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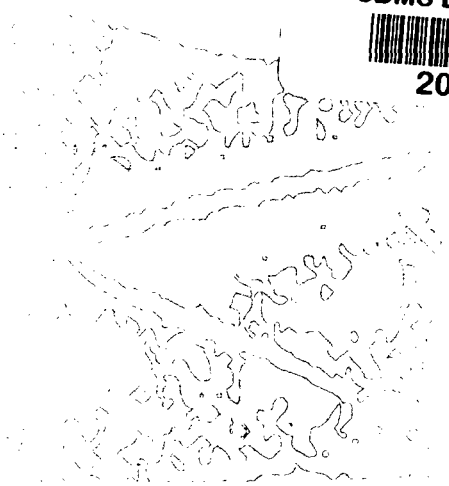

THE FORRESTER GROUP
INSIGHTFUL ENVIRONMENTAL SOLUTIONS™

**VOLUME 1 OF 2**

# REMEDIAL INVESTIGATION REPORT - PART 1

**FINAL**

CERCLA-8-99-12
Union Pacific Railroad
Ogden, Utah

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# LIST OF ACRONYMS

| | |
|---|---|
| AOI | Area of interest |
| AOC | Administrative Order on Consent |
| AST | Aboveground storage tank |
| bbls | Barrels |
| BGS | Below ground surface |
| BMI | Benthic macroinvertebrate |
| BRA | Baseline risk assessment |
| BTEX | Benzene, toluene, ethylbenzene, and xylene |
| CAP | Corrective Action Plan |
| CERCLA | Comprehensive environmental response, compensation, and liability act |
| CFS | Cubic feet per second |
| COC | Constituent of concern |
| CVOC | Chlorinated volatile organic compound |
| DCA | Dichloroethane |
| DCE | Dichloroethene |
| DERR | Division of Environmental Response and Remediation |
| DNAPL | Dense nonaqueous phase liquid |
| DPT | Direct push technology |
| DQO | Data quality objective |
| DRO | Diesel range organics |
| D&RGW | Denver and Rio Grande Western Railroad |
| EPA | U.S. Environmental Protection Agency |
| ERA | Ecological risk assessment |
| FSP | Field Sampling Plan |
| GRO | Gasoline range organics |
| HQ | Hazard quotient |
| LES | Laidlaw Environmental Services (Also known as EDG, Inc. - a Safety-Kleen company) |
| LNAPL | Light nonaqueous phase liquid |
| LUST | Leaking underground storage tank |
| MADL | Maximum acceptable detection limit |
| MCL | Maximum Contaminant Level |
| MNA | Monitored natural attenuation |
| MPH | Miles per Hour |
| NPL | National Priority List |
| NRM | National Railroad Materials |
| NTU | Nephelometric turbidity unit |
| OD | Outside diameter |
| OU | Operable Unit |
| OUR&D | Ogden Union Railway and Depot Company |
| PAH | Polynuclear aromatic hydrocarbons |

| | |
|---|---|
| PCB | Polychlorinated biphenyls |
| PID | Photoionization detector |
| PpbV | part per billion by volume |
| PQL | Practical quantitation limit |
| PSI | Pounds per square inch |
| QA/QC | Quality assurance/quality control |
| QAPP | Quality assurance project plan |
| RAL | Remedial Action Level |
| RI/FS | Remedial Investigation/Feasibility Study |
| RBC | Risk-based concentration |
| RME | Reasonable Maximum Exposure |
| SAP | Sampling and Analysis Plan |
| SIM | Single ion monitoring |
| SLV | Screening Level Value |
| SOP | Standard operating procedures |
| SPRR | Southern Pacific Railroad |
| SVOC | Semi-volatile organic compound |
| TAL | Target analyte list |
| TCA | Trichloroethane |
| TCE | Trichloroethene |
| TDS | Total dissolved solids |
| TPH | Total petroleum hydrocarbons |
| TOC | Total organic carbon |
| TSS | Total suspended solids |
| UDEQ | Utah Department of Environmental Quality |
| UPRR | Union Pacific Railroad |
| USCS | Unified Soil Classification system |
| USGS | United States Geological Survey |
| USPCI | US Pollution Control Incorporated |
| UST | Underground storage tank |
| VOC | Volatile organic compounds |
| WMCHD | Weber-Morgan County Health Department |

# EXECUTIVE SUMMARY

## SITE DESCRIPTION

The Ogden Rail Yard is located in Weber County, Utah to the west of the City of Ogden. The rail yard is elongated in a north-south direction over a distance of 3.4 miles, and occupies the floodplain on the east side of the Weber River. It is an active railroad facility.

The Site was first used as a rail yard in 1869. Four railroad companies -- UPRR, Southern Pacific Railroad (SPRR), Denver and Rio Grande Western Railroad (D&RGW), and the Ogden Union Railway and Depot Company (OUR&D) -- built and operated on various portions of the site over the years. SPRR and D&RGW operated in the northern portion of the Site, while UPRR and OUR&D operated in the southern portion of the Site. With the completion of the UPRR-SPRR merger in 1996, nearly the entire yard is now under the ownership of UPRR.

Facilities previously located at the site include coal yards, freight houses, passenger service depots, switching yards, machine shops, boiler shops, transfer tracks, oil/water treatment plants, fuel storage tanks, cold storage houses, warehouses, offices, turntables, and roundhouses. These facilities were needed to support the various maintenance and business activities related to operation of the railroads. Use of the various facilities at the site has declined significantly and the majority of the older facilities have been demolished.

Major surface water features at the site include the following:

- The Weber River, which flows south to north along the western site boundary.
- The Ogden River, which flows roughly east to west along the northern boundary of the site.
- The 21st Street Pond, an approximate 25-acre pond located immediately north of the rail yard.

## PROJECT OVERVIEW

Union Pacific Railroad (UPRR) has been conducting site investigation activities under CERCLA protocol in the Ogden rail yard since 1997. The site investigation has been conducted in a phased approach. During the site investigation, UPRR has also conducted a number of actions to address environmental conditions existing at the site.

### Phase I Investigation

The Phase I investigation was initiated partly in response to concerns by the Weber-Morgan County Health Department (WMCHD) over potential rail yard impacts on the adjacent Weber River, which had recently been designated a culinary drinking water source. The Phase I investigation was voluntarily conducted by UPRR pursuant to an agreement with the Utah Department of Environmental Quality (UDEQ) and the U. S. Environmental Protection Agency Region VIII (EPA).

The Phase I investigation focused on Areas of Interest (AOIs) that had been identified by EPA based on historical site information and aerial photograph interpretation. The purpose of the Phase I portion of the RI was to identify those AOIs that contained detected concentrations of contaminants above site-specific screening levels, and consequently would be subject to further investigation in Phase II of the RI. Screening levels based on protection of human health were developed by EPA as numerical points of comparison for site chemical data.

The Phase I field activities were conducted in 1997 and 1998, pursuant to a Work Plan (and subsequent Work Plan addenda) approved by the regulatory agencies. The primary components of the Phase I field investigation were surface soil sampling, borings and subsurface sample collection using direct push technology, and monitoring well installation and sampling. Environmental samples were analyzed for constituents judged to be potentially present based on historic operations. These constituents included oil and grease, gasoline-range and diesel-range petroleum hydrocarbons, volatile organic compounds (VOCs), polynuclear aromatic hydrocarbons (PAHs), other semi-volatile organic compounds (SVOCs), pesticides, and PCBs.

## Phase II Investigation

After the Phase I study was completed, an Administrative Order on Consent (USEPA Docket No. CERCLA-8-99-12) was signed on May 26, 1999, between UPRR and the EPA. The AOC provides the regulatory framework for completing the remedial investigation/feasibility study (RI/FS) tasks for the Ogden rail yard.

Based on the results of the Phase I investigation and a preliminary risk characterization performed by EPA, the scope of work for the Phase II investigation was developed. The primary purposes of the RI were to generate the additional data needed to perform a risk assessment for the site and to support the Feasibility Study (FS). The Phase II fieldwork was conducted during 2000 through June of 2001, pursuant to a Work Plan, Field Sampling Plan, and Quality Assurance Project Plan which were reviewed and approved by the regulatory agencies. The Work Plan included a Sampling and Analysis Plan prepared by EPA (1999a) to support the human and ecological risk assessments.

Major components of the Phase II field investigation included installation of additional groundwater monitoring wells, four sampling events on the expanded groundwater monitoring network, further characterization of surface soil conditions to support the human health risk assessment, directed source area sampling, and collection of soil, sediment, and surface water samples to support the ecological risk assessment.

During the Phase II RI, a zone containing hydrocarbons in the form of dense, nonaqueous phase liquid (DNAPL) was discovered at the northern end of the rail yard. This discovery led to an expanded investigation of the DNAPL zone, the 21$^{st}$ Street Pond (which contained DNAPL-impacted sediments), and the Ogden River. In the Site Management Plan that has been developed for the site, the DNAPL zone, 21$^{st}$ Street Pond, and adjacent section of the Ogden River are all part of the Northern Area Operable Unit (OU). The Northern Area OU is addressed in Part 2 of this RI Report, and is not addressed further in this Executive Summary.

## Cleanup Activities Conducted to Date

While the remedial investigation of the site has progressed, UPRR has performed a considerable amount of work to address environmental conditions at the site. This work is briefly summarized below.

**Underground Storage Tanks.** Seventeen underground storage tank (UST) located throughout the rail yard have been investigated by UPRR. The tanks contained diesel, fuel oil, waste oil, heating oil, or gasoline. All of the tanks except one (which is located beneath a structure, SPRR-UST2) have been removed.

**Ogden Pond.** The Ogden Pond area (AOI-27) is a historic sludge disposal area located between the rail yard and the Weber River. Between November 1995 and April 1996, 9,972 tons of sludge and contaminated soil were excavated from within the limits of the pond.

**SPRR Wastewater Treatment Plant.** The SPRR Treatment Plant facility (AOI-34) is located at the northern end of the rail yard complex, adjacent to the east bank of the Weber River. The SPRR facility treated industrial wastewater from the SPRR shops (AOI-38) and locomotive fueling facility. Industrial use of the facility ended in January 2000, at which time the oily liquids in the main concrete separation lagoon were removed, treated, and discharged. Oily sludge in the concrete lagoon was removed in May 2001. 3070 tons of sludge and mixed stabilization material were removed from the concrete lagoon and transported to the Pacific West facility in Erda, Utah for recycling use in road base.

**Former Oil Reclamation Site.** An oil reclamation facility was formerly located on the rail yard along the eastern side of the Fort Buenaventura State Park. This site (AOI-26) covers approximately two acres. Approximately 29,000 tons of petroleum-based sludge waste were excavated from AOI-26 and shipped off-site for disposal at the East Carbon Development Corporation (ECDC) facility by UPRR in 1993.

**D&RGW RIP Track Area.** The D&RGW RIP Track area (AOI-35) is located at the northern limit of the rail yard. The D&RGW RIP Track area was a small maintenance facility and siding yard that was active during the steam and diesel locomotive eras. Approximately 16 tons of oil-

stained soil were removed from an area near the Oil and Tool House to a depth of six feet. In addition, 20 tons of petroleum-contaminated soil were removed from the location of an above-ground kerosene storage tank, located near the Section House. The excavated soil was transported to ET Technologies for disposal (Morrison-Knudsen, 1988).

## SUMMARY OF MAJOR INVESTIGATION FINDINGS

Findings and conclusions from the remedial investigation of the Ogden Rail Yard site are presented in this section.

### Surface Soil

The Ogden Rail Yard was built in the flood plain of the Weber River. On the northern end of the rail yard, the Weber River flood plain merges with that of the Ogden River. The site has been used for railroad operations for over a century. Over that time, there have been multiple events of fill and grade to produce the ground surface elevation necessary for track construction and other railroad operations. As a result, the surface soil horizon throughout the active portion of the rail yard is now generally comprised of fill.

A focus of the remedial investigation has been characterization of the surface soil horizon within the rail yard. In the Phase I and Phase II field investigations, over 200 samples of the surface soil horizon have been collected and analyzed. These samples included just over 160 samples in the AOIs, and another 40 samples of surface soil from the Weber River riparian zone lying between the river and the active portion of the rail yard. Results have been compared to the Human Health Risk-Based Screening Levels (SLVs) developed by EPA during the Phase I investigation. The constituents that most frequently exceeded the SLVs were arsenic, lead, and a variety of PAHs. Surface water and sediment samples were compared to ecological screening level benchmark concentrations.

From the frequency and distribution of arsenic and lead exceedences in soils, it appears that these two constituents are naturally occurring constituents of the soil that was used for fill at the site. However, arsenic concentrations in soils at AOI-21 are above EPA's acceptable risk range for exposure of on-site workers (EPA, 2003a).

As part of the Phase II RI work planning process, the USEPA used Phase I data to perform a preliminary calculation of the risk posed by arsenic, lead, and PAHs to human health (Appendix B of Phase II RI Work Plan; Safety-Kleen, 2000a). The EPA concluded that risks to rail yard workers from exposure to surface soil were likely to be below a level of concern. In addition, the EPA concluded that off-yard exposures are likely to be lower than exposures to site workers, and that risks to off-yard human receptors were also likely below a level of concern. However, these conclusions were preliminary based on limitations in the Phase I data. The Phase II RI was designed to generate the additional data needed to more definitively evaluate risks posed by the surface soils to human receptors. The Phase II RI generated the data EPA had specified was needed. EPA has finalized both the human-health and ecological risk assessments for the site (EPA; 2003a, 2003b). Results of the final human-health risk assessment are consistent with the draft version, with the exception that arsenic concentrations are above the reasonable maximum exposure (RME) for soils in AOI-21, and PAH concentrations are above the RME for soils in AOI-27.

The Phase II RI also included collection of 40 surface soil samples from the Weber River riparian zone, to support an assessment of potential risk posed to ecological receptors. Samples were collected from three different zones along the length of the rail yard, and from a fourth "background" zone located along the river south of the rail yard (EPA riparian zone RZ-4). Ten samples were collected from each zone. A variety of metals and PAHs were detected in these samples. Concentrations of several metals exceeded Ecological Risk-Based Benchmark Concentrations previously used by EPA in their screening level ecological assessment, in both rail yard and background samples. Results of the baseline ecological risk assessment show that site-related chemicals are not of population-level concern in the riparian area west of the rail yard site (EPA, 2003b). Contingent upon a planned removal action, EPA did not include AOI-27 (Site ID #08-6E) in the ecological risk assessment evaluation. The potential threat to human health and the environment at AOI-27 will be addressed via a removal action (CERCLA-VIII-96-10).

## Groundwater

The groundwater zone of primary interest beneath the Ogden Rail Yard is the saturated alluvial zone. This zone is continuous across the site, and is comprised of channel deposits containing poorly sorted gravel in a matrix of silt and fine-grained to medium-grained sand. This zone

typically exists from the water table down to the Alpine Clay. Given the variable depth to the Alpine Clay, the thickness of the saturated alluvial zone ranges from 1 to 22 feet, with a typical thickness of 10 to 12 feet.

Groundwater in the alluvial zone beneath the Ogden Rail Yard has been investigated in the Phase I and Phase II RI field studies. Groundwater samples were collected from nearly 100 different locations in the Phase I RI using Direct Push Technology (DPT). With the completion of Phase II RI fieldwork, there are now 89 monitoring wells on the rail yard site (not including the 24 additional monitoring wells in the Northern Area operable unit). Four quarters of groundwater monitoring have been performed on the monitoring well network. Findings of the groundwater investigation are summarized below.

### *Nature and Extent of Groundwater Impacts*

The RI has revealed that the most significant groundwater impacts at the site are limited to the vicinities of most intensive industrial activity. There are two major zones of impact. Both zones are impacted by fuel hydrocarbons and chlorinated solvents.

This first zone, called the south plume, originates from the former location of the UPRR Roundhouse (AOI-22b). In this zone, there is an area in which historic releases of diesel fuel have apparently resulted in the sporadic occurrence of fuel hydrocarbons in the form of LNAPL over an area of approximately 1.2 acres. This LNAPL zone is located within the extent of a groundwater zone impacted by a variety of chlorinated volatile organic compounds (CVOCs). The CVOCs are believed have resulted from historic releases of chlorinated solvents and their subsequent degradation. The constituent that has the most widespread occurrence is vinyl chloride (Figure 6-2), which is believed to be a degradation product of TCE and/or 1,1,1-TCA. The CVOC plume is roughly circular in shape, covering an area of approximately 4.5 acres, and extends to AOI-26.

The second zone, called the north plume, originates from the former location of the SPRR Roundhouse (AOI-22b), and Engine Maintenance Area and Machine Shop (AOI-38). In this zone, there are two fuel hydrocarbons LNAPL zones. The LNAPL zones cover areas of approximately 10 acres and 1.2 acres. These LNAPL zones are almost completely underlain by a

groundwater zone impacted by a variety of chlorinated volatile organic compounds (CVOCs). Like the southern plume, the CVOCs are believed to have resulted from historic releases of chlorinated solvents and their subsequent degradation. The constituent that has the most widespread occurrence is again vinyl chloride (Figure 6-3). The CVOC plume is an elongated oval in shape, extending downgradient from the source area to northwest of the SPRR Waste Water Treatment Plant (AOI-34). The CVOC plume covers an area of approximately 60 acres.

Outside the north and south CVOC plumes, groundwater impacts by organic constituents are very limited. Across the rail yard, arsenic and barium concentrations in groundwater routinely exceed the Human Health Risk-Based Screening Levels. The widespread nature of these arsenic and barium exceedences suggests these constituents are associated with background conditions and are unrelated to chemical or waste handling operations on the rail yard. Similar arsenic and barium concentrations are detected in groundwater from other sites in the area, such as the Hill Air Force Base.

### *Source Investigation*

An objective of the Phase II RI was to investigate potential sources of the CVOC plumes. The LNAPL was sampled to determine if solvents had partitioned into the LNAPL in sufficient concentrations for the LNAPL to serve as the source of the aqueous phase CVOCs emanating from the same general vicinity as the LNAPL zones. Five LNAPL samples (covering both the north and south LNAPL zones) were analyzed for CVOCs. No CVOCs were detected in the samples. Based on these results, it is unlikely the LNAPL is the source of the aqueous phase CVOC plumes.

Investigations were also performed to assess the potential presence of chlorinated solvents in the form of DNAPLs, which could serve as an ongoing source of aqueous phase CVOCs. These investigations included vertical profiling of groundwater quality, a cluster of borings to explore the potential presence of a stratigraphic trap which could have resulted in DNAPL accumulation in a potential source area, and examination of soil cores for presence of DNAPL using special core examination techniques (UV/fluorescence and dye testing). No DNAPL was found. Based largely on the probability of historic solvent use at the site (as a degreaser in heavy equipment repair), it is concluded that DNAPL could be present at the site, although no DNAPL has been

observed in the targeted investigations described above. If DNAPL is present at the site, it is likely present in small pockets that would defy practical discovery and delineation efforts.

The configuration of the north CVOC plume suggests a potential source of ongoing CVOC loading to that plume. The major axis of this oval plume is roughly coincident with the industrial sewer line that conveyed wastewater from the Roundhouse and Machine Shop to the Wastewater Treatment Plant. Sampling of water in this sewer revealed the presence of relatively high concentrations of CVOCs, suggesting the possible presence of CVOC-containing sludge in the line. The outlet of the sewer has been plugged, but some inlet drains are still open. The sewer is believed to be constructed of vitrified clay pipe. The materials of construction, the sewer's age (constructed in the 1960's), and the open inlet drains may result in some potential for ongoing release of CVOCs from the sewer.

### *Fate and Transport Considerations*

The RI fieldwork defined the current extent of impacted groundwater. The potential for future migration of the impacted groundwater was also assessed.

The best insight that can be drawn regarding the potential future extent of the LNAPL and CVOC plumes is from their current extent. When one considers the likely age of these plumes and groundwater velocities, it becomes obvious that the extent of the CVOC plumes is far less than the plume extent that would be expected if no attenuation were occurring. Data derived from plume extent, the presence of degradation products, and groundwater geochemistry combine to produce a compelling case that intrinsic bioremediation is a significant factor in aqueous phase CVOC transport.

Based on the groundwater sampling data, it appears that intrinsic bioremediation is occurring at a rate sufficient to prevent significant expansion of the CVOC plumes. In fact, examination of "concentration versus time" data for key monitoring wells suggests that the south CVOC plume may actually be shrinking, while the north plume appears to have reached a steady-state extent. Continued monitoring of key wells is recommended to provide a more definitive analysis of plume status.

Given the continued industrial/commercial use of the site (as recognized in the AOC) and the location of the site within the boundaries of the City of Ogden's municipal water supply system, use of the alluvial groundwater for water supply (particularly for potable purposes) is not plausible. Potential receptors of impacted groundwater are off-site, down-gradient receptors and the Weber River.

As discussed above, the South CVOC plume appears to be shrinking. Base on this and its location in the interior of the site, off-site migration of the South CVOC plume is not plausible. The North CVOC Plume appears to be at a steady-state extent. Wells at the northern edge of the plume do not exhibit any evidence of increasing CVOC concentrations. However, should the North CVOC expand to the north, it would discharge into the 21st Street Pond, which serves as a groundwater sink along its southern edge. Thus, impacts to down-gradient off-site locations where the alluvial groundwater could potentially be used as a source of water supply do not appear plausible based on the available data. Some wells within the North Plume area show a fluctuation of vinyl chloride concentrations over the four quarters of data. Temporal trends in groundwater may be responsible for the observed variations, and will be further assessed as part of the Feasibility Study.

Based on the available data, it does not appear that impacted groundwater from the South CVOC Plume or North CVOC Plume is discharging to the Weber River. Of the two plumes, the North CVOC Plume extends much nearer to the Weber River. Investigations were undertaken as part of the Phase II RI fieldwork to assess discharge of the North CVOC plume to the Weber River.

An additional monitoring well (34-MW9) was installed between the Waste Water Treatment Plant and the Weber River, as close to the Weber River as possible. In four quarters of monitoring, no CVOCs were detected in this well. This well was also part of water level monitoring transect that included a water level gauging station in the Weber River. Results show the Weber River is an influent (losing) stream with respect to the adjacent riverbank at this location. This relationship would tend to keep the alluvial groundwater from discharging to the river.

This finding is consistent with the conceptual model that has been developed by the United States Geologic Survey for Wasatch Front streams, which indicates that the Weber River should indeed generally be a losing stream in the vicinity of the site. This finding is also consistent with the investigations of the Ogden River (addressed in Part 2 of this report), which demonstrated the Ogden River is generally a losing stream in the area of interest, although there were small, localized areas of groundwater discharge to the river.

## Weber River

UPRR's voluntary Phase I investigation of the rail yard was initiated in response to concerns of the Weber-Morgan County Health Department regarding potential rail yard impacts on Weber River water quality, which had recently been designated a culinary drinking water source. The investigations performed by UPRR and EPA have generated a considerable amount of data on potential site impacts on the Weber River.

### *Groundwater Discharge*

As described previously, the available data shows limited potential for discharge of impacted groundwater from the South CVOC Plume and North CVOC Plume to the Weber River.

### *Surface Water and Sediment Discharge*

There are three features that discharge runoff from the site, all of which also carry runoff from the urban area to the east of the rail yard: Strongs Creek, Burch Creek, and the 33rd Street Slough. The majority of the flow in each of these features originates in areas east of the rail yard. There is a fourth feature, a storm drain south of the 35th Street alignment that carries runoff from a paved area east of the rail yard, but there is no defined drainage channel extending all the way to the river, and runoff infiltrates into a low-lying area west of the rail yard tracks.

Surface water and sediment samples were collected from these drainage features in both the Phase I and Phase II investigations. There were only a few exceedences of the Ecological Benchmark concentrations in the surface water samples, and these were for inorganic constituents (primarily lead).

Each of the four drainage features had at least one sediment sample in which at least one constituent was present at concentrations exceeding the Ecological Benchmark Concentrations (principally PAHs and arsenic). Because each of the four drainage features carries the majority of its runoff from areas east of the rail yard, the presence of constituents in the surface water drainages on the rail yard does not necessarily mean that the rail yard is the source of the constituents. Investigation results suggest similar concentrations of certain constituents in off-site sediment samples collected east of the rail yard and samples collected on the rail yard.

There is an additional point of surface water discharge that crosses the site. A City of Ogden storm sewer line crosses the site in an east-west direction, passing just north of the SPRR Waste Water Treatment Plant, and discharges into the Weber River. The sewer line crosses the Northern CVOC plume. Sampling of the storm sewer revealed low concentrations of vinyl chloride that apparently is the result of impacted groundwater leaking into the sewer.

### *Weber River Water Quality*

Surface water samples were collected from the Weber River in both the Phase I field work (17 samples) and Phase II field work (20 samples). No constituents were detected in surface water at concentrations above the Human Health Risk-Based Screening Levels established for the site by EPA. Lead was detected in numerous surface water samples, including samples collected at the upstream end of the rail yard. While the lead concentrations were below the ambient water quality criteria for lead (29 ug/l), many samples exceeded the Ecological Benchmark Concentration for lead of 1.3 ug/l.

As previously described, site data indicates an ongoing, continuous discharge of low concentrations of vinyl chloride to the Weber River via leakage of impacted groundwater into a City of Ogden storm sewer. No CVOCs have been detected in Weber River surface water samples, including samples collected at the down-stream end of the rail yard. This is expected. Site data suggests a very low mass flux of CVOCs to the river. CVOCs discharging to the river would be readily attenuated through dilution, volatilization, and biodegradation. The finding that the Ogden rail yard site exerts no measurable impact on Weber River surface water quality is consistent with these considerations.

A variety of constituents have been detected in Weber River sediments. The significance of the sediment conditions was evaluated by EPA in the Ecological Risk Assessment for the site.

## SUMMARY OF MAJOR FINDINGS AND PATH FORWARD

In planning the site investigation, exposure to surface soil and potential impacts to the Weber River were considered among the most significant potential risks posed by site conditions to human health. With respect to surface soil, a preliminary risk assessment on Phase I data indicated that potential risks to humans posed by surface soils were probably below levels of concern. The Phase II investigation generated the additional surface soil data needed to support a more definitive assessment. Based on the combined results of the Phase I and Phase II investigations, EPA performed a final human health risk assessment for site surface soils.

With respect to the Weber River, the site investigations have not revealed any site impacts on Weber River water quality.

The site investigations have revealed two general zones of significant groundwater impacts associated with historical railroad operations. These zones are the South Plume (which emanates from the former UPRR roundhouse area) and the North Plume (which emanates from the former SPRR roundhouse area). The constituents of concern in these areas are petroleum hydrocarbons, certain specific components of diesel fuel, and CVOCs. Under current site conditions, the impacted groundwater poses very limited risk. The impacted groundwater is limited to a relatively shallow alluvial groundwater zone that is not used as a source of water supply. The constituents of concern in these plumes have not been detected in Weber River water samples. Potential for further migration of the plumes is believed to be limited. The potential for impacted groundwater to pose risks to human receptors was evaluated in the human health risk assessment performed by EPA.

The Phase II investigation generated information required to support an assessment of potential risk to ecological receptors. No acute risks to ecological receptors were identified in the site investigations. However, a variety of constituents were detected in Weber River riparian zone soils, sediments, and surface water at concentrations exceeding conservative, ecological risk-based benchmark concentrations that had been developed by EPA. Some of the conditions

observed in the site investigation that could be of potential concern with respect to ecological risks (for example, lead in Weber River surface water samples) appear to be associated with background conditions. Potential risks posed by site conditions to ecological receptors were more thoroughly assessed in the ecological risk assessment performed by EPA.

In summary, the RI generated the data needed to support the human health and ecological risk assessments performed by EPA. These risk assessments provide an assessment of potential risks posed by site conditions to human and ecological receptors for the RI/FS project. Based on the risk assessments, risk-based remedial action objectives will be developed for the site.

UPRR will then perform a Feasibility Study (FS) for the site. Alternatives for addressing impacted groundwater at the site will be evaluated in the FS. Based on the results of the EPA risk assessments and subsequent development of risk-based remedial action objectives, the FS will also evaluate alternatives for other site conditions judged to pose unacceptable levels of risk to human health and/or the environment.

# 1 INTRODUCTION

Union Pacific Railroad (UPRR) has been conducting site investigation activities under CERCLA protocol in the Ogden rail yard since 1997. Because of the large size of the rail yard and uncertainty regarding the presence or absence of contamination, the RI was conducted in a phased approach.

The initial phase of the project (Phase I, 1997-1998) was conducted under a voluntary agreement with the Utah Department of Environmental Quality (UDEQ) and the U. S. Environmental Protection Agency Region VIII (EPA), and was consistent with the remedial investigation/feasibility study (RI/FS) process under CERCLA. The Phase I study was conducted as a screening level investigation to identify the initial nature and extent of potential contaminants of concern, which would be further assessed in the Phase II portion of the RI. After the Phase I study was completed, an Administrative Order on Consent (USEPA Docket No. CERCLA-8-99-12) was signed on May 26, 1999, between UPRR and the EPA. The AOC provides the regulatory framework for completing the RI/FS tasks for the Ogden rail yard.

Based on the results of the Phase I investigation (Safety-Kleen, 1998) and an assessment of the Phase I data quality by EPA (Section 2.0 of EPA, 1999a), a Phase II investigation was executed to fill the data gaps identified by EPA and complete the RI. The Phase II fieldwork was conducted during 2000 through September of 2001.

## 1.1 PURPOSE OF REPORT

The purpose of this report is to present the combined Phase I and Phase II remedial investigation results. The overall goals of the RI activities at the Site are to:

- Define the nature and extent of contamination.
- Provide data to support subsequent assessment of potential risks to human health and the environment.

- Provide data to support development and assessment of remedial action alternatives in the subsequent Feasibility Study, if unacceptable risks to human health and the environment are identified.

## 1.2 SITE BACKGROUND

This section presents background information, a physical description of the site, a breakdown of the individual Areas of Interest, and a summary of previous site investigations. The location of the Union Pacific Ogden rail yard is shown in Figure 1-1.

### 1.2.1 Site Description

The Ogden Rail Yard is located in Weber County, Utah to the west of the City of Ogden (Figure 1-1). The Rail Yard is elongated in a north-south direction over a distance of 3.4 miles, and occupies the floodplain on the east side of the Weber River. The mean elevation above sea level across the site is about 4,300 feet. Ground surface elevations range from a high of 4349 feet at the southern terminus of the Yard (AOI 12), to a low of 4280 feet at the northern end of the Site (AOI 35). Most of the site consists of a flat, open yard, with both railroad-related facilities and private industrial facilities located at various positions along the perimeter. The operating portion of the Yard, generally extending from the westernmost track areas to the eastern boundary, is variably covered with concrete, asphalt, rail track, or non-vegetated soil. The western border of the site contains wildlife habitat areas situated between the Weber River and western extent of railroad operations.

Standing surface water is non-existent in the operating portion of the Rail Yard, with the exception of intermittent pools following storm events. A man-made pond known locally as the 21st Street Pond (AOI-33) is adjacent to the northern edge of the Site. It has been used for recreational fishing. Standing water has been noted in low areas between the westernmost tracks and the Weber River. Four surface drainage ditches listed below cross through the Yard and discharge to the Weber River. Sources of water in these ditches are located in the City east of the Site:

- Burch Creek, AOI-9

- Strongs Creek, AOI-29
- 33rd Street Slough
- Unnamed intermittent drainage, AOI-10

The Weber River flows northward along the western side of the site, after which the channel turns westward at the north end of the Rail Yard and joins the Ogden River about a mile further downstream. The elevation of the Weber River declines about 60 feet between the southern end of the rail yard at the Riverdale Street overpass, and the northern (downstream) end of the rail yard at 21st Street.

The site boundary is shown on Figure 1-2. The yard generally extends from Riverdale Road on the south, to the Ogden River (20th Street) on the north; and from the Weber River on the west, to Wall Avenue and Pacific Avenue on the east. Consistent with the site definition specified in the AOC; "*...The Site includes any areas where migration of hazardous substances, pollutants, and contaminants from Respondent's railroad yard has occurred or will likely occur.*" the site boundary has been extended in the area of AOI-33 to include the 21st street Pond and other land areas north and west of UPRR property under which a DNAPL zone extends. The AOI-33 and 21st Street Pond are addressed in Part 2 of this RI report.

### 1.2.2 Site History

The Site was first used as a rail yard by the Central Pacific (predecessor of the Southern Pacific) and Union Pacific railroads in 1869. Since that time, four railroad companies -- UPRR, Southern Pacific Railroad (SPRR), Denver and Rio Grande Western Railroad (D&RGW), and the Ogden Union Railway and Depot Company (OUR&D) -- built and operated on various portions of the Site. SPRR and D&RGW operated in the northern portion of the Site, while UPRR and OUR&D operated in the southern portion of the Site. With the completion of the UPRR-SPRR merger in 1996, the entire Yard is now under the ownership of UPRR, with the exception of the metal-recycling facility owned and operated by Atlas Steel – Western Metals (AOI 21).

Facilities previously located at the Site include coal yards, freight houses, passenger service depots, switching yards, machine shops, boiler shops, transfer tracks, oil/water treatment plants, fuel storage tanks, cold storage houses, warehouses, offices, turntables, and roundhouses. These facilities were needed to support the various maintenance and business activities related to operation of the railroads. Use of the various facilities at the Site has declined significantly and the majority of the old shop buildings have been demolished. The former Southern Pacific Machine Shop, which existed in AOI 38 during the Phase I fieldwork, was demolished in the spring of 1999.

Both railroad-related facilities and private industrial facilities are located at various points along the perimeter of the yard. Additional industrial facilities, on both privately held property and on property leased from UPRR, are located within the confines of the Yard.

### 1.2.3 Areas of Interest

The Areas of Interest (AOIs) subject to the Phase I and Phase II investigation activities are shown on Figure 1-3. The original Area of Interest designation numbers (e.g. AOI-23) were assigned by Lockheed Martin (1997a, 1997b) to document areas of potential "*...environmentally significant features and conditions at the railroad yard.*". These AOIs were identified by Lockheed Martin (1997b) from an analysis of historical aerial photographs from 1958 through the 1993 time frame, and were taken directly from an annotated photo scene (frame 5093-261) that accompanied the document.

Lockheed Martin (1997a) identified 31 separate AOIs based on aerial photographic interpretation for the presence of surface drainage patterns, mounds of solid waste material, probable solid waste, vertical tanks, horizontal tanks, staining, re-vegetated hummocky terrain, lagoons, mounds of light- and/or dark-toned material, standing liquid, fill areas, roundhouse locations, and other structures/facilities with the potential for releases to the environment based on their historic uses. Of the initial 31 AOIs, 12 were not included in the RI/FS investigation for the rail yard (Table 1-1). With the exception of AOI-24, these excluded AOIs were not subject to investigation because they are non-UPRR owned properties and are not located adjacent to the rail yard. AOI-24 was

not investigated because it was misidentified in aerial photographs as being a filled channel, when in fact it was an abandoned meander scar from the Weber River.

The specific AOIs subject to the Phase I and Phase II RI are listed in Table 1-2. AOI numbers 32 and higher were added by UPRR prior to, and during, the course of the Phase I investigation. These additional nine numbered AOIs were added because they were;

1. Additional LUST sites from tanks removed after the start of the Phase I investigation activities, and were not located in an existing AOI (SPRR-3, SPRR-5),
2. Described by Lockheed Martin (1997a) but not included on the annotated photograph because of coverage limitations (AOI-33, AOI-34, AOI-35, AOI-36, AOI-38),[1]
3. Added to differentiate between two oil-water separator sites labeled as No. 12 (AOI-32),
4. Used to identify an additional drainage identified on the west side of the rail yard (33rd St. Slough).

### 1.2.4 Operable Units

UPRR and the regulatory agencies have developed a Site Management Plan for the Ogden Rail Yard site (Forrester Group, 2001c). The Site Management Plan specifies the overall structure of RI/FS and remedial action activities at the site, including the division of the overall project into operable units (OUs). An OU is a portion of the site or an element of the overall project that can be managed in a process and on a timeline that is largely independent from the remaining portions of the site or project. Based on these criteria, the following OUs have been established for the site:

- OU-00 - Ogden Rail Yard Site. This is the general OU for the railroad facility, which covers all activities not included in the more specific OUs listed below.

[1] The aerial photograph provided by Lockheed Martin (1997a) was the most complete single photograph of the yard available; however, the northern portion of the yard was truncated, so some of the locations referred to in the Lockheed Martin (1997a) Sampling and Analysis Approach for the Ogden Rail Yard document were not displayed on the photo.

- OU-01 - Northern Area. Due to the discovery of a DNAPL zone that was impacting the 21st Street Pond, the investigation of the northern end of the rail yard and off-site impacts (including the DNAPL Zone, the 21st Street Pond, and the Ogden River) evolved into a rather extensive "stand alone" remedial investigation. In addition, this area will have unique remediation requirements due to the presence of the DNAPL. This OU is the subject of Part 2 of the RI report.

- OU-02 - PCB Contamination. Subject of Phase 3 investigation by EPA (2001) to identify source of PCBs detected in Ogden River sediments and fish samples from 21st Street Pond.

- OU-03 Wastewater Treatment Plant. Subject of the decommissioning, demolition, and removal activities for the former wastewater treatment plant in AOI-34.

- OU-04 Ogden Rail Yard Groundwater. Because groundwater impacts are an environmental condition that would clearly have to be addressed in subsequent FS activities, the groundwater beneath the Ogden Rail Yard (not including the Northern Area) was identified as an OU.

- Site No. 6E Impoundment Area Removal Action. A non-time critical removal action is planned to be completed under a separate existing AOC for AOI-27, to remove remaining sludge from this area.

### 1.2.5 Remediation Activities Implemented to Date

A considerable amount of remediation activities have already been conducted at the site. The results of these previous investigations are briefly summarized below.

#### *1.2.5.1 UST/LUST Site Investigations and Remediation Activities*

Seventeen USTs were investigated at various locations in the rail yard as shown in Figure 1-4. The tanks contained diesel, fuel oil, waste oil, heating oil, or gasoline. All of the tanks associated with these sites have been removed with the exception of SPRR UST-2, which is located beneath a structure.

Information relative to each UST is summarized in Table 1-3. Thirteen of the tanks have been granted closure by the UDEQ. SPRR UST-4 is exempt from UST regulations due to its small capacity (<110 gallons). This tank was located adjacent to the SPRR machine shop (AOI-38) and contamination associated with this tank is discussed in Section 4.2.28. Three USTs remain to be closed:

- SPRR UST-3 is located adjacent to the SPRR Machine Shop area (AOI-38). Closure activities are proceeding under an UDEQ-approved Corrective Action Plan (ERM, 2000). Hydrocarbon LNAPL is present on the groundwater in the area.
- The East Tank and West Tank sites are located in AOI-35. The tank sites were over-excavated and contaminated soils were removed in 1988. No records of regulatory closure on these sites have been located.

#### *1.2.5.2 Ogden Pond Area (AOI-27), Operable Unit Site No. 6E*

The Ogden Pond area is located between the rail yard and the Weber River. Contaminated soil within the confines of the pond was remediated under an Administrative Order on Consent (AOC) for Removal Actions, between the EPA and OUR&D (EPA, 1995). Between November 1995 and April 1996, 9,972 tons of sludge and contaminated soil were excavated from within the limits of the pond. Some of the sludge had a measured pH of <2 units. The sludge was shipped as non-hazardous material under a bill of lading to the ECDC Facility in East Carbon, Utah. The excavated pond was back-filled with 12,000 cubic yards of native soil, borrowed from an area 500 yards to the south (USPCI, 1996). Analytical testing of two backfill samples showed TPH concentrations were less than 2.0 mg/kg, and total lead concentrations were 9.9 mg/kg and 13.0 mg/kg (USPCI, 1996).

#### *1.2.5.3 SPRR treatment plant AOI-34, Operable Unit OU-03*

The SPRR Treatment Plant facility (AOI-34) is located at the northern end of the rail yard complex, adjacent to the east bank of the Weber River. The SPRR facility treated industrial wastewater from the SPRR shops (AOI-38) and locomotive fueling facility. Industrial use of the facility ended in January 2000, at which time the oily liquids in the main concrete separation

lagoon were removed, treated, and discharged. Oil-sludge in the concrete lagoon was removed in May 2001. 3070 tons of sludge and mixed stabilization material were removed from the concrete lagoon and transported as non-hazardous petroleum–contaminated-soil to the Pacific West facility in Erda, Utah for recycling use in road base.

#### *1.2.5.4 Oil Sludge Location (AOI-26)*

AOI-26 borders the eastern side of the Fort Buenaventura State Park, and covers approximately two acres. The AOI encompasses a disposal area of a former pile of sludge, from the former UPRR oil reclamation plant in the rail yard. The reclamation plant was located east of the "roundabout track", and adjacent to the north side of AOI 30 (Figure 1-2). About 29,000 tons of petroleum-based sludge waste was excavated from AOI-26 and shipped off-site for disposal at the ECDC Facility in East Carbon, Utah by UPRR in 1993. A monitoring well (STMW-1) was installed at the north end of the area by UPRR in December 1994.

#### *1.2.5.5 D&RGW RIP Track Area (AOI-35)*

The D&RGW RIP Track area (AOI-35) is located at the northern limit of the rail yard (Figure 1-2). The D&RGW RIP Track area was a small maintenance facility and siding yard that was active during the steam and diesel locomotive eras. Approximately 16 tons of oil-stained soil were removed from an area near the Oil and Tool House to a depth of six feet. The excavated soil was transported to ET Technologies for disposal (Morrison-Knudsen, 1988).

In addition, 20 tons of petroleum-contaminated soil were removed from the location of an above-ground kerosene storage tank, located near the Section House. The excavation extended to a depth of 2 feet below the ground surface, and all soil exhibiting organic vapor concentrations greater than 5 ppm were removed (Morrison-Knudsen, 1988). The excavated soil was transported to ET Technologies for disposal.

Two 250-gallon USTs (East tank and West tank) were removed from the east side of the Carmen's Building. Morrison-Knudsen (1988) determined that the West tank had not leaked, and that hydrocarbon leakage from the East tank was contained in the soil zone and had not impacted

groundwater. This area was designated AOI-35 during the Phase I and II investigations of the rail yard.

### 1.2.6 Community Involvement

A community relations program has been established for the site and is being managed by Community Involvement specialists from the UDEQ and EPA. A Community Involvement Plan was completed in 1999 (UDEQ/USEPA, 1999). As a means of providing accessible site-related information to the general public, a local document repository has been established in the Ogden area. The repository is maintained by Stan Hadden (Weber River Keeper), and is located in the Weber County Environmental Affairs office at 2380 Washington Boulevard in Ogden. Included in the repository are final-version copies of site work plans, data summary reports, progress reports, and other miscellaneous site-related documentation.

## 1.3 REPORT SCOPE

The RI Report for the entire rail yard is divided into two parts. Part 1 covers the all of OU-00 except the Northern Area (OU-01) and the associated investigation of the source of PCBs found in the Northern Area (OU-02). Part 1 of the RI Report is a multi-volume document covering all other components of the overall RI, including the characterization of surface soils on the rail yard and Weber River riparian zone, the investigation of groundwater beneath the rail yard (not including the DNAPL zone in the Northern Area), and the ecological investigation of the Weber River. This document constitutes the first volume of Part 1 of the RI Report.

This document contains no information on OU-01 and OU-02. These components of the RI are covered in Part 2 of the RI Report.

A seep of diesel into the Weber River in the vicinity of AOI-12 was discovered in December of 2001. Pursuant to an EPA Administrative Order executed in January of 2002 (separate from the AOC covering the RI/FS Work), UPRR implemented mitigation actions and initiated and investigation of the source of the seep. UPRR is proceeding to address the seep pursuant to a Corrective Action Plan under the direction of the Utah Water Quality Board. Because these

actions are being implemented in a regulatory framework totally independent of the RI/FS project, the data generated and actions undertaken at the AOI-12 diesel seep are not included in this RI Report.

## 1.4 REPORT ORGANIZATION

The remainder of this report follows the general reporting format suggested in OSWER directive 9355.3-01. Additions and deletions are made as necessary. This report references the results of a baseline risk assessment for the site. The baseline risk assessment (human health and ecological) was performed by EPA, and incorporated the data included in this RI report (volume 1) and the RI report (volume 2) for the Northern Area Operable Unit (AOI-33).

The remainder of this RI report is divided into five sections:

- Section 2 summarizes the various study area investigation activities that have been performed.
- Section 3 describes the physical characteristics of the rail yard study area, as determined from the both existing data sources and the field investigations undertaken pursuant to this project.
- Section 4 describes the identified nature and extent of the contamination as determined from the investigation activities. The nature and extent of contamination is summarized with respect to source areas and impacted media. This information is further presented on an AOI-by-AOI basis for the various media evaluated.
- Section 5 presents a fate and transport assessment of LNAPL zones and CVOC plumes.
- Section 6 presents the summary and conclusions of the RI.

## 1.5 INFORMATION PRESENTATION

Presentation of the RI data is complicated by the large size and configuration of the site (3.4 miles long but relatively narrow) and the large amount of data that has been collected over the course of

the various field investigations. The following description of RI data presentation is offered to facilitate the reader's efforts to assimilate the RI information.

Due to the length and shape of the site, it is difficult to present much detail in any single figure that encompasses the entire rail yard. Therefore, detailed information is presented on figures that cover only a sub-area of the entire site. All plan view figures of sub-areas of the site are derived from a 2001 topographic map of the site. An aerial photographic survey of the entire site was conducted in January 2001. This survey data was converted into a base map using the NAD83 State Plane coordinate system.

Of particular interest are the three oversize figures ("plates") showing the location of each sample collected during the RI. Given the length and shape of the site, the sample location data are presented in separate plates covering the north, central, and southern portions of the site. Table 1-2 specifies the plate in which each AOI is located.

There is a vast amount of chemical data generated from laboratory analysis of various environmental media for a suite of different analytical parameters. These data are summarized in Appendices A and B.

Appendix A presents results for every analyte that was detected in at least one location at a concentration above its site-specific screening level value (SLV) or ecological benchmark concentration. These data are organized according to the following hierarchy:

1. Individual AOI or "other category". The appendix is organized by AOI, in numerical order. "Other categories" are covered after the AOIs.

2. Environmental media. For each AOI or "other category", the data is organized by environmental media, in the following order: soil, sediment, groundwater, surface water, miscellaneous.

3. Analyte. For each environmental medium, results are presented by analyte, in numerical/alphabetical order.

Appendix A does include all results for any constituent that was present above the detection limit. It does not include any data for samples in which no constituents were detected (i.e. not detected above PQLs). A list of the samples collected and the types of analytical testing conducted for each sample is provided in Table 1-4.

Appendix B presents a summary of the groundwater data collected from four quarters of sampling conducted on the monitoring well network. The data in Appendix B are organized by AOI. For each AOI, the table includes data for every monitoring well within that AOI. Each table includes all analytes that exceeded the Human Health SLV in any single AOI, in any single well, in any single monitoring event.

# 2 STUDY AREA INVESTIGATION

This section summarizes the scope of the remedial investigations that have been performed at the site. The section is organized as follows:

- Overview of Phase I and Phase II Investigations
- RI Scope of Work
- RI Methods
- Non-RI/FS Project Investigations

## 2.1 OVERVIEW OF PHASE I AND PHASE II INVESTIGATION

Environmental conditions at the Ogden Rail Yard were assessed in a phased process, pursuant to the CERCLA process. The basic tool used in the Phase I and Phase II investigations was collection and analysis of environmental samples. These samples were collected from various environmental media in each of the AOIs to achieve the data objectives listed in the project documents. The number and types of samples to be collected in each AOI, and the types of analytical testing to be performed were specified in the FSP and SAP documents listed in Table 2-1. A chronology of key events in the CERCLA investigation of the site is presented in Table 2-2.

### 2.1.1 Phase I Investigation

The Weber-Morgan County Health Department (WMCHD) requested regulatory agency assistance in the assessment and evaluation of the Rail Yard's impact upon on the adjacent Weber River; recently designated a culinary drinking water source. In response to previous assessments and the WMCHD's concern, UPRR initiated a voluntary Phase I Remedial Investigation program focused on shallow soils, groundwater, surface water and sediments.

Phase I of the RI assessment for the rail yard was conducted by UPRR as a screening-level assessment to determine if environmental contamination was present in 31 areas of interest (AOIs) located throughout the site. Collection and testing of the environmental samples from these AOIs followed procedures outlined in a Phase I Work Plan (LES, 1997a) and three subsequent work plan addendums (LES; 1997b, 1997c, 1998). The Phase I samples collected from the individual AOIs were directed (non-random) samples, focused on areas with field evidence of potential contamination.

The data generated under the Phase I investigation included soil and water analytical results, GeoProbe boring and monitoring well logs (Appendices C and D), groundwater and LNAPL level gauging measurements, land survey data, historical information on railroad activities and previous environmental assessments, public information on water wells and hydrology-geology, and on-site observations.

### 2.1.2 Human Health Risk-Based Screening Levels

The purpose of the Phase I portion of the RI was to identify those AOIs that contained detected concentrations of contaminants above site-specific SLVs, and consequently would be subject to further investigation in Phase II of the RI. Screening levels were established as numerical points of comparison for site chemical data. On November 23, 1998, the EPA presented a set of risk-based screening level concentrations for soil and water to be applied to the Ogden site (EPA, 1998a). The EPA derived the risk-based screening level concentrations using the following assumptions.

| | |
|---|---|
| Target Risk Level | 1E-6 |
| Target Hazard Quotient | 0.1 |
| Land Use | Soil - Commercial/Industrial |
| | Water - Residential |
| Inhalation Exposure to VOCs in soil | RBC based on ingestion exposure only. |

The November 23rd SLVs were calculated without consideration for achievable laboratory practical quantitation limits (PQLs). Because of numerous constituents of potential concern with laboratory PQLs higher than the screening level risk-based concentrations for aqueous medium, EPA revised the SLV for those affected constituents (EPA, 1999b). Revised SLV concentrations

are based on maximum acceptable detection limits (MADLs) to be consistent with EPA's general risk management goals. MADLs are defined as the lower of either, 1) the risk-based concentration based on targets of HQ=1 and cancer risk=1E-04, or 2) the MCL. The resultant site-specific risk-based screening level concentrations used in this document for soil and water are shown in Table 2-3.

### 2.1.3 Identification of Target Analytes

In the *Sampling and Analysis Approach* document prepared by Lockheed (1997a) prior to the start of the Phase I activities, specific target analytes were not defined. Rather, the following target analyte groups (TPH, VOCs, metals, pesticides, PAHs, PCBs) were specified for soil, sediment, surface water, and groundwater analyses in various combinations specific to each AOI. Based on the discussion contained in Section C (Candidate Analytical Methods) of Lockheed (1997a), the following SW-846 analytical methods were selected for the site: VOCs 8260B (purge and trap extraction method 5030A for solid and aqueous matrices); PAHs, phenols, and other SVOCs 8270C (sonication extraction method 3550B for solid matrices, liquid/liquid continuous extraction method 3520A for aqueous matrices); Pesticides and PCBs 8080/8081 (sonication extraction method 3550B for solid matrices, liquid/liquid continuous extraction method 3520A for aqueous matrices, PCB samples were subject to extended sulfuric acid/permanganate cleanup method 3665A); metals 6010A (mercury by 7470 and 7471) (acid extraction method 3005A for aqueous matrices, 3050A for soil matrices). Method 8015-modified (purge and trap extraction method 5030A for solid and aqueous matrices) was selected for TPH-diesel and -gasoline range hydrocarbon analysis based on Utah UST regulations. Phase I oil & grease analyses were determined by Method 9071, and pH by 9040/9045.

The target analytes for each analytical method are those standard analytes that are routinely reported by the laboratory for each method. The analytes subject to analysis in the Phase I and Phase II field investigations are listed in Table 2-4. Those analytes with a site-specific SLV (Table 2-3) are indicated. Note that some analytes do not have an associated SLV. Screening levels were not developed by the EPA for these analytes because toxicity factors and other reference information were not available. These analytes have not been detected in the site data.

### 2.1.4 Overview of Phase II RI

Results of the Phase I investigation and finalization of the site-specific SLVs (Table 2-3) led to the development of the Phase II work plan, FSP, and QAPP (Safety-Kleen; 2000a, 2000b, 2000c).[2] Incorporated into the Phase II work plan was a Sampling and Analysis Plan prepared by EPA (1999a) to support the human and ecological risk assessments.

Data obtained under the Phase II investigation was generated to augment the Phase I data and to complete an assessment of contaminant exposure pathways. An overview of the specific objectives and data collection strategies developed for the Phase II RI is presented in Table 2-5.

Additional chemical data consisted of surface and subsurface soil, sediment and surface water, collection of four quarters of groundwater analytical data, contaminant source delineation, soil-vapor analysis, and biota analysis. Generation of physical site data consisted of measured elevations of the Alpine clay surface throughout the yard, monitoring groundwater-river elevation relationships over the spring runoff period, and visual examination of all soil cores retrieved from borings (Appendix C) and monitoring well installations (Appendix D).

The scope and methodologies of the Phase II RI field investigation were consistent with the approved UPRR and EPA Work Plans, Work Plan Addendums, and SAPs with few deviations. These deviations are briefly summarized below:

- Additional sample collection activities above and beyond those specified in the work plans were conducted during both the Phase I and Phase II RI. The additional samples were required as new information on contamination extent was brought to light through the investigation activities. The additional sample collections were described in addenda to the Phase I and Phase II work plans (see Table 2-1).

[2] The Phase I RI report (EDG, 1999) was issued in draft form only, at the request of EPA to combine the results of the Phase I and Phase II investigation into a single RI report (EPA, 1999c). Regulatory comments on the draft Phase I report (EPA, 1999c) were largely incorporated into the approved Phase II work plan. Remaining comments on the Phase I text have been addressed in this document to the extent they are still applicable.

- Various samples were not collected as required by the work plans because of site-specific conditions, such as: No soil present in the AOI-22A turntable; No groundwater sample collected because of the presence of LNAPL; No surface water present during the sampling event. These and other individual limitations to sample collection are noted, where applicable, in the respective discussions in Section 4.2 for each AOI.

- All of the surface soil samples collected during the Phase II on-yard investigation were sieved to 60-mesh prior to extraction for metal analyses.

- Only 10 Phase II soil samples were collected from each of the Riparian Zones as opposed to the 15 planned for each RZ-1, RZ-2, RZ-3, and 20 planned for background (RZ-4) (FSP Section 3.2.1).

- Phase II interstitial water samples from soils adjacent to the Weber River were not collected with concurrence from EPA (FSP Section 3.3.1).

### 2.1.5 RI Data Reports

Over the course of the Phase I and Phase II RI, documents have been prepared that present and summarize the analytical results. These documents are listed below. All Phase II RI analytical data have undergone validation in accordance with the Phase II QAPP (Safety-Kleen, 2000c). Results of the data validation, including qualification of data points and quality control summary reports, are presented in the Phase II data summary reports. A data quality assessment of the Phase II chemical data used in this report is presented in Appendix E.

| Result/Summary Documents Already Submitted | |
|---|---|
| Safety-Kleen, 1999 | Comparison of Phase I site data to revised screening-level concentrations for soil and water. Data tabulated by AOI with screening level exceedences indicated. |
| EPA, 2001b | Final field sampling report on the results of EPA biotic and abiotic sampling conducted during March 2000. |
| EPA, 2001c | Screening Level Ecological Risk Assessment and evaluation of pre-November 1999 site data. |
| Forrester Group, 2000b | Data validation report and comparison to site-specific screening levels for Phase II data collected through July 2000. |
| Forrester Group, 2001e | Data validation report and comparison to site-specific screening levels for Phase II data collected from August through December 2000. |
| Forrester Group, 2001f | Data validation report and comparison to site-specific screening levels for Phase II groundwater data collected January and February 2001. |
| Forrester Group, 2001g | Data validation report and comparison to site-specific screening levels for Phase II soil data collected May 2001. |

| | |
|---|---|
| Forrester Group, 2001h | Data validation report and comparison to site-specific screening levels for Phase II groundwater data collected May 2001. |
| Forrester Group, 2001i | Data validation report and comparison to site-specific screening levels for Phase II groundwater data collected September 2001. |

## 2.2 Scope of Phase I and Phase II Field Activities

The field activities described in the following subsections were conducted to complete the site characterization. The documents listed in Table 2-1 provide the objectives and investigation parameters for each of the activities.

All surface- and subsurface-soil sampling locations are summarized in Table 2-6. Groundwater sample collection points from monitoring wells are summarized in Table 2-7. Sediment and surface water sampling locations are summarized in Table 2-8. All other types of sampling locations are summarized in Table 2-9. The tabulated locations include all of the Phase I and Phase II samples collected by UPRR, as well as the Phase II and Phase III samples collected by EPA. The tables do not include the samples collected as part of the Northern Area operable unit (AOI-33) that are presented in Volume 2 (Forrester Group, 2001a).

The sampling locations referenced in Tables 2-6 through 2-9 are shown on Plates 2-1 (northern yard), 2-2 (central yard), and 2-3 (southern yard).

### 2.2.1 Surface Features

Given the long historic use of the rail yard, the generally flat site morphology has remained constant over the past 100 years. Investigation activities at three AOIs (26, 27, and 34) were specifically directed at surface features [treatment plant lagoons (AOI-34), sludge deposited on the land surface (AOI-26), and buried sludge (AOI-27)]. The sampling activities for these AOIs are discussed in the following section (2.3.2) on Contaminant Source Investigations.

An aerial photographic survey of the entire site was flown in January 2001 by Aerographics Incorporated of Salt Lake City. The survey was used to generate a new topographic base map for the site, based on the NAD83 State Plane coordinate system. This map is used as the base for all of the figures contained in this report.

### 2.2.2 Contaminant Source Investigations

At seven areas in the yard, investigation activities were conducted to identify and/or delineate known or suspected sources of contamination. One of the main contaminant sources identified at the site during the Phase II field investigation is a hydrocarbon DNAPL. This DNAPL is the subject of the 21st Street Pond Northern Area Operable Unit, RI report volume 2 (Forrester Group, 2001a). The six remaining contaminant source investigations were focused on the following, each of which is described in the subsections below.

1. Surface deposits of oil sludge (AOI-26),

2. Buried oil sludge (AOI-27),

3. Sludge lagoons at a former wastewater treatment plant (AOI-34),

4. LNAPL characterization, and

5. & 6. Two groundwater plumes of chlorinated volatile organic compounds (CVOCs), termed the North Plume and South Plume.

#### *2.2.2.1 AOI-26*

The Phase I investigation consisted of six GeoProbe borings (26-B1 to 26-B6) and the installation of one monitoring well (26-MW1). Under the Phase I work plan (LES, 1997a) four borings were originally proposed for the Phase I assessment. Soil and GeoProbe water samples were collected from borings 26-B1 through 26-B4, and groundwater samples were collected from wells 26-MW1 and STMW-1. All samples were analyzed for VOCs, TPH-DRO, and PAHs. Soils were also analyzed for oil/grease. Borings 26-B5 and 26-B6 were drilled only to retrieve Geoprobe groundwater samples for dissolved vinyl chloride analysis, because this AOI is located at the downgradient edge of the southern dissolved vinyl chloride plume (see Section 2.3.2.5).

The Phase II investigation activities consisted of the installation of monitoring well 26-MW2 in the center of the former sludge area, and collection of four quarters of groundwater analytical data

from the three site wells. Additional exploratory borings were completed in the AOI to delineate the extent of remaining sludge material, as requested by the regulatory agencies (Comment #21, EPA, 1999d).

As directed by Section 3.8.4 of the Phase II FSP (Safety-Kleen, 2000b), 12 GeoProbe borings 26-B8 through 26-B19) were completed in and around the former sludge area. The extent of residual sludge material in the subsurface was determined by visual observation and field monitoring methods. Soil and sludge samples were collected for analysis to support the field observations. All samples were analyzed for VOCs, SVOCs, TPH, and metals.

#### *2.2.2.2 AOI-27*

The Phase I investigation at this AOI consisted of the collection and analysis of soil samples from seven Geoprobe borings; five were completed around the perimeter of the sludge area and two were completed within it. Geoprobe groundwater samples were collected from the borings and the existing monitoring well, OGP-1, was also sampled. Both soil and groundwater samples were analyzed for TPH-DRO, VOCs, PAHs, and metals. The soil and Geoprobe groundwater samples were also tested for pH.

The Phase II investigation activities consisted of the installation of two monitoring wells (27-MW1 and 27-MW2) downgradient of the sludge area, and collection of four quarters of groundwater analytical data from the three site wells. The wells samples were tested for metals, SVOCs, VOCs, and TPH. The two additional Geoprobe borings specified in the Phase II FSP (Section 3.8.5.1, Safety-Kleen, 2000b) to define the northwest limit of contamination were not installed. Instead, 27 test pits (TP-21 through TP-47) were excavated throughout the area to more accurately define the horizontal and vertical limits of the sludge. Outlying pods of sludge remain on the north and northeast side of the former pond.

#### *2.2.2.3 AOI-34 (SPRR Wastewater Treatment Plant)*

The Phase I RI work conducted between October 1997 and March 1998 resulted in the completion of 43 GeoProbe borings (34-B1 through 34-B43) in and around this AOI. Most of these borings were located to the east and southeast of the fenced WWTP compound, to delineate

a groundwater plume of dissolved vinyl chloride (see Section 2.3.2.5 below). Phase I groundwater samples were also collected from eight existing wells and six wells installed under the Phase I field program. Groundwater GeoProbe samples numbered 34-B8 and higher were only tested for vinyl chloride. The monitoring well and remaining Geoprobe groundwater samples were analyzed for VOCs, TPH-DRO, PAHs, and metals. Soil samples collected from the Geoprobe borings and well installations were analyzed for VOCs, TPH-DRO, PAHs, and metals.

The Phase II investigation activities in this AOI were focused on characterization of the lagoon sludge. Two sludge samples were collected for analysis from lagoon B (34-LBE, 34-LBW), and three samples were collected from lagoon A (34-LAE, 34-LAW1, 34-LAW2). The samples were collected from the 0-1 foot depth as an initial phase of characterization. Results of the sludge analyses showed the material to be non-hazardous.

As an initial step in planned decommissioning of the treatment plant, UPRR submitted a Work Plan for Demolition and Removal in May 1999 (EDG, 1999a). A subsequent work plan letter was submitted to the regulatory agencies requesting approval to proceed with the removal of the sludge and standing liquids in the concrete lagoon (Lagoon C) (Safety-Kleen, 2000f). Removal of the liquids was approved by EPA on January 18, 2000. The oily water in the lagoon was treated and discharged under permit to the Central Weber Sewer Improvement District in March 2000. 172,470 gallons of water were removed from the lagoon, treated, and discharged.

After the bulk of the lagoon C liquid was removed, the sludge was sampled and found to be non-hazardous. EPA approved the scope of work for removal of the sludge on January 11, 2001. Sludge removal activities were conducted in May 2001. 3070 tons of sludge and mixed stabilization material were removed from the concrete lagoon and transported to the Pacific West facility in Erda, Utah for recycling use in road base.

Subsequent Phase II fieldwork was conducted to define the lateral and vertical extent of soil contamination beneath the lagoons as outlined in the Phase II Work Plan Addendum 3 (Forrester Group, 2001d). This work involved the completion of 16 Geoprobe borings through the bottoms of the lagoons. Sludge and soil samples were collected and analyzed for VOCS, SVOCs, and

TPH. Field analyses conducted during sludge and soil sampling consisted of field screening for organic vapors, visual observations of contamination extent, and field soil classification.

Four of the borings were advanced down to the upper Alpine clay contact, where soil samples were tested for VOCs, SVOCs, and PCBs. The VOC and SVOC analyses were performed to evaluate the presence of a DNAPL on the clay surface. PCB analyses were performed to complete an assessment of the AOI as being a source of PCB contamination detected in sediments in the Ogden River and in fish tissue from the 21st Street Pond (see Section 5, Volume 2, Forrester Group, 2001a).

Remediation activities for removal of sludge and soil in and beneath the lagoons were conducted during the fall of 2002. This AOI has been designated Operable Unit OU-03.

#### *2.2.2.4 LNAPL Characterization*

Small pools of hydrocarbons in the form of light non-aqueous phase liquid (LNAPL) were identified at various locations beneath the Site during the Phase I field investigation. Most of these LNAPL pools are also in locations where dissolved plumes of vinyl chloride have been identified. To evaluate whether the LNAPL is a potential source of the vinyl chloride, LNAPL samples were collected from five locations on-yard that contain the most expansive LNAPL pools. One sample was collected from each pool during a one-time Phase II investigation event. The sampling locations are: 30-MW6, 38-MW6, 38-caisson, 38-MW1, and 22A-B4. The LNAPL hydrocarbon samples were tested for VOCs and SVOCs.

The diesel LNAPL pool in AOI 38 is the largest identified at the site (Plate 9, Safety-Kleen, 2000b). The apparent thickness of LNAPL in this plume has been measured at 3.5 feet (38-MW6) and 2 feet (38-MW1) (see Table 2-10). To estimate the volume of recoverable LNAPL in this pool, bail down tests were conducted on three wells in this plume that contained the greatest LNAPL thicknesses (38-MW6, 38-MW1, 38-B28). Following removal of the oil, the rate of oil recharge to each well was measured by gauging the LNAPL thickness on the following schedule: 1 hour, 1 day, 1 week, 2 weeks, 1 month.

#### 2.2.2.5 *Chlorinated Volatile Organic Compound (CVOC) Plumes*

Two plumes of chlorinated volatile organic compounds (CVOCs) exist in the groundwater beneath the Site. The extent of these plumes (south plume in AOIs 21, 22b, 30; north plume in AOIs 22a, 34) was defined from the Phase I analytical testing data which was collected according to the Phase I Work Plan Addendum 3 (LES, 1998). The Phase I testing consisted of analysis of groundwater samples from monitoring wells and Geoprobe groundwater samples collected from the AOIs overlying the plumes (south plume – approximately 47 sampling points; north plume – approximately 66 sampling points).

The north plume is elongated in shape and trends NW from the AOI-38/22a area to AOI-34. An industrial sewer line network leading to the AOI-34 treatment plant from the former SPRR machine shop area (AOI-38) was sampled from manholes at and near AOIs 34 and 38. Seven water samples (WW1 through WW7) were collected from manholes along the sewer line and analyzed for VOCs, to determine whether the sewer line contain evidence of solvents or other vinyl chloride source material.

Phase II investigative work was conducted for the north plume, and directed toward identifying the source of the dissolved vinyl chloride. Because of the similarities between the two, it was anticipated that results from the northern area plume investigation could then be applied to the south plume. The Phase II investigation involved: (1) gathering data to evaluate the potential presence of DNAPL acting as a continuing source of the CVOC plumes; and (2) generating detailed site-specific information on indicators of intrinsic bioremediation of the CVOCs (e.g., groundwater geochemistry).

Among the additional wells installed during the Phase II investigation, three of the wells (22b-MW2D, 22a-MW6D, 34-MW7D) within the vinyl chloride plumes were completed at the Alpine clay horizon. Soil samples collected at the clay contact were analyzed for VOCs and SVOCs to provide evidence for the presence or absence of DNAPL.

The elongated shape of the north plume suggests a potential migration of the plume being controlled by soils of higher permeability associated with a buried stream channel. If this were the case, a channel cut into the surface of the Alpine clay layer would be a likely location for the

presence of a DNAPL source. To investigate this theory, a transect of borings was completed across the plume in AOI-22a (borings 22a-B12 through 22a-B21) to measure the elevation of the Alpine clay surface perpendicular to the trend of the plume. A progressive series of groundwater samples (analyzed for VOCs) were collected down to the clay horizon to evaluate the vertical vinyl chloride concentration gradient.

All monitoring wells within the vinyl chloride plumes were subject to collection of four quarterly groundwater samples to establish concentration trends of the volatile contaminants. Analyte groups consisted of VOCs, SVOCs, and metals. Two of the quarterly events for the north plume included analysis of special parameters that are indicative of degradation and natural attenuation processes. The natural attenuation parameters analyzed from 20 wells associated with the north plume are: dissolved oxygen, nitrate, ferrous iron, manganese, sulfate, methane/ethane/ethene, alkalinity, chloride, and major cations.

### 2.2.3 Meteorological Investigations

No on-site meteorological investigations were conducted as part of the RI. Local data on meteorological conditions were obtained from three observation stations near the site. These data are presented in Section 3.2.

1. Ogden-Hinckley Airport (elevation: 4470 ft, lat: 41° 11' 43" N, long: 112° 0' 40" W)

2. Ogden Sugar Factory (elevation: 4280', lat: 41° 14' N, long: 112° 02' W)

3. Hill Air Force Base (elevation: 4788', lat: 41° 07' N, long: 111° 58' W)

The elevation of the rail yard site is approximately 4,300 feet.

### 2.2.4 Surface-Water and Sediment Investigations

Sediment and surface water samples were collected over the course of the rail yard RI to evaluate contaminant loading to the Weber River. A listing of all surface water and sediment samples

collected is provided in Table 2-8. Locations are shown on Plates 2-1 through 2-3 for the corresponding samples.

For the Phase I investigation, paired surface-water ("SW") and sediment ("S" or "SE") samples were collected from the surface drainage features that cross the yard; specifically Burch Creek (3 sample pairs AOI-9), an unnamed ephemeral drainage stream (2 sediment samples AOI-10), 33rd Street drainage slough (1 sample pair), and Strongs Creek (3 sample pairs AOI-29). Additional surface-water and sediment samples were collected from selected locations along the east bank of the Weber River (20 aqueous samples, 18 sediment samples). Surface water samples were also collected from ponded water in several of the AOIs (34-SW1, 35-SW1). The samples were analyzed for metals, SVOCs, VOCs, and pesticides.

All surface-water and sediment samples were collected as specified in the Phase I Work Plan, with the following exceptions.

- Two surface water samples specified for AOI-28 were not collected because of the lack of water (3 sediment and 1 aqueous sample collected).

- Two surface water samples specified for the downstream reach of AOI-10 were not collected because the drainage was dry (2 sediment samples collected). The paired sediment and water samples to be collected from the upstream reach of the drainage were not collected because the portion of the drainage east of the rail yard is contained in an underground culvert.

Phase II sediment and surface water samples were collected by the EPA's Response Engineering and Analytical Contract /Emergency Response Team (REAC/ERT) to assist in the generation of site-specific ecological and contaminant data (REAC, 2000). Nineteen sediment and surface water sampling locations were focused on the east bank of the Weber River to evaluate the site's potential for release of contamination to the Weber River. Paired sediment and surface water samples were collected from other site water bodies as follows:

| Area of Interest | Number of Sediment – Surface Water Sample Pairs |
|---|---|
| Buenaventura Park Pond | 3 |
| AOI-28 | 3 |
| AOI-10 | 2 |
| 33rd Street Slough | 3 |
| Strongs Creek | 4 |
| Burch Creek | 4 |

Surface water samples were analyzed for metals, SVOCs, VOCs, TPH, hardness, TSS and TOC. Sediment samples were analyzed for metals, SVOCs, VOCs, pesticides/PCBs, TPH, TOC, and grain size.

Additional sediment samples were collected by EPA in July 2001. Samples were collected according to the Phase III SAP (EPA, 2001a).

The Phase I investigation delineated the extent of two dissolved-phase vinyl chloride plumes in the site groundwater (Section 2.3.2.5). Maps of the potentiometric surface for the site show that the Weber River is the receptor for shallow groundwater flow at the site. With respect to fate and transport assessments of the contaminant plumes, a key consideration is whether (and during which time periods), the Weber River is in a losing or gaining stage. To determine the river stage, a series of pressure transducers were installed in the Weber River and four monitoring wells, located at increasing distances from the river.

The River transducer was set in a perforated vertical PVC pipe, adjacent to the west bank of the Weber River. Well transducers were set in well 34-MW9 (30 feet from the river), 34-MW2 (75 feet from the river), 34-SPMW-02 (90 feet from the river), and in 34-MW1 (350 feet from the River). Well 34-MW9 is the closest well to the River and is located 50 feet downstream from the River transducer location. The transducers recorded elevations (record as PSI) for the time interval from February 27, 2001 through June 12, 2001. This time interval was set to span the winter low-water period through the spring snow melt and runoff period.

Data was recorded at each location by In-Situ MiniTroll loggers. In-Situ's Data Manager Package (ver. 3.69) was used to process the data and convert PSI measurements to water level elevations. The resultant elevation data was graphed to show the measured changes in water

elevation for each of the five monitoring points. Results of this data assessment are discussed in Section 3.3.

### 2.2.5 Geological Investigations

Investigations into the subsurface geology of the site were completed through observation and analysis of soil cores retrieved during the completion of soil borings and monitoring wells for the Phase I and Phase II investigation activities. All borings drilled for well installations (hollow-stem auger rig) and subsurface soil sampling (Geoprobe direct push) had a target of 100% core recovery. Descriptive lithology logs were completed for each of the drilling locations, and are provided in Appendix C (soil borings) and Appendix D (monitoring wells). Locations of the site borings and monitoring wells are shown on Plates 2-1 through 2-3.

The focus of the Phase I investigation was the shallow groundwater and vadose zone soils in the AOIs. Geoprobe borings used to collect soil samples in the AOIs were usually advanced no deeper than 10 feet, and most of the monitoring wells installed for the Phase I investigation were completed with shallow screened intervals spanning the water table. Two well borings and two soil borings were advanced deep enough to encounter a significant clay horizon (Alpine Formation) beneath the site.

Because of the potential significance of this clay horizon acting as a barrier to downward contaminant migration, additional drilling activities were conducted during the Phase II field investigation to define the lateral extent and depth of the Alpine throughout the yard. During the Phase II investigation, data on the continuity and elevation of the top of the Alpine Clay was generated through installation of 11 soil borings and 10 monitoring wells. Additional elevation and continuity data on the Alpine was generated from 68 borings and 15 wells installed pursuant to the Northern Area Operable Unit RI (Forrester Group, 2001a).

All subsurface drilling locations were surveyed for X,Y coordinates and ground surface elevation to allow for estimations of unit thicknesses and bedding elevations to be made. Subsurface soil samples for geotechnical analysis were collected from the following borings; 12-MW2, 19-MW1, 27-MW2, and 35-MW2. At each location, soil samples were collected for laboratory analysis for

permeability, grain size, moisture content, density, and Atterberg limits according to Section 6.3.2 of the Phase II FSP.

### 2.2.6 Soil Investigations

Phase I and Phase II field investigation activities were conducted to identify the nature and extent of soil contamination at the identified AOIs in the rail yard and in areas of ecological interest. Results of the soil investigations are described in Section 4. Physical characteristics derived from the investigations are described in Section 3.5. Phase II investigation activities were also conducted to assess the extent of vadose-zone soil vapor associated with identified groundwater contaminant plumes. Each of these general investigations is described below.

Table 2-6 lists the site Phase I and Phase II soil samples collected and the analyses performed. All sampling locations are shown on Plates 2-1 through 2-3. For the Phase I sampling, the soil sample analyses at the AOIs included surface grab samples (SG, top two inches of soil), and subsurface samples collected from GeoProbe borings and monitor well borings. Subsurface samples were generally collected from target depths of 2-4 feet and the 2-foot interval above the water table.

Additional Phase I surface soil samples were collected as "ecology-based" surface samples (ES), and background surface samples (BG). Ecology based samples were collected in riparian habitat areas located between the rail tracks and the east bank of the Weber River. Soil "background" samples were collected during the Phase I investigation to determine the general range of concentrations of the soil and rail yard fill in areas outside of specific AOIs, and as such they are not associated with any particular AOI. The "ES" samples and analytical data were generated for use in developing the Ecological Risk Assessment portion of the Baseline Risk Assessment (BRA) for the site. Additional ecological samples (riparian zone) were collected by EPA during the Phase II investigation.

All Phase I soil samples were collected as specified in the Phase I Work Plan and work plan addendums with the following exceptions.

1. Sampling locations for the surface soil samples and boring locations for AOI-21 were relocated around the perimeter of the Atlas Steel facility. The Atlas Steel site is privately held property, and access to the site was denied to the field investigation team. Site access was obtained during the Phase II field investigation, and onsite sampling was completed according to section 3.8.6 of the Phase II FSP.

2. The specified surface soil samples from the interior of the roundtable structure (AOI-38) were not collected. This structure has a concrete bottom, and no soil was present.

3. Borings B1, B2, and B3 in AOI 12 were terminated short of the target depth (water table), because the Geoprobe was unable to push the sampling tube through buried concrete and other obstructions. During the Phase II investigation a hollow-stem auger rig was used to drill and complete the installation of 3 monitoring wells in this AOI, which provided for the collection of the required groundwater samples.

Phase II soil samples were collected to (1) support the human health baseline risk assessment, (2) support the ecological baseline risk assessment, and (3) support the contaminant source investigations described above in section 2.3.2. For human health, the need for additional on-site surface soil (0-2 inches) and shallow subsurface (2-24 inches) samples was identified through a screening level risk assessment conducted by EPA using the Phase I data (EPA, 1999a). The number and locations of the required Phase II samples were also determined by the EPA (Phase II Work Plan, Table 3-1 of Appendix B). These additional locations (ranging from 1 to 3 in the specified AOIs) were chosen to ensure that the total number of combined Phase I and Phase II samples in each AOI is at least three for each of the VOC, SVOC and metal analyte groups the surface (0-2 inches) and shallow subsurface (2-24 inches).

Sampling of surface soil chemistry was identified as a data need to support the ecological risk analysis for the Weber River riparian area. The riparian area was divided in to four exposure units that were subsequently sampled by the EPA field investigation team in March 2000:

- RZ-1 (the portion south of Interstate 79 and north of AOI 12);
- RZ-2 (the area to the north of Interstate 79 and south of the 24$^{th}$ Street overpass);

- RZ-3 (the area to the north of the 24th Street overpass and south of the 21st Street overpass); and
- RZ-4 (background riparian area of the Weber River).

Ten randomly selected locations were sampled in each exposure unit. Locations are shown on Plates 2-1 through 2-3. Samples were collected from depths of 0 to 15 cm below ground surface, and were analyzed for VOCs, SVOCs, pesticides/PCBs, and TAL metals.

### 2.2.7 Air and Vapor Investigations

As specified in Section 3.7 of the Phase II FSP, on-yard indoor air and soil vapor samples were collected to evaluate airborne contaminant concentrations in on-yard structures, and to evaluate the vapor-phase migration (emission rate) of volatile contaminants from potential source areas. The results of these evaluations are discussed in section 4.1.5.

Collection of air/vapor samples was conducted over two areas of the yard, each located above one of the dissolved vinyl chloride plumes identified from the Phase I RI (EDG, 1999); AOI 22a – northern CVOC plume (Figure 2-4), AOI 30 – southern CVOC plume (Figure 2-5). Indoor air was assessed through collection of direct indoor air samples. The soil-vapor emission rate was assessed through collection of flux chamber samples (Schmidt, 1999).

Three samples related to indoor air (2 indoor, 1 ambient in the upwind direction from the buildings) were collected at each plume. For the north plume, indoor air samples were collected in an office area in the soda-ash transfer building (AOI-22a). For the south plume, indoor air samples were collected in the Durbano Metals office building (AOI-30). For soil vapor, one sample was taken from each flux chamber location. Ten flux chamber locations were established above each plume, for a total of 20 field samples.

All samples were analyzed by USEPA method TO-14 for three select target compounds. These compounds are benzene, 1,1-DCE, and vinyl chloride, as discussed in Appendix D of the Phase II RI Work Plan (Safety-Kleen, 2000a).

### 2.2.8 Ground-Water Investigations

As part of the data collection effort for the rail yard RI, over 100 monitoring wells and piezometers have been installed at the site. Locations of the wells are shown on Plates 2-1 to 2-3. Lithologic logs of the well borings and completion diagrams for the installed monitoring wells are provided in Appendix D. A summary of the well-completion data is presented in Table 2-11.

Groundwater investigative activities involved the collection of fluid level data and laboratory analytical data. Gauging data on the groundwater level and LNAPL thickness was obtained from the site monitoring wells and piezometers on a monthly basis during the Phase II investigation, to provide the potentiometric data for a better understanding of groundwater flow direction and flux. This data is presented in Table 2-10 for the period of time from March 2000 through September 2001. For monitoring wells that were more recently installed as part of the Phase II investigation activities, the initial gauging began in June 2000.

Representative groundwater samples were collected from GeoProbe borings and monitoring wells as a one-time event during the Phase I investigation. Aqueous samples collected from Geoprobe borings are identified with an AOI number and boring number (e.g. 38-B3). Samples from monitoring wells are identified by the well designation (e.g. 34-MW1). Additional water samples were collected from storm sewers (ST), and waste water lines (WW). Groundwater analyte groups subject to analysis for the Phase I samples include VOCs, metals, PAHs, SVOCs, TPH, pesticides and PCBs. Actual analysis varied according to AOI, and was based on likely analyte groups of concern associated with past operations (Table 9, LES 1997a).

Additional collection and analysis of groundwater samples was identified as being essential to defining the extent and migration potential of groundwater contamination. During the Phase II RI, groundwater samples were collected on a quarterly basis for a period of one year (July 2000 through May 2001) from all site monitoring wells that did not have evidence of LNAPL. The sampling events were scheduled such that a period of seasonal high (July 2000) and seasonal low (January 2001) river discharge rates were included. All groundwater samples were analyzed for metals, VOCs, SVOCs, and PAHs.

### 2.2.9 Human Population Surveys

A community relations program has been established for the site and is being run by Community Involvement specialists from the UDEQ and EPA. A Community Involvement Plan was completed in 1999 (UDEQ/USEPA, 1999). The plan presents the results of a community survey and summarizes the community profile and concerns at the time of the survey. Information on demographics in the area was obtained by the Community Involvement personnel from field interviews and 1994 census data, and is presented in Section 3.6.

### 2.2.10 Ecological Investigations

An ecological investigation of the site was conducted by EPA to assist in the generation of site-specific ecological and contaminant data for the rail yard, and to generate a technical data evaluation for the aquatic components of the site. The field study was conducted in March 2000 and included habitat evaluation, benthic macroinvertebrate sampling, toxicity evaluations, and fish collection.

The in-stream and riparian habitat was evaluated at all EPA sampling locations in the Weber River. The habitat parameters evaluated for an assessment of biological quality include those that characterize the stream micro- and macro-scale habitat and influence the structure of the biological community (EPA, 2001b; Appendix F). These parameters include; epifaunal substrate/available cover, embeddedness, velocity-depth regime, sediment deposition, channel flow status, channel alteration riffle frequency, bank stability, bank vegetative protection, and vegetative zone width.

At seven of the 19 Weber River sediment and surface water sampling locations (section 2.3.4), a stream benthic macroinvertebrate survey was conducted, as well as solid-phase sediment laboratory toxicity tests (Weber River sampling locations; WR09, WR011, WR012, WR014, WR019, WR024, WR028). Rapid Bioassessment Protocols were used to identify and evaluate the abundance and distribution of habitat and ecological communities. Sampling locations were located in areas that typify the drainage and were likely to yield representative specimens of the benthic macroinvertebrates (EPA, 2001b).

Sediment samples for the solid-phase toxicity evaluations were co-located with the macroinvertebrate sampling. Toxicity testing was conducted on chironomids (*chironomus tentans*) and amphipods (*Hyalella azteca*) to provide data on the availability and toxicity of contaminants present in the Weber River sediments.

Ecological investigations of the 21st Street Pond and Ogden River were also conducted. The results of these investigations are reported in Part 2 of this RI Report, which encompasses the Northern Area Operable Unit (Forrester Group, 2001a).

As part of the Phase III field investigation conducted by EPA in July and August 2001, EPA collected two sets of samples from the Buenaventura park pond (west of AOI-26). These samples were selected to serve as reference samples for similar samples collected from the 21st Street Pond. The samples were subject to analysis of sediment contamination, sediment toxicity, and BMI community status.

## 2.3 SAMPLE COLLECTION METHODOLOGY

Sample collection methodologies described in this section pertain to the environmental sampling activities conducted by UPRR contractors. The Phase II and Phase III sample collection activities conducted by EPA followed the SOPs contained in the Phase II FSP (Safety-Kleen, 2000b) and in the Phase III SAP (EPA, 2001a). Sample-collection methodology as implemented in the field by EPA is further described in Section 2 of the *Final Field Sampling Report* (EPA, 2001b) and in Section 2 of the *Phase 3 Field Sampling Summary Report* (EPA, 2001d).

Phase I samples were collected by UPRR to identify AOIs that had soil, sediment, groundwater and/or surface water contaminant concentrations above the site specific SLVs. In general the Phase II samples were collected as necessary to fill data gaps identified from a screening level risk assessment conducted on the Phase I data by EPA. The sample collection methods used for the Phase I investigation are discussed in Section 7 of the Phase I Work Plan (LES, 1997a); sampling equipment and procedures used for the Phase II investigation are discussed in Section 5 of the Phase II FSP (Safety-Kleen, 2000b). Sample collection followed the methodology described in the appropriate SOPs for the collection of field samples as contained in Appendix A

of the Phase I Work Plan, and also in Appendix A of the Phase II FSP. Sample collection methodology as implemented in the field is described in the subsections below.

All samples were placed in sample collection containers provided by the analytical laboratories. Filled sample containers were placed in coolers chilled with ice, and delivered under chain of custody by over-night courier to the analytical laboratory. Groundwater samples collected under the Phase I Addendum 3 sampling plan (LES, 1998) for vinyl chloride analyses were hand-delivered to a local testing laboratory because rapid (24 hour) turn around was required in order to get quick turnaround, necessary to direct the subsequent drilling locations for the vinyl chloride delineation investigation. The soil and groundwater samples were analyzed by the various analytical methods listed in Table 2-4. All sampling locations are shown on Plates 2-1, 2-2, and 2-3.

Copies of chain of custody forms and field forms for the Phase II investigation were submitted to the regulatory agencies in the corresponding Data Summary reports listed above in Section 1.2.6. Chain of custody forms for the Phase I investigation are contained in the 6-volume Appendix C (*Data Quality Assessment and Analytical Data Reports*) to the draft Phase I RI report (Safety-Kleen, 1998). Copies of the field forms are contained revised Appendix C-A to the same report.

### 2.3.1 Soil Sample Collection

Surface soil (0-6 inches Phase I, and 0-2 inches Phase II) and sediment samples were collected with a hand-held trowel, which was also used to immediately fill the required sample containers. The trowel was decontaminated following the collection of each sample. Gravels were removed by hand from the retrieved sample material so as not to affect the usable sample volume. All surface soil samples collected during the Phase II investigation for analysis of metals were subject to a sieving by the laboratory prior to sample digestion. These aliquots for metals analyses were sieved to less than 60 mesh.

All subsurface soil samples were collected with a Geoprobe, with the exception of the soil samples collected from borings in which monitoring wells were installed. The samples collected during the well drilling were collected with a hollow-stem-auger drilling rig. Geoprobe borings and collection of subsurface soil samples in the Phase I investigation were completed from

September through November 1997, and March and May 1998. Collection of Geoprobe subsurface soil samples under Phase II was completed in May and November 2001[3]. Drilling logs were completed for the collection of all subsurface soils samples. The sample depth and soil characteristics are noted on the logs (Appendix C, Appendix D).

Soil samples collected with the Geoprobe were collected in continuous 4-foot lengths of core inside a clear PVC liner. The recovered footage is noted on the logs for each 4-foot length. When recovery rates were low (generally below the water table) a closed piston sampler was used. The sampler was mounted on the end of a probe rod and driven into the subsurface by the probing machine. At the desired sampling depth, the sampler was mechanically opened and the probe rod was further advanced to fill the sampler from the desired interval. The sampler was decontaminated between sampling runs.

For the Phase I investigation, Geoprobe soil samples were collected of the subsurface soil at depths of 2 to 4 feet, and of the 2-foot interval above the water table (generally in the range of 6 to 8 feet or 7 to 9 feet). For the Phase II investigation, the target sampling depth varied. All soil-sampling intervals were screened with a PID, and visually inspected. Because of the small diameter of the core tube (1.5 inches) and numerous containers required for various analyses, all material from the required depth intervals was used to fill the sample containers. Resultant PID determinations are included on the boring logs (Appendix C) at the corresponding sample depth. Because subsurface soil samples were collected from discrete depths as shown on the boring logs in Appendix C, all soil samples were representative of the targeted depths and were not affected by cave-in material. Each GeoProbe boring was backfilled with hydrated bentonite the same day it was drilled.

Soil samples were collected from the borings for the newly installed monitoring wells as required by the work plans and SAPs. The depths from which the samples were collected are shown on the well completion diagrams in Appendix D. Initially, continuous coring with a sleeve inside the hollow-stem auger flights was used for the collection of soil samples. Because of the generally poor recovery with this method, later soil samples were collected with a 2-foot long split spoon

[3] Additional site field work (boring and well completion, sample collection) was focused on and conducted for the Northern Area Operable Unit during the intervening time period. A summary of the Northern Area OU data is presented in Volume 2.

sampler advanced below the auger flights. All recovered soil samples were screened with a PID, and visually inspected. Resultant PID determinations are included on the well logs (Appendix D) at the corresponding sample depth. The split spoon sampler was decontaminated between sampling runs.

### 2.3.2 Water Sample Collection

Surface water samples were collected by immersing the sample collection containers in the surface water body. Groundwater samples were collected from the GeoProbe screen point (41-inch maximum exposed screen length) and from site monitoring wells. Water samples were not retrieved from borings or monitor wells where light nonaqueous phase liquid (LNAPL) was encountered, with the exception of four monitoring wells that LNAPL samples were collected from (Section 2.2.2.4). Both LNAPL and groundwater samples were collected from four wells during a one-time sampling event. At the discretion of the investigator, 1-inch diameter, PVC piezometers with 10-foot screens were set in 22 of the Phase I Geoprobe borings for later free-phase product measurements. The borings converted to piezometers are marked with a "P" on Plates 2-1 through 2-3.

#### *2.3.2.1 Geoprobe Water Samples*

Groundwater samples were collected from the Geoprobe borings using a Geoprobe System Groundwater Sampler (GW sampler). The GW sampler is driven to the subsurface target depth on the leading end of a probe rod. Groundwater samples are obtained by means of inserting a ¼ inch OD polyethylene tubing down the inside diameter of the probe rod into the sampler screen, and the water sample is pumped to the surface with a peristaltic pump. Dedicated tubing is used for the collection of each water sample. A minimum of three tubing volumes are evacuated before the water sample is collected, and pH, temperature, conductivity parameters are measured for stabilization. Under the Phase I Work Plan sampling protocol for AOIs 1, 8, 12, 13, 20, 22A, 35, and 36, groundwater samples were only collected if visual or elevated PID measurements (above background) of the soil sample collected above the water table, indicated the presence of potential contamination. All water samples were unfiltered with the exception of the samples for evaluation of MNA parameters.

#### 2.3.2.2 *Monitoring Well Water Samples*

Under the Phase I field program, 38 monitoring wells were installed at the site. Twenty-seven were installed under the Phase II program. The new monitoring wells were completed within the various groundwater plumes and near the boundaries of the plumes as they had been defined. All but eight of the wells are screened in the upper alluvial aquifer. The remaining eight wells (12-MW2D, 19-MW1, 20-MW3D, 22A-MW6D, 22B-MW2D, 30-MW6D, 34-MW3D, and 34-MW7D) are screened at the clay layer below the upper alluvial aquifer, in order to test for the presence of dense nonaqueous phase liquid (DNAPL) and provide information on the depth to the clay. The newly installed site wells were completed in June 1998 for Phase I, and in April and May 2000 for Phase II.

Monitoring wells were completed with a hollow-stem auger drilling rig, operated by Earthcore Inc. (Phase I) and Layne-Christensen (Phase II) of Salt Lake City. Borings for each well were drilled with either 6¼ or 8-inch OD augers. Once the total depth of the well was reached, 2-inch diameter PVC (sched. 40) well casing was placed through the hollow stem of the auger. All connections between PVC well components are threaded. Well screens consist of a ten-foot length of 0.010 slot screen, with the exception of the wells completed on top of the Alpine clay, which have a five-foot length of 0.010 screen. Filter pack sand (10-20 Colorado Silica Sand) was added through the hollow stem of the augers as the augers were withdrawn from the hole. Two to four inches of fine sand (16-40) was placed on top of the completed filter pack to prevent infiltration of the bentonite seal. A two-foot thick layer of 3/8-inch bentonite chips was hydrated above the sand pack. Any remaining void to within 1 foot of the ground surface was filled with neat cement. The top of the boring from a depth of one foot to the ground surface was filled with concrete, which also anchored the protective well casing. The completed depths of the well screen, filter pack, and bentonite seal for each well are shown on the well completion diagrams in Appendix D.

Groundwater samples were collected from the newly constructed site wells and the previously existing wells within the yard. Prior to collection of the Phase I samples, all wells were purged of at least three well volumes, using dedicated disposable bailers. The volumes of water purged and results of stabilization parameters (pH, temperature, conductivity, turbidity) for each well are

contained on the well sampling and stabilization forms presented in Appendix C-A of the Phase I report (EDG, 1999b).

Four quarters of groundwater sampling was conducted under the Phase II SAP. The samples were collected with peristaltic pumps, following low-flow purging/sampling techniques. Five parameters were monitored for stabilization prior to collection of the samples (pH, temperature, conductivity, dissolved oxygen, and turbidity). The samples were collected in June 2000, September 2000, January 2001, and May 2001.

### 2.3.3 Vapor Samples

An assessment of the flux of soil vapors to the atmosphere from the vadose zones above the north and south vinyl chloride plumes was conducted in June 2000. Flux measurements were performed following the EPA flux chamber protocol at 22 locations. Ten were collected over each of the two areas of concern (north plume and south plume) and two were collected as background. (Six additional samples were collected over the Northern Area Operable Unit – RI Report Part 2.) All surface flux samples were submitted for EPA Method TO-14 analysis. A more detailed description of the test methodology is provided in the Technical Memorandum on surface flux chamber testing in Appendix G.

### 2.3.4 Disposal of Investigation-Derived Waste

Investigation derived waste was disposed of in accordance with all state and federal regulation. Purge and development water was drummed and treated through a carbon-treatment system constructed near the former SPRR treatment plant (AOI-34). After treatment and sampling, the water was discharged on a batch basis under permit to the Central Weber Sewer Improvement District.

Soil cuttings from the Geoprobe borings and well completions were drummed, pending receipt of the analytical testing results. All cuttings were determined to be RCRA non-hazardous material. The drummed soil was added as filler to the petroleum contaminated soil/sludge removed from the concrete lagoon (lagoon C), at the former SPRR wastewater treatment plant. This material (as discussed in Section 2.2.2.3) was disposed of by Pacific West for recycling use in road base.

### 2.3.5 Surveying

Following completion of each drilling activity, a survey was conducted by Mountain West Surveyors of Roy, Utah. Horizontal coordinates were established for all borings and well locations. The locations are relative to a site benchmark location and are also tied to state plane coordinates. Surface elevations and measuring point elevations were determined for monitoring wells to +/- 0.01 feet mean sea level.

## 2.4 NON-RI/FS INVESTIGATIONS

This section discusses the investigation activities that have been conducted at the site, outside the scope of the Phase I and Phase II investigations conducted pursuant to the CERCLA process. Most of these other investigations of the site were conducted at specific locations in the rail yard to address remediation requirements. The focuses of the previous investigations are listed below.

- Various UST/LUST site investigations,
- Ogden Pond Area (AOI-27),
- Southern Pacific Transport Treatment Facility (AOI-34),
- Oil Sludge Location (AOI-26),
- D&RGW Rip Track AREA (AOI-35),
- Former D&RGW Roundhouse and Salvage Yard area (AOI-36).

### 2.4.1 UST/LUST Site Investigations

Summary information on the seventeen UST sites that were investigated at the rail yard was previously presented in Section 1.2.5.1.

### 2.4.2 Ogden Pond Area (AOI-27), Operable Unit Site No. 6E

The Ogden Pond area is located between the rail yard and the Weber River. It was referred to as the "Ogden Pond" in the early 1990s because a shallow 3/4-acre pond had formed in a closed depression. The area (AOI-27) covers approximately 10 acres and includes the location of the

former pond. A preliminary assessment report prepared by the UDEQ (1993) investigated oily extrusions on the ground surface and an oily sheen on the pond water surface. Subsequent investigative work by the UDEQ (1994a), E&E (1994), and USPCI (1995) characterized the contamination and delineated its extent in the vicinity of the pond.

As a result of the investigations referenced above, the area was found to contain a mixture of construction debris and oily sludge. The source of the contaminant appeared to be waste sludge from oil/water separation. Constituents of concern (COCs) in soil were identified as; low pH, lead, total petroleum hydrocarbons (TPH), benzene, toluene, ethyl benzene, xylenes, naphthalene, and benzo(a)pyrene. Previous work in the area included the installation of a single monitoring well (27-OGP-1); excavation of 20 test pits; and collection of sediment, surface water, and source samples. The well log for 27-OGP-1 is provided in Appendix D. The previous sampling locations and locations of the test pits are shown in Figure 2-6. Logs of the test pits are contained in Appendix H. Figure 2-7 shows the estimated horizontal extent of TPH contamination as determined by USPCI (1995).

The analytical results of previous soil testing in AOI-27 are provided in Table 2-12. Sampling locations referenced in the tables are shown on Figure 2-6. Additional remediation in this AOI will be addressed under Operable Unit Site No. 6-E.

### 2.4.3 SPRR treatment plant AOI-34, Operable Unit OU-03

Existing structures at the facility include a concrete separation pond, one pump building, a treatment building, and four evaporation ponds. The facility was previously investigated by E&E (1990) for the USEPA, and by the UDEQ (1992a). Environmental samples were collected to characterize the soil, lagoon water, groundwater, sediment, and source contaminant concentrations. Analytical results for the sampling locations shown on Figure 2-8 are listed in Table 2-13 for the UDEQ (1992a) testing. Constituents of concern (COCs) have been identified as vinyl chloride in the groundwater, and fluorene and other polynuclear aromatic hydrocarbons (PAHs) in the soil and groundwater.

An addendum to the Phase II work plan was developed to obtain additional site-characterization data (Forrester Group, 2001d). This data was needed to support remediation of the remaining

sludge and soils beneath the lagoons. Based on results of the analyses, the sludge has been determined to be non-hazardous (Forrester Group, 2002b). Remediation activities for removal of sludge and soil, in and beneath the lagoons were conducted during the fall of 2002. This AOI has been designated Operable Unit OU-03.

### 2.4.4 Oil Sludge Location (AOI-26)

The AOI encompasses a disposal area of a former pile of sludge, from the former UPRR oil reclamation plant in the rail yard. The area was previously investigated by the Utah DEQ during a 1992 Preliminary Assessment (UDEQ, 1992b). A subsequent site inspection was conducted by the UDEQ Division of Environmental Response and Remediation (DERR) (UDEQ, 1994b) under CERCLA authority. The UDEQ investigations involved the collection of source, sediment, and water samples. Prior to the field portion of the 1994 UDEQ investigation, 29,000 tons of the sludge had been removed by UPRR and transported for disposal at ECDC. An additional 25 cubic yards of sludge and heavily-stained soil were removed in the fall of 2002 during the remediation activities conducted at AOI-34.

### 2.4.5 D&RGW Rip Track Area (AOI-35)

The D&RGW Rip Track area is located at the northern limit of the rail yard (Figure 1-2). The D&RGW rip track area was a small maintenance facility and siding yard that was active during the steam and diesel locomotive eras. The only remaining remnant of the area is the concrete foundation of the Section House. Stained surface soils near the Section House and the Oil and Tool House were investigated by Morrison-Knudsen (1988) as part of an environmental audit. One monitoring well (OB-1) was installed.

The Morrison-Knudsen investigation identified soil with elevated concentrations of petroleum-related organic compounds. Approximately 16 tons of oil-stained soil were removed from an area near the Oil and Tool House to a depth of six feet. The excavated soil was transported to ET Technologies for disposal (Morrison-Knudsen, 1988).

In addition, 20 tons of petroleum-contaminated soil were removed from the location of an above-ground kerosene storage tank, located near the Section House. The excavation extended to a

depth of 2 feet below the ground surface, and all soil exhibiting organic vapor concentrations greater than 5 ppm were removed (Morrison-Knudsen, 1988). The excavated soil was transported to ET Technologies for disposal.

Two 250-gallon USTs (East tank and West tank) were removed from the east side of the Carmen's Building. Morrison-Knudsen (1988) determined that the West tank had not leaked, and that hydrocarbon leakage from the East tank was contained in the soil zone and had not impacted groundwater. This area was designated AOI-35 during the Phase I and II investigations of the rail yard.

### 2.4.6 Former D&RGW Roundhouse and Salvage Yard area (AOI-36)

This AOI encompasses the area of the former D&RGW roundhouse and an adjacent salvage yard, located between 21st Street and 20th Street, at the northeast end of the rail yard (Figure 1-3). At present, the 21st Street ramp and overpass covers a portion of the former engine maintenance area including the site of the D&RGW roundhouse, which was demolished in the 1950s. An auto salvage yard existed for several decades at the southeast end of the railroad property. The salvage operation was discontinued in the 1980s. Nothing remains of the railroad facility or the salvage operation.

The property comprising AOI-36 has undergone two environmental assessments in addition to its inclusion into the present RI/FS. As part of a possible property transfer in 1992, Phase I and Phase II environmental site assessments were conducted for the City of Ogden Corporation by Sergent, Hauskins, and Beckwith (1992a, 1992b). The consultants installed two monitor wells (MW-1, MW-2), drilled several soil borings, and collected surface soil samples on the property. Logs of the monitoring wells (currently identified as 36-MW1 and 36-MW2) are contained in Appendix D.

