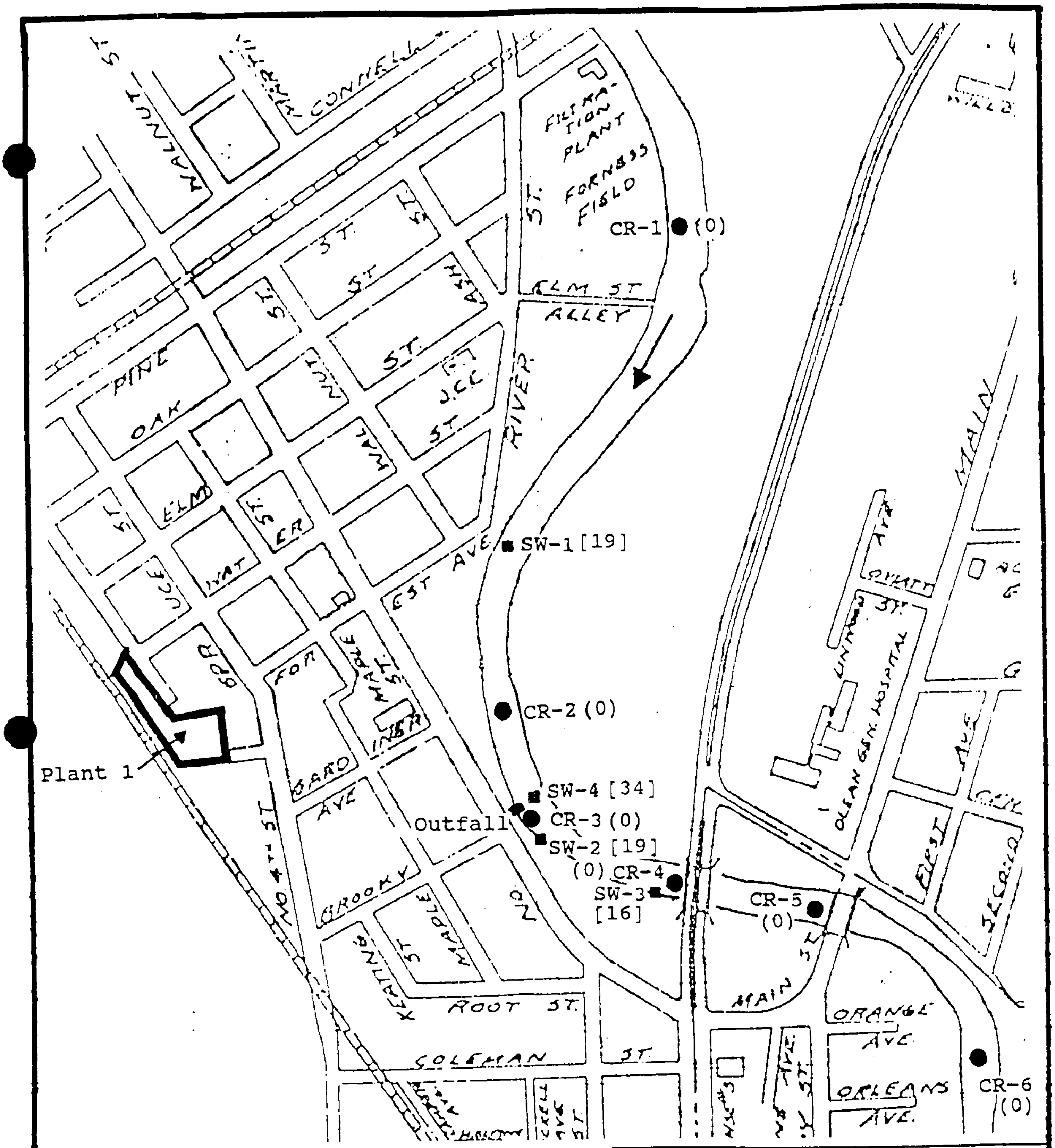
SCALE	FIGURE
DATE	6-15

Surface Water

Aluminum, iron and zinc were the only analytes detected above Class "C" surface water quality standards in both the Phase I and Phase II RI sampling programs. During the Phase I sampling, elevated concentrations of aluminum and iron were detected within the sample collected further downstream of the Brookview St. outfall (SW-2). The sample collected upstream of the outfall (SW-1) had the lowest levels of all three metals. The outfall sample (SW-4) contained the highest amounts of the three metals. Low levels of hexavalent chromium were also detected at all four sampling locations (see Figure 6-16). Phase I samples were collected during turbid stream conditions, which could not be avoided due to the unseasonably wet conditions during the spring and summer of 1989.

During the Phase II sampling of surface water, aluminum and iron were detected at higher concentrations upstream of the outfall than they were downstream of this outfall, and zinc was detected at only one location. Hexavalent chromium was not detected in any of the surface water samples and total chromium was not detected above surface water quality standards. Based on the



■ PHASE I SAMPLING LOCATION
● PHASE II SAMPLING LOCATION
[19] PHASE I HEXAVALENT Cr CONCENTRATION (ug/L)
(0) PHASE I HEXAVALENT Cr CONCENTRATION (ug/L)

Note: Duplicate sample CR-7 was also collected at CR-3

TITLE

HEXAVALENT CHROMIUM
CONCENTRATIONS,
OLEAN CREEK SURFACE WATER

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SCALE

DATE

FIGURE
6-16

Phase I and II results, it appears that the surface water in Olean Creek was not significantly impacted by the Brookview outfall (i.e., contaminants associated with the subject site migrating through the storm sewer) at the times of sampling. Any suspension of creek sediments also appeared to have a minimal effect on the surface water quality the time of the Phase II sampling event. The higher metal concentrations found in the Phase I samples probably resulted from greater stream turbidity.

6.2.7 Ground Water

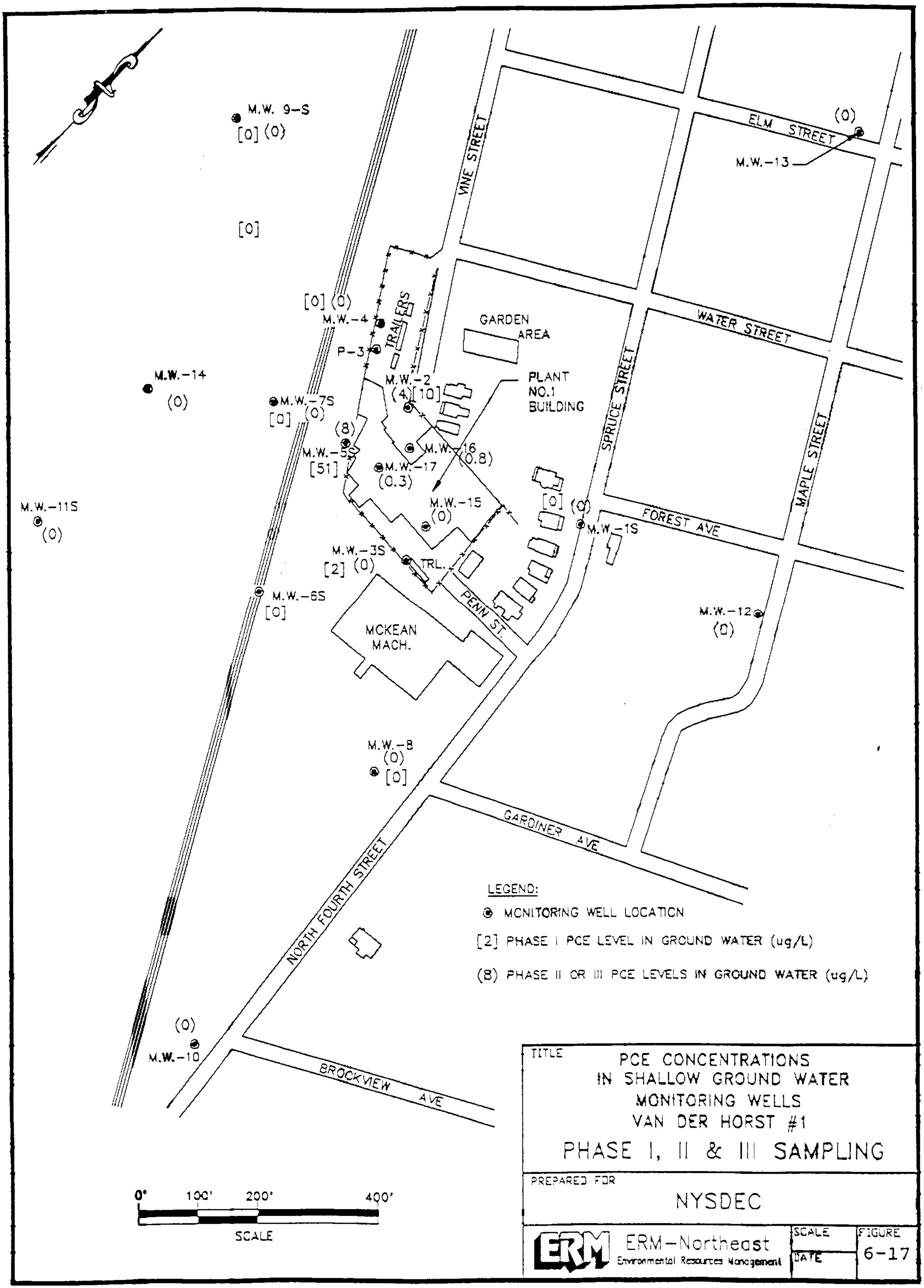
Phase III Sampling and Analysis

The objective of the Phase III ground water sampling was to locate the ground water contamination source(s), and to further delineate the extent and concentration of on-site and off-site ground water contamination. Three (3) additional shallow monitoring wells (MW-15, MW-16 and MW-17) and one (1) additional deep monitoring well (MW-19D) were installed and sampled during Phase III. Ground water samples were analyzed for TCL volatile organics, TAL metals and hexavalent chromium.

Volatile Organics

Only four TCL Volatile Organics (PCE, TCE, 1,2-dichloroethene(total) and vinyl chloride) were detected above NYSDEC ground water standards during all three phases of the RI. PCE concentrations will be discussed in this section since PCE was the only volatile organic identified in the final Risk Assessment (Section 5.0) as posing a risk to human health or the environment.