The 1992 field investigations concentrated on the west end and southeast corner of the property (areas with visible soil staining). Soil and groundwater samples were tested for volatile organic compounds (VOCs). Soil samples were also tested for TPH, oil & grease, and lead. Lead values in the soil samples ranged from 2 to 1,400 ppm. TPH concentrations ranged from less than the detection limit to 260 ppm. Oil and grease ranged from 860 to 11,000 ppm.

In 1997, the area became the subject of another possible property transfer to Weber County Public Works for use as a solid waste transfer station. Concurrent with the Phase I stage of the railroad's RI, the EPA Region VIII Technical Assistance and Response Team (START) (URS Operating Services Inc.) conducted a site investigation for Weber County under contract 68-W5-0031. Fieldwork completed by URS (1998) included collection of 31 surface soil samples, completion of 11 soil borings, and installation of five additional monitor wells. Logs of the wells installed by URS are provided in Appendix D (36-MW3 through 36-MW7). Sampling locations are shown in Figure 2-9. Data from the URS investigation was provided in a site assessment report dated March 2, 1998 (URS, 1998). This data has been included in the data assessment of AOI-36 (see Section 4.2.26).

# 3 PHYSICAL CHARACTERISTICS OF THE STUDY AREA

This section describes various aspects of the physical characteristics of the study area. The physical characteristics were determined from the results of the field activities (Section 2.2) and observations made in the field, along with information published in reports of the geology and hydrology of the Ogden area.

## 3.1 SURFACE FEATURES

This section describes the geomorphic features of the site and surface features of potential interest.

The rail yard occupies the floodplain on the east side of the Weber River. The elevation of floodplain and river declines about 55 feet between the southern extremity of the rail yard at the Riverdale Overpass and the northern downstream end of the rail yard at 21st Street. The northern portion of the site down to 29th Street is within the 500-year flood zone, as is the area between 31st and 37th Street. Areas of the site between 29th and 31st Street, and south of 37th Street are above the 500-year flood zone (FEMA, 1983, 1995). AOI-36 is also above the 500-year flood zone. The 100-year flood zone extends eastward into the rail yard for various distances ranging from 40 to 1,100 feet. Only AOIs-26, 34, and 27 are located within the 100-year flood zone.

In the central portion of the yard, a lower flood plain terrace exists west of the elevated track area. This lower terrace is covered by woods or brushy fields, and extends from AOI-12 to AOI-30 (Durbano Metals).

The rail yard has been filled and graded over time to produce the present level surface of the yard necessary for the tracks. All of the creeks crossing the rail yard to the Weber River now flow predominantly through buried culverts. The Weber River level is typically from 7 to 15 feet below the rail yard surface.

At the north end of the rail yard the Weber River floodplain merges with that of the Ogden River along the railroad right-of-way. The ramps and overpasses for 20th and 21st Streets cross the

northbound tracks running between the two rivers. The overpass embankments are constructed on the floodplain and cover portions of the old D&RGW track system. The 21st Street Pond (at AOI-33) originated as a borrow pit for material used to build the 20th and 21st Streets ramps.

To facilitate operational requirements of the railroad, older structures and features within the rail yard are demolished and removed as they are no longer needed, and new facilities are constructed. During the course of the RI, the former SPRR machine shop was demolished in AOI-38, and the oil-water separator was removed from AOI-12. Details of the demolition activities for the machine shop are provided in Appendix I. Details of the demolition activities for the AOI-12 oil-water separator were provided to the regulatory agencies in the monthly progress report dated and December 7, 2000. During the summer of 2001, two new mainline tracks were added in the yard. A new crew-change facility is sited for construction just west of AOI-22A. Additional reworking or modifications to the land surface are likely to be conducted by Utah Transit Authority for addition of commuter rail line.

During the Phase I and Phase II field investigation activities, three surface features were investigated as discussed in Section 2.2.2; wastewater treatment plant lagoons (AOI-34), sludge deposited on the land surface (AOI-26), and buried hydrocarbon sludge (AOI-27).

## 3.2 METEOROLOGY

Data on site meteorological conditions was obtained from three observation stations near the site (Section 2.2.3). The average high, low, and mean temperatures for Ogden are listed below by season (degrees Fahrenheit).

| | Spring (M,A,M) | Summer (J,J,A) | Fall (S,O,N) | Winter (D,J,F) |
|---|---|---|---|---|
| Average High | 62.2 | 87.9 | 65.3 | 39.4 |
| Average Low | 37.3 | 56.5 | 38.1 | 20.3 |
| Mean | 49.8 | 72.2 | 51.7 | 29.8 |

July is the hottest month with an average high temperature of 91.8 °F, the same month in which Ogden's record high temperature of 106 °F occurred in 1953. Ogden's record low temperature (-

26 °F) occurred in January 1937, which with an average high temperature of 36.3 °F, is Ogden's coldest month.

The average annual wind speed is 7.5 mph, varying from 6 to 8 mph in any given month. The prevailing wind direction in Ogden is from the west-northwest, which pushes weather masses up and over the Wasatch Mountain Range, located along Ogden's eastern boundary. As a consequence, Ogden typically receives more precipitation than much of the rest of Utah.

The Annual average precipitation in Ogden is approximately 17.2 inches per year, with April being the wettest month (2.05 inches), and the only month with an average monthly precipitation total greater than 2 inches. July and August, the driest months, have an average monthly precipitation total of 0.56 and 0.79 inches, respectively. The other nine months have between 1.2 and 1.9 inches of precipitation on average, with a mean of 1.53 inches. Since 1924, the highest recorded total yearly precipitation amount is 34.31 inches (1983). The driest year on record was 1966 in which only 8.25 inches of precipitation fell. It rains in Ogden an average of 88 days per year. Thunderstorms, which bring the most intense rains to the area, occur an average of 5 days per month between May and September.

Snowfall in Ogden varies greatly from year to year. While the average total snowfall is approximately 29.3 inches, snow years 1994/95 and 1998/99 saw no snow at all whereas the 1928/29 and 1992/93 seasons had 90.6 and 83.3 inches, respectively. January is by far the snowiest month, receiving on average over twice as much snow (11.74 inches) as the next snowiest month February, which only receives 5.42 inches on average. Since 1923, no snow has been recorded in Ogden from June through September. Because of the relatively mild climate and low average snowfalls, average snow depths for December, January, and February are 1, 3, and 2 inches, respectively. Average monthly snow depth for all other months is zero. Ogden experiences snowfall an average of 39 days per year.

## 3.3 SURFACE-WATER HYDROLOGY

This section describes the physical characteristics of the surface water hydrology at the site. The locations and flow directions of surface water features mentioned below may be found on Figure 3-1. The primary surface water bodies in the area are the Weber River, Ogden River, and 21st

Street Pond. Hydrologic characteristics of the Ogden River and 21st Street Pond are discussed in Volume 2 of this RI report.

The Weber River is the major surface water body in the area, and is the main receptor-medium of concern with respect to contaminants at the site. The river issues forth from Weber Canyon on a generally westward course, six miles southeast of the site. One mile south of the site, the river course turns northward. The river defines the western 3.5-mile long edge of the site, then again turns westward at the north end of the rail yard near AOI-34. The general drop in river elevation along the edge of the rail yard from south to north is 55 feet.[4] The Ogden River, flowing due west out of Ogden Canyon, flows into the Weber River approximately 1000 feet west of the 21st Street Pond.

The nearest stream gauging station for the Weber River upgradient from the site is monitored by the USGS at Gateway Utah, approximately 12 miles upstream from the rail yard (Station ID No. 10136500). Recorded discharge extremes at Gateway are a low of 30 CFS in December 1992, and a high of 7980 CFS in May 1896. A hydrograph showing daily mean stream flow as measured at Gateway is shown in Figure 3-2 for the time period of January 1998 through September 2000. Flow in the Weber River varies seasonally, with the low of 100 to 200 CFS during the months of November through January, and highs of around 2000 CFS during the months of April through July. The high season flow of the river in the vicinity of the rail yard may be somewhat reduced from the measured discharge because of numerous diversions for irrigation located between the gauging station and the rail yard.

### 3.3.1 Weber River – Groundwater Relationship

As discussed in Section 2.2.4, hydrostatic elevation data were generated for the Weber River and four monitoring wells at various distances from the river (34-MW9, 34-MW2, 34-SPMW02, 34-MW1). The resultant elevation data was graphed to show the measured changes in water elevation for each of the five monitoring points. Individual graphs of the water levels and tables of processed elevation data are provided in Appendix J. Locations of the five monitoring points are shown in Figure 3-3. Based on the graphical comparisons of elevation data as discussed

[4] River elevation of 4289.33 feet at EPA sample location WR12 – river elevation of 4234.00 feet at EPA sample location WR28.

below, the Weber River is generally an influent (losing) stream in the vicinity of the study area, especially during the spring runoff period. This determination corresponds with the conceptual model of gaining/losing streams along the Wasatch front as shown by Price (1985) (see Figure 3-4).

The hydrograph for the Weber River is shown in Figure 3-5. This figure shows that the low-level winter river conditions continue through the first part of March, at an elevation of about 4275.7 feet, then rise 0.6 feet to 4276.3 for a 3-week period. The elevation in the River then rises above 4277 feet, and maintains an average level of 4277 feet until about May 2. During this period the River reached a maximum elevation of 4277.7 feet. This change reflects a 1.3-foot rise in the surface of the Weber River during the spring runoff. After May 2, the river elevation levels steadily decrease to around 4275.32 through the end of the test on June 12. These elevation changes measured in February through June of this year generally correspond to the timing of the mean stream flows shown in Figure 3-1.

Fluctuations recorded in nearby well 34-MW9 located 30 feet from the riverbank (Figure 3-6), reflect the same pattern of variation as the Weber River. Throughout the test, the measured elevations in 34-MW9 were about 1 foot lower than those measured in the Weber River during the low water stage. During the highest stages of the Weber River, the groundwater elevation in 34-MW9 was still lower, but only by 0.2 to 0.4 feet. The overall change in measured elevation recorded in 34-MW9 is 3.2 feet.

Fluctuations recorded in well 34-SPMW-02 (Figure 3-7, 90 feet from the river) also reflect the same rise and fall trend as the Weber River. The measured elevations are similar over the entire length of the February to June monitoring. During the general rise in river elevation from the start of the monitoring through the highest elevation (around May 2), elevations are slightly higher in the Weber River. During the following period of declining river levels, elevations are slightly higher in 34-SPMW02. The overall change in measured elevation recorded in 34-SPMW02 is 2.3 feet.

Fluctuations recorded in well 34-MW2 (Figure 3-8, 75 feet from the river) reflect the same rise and fall trend as the Weber River and the two wells discussed above. The measured elevations in

this well are higher than those measured in the Weber River. This is mostly likely due to the fact that although this well is only 75 feet from the River, it is located 370 feet upgradient of the river monitoring point. Thus its higher elevations are a factor of its upgradient location relative to the Weber River monitoring point. The overall change in measured elevation recorded in 34-MW2 is 3.0 feet.

Well 34-MW1 is located 350 feet from the river (Figure 3-9), and its recorded changes in water level elevations do not reflect the same association as the wells closer to the river. The overall change in measured elevation recorded in 34-MW1 is only 0.9 feet. This more subdued fluctuation in the groundwater elevations is similar to that observed in other monitoring wells in the yard that are outside of the zone of river influence (Section 3.5). During the spring runoff period (March – April) the measured elevations in this well are generally below the river levels. During the lower river periods, before and after the runoff event, the levels are higher in the well. The measured elevations for well 34-MW1 (Figure 3-9) show a distinct rise in groundwater elevation around April 6. This is most likely to be the result of increased precipitation, because April is the wettest month of the year in Ogden (see Section 3.2).

The relationship shown in Figure 3-6 shows that the Weber River is an influent (losing) stream with respect to the adjacent bank area. The trends graphed in Figures 3-6, 3-7, and 3-8 show that the stream flow stages in the Weber River influence groundwater levels in the adjacent bank areas up to a minimum lateral distance of 90 feet. As expected, the magnitude of influence decreases with increasing distance from the river.

| Well | Distance From River | Maximum Fluctuation |
|---|---|---|
| 34-MW9 | 30 feet | 3.2 feet |
| 34-MW2 | 75 feet | 3.0 feet |
| 34-SPMW02 | 90 feet | 2.3 feet |

At a lateral distance of 350 feet, or less from the bank, the groundwater potentiometric surface does not appear to be influenced by the River (Figure 3-9).

From the data presented above, it can be concluded that the Weber River is typically a losing stream; at least as determined for the vicinity of AOI-34 where the monitoring was done. This

finding is also consistent with the conceptual model that has been developed for mountain streams along the Wasatch Front (Price, 1985). Additional support for this conclusion comes from the analytical data for the area (Section 4.1.3). Site-related volatile compounds are not detected above the SLVs in well 34-MW9, which may be due to the influx of river water at this monitoring point.

### 3.3.2 Additional Surface Water Features

Buenaventura State Park is located adjacent to the western limit of the rail yard near AOI-26. A diversion canal from the Weber River supplies water to a shallow pond located in the park. An outlet from the pond reconnects to the River. This pond covers roughly 3 acres, and was used as a reference location for ecological samples collected by the EPA to evaluate the ecological health of the 21st Street Pond.

Three perennial drainages and one ephemeral drainage pass westward through the rail yard to the Weber River; Strongs Creek (AOI-29), Burch Creek (AOI-9), storm drain along the 33rd Street alignment (33rd St Slough), storm drain south of the 35th Street alignment (AOI-10). Each drainage system flows through culverts under the sections of track adjacent to the eastern edge of the yard, and flow in open ditches from the western edge of the tracks to the river. Water and sediment samples were collected from all four of these tributary systems.

AOI-10 is an ephemeral drainage that has been observed to have a limited infrequent flow over the course of the field investigations. The main source of water for this drainage appears to be storm water runoff from the extensively paved shopping area directly east of the rail yard. There is no defined stream course that continues to the Weber River, and all flow infiltrates into the field west of the tracks.

The 33rd Street slough is a perennial channelized drainage that is maintained by the City. While one source of water in this stream is storm water drainage from the area of Ogden east of the yard, it maintains a year round flow.

The rail yard covers the down stream terminus of Burch Creek (AOI-9) and Strongs Creek (AOI-29), both of which originate as perennial streams in Burch Creek Canyon and Strongs Canyon

(respectively) in the Wasatch Mountain foothills. Burch Creek remains an exposed stream over its entire course, except for the section underlying the tracks. Strongs Creek follows an open streambed to Madison Avenue (1.2 miles east of the yard), at which point it flows underground until it daylights in the rail yard.

## 3.4 GEOLOGY

This section describes the regional and local geology of the site. Regional geology is summarized from published reports that include Feth et al (1966) and Anderson et al (1994). The local geology has been characterized through the completion of the investigation activities outlined in the Phase II FSP.

### 3.4.1 Regional Geology

The Ogden rail yard is constructed upon Holocene (Recent) floodplain deposits of the Weber River. These alluvial deposits overlie lacustrine and fluvial sediments of the late Pleistocene Lake Bonneville Group. The Lake Bonneville Group occupies the uppermost 200 to 350 feet of an estimated 6,000 vertical feet of Quaternary and possibly Pliocene unconsolidated fluvial and lacustrine strata that have been deposited in the Great Salt Lake Basin in the vicinity of the rail yard. The exact thickness and the depth range of the Lake Bonneville Group lithology at Ogden is uncertain because of difficulties in discerning the stratigraphic break between the lower Alpine Formation deposits of the Lake Bonneville Group, and the earlier pre-Lake Bonneville Group basin-fill sediments.

The Lake Bonneville Group deposits around Ogden consist of unconsolidated sediments that make up the Weber Delta, the largest delta deposited in ancient Lake Bonneville. The unconsolidated fluvial and lacustrine deposits of the Weber Delta form most of the land surface between the abrupt slope of the Wasatch Front mountains east of Ogden, and the shoreline of the Great Salt Lake, about 12 miles west of the Front. Since the fall of the historical lake level at the end of the Pleistocene Epoch, the Weber Delta has been in a state of degradation by the river systems crossing it. The Weber River has incised a 500-foot deep valley into the head of the Weber Delta sedimentary prism upstream of the rail yard.

Precambrian and early Paleozoic rocks crop out in the mountains of the Wasatch Front. In the valley, these same rocks and perhaps later Paleozoic to Tertiary rocks, form the basement floor for the basin-fill sediments. The topographic contrast between the Wasatch Front highland and the Great Salt Lake Basin valley is the result of continuous regional tectonic disturbance from normal faulting beginning in the mid-late Tertiary Period (basin and range faulting). This structural activity is responsible for most of the basic drainage and basin controls that produced Lake Bonneville, the Weber Delta, and the attending river systems, past and current. The northward jog of the Weber River in the vicinity of the Ogden rail yard may be the result of late tectonic faulting of the basement west of the Wasatch Front or perhaps large scale slumping/growth faulting of the unconsolidated sediments.

The Alpine Formation comprises most of the Lake Bonneville Group mapped in the Ogden area, and its fine-grained facies underlie the floodplain deposits at the rail yard. A thin blanket of coarse-grained alluvium belonging to the younger Provo Formation covers portions of the Alpine Formation on the higher benches east and south of the rail yard. Most of the sand and gravel facies of the Alpine Formation occur within 1-1.5 miles of the mountains of the Wasatch Front, and they provide a zone of important infiltration and groundwater recharge for the Weber Delta (water) district. At greater distances from the Front, the finer grained, clayey facies of the Alpine Formation is predominant and prevents much of the downward seepage of surface and shallow groundwater to deeper aquifers. A State water well (DNR, Division of Water Rights, driller's log B-6-1, 29cbb - 1961), located near the north end of the rail yard, describes a thick clayey section from 45 to 170 feet deep. These fine-grained deposits likely belong to the Alpine Formation underlying the Recent alluvium.

### 3.4.2 Local Geology

This discussion of the local geology is focused on the unconsolidated sedimentary deposits of Pleistocene and later age that underlay the site. While these deposits are all classified according to the USCS, investigation activities conducted under the RI did not include specific soil characterization (i.e. identification of A and B type soil horizons). Organic soil horizons generally do not exist in the areas of interest in the rail yard. Field classification of the soil type as reported on the boring logs was verified by laboratory classification of similar materials (Appendix K).

Observations of the near-surface alluvial stratigraphy come from results of the Phase I and II drilling programs for the completion of borings and installations of monitoring wells. Drilling logs showing the subsurface lithologies are provided in Appendices C and D. Most of the drilling has produced information about the upper 10 to 15 feet of the floodplain alluvial sequence. During the Phase I investigation, few borings advanced deeper than 15 feet to penetrate the remaining thickness of coarse-grained alluvium and intersect the underlying clayey section. Additional borings and deeper wells were completed during the Phase II investigation to more accurately characterize the Alpine Formation at the site.

The uppermost soil type at the site is typically fill. The fill consists of a wide variety of materials, ranging from silts to gravels, with construction debris and coal/cinders. In the rail yard, fill extends to a minimum depth of 4 feet (boring 36-B1). Silty clays and sands that extend to deeper depths may also be imported fill material. Commonly, soil borings encountered a thin layer of fill overlying all or part of a single fining-upwards sequence of Recent unconsolidated fluvial alluvium.

General lithologic or "soil" units underlying the fill have been found to be laterally consistent throughout the site. They consist of the following units, each of which is further discussed in the subsections below.

1. A section of graded bedding composed of silty clay and fine grained sand facies that grades downward through fine sand to coarse sand - a typical section associated with point bar and overbank deposits. These overbank deposits extent down to the water table, which is encountered 5-12 feet below grade.

2. Channel deposits consisting of sandy gravel that underlie the overbank deposits. In general, the channel deposits begin at the water table and extend to the Alpine Formation clay.

3. Underlying the gravel unit is thick clay believed to represent the upper part of the Alpine Formation, based on its depth of occurrence and continuity across the entire rail yard. Formation, based on its depth of occurrence and continuity across the entire rail yard.

#### 3.4.2.1 Overbank Deposits

Underlying the fill, or where fill is absent, sandy-silt overbank deposits are encountered. In general, overbank silt and sand deposits extent down to the water table, which is encountered 5-13 feet below grade. Within this unit, a clayey section (less than 3 feet thick) is infrequently encountered. These shallow clay units appear to be discontinuous and rarely extend horizontally to neighboring borings. The overall section of the near-surface alluvium reflects a crude fining-upward sequence of deposits. Observations of the core and cuttings do not yet reveal any systematic, broad lithofacies changes to fine grained sediment that would significantly influence large-scale groundwater movement in the rail yard. Three samples of this finer grained interval were collected from depths of 3 to 8 feet from well boring 19-MW1D, for analysis of geotechnical parameters. The results of these analyses are contained in Table 3-1. Laboratory analyses of the soil type (ASTM D-2487) identify this unit as a silty sand (SM), with an increase in the sand fraction (56% to 75%) with depth. Soil geotechnical testing results are presented in Appendix K.

The lower portion of this unit is dominated by sand and may be equivalent to point bar sands. This sand typically appears to be well-sorted, medium to fine grain, and loose, with a variable brown color.

#### 3.4.2.2 Channel Deposits

Unconsolidated channel deposits underlie the overbank deposits. In general, the channel deposits begin at the water table and extend to the Alpine Formation clay. The gravel is poorly sorted, with well-rounded gravels and cobbles representing a varied provenance (i.e., geologic origin). In open excavations, cobbles have been observed exceeding 5 inches in diameter.[5]

The gravel matrix typically consists of silt and fine to medium grained sand. The content of the fine-grained fraction (silt and smaller) is usually minor (<10%). A number of borings intersected beds where fines are completely absent or where only gravel and the coarsest sand fractions are present. Gravel and the coarser sand are sub-rounded to rounded.

[5] Due to the non-cohesive loose nature of the gravels, and the rounded large size of the gravel clasts, core recovery was often limited to the sand size, and finer, particles. This was especially noticeable with the 2-inch diameter GeoProbe core tubes.

The channel gravel has been encountered in borings throughout the rail yard. The thickness of the gravel unit across the site varies from 4 feet (22B-MW2D) to 25.5 feet (STRAT-B1). Geotechnical data for gravel samples from two well borings (27-MW2, 12-MW2D) are provided in Table 3-1. Laboratory analysis of the soil type (ASTM D-2487) identifies this unit as a poorly graded gravel with sand (GPs) to a poorly graded gravel with sand and silt (GP-GMs). The percentage of gravel-size grains ranges from 46 to 74.

#### *3.4.2.3 Alpine Clay*

Underlying the gravel unit is thick lacustrine clay believed to represent the upper part of the Alpine Formation, based on its depth of occurrence and continuity across the entire rail yard. This clay is regionally extensive in the Ogden area. The contact between the clay and overlying gravel is typically sharp.

Reaching a thickness of 200 feet, the Alpine forms a confining layer for shallow aquifers (Feth et al., 1966). In the vicinity of the site, the Alpine Clay is estimated to be over 50 feet thick, based on the following:

1. A thick clayey section, from 45 to 170 feet below ground surface, is described in a State Water Well log (Well No. B-6-1, 29cbb located 3100 feet east of the site) (Anderson et al, 1994) that likely correlates to the Alpine Formation.

2. Two deeper GeoProbe holes were drilled for stratigraphic information at AOIs 21 and 34. Boring 21-B5D intersected clay at 18 feet and remained in clay to the total depth of 40 feet. Boring 34-B39D cut into similar clay at 32 feet, which continued as a massive unit throughout the remainder of the 48-foot hole.

This clay has the field appearance of an olive gray, homogeneous, soft, highly plastic clay, with occasional silt partings. Geotechnical parameters determined for samples of the clay collected from the 19-MW1D and 12-MW2D well borings (Table 3-1). An ASTM D-2487 analysis of the samples identifies it as a lean clay (CL), with a liquid limit of 39 to 40. Grain size analyses show the percent of fines (passing #200 sieve) to range from 89 to 95.

The depth of the clay is variable across the area of investigation and ranges from measured depths of 4 (36-B2) to 30.5 (STRAT-B1) feet below ground surface. While the number of site borings that were extended deep enough to identify the Alpine are limited (22, exclusive of AOI-33 borings), the site-wide distribution of these borings and the uniform occurrence of the clay underlying the gravel provides evidence of its lateral continuity. A contour map of the clay surface is shown in Figure 3-10. Depth data for the top-of-Alpine is provided in Table 3-2.

#### *3.4.2.4 Summary*

The two most significant geologic features at the site are the gravel and clay units. These are shown in the generalized geologic cross section for the site (Figure 3-11). The gravel serves as the unconfined alluvial aquifer, and its hydrogeologic properties are discussed below in Section 3.5.

The thick clay horizon that underlies the unconfined alluvial aquifer at the rail yard represents a likely barrier to downward migration of contaminants to lower water-bearing zones. This low permeability barrier, if continuous and not perforated by any unsealed deep wells, would also likely prevent further downward migration of any dense nonaqueous phase liquid contaminants. Field evidence from the Northern Area OU investigation (Forrester Group, 2001a) suggests this clay is an effective barrier to downward migration or flow of the identified DNAPL. All borings completed within the area of hydrocarbon contamination in the Northern Area OU show that the DNAPL is pooled on the clay surface and does not penetrate it.

Assessments of the fate and transport of two dissolved-phase CVOC plumes are discussed later on in sections 5.2.1 and 5.2.2 of this report. Two geologic cross-sections (N-S and E-W trending) through each of these specific areas are provided in Figures 3-12 and 3-13, which visually summarize the geology of the site described in the preceding subsections.

## 3.5 HYDROGEOLOGY

The basis for the following discussions of regional and local hydrogeology includes information obtained from published sources and an analysis of field data generated during the installation of the groundwater-monitoring network at the site. Also considered are the data collected in the

subsequent water level and monitoring efforts. Lithologic logs of the well borings and completion diagrams for the installed monitoring wells are provided in Appendix D.

### 3.5.1 Regional Hydrogeology

The principal groundwater zones of economic importance in the Weber Delta (water) district are the Delta and Sunset aquifers. These widespread confined aquifers are part of the underlying fluvio-lacustrine pre-Lake Bonneville Group sediments. The shallowest of these, the Sunset aquifer, is at least 200 feet deep and in most places ranges from 250-400 feet BGS or more. It is mapped only west (downgradient) of the rail yard (Anderson et al, 1994). The more extensive Delta aquifer is typically from 300 to 500 feet BGS and is located under the rail yard. The Delta aquifer is composed of deltaic deposits of the Weber River and is about 50 to 150 feet thick (Clark et al, 1990). Within a mile and a half of the Wasatch Front, the coarse grained facies of the Lake Bonneville Group and pre-Lake Bonneville Group sediments (beach, long-shore, and fluvial sand-gravel deposits) provide a permeable path for the bulk of recharge to these regional groundwater reservoirs, both from surface sources and subsurface mountain-front flow.

Part of this aquifer recharge comes from infiltration through the bed of the Weber River along its course in the vicinity of the Wasatch Front, to a point about 5 miles downstream from the rail yard (Figure 10 of Feth, et al, 1966). The Weber River loses about 16,000 acre-feet of water annually to infiltration and groundwater recharge in this area (Feth, et al, 1966). At a distance from the Front, the nearly impervious clayey beds above the Delta and Sunset aquifers in these same formations provide confining conditions. Deep artesian wells in Section 29 at the northern end of the rail yard (State Well ID Number "B-6-1 29cbb – 1961", and State Well ID Number "B-6-1 29abb – 1939") are presumably screened in the Delta aquifer at 800-840 feet and 455-464 feet, respectively. The water levels are recorded at above ground surface (artesian conditions) in both wells.

From published evaluations of the water supplies of the Weber Delta district, the shallow alluvial aquifer is not currently used as a source of potable water. The UDEQ views the groundwater as a potential future drinking water source, given it is a Class II aquifer with a TDS less than 3,000.

Recharge to the deeper aquifers from the near-surface Recent floodplain aquifers that cross the Weber Delta is considered to be a very minor increment of the total recharge budget. The estimated recharge to deep aquifers from combined irrigation seepage, canal losses, and floodplains is 6,000 acre-feet out of a total recharge of 70,000 acre-feet for the entire Weber Delta district (Feth, et al, 1966).

### 3.5.2 Local Hydrogeology

As described above in section 3.4, the principle stratigraphic units of concern at the site are alluvial deposits associated with the Weber River, and an underlying lacustrine clay associated with historic Lake Bonneville. In descending order the sediments encountered include fill, over-bank silts, point bar sands, channel gravels, and lacustrine clay. The continuous gravel deposits overlying the clay comprise the surface or uppermost aquifer for the site, which is mostly unconfined. Based on the results of low-flow pumping tests the hydraulic conductivity of the gravel deposit is estimated to be 0.1 cm/sec (Appendix M of Forrester Group, 2001a). There are some local perched zones over minor clayey lenses in the coarse alluvium above the main water table. For example, the excavation for the removal of UST SPRR3 encountered a strong temporal flow from a perched zone above a thin clay lens at about four feet below ground surface. Some perched saturation also occurs over buried foundations of demolished railroad buildings.

A MODFLOW groundwater model was developed for the Northern Area Operable Unit to assist with the evaluation of remedial alternatives (Appendix N of Forrester Group, 2001a). The calibrated hydraulic properties of the model (gravel) aquifer, derived from hydraulic testing or representing typical values, are presented below. These values describe an aquifer that exhibits relatively high porosity and permeability to water and that is well connected to the adjacent river.

| Hydraulic Parameters Used | |
|---|---|
| Parameter | Value |
| Hydraulic Conductivity (x, y and z directions) | 0.1 cm/sec ($3.28 \times 10^{-3}$ ft/sec) |
| Effective Porosity | 0.2 |
| Specific Yield | 0.2 |
| Specific Storage | 0.01 |

The depth to groundwater is typically 8 to 11 feet below the flat ground surface across the rail yard. On the isolated lower stream terraces (AOI-27, AOI-26), the depth to groundwater typically varies between 3 and 6 feet. As determined from routine monthly gauging of the site monitoring wells, the elevation of the potentiometric surface varies seasonally, with lows occurring from August through December and highs occurring from March through May (Table 2-13). The seasonal fluctuation is greatest for wells in close proximity to the Weber River (3.4 feet as measured in 12-MW1, and 3.2 feet as measured in 34-MW9). As discussed in Section 3.3.1, this degree of fluctuation is attributed to seasonal flow variation and discharge from the Weber River. Elsewhere in the yard, at distances over 100 feet from the river, the seasonal fluctuation is on the order of two feet or less (2 ft, 27-MW1; 1.5 ft, 20-MW1; 1.5 ft, 38-MW9; 1.9 ft, 21-MW1; 2.4 ft, 37-MW1; 2.1 ft, 18-MW1).

The Alpine clay defines the bottom of the shallow surface aquifer. This clay unit has a hydraulic conductivity of 4E-8 cm/sec, as determined from laboratory tests (Forrester Group, 2001a, Appendix M). The Alpine clay is laterally extensive and has a variable relief as shown on Figure 3-10. Thus the thickness of the surficial gravel aquifer varies accordingly from 6 feet (well 12-MW2D) to 26.5 feet (boring STRAT-B1).

Various water quality parameters have been measured for the site, which are discussed later in Section 4.2.3. As part of the quarterly groundwater sampling activities, temperature, hydrogen ion concentration (pH), and specific electrical conductance (conductivity) are measured prior to sample collection. These groundwater properties are listed below for three site wells that are not impacted by site contaminants, and are located in the southern (13-MW1), central (22A-MW4),

and northern (36-MW4) portions of the site. The data shown for comparison are for the period of high groundwater elevation (June 2000) and low groundwater elevation (January 2001).

| Groundwater Properties | | | |
|---|---|---|---|
| Well | pH | Temperature °C | Conductivity uS/cm |
| 36-MW4 (6/00) | 6.87 | 19 | 1321 |
| 36- MW4 (1/01) | 6.61 | 8.1 | 1777 |
| 13-MW1 (6/00) | 6.86 | 19.5 | 2570 |
| 13-MW1 (1/01) | 6.96 | 9.5 | 3020 |
| 22A-MW4 (6/00) | 6.81 | 19.6 | 1377 |
| 22A-MW4 (1/01) | 6.92 | 11.3 | 1770 |

As noted above, the pH of the site groundwater is consistently between 6.5 and 7.0 units. While the conductivity increases slightly in the winter, the temperature of the groundwater shows a significant 10 °C variation from summer to winter.

### 3.5.3 Groundwater Flow

Over the course of the Remedial Investigation, site-monitoring wells have been gauged on a monthly basis. The monthly water-level data generated for the entire rail yard is provided in Table 2-10. Using the data in Table 2-10, Appendix L presents hydrographs for each of the site monitoring wells and piezometers. For various reasons (e.g. access blocked by construction, flush-mount lid frozen) not every well was able to be gauged on the monthly basis. Highlighted data in Table 2-10 shows where an elevation data point was not measured, but was interpolated from the hydrographs in Appendix L. This was only done for the months of October 2000, and January, April, July 2001 which were used to generate the potentiometric surface maps discussed below.

A portion of this data (quarterly, October 2000 to July 2001) was used to generate the maps of the potentiometric surface for the site as shown in Figures 3-14(A-E) through 3-17(A-E). The northern area of the yard is shown on the "A" series maps; the central portion of the yard is

shown on the "B" series maps. Isolated areas of the southern part of the yard are shown on the "C" series (AOI-27, 32 area), "D" series (AOI-13 LUST site), and "E" series (AOI-12 and AOI-37 LUST site area). A generalized potentiometric surface map of the entire rail yard is shown in Figure 3-18.

Review of Figures 3-14A through 3-17E shows little variation in the flow direction or gradient over the course of a year. For the limited areas of coverage in the southern part of the rail yard (south of 33rd Street and about 400 feet from the river), the general direction of groundwater flow is consistent in each area over the course of a year but varies in flow direction from area to area.

At the southern end of the yard (Area 5 on E series figures) the groundwater flow direction is westward toward the Weber River, and the localized gradient ranges from about 0.013 to 0.018 ft/ft in AOI-37 and is consistently at 0.035 ft/ft in AOI-12, which is closer to the River. At the small AOI-13 area (Area 4 on D series figures), the flow direction is generally to the NW and is more pronounced in the July to October time frame. From January to April there is a more northerly flow component reflected by well 13-MW16A. The potentiometric surface in the AOI-27, 35 area is relatively flat, with a gradient of less than 0.009 ft/ft (Area 3 on C series figures). Flow direction in the AOI-35 area is consistent with other areas in the yard; northwesterly toward the River. Flow direction in the vicinity of AO-27 is reverse of the general trend, and flows eastward way from the Weber River.

The central portion of the rail yard with monitoring well coverage north and south of AOI-30 is generally 700 to 2,000 feet from the river. The direction of groundwater flow in this area is to the north, with a consistent annual gradient of 0.006 to 0.008 ft/ft. The groundwater flow direction is generally northward; with NNE flow component from the western location of AOI-26 and AOI-20 (Area 2 on B series figures).

The northern portion of the rail yard with monitoring well coverage extends 1,700 feet eastward from the bank of the Weber River. The direction of groundwater flow is to the northwest, sub-parallel to the trend of the Weber River, and is consistent throughout the year (Area 1 on "A" series figures). Compared to the central portion of the yard, the gradient in the northern portion is further reduced to 0.004 ft/ft. The water table contours in the Area 1 maps show that the 21st

Street Pond acts as a sink for the shallow groundwater in the area and most flow is directed toward it. An apparent minor seasonal variation in groundwater flow is manifested in the area adjacent to the former Transwood facility and is represented by only one monitoring point (22A-B5P). In April there is a four-foot high mound shown by this piezometer, which is reduced to one foot in July. This mound creates a localized area of groundwater flow reversal toward the south.

## 3.6 DEMOGRAPHY AND LAND USE

### DEMOGRAPHY

The following information on population is paraphrased from the Community Profile section of the 1999 Community Involvement Plan (UDEQ/USEPA, 1999).

Ogden, the sixth largest city in Utah, has an estimated population of 67,000 (1994 census), which reflects a 7% increase over the prior five years. An estimated 3,562 people live within ¼ mile of the rail yard. Most of the residents have lived in the area for at least 20 years.

The racial makeup of Weber County is 89% Caucasian, 5% Hispanic, 2% African-American, 2% Asian, and 1% American Indian. The economic and ethnic profile in the residential areas near the site is different than that of the overall community. The limited residential areas near the site, traditional with many neighborhoods near industrial sites, are lower income areas. The minority population in these areas ranges from 40 to 67%.

North of the site, most residents are of Hispanic origin; there are also several African-American families. East of the site, near 26th and Wall Avenue, several homes serve as an Asian Refugee Center. The Center currently serves as a recreational and a meeting place for the Asian population. The Weber County Sheriff's Office has reported 30-40 "resident homeless" living in the wooded area between the western tracks and the Weber River.

### LAND USE

Prevailing land use at the site is industrial; all aspects of which are directly related to rail operation, maintenance, and transport. Continued industrial use of the site with expanded operations is planned for the future, because of the site's strategic location as an east-west north-south rail corridor junction.

An unused strip of land exists between the western most track and the Weber River. This strip extends from about 33rd Street, south to AOI-12, and covers roughly 71 acres. Much of the area is covered by woods or brushy fields and it has been designated as riparian zone RZ1. The riparian zone was evaluated by EPA using ecological risk factors. This area varies in width from 170 to 1,100 feet (east-west distance between the river and the westernmost track). With the exception of the sludge disposal in AOI-27 this area has not been of historical use, although there is always the possibility of future industrial use/development for this area.

Buenaventura State Park adjoins the western edge of the railroad facility (Figure 1-2) and covers about 40 acres of floodplain area between the rail yard and the Weber River. This park is administered by the Utah Department of Natural Resources, Division of Parks and Recreation. While sections of the park may be classified as riparian areas, the majority of the park is used for recreational purposes.

## 3.7 ECOLOGY

A habitat evaluation and assessment of the Weber River was conducted by EPA during the RI field investigation activities in March 2000 (EPA, 2001b). The purpose of the activity was to assess habitat quality in the Weber River. The habitat parameters evaluated for an assessment of biological quality include those that characterize the stream micro- and macro-scale habitat and influence the structure of the biological community (Section 2.3.9).

The abundance and distribution of habitat and ecological communities was evaluated at seven of the Weber River sediment and surface water sampling locations (WR09, WR011, WR012, WR014, WR019, WR024, and WR028). The full results of the habitat evaluation, which are summarized below, are contained in Section 3.1 of EPA (2001b).

For the areas of habitat evaluated, the Weber River ranges from; (1) a relatively fast flowing stream dominated by riffles (WR09, WR011, WR019), to (2) a fast flowing stream with pool and run areas (WR012), to (3) run and fast laminar flow (WR014, WR024, WR028). At the time of the study, the maximum river depth ranged from 1.5 to 4 feet, and the width ranged from 25 to 40 feet. When compared to the upstream reference location (WR09); habitat quality at WR011 was found to be comparable; habitat quality at WR012, WR014, and WR019 were found to be supporting; habitat quality at WR028 was found to be partially supporting; habitat quality at WR024 was found to be non-supporting.

Listed below are the threatened and endangered species, and species of special concern identified by the US Fish and Wildlife Service that may potentially be impacted at the site (USFWS, 1999). While these species have not been identified at the site, they are found in Weber and adjacent Davis Counties. Species of Special Concern are those listed by the State of Utah's Natural Heritage Program as being most vulnerable to population or habitat loss.

| Common Name | Status |
|---|---|
| Bald Eagle | Threatened (wintering population) |
| Peregrine Falcon | Endangered (nests in Davis county) |
| Spotted Frog | Species of Special Concern |
| Deseret Mountainsnail | Species of Special Concern |
| Toquerville Springsnail | Species of Special Concern |
| Wasatch Rockcress | Species of Special Concern |
| Rockcress | Species of Special Concern |

# 4 NATURE AND EXTENT OF CONTAMINATION

This section presents the results of the site characterization. It is divided into two sections: Section 4.1 provides an overview of findings, organized according to environmental media. Section 4.2 describes the nature of contamination detected in each of the individual AOIs as compared to the site-specific SLVs and benchmark concentrations, as applicable.

## 4.1 OVERVIEW OF FINDINGS

This subsection presents an overview of the RI results. It is organized as follows:

- Potential sources of contamination
- Soils
- Groundwater
- Surface water and sediments
- Air and soil vapor.

### 4.1.1 Potential Sources of Contamination

Sources and potential sources of contamination in site soils and groundwater were investigated as part of the RI field investigation. These include accumulations of known source material (e.g. AOI-27 sludge) and activities to identify the source(s) of other identified large-scale contamination (e.g. the CVOC plumes).

#### *4.1.1.1 Hydrocarbon Sludge*

Hydrocarbon-based sludges have been identified as contaminant sources in AOIs 26, 27, and 34. The RI sampling shows that areas of remnant sludge exist in AOI-26, with TPH and grease & oil concentrations up to 40,000 mg/kg. Elevated TPH concentrations have also been detected in groundwater samples from this AOI on an irregular basis. TPH concentrations have not been detected in the well located downgradient of this AOI (26-MW1).

A removal action was conducted in the fall of 2002 to remove the sludge from the lagoons in AOI-34. A removal action to be conducted in 2003 will remove the sludge source material from AOI-27. Upon completion of the removal action in AOI-27, the remaining soil will only exceed the site-specific soil SLVs for metals which are unrelated to the hydrocarbon sludge. As discussed in Section 4.2.18, groundwater has not been chemically affected by the sludge in this AOI.

The removal of the sludge and highly TPH-contaminated soil from the AOI-34 lagoons removed a potential source of hydrocarbon contamination to underlying soils and groundwater. The field evidence (section 4.2.24) shows that hydrocarbon related contamination exists in subsurface soils throughout this AOI. Groundwater is impacted by arsenic, barium, benzene, chloroethene, and vinyl chloride. Arsenic and barium are detected at elevated concentrations in other AOIs and cannot be tied to a specific source. Benzene is likely the result of leakage from the former USTs at the site. The source of the solvent constituents (vinyl chloride, chloroethene) may be associated with the past treatment process of industrial wastewater.

#### *4.1.1.2 LNAPL*

Hydrocarbon in the form of LNAPL is present on the water table in two general areas of the railroad facility; former SPRR machine shop (AOI-38) and former UPRR Roundhouse (AOI-22b). The LNAPL occurrence is discussed in detail in Section 5.1. An additional assessment of LNAPL partitioning as a potential source of VOC-contamination of groundwater was completed, and discussed in the following section.

#### *4.1.1.3 LNAPL Partitioning*

Monitoring wells and piezometers at the site were gauged on a monthly basis for a period of over one year. For wells containing LNAPL, well gauging was conducted using an oil/water probe attached to the end of a graduated tape. Depth to LNAPL and depth to groundwater measurements were done according to procedures contained in the Phase II RI Field Sampling Plan.

As shown in Figures 4-1 to 4-4, the "north pools" are the largest LNAPL pools. These pools are located in AOI-22a (former turntable/fueling rack), AOI-SPRR3, and AOI-38 (former machine shop). Smaller LNAPL pools are located in the southern half of the site (Figures 4-5 to 4-8). The "south pools" are located in AOI-21 (Atlas Steel Salvage Yard), AOI-30 (Durbano Metals), and AOI-22b (former SPRR roundhouse).

Most of these LNAPL pools are also in locations where dissolved plumes of vinyl chloride have been identified. Because organic compounds like TCE, 1,1,1-TCA, and vinyl chloride partition between aqueous and organic phases, samples of LNAPL were collected and analyzed to evaluate whether the LNAPL is a potential source of these chemicals.

Samples were collected from monitoring wells 30-MW6, 38-MW1, 38-MW6, piezometer 22A-B4, and the "caisson well" in AOI-38[6]. One sample was collected from each location in a one-time monitoring event. The samples collected from 30-MW6, 38-MW1, 38-MW6, and 22A-B4 consisted of LNAPL, while the sample from the caisson well in AOI-38 was a mixture of LNAPL and water. All samples were analyzed for VOCs and SVOCs, and data for the chlorinated organic chemicals is shown in Table 4-1.

The data in Table 4-1 show that chlorinated organic chemicals were not detected in these samples. Even if these chemicals were present at the detection limit concentrations, these chemicals would partition into the aqueous phase at concentrations well below those that were measured in the plume (See the memorandum addressing partitioning in Appendix M). This suggests that the source of the vinyl chloride is not the LNAPL measured at these wells.

#### *4.1.1.4 Potential DNAPL Occurrence*

The vinyl chloride observed in site groundwater could theoretically be attributed to the presence of an accumulation of DNAPL at the base of the fluvial sand and gravel deposit. Because nonaqueous phase chlorinated ethenes are denser than water, they would tend to sink through an aquifer until a porous media having a relatively low permeability is encountered (if sufficient

[6] The SPRR response to an early-1970's ruptured diesel fuel service pipeline included the installation and recovery of diesel from a caisson well that is still located on the northeast end of the AOI. This is a vertical 3-foot diameter corrugated-metal-pipe sump with a total depth of 10.45 feet. The extent and length of perforations are not known.

quantities were released). In the hydrologic environment beneath the site, the Alpine clay formation would act as the first continuous low permeability unit. Although previous investigations provide no indications of DNAPL at the site, additional data was collected to investigate for the potential presence of DNAPL at the top of the Alpine formation.

## *Alpine Formation Topography*

The elongated shape of the north plume suggested that the migration of the plume might be controlled by soils of higher permeability associated with a buried stream channel. If this were the case, a channel cut into the surface of the Alpine clay layer would be a likely location for the presence of the DNAPL source. To investigate this theory, a transect of Geoprobe borings was completed across an area where high vinyl chloride concentrations were measured in monitoring wells. As shown in Figure 4-9, the transect generally extends from southwest to northeast. Nine stratigraphic borings were completed with an approximate spacing of 30 feet between borings. A tenth boring (22A-B22) was completed in the middle of the transect to facilitate the collection of ground water samples.

The geologic borings were used to map a two-dimensional geologic cross-section cutting through the aqueous phase vinyl chloride plume (Figure 4-10). The top of the alpine clay surface was located approximately between 18-23 feet bgs, gently sloping from northeast to southwest. Based on these borings, there does not appear to be a buried stream channel or other stratigraphic trap at the site, of a scale that would be revealed through the frequency of borings used in this investigation. Therefore the probability of a large accumulation of DNAPL in a "low spot" of the Alpine formation surface is low.

## *Field Tests*

The installation of six additional deep monitoring wells provided further information about the continuity of the Alpine clay formation. These wells were drilled to the top of the Alpine layer and screened at the base of the fluvial sands and gravels, and the depth to the top of the alpine clay was estimated based on the retrieval of soil cores. Additionally, two GeoProbe soil borings

(labeled Strat-B1 and Strat-B2) were taken in areas of the yard where there was a low density of monitoring wells. Well and boring locations are shown on Plates 2-1 to 2-3.

Monitoring well cores and soil borings completed during the Phase II investigation were inspected and field-tested for the presence of chlorinated solvents and other DNAPLs. All samples were analyzed with an organic vapor analyzer (OVA). Well core were scanned with an ultraviolet (UV) light for fluorescence and examined for NAPL using the Sudan IV dye shake tests. Data collected during the field inspection are available in Appendix N.

The following may be concluded from above the above discussion.

- The alpine clay layer was found in each drilled deep well coring and boring, indicating that this relatively impervious layer is continuous throughout the site. The depth to the alpine clay layer in these borings ranged from 12-32 feet.
- Volatile organics were measured in five of the eight samples, and the concentration ranged up to 5 ppm. This shows that the total concentration of volatile organics in these borings was very low (relative to what would be expected in a sample containing DNAPL).
- Two of the six samples that were examined with the UV lamp reported weak or very slight fluorescence. The slight florescence that was recorded in two of the samples may be the result of minerals in gravels that also fluoresce, because no other evidence for the presence of NAPL was observed.
- Soil core from wells and borings examined using the Sudan IV tested did not test positive for NAPL. This further supports evidence that NAPL was not present in these samples.

Because the Alpine clay layer appears to be continuous over the site and is relatively impermeable, any accumulation of chlorinated DNAPL would likely be found at the top of this layer. However, a chlorinated DNAPL plume has not been observed in investigations conducted to date.

## *Groundwater Vertical Profiling*

Vertical profiling of groundwater quality was also performed to provide information on the source of vinyl chloride because consistently higher concentrations at a given depth may suggest the location of the source. If higher aqueous vinyl chloride concentrations were found in shallow depths, the source might be near the surface, while higher concentrations with increasing depth could indicate a deeper source (specifically, the presence of CVOCs in the form of DNAPL).

To determine if there was a noticeable trend in vinyl chloride concentration with depth, groundwater data from a soil boring and shallow/deep well pairs was examined. During the installation of a GeoProbe soil boring in AOI-22a (22a-B22), groundwater samples were collected from the boring at progressive depths (11 ft, 15 ft, 18.5 ft). This one-time event occurred in May 2001. Three shallow/deep well pairs were installed in the fluvial sand and gravel. The shallow/deep well pair at 22a-MW6/6D and 34-MW3/3D provided groundwater contaminant concentrations, however the well pair at 30-MW6/6D did not because NAPL was present in the shallow well[7]. Well boring 22a-B22 and monitoring wells 22a-MW6/6D and 34-MW3/3D are located in the northern vinyl chloride plume (Plate 2-1). The analytical data from the soil boring is shown in Figure 4-11; data for the two shallow/deep well pairs are shown in Tables 4-2 and 4-3.

- In groundwater samples generated through GeoProbe soil borings, five chlorinated organic chemicals were detected. As shown in Figure 4-11, concentrations of chlorinated organic chemicals generally increased with increasing depth. The difference in vinyl chloride concentration was nearly an order of magnitude between depths of 15 and 18.5 feet.

- Nine chlorinated organic chemicals were detected in both 22a-MW6 and 22a-MW6D. Concentrations of chlorinated organic chemicals, including vinyl chloride, generally decreased with increasing depth. This indicates that the presence of DNAPL near these wells is unlikely.

- Five chlorinated organic chemicals were detected in 34-MW3 and 34-MW3D. Concentrations of chlorinated organic chemicals, including vinyl chloride, generally

[7] In accordance with the Phase II RI Field Sampling Plan, groundwater samples were not collected from monitoring wells that had visible LNAPL accumulations.

decreased with increasing depth. This indicates that the presence of DNAPL near these wells is unlikely.

The EPA reference fact sheet "*Estimating Potential for Occurrence of DNAPL at Superfund Sites*" (in Appendix O), known historical information about the site, and the data presented above were used to evaluate the presence of DNAPL at the Ogden Railroad Facility.

The reference fact sheet contains a decision chart that is composed of two questions, which are addressed below:

- ***Does historical site use information indicate presence of DNAPL***? According to Decision Chart 1, the answer to this question is "yes". This answer is based on the industrial processes and the probability of historical DNAPL release associated with the former machine shop in AOI-38.
- ***Do site characterization data indicate presence of DNAPL***? According to Decision Chart 2, the answer is "maybe". Chlorinated DNAPL has not been detected in investigations performed to date and it is unlikely that DNAPL is present near the shallow/deep well pairs. However, because the soil boring groundwater analysis shows that the concentration of DNAPL-related chemicals in groundwater increased with depth, the presence of DNAPL is possible.

Based on the answers to these two questions, the potential for occurrence of chlorinated DNAPL according to the fact sheet is high to moderate. However, DNAPL has not been detected in an investigation specifically designed to do so. While DNAPL may be present at the site, its existence would likely be in small pockets that would defy practical delineation efforts.

#### *4.1.1.5 Former Industrial Sewer*

As shown in Figure 4-12, the northern CVOC groundwater plume is of oblong shape, with its longer axis running from its origin in the vicinity of the SPRR Roundhouse and Machine Shop, northwest, to a point beyond the SPRR Wastewater Treatment Plant. This axis is roughly parallel to direction of groundwater flow and is roughly coincident with the industrial sewer line that conveyed wastewater from the Roundhouse and Machine Shop to the Wastewater Treatment

Plant. Sampling of sewer line contents revealed the presence of relatively high concentrations of CVOCs, suggesting the possible presence of CVOC-containing sludge in the line. The outlet of the sewer has been plugged, but some inlet drains are still open. The sewer is believed to be constructed of vitrified clay pipe. The materials of construction, the sewer's age (constructed in the 1960's), and the open inlet drains may result in some potential for ongoing release of CVOCs from the sewer.

### 4.1.2 Soils

The extent of soil contamination at concentrations above the site–specific SLVs is discussed on an AOI by AOI basis in Section 4.2. In summary of that section, ten parameters exceeded the soil SLV concentrations at various locations in the rail yard; arsenic, lead, chromium, grease & oil, TPH, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, and indeno(123-cd)pyrene. Arsenic is the most prevalent of the analytes detected above SLVs.

Arsenic concentrations in soils were detected at concentrations above the soil SLV of 4.8 mg/kg in all AOIs with the exception of AOIs 19 and 37. The arsenic exceedences are generally at concentrations of 35 mg/kg or less with a few outlier exceptions (Figure 4-13). These exceptions are all in surface soil at depths of 0.5 feet or less:

- AOI-21. Two surface soil samples have arsenic concentrations of 170 and 450 mg/kg.
- AOI-36. Five surface soil samples have arsenic concentrations ranging from 43.2 to 116 mg/kg.

Lead concentrations in soils were detected at concentrations above the soil SLV of 400 mg/kg in 11 AOIs (1, 2, 21, 22A, 18, 23, 27, 26, 36, 38) and two background samples from within the rail yard. The lead exceedences generally range from 420 to 880 mg/kg with a few outlier exceptions (Figure 4-14). These exceptions are:

- AOI-21. One surface soil sample with a concentration of 2200 mg/kg, and one subsurface soil sample (4 foot depth) with a concentration of 7290 mg/kg.

- AOI-23. One surface soil sample with a concentration of 2,000 mg/kg.

- AOI-36. Three surface soil samples with concentrations of 2,260, 2,840, and 2,970 mg/kg, and one subsurface soil sample (3 foot depth) with a concentration of 20,700 mg/kg.

- AOI-38. One subsurface soil sample (8 foot depth) with a concentration of 8,400 mg/kg.

Benzo(a)anthracene, benzo(b)fluoranthene, and indeno(123-cd)pyrene each exceeded their respective SLVs in only one soil sample. This sample is a surface soil sample (19-SG2) from AOI-19. The concentrations above SLVs are; 14 mg/kg Benzo(a)anthracene, 17 mg/kg benzo(b)fluoranthene, and 18 mg/kg indeno(123-cd)pyrene.

Dibenzo(a,h)anthracene concentrations in surface soils were detected at concentrations above the soil SLV of 0.78 mg/kg in two AOIs (19 and 36). The dibenzo(a,h)anthracene exceedences range from 0.8 to 4 mg/kg.

Benzo(a)pyrene concentrations in soils were detected at concentrations above the soil SLV of 0.78 mg/kg in six AOIs (19, 21, 22A, 26, 30, 36). The benzo(a)pyrene exceedences range from 0.9 to 20 mg/kg and are all in surface soil with the single exception of a sample from a 2-foot depth in AOI-26 (3.8 mg/kg).

Chromium concentrations in soils were detected at concentrations above the soil SLV of 613 mg/kg in two AOIs (21 and 30). The exceedences are all in surface soils at concentrations ranging from 710 to 1780 mg/kg. Both of these AOIs are active scrap metal salvage yards (Durbano Metals AOI-30, Atlas Steel AOI-21).

TPH concentrations in soils were detected at concentrations above the soil SLV of 5000 mg/kg in four AOIs (21, 22b, 26, 38). The exceedences are all in subsurface soils at concentrations ranging from 5,600 to 34,000 mg/kg.

Grease & Oil concentrations in soils were detected at concentrations above the soil SLV of 10,000 mg/kg in five AOIs (22A, 26, 30, 36, 38). The exceedences are all in subsurface soils at concentrations ranging from 13,000 to 32,000 mg/kg.

### 4.1.3 Groundwater

Twelve constituents have routinely exceeded the groundwater SLV concentrations at one or more locations in the rail yard during the quarterly monitoring events, and may represent contaminants of concern to groundwater. These constituents include a variety of CVOCs: TCE, 1,1,1-TCA, 1,1,2-TCA, 1,1-DCA, 1,1-DCE, 1,2-DCE, vinyl chloride, and chloroethane. The other constituents of potential concern are pentachlorophenol, benzene, arsenic, and barium. Arsenic, barium, and vinyl chloride are the most pervasive of the analytes detected above SLVs. As discussed in Section 4.2, there are additional constituents that have been detected in at least one sample above the associated SLV, but the detection of these constituents at concentrations above their SLVs were limited to non-repetitive detections (only one or two of the quarterly monitoring events) and were limited to isolated wells.

Appendix B contains tables of quarterly groundwater data for the site monitoring wells, for those parameters detected above SLVs. This data is provided for the wells in the following AOIs; 12, 19, 20, 21, 22A, 22b, 26, 30, 32, 34, 35, 36, and 38. Site monitoring wells located in AOIs 13, 18, 27, 37, and SPRR5 do not have any parameters above SLVs and are not included in the Appendix.

Accompanying each table in Appendix B are graph(s) of analyte concentrations. These graphs were constructed to evaluate contaminant concentrations in wells over time and to determine if trends of increasing or decreasing concentrations are apparent. As can be observed from the tables, not all analytes detected above SLVS are graphed for every monitoring point. Graphs were generated only for wells and analytes that had at least 3 definable values. For graphing, "J" qualifiers were removed from the reported values, and less-than data (<2) was replaced with 1/2 the value. It should be noted that the trend graphs were developed from four quarters of monitoring data, and that additional data would be required to definitively establish actual trends.

#### *4.1.3.1 Chlorinated Volatile Organic Compounds (CVOCs)*

A variety of CVOCs have been detected in groundwater at the site above SLVs. Many of these CVOCs are related in that some constituents may represent products of degradation of other constituents. The degradation of the CVOCs is discussed in Section 5.2.

**TCE**. TCE concentrations in groundwater exceeded the SLV of 6.1 ug/l in only two site wells (21-MW2, 38-MW12).

**1,1,1-TCA and 1,1,2-TCA**. 1,1,1-TCA concentrations in groundwater exceed the SLV of 73 ug/l in AOI 22A and 38. 1,1,2-TCA concentrations in groundwater exceed the SLV of 1.2 ug/l in only a single AOI 38 well , which also has a 1,1,1-TCA exceedence.

**1,1-DCA.** 1,1-DCA concentrations in groundwater exceed the SLV of 365 ug/l in AOI 22A and 38.

**1,1-DCE**. 1,1-DCE concentrations in groundwater exceed the SLV of 7 ug/l in AOI 22A and 38.

**1,2-DCE**. Concentrations of total 1,2-DCE in groundwater exceed the SLV of 33 ug/l in AOI 21, 22A, 22B, 30, and 38.

**Vinyl chloride**. Vinyl chloride concentrations in groundwater exceed the SLV of 2 ug/l in AOI 21, 22A, 22B, 26, 30, 34, and 38. There are very strong trends of decreasing vinyl chloride concentrations, including order-of-magnitude reductions in concentration, in several wells in the southern CVOC plume (see Section 5.2).

**Chloroethane**. Chloroethane concentrations in groundwater exceed the SLV of 23 ug/l in AOI 22A, 34, and 38.

#### *4.1.3.2 Other Constituents*

**Benzene**. Benzene concentrations in groundwater exceed the SLV of 2.3 ug/l in AOI 21, 22A, 30, 34, and 38.

**Pentachlorophenol**. Pentachlorophenol concentrations in groundwater repetitively exceeded the SLV of 1 ug/l in only one site well (32-MW14). The concentrations have shown a steady decrease, such that the most recent pentachlorophenol concentration is below the SLV. The lack of detection of pentachlorophenol at other locations at the site may be due to an elevated detection limit of up to 3 ug/l. In the quarterly well data, there are other one-time-only detections as follows: 38-MW7 Jan 01 - 2 ug/L, 12-MW2D Sept 00 – 3 ug/L, 12-MW3 Sept 00 – 3 ug/L, 22b-MW2D Feb 01 – 2 ug/l, and 27-MW1 Sept 00 – 3 ug/L.

**Arsenic**. Arsenic concentrations in groundwater exceed the SLV of 4.5 ug/l in AOI 22A, 30, 34, 35, 36, and 38. In AOI-22A arsenic exceeds the SLV only in the deep-shallow well pair of 22A-MW6.

**Barium.** Barium concentrations in groundwater exceed the SLV of 256 ug/l in AOI 12, 19, 20, 22A, 22B, 26, 30, 32, 34, 35, and 38.

### 4.1.4 Surface Water and Sediments

Surface water and sediment samples were collected by UPRR during the Phase I RI and by EPA during the Phase II RI. The number of samples and locations are described in Section 4.2 under the various AOI headings in which they were collected. In summary, stream sediment and surface water samples were collected from the following areas of the site; Burch Creek (AOI-9), Weber River, 33rd Street Slough, Strongs Creek (AOI-29), an ephemeral drainage (AOI-10), and the "roundhouse" ditch (AOI-28).

Results of the surface water and sediment sampling conducted by EPA are presented in the February 2001 Field Sampling Report (EPA, 2001b) contained in Appendix F. An initial screening-level ecological risk assessment of the combined UPRR and EPA surface water and sediment data for the railroad facility, was conducted by EPA (EPA, 2001c). In the assessment, the maximum detected sediment and surface water contaminant concentrations were compared to screening benchmarks for ecological receptors. The results of the comparisons are summarized in Table 4-4, and are compiled from sections 7.1 (Surface Water) and 7.2 (Sediment) of the EPA document (EPA, 2001c).

As shown in Table 4-4, lead, arsenic, and chromium, are the only contaminants of concern that exceed the surface water benchmark concentrations. The lead surface water benchmark was exceeded in the Weber River, Burch Creek, Strongs Creek, AOI-28, and the 33rd Street Slough. Arsenic was only exceeded in AOI-10 and cadmium was only exceeded in AOI-28. In sediment samples, the following parameters (metals and PAHs) were detected at a maximum concentration that exceeds the sediment benchmark concentrations in one or more of the drainages; lead, cadmium, chromium, arsenic, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(ghi)perylene, chrysene, dibenzo(ah)anthracene, fluoranthene, indeno(123-cd)pyrene, phenanthrene, and pyrene.

### 4.1.5 Air and Soil Vapor

As part of the Phase II field investigation, air samples were collected for analysis from areas of the yard directly overlying the north and south vinyl chloride plumes. The samples were collected to evaluate the vapor phase contamination associated with the dissolved vinyl chloride plumes.

#### *4.1.5.1 Methods*

Vapor phase flux measurements were performed according to the sampling program described in Appendix E of *Phase II Remedial Investigation and Feasibility Study Work Plan* (S-K, 2000a). The sampling was performed as described in Appendix A of *Phase II RI Field Sampling Plan* (S-K, 2000d, SOPs 126A and 126B).

In addition to background flux measurements taken from a location adjacent to the rail yard and from residential areas east of the rail yard, data were collected above each vinyl chloride plume and included:

- Six flux chamber measurements distributed across the land surface above the known extent of the vinyl chloride plume.

- Two flux measurements in the immediate vicinity of the highest vinyl chloride concentrations that were detected in the Phase I RI.

- Two flux chamber measurements adjacent to a structure overlying each vinyl chloride plume. The soda ash transfer building and the Durbano Metals buildings were studied at the north and south plumes, respectively.

- Two integrated ambient air measurements inside each structure above each vinyl chloride plume.

- One integrated ambient air measurement outside each structure.

Sampling was performed June 21-22, 2000 at the locations shown in Figure 2-4 and 2-5.

Samples were analyzed by Method TO-14, GC-MS Selective Ion Mode ("SIM") for vinyl chloride, 1,1-dichloroethene, and benzene. For each plume, full-scan GC-MS analyses were performed on the two samples exhibiting the highest concentrations of benzene. Full scan analyses were also performed for the background locations.

#### *4.1.5.2 Results*

Validated data for the flux SIM and full scan data are provided in Tables 4-5, 4-6, and 4-7 for the north plume, south plume, and background measurements, respectively. Results of the flux calculations and the corresponding flux chamber air concentrations are reported. Full scan analyses were performed on NF-07 and NF-09 for the north plume and SF-01 and SF-07 for the south plume.

In the northern vinyl chloride plume, benzene was detected in the SIM analysis from locations NF-07 and NF-09. 1,1-Dichloroethene (1,1-DCE) was detected at only one location, NF-05. Vinyl chloride was not detected at any location. A total of seven compounds were detected in the full scan analyses. The highest detected concentration was tetrachloroethene in NF-07 at 1.3 ug/($m^2$-min).

Vinyl chloride and 1,1-DCE were not detected in indoor and outdoor ambient air samples collected at the north vinyl chloride structure. Benzene was detected in both indoor samples at approximately the same concentration (16.2 ppbV (part per billion by volume) and 19.5 ppbV). The concentration of benzene was 0.26 ppbV in the outdoor sample.

In the southern vinyl chloride plume, benzene was detected in the SIM analysis from locations SF-01, SF-02, SF-07, and SF-08. Neither 1,1-Dichloroethene nor vinyl chloride was detected in any measurement. A total of 15 compounds were detected in the full scan analyses. The highest detected concentration was m- and p-xylene in SF-01 at 0.19 ug/($m^2$-min).

Vinyl chloride and 1,1-DCE were not detected in indoor and outdoor ambient air samples collected at the south vinyl chloride structure. Benzene was detected in one of the indoor air samples (0.36 ppbV). The concentration of benzene was 0.62 ppbV in the outdoor sample.

In the background samples, benzene was detected in the SIM analyses from BKGD-1 and BKGD-2 at 0.007 and 0.008 ug/($m^2$-min), respectively. Toluene was detected in the full scan analyses from both background samples (0.024 and 0.11 ug/($m^2$-min)), while m and p-xylene and trichlorofluoromethane were detected in BKGD-2 at 0.033 and 0.051 ug/($m^2$-min), respectively.

#### *4.1.5.3 Discussion*

The Human Health Risk Assessment (EPA, 2003a) calculated hypothetical exposure point concentrations for each flux sample in which VOCs were detected, conservatively estimating that the entire vapor flux below the building penetrates the cement slab floor, resulting in vapor intrusion. The exposure point concentrations were subsequently used to calculate risk on a sample-by-sample basis. Results demonstrated that risks to workers in onsite structures from soil gas intrusion are within or below EPA's target risk range for carcinogenic and noncarcinogenic risks. These results indicate that soil gas intrusion is not a pathway of concern for on-site buildings.

## 4.2 AREAS OF INTEREST

The following subsections individually discuss the results of the sampling conducted at each of the site AOIs. Each subsection contains a description of the AOI, sampling results, and a comparison of all detected concentrations for a parameter to the Site-Specific SLV concentrations, or to the EPA Ecological Benchmark Concentrations for surface water and sediment samples. The analytical results for each AOI are summarized in relevant tables contained in Appendix A. These tables list only the detected concentrations of analytes for which there was at least one detection at a concentration at or above the SLV, somewhere in the rail yard site. A table showing all samples collected and the analytical testing parameters for each sample is contained in Table 1-4 and in the Data Quality Assessment in Appendix E. Also contained in Appendix E is a table showing the parameters with detection limits above the soil and groundwater screening levels.

The tables in Appendix A are arranged by AOI and media, and the concentrations above SLVs (Table 2-3) or Benchmark concentrations are marked (indicated by an "x"). All sampling locations identified in the Appendix A tables are shown on Plates 2-1 through 2-3. The AOI locations are shown on Figure 1-3. Logs of the borings referenced in each AOI discussion are provided in Appendix C.

Discussions on groundwater contaminant concentrations include two types of data: (1) quarterly monitoring data from wells installed for the quarterly collection of groundwater samples, and (2) single-event screening level data from Geoprobe borings. The groundwater contaminant discussions for the individual AOIs are focused on the quarterly (Phase II) groundwater data from the monitoring wells. In some instances, a one-time Geoprobe groundwater sample will have a higher concentration than the quarterly well samples, primarily a result of the sampling methodology (no filter pack, higher turbidity). Discussions of the overall maximum groundwater detections are included for the Geoprobe groundwater samples where appropriate.

Each AOI investigated in the Phase I and/or Phase II investigation is covered in numerical order. At the end of this section, areas which were sampled but which were not part of an AOI are also addressed. These "other areas" are:

- Background Soil
- Riparian Zone
- Weber River

### 4.2.1 AOI-1 – Former SPRR Diesel ASTs

AOI-1 encompasses the former location of the two above ground storage tanks that functioned as the central diesel fuel supply for locomotive refueling at the SPRR rail yard. Each tank held about 10,000 bbls, and both were empty during the Phase I investigation. The tanks were later demolished for scrap in the Spring of 1998, and no evidence of significant leakage was observed on the tank pads after removal. Each tank was surrounded by an intact, earthen spill berm. Surface staining from petroleum product was not observed around the ASTs. No historical releases directly from the ASTs have been reported. During the Phase II investigation, the berms had been removed and the location was used as a tie storage yard and fabrication area for track panels. Target contaminants are diesel-related compounds.

Four Phase I GeoProbe borings were completed around the tanks (1-B1 through 1-B4). The surface and subsurface soil samples were analyzed for TPH-DRO, VOCs, and PAHs. One surface soil sample was collected for analysis of VOCs, metals, and PAHs (R1-SG3). Phase II soil samples were collected from 2 surface soil locations (1-SG1, 1-SG2) and one Geoprobe boring (1-B5). Surface soil samples were analyzed for metals. Shallow subsurface soil samples (0.2 to 2 feet) were analyzed for metals, SVOCs, and VOCs. Analytes detected above SLVs are limited to metals in soil less than 2 feet deep: arsenic (15 to 23.6 mg/kg), and lead (1 detection at 737 mg/kg).

Phase I groundwater samples were collected from borings 1-B1 and 1-B4, because the soil at the water table in these two borings had traces of volatiles detected by PID analysis and a slight odor. The groundwater samples were analyzed for TPH-DRO, VOCs, and PAHs. No analytes were detected above SLVs in the groundwater samples.

### 4.2.2 AOI-2 – Rail Line to Granary

AOI-2 encompasses a granary adjacent to the eastern edge of the rail yard. Rail cars are parked and shuttled in and out of the track system at a granary loading/unloading facility on the northwest side of the granary. No staining from petroleum releases was observed on the ground surface, nor was there evidence of any pesticide storage or handling to provide a source of release of those materials. Old, souring grain spillage was common along all the trackage in the delivery area during the Phase I investigation. Target contaminants are pesticide compounds.

Three Phase I surface soil samples were collected along the tracks and at unloading points (R2-SG10 to R2-SG12). Each sample was analyzed for VOCs, pesticides, and PCBs. Phase II soil samples were collected from one surface soil location (2-SG4) and two Geoprobe borings (2-B1, 2-B2). Surface soil samples were analyzed for metals and SVOCs. Shallow subsurface soil samples (0.2 to 2 feet) were analyzed for metals, SVOCs, and VOCs. Analytes detected above SLVs are limited to metals in soil less than 2 feet deep: arsenic (8.9 to 16.2 mg/kg), and lead (1 detection at 519 mg/kg). Groundwater samples were not required from this AOI due to the lack of a potential source of groundwater contamination.

For the Phase I soil samples submitted for pesticide analysis, all of the analyte PQLs were at least one order of magnitude less than the SLVs. Only one pesticide was detected above the PQL (sample R2-SG11; 4'4'DDE detected at concentration of 0.27 mg/kg vs. SLV of 17 mg/kg).

### 4.2.3 AOI-5 – Railroad Tie Storage and Handling

The National Railroad Materials (NRM) tie storage facility covers several acres in Region 2. Concrete ties and some wooden ties are delivered and stored here for subsequent distribution throughout the railroad system. NRM and CXT (wholesale company for NRM) have been operating at the site for about the past seven years. No creosote treatment of ties has occurred at the site since occupancy by NRM (personal communication with Bart Peterson, Manager CXT, 801-621-6407). Historical aerial photographs dating from 1987 back to 1958 (Lockheed, 1997b) show no evidence of tie storage or use at the site prior to occupancy by NRM. The contaminants of concern for the investigation are wood preservative chemicals (PAHs).

Four Phase I surface soil samples were collected and analyzed for PAHs. The samples were collected within the active areas of the open warehousing facility (R2-SG6 through R2-SG9). Phase II soil samples were collected from one surface soil location (5-SG1) and two Geoprobe borings (5-B1, 5-B2). Surface soil samples were analyzed for metals. Shallow subsurface soil samples (0.2 to 2 feet) were analyzed for metals, SVOCs, and VOCs. Analytes detected above SLVs are limited to arsenic in soil less than 2 feet deep (5.2 to 6.6 mg/kg). Consistent with the Phase I Work Plan, groundwater samples were not required from this AOI due to the lack of a potential source of groundwater contamination.

### 4.2.4 AOI-8 – Refrigerator Car Maintenance Area

This AOI encompasses an area of the yard in Region 3, where refrigerator cars were routinely parked along two parallel tracks for cleaning and refrigeration equipment maintenance. There are no ground surfaces showing visible contamination, nor are there any specific locations where contaminant discharge is likely to occur within the maintenance zone. Most of this area is now grass covered. The target contaminants are hydrocarbons related to refrigerants (VOCs).

Three Phase I Geoprobe borings were located along the service tracks (8-B1 through 8-B3). Three soil samples were collected from each boring and analyzed for VOCs, TPH-DRO, and metals. Phase II soil samples were collected from two surface soil locations (8-SG1, 8-SG2) and one Geoprobe boring (8-B4). Surface soil samples were analyzed for SVOCs. Shallow subsurface soil samples (0.2 to 2 feet) were analyzed for metals, SVOCs, and VOCs. Analytes detected above SLVs are limited to arsenic in soil less than 0.5 feet deep (5.7 to 13 mg/kg). Consistent with the Phase I Work Plan, groundwater samples were not required from this AOI due to the lack of a potential source of groundwater contamination.

### 4.2.5 AOI-9 – Burch Creek

Burch Creek is a permanent stream that flows westward across the southern portion of the rail yard in Region 4 (Section 3.3.2). The creek flows through a buried culvert under the rail yard track network and rail yard access roads. The stream reach between the west access road and the Weber River is open. East (or upstream) of the rail yard, part of the stream drainage flows within an industrial-commercial area (Figure 3-1). Two 10,000 gallon ASTs which store diesel fuel are

located about 30 feet north of the creek on the west side of the rail yard tracks, next to the rail yard access road. Overfilling caused a diesel spill at these tanks in the mid-1990s (12/14/94); the release was reported to the UDEQ (J. L. Thiros) and the affected soil excavated from the site. The creek was not directly affected by this contamination as documented in the release report. Diesel-related compounds were the contaminants of concern.

The Phase I investigation at this AOI included two Geoprobe borings at the ASTs (9-B1, 9-B2) and four paired stream sediment and stream water samples from the creek (R4-S&SW5 through R4-S&SW8). All samples were analyzed for VOCs, PAHs, TPH-DRO, and metals. Phase II sediment and surface water samples were collected by EPA (4 sample pairs, BC1B through BC4B). The samples were analyzed for VOCs, SVOCs, and metals. No evidence of contamination was observed at the water table during the Phase I investigation, thus groundwater samples were not taken. Phase II soil samples were collected from two surface soil locations (9-SG1, 9-SG2) and one Geoprobe boring (9-B3). Surface soil samples were analyzed for metals and SVOCs. Shallow subsurface soil samples (0.2 to 2 feet) were analyzed for metals, SVOCs, and VOCs.

Analytes detected above SLVs in soil are limited to arsenic, less than 0.2 feet deep (5.5 mg/kg). Analytes were detected in sediments at concentrations above the sediment Benchmark Concentrations for benzo(a)anthracene, benzo(a)pyrene, benzo(g,h,i)perylene, chrysene, dibenzo(ah)anthracene, fluoranthene, phenanthrene, pyrene, and cadmium. The only analyte detected in the stream water samples at concentrations above surface water Benchmark Concentrations was lead.

### 4.2.6 AOI-10 – Storm Drain and Slough

AOI-10 is a minor, ephemeral drainage ditch that diverts surface water under the rail yard via a culvert that opens under the refrigerator car repair tracks at AOI-8. The shallow slough ends in the meadow south of AOI-27 and cannot be directly traced to the Weber River. It carries water only during very wet weather cycles and was dry during the Phase I field investigation. The extension of the drainage east of the rail yard could not be located; recent extensive urban (commercial/industrial) development has obliterated the small natural creek channel. The diversion of the upstream catchment drainage leaves the slough in AOI-10 dry most of the time.

The contaminants of concern are diesel and metals that may have been carried into the slough from general railroad operations.

During Phase I, two sediment samples were collected from the ditch (R3-S5, R3-S7), and a co-located sediment - surface water sample (R3-S&SW3) was collected where an apparent channel meets the Weber River. (This surface water sample probably represents water from the Weber River, as the upstream reaches of the slough were dry.) All samples were analyzed for VOCs, PAHs, and metals. Phase II sediment and surface water samples were collected by EPA (2 sample pairs, AO101B, AO102B). The samples were analyzed for VOCs, SVOCs, PCBs, and metals.

Analytes were detected in sediments at concentrations above the sediment Benchmark Concentrations for the following analytes. (The maximum detected concentration is provided): anthracene (0.36 mg/kg), benzo(a)anthracene (0.22J mg/kg), benzo(a)pyrene (0.33 mg/kg), benzo(ghi)perylene (0.42 mg/kg), chrysene (0.64 mg/kg), dibenzo(ah)anthracene (0.1J mg/kg), fluoranthene (0.41 mg/kg), phenanthrene (0.19J mg/kg), pyrene (0.42 mg/kg), indeno(123-cd)pyrene (0.29J), cadmium (4.7 mg/kg), arsenic (13 mg/kg), and lead (330 mg/kg). The only analytes detected in the surface water samples at concentrations above surface water Benchmark Concentrations were arsenic (57 ug/L) and lead (59 ug/L).

### 4.2.7 AOI-12 – Oil - Water Separator

AOI-12 encompasses the former area of a sub-grade oil - water separator and its associated storage tank, which were located at the south end of the rail yard in Region 5. The belt-stripper type separator sat on the west side of the rail yard within 30 feet of the Weber River. The Weber River embankment is steep here, and the water runs about 12-15 feet below the terrace step where the oil - water separator was located. Much of the terrace and embankment adjacent to the river has been built up to prevent washouts along the rail yard. Extensive boulders and concrete fill prevented the deep penetration of Geoprobe borings around the separator during the Phase I investigation. The oil-water separator and drip pans under the adjacent rack were removed from AOI-12 in May 2000. The contaminants of interest are diesel and heavier hydrocarbons.

Five Geoprobe borings (12-B1 through 12-B5) were completed at and near the oil/water separator for the Phase I investigation. In addition to these five borings, six additional borings were begun and abandoned due to auger refusal at 3 to 4 feet bgs. None of the borings completed adjacent to the oil/water separator and recovery tank (12-B1, B2, B3) successfully reached groundwater, because of refusal due to boulders or buried concrete debris. However, none of the soil cores from these holes contained any visible petroleum contamination, odor, nor PID measurements above background. The remaining two borings, 12-B4 and 12-B5, were located just east of the separator along the track equipped with a drip pan and a service pit. Boring 12-B4 advanced to semi-saturated conditions before meeting refusal at a depth of 9.5 feet. This depth was not sufficient for the collection of a groundwater sample. Saturated conditions were encountered in boring 12-B5, but a groundwater sample was not collected because there was no field evidence of soil contamination at the saturated zone. Thirteen surface and subsurface soil samples were collected from the five borings and analyzed for VOCs, TPH-DRO, and PAHs.

Phase II investigation activities consisted of the installation of three monitoring wells and four quarters of subsequent groundwater analyses. Groundwater samples were analyzed for VOCs, SVOCs, and metals. Phase II soil samples were collected from the well borings, one surface soil location (12-SG1), and one Geoprobe boring (12-B4-2001). Surface soil samples were analyzed for metals. Shallow subsurface soil samples (0.2 to 2 feet) were analyzed for metals, SVOCs, and VOCs.

Analytes detected above SLVs in soil are limited to arsenic, at depths of 2 feet or less (5 to 7.2 mg/kg). Analytes detected above SLVs in quarterly groundwater samples include arsenic, barium, cadmium, selenium, and pentachlorophenol. Only barium is routinely detected above the SLV (260 to 590 ug/l) in site monitoring wells. All other groundwater analytes detected above the screening levels are limited to a one-time occurrence in either the Geoprobe boring or monitoring wells.

### 4.2.8 AOI-13 - RIP Tracks (Rail Car Maintenance Area)

The RIP (repair-in-place) tracks are a series of tracks devoted to maintenance and repair of railroad cars. This repair facility has been operating at this site since 1955. Most of the ground surface between the tracks is paved with concrete. Much of the work on the RIP tracks involves

welding, metal work, general mechanics, and lubrication. Locomotives are not serviced or fueled in this area. In addition to the investigation of the RIP tracks working area, further assessment was performed for a diesel release from two former USTs (Tanks 3 and 4) located about 100 feet west of the repair tracks. This work augmented the previous LUST investigation phases already reported to the DERR (Facility ID 1200409) that included monitoring well installations and product recovery (skimming). This LUST site was granted no-further–action status by the UDEQ in August 2002 (Table 1-3). The target contaminants are general petroleum-based hydrocarbons and metals.

During Phase I, three GeoProbe borings (13-B1, 13-B2, 13-B3) were drilled between the maintenance tracks in the RIP working area, and three Geoprobe borings (13-B4, B5, B6) and two new monitor wells (13-MW1, 13-MW2) were completed near the LUST site. Soil samples were analyzed for VOCs, TPH-DRO, and metals. One groundwater sampling event was conducted on the five site wells. Groundwater samples were analyzed for TPH and PAHs. An additional boring (13-B7) was drilled at the independent request of UPRR solely for a water sample located next to a track repair excavation. This water sample was analyzed for VOCs and metals as were two surface water samples from the excavation (13-SW1, 13-SW2).

Phase II soil samples were collected from two Geoprobe borings (13-B8, 13-B9). Shallow subsurface soil samples were analyzed for metals. Four quarters of groundwater analyses were generated from the five site monitoring wells[8]. The groundwater samples were analyzed for BTEX, TPH, and PAHs.

Analytes detected above SLVs in soil are limited to arsenic, at a depth of 8 to 10 feet (1 detection at 5.8 mg/kg). Analytes detected above SLVs in groundwater samples include arsenic, barium, cadmium, chromium, lead, 2,6-dinitrotoluene, 2-methylnaphthalene, benzene, bis(2-ethylhexyl)phthalate, naphthalene, and phenanthrene. Only benzene (4 to 36 ug/l) and naphthalene (110 to 230 ug/l) are routinely detected above the SLVs. All other groundwater analytes detected above the SLVs are limited to one-time occurrences.

[8] The LUST site was over-excavated in June 2000, and well 13-MW16 was removed from the source area. A replacement well (13-MW16A) was installed in the area of excavation in October 2000.

### 4.2.9 AOI-17 - Surplus Storage and Salvage

The non-railroad property included as AOI-17 is an independent salvage facility. The open salvage yard is adjacent to the western edge of the rail yard, and the property appears to warehouse old industrial equipment such as vehicles, machinery, scrap metal, and wood. Prior to about 1978 (based on aerial photo interpretation) the structure originally served as a slaughterhouse. The perimeter of the property is fenced off from the rail yard, and the east fence line parallels the rail yard access road and railroad tracks used typically for parking rail cars. No surface contamination from petroleum products, chemicals, or metals was observed in the rail yard property adjacent to the fence. The contaminants of concern in this AOI are metals.

For the Phase I investigation, four surface soil samples (17-SG1 to SG4) were collected on rail yard property along the eastern fence line. Each sample was analyzed for TPH-DRO and metals. Phase II soil samples were collected from two surface soil locations (17-SG1-2001, 17-SG2-2001), and one Geoprobe boring (17-B1). Surface soil samples were analyzed for SVOCs. Shallow subsurface soil samples (0.2 to 2 feet) were analyzed for metals, SVOCs, and VOCs. Soil analytes detected above SLV concentrations are limited to arsenic (5.9 to 11 mg/kg).

### 4.2.10 AOI-18 - Dyce Chemical Company

The Dyce Chemical facility sits adjacent to the north end of the AOI-17 salvage yard. The Dyce company buildings and delivery/pickup area are located on non-railroad property between the rail yard and the Weber River. The company manufactures and handles organic chemicals and unspecified acids and bases. Numerous drums of chemicals are stored on the Dyce property in an apparent orderly and prescribed manner. There were no obvious environmental problems observed on or off of the Dyce property that would potentially affect the adjacent UPRR property. Tank cars for delivery or pickup at Dyce are typically parked on rail yard property on the siding tracks leading to the entry gate to the Dyce company grounds on the north side of the facility.

The Phase I investigation consisted of two surface soil samples (18-SG1, SG2), and collection of a groundwater sample and soil samples from GeoProbe boring 18-B1. All samples were analyzed for VOCs. Phase II investigation activities consisted of the installation of one monitoring well (18-MW1) and four quarters of subsequent groundwater analyses. Groundwater samples were

analyzed for VOCs, SVOCs, and metals. Phase II soil samples were collected from the well boring, two surface soil locations (18-SG1-2001, 18-SG2-2001), and one Geoprobe location (18-B3). Surface soil samples were analyzed for metals and SVOCs. Subsurface soil samples were analyzed for metals, VOCs, and SVOCs.

Analytes detected above SLVs in soil are limited to arsenic in soil less than 2 feet deep (8.15 to 8.57 mg/kg), and lead in soil at a depth of 2 to 3 feet (1 detection at 619 mg/kg). No analytes were detected above SLVs in groundwater samples from this AOI.

### 4.2.11 AOI-19 - Former Union Pacific Railroad Laundry

The brick building in this AOI housed the former laundry operations that once serviced the entire UPRR passenger rail system. The laundry operated until the 1960s. Target contaminants for the investigation are chlorinated solvents and benzene that may have been used during laundering, although the laundry reportedly only used steam and water for cleaning.

Two Phase I Geoprobe borings (19-B1, 19-B2) were drilled to groundwater at the west side of the building. Three soil samples were taken from each boring and analyzed for VOCs. The Phase I scope of work did not include sampling of groundwater from this AOI.

Phase II investigation activities consisted of the installation of one monitoring well (19-MW1D) and four quarters of subsequent groundwater analyses. Groundwater samples were analyzed for VOCs, SVOCs, TPH, and metals. Phase II soil samples were collected from the well boring, two surface soil locations (19-SG1, 19-SG2), and one Geoprobe locations (19-B3). Surface soil samples were analyzed for metals and SVOCs. Subsurface soil samples were analyzed for metals, VOCs, and SVOCs.

Analytes detected above SLVs in soil are hydrocarbon related compounds in the surface soil, which consist of benzo(a)anthracene (14 mg/kg), benzo(a)pyrene (7.3 to 20 mg/kg), benzo(b)fluoranthene (17 mg/kg), dibenzo(ah)anthracene (2.1 to 4.2 mg/kg), and indeno(123-cd)pyrene (18 mg/kg). Analytes detected above SLVs in groundwater samples are limited to barium and selenium. Only barium (379 to 462 ug/l) is routinely detected above the SLV. The selenium exceedence is limited to a one-time occurrence.

### 4.2.12 AOI-20 - Former UPRR Diesel ASTs

AOI-20 contains the remnants of the pads for two diesel ASTs. The ASTs were removed in the 1970s; they were part of the UPRR maintenance and fueling operations that were once carried out in adjacent AOIs 30 and 22B. Each tank appears to have held at least 10,000 bbl of diesel fuel. During the Phase I investigation, the land in AOI-20 was unused except for scattering of miscellaneous construction debris. During the Phase II investigation, the area had been cleared and was being used for storage of wood chips. No surface contamination from petroleum products was observed during the fieldwork. The contaminants of concern are diesel-related compounds.

The Phase I assessment consisted of three Geoprobe borings (30-B9, 30-B10, 30-B11[9]). Three soil samples and a water sample were collected from each boring. The samples were analyzed for TPH-DRO, metals, and PAHs. Boring 30-B11 intersected aged petroleum staining (old diesel) in sandy gravel at the water table (saturation depth about 7 feet). Free product (LNAPL) was not present. This AOI is hydrologically down gradient from AOI-30 and the subsurface diesel/oil groundwater and soil contamination found at the north end of that AOI (see AOI-30 Section 4.2.21 below for further discussion of assessment results).

Phase II investigation activities consisted of the installation of three monitoring wells (20-MW1, 20-MW2, 20-MW3D) and four quarters of subsequent groundwater analyses. Groundwater samples were analyzed for VOCs, SVOCs, TPH, and metals. Soil samples from the well borings were analyzed for metals, VOCs, and PAHs. One soil sample collected from the gravel-clay contact in well boring 20-MW3D was analyzed for VOCs.

Analytes detected above SLVs in soil are limited to arsenic (7.3 to 8.6 mg/kg). No VOC constituents were detected above the method detection limits in soil sample 20-MW3D-14 from the bottom of the gravel horizon. Analytes detected above SLVs in groundwater samples include arsenic, barium, cadmium, chromium, lead, and TPH. Only barium (261 to 387 ug/l) is routinely detected above the SLVs. The highest concentration of barium was detected in a Phase I groundwater sample from Geoprobe boring 30-B10 (720 ug/L). All other groundwater analytes

[9] In the field, the borings and samples were incorrectly identified with the prefix "30" rather than "20" and kept within the continued numbering scheme for AOI-30.

detected above the screening levels are limited to a one-time occurrence (i.e., the constituents were not detected at concentrations above screening levels in the other quarterly monitoring events).

### 4.2.13 AOI-21, Atlas Steel Salvage Yard

AOI-21 encompasses a privately-owned property block that is entirely surrounded by UPRR property. Since the 1980s the property has been used as a metals salvage yard. The buildings on the northeast end of the Atlas Steel site have existed for several decades. A 1960 rail yard map shows the property then under use by the Colorado By-Products Company (another salvage company). AOI-21 is located immediately south and hydrologically upgradient of the former UPRR engine and rail car maintenance and fueling center (AOIs 22B and 30). The original contaminants of concern were TPH-DRO and metals, but the Phase I investigation of adjacent AOIs 22B and 30 revealed a dissolved vinyl chloride plume near the north side of AOI-21. As a consequence, groundwater samples from borings drilled later in the Phase I program (Phase I Work Plan Addendum 3; LES, 1998, borings 21-B4 through 21-B7) were analyzed for vinyl chloride and VOCs.

During the Phase I investigation, Atlas Steel personnel did not permit sampling within the scrap yard and the proposed Phase I boring and grab sample locations for this AOI had to be revised (Phase I Work Plan Addendum 2; LES, 1997c). The Phase I investigation of AOI-21 included seven Geoprobe borings (21-B1 to 21-B7), one monitor well (21-MW1), and three surface soil grab samples (R2-SG16, R-SG17, R2-SG18), all of which were located around the perimeter of the Atlas Steel property. Soil samples collected from GeoProbe borings 21-B1 to 21-B3, and from the three surface soil sampling locations were analyzed for TPH-DRO and metals. Groundwater samples collected from the Geoprobe borings were analyzed for VOCs. A groundwater sample from 21-MW1 was analyzed for VOCs, SVOCs, and metals.

Phase II investigation activities consisted of the installation of two monitoring wells (21-MW2, 21-MW3) and four quarters of subsequent groundwater analyses from the three site wells. Groundwater samples were analyzed for VOCs, SVOCs, and metals. Soil samples from the well borings were analyzed for metals, VOCs, and PAHs. Additional soil and groundwater samples were collected from four Geoprobe borings completed within the property confines (21-B8 to 21-

B11). Surface soil samples were analyzed for SVOCs and metals. Shallow subsurface soil samples (0.2 to 2 feet) and groundwater samples were analyzed for metals, SVOCs, and VOCs.

Analytes detected above SLVs in soil are limited to metals and diesel related contamination. Metal exceedences include arsenic (5.2 to 450 mg/kg), chromium (2 detections at 1380 and 1780 mg/kg), and lead (492 to 7290 mg/kg). Diesel related exceedences include TPH (6300 mg/kg) and benzo(a)pyrene (1.5 to 2 mg/kg). Analytes detected above SLVs in groundwater samples include arsenic, barium, cadmium, chromium, lead, 1,2-DCE, benzene, chloromethane, TCE, and vinyl chloride. Only 1,2-DCE (41 to 67 ug/l), barium (315 to 336 ug/l), benzene (3 ug/l) and vinyl chloride (8 to 41 ug/l) are routinely detected above the SLVs in the well samples. The highest detections of these analytes in the AOI are 120 ug/l 1,2-DCE, 470 ug/l barium, 11 ug/l benzene, and 110 ug/l vinyl chloride. All other groundwater analytes detected above the screening levels are limited to a one-time occurrence (i.e., the constituents were not detected at concentrations above screening levels in the other quarterly monitoring events).

### 4.2.14 AOI-22A, Former SPRR Roundhouse

AOI-22A encompasses the former SPRR roundhouse area. SPRR carried out primary engine maintenance for both diesel and steam locomotives in the roundhouse, which was built in 1906. The entire roundhouse was retired and dismantled in 1954, and only the concrete turntable basin and building foundations remain on-site. The SPRR diesel maintenance was then transferred to the former machine shop area in adjacent AOI-38. Some diesel fueling continued north and west of the old turn-table until the early 1990s, and remnants of the old fuel dispenser rack remain along the west side of the present soda-ash transfer building. Data collected during the Phase I investigation resulted in an expansion of the original perimeter of AOI-22A to encompass the old fueling dispenser racks and the area around the soda-ash facility.

Historical investigations have disclosed that an oil/water separation facility once existed on the land now occupied by the soda-ash facility. In the 1960s, SPRR eventually replaced this oil/water treatment facility with the wastewater treatment facility in AOI-34. The relatively new soda-ash transfer facility, operated by a non-railroad company, is the only current activity on this AOI other than active tracks for parking and passing trains. Raw soda-ash (trona) spillage is common on the tracks. Diesel fuel, lubrication oils, solvents, and PCBs were identified as the

constituents of potential concern in this AOI, based on the nature of the previous railroad activities.

The Phase I investigation of this AOI included the completion of 12 Geoprobe borings (22A-B1 through 22A-B12), collection of two surface soil samples (R1-SG1, R1-SG2), and installation of four monitor wells (22A-MW1 to MW4)[10]. Surface and subsurface soil samples were collected from borings 22A-B1 through 22A-B5, and the monitoring-well borings. Soil and groundwater samples were analyzed for TPH-DRO, VOCs, PAHs, PCBs, and metals. Soil samples were also analyzed for oil and grease. Borings 22A-B6 through 22A-B12 were drilled under Addendum 3 to the Phase I work plan, to further delineate dissolved vinyl chloride in groundwater and diesel in the form of LNAPL. Groundwater samples from these borings were only analyzed for selected VOCs and vinyl chloride. Grab soil samples were not collected from the interior of the turntable as specified in the Phase I work plan, because the turntable basin has a concrete floor with no soil accumulation.

Phase II investigation activities consisted of the installation of three monitoring wells (22A-MW5, 22A-MW6, 22A-MW6D) and four quarters of subsequent groundwater analyses from the seven site wells. Groundwater samples were analyzed for VOCs, SVOCs, and metals. Soil samples from the well borings were analyzed for metals, VOCs, and PAHs. Soil samples from the 22A-MW5 boring were also tested for SVOCs and TPH.

An additional Phase II investigative task was to complete a line of ten borings across the northern vinyl chloride plume. The purpose of these borings was to both determine if (1) the elongated nature of the plume was structurally controlled by a buried stream channel and (2) to test for the presence of a DNAPL (FSP Section 3.8.3.1, Safety-Kleen, 2000b). A channel in the surface of the Alpine clay was not found and results of this investigative task are further discussed in Section 4.1.1.4 of this report.

Analytes detected above SLVs in soil are limited to arsenic (5.2 to 17 mg/kg), lead (1 detection at 810 mg/kg), and benzo(a)pyrene (0.87 and 1 mg/kg) in shallow soils (0 to 1 foot deep), and one detection of grease and oil (11,000 mg/kg, sample 22A-B5-2) at a depth of two to four feet.

[10] Four of the Geoprobe borings (B4, B5, B7, B11) were converted to 1-inch piezometers to gauge LNAPL hydrocarbon.

Analytes detected above SLVs in groundwater samples (and the maximum detected concentrations) include 1,1,1-TCA (580 ug/l), 1,1,2-TCA (3 ug/l), 1,1-DCA (920 ug/l), 1,1-DCE (66 ug/l), 1,2-DCE (1300 ug/l), 1,2,3-Trichloropropane (15 ug/l), arsenic (77.2 ug/l), barium (1200 ug/l), benzene (18 ug/l), chloroethane (170 ug/l), lead (56 ug/l), pentachlorophenol (3 ug/l), and vinyl chloride (2300 ug/l). Of the above analytes, 1,1,1-TCA (180 to 580 ug/l), 1,1-DCA (390 to 2000 ug/l), 1,1-DCE (11 to 66 ug/l), 1,2-DCE (42 to 3700 ug/l), arsenic (8 to 77 ug/l), barium (270 to 1200 ug/l), benzene (3 to 18 ug/l), chloroethane (23 to 200 ug/l), and vinyl chloride (4 to 2300 ug/l) are routinely detected above the SLVs in the well samples. All other groundwater analytes detected above the screening levels are limited to a one-time occurrence (i.e., the constituents were not detected at concentrations above screening levels in the other quarterly monitoring events).

### 4.2.15 AOI-22B, Former UPRR Roundhouse

AOI-22B encompasses the former UPRR roundhouse that serviced steam locomotives and the early years of diesel locomotives. Engine maintenance operations decreased steadily from the middle 1950s to the early 1970s, and the roundhouse was finally demolished in 1974. Now only the concrete foundations remain at ground level. No railroad operations are currently active in this area, and it is mainly used for storage of piles of scrap metal from the Durbano Metals operation in adjacent AOI-31. Remnants of a diesel fueling dispenser rack are present along the northern end of the boundary between AOI-22B and AOI-30. The nature of the past railroad activities suggested that the contaminants of concern for both soil and water samples include TPH-DRO, VOCs, PAHs, PCBs, and metals.

The Phase I assessment of this AOI included samples and observations from 22 GeoProbe borings (22B-B1 through B22). Geoprobe borings 22B-B3 and B17 were converted into 1-inch diameter piezometers with 10-feet of screen (0.010 slot), when LNAPL diesel/oil product was encountered in the borings. Soil and groundwater samples were collected from GeoProbe borings 22B-B1 through 22B-B7. The samples were analyzed for VOCs metals, SVOCs, TPH, and PCBs. The remaining borings (22B-B8 through 22B-B22) were drilled under the Phase I Addendum 3 Work Plan (LES, 1998) and were completed to obtain groundwater samples only. (Soil samples were not collected from these later borings.) The groundwater samples from these

borings were analyzed for vinyl chloride, although the samples from 22B-B16, 22B-B21, and 22B-B22 were analyzed for the full suite of VOCs.

Phase II investigation activities consisted of the installation of two monitoring wells (22B-MW1, 22B-MW2D) and four quarters of subsequent groundwater analyses from the two site wells. Groundwater samples were analyzed for VOCs, SVOCs, and metals. Soil samples from the well borings were analyzed for metals, TPH, VOCs, and SVOCs.

Analytes detected above SLVs in soil are limited to arsenic (5.9 to 24 mg/kg), and one detection of TPH (9,900 mg/kg, sample 22B-MW2D-5) at a depth of five to six feet. Analytes detected above SLVs in groundwater samples (and the maximum detected concentrations) include 1,2-DCE (150 ug/l), arsenic (15 ug/l), barium (560 ug/l), chromium (23 ug/l), selenium (46.3 ug/l), pentachlorophenol (2 ug/l), and vinyl chloride (460 ug/l). Of the above groundwater analytes, barium (299 to 341 ug/l) and vinyl chloride (7 to 460 ug/l) are routinely detected above the SLVs in the well samples. All other groundwater analytes detected above the screening levels are limited to a one-time occurrence (i.e., the constituents were not detected at concentrations above screening levels in the other quarterly monitoring events).

### 4.2.16 AOI-23 – Mucking Lines

This AOI encompasses an area of track, designated by Lockheed as the mucking lines, which lies southwest of Union Station along the west side of the former passenger platforms in Region 2 (Figure 1-2). It is not clear what meaning Lockheed intended with the designation of "mucking lines". Archival photos show parked rail cars on holding tracks and buildings that may have belonged to the UPFE (Union Pacific Fruit Express) for cold storage refrigeration. Old railroad maps do not label anything called "mucking lines". Inquiries to present and retired railroad personnel have not revealed the nature of or past location of the mucking lines. At present, most of the tracks in the AOI have been removed, and little evidence of past activities remains.

During the Phase I investigation, three surface soil grab samples (R2-SG13 to SG15) were collected in the designated area (Plate 2-2). The soil samples were analyzed for metals, TPH-DRO, and PCBs. Analytes detected above SLVs in soil are limited to arsenic and lead. One lead value at 2,000 mg/kg (R2-SG14) exceeded the 400 mg/kg SLV for lead. The arsenic SLV was

exceeded in all three samples (6.6 to 11 mg/kg). No phase II work was conducted in this AOI, and no groundwater samples were required.

### 4.2.17 AOI-26 – Sludge Reclamation Area

This AOI encompasses an area of a former pile of sludge, from the former UPRR oil reclamation plant. At present the site is a grassy meadow and groundwater is only 2 to 4 feet bgs. Previous investigation history of the site is described in Section 1.2.5.4. The Phase I and Phase II RI activities are described in Section 2.2.2.1. Soil and groundwater samples were collected for analyses.

Analytes detected above SLVs in soil are hydrocarbon-related compounds and metals. Arsenic was detected above the SLV at concentrations of 5 to 25 mg/kg. Lead was detected above the SLV in the surface soil (536 to 733 mg/kg). Detections of hydrocarbon-related compounds above SLVs consist of benzo(a)pyrene (1 detection at 3.2 mg/kg), Oil & Grease (14,000 to 40,000 mg/kg), and TPH-DRO (5600 and 34,000 mg/kg).

Analytes detected above SLVs in groundwater samples include arsenic, barium, cadmium, benzo(a)pyrene, lead, mercury, TPH, and vinyl chloride. Of the above groundwater analytes only barium (up to 337 ug/l) and vinyl chloride (up to 4.7 ug/l) have been routinely detected above the SLVs in the well samples. The highest detection of vinyl chloride was 7 ug/l in a groundwater sample from Geoprobe boring 26-B1. Vinyl chloride concentrations have decreased over time to levels below the SLV concentration (Appendix B). All other groundwater analytes detected above the SLVs are limited to a one-time occurrence.

### 4.2.18 AOI-27 – Ogden Pond, Operable Unit Site No. 6E

AOI-27 encompasses an area west of the rail tracks that was formerly used for hydrocarbon-based sludge disposal. Previous investigation and remediation history of the site is described in Section 2.5.2. The Phase I and Phase II RI investigation activities are described in Section 2.3.2.2. Soil and groundwater samples were collected for analyses. The Phase I and limited Phase II soil sampling activities included analysis of both soil and sludge.

Analytes detected above SLVs in soil are hydrocarbon-related compounds and metals. Arsenic was detected above the SLV at concentrations of 5.2 to 17 mg/kg. Lead was detected above the SLV at concentrations of 650 to 5800 mg/kg. Detections of hydrocarbon-related compounds above SLVs in sludge samples consist of benzo(a)anthracene (74 mg/kg), benzo(a)pyrene (199 mg/kg), benzo(b)fluoranthene (256 mg/kg), benzo(k)fluoranthene (189 mg/kg), chrysene (895 mg/kg), and TPH-DRO (61,000 mg/kg). Detections above SLVs in non-visually contaminated soil are limited to the metals (arsenic and lead) and ethylene dibromide (boring 27-B2, 0.17 and 0.31 mg/kg).

The pH of the soil recovered from a boring in the sludge was 0.8 (boring 27-B2). In contrast, the soil pH from both the unsaturated and saturated zone elsewhere in the AOI remained slightly basic (7.3 to 9.09).

Analytes detected above SLVs in groundwater samples include arsenic, barium, chromium, selenium, and pentachlorophenol. All of the groundwater SLV exceedences are limited to a one-time occurrence and have not been repeated in the samples from monitoring wells. The groundwater pH measurements range from 6.5 to 7.2.

This sludge remaining in this OU is scheduled to be excavated and removed during the summer of 2002 (Forrester Group, 2002a). This planned removal action activity is designed to eliminate all of the remaining sludge source material that results in oil seeps on the ground surface during the summer months. The removal action will be conducted under the previous Removal Action Order (Docket No. CERCLA-VIII-96-10). As part of the removal action, verification sampling will be conducted to determine contaminant concentrations that remain in the unstained soil.

### 4.2.19 AOI-28 – Roundhouse Drainage Ditch

AOI-28 is a remnant slough on Fort Buenaventura Park property that was identified by Lockheed Martin (1997b) on 1958 and 1965 aerial photo coverage. The ditch channeled water northwestward from a culvert under the roundabout track to the Weber River. Much of the original ditch alignment is covered by the Buenaventura Park pond and main diversion canal from the Weber River. Surface water flow through the remaining section of the slough is limited to seasonal periods.

The Phase I assessment consisted of three stream sediment samples (28-S1 to S3) and one surface water sample (28-SW1). The sediment and surface water sample were analyzed for VOCs, PAHs and metals. The water was without odor or sheen. Phase II sampling activities were conducted by EPA. Three additional paired sediment/surface water samples were collected (RD1B, RD2B, RD3B). The samples were analyzed for metals, VOCs, and SVOCs.

No analytes were detected in the sediment samples at concentrations above the soil SLVs. However, eleven of the analytes (anthracene, benzo(a)pyrene, benzo(a)anthracene, benzo(g,h,i)perylene, chrysene, fluoranthene, indeno(123-cd)pyrene, phenanthrene, pyrene, cadmium, and lead) were detected at concentrations that exceed the Sediment Screening Benchmarks used by EPA for screening-level ecological risk comparisons (EPA, 2001c, Table 6-2).

Results of the surface water samples were compared to the Surface Water Ecological Screening Benchmarks used by EPA for screening-level ecological risk comparisons (EPA, 2001c, Table 6-1). Measured analyte concentrations in one sample (Phase I 28-SW1) exceed the surface water benchmark for cadmium and lead. The analytical results of the Phase II surface water samples were all below the screening levels and benchmark concentrations.

### 4.2.20 AOI-29 – Strongs Creek

Surface water flow in Strongs Creek emerges from a culvert just north of the former UPRR roundhouse complex and continues as an open drainage that discharges to the Weber River. Channel flow was always present during the Phase I and Phase II investigations. The culvert runs westward under the rail yard. East of the rail yard, the stream flow remains largely confined to culverts within the city (see Section 3.3.2).

During the RI investigation, samples of sediment and surface water were collected to determine if any impact has occurred to the stream from rail yard operations. The Phase I investigation included three paired stream sediment and surface water samples (R2-S6, R2-S7, R2-S9 sediment; and R2-SW6, R2-SW7, R2-SW9 water). Each sample was analyzed for VOCs, PAHs, and metals. The sample pair from the mouth of the creek (S9 & SW9), also included pesticide analysis. Four additional surface water/sediment samples were collected by EPA during the

Phase II investigation (SC1B through SC4B). These samples were analyzed for VOCs, SVOCs, and metals.

The results of both the sediment and water sample analyses reveal that metals and PAHs exceed the Selected Sediment Screening Benchmarks. These parameters include anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(ghi)perylene, chrysene, dibenzo(ah)anthracene, fluoranthene, phenanthrene, pyrene, indeno(123-cd)pyrene, cadmium, chromium, arsenic, and lead concentrations. The Surface Water Ecological Screening Benchmark for lead was exceeded in one of the surface water samples. No other parameters exceeded the surface water benchmarks.

### 4.2.21 AOI-30 - Current Durbano Salvage Yard and Former UPRR Maintenance Area

AOI-30 encompasses the former UPRR RIP-track rail-car maintenance area, and part of the general maintenance and fueling operations, associated with the roundhouse activities in adjacent AOI-22B. These maintenance and fueling operations ceased in the mid-1960s and were moved to the southern part of the rail yard in AOI-13 or transferred to Salt Lake City. As maintenance operations were winding down, a UPRR oil/water treatment and recycling facility began operation in AOI-30 in the early 1960s. The oil/water separation and recycling operations involved ASTs, process tanks, piping networks, and settling and holding ponds. An 8,200-gallon UST (UST #8) was located near the north side of the remaining office building. In the early 1970s the oil/water treatment and recycling activities ceased and the facility was dismantled. The UST, which reportedly held diesel, was removed in July 1990.

The current Durbano Metals salvage and recycling operation began in the mid-1970s, and it occupies the same area as the former oil recycling facility. The salvage company leases the property from UPRR. A roofed extension of the Durbano garage at the north end of AOI-30 now partially covers the former site of the two reclamation lagoons used during oil reclamation. Temporary piles of sorted and unsorted metal salvage also lie over areas where oil reclamation processing once took place. The only structures remaining from former railroad operations are the office building now occupied by Durbano Metals and a shop building, now used as Durbano's repair shop, that once sat next to the two former holding lagoons at the north end of the oil

recycling operation. The nature of the past activities in this AOI indicates the contaminants of concern are from diesel fuel, oil and grease, solvents, and metals.

The Phase I investigation at AOI-30 included 30 GeoProbe borings, 30-B1 to B33 (excluding 30-B9 to B11 which were drilled in AOI-20), seven monitor wells (30-MW1 to MW6 and MW6D), and five surface soil samples, (R2-SG1 through R2-SG5). All soil samples were analyzed for TPH-DRO, VOCs, PAHs, metals, and grease & oil. Groundwater samples were collected from Geoprobe borings B14 through B33 (under the Phase I RI Addendum 3, LES, 1998) to define the extent of the dissolved vinyl chloride groundwater plume: These samples were only analyzed for vinyl chloride. Groundwater samples from the other Geoprobe borings and the monitoring wells were analyzed for TPH-DRO, VOCs, PAHs, and metals. Five of the Geoprobe borings (30-B7, B8, B16, B26, and B32) were converted to piezometers because they encountered hydrocarbon LNAPL.

The Phase II investigation activities consisted of the installation of one monitoring well (30-MW7). A soil sample was collected for VOC, SVOC, and TPH analysis from a depth of 4 feet (water table) in this well boring. The Phase II investigation also included four quarters of groundwater sample collection from the AOI wells that did not have evidence of LNAPL. One of the earlier UST #8 wells (30-MW-3) was located in an effort to locate four wells previously associated with the UST #8 site that were lost. This well was included in the quarterly groundwater-sampling program. Groundwater samples were analyzed for VOCs, SVOCs, metals, and TPH.

Analytes detected above SLVs in soil are arsenic, benzo(a)pyrene, chromium, lead, and grease & oil. Arsenic was detected above the SLV at depths down to 4 feet at concentrations of 5.8 to 350 mg/kg. The following parameters were detected above SLVs in shallow soil (<1 foot); benzo(a)pyrene (0.9 mg/kg) and chromium (630 to 1700 mg/kg). Lead was detected above SLVs in soil down to depths of 4 feet in five samples (500 to 730 mg/kg), and grease & oil was detected above the SLV at depths of 2 to 8 feet in three samples (13,000 to 26,000 mg/kg).

Analytes detected above SLVs in groundwater samples include 1,2,3-trichloropropane, 1,2-DCE, 2-methylnaphthalene, acenaphthylene, arsenic, barium, benzene, benzo(a)anthracene,

benzo(a)pyrene, benzo(b)fluoranthene, cadmium, chloromethane, chromium, chrysene, fluoranthene, fluorene, lead, naphthalene, pentachlorophenol, phenanthrene, pyrene, selenium, TPH, and vinyl chloride. Of these parameters, 1,2-DCE (up to 600 ug/l), arsenic (up to 46 ug/l), barium (up to 2200 ug/l), benzene (up to 9 ug/l), and vinyl chloride (up to 2000 ug/l) are routinely detected in the groundwater samples from site monitoring wells. All other groundwater analytes detected above the SLVs are limited to a one-time or non-repetitive occurrence (i.e., the constituents were not detected at concentrations above SLVs in the other quarterly monitoring events).

### 4.2.22 AOI-32 - Oil\Water Separator and LUST Site

AOI-32 is a former oil/water separator facility in Region 3 that is surrounded by the track network near the current operations office of the UPRR rail yard. The belt stripper oil separator facility was similar to the former one in AOI-12. Currently, the buildings near the separator serve as a staging area for track maintenance crews. In the past, this AOI was used for caboose maintenance, and fuel oil was dispensed to heating systems in the cabooses.

The 6,000-gallon UST formerly used to store the fuel oil for the cabooses was removed in 1990. This tank site is identified as Utah LUST facility 1200409 and UPRR UST-2. The tank berth was located about 150 feet south of the oil/water separator. Since removal, the site has undergone a site investigation that included the installation of three monitor wells (MW-13, MW-14, MW-15, November 1990) and soil over-excavation (September 1992). The soil contamination was successfully removed from all but the northeast end of the excavation where a steam line prevented further digging. Two of the monitor wells were abandoned in 1992 during the over-excavation, and one well remaining well (MW14) was included in the groundwater sampling activities for the RI. The LUST site was granted closure from the Utah DEQ in June 2000 (Table 1-3).

The Phase I investigation at this AOI consisted of the completion of three Geoprobe borings around the oil/water separator (32-B1, B2, and B5), and four Geoprobe borings around the former tank berth (32-B3, B4, B6, and B7). The soil and groundwater samples were analyzed for TPH-DRO, VOCs, and PAHs. The soil samples from the borings near the separator were also analyzed for oil/grease.

Phase II investigation activities consisted of the installation of a monitoring well (32-MW1) downgradient from the separator and four quarters of groundwater sample collection and analysis from the two site monitoring wells. Two soil samples from the well boring were collected for analysis of PAHs, metals, and VOCs. Groundwater samples were analyzed for SVOCs, VOCs, metals and TPH. Three surface soil samples (32-SG, 32-SG2, 32-B8-0) and one shallow subsurface soil sample (32-B8-2) were collected for analysis of metals.

For the soil analyses, only arsenic was detected above the SLV concentration (2 detections in surface soil at 13.6 and 7.8 mg/kg). Several analytes were detected above SLVs in the groundwater samples on a one-time-only basis. These analytes include acetone, cadmium, chloromethane, oil & grease, methylene chloride and vinyl chloride. Three groundwater analytes have been detected on a more frequent basis above SLVs in the site monitoring wells: arsenic (11 to 17 ug/l), barium (367 to 665 ug/l), and pentachlorophenol (3 and 6.3 ug/l).

### 4.2.23 AOI-33 - 21st Street Pond

This AOI is has been investigated separately from the rest of the AOIs at the railroad facility. This AOI has been designated as the Northern Area Operable Unit. All activities and investigation results related to this AOI are discussed in Part 2 of this report.

### 4.2.24 AOI-34 - SPRR Waste Water Treatment Plant

AOI-34, located in Region 1, encompasses the fenced-in compound of the in-active SPRR waste water treatment plant (WWTP) as well as land north and east of the fenced compound. The area of the AOI was expanded from the original Phase I work plan to include the UDEQ monitoring-well field north of the water treatment plant, and the eastern extent of a dissolved vinyl chloride plume. The southwest perimeter of the plant compound is within 40 to 100 feet of the Weber River channel.

The wastewater treatment plant was constructed in the 1960s to replace a smaller water treatment plant formerly located in AOI-22A. Before construction of the holding ponds and sludge pits, an irrigation canal (Plain City Irrigation Canal) ran northward across the present east side of the plant from the Weber River. Remnants of this canal still can be seen north of the 21st Street

extension and between the plant (south of the concrete lagoon) and the river. Former "trainmen's" buildings were once located just east of the present plant gate. These structures were demolished in the 1980s. Construction of wastewater pits on the north side of the plant began in the early 1960s, and by 1980 the concrete-lined pond on the southeast end of the plant was completed. Two 12,000 gallon USTs were also installed in the plant compound for sludge storage. Former railroad employees have indicated that sludge was sometimes dried on the open ground within the compound, and some of it was buried as the plant was constructed. When the two USTs in the plant were closed in 1997, remnants of the buried sludge could be seen in the tank excavations.

Wastewater was transferred to the plant by a sub-grade industrial sewer line that extends eastward from the compound gate, then southward to split into several tributary lines that serviced waste streams from the former roundhouse and machine shop maintenance areas in AOIs 22A and 38. The outlet of this sewer line was plugged in 1991 before the sludge was removed from lagoon C.

A City of Ogden storm sewer line is buried along the old, unpaved 21st Street extension and passes east to west along the north side of the plant compound fence. The brick-lined sewer carries surface water from the city east of the rail yard to an outlet at the Weber River located several hundred feet west of the plant (Figure 4-12). The sewer was built prior to 1920 and has interior dimensions of 3 feet wide by 4 feet high. The level of flow in a manhole at the northeast end of the water treatment compound is about 9.7 feet below grade; thus the water flow in portions of the conduit is below the local static groundwater level. The porous nature of the brick walls allows groundwater to enter the sewer.

Previous investigation activities in this AOI are summarized in Section 1.2.5.3. Phase I and Phase II RI sampling activities are summarized in Section 2.2.2.3. This AOI has been designated operable unit OU-03 for the removal action.

Analytical results for soil samples show that only arsenic and diesel-range petroleum hydrocarbons were detected above the SLV concentrations.[11] Arsenic was detected at a maximum

[11] Soil samples listed in the AOI-34 Soil table (Appendix H) that begin with either an "AOI-34" or "SP" designation were not considered in the comparisons. These samples are from the sludge material in the lagoons. This sludge was removed in the fall of 2002. Thus the analyses are not applicable to site soils.

concentration of 11 mg/kg. Diesel range TPH was detected at a maximum of 11,000 mg/kg; however, the locations with the highest TPH exceedences are at shallow depths underneath Lagoon A, and was excavated in 2002 (Forrester Group, 2002b). The groundwater sampling results show that several parameters have been detected above SLVs on a sporadic or one-time-only basis. These parameters include 1,1-DCE, 2-methylnaphthalene, cadmium, chromium, lead, methylene chloride, pentachlorophenol, selenium, and silver. The quarterly groundwater analytical results show that other parameters are routinely detected above SLVs in site wells. These parameters are: 1,1-DCA (309 – 620 ug/l, MW6; maximum concentration of 790 ug/l from 34-SP-MW01); 1,2DCE (53 – 200 ug/l, MW6); arsenic (most site wells, with a maximum concentration of 142 ug/l in MW3D); barium (most site wells, with a maximum concentration of 1200 ug/l in MW3D and 34-SPMW-03); benzene (3 – 6 ug/l MW8; with a maximum concentration of 7.2 ug/l in the Geoprobe boring 34-B2 water sample); chloroethane (43-83 ug/l 34-MW6, 24-90 ug/l 34-SPMW-02); and vinyl chloride (most site wells, with a maximum concentration of 3100 ug/l in MW3D).

Water runoff samples were collected from three manholes along the storm sewer and analyzed for VOCs during the quarterly sampling events (samples 34-ST1, ST2, and ST3; See Appendix A AOI-34 Storm Sewer Detections). The water samples were tested to determine if vinyl chloride impacted groundwater is leaking into the storm sewer. The highest detection of vinyl chloride was in 34-ST1 (17 ug/l), located nearest to the north side of the WWTP. The lack of a vinyl chloride detection in sample 34-ST3 collected from the storm sewer east and upgradient of the rail yard, indicates that the detected vinyl chloride is likely entering the sewer line in the rail yard from a groundwater source near the plant. (Samples were collected from this storm sewer during the following sampling events; 5/98, 6/00, 9/00, 1/01, 5/01, 9/01, 12/01.) As previously mentioned, the static groundwater table is above the flow level in the sewer.

### 4.2.25 AOI-35 - Former D&RGW RIP Track Area

This AOI is located at the north end of the railroad facility in Region 1, the former D&RGW rip track area was a small maintenance facility and siding yard that was active during the steam and diesel locomotive eras. Operations at the yard ceased in the mid to late 1980s. In 1988, Morrison-Knudsen (1988) conducted an audit, site assessment, and subsequent soil remediation in the former yard because of a possible transfer of railroad property. A soil remediation was

conducted by Morrison-Knudsen (1988) to remove contaminated soil associated with two UST sites (see Section 1.2.5.5).

At present there are no railroad activities at the former D&RGW maintenance area. All buildings and tracks have been removed, and much of the area has been graded. A large AST once sat in the present 21st Street right-of-way. The tank was probably used for diesel storage, and it was removed in the early 1970s before the new 21st Street route was constructed. Several grain silos have recently been built in the former yard for railroad freight pickup. The Utah Railroad now holds and switches rail cars on the track network that remains between the former maintenance yard and the Weber River. Diesel fuel, oil products, and PCBs were identified as constituents of potential concern at this AOI.

Phase I sampling activities consisted of the completion of four borings (35-B1 to 35-B4). Three soil samples were collected from each boring for analysis of TPH, PAHs, and PCBs. The soil samples from 34-B3 and 34-B4 were also analyzed for VOCs and metals. Groundwater samples were also collected from these two later borings. The samples were analyzed for TPH, PCBs, PAHs, VOCs, and metals. The same analytical suite was also determined for a surface water sample, 35-SW1. This sample was from a large puddle in a low area near 35-B3. The puddle had the odor and reddish brown color distinctive to soda ash (trona) spillage mixed in water.

Phase II investigation activities consisted of the installation of 2 monitoring wells (35-MW1, 35-MW2). Four quarterly groundwater samples were collected from the monitoring wells. The groundwater samples were analyzed for metals, SVOCs, and VOCs. Two soil samples were collected for analysis from each of the well borings. The soil samples from the 35-MW2 boring were analyzed for VOCs, PAHs, and metals. The soil samples from 35-MW1 (upgradient direction from the AOI-33 seeps) were analyzed for TPH, VOCs, PAHs, and metals (sample from the 4-5 foot depth), and solely for VOCs (sample from the 9-10 foot depth). Three surface (0-2") and two shallow subsurface soil samples (2"-2') were collected for analysis of VOCs, metals, and SVOCs (sample locations 35-B5, 35-B4, 35-SG1).

For the soil samples, arsenic was the only parameter detected above site soil SLVs (concentrations up to 35 mg/kg). Arsenic and barium were detected above SLVs in site

groundwater samples (barium 334 ug/l maximum, arsenic 9.5 ug/l maximum). Vinyl chloride was detected above the SLV in the sample from Geoprobe borings 35-B2 (10 ug/l). Vinyl chloride was detected at the SLV concentration of 2 ug/l in 35-MW1, but was not detected in samples from 35-MW2.

The surface water sample from the puddle present during the Phase I investigation had detected concentrations of arsenic (340 ug/l) and lead (410 ug/l) above the surface water Benchmark concentrations. The location of this puddle as it existed for a short time during the Phase I investigation is no long present. The area has been graded at various times over the past few years.

### 4.2.26 AOI-36 - Former D&RGW Roundhouse and Salvage Yard

This AOI encompasses the area of the former D&RGW roundhouse and an adjacent salvage yard, located between 21st Street and 20th Street, at the northeast end of the rail yard in Region 1. At present, the 21st Street ramp and overpass covers a portion of the former engine maintenance area including the site of the small D&RGW roundhouse, which was demolished in the 1950s. An auto salvage yard existed for several decades at the east end of the railroad property. The salvage operation appears to have discontinued in the 1980s. Nothing remains of the railroad facility or the salvage operation.

The property comprising AOI-36 has undergone two environmental assessments in addition to its inclusion into the present RI/FS.

1. As part of a possible property transfer in 1992, two investigation phases were conducted for the City of Ogden Corporation by Sergent, Hauskins, and Beckwith (1992a, 1992b) consultants. Two monitor wells, 36-MW1 and MW2, were installed on the western half of the property. The wells still exist and were included in the quarterly groundwater sampling as part of this RI.

2. In 1997, the area became the subject of another possible property transfer to Weber County Public Works for use as a solid waste transfer station. Concurrent with the Phase I RI, the EPA Region VIII technical assistance and response team, URS Operating

Services, Inc., conducted a site investigation for Weber County under contract 68-W5-0031. Five additional monitor wells were installed. A site assessment report dated March 2, 1998 was prepared by URS (1998).

The Phase I RI investigation activities included four GeoProbe borings (36-B1 to 36-B4), and collection of water samples from the two existing monitor wells (MW1, MW2). No water samples were collected from the Geoprobe borings, because no field evidence of contamination was observed at the zone of saturation in the borings. The soil samples were analyzed for VOCs, TPH-DRO, oil/grease, SVOCs, and metals. The Phase I water samples from the monitor wells were analyzed for VOCs, TPH-DRO, and metals. Fieldwork completed by URS (1998) included collection of 31 surface soil samples and completion of 11 soil borings (Figure 2-9).

Phase II investigation activities included collection a quarterly groundwater samples from the seven site wells. (The 5 wells completed by URS (1998) were included as monitoring wells 36-MW3 through 36-MW7.) Two surface (0-2") and two shallow subsurface soil samples (2"-2') were collected for analysis of VOCs, metals, and SVOCs (sample locations 36-B5, 36-B4). One additional surface soil sample (36-SG1) was collected for SVOC analysis.

Results of the soil sample analyses by UPRR and URS (1998) show that arsenic, lead, benzo(a)pyrene, dibenzo(ah)anthracene, and grease & oil were detected above the SLV concentrations. Arsenic was detected above the SLV at depths up to 9 feet. The maximum concentration detected in surface soil is 130 mg/kg. The maximum detected in subsurface soils is 35 mg/kg. Lead was also detected above the SLV at depths up to 9 feet. The maximum concentration detected in surface soil is 2970 mg/kg. The maximum measured lead concentration in subsurface soils was 20,700 mg/kg. There were three exceedences of benzo(a)pyrene in surface soils at concentrations up to 4.1 mg/kg. There was also one exceedence each of grease & oil (18,000 mg/kg) and dibenzo(ah)anthracene (0.79 mg/kg) in surface soils.

Analytes detected above SLV concentrations in groundwater included arsenic (up to 18.8 ug/l), barium (up to 1500 ug/l), cadmium ( up to 5 ug/l), chromium (up to 180 ug/l), lead (up to 208 ug/l), 1,1,2-TCA (one detection at 2 ug/l), and vinyl chloride (one detection at 11 ug/l).

### 4.2.27 AOI-37 – Underground Storage Tank Release

This AOI was identified because of an active LUST site at the time of the RI initiation. The DERR facility ID No. is 1200255. Two diesel USTs (UST-6, UST-9) were pulled in October 1990, and five monitoring wells were installed. Three of the wells (RIV-MW-10, RIV-MW-11, RIV-MW-12) were abandoned when an over-excavation of diesel-contaminated soil was conducted in October 1992. Diesel LNAPL was never encountered at this site. Additional fieldwork was conducted under the DERR LUST section, and the LUST site was granted a No-Further-Action status in June 2000 (Table 1-3).

The site was further investigated during the Phase I investigation by the completion of three Geoprobe borings (37-B1 through B3), and the installation of two monitor wells (37-MW3, MW4). Three soil samples and one groundwater sample were collected from each Geoprobe boring. The four monitoring wells were also sampled. Each soil and water sample was analyzed for TPH-DRO, VOCs, and PAHs.

The Phase II activities consisted of four quarters of groundwater sample collection form the four site wells, and collection of three surface (0-2") and one shallow subsurface (2"-2') soil samples. The shallow subsurface sample and overlying surface sample were analyzed for VOCs, metals, and SVOCs (boring 37-B4). The two other surface samples were analyzed for metals (37-SG1, 37-SG2).

Analytical results of the soil samples show that no parameters were detected above site-specific SLVs. Groundwater sampling results show one-time exceedences for the Phase I data in 1997 in two wells for 2-methylnaphthalene (170 ug/l) and TPH (74,000 ug/l, 16,000 ug/l).

### 4.2.28 AOI-38 - Former SPRR Engine Maintenance Area and Machine Shop

AOI-38 encompasses the area of the former SPRR shops area, including the machine shop, tin and tank shop, powerhouse, and storehouse. This AOI provided engine servicing for both steam and diesel locomotives since 1906. The only remaining building is an auto/truck repair shop for railroad vehicles. The machine shop existed during the Phase I investigation, but was demolished

by UPRR in June 1999. The remnants of a locomotive transfer table still remain on the north side of the machine shop.

Past service operations included diesel fueling. The fuel dispenser rack was located on the west side of the machine shop. All of the SPRR maintenance facilities in AOI-38 were retired in 1988 when the operations were moved to Salt Lake City. The only current railroad operations in AOI-38 are minor vehicle maintenance in the auto shop and a few remaining active tracks for parking rail cars.

In the early-1970s, a rupture of the diesel fuel service pipe line leading from the former main diesel storage tanks in AOI-1 to the fuel dispensers in AOI-22A resulted in a LNAPL diesel plume on the groundwater at the north end of AOI-38. The SPRR response included the recovery of diesel from a caisson well that is still located on the northeast end of the AOI. In the 1970s, the main diesel fuel pipeline leading to the fuel dispensers at the machine shop was replaced. A secondary line also extended to a heating oil tank at the machine shop.

In June 1997 a 70-gallon heating oil UST (identified as SPRR4 in release documents submitted to the DERR, SPRR UST4 on Table 1-3) was removed from a location between the machine shop and the transfer table. The tank excavation intersected hydrocarbon-impacted soil. The tank location is within the area of the diesel release associated with the fuel line near the machine shop. This UST is unregulated because of it small size, and the hydrocarbon contamination in the tank berth is most likely associated with the release from the fuel line leak. The past rail yard operations in this AOI suggest that diesel fuel, oil/grease, solvents, and metals constitute the general contaminants of concern in this area.

The Phase I investigation at AOI-38 included the drilling of 34 Geoprobe borings for soil and groundwater sampling (38-B1 through 38-B34) and installation of ten monitor wells (38-MW1 through 38-MW10). Eight borings were originally scheduled for the Phase I assessment, but more subsurface information had to be collected to characterize the site. Ten of the Geoprobe borings were converted to piezometers to gauge free-phase product encountered (38-B1, -B3, -B11, -B12, -B21, -B22, -B23, -B24, -B25, and -B28). Soil and water samples from the first twelve borings, 38-B1 to -B12, and all the monitor wells were analyzed for TPH-DRO, VOCs,

PAHs, PCBs, and metals. The GeoProbe borings from 38-B13 to 38-B34 were completed under the Phase I Work Plan Addendum 3 to further characterize the diesel LNAPL plume and/or the dissolved vinyl chloride plume. No soil samples were retrieved from these borings. Groundwater samples for analysis of vinyl chloride were collected from borings 38-B13, B14, B15, B16, and B17. Groundwater samples for analysis of VOCs were collected from borings 38-B27, and B29 through B34.

Phase II investigation activities consisted of the installation of one additional monitoring well (38-MW12), completion of 2 shallow soil borings (38-B35, 38-B36), and collection of quarterly groundwater samples from site wells that did not have evidence of LNAPL. The quarterly groundwater samples were analyzed for VOCs, metals, and SVOCs. Surface soil samples from the two borings were analyzed for metals and SVOCS. Shallow subsurface soil samples from the two borings were analyzed for metals, SVOCs, and VOCs. Two soil samples were also collected from the well boring. These samples were analyzed for VOCs, SVOCs, TPH, and metals.

Diesel LNAPL analytical results for this AOI are discussed under Section 4.2.6.

Analytes in the soil samples that were detected above SLVs are arsenic (5–38 mg/kg), grease & Oil (17,000 and 32,000 mg/kg), lead (549 - 8,400 mg/kg), and TPH (5100 and 14,000 mg/kg). Numerous analytes were detected above SLVs in the groundwater samples. The analytes and maximum detected concentrations are: 1,1,1-TCA (4100 ug/l); 1,1,2-TCA (4 ug/l); 1,1-DCA (1200 ug/l); 1,1-DCE (350 ug/l); 1,2-DCE (5300 ug/l); 2-methylnaphthalene (2500 ug/l); arsenic (130 ug/l); barium (2300 ug/l); benzene (74 ug/l); benzo(a)anthracene (12 ug/l); benzo(a)pyrene (6.2 ug/l); benzo(b)fluoranthene (10 ug/l); cadmium (8.1 ug/l); chloroethane (190 ug/l); chromium (160 ug/l); chrysene (14 ug/l); ethylbenzene (700 ug/l); fluorene (170 ug/l); lead (350 ug/l); naphthalene (650 ug/l); pentachlorophenol (3 ug/l); phenanthrene (550 ug/l); selenium (37 ug/l); TPH (52,000 ug/l); TCE (430 ug/l); and vinyl chloride (710 ug/l).

An industrial sewer line network leading to the AOI-34 treatment plant from the machine shop area (AOI-38) was sampled from manholes at and near AOIs 34 and 38 as part of the Phase I investigation. Seven water samples (WW1 through WW7) were collected from manholes along the sewer line (Figure 4-12). Parts of the line were dry during the sample collection, and the low

levels of flowing water appeared clear and without obvious hydrocarbon contamination. No industrial wastewater has been discharged to the sewer since the late 1980s, and the current flow is now from surface runoff. The depth of the sewer line is generally above the water table. All water samples were analyzed for VOCs. Concentrations were detected above SLVs for the sample from 38-WW7 (1,1,1-TCA 1900 ug/l; 1,1-DCA 5400 ug/l; 1,2-DCE 19,000 ug/l); methylene chloride 340 ug/l).

### 4.2.29 SPRR3 LUST Site

This LUST site is located in Region 1 just west of AOI-38, near the former main Southern Pacific rail yard access road. UPRR removed a 1,000 gallon gasoline UST in June 1997 (Table 1-4). Observations and sampling during the UST closure confirmed that gasoline released from the tank or dispenser piping had infiltrated through sandy gravel substrate to the water table. The tank had been out of service for more than 10 years.

The Phase I assessment of the site included the completion of four Geoprobe borings (SPRR3-B1 through SPRR3- B4), and three monitor wells (SPRR3-MW1, -MW2, -MW3). One Geoprobe boring next to the former tank excavation (SPRR3-B1) was completed as a piezometer. Both soil and groundwater samples were analyzed for the gasoline range organic compounds TPH-GRO and VOCs as required by the UDEQ-DERR UST program. LNAPL is present in the monitoring wells and piezometers associated with this AOI. The site monitoring wells that did not have accumulated LNAPL were included in the Phase II quarterly groundwater sampling.

No soil samples had contaminant concentrations above SLVs. Maximum detected concentrations of groundwater contaminants above SLVs are; 1,1,1-TCA (78 ug/l); 1,1-DCE (9 ug/l); 1,2-DCE (270 ug/l); benzene (52 ug/l); chloroethane (230 ug/l); methylene chloride (9.6 ug/l); naphthalene (360 ug/l); and vinyl chloride (330 ug/l).

Additional investigation activities for this AOI are proceeding under an UDEQ-approved Corrective Action Plan (ERM, 2000).

### 4.2.30 SPRR5 LUST Site

This LUST site is located in Region 1 at the Southern Pacific Railroad B&B shop yard (bridge and building shop) at the corner of 21st Street and Pacific Avenue. UPRR removed this 850-gallon gasoline UST in June 1997 (Table 1-3). Observations and sampling during the UST closure confirmed that gasoline released from the tank or dispenser piping, had infiltrated through sandy gravel substrate to the water table.

The Phase I assessment of the site included the completion of three Geoprobe borings (SPRR5-B1 to -B3), three monitor wells (SPRR5-MW1 to MW3), and two surface soil samples (R1-SG12, R1-SG13). Both the Geoprobe soil and groundwater samples were analyzed for gasoline range organic compounds (TPH-GRO and VOCs) as required by the UDEQ-DERR UST program. The surface soil samples were analyzed for VOCs, PHAs, and metals. The site monitoring wells were included in the Phase II quarterly groundwater-sampling program.

Only one soil sample (R1-SG13) had a contaminant concentration above SLVs (arsenic at 11 mg/kg). Maximum detected concentrations of groundwater contaminants above SLVs over the course of the Phase I and Phase II assessment are; 1,2-DCE (61 ug/l); benzene (1300 ug/l); ethylbenzene (1300 ug/l); methylene chloride (86 ug/l); toluene (2800 ug/l); TPH (4100 ug/l); xylenes (7900 ug/l); and vinyl chloride (110 ug/l).

Given the decrease in UST-related contaminant concentrations to levels that are not considered a threat under the State UST program, this LUST site was granted a No-Further-Action status by the UDEQ-DERR in June 2000 (Table 1-3).

### 4.2.31 33rd Street Slough

As the Phase I field program proceeded, another drainage feature was identified, and was sampled in March 1998. This is referred to as the 33rd Street Slough. Surface water flow in storm sewers in the city of Ogden east of the railroad facility is channeled under the rail yard at 33rd Street (Section 3.3.2). A sub-grade culvert ends west of the tracks, and the water flow then flows in an open slough to the Weber River, a few hundred feet to the west.

During the Phase I assessment a single pair of sediment and surface water samples (R3-S6, R3-SW6) was collected and analyzed for VOCs, PAHs, metals, and pesticides. The samples were collected about 50 feet west of the mouth of the culvert. Phase II investigation activities were conducted by EPA. EPA collected three co-located sediment and surface water samples (33SS1B, 33SS2B, 33SS3B) that were analyzed for VOCs, SVOCs, and metals.

Analytes in the sediment samples were detected above the ecological Benchmark Concentrations for anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(ghi)perylene, chrysene, dibenzo(ah)anthracene, fluoranthene, phenanthrene, pyrene, indeno(123-cd)pyrene, lead, and cadmium. None of the detected analytes in surface water exceeded the Ecological Screening Benchmark surface water concentrations.

### 4.2.32 Background Soil

Twelve surface-soil background samples were collected throughout the railroad facility during the Phase I investigation. These background samples include the letters "BG" in the sample designation (R#-BG#). Sample locations are shown on Plates 2-1, 2-2, 2-3. The samples were collected from areas thought to represent the least impacted areas of the facility, where known railroad operations and known or suspected contaminant sources are absent. Each sample was analyzed for VOCs, PAHs, and metals.

Analytes detected above the soil SLVs are metals that have been routinely detected in site soils: arsenic, 6 exceedences at 5.3 to 68 mg/kg; and lead, two exceedences at 580 and 860 mg/kg.

### 4.2.33 Riparian Zone

A riparian zone area exists between the east bank of the Weber River and the western extent of land developed for railroad use. This area is defined by the location(s) where sufficient vegetation exists to provide habitat for ecological receptors.

During the Phase I investigation, six surface soil samples were collected in the wooded and riparian habitat area near the east bank of the Weber River. The sample locations were in areas that have not been significantly disturbed or altered by human activities. The sampled areas were

chosen to be representative of the current state of natural conditions west of the railroad facility, where railroad operations are not known to have occurred. The samples are numbered by region "R" and with an "ES" - e.g., R2-ES1. Each sample was analyzed for VOCs, PAHs, metals, and pesticides. No surface water samples were collected because standing water was not present in these areas during the Phase I sampling.

During the Phase II investigation, EPA conducted a more thorough sampling of the riparian zone. The site was divided into 4 riparian zones:

- RZ1 – From the southern most extent of the facility (AOI-12) to the 32nd Street overpass.
- RZ2 – From the 32nd Street overpass to the 24th Street overpass.
- RZ3 – From the 24th Street overpass to a point along the Weber River about 2000 feet west of AOI-34.
- RZ4 – Reference are located south of the Riverdale road overpass (south of the site).

Ten samples were collected from each of the four riparian zone areas. All samples were analyzed for metals, VOCS, and SVOCs.

Arsenic was the only parameter that exceeds the human-health soil SLVs; one sample each from RZ1, RZ2, and RZ3 (4.9 – 7 mg/kg). All measured metal concentrations for arsenic, lead, chromium and mercury exceed the Ecological Screening Benchmarks for soil used by EPA (Table 2-5 of EPA, 1999a).

### 4.2.34 Weber River

During the Phase I investigation, 17 pairs of surface-water and stream-sediment samples were collected from the channel along the east bank of the Weber River. Sample points on the river are interspersed along the entire length of the railroad facility, although the majority of the sampling points are located near the mouths of tributary drainages. Most of the sediment samples consisted of fine to coarse sand or silty clay. Samples are identified with an R (region number)

and either SW (surface water) or S (sediment) - e.g., R1-SW2 and R1-S2. The sediment and surface water samples were analyzed for VOCs, PAHs, metals, and pesticides.

During the Phase II investigation, EPA collected 20 surface water samples (WR09 through WR28). Co-located sediment samples were collected at 10 locations (WR09, WR11, WR12, WR14, WR19, WR21, WR22, WR24, WR25, WR28). Sediment samples were analyzed by the UPRR laboratory for VOCs. Surface water samples were analyzed for metals and VOCs. Eleven of the surface water samples were also analyzed for SVOCs (WR09, WR10, and WR20 through WR28).

Dates of sample collection are listed below along with the estimated flow conditions of the Weber River at the time of sampling. Flow rates are taken from Figure 3-2.

| Sampling Date | General Flow Condition | Stream flow at Gateway Utah (CFS) |
|---|---|---|
| Sept-Oct 1997 | Med-Low | 250 |
| March 2000 | Medium | 350 |

Ecological Screening Benchmarks were exceeded in the Weber River sediment samples for the following parameters; benzo(a)anthracene, benzo(a)pyrene, benzo(ghi)perylene, chrysene, fluoranthene, phenanthrene, pyrene, lead, and cadmium. Thirteen of the 14 total-lead concentrations exceed the Ecological Screening Benchmarks for surface water (maximum detection of 6.1 ug/L). No other analytes exceed the surface water Benchmark Concentrations.

# 5 CONTAMINANT FATE AND TRANSPORT

## 5.1 LNAPL ZONES

Small pools of light non-aqueous phase liquid (LNAPL) are present at the water table in various locations beneath the site. As shown in Figures 4-1 through 4-4, the largest LNAPL pools are located in AOI-22a (former turntable/fueling rack), AOI-SPRR3, and AOI-38 (former machine shop); these pools are referred to as the north LNAPL pools. Smaller LNAPL pools are located in AOI-21 (Atlas Steel Salvage Yard), AOI-30 (Durbano Metals), and AOI-22b (former SPRR roundhouse); these pools are referred to as the south LNAPL pools (Figures 4-5 through 4-8). Both north and south LNAPL pools are associated with historic releases of petroleum hydrocarbons (e.g. diesel fuel).

Monitoring wells and piezometers in the north and south LNAPL pools were gauged on a monthly basis for over one year. A graduated oil/water probe was used to measure LNAPL thickness. Figures 4-1 through 4-8 show the extent and thickness of LNAPL for four consecutive quarters. These figures provide useful information on LNAPL thickness and rates of LNAPL pool migration.

### 5.1.1 Pool Description

There are two LNAPL pools in the north plume area as shown in Figures 4-1 through 4-4. The largest pool, located in AOI-38 and AOI-SPRR3, is approximately 700 feet wide and 600 feet long. A smaller pool in AOI-22a is approximately 170 feet wide and 300 feet long. In each pool, the apparent thickness was measured to be between 0-4 feet. Neither pool appears to have reached the Weber River or the 21st Street Pond. Monitoring wells located west (toward the Weber River) of both LNAPL plumes do not have evidence of LNAPL (18-MW1, 34-MW8, 22A-MW1). In addition, there are numerous monitoring wells located to the NNW in the downgradient direction of both plumes that also show no evidence of LNAPL occurrence. Such wells in the immediate vicinity of the plumes include 38-MW5, 22A-MW6, and 22A-MW1.

The south LNAPL pools are shown in Figures 4-5 through 4-8. The south pools are located in pockets, generally localized to specific monitoring wells that are scattered throughout AOI-21,

AOI-22b, and AOI-30. Apparent LNAPL thickness in these pools is typically 1 foot or less. Most of the LNAPL in this area is believed to exist at residual saturation (immobile as LNAPL). None of the south pools appears to have reached the Weber River.

### 5.1.2 Pool Attenuation

As described in API publication 4561 (1992), LNAPL pools at the water table tend to expand as long as significant releases of LNAPL continue to occur. Once releases cease, pools continue to spread until a hydrostatic force balance exists at the perimeter of the pool. This balance occurs when the difference in pressure between the LNAPL and the water (capillary pressure) is less than or equal to pressure needed to displace water from pore spaces in the sediments at the perimeter of the pool (displacement pressure). The height of stable LNAPL pools is primarily a function of the LNAPL density and the grain size of the porous medium. In general, the stable pool height will be larger in fine versus coarse-grained soils.

Over time, LNAPL pools remain stable unless mobilized by altered hydrostatic conditions at the perimeter of the pool. Typically, over a period of years, the range of hydraulic conditions that occurs results in a pseudo steady-state or "final" LNAPL pool extent.

Dissolved phase hydrocarbons are biodegradable under a variety of redox conditions. In natural systems where hydrocarbons are being degraded, methanogenic and sulfate-reducing conditions in aquifers typically dominate closest to the LNAPL. As microbial biodegradation removes the aqueous phase hydrocarbon, a fraction of the LNAPL is dissolved into the aqueous phase. As LNAPL is depleted by dissolution or another removal mechanism, the fraction of pore space occupied by LNAPL (saturation) decreases. With depletion, LNAPL flow paths become smaller and more tortuous. This reduces the ease with which LNAPL can move (mobility) (API, 2003). After sufficient degradation, LNAPL is reduced to residual saturations, which are no longer mobile even with altered hydraulic gradients.

Lateral movement of the plume is controlled by a number of factors, including sorption of LNAPL onto the aquifer matrix, sequestration of LNAPL in water-wet pore spaces, vertical smearing of LNAPL with varying water levels, dissolution of the LNAPL constituents into the groundwater, and biodegradation.

As shown in Figures 4-1 through 4-4, the aerial extent of each pool was generally constant over the year, and similar in extent to pool dimensions identified in the Phase I investigation. This suggests that the pools may have reached their steady-state extent.

### 5.1.3 LNAPL Baildown/Recharge Testing

Estimates of the conductivity of the aquifer to LNAPL were developed using LNAPL bail-down recharge data collected in December 2000. The tests were performed on ten wells in AOIs 30 and 38. The tests were performed by quickly bailing the product from each location and then measuring the depth to LNAPL (product recharge) and depth to water (water recharge) at periodic time intervals. Using this data, LNAPL transmissivity and conductivity were calculated using a method developed by D. Huntley (2000).

The analysis method requires that the elevation of the potentiometric surface ($Z_p$) remain constant during recovery. The potentiometric surface is calculated by $Z_p = Z_w + \rho_r(Z_o - Z_w)$ where $Z_w$ is the elevation of the oil/water interface, $\rho_r$ is relative density of the hydrocarbon, and $Z_o$ is the elevation of the oil/air interface. The potentiometric surface elevation calculated from the data from seven of the ten wells/piezometers was not constant during the testing period. The method also requires that drawdown (i.e. the difference between the original hydrocarbon elevation and the hydrocarbon elevation during the recovery period) decrease through the testing period. This was not the case for these same seven locations. Additionally, product thickness in most of these seven locations was quite erratic (thickening and thinning randomly over time) during the recovery period. For these three reasons, data from only three of the ten locations (30-MW3, 38-B11, and 38-MW6) were used in the analysis.

Field data, analysis (assumptions and calculations), and associated graphs can be found in Appendix M. Analysis results are summarized below.

| Data From: | LNAPL Transmissivity $ft^2$/day ($cm^2$/s) | LNAPL Conductivity ft/day (cm/s) |
|---|---|---|
| 30-MW3 | 2.0 ($2.1 \times 10^{-2}$) | 3.0 ($1.1 \times 10^{-3}$) |
| 38-B11 | 1.5 ($1.6 \times 10^{-2}$) | 6.3 ($2.2 \times 10^{-3}$) |
| 38-MW6 | 10.5 ($1.1 \times 10^{-1}$) | 6.6 ($2.3 \times 10^{-3}$) |

There is only about half an order of magnitude difference in the results from the three locations. Using the highest calculated hydrocarbon conductivity (6.6 ft/day), the conductivity of LNAPL is more than two orders of magnitude less conductive than the conductivity of groundwater.

As Huntley (2000) points out in his paper, "... lateral plume movement is usually impeded by the low effective conductivity of hydrocarbon at the plume boundaries, where product thicknesses and saturations are often small. Therefore, discrete areas of high effective conductivity should not be misinterpreted as indicating mobility of the entire free-product plume."

### 5.1.4 Conclusions

Monitoring data indicates the LNAPL pools may have reached their steady-state extent. The LNAPL in the southern area, in particular, is thought to be predominantly comprised of LNAPL that has reached a residual saturation (immobile as LNAPL). Given the distance of the LNAPL zones to surface water bodies, LNAPL migration into the Weber River or 21st Street Pond is not considered likely. Additional monitoring may be appropriate to confirm the stability of these LNAPL pools.

The results of the LNAPL baildown/recharge testing indicate some potential for sustainable LNAPL recovery, at least in select areas and over the short term, in the northern LNAPL area. Such recovery could potentially reduce the potential for LNAPL migration.

## 5.2 CVOC Plumes

There are two areas where groundwater has been impacted by chlorinated volatile organic chemicals, primarily vinyl chloride. These areas of impact are termed the "northern CVOC plume" and "southern CVOC plume". The north plume is an elongated plume, extending from AOI-38 (the area of the former SPRR machine shop) and AOI-22a (turntable/fueling rack) to the western edge of AOI-34 (former wastewater treatment plant). The south plume is a more circular plume roughly centered over AOI-22b (the former SPRR roundhouse), extending over a portion of AOI-21 (Atlas Steel Salvage Yard) and AOI-30 (Durbano Metals). A separate lobe of the south plume is confined to a groundwater trough extending 800 feet northward from the main

body of the plume. The fate and transport of each vinyl chloride plume is discussed in Sections 5.2.1 and 5.2.2.

### 5.2.1 Fate and Transport Assessment of the North Vinyl Chloride Plume

#### *5.2.1.1 Plume Description*

As shown in Figures 5-1 to 5-4, the north plume is roughly 3,000 feet long and 900 feet wide, approximately bound on the southeast by well 38-MW9 and on the northwest by well 35-MW1. Quarterly groundwater samples were analyzed from monitoring wells in the AOIs of interest. Measured vinyl chloride concentrations ranged from less than 1 ug/L to 3100 ug/L. Figure 3-12 shows a geologic cross-section through the north plume area.

#### *5.2.1.2 Vinyl Chloride Source*

Based on the following, the vinyl chloride found in the north plume is likely the product of chemical transformation of perchloroethylene (PCE), trichloroethylene (TCE), and 1,1,1-trichloroethane (1,1,1-TCA).

- PCE, TCE and 1,1,1-TCA may be transformed into vinyl chloride through reductive dechlorination, as shown in Figure 5-5.
- The highest concentrations of PCE, TCE and 1,1,1-TCA were found in 38-MW12 (Figure 5-6). Historically, the area near 38-MW12 was used as a machine shop and rail transfer pit, and these chemicals were likely used near these facilities in common industrial activities. Based on the relatively high concentrations found and the historical operations there, a potential primary source area is in AOI-38.
- Low concentrations of PCE and TCE were detected in monitoring wells near the industrial wastewater plant in AOI-34. A potential secondary source of TCE may be near this facility. The industrial sewer line (if leaking) coming from AOI-38 could also be a potential source.
- Transformation of PCE, TCE and 1,1,1-TCA to vinyl chloride is likely given the geochemical conditions at the site. This is described in detail in Section 5.2.1.4.

- The highest vinyl chloride concentrations were generally measured downgradient of where PCE, TCE, and 1,1,1-TCA were detected.

An unlikely explanation for the presence of vinyl chloride in site groundwater is that the chemical was somehow spilled and then seeped to the groundwater. Typical storage and shipping procedures, in combination with the physical properties of vinyl chloride, make it unlikely that the presence of vinyl chloride in site groundwater was caused by spilling and seeping. VC is typically shipped and stored in pressurized cylinders, where it exists either as a pressurized gas or as a liquid.[12] If a pressurized cylinder of VC did leak, the VC from the tank would very likely have escaped as a gas. Because vinyl chloride is a volatile chemical, a very large gaseous concentration would have been required to produce the aqueous concentrations detected in monitoring wells (Appendix B). A large gaseous concentration of vinyl chloride would have been very unlikely given the open atmosphere conditions where the release would have most likely occurred.

The NW elongation of the northern CVOC plume parallel to the direction of groundwater flow, may be the result of advective transport and the coalescence of several smaller plumes from other unknown sources. One such possibility is a line-source created by several leak points along the industrial sewer line that connects the old SPRR machine shop area (AOI-38) to the treatment plant (AOI-34) (see Figure 4-12). The elevated vinyl chloride detections in the northern 1/3 of the plume (well 34-MW3) may be evidence for this hypothesis.

#### *5.2.1.3 Groundwater Flow*

As stated in Section 3.3.1, groundwater in the near-surface aquifer where the north plume is located generally travels toward the northwest. Additionally, there is an influx of groundwater entering the extreme northern edge of the north plume from the Weber River. The overall data set for monitoring wells 34-MW2, 34-SPMW-02, and 34-MW9 indicates that advective flow carries the CVOC plume near the river, but recharge of Weber River surface water to the alluvium prevents (or at least significantly mitigates) discharge of the CVOC plume into the river. CVOCs are fairly consistently present in 34-MW2 and 34-SPMW-02, which are located

[12] Vinyl chloride exists as a gas at temperatures above -14° C. Fire Protection Guide to Hazardous Materials. National Fire Protection Association. 12th Ed. 1994.

approximately 75 feet from the river bank. However, CVOCs were not detected in samples generated in four monitoring events at 34-MW9. Monitoring well 34-MW9 is located downgradient of 34-MW2 and 34-SPMW-02 (see figure 5-1 to 5-4), and is closer to the river (approximately 30 feet from the river bank).

During aqueous transport, organic chemicals can adsorb to organic material in the soil, effectively retarding the rate of their transport. The effect of adsorption on retarding vinyl chloride transport is very low because vinyl chloride does not strongly adsorb to organic material. This is reflected by the low vinyl chloride soil-partitioning coefficient ($K_D$), which was calculated to be 0.004 L/kg for this site (Appendix O). Based on the calculations presented in Appendix O, the impact of adsorption on vinyl chloride advective transport is negligible. Therefore it may be assumed that vinyl chloride migrates at essentially the same rate as the groundwater seepage velocity.

Using hydraulic parameters from Section 3.5, the groundwater seepage velocity in the vicinity of the north plume was calculated to be approximately 5.7 ft/day (2080 ft/yr). Any release of chlorinated solvents likely occurred well before 1996.[13] Based on the groundwater seepage velocity and a four-year time lapse, an un-attenuated plume could extend more than 8300 ft. However, the north plume length is approximately 3,000 feet (Figures 5-1 to 5-4), which is substantially less. It is likely that attenuation mechanisms are responsible for reducing the size of the north vinyl chloride plume.

#### *5.2.1.4 Vinyl Chloride Attenuation*

Attenuation mechanisms may be biotic or abiotic, depending on the chemical constituents and the groundwater geochemistry. Geochemical data and chlorinated solvent concentrations were used to evaluate a potential for bioattenuation.

[13] UPRR obtained this portion of the rail yard from SPRR in 1996. While it is likely that the release occurred before 1996, this is last year that a release can be verified.

## *Groundwater Geochemistry*

Sulfate-reducing or methanogenic redox conditions are generally recognized as necessary conditions for reductive dechlorination of vinyl chloride to ethene. Geochemical analyses were collected in June and September 2000 to determine if geochemical conditions are conducive to bioattenuation of vinyl chloride. Sampling locations and results are shown in Figure 5-6 and indicate the following:

- Alkalinity levels were generally higher in wells located inside the plume (up to 620 mg/l) although higher levels of alkalinity are also measured in wells 38-MW4 and 22A-MW4 located outside of and east of the plume (Figure 5-6). The higher alkalinity may be attributed to microbial activity through the production of compounds such as carbon dioxide and bicarbonate.

- Dissolved oxygen and nitrate were generally low or not detected within the plume. (See results for 38-MW12, 22a-MW6/6D, 34-MW1, 34-MW3/3D, 34-OB-12, and others.).

- Dissolved iron concentrations in the plume were elevated within the plume, indicating that ferrous iron ($Fe^{2+}$) was being produced from ferric iron ($Fe^{3+}$). (See results for 38-MW12, 22a-MW6/6D, 34-MW1, 34-MW3/3D, 34-OB-12, and others.)

- Lower sulfate concentrations were measured in monitoring wells downgradient of the areas with highest CVOC concentrations. The most upgradient well where MNA sulfate measurements were taken was 38-MW9; sulfate concentrations in this well ranged from 163-164 mg/L. Downgradient of this well, sulfate concentrations were lower. Sulfate concentrations downgradient of 38-MW9 were in the general range of 17-48 mg/L, and were measured as low as 5.87 mg/L (34-MW3D). Given that downgradient samples had lower sulfate concentrations than upgradient samples, data indicate that sulfate is being consumed.

- Methane was not measurable in any monitoring well.

These factors indicate that sulfate-reducing conditions are present in the vinyl chloride plume. Diesel LNAPL near the primary and secondary source wells is likely responsible for driving the redox potential to sulfate-reducing levels. Comparison of Figures 4-1 and 5-7 shows that the

LNAPL is located over the same location as where chlorinated solvents were measured. (This relationship is also shown in Figure 5-8, which shows the areas of groundwater impact for the entire railroad facility.) Biodegradation of the diesel LNAPL would quickly consume dissolved oxygen and nitrates, convert ferrous iron to ferric iron, and result in the sulfate-reducing conditions required to dechlorinate vinyl chloride. The LNAPL would also provide organisms with an energy source to drive the dechlorination of TCE, 1,1,1-TCA, and their daughter products (e.g. vinyl chloride) to ethene.

## *Degradation Evidence*

PCE and TCE were both detected in site monitoring wells, although TCE was detected more frequently and in higher concentrations. As shown in Figure 5-5, TCE may be the result of dechlorination of PCE, and it is not clear whether the detected TCE was released or is the result of PCE biodegradation. As shown in Figure 5-5, the first daughter product resulting from the reductive dechlorination of TCE is 1,2-DCE. 1,2-DCE was detected in several northern-plume monitoring wells. The 1,2-DCE found in these monitoring wells is more than 80 percent cis-1,2-DCE isomer, further suggesting that the 1,2-DCE in these monitoring wells is the product of reductive dechlorination.[14] cis-1,2-DCE can then be reductively dechlorinated to vinyl chloride.

1,1,1-TCA can be abiotically transformed to 1,1-DCE; and 1,1-DCE was found in several in monitoring wells downgradient of 38-MW12. 1,1-DCE may then be reductively dechlorinated to vinyl chloride.

Based on the following, it can be reasonably concluded that the vinyl chloride is being degraded.

- The protocol specified in the *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater* (USEPA, 1998b) was used to evaluate the probability of biodegradation of chlorinated solvents in the northern CVOC plume based on site data (see the analysis presented in Appendix O). Based on data from the northern vinyl chloride plume, the protocol indicated "adequate evidence" for anaerobic biodegradation of chlorinated organics.

- As stated in Section 5.2.1.3, the plume extent should be much greater than it currently appears to be if attenuation was not occurring.

- Vinyl chloride concentrations from north plume monitoring wells were examined for four quarterly monitoring events to see if any there was a discernable trend in the vinyl chloride concentration over time. Data were analyzed by both log and linear trend lines, however no definitive correlation was observed (Appendix O). Given that the possible plume travel time (1.3 years) is roughly equivalent to the period of four quarterly measurements, the absence of a correlation indicates that the plume may have reached steady-state.

- Vinyl chloride isoconcentration contour lines (Figure 5-1 through 5-4) were examined for four quarterly monitoring events to see if any there was a discernable trend in the distribution of vinyl chloride concentrations over time (Appendix O). Concentrations at the plume edge do not appear to be substantially increasing, and the shape of the isoconcentration contour lines is generally similar through time. Similar to the examination of the concentration versus time graphs, this lack of significant change in vinyl chloride distribution provides an indication that the plume has reached steady-state.

- A range of first-order vinyl chloride decay rates and half-lives was calculated based on the one-dimensional steady-state model of Buscheck and Alcantar (1995, see Appendix O). The range of derived rates ranged from a half-life of 9 days to 423 days, with the derived half-life for the most reasonably expected site conditions ranging from 12 to 62 days. The most significant aspect of this modeling effort is that, over the wide range of site conditions modeled, vinyl chloride removal was required to explain the observed plume configuration.

- While ethane and ethene were not detected in monitoring wells, these results may not accurately reflect their presence or absence because their method detection limits (3,000 ug/L for both) were generally higher relative to plume vinyl chloride concentrations.

Groundwater monitoring-well results suggest that vinyl chloride is being attenuated to undetectable concentrations before it reaches any receptor water body. The two receptors for the

[14] Wiedemeyer et al. Natural Attenuation of Fuels and Chlorinated Solvents in the Subsurface. 1999.

northern CVOC plume are the 21st Street Pond or the Weber River. Upon entering either the 21st Street Pond or the Weber River, dilution would considerably reduce the vinyl chloride concentration. Also, vinyl chloride would quickly bioattenuate because both receptors are aerobic bodies of water and vinyl chloride is very amenable to aerobic biodegradation. Furthermore, vinyl chloride is a volatile chemical that would escape from surface water to the atmosphere where it could be rapidly destroyed by photo-oxidation. Therefore it is quite probable that these attenuation mechanisms would prevent vinyl chloride from exceeding surface water risk-based SLVs.

#### *5.2.1.5 Conclusions*

Based on the above discussion, the following conclusions may be made concerning the fate and transport of the northern CVOC plume.

- The north vinyl chloride plume is most likely the result of natural attenuation processes that are reductively dechlorinating PCE, TCE and 1,1,1-TCA.
- The Weber River appears to be a losing stream in the plume vicinity of well 33-MW9. While the river-groundwater flow relationship is not confirmed for other portions of the site, at this location the losing stream configuration may help prevent the northern vinyl chloride plume from migrating toward the river.
- Based on trend data, the CVOC plume (as defined by vinyl chloride, which is the most extensive constituent), appears to be at a steady-state extent. Continued plume monitoring to generate a more extensive concentration versus time data set will be conducted under the Feasibility Study, and will provide more certainty as to actual plume status.

### 5.2.2 Fate and Transport Assessment of the Southern Vinyl Chloride Plume

#### *5.2.2.1 Plume Description*

As shown in Figure 5-9, the south plume is roughly 1,400 feet long and 1,300 feet wide, approximately bound on the south by well 21-MW1 and on the north by well 30-MW3. A separate lobe of the south plume follows a trough in the water table and extends northward into AOI-26. Figure 5-9 shows the historic distribution of the south vinyl chloride plume based on a

compilation of Phase I (Geoprobe), Phase II (monitoring well), and additional (May 2003, Geoprobe) groundwater analytical data.

Quarterly groundwater samples were analyzed during the Phase II investigation from monitoring wells in the AOIs of interest. Figures 5-10 to 5-13 show the vinyl chloride concentrations based solely on the monitoring well data. Measured vinyl chloride concentrations ranged from less than 1 ug/L to 2000 ug/L. The figures show generally decreasing concentrations in vinyl chloride over time for the main body of the plume. Concentrations measured in the western lobe of the plume that extends through AOI-26 generally remained constant in the range of 1 to 4 ug/l.

While vinyl chloride is the main contaminant of concern in the south CVOC plume, other volatile and semi-volatile constituents are occasionally detected above their respective SLV. Figure 5-14 summarizes the concentrations of other VOC and SVOC analytes detected at concentrations above the SLVs during the two final quarters of Phase II groundwater sampling. The figure shows the highest concentrations detected from the February (low water level) and May (high water level) 2001 data for 1,2,3-trichloropropane, 1,2-DCE, benzene, and pentachlorophenol. Figure 3-13 shows a geologic cross-section through the south plume area.

#### 5.2.2.2 *Vinyl Chloride Source*

Similar to the north plume, the south vinyl chloride plume is likely the product of chemical transformation of trichloroethylene (TCE).

- Low levels of TCE were measured in 21-MW2 (Figure 5-15) at the upgradient edge of the south plume (The upgradient extent of the CVOCs in groundwater at this location will be defined as part of the Feasibility Study for the site).
- It is likely that TCE was used in historical activities associated with the machine shop area, which was located NE of well 30-MW6D.
- TCE may be transformed into vinyl chloride through reductive dechlorination, as shown in Figure 5-5. Transformation of TCE to vinyl chloride is possible given that the geochemical conditions at the site are likely sulfate-reducing or methanogenic. These conditions are likely due to the pockets of diesel LNAPL that are located in the vicinity of the south plume.

- TCE was not detected in wells downgradient of 21-MW2, while the highest 1,2-DCE and vinyl chloride concentrations were measured downgradient of 21-MW2 in well 30-MW6D. This further supports the theory that vinyl chloride is formed from the destruction of TCE in groundwater.

- As explained in section 5.2.1.2, it is unlikely that a vinyl chloride release of the magnitude required to produce the measured concentrations of vinyl chloride in groundwater has occurred at this site.

#### *5.2.2.3 Groundwater Flow*

Groundwater in the near-surface aquifer where the south plume is located generally travels toward the north-northwest (Section 3.5). This indicates that the south plume is not immediately directed toward the Weber River. Several monitoring wells between the south plume and the Weber River also support this conclusion, as vinyl chloride was not detected in samples collected during quarterly monitoring events[15].

As stated in Section 5.2.1.3, the effect of adsorption on advective transport of vinyl chloride transport is negligible. Therefore it may be assumed that vinyl chloride in the south plume travels at essentially the same rate as the groundwater seepage velocity. Based on hydraulic parameters stated in Section 3.6, the south plume groundwater seepage velocity was calculated to be 11.3 ft/day (4137 ft/yr) (Appendix O).

Using the same four-year time lapse used to calculate possible the extent of the north plume, vinyl chloride in the south plume should have traveled more than 16,500 feet. However the length of the south plume (480 feet) is much less, strongly suggesting that the plume is being attenuated.

[15] Monitoring wells between the south plume and the Weber River include 30-MW3 and 26-MW1.

#### 5.2.2.4 *Vinyl Chloride Attenuation*

### *Groundwater Geochemistry*

Inorganic natural attenuation measurements, which were used as indicators of redox conditions during the discussion of the north plume, were not taken for the south plume. However sulfate-reducing or methanogenic conditions are likely in the south plume because it exists near pools of diesel LNAPL. Diesel LNAPL is believed to be the driver of low redox conditions in the north plume, and it is reasonable to assume that the pockets of diesel LNAPL located over the south plume would have the same effect. Therefore it is likely that geochemical conditions in the south plume are similar to those in the north plume.

### *Degradation Evidence*

Organic natural attenuation parameters, which provide degradation evidence for the south plume, are shown in Figure 5-12. Given that 1,2-DCE is the first daughter product resulting from reductive dechlorination of TCE, one would typically expect to measure 1,2-DCE in monitoring wells downgradient of where TCE was measured. 1,2-DCE was measured in several downgradient monitoring wells, and the 1,2-DCE is these wells was more than 80 percent cis-isomer. This suggests that the 1,2-DCE measured in the south plume monitoring wells is the product of TCE dechlorination. It also suggests that the original release of TCE to the environment occurred long enough ago that very little is left; thus the sole detections in upgradient well 21-MW2. Alternatively, an unknown source area of TCE may exist upgradient of 21-MW2, which will be investigated as part of the Feasibility Study. In either case, the reduction of 1,2-DCE is likely the source of vinyl chloride in the south plume. Vinyl chloride and 1,2-DCE are the two most prevalent contaminants detected in the wells.

Based on the following, it appears that vinyl chloride in the south plume is being degraded.

- Figures 5-10 to 5-13 show that the aerial extent of the south plume changes very little over time. These figures also show that the south plume is contained well within the

railroad facility. Given the apparent groundwater velocity, vinyl chloride should have traveled much further than it apparently has if attenuation was not occurring.

- A trend analysis was performed on data from seven south-plume monitoring wells (21-MW2, 22B-MW1, 22b-MW2D, 26-MW2, 26-STMW-1, 30-MW1, and 30-MW6D) to determine if there was a noticeable change in concentration over time (Appendix O). These wells were chosen because vinyl chloride was detected in 3 of 4 quarterly monitoring events. While there is variability in the data for specific wells, the trend analysis indicates that overall, plume concentrations are likely decreasing over time. This conclusion is especially supported by data at 30-MW6D, where sampling results decreased exponentially over time. Additional monitoring data will be collected from south plume monitoring wells to confirm that concentrations are continuing to decrease and that the plume is shrinking.

- The observation of decreasing vinyl chloride concentrations over time for the wells implies that the south plume is not at steady state, but actually shrinking. The Buscheck and Alcantar (1992) model is not applicable to the south plume because this model assumes the plume has achieved steady state.

Based on vinyl chloride measurements that appear to be decreasing over time for the majority of the wells, it is reasonable to conclude that the source of the south plume has been depleted and that the plume is shrinking. Additional data to further define this trend will be collected as part of the Feasibility Study.

#### *5.2.2.5 Conclusions*

The following conclusions may be made concerning the fate and transport of the south plume.

- The south plume appears to be contained to the rail yard. It does not appear to be impacting the Weber River.

- The south vinyl chloride plume is most likely the result of attenuation processes that have reductively dechlorinated TCE and its daughter products.

- Diesel LNAPL over the south plume is likely driving the redox condition to sulfate-reducing or methanogenic conditions, which are required for reductive dechlorination of TCE to vinyl chloride.
- Vinyl chloride attenuation processes could include both aerobic and anaerobic biodegradation, and abiotic removal.

The measured concentration of vinyl chloride appears to be exponentially decreasing over time in 30-MW6D. This suggests that the source of the plume is disappearing and that the plume extent is shrinking. However, additional groundwater monitoring to generate a more extensive concentration versus time data set as planned for the Feasibility Study, would provide more definitive insight onto actual plume status.

# 6 SUMMARY AND CONCLUSIONS

Findings and conclusions from the remedial investigation of the Ogden Rail Yard site are presented in this section. Please note that the Northern Area Operable Unit is covered in Part 2 of this RI Report, and is not discussed in this section.

## 6.1 SURFACE SOIL

The Ogden Rail Yard was built in the flood plain of the Weber River. On the northern end of the rail yard, the Weber River flood plain merges with that of the Ogden River. The site had been used for railroad operations for over a century. Over that time, there have been multiple events of fill and grade to produce the ground surface elevation necessary for track construction and other railroad operations. As a result, the surface soil horizon throughout the active portion of the rail yard is now generally comprised of fill.

A focus of the remedial investigation has been characterization of the surface soil horizon within the rail yard because of complete exposure pathways. In the Phase I and Phase II field investigations, over 200 samples of the surface soil horizon have been collected and analyzed. These samples included just over 160 samples in the AOIs, and another 40 samples of surface soil from the Weber River riparian zone lying between the river and the active portion of the rail yard. Results have been compared to the Human Health Risk-Based Screening Levels developed by EPA during the Phase I investigation. The constituents that most frequently exceeded the SLVs were arsenic, lead, and a variety of PAHs.

- Arsenic concentrations were detected above the SLV of 4.8 mg/kg in 23 of the 25 AOIs investigated in Phase I and Phase II (the total of 25 excludes AOI-33 which is addressed in Part 2 of this RI Report).
- Lead concentrations were detected above the SLV of 400 mg/kg in 11 AOIs.
- PAHS were detected above their SLVs in 6 AOIs. The specific PAH that was most frequently detected at a concentration above the SLV was benzo(a)pyrene, which has a Human Health SLV of 0.78 mg/kg.

From the frequency and distribution of arsenic and lead exceedences, it appears that these two constituents are naturally occurring constituents of the soil that was used for fill at the site. The apparent random distribution in the concentrations of these parameters in surface soil is illustrated by the results for AOI-36, as shown in Figure 6-1. (AOI-36 was chosen to illustrate this point in part due to the more extensive data set available for this AOI.) This figure also shows the surface soil concentrations of benzo(a)pyrene.

EPA used the Phase I and Phase II data as input in completing the baseline human health risk assessment for the site (EPA, 2003a). The assessment concluded that risks to rail yard workers from exposure to surface soil were below a level of concern with two exceptions; (1) PAHs in AOI-27 and (2) arsenic in AOI-21. The excessive PAH concentrations in AOI-27 above acceptable exposure limits are associated with the hydrocarbon sludge. This sludge material will be addressed by a planned removal action in the Fall of 2003. Based on the human health risk assessment calculations for reasonable maximum exposure assumptions, the arsenic concentration above acceptable risk limits in AOI-21 is the result of a hot-spot outlier with a concentration of 450 mg/kg. This single data point is about 3 times higher than the remaining arsenic concentrations in this AOI. In addition, the risk assessment concluded that off-yard exposures of residents to dust from the yard are lower than exposures to site workers, and that risks to off-yard human receptors were also below a level of concern.

The Phase II RI also included collection of 40 surface soil samples from the Weber River riparian zone, to support an assessment of potential risk posed to ecological receptors. Samples were collected from three different zones along the length of the rail yard, and from a fourth "background" zone located along the river south of the rail yard. Ten samples were collected from each zone.

There were many riparian zone soil samples in which concentrations of arsenic, chromium, lead, and mercury exceeded the Ecological Risk-Based Benchmark Concentrations previously used by EPA in their screening level ecological assessment (EPA, 2001c). For samples in which these constituents were detected, the concentrations in the various zones were generally similar. The exception to this is mercury. A mercury concentration of 3.6 mg/kg was detected in one sample from the background zone (versus a benchmark concentration of 0.005 mg/kg). This concentration was an order of magnitude higher than mercury concentrations reported for samples

collected adjacent to the rail yard. The frequency with which these constituents (arsenic, chromium, lead, and mercury) exceeded the benchmark concentrations was generally higher in the riparian zones along the rail yard than in the "background" zone south of the rail yard.

A variety of PAHs were detected in the riparian zone surface soils samples. The frequency of PAH detection was greatest in "background" zone, where 5 of the 10 samples had detectable concentrations of 2-methylnaphthalene. PAH detection frequencies in the zones adjacent to the rail yard were 1/10, 1/10, and 3/10 for the southern, central, and northern zones, respectively. Benzo(a)pyrene (B(a)P) is the only PAH with an Ecological Risk-Based Benchmark Concentration in EPA's screening level ecological assessment (EPA, 2001c). None of the PAHs were detected in the Phase II riparian zone soil samples at a concentration exceeding the B(a)P benchmark of 1.98 mg/kg.

## 6.2 GROUNDWATER

The groundwater zone of primary interest beneath the Ogden Rail Yard is the saturated alluvial zone. This zone is continuous across the site, and is comprised of channel deposits containing poorly sorted gravel in a matrix of silt and fine-grained to medium-grained sand. The content of the fine-grained portion is typically less than 10% by volume. This zone typically exists from the water table down to the Alpine Clay. Given the variable depth to the Alpine Clay, the thickness of the saturated alluvial zone ranges from 1 to 22 feet with a typical thickness of 10 to 12 feet.

Groundwater in the alluvial zone beneath the Ogden Rail Yard has been investigated in the Phase I and Phase II RI field studies. Groundwater samples were collected from nearly 100 different locations in the Phase I RI using Direct Push Technology (DPT). With the completion of Phase II RI fieldwork, there are now 89 monitoring wells on the rail yard site (not including the 24 additional monitoring wells in the Northern Area operable unit). Four quarters of groundwater monitoring has been performed on the monitoring well network.

Findings of the groundwater investigation are summarized below. This discussion is organized as follows:

- Nature and extent of groundwater impacts

- Source investigation
- Fate and transport considerations

### 6.2.1 Nature and Extent of Groundwater Impacts

The RI has revealed that the most significant groundwater impacts at the site are limited to the vicinities of most intensive industrial activity (Figure 5-8). There are two major zones of impact. Both zones are impacted by fuel hydrocarbons and chlorinated solvents.

This first zone, called the south plume, originates from the former location of the UPRR Roundhouse (AOI-22b). In this zone, there is an area in which historic releases of diesel fuel have apparently resulted in the sporadic occurrence of fuel hydrocarbons in the form of LNAPL over an area of approximately 1.2 acres. This LNAPL zone is located within the extent of a groundwater zone impacted by a variety of chlorinated volatile organic compounds (CVOCs). The CVOCs are believed have resulted from historic releases of chlorinated solvents and their subsequent degradation. The constituent that has the most widespread occurrence above federal MCLs is vinyl chloride (Figure 6-2), which is believed to be a degradation product of TCE. The CVOC plume is roughly circular in shape and extends to the area of AOI-26, covering an area of approximately 4.5 acres.

The second zone, called the north plume, originates from the former location of the SPRR Roundhouse (AOI-22b), and Engine Maintenance Area and Machine Shop (AOI-38). In this zone, there are two fuel hydrocarbons LNAPL zones. The LNAPL zones cover areas of approximately 10 acres and 1.2 acres. These LNAPL zones are almost completely underlain by a groundwater zone impacted by a variety of chlorinated volatile organic compounds (CVOCs). Like the south plume, the CVOCs are believed to have resulted from historic releases of chlorinated solvents and their subsequent degradation. The constituent that has the most widespread occurrence is again vinyl chloride (Figure 6-3). The CVOC plume is an elongated oval in shape, extending downgradient from the source area to northwest of the SPRR Waste Water Treatment Plant (AOI-34). The CVOC plume covers an area of approximately 60 acres.

Outside the north and south CVOC plumes, groundwater impacts by organic constituents are limited. The only well outside of these plumes with repeated detection of organic constituents

above the Human Health-Based SLVs is Well 32-MW14 at the former Oil/Water Separator and Lust Site (Figure 5-8). Quarterly monitoring of this well produced reported Pentachlorophenol concentrations of 6.3, 3, 1, and 0.5 mg/l (an apparent trend of declining concentrations) versus a SLV of 1 microgram per kilogram.

Across the rail yard, arsenic and barium concentrations in groundwater routinely exceed the Human Health-Based SLVs. There are monitoring wells across the site that contain concentrations of arsenic (10 wells) and barium (35 wells) above the SLVs. In addition, during the Phase I investigation 93 GeoProbe groundwater samples were collected. Arsenic and barium concentrations exceeded SLVs in 67 and 69 of the 93 samples, respectively. The widespread nature of these exceedences suggests arsenic and barium are associated with background conditions and are unrelated to chemical or waste handling operations on the rail yard. This assumption is further supported by the following;

- Two of the AOIs located on the upgradient edges of the rail yard (AOI-19 and AOI-12) have wells in which barium concentrations routinely exceed the SLV. Because of their locations, any on-site sources of barium contamination in these areas are highly questionable.

- Groundwater quality data from the Ogden Gas Company site (2,000 feet east of the rail yard between 20$^{th}$ and 21$^{st}$ Streets), shows that four groundwater samples were analyzed for arsenic and barium. All four arsenic detections and three of the barium detections exceeded the Ogden railroad facility SLVs.

- Information on groundwater quality data generated from wells at Hill Air Force Base (about 4 miles south of the rail yard) from 1998 through 2001 was supplied by the site contractor CH2M HILL (Randy Gates, personal communication). Neither arsenic nor barium is identified as a constituent of concern is groundwater at the site. Of the 1106 analyses for barium, 648 (59%) exceed the Ogden railroad facility SLV. Of the 1118 analyses for arsenic, 606 (54%) exceed the Ogden railroad facility SLV.

- Barium concentrations do not exceed federal MCLs.

### 6.2.2 Source Investigation

An objective of the Phase II RI was to investigate potential sources of the CVOC plumes. The LNAPL was sampled to determine if solvents had partitioned into the LNAPL in sufficient concentrations for the LNAPL to serve as the source of the aqueous phase CVOCs emanating from the same general vicinity as the LNAPL zones. A total of five LNAPL samples (covering both the north and south LNAPL zones) were analyzed for CVOCs. No CVOCs were detected in the samples. Based on these results, it is unlikely the LNAPL is the source of the aqueous phase CVOC plumes.

Investigations were also performed to assess the potential presence of chlorinated solvents in the form of DNAPLs, which could serve as an ongoing source of aqueous phase CVOCs. These investigations included vertical profiling of groundwater quality, a cluster of borings to explore the potential presence of a stratigraphic trap which could have resulted in DNAPL accumulation in a potential source area, and examination of soil cores for presence of DNAPL using special core examination techniques (UV/fluorescence and dye testing). No DNAPL was found (Appendix N). Vertical profiles of groundwater quality produced mixed results (in one location, there was evidence of increasing concentrations with depth, an indicator of potential DNAPL presence). Based largely on the probability of historic solvent use at the site (as a degreaser in heavy equipment repair), it is concluded that DNAPL could be present at the site, although no DNAPL has been observed in the targeted investigations described above. It is further concluded that if DNAPL is present at the site, it is likely present in small pockets that would defy practical discovery and delineation efforts.

The configuration of the northern CVOC plume suggests a potential source of ongoing CVOC loading to that plume. As previously stated, the plume is of oblong shape, with its longer axis running from its origin in the vicinity of the SPRR Roundhouse and Machine Shop, northwest, to a point beyond the SPRR Wastewater Treatment Plant. While this axis is roughly parallel to direction of groundwater flow, this axis is also roughly coincident with the industrial sewer line that conveyed wastewater from the Roundhouse and Machine Shop to the Wastewater Treatment Plant. Sampling of water in this sewer revealed the presence of relatively high concentrations of CVOCs, suggesting the possible presence of CVOC-containing sludge in the line. The outlet of the sewer has been plugged, but some inlet drains are still open. The sewer is believed to be

constructed of vitrified clay pipe. The materials of construction, the sewer's age (constructed in the 1960's), and the open inlet drains may result in some potential for ongoing release of CVOCs from the sewer.

### 6.2.3 Fate and Transport Considerations

The RI fieldwork defined the current extent of impacted groundwater. The potential for future migration of the impacted groundwater was also assessed, and findings are summarized in this section. This assessment focused on the north and south LNAPL and CVOC plumes which were described in the preceding section.

The best insight that can be drawn regarding the potential future extent of the LNAPL and CVOC plumes is their current extent. When one considers the likely age of these plumes and groundwater velocities, it becomes obvious that the extent of the CVOC plumes is far less than the extent of the plumes would be if no attenuation were occurring. Data derived from plume extent, the presence of degradation products, and groundwater geochemistry combine to produce a compelling case that intrinsic bioremediation is a significant factor in aqueous phase CVOC transport.

In light of this intrinsic bioremediation, the co-location of the fuel hydrocarbon and chlorinated solvent sources in the north and south plumes may be fortuitous. Biodegradation of more highly chlorinated solvents like DCE, TCE and 1,1,1-TCA generally requires the presence of another organic to drive the solvent biodegradation process, in which the other organic serves as the substrate ("food"), and the CVOC serves as the terminal electron acceptor. It appears the fuel hydrocarbons are providing an effective substrate for reductive dechlorination of the more highly chlorinated CVOCs.

Progressive dechlorination and degradation of the more highly chlorinated CVOCs (the "parent" compounds) yields lesser chlorinated CVOCs ("daughter products"), and eventually results in the presence of vinyl chloride, which is the predominant constituent now present in the CVOC plumes at the site (Figure 5-5). Vinyl chloride is less readily degraded under anaerobic conditions than the more highly chlorinated parent compounds, but is more readily degraded under aerobic conditions. Oxygen diffusion and rainwater infiltration provides a source of oxygen to support some aerobic biodegradation.

Based on the groundwater sampling data, it appears that intrinsic bioremediation is occurring at a rate sufficient to prevent significant expansion of the CVOC plumes. In fact, examination of "concentration versus time" data for key monitoring wells suggests that the south CVOC plume may actually be shrinking, while the north plume appears to have reached a steady-state extent. Continued monitoring of key wells will be conducted under the Feasibility Study to provide a more extensive set of concentration versus time data, which in turn will support a more definitive analysis of plume status.

Given the continued industrial/commercial use of the site (as recognized in the AOC) and the location of the site within the boundaries of the City of Ogden's municipal water supply system, use of the alluvial groundwater for water supply (particularly for potable purposes) is not plausible. Potential receptors of impacted groundwater are off-site, down-gradient receptors and the Weber River.

As discussed above, the North CVOC Plume appears to be at a steady-state extent. Wells within the northern edge of the plume do not exhibit any evidence of increasing CVOC concentrations. However, should the North CVOC expand to the north, it would discharge into the 21st Street Pond, which serves as a groundwater sink along its southern edge. Thus, impacts to down-gradient off-site locations where the alluvial groundwater could potentially be used as a source of water supply do not appear plausible based on the available data.

Based on the available data, it does not appear that impacted groundwater from the South CVOC Plume or North CVOC Plume is discharging to the Weber River. Of the two plumes, the North CVOC Plume extends much nearer to the Weber River. Based on the Phase I field work, it was known that the CVOC plume extended to the area of the SPRR Waste Water Treatment Plant, where the Weber River veers to the west. CVOCs are fairly consistently present in 34-MW2 and 34-SPMW-02, which are located approximately 75 feet from the river bank. The Weber River in this vicinity appeared to constitute a potential discharge point for the northern CVOC plume. Additional investigations were undertaken in this area as part of the Phase II RI fieldwork.

An additional monitoring well (34-MW9) was installed between the Waste Water Treatment Plant and the Weber River, as close to the Weber River as possible in the area of suspected potential groundwater discharge to the river. In four quarters of monitoring, no CVOCs were

detected in this well. In four quarters of monitoring, CVOCs were detected in this well. This well was also part of water level monitoring transect that included a water level gauging station in the Weber River. Results show the Weber River is an influent (losing) stream with respect to the adjacent riverbank at the 34-MW9 location. This relationship would tend to keep the alluvial groundwater from discharging to the river.

This finding is consistent with the conceptual model by the USGS (Price, 1985) for Wasatch Front mountain streams, which indicates that the Weber River should indeed generally be a losing stream in the vicinity of the site. This finding is also consistent with the investigations of the Ogden River (addressed in Part 2 of this report), which demonstrated the Ogden River is generally a losing stream in the area of interest, although there were small, localized areas of groundwater discharge to the river.

Thus, the overall data set for monitoring wells 34-MW2, 34-SPMW-02, and 34-MW9 is consistent with the assumption that the Weber River is generally a losing stream in this portion of the site. As indicated by results for 34-MW2 and 34-SPMW-02, advective flow carries CVOCs close to the river, but recharge of Weber River surface water to the alluvium prevents (or at least significantly mitigates) discharge of the CVOC plume into the river, as indicated by results for 34-MW9.

## 6.3 WEBER RIVER

UPRR's voluntary Phase I investigation of the rail yard was initiated in response to concerns of the Weber-Morgan County Health Department regarding potential rail yard impacts on Weber River water quality, which had recently been designated a culinary drinking water source. The investigations performed by UPRR and EPA have generated a considerable amount of data on potential site impacts on the Weber River. Findings regarding potential river impacts are summarized in this section, which is organized as follows:

- Groundwater discharge
- Surface water and sediment discharge
- Weber River water quality

### 6.3.1 Groundwater Discharge

As described previously, the available data shows limited potential for discharge of impacted groundwater from the South CVOC Plume and Northern CVOC Plume to the Weber River.

The western extent of the South CVOC Plume is 550 feet from the Weber River. The plume is not discharging to the river at the present time. Concentration versus time trend data indicates this aqueous phase CVOC plume is shrinking.

The North CVOC plume is closer to the Weber River. A field investigation focused on determining the nature of the groundwater-surface water relationship in an area of suspected impacted groundwater discharge revealed that the groundwater impacts in this location (AOI-34) did not extend to the river, and that in this location the river was a losing stream. The finding that the Weber River is a losing stream at this location is consistent with both the conceptual model that has been developed for Wasatch Front streams (Price, 1985), and the investigation findings for the Ogden River (see Part 2 of this RI Report). In addition, field measurements were made by EPA in the Ogden River during the Phase 3 investigation (EPA, 2002) to determine the water flow direction (gaining, losing). The results show that while there may be some very localized areas of the Ogden River that are periodically gaining groundwater, the Ogden River is generally a losing river in the vicinity of the site.

The overall shape of the northern CVOC plume lends additional evidence for the non-gaining nature of the Weber River. Rather than having the Weber River at its terminus, the downgradient end of the plume is directed toward the 21st Street Pond which acts as a groundwater sink north of the plume (see figures 5-1 through 5-4). In summary, the weight of evidence supports the hypothesis that the Weber River is generally a losing stream in the vicinity of the plume, and the conclusion that there is limited potential for discharge of impacted groundwater from the northern CVOC plume to the Weber River.

### 6.3.2 Surface Water and Sediment Discharge

There are three features that discharge runoff from the site, all of which also carry runoff from the urban area to the east of the rail yard: Strongs Creek (AOI-29), Burch Creek (AOI-9), and the storm drain along the 33rd Street Alignment (called the 33rd Street Slough). The majority of the

flow in each of these features originates in areas east of the rail yard. There is a fourth feature, a storm drain south of the 35th Street alignment (AOI-10) that carries runoff from a paved area east of the rail yard, but there is no defined drainage channel extending all the way to the river, and runoff infiltrates into a low-lying area west of the rail yard tracks.

Surface water and sediment samples were collected from these drainage features in both the Phase I and Phase II investigations. There were only a few exceedences of the Ecological Benchmark concentrations in the surface water samples, and these were for inorganic constituents (lead in two samples from Burch Creek, lead in two samples from Strongs Creek, and lead and arsenic in two samples from the intermittent drainage in AOI-10).

These surface features can also convey impacted sediments, samples of which were collected from each of these drainage features. Burch Creek, Strongs Creek, AOI-10, and the 33rd Street Slough sediment samples had constituents at concentrations exceeding the Ecological Benchmark Concentrations. Sediment samples in all four drainages exceeded Benchmark concentrations for PAHs. Burch Creek and the 33rd Street Slough sediments exhibited concentrations of arsenic above the Ecologic Benchmark concentration. AOI-10 and Strongs Creek sediments exhibited concentrations of cadmium, arsenic, and lead above the Benchmark concentrations. Chromium also exceeded the sediment Benchmark concentration in Strongs Creek.

The presence of these constituents in the surface water drainages on the rail yard does not necessarily mean that the rail yard is the source of the constituents. As stated previously, each of the four drainage features carries the majority of its runoff from areas east of the rail yard. In one of these drainages (Burch Creek), sediment samples were collected from locations both east (upstream) of the rail yard, and on the rail yard. Lead and PAH concentrations in the off-site samples collected east of the rail yard (BC4B and R4-S8) were similar to or higher than concentrations in samples collected on the rail yard.

There is an additional point of surface water discharge that crosses the site. A City of Ogden storm sewer line crosses the site in an east-west direction, passing just north of the SPRR Waste Water Treatment Plant, and discharges into the Weber River. The sewer line crosses the Northern CVOC plume. On the eastern end of the plume, the alluvial groundwater level is higher than the invert of the storm sewer. Sampling of the storm sewer revealed low concentrations of

vinyl chloride that apparently are the result of impacted groundwater leaking into the sewer. The maximum concentration of vinyl chloride detected in the sewer was 17 micrograms per liter. On four occasions, the sewer was sampled near its point of discharge to the Weber River (34-ST2). Vinyl chloride was estimated to be present in two of these samples at concentrations of 2.2 and 5 micrograms per liter, which is below the method PQL (10 micrograms per liter) and only slightly above the SLV (2 micrograms per liter).

### 6.3.3 Weber River Water Quality

Surface water samples were collected from the Weber River in both the Phase I field work (17 samples) and Phase II field work (20 samples). No constituents were detected in surface water at concentrations above the Human Health Risk-Based Screening Levels established for the site by EPA. Lead was detected in numerous surface water samples, including samples collected at the upstream end of the rail yard. While the lead concentrations were below the Ambient Water Quality Criteria for lead on a one-day average basis (estimated at 29 ug/l)[16], many samples exceeded the Ecological Benchmark Concentration for lead of 1.3 ug/l. Seven other parameters were detected in the surface water samples. Arsenic, barium and ethylbenzene are lower than the respective Benchmark Concentrations. The remaining four detected parameters are associated with laboratory contamination (EPA, 2001C).

As previously described, site data indicates an ongoing, continuous discharge of low concentrations of vinyl chloride to the Weber River via leakage of impacted groundwater into a City of Ogden storm sewer. No CVOCs have been detected in Weber River surface water samples, including samples collected at the down-stream end of the rail yard. This is expected. Site data suggests a very low mass flux of CVOCs to the river. CVOCs discharging to the river would be readily attenuated through dilution and volatilization. The finding that the Ogden rail yard site exerts no measurable impact on Weber River surface water quality may be the result of dilution.

[16] The 24-hour average lead concentration was calculated using the formula presented in *Ambient Water Quality Criteria for Lead* (EPA, 1980). The hardness variable in the formula expressed in terms of mg/l CaCO3, was calculated from specific site data on measured concentrations of calcium and magnesium from EPA's March 2000 sampling of the Weber River. The calculated hardness is 237.21 mg/L CaCO3, based on a calcium content of 65.2 ppm and magnesium content of 18.1 ppm.

Two additional wells were monitored on a quarterly basis upgradient of 34-MW9 and located approximately 75 feet from the river (34-MW2, 34-SPMW-02). Samples from both wells had detections of vinyl chloride and 1,1-DCA, although 1,1-DCA was not detected above the SLV. Well 34-MW2 showed increasing concentrations of 1,1-DCA and vinyl chloride in the first three quarters of monitoring when groundwater was at the normal level. In the fourth quarter when groundwater was 2.5 feet higher due to spring flow conditions, the 1,1-DCA and vinyl chloride concentrations dropped to <1 and 1 ug/l respectively.

1,1-DCA and vinyl chloride concentrations measured in 34-MW2 showed the reverse pattern. During the first three quarters of normal groundwater levels, both analyte concentrations were detected at constant low levels of 2 to 5 ug/l. In the fourth quarter when groundwater was two feet higher due to spring flow conditions, the 1,1-DCA and vinyl chloride concentrations rose to 18 and 20 ug/l respectively. Continued monitoring of these wells during the Feasibility Study will provide additional data to allow for a further evaluation of the stability or potential further migration of the northern CVOC plume.

## 6.4 Summary of Major Findings and Path Forward

In planning the site investigation, exposure to surface soil and potential impacts to the Weber River were considered among the most significant potential risks posed by site conditions to human health. With respect to surface soil, a preliminary risk assessment on Phase I data indicated that potential risks to humans posed by surface soils were probably below levels of concern. The Phase II investigation generated the additional surface soil data needed to support a more definitive assessment. Based on the combined results of the Phase I and Phase II investigations, EPA will perform a final human health risk assessment for site surface soils.

With respect to the Weber River, the site investigations have not revealed any site impacts on Weber River water quality.

The site investigations have revealed two general zones of significant groundwater impacts associated with historical railroad operations. These zones are the South Plume (which emanates from the former UPRR roundhouse area) and the North Plume (which emanates from the former SPRR roundhouse area and/or the industrial sewer line extending from it). The constituents of concern in these areas are petroleum hydrocarbons, certain specific components of diesel fuel,

and CVOCs. Under current site conditions, the impacted groundwater poses very limited risk. The impacted groundwater is limited to a relatively shallow alluvial groundwater zone that is not used as a source of water supply. The constituents of concern in these plumes have not been detected in Weber River water samples. Potential for further migration of the plumes is believed to be limited. The potential for impacted groundwater to pose risks to human receptors is evaluated in the human health risk assessment (EPA, 2003a).

The Phase II investigation generated information required to support an assessment of potential risk to ecological receptors. No acute risks to ecological receptors were identified in the site investigations. However, a variety of constituents were detected in Weber River riparian zone soils, sediments, and surface water at concentrations exceeding conservative, ecological risk-based benchmark concentrations that had been developed by EPA. Some of the conditions observed in the site investigation that could be of potential concern with respect to ecological risks (for example, lead in Weber River surface water samples) appear to be associated with background conditions. Potential risks posed by site conditions to ecological receptors are assessed in the ecological risk assessment (EPA, 2003b).

In summary, the RI generated the data needed to support the upcoming human health and ecological risk assessments to be performed by EPA. These risk assessments provide the definitive assessment of potential risks posed by site conditions to human and ecological receptors for the RI/FS project. Based on the risk assessments, risk-based remedial action objectives will be developed for the site.

UPRR will then perform a Feasibility Study (FS) for the site. Alternatives for addressing impacted groundwater at the site will be evaluated in the FS. Depending on the results of the EPA risk assessments and subsequent development of risk-based remedial action objectives, the FS will also evaluate alternatives for other site conditions judged to pose unacceptable levels of risk to human health and/or the environment.

### 6.4.1 Summary of Baseline Risk Assessments

The EPA released the final versions of the *Baseline Human Health Risk Assessment* (EPA, 2003a) and *Baseline Ecological Risk Assessment* (EPA (2003b) in February 2003. Both

assessments consisted of a data summary and evaluation, an exposure assessment, a toxicity assessment, a risk characterization, and an uncertainty evaluation.

#### *6.4.1.1 Human Health Risk Assessment*

In the human health risk assessment, risks were estimated for on-yard workers, off-yard residents, and off-yard recreational visitors. Conclusions of the human health baseline risk assessment for each of these potential receptors are that there are no unacceptable health risks with the exceptions listed below.

RISK ESTIMATES FOR ON-YARD WORKERS

SOIL - Non-cancer HI values at most AOIs do not exceed a value of one for either the CTE or the RME receptor. The exception is for AOI 21, where non-cancer risks for RME workers are slightly above one, mainly from the ingestion of arsenic. Cancer risks are mainly within or below EPA's risk range (1 in 10,000 to 1 in 1,000,000), except for RME workers at AOI 21 and 27. At AOI 21, cancer risk to an RME worker may reach a level of 2 in 10,000, due mainly to the presence of arsenic. At AOI 27, cancer risk to an RME worker may reach 7 in 10,000, due mainly to PAHs (especially benzo(a)pyrene) in soil.

GROUNDWATER - Ingestion of groundwater would be of clear and substantial non-cancer and cancer concern to workers at a number of AOIs. In most cases the excess cancer risk is due primarily to vinyl chloride, although arsenic and benzo(a)pyrene contribute to the risk in a few cases. Non-cancer risk drivers vary from AOI to AOI, with most of the risk coming from vinyl chloride, arsenic, antimony, naphthalene, benzene, trichloroethene, or acetone.

Inhalation of VOCs that could be released from water into indoor air is also of potential concern at a number of AOIs. Excess cancer risks above EPA's usual maximum of 1 in 10,000 are attributable to several different chemicals including vinyl chloride, benzene, ethylbenzene, and 1,2,3-trichloropropane. Non-cancer risks are due mainly to naphthalene and 1,2- dichloroethene, with benzene, vinyl chloride, 2-methylnaphthalene and acetone contributing risk in some cases.

These results indicate that groundwater beneath several areas of the site would pose a substantial risk to workers from one or both of two pathways (direct ingestion of water, inhalation of VOCs released from water) if it were ever used for drinking or other indoor purposes.

### RISK ESTIMATES FOR OFF-YARD RESIDENTS

**GROUNDWATER** - If on-site groundwater were to migrate to off-site locations and be used for drinking, risks to residents would be unacceptable in many cases, with risks even higher than to on-yard workers. This is because water ingestion rates and time spent inside are both higher for residents than workers. These results further support the conclusion that groundwater at several locations onsite is not suitable for human use or consumption.

### RISK ESTIMATES FOR OFF-YARD RECREATIONAL VISITORS

**INGESTION OF FISH** - Risks from PCBs in fish were estimated using two different approaches. The first approach is based on an estimate of the total amount of PCB present in fish tissue, expressed as the Aroclor-equivalent concentration (mg/kg). At this site, Aroclor-equivalent data are available for fish caught from the 21st Street Pond. Based on this approach, the estimated cancer and non-cancer risks to area anglers from ingestion of these fish are as follows:

**Estimated Risks from PCBs (as Aroclor) in Fish from the 21st Street Pond**

| Recreational Population | Non-Cancer HQ | | Excess Cancer Risk | |
|---|---|---|---|---|
| | CTE | RME | CTE | RME |
| Adult | 0.9 | 6 | 8 per 1,000,000 | 9 per 100,000 |
| Child | 0.8 | 5 | 2 per 1,000,000 | 3 per 100,000 |

These results suggest that ingestion of fish caught within the 21st Street Pond might be of potential health concern to fishermen because of non-cancer (but not cancer) risks from PCBs.

The second approach for evaluating risks from PCBs is to measure the concentration of each of 12 different PCB congeners that has significant 2,3,7,8-tetrachlorodibenzodioxin (TCDD) activity, and then to calculate the probability of cancer based on the TCDD-equivalent concentration. Based on this approach, estimated cancer risks are mainly within or below EPA's risk range, except for a risk estimate of 2 in 10,000 for an RME adult who fishes mainly along the Ogden River in Reach B (just upstream of the 21st Street Pond).

Taken together, these results suggest that cancer risks from PCBs in fish from within and near the 21st Street Pond are likely to be mainly within EPA's acceptable risk range. Potential noncancer risks based on the Aroclor equivalent method suggest a basis for concern, but these results should be interpreted cautiously. Most importantly, the Aroclor-based approach is uncertain because the toxicity factor is derived from studies of a commercial Aroclor mixture, while the on-site exposure is to a mixture of congeners that is generally quite different than the original commercial Aroclor mixture. However, at present there is no congener-based method for estimating non-cancer-based risks from PCBs. If it is assumed that the ratio of congener-based non-cancer risk compared to Aroclor-based non-cancer risk is the same as was observed for cancer risk (congener-based cancer risk estimates for fish from the 21st Street Pond are about 2-3 fold lower than estimates based on the Aroclor-equivalent method), then non-cancer risk estimates for RME receptors would likely be at or below the threshold for concern.

#### *6.4.1.2 Ecological Risk Assessment*

Conclusions of the ecological baseline risk assessment are as follows, based on the available data. It was concluded that population-level risks to aquatic, terrestrial, and wildlife receptors are minimal at most locations around the Ogden Rail Yard Site. Exceptions to this conclusion include the following:

- The Hazard Quotient approach predicts that risks to benthic organisms from PCBs in sediment are above a level of population concern in the Ogden River near the 21st Street Pond. However, there are no other lines of evidence to confirm or refute this prediction.

- The Hazard Quotient approach predicts that risks to benthic organisms are above a level of concern due to PAHs and xylenes in sediment in the east end of the 21st Street Pond (in

the area where the DNAPL plume has intersected the pond). The risk from PAHs is predicted using the Hazard Quotient approach using one set of sediment toxicity benchmarks, but not on two other approaches. Direct toxicity testing of sediments from the 21st Street Pond did not demonstrate the sediments were toxic, but the test organisms may not have had substantial contact with the sediment.

- Risks to semi-aquatic wildlife receptors (kingfisher, mallard, and/or mink) may be significant for individuals that ingest PCBs in aquatic prey from the 21st Street Pond and/or from the Ogden River near the pond. These risks are based on calculated Hazard Quotients, and data from other lines of evidence are not available. Because the size of the exposed population may be small, population-level risks are of potential concern.

# 7 REFERENCES CITED

Anderson, P. B., et al., 1994, Hydrology of Recharge Areas and Water Quality of the Principal Aquifers along the Wasatch Front and Adjacent areas, Utah; USGS Water-Resource Investigation Report 93-4221.

API, 2003, Answers to Frequently Asked Questions About Managing Risk at LNAPL Sites; American Petroleum Institute Soil and Groundwater Research Bulletin Number 18.