The Phase I, II and III PCE concentrations in shallow monitoring well ground water samples are illustrated in Figure 6-17. PCE was detected in only five (5) of the shallow wells (MW-2, MW-3S, MW-5S, MW-6S and MW-16) at concentrations ranging from 51 ug/L (MW-5S, Phase I) to 0.8 ug/L (MW-16, Phase III). PCE was also detected in MW-5D (18 ug/L in Phase I and 0.8 ug/L in Phase II) but was not found in any other deeper wells within the upper aquifer. The NYSDEC limit for PCE in ground water is 0.7 ug/L. Phase I PCE levels are higher than concentrations detected during Phase II and III; however all results from Phases I, II and III indicate that the extent of PCE contamination is relatively small (Figure 6-17). PCE contamination



TITLE
PCE CONCENTRATIONS
IN SHALLOW GROUND WATER
MONITORING WELLS
VAN DER HORST #1
PHASE I, II & III SAMPLING

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SCALE	FIGURE
DATE	6-17

appears to be limited to the area beneath and east/southeast of the Plant 1 building.

Metals

The following metals were detected above NYSDEC ground water standards in samples from all three phases of the RI:

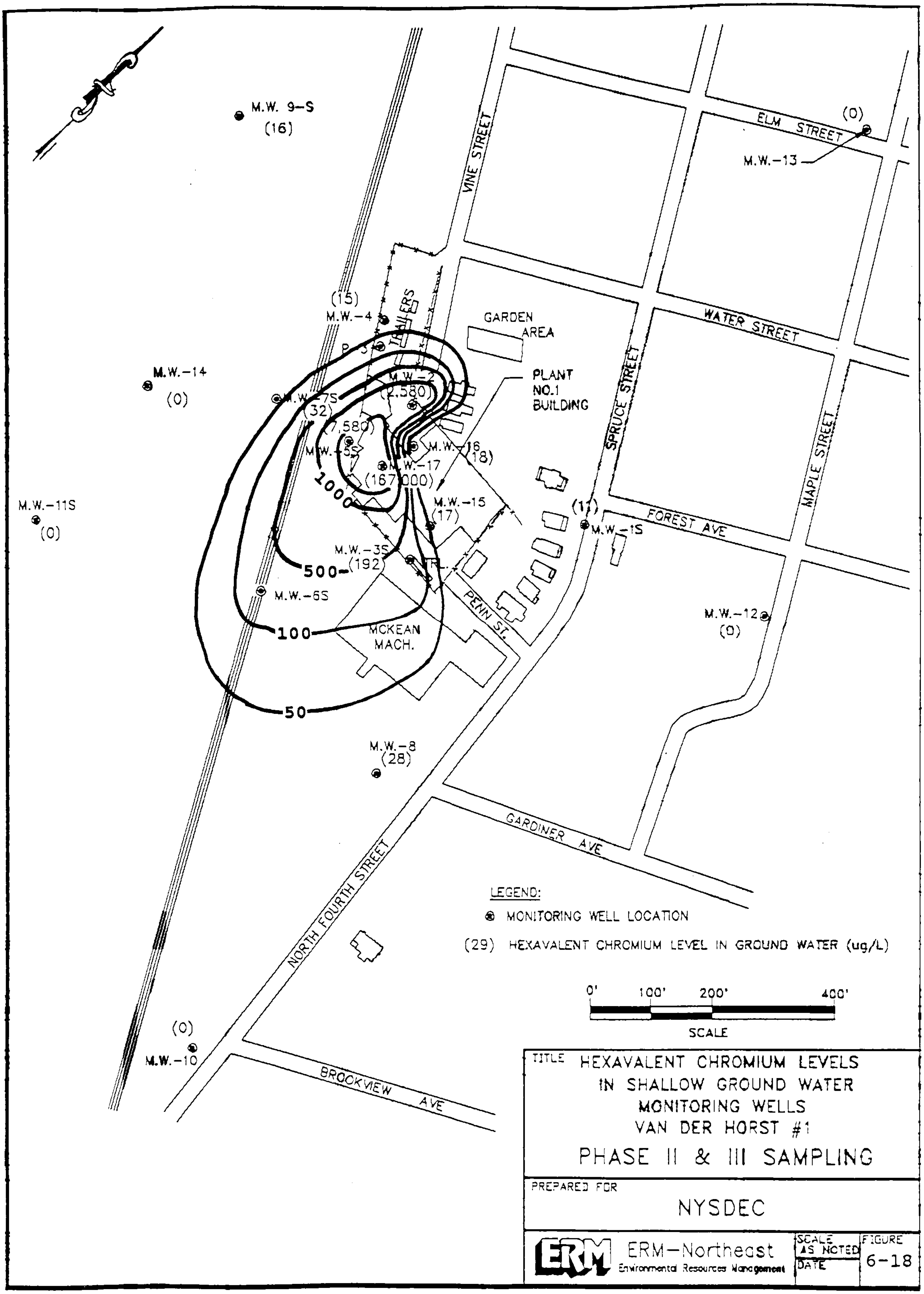
> arsenic, total chromium, hexavalent chromium, copper, iron, lead, magnesium, manganese, and zinc.

Total chromium and hexavalent chromium were the only two metals which have been identified to pose a significant potential health or environment risk in the ground water (see Section 5.0). Elevated levels of the other metals were not considered to be significant risk for the following reasons:

- Lead, iron and manganese exceeded ground water standards in background wells and were not believed to originate from on-site sources.
- Magnesium and zinc were was high in background wells.
- Copper and arsenic could not be directly linked to previous site activities.

The most extensive ground water contaminants associated with Plant No. 1 were total and hexavalent chromium. Estimated areas of total and hexavalent chromium in ground water during the Phase II and III sampling events are illustrated in Figures 6-18 to 6-21. The 50 ug/L contour was used to estimate the outermost limits of the ground water contaminant-plume, since this concentration is the NYSDEC ground water standard for total and hexavalent chromium.

Figures 6-18 and 6-19 present the distribution of hexavalent and total chromium within ground water collected from the shallow monitoring wells. The hexavalent chromium distribution in Figure 6-18 appears to primarily occur southwest of MW-15 and MW-16. The plume axis runs southeast to northwest. The area of total chromium contamination in the shallow wells extends beyond the limits of hexavalent chromium contamination (i.e., some wells exhibit total chromium contamination but not hexavalent chromium). The primary axis of the contamination plume runs north to south. The principle directions of chromium migration in the shallow monitoring wells appear to be south and southeast of the Plant No. 1 building, based on the contaminant distribution shown in Figures 6-18 and 6-19. The highest



LEGEND:

● MONITORING WELL LOCATION

(29) HEXAVALENT CHROMIUM LEVEL IN GROUND WATER (ug/L)

TITLE HEXAVALENT CHROMIUM LEVELS
IN SHALLOW GROUND WATER
MONITORING WELLS
VAN DER HORST #1
PHASE II & III SAMPLING

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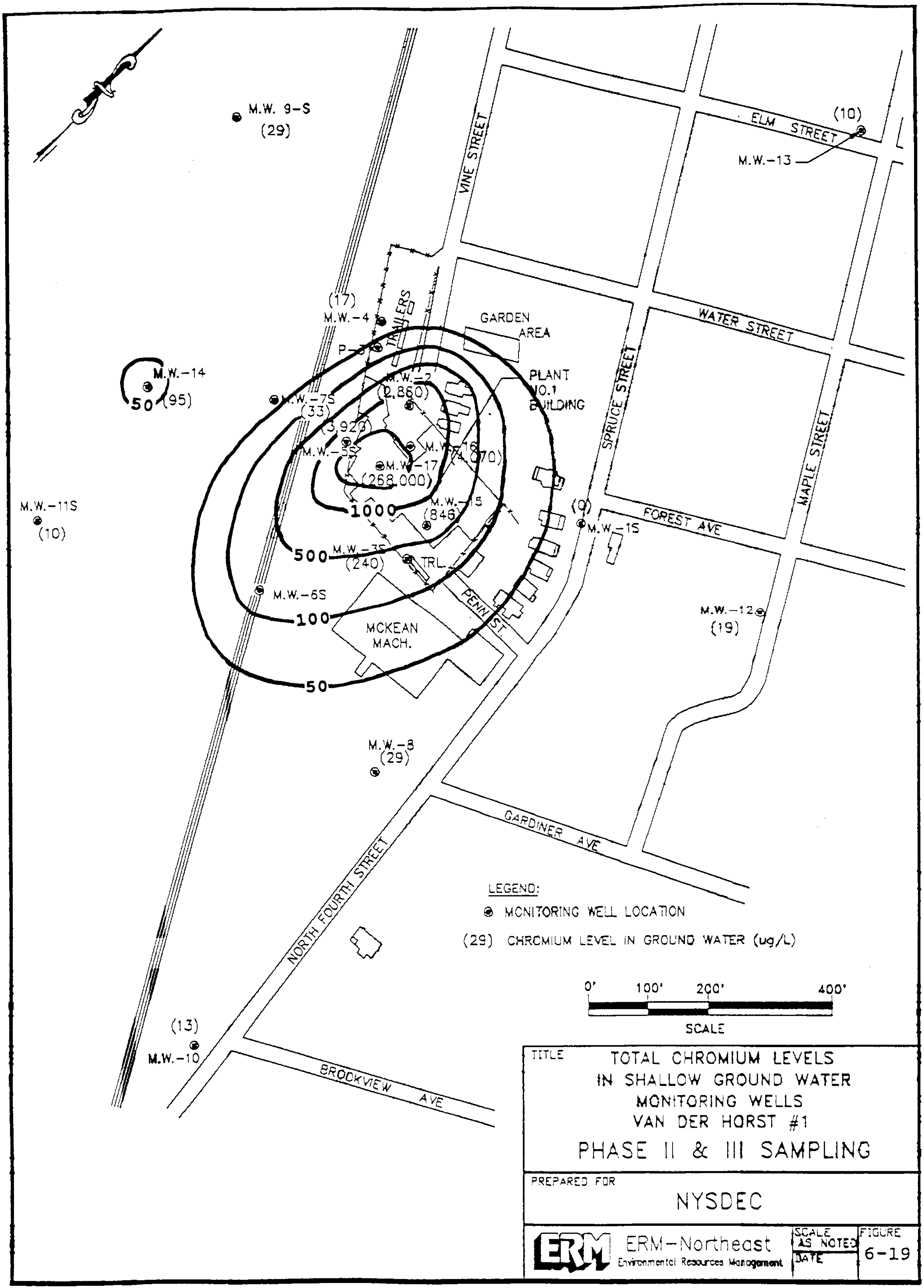
SCALE AS NOTED	FIGURE 6-18
DATE	