API, 1992, Pump and Treat: The Petroleum Industry Perspective; American Petroleum Institute Publication No 4561.

Aronson, D., and Howard, P.H., 1997, Anaerobic Biodegradation of Organic Chemicals in Groundwater: A Summary of Field and Laboratory Studies; American Petroleum Institute.

Buscheck, T.E., and Alcantar, C.M., 1995, Regression Techniques and Analytical Solutions to Demonstrate Intrinsic Bioremediation; Intrinsic Bioremediation, Battelle Press.

Clark, D. W., et al., 1990, Ground-water Resources and Simulated Effects of Withdrawal in the East Shore Area of the Great Salt Lake, Utah; Utah Department of Natural Resources, Technical Publication No. 93, 150 p.

EDG, 1999a, Workplan for the Demolition and Removal of the Former SPRR Wastewater Treatment Plant & Ponds; Environmental Decision Group, Boulder, CO, May 5, 1999, 15 p. + Append.

EDG, 1999b, Phase I Remedial Investigation Report, Union Pacific Railroad, Ogden, Utah; revised draft 1-28-99: Environmental Decision Group, Inc., Boulder, CO, 76p.

E&E, 1994, Sampling Activities Report for the Union Pacific Ogden Rail Yard Site; Ecology and Environment Inc., prepared for USEPA, November 10, 1994, 4 p. + Append.

E&E, 1990, Preliminary Assessment Report Southern Pacific Transport Ogden, Utah; Ecology and Environment Inc., prepared for USEPA, February 12, 1990, 8p + Append.

EPA, 2003a, Baseline Human Health Risk Assessment for the Ogden Rail Yard Site, Ogden Utah; USEPA Region 8 and Syracuse Research Corporation, Denver Colorado, January 2003.

EPA, 2003b, Baseline Ecological Risk Assessment for the Ogden Rail Yard Site, Ogden Utah; USEPA Region 8 and Syracuse Research Corporation, Denver Colorado, January 2003.

EPA, 2002, Phase 3 Field Sampling Summary Report in Support of Risk Assessment at the Ogden Rail Yard Site, Ogden Utah; USEPA, Region 8, prepared by Syracuse Research Corporation, Denver Colorado, October 2002.

EPA, 2001a, Sampling and Analysis Plan to Support Human and Ecological Risk Assessment, Phase 3; US Environmental Protection Agency, Region 8, Denver, CO, July 18, 2001, 33 p. + Append.

EPA, 2001b, Final Field Sampling Report in Support of Risk Assessment at Ogden Rail Yard, Ogden, Utah; USEPA Environmental Response Team Center and REAC/ERT Lockheed Martin, February 2001, 17 p.

EPA, 2001c, Screening Level Ecological Risk Assessment, Ogden Railyard, Ogden, Utah; Prepared for USEPA Region 8 by Syracuse Research Corporation, Denver, CO, March 5, 2001.

EPA, 2001d, Phase 3 Field Sampling Summary Report in Support of Risk Assessment at Ogden Rail Yard, Ogden, Utah; Prepared for USEPA Region 8 by Syracuse Research Corporation, Denver, CO, December 7, 2001.

EPA, 1999a, Sampling and Analysis Plan to Support Human and Ecological Risk Assessment for the Ogden Rail Yard; US Environmental Protection Agency, Region 8, Denver, CO, December 21, 1999, 40 p. + appendices.

EPA, 1999b, Letter from J. Mario Robles (EPA) to Gary Honeyman (UPRR); listing Maximum Acceptable Detection Limits, February 25, 1999, 3 p.

EPA, 1999c, Comments on the Draft Phase I Remedial Investigation Report for the Union Pacific Railyard at Ogden, Utah – January 28,1999; Letter from J. Mario Robles (EPA) to Gary Honeyman (UPRR), April 1, 1999, 17 p.

EPA, 1999d, Comments on the Phase 2 RI/FS Work Plan, Sampling and Analysis Plan, and Quality Assurance Project Plan for the Ogden Railyard Site; Letter from Mario Robles, EPA to Gary Honeyman, September 15, 1999, 33 p.

EPA, 1998a, Letter from J. Mario Robles (USEPA, Region 8) to Harry Patterson and Gary Honeyman (UPRR); listing Draft Final Screening Level Risk-based Concentrations (RBCs) for soil and Water for the Ogden Rail Yard Phase I Remedial Investigation, November 23, 1998, 22p.

EPA, 1998, technical Protocol for Evaluating Natural Attenuation of Chlorinated solvent in Groundwater; EPA/600/R-98/128.

EPA, 1995, Administrative Order on Consent for Removal Action; USEPA Region VIII, In the Matter of the Impoundment Area at the Ogden Union Railway and Depot Site, Site No. 6E, EPA Docket No. CERCLA-VIII-96-10.

EPA, 1992, Estimating Potential for Occurrence of DNAPL at Superfund Sites; R.S. Kerr Environmental Research Laboratory, Office of Solid Waste and Emergency Response, Publication: 9355.4-07 FS.

EPA, 1980, Ambient Water Quality Criteria for Lead; USEPA, Office of Water Regulations and Standards, Criteria and Standards Division, Washington, DC, October 1980, EPA 440/5-80-057.

ERM, 2000, Corrective Action Plan – SPRR UST No. 3, Release EKCP; Environmental Resources Management, Salt Lake City, Utah, June 23, 2000, 9 p. + appendices.

FEMA, 1995, Flood Insurance Rate Map, City of Riverdale Utah, Weber County; National Flood Insurance Program, Federal Emergency Management Agency, September 6, 1995, Panel no. 490190 0001D.

FEMA, 1983, Flood Insurance Rate Map, City of Ogden Utah, Weber County; National Flood Insurance Program, Federal Emergency Management Agency, Panel 3 of 8 and 5 of 8, January 19, 1983, Panel nos. 490189 0003B and 0005B.

Feth et al., 1966, Lake Bonneville: Geology and Hydrology of the Weber Delta District including Ogden, Utah; USGS Professional Paper 518.

Forrester Group, 2002a, Work Plan for Removal Action, Former Ogden Pond Area Closure, UP Rail Yard Site, Ogden Utah, *draft*; The Forrester Group, Arvada, CO, February, 2002.

Forrester Group, 2002b, Removal Action Plan, AOI-34; The Forrester Group, Arvada, CO, letter to J. Mario Robles, EPA, 5 p. + attachments, February 19, 2002.

Forrester Group, 2001a, Remedial Investigation Report, Ogden Rail Yard, Northern Area, Union Pacific Railroad Company, Ogden, Utah, *draft/final*; The Forrester Group, Arvada, CO, July 9, 2001.

Forrester Group, 2001b, Interim Remedial Action Assessment, 21st Street Pond, Ogden, Utah; The Forrester Group, Arvada, CO, March 16, 2001.

Forrester Group, 2001c, Draft/Final Site Management Plan, Ogden Rail Yard, Ogden, Utah; The Forrester Group, Chesterfield, MO, November 29, 2001.

Forrester Group, 2001d, Characterization Work Plan Sludge and Underlying Soil, Former SPRR Waste Water Treatment Plant, Phase II RI Work Plan Addendum 3, Ogden Rail Yard, Ogden, Utah; The Forrester Group, Arvada CO, September 10, 2001.

Forrester Group, 2001e, Data Summary Report, Samples Collected Through December 2000, Union Pacific Railroad Company, Ogden, Utah; The Forrester Group, Arvada, CO, February 13, 2001.

Forrester Group, 2001f, Data Summary Report, Samples Collected January-February 2001, Union Pacific Railroad Company, Ogden, Utah; The Forrester Group, Arvada, CO, July 2, 2001.

Forrester Group, 2001g, Data Summary Report, GeoProbe Samples Collected May 2001, Union Pacific Railroad Company, Ogden, Utah; The Forrester Group, Arvada, CO, August 13, 2001.

Forrester Group, 2001h, Data Summary Report, Groundwater Samples Collected May 2001, Union Pacific Railroad Company, Ogden, Utah; The Forrester Group, Arvada, CO, August 21, 2001.

Forrester Group, 2001i, Data Summary Report, Groundwater Samples Collected September 2001, Union Pacific Railroad Company, Ogden, Utah; The Forrester Group, Arvada, CO, December 10, 2001.

Forrester Group, 2000a, RI/FS Work Plan Addendum 2, AOI-33, 21st Street Pond, Union Pacific Rail Yard, Ogden Utah, CERCLA-8-99-12, *final*; The Forrester Group, Arvada, CO, November 13, 2000.

Forrester Group, 2000b, Data Summary Report, Samples Collected Through July 2000, Union Pacific Railroad Company, Ogden, Utah; The Forrester Group, Arvada, CO, December 19, 2000.

Howard, P.H., et al, 1991, Handbook of Environmental Degradation Rates; CRC Press LLC, Boca Raton, FL.

Huntley, D., 2000, Analytic Determination of Hydrocarbon Transmissivity From Baildown Tests; Groundwater, Vol. 38, No. 1, p. 46-52.

LES, 1998, Addendum 3 to Phase I Remedial Investigation Workplan, UPRR Ogden, Utah Facility; Laidlaw Environmental Services, Prepared for Union Pacific Railroad, March 9, 1998, 13 p. + Append.

LES, 1997a, Final Workplan Phase I Remedial Investigation, UPRR Ogden, Utah Facilities; Laidlaw Environmental Services, Prepared for Union Pacific Railroad, November 19, 1997, 47 p. + Append.

LES, 1997b, Addendum I to Phase I Remedial Investigation Workplan, UPRR Ogden, Utah Facility; Laidlaw Environmental Services, Prepared for Union Pacific Railroad, September 19, 1997, 4 p.

LES, 1997c, Addendum 2 to Phase I Remedial Investigation Workplan, UPRR Ogden, Utah Facility; Laidlaw Environmental Services, Letter to Region VIII EPA, September 29, 1997, 2 p.

Lockheed Martin, 1997a, A Sampling and Analysis Approach for the Ogden Railyard, Ogden, Utah; Prepared for U.S. EPA by Lockheed Martin Services Group, Las Vegas, NV, March 24, 1997, 26 p, Contract No. 68-C5-0091.

Lockheed Martin, 1997b, Aerial Photographic Analysis, Ogden Railroad Yard Site, Ogden, Utah; Prepared for U.S. EPA by Lockheed Martin Services Group, Las Vegas, NV, Draft version, April 1997, 34 p, Contract No. 68-C5-0065.

Morrison-Knudsen, 1988, Investigations and Soil Removal at Ogden Yard; Morrison-Knudsen Engineers, Boise, ID, August 26, 1988, 17 p. + Append.

Price, Don, 1985, Ground Water in Utah's Densely Populated Wasatch Front Area – the Challenge and the Choices; US Geological Survey Water-Supply Paper 2232, 71 p.

REAC, 2000, Supplemental Field Sampling Plan for Work Assignment No. 0-119, Ogden Rail Yard; Prepared for US Environmental Protection Agency by Lockheed Martin REAC, Edison, N.J., April 28, 2000.

Safety-Kleen, 2000a, Phase II Remedial Investigation and Feasibility Study Work Plan, UPRR Ogden Rail Yard, Ogden, Utah; Safety-Kleen Environmental Services Inc, Boulder, CO, February 15, 2000, 68 p. + appendices.

Safety-Kleen, 2000b, Phase II RI Field Sampling Plan, UPRR Ogden Rail Yard, Ogden, Utah; Safety-Kleen Environmental Services Inc, Boulder, CO, February 15, 2000, 46 p. + appendices.

Safety-Kleen, 2000c, Quality Assurance Project Plan, UPRR Ogden Rail Yard, Ogden, Utah; Safety-Kleen Environmental Services Inc, Boulder, CO, January 7, 2000, 66 p. + appendices.

Safety-Kleen, 2000d, RI/FS Work Plan Addendum 1, AOI-33, 21st Street Pond, Union Pacific Rail Yard, Ogden Utah; Safety-Kleen Consulting, Boulder, CO, April 11, 2000, 6 p. + Appendices.

Safety-Kleen, 2000e, Corrective Action Plan, Soil Remediation, Well Installation, and Monitoring, Union Pacific Railroad LUST Site Tanks 3 and 4; Safety-Kleen Consulting, Boulder, CO, September 2000, 7 p. + Appendices.

Safety-Kleen, 2000f, Sludge Removal AOI-34 Pond, UPRR Ogden Rail Yard, CERCLA-8-99-12; Letter to Mario Robles, USEPA Region 8, August 16, 2000, 2 p.

Safety-Kleen, 1999, Revised Screening Level Comparisons, Phase I RI Data, UPRR Ogden Utah, EPA Docket No. CERCLA-8-99-12; Letter to Mario Robles with Table Attachments, August 4, 1999.

Safety-Kleen, 1998, Phase I RI Report UPRR Railroad, Ogden, Utah, *draft*; Safety-Kleen Environmental Services Inc, Boulder, CO, September 1998, 59 p. + appendices.

Sargent, Hauskins & Beckwith, 1992a, Phase I Environmental Assessment, Proposed Halfway House Facility, DRGW Site; February 7, 1992, SHB Job No. E12396.

Sargent, Hauskins & Beckwith, 1992b, Phase II Environmental Assessment, Soil and Groundwater Sampling, DRGW Site; May 28, 1992, SHB Job No. E92-2119, 11 p.

Schmidt, C.E., 1999, Work Plan for Surface Flux Chamber Testing at the Union Pacific Rail Yard Site Located in Ogden, Utah, November 1999.

UDEQ/USEPA, 1999, Ogden Rail Yard Site, Community Involvement Plan; Utah Department of Environmental Quality and US Environmental Protection Agency, August 1999, 35 p. + appendix.

UDEQ, 1999, Analytical Results Report, Ogden Gas Company Site, UT0000248997, Weber County, Utah; Utah Department of Environmental Quality, DERR, prepared by Keetley, J. D., January 1999.

UDEQ, 1994a, Analytical Results Report Ogden Union Railway Depot UT988075271; Utah Department of Environmental Quality, May 25, 1994, 16 p. + Append.

UDEQ, 1994b, Analytical Results Report Union Pacific Railroad Yard; Department of Environmental Response & Remediation (DERR), UTD988075339; April 19, 1994, 16 p. + Append.

UDEQ, 1993, Preliminary Assessment Ogden Union Railway Depot Site, UTD988075271; Utah Department of Environmental Quality, February 17, 1993, 7 p. + Append.

UDEQ, 1992a, Analytical Results Report Southern Pacific Transport, Weber County Utah, UTD000716407, April 7, 1992, 22p. + Append.

UDEQ, 1992b, Preliminary Assessment, Union Pacific Railroad Yard, 1992.

URS, 1998, Analytical Results Report, Weber County Solid Waste Transfer Station, Ogden, Utah; URS Operating Systems, START, EPA Region VIII, March 2, 1998, 41 p. + Append.

USFWS, 1999, Ogden Rail Yard Site: Threatened and Endangered Species, Species of Special Concern, and Endangered Species Act Section 7 Consultation; US Fish and Wildlife Service letter to J Mario Robles (EPA), January 20, 1999.

USPCI, 1996, Final Report, Pond Closure Ogden, Utah; USPCI, Boulder, CO, June 13, 1996, 7 p. + Append.

USPCI, 1995, Summary Report UPRR Depot Site Investigation Ogden, Utah; USPCI, Boulder, CO, March 10, 1995, 16 p. + Append.

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U.P.R.R. RAILYARD - OGDEN, UTAH

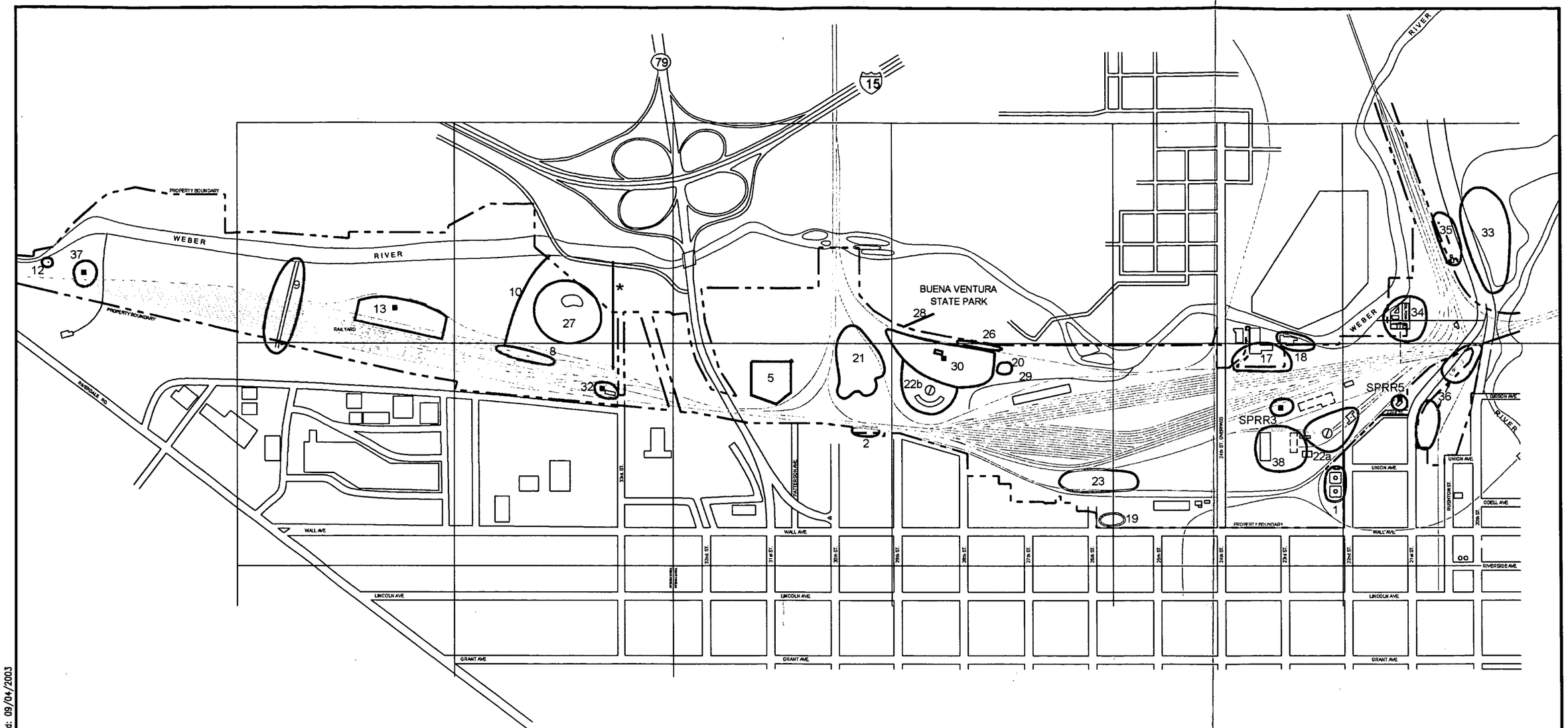
FIGURE 1-1

RAIL YARD LOCATION MAP

SCALE: 1" = 2000'

DATE: 3/22/02

M:\clien REST\Ogden\RI-2002\1329-topo-base.dwg plotted: 09/02/2003




## LEGEND

- RI/FS SITE BOUNDARY
- (30) RI/FS AREA OF INTEREST
- ■ LUST LOCATIONS
- * 33rd. ST. SLOUGH

North

0 1200

FEET

| | BY | DATE |
|---|---|---|
| DRAWN | WRB | 1/3/2000 |
| CHECKED | | |
| APPROVED | | |
| APPROVED | | |
| APPROVED | | |

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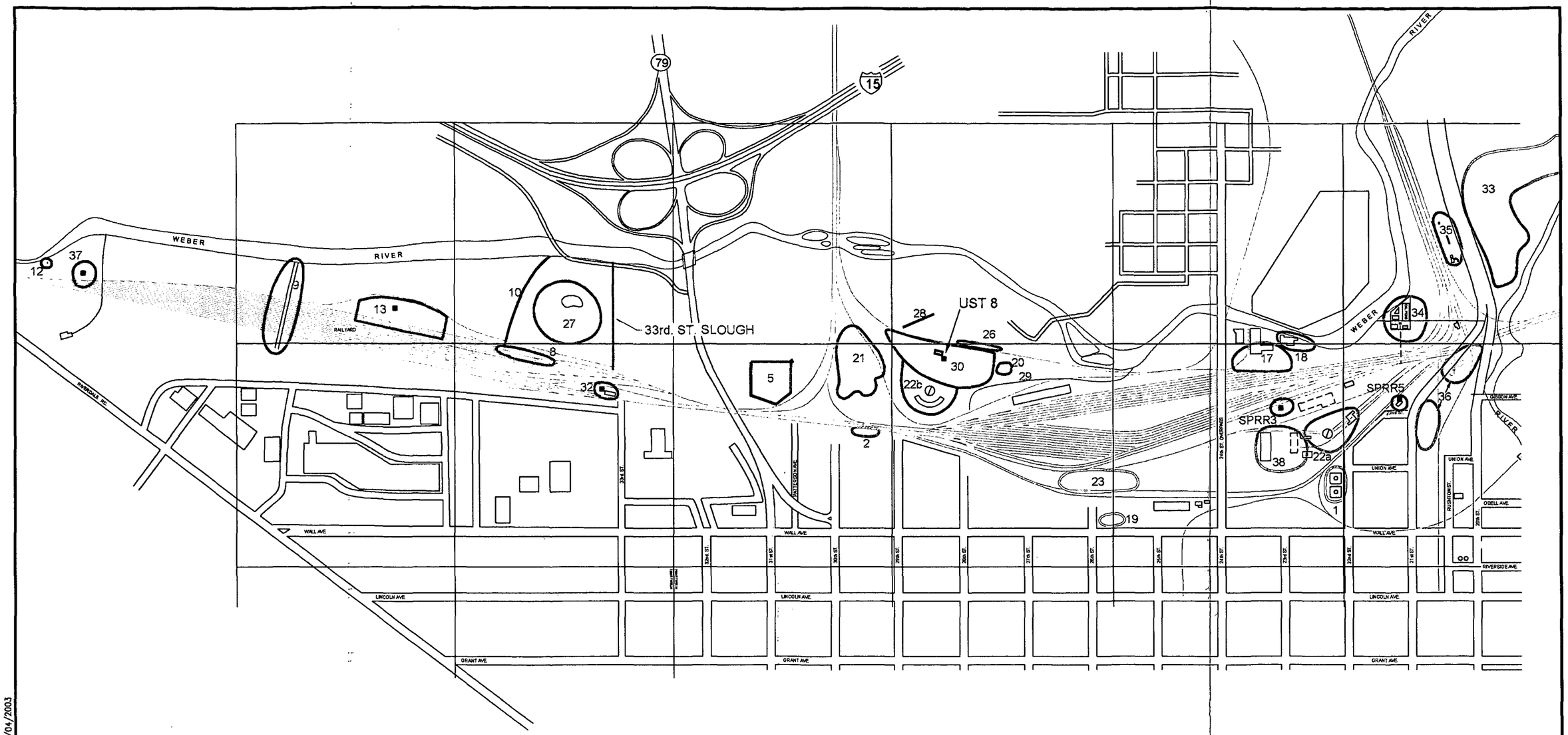
OGDEN RAILYARD - OGDEN, UTAH

FIGURE 1-2
SITE BOUNDARY

SCALE: 1" = 1200'

DWG. NO.: 1329-RI-SITEBOUND.dwg

M:\clients\FORREST\Ogden\RI-2002\1329-RI-SITEBOUND.dwg plotted: 09/04/2003




## LEGEND

30 RI/FS AREA OF INTEREST

■ LUST LOCATIONS

North

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# OGDEN RAILYARD - OGDEN, UTAH

## FIGURE 1-3
## AREA OF INTEREST (AOI) IDENTIFICATION

SCALE: 1" = 1200'

DWG. NO.: 1329-RI-AOI

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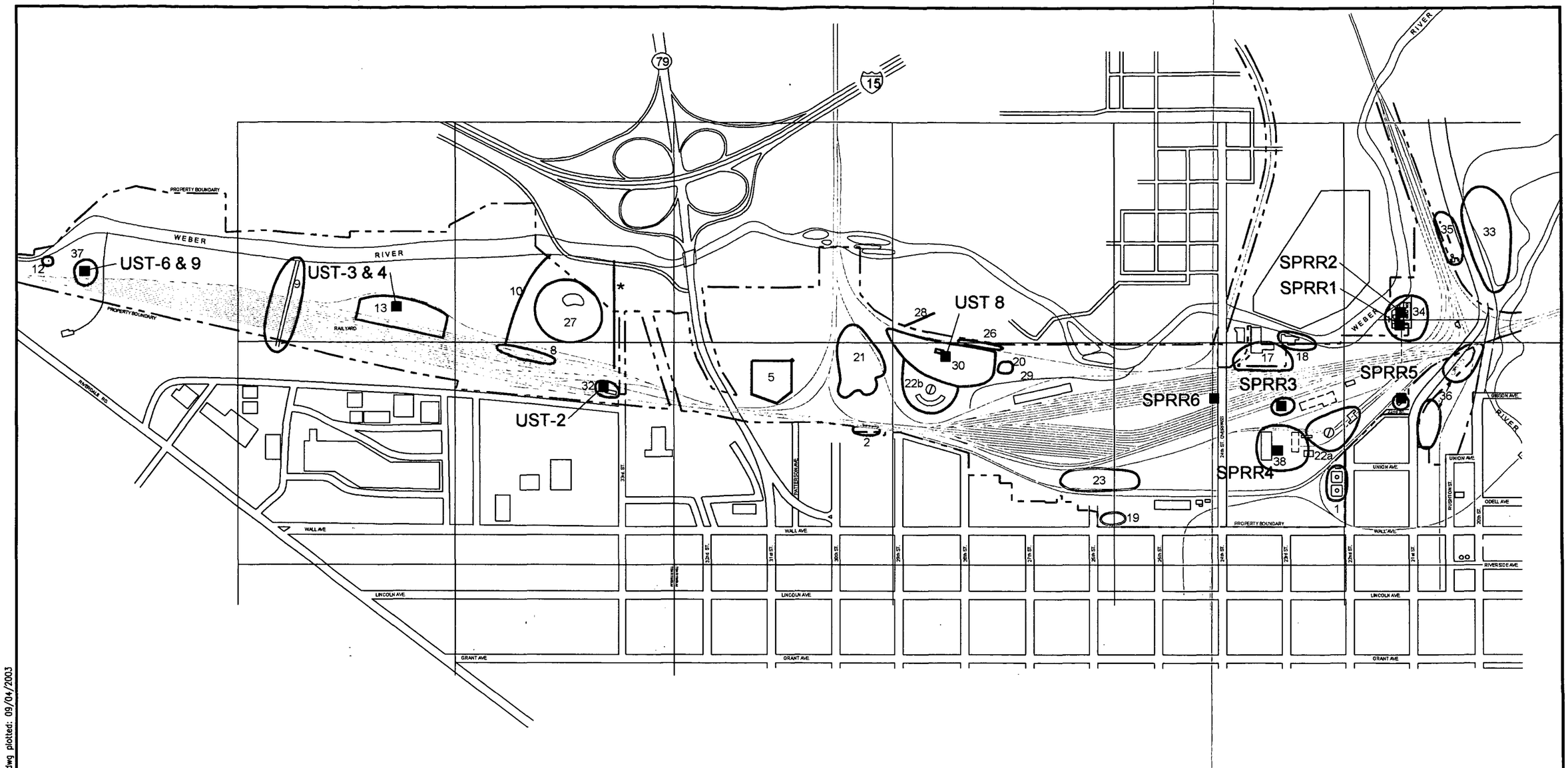


## LEGEND

- RI/FS SITE BOUNDARY
- (30) RI/FS AREA OF INTEREST
- ■ LUST LOCATIONS
- * 33rd. ST. SLOUGH

North

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| | BY | DATE |
|---|---|---|
| DRAWN | WRB | 1/3/2000 |
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FIGURE 1-4

UST LOCATION MAP

SCALE: 1" = 1200'

DWG. NO.: 1329-RI-UST-LOCS.dwg

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# TARGET SHEET

EPA REGION VIII

SUPERFUND DOCUMENT MANAGEMENT SYSTEM

DOCUMENT NUMBER: 2011803

SITE NAME: OGDEN RAILROAD YARD

DOCUMENT DATE: 09/01/2003

## DOCUMENT NOT SCANNED

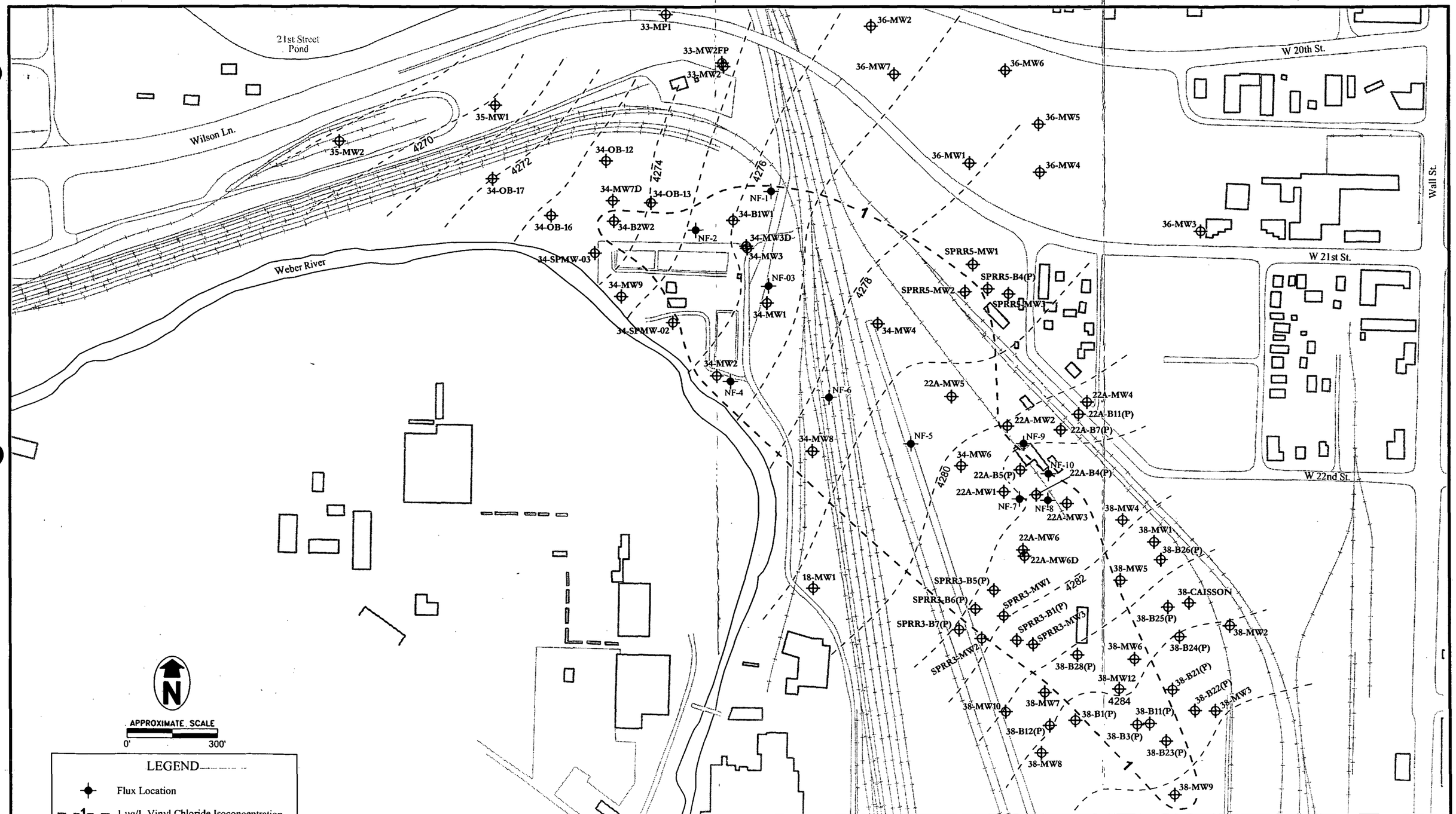
Due to one of the following reasons:

- ☐ PHOTOGRAPHS
- ☐ 3-DIMENSIONAL
- ☑ OVERSIZED
- ☐ AUDIO/VISUAL
- ☐ PERMANENTLY BOUND DOCUMENTS
- ☐ POOR LEGIBILITY
- ☐ OTHER
- ☐ NOT AVAILABLE
- ☐ TYPES OF DOCUMENTS NOT TO BE SCANNED
  (Data Packages, Data Validation, Sampling Data, CBI, Chain of Custody)

DOCUMENT DESCRIPTION:

PLATE 2-1 Sampling Locations Northern Yard Area
PLATE 2-2 Sampling Locations Central Yard Area
PLATE 2-3 Sampling Locations Southern Yard Area

Contact the Superfund Records Center to view available document.
(303) 312-6473

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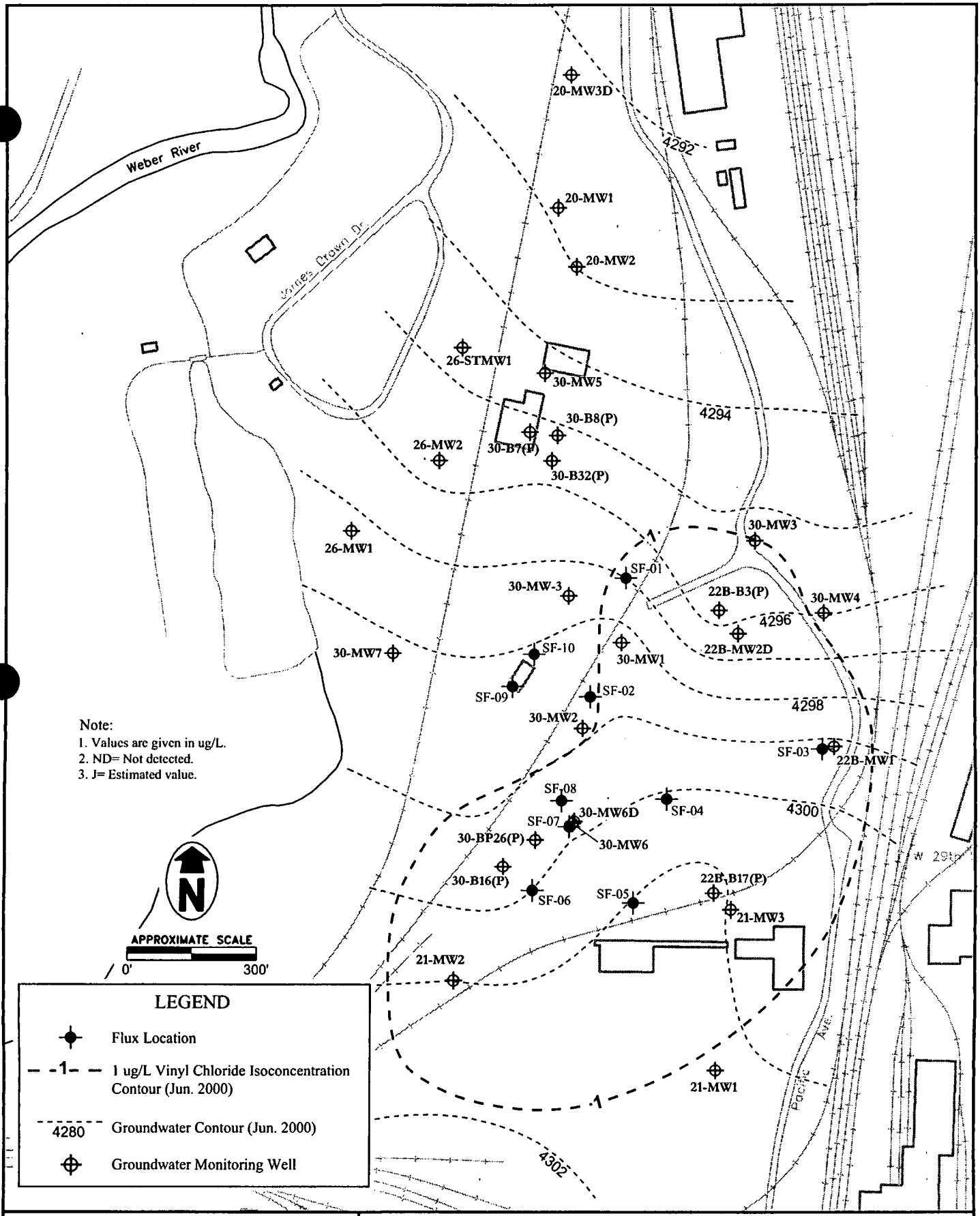
TITLE:

**FIGURE 2-4**
**AIR & SOIL VAPOR SAMPLING LOCATIONS**
**NORTH CVOC PLUME**

1330-00

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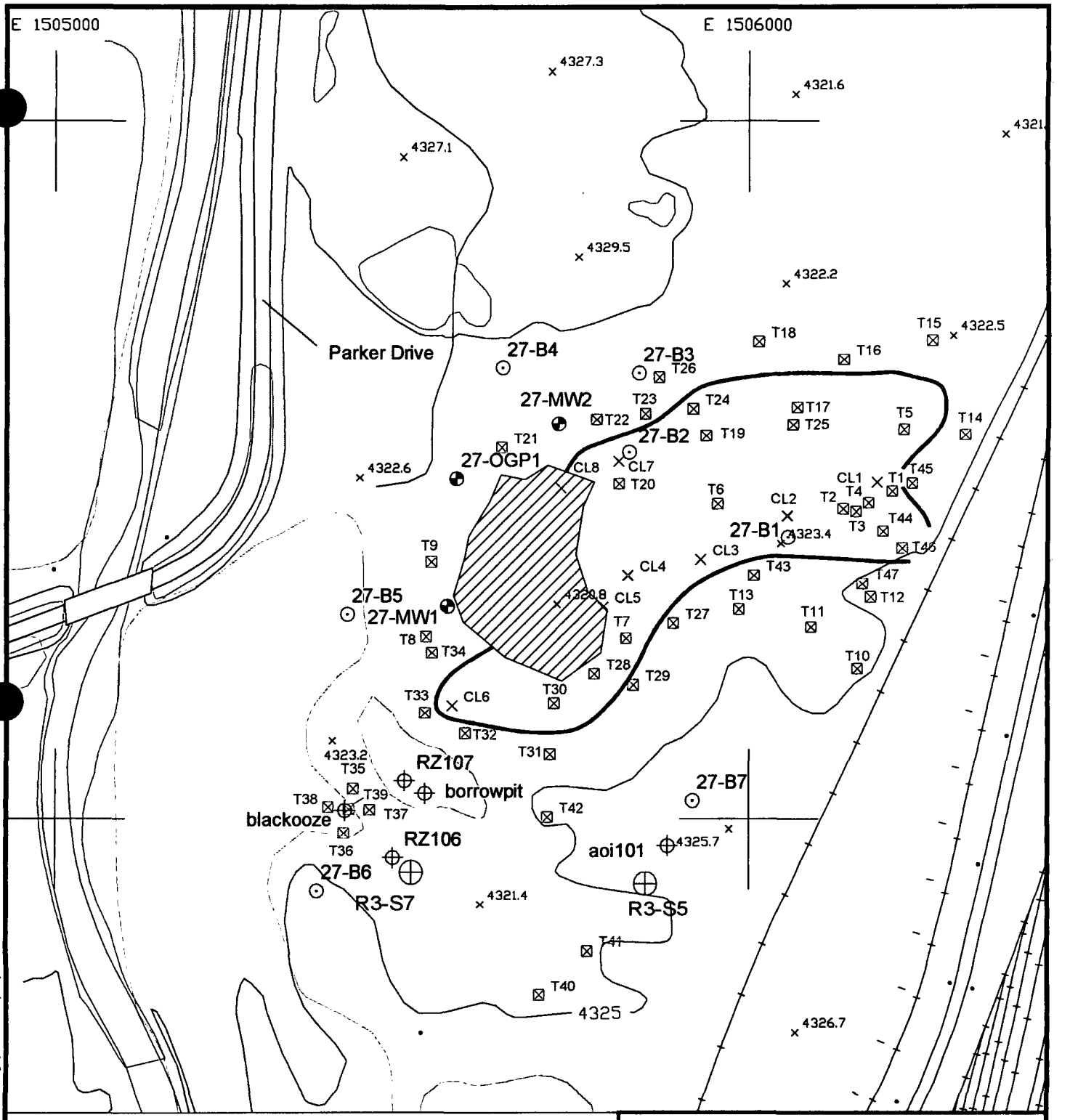
ENVIRONMENTAL MANAGEMENT & PLANNING

TITLE:

**FIGURE 2-5**
**AIR AND SOIL VAPOR SAMPLING LOCATIONS**
**SOUTH CVOC PLUME**

1330-00


E 1505000
E 1506000
4327.3
4321.6
4327.1
4329.5
4322.2
4322.5
Parker Drive
27-B4
27-B3
T26
T18
T16
T15
27-MW2
T23
T24
T22
T17
T25
T5
T14
27-B2
T19
T21
27-OGP1
CL8
CL7
T20
4322.6
T45
CL1
T1
T4
T2
T6
CL2
T44
T3
27-B1
4323.4
T46
T9
CL3
CL4
T43
T47
T12
27-B5
27-MW1
4328.8
CL5
T13
T27
T11
T7
T8
T34
T10
T28
T29
T30
T33
CL6
T32
T31
4323.2
T35
RZ107
borrowpit
27-B7
T38
T39
T37
T42
blackooze
T36
RZ106
aoi101
4325.7
27-B6
R3-S7
4321.4
R3-S5
T41
T40
4325
4326.7
LEGEND
CL4 CONTROL LINE
T40 TRENCH & ID
LIMIT OF SLUDGE
PREVIOUS EXCAVATION
North
0
200
SCALE IN FEET
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U.P.R.R. YARD - OGDEN, UTAH
FIGURE 2-6
AOI-27
PREVIOUS SAMPLING LOCATIONS
SCALE:
1" = 200'
DATE:
9/20/01
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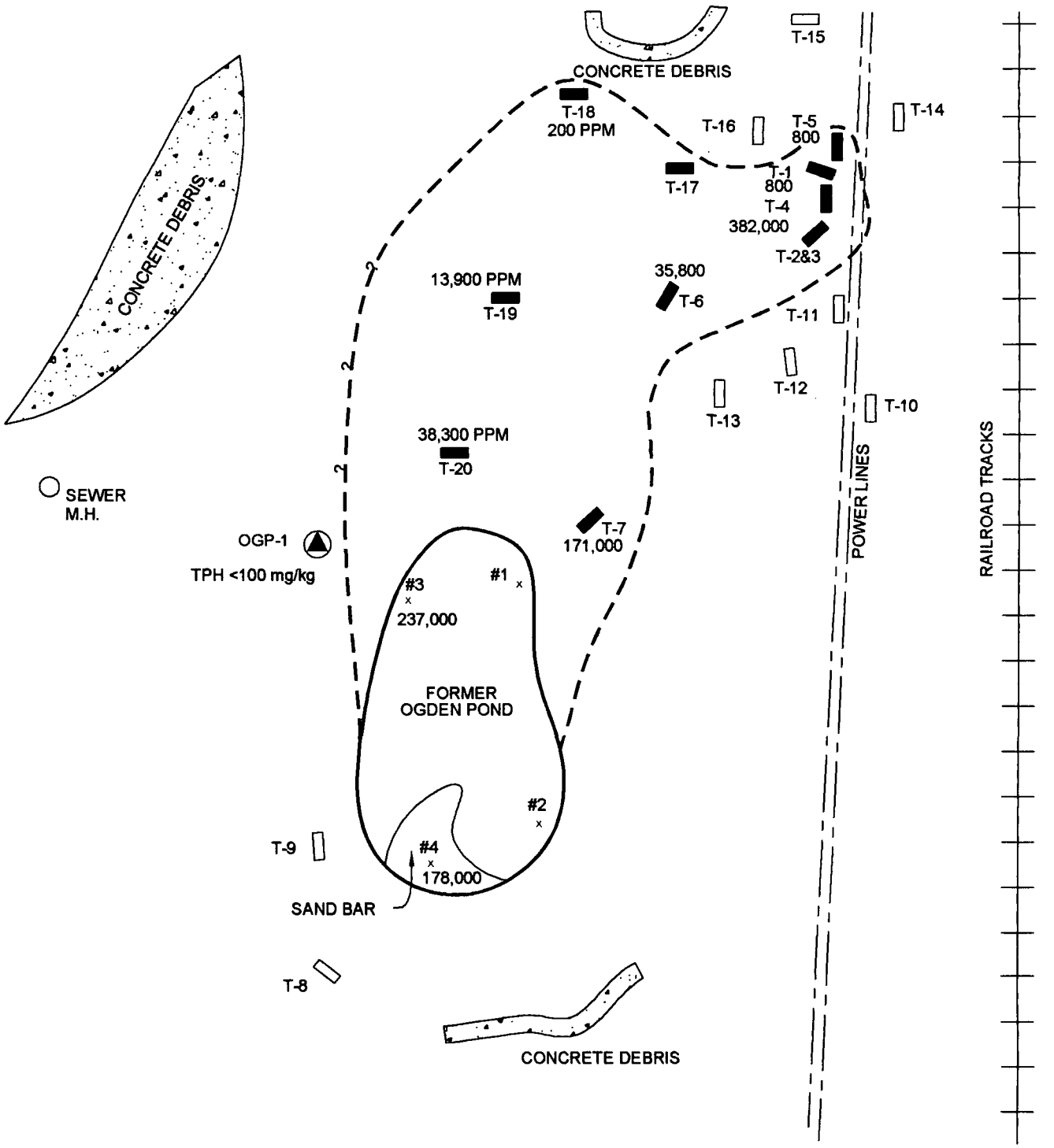


## LEGEND

- MONITORING WELL
- TEST PIT WITH TPH <100 mg/kg
- TEST PIT SHOWING HYDROCARBONS
- APPROXIMATE EXTENT OF CONTAMINATION AS DEFINED BY USPCI, 1995

North

0 100
SCALE IN FEET

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FIGURE 2-7
EXTENT OF TPH CONTAMINATION
AOI-27

SCALE: 1" = 100'
DATE: 2/6/02

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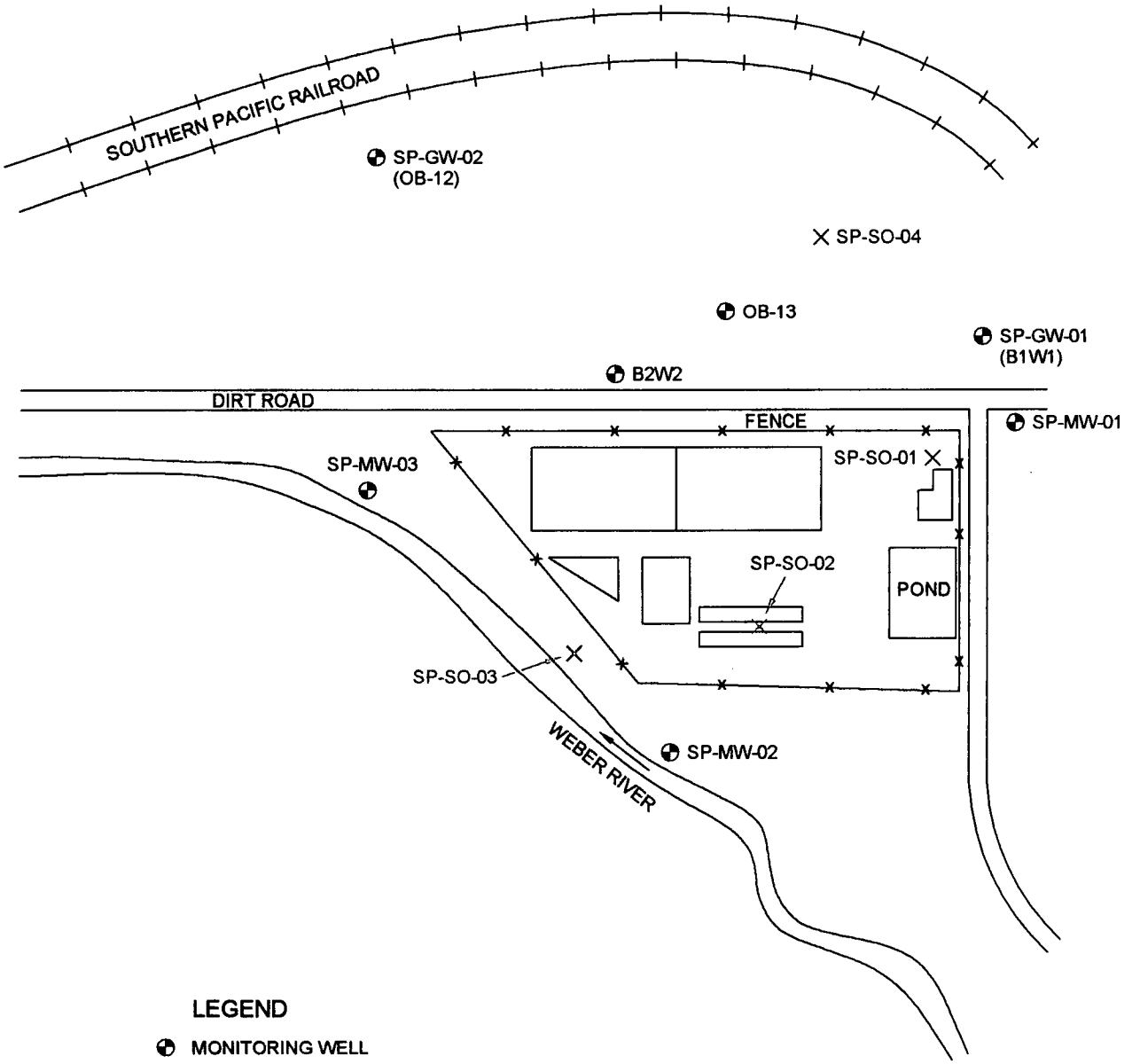


**LEGEND**

- MONITORING WELL
- SAMPLE LOCATION

North

ADAPTED FROM UDEQ, 1992a

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FIGURE 2-8
SPT TREATMENT FACILITY-AOI #34
PREVIOUS SAMPLE LOCATIONS

| SCALE: | DATE: |
|---|---|
| NTS | 3/18/02 |

M:\clients\...T\Ogden\RI-2002\AOI-34-SPT.dwg plotted: 09/02/2003

# Color Map(s)

The following pages contain color that does not appear in the scanned images.

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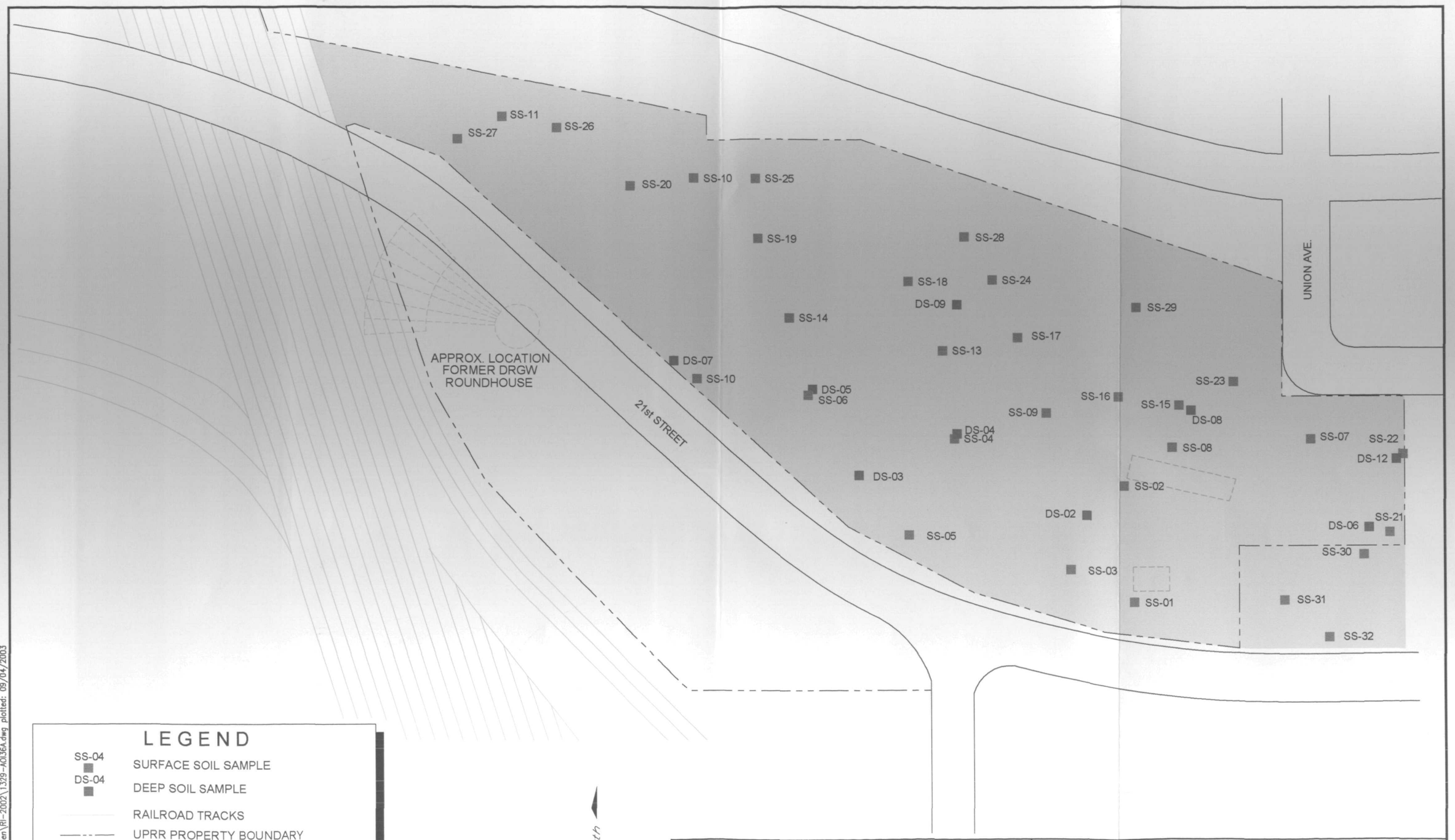


| | BY | DATE |
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| DRAWN | FR | 3/20/02 |
| CHECKED | | |
| APPROVED | | |
| APPROVED | | |
| APPROVED | | |

THE FORRESTER GROUP
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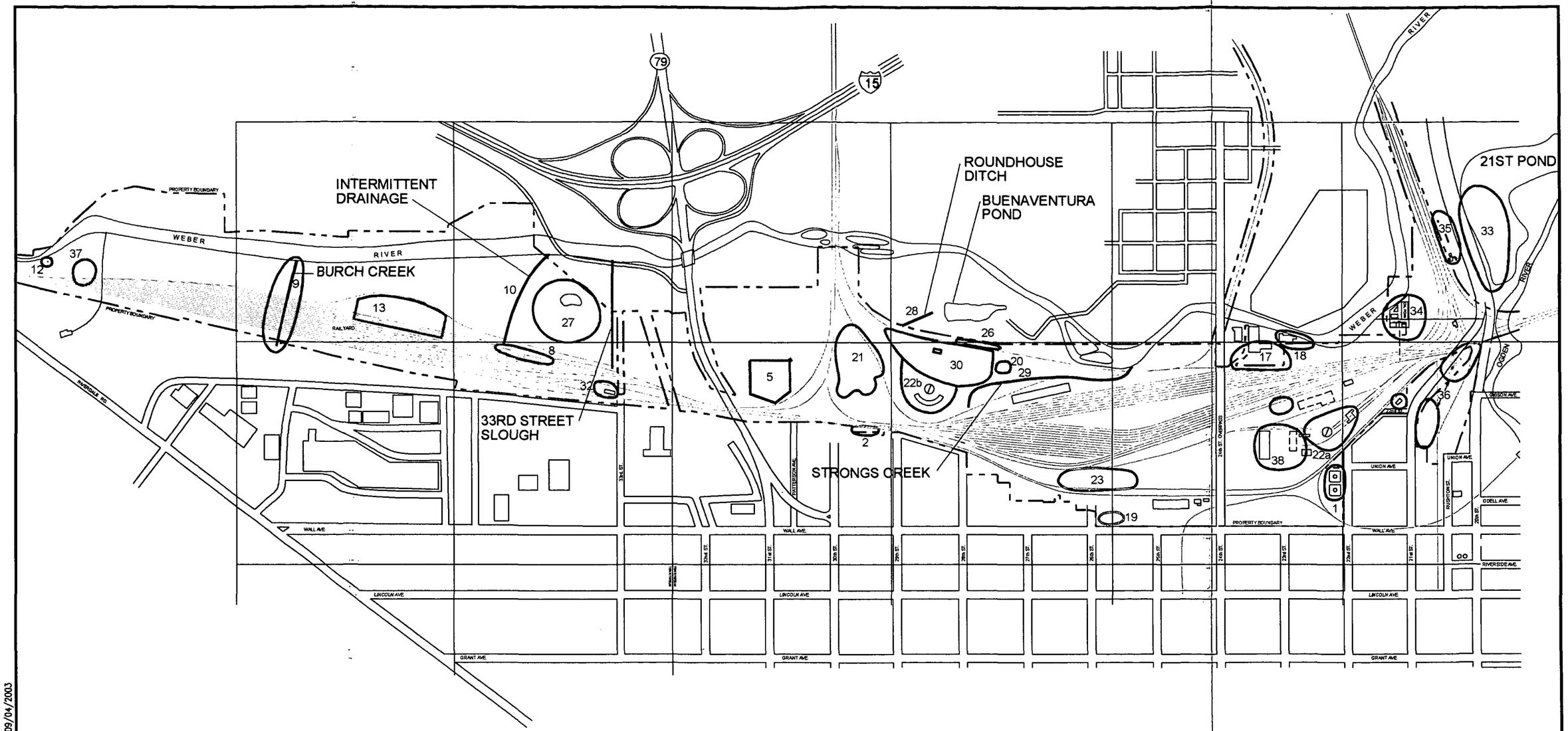
OGDEN RAILYARD - OGDEN, UTAH

FIGURE 2-9
AOI-36 URS (1988) SAMPLE LOCATIONS

SCALE: 1" = 120'

DWG. NO.: 1329-AOI36A.dwg

M:\clients\FORREST\Ogden\RI-2002\1329-AOI36A.dwg plotted: 09/04/2003




## LEGEND

- RI/FS SITE BOUNDARY
- (30) RI/FS AREA OF INTEREST
- SURFACE WATER FEATURE

North

0 1200

FEET

| | BY | DATE |
|---|---|---|
| DRAWN | WRB | 1/3/2000 |
| CHECKED | | |
| APPROVED | | |
| APPROVED | | |
| APPROVED | | |

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OGDEN RAILYARD - OGDEN, UTAH

FIGURE 3-1

SURFACE WATER FEATURES

SCALE: 1" = 1200'

DWG. NO.: 1329-RI-SWFEA.dwg

M:\clients\FORREST\Ogden\RI-2002\1329-RI-SWFEA.dwg plotted: 09/04/2003

# Color Chart(s)

The following pages contain color that does not appear in the scanned images.

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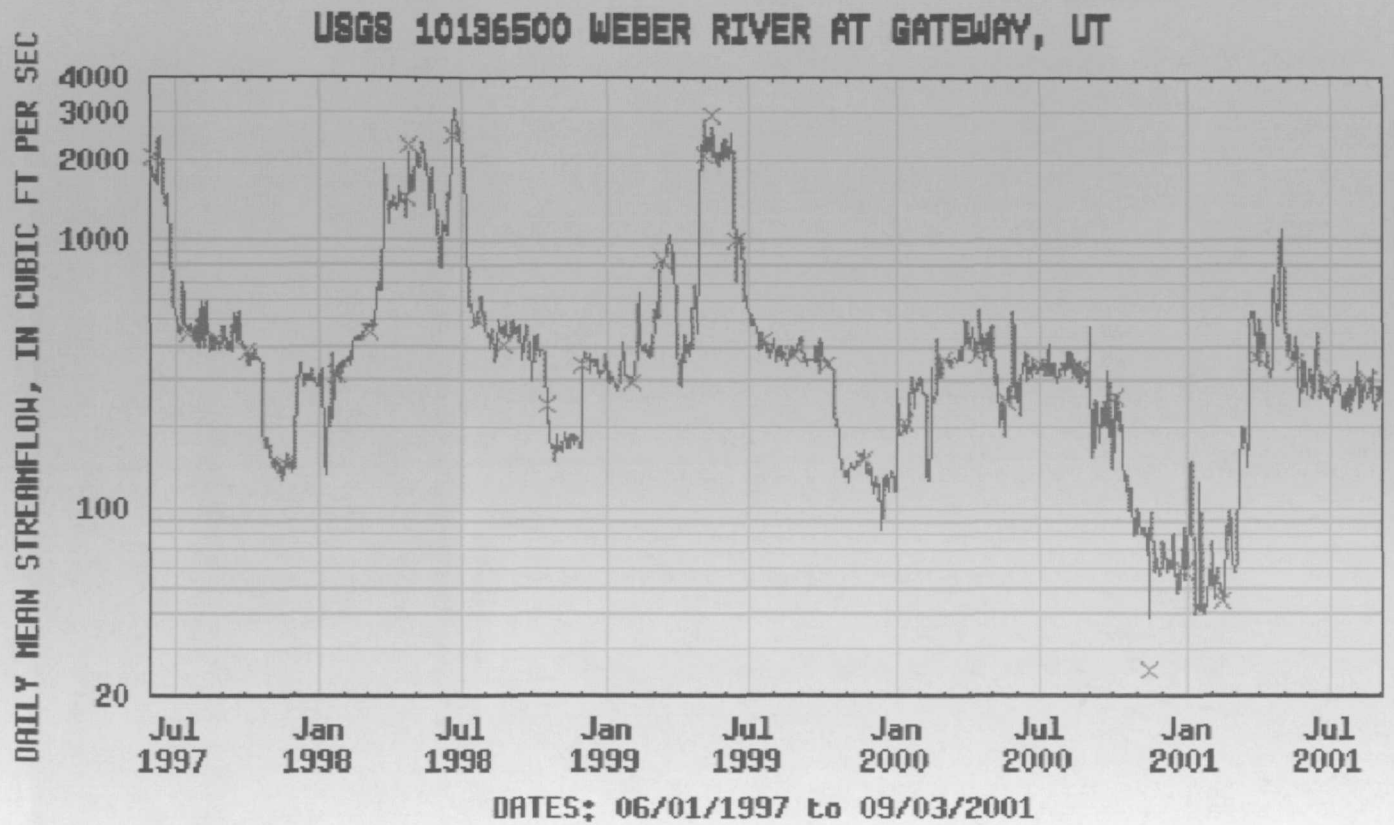
USGS




EXPLANATION

— DAILY MEAN STREAMFLOW × MEASURED STREAMFLOW — ESTIMATED STREAMFLOW

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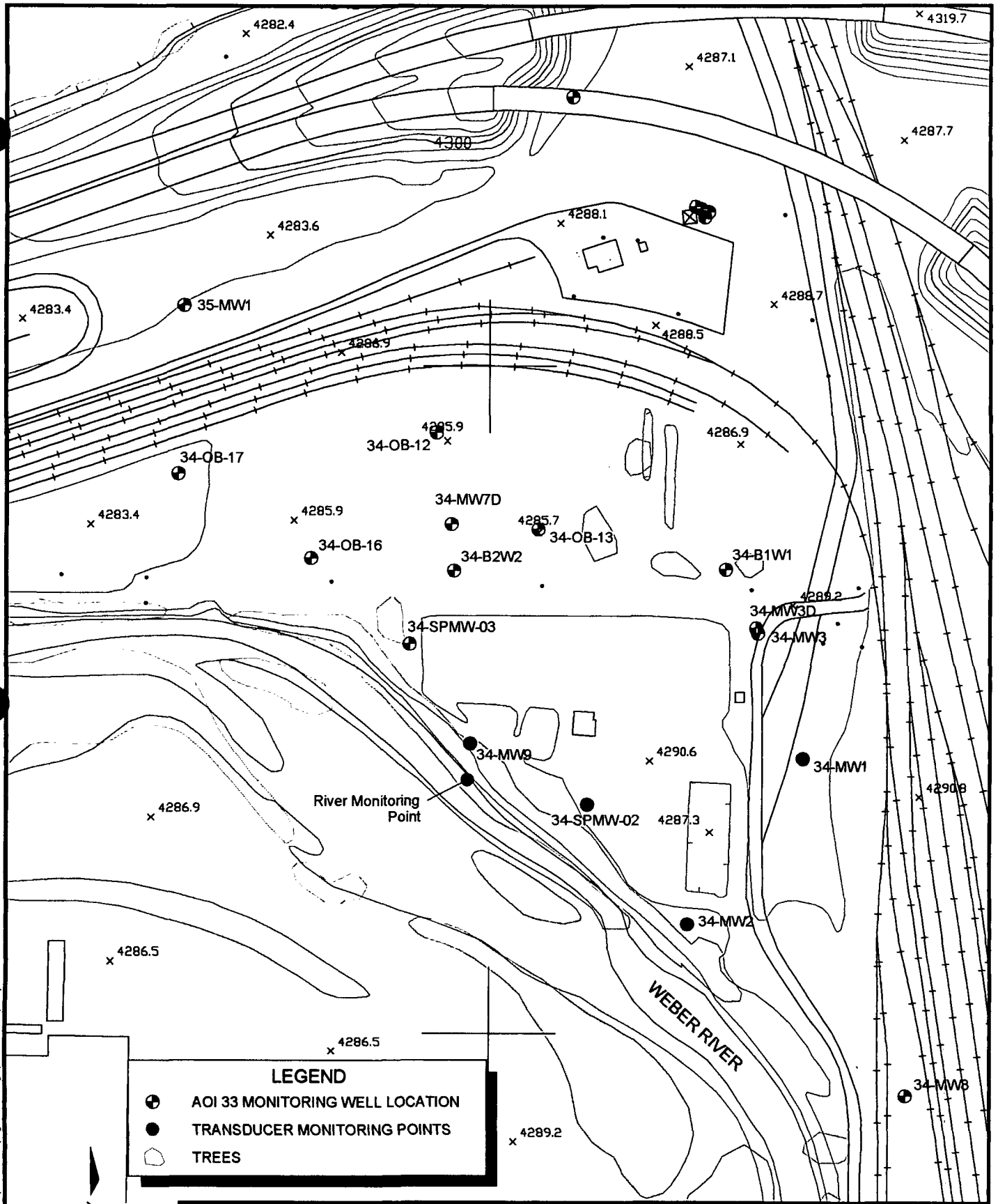
UPRR OGDEN, UTAH

FIGURE 3-2
WEBER RIVER HYDROGRAPH

| SCALE: | DATE: |
|---|---|
| AS SHOWN | 3/22/02 |

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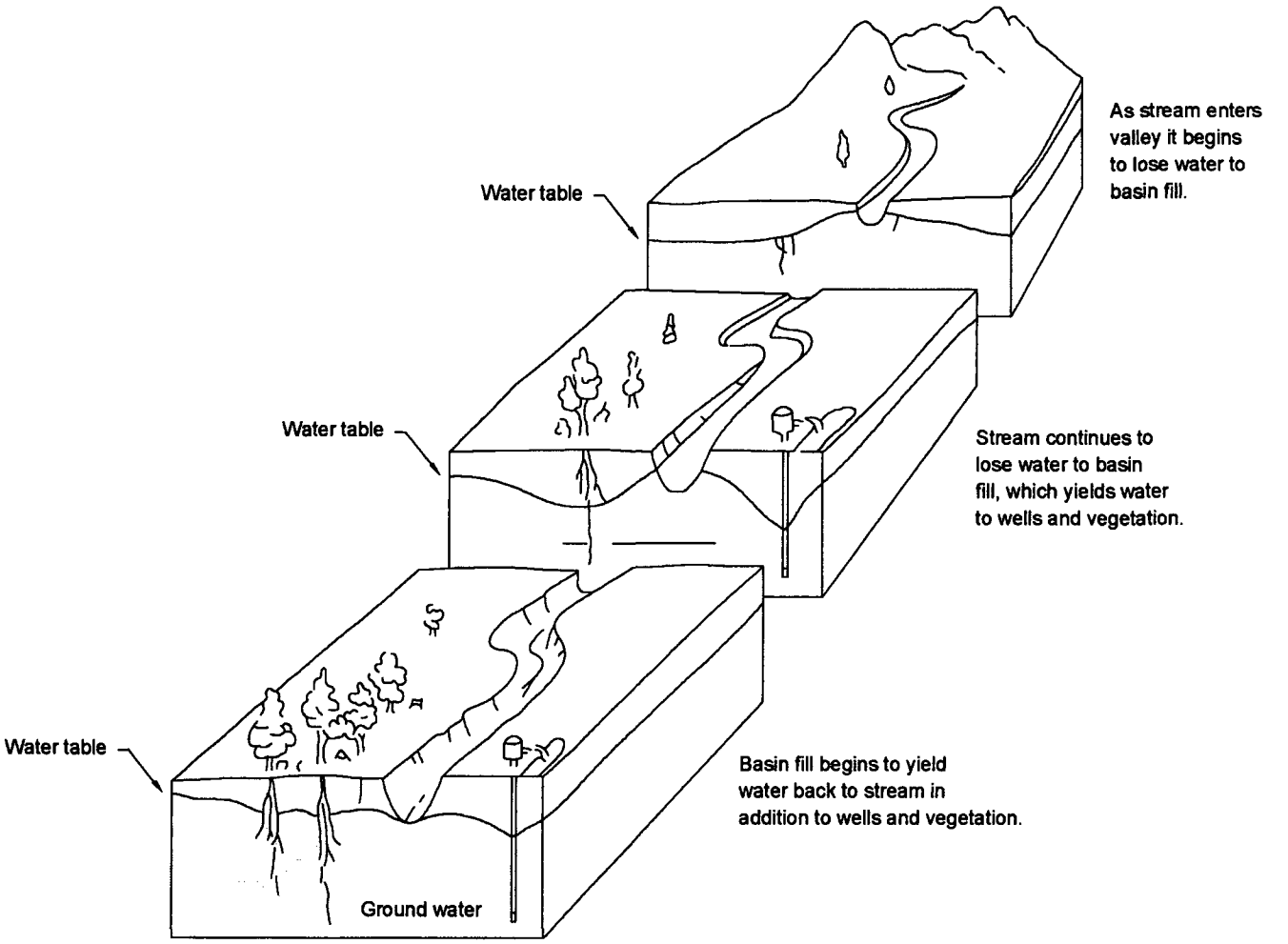
OGDEN RAILYARD- OGDEN, UTAH

FIGURE 3-3

TRANSDUCER LOCATION MONITORING POINTS

| SCALE: | DATE: |
|---|---|
| 1"=200' | 1/14/02 |

M:\clients\...EST\Ogden\RI-2003\Fig3-16.dwg plotted: 09/02/2003




Source: Price, 1985; Figure 34

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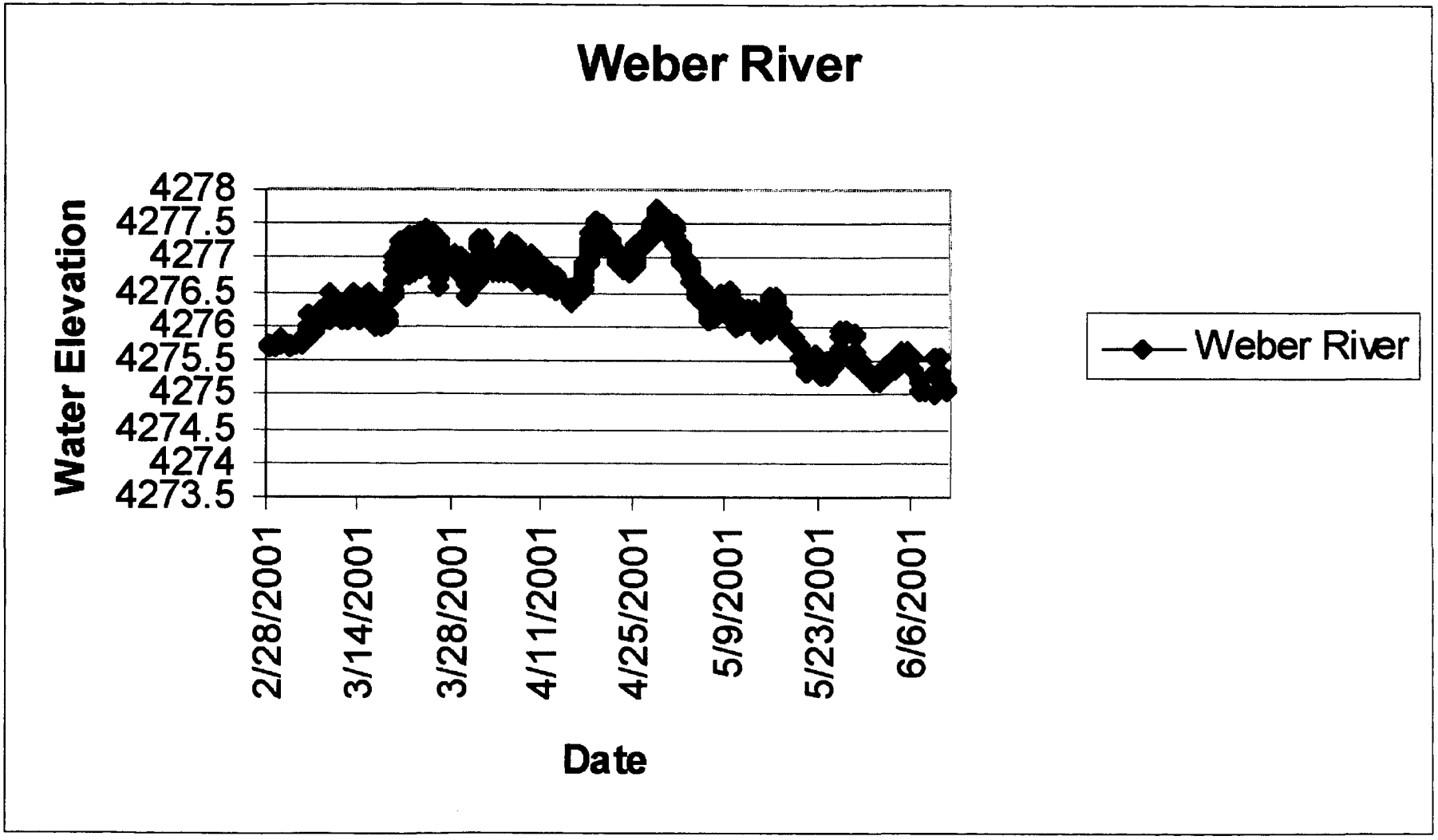
OGDEN RAILYARD- OGDEN, UTAH

FIGURE 3-4
RELATION BETWEEN GROUND WATER AND SURFACE WATER, WASATCH FRONT AREA

| SCALE: | DATE: |
|---|---|
| NTS | 1/13/02 |

M:\clients\...EST\Ogden\RI-2003\Fig3-15.dwg plotted: 09/02/2003

M:\clients\FORREST\Ogden\RI-2002\1329-Fig3-3.dwg plotted: 09/02/2003

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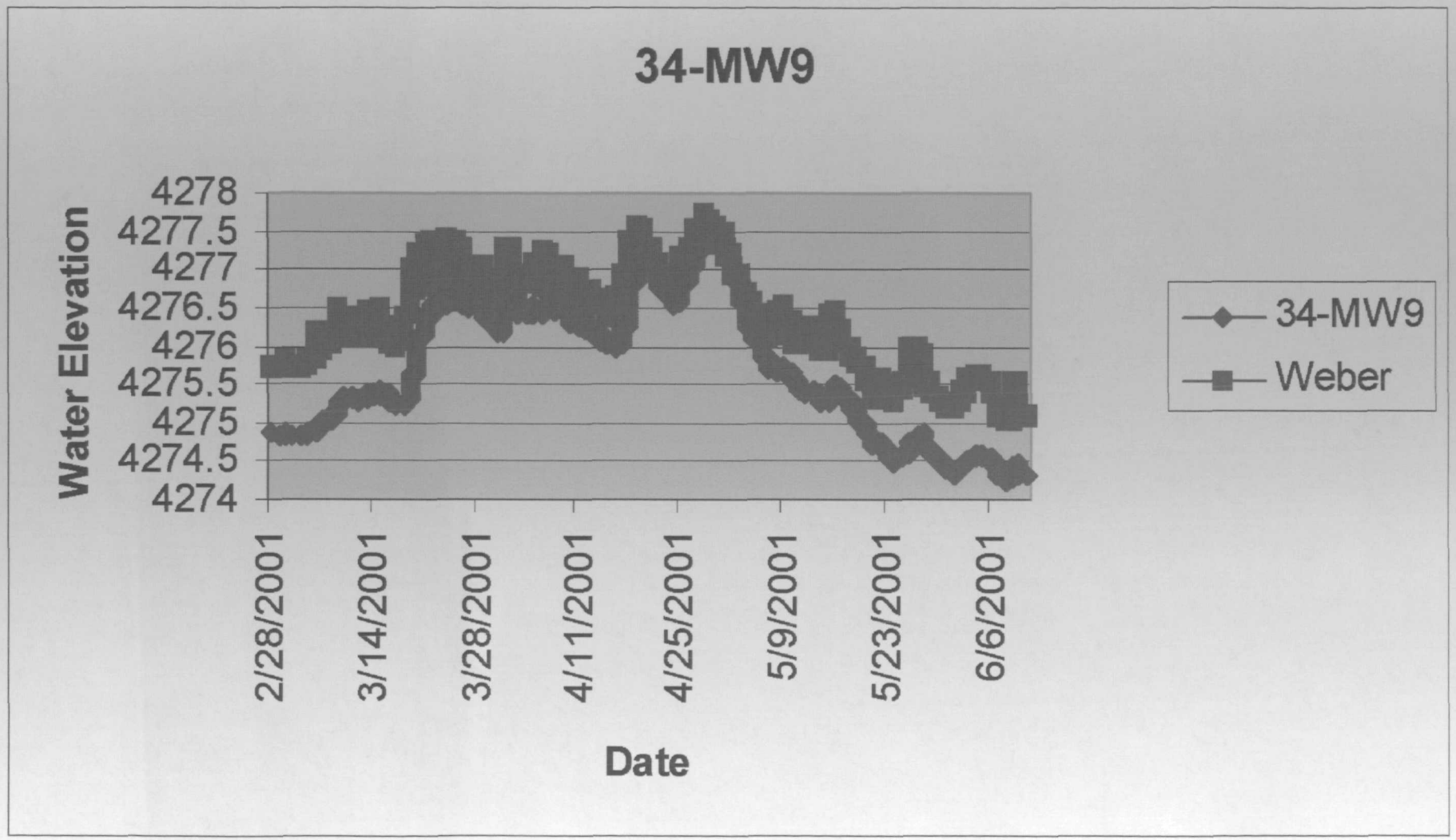
UPRR OGDEN, UTAH

FIGURE 3-5
WEBER RIVER WATER LEVELS

| SCALE: | DATE: |
|---|---|
| AS SHOWN | 3/22/02 |

M:\clients\FORREST\Ogden\RI-2002\1329-Fig3-4.dwg plotted: 09/02/2003

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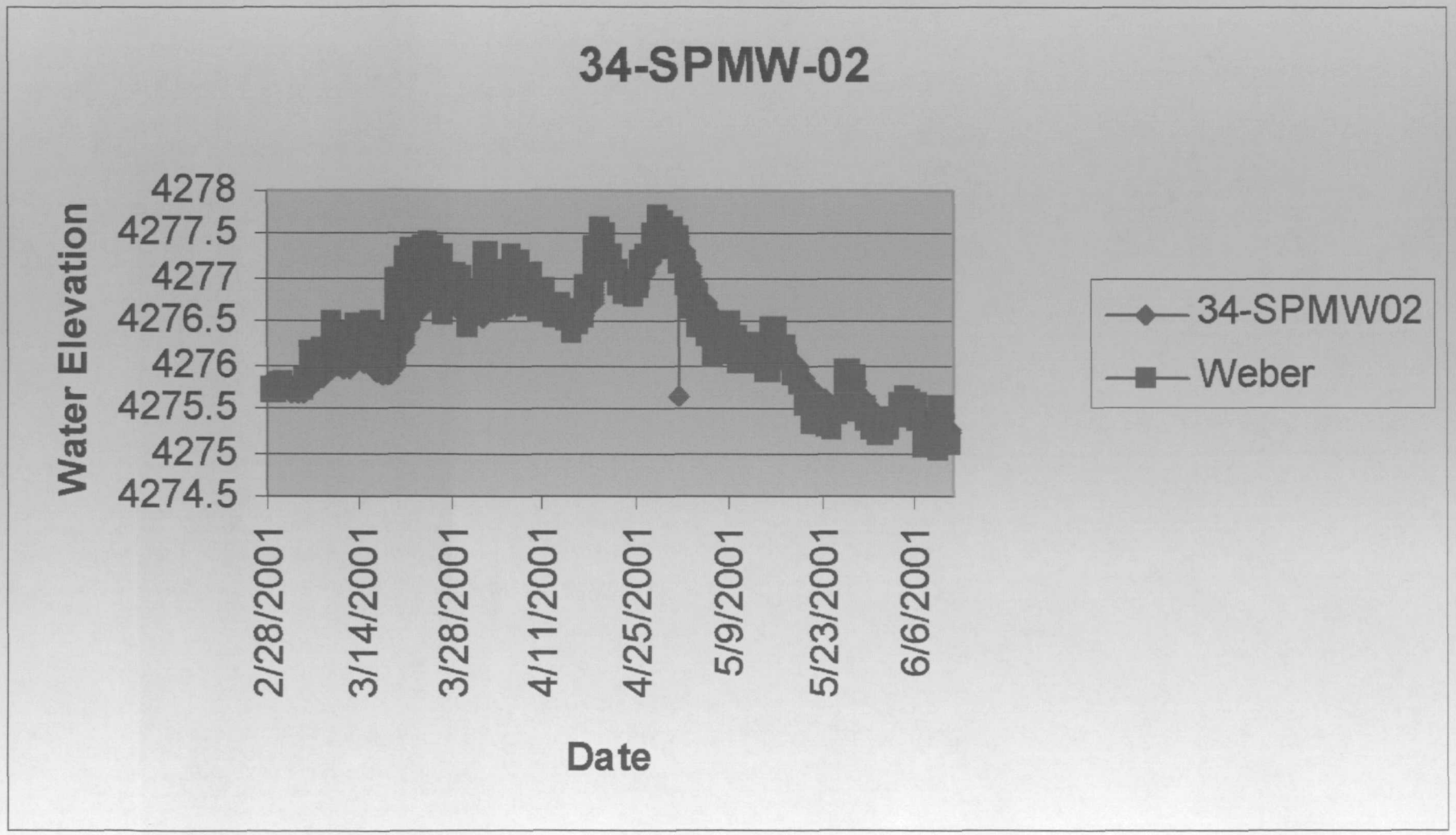
UPRR OGDEN, UTAH

FIGURE 3-6
WELL 34-MW9 WATER LEVELS

| SCALE: | DATE: |
|---|---|
| AS SHOWN | 3/22/02 |

M:\clients\FORREST\Ogden\RI-2002\1329-Fig3-5.dwg plotted: 09/02/2003

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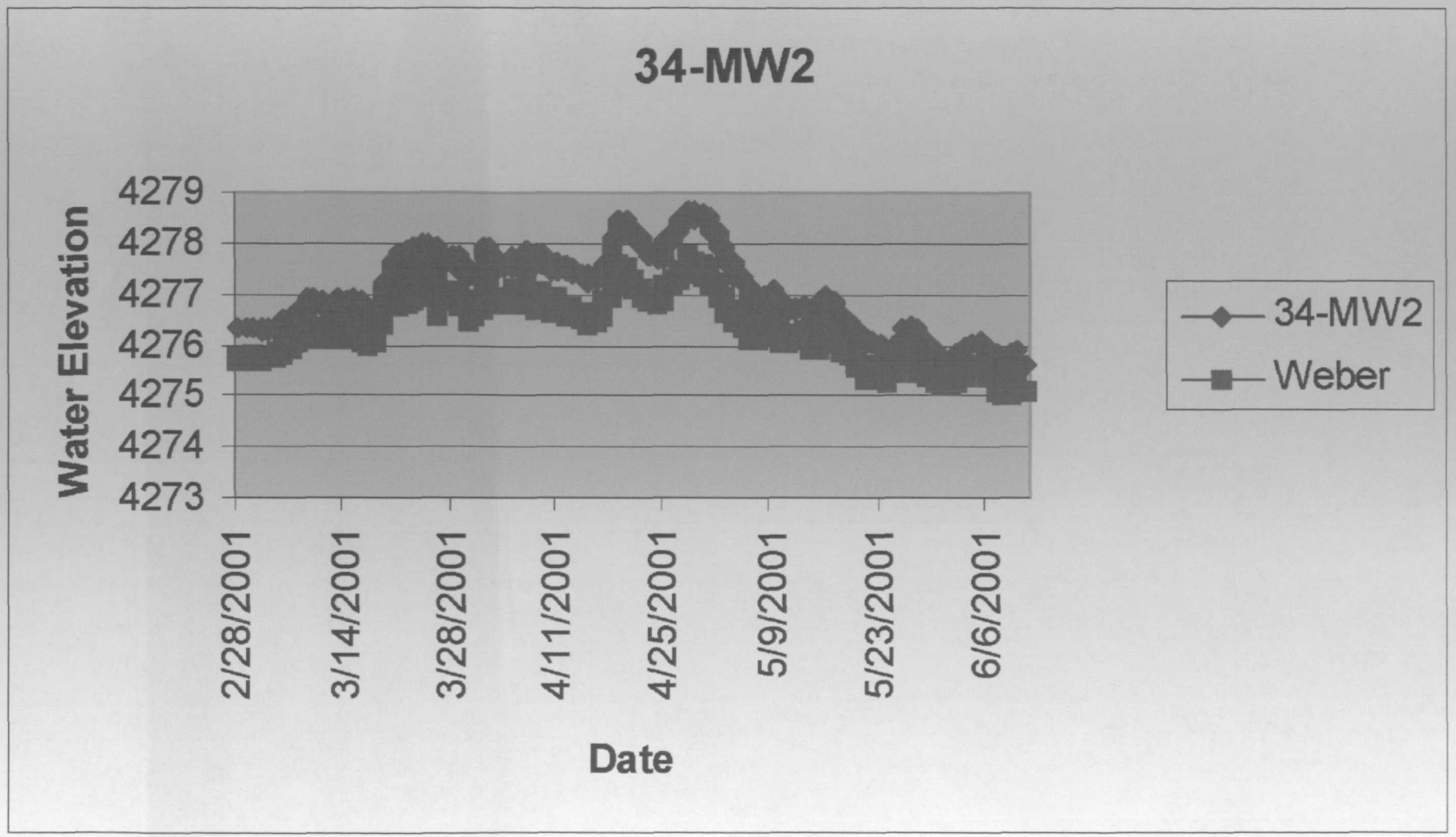
UPRR OGDEN, UTAH

FIGURE 3-7

WELL 34-SPMW-02 WATER LEVELS

| SCALE: | DATE: |
|---|---|
| AS SHOWN | 3/22/02 |

M:\clients\FORREST\Ogden\RI-2002\1329-Fig3-6.dwg plotted: 09/02/2003

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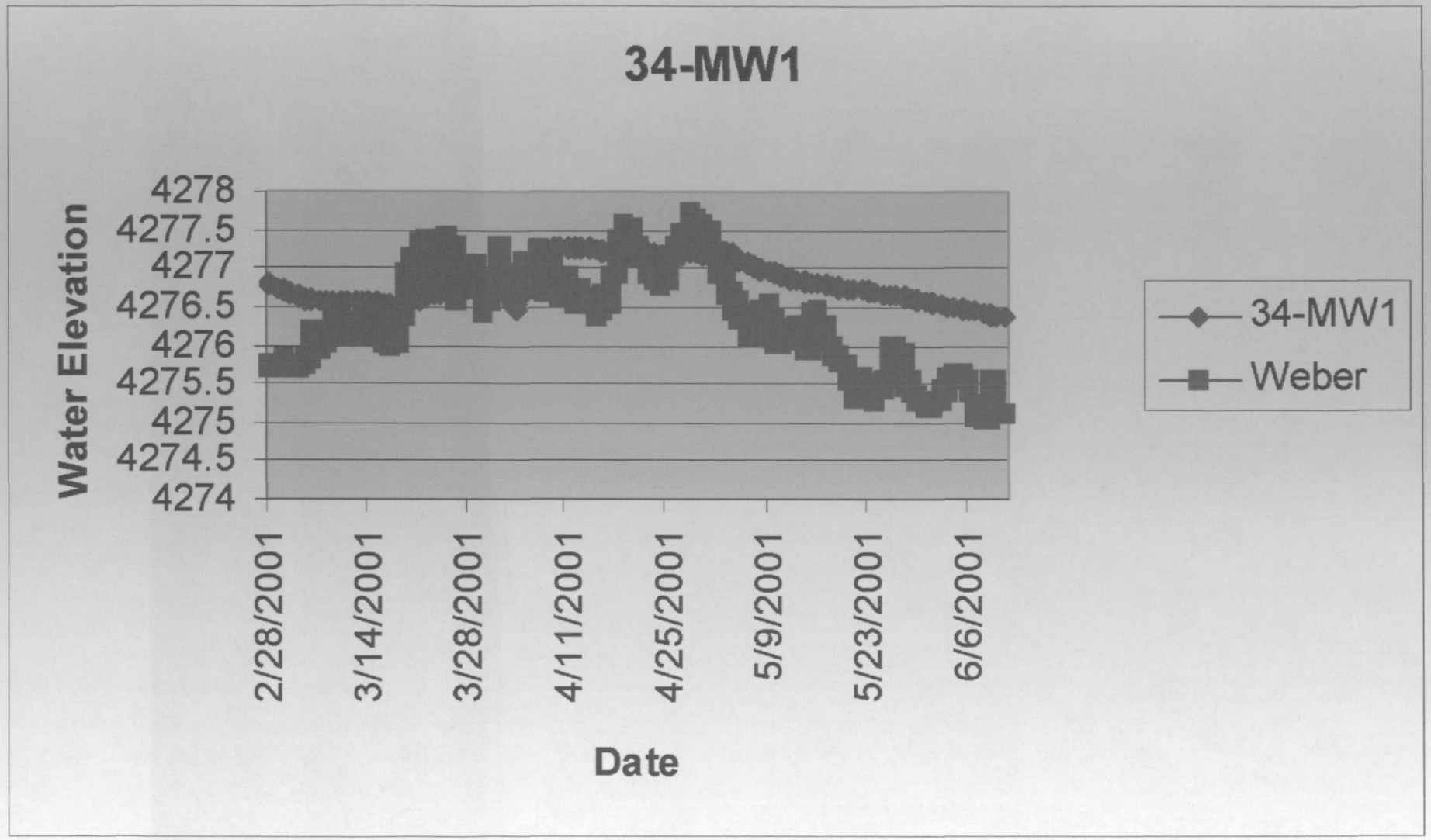
UPRR OGDEN, UTAH

FIGURE 3-8

WELL 34-MW2 WATER LEVELS

| SCALE: | DATE: |
|---|---|
| AS SHOWN | 3/22/02 |

M:\clients\FORREST\Ogden\RI-2002\1329-Fig3-7.dwg plotted: 09/02/2003

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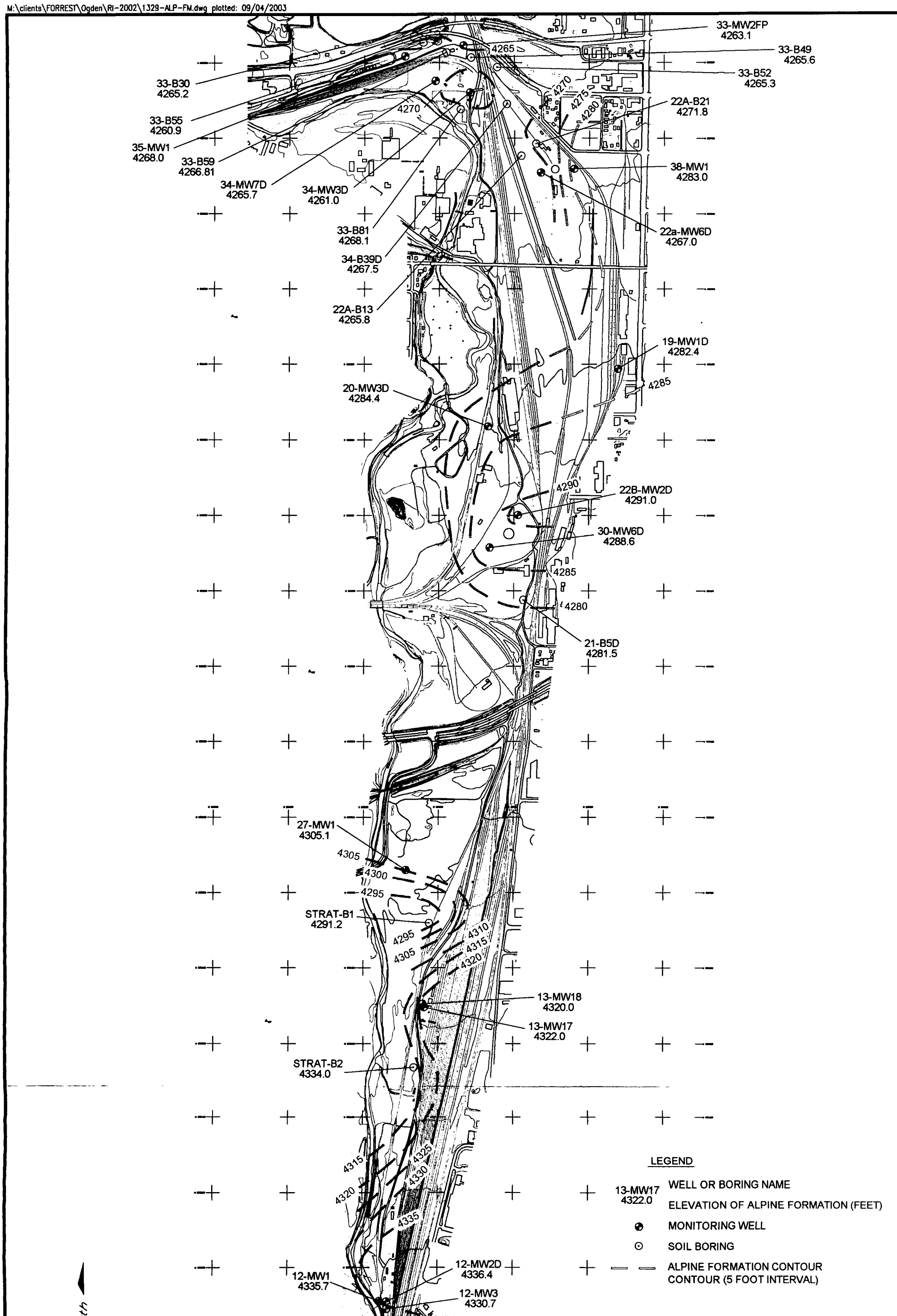
UPRR OGDEN, UTAH

FIGURE 3-9
WELL 34-MW1 WATER LEVELS

| SCALE: | DATE: |
|---|---|
| AS SHOWN | 3/22/02 |

M:\clients\FORREST\Ogden\RI-2002\1329-ALP-FM.dwg plotted: 09/04/2003

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| DRAWN | FR | 3/22/02 |
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"INSIGHTFUL ENVIRONMENTAL SOLUTIONS"

UNION PACIFIC RAILROAD-OGDEN YARD

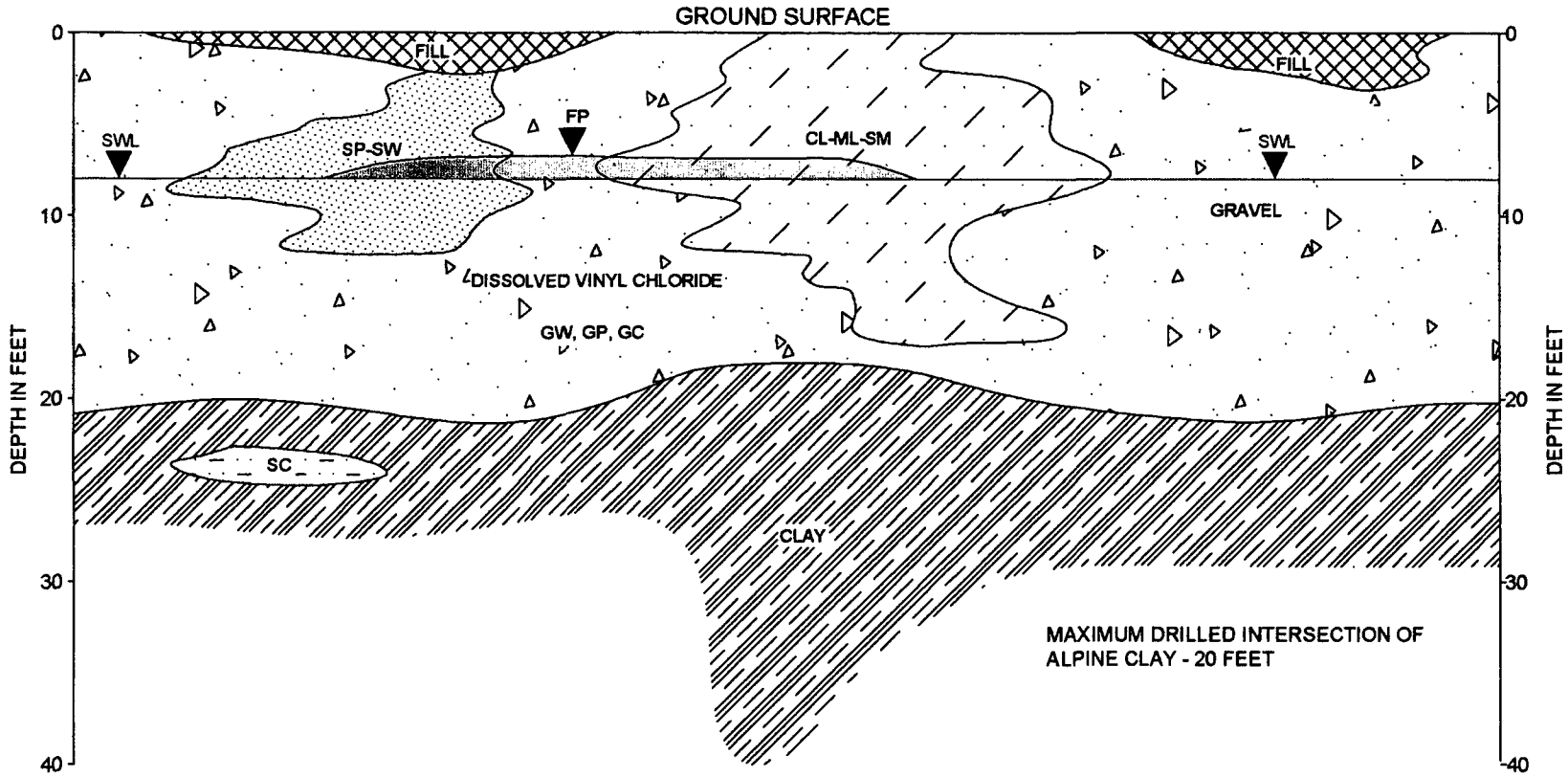
FIGURE 3-10

CONTOUR MAP - TOP OF ALPINE FORMATION

SCALE: AS SHOWN

DWG. NO.: 1329-ALP-FM.dwg

M:\clients\FORREST\Ogden\RI-2002\1329-GEOSECT.dwg plotted: 09/02/2003

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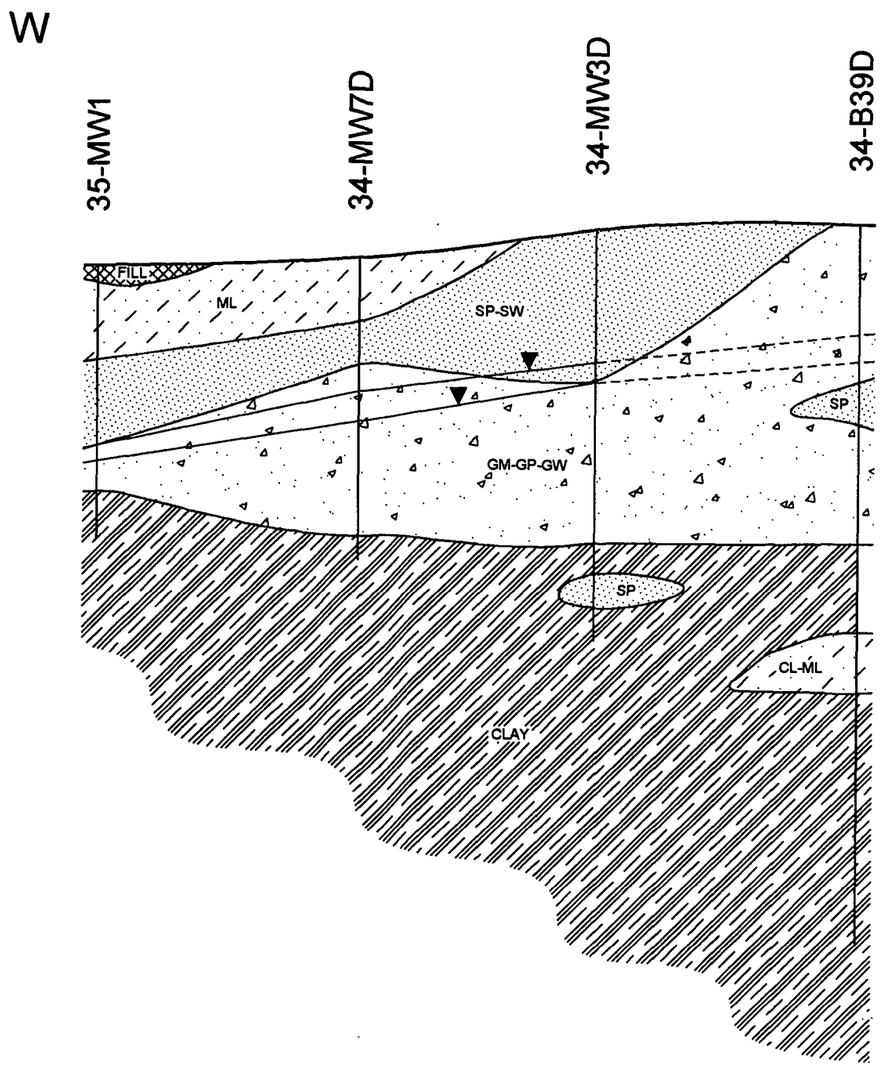
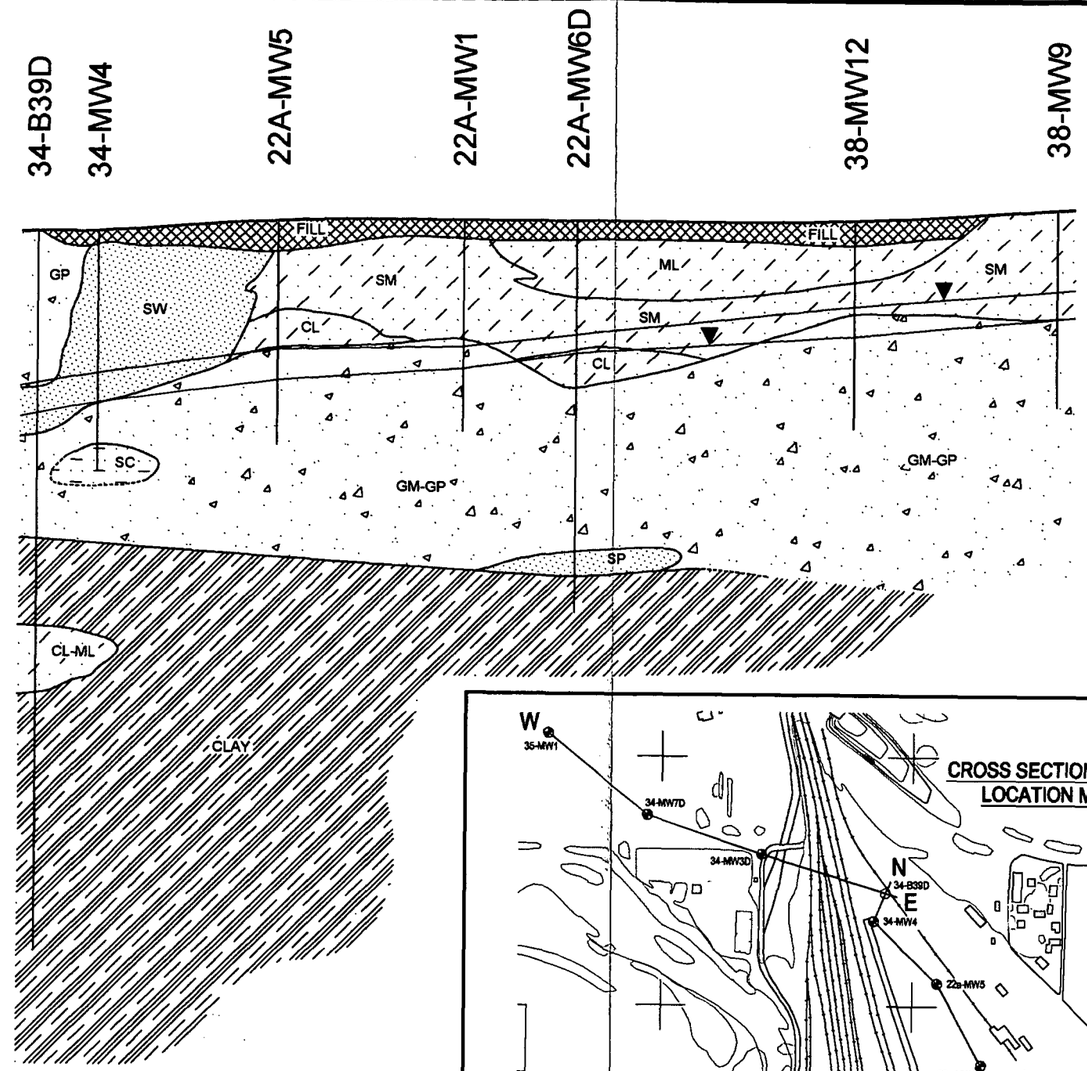
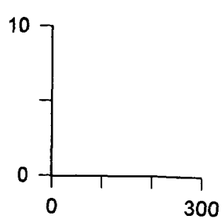
UPRR OGDEN, UTAH

FIGURE 3-11
REPRESENTATIVE SECTION OF
ALLUVIAL STRATIGRAPHY OGDEN RAILYARD

| SCALE: | DATE: |
|---|---|
| AS SHOWN | 3/22/02 |



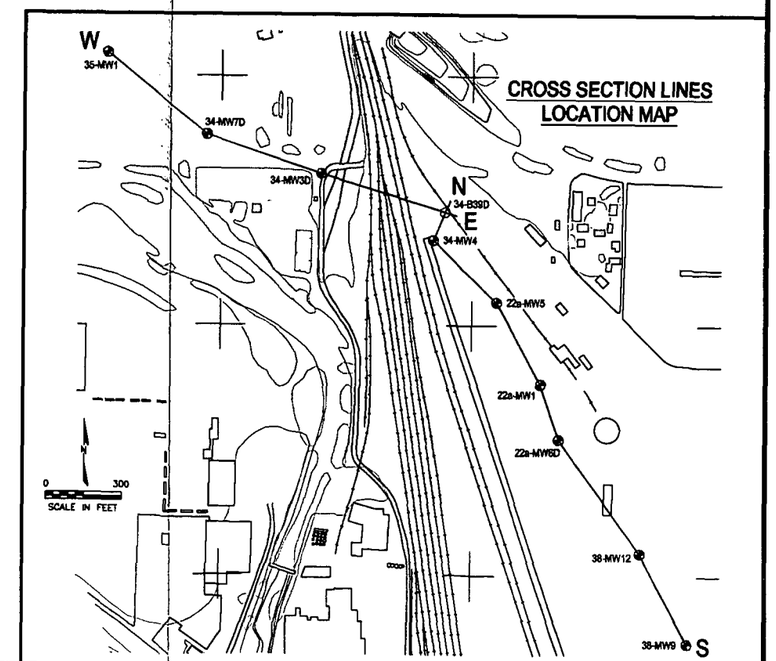




SCALE IN FEET
VERTICAL EXAGGERATION 30X

▼ SEASONAL HIGH GROUNDWATER

▼ SEASONAL LOW GROUNDWATER




| | BY | DATE |
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| DRAWN | JPS | 2/7/03 |
| CHECKED | | |
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| APPROVED | | |

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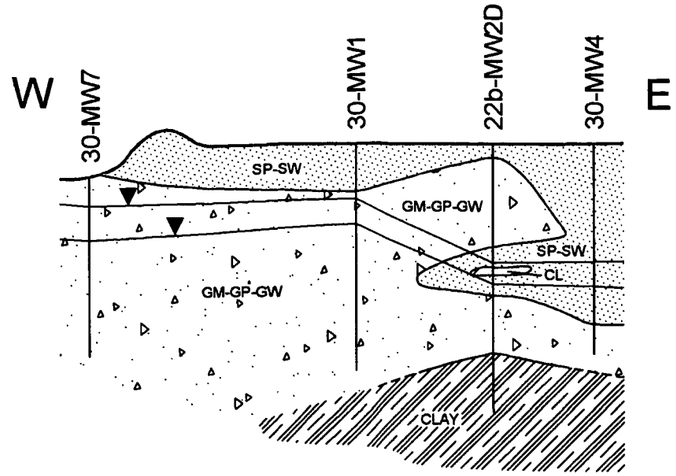
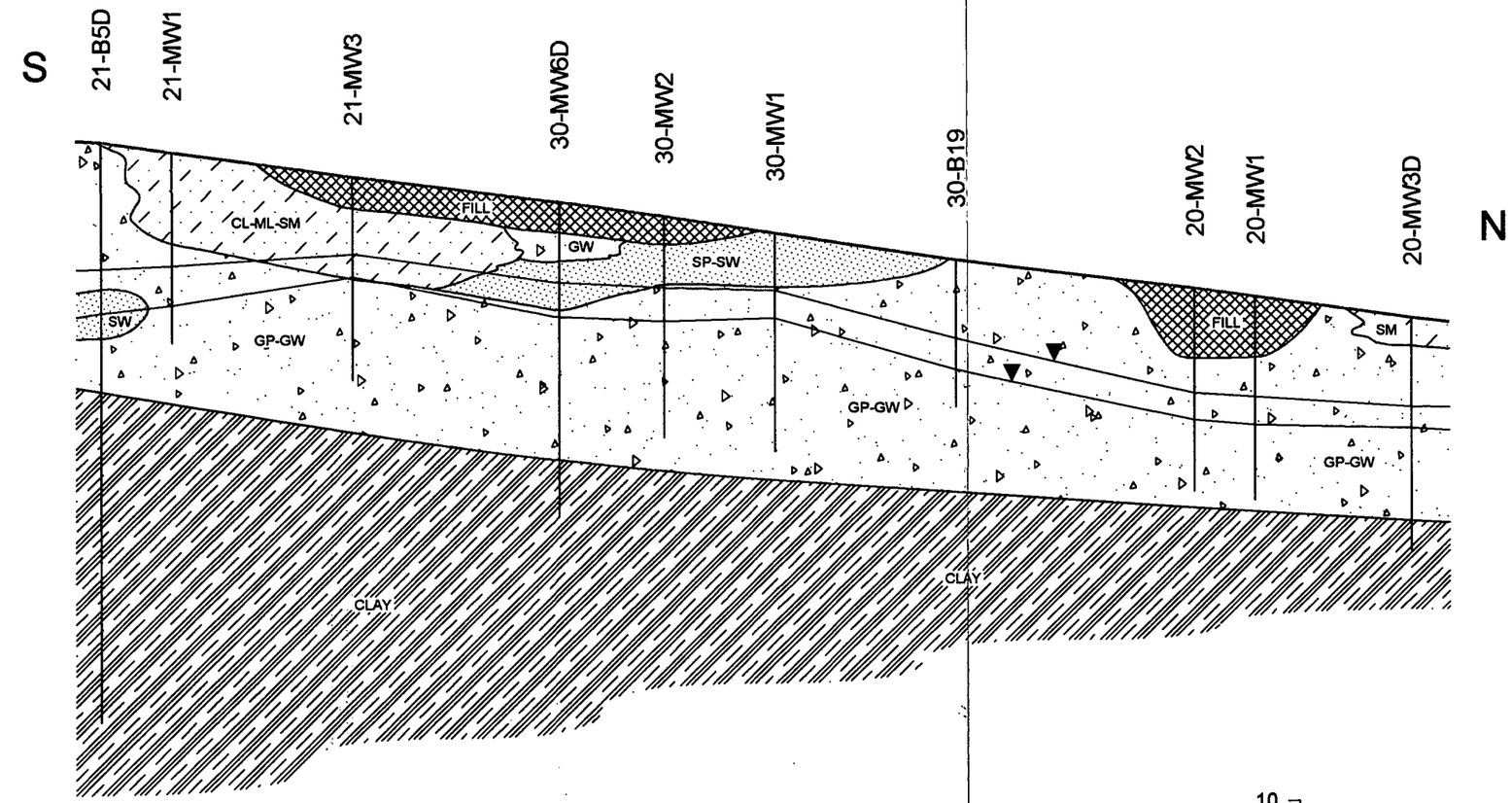
FIGURE 3-12
Geologic Cross Section - Northern CVOC Plume Area
AOI's - 34, 22A, 38

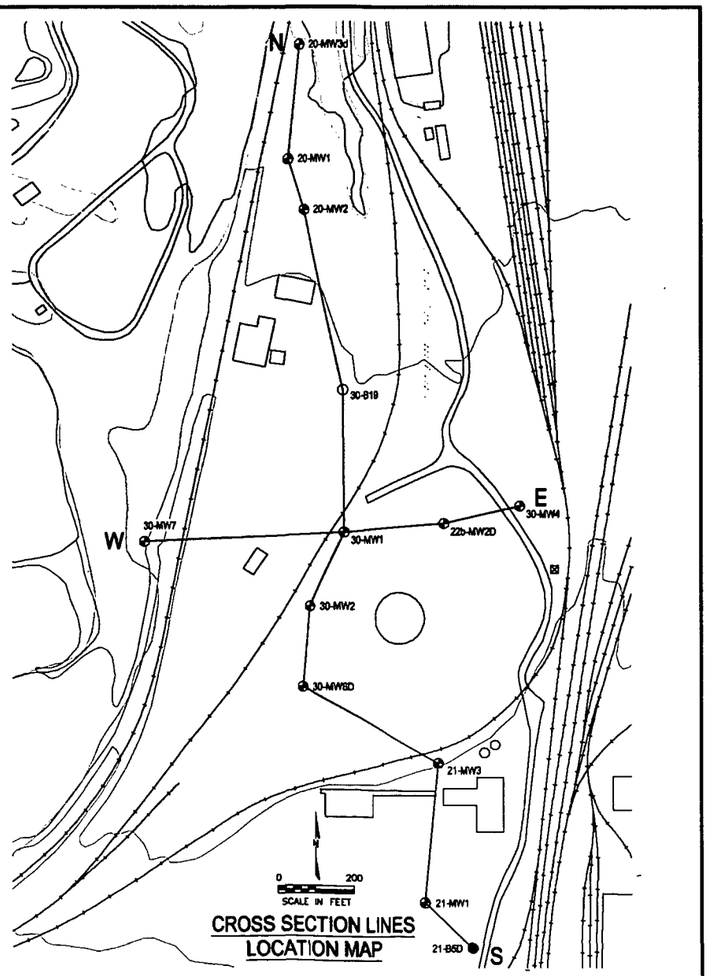
SCALE: AS SHOWN

DWG. NO.: 1329-xsec fig3-17.dwg

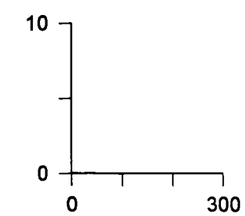
M:\CLIENTS\FORREST\OGDEN\RI-2002\1329-XSEC FIG3-17.DWG-(FIGURE 3-17) 09/04/2003 9:36AM




CROSS SECTION LINES
LOCATION MAP




▼ SEASONAL HIGH GROUNDWATER

▼ SEASONAL LOW GROUNDWATER

SCALE IN FEET
VERTICAL EXAGGERATION 30X

| | BY | DATE |
|---|---|---|
| DRAWN | JPS | 2/7/03 |
| CHECKED | | |
| APPROVED | | |
| APPROVED | | |
| APPROVED | | |

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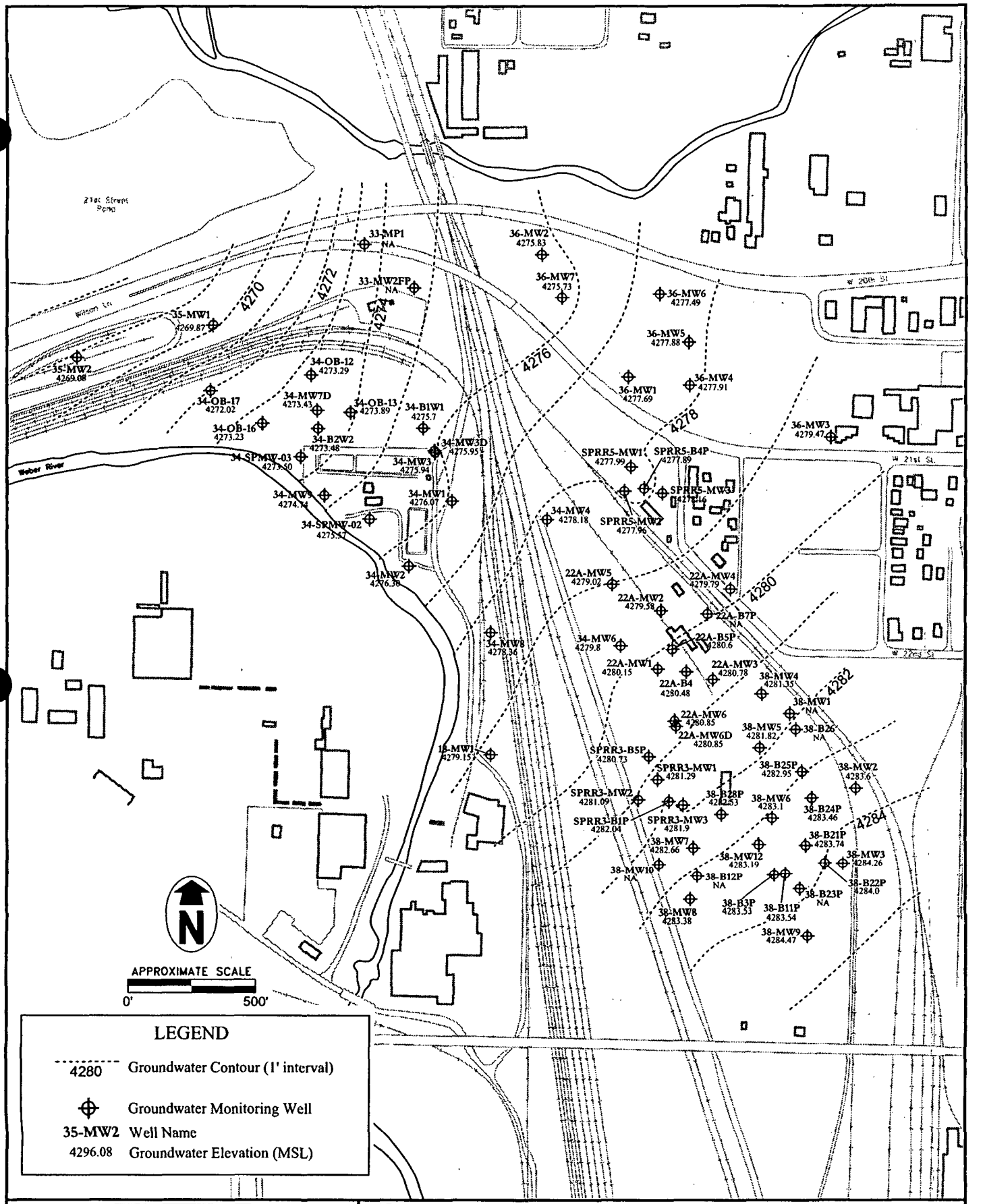
UNION PACIFIC RAILROAD-OGDEN, UTAH

FIGURE 3-13
Geologic Cross Section - Southern CVOC Plume Area
AOI's - 21, 22B, 30

SCALE: AS SHOWN

DWG. NO.: 1329-xsec fig3-18.dwg

M:\CLIENTS\FORREST\OGDEN\RI-2002\1329-XSEC FIG3-18.DWG-(FIGURE 3-18) 09/04/2003 9:38AM

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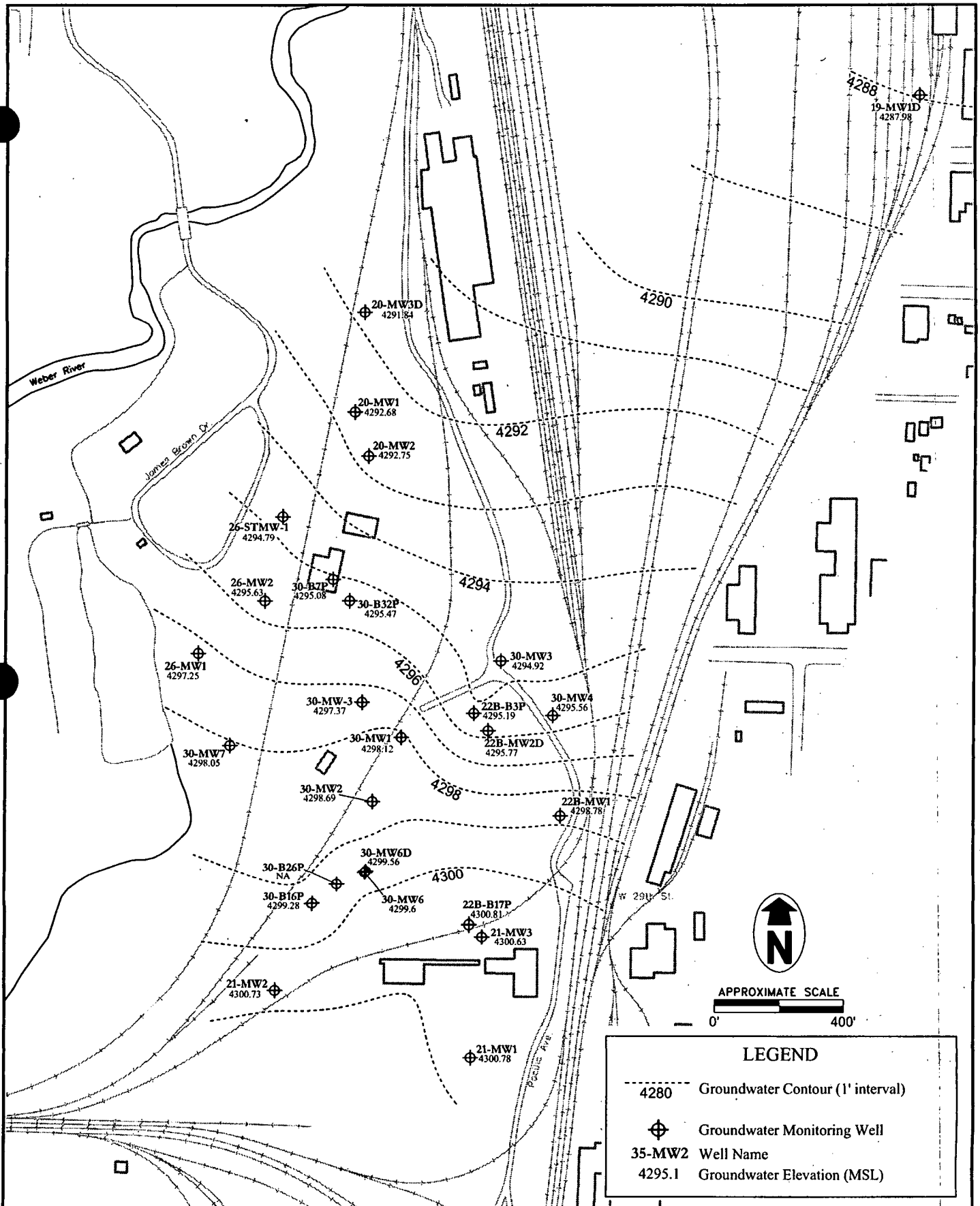
TITLE:

**FIGURE 3-14A**
**GROUNDWATER POTENTIOMETRIC SURFACE**
**AREA 1**
**OCTOBER, 2000**

1330-GW (9/4/03)

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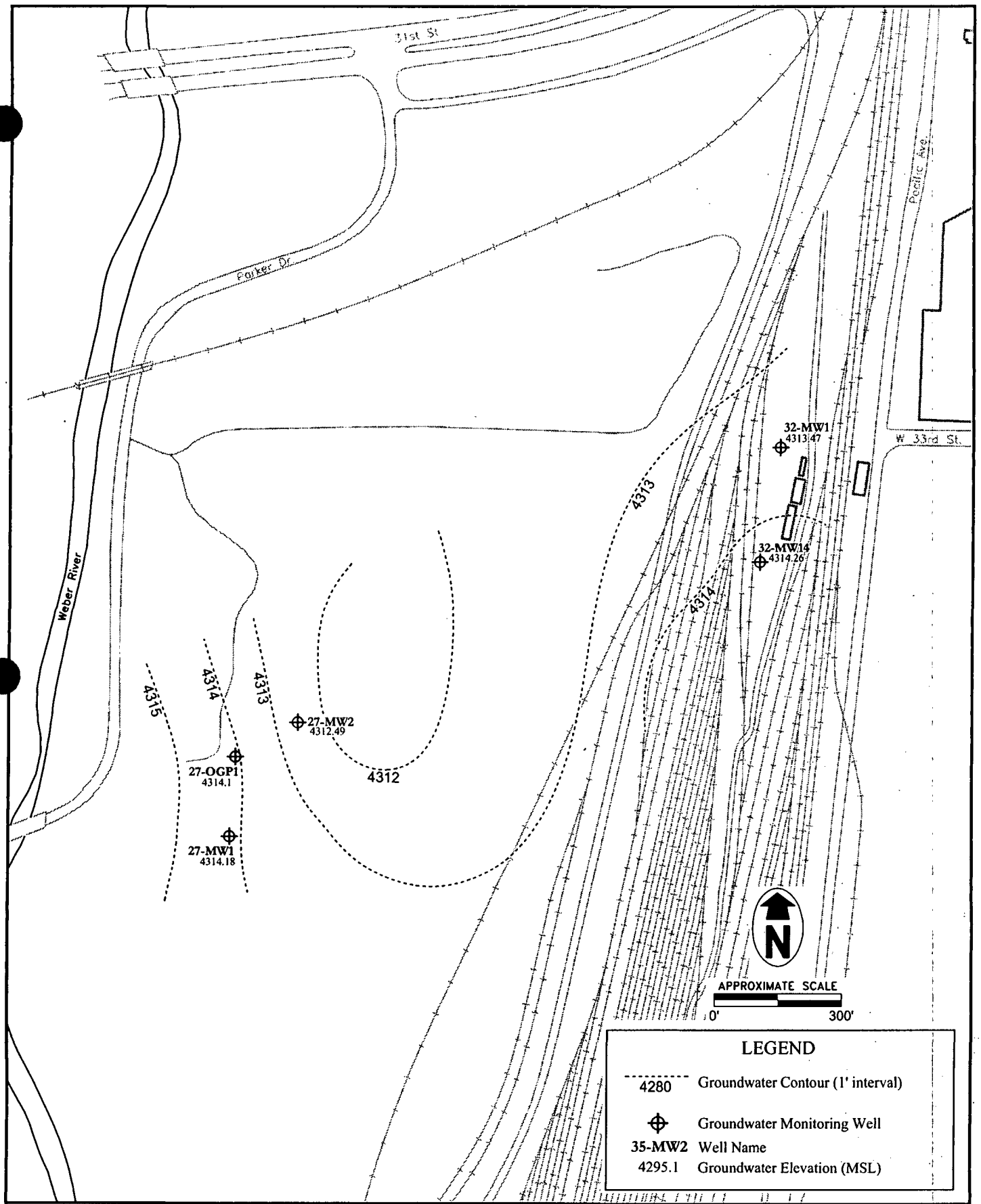
ENVIRONMENTAL MANAGEMENT & PLANNING

TITLE:

**FIGURE 3-14B**
**GROUNDWATER POTENTIOMETRIC SURFACE**
**AREA 2**
**OCTOBER, 2000**

1330-GW (9/5/03)

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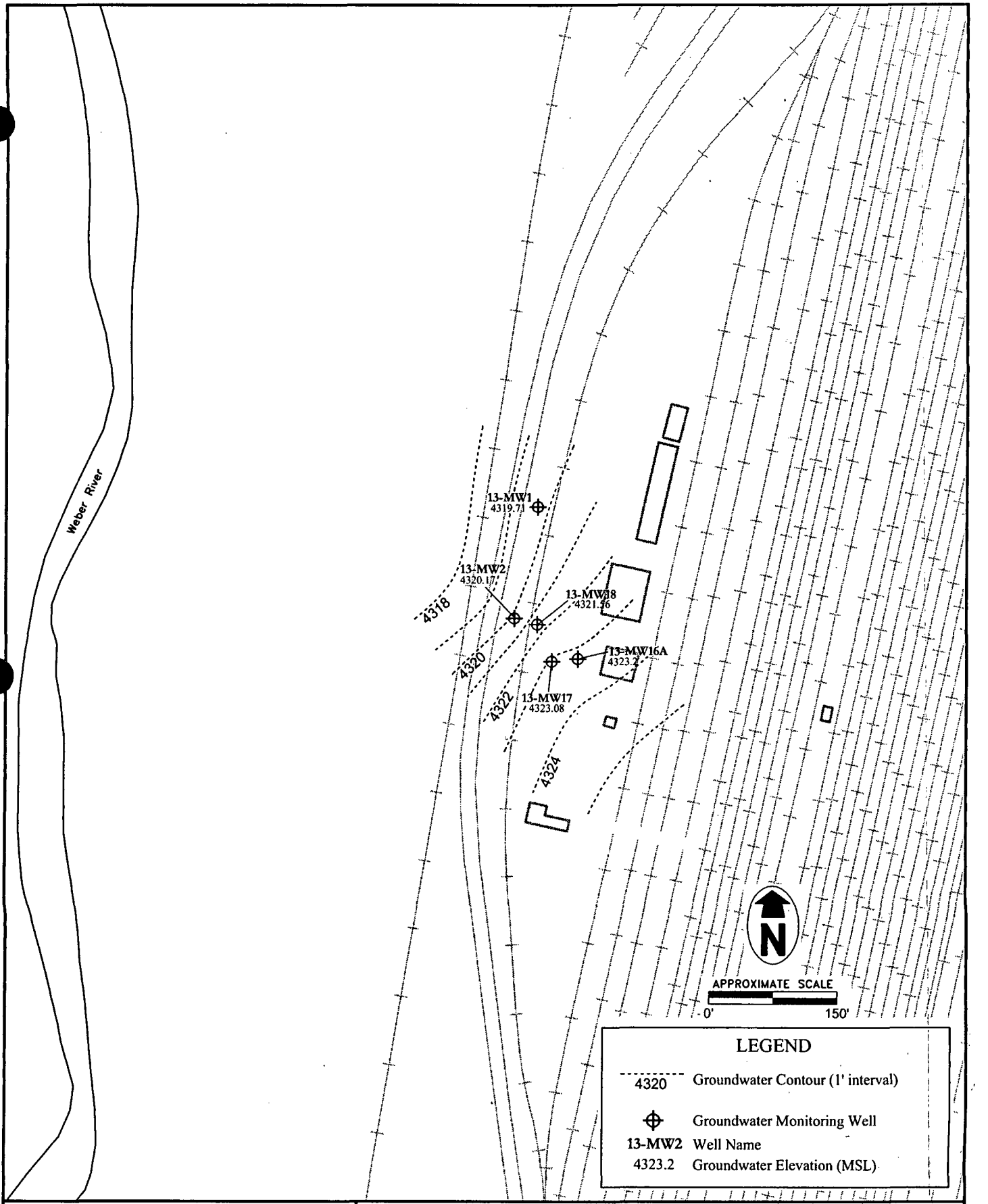
ENVIRONMENTAL MANAGEMENT & PLANNING

TITLE:

**FIGURE 3-14C**
**GROUNDWATER POTENTIOMETRIC SURFACE**
**AREA 3**
**OCTOBER, 2000**

1330-GW (9/5/03)

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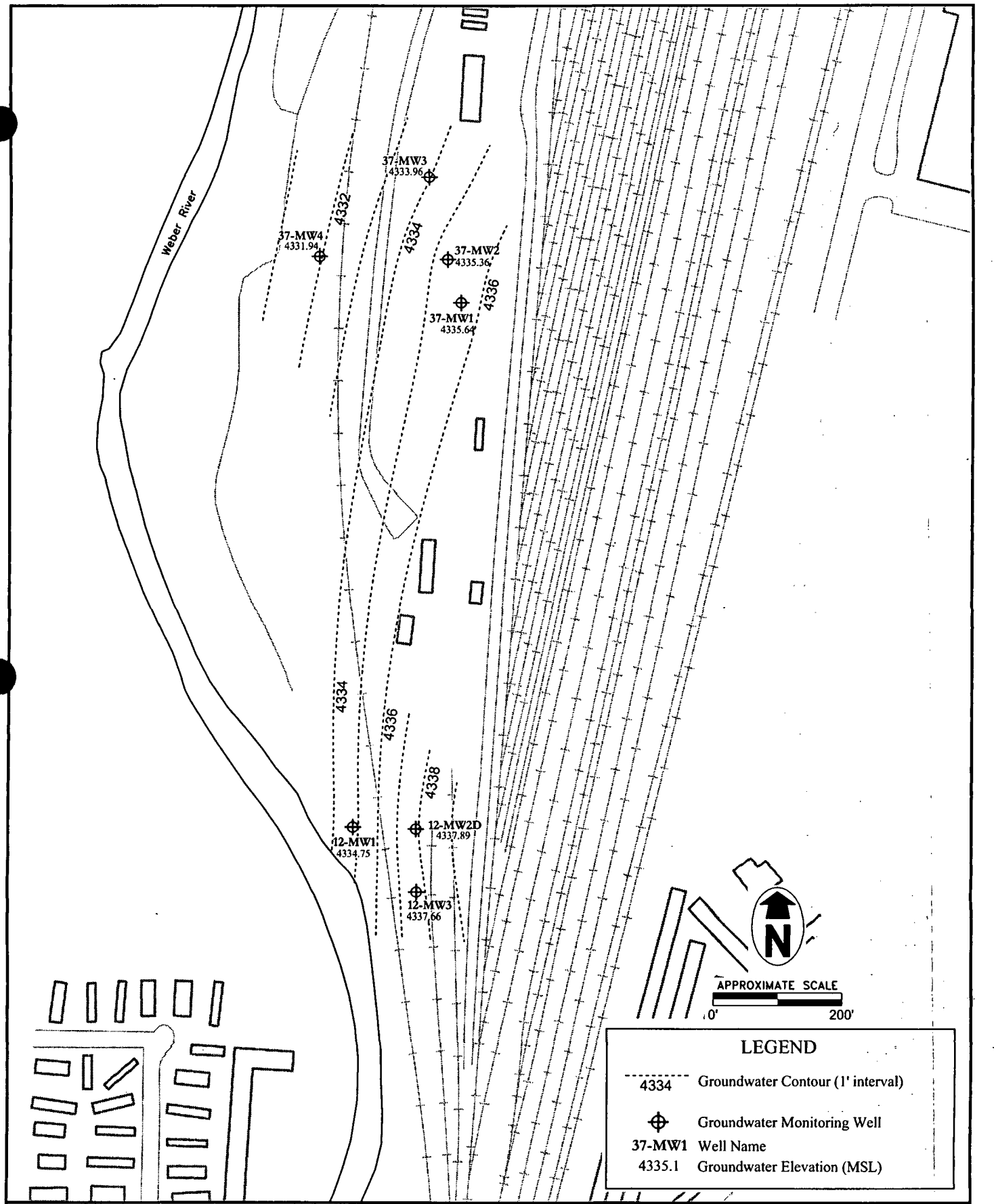
TITLE:

**FIGURE 3-14D**
**GROUNDWATER POTENTIOMETRIC SURFACE**
**AREA 4**
**OCTOBER, 2000**

1330-GW (9/5/03)

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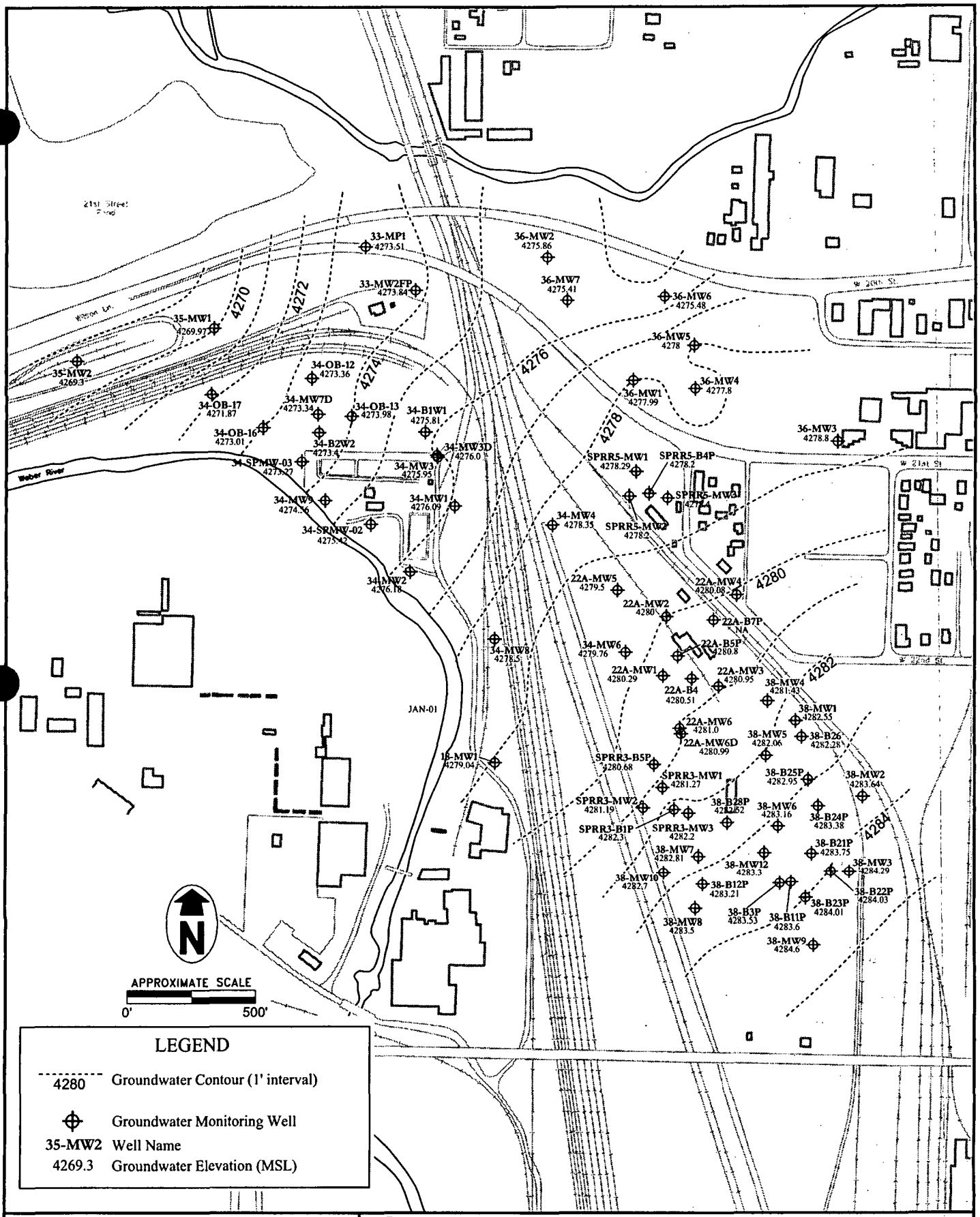
TITLE:

**FIGURE 3-14E**
**GROUNDWATER POTENTIOMETRIC SURFACE**
**AREA 5**
**OCTOBER, 2000**

1330-GW (9/5/03)

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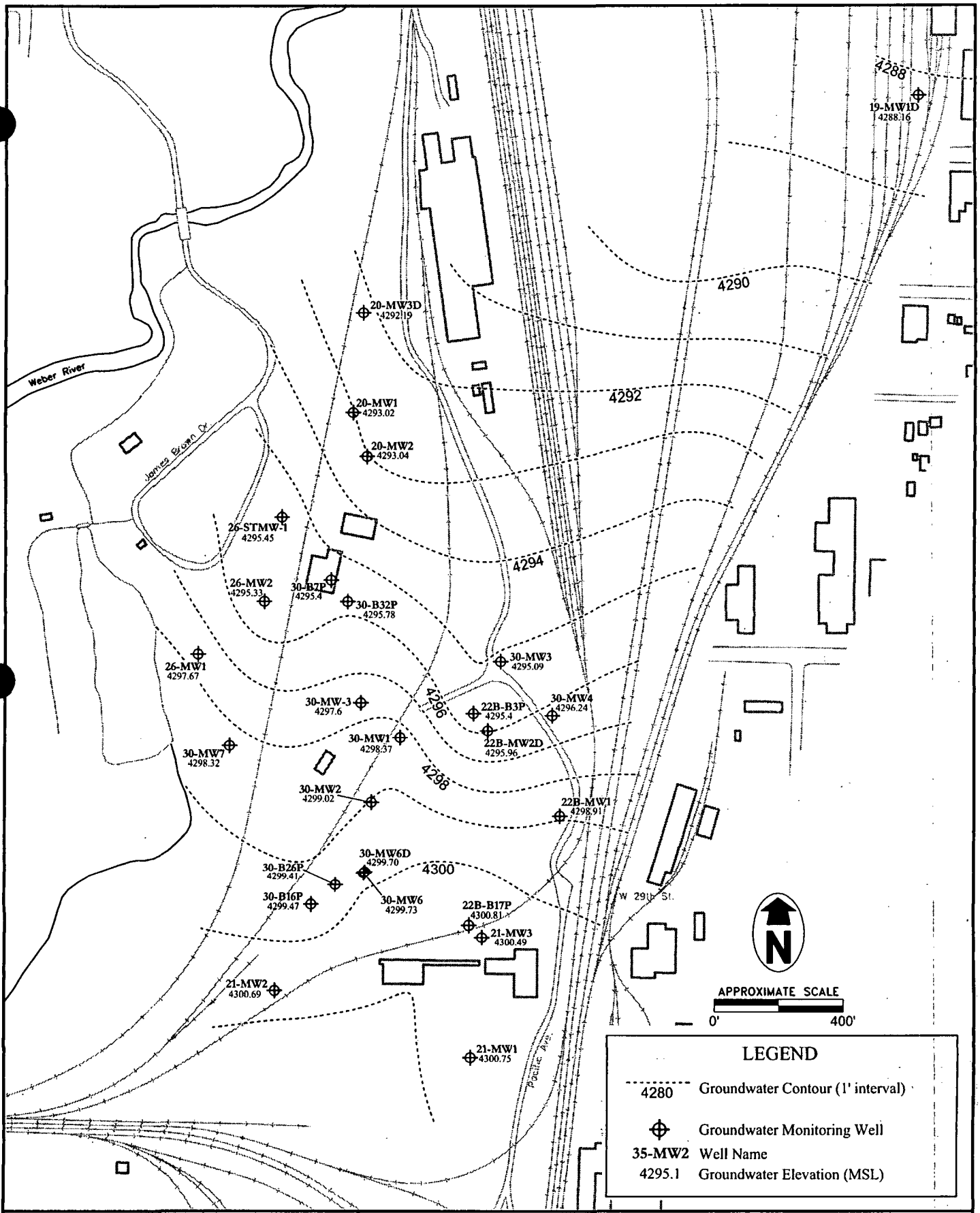
ENVIRONMENTAL MANAGEMENT & PLANNING

TITLE:

**FIGURE 3-15A**
**GROUNDWATER POTENTIOMETRIC SURFACE**
**AREA 1**
**JANUARY, 2001**

1330-GW (9/5/03)

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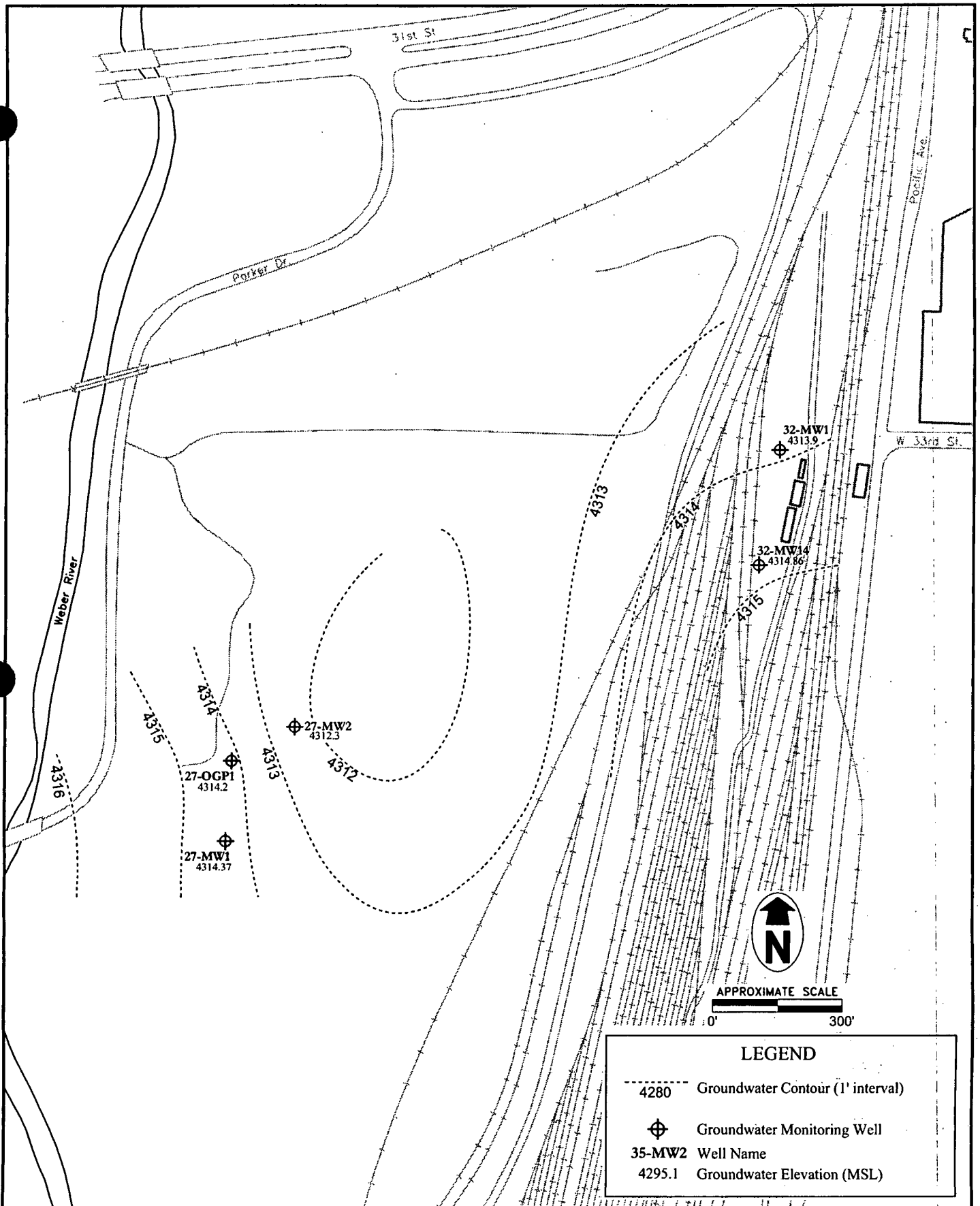
ENVIRONMENTAL MANAGEMENT & PLANNING

TITLE:

**FIGURE 3-15B**
**GROUNDWATER POTENTIOMETRIC SURFACE**
**AREA 2**
**JANUARY, 2001**

1330-GW (9/5/03)

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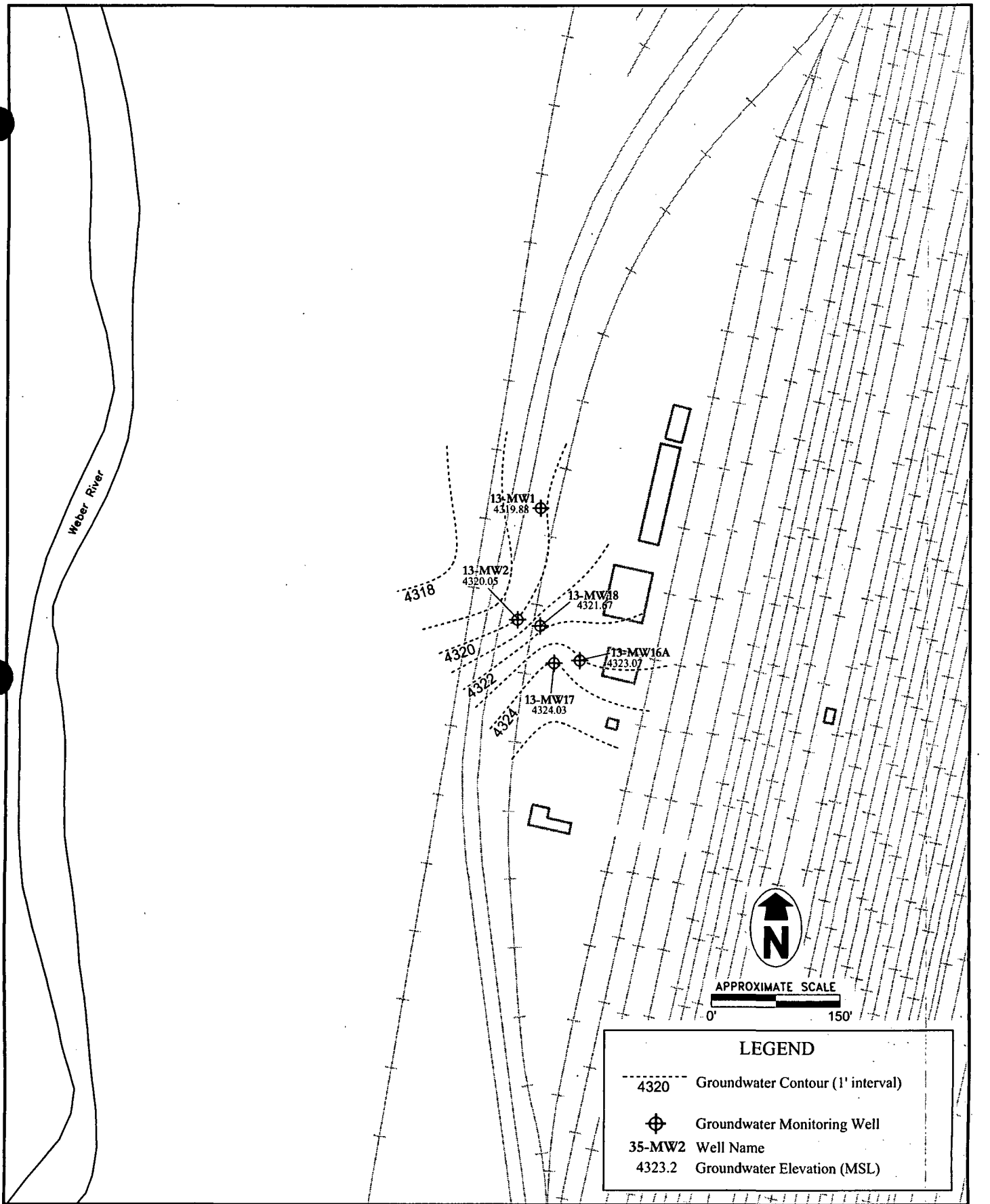
ENVIRONMENTAL MANAGEMENT & PLANNING

TITLE:

**FIGURE 3-15C**
**GROUNDWATER POTENTIOMETRIC SURFACE**
**AREA 3**
**JANUARY, 2001**

1330-GW (9/5/03)

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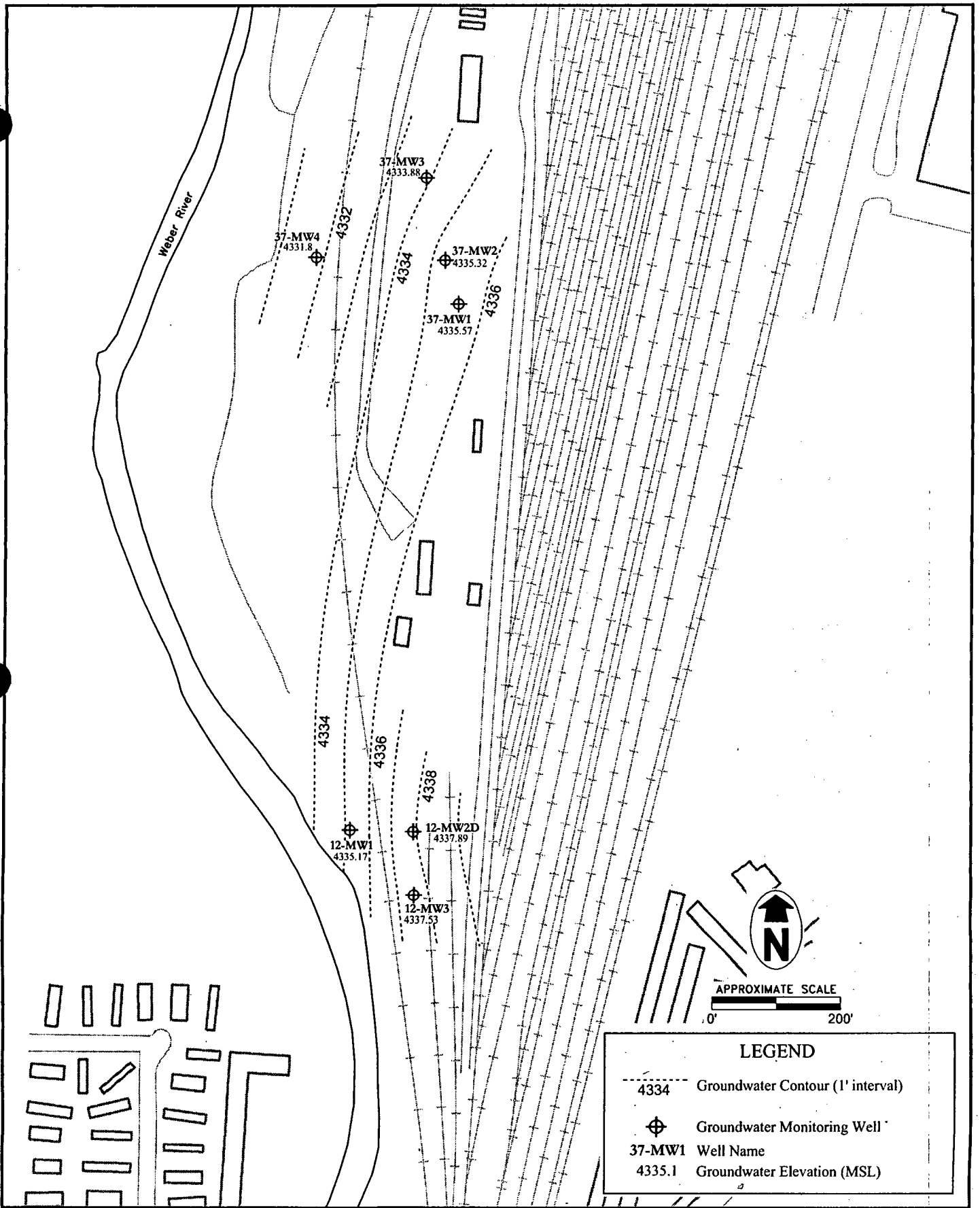
TITLE:

**FIGURE 3-15D**
**GROUNDWATER POTENTIOMETRIC SURFACE**
**AREA 4**
**JANUARY, 2001**

1330-GW (9/5/03)

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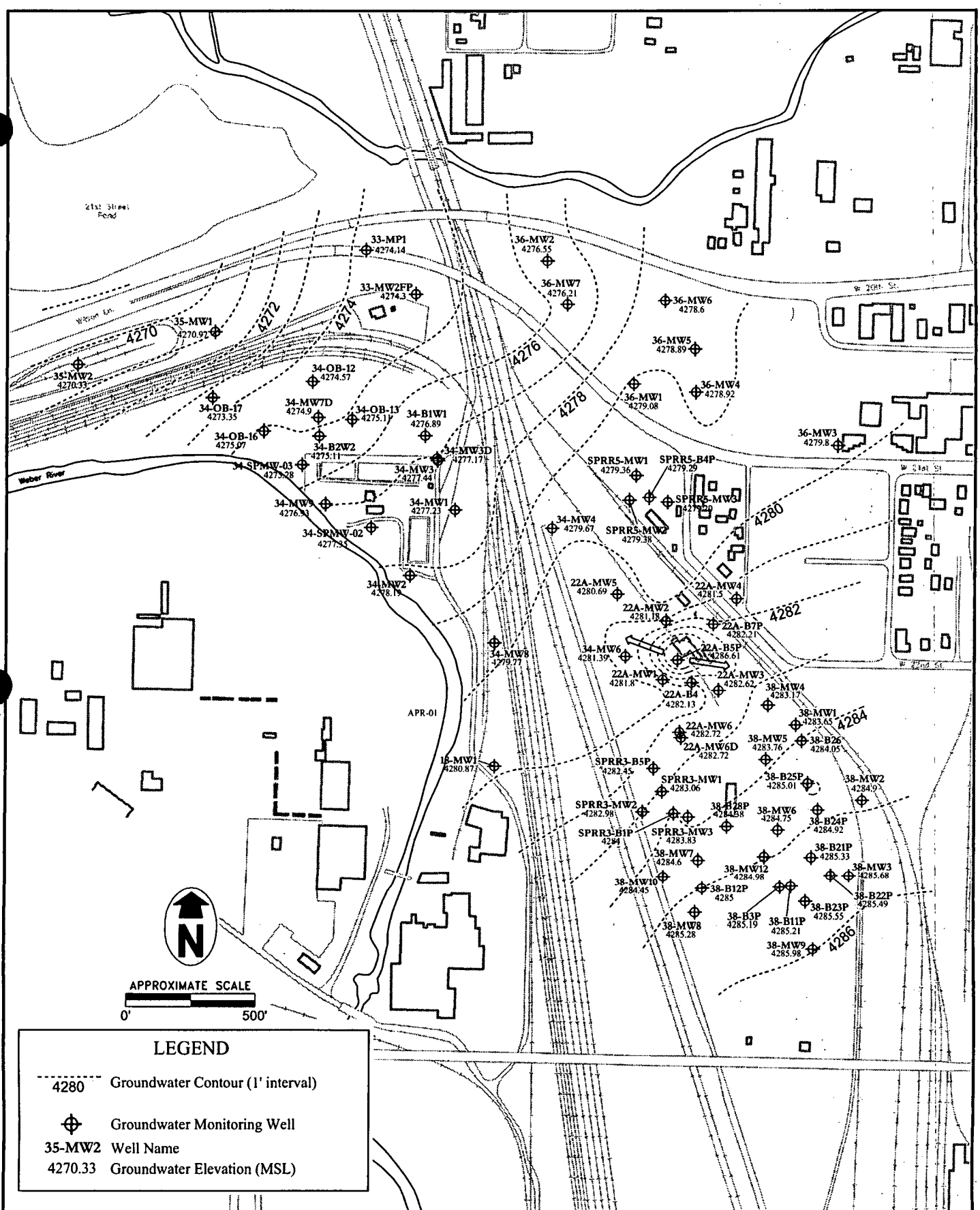
TITLE:

**FIGURE 3-15E**
**GROUNDWATER POTENTIOMETRIC SURFACE**
**AREA 5**
**JANUARY, 2001**

1330-GW (9/5/03)

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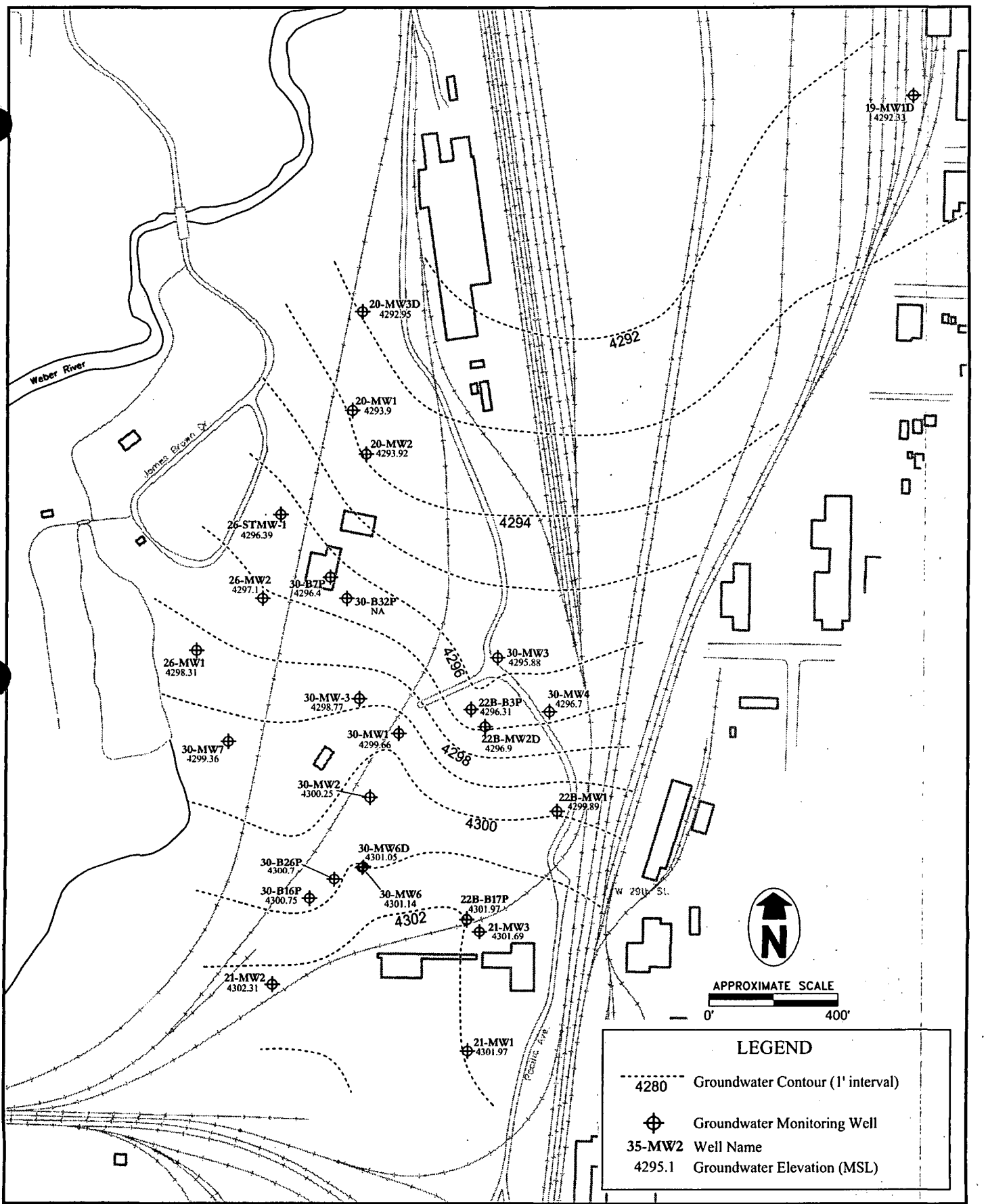
TITLE:

**FIGURE 3-16A**
**GROUNDWATER POTENTIOMETRIC SURFACE**
**AREA 1**
**APRIL, 2001**

1330-GW (9/5/03)

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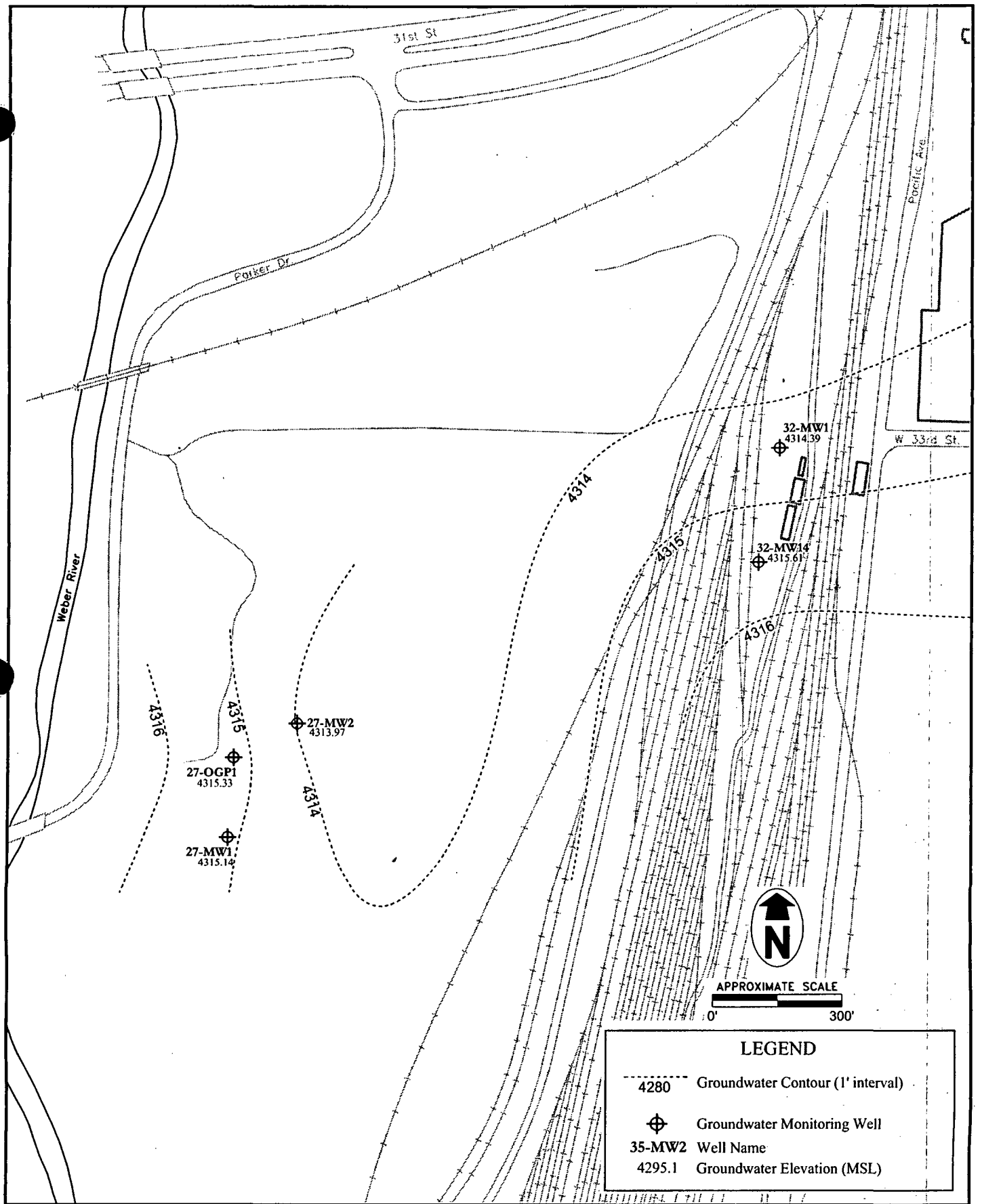
ENVIRONMENTAL MANAGEMENT & PLANNING

TITLE:

**FIGURE 3-16B**
**GROUNDWATER POTENTIOMETRIC SURFACE**
**AREA 2**
**APRIL, 2001**

1330-GW (9/5/03)

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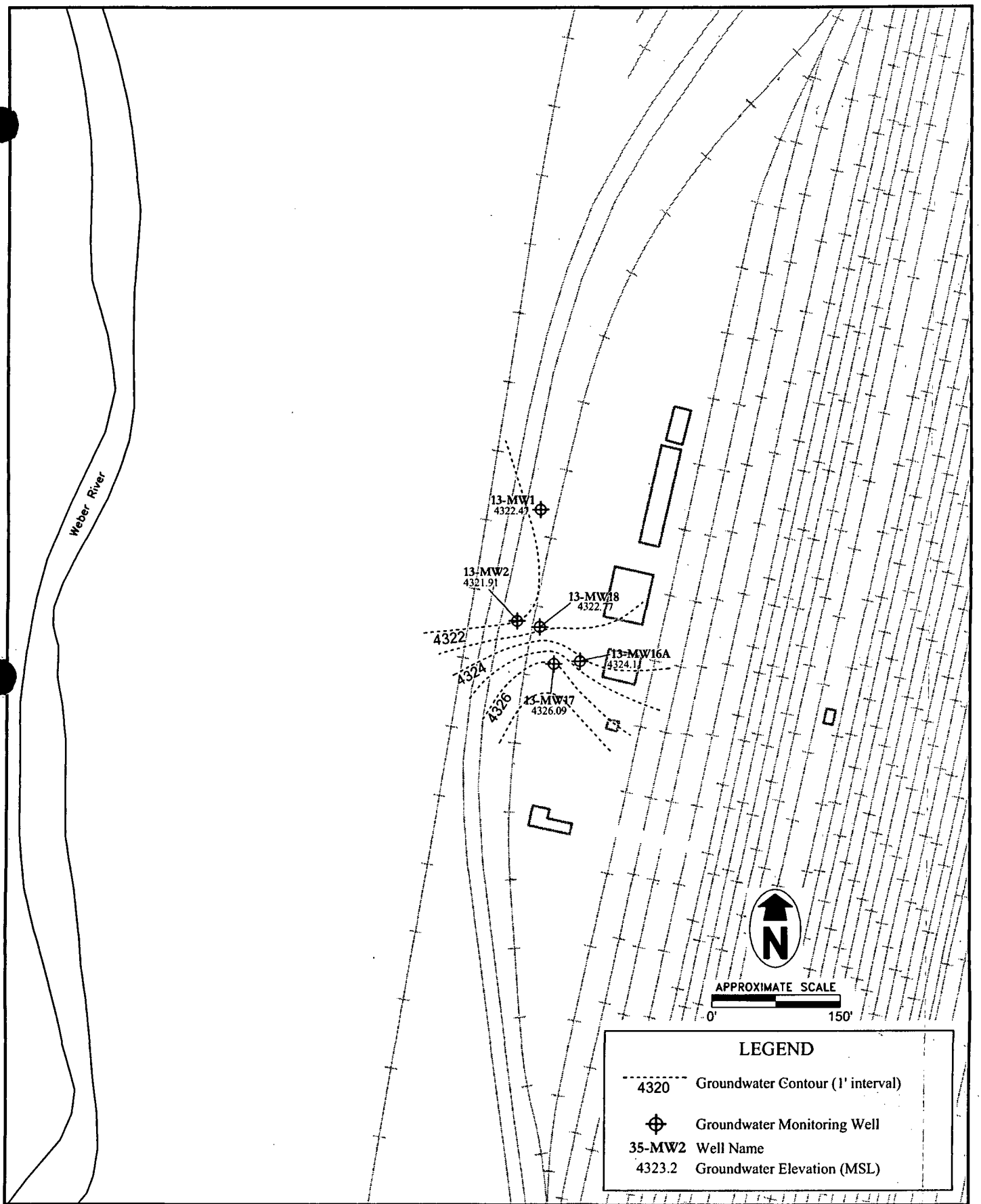
ENVIRONMENTAL MANAGEMENT & PLANNING

TITLE:

**FIGURE 3-16C**
**GROUNDWATER POTENTIOMETRIC SURFACE**
**AREA 3**
**APRIL, 2001**

1330-GW (9/5/03)

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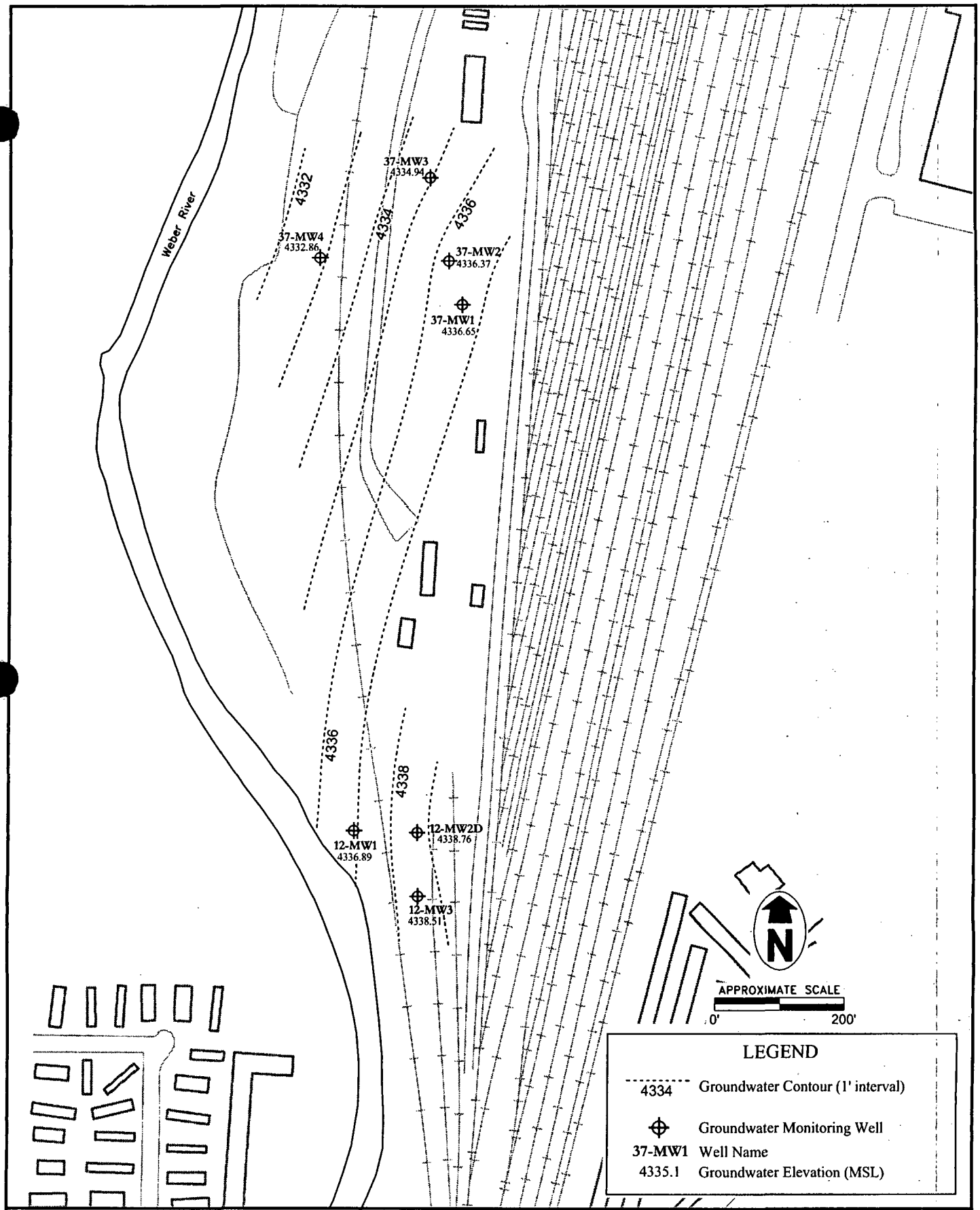
TITLE:

**FIGURE 3-16D**
**GROUNDWATER POTENTIOMETRIC SURFACE**
**AREA 4**
**APRIL, 2001**

1330-GW (9/5/03)

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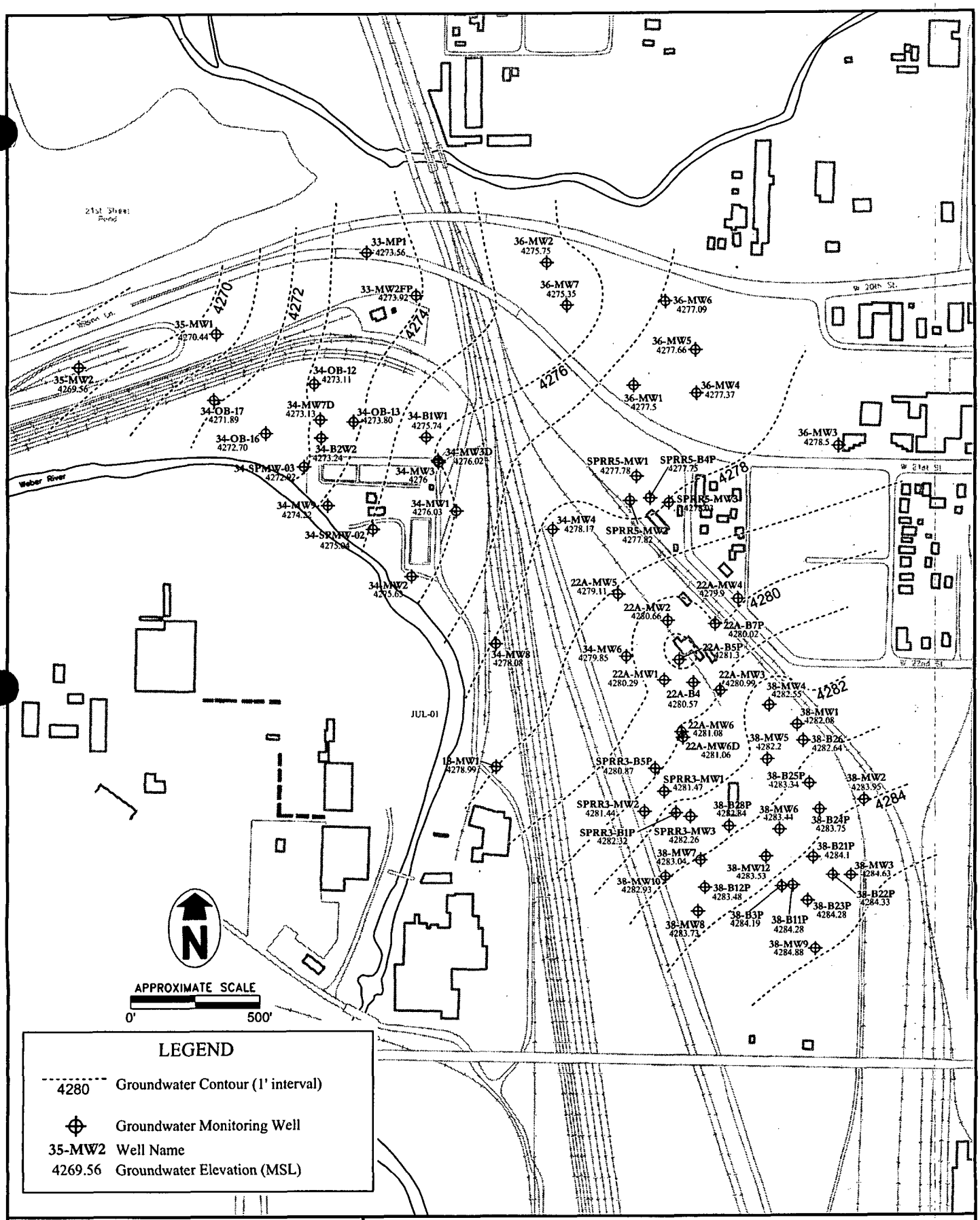
ENVIRONMENTAL MANAGEMENT & PLANNING

TITLE:

**FIGURE 3-16E**
**GROUNDWATER POTENTIOMETRIC SURFACE**
**AREA 5**
**APRIL, 2001**

1330-GW (9/5/03)

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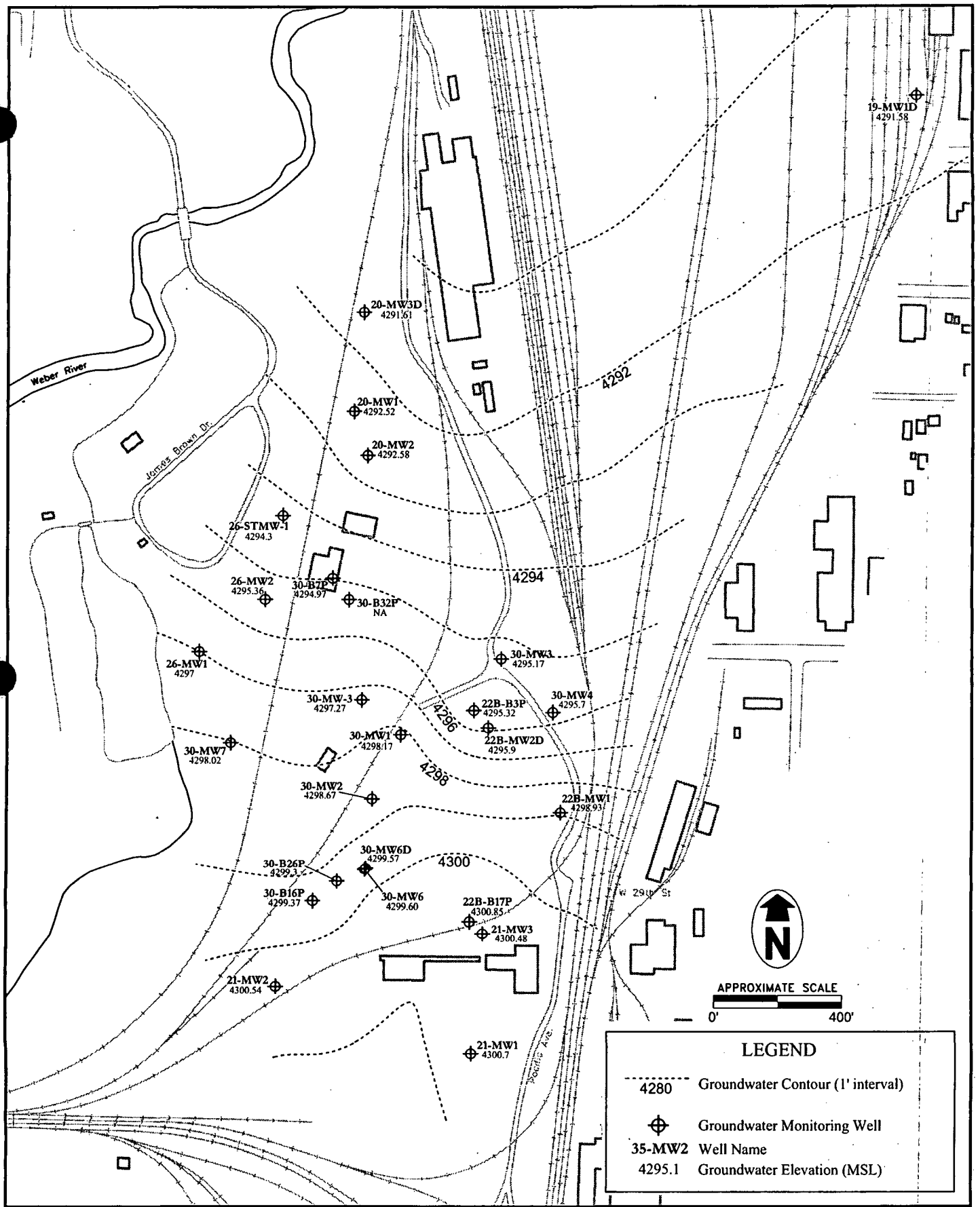
ENVIRONMENTAL MANAGEMENT & PLANNING

TITLE:

**FIGURE 3-17A**
**GROUNDWATER POTENTIOMETRIC SURFACE**
**AREA 1**
**JULY, 2001**

1330-GW (9/5/03)

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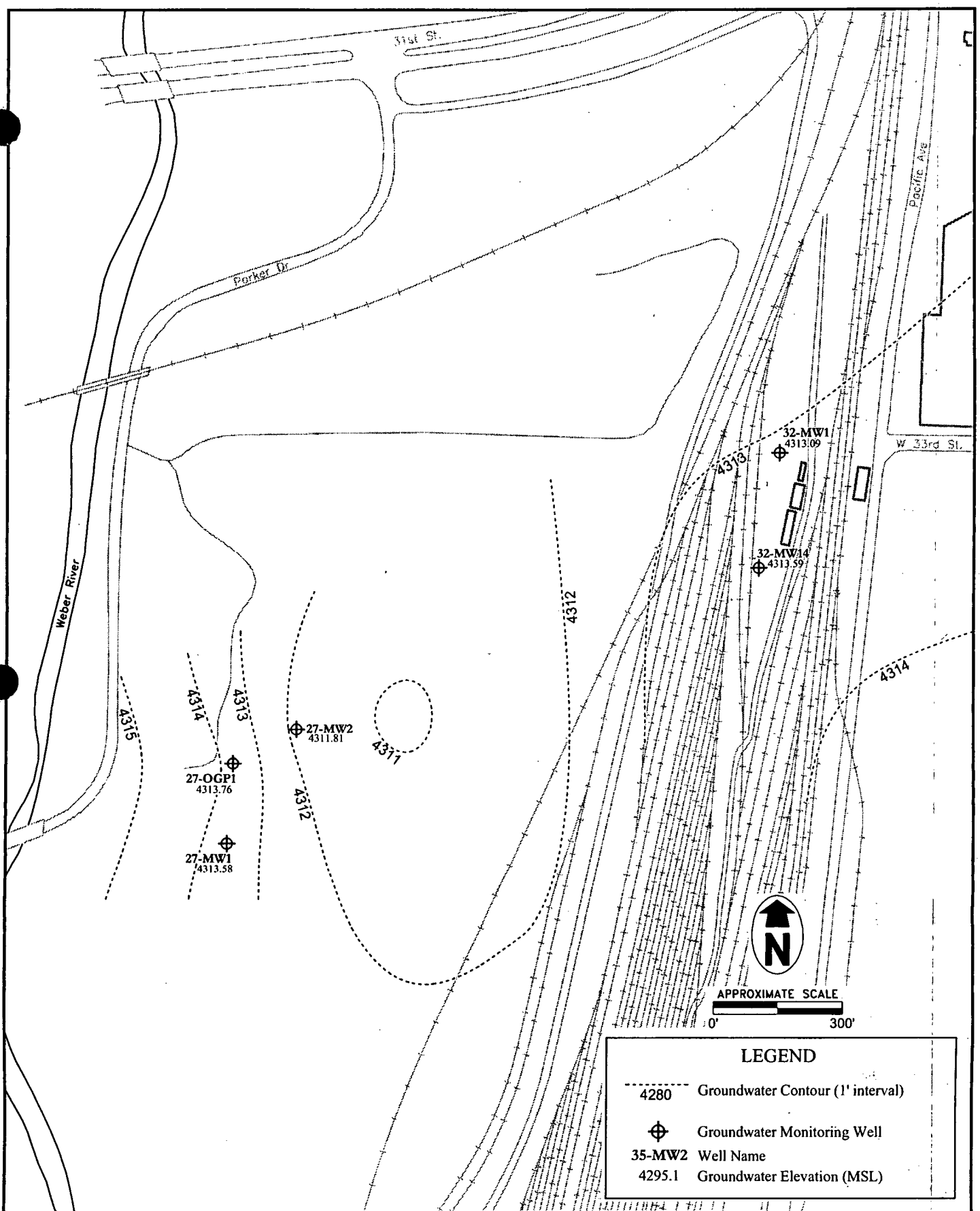
ENVIRONMENTAL MANAGEMENT & PLANNING

TITLE:

**FIGURE 3-17B**
**GROUNDWATER POTENTIOMETRIC SURFACE**
**AREA 2**
**JULY, 2001**

1330-GW (9/5/03)

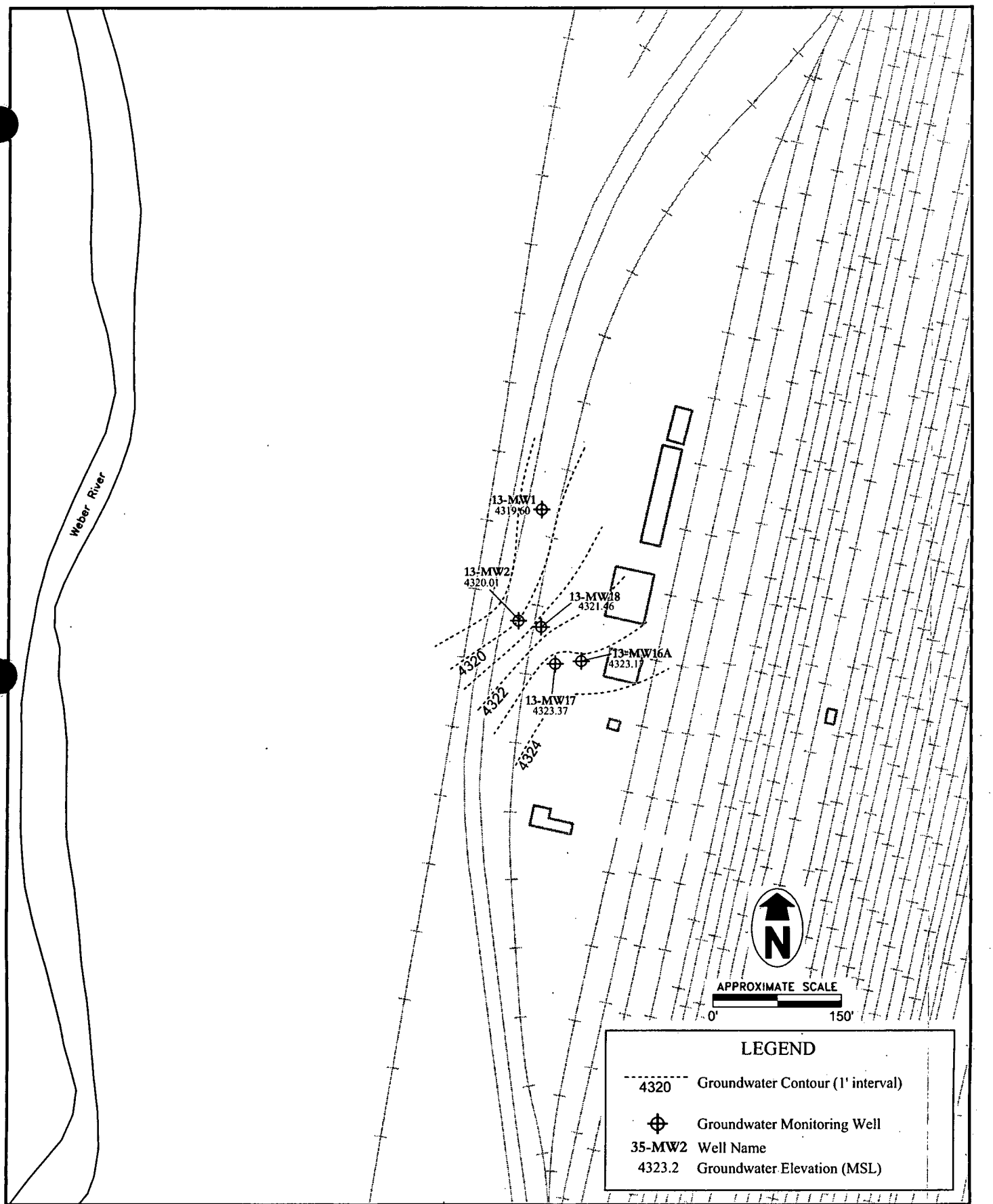



The Forrester Group
ENVIRONMENTAL MANAGEMENT & PLANNING

TITLE:

**FIGURE 3-17C**
**GROUNDWATER POTENTIOMETRIC SURFACE**
**AREA 3**
**JULY, 2001**

1330-GW (9/5/03)

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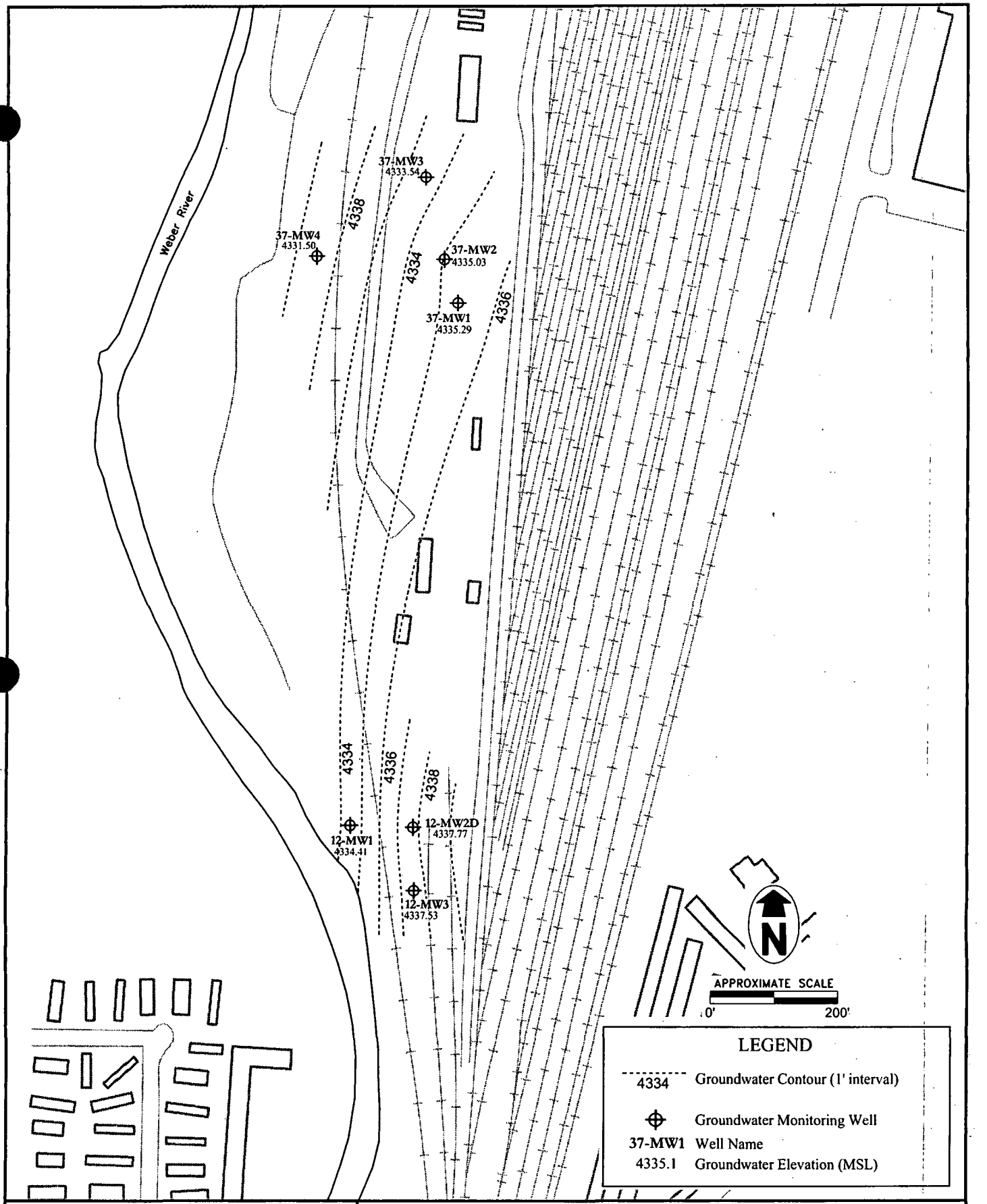
ENVIRONMENTAL MANAGEMENT & PLANNING

TITLE:

**FIGURE 3-17D**
**GROUNDWATER POTENTIOMETRIC SURFACE**
**AREA 4**
**JULY, 2001**

1330-GW (9/5/03)

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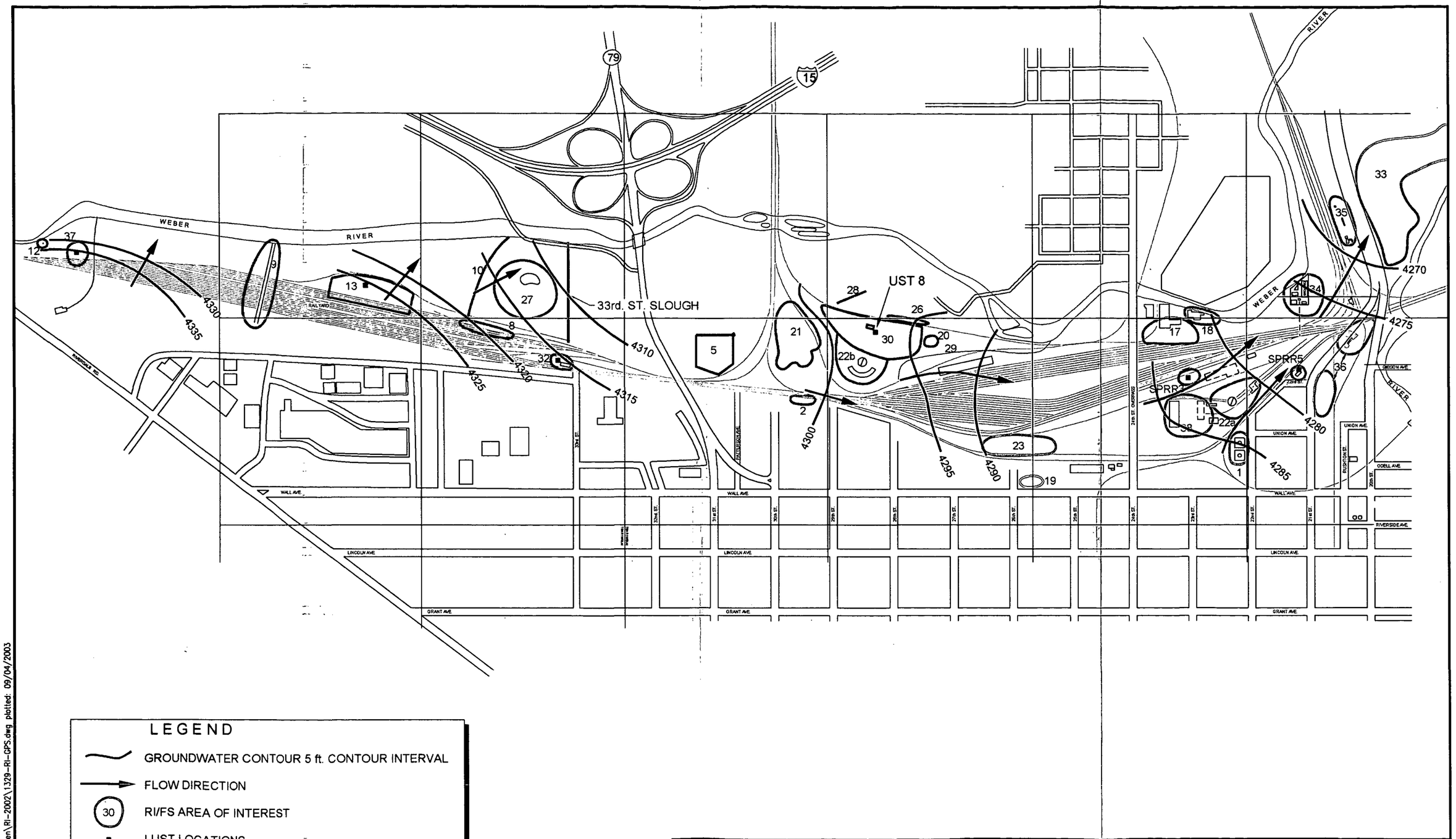
ENVIRONMENTAL MANAGEMENT & PLANNING

TITLE:

**FIGURE 3-17E**
**GROUNDWATER POTENTIOMETRIC SURFACE**
**AREA 5**
**JULY, 2001**

1330-GW (9/5/03)




| | BY | DATE |
|---|---|---|
| DRAWN | FR | 3/22/02 |
| CHECKED | | |
| APPROVED | | |
| APPROVED | | |
| APPROVED | | |

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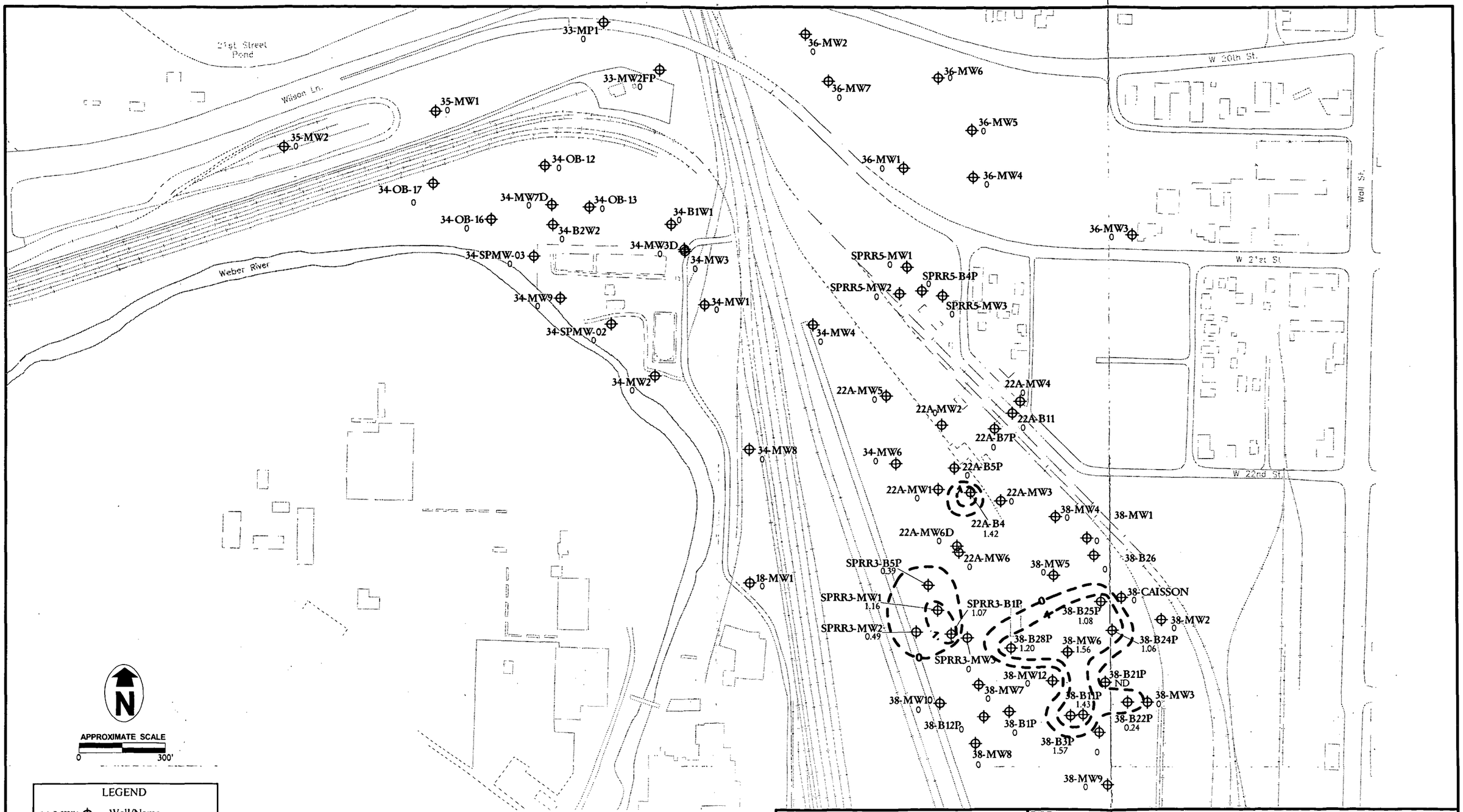
OGDEN RAILYARD - OGDEN, UTAH