TITLE

TOTAL CHROMIUM LEVELS
IN SHALLOW GROUND WATER
MONITORING WELLS
VAN DER HORST #1
PHASE II & III SAMPLING

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SCALE AS NOTED

DATE

FIGURE 6-19

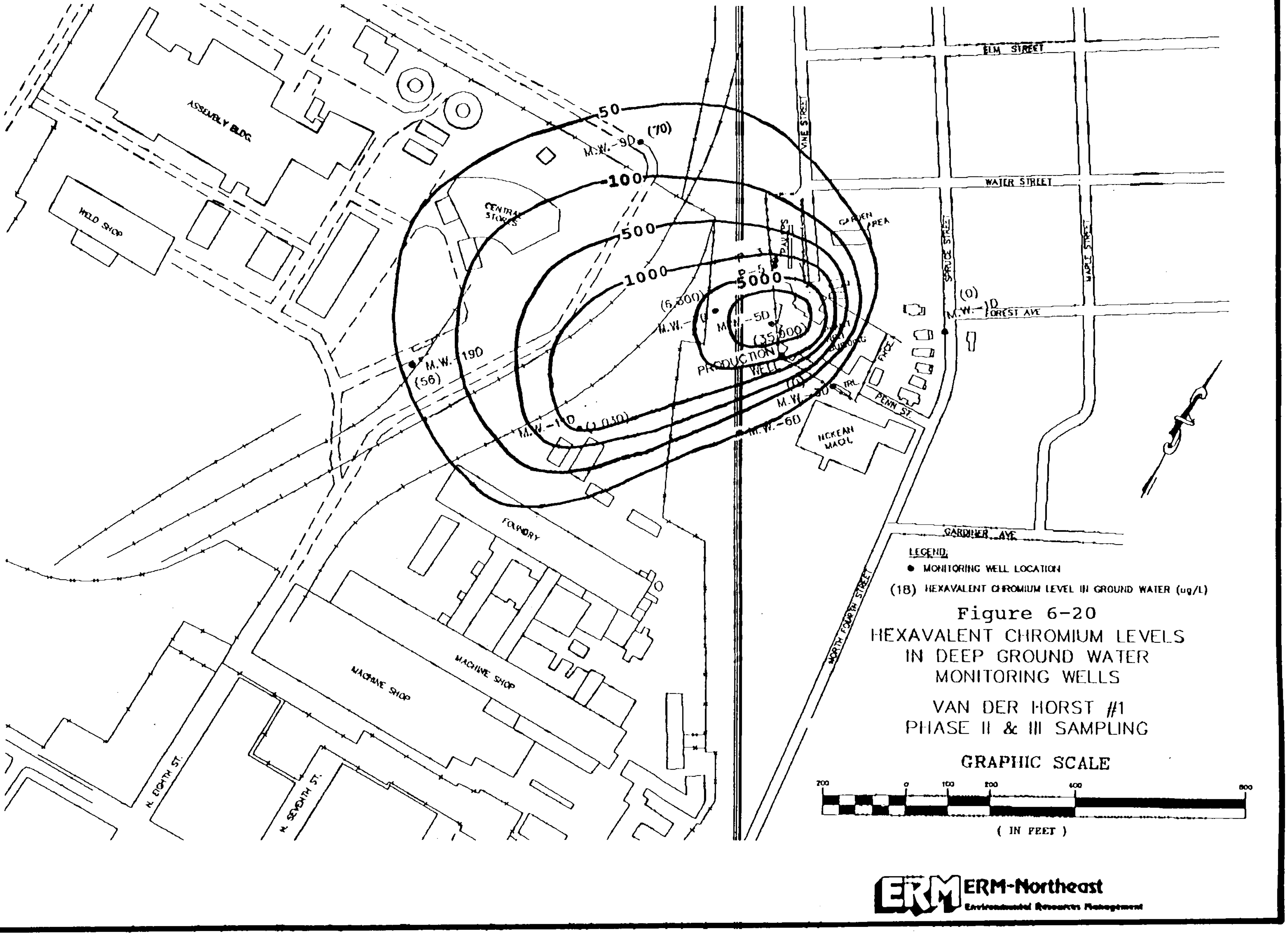
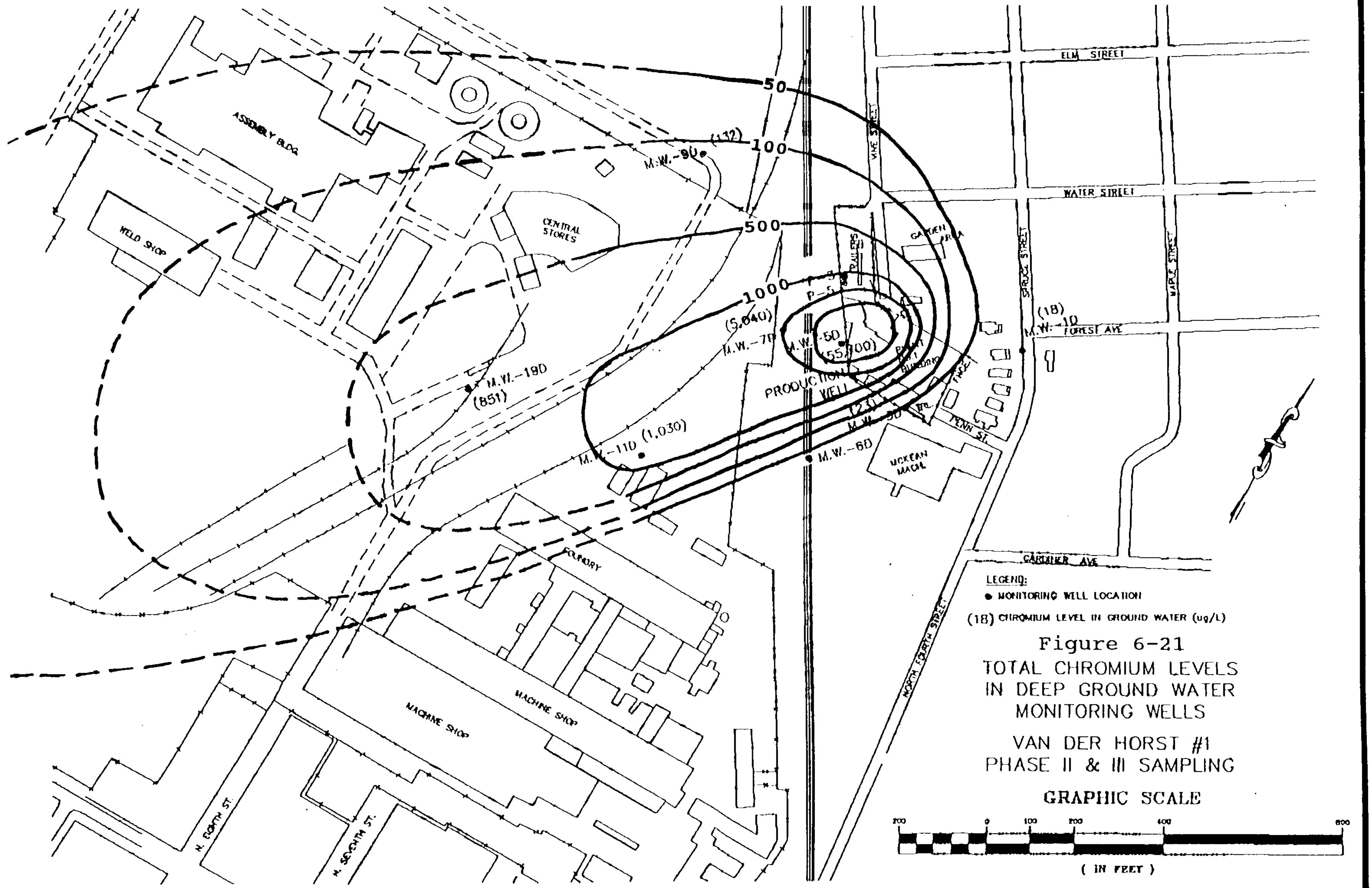


Figure 6-20
HEXAVALENT CHROMIUM LEVELS IN DEEP GROUND WATER MONITORING WELLS

VAN DER HORST #1
PHASE II & III SAMPLING



LEGEND:

● MONITORING WELL LOCATION

(18) CHROMIUM LEVEL IN GROUND WATER (ug/L)

Figure 6-21
TOTAL CHROMIUM LEVELS
IN DEEP GROUND WATER
MONITORING WELLS
VAN DER HORST #1
PHASE II & III SAMPLING

GRAPHIC SCALE

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concentrations of chromium within the ground water have been detected beneath the Plant No. 1 building in well MW-17 (264,000 ug/L total chromium and 167,000 ug/L hexavalent chromium).

Figures 6-20 and 6-21 show hexavalent or total chromium ground water contamination in deep monitoring wells during the Phase II and III sampling events. The axes of the total and hexavalent chromium plumes are northeast to southwest. The major directions of chromium migration are apparently southwest to west. Though the levels of on-site chromium contamination are less than that observed in shallow wells, chromium contamination has spread further off-site within the deeper portion of the aquifer.

The off-site limits of total chromium contamination from Plant No. 1 have not been defined for ground water in the deep monitoring wells. The 50 ug/L concentration contour in Figure 6-21 is open ended to the southwest and west. Dashed portions of the 100 ug/L and 500 ug/L contours have been estimated. The total chromium level in Phase III monitoring well MW-19D (851 ug/L) indicates that a significant amount of contamination has migrated beyond the present deep monitoring well network.

Estimated concentration limit contours are based on known chromium levels and the ground water flow direction in the deep monitoring wells. Additional monitoring well installation and sampling will be required to define the plume west and southwest of Plant No. 1.

The distribution of chromium contamination in the shallow and deep monitoring wells (Figures 6-18 to 6-21) appears to be fairly consistent with the ground water flow direction within this upper aquifer. The primary direction of chromium transport in the shallow wells is towards the south. Ground water flow has been shown, on occasion, to have a southern trend in the shallow wells; however the primary flow direction is apparently to the southwest. Chromium contamination in the deep monitoring wells appears to be moving in a southwest and west direction. The principle ground water flow directions in the deep wells are similarly southwest and west.

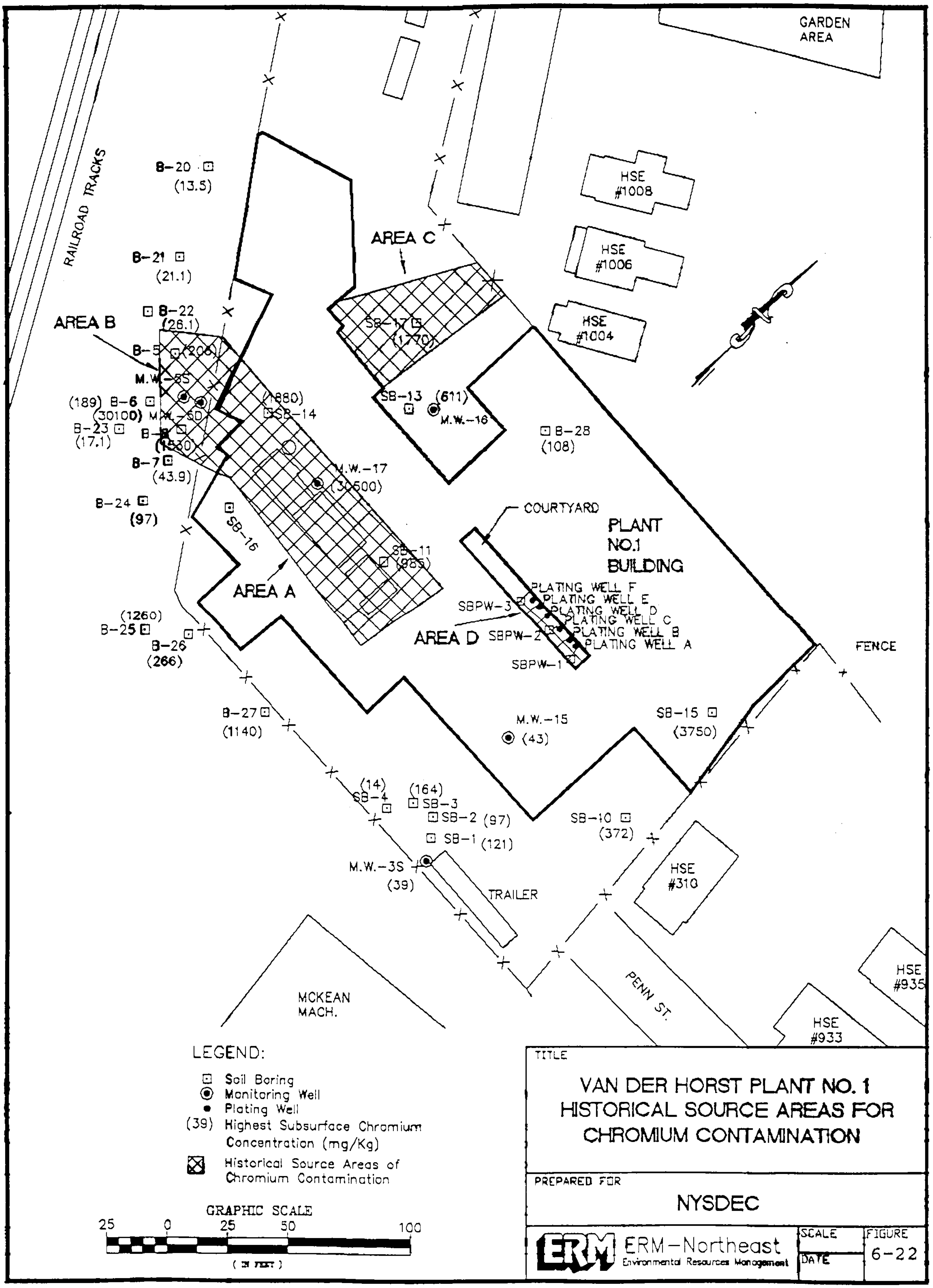
The extent of total and hexavalent chromium contamination within the shallow monitoring wells appears to be fairly well defined by the RI analytical results. Likewise, the limits of hexavalent chromium in the deep monitoring wells seems to be established. However, the total chromium plume in the deep monitoring wells extends beyond the well network and will require additional well installation and sampling before the plume is adequately delineated. The present data suggest that the concentrations of chromium diminish to the south and southwest. The downward hydraulic gradient in the upper aquifer southwest of Plant No. 1 may have been the cause for the greater areal extent of the deep well contaminant-plume. The downward hydraulic gradient within the upper aquifer can be up to an order of magnitude more than the horizontal gradient. Contamination in the shallow wells appears to have moved downward within the upper aquifer (i.e., towards the deeper wells) as it was transported southwest of the site.

6.3 Potential Sources of Contamination

In the context of this discussion, a source area is a deposit of contaminated soil or waste that appears to be a source of contamination to either the ground water, surface water or air, and is an area where one or more of the indicator chemicals was measured at a concentration above the cleanup level determined in the risk assessment. Based on this definition of a source, all surface and subsurface soil with chromium concentrations greater than 50 mg/Kg would be considered as a source area. Surface and subsurface soil source areas are presented in Figures 6-2 and 6-3. Subsurface soil profiles located on Figure 6-5 and illustrated in Figures 6-6, 6-7 and 6-8 indicate the depth of these subsurface source areas.

Within the chromium contamination source areas are regions which are believed to be the sources for most of the ground water contamination at the site. These regions contain chromium levels which exceed 1000 mg/Kg and are associated with historical plant operations which have led to these high concentrations. Contamination regions of this nature are referred to as "historical contaminant source areas". Four historical contaminant source areas have been identified at the Plant No. 1 site. These areas have been respectively named Areas A, B, C and D, and are shown in Figure 6-22.

Historical source Area A is located along the chromium plating tanks in the main building of the plant. This area is roughly 4150 square feet. High levels of chromium Area A are believed to have occurred by chromic acid leakage from tanks during the plating process. A soil sample from monitoring well MW-17 in Area A contained the highest level of chromium detected in subsurface soil at the plant (3.05 percent or



TITLE

VAN DER HORST PLANT NO. 1 HISTORICAL SOURCE AREAS FOR CHROMIUM CONTAMINATION

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Environmental Resources Management

SCALE

DATE

FIGURE 6-22

30,500 mg/Kg). This level of chromium is particularly significant because it was detected in a soil sample collected 5 to 7 feet below the water table. Chromium concentrations greater than 1000 mg/Kg were also detected in several subsurface soil samples above the water table. A total chromium concentration of 270,000 ug/L was detected in MW-17 ground water during the Phase III sampling round. High chromium levels found in MW-17 ground water appear to have been originated from the saturated soil in Area A, since the soil concentrations are approximately 100 times greater than ground water concentrations. Area A appears to be the primary source of ground water contamination at the site. The areal and vertical extent of high concentrations of chromium in saturated and unsaturated soil from Area A has not yet been determined.

Historical source Area B is located immediately west of the western plant wall and property fence. This area is roughly 1450 square feet. Chromium contamination in Area B is believed to have resulted from surface discharge of fluids from the plant chromic acid filters (Gino Lorenzino, personal communication). Soil with the highest chromium level (585,000 mg/Kg) was detected in surface soil sample MW-5A (0'-2') from this area. Chromium levels greater than 1,000 mg/Kg have been found in Area B soil samples collected below the water table.

Elevated chromium concentrations in Area B soil below the water table are believed to have been caused by sorption of chromium from contaminated ground water.

Historical source Area C is northwest of the main plant building (surrounding SB-17) and covers an area approximately 1800 square feet. Chromium contamination greater than 1,000 mg/Kg was observed in two of the unsaturated subsurface soil samples from SB-17. The exact source of the subsurface chromium contamination is not known, but may have resulted from former disposal practices or spillage, since this area is immediately outside of the major storage area within the building.

Historical source Area D is located in the courtyard surrounded by the plant buildings and has an approximate surface area of 300 square feet. The potential source of chromium contamination in this area is not the soil, but the liquid contained in three of the six formerly operating plating wells. These wells were used for chromium plating of navy cannon barrels. The wells are 32 ft deep and could have discharged chromium directly to the ground water. Saturated and unsaturated subsurface soil may also have been contaminated by these plating wells. The following wells contained high levels of chromium: Plating Well A (700,000 ug/L); Plating Well B (22,900 ug/L) and Plating Well D (610 ug/L). NYSDEC Ground water standards for chromium are 50 ug/L.

It is possible that saturated soil with elevated chromium levels could serve as a contamination source as chromium desorbs from the soil to the ground water. Desorption of chromium from saturated soil would be most prevalent during pump and treat operations, when chromium concentrations in ground water would be decreasing. Desorption of chromium from the aquifer material could significantly increase the pump and treat time required to reduce chromium levels in ground water to 50 ug/L.

7.0 SUMMARY AND CONCLUSIONS

7.1 Summary

This section summarizes the results of Phases I, II and III of the RI. Data from all three studies have been collectively used in delineating the extent of soil/storm sewer water/sediment, surface water/sediment and ground water contamination. Specifically, this section focusses on the results presented in Sections 5.0 and 6.0, since these sections provide the findings and interpretations of the study, and are based on the data presented in preceding sections (i.e. Sections 1.0 through 4.0).