FIGURE 3-18
SITEWIDE GENERALIZED POTENTIOMETRIC SURFACE
(FROM FIGURES 3-14A TO 3-14E)

SCALE: 1" = 1200'

DWG. NO.: 1329-RI-GPS

M:\clients\FORREST\Ogden\RI-2002\1329-RI-GPS.dwg plotted: 09/04/2003

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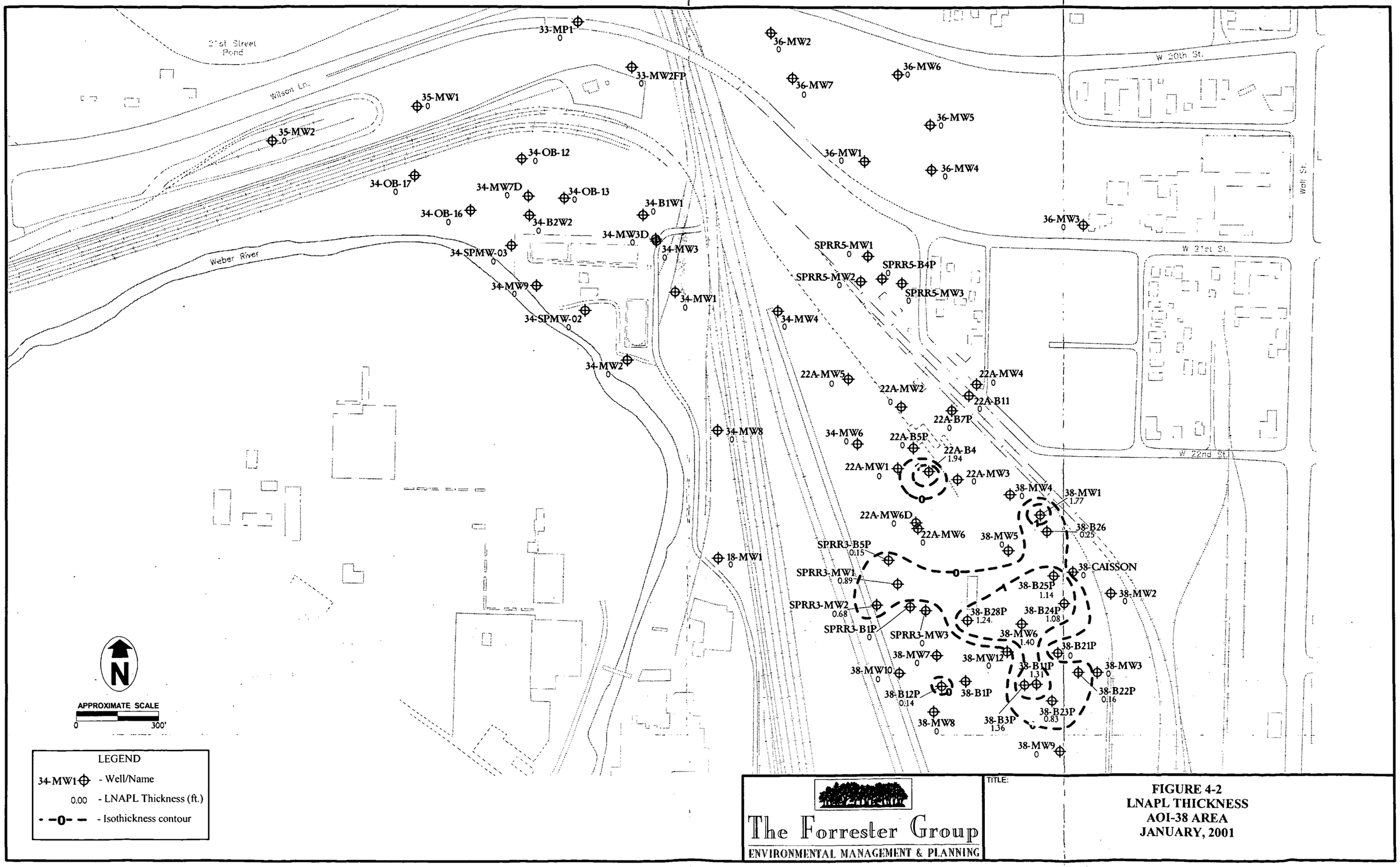
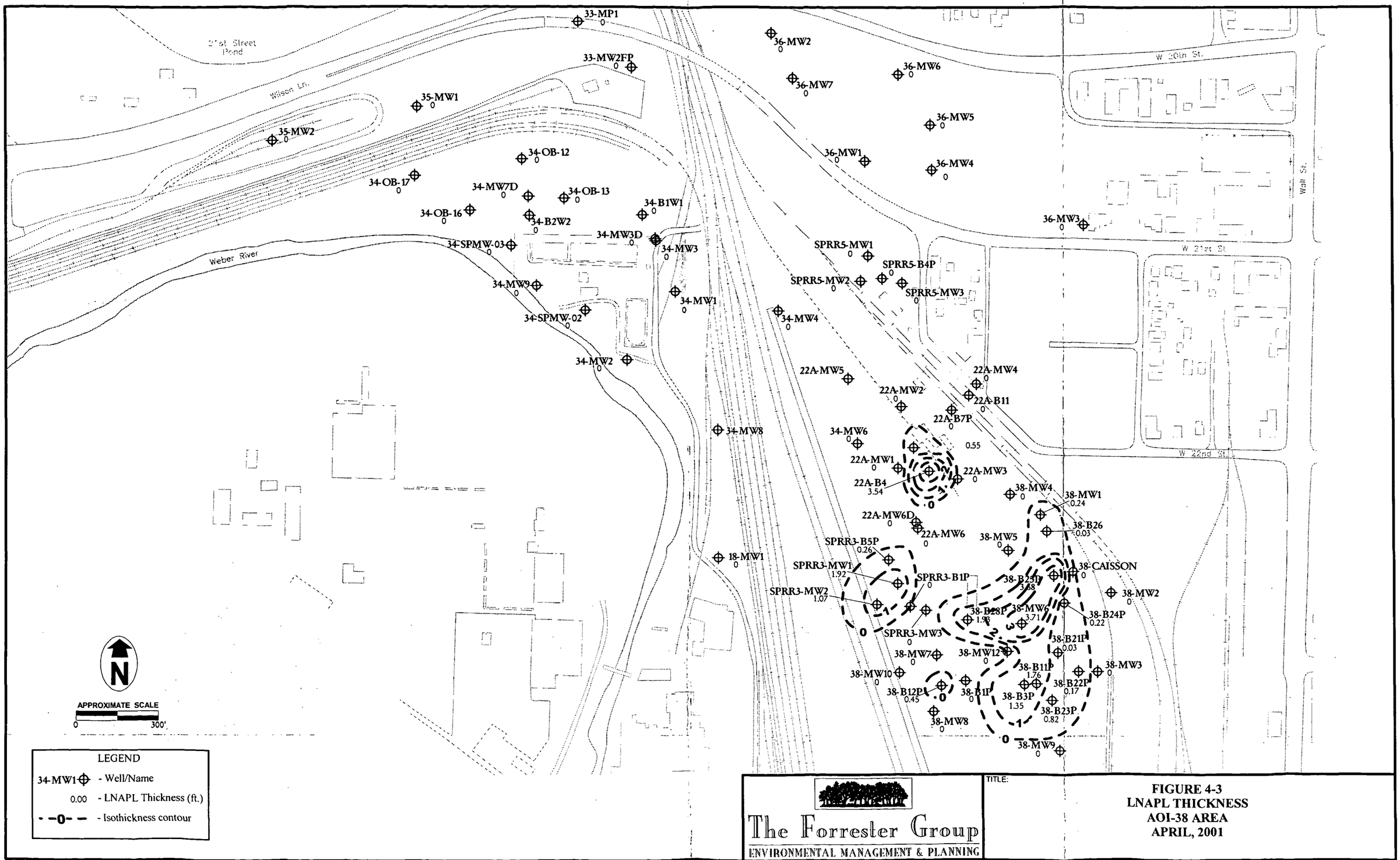
ENVIRONMENTAL MANAGEMENT & PLANNING

TITLE:

**FIGURE 4-1**
**LNAPL THICKNESS**
**AOI-38 AREA**
**OCTOBER, 2000**


21st Street Pond
Wilson Ln.
Weber River
W 20th St.
W 21st St.
W 22nd St.
Wall St.
33-MP1
33-MW2FP
35-MW1
35-MW2
34-OB-12
34-OB-17
34-MW7D
34-OB-13
34-OB-16
34-B1W1
34-B2W2
34-MW3D
34-MW3
34-SPMW-03
34-MW9
34-MW1
34-SPMW-02
34-MW4
34-MW2
34-MW8
34-MW6
36-MW2
36-MW6
36-MW7
36-MW5
36-MW1
36-MW4
36-MW3
SPRR5-MW1
SPRR5-B4P
SPRR5-MW2
SPRR5-MW3
22A-MW5
22A-MW4
22A-MW2
22A-B11
22A-B7P
22A-B5P
22A-B4
1.94
22A-MW1
22A-MW3
22A-MW6D
22A-MW6
18-MW1
38-MW4
38-MW1
1.77
38-B26
0.25
38-MW5
38-CAISSON
38-B25P
1.14
38-MW2
38-B24P
1.08
38-B28P
1.24
38-MW6
1.40
38-B21P
38-MW3
38-B22P
0.16
38-B1P
1.31
38-B23P
0.83
38-B3P
1.36
38-MW12
38-MW7
38-MW10
38-B12P
0.14
38-B1P
38-MW8
38-MW9
SPRR3-B5P
0.15
SPRR3-MW1
0.89
SPRR3-MW2
0.68
SPRR3-B1P
SPRR3-MW3
N
APPROXIMATE SCALE
0
300'
LEGEND
34-MW1 - Well/Name
0.00 - LNAPL Thickness (ft.)
- -0- - - Isothickness contour
The Forrester Group
ENVIRONMENTAL MANAGEMENT & PLANNING
TITLE:
FIGURE 4-2
LNAPL THICKNESS
AOI-38 AREA
JANUARY, 2001


21st Street Pond
Wilson Ln.
Weber River
W 20th St.
W 21st St.
W 22nd St.
Wall St.
33-MP1
33-MW2FP
35-MW1
35-MW2
34-OB-12
34-OB-17
34-MW7D
34-OB-13
34-OB-16
34-B1W1
34-B2W2
34-MW3D
34-SPMW-03
34-MW3
34-MW9
34-MW1
34-SPMW-02
34-MW2
34-MW4
34-MW8
34-MW6
36-MW2
36-MW6
36-MW7
36-MW5
36-MW1
36-MW4
36-MW3
SPRR5-MW1
SPRR5-B4P
SPRR5-MW2
SPRR5-MW3
22A-MW5
22A-MW4
22A-MW2
22A-B11
22A-B7P
0.55
22A-MW1
22A-MW3
22A-B4
3.54
22A-MW6D
22A-MW6
38-MW4
38-MW1
0.24
38-B26
0.03
38-MW5
SPRR3-B5P
0.26
18-MW1
SPRR3-MW1
1.92
SPRR3-B1P
SPRR3-MW2
1.07
SPRR3-MW3
38-CAISSON
38-B25P
3.48
38-MW2
38-B28P
1.98
38-MW6
3.71
38-B24P
0.22
38-B21P
0.03
38-MW7
38-MW12
38-B11P
1.76
38-MW3
38-MW10
38-B12P
0.45
38-B1P
38-B3P
1.35
38-B22P
0.17
38-B23P
0.82
38-MW8
38-MW9
N
APPROXIMATE SCALE
0
300'
LEGEND
34-MW1 - Well/Name
0.00 - LNAPL Thickness (ft.)
- -0- - - Isothickness contour
The Forrester Group
ENVIRONMENTAL MANAGEMENT & PLANNING
TITLE:
FIGURE 4-3
LNAPL THICKNESS
AOI-38 AREA
APRIL, 2001

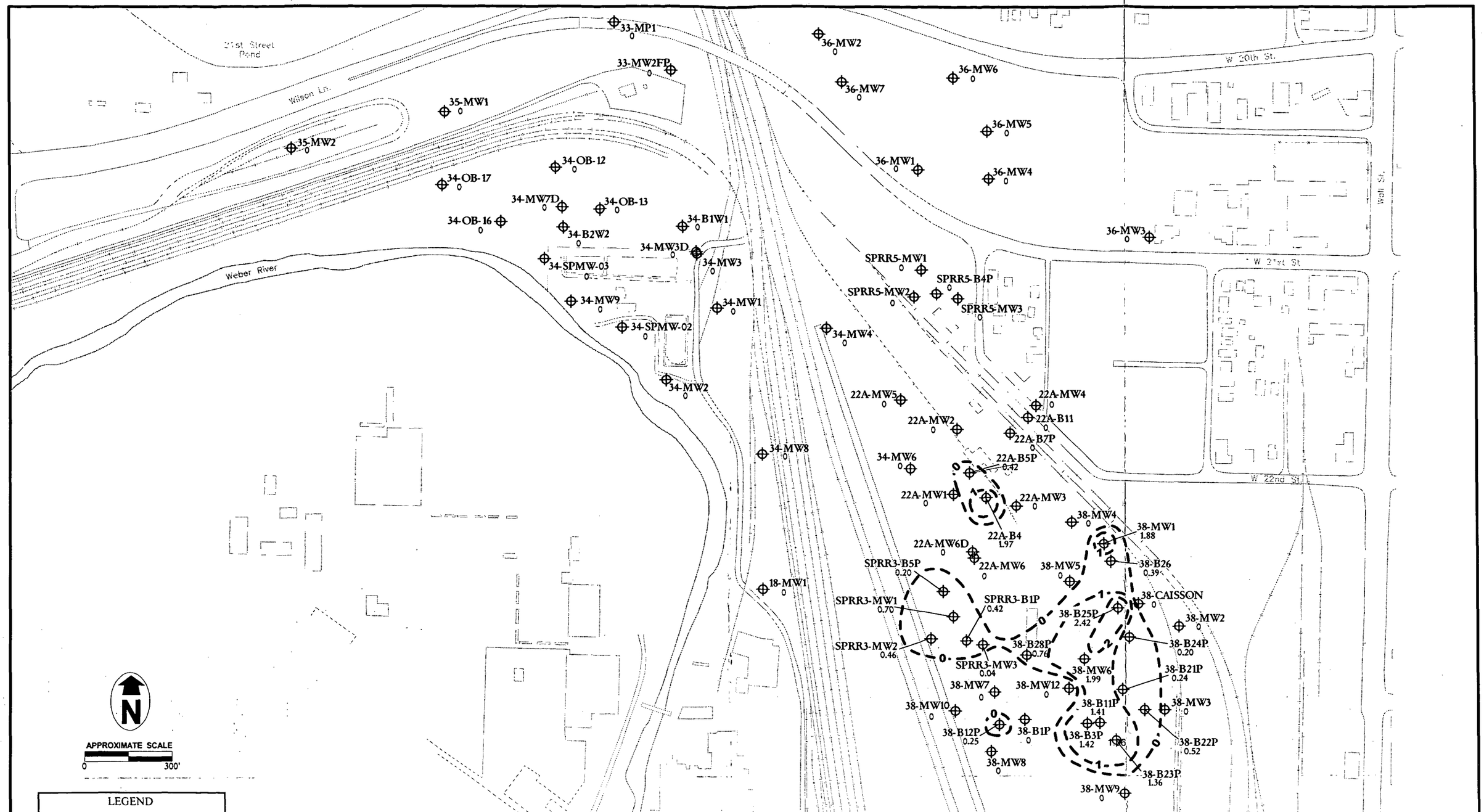
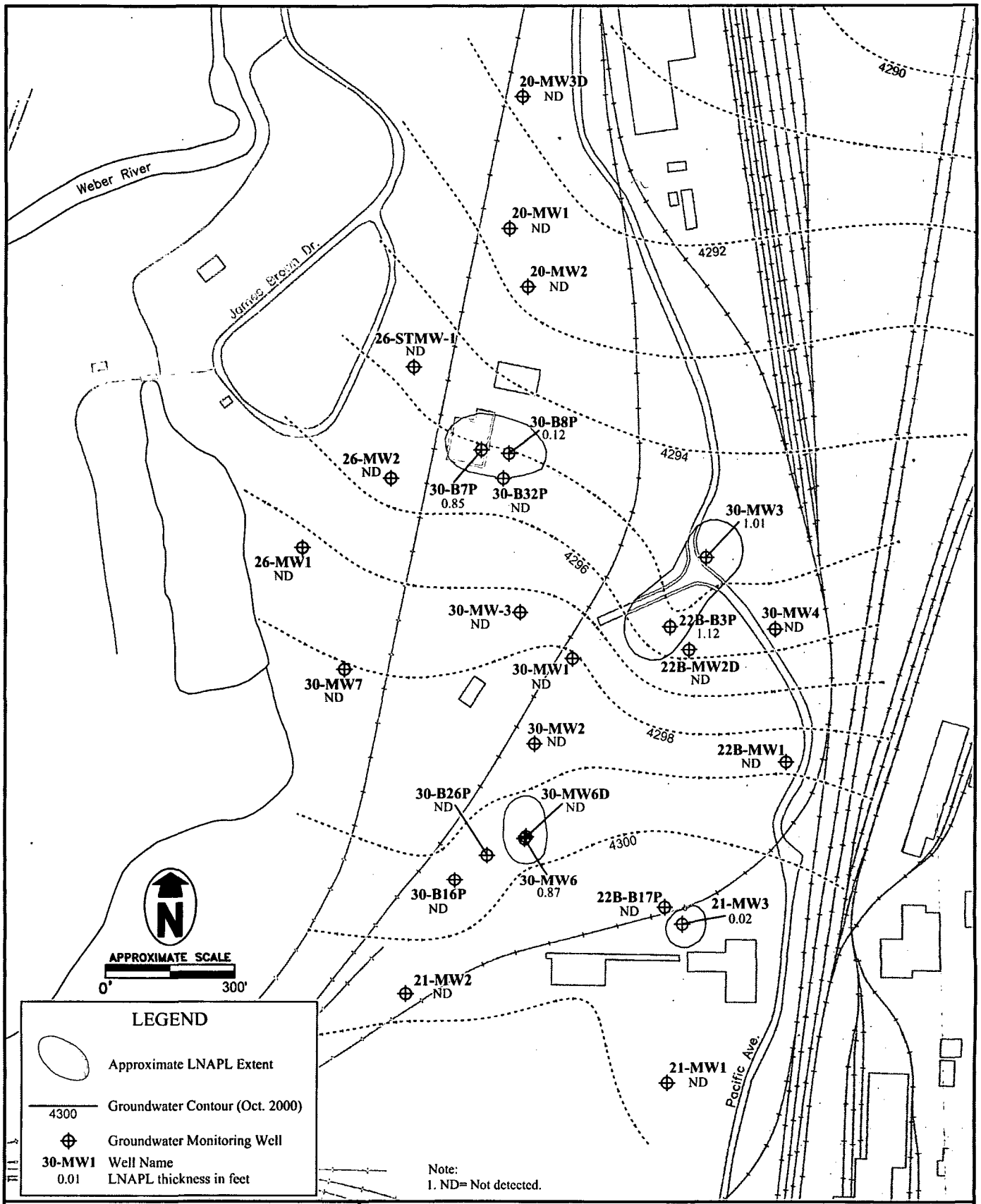



**FIGURE 4-4**
**LNAPL THICKNESS**
**AOI-38 AREA**
**JULY, 2001**

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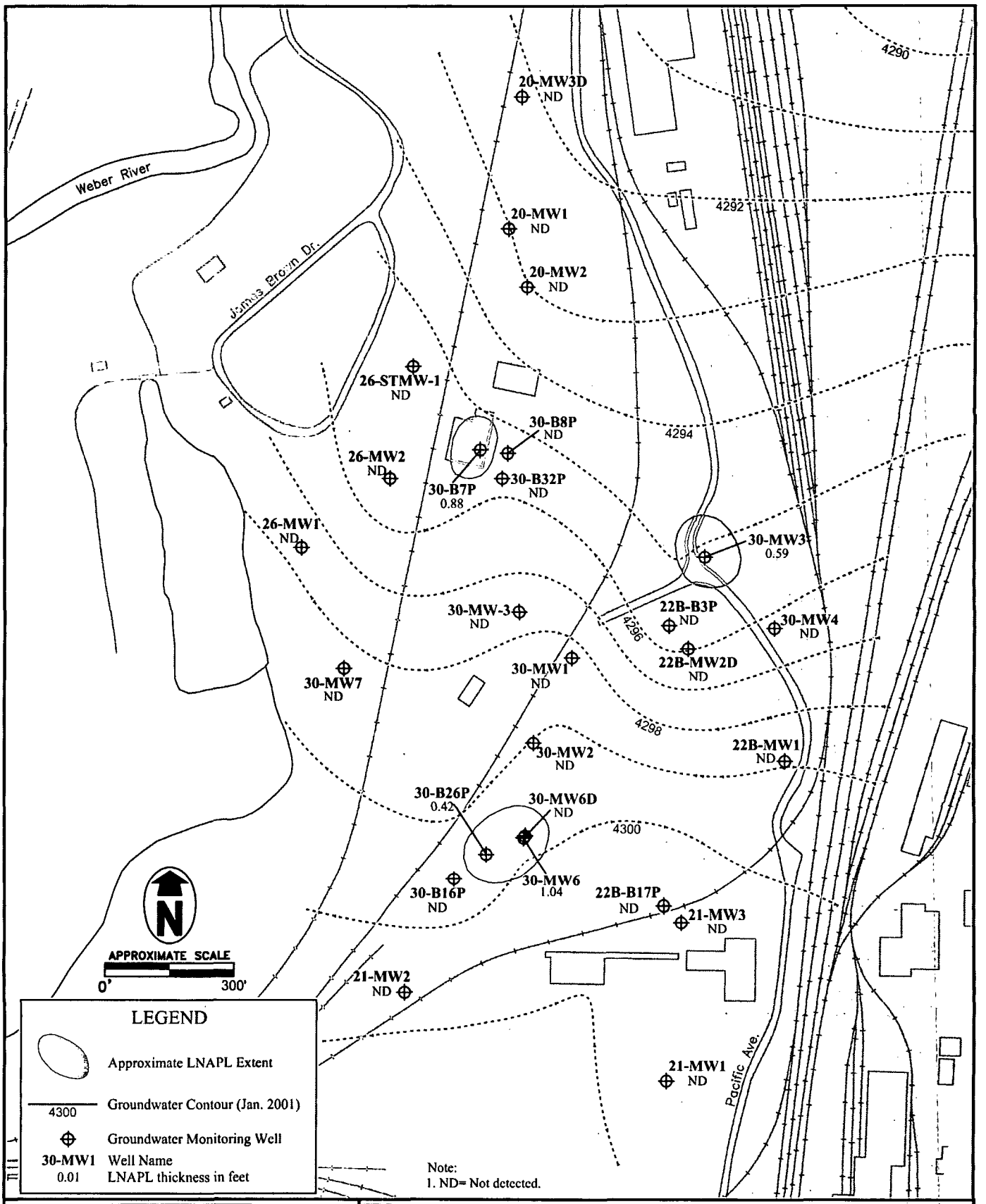
ENVIRONMENTAL MANAGEMENT & PLANNING

TITLE:

**FIGURE 4-5**
**LNAPL THICKNESS**
**AOI-22B & AOI-30 AREAS**
**OCTOBER, 2000**

1330-01

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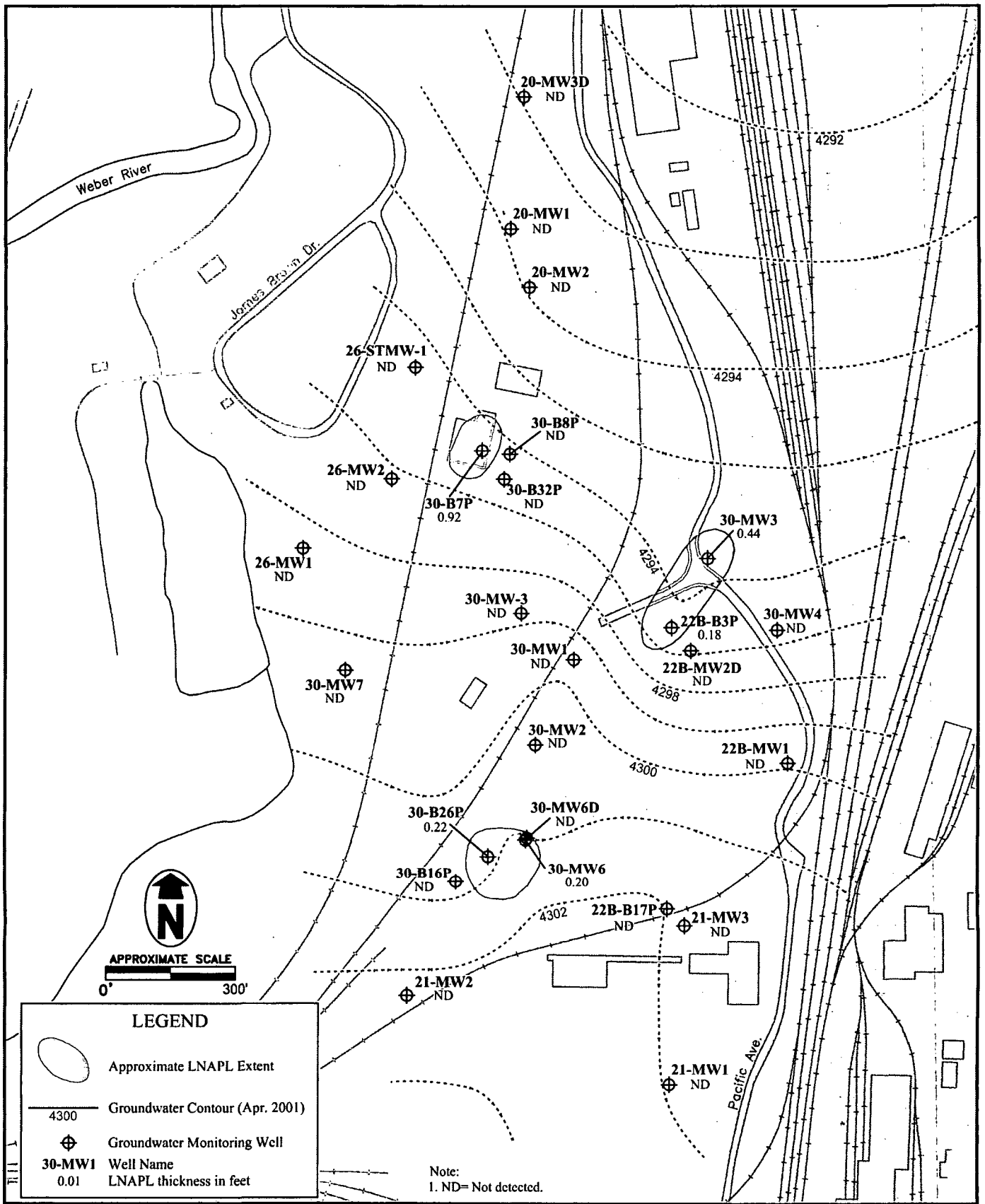
ENVIRONMENTAL MANAGEMENT & PLANNING

TITLE:

**FIGURE 4-6**
**LNAPL THICKNESS**
**AOI-22B & AOI-30 AREAS**
**JANUARY, 2001**

1330-01

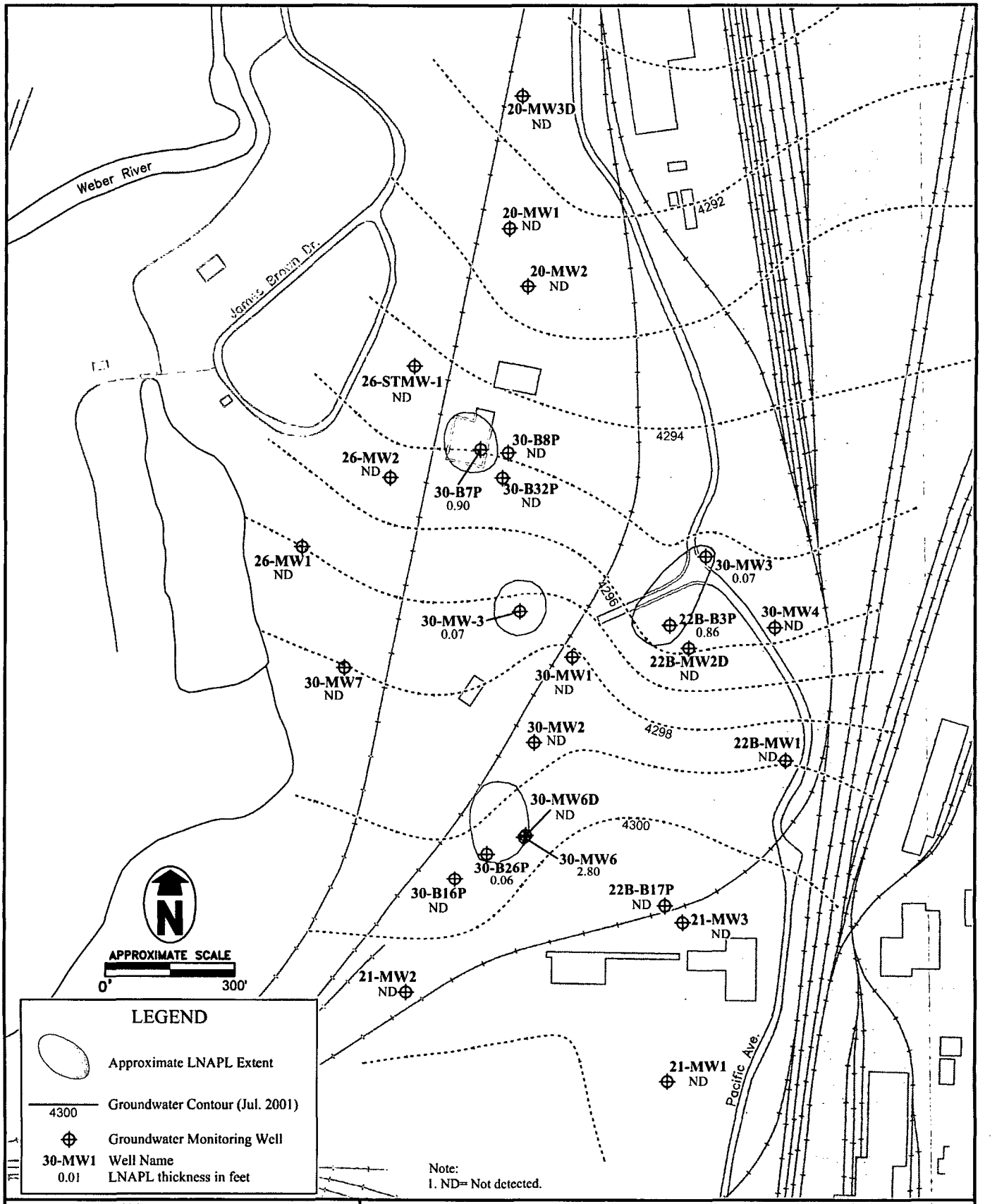



The Forrester Group
ENVIRONMENTAL MANAGEMENT & PLANNING

TITLE:

**FIGURE 4-7**
**LNAPL THICKNESS**
**AOI-22B & AOI-30 AREAS**
**APRIL, 2001**

1330-01



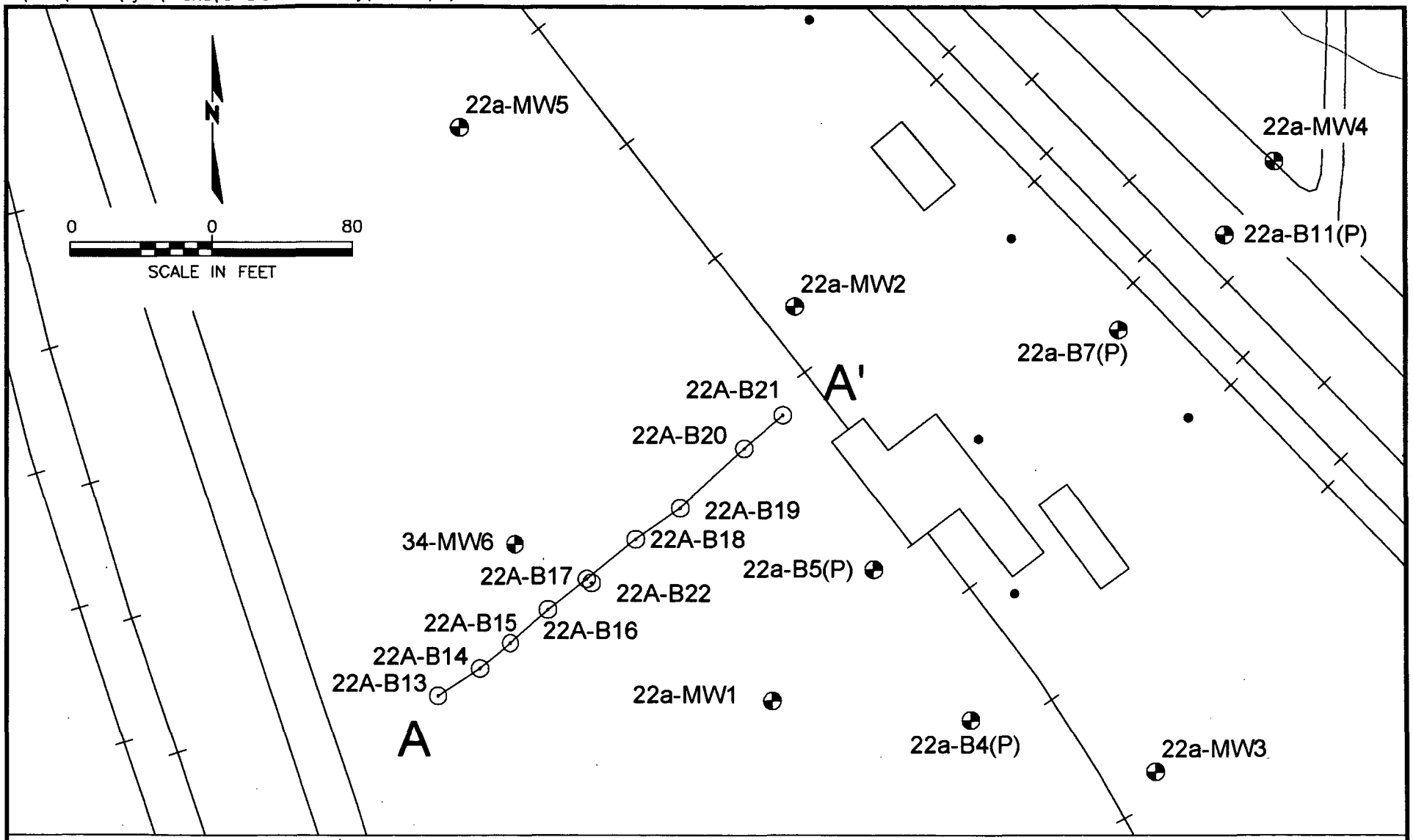

The Forrester Group
ENVIRONMENTAL MANAGEMENT & PLANNING

TITLE:

**FIGURE 4-8**
**LNAPL THICKNESS**
**AOI-22B & AOI-30 AREAS**
**JULY, 2001**

1330-01

M:\clients\FORREST\Ogden\RI-2002\ALPINE-22A-BORINGS.dwg plotted: 09/02/2003




LEGEND

⊙ SOIL BORING LOCATION

◕ MONITORING WELL LOCATION

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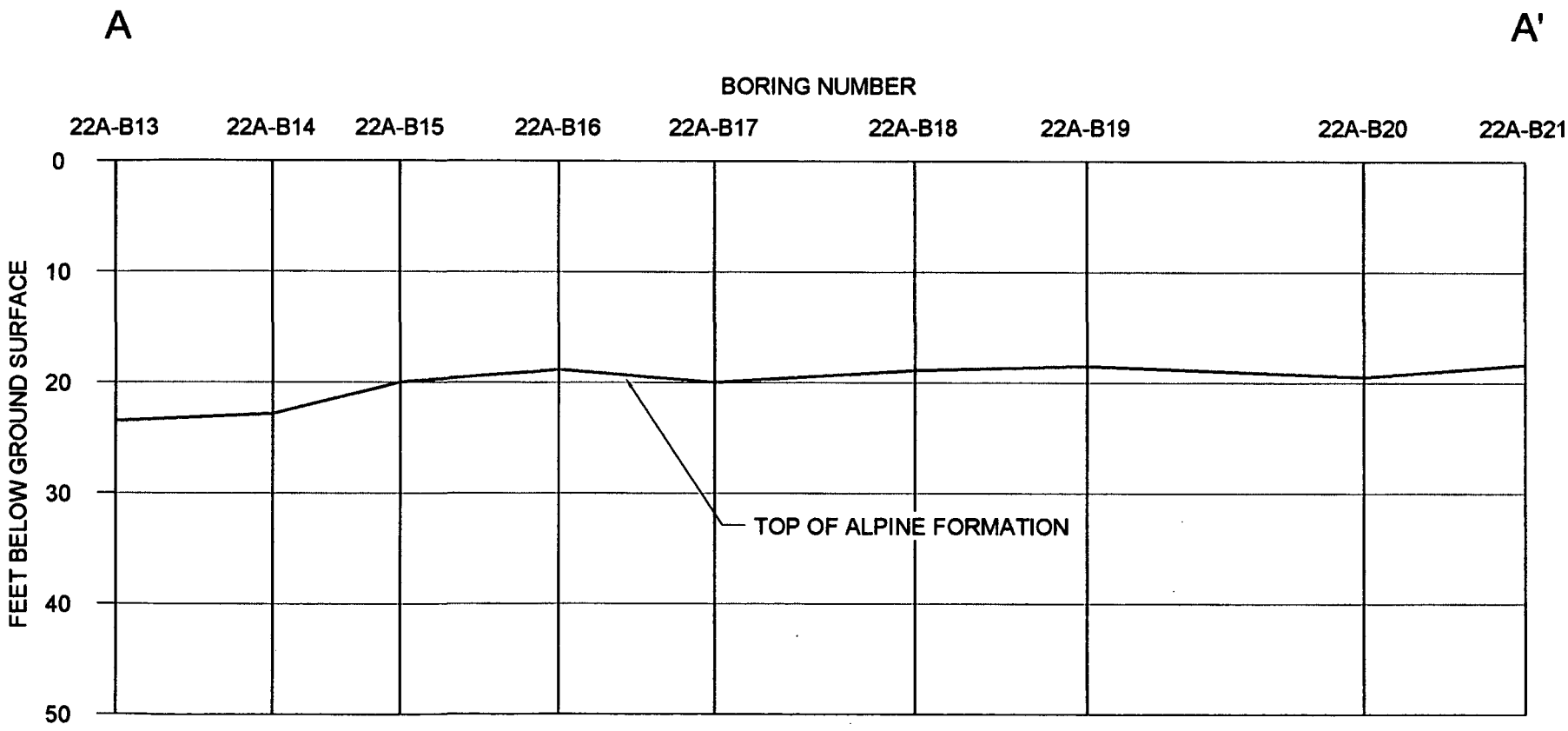
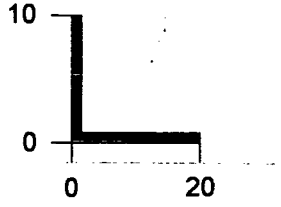
UPRR OGDEN, UTAH

FIGURE 4-9
AOI-22A BORING LOCATIONS

| SCALE: | DATE: |
|---|---|
| 1"=80' | 7/26/01 |

M:\clients\FORREST\Ogden\RI-2002\ALPINE-22A-BORINGS.dwg plotted: 09/02/2003




SCALE IN FEET
VERTICAL EXAGGERATION 2X

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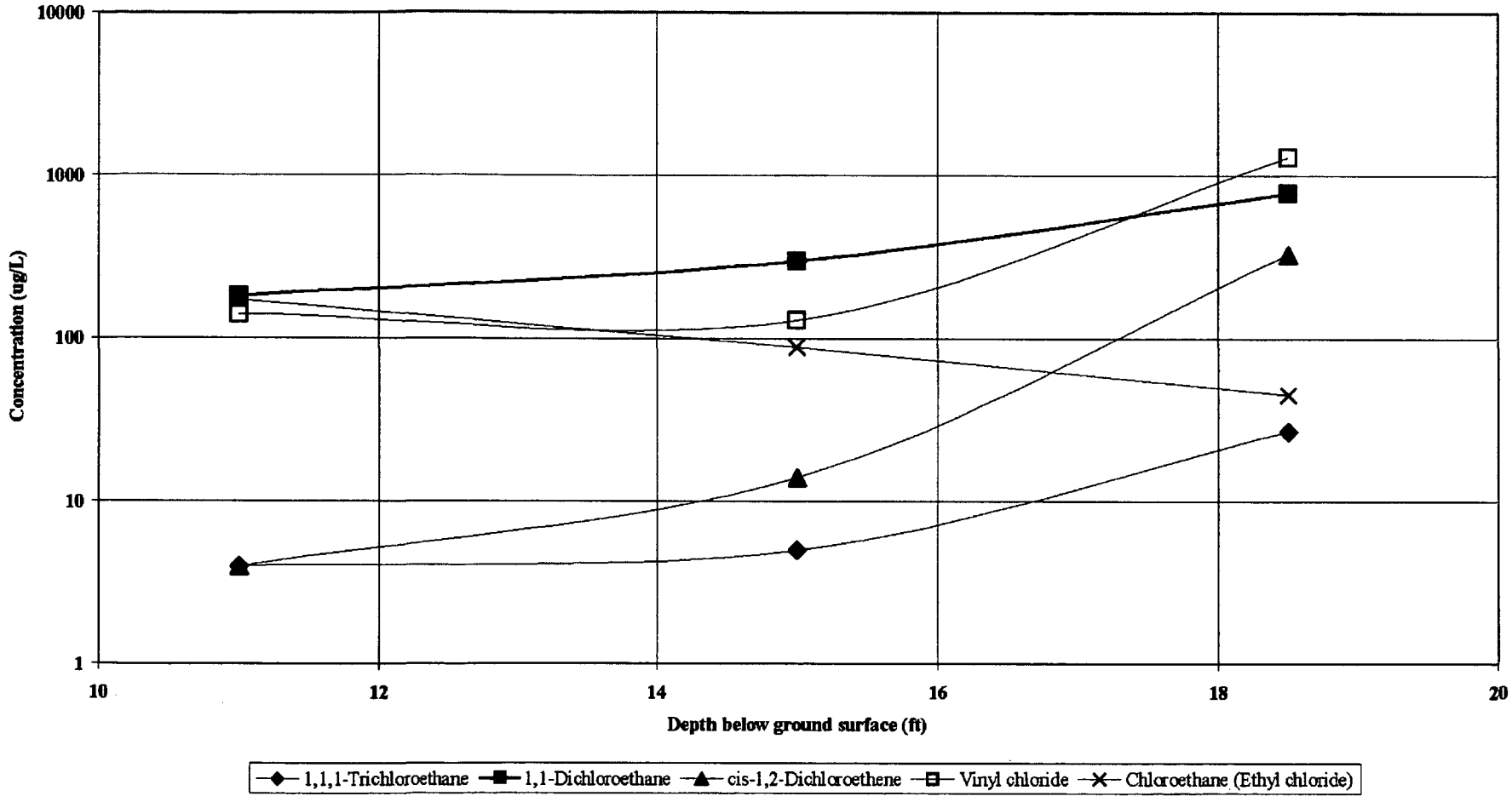
INSIGHTFUL ENVIRONMENTAL SOLUTIONS™

UPRR OGDEN, UTAH

FIGURE 4-10
AOI-22a
ALPINE FORMATION TOPOGRAPHY

| SCALE: | DATE: |
|---|---|
| AS SHOWN | 7/26/01 |

M:\clients\FORREST\Ogden\RI-2002\1329-Fig4-11.dwg plotted: 09/02/2003

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UPRR OGDEN, UTAH

FIGURE 4-11
GROUNDWATER CONTAMINATION VS DEPTH
BORING 22A-B22

| SCALE: | DATE: |
|---|---|
| AS SHOWN | 3/33/02 |

| | BY | DATE |
|---|---|---|
| DRAWN | FR | 3/20/02 |
| CHECKED | | |
| APPROVED | | |
| APPROVED | | |
| APPROVED | | |

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OGDEN RAILYARD - OGDEN, UTAH

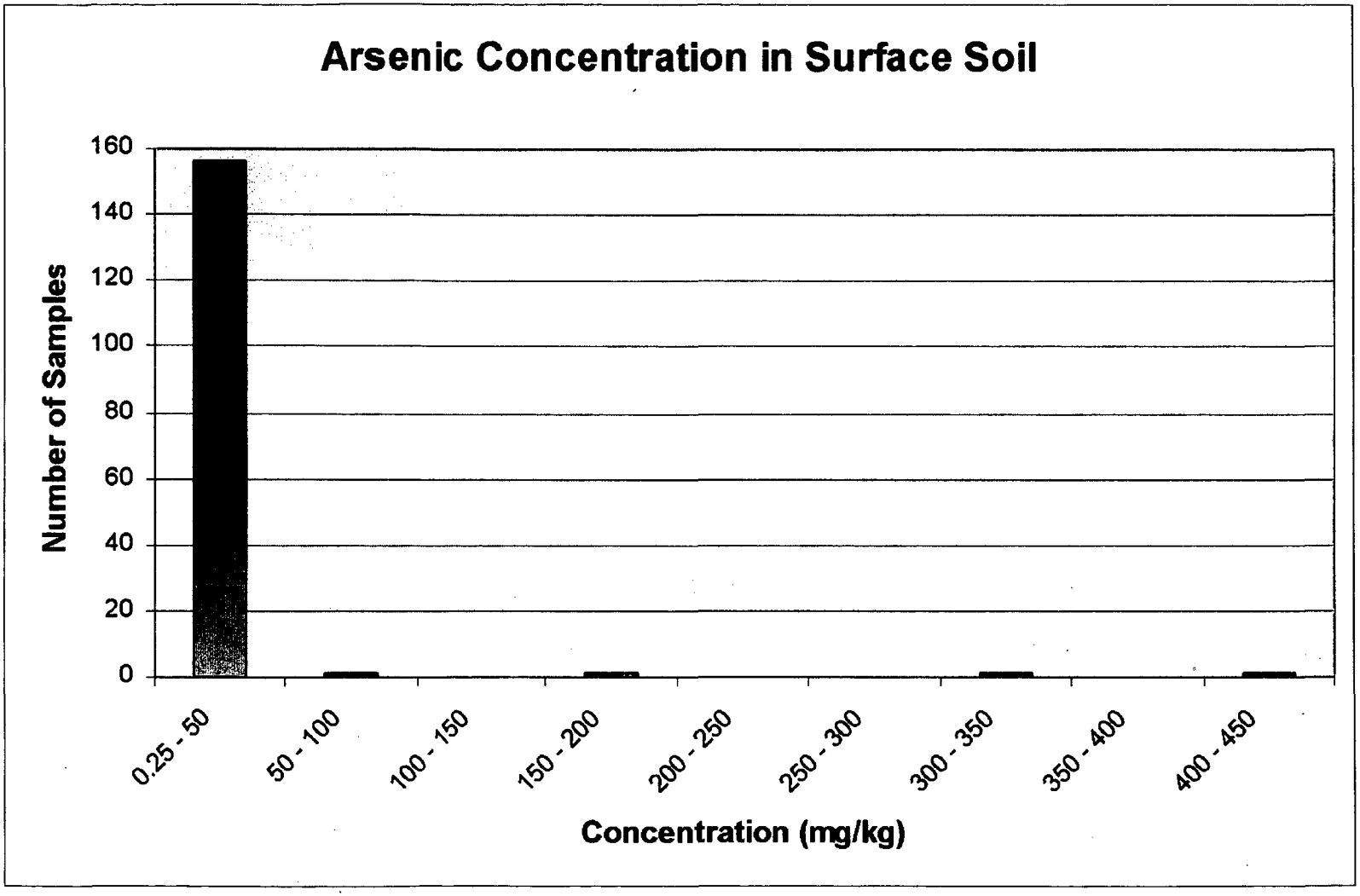
FIGURE 4-12
AOI-34/38 WASTE WATER SAMPLING LOCATIONS

SCALE: 1" = 300'

DWG. NO.: 1329-AOI34-38WW.dwg

M:\clients\FORREST\Ogden\RI-2002\1329-AOI34-38WW.dwg plotted: 09/08/2003

M:\clients\FORREST\Ogden\RI-2002\1329-Fig4-12a.dwg plotted: 09/02/2003

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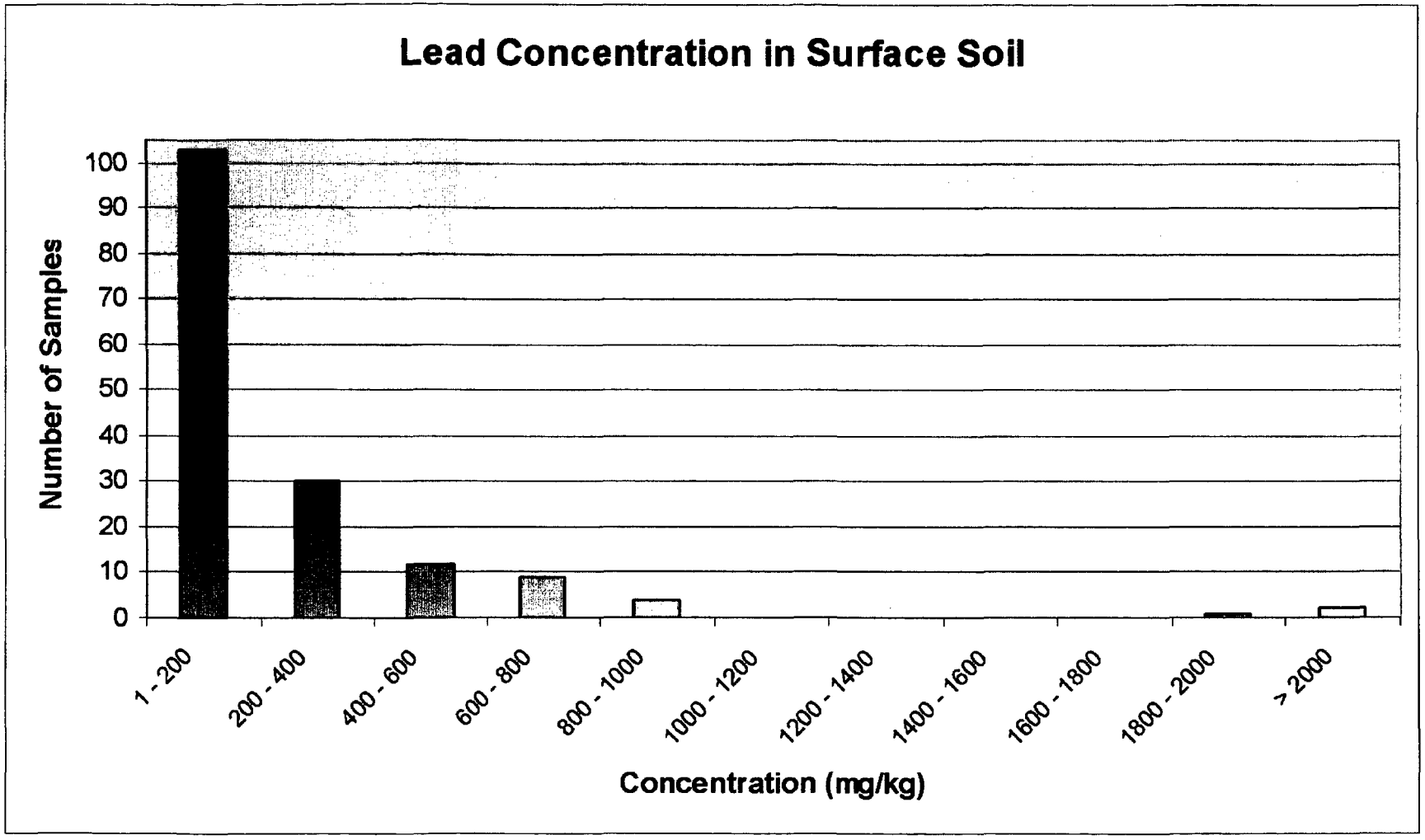
UPRR OGDEN, UTAH

FIGURE 4-13
ARSENIC CONCENTRATION IN SURFACE SOIL

| SCALE: | DATE: |
|---|---|
| AS SHOWN | 3/27/02 |

M:\clients\FORREST\Ogden\RI-2002\1329-Fig4-13a.dwg plotted: 09/02/2003

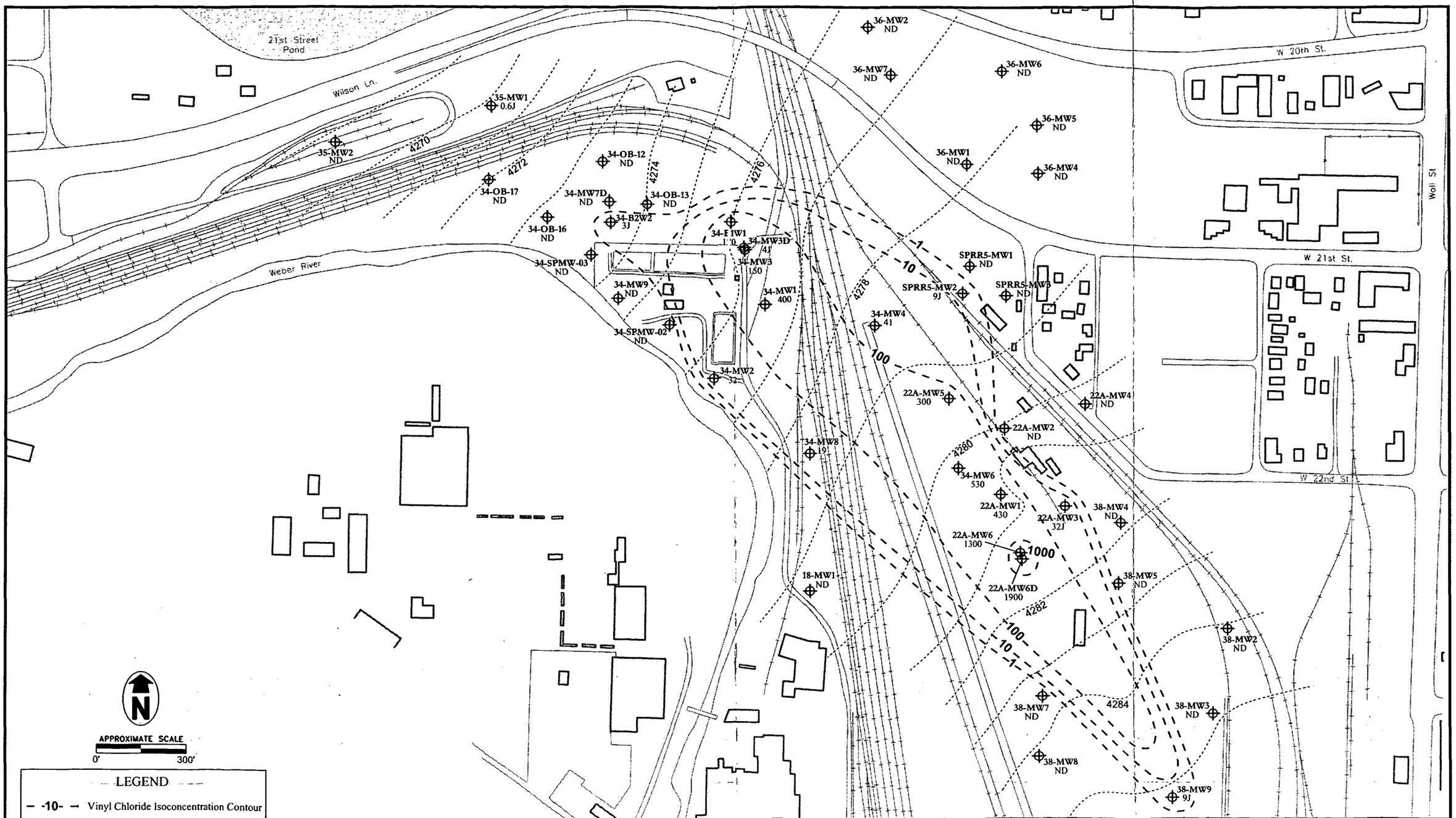



THE FORRESTER GROUP
INSIGHTFUL ENVIRONMENTAL SOLUTIONS™

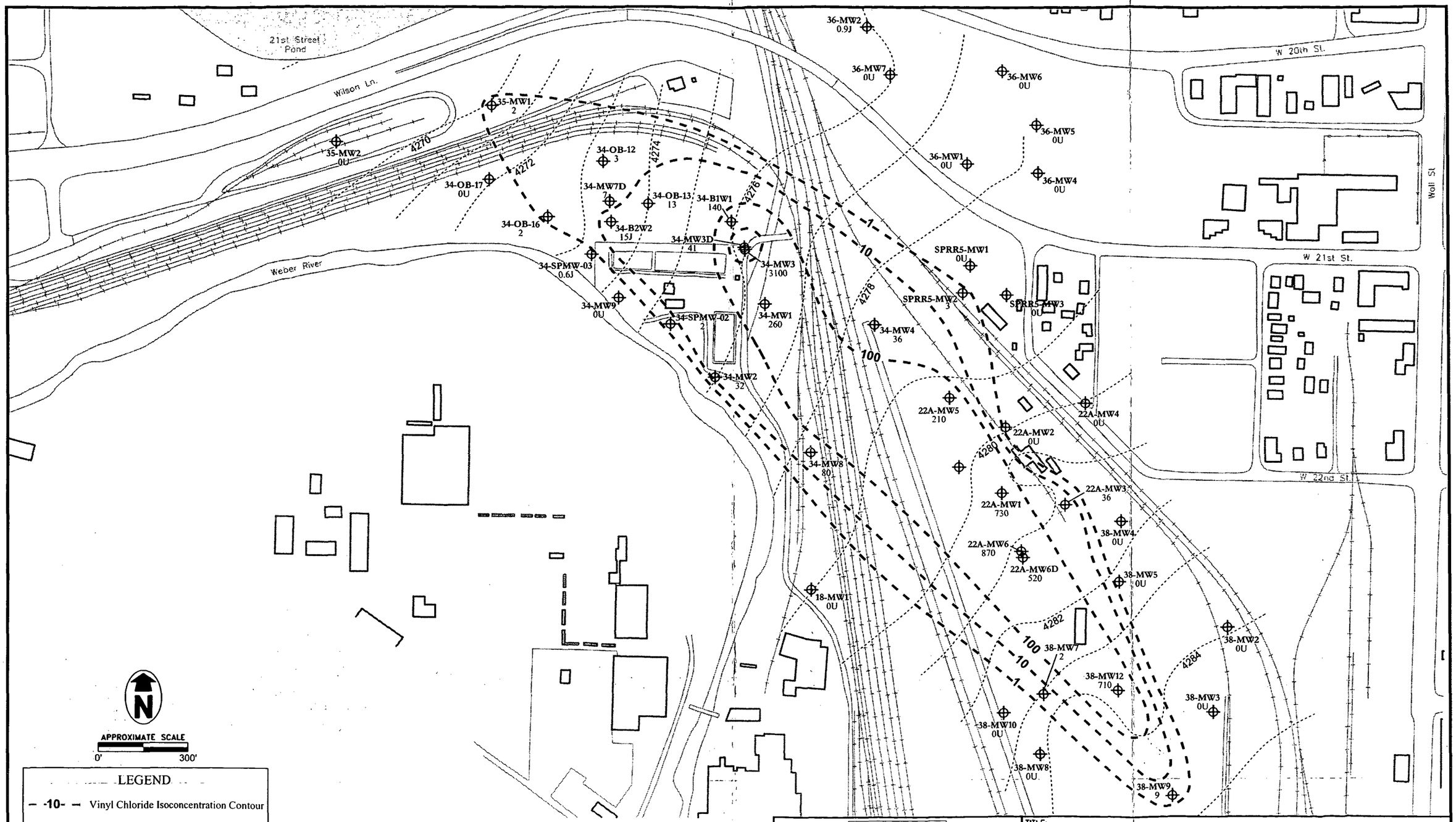
UPRR OGDEN, UTAH

FIGURE 4-14
LEAD CONCENTRATION IN SURFACE SOIL

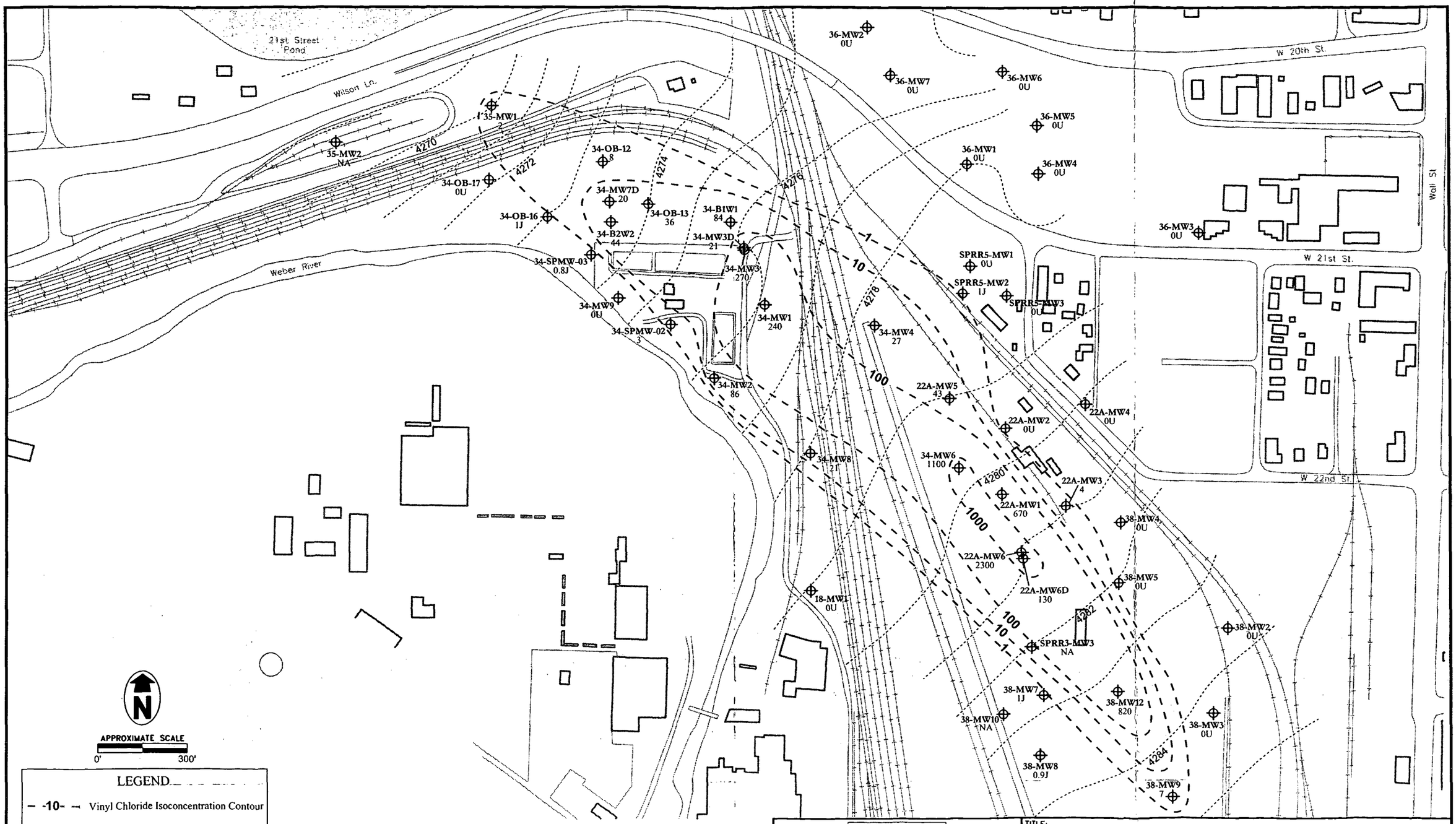
| SCALE: | DATE: |
|---|---|
| AS SHOWN | 3/27/02 |


21st Street Pond
Wilson Ln.
Weber River
W 20th St.
W 21st St.
W 22nd St.
Wall St
35-MW1 0.6J
35-MW2 ND
34-OB-12 ND
34-OB-17 ND
34-MW7D ND
34-OB-13 ND
34-B2W2 3J
34-OB-16 ND
34-E1W1 1.0
34-MW3D 4J
34-MW3 150
34-SPMW-03 ND
34-MW9 ND
34-MW1 400
34-SPMW-02 ND
34-MW2 32
34-MW4 41
34-MW8 19
34-MW6 530
36-MW2 ND
36-MW7 ND
36-MW6 ND
36-MW5 ND
36-MW1 ND
36-MW4 ND
SPRR5-MW1 ND
SPRR5-MW2 9J
SPRR5-MW3 ND
22A-MW5 300
22A-MW4 ND
22A-MW2 ND
22A-MW1 430
22A-MW3 32J
22A-MW6 1300
22A-MW6D 1900
38-MW4 ND
38-MW5 ND
38-MW2 ND
38-MW7 ND
38-MW3 ND
38-MW8 ND
38-MW9 9J
18-MW1 ND
4270
4272
4274
4276
4278
4280
4282
4284
1
10
100
1000
N
APPROXIMATE SCALE
0'
300'
LEGEND
-10- Vinyl Chloride Isoconcentration Contour
4280 Groundwater Contour (Jun. 2000)
Groundwater Monitoring Well
35-MW2 Well Name
2 VC Concentration in ug/L.
Note:
1. Values are given in ug/L.
2. ND= Note detected.
3. J= Estimated value.
The Forrester Group
ENVIRONMENTAL MANAGEMENT & PLANNING
TITLE:
FIGURE 5-1
NORTH VINYL CHLORIDE PLUME
JUNE, 2000

1330-00


21st Street Pond
Wilson Ln.
Weber River
W 20th St.
W 21st St.
W 22nd St.
Wall St
35-MW1 2
35-MW2 0U
34-OB-12 3
34-OB-17 0U
34-MW7D 7
34-OB-13 13
34-B1W1 140
34-OB-16 2
34-B2W2 15J
34-MW3D 41
34-SPMW-03 0.6J
34-MW3 3100
34-MW9 0U
34-SPMW-02 2
34-MW1 260
34-MW4 36
34-MW2 32
34-MW8 80
18-MW1 0U
36-MW2 0.9J
36-MW7 0U
36-MW6 0U
36-MW5 0U
36-MW1 0U
36-MW4 0U
SPRR5-MW1 0U
SPRR5-MW2 3
SPRR5-MW3 0U
22A-MW5 210
22A-MW4 0U
22A-MW2 0U
22A-MW1 730
22A-MW3 36
22A-MW6 870
22A-MW6D 520
38-MW4 0U
38-MW5 0U
38-MW7 2
38-MW12 710
38-MW2 0U
38-MW3 0U
38-MW10 0U
38-MW8 0U
38-MW9 9
4270
4272
4274
4276
4278
4280
4282
4284
1
10
100
N
APPROXIMATE SCALE
0'
300'
LEGEND
-10- Vinyl Chloride Isoconcentration Contour
4280 Groundwater Contour (Sep. 2000)
Groundwater Monitoring Well
35-MW2 Well Name
2 VC Concentration in ug/L.
Note:
1. Values are given in ug/L.
2. ND= Note detected.
3. J= Estimated value.
The Forrester Group
ENVIRONMENTAL MANAGEMENT & PLANNING
TITLE:
FIGURE 5-2
NORTH VINYL CHLORIDE PLUME
SEPTEMBER, 2000

1330-00




LEGEND

| | |
|---|---|
| -10- | Vinyl Chloride Isoconcentration Contour |
| 4280 | Groundwater Contour (Jan. 2001) |
| ⊕ | Groundwater Monitoring Well |
| 35-MW2 | Well Name |
| 2 | VC Concentration in ug/L. |

Note:
1. Values are given in ug/L.
2. ND= Note detected.
3. J= Estimated value.

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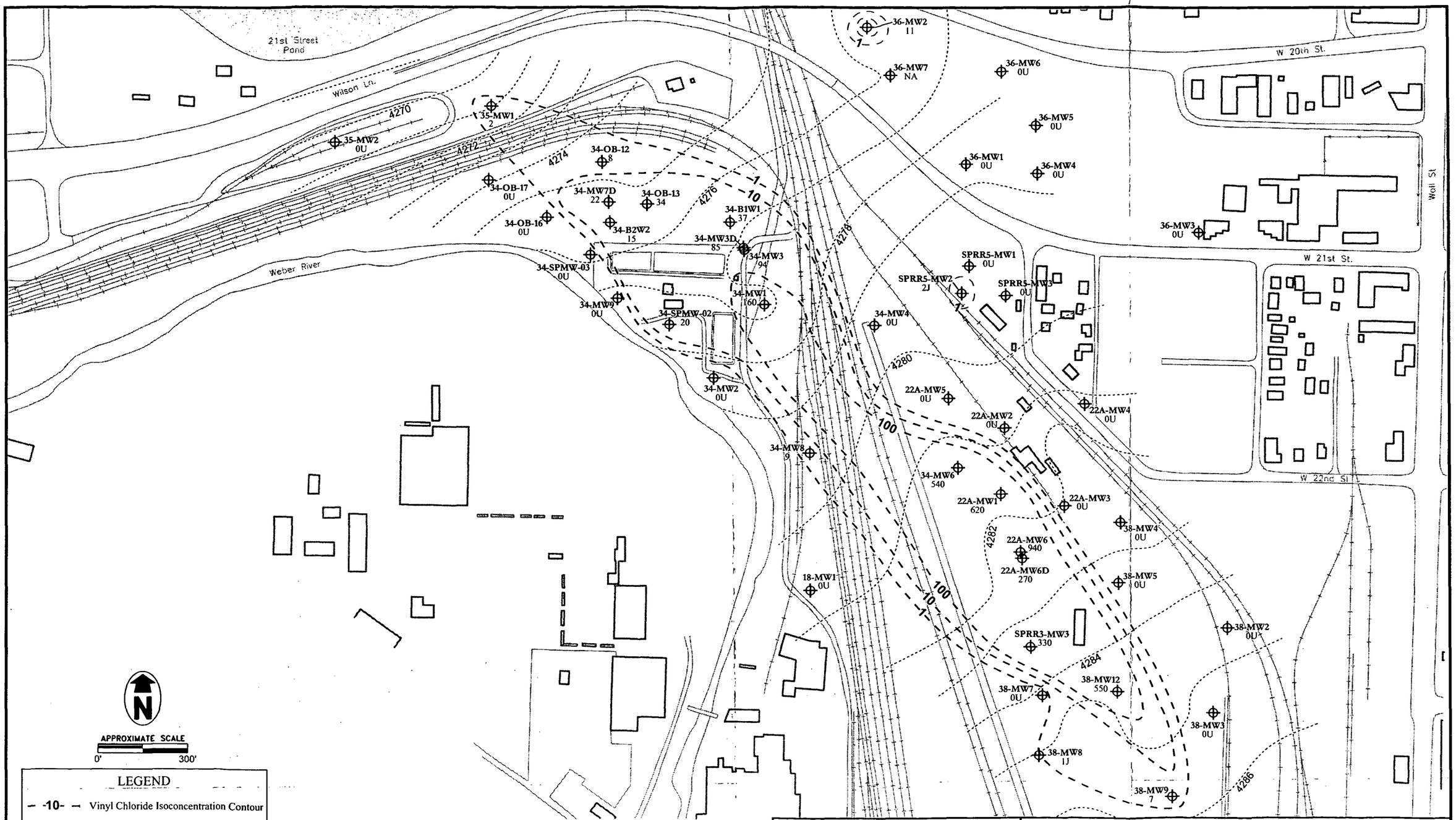
ENVIRONMENTAL MANAGEMENT & PLANNING

TITLE:

**FIGURE 5-3**
**NORTH VINYL CHLORIDE PLUME**
**JANUARY, 2001**

1330-00




## LEGEND

| | |
|---|---|
| -10- | Vinyl Chloride Isoconcentration Contour |
| 4280 | Groundwater Contour (May 2001) |
| ⊕ | Groundwater Monitoring Well |
| 35-MW2 | Well Name |
| 2 | VC Concentration in ug/L. |

Note:
1. Values are given in ug/L.
2. ND= Note detected.
3. J= Estimated value.

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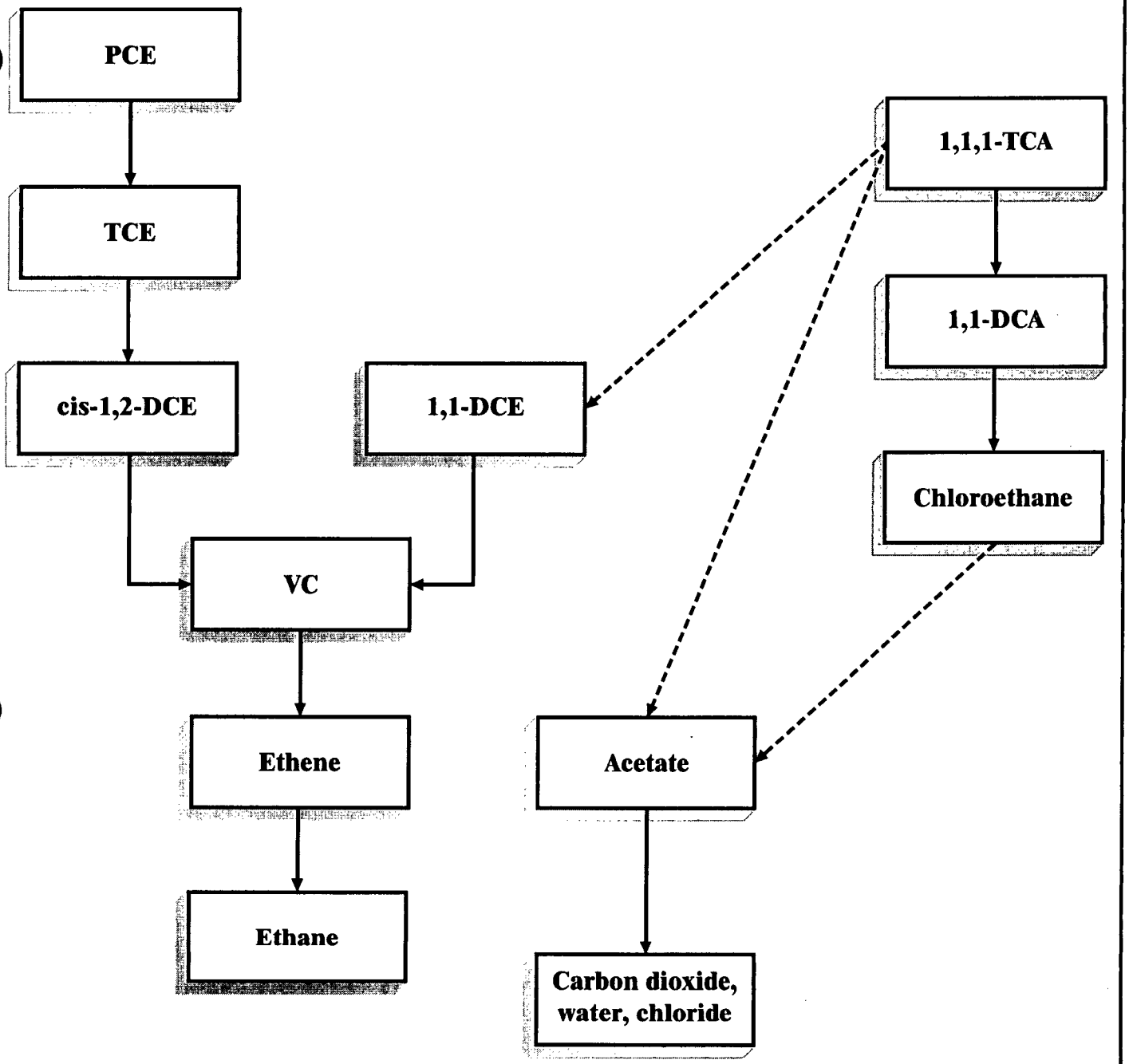
ENVIRONMENTAL MANAGEMENT & PLANNING

TITLE:

**FIGURE 5-4**
**NORTH VINYL CHLORIDE PLUME**
**MAY, 2001**

1330-00




Abiotic Reactions

Biotic Reactions

1. (Adapted from McCarty and Semprini, 1994; after Vogal etal, 1987)

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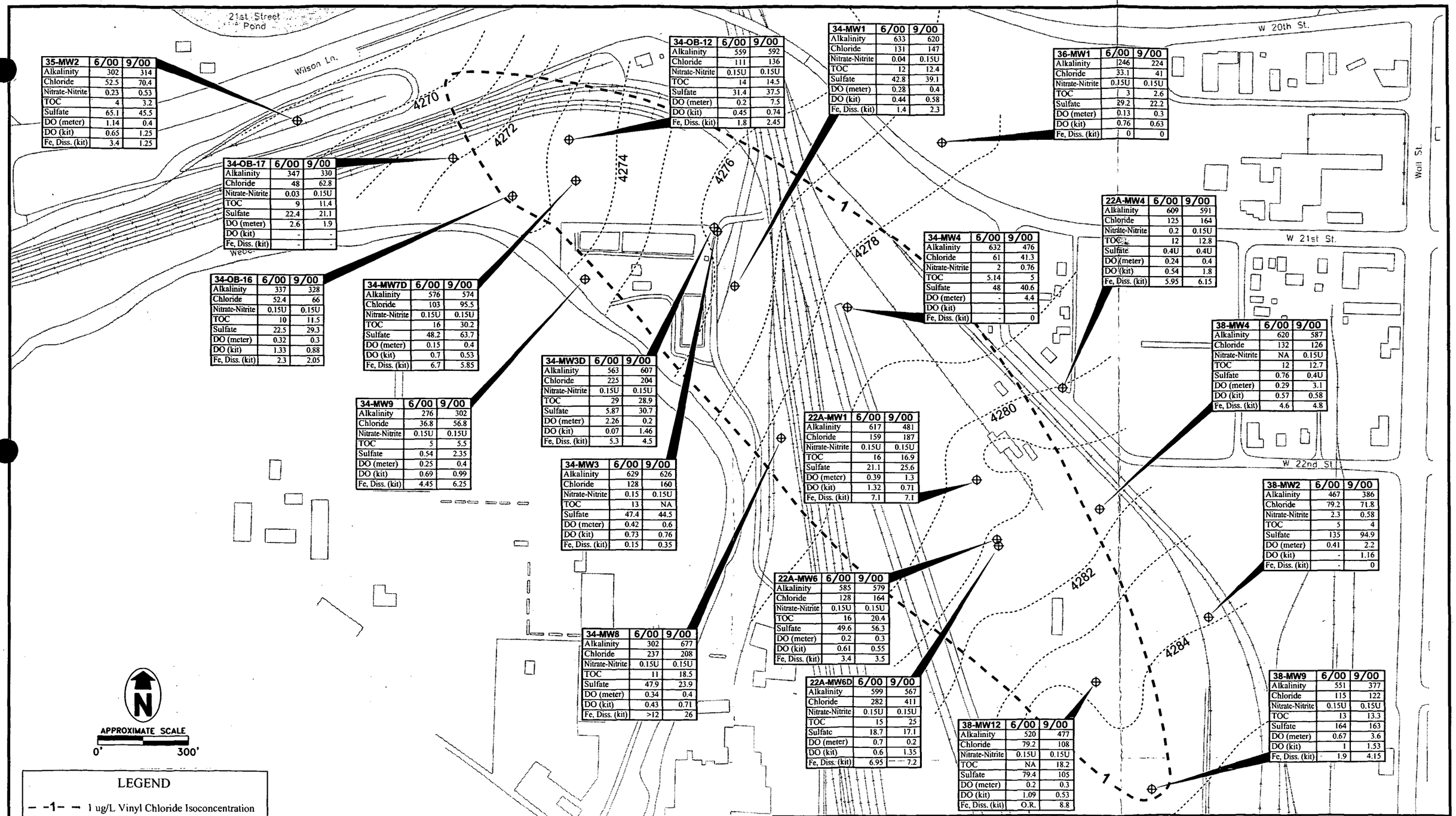
TITLE:

**FIGURE 5-5**
**PCE-TCA TRANSFORMATION PATHWAYS**

1330-04




| 35-MW2 | 6/00 | 9/00 |
|---|---|---|
| Alkalinity | 302 | 314 |
| Chloride | 52.5 | 70.4 |
| Nitrate-Nitrite | 0.23 | 0.53 |
| TOC | 4 | 3.2 |
| Sulfate | 65.1 | 45.5 |
| DO (meter) | 1.14 | 0.4 |
| DO (kit) | 0.65 | 1.25 |
| Fe, Diss. (kit) | 3.4 | 1.25 |

| 34-OB-12 | 6/00 | 9/00 |
|---|---|---|
| Alkalinity | 559 | 592 |
| Chloride | 111 | 136 |
| Nitrate-Nitrite | 0.15U | 0.15U |
| TOC | 14 | 14.5 |
| Sulfate | 31.4 | 37.5 |
| DO (meter) | 0.2 | 7.5 |
| DO (kit) | 0.45 | 0.74 |
| Fe, Diss. (kit) | 1.8 | 2.45 |

| 34-MW1 | 6/00 | 9/00 |
|---|---|---|
| Alkalinity | 633 | 620 |
| Chloride | 131 | 147 |
| Nitrate-Nitrite | 0.04 | 0.15U |
| TOC | 12 | 12.4 |
| Sulfate | 42.8 | 39.1 |
| DO (meter) | 0.28 | 0.4 |
| DO (kit) | 0.44 | 0.58 |
| Fe, Diss. (kit) | 1.4 | 2.3 |

| 36-MW1 | 6/00 | 9/00 |
|---|---|---|
| Alkalinity | 246 | 224 |
| Chloride | 33.1 | 41 |
| Nitrate-Nitrite | 0.15U | 0.15U |
| TOC | 3 | 2.6 |
| Sulfate | 29.2 | 22.2 |
| DO (meter) | 0.13 | 0.3 |
| DO (kit) | 0.76 | 0.63 |
| Fe, Diss. (kit) | 0 | 0 |

| 34-OB-17 | 6/00 | 9/00 |
|---|---|---|
| Alkalinity | 347 | 330 |
| Chloride | 48 | 62.8 |
| Nitrate-Nitrite | 0.03 | 0.15U |
| TOC | 9 | 11.4 |
| Sulfate | 22.4 | 21.1 |
| DO (meter) | 2.6 | 1.9 |
| DO (kit) | - | - |
| Fe, Diss. (kit) | - | - |

| 22A-MW4 | 6/00 | 9/00 |
|---|---|---|
| Alkalinity | 609 | 591 |
| Chloride | 125 | 164 |
| Nitrate-Nitrite | 0.2 | 0.15U |
| TOC | 12 | 12.8 |
| Sulfate | 0.4U | 0.4U |
| DO (meter) | 0.24 | 0.4 |
| DO (kit) | 0.54 | 1.8 |
| Fe, Diss. (kit) | 5.95 | 6.15 |

| 34-OB-16 | 6/00 | 9/00 |
|---|---|---|
| Alkalinity | 337 | 328 |
| Chloride | 52.4 | 66 |
| Nitrate-Nitrite | 0.15U | 0.15U |
| TOC | 10 | 11.5 |
| Sulfate | 22.5 | 29.3 |
| DO (meter) | 0.32 | 0.3 |
| DO (kit) | 1.33 | 0.88 |
| Fe, Diss. (kit) | 2.3 | 2.05 |

| 34-MW7D | 6/00 | 9/00 |
|---|---|---|
| Alkalinity | 576 | 574 |
| Chloride | 103 | 95.5 |
| Nitrate-Nitrite | 0.15U | 0.15U |
| TOC | 16 | 30.2 |
| Sulfate | 48.2 | 63.7 |
| DO (meter) | 0.15 | 0.4 |
| DO (kit) | 0.7 | 0.53 |
| Fe, Diss. (kit) | 6.7 | 5.85 |

| 34-MW4 | 6/00 | 9/00 |
|---|---|---|
| Alkalinity | 632 | 476 |
| Chloride | 61 | 41.3 |
| Nitrate-Nitrite | 2 | 0.76 |
| TOC | 5.14 | 5 |
| Sulfate | 48 | 40.6 |
| DO (meter) | - | 4.4 |
| DO (kit) | - | - |
| Fe, Diss. (kit) | - | 0 |

| 38-MW4 | 6/00 | 9/00 |
|---|---|---|
| Alkalinity | 620 | 587 |
| Chloride | 132 | 126 |
| Nitrate-Nitrite | NA | 0.15U |
| TOC | 12 | 12.7 |
| Sulfate | 0.76 | 0.4U |
| DO (meter) | 0.29 | 3.1 |
| DO (kit) | 0.57 | 0.58 |
| Fe, Diss. (kit) | 4.6 | 4.8 |

| 34-MW3D | 6/00 | 9/00 |
|---|---|---|
| Alkalinity | 563 | 607 |
| Chloride | 225 | 204 |
| Nitrate-Nitrite | 0.15U | 0.15U |
| TOC | 29 | 28.9 |
| Sulfate | 5.87 | 30.7 |
| DO (meter) | 2.26 | 0.2 |
| DO (kit) | 0.07 | 1.46 |
| Fe, Diss. (kit) | 5.3 | 4.5 |

| 34-MW9 | 6/00 | 9/00 |
|---|---|---|
| Alkalinity | 276 | 302 |
| Chloride | 36.8 | 56.8 |
| Nitrate-Nitrite | 0.15U | 0.15U |
| TOC | 5 | 5.5 |
| Sulfate | 0.54 | 2.35 |
| DO (meter) | 0.25 | 0.4 |
| DO (kit) | 0.69 | 0.99 |
| Fe, Diss. (kit) | 4.45 | 6.25 |

| 22A-MW1 | 6/00 | 9/00 |
|---|---|---|
| Alkalinity | 617 | 481 |
| Chloride | 159 | 187 |
| Nitrate-Nitrite | 0.15U | 0.15U |
| TOC | 16 | 16.9 |
| Sulfate | 21.1 | 25.6 |
| DO (meter) | 0.39 | 1.3 |
| DO (kit) | 1.32 | 0.71 |
| Fe, Diss. (kit) | 7.1 | 7.1 |

| 34-MW3 | 6/00 | 9/00 |
|---|---|---|
| Alkalinity | 629 | 626 |
| Chloride | 128 | 160 |
| Nitrate-Nitrite | 0.15 | 0.15U |
| TOC | 13 | NA |
| Sulfate | 47.4 | 44.5 |
| DO (meter) | 0.42 | 0.6 |
| DO (kit) | 0.73 | 0.76 |
| Fe, Diss. (kit) | 0.15 | 0.35 |

| 38-MW2 | 6/00 | 9/00 |
|---|---|---|
| Alkalinity | 467 | 386 |
| Chloride | 79.2 | 71.8 |
| Nitrate-Nitrite | 2.3 | 0.58 |
| TOC | 5 | 4 |
| Sulfate | 135 | 94.9 |
| DO (meter) | 0.41 | 2.2 |
| DO (kit) | - | 1.16 |
| Fe, Diss. (kit) | - | 0 |

| 22A-MW6 | 6/00 | 9/00 |
|---|---|---|
| Alkalinity | 585 | 579 |
| Chloride | 128 | 164 |
| Nitrate-Nitrite | 0.15U | 0.15U |
| TOC | 16 | 20.4 |
| Sulfate | 49.6 | 56.3 |
| DO (meter) | 0.2 | 0.3 |
| DO (kit) | 0.61 | 0.55 |
| Fe, Diss. (kit) | 3.4 | 3.5 |

| 34-MW8 | 6/00 | 9/00 |
|---|---|---|
| Alkalinity | 302 | 677 |
| Chloride | 237 | 208 |
| Nitrate-Nitrite | 0.15U | 0.15U |
| TOC | 11 | 18.5 |
| Sulfate | 47.9 | 23.9 |
| DO (meter) | 0.34 | 0.4 |
| DO (kit) | 0.43 | 0.71 |
| Fe, Diss. (kit) | >12 | 26 |

| 22A-MW6D | 6/00 | 9/00 |
|---|---|---|
| Alkalinity | 599 | 567 |
| Chloride | 282 | 411 |
| Nitrate-Nitrite | 0.15U | 0.15U |
| TOC | 15 | 25 |
| Sulfate | 18.7 | 17.1 |
| DO (meter) | 0.7 | 0.2 |
| DO (kit) | 0.6 | 1.35 |
| Fe, Diss. (kit) | 6.95 | 7.2 |

| 38-MW12 | 6/00 | 9/00 |
|---|---|---|
| Alkalinity | 520 | 477 |
| Chloride | 79.2 | 108 |
| Nitrate-Nitrite | 0.15U | 0.15U |
| TOC | NA | 18.2 |
| Sulfate | 79.4 | 105 |
| DO (meter) | 0.2 | 0.3 |
| DO (kit) | 1.09 | 0.53 |
| Fe, Diss. (kit) | O.R. | 8.8 |

| 38-MW9 | 6/00 | 9/00 |
|---|---|---|
| Alkalinity | 551 | 377 |
| Chloride | 115 | 122 |
| Nitrate-Nitrite | 0.15U | 0.15U |
| TOC | 13 | 13.3 |
| Sulfate | 164 | 163 |
| DO (meter) | 0.67 | 3.6 |
| DO (kit) | 1 | 1.53 |
| Fe, Diss. (kit) | 1.9 | 4.15 |

## LEGEND

- 1 ug/L Vinyl Chloride Isoconcentration Contour (Sep. 2000)
- 4280 Groundwater Contour (Sep. 2000)
- Groundwater Monitoring Well

Note:
1. Tabular values are given in mg/L.
2. O.R.= Over range.
3. U= Not detected at reporting limit.
4. NA= not tested.

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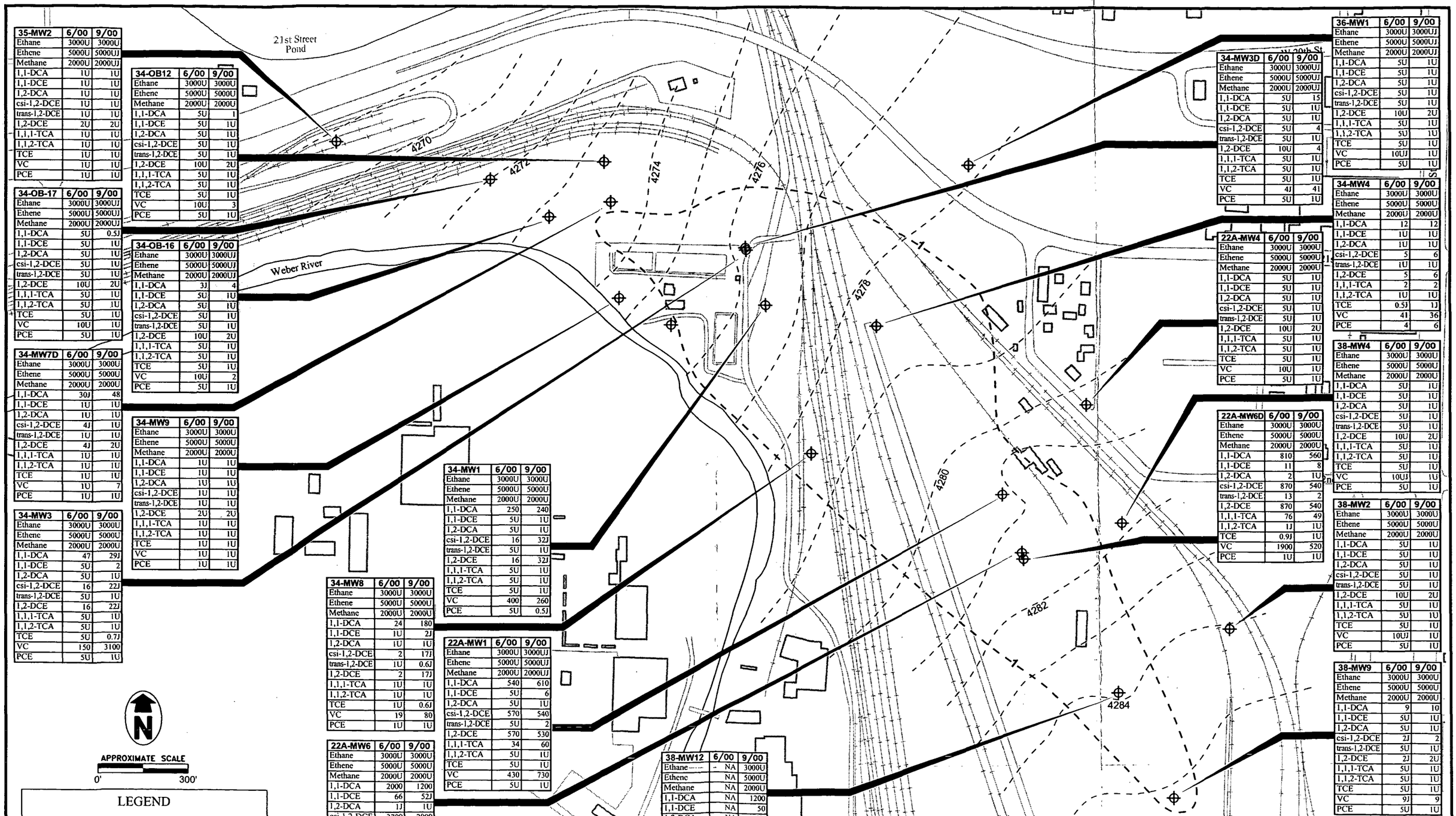
TITLE:

**FIGURE 5-6**
**GROUNDWATER NATURAL ATTENUATION**
**INORGANIC PARAMETERS**
**NORTH CVOC PLUME**

1330-03




| 35-MW2 | 6/00 | 9/00 |
|---|---|---|
| Ethane | 3000U | 3000U |
| Ethene | 5000U | 5000UJ |
| Methane | 2000U | 2000UJ |
| 1,1-DCA | 1U | 1U |
| 1,1-DCE | 1U | 1U |
| 1,2-DCA | 1U | 1U |
| csi-1,2-DCE | 1U | 1U |
| trans-1,2-DCE | 1U | 1U |
| 1,2-DCE | 2U | 2U |
| 1,1,1-TCA | 1U | 1U |
| 1,1,2-TCA | 1U | 1U |
| TCE | 1U | 1U |
| VC | 1U | 1U |
| PCE | 1U | 1U |

| 34-OB-17 | 6/00 | 9/00 |
|---|---|---|
| Ethane | 3000U | 3000UJ |
| Ethene | 5000U | 5000UJ |
| Methane | 2000U | 2000UJ |
| 1,1-DCA | 5U | 0.5J |
| 1,1-DCE | 5U | 1U |
| 1,2-DCA | 5U | 1U |
| csi-1,2-DCE | 5U | 1U |
| trans-1,2-DCE | 5U | 1U |
| 1,2-DCE | 10U | 2U |
| 1,1,1-TCA | 5U | 1U |
| 1,1,2-TCA | 5U | 1U |
| TCE | 5U | 1U |
| VC | 10U | 1U |
| PCE | 5U | 1U |

| 34-MW7D | 6/00 | 9/00 |
|---|---|---|
| Ethane | 3000U | 3000U |
| Ethene | 5000U | 5000U |
| Methane | 2000U | 2000U |
| 1,1-DCA | 30J | 48 |
| 1,1-DCE | 1U | 1U |
| 1,2-DCA | 1U | 1U |
| csi-1,2-DCE | 4J | 1U |
| trans-1,2-DCE | 1U | 1U |
| 1,2-DCE | 4J | 2U |
| 1,1,1-TCA | 1U | 1U |
| 1,1,2-TCA | 1U | 1U |
| TCE | 1U | 1U |
| VC | 1U | 7 |
| PCE | 1U | 1U |

| 34-MW3 | 6/00 | 9/00 |
|---|---|---|
| Ethane | 3000U | 3000U |
| Ethene | 5000U | 5000U |
| Methane | 2000U | 2000U |
| 1,1-DCA | 47 | 29J |
| 1,1-DCE | 5U | 2 |
| 1,2-DCA | 5U | 1U |
| csi-1,2-DCE | 16 | 22J |
| trans-1,2-DCE | 5U | 1U |
| 1,2-DCE | 16 | 22J |
| 1,1,1-TCA | 5U | 1U |
| 1,1,2-TCA | 5U | 1U |
| TCE | 5U | 0.7J |
| VC | 150 | 3100 |
| PCE | 5U | 1U |

| 34-OB12 | 6/00 | 9/00 |
|---|---|---|
| Ethane | 3000U | 3000U |
| Ethene | 5000U | 5000U |
| Methane | 2000U | 2000U |
| 1,1-DCA | 5U | 1 |
| 1,1-DCE | 5U | 1U |
| 1,2-DCA | 5U | 1U |
| csi-1,2-DCE | 5U | 1U |
| trans-1,2-DCE | 5U | 1U |
| 1,2-DCE | 10U | 2U |
| 1,1,1-TCA | 5U | 1U |
| 1,1,2-TCA | 5U | 1U |
| TCE | 5U | 1U |
| VC | 10U | 3 |
| PCE | 5U | 1U |

| 34-OB-16 | 6/00 | 9/00 |
|---|---|---|
| Ethane | 3000U | 3000UJ |
| Ethene | 5000U | 5000UJ |
| Methane | 2000U | 2000UJ |
| 1,1-DCA | 3J | 4 |
| 1,1-DCE | 5U | 1U |
| 1,2-DCA | 5U | 1U |
| csi-1,2-DCE | 5U | 1U |
| trans-1,2-DCE | 5U | 1U |
| 1,2-DCE | 10U | 2U |
| 1,1,1-TCA | 5U | 1U |
| 1,1,2-TCA | 5U | 1U |
| TCE | 5U | 1U |
| VC | 10U | 2 |
| PCE | 5U | 1U |

| 34-MW9 | 6/00 | 9/00 |
|---|---|---|
| Ethane | 3000U | 3000U |
| Ethene | 5000U | 5000U |
| Methane | 2000U | 2000U |
| 1,1-DCA | 1U | 1U |
| 1,1-DCE | 1U | 1U |
| 1,2-DCA | 1U | 1U |
| csi-1,2-DCE | 1U | 1U |
| trans-1,2-DCE | 1U | 1U |
| 1,2-DCE | 2U | 2U |
| 1,1,1-TCA | 1U | 1U |
| 1,1,2-TCA | 1U | 1U |
| TCE | 1U | 1U |
| VC | 1U | 1U |
| PCE | 1U | 1U |

| 34-MW8 | 6/00 | 9/00 |
|---|---|---|
| Ethane | 3000U | 3000U |
| Ethene | 5000U | 5000U |
| Methane | 2000U | 2000U |
| 1,1-DCA | 24 | 180 |
| 1,1-DCE | 1U | 2J |
| 1,2-DCA | 1U | 1U |
| csi-1,2-DCE | 2 | 17J |
| trans-1,2-DCE | 1U | 0.6J |
| 1,2-DCE | 2 | 17J |
| 1,1,1-TCA | 1U | 1U |
| 1,1,2-TCA | 1U | 1U |
| TCE | 1U | 0.6J |
| VC | 19 | 80 |
| PCE | 1U | 1U |

| 22A-MW6 | 6/00 | 9/00 |
|---|---|---|
| Ethane | 3000U | 3000U |
| Ethene | 5000U | 5000U |
| Methane | 2000U | 2000U |
| 1,1-DCA | 2000 | 1200 |
| 1,1-DCE | 66 | 52J |
| 1,2-DCA | 1J | 1U |
| csi-1,2-DCE | 3700 | 2000 |
| trans-1,2-DCE | 37 | 10J |
| 1,2-DCE | 3700 | 2000 |
| 1,1,1-TCA | 580 | 300 |
| 1,1,2-TCA | 3 | 1U |
| TCE | 4 | 3J |
| VC | 1300 | 870 |
| PCE | 0.7J | 0.6J |

| 34-MW1 | 6/00 | 9/00 |
|---|---|---|
| Ethane | 3000U | 3000U |
| Ethene | 5000U | 5000U |
| Methane | 2000U | 2000U |
| 1,1-DCA | 250 | 240 |
| 1,1-DCE | 5U | 1U |
| 1,2-DCA | 5U | 1U |
| csi-1,2-DCE | 16 | 32J |
| trans-1,2-DCE | 5U | 1U |
| 1,2-DCE | 16 | 32J |
| 1,1,1-TCA | 5U | 1U |
| 1,1,2-TCA | 5U | 1U |
| TCE | 5U | 1U |
| VC | 400 | 260 |
| PCE | 5U | 0.5J |

| 22A-MW1 | 6/00 | 9/00 |
|---|---|---|
| Ethane | 3000U | 3000UJ |
| Ethene | 5000U | 5000UJ |
| Methane | 2000U | 2000UJ |
| 1,1-DCA | 540 | 610 |
| 1,1-DCE | 5U | 6 |
| 1,2-DCA | 5U | 1U |
| csi-1,2-DCE | 570 | 540 |
| trans-1,2-DCE | 5U | 2 |
| 1,2-DCE | 570 | 530 |
| 1,1,1-TCA | 34 | 60 |
| 1,1,2-TCA | 5U | 1U |
| TCE | 5U | 1U |
| VC | 430 | 730 |
| PCE | 5U | 1U |

| 38-MW12 | 6/00 | 9/00 |
|---|---|---|
| Ethane | NA | 3000U |
| Ethene | NA | 5000U |
| Methane | NA | 2000U |
| 1,1-DCA | NA | 1200 |
| 1,1-DCE | NA | 50 |
| 1,2-DCA | NA | 1U |
| csi-1,2-DCE | NA | 3500 |
| trans-1,2-DCE | NA | 14J |
| 1,2-DCE | NA | 3500 |
| 1,1,1-TCA | NA | 2200 |
| 1,1,2-TCA | NA | 1U |
| TCE | NA | 91 |
| VC | NA | 710 |
| PCE | NA | 5 |

| 34-MW3D | 6/00 | 9/00 |
|---|---|---|
| Ethane | 3000U | 3000UJ |
| Ethene | 5000U | 5000UJ |
| Methane | 2000U | 2000UJ |
| 1,1-DCA | 5U | 15 |
| 1,1-DCE | 5U | 1U |
| 1,2-DCA | 5U | 1U |
| csi-1,2-DCE | 5U | 4 |
| trans-1,2-DCE | 5U | 1U |
| 1,2-DCE | 10U | 4 |
| 1,1,1-TCA | 5U | 1U |
| 1,1,2-TCA | 5U | 1U |
| TCE | 5U | 1U |
| VC | 4J | 41 |
| PCE | 5U | 1U |

| 22A-MW4 | 6/00 | 9/00 |
|---|---|---|
| Ethane | 3000U | 3000U |
| Ethene | 5000U | 5000U |
| Methane | 2000U | 2000U |
| 1,1-DCA | 5U | 1U |
| 1,1-DCE | 5U | 1U |
| 1,2-DCA | 5U | 1U |
| csi-1,2-DCE | 5U | 1U |
| trans-1,2-DCE | 5U | 1U |
| 1,2-DCE | 10U | 2U |
| 1,1,1-TCA | 5U | 1U |
| 1,1,2-TCA | 5U | 1U |
| TCE | 5U | 1U |
| VC | 10U | 1U |
| PCE | 5U | 1U |

| 22A-MW6D | 6/00 | 9/00 |
|---|---|---|
| Ethane | 3000U | 3000U |
| Ethene | 5000U | 5000U |
| Methane | 2000U | 2000U |
| 1,1-DCA | 810 | 560 |
| 1,1-DCE | 11 | 8 |
| 1,2-DCA | 2 | 1U |
| csi-1,2-DCE | 870 | 540 |
| trans-1,2-DCE | 13 | 2 |
| 1,2-DCE | 870 | 540 |
| 1,1,1-TCA | 76 | 49 |
| 1,1,2-TCA | 1J | 1U |
| TCE | 0.9J | 1U |
| VC | 1900 | 520 |
| PCE | 1U | 1U |

| 36-MW1 | 6/00 | 9/00 |
|---|---|---|
| Ethane | 3000U | 3000UJ |
| Ethene | 5000U | 5000UJ |
| Methane | 2000U | 2000UJ |
| 1,1-DCA | 5U | 1U |
| 1,1-DCE | 5U | 1U |
| 1,2-DCA | 5U | 1U |
| csi-1,2-DCE | 5U | 1U |
| trans-1,2-DCE | 5U | 1U |
| 1,2-DCE | 10U | 2U |
| 1,1,1-TCA | 5U | 1U |
| 1,1,2-TCA | 5U | 1U |
| TCE | 5U | 1U |
| VC | 10UJ | 1U |
| PCE | 5U | 1U |

| 34-MW4 | 6/00 | 9/00 |
|---|---|---|
| Ethane | 3000U | 3000U |
| Ethene | 5000U | 5000U |
| Methane | 2000U | 2000U |
| 1,1-DCA | 12 | 12 |
| 1,1-DCE | 1U | 1U |
| 1,2-DCA | 1U | 1U |
| csi-1,2-DCE | 5 | 6 |
| trans-1,2-DCE | 1U | 1U |
| 1,2-DCE | 5 | 6 |
| 1,1,1-TCA | 2 | 2 |
| 1,1,2-TCA | 1U | 1U |
| TCE | 0.5J | 1J |
| VC | 4J | 36 |
| PCE | 4 | 6 |

| 38-MW4 | 6/00 | 9/00 |
|---|---|---|
| Ethane | 3000U | 3000U |
| Ethene | 5000U | 5000U |
| Methane | 2000U | 2000U |
| 1,1-DCA | 5U | 1U |
| 1,1-DCE | 5U | 1U |
| 1,2-DCA | 5U | 1U |
| csi-1,2-DCE | 5U | 1U |
| trans-1,2-DCE | 5U | 1U |
| 1,2-DCE | 10U | 2U |
| 1,1,1-TCA | 5U | 1U |
| 1,1,2-TCA | 5U | 1U |
| TCE | 5U | 1U |
| VC | 10UJ | 1U |
| PCE | 5U | 1U |

| 38-MW2 | 6/00 | 9/00 |
|---|---|---|
| Ethane | 3000U | 3000U |
| Ethene | 5000U | 5000U |
| Methane | 2000U | 2000U |
| 1,1-DCA | 5U | 1U |
| 1,1-DCE | 5U | 1U |
| 1,2-DCA | 5U | 1U |
| csi-1,2-DCE | 5U | 1U |
| trans-1,2-DCE | 5U | 1U |
| 1,2-DCE | 10U | 2U |
| 1,1,1-TCA | 5U | 1U |
| 1,1,2-TCA | 5U | 1U |
| TCE | 5U | 1U |
| VC | 10UJ | 1U |
| PCE | 5U | 1U |

| 38-MW9 | 6/00 | 9/00 |
|---|---|---|
| Ethane | 3000U | 3000U |
| Ethene | 5000U | 5000U |
| Methane | 2000U | 2000U |
| 1,1-DCA | 9 | 10 |
| 1,1-DCE | 5U | 1U |
| 1,2-DCA | 5U | 1U |
| csi-1,2-DCE | 2J | 2 |
| trans-1,2-DCE | 5U | 1U |
| 1,2-DCE | 2J | 2U |
| 1,1,1-TCA | 5U | 1U |
| 1,1,2-TCA | 5U | 1U |
| TCE | 5U | 1U |
| VC | 9J | 9 |
| PCE | 5U | 1U |

## LEGEND

- 1 ug/L Vinyl Chloride Isoconcentration Contour (Jun. 2000)
- 4280 Groundwater Contour (Jun. 2000)
- Groundwater Monitoring Well

Note:
1. Values are given in ug/L.
2. NA= Not tested.
3. J= Estimated value.