7.1.1 Risk Assessment Overview

The public health risk assessment concluded that under current conditions there are carcinogenic effects from chromium in fugitive dust emissions and arsenic in residential soil (incidental ingestion by children). Under future conditions, if no remedial action is taken, the carcinogenic effects include PCE in drinking water, chromium in fugitive dust emissions and arsenic in residential soil. Additionally, the risk assessment concluded that noncarcinogenic effects under future conditions include chromium and lead in groundwater. Noncarcinogenic effects under future conditions for lead in ground water were only significant in the Phase I data.

Based on the environmental risk assessment, no adverse effects to sensitive environmental resources are expected to occur as a result of the site contaminants. However, several of the contaminants found in sediment and surface water samples collected from Olean Creek are above SCGs, and may be impacting benthic and aquatic life in this creek.

7.1.2 Delineations of Contamination and Potential Sources

Surface Soil

Based on surface soil samples collected during the entire RI, it appears that the area of chromium contaminated surface soil (see Figure 6-1) includes:

- The majority of the surface soil within the fenced-in confines of the site;
- An area outside the fence (i.e., approximately 50 feet beyond the fence to the east and north);
- An area from Penn St. to about 100 ft north of Penn St;

- McKean Machinery property south of Plant No. 1;
- The area between the railroad tracks and the southwest property fences for Plant No. 1 and McKean Machinery; and
- The courtyard area surrounded by the Plant No. 1 buildings.

The area of chromium contaminated soil was delineated by the 50 ppm cleanup level recommended in the final risk assessment (Section 5.3.1.2).

The extent of surface soil contamination at the southern most portion of the outlined region on Figure 6-1 went beyond the RI sampling locations and is labelled with question marks. Surface water runoff from Plant No. 1 appears to have carried chromium contamination south of sample SFS-20.

Subsurface Soil

Chromium concentrations greater than 50 mg/Kg were detected in on-site subsurface soil southeast of the northwest addition to the building. Off-site areas with subsurface levels greater than 50 mg/Kg included the Conrail property between the plant fence and the railroad tracks, and McKean Machinery property adjacent to the south property fence and Plant No. 1 (see Figure 6-4).

The vertical extent of contamination in unsaturated subsurface soils has been found to extend from ground level to the water table in many areas beneath the plant building. The typical pattern of chromium concentrations in these areas is:

- High levels of chromium near the ground surface;
- Decreasing chromium concentrations with depth; and
- Increasing chromium levels near the water table.

Chromium concentrations in saturated soils are also elevated in some on-site areas and adjacent to the Plant No. 1 western property fence. The extent of elevated chromium levels in these areas has not been defined. Saturated soil with chromium concentrations that are significantly greater than that present in the interstitial could be a potential source of ground water contamination (i.e., chromium adsorbed onto soil). The highest levels of chromium detected in saturated subsurface soils were found in monitoring well MW-17 (which is positioned adjacent to the formerly used plating tanks).

Storm Sewer

The sediment and water samples collected from the storm-sewer system that runs from the east side of the site to the Brookview outfall indicate that this system contains elevated levels of chromium and lead. Based on Phase II data, it appears that the chromium concentrations are highest in water and sediment samples that were collected between the Van Der Horst connection to the storm sewer and Keating Street (i.e., down-flow from Van Der Horst Plant No.1).

Creek Sediment

Chromium concentrations in sediment appear to be the highest near the Brookview storm-sewer outfall; however, elevated chromium concentrations (i.e., chromium concentrations greater than 50 ppm) were measured in three of the bank-sediment samples downstream of the outfall. Based on a comparison of the chromium concentrations in sediment upstream and downstream of the outfall, it appears that this outfall was/is a source of the elevated chromium in Olean Creek.

Surface Water

Aluminum, iron and zinc were the only analytes detected above Class "C" surface water quality standards in surface water from Olean Creek during the Phase I and II RI sampling programs. Thus, it appears that the surface water in Olean Creek was not being significantly impacted by the Brookview outfall (i.e., contaminants associated with the subject site migrating through the storm sewer) or the creek sediments (i.e., through suspension of contaminated sediments) at the time of the Phase II sampling event. Phase I concentration of these metals were higher and may have been impacted by suspended sediment, since the creek was relatively turbid during the time of sampling.

Ground Water

Chromium and PCE have been determined to be the principle ground water contaminants. PCE levels in ground water samples indicate that PCE contamination primarily occurs within the shallow monitoring wells beneath and immediately adjacent to the Plant No. 1 building. Chromium contamination within the shallow monitoring wells, has predominately migrated south of

Plant No. 1. The extent of the chromium plume in the shallow monitoring wells appears to lie within the existing monitoring well network. The plume limits were defined by the NYSDEC ground water limit of 50 ug/L.

Chromium contamination in the deep monitoring wells has been transported to the southwest and west beyond the Phase I, II and III wells. This plume has been delineated on all sides except to the southwest. Additional well installation and ground water sampling to the southwest will be required to delineate the chromium ground water plume in the deep monitoring wells.

Areas of Soil Contamination

Four historical source areas (Areas A, B, C and D) were identified during the review of data from Phases I, II and III of the RI (see Figure 6-22). These historical source areas were regions where specific plant activities have been identified as the cause of surface and subsurface soil contamination. All areas contain at least one subsurface soil sample which had chromium concentrations exceeding 1000 mg/Kg.

Area A is located along a series of chromium plating tanks within the main building of the plant. The tanks are believed to have leaked during plant operations. One subsurface, saturated soil sample from this area had a chromium concentration of 30,500 mg/Kg or 3.05 percent. Area A is believed to be the primary source of ground water contamination at the site. Ground water from Area A monitoring well MW-17 had a chromium concentration of 264,000 ug/L.

Area B is located immediately west of the western plant wall and property fence. Chromium contamination in Area B is believed to have resulted from surface discharge of fluids from the plant chromic acid filters. Percent levels of chromium were detected in Area B surface soil. Chromium concentrations greater than 1000 mg/Kg were found in saturated subsurface soil beneath Area B.

Historical source Area C is northwest of the main plant building. Chromium contamination in this area may have resulted from former disposal practices or spillage from the nearby storage area within the building.

Area D is located in the courtyard surrounded by the plant buildings. The potential source of contamination in this area is the liquid contained in three of the six formerly operating plating wells. These wells extend below the water table and could be in hydraulic connection with the aquifer. Chromium concentrations of 700,000 ug/L, 22,900 ug/L, and 610 ug/L were respectively detected in wells A, B and D. Saturated and unsaturated soil surrounding these wells may also be a source of chromium contamination to ground water.

Two off-site areas of sediment contamination have been identified based on the Phase II RI. The first is the sediments in the storm sewer system that runs between the site and the Brookview outfall. The second off-site area is the Olean Creek sediments near the Brookview outfall. It appears that these sediments are in the immediate vicinity of the outfall, and are believed to extend across the entire stream channel at this location.

7.2 Conclusions

This section summarizes: 1) the limitations of the RI data; and 2) recommendations for the initial phase of the remedial action program. The conclusions presented with regard to these two items are based upon the information presented in previous sections.

7.2.1 Limitations

The findings of this study are based upon explorations, field measurements and analyses which are subject to certain limitations. These limitations are summarized below:

Explorations and Measurements

The geologic profiles presented and described herein are intended to convey trends in subsurface conditions. The boundaries between strata are approximate and have been developed by interpretations of widely spaced explorations.

Ground water level readings have been made in the monitoring wells at times and under conditions stated on the field reports. These data have been reviewed and interpretations have been made. However, note that fluctuations in the ground water level will occur due to variations in rainfall and other factors occurring at the time of measurement.

Surveying (elevation of test borings/monitoring wells) was done by others using optical survey techniques. These data were used in developing conclusions made in this report. Should variations become evident, it will be necessary to reevaluate the findings of this report.

Analyses

The analyses and conclusions submitted in this report are based in part on samples tested by others, and are contingent upon their validity. Fluctuations of contaminant levels, types and migration paths may occur due to seasonal fluctuations, temperature variations, ground water fluctuations and other factors.

Use of Report

This report was prepared exclusively for the NYSDEC for specific application to the Van Der Horst Plant No. 1 site in accordance with generally accepted engineering practice. No other warranty, expressed or implied, is made.

7.2.2 Recommendations for Future Work

Although the Phases I, II and III RI provided additional information regarding the physical characteristics of the study area and the contaminants of interest, some additional study will be required to further evaluate site conditions and collect the necessary data for the remedial action and remedial design programs. Some recommended studies for the initial phase of the remedial action program are summarized below:

1) The horizontal extent of total chromium ground water contamination needs to be further delineated with additional deep monitoring wells southwest of the site. This work is necessary to estimate the volume of ground water that is contaminated, so that treatment/disposal alternatives can be evaluated. The limit of chromium contamination in the shallow wells is presently fairly well defined.

2) The existing ground water modeling data should be expanded to include the entire ground water plume, after the limits of total chromium in the deep monitoring well have been defined. Expanded ground water flow simulations which will be used to optimize the recovery of contaminated ground water from the entire plume. The following factors will be evaluated during modeling:

   - Numbers of recovery wells;
   - Recovery well locations; and
   - Recovery well pumping rates.

3) The area of subsurface soil contamination (see Figure 6-4) should be further defined vertically and horizontally to determine remedial action methodologies and cleanup costs. Although the approximate extent of contamination can be estimated in the unsaturated soil, no vertical limits have been determined for the vertical extent of chromium contamination in the saturated soil. Remedial measures for saturated soil can not presently be reliably determined since the vertical

extent is unknown. The maximum possible depth of saturated soil contamination is believed to be the bottom of the upper aquifer beneath Plant No. 1 (at an approximate depth of 90 feet). At the base of the upper aquifer is a 19-foot thick clay layer. Chromium contamination limits in saturated soil are particularly important, since this soil is in direct contact with ground water and is believed to be the primary source of ground water contamination at the site.

4) The southern extent of surface soil contamination on Conrail property east of the railroad tracks should be delineated. Surface water runoff is believed to have transported chromium contamination beyond the southern most Phase III RI sampling point (SFS-20, see Figure 6-1). The delineation should be two-fold: 1) The soil having concentrations of total chromium in excess of the 50 mg/Kg cleanup limit; and 2) The soil that classifies as hazardous (i.e. exceeds TCLP limits).

5) Water from plating wells A, B and D should be pumped out and properly disposed of. These wells should <u>not</u> be grouted as this may interfere with the local soil remediation however, it may be prudent to put a permanent cap on the well casing. Saturated and unsaturated subsurface soil near these wells should be sampled to determine if these soils are also sources of contamination. Subsurface soil sampling may be difficult due to limited access to the courtyard where the plating wells are located; consequently, this task may be postponed until after the building is demolished (if selected).

6) The limit of chromium contamination in Olean Creek sediment near the Brookview storm sewer outfall should be established. Additional creek sediment sampling would be necessary to accomplish this task. A chromium concentration of 50 mg/Kg would be used to delineate sediment contamination.

7.2.3 Recommended Remedial Action Objectives

The remedial action objectives are contingent upon current and future use of ground water by local residents and the potential for contaminant migration to public supply wells. This information has, in part, been collected by the NYSDOH during their residential well survey and the results, combined with the USGS records, are not conclusive that there is no active local (and downgradient) withdrawal of ground water. However, assuming that there is some future exposure path for the contaminated ground water, the following remedial action objectives have been developed:

- Remediate identified areas of contaminated surface and subsurface soil to limit future migration of chromium, lead and PCE;
- Remediate ground water to acceptable risk levels for chromium, lead and PCE;
- Remediate the storm sewer system (i.e. lines between the site and Olean Creek) of residual contamination.
- Remediate the contaminated sediments in the vicinity of the Brookview outfall to Olean Creek; and
- Remediate on-site building structures (possibly including demolition of the plant building) if necessary.
- Remediate the plating well water and contaminated soil associated with the plating wells, if present.

EPA

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3.0 AQUIFER CHARACTERISTICS AND HYDRAULIC TESTING

3.1 Regional Geology

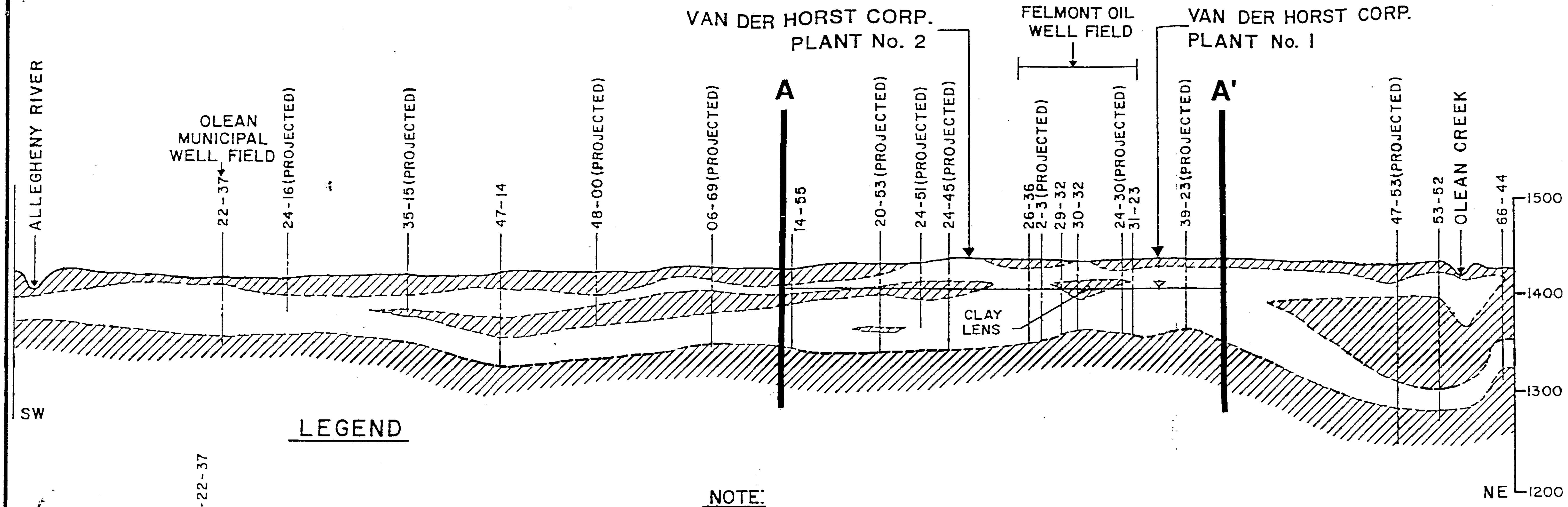
The City of Olean is located within the Allegheny River Basin of the Appalachian Plateau Physiographic Province. The glaciated Allegheny River valley trends east to west and has been eroded several hundred feet into bedrock. Bedrock outcrops can be seen on the steep hills forming the north and south sides of the valley, while bedrock on the valley floor is covered by up to three hundred feet of sediment, consisting mainly of glaciofluvial outwash. These surficial glacial deposits are present at the Van Der Horst Plant No. 1 site and overlie the Upper Devonian shale and siltstone bedrock.

Previous geological studies (USGS, 1987b; USGS, 1988) have concluded that the overlying surficial material locally consists of unconsolidated glacial and fluvial deposits, ranging from 150 to 300 feet in thickness. The underlying material consists of unconsolidated sediments which have tentatively been identified as predominately lacustrine clays and silts. Such sediments are deposited in glacial lakes and locally can range up to 150 feet in thickness (USGS, 1988). Shallower sediments consist of till and stratified drift which were deposited by a former glacial ice tongue which extended down Olean Creek. The post-glacial deposits generally consist of well sorted sand-and-gravel alluvium overlain by silt, and these range from 10 to 30 feet in thickness.

The surficial soils in the valleys are classified as Recent alluvium and exhibit a wide range of sediment grain size. These deposits are made up of gravelly silt loams which may range in thickness from 10 to 30 feet in some areas of the valleys.

A valley fill deposit of fluvial sands and gravels generally occurs beneath the Recent alluvium. The fluvial deposits are typically 40 to 60 feet thick and extend to an average depth of 80 feet below land surface. This deposit of fluvial sands and gravels constitutes the major aquifer in the Olean area and is saturated at depths of 15 - 20 feet below grade. Clay lenses have been documented to occur within the valley fill deposit.

A map of the area surrounding the site is presented in Figure 3-1. Line A - A' is the location of a cross section which passes through the modelled area. Figure 3-2 illustrates the aquifer cross section along A - A'.



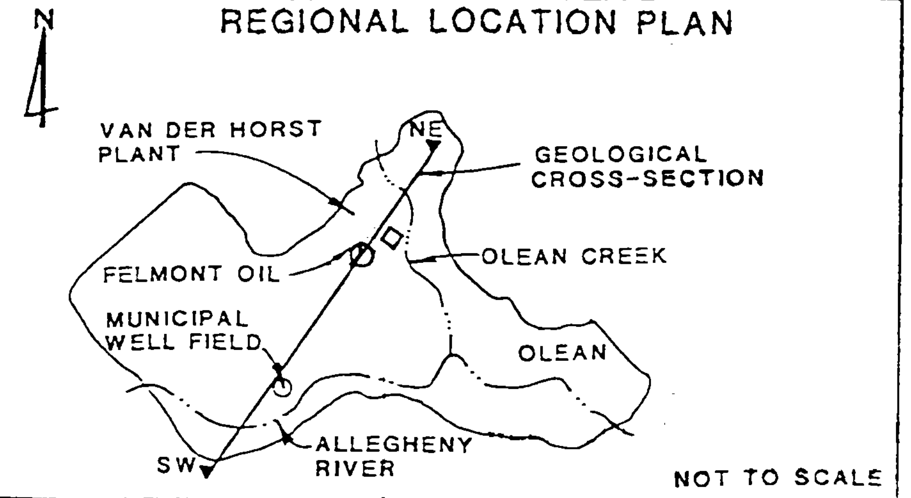
LEGEND

22-37	WELL LOCATION AND NUMBER (LATITUDE AND LONGITUDE)
▨	DEPOSITS OF SILTS AND CLAYS (GLACIOLACUSTRINE OR ALLUVIAL)
☐	FLUVIAL DEPOSITS OF SAND AND GRAVEL

NOTE:

GROUND WATER FLOWS FROM THE NORTHEAST TO THE SOUTHWEST. CONSEQUENTLY, THE CLAY LENS BENEATH THE FELMONT OIL FACILITY MUST BE CONSIDERED WHEN INSTALLING DOWNGRADIENT WELLS.