The Forrester Group
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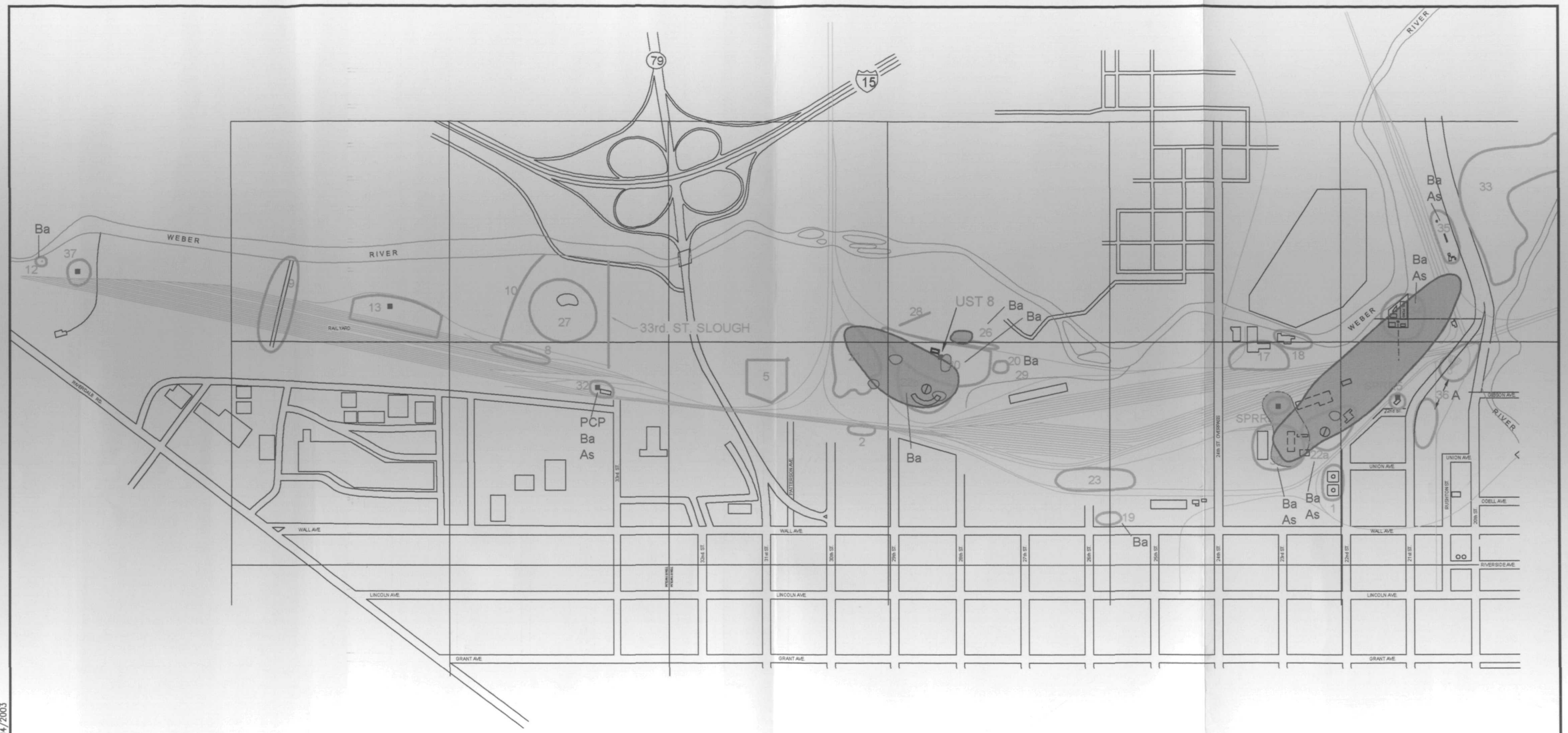
TITLE:

**FIGURE 5-7**
**GROUNDWATER NATURAL ATTENUATION PARAMETERS NORTH PLUME**

1330-00




## LEGEND

30 RI/FS AREA OF INTEREST

■ LUST LOCATIONS

CONTAMINANT PLUMES

CVOC PLUME

LNAPL PLUME

PARAMETER EXCEEDING SCREENING LEVELS

Ba = BARIUM
As = ARSENIC
PCP = PENTACHLOROPHENOL

North

0 1200
FEET

| | BY | DATE |
|---|---|---|
| DRAWN | FR | 3/22/02 |
| CHECKED | | |
| APPROVED | | |
| APPROVED | | |
| APPROVED | | |

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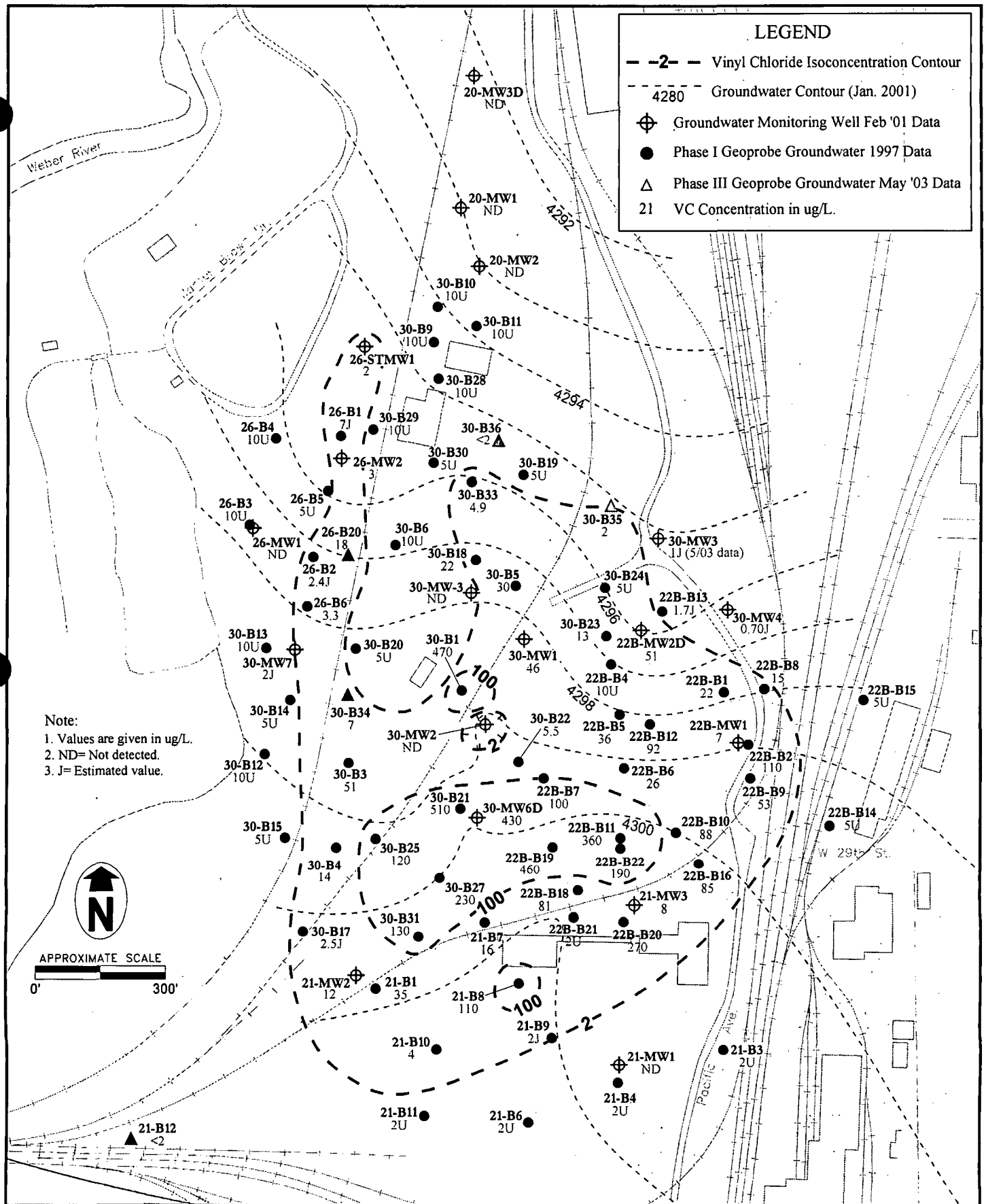
OGDEN RAILYARD - OGDEN, UTAH

FIGURE 5-8
DISTRIBUTION OF GROUNDWATER IMPACTS

SCALE: 1" = 1200'

DWG. NO.: 1329-DGWI.dwg

M:\clients\FORREST\Ogden\RI-2002\1329-DGWI.dwg plotted: 09/04/2003

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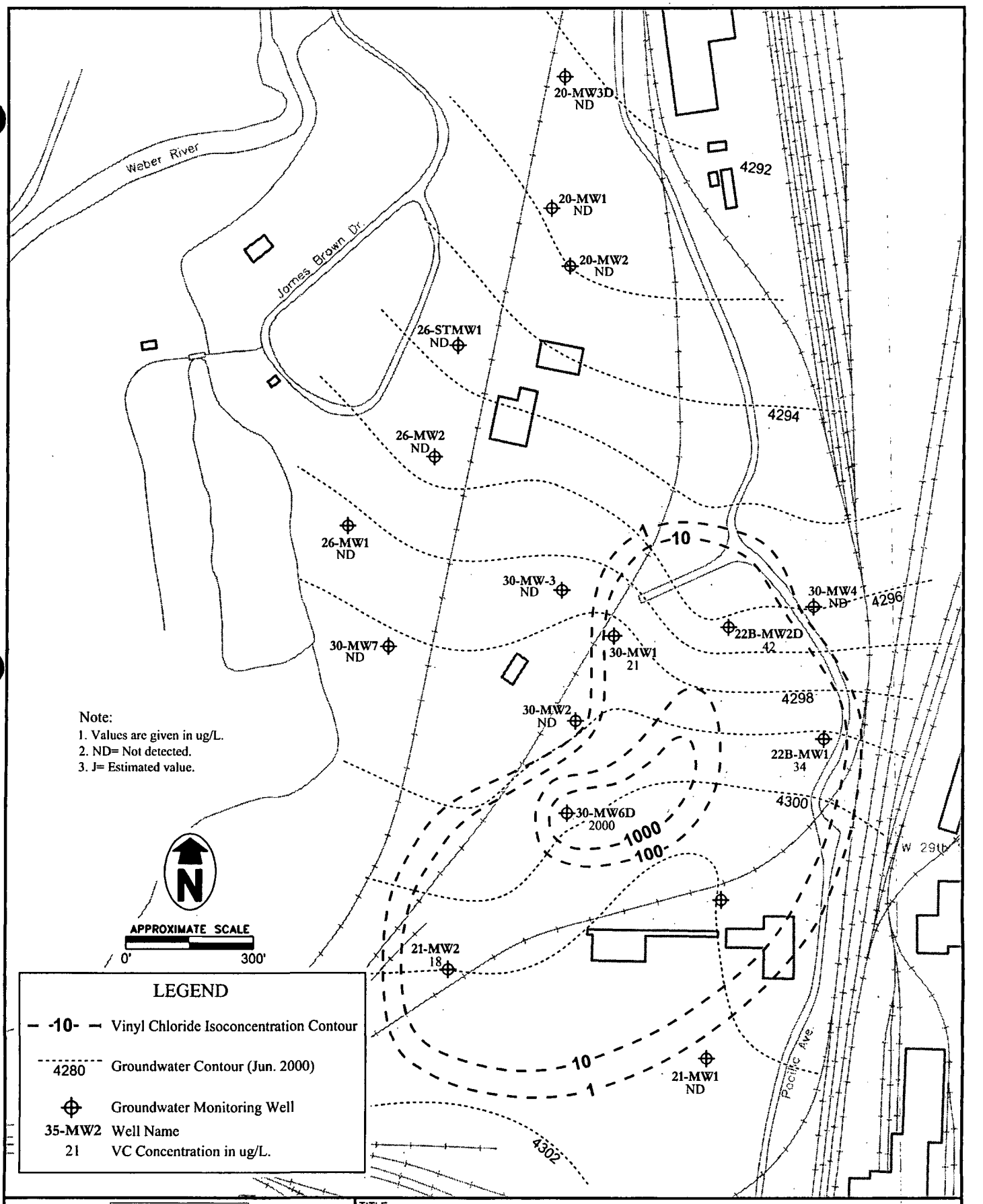
TITLE:

**FIGURE 5-9**
**HISTORICAL SOUTH VINYL CHLORIDE PLUME DISTRIBUTION**

1330-00

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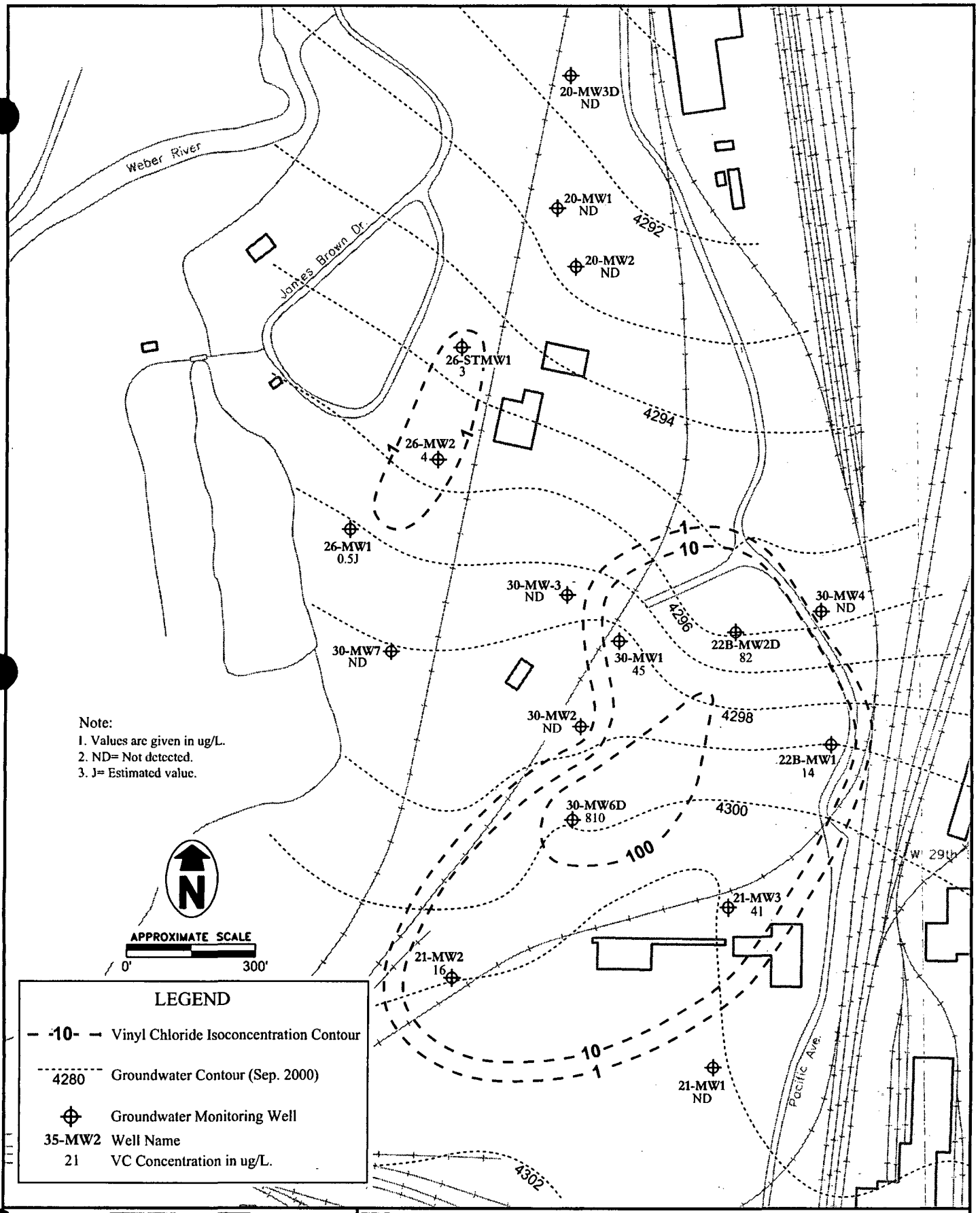
TITLE:

**FIGURE 5-10**
**SOUTH VINYL CHLORIDE PLUME**
**JUNE, 2000**

1330-00

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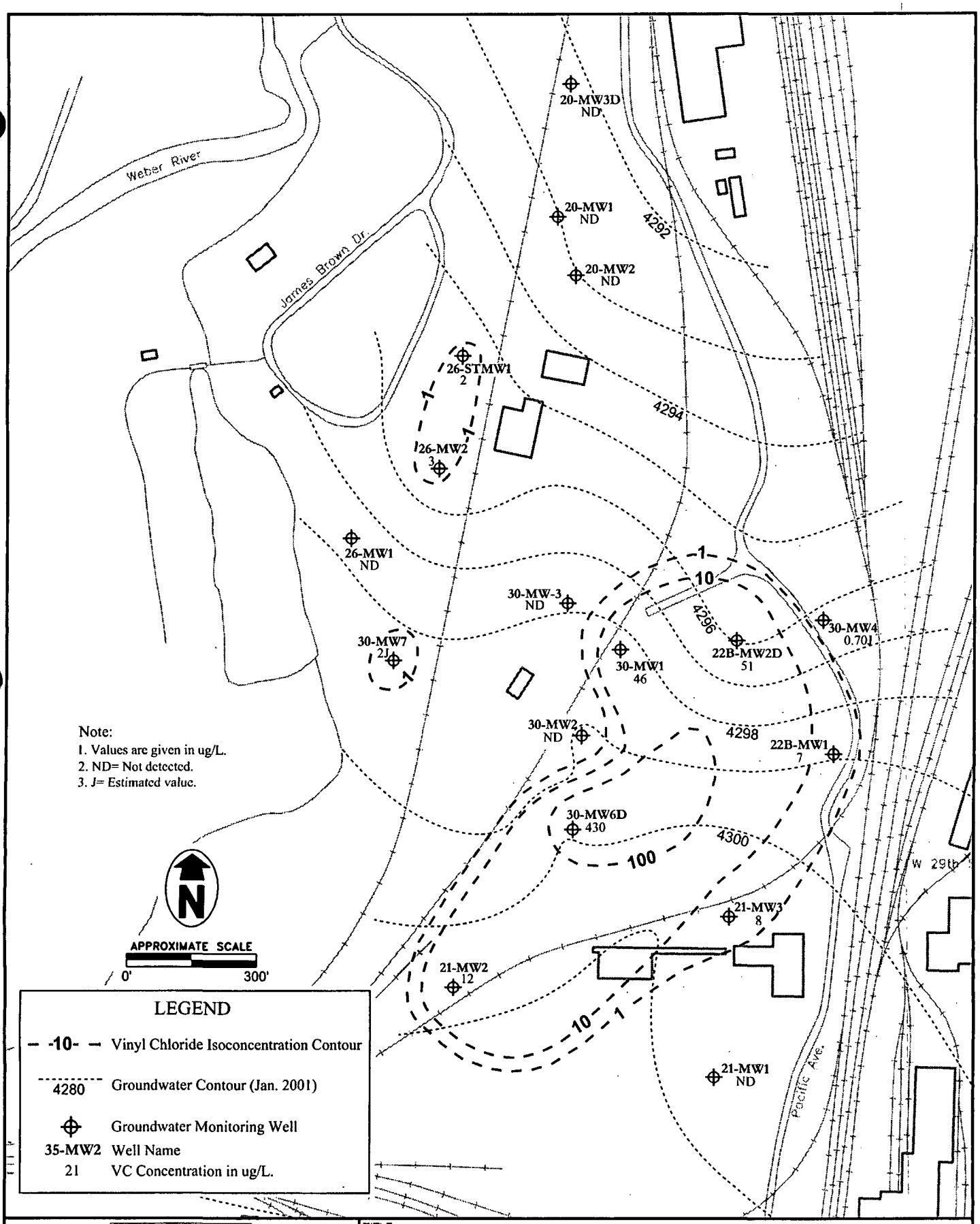
TITLE:

**FIGURE 5-11**
**SOUTH VINYL CHLORIDE PLUME**
**SEPTEMBER, 2000**

1330-00

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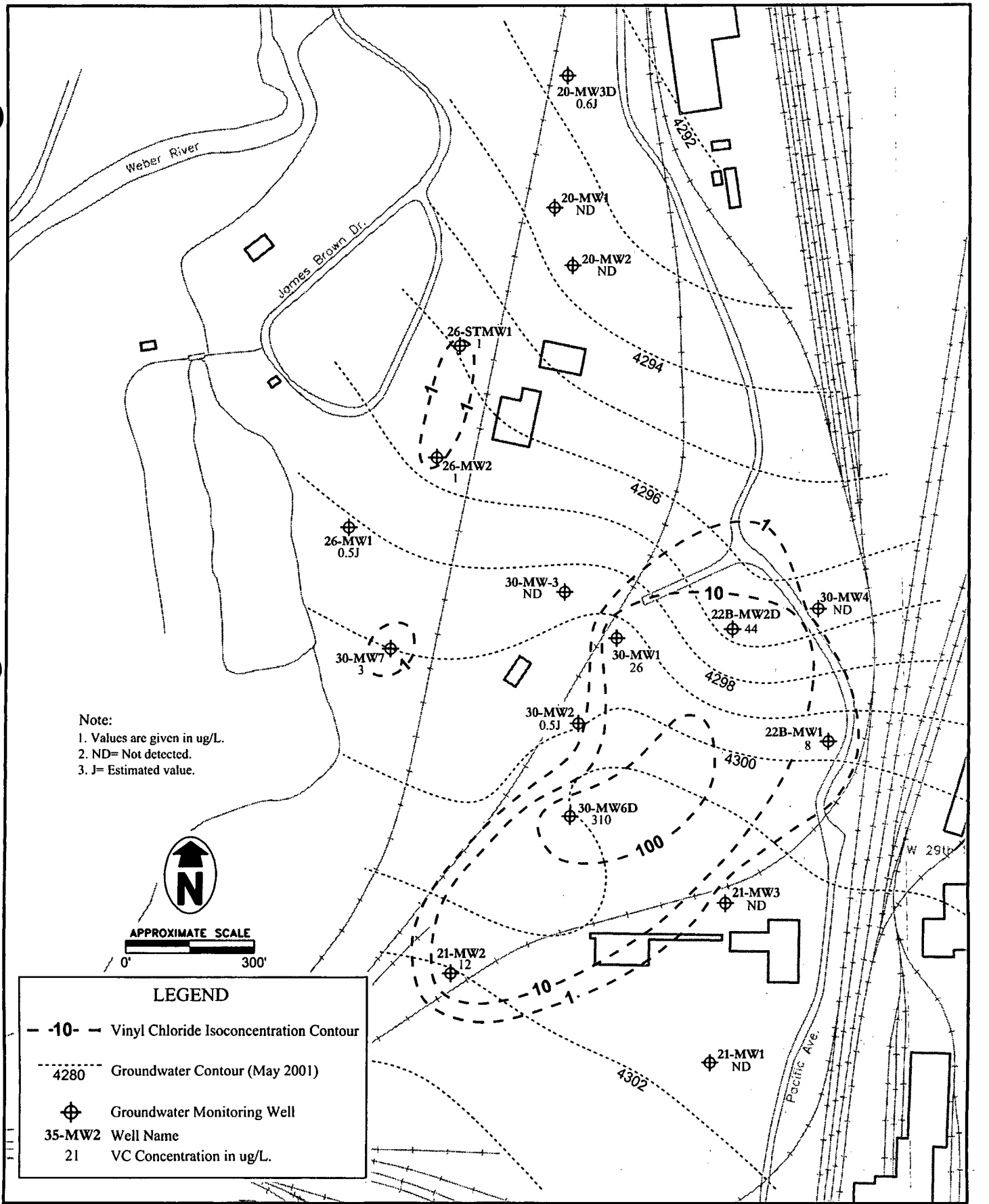
TITLE:

**FIGURE 5-12**
**SOUTH VINYL CHLORIDE PLUME**
**FEBRUARY, 2001**

1330-00

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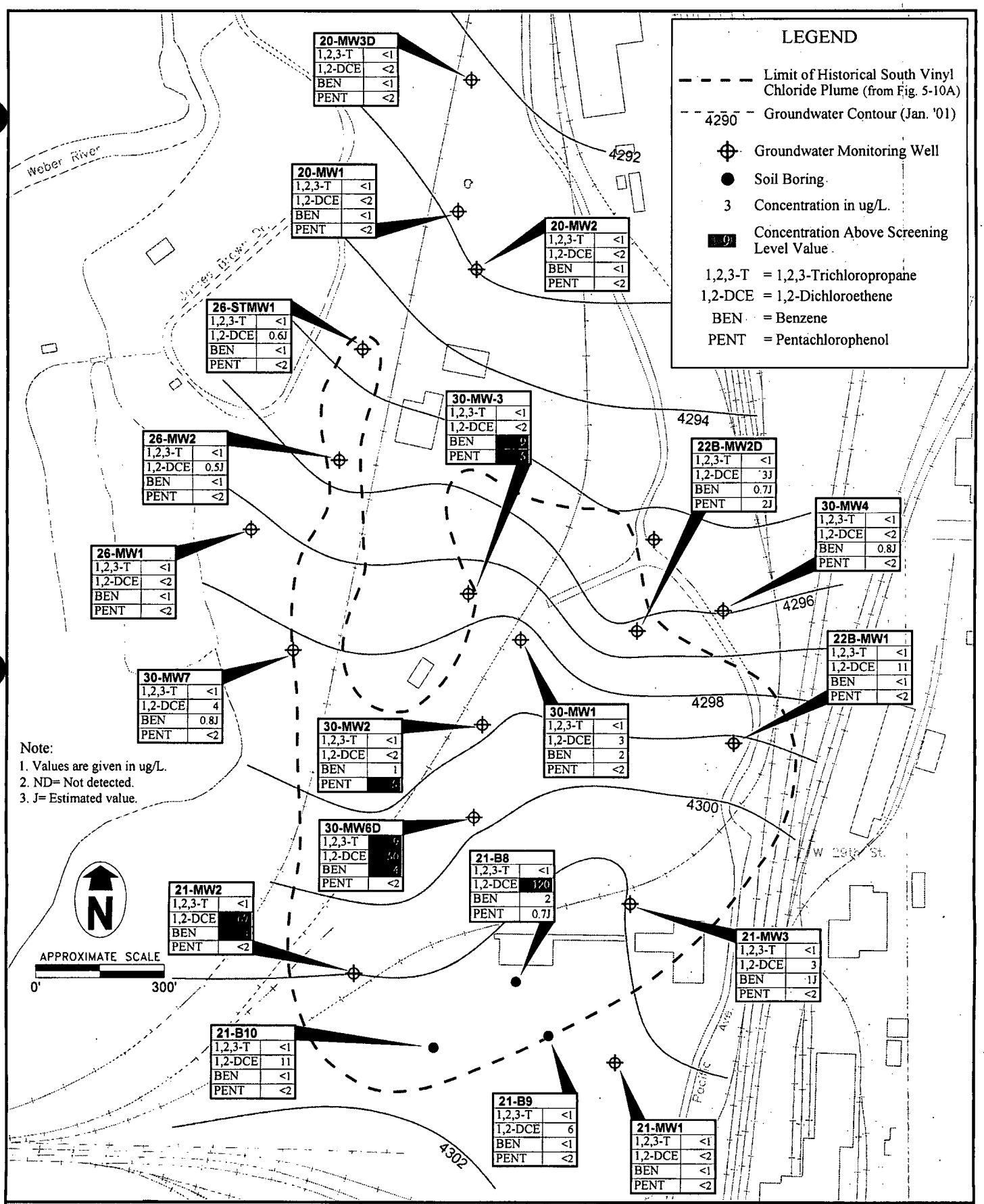
TITLE:

**FIGURE 5-13**
**SOUTH VINYL CHLORIDE PLUME**
**MAY, 2001**

1330-00

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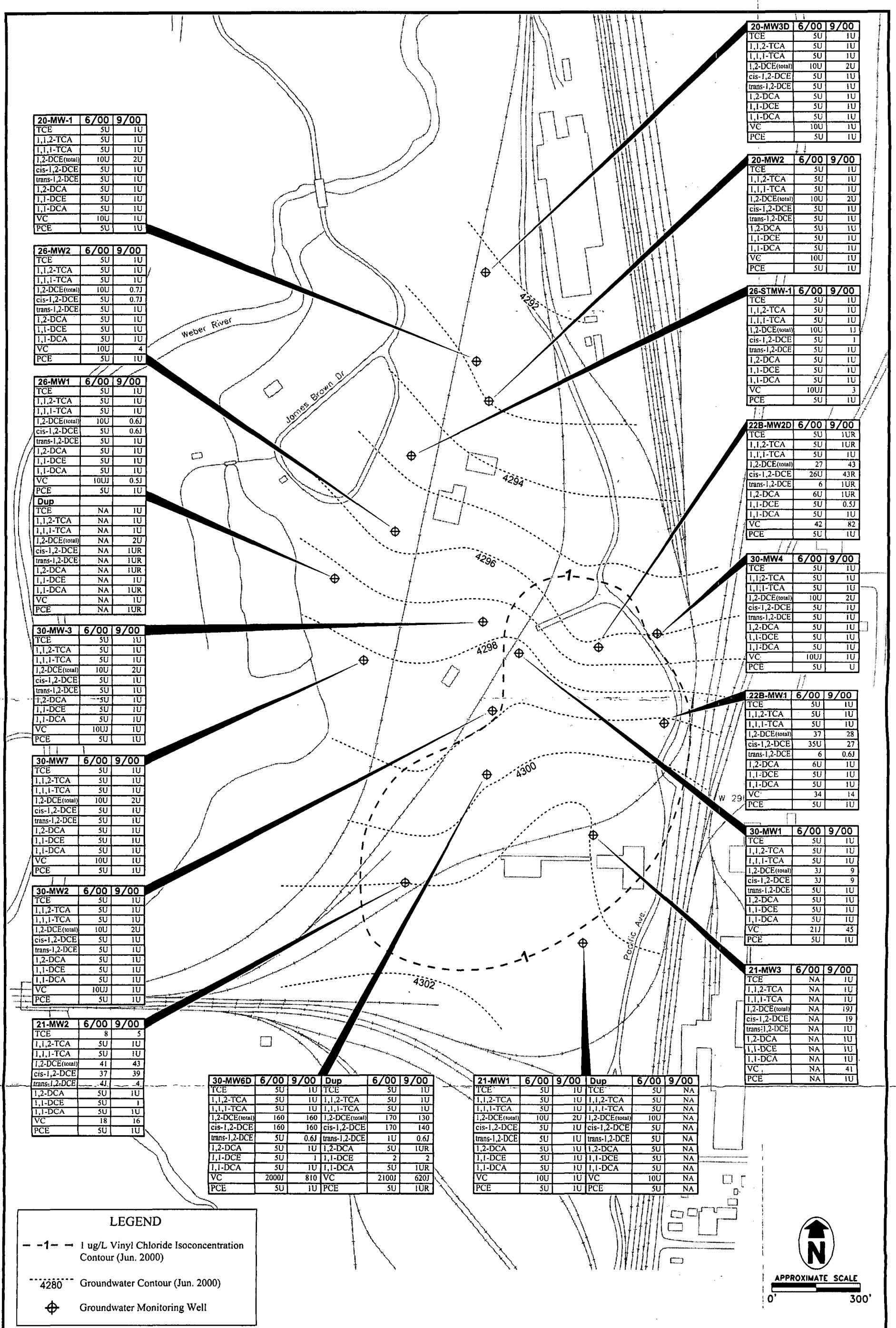
TITLE:

**FIGURE 5-14**
**CONCENTRATIONS OF OTHER VOC & SVOC ANALYTES BASED ON FEBRUARY AND MAY, 2001 DATA**
**SOUTH CVOC PLUME**

1330.00




| 20-MW-1 | 6/00 | 9/00 |
|---|---|---|
| TCE | 5U | 1U |
| 1,1,2-TCA | 5U | 1U |
| 1,1,1-TCA | 5U | 1U |
| 1,2-DCE(total) | 10U | 2U |
| cis-1,2-DCE | 5U | 1U |
| trans-1,2-DCE | 5U | 1U |
| 1,2-DCA | 5U | 1U |
| 1,1-DCE | 5U | 1U |
| 1,1-DCA | 5U | 1U |
| VC | 10U | 1U |
| PCE | 5U | 1U |

| 26-MW2 | 6/00 | 9/00 |
|---|---|---|
| TCE | 5U | 1U |
| 1,1,2-TCA | 5U | 1U |
| 1,1,1-TCA | 5U | 1U |
| 1,2-DCE(total) | 10U | 0.7J |
| cis-1,2-DCE | 5U | 0.7J |
| trans-1,2-DCE | 5U | 1U |
| 1,2-DCA | 5U | 1U |
| 1,1-DCE | 5U | 1U |
| 1,1-DCA | 5U | 1U |
| VC | 10U | 4 |
| PCE | 5U | 1U |

| 26-MW1 | 6/00 | 9/00 |
|---|---|---|
| TCE | 5U | 1U |
| 1,1,2-TCA | 5U | 1U |
| 1,1,1-TCA | 5U | 1U |
| 1,2-DCE(total) | 10U | 0.6J |
| cis-1,2-DCE | 5U | 0.6J |
| trans-1,2-DCE | 5U | 1U |
| 1,2-DCA | 5U | 1U |
| 1,1-DCE | 5U | 1U |
| 1,1-DCA | 5U | 1U |
| VC | 10UJ | 0.5J |
| PCE | 5U | 1U |
| **Dup** | | |
| TCE | NA | 1U |
| 1,1,2-TCA | NA | 1U |
| 1,1,1-TCA | NA | 1U |
| 1,2-DCE(total) | NA | 2U |
| cis-1,2-DCE | NA | 1UR |
| trans-1,2-DCE | NA | 1UR |
| 1,2-DCA | NA | 1UR |
| 1,1-DCE | NA | 1U |
| 1,1-DCA | NA | 1UR |
| VC | NA | 1U |
| PCE | NA | 1UR |

| 30-MW-3 | 6/00 | 9/00 |
|---|---|---|
| TCE | 5U | 1U |
| 1,1,2-TCA | 5U | 1U |
| 1,1,1-TCA | 5U | 1U |
| 1,2-DCE(total) | 10U | 2U |
| cis-1,2-DCE | 5U | 1U |
| trans-1,2-DCE | 5U | 1U |
| 1,2-DCA | 5U | 1U |
| 1,1-DCE | 5U | 1U |
| 1,1-DCA | 5U | 1U |
| VC | 10UJ | 1U |
| PCE | 5U | 1U |

| 30-MW7 | 6/00 | 9/00 |
|---|---|---|
| TCE | 5U | 1U |
| 1,1,2-TCA | 5U | 1U |
| 1,1,1-TCA | 5U | 1U |
| 1,2-DCE(total) | 10U | 2U |
| cis-1,2-DCE | 5U | 1U |
| trans-1,2-DCE | 5U | 1U |
| 1,2-DCA | 5U | 1U |
| 1,1-DCE | 5U | 1U |
| 1,1-DCA | 5U | 1U |
| VC | 10U | 1U |
| PCE | 5U | 1U |

| 30-MW2 | 6/00 | 9/00 |
|---|---|---|
| TCE | 5U | 1U |
| 1,1,2-TCA | 5U | 1U |
| 1,1,1-TCA | 5U | 1U |
| 1,2-DCE(total) | 10U | 2U |
| cis-1,2-DCE | 5U | 1U |
| trans-1,2-DCE | 5U | 1U |
| 1,2-DCA | 5U | 1U |
| 1,1-DCE | 5U | 1U |
| 1,1-DCA | 5U | 1U |
| VC | 10UJ | 1U |
| PCE | 5U | 1U |

| 21-MW2 | 6/00 | 9/00 |
|---|---|---|
| TCE | 8 | 5 |
| 1,1,2-TCA | 5U | 1U |
| 1,1,1-TCA | 5U | 1U |
| 1,2-DCE(total) | 41 | 43 |
| cis-1,2-DCE | 37 | 39 |
| trans-1,2-DCE | 4J | 4 |
| 1,2-DCA | 5U | 1U |
| 1,1-DCE | 5U | 1 |
| 1,1-DCA | 5U | 1U |
| VC | 18 | 16 |
| PCE | 5U | 1U |

| 30-MW6D | 6/00 | 9/00 | Dup | 6/00 | 9/00 |
|---|---|---|---|---|---|
| TCE | 5U | 1U | TCE | 5U | 1U |
| 1,1,2-TCA | 5U | 1U | 1,1,2-TCA | 5U | 1U |
| 1,1,1-TCA | 5U | 1U | 1,1,1-TCA | 5U | 1U |
| 1,2-DCE(total) | 160 | 160 | 1,2-DCE(total) | 170 | 130 |
| cis-1,2-DCE | 160 | 160 | cis-1,2-DCE | 170 | 140 |
| trans-1,2-DCE | 5U | 0.6J | trans-1,2-DCE | 1U | 0.6J |
| 1,2-DCA | 5U | 1U | 1,2-DCA | 5U | 1UR |
| 1,1-DCE | 5U | 1 | 1,1-DCE | 2 | 2 |
| 1,1-DCA | 5U | 1U | 1,1-DCA | 5U | 1UR |
| VC | 2000J | 810 | VC | 2100J | 620J |
| PCE | 5U | 1U | PCE | 5U | 1UR |

| 21-MW1 | 6/00 | 9/00 | Dup | 6/00 | 9/00 |
|---|---|---|---|---|---|
| TCE | 5U | 1U | TCE | 5U | NA |
| 1,1,2-TCA | 5U | 1U | 1,1,2-TCA | 5U | NA |
| 1,1,1-TCA | 5U | 1U | 1,1,1-TCA | 5U | NA |
| 1,2-DCE(total) | 10U | 2U | 1,2-DCE(total) | 10U | NA |
| cis-1,2-DCE | 5U | 1U | cis-1,2-DCE | 5U | NA |
| trans-1,2-DCE | 5U | 1U | trans-1,2-DCE | 5U | NA |
| 1,2-DCA | 5U | 1U | 1,2-DCA | 5U | NA |
| 1,1-DCE | 5U | 1U | 1,1-DCE | 5U | NA |
| 1,1-DCA | 5U | 1U | 1,1-DCA | 5U | NA |
| VC | 10U | 1U | VC | 10U | NA |
| PCE | 5U | 1U | PCE | 5U | NA |

| 20-MW3D | 6/00 | 9/00 |
|---|---|---|
| TCE | 5U | 1U |
| 1,1,2-TCA | 5U | 1U |
| 1,1,1-TCA | 5U | 1U |
| 1,2-DCE(total) | 10U | 2U |
| cis-1,2-DCE | 5U | 1U |
| trans-1,2-DCE | 5U | 1U |
| 1,2-DCA | 5U | 1U |
| 1,1-DCE | 5U | 1U |
| 1,1-DCA | 5U | 1U |
| VC | 10U | 1U |
| PCE | 5U | 1U |

| 20-MW2 | 6/00 | 9/00 |
|---|---|---|
| TCE | 5U | 1U |
| 1,1,2-TCA | 5U | 1U |
| 1,1,1-TCA | 5U | 1U |
| 1,2-DCE(total) | 10U | 2U |
| cis-1,2-DCE | 5U | 1U |
| trans-1,2-DCE | 5U | 1U |
| 1,2-DCA | 5U | 1U |
| 1,1-DCE | 5U | 1U |
| 1,1-DCA | 5U | 1U |
| VC | 10U | 1U |
| PCE | 5U | 1U |

| 26-STMW-1 | 6/00 | 9/00 |
|---|---|---|
| TCE | 5U | 1U |
| 1,1,2-TCA | 5U | 1U |
| 1,1,1-TCA | 5U | 1U |
| 1,2-DCE(total) | 10U | 1J |
| cis-1,2-DCE | 5U | 1 |
| trans-1,2-DCE | 5U | 1U |
| 1,2-DCA | 5U | 1U |
| 1,1-DCE | 5U | 1U |
| 1,1-DCA | 5U | 1U |
| VC | 10UJ | 3 |
| PCE | 5U | 1U |

| 22B-MW2D | 6/00 | 9/00 |
|---|---|---|
| TCE | 5U | 1UR |
| 1,1,2-TCA | 5U | 1UR |
| 1,1,1-TCA | 5U | 1U |
| 1,2-DCE(total) | 27 | 43 |
| cis-1,2-DCE | 26U | 43R |
| trans-1,2-DCE | 6 | 1UR |
| 1,2-DCA | 6U | 1UR |
| 1,1-DCE | 5U | 0.5J |
| 1,1-DCA | 5U | 1U |
| VC | 42 | 82 |
| PCE | 5U | 1U |

| 30-MW4 | 6/00 | 9/00 |
|---|---|---|
| TCE | 5U | 1U |
| 1,1,2-TCA | 5U | 1U |
| 1,1,1-TCA | 5U | 1U |
| 1,2-DCE(total) | 10U | 2U |
| cis-1,2-DCE | 5U | 1U |
| trans-1,2-DCE | 5U | 1U |
| 1,2-DCA | 5U | 1U |
| 1,1-DCE | 5U | 1U |
| 1,1-DCA | 5U | 1U |
| VC | 10UJ | 1U |
| PCE | 5U | U |

| 22B-MW1 | 6/00 | 9/00 |
|---|---|---|
| TCE | 5U | 1U |
| 1,1,2-TCA | 5U | 1U |
| 1,1,1-TCA | 5U | 1U |
| 1,2-DCE(total) | 37 | 28 |
| cis-1,2-DCE | 35U | 27 |
| trans-1,2-DCE | 6 | 0.6J |
| 1,2-DCA | 6U | 1U |
| 1,1-DCE | 5U | 1U |
| 1,1-DCA | 5U | 1U |
| VC | 34 | 14 |
| PCE | 5U | 1U |

| 30-MW1 | 6/00 | 9/00 |
|---|---|---|
| TCE | 5U | 1U |
| 1,1,2-TCA | 5U | 1U |
| 1,1,1-TCA | 5U | 1U |
| 1,2-DCE(total) | 3J | 9 |
| cis-1,2-DCE | 3J | 9 |
| trans-1,2-DCE | 5U | 1U |
| 1,2-DCA | 5U | 1U |
| 1,1-DCE | 5U | 1U |
| 1,1-DCA | 5U | 1U |
| VC | 21J | 45 |
| PCE | 5U | 1U |

| 21-MW3 | 6/00 | 9/00 |
|---|---|---|
| TCE | NA | 1U |
| 1,1,2-TCA | NA | 1U |
| 1,1,1-TCA | NA | 1U |
| 1,2-DCE(total) | NA | 19J |
| cis-1,2-DCE | NA | 19 |
| trans-1,2-DCE | NA | 1U |
| 1,2-DCA | NA | 1U |
| 1,1-DCE | NA | 1U |
| 1,1-DCA | NA | 1U |
| VC | NA | 41 |
| PCE | NA | 1U |

Note:
1. Values are given in ug/L.
2. U= Not detected at reporting limit.
3. J= Estimated value.
4. NA= not tested.

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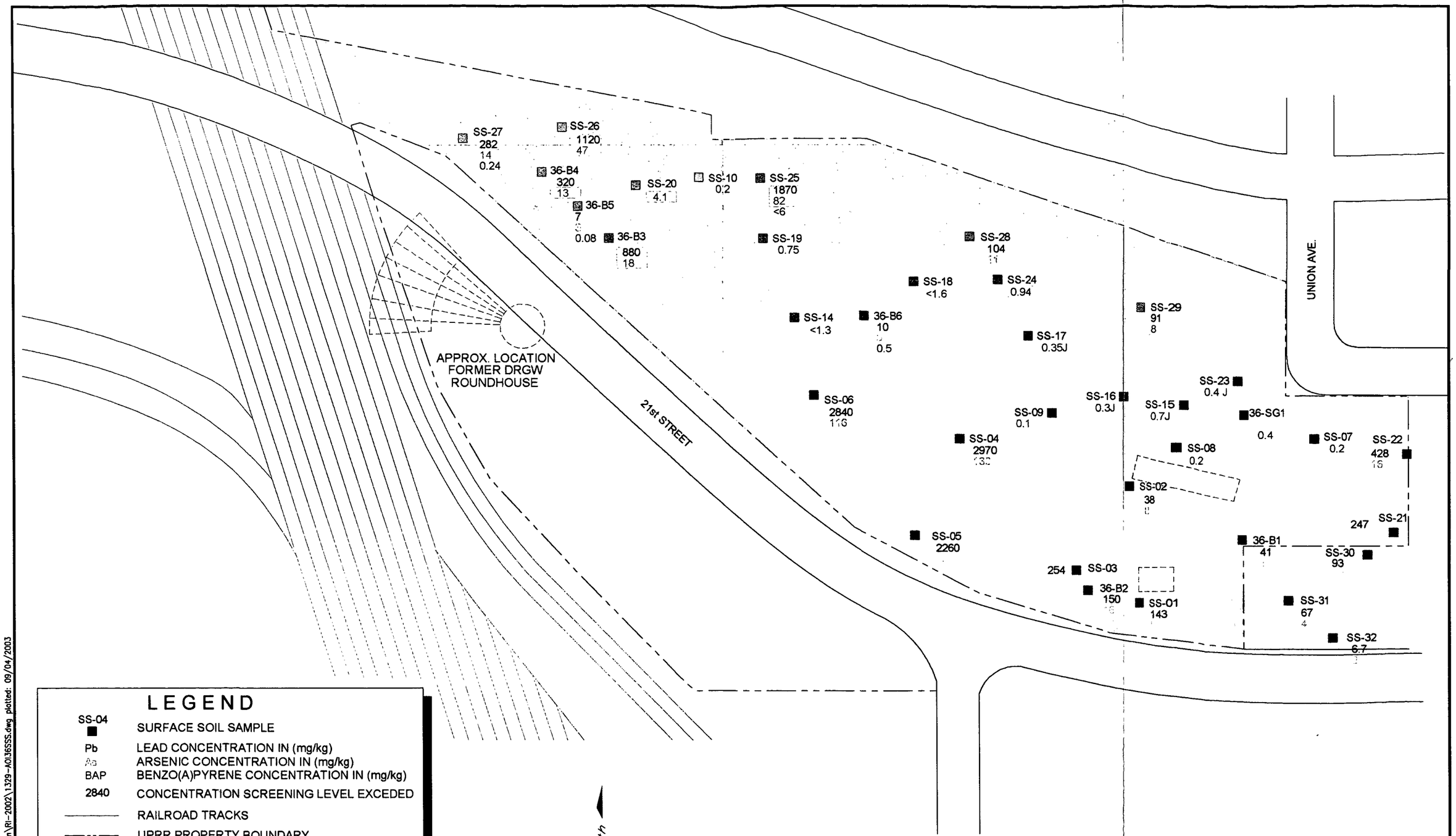
TITLE:

**FIGURE 5-15**
**GROUNDWATER NATURAL ATTENUATION**
**ORGANIC PARAMETERS**
**SOUTH CVOC PLUME**

1330-03




| | BY | DATE |
|---|---|---|
| DRAWN | FR | 3/20/02 |
| CHECKED | | |
| APPROVED | | |
| APPROVED | | |
| APPROVED | | |

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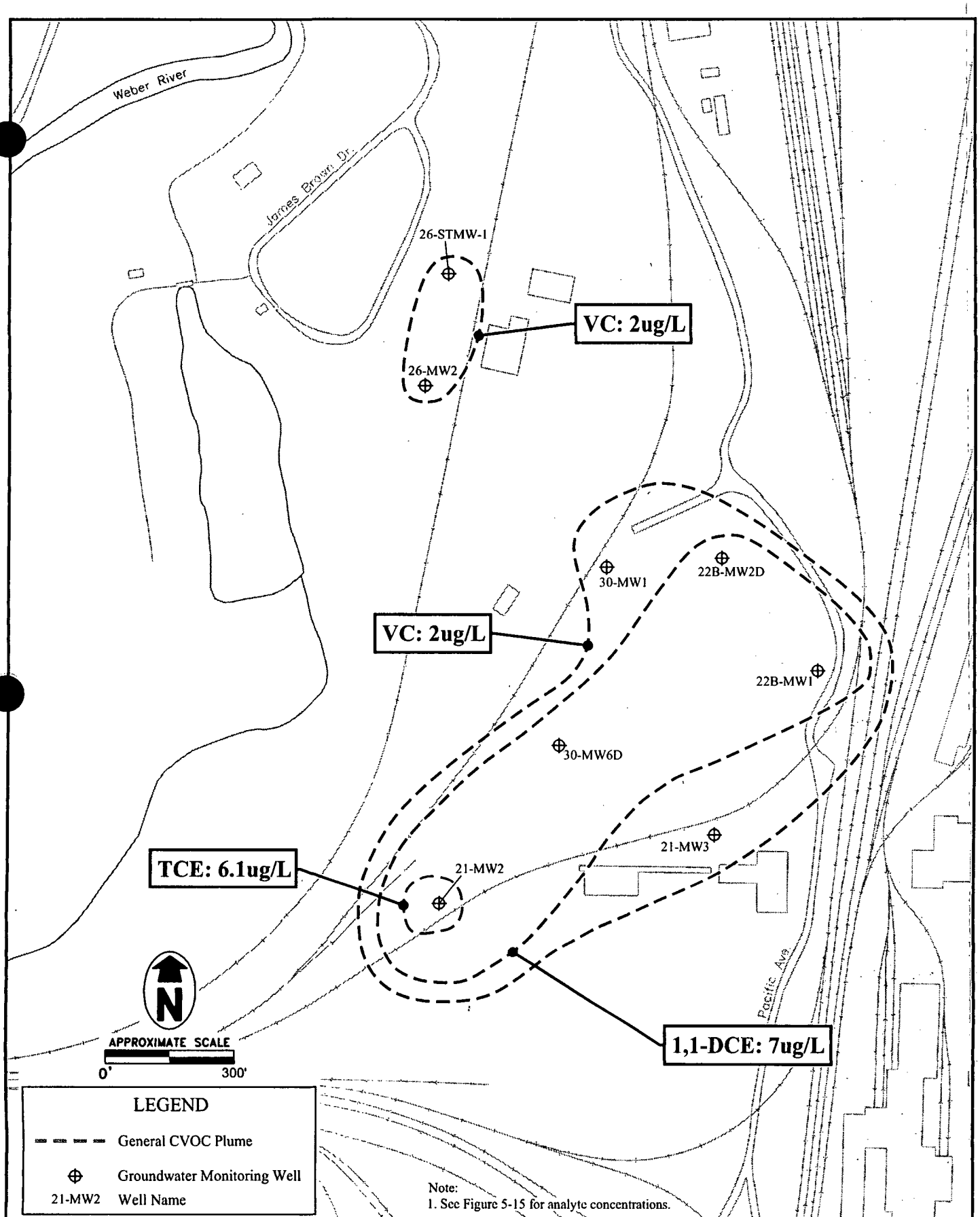
OGDEN RAILYARD - OGDEN, UTAH

FIGURE 6-1
AOI-36 SURFACE SOIL SAMPLE RESULTS

SCALE: 1" = 120'

DWG. NO.: 1329-AOI36SSS.dwg

M:\clients\FORREST\Ogden\RI-2002\1329-AOI36SSS.dwg plotted: 09/04/2003




Note:
1. See Figure 5-15 for analyte concentrations.

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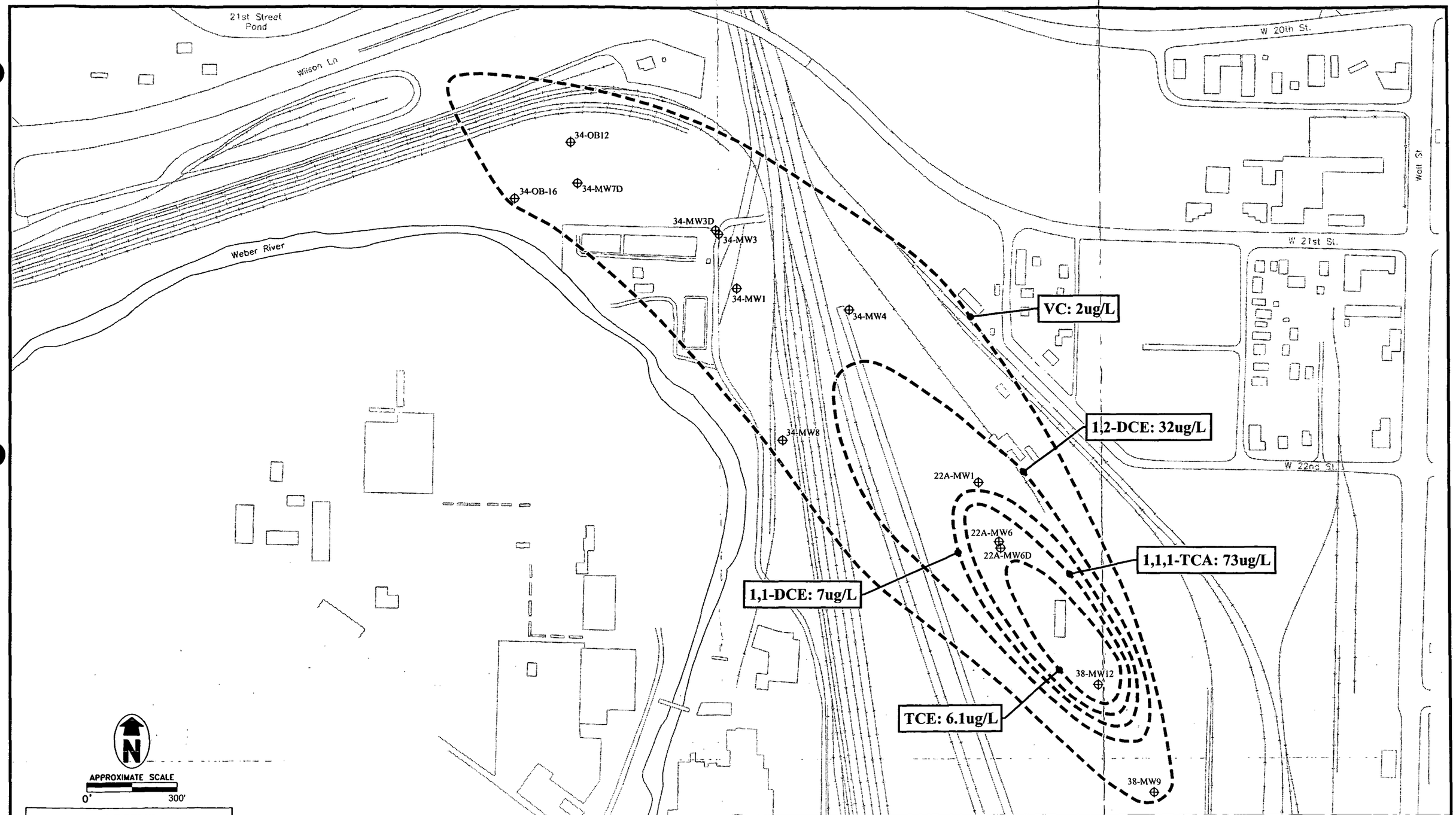
ENVIRONMENTAL MANAGEMENT & PLANNING

TITLE:

**FIGURE 6-2**
**GENERAL VOC DISTRIBUTION**
**SOUTH CVOC PLUME**

1330-01




Note:
1. See Figure 5-7 for analyte concentrations.

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TITLE:

**FIGURE 6-3**
**GENERAL VOC DISTRIBUTION**
**NORTH CVOC PLUME**

1330-01

# TARGET SHEET

EPA REGION VIII

SUPERFUND DOCUMENT MANAGEMENT SYSTEM

DOCUMENT NUMBER: 2011803

SITE NAME: OGDEN RAILROAD YARD

DOCUMENT DATE: 09/01/2003

## DOCUMENT NOT SCANNED

Due to one of the following reasons:

- ☐ PHOTOGRAPHS
- ☐ 3-DIMENSIONAL
- ☐ OVERSIZED
- ☐ AUDIO/VISUAL
- ☐ PERMANENTLY BOUND DOCUMENTS
- ☐ POOR LEGIBILITY
- ☐ OTHER
- ☐ NOT AVAILABLE
- ☑ TYPES OF DOCUMENTS NOT TO BE SCANNED
  (Data Packages, Data Validation, Sampling Data, CBI, Chain of Custody)

DOCUMENT DESCRIPTION:

TABLES (See Table of Contents)
APPENDIX A AOI Analytical Data Tables

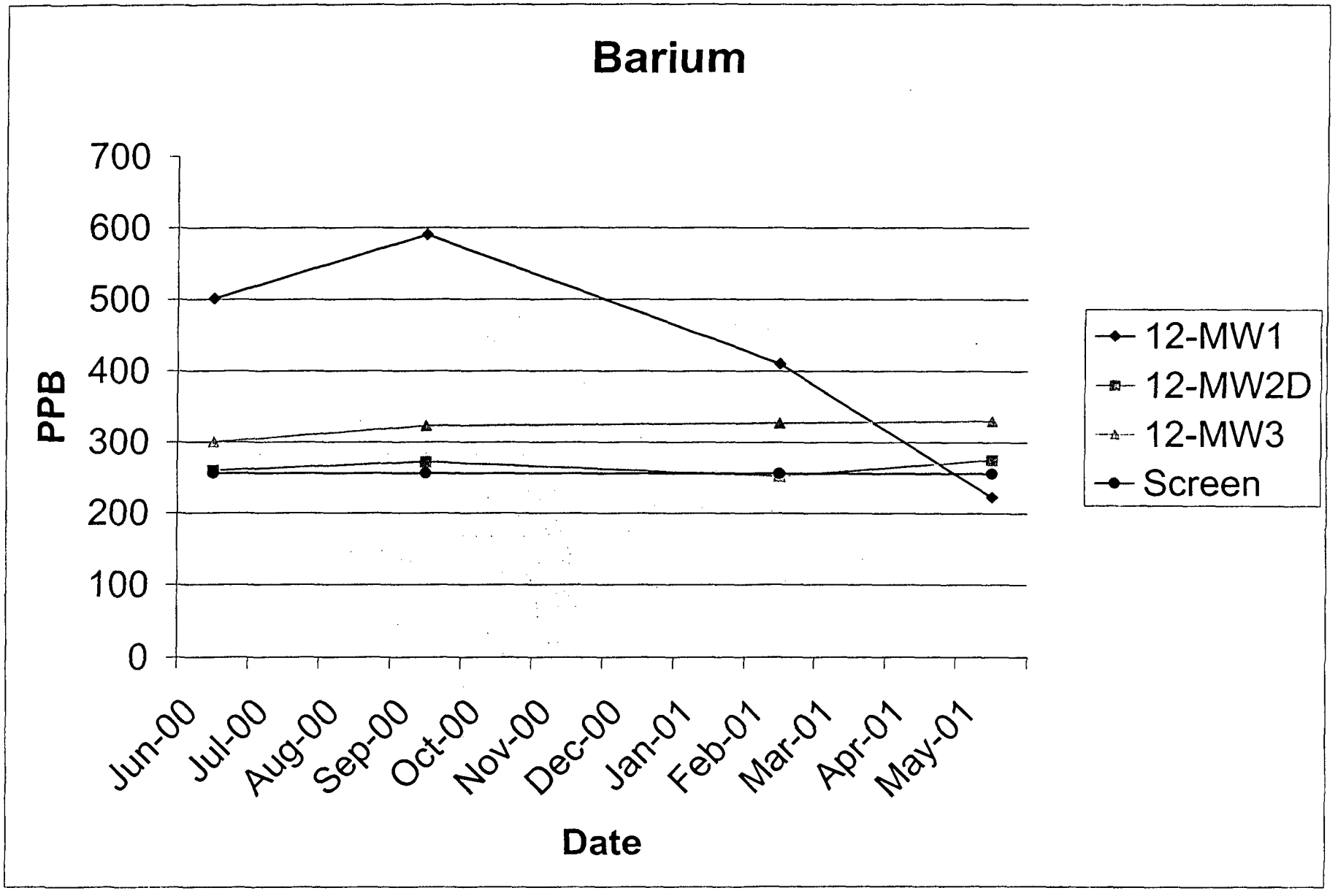
Contact the Superfund Records Center to view available document.
(303) 312-6473

# APPENDIX B
# GROUNDWATER CONCENTRATION GRAPHS

# AOI-12

| ParameterName | Screen Level | AOI | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Location | 12-MW1 | 12-MW1 | 12-MW1 | 12-MW1 | 12-MW2D | 12-MW2D | 12-MW2D | 12-MW2D | 12-MW3 | 12-MW3 | 12-MW3 | 12-MW3 |
| | | Depth (ft) | 13.5 | 13.5 | 13.5 | 13.5 | 12.5 | 12.5 | 12.5 | 12.5 | 13.5 | 13.5 | 13.5 | 13.5 |
| | | Date | 06/28/00 | 09/27/00 | 02/03/01 | 05/08/01 | 06/28/00 | 09/20/00 | 02/02/01 | 05/09/01 | 06/28/00 | 09/20/00 | 02/03/01 | 05/09/01 |
| | | Units | | | | | | | | | | | | |
| Arsenic | 4.5 | g/L | < 20 | **8.6 J** | < 5.2 J | < 1.6 | < 20 | < 5.2 | < 5.2 | 5 J | < 20 | < 5.2 | < 5.2 J | 2.4 J |
| Barium | 256 | ug/L | ***501*** | ***590*** | ***410*** | ***223*** | ***260*** | ***272*** | ***252*** | ***275*** | ***300*** | ***323*** | ***327*** | ***330*** |
| Cadmium | 3.7 | ug/L | < 5 | < 0.16 | < 0.15 J | 4.7 J | < 0.22 | < 1.7 | < 0.15 J | 2.5 J | < 5 | < 1.4 | < 0.15 J | 0.97 J |
| Selenium | 18 | ug/L | < 40 | 4.2 J | < 26.7 | 1.8 J | < 40 | < 25.7 | 19.6 J | 5.1 J | < 40 | < 15.2 | < 14.5 | 2.4 J |
| 2-Methylnaphthalene | 110 | ug/L | < 1 | < 2 | < 2 | < 2 | < 1 | < 2 | < 2 | < 2 | < 1 | < 2 | < 2 | < 2 |
| Acenaphthene | 219 | ug/L | < 1 | < 2 | < 2 | < 2 | < 1 | < 2 | < 2 | < 2 | < 1 | < 2 | < 2 | < 2 |
| Benzo(a)anthracene | 9.2 | ug/L | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 |
| Benzo(a)pyrene | 0.2 | ug/L | < 1 | < 2 | < 2 | < 2 | < 1 | < 2 | < 2 | < 2 | < 1 | < 2 | < 2 | < 2 |
| Chrysene | 9.2 | ug/L | < 1 | < 2 | < 2 | < 2 | < 1 | < 2 | < 2 | < 2 | < 1 | < 2 | < 2 | < 2 |
| Dibenzo(a,h)anthracene | 0.92 | ug/L | < 2 | < 2 | < 3 | < 2 | < 2 | < 2 | < 3 | < 2 | < 2 | < 2 | < 3 | < 2 |
| Naphthalene - SW-846 8270C | 73 | ug/L | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 |
| Pentachlorophenol | 1 | ug/L | < 1 | < 2 | < 2 J | < 2 | < 1 | **3** | < 2 J | < 2 | < 1 | **3** | < 2 J | < 2 |
| Phenanthrene | 110 | ug/L | < 1 | < 2 | < 2 | < 2 | < 1 | < 2 | < 2 | < 2 | < 1 | < 2 | < 2 | < 2 |
| 1,1,1-Trichloroethane | 73 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| 1,1,2-Trichloroethane | 1.2 | ug/L | < 5 | 1 | < 1 | < 1 R | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| 1,1-Dichloroethane | 365 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| 1,1-Dichloroethene | 7 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| 1,2-Dichloroethane | 5 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| 1,2-Dichloroethene (total) | 33 | ug/L | < 10 | 2 | < 2 | < 2 | < 10 | 2 | < 2 | < 2 | < 10 | 2 | < 2 | < 2 |
| Benzene | 2.3 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| Chloroethane (Ethyl chloride) | 23 | ug/L | < 10 | < 1 | < 2 | < 2 | < 10 | < 1 | < 2 | < 2 | < 10 | < 1 | < 2 | < 2 |
| Chloromethane (Methyl chloride) | 5.2 | ug/L | < 10 | < 1 | < 2 | < 2 | < 10 | < 1 | < 2 | < 2 | < 10 | < 1 | < 2 | < 2 |
| Ethylbenzene | 365 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| Trichloroethene | 6.1 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| Vinyl chloride | 2 | ug/L | < 10 | < 1 | < 2 | < 2 | < 10 | < 1 | < 2 | < 2 | < 10 | < 1 | < 2 | < 2 |

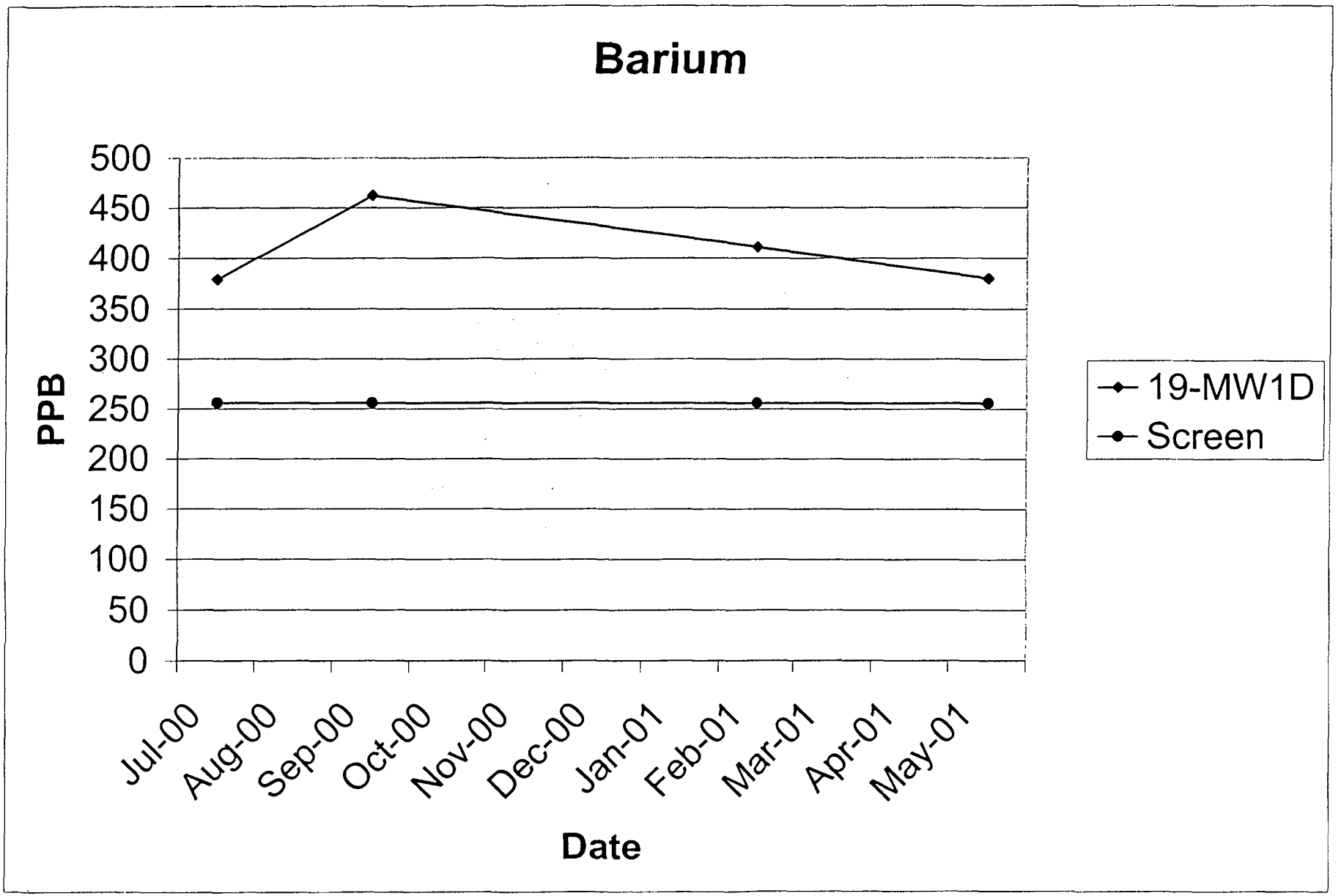
Note: Screening level exceedences are in bold.
The bolded itlalic data are graphed.
"Screen" label on graphs = screening level concentration


Barium
700
600
500
400
300
200
100
0
PPB
Jun-00
Jul-00
Aug-00
Sep-00
Oct-00
Nov-00
Dec-00
Jan-01
Feb-01
Mar-01
Apr-01
May-01
Date
12-MW1
12-MW2D
12-MW3
Screen

# AOI-19

| ParameterName | Screen Level | AOI | 19 | 19 | 19 | 19 |
|---|---|---|---|---|---|---|
| | | Location | 19-MW1D | 19-MW1D | 19-MW1D | 19-MW1D |
| | | Depth (ft) | 11.5 | 11.5 | 11.5 | 11.5 |
| | | Date | 07/12/00 | 09/26/00 | 02/01/01 | 05/09/01 |
| | | Units | | | | |
| Arsenic | 4.5 | ug/L | < 20 | < 4.4 | < 5.2 | < 1.6 |
| **Barium** | **256** | ug/L | ***379*** | ***462*** | ***411*** | ***380*** |
| Cadmium | 3.7 | ug/L | < 5 | < 0.16 | < 0.15 J | < 0.29 |
| Selenium | 18 | ug/L | < 5.3 | 3.9 J | **23.4 J** | < 1.8 |
| 2-Methylnaphthalene | 110 | ug/L | 2 J | < 2 | < 0.2 | < 2 |
| Acenaphthene | 219 | ug/L | 0.7 J | 0.6 J | 0.4 | 0.8 J |
| Benzo(a)anthracene | 9.2 | ug/L | < 2 | < 2 | < 0.2 | < 2 |
| Benzo(a)pyrene | 0.2 | ug/L | < 1 | < 2 | < 0.2 | < 2 |
| Chrysene | 9.2 | ug/L | < 1 | < 2 | < 0.2 | < 2 |
| Dibenzo(a,h)anthracene | 0.92 | ug/L | < 2 | < 2 | < 0.3 | < 2 |
| Naphthalene - SW-846 8270C | 73 | ug/L | < 2 R | < 2 | < 0.2 | < 2 |
| Pentachlorophenol | 1 | ug/L | < 1 | < 2 | < 0.2 J | < 2 |
| Phenanthrene | 110 | ug/L | 0.2 J | < 2 | < 0.2 | < 2 |
| 1,1,1-Trichloroethane | 73 | ug/L | < 1 | < 1 | < 1 | < 1 |
| 1,1,2-Trichloroethane | 1.2 | ug/L | < 1 | < 1 | < 1 | < 1 |
| 1,1-Dichloroethane | 365 | ug/L | < 1 | < 1 | < 1 | < 1 |
| 1,1-Dichloroethene | 7 | ug/L | < 1 | < 1 | < 1 | < 1 |
| 1,2-Dichloroethane | 5 | ug/L | < 1 | < 1 | < 1 | < 1 |
| 1,2-Dichloroethene (total) | 33 | ug/L | < 2 | 2 | < 2 | < 2 |
| Benzene | 2.3 | ug/L | < 1 | < 1 | < 1 | < 1 |
| Chloroethane (Ethyl chloride) | 23 | ug/L | < 1 | < 1 | < 2 | < 2 |
| Chloromethane (Methyl chloride) | 5.2 | ug/L | < 1 | < 1 | < 2 | < 2 |
| Ethylbenzene | 365 | ug/L | < 1 | < 1 | < 1 | < 1 |
| Trichloroethene | 6.1 | ug/L | < 1 | < 1 | < 1 | < 1 |
| Vinyl chloride | 2 | ug/L | < 1 | < 1 | < 2 | < 2 |

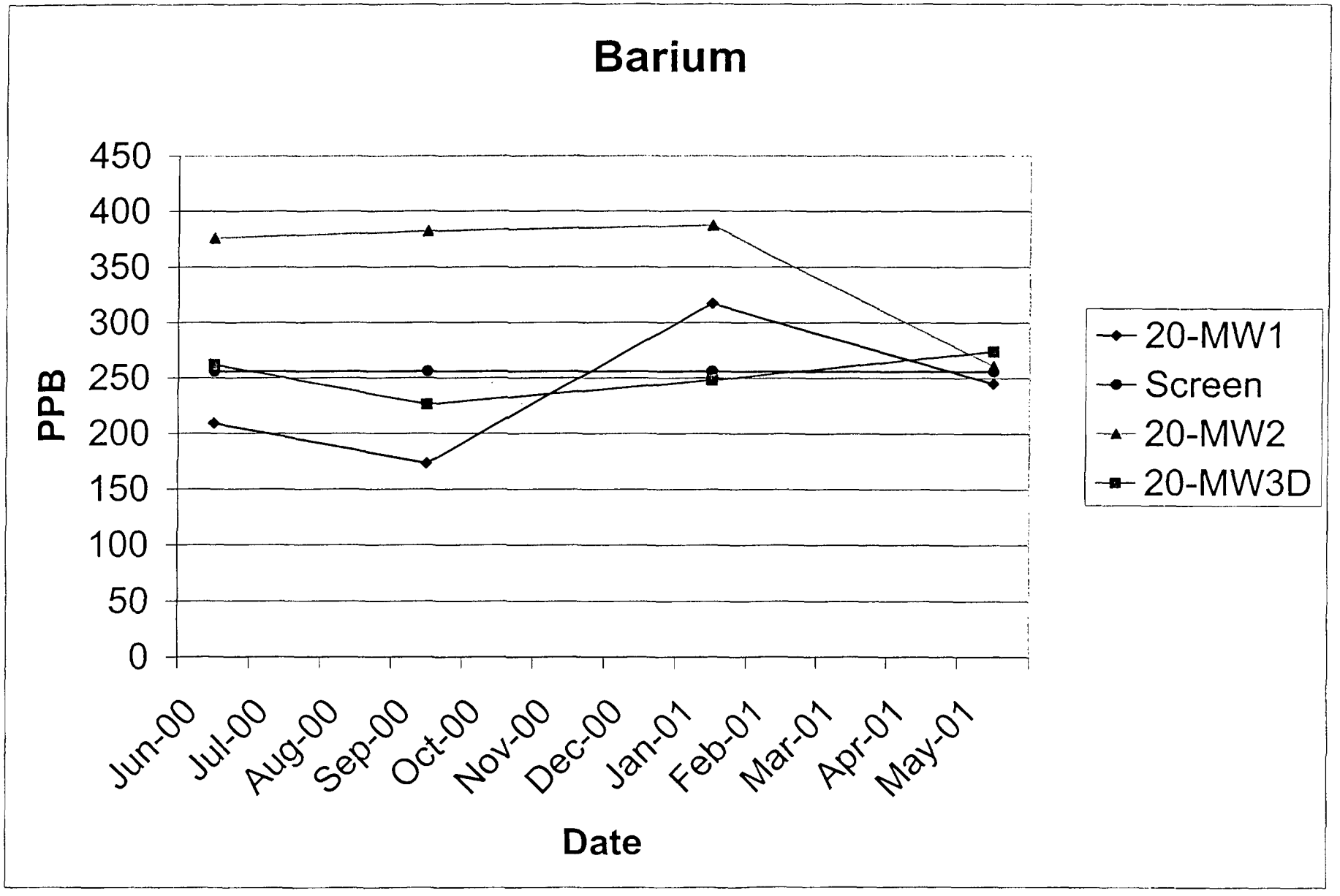
Note: Screening level exceedences are in bold.
The bolded italic data are graphed.
"Screen" label on graphs = screening level concentration


Barium
500
450
400
350
300
250
200
150
100
50
0
PPB
Jul-00
Aug-00
Sep-00
Oct-00
Nov-00
Dec-00
Jan-01
Feb-01
Mar-01
Apr-01
May-01
Date
19-MW1D
Screen

# AOI-20

| | Screen Level | AOI | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Location | 20-MW1 | 20-MW1 | 20-MW1 | 20-MW1 | 20-MW2 | 20-MW2 | 20-MW2 | 20-MW2 | 20-MW3D | 20-MW3D | 20-MW3D | 20-MW3D |
| | | Depth (ft) | 9 | 9 | 9 | 9 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| | | Date | 06/28/00 | 09/27/00 | 01/30/01 | 05/08/01 | 06/29/00 | 08/25/00 | 01/30/01 | 05/08/01 | 06/29/00 | 08/25/00 | 01/30/01 | 05/08/01 |
| ParameterName | | Units | | | | | | | | | | | | |
| Arsenic | 4.5 | ug/L | < 20 | < 4.4 | < 5.2 | 4.9 J | < 20 | 2.8 J | < 5.2 | < 1.6 | < 20 | < 4.4 | < 5.2 | < 1.6 |
| Barium | 256 | ug/L | ***209*** | ***173*** | ***317*** | ***245*** | ***376*** | ***382*** | ***387*** | ***261*** | ***262*** | ***226*** | ***248*** | ***274*** |
| Cadmium | 3.7 | ug/L | < 5 | < 0.16 | < 0.15 J | 1.6 J | < 5 | < 0.17 | < 0.15 J | 2.1 J | < 5 | < 0.16 | < 0.15 J | 2.6 J |
| Selenium | 18 | ug/L | < 40 | 4 J | < 42.1 | < 1.8 | < 40 | < 2.1 J | < 57.4 | < 1.8 | < 40 | < 3.7 | < 29.5 | < 1.8 |
| 2-Methylnaphthalene | 110 | ug/L | < 1 | < 2 | < 2 | < 2 | < 1 | 0.7 J | < 2 | < 2 | < 1 | < 2 | < 2 | < 2 |
| Acenaphthene | 219 | ug/L | < 1 | < 2 | < 2 | < 2 | 3 | 2 | 2 | 0.5 J | < 1 | < 2 | < 2 | < 2 |
| Benzo(a)anthracene | 9.2 | ug/L | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 |
| Benzo(a)pyrene | 0.2 | ug/L | < 1 | < 2 | < 2 | < 2 | < 1 | < 2 | < 2 | < 2 | < 1 | < 2 | < 2 | < 2 |
| Chrysene | 9.2 | ug/L | < 1 | < 2 | < 2 | < 2 | < 1 | < 2 | < 2 | < 2 | < 1 | < 2 | < 2 | < 2 |
| Dibenzo(a,h)anthracene | 0.92 | ug/L | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 |
| Naphthalene - SW-846 8270C | 73 | ug/L | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 |
| Pentachlorophenol | 1 | ug/L | < 1 | < 2 | < 2 J | < 2 | < 1 | < 2 | < 1 J | < 2 | < 1 | < 2 | < 2 J | < 2 |
| Phenanthrene | 110 | ug/L | < 1 | < 2 | < 2 | < 2 | < 1 | 0.2 J | < 2 | < 2 | < 1 | < 2 | < 2 | < 2 |
| 1,1,1-Trichloroethane | 73 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| 1,1,2-Trichloroethane | 1.2 | ug/L | < 5 | < 1 | < 1 | < 1 R | < 5 | < 1 | < 1 | < 1 R | < 5 | < 1 | < 1 | < 1 R |
| 1,1-Dichloroethane | 365 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| 1,1-Dichloroethene | 7 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| 1,2-Dichloroethane | 5 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| 1,2-Dichloroethene (total) | 33 | ug/L | < 10 | 2 | < 2 | < 2 | < 10 | 2 | < 2 | < 2 | < 10 | 2 | < 2 | < 2 |
| Benzene | 2.3 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | 0.6 J | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| Chloroethane (Ethyl chloride) | 23 | ug/L | < 10 | < 1 | < 2 | < 2 | < 10 | < 1 | < 2 | < 2 | < 10 | < 1 | < 2 | < 2 |
| Chloromethane (Methyl chloride) | 5.2 | ug/L | < 10 | < 1 | < 2 | < 2 | < 10 | < 1 J | < 2 | < 2 | < 10 | < 1 | < 2 | < 2 |
| Ethylbenzene | 365 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| Trichloroethene | 6.1 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| Vinyl chloride | 2 | ug/L | < 10 | < 1 | < 2 | < 2 | < 10 | < 1 | < 2 | < 2 | < 10 | < 1 | < 2 | 0.6 J |

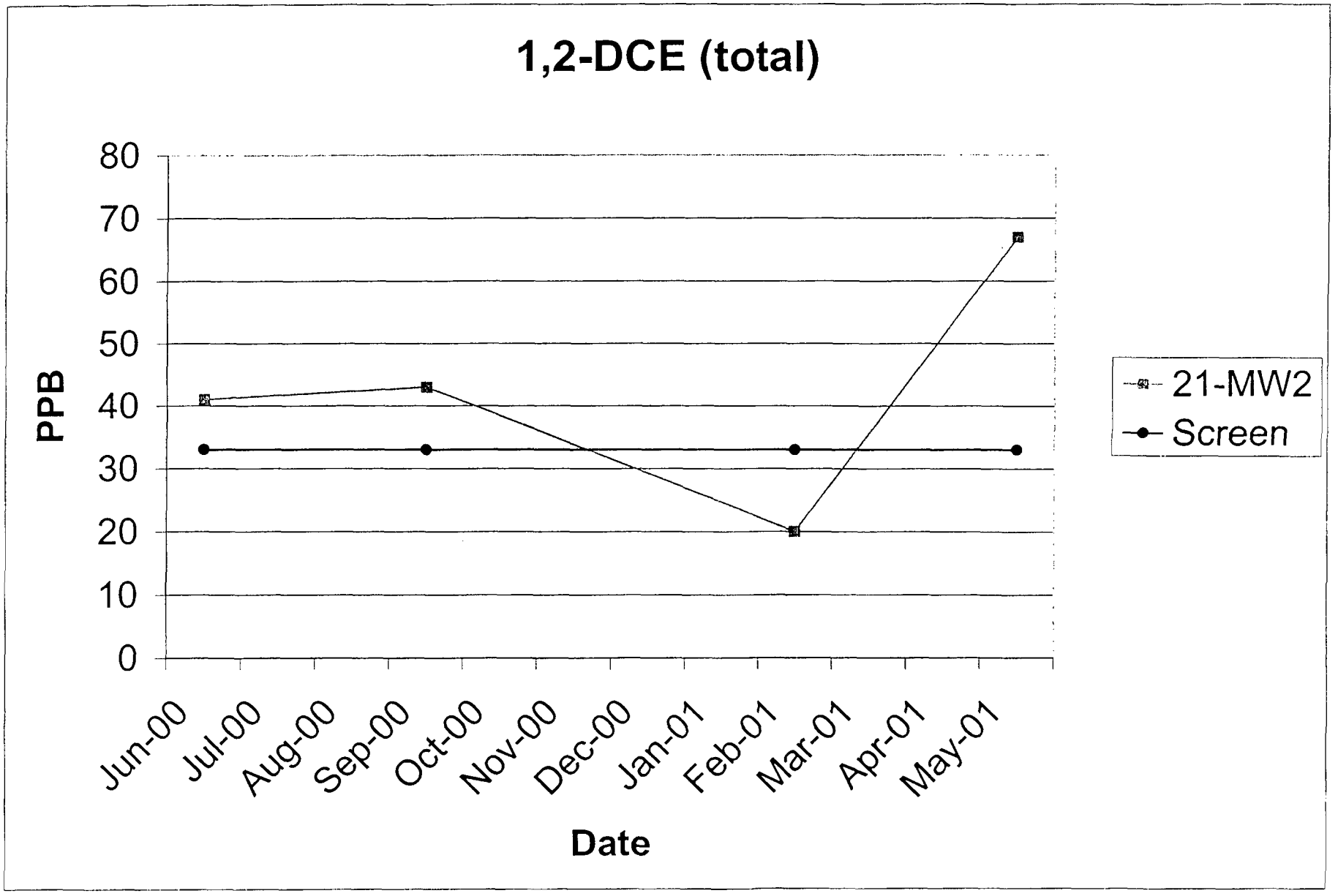
Screening level exceedences are in bold.
Note: The bolded italic data are graphed.
"Screen" label on graphs = screening level

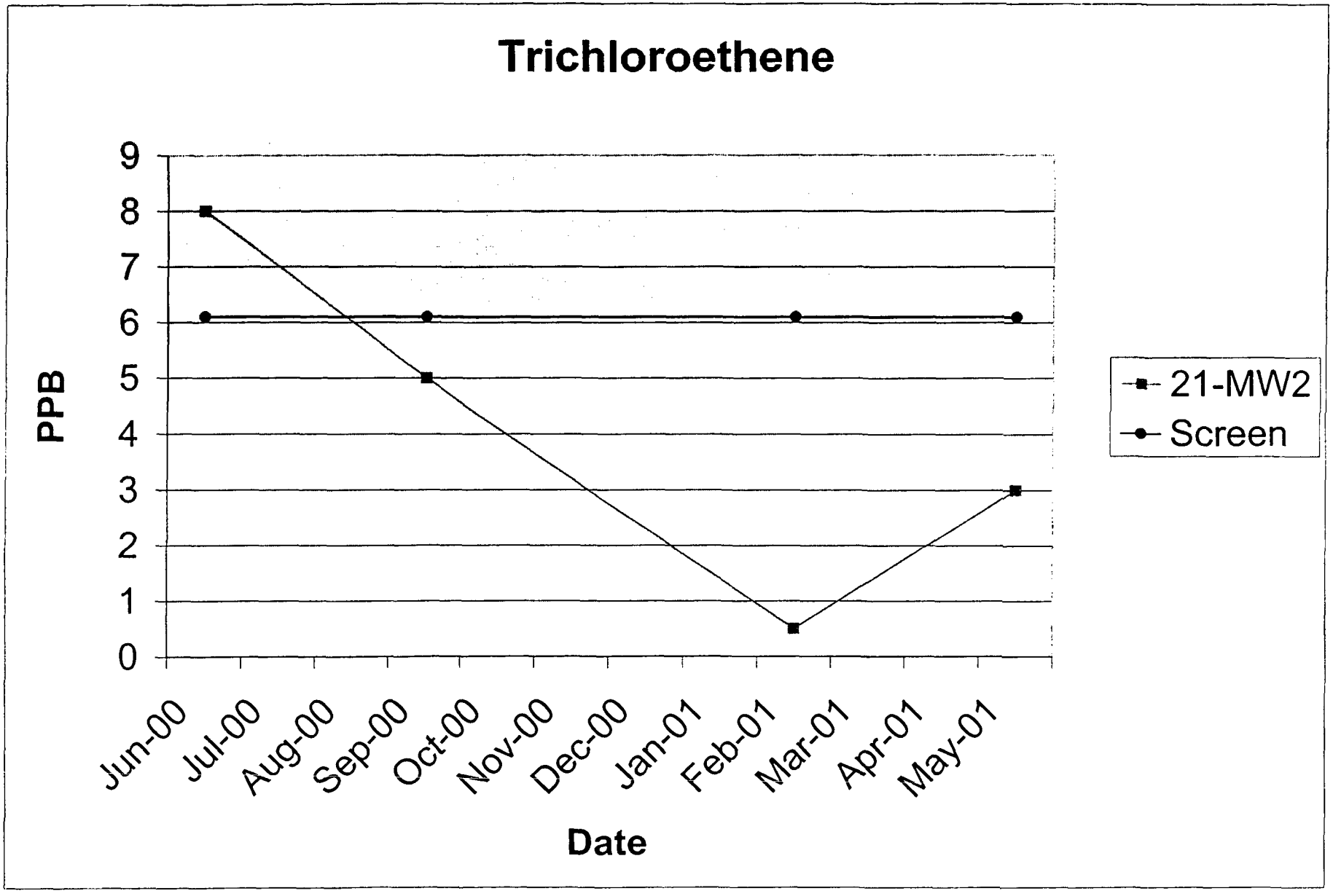

Barium
450
400
350
300
250
200
150
100
50
0
PPB
Jun-00
Jul-00
Aug-00
Sep-00
Oct-00
Nov-00
Dec-00
Jan-01
Feb-01
Mar-01
Apr-01
May-01
Date
20-MW1
Screen
20-MW2
20-MW3D

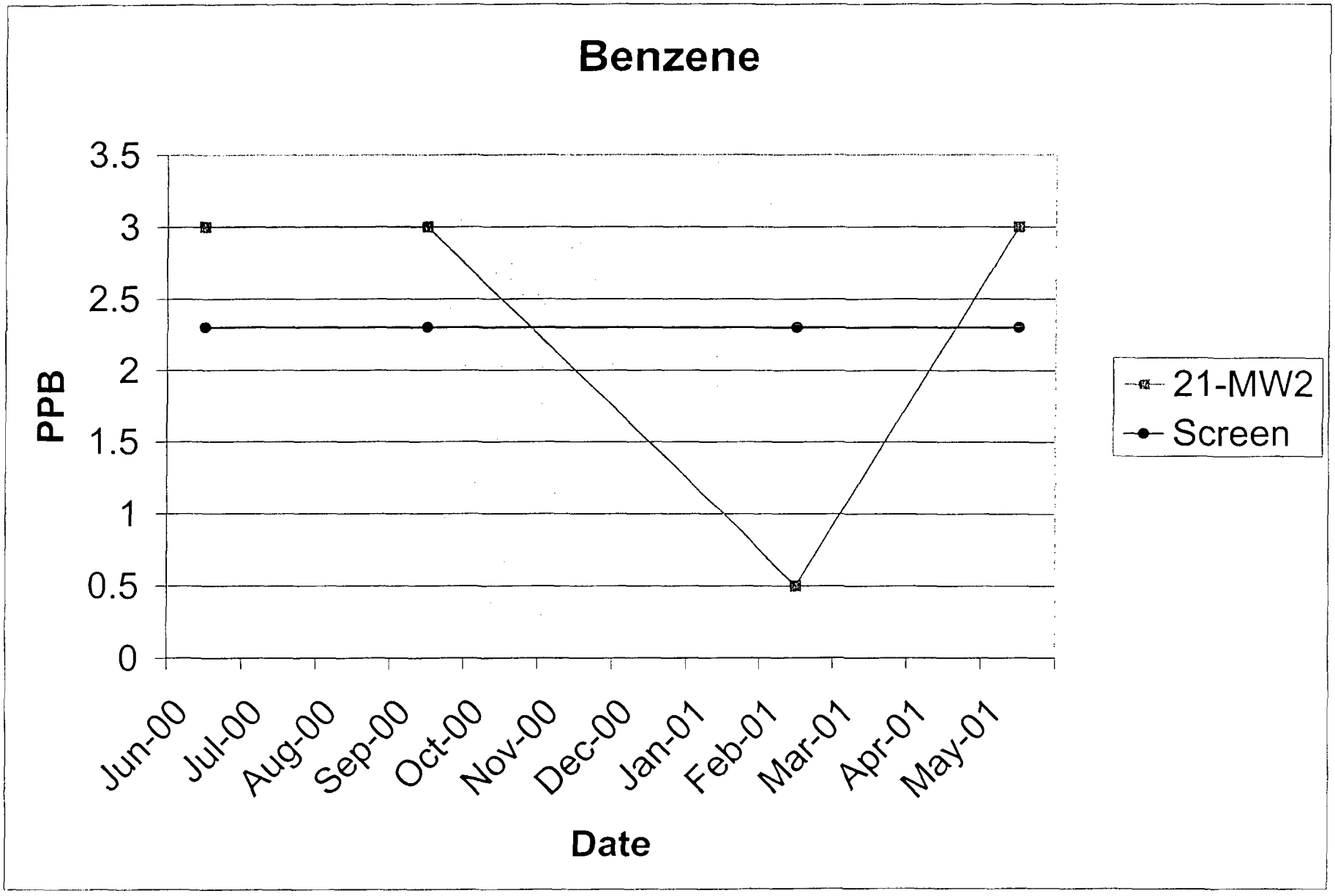
# AOI-21

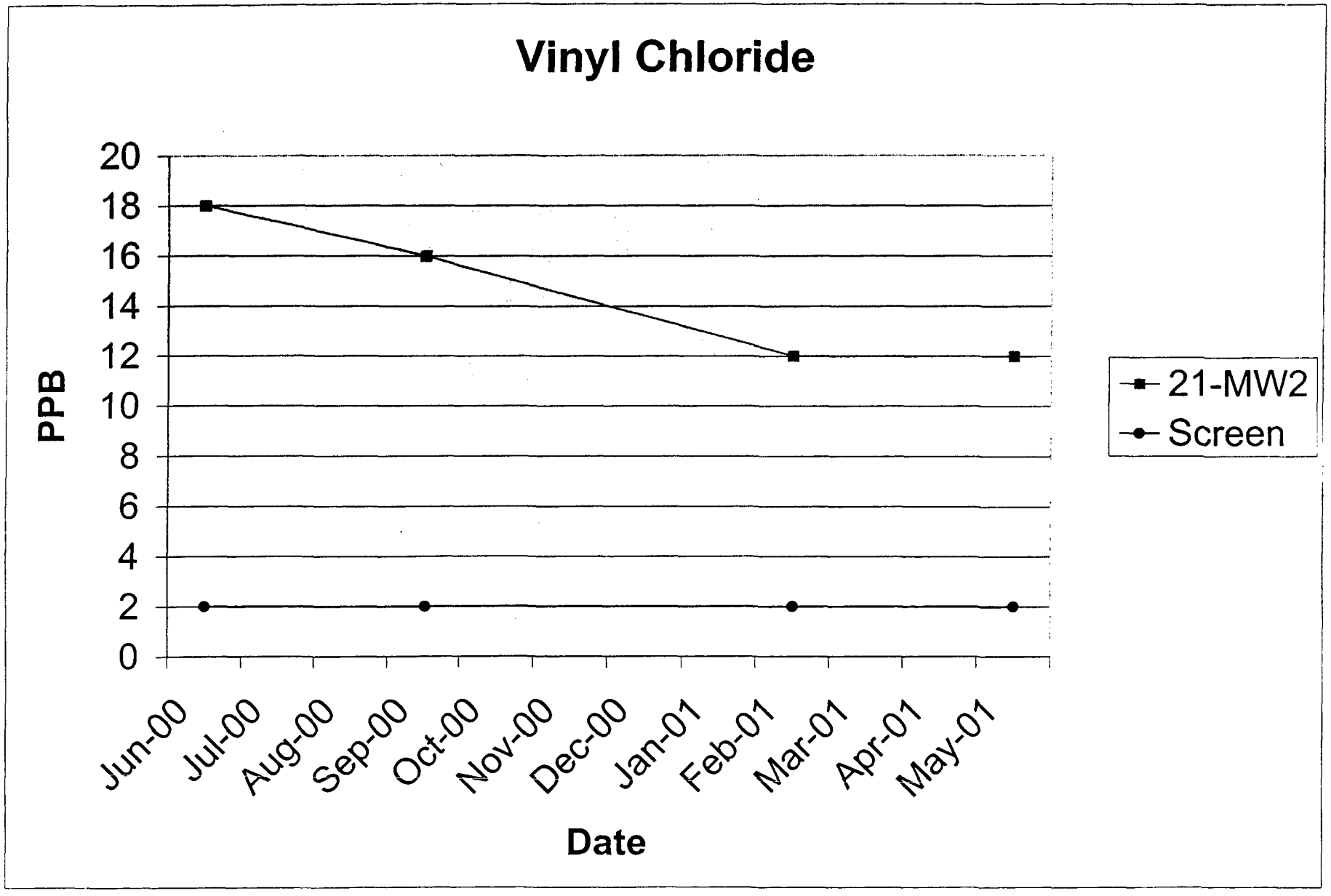
| ParameterName | Screen Level | AOI | 21 | 21 | 21 | 21 | 21 | 21 | 21 | 21 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Location | 21-MW1 | 21-MW1 | 21-MW1 | 21-MW1 | 21-MW2 | 21-MW2 | 21-MW2 | 21-MW2 |
| | | Depth (ft) | 12 | 12 | 12 | 12 | 7 | 7 | 7 | 7 |
| | | Date | 06/29/00 | 09/19/00 | 02/02/01 | 05/09/01 | 06/29/00 | 09/19/00 | 02/02/01 | 05/09/01 |
| | | Units | | | | | | | | |
| Arsenic | 4.5 | ug/L | < 20 | < 1.8 | < 5.2 J | < 1.6 | 3.1 J | 4 J | < 5.2 J | 7 J |
| Barium | 256 | ug/L | 101 J | 126 | 115 | 131 J | 162 J | 171 | 132 | 157 J |
| Cadmium | 3.7 | ug/L | < 5 | < 0.17 | < 0.15 J | 0.4 J | < 5 | 0.41 J | < 0.15 J | < 0.29 |
| Selenium | 18 | ug/L | < 40 | 4.7 J | < 14.5 | 2.5 J | < 40 | 4.5 J | < 14.5 | < 1.8 |
| 2-Methylnaphthalene | 110 | ug/L | < 1 | < 2 | < 1 | < 1 | < 1 | 6 | < 1 | < 1 |
| Acenaphthene | 219 | ug/L | < 1 | < 2 | < 1 | < 1 | < 1 | 4 | < 1 | < 1 |
| Benzo(a)anthracene | 9.2 | ug/L | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 |
| Benzo(a)pyrene | 0.2 | ug/L | < 1 | < 2 | < 1 | < 1 | < 1 | < 2 | < 1 | < 1 |
| Chrysene | 9.2 | ug/L | < 1 | < 2 | < 1 | < 1 | < 1 | < 2 | < 1 | < 1 |
| Dibenzo(a,h)anthracene | 0.92 | ug/L | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 |
| Naphthalene - SW-846 8270C | 73 | ug/L | < 2 | < 2 J | < 2 | < 2 | < 2 | < 2 J | < 2 | < 2 |
| Pentachlorophenol | 1 | ug/L | < 1 | < 2 | < 1 J | < 1 | < 1 | < 2 | < 1 J | < 1 |
| Phenanthrene | 110 | ug/L | < 1 | < 2 | < 1 | < 1 | < 1 | 3 | < 1 | < 1 |
| 1,1,1-Trichloroethane | 73 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| 1,1,2-Trichloroethane | 1.2 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| 1,1-Dichloroethane | 365 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| 1,1-Dichloroethene | 7 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | 1 | < 1 | < 1 |
| 1,2-Dichloroethane | 5 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| **1,2-Dichloroethene (total)** | **33** | ug/L | < 10 | 2 | < 2 | < 2 | ***41*** | ***43*** | ***20*** | ***67*** |
| **Benzene** | **2.3** | ug/L | < 5 | < 1 | < 1 | < 1 | ***3*** | ***3*** | ***0.5*** | ***3*** |
| Chloroethane (Ethyl chloride) | 23 | ug/L | < 10 | < 1 | < 2 | < 2 | < 10 | < 1 | < 2 | < 2 |
| Chloromethane (Methyl chloride) | 5.2 | ug/L | < 10 | < 1 | < 2 | < 2 | < 10 | < 1 | < 2 | < 2 |
| Ethylbenzene | 365 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| **Trichloroethene** | **6.1** | ug/L | < 5 | < 1 | < 1 | < 1 | ***8*** | ***5*** | ***0.5*** | ***3*** |
| **Vinyl chloride** | **2** | ug/L | < 10 | < 1 | < 2 | < 2 | ***18*** | ***16*** | ***12*** | ***12*** |