REGIONAL LOCATION PLAN



HORIZONTAL SCALE: 1"= 1,000'
VERTICAL SCALE: 1"= 100'
VERTICAL EXAGGERATION: 10X
(SOURCE: U.S.G.S., 1985)

TITLE

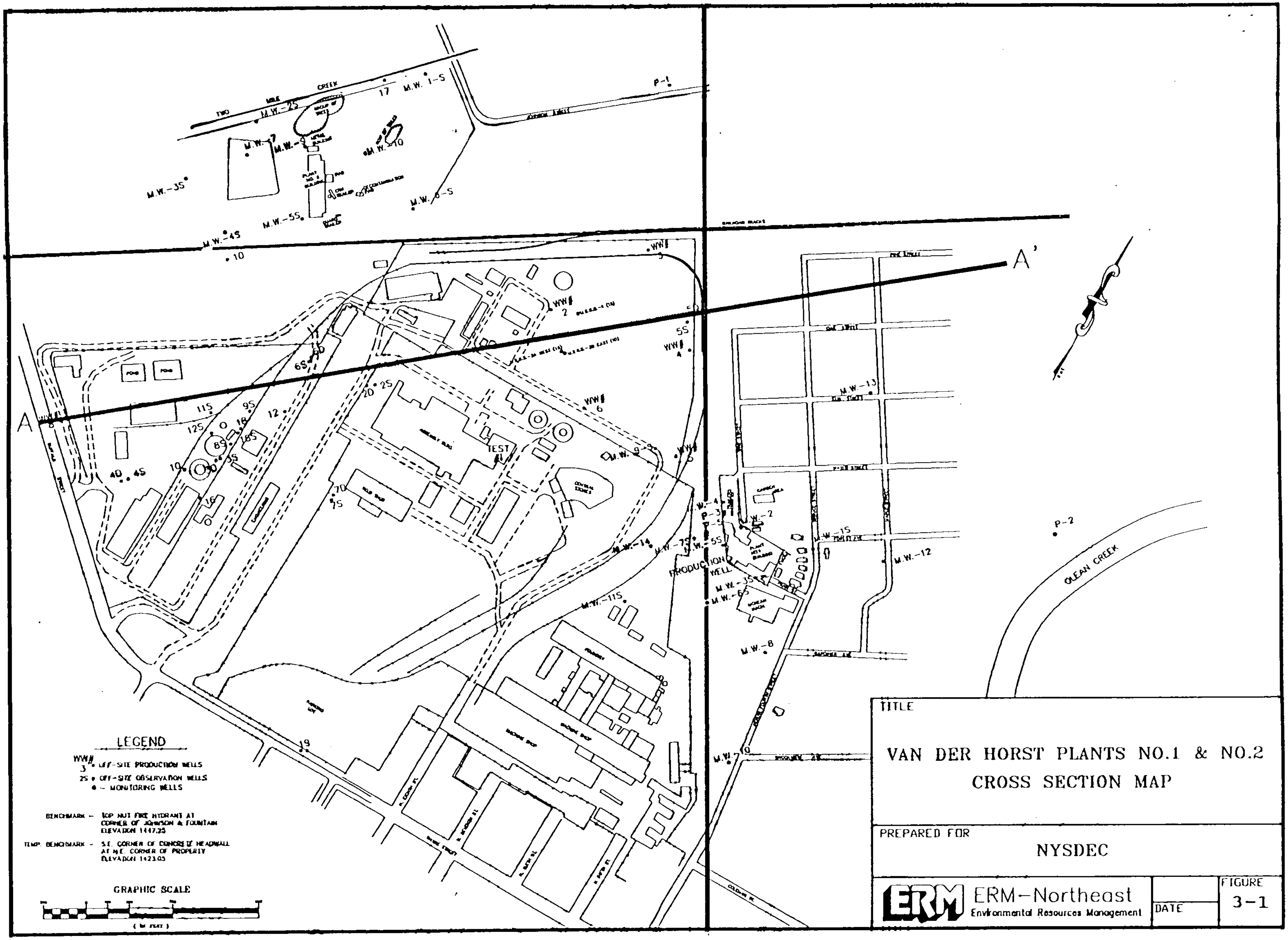
VAN DER HORST RI/FS
GEOLOGICAL CROSS-SECTION

PREPARED FOR

NYSDEC

ERM-Northeast
Environmental Resources Management

SCALE	FIGURE
DATE	3-2



TITLE

VAN DER HORST PLANTS NO.1 & NO.2
CROSS SECTION MAP

PREPARED FOR

NYSDEC

ERM-Northeast
Environmental Resources Management

DATE

FIGURE
3-1

3.2 Site Hydrogeology

Local hydrogeologic conditions at Plant No. 1 have been found to be somewhat different than those of earlier studies. The thickness of Recent alluvial deposits is approximately 10 feet. The top of the upper aquifer at Plant No. 1 is at a depth of about 20 feet. The base of the upper aquifer occurs at a depth of 90 feet (at well MW-5B), and lies above a 19-foot thick, silty clay aquitard. Beneath this aquitard is a semi-confined lower aquifer of unknown thickness. Both the upper and lower aquifers are within sand and gravel deposits. The lower aquifer at Plant No. 1 is not in good hydraulic connection with the upper aquifer, based on pumping test results.

3.3 Ground Water Flow

3.3.1 Regional Ground Water Flow

Static ground water levels were measured twenty-one times at monitoring wells during the period of July 1989 through July 1991. Water levels were measured to the nearest 0.01 feet with an electronic water level indicator. These data are presented in Table 3-1.

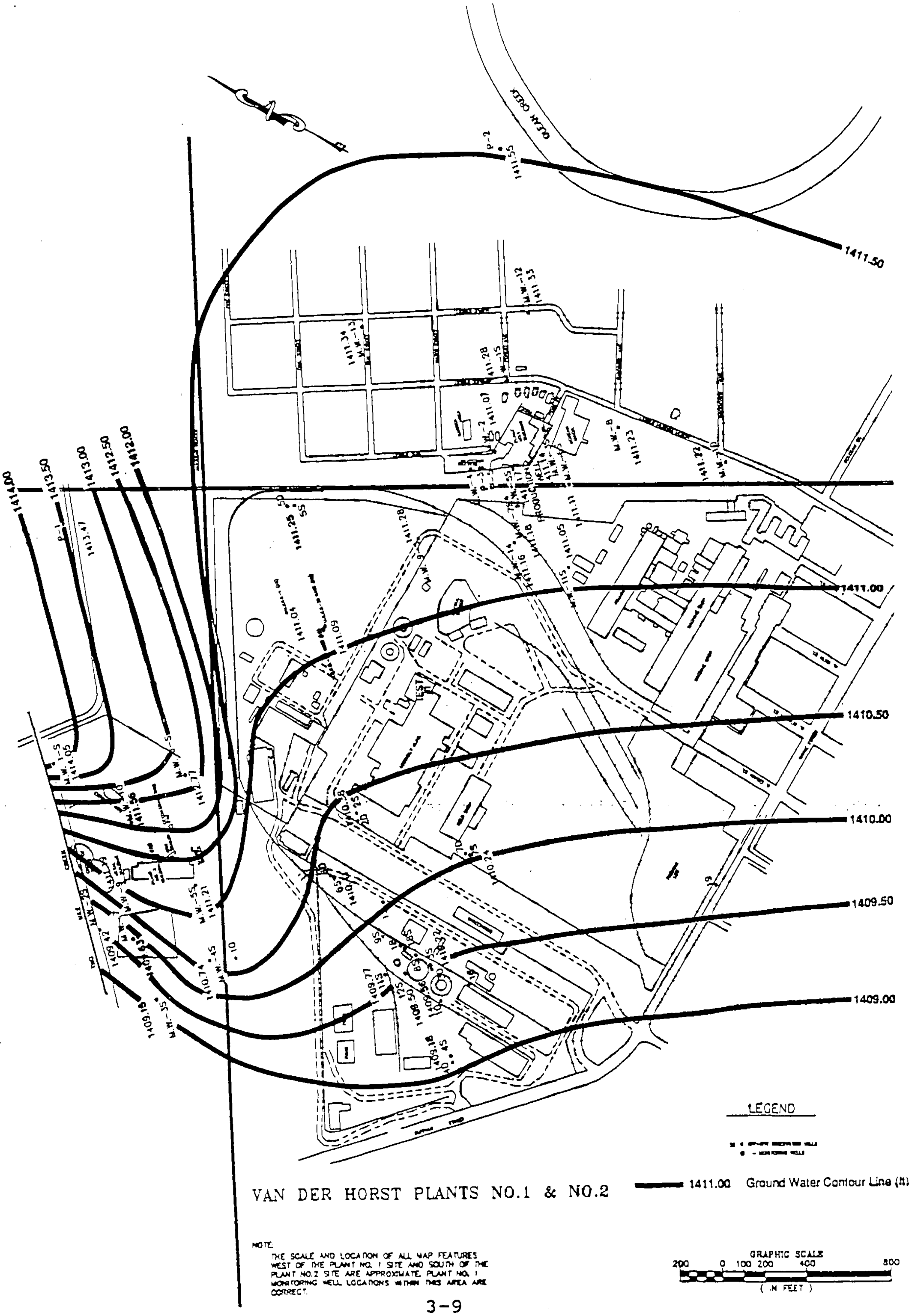
Figure 3-3 presents the April 3, 1991 regional ground water flow in shallow wells within the modelled area. Ground water flow on this date is believed to be representative of typical regional flow conditions. The direction of flow downgradient of Plant No. 1 was towards the southwest. The hydraulic gradient in Figure 3-3 ranged from 0.00025 at Plant No. 1 to 0.005 at Plant No. 2.

In general, the ground water flow direction in the shallow wells located along the railroad tracks between Plants No. 1 and No. 2, is to the southeast. This southeastern component of ground water flow is believed to result from the much lower hydraulic conductivity of the shallow sediments northwest of Johnson Street. The gradient in the shallow wells of this area is not believed to be representative of the overall regional flow direction of the aquifer.

Figure 3-4 presents the regional ground water flow in the deep wells. The flow direction in the deep wells throughout the modelled area is to the southwest, and the hydraulic gradient ranges from 0.0003 at Plant No. 1 to 0.0009 southwest of Plant No. 1. The direction and magnitude of the hydraulic gradient in the deep

Figure 3-

Ground Water Contours for Shallow Monitoring Wells on April 3, 1991



VAN DER HORST PLANTS NO.1 & NO.2

NOTE:
THE SCALE AND LOCATION OF ALL MAP FEATURES WEST OF THE PLANT NO. 1 SITE AND SOUTH OF THE PLANT NO.2 SITE ARE APPROXIMATE. PLANT NO. 1 MONITORING WELL LOCATIONS WITHIN THIS AREA ARE CORRECT.

Figure 3-4

Ground Water Contours for Deep Monitoring Wells on April 3, 1991

1411.00 Ground Water Contour Line (ft)

VAN DER HORST PLANTS NO.1 & NO.2

NOTE:
THE SCALE AND LOCATION OF ALL MAP FEATURES WEST OF THE PLANT NO. 1 SITE AND SOUTH OF THE PLANT NO.2 SITE ARE APPROXIMATE. PLANT NO. 1 MONITORING WELL LOCATIONS WITHIN THIS AREA ARE CORRECT.

GRAPHIC SCALE
200 0 100 200 400 800
(IN FEET)

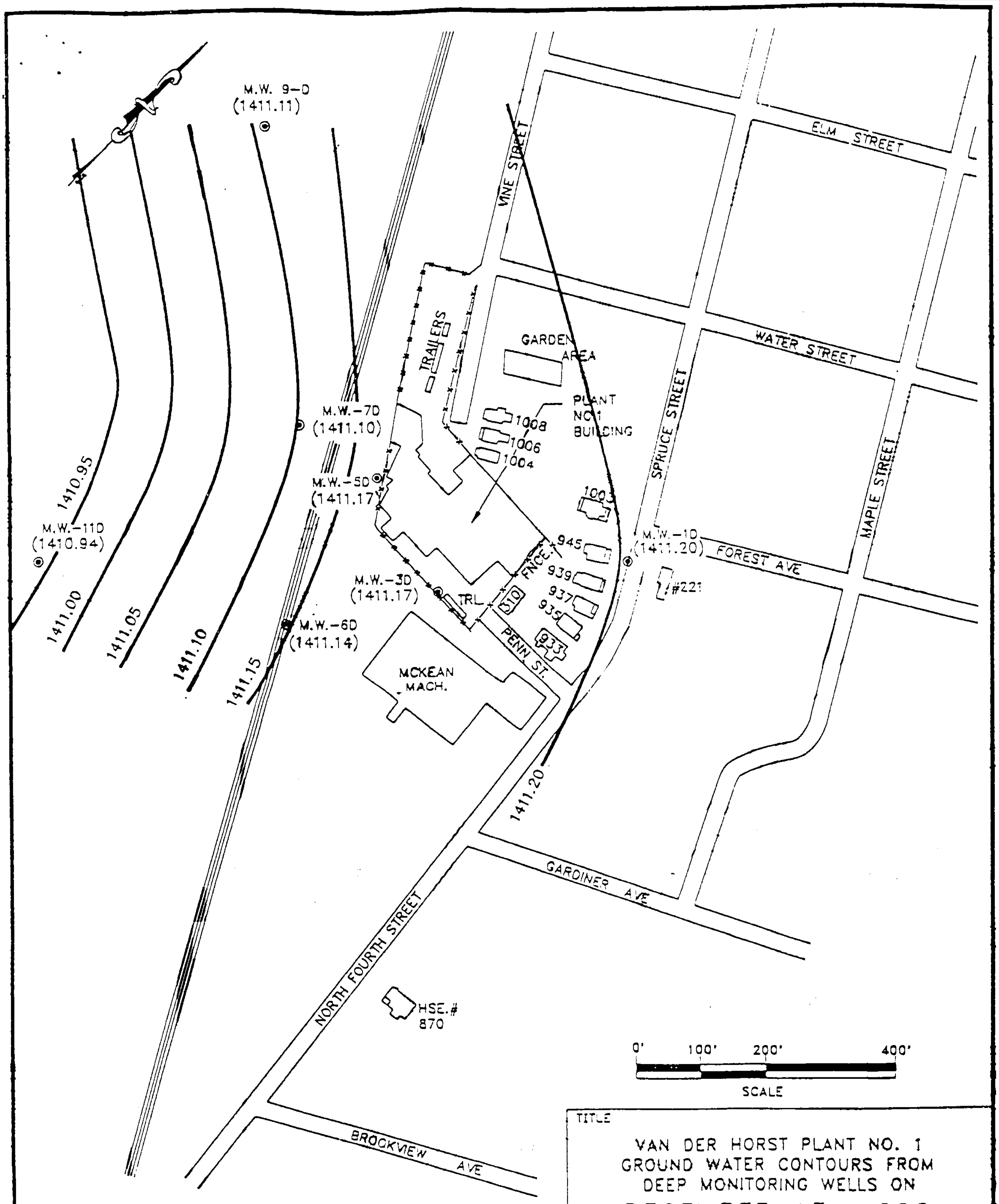
monitoring wells is believed to be representative of the predominant flow characteristics of that portion of the aquifer.

3.3.2 Ground Water Flow at Plant No. 1

Shallow Wells

Water level data were also plotted on the Plant No. 1 base map and used to generate local ground water contour maps. Ground water contours for shallow and deep monitoring wells, generated from water level data obtained on December 13, 1990, are presented in Figures 3-5 and 3-6. The contours in these figures are representative of the general pattern of ground water flow beneath the site. Other ground water contour maps generated for Plant No. 1 are presented in Appendix F of the Phase II RI.

The general direction of ground water flow in the shallow wells of the upper aquifer is to the southwest, although flow direction has ranged from due south to due west during some measuring events. This range in direction of flow could be a result of the low flow gradient. The average horizontal hydraulic gradient in



TITLE

VAN DER HORST PLANT NO. 1
GROUND WATER CONTOURS FROM
DEEP MONITORING WELLS ON
DECEMBER 13, 1990

PREPARED FOR

NYSDEC

ERM-Northeast
Environmental Resources Management

SCALE	FIGURE
AS NOTED	3-6
DATE	

LEGEND

1411.00 ——— GROUND WATER CONTOURS (FT.)

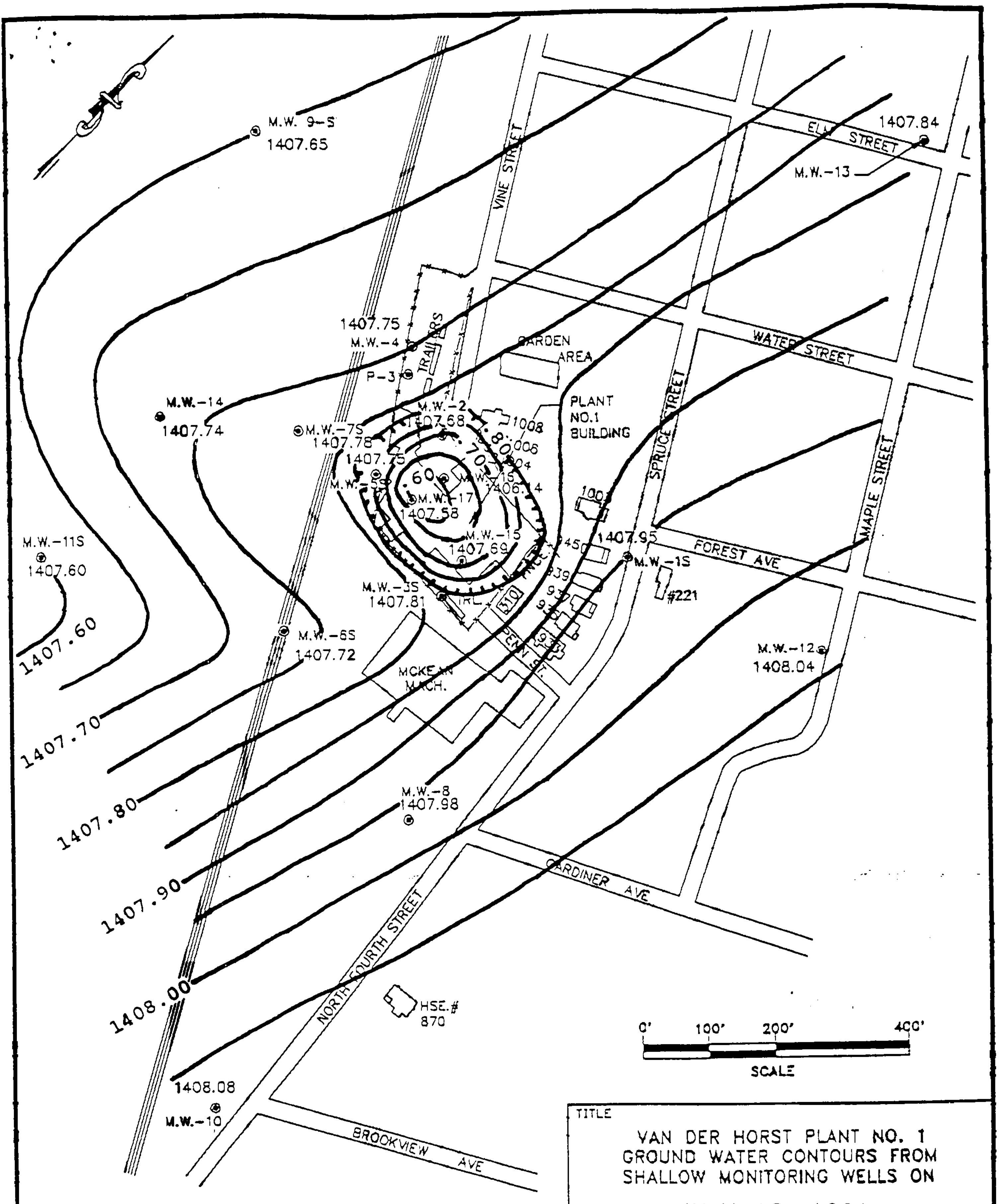
(1410.88) GROUND WATER ELEVATIONS (FT.)

the shallow wells down-flow of the site was 0.0004 and, to date, has ranged from 0.0003 to 0.0006.

A depression in the potentiometric surface beneath part of the Plant No. 1 building and the area immediately north of the building, has been indicated on all shallow well ground water contour maps. The depth and size of the depression were more accurately defined with the July 18, 1991 water level data due to additional Phase III monitoring wells MW-15, MW-16 and MW-17. A ground water contour map of shallow monitoring wells on July 18, 1991 is presented in Figure 3-7. The depth of the depression on this date was approximately 0.20 feet. This depression may have resulted from localized decreased rainwater infiltration beneath the Plant No. 1 building.

Deep Wells

The typical ground water flow direction in the deep wells of the upper aquifer was towards the southwest. The deep well flow direction exhibited a greater range than that of the shallow wells and varied from southeast to northwest. The average horizontal hydraulic gradient down-flow of the site was 0.0006 and fluctuated between 0.0002 and 0.0010.



TITLE

VAN DER HORST PLANT NO. 1
GROUND WATER CONTOURS FROM
SHALLOW MONITORING WELLS ON

JULY 18, 1991

PREPARED FOR

NYSDEC

ERM ERM–Northeast
Environmental Resources Management

SCALE	FIGURE
DATE	3-7