Note:Screening level exceedences are in bold.
The bolded italic data are graphed.
"Screen" label on graphs = screening level concentration


1,2-DCE (total)
PPB
80
70
60
50
40
30
20
10
0
Jun-00
Jul-00
Aug-00
Sep-00
Oct-00
Nov-00
Dec-00
Jan-01
Feb-01
Mar-01
Apr-01
May-01
Date
21-MW2
Screen


Trichloroethene
PPB
9
8
7
6
5
4
3
2
1
0
Jun-00
Jul-00
Aug-00
Sep-00
Oct-00
Nov-00
Dec-00
Jan-01
Feb-01
Mar-01
Apr-01
May-01
Date
21-MW2
Screen


Benzene
3.5
3
2.5
2
1.5
1
0.5
0
PPB
Jun-00
Jul-00
Aug-00
Sep-00
Oct-00
Nov-00
Dec-00
Jan-01
Feb-01
Mar-01
Apr-01
May-01
Date
21-MW2
Screen


Vinyl Chloride
PPB
20
18
16
14
12
10
8
6
4
2
0
Jun-00
Jul-00
Aug-00
Sep-00
Oct-00
Nov-00
Dec-00
Jan-01
Feb-01
Mar-01
Apr-01
May-01
Date
21-MW2
Screen

# AOI-22A

| ParameterName | Screen Level | AOI | 22A | 22A | 22A | 22A | 22A | 22A | 22A | 22A |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Location | 22A-MW1 | 22A-MW1 | 22A-MW1 | 22A-MW1 | 22A-MW2 | 22A-MW2 | 22A-MW2 | 22A-MW2 |
| | | Depth (ft) | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 |
| | | Date | 06/24/00 | 09/23/00 | 01/26/01 | 05/03/01 | 06/23/00 | 09/24/00 | 02/26/01 | 05/09/01 |
| | | Units | | | | | | | | |
| Arsenic | 4.5 | ug/L | 3.2 J | 3.8 J | < 4.4 | 3.7 J | < 20 | < 1.8 | < 1.6 | < 1.6 |
| Barium | 256 | ug/L | 322 | 330 | 311 | 315 | 301 | 301 | 250 | 317 |
| Cadmium | 3.7 | ug/L | < 5 | < 0.17 | < 0.16 | < 0.29 | < 0.22 J | < 0.17 | < 0.29 | 0.66 J |
| Selenium | 18 | ug/L | < 40 | < 2.1 J | < 3.7 | < 1.8 | < 40 | 3 J | 1.9 J | < 1.8 |
| 2-Methylnaphthalene | 110 | ug/L | < 1 J | < 2 | NA | < 1 | < 2 | < 2 J | 0.7 J | < 2 |
| Acenaphthene | 219 | ug/L | 2 | 2 | 2 | 3 | 1 J | 1 J | 0.7 J | 0.6 J |
| Benzo(a)anthracene | 9.2 | ug/L | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 J | < 2 | < 2 |
| Benzo(a)pyrene | 0.2 | ug/L | < 1 | < 2 | < 2 | < 1 | < 2 | < 2 J | < 2 | < 2 |
| Chrysene | 9.2 | ug/L | < 1 | < 2 | < 2 | < 1 | < 2 | < 2 J | < 2 | < 2 |
| Dibenzo(a,h)anthracene | 0.92 | ug/L | < 1 | < 2 | < 2 | < 2 | < 2 | < 2 J | < 2 | < 2 |
| Naphthalene - SW-846 8270C | 73 | ug/L | < 2 J | < 2 | 0.2 J | 0.1 J | < 2 | < 2 J | < 2 | < 2 |
| Pentachlorophenol | 1 | ug/L | < 1 | < 2 | NA | < 1 | < 2 | < 2 J | 0.5 J | < 2 |
| Phenanthrene | 110 | ug/L | < 1 | < 2 | 0.1 J | < 1 | < 2 | < 2 J | < 2 | < 2 |
| 1,1,1-Trichloroethane | 73 | ug/L | 34 | 60 | 14 | 24 | < 5 | < 1 | < 1 | < 1 |
| 1,1,2-Trichloroethane | 1.2 | ug/L | < 5 | < 1 | < 1 | 0.6 J | < 5 | < 1 | < 1 | < 1 |
| 1,1-Dichloroethane | 365 | ug/L | 540 | 610 | 310 | 390 | 8 | 5 | < 1 | < 1 |
| 1,1-Dichloroethene | 7 | ug/L | < 5 | 6 | 0.7 J | 3 | < 5 | < 1 | < 1 | < 1 |
| 1,2-Dichloroethane | 5 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| 1,2-Dichloroethene (total) | 33 | ug/L | 570 | 530 | 5 | 120 | < 10 | 2 | < 2 | < 2 |
| Benzene | 2.3 | ug/L | 6 | 7 | 5 | 6 | 2 | 3 | 2 | 0.6 |
| Chloroethane (Ethyl chloride) | 23 | ug/L | 19 | 32 | 22 | 35 | 35 | 56 | 41 | 5 |
| Chloromethane (Methyl chloride) | 5.2 | ug/L | < 10 | < 1 J | < 2 | < 2 | < 10 J | < 1 | < 2 | < 2 |
| Ethylbenzene | 365 | ug/L | < 5 | 2 | 1 | 2 | < 5 | < 1 | < 1 | < 1 |
| Trichloroethene | 6.1 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | 0.5 J | < 1 |
| Vinyl chloride | 2 | ug/L | 430 | 730 | 670 | 620 | < 10 J | < 1 | < 2 | < 2 |

Note:Screening level exceedences are in bold.
The bolded italic data are graphed.
"Sc[illegible] label on graphs = screening level concentration

# AOI-22A

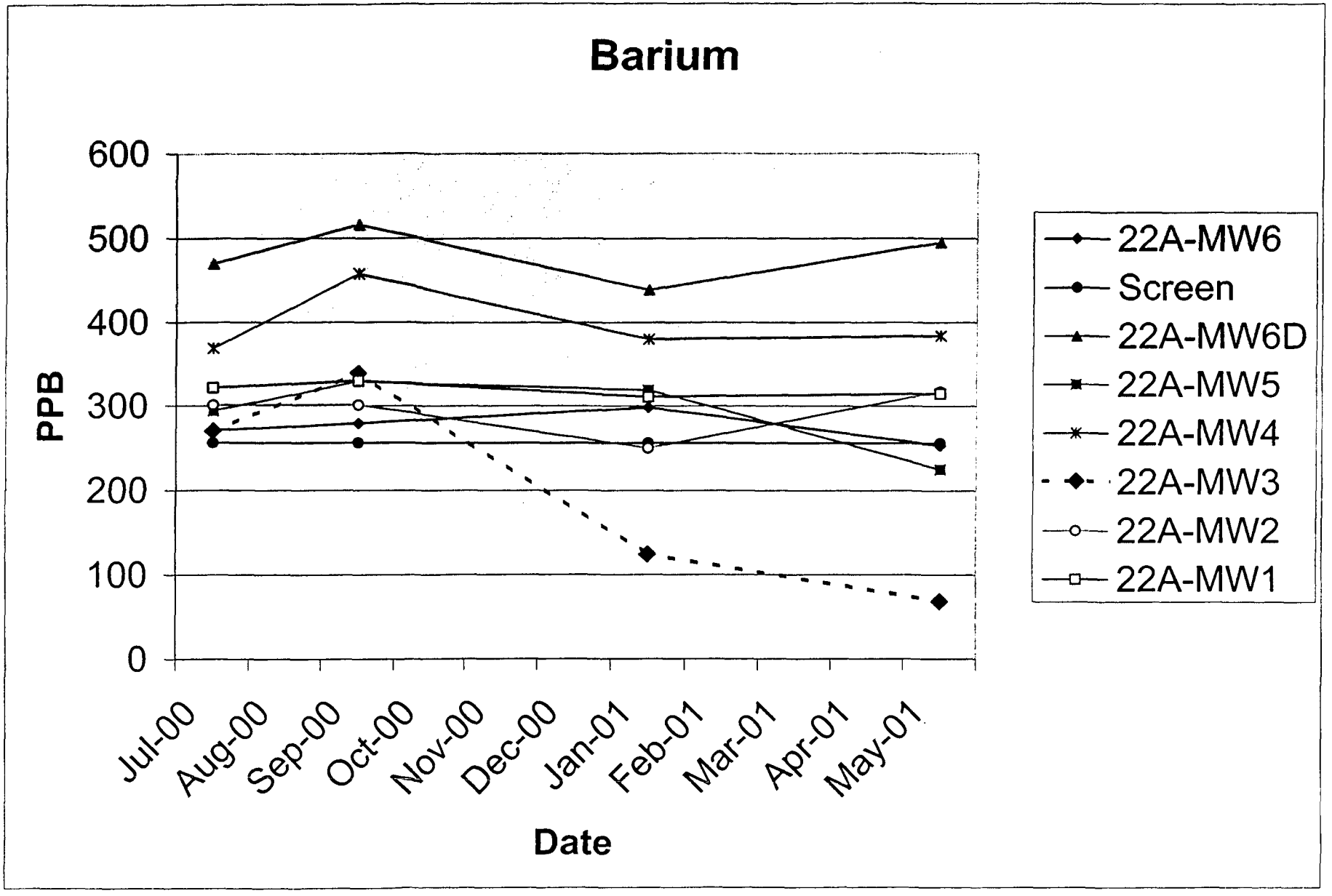
| ParameterName | Screen Level | AOI | 22A | 22A | 22A | 22A | 22A | 22A | 22A | 22A | 22A | 22A |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Location | 22A-MW3 | 22A-MW3 | 22A-MW3 | 22A-MW3 | 22A-MW4 | 22A-MW4 | 22A-MW4 | 22A-MW4 | 22A-MW5 | 22A-MW5 |
| | | Depth (ft) | 12 | 12 | 12 | 12 | 10 | 10 | 10 | 10 | 12 | 12 |
| | | Date | 06/23/00 | 09/23/00 | 01/26/01 | 05/03/01 | 06/27/00 | 09/21/00 | 01/30/01 | 05/04/01 | 07/11/00 | 09/27/00 |
| | | Units | | | | | | | | | | |
| **Arsenic** | **4.5** | **ug/L** | < 20 | < 1.8 | < 4.4 | 2 J | < 20 | < 1.8 | < 5.2 | 2.3 J | < 20 | 6.7 J |
| **Barium** | **256** | **ug/L** | ***270*** | ***339*** | ***124*** | ***68.5*** | ***369*** | ***458*** | ***380*** | ***384*** | ***294*** | ***329*** |
| Cadmium | 3.7 | ug/L | < 0.22 J | < 0.17 | < 0.16 | < 0.29 | < 5 | < 0.17 | < 0.15 J | < 0.29 | < 0.17 J | 0.31 J |
| Selenium | 18 | ug/L | < 40 | 3.5 J | < 3.7 | 2.6 J | < 40 | 2.4 J | < 35.9 | 3 J | < 40 | 3.7 J |
| 2-Methylnaphthalene | 110 | ug/L | < 2 | < 2 R | NA | < 2 | 2 J | < 2 | < 1 | < 2 | < 1 | < 2 |
| Acenaphthene | 219 | ug/L | 1 J | 2 J | 2 | 2 | 1 J | 2 | 0.6 J | < 2 | 0.1 J | 0.2 J |
| Benzo(a)anthracene | 9.2 | ug/L | < 2 | < 2 R | < 2 | < 2 | < 4 | < 2 | < 2 | < 2 | < 2 | < 2 |
| Benzo(a)pyrene | 0.2 | ug/L | < 2 | < 2 R | < 1 | < 2 | < 3 | < 2 | < 2 | < 2 | < 1 | < 2 |
| Chrysene | 9.2 | ug/L | < 2 | < 2 R | < 1 | < 2 | < 3 | < 2 | < 2 | < 2 | < 1 | < 2 |
| Dibenzo(a,h)anthracene | 0.92 | ug/L | < 2 | < 2 R | < 2 | < 2 | < 3 | < 2 | < 2 | < 2 | < 2 | < 2 |
| Naphthalene - SW-846 8270C | 73 | ug/L | < 2 | < 2 R | < 2 | < 2 | < 4 J | < 2 | < 2 | < 2 | < 2 | < 2 |
| Pentachlorophenol | 1 | ug/L | < 2 | < 2 J | NA | 3 | < 3 | < 2 | < 1 J | < 2 | < 1 | < 2 |
| Phenanthrene | 110 | ug/L | < 2 | < 2 R | 0.2 J | 0.3 J | < 3 | < 2 | < 2 | < 2 | < 1 | < 2 |
| **1,1,1-Trichloroethane** | **73** | **ug/L** | < 5 | 0.5 J | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | 0.6 J | < 1 |
| 1,1,2-Trichloroethane | 1.2 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 1 | < 1 |
| **1,1-Dichloroethane** | **365** | **ug/L** | ***47*** | ***43*** | ***12*** | ***5*** | < 5 | < 1 | < 1 | < 1 | ***170*** | ***140*** |
| **1,1-Dichloroethene** | **7** | **ug/L** | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 1,2-Dichloroethane | 5 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 1 | < 1 |
| **1,2-Dichloroethene (total)** | **33** | **ug/L** | 10 J | 1 | < 2 | < 2 | < 10 | 2 | < 2 | < 2 | ***44*** | ***23*** |
| **Benzene** | **2.3** | **ug/L** | 2 J | 2 | 0.8 J | 0.9 J | < 5 | < 1 | < 1 | < 1 | ***4*** | ***4*** |
| **Chloroethane (Ethyl chloride)** | **23** | **ug/L** | < 10 | < 1 | < 2 | < 2 | < 10 | < 1 | < 2 | < 2 | ***37*** | ***13*** |
| Chloromethane (Methyl chloride) | 5.2 | ug/L | < 10 J | < 1 | < 2 J | < 2 | < 10 | < 1 | < 2 | < 2 | < 1 | < 1 |
| Ethylbenzene | 365 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 1 | < 1 |
| Trichloroethene | 6.1 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 1 | < 1 |
| **Vinyl chloride** | **2** | **ug/L** | ***32*** | ***36*** | ***4*** | ***1*** | < 10 | < 1 | < 2 | < 2 | ***300*** | ***210*** |

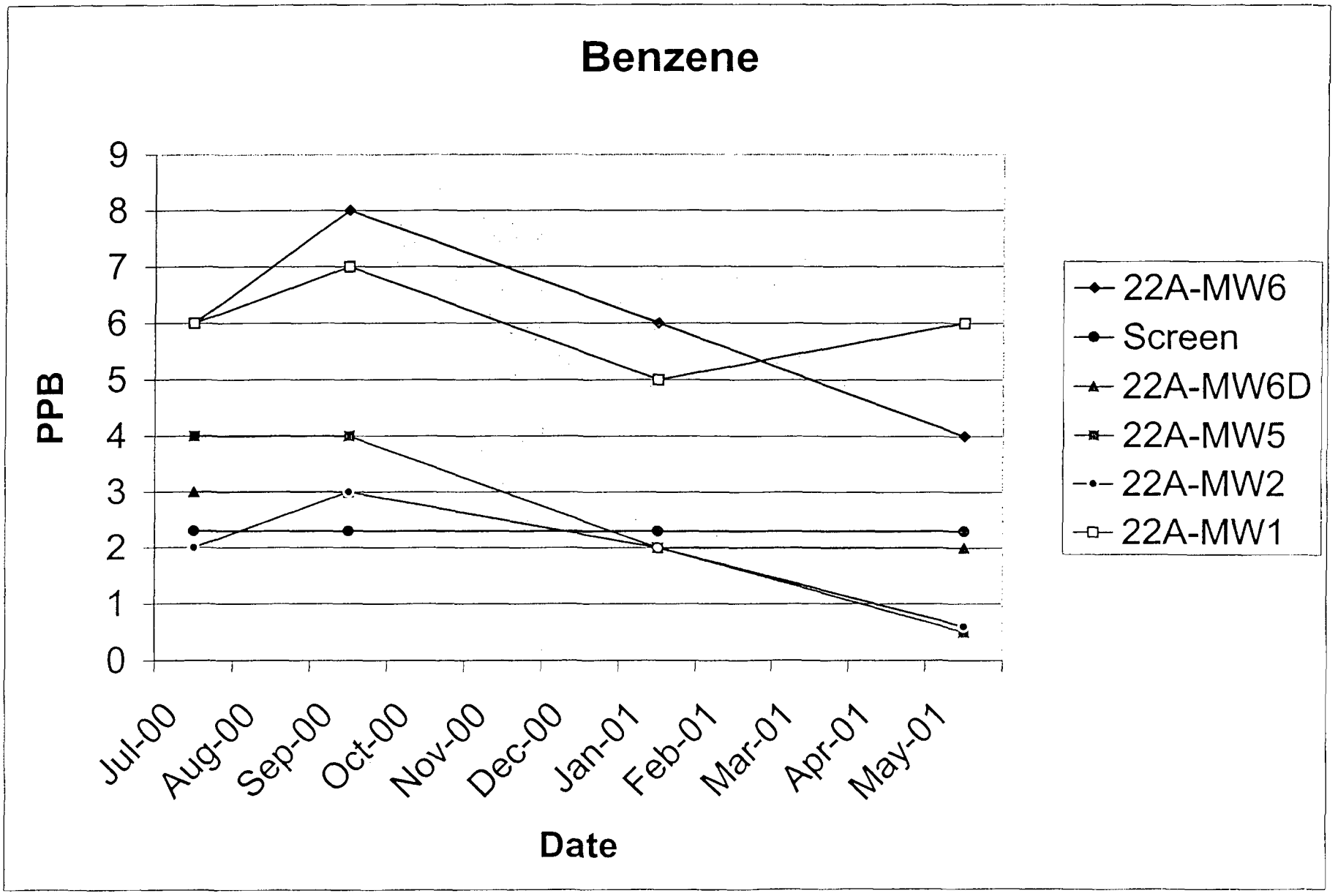
Note:Screening level exceedences are in bold.
The bolded italic data are graphed.
"Screen" label on graphs = screening level concentration

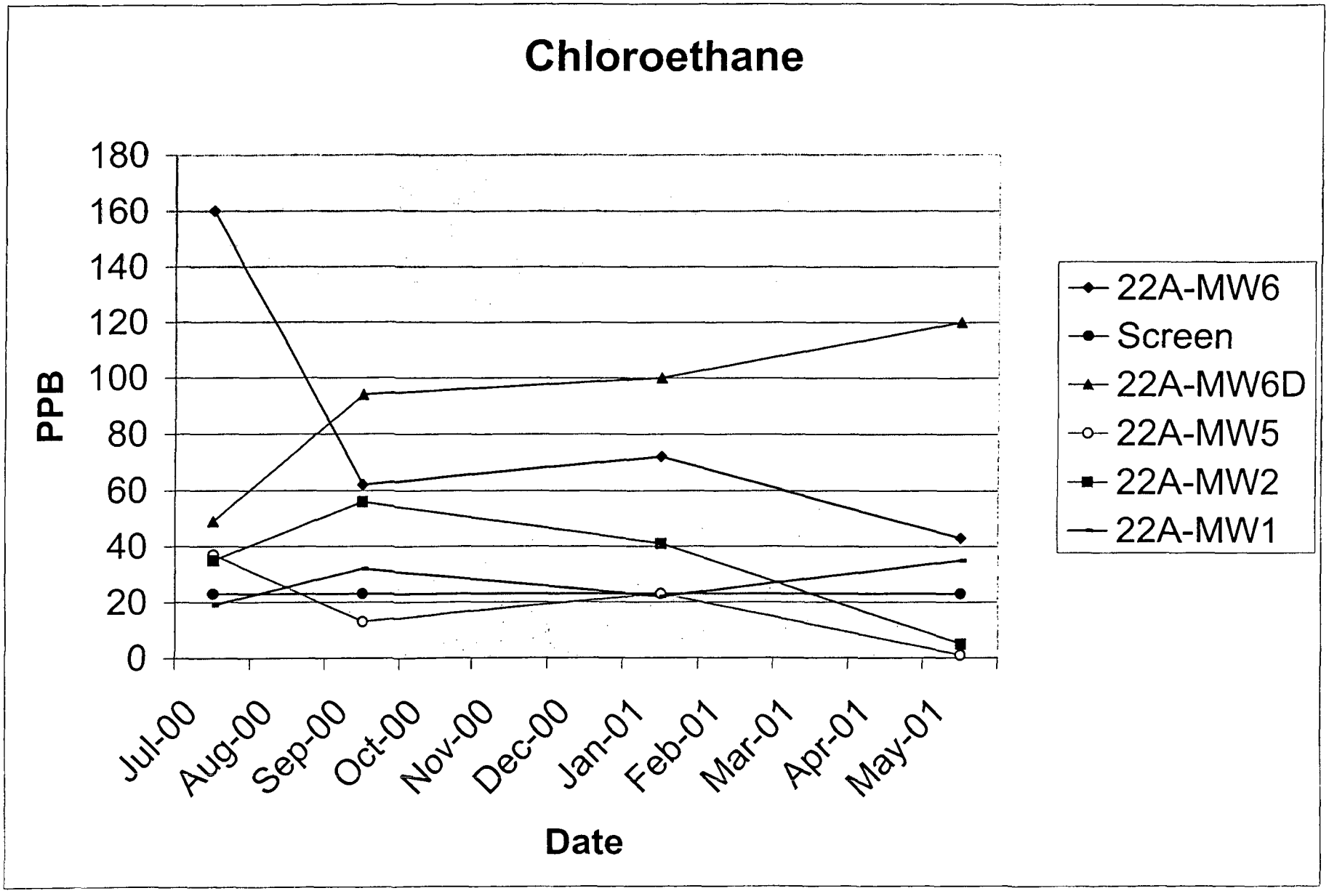
# AOI-22A

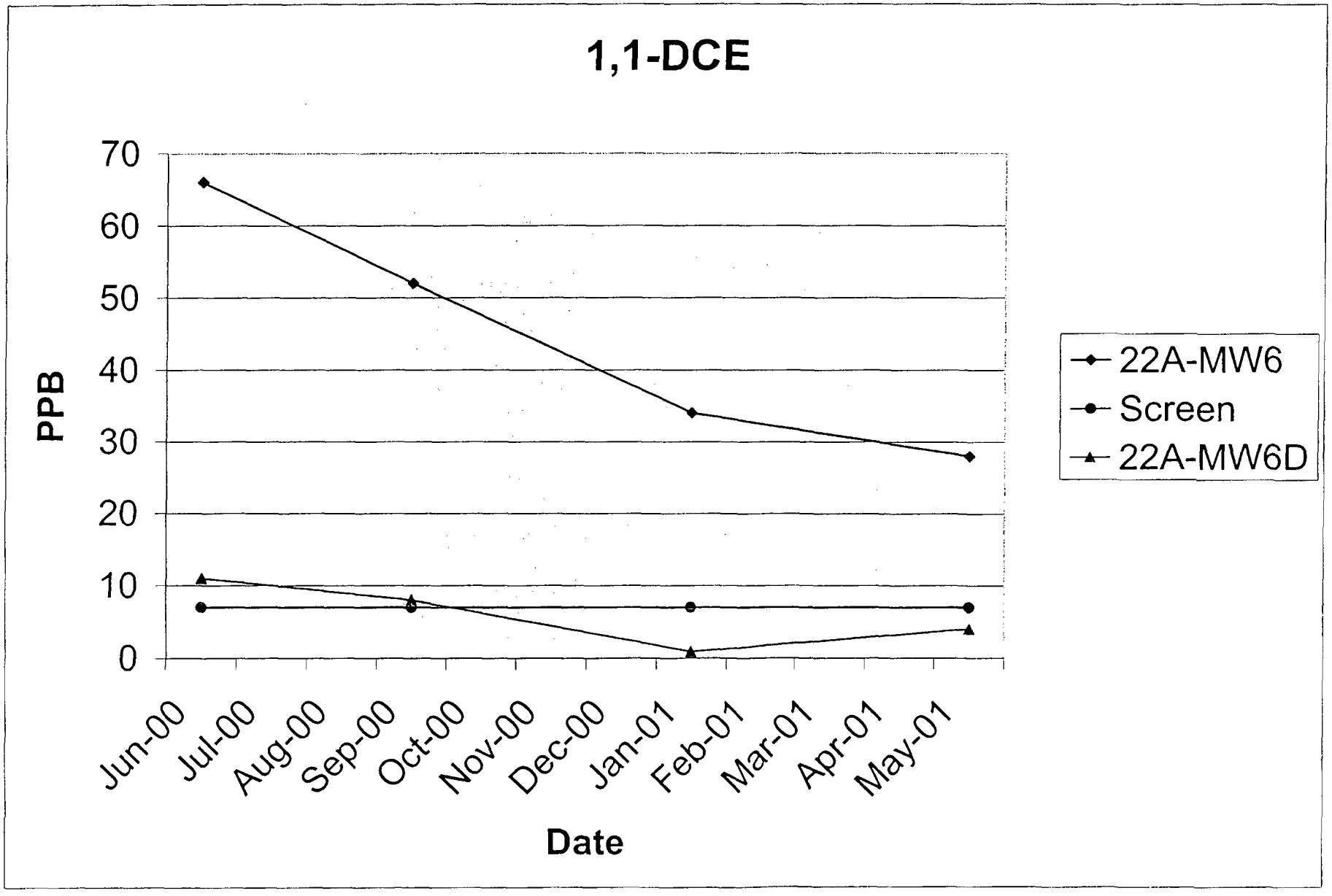
| ParameterName | Screen Level | AOI | 22A | 22A | 22A | 22A | 22A | 22A | 22A | 22A | 22A | 22A |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Location | 22A-MW5 | 22A-MW5 | 22A-MW6 | 22A-MW6 | 22A-MW6 | 22A-MW6 | 22A-MW6D | 22A-MW6D | 22A-MW6D | 22A-MW6D |
| | | Depth (ft) | 12 | 12 | 11 | 11 | 11 | 11 | 13 | 13 | 13 | 13 |
| | | Date | 02/03/01 | 05/04/01 | 07/11/00 | 09/21/00 | 01/26/01 | 05/03/01 | 07/11/00 | 09/21/00 | 01/26/01 | 05/03/01 |
| | | Units | | | | | | | | | | |
| Arsenic | 4.5 | ug/L | < 5.2 J | 3.6 J | 1.8 | 2.1 | 2.2 | 8 | 16.9 | 30.6 | 69.4 | 77.2 |
| Barium | 256 | ug/L | *319* | *225* | *271* | *279* | *298* | *253* | *470* | *516* | *439* | *495* |
| Cadmium | 3.7 | ug/L | < 0.15 J | < 0.29 | < 0.17 J | < 0.17 | < 0.16 | < 0.29 | < 0.17 J | < 0.17 | 0.33 J | < 0.29 |
| Selenium | 18 | ug/L | < 14.5 | 5.9 J | < 40 | < 2.1 | < 3.7 | 2.6 J | < 40 | 3.2 J | < 3.7 | 2.1 J |
| 2-Methylnaphthalene | 110 | ug/L | < 1 | < 2 | 28 | < 2 | NA | < 2 | < 1 | < 2 | NA | < 2 |
| Acenaphthene | 219 | ug/L | < 1 | < 2 | 1 J | 2 | 1 J | 1 J | 0.7 J | 0.3 J | < 1 | 0.1 J |
| Benzo(a)anthracene | 9.2 | ug/L | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 |
| Benzo(a)pyrene | 0.2 | ug/L | < 1 | < 2 | < 1 | < 2 | < 2 | < 2 | < 1 | < 2 | < 1 | < 2 |
| Chrysene | 9.2 | ug/L | < 1 | < 2 | < 1 | < 2 | < 2 | < 2 | < 1 | < 2 | < 1 | < 2 |
| Dibenzo(a,h)anthracene | 0.92 | ug/L | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 |
| Naphthalene - SW-846 8270C | 73 | ug/L | < 2 | < 2 | 0.6 J | < 2 | 0.4 J | 0.2 J | 0.2 J | 0.2 J | < 2 | < 2 |
| Pentachlorophenol | 1 | ug/L | < 1 J | < 2 | < 1 | < 2 | NA | 2 | < 1 | < 2 | NA | 2 |
| Phenanthrene | 110 | ug/L | < 1 | < 2 | 0.8 J | 0.9 J | 0.7 J | 0.5 J | 0.3 J | < 2 | < 1 | < 2 |
| 1,1,1-Trichloroethane | 73 | ug/L | < 1 | < 1 | *580* | *300* | *310* | *180* | *76* | *49* | *3* | *13* |
| 1,1,2-Trichloroethane | 1.2 | ug/L | < 1 | < 1 | 3 | < 1 | 2 | 1 | 1 J | < 1 | < 1 | < 1 |
| 1,1-Dichloroethane | 365 | ug/L | *44* | *0.5* | *2000* | *1200* | *1200* | *600* | *810* | *560* | 170 | 310 |
| 1,1-Dichloroethene | 7 | ug/L | < 1 | < 1 | *66* | *52* | *34* | *28* | *11* | *8* | *0.9* | *4* |
| 1,2-Dichloroethane | 5 | ug/L | < 1 | < 1 | 1 J | < 1 | 0.9 J | < 1 | 2 | < 1 | < 1 | < 1 |
| 1,2-Dichloroethene (total) | 33 | ug/L | *0.7* | *1* | *3700* | *2000* | *1500* | *800* | *870* | *540* | *42* | *170* |
| Benzene | 2.3 | ug/L | *2* | *0.5* | *6* | *8* | *6* | *4* | *3* | *3* | *2* | *2* |
| Chloroethane (Ethyl chloride) | 23 | ug/L | *23* | *1* | *160* | *62* | *72* | *43* | *49* | *94* | *100* | *120* |
| Chloromethane (Methyl chloride) | 5.2 | ug/L | < 2 | < 2 | < 1 | < 1 J | < 2 | < 2 | < 1 | < 1 J | < 2 | < 2 |
| Ethylbenzene | 365 | ug/L | < 1 | < 1 | 5 | 5 J | 4 | 2 | 2 | 1 | < 1 | 0.5 J |
| Trichloroethene | 6.1 | ug/L | < 1 | < 1 | 4 | 3 J | 2 | 2 | 0.9 J | < 1 | < 1 | < 1 |
| Vinyl chloride | 2 | ug/L | *43* | *1* | *1300* | *870* | *2300* | *940* | *1900* | *520* | *130* | *270* |

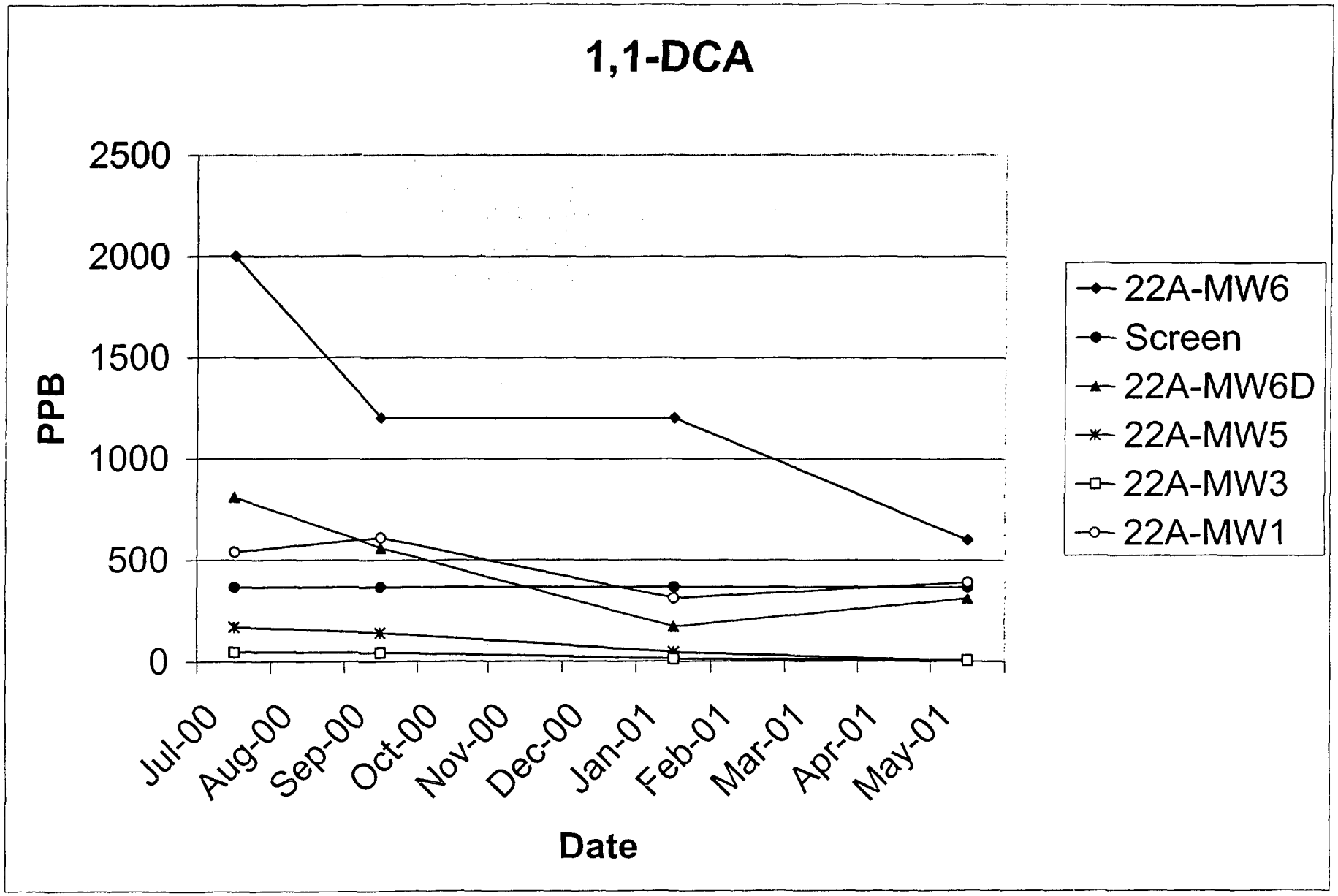
Note:Screening level exceedences are in bold.
The bolded italic data are graphed.
"Scr[illegible]abel on graphs = screening level concentration

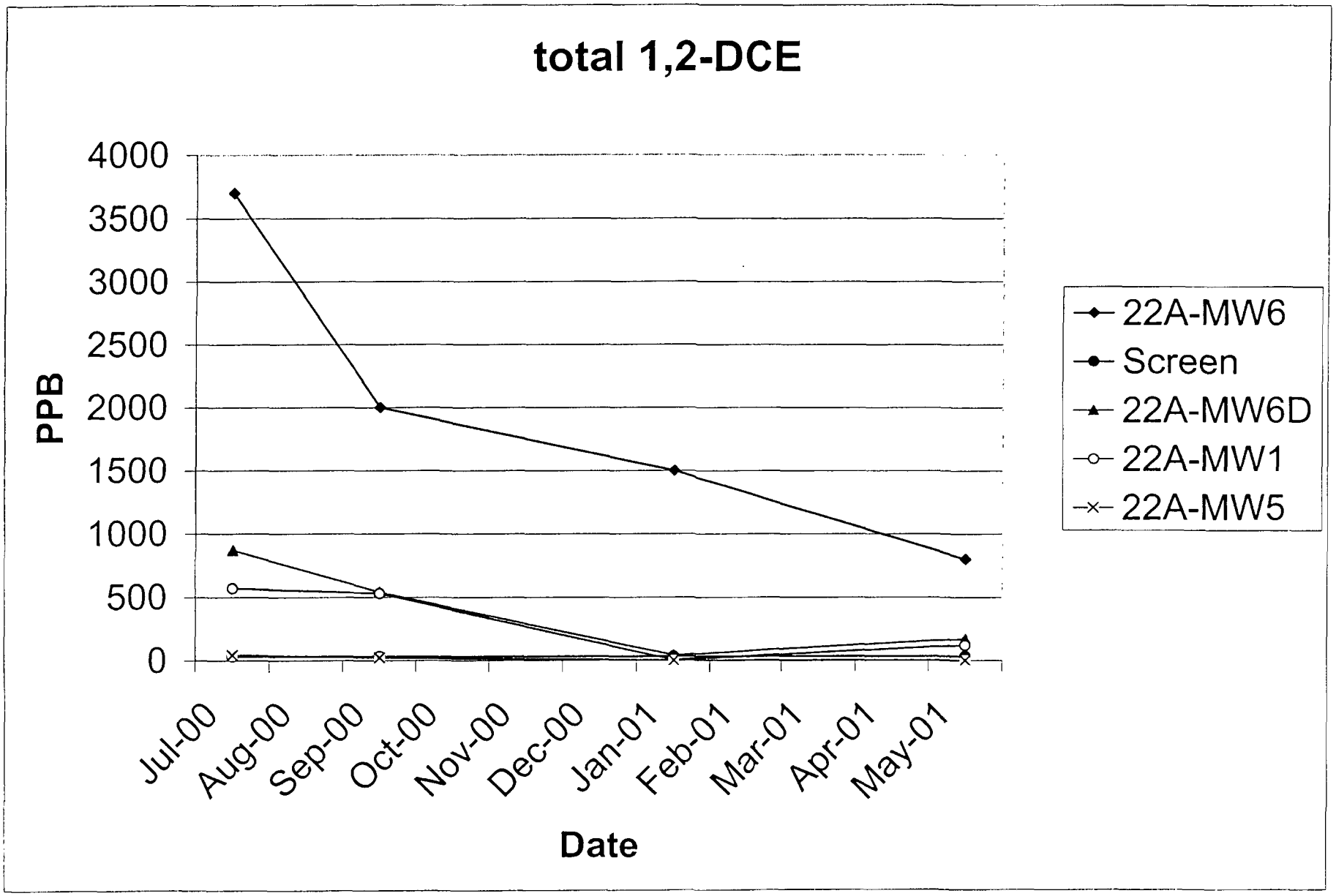

Barium
600
500
400
300
200
100
0
PPB
Jul-00
Aug-00
Sep-00
Oct-00
Nov-00
Dec-00
Jan-01
Feb-01
Mar-01
Apr-01
May-01
Date
22A-MW6
Screen
22A-MW6D
22A-MW5
22A-MW4
22A-MW3
22A-MW2
22A-MW1

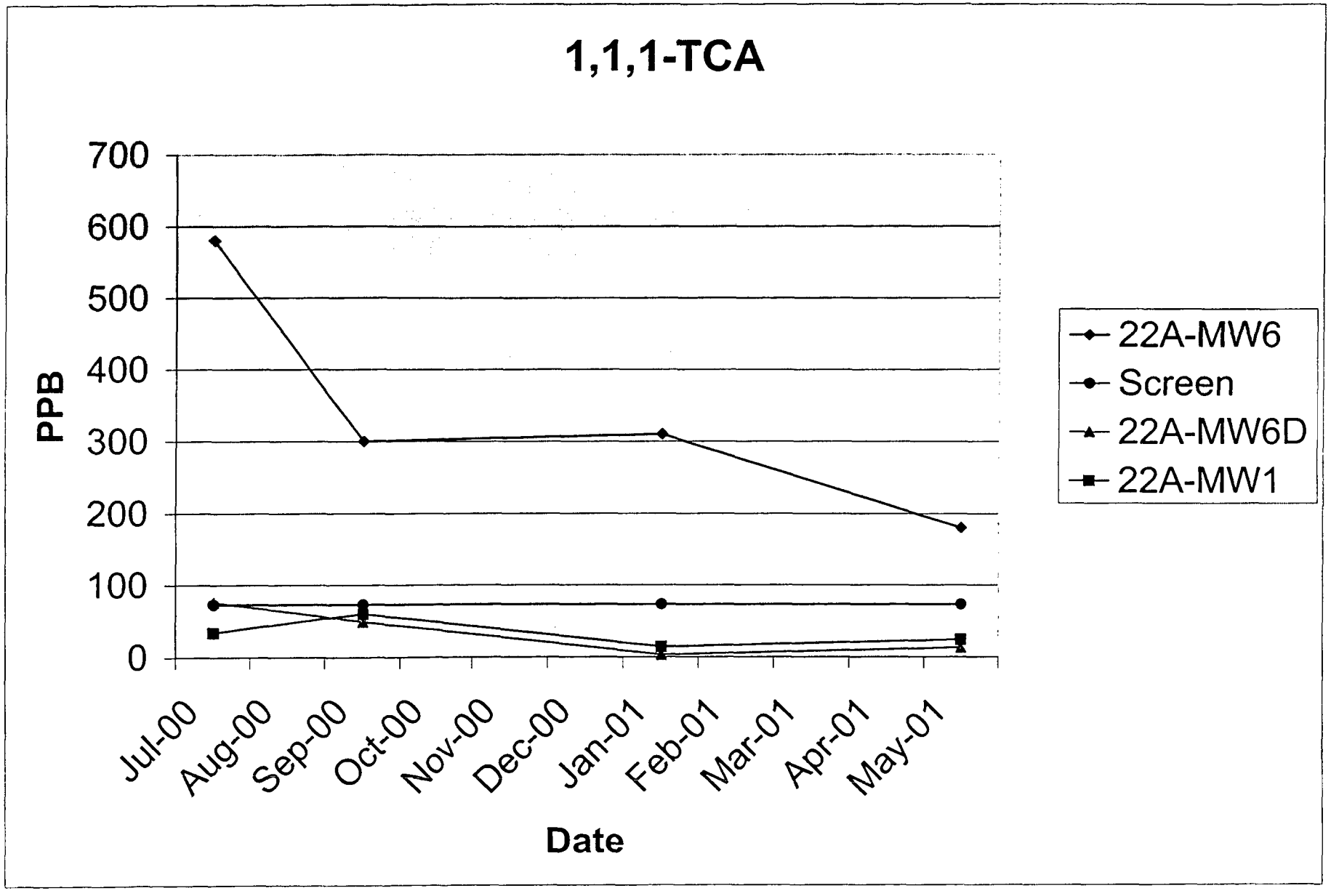

Benzene
PPB
9
8
7
6
5
4
3
2
1
0
Jul-00
Aug-00
Sep-00
Oct-00
Nov-00
Dec-00
Jan-01
Feb-01
Mar-01
Apr-01
May-01
Date
22A-MW6
Screen
22A-MW6D
22A-MW5
22A-MW2
22A-MW1

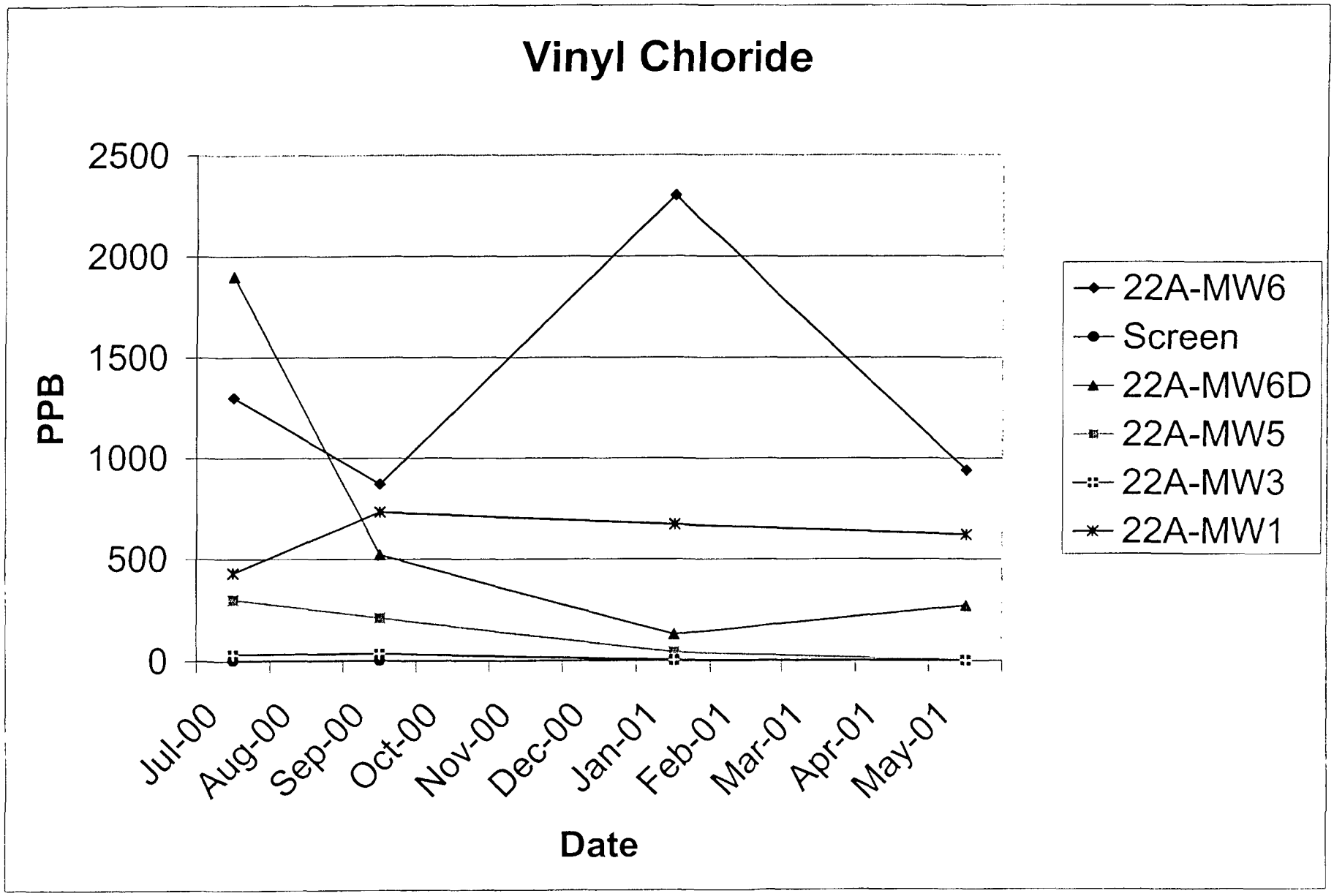

Chloroethane
PPB
180
160
140
120
100
80
60
40
20
0
Jul-00
Aug-00
Sep-00
Oct-00
Nov-00
Dec-00
Jan-01
Feb-01
Mar-01
Apr-01
May-01
Date
22A-MW6
Screen
22A-MW6D
22A-MW5
22A-MW2
22A-MW1


1,1-DCE
PPB
70
60
50
40
30
20
10
0
Jun-00
Jul-00
Aug-00
Sep-00
Oct-00
Nov-00
Dec-00
Jan-01
Feb-01
Mar-01
Apr-01
May-01
Date
22A-MW6
Screen
22A-MW6D


1,1-DCA
2500
2000
1500
1000
500
0
PPB
Jul-00
Aug-00
Sep-00
Oct-00
Nov-00
Dec-00
Jan-01
Feb-01
Mar-01
Apr-01
May-01
Date
22A-MW6
Screen
22A-MW6D
22A-MW5
22A-MW3
22A-MW1


total 1,2-DCE
PPB
4000
3500
3000
2500
2000
1500
1000
500
0
Jul-00
Aug-00
Sep-00
Oct-00
Nov-00
Dec-00
Jan-01
Feb-01
Mar-01
Apr-01
May-01
Date
22A-MW6
Screen
22A-MW6D
22A-MW1
22A-MW5

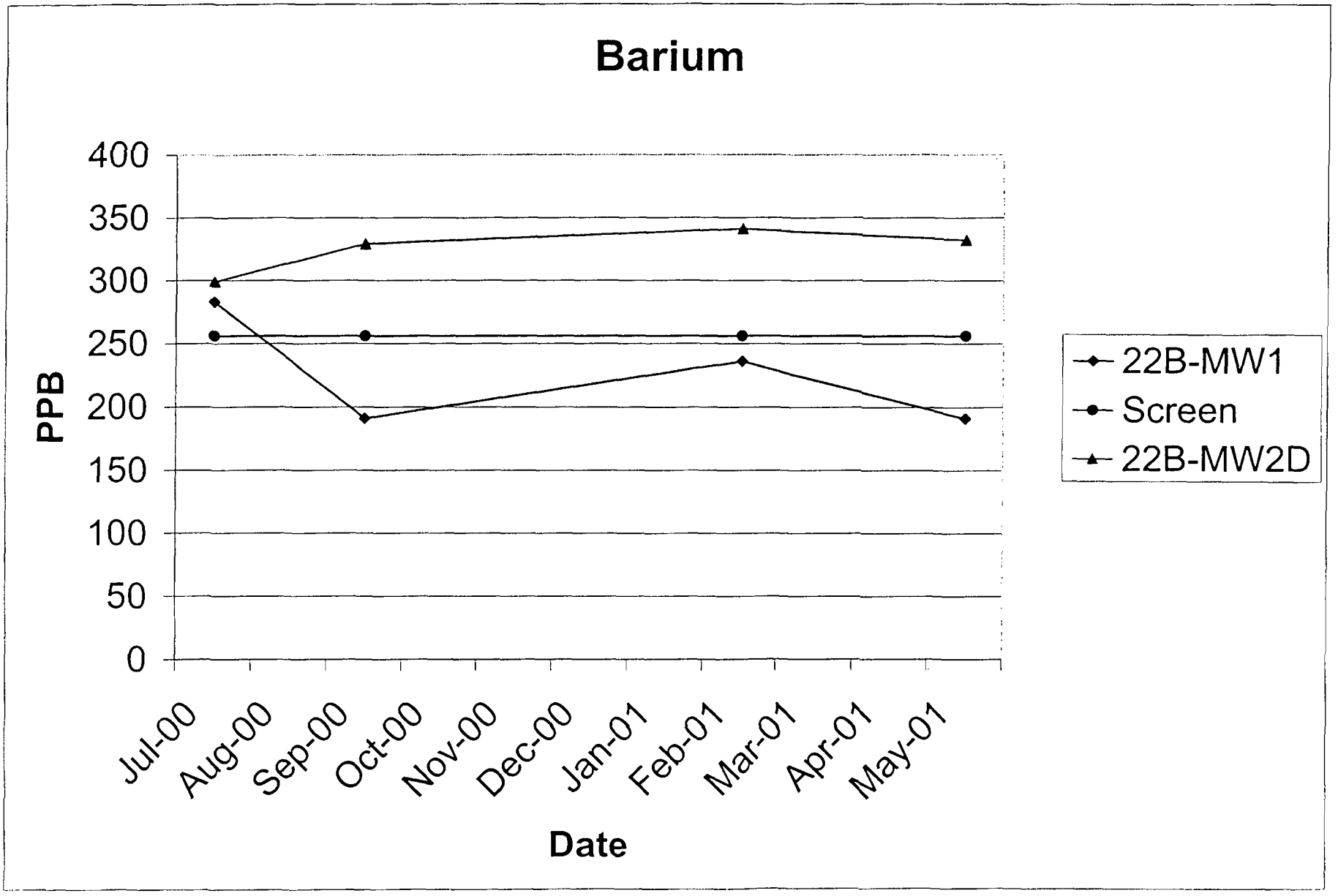

1,1,1-TCA
700
600
500
400
300
200
100
0
PPB
Jul-00
Aug-00
Sep-00
Oct-00
Nov-00
Dec-00
Jan-01
Feb-01
Mar-01
Apr-01
May-01
Date
22A-MW6
Screen
22A-MW6D
22A-MW1

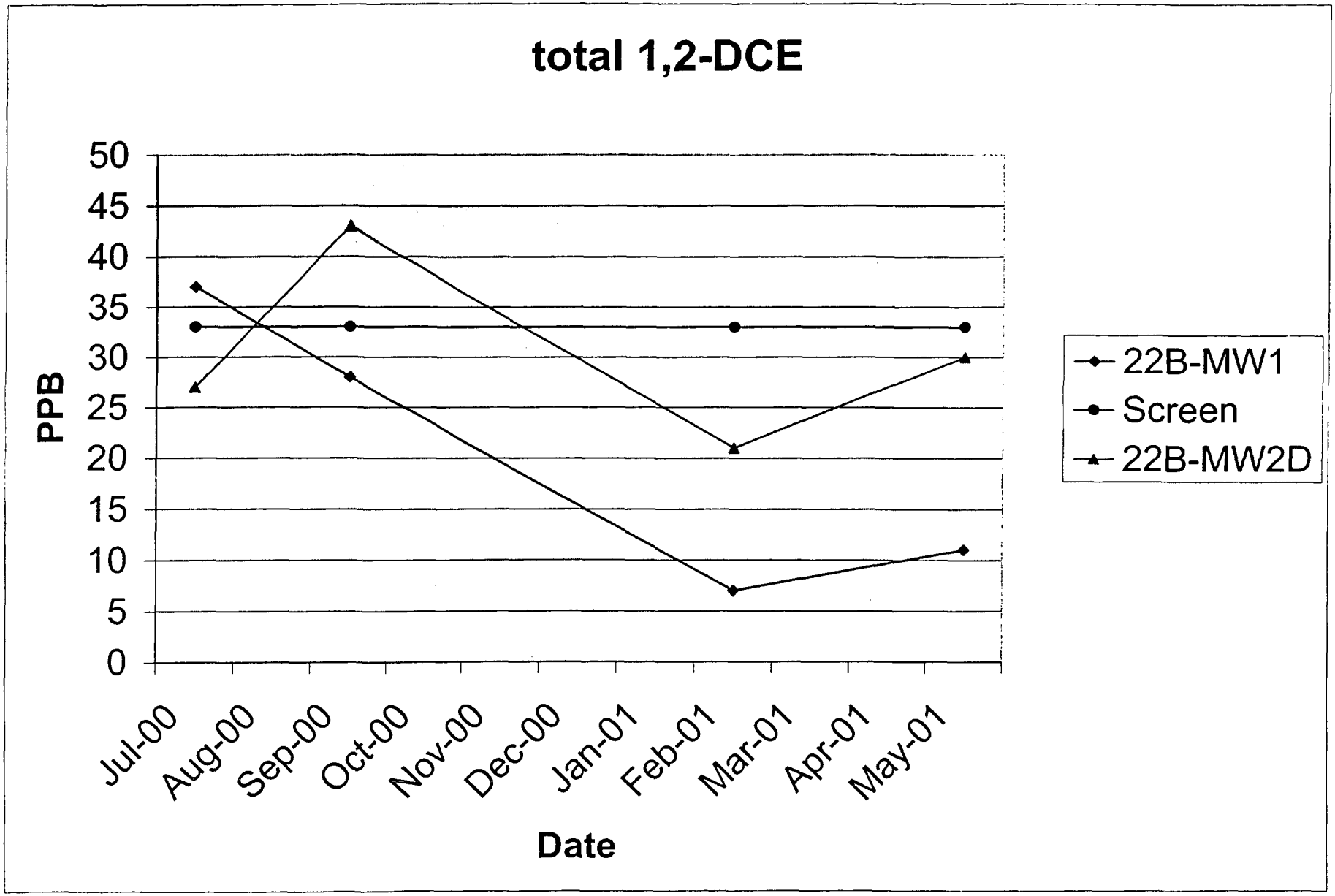

Vinyl Chloride
2500
2000
1500
1000
500
0
PPB
Jul-00
Aug-00
Sep-00
Oct-00
Nov-00
Dec-00
Jan-01
Feb-01
Mar-01
Apr-01
May-01
Date
22A-MW6
Screen
22A-MW6D
22A-MW5
22A-MW3
22A-MW1

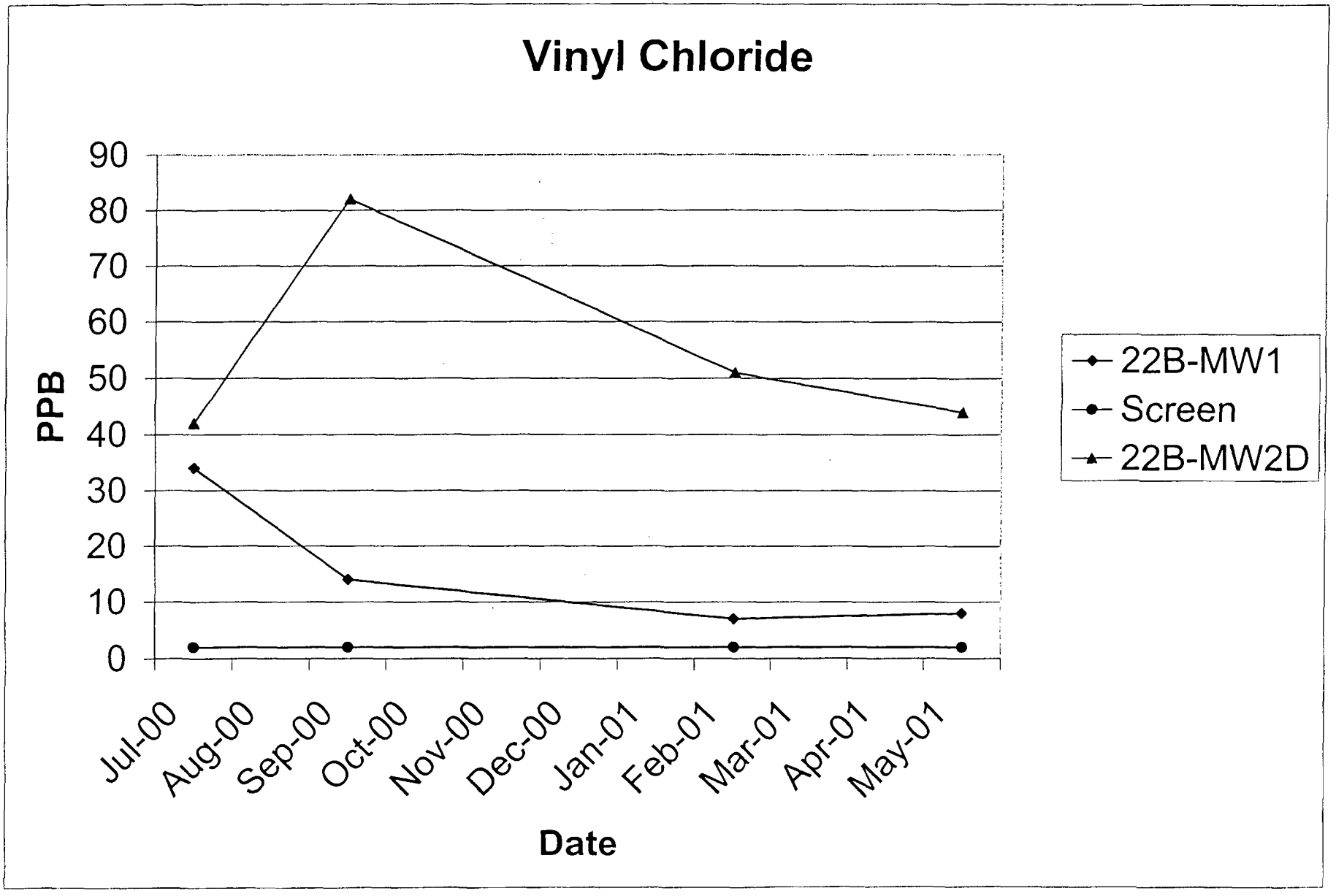
# AOI-22B

| ParameterName | Screen Level | AOI | 22B | 22B | 22B | 22B | 22B | 22B | 22B | 22B |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Location | 22B-MW1 | 22B-MW1 | 22B-MW1 | 22B-MW1 | 22B-MW2D | 22B-MW2D | 22B-MW2D | 22B-MW2D |
| | | Depth (ft) | 10 | 10 | 10 | 10 | 12 | 12 | 12 | 12 |
| | | Date | 07/12/00 | 09/27/00 | 02/01/01 | 05/09/01 | 07/12/00 | 09/24/00 | 02/01/01 | 05/09/01 |
| | | Units | | | | | | | | |
| Arsenic | 4.5 | ug/L | 1.9 J | < 4.4 | < 5.2 | < 1.6 | < 20 | < 7 | < 5.2 | **6.4 J** |
| **Barium** | **256** | **ug/L** | ***283*** | ***191*** | ***236*** | ***191*** | ***299*** | ***329*** | ***341*** | ***332*** |
| Cadmium | 3.7 | ug/L | < 5 | < 0.16 | < 0.15 J | 0.33 J | < 5 | < 0.17 | < 0.15 J | 0.67 J |
| Selenium | 18 | ug/L | < 5.5 | < 3.7 | **46.3** | < 1.8 | < 3.6 | < 2.1 | 16.4 J | < 1.8 |
| 2-Methylnaphthalene | 110 | ug/L | < 2 J | < 2 | < 2 | < 2 | < 1 J | < 2 R | < 2 | < 1 |
| Acenaphthene | 219 | ug/L | 2 | 0.4 J | 0.7 J | 0.9 J | 0.7 J | 0.3 J | 0.1 J | 0.3 J |
| Benzo(a)anthracene | 9.2 | ug/L | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 R | < 2 | < 2 |
| Benzo(a)pyrene | 0.2 | ug/L | < 1 | < 2 | < 2 | < 2 | < 1 | < 2 R | < 2 | < 1 |
| Chrysene | 9.2 | ug/L | < 1 | < 2 | < 2 | < 2 | < 1 | < 2 R | < 2 | < 1 |
| Dibenzo(a,h)anthracene | 0.92 | ug/L | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 R | < 2 | < 2 |
| Naphthalene - SW-846 8270C | 73 | ug/L | < 2 R | < 2 | < 2 | < 2 | < 2 R | < 2 R | < 2 | < 2 |
| Pentachlorophenol | 1 | ug/L | < 1 | < 2 | < 2 J | < 2 | < 1 | < 2 R | 2 J | < 1 |
| Phenanthrene | 110 | ug/L | 0.3 J | 0.2 J | < 2 | < 2 | < 1 | < 2 R | 0.3 J | < 1 |
| 1,1,1-Trichloroethane | 73 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| 1,1,2-Trichloroethane | 1.2 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 R | < 1 | < 1 |
| 1,1-Dichloroethane | 365 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| 1,1-Dichloroethene | 7 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | 0.5 J | < 1 | < 1 |
| 1,2-Dichloroethane | 5 | ug/L | < 6 | < 1 | < 1 | < 1 | < 6 | < 1 R | < 1 | < 1 |
| **1,2-Dichloroethene (total)** | **33** | **ug/L** | ***37*** | ***28*** | ***7*** | ***11*** | ***27*** | ***43*** | ***21*** | ***30*** |
| Benzene | 2.3 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | 0.6 J | < 1 | 0.7 J |
| Chloroethane (Ethyl chloride) | 23 | ug/L | < 5 | < 1 | < 2 | < 2 | < 5 | < 1 | < 2 | < 2 |
| Chloromethane (Methyl chloride) | 5.2 | ug/L | < 5 | < 1 | < 2 | < 2 | < 5 | < 1 R | < 2 | < 2 |
| Ethylbenzene | 365 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| Trichloroethene | 6.1 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 R | < 1 | < 1 |
| **Vinyl chloride** | **2** | **ug/L** | ***34*** | ***14*** | ***7*** | ***8*** | ***42*** | ***82*** | ***51*** | ***44*** |

Note: Screening level exceedences are in bold.
The bolded italic data are graphed.
"Screen" label on graphs = screening level


Barium
400
350
300
250
200
150
100
50
0
PPB
Jul-00
Aug-00
Sep-00
Oct-00
Nov-00
Dec-00
Jan-01
Feb-01
Mar-01
Apr-01
May-01
Date
22B-MW1
Screen
22B-MW2D


total 1,2-DCE
PPB
50
45
40
35
30
25
20
15
10
5
0
Jul-00
Aug-00
Sep-00
Oct-00
Nov-00
Dec-00
Jan-01
Feb-01
Mar-01
Apr-01
May-01
Date
22B-MW1
Screen
22B-MW2D


Vinyl Chloride
PPB
90
80
70
60
50
40
30
20
10
0
Jul-00
Aug-00
Sep-00
Oct-00
Nov-00
Dec-00
Jan-01
Feb-01
Mar-01
Apr-01
May-01
Date
22B-MW1
Screen
22B-MW2D

# AOI-26

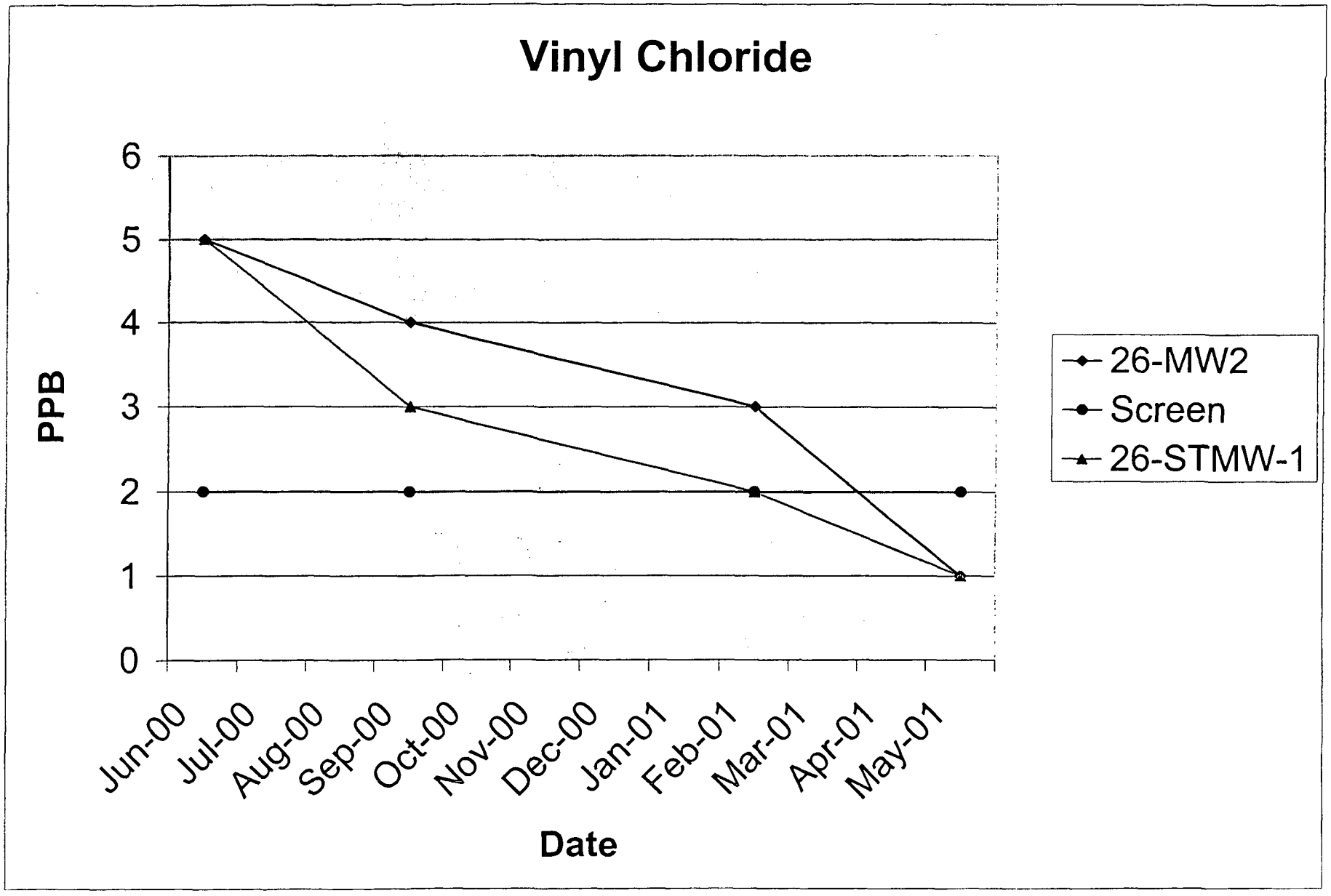
| ParameterName | Screen Level | AOI | 26 | 26 | 26 | 26 | 26 | 26 |
|---|---|---|---|---|---|---|---|---|
| | | Location | 26-MW1 | 26-MW1 | 26-MW1 | 26-MW1 | 26-MW2 | 26-MW2 |
| | | Depth (ft) | 8 | 8 | 8 | 8 | 9.5 | 9.5 |
| | | Date | 06/22/00 | 09/25/00 | 02/01/01 | 05/07/01 | 06/29/00 | 09/24/00 |
| | | Units | | | | | | |
| Arsenic | 4.5 | ug/L | < 20 | < 1.8 | < 5.2 | < 1.6 | < 20 | < 1.8 |
| **Barium** | **256** | **ug/L** | ***203*** | ***190*** | ***226*** | ***337*** | ***282*** | ***288*** |
| Cadmium | 3.7 | ug/L | < 0.22 J | < 0.17 | < 0.15 J | 2.4 J | < 5 | < 0.17 |
| Selenium | 18 | ug/L | < 40 | 2.4 J | < 14.5 | < 1.8 | < 40 | < 2.1 |
| 2-Methylnaphthalene | 110 | ug/L | < 2 | < 2 R | < 2 | < 1 | < 1 | < 2 R |
| Acenaphthene | 219 | ug/L | < 2 | < 2 R | < 2 | < 1 | < 1 | < 2 R |
| Benzo(a)anthracene | 9.2 | ug/L | < 2 | < 2 R | < 2 | < 2 | < 2 | < 2 R |
| Benzo(a)pyrene | 0.2 | ug/L | < 2 | < 2 R | < 2 | < 1 | < 1 | < 2 R |
| Chrysene | 9.2 | ug/L | < 2 | < 2 R | < 2 | < 1 | < 1 | < 2 R |
| Dibenzo(a,h)anthracene | 0.92 | ug/L | < 2 | < 2 R | < 2 | < 2 | < 2 | < 2 R |
| Naphthalene - SW-846 8270C | 73 | ug/L | < 2 | < 2 R | < 2 | < 2 | < 2 | < 2 R |
| Pentachlorophenol | 1 | ug/L | < 2 | < 2 R | < 2 J | < 1 | < 1 | < 2 R |
| Phenanthrene | 110 | ug/L | < 2 | < 2 R | < 2 | < 1 | < 1 | < 2 R |
| 1,1,1-Trichloroethane | 73 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 |
| 1,1,2-Trichloroethane | 1.2 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 |
| 1,1-Dichloroethane | 365 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 |
| 1,1-Dichloroethene | 7 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 |
| 1,2-Dichloroethane | 5 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 |
| 1,2-Dichloroethene (total) | 33 | ug/L | < 10 | 0.6 | < 2 | < 2 | < 10 | 0.7 |
| Benzene | 2.3 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 |
| Chloroethane (Ethyl chloride) | 23 | ug/L | < 10 | < 1 | < 2 | < 2 | < 10 J | < 1 |
| Chloromethane (Methyl chloride) | 5.2 | ug/L | < 10 J | < 1 | < 2 | < 2 | < 10 J | < 1 |
| Ethylbenzene | 365 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 |
| Trichloroethene | 6.1 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 |
| **Vinyl chloride** | **2** | ug/L | < 10 J | 0.5 J | < 2 | 0.5 J | ***5*** | ***4*** |

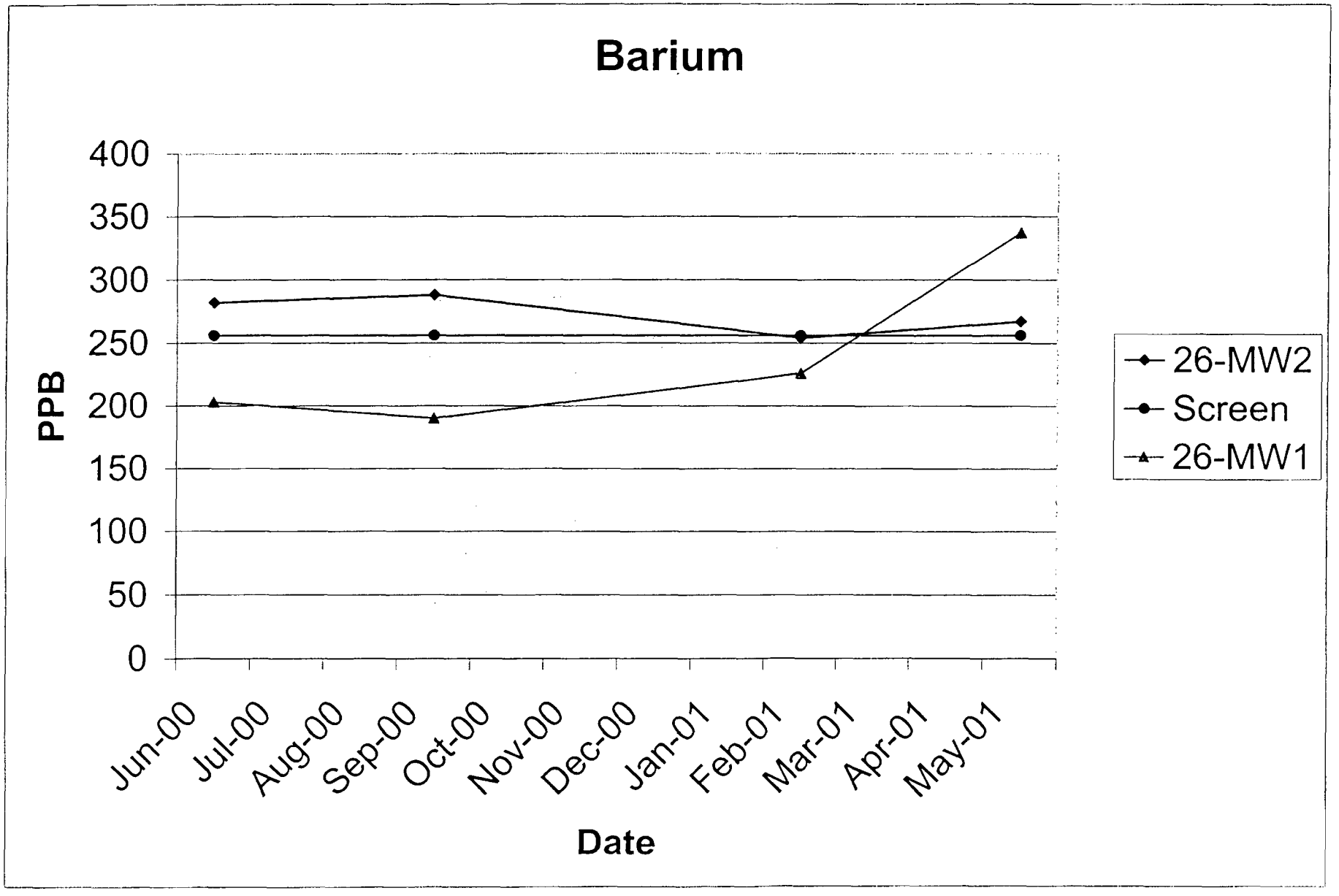
Note: Screening level exceedences are in bold.
The bolded italic data are graphed.
"Screen" label on graphs = screening level concentration

# AOI-26

| ParameterName | Screen Level | AOI | 26 | 26 | 26 | 26 | 26 | 26 |
|---|---|---|---|---|---|---|---|---|
| | | Location | 26-MW2 | 26-MW2 | 26-STMW-1 | 26-STMW-1 | 26-STMW-1 | 26-STMW-1 |
| | | Depth (ft) | 9.5 | 9.5 | 8 | 8 | 8 | 8 |
| | | Date | 02/01/01 | 05/07/01 | 06/22/00 | 09/24/00 | 02/01/01 | 05/07/01 |
| | | Units | | | | | | |
| Arsenic | 4.5 | ug/L | < 5.2 | < 1.6 | 4.1 J | **11.6 J** | < 5.2 | 2.5 J |
| **Barium** | **256** | **ug/L** | ***254*** | ***267*** | 164 | **270** | 204 | 135 J |
| Cadmium | 3.7 | ug/L | < 0.15 J | 3 J | < 0.22 J | 0.33 J | < 0.15 J | 4.1 J |
| Selenium | 18 | ug/L | < 14.5 | < 1.8 | < 40 | < 2.1 | < 14.5 | < 1.8 |
| 2-Methylnaphthalene | 110 | ug/L | < 2 | < 1 | < 2 | < 2 R | < 2 | < 1 |
| Acenaphthene | 219 | ug/L | < 2 | 0.2 J | < 2 | < 2 R | < 2 | < 1 |
| Benzo(a)anthracene | 9.2 | ug/L | < 2 | < 2 | < 2 | < 2 R | < 2 | < 2 |
| Benzo(a)pyrene | 0.2 | ug/L | < 2 | < 1 | < 2 | < 2 R | < 2 | < 1 |
| Chrysene | 9.2 | ug/L | < 2 | < 1 | < 2 | < 2 R | < 2 | < 1 |
| Dibenzo(a,h)anthracene | 0.92 | ug/L | < 2 | < 2 | < 2 | < 2 R | < 2 | < 2 |
| Naphthalene - SW-846 8270C | 73 | ug/L | < 2 | < 2 | < 2 | < 2 R | < 2 | < 2 |
| Pentachlorophenol | 1 | ug/L | < 2 J | < 1 | < 2 | < 2 R | < 2 J | < 1 |
| Phenanthrene | 110 | ug/L | < 2 | < 1 | < 2 | < 2 R | < 2 | < 1 |
| 1,1,1-Trichloroethane | 73 | ug/L | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| 1,1,2-Trichloroethane | 1.2 | ug/L | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| 1,1-Dichloroethane | 365 | ug/L | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| 1,1-Dichloroethene | 7 | ug/L | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| 1,2-Dichloroethane | 5 | ug/L | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| 1,2-Dichloroethene (total) | 33 | ug/L | 0.5 J | < 2 | < 10 | 1 | 0.6 J | < 2 |
| Benzene | 2.3 | ug/L | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| Chloroethane (Ethyl chloride) | 23 | ug/L | < 2 | < 2 | < 10 | < 1 | < 2 | < 2 |
| Chloromethane (Methyl chloride) | 5.2 | ug/L | < 2 | < 2 | < 10 J | < 1 | < 2 | < 2 |
| Ethylbenzene | 365 | ug/L | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| Trichloroethene | 6.1 | ug/L | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| **Vinyl chloride** | **2** | ug/L | ***3*** | ***1*** | ***5*** | ***3*** | ***2*** | ***1*** |

Note: Screening level exceedences are in bold.
The bolded italic data are graphed.
"Sc[illegible] label on graphs = screening level concentration


Vinyl Chloride
PPB
6
5
4
3
2
1
0
Jun-00
Jul-00
Aug-00
Sep-00
Oct-00
Nov-00
Dec-00
Jan-01
Feb-01
Mar-01
Apr-01
May-01
Date
26-MW2
Screen
26-STMW-1


Barium
400
350
300
250
200
150
100
50
0
PPB
Jun-00
Jul-00
Aug-00
Sep-00
Oct-00
Nov-00
Dec-00
Jan-01
Feb-01
Mar-01
Apr-01
May-01
Date
26-MW2
Screen
26-MW1

# AOI-30

| ParameterName | Screen Level | AOI | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Location | 30-MW1 | 30-MW1 | 30-MW1 | 30-MW1 | 30-MW2 | 30-MW2 | 30-MW2 | 30-MW2 |
| | | Depth (ft) | 9 | 9 | 9 | 9 | 8.5 | 8.5 | 8.5 | 8.5 |
| | | Date | 06/21/00 | 09/25/00 | 02/01/01 | 05/07/01 | 06/21/00 | 09/25/00 | 02/02/01 | 05/08/01 |
| | | Units | | | | | | | | |
| **Arsenic** | **4.5** | ug/L | < 20 | < 4.4 | < 5.2 | < 1.6 | ***9.3*** | ***14.8*** | ***2.6*** | ***7*** |
| **Barium** | **256** | ug/L | 193 | 174 | 105 | 136 J | ***553*** | ***501*** | ***373*** | ***423*** |
| Cadmium | 3.7 | ug/L | < 0.22 J | 0.16 J | < 0.15 J | 1.7 J | < 0.22 J | < 0.16 | < 0.15 J | < 7.5 |
| Selenium | 18 | ug/L | 3.6 J | 4.4 J | 17.1 J | < 1.8 | < 40 | 4.6 J | 16.5 J | 3.8 J |
| 2-Methylnaphthalene | 110 | ug/L | < 3 J | < 2 | < 2 | < 2 | 1 J | 4 | < 2 | < 2 |
| Acenaphthene | 219 | ug/L | < 3 | < 2 | < 2 | < 2 | 3 | 3 | < 2 | 1 J |
| Benzo(a)anthracene | 9.2 | ug/L | < 4 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 |
| Benzo(a)pyrene | 0.2 | ug/L | < 3 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 |
| Chrysene | 9.2 | ug/L | < 3 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 |
| Dibenzo(a,h)anthracene | 0.92 | ug/L | < 5 | < 2 | < 3 | < 2 | < 2 | < 2 | < 3 | < 2 |
| Naphthalene - SW-846 8270C | 73 | ug/L | < 4 J | < 2 | < 2 | < 2 | < 2 | 0.5 J | 1 J | 0.8 J |
| Pentachlorophenol | 1 | ug/L | < 3 | < 2 | < 2 J | < 2 | < 2 R | < 2 | < 2 R | **5** |
| Phenanthrene | 110 | ug/L | < 3 | < 2 | < 2 | < 2 | < 2 R | 0.4 J | < 2 R | < 2 |
| 1,1,1-Trichloroethane | 73 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| 1,1,2-Trichloroethane | 1.2 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 R |
| 1,1-Dichloroethane | 365 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| 1,1-Dichloroethene | 7 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| 1,2-Dichloroethane | 5 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| **1,2-Dichloroethene (total)** | **33** | ug/L | 3 J | 9 | 3 | 2 | < 10 | 2 | < 2 | < 2 |
| **Benzene** | **2.3** | ug/L | < 5 | 2 | 1 | 2 | < 5 | 2 | 0.9 J | 1 |
| Chloroethane (Ethyl chloride) | 23 | ug/L | < 10 | < 1 | < 2 | < 2 | < 10 | < 1 | < 2 | < 2 |
| Chloromethane (Methyl chloride) | 5.2 | ug/L | < 10 J | < 1 | < 2 | < 2 | < 10 J | < 1 | < 2 | < 2 |
| Ethylbenzene | 365 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| Trichloroethene | 6.1 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| **Vinyl chloride** | **2** | ug/L | ***21*** | ***45*** | ***46*** | ***26*** | < 10 J | < 1 | < 2 | 0.5 J |

Note: Screening level exceedences are in bold.
The bolded italic data are graphed.
"Screen" label on graphs = screening level concentration

# AOI-30

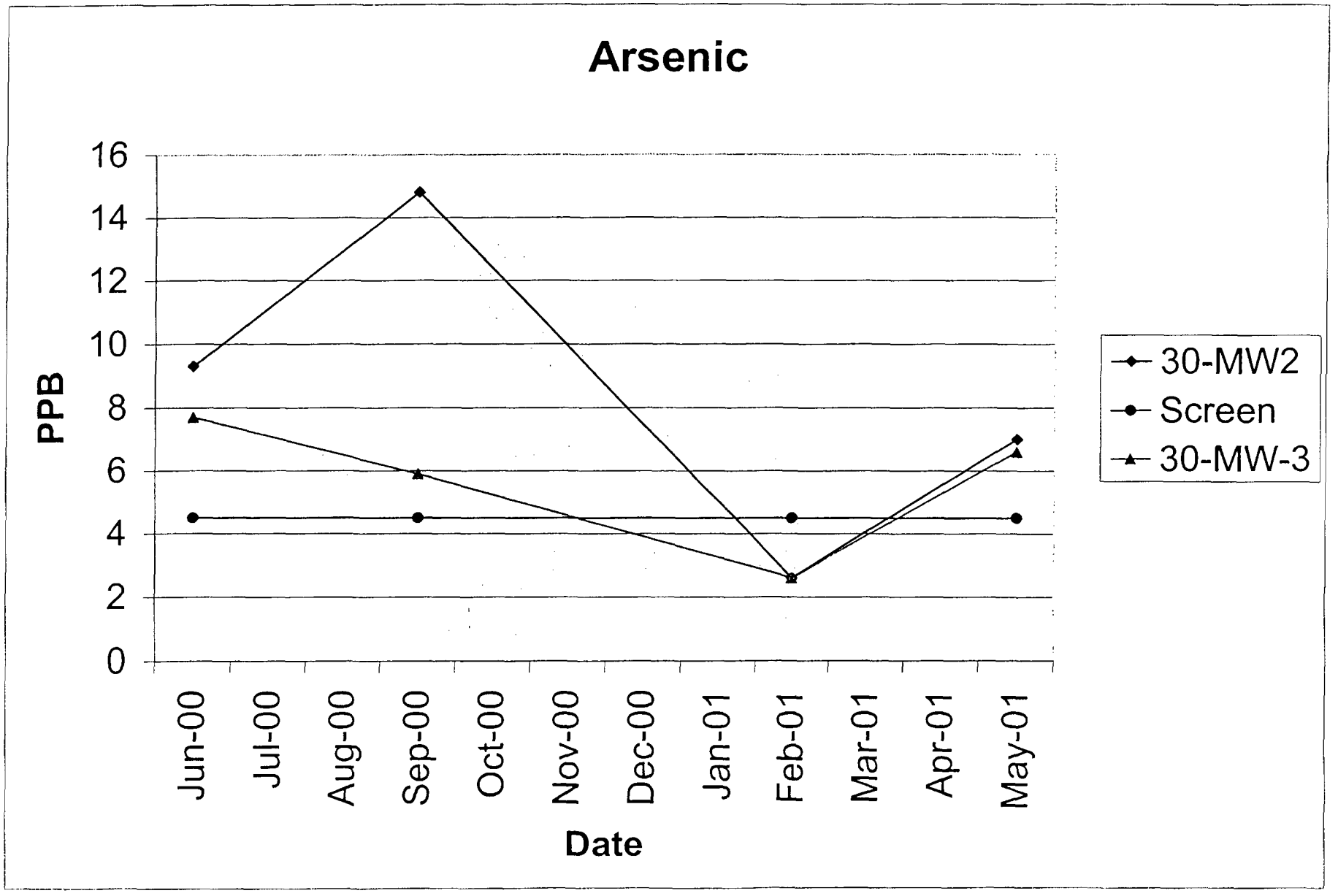
| ParameterName | Screen Level | AOI | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Location | 30-MW-3 | 30-MW-3 | 30-MW-3 | 30-MW-3 | 30-MW4 | 30-MW4 | 30-MW4 | 30-MW4 |
| | | Depth (ft) | 10.5 | 10.5 | 10.5 | 8 | 11 | 11 | 11 | 11 |
| | | Date | 06/22/00 | 09/25/00 | 02/02/01 | 05/08/01 | 06/21/00 | 09/25/00 | 02/01/01 | 05/07/01 |
| | | Units | | | | | | | | |
| **Arsenic** | **4.5** | ug/L | ***7.7*** | ***5.9*** | ***2.6*** | ***6.6*** | < 20 | < 4.4 | < 5.2 | < 1.6 |
| **Barium** | **256** | ug/L | ***504*** | ***473*** | ***468*** | ***647*** | ***564*** | ***603*** | ***616*** | ***560*** |
| Cadmium | 3.7 | ug/L | < 0.22 J | < 0.16 | < 0.15 J | 2.6 J | < 0.22 J | < 0.16 | < 0.15 J | 1.7 J |
| Selenium | 18 | ug/L | < 40 | 4.3 J | < 14.5 | < 1.8 | < 40 | < 3.7 | 17.1 J | 1.9 J |
| 2-Methylnaphthalene | 110 | ug/L | < 2 | 3 | 29 | < 2 | < 2 | < 2 | 9 | 10 |
| Acenaphthene | 219 | ug/L | 0.5 J | 0.6 J | 0.5 J | < 2 | < 2 | < 2 | 3 | 4 |
| Benzo(a)anthracene | 9.2 | ug/L | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 |
| Benzo(a)pyrene | 0.2 | ug/L | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 |
| Chrysene | 9.2 | ug/L | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 |
| Dibenzo(a,h)anthracene | 0.92 | ug/L | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 |
| Naphthalene - SW-846 8270C | 73 | ug/L | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 |
| Pentachlorophenol | 1 | ug/L | < 2 | < 2 | **1 J** | **5** | < 2 | < 2 | < 2 J | < 2 |
| Phenanthrene | 110 | ug/L | < 2 | < 2 | 0.2 J | < 2 | < 2 | < 2 | 0.3 J | 0.4 J |
| 1,1,1-Trichloroethane | 73 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| 1,1,2-Trichloroethane | 1.2 | ug/L | < 5 | < 1 | < 1 | < 1 R | < 5 | < 1 | < 1 | < 1 |
| 1,1-Dichloroethane | 365 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| 1,1-Dichloroethene | 7 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| 1,2-Dichloroethane | 5 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| **1,2-Dichloroethene (total)** | **33** | ug/L | < 10 | 2 | < 2 | < 2 | < 10 | 2 | < 2 | < 2 |
| **Benzene** | **2.3** | ug/L | ***9*** | ***9*** | ***8*** | ***9*** | < 5 | < 1 | < 1 | 0.8 J |
| Chloroethane (Ethyl chloride) | 23 | ug/L | < 10 | < 1 | < 2 | < 2 | < 10 | < 1 | < 2 | < 2 |
| Chloromethane (Methyl chloride) | 5.2 | ug/L | < 10 J | < 1 | < 2 | < 2 | < 10 J | < 1 | < 2 | < 2 |
| Ethylbenzene | 365 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| Trichloroethene | 6.1 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| **Vinyl chloride** | **2** | ug/L | < 10 J | < 1 | < 2 | < 2 | < 10 J | < 1 | 0.7 J | < 2 |

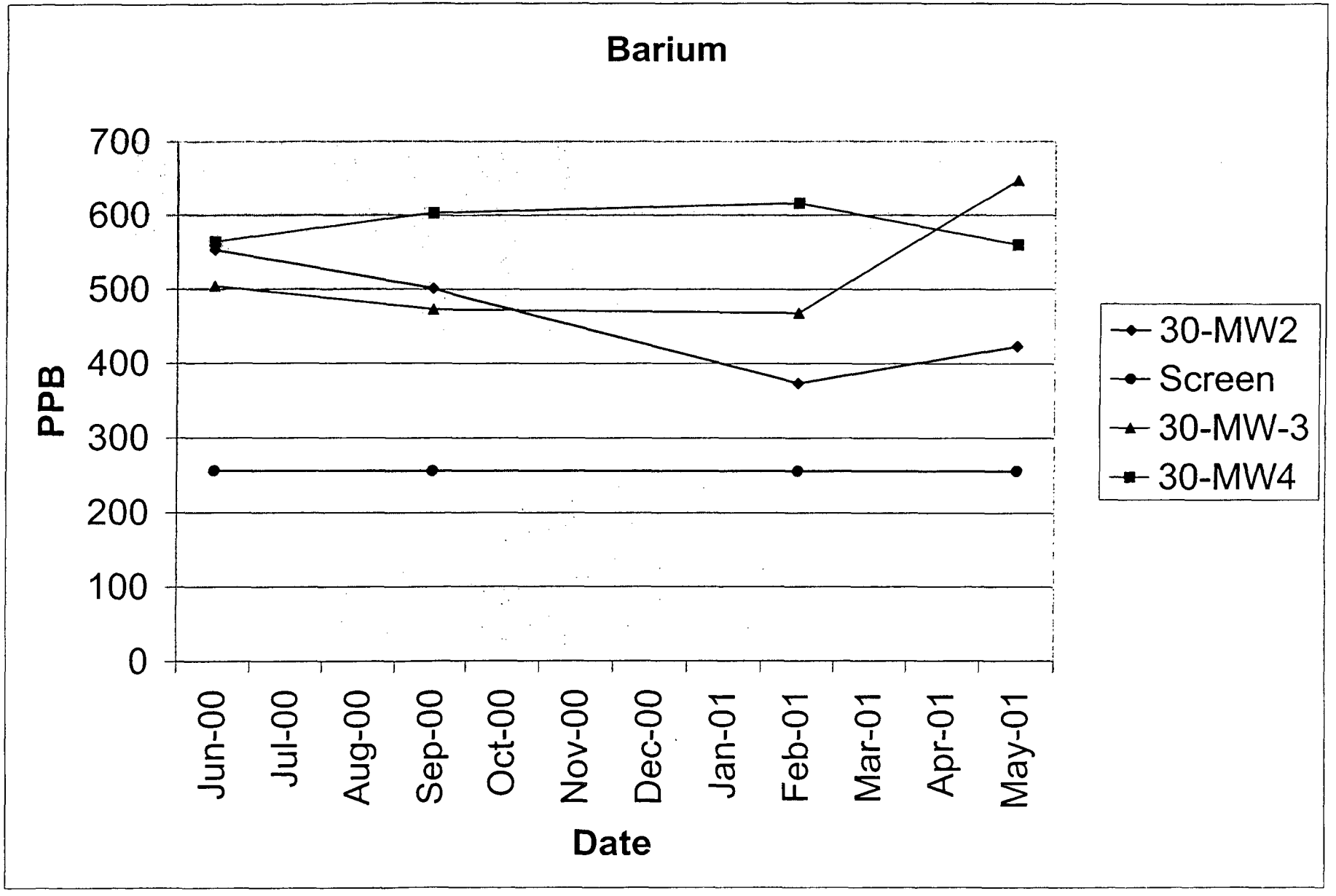
Note: Screening level exceedences are in bold.
The bolded italic data are graphed.
"Scr[illegible] label on graphs = screening level concentration

# AOI-30

| ParameterName | Screen Level | AOI | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Location | 30-MW6D | 30-MW6D | 30-MW6D | 30-MW6D | 30-MW7 | 30-MW7 | 30-MW7 | 30-MW7 |
| | | Depth (ft) | 14.5 | 14.5 | 14.5 | 14.5 | 5.5 | 5.5 | 5.5 | 5.5 |
| | | Date | 06/21/00 | 09/25/00 | 02/01/01 | 05/09/01 | 06/29/00 | 09/24/00 | 02/01/01 | 05/07/01 |
| | | Units | | | | | | | | |
| **Arsenic** | **4.5** | ug/L | < 20 | < 1.8 | < 5.2 | 3.4 J | < 20 | < 1.8 | < 5.2 | < 1.6 |
| **Barium** | **256** | ug/L | 161 | 177 | 190 | 195 J | 126 J | 86.4 | 153 | 225 J |
| Cadmium | 3.7 | ug/L | **5 J** | < 0.17 | < 0.15 J | < 0.29 | < 5 | < 0.17 | < 0.15 J | 1.9 J |
| Selenium | 18 | ug/L | < 40 | 5.8 J | < 14.5 | < 1.8 | < 40 | < 2.1 | **26.5 J** | < 1.8 |
| 2-Methylnaphthalene | 110 | ug/L | < 1.5 | 0.06 R | < 2 | < 2 | < 1 | < 2 R | < 2 | < 1 |
| Acenaphthene | 219 | ug/L | < 1.5 | 0.1 R | < 2 | < 2 | < 1 | < 2 R | < 2 | < 1 |
| Benzo(a)anthracene | 9.2 | ug/L | < 2 | < 2 R | < 2 | < 2 | < 2 | < 2 R | < 2 | < 2 |
| Benzo(a)pyrene | 0.2 | ug/L | < 1.5 | < 2 R | < 2 | < 2 | < 1 | < 2 R | < 2 | < 1 |
| Chrysene | 9.2 | ug/L | < 1.5 | < 2 R | < 2 | < 2 | < 1 | < 2 R | < 2 | < 1 |
| Dibenzo(a,h)anthracene | 0.92 | ug/L | < 2.5 | < 2 R | < 3 | < 2 | < 2 | < 2 R | < 2 | < 2 |
| Naphthalene - SW-846 8270C | 73 | ug/L | < 2 | < 2 R | < 2 | < 2 | < 2 | < 2 R | < 2 | < 2 |
| Pentachlorophenol | 1 | ug/L | < 1.5 | < 2 R | < 2 J | < 2 | < 1 | < 2 R | < 2 J | < 1 |
| Phenanthrene | 110 | ug/L | < 1.5 | < 2 R | < 2 | < 2 | < 1 | < 2 R | < 2 | < 1 |
| 1,1,1-Trichloroethane | 73 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| 1,1,2-Trichloroethane | 1.2 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| 1,1-Dichloroethane | 365 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| 1,1-Dichloroethene | 7 | ug/L | < 5 | 1 | < 1 | 0.8 J | < 5 | < 1 | < 1 | < 1 |
| 1,2-Dichloroethane | 5 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| **1,2-Dichloroethene (total)** | **33** | ug/L | ***160*** | ***160*** | ***49*** | ***50*** | < 10 | 2 | 1 J | 4 |
| **Benzene** | **2.3** | ug/L | ***7*** | ***7*** | ***3*** | ***4*** | < 5 | < 1 | < 1 | 0.8 J |
| Chloroethane (Ethyl chloride) | 23 | ug/L | < 10 | < 1 | < 2 | < 2 | < 10 | < 1 | < 2 | < 2 |
| Chloromethane (Methyl chloride) | 5.2 | ug/L | 10 J | < 1 | < 2 | < 2 | < 10 | < 1 | < 2 | < 2 |
| Ethylbenzene | 365 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| Trichloroethene | 6.1 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| **Vinyl chloride** | **2** | ug/L | ***2000*** | ***810*** | ***430*** | ***310*** | < 10 | < 1 | 2 J | 3 |

Note: Screening level exceedences are in bold.
The bolded italic data are graphed.
"Screen" label on graphs = screening level concentration


Arsenic
PPB
16
14
12
10
8
6
4
2
0
Jun-00
Jul-00
Aug-00
Sep-00
Oct-00
Nov-00
Dec-00
Jan-01
Feb-01
Mar-01
Apr-01
May-01
Date
30-MW2
Screen
30-MW-3


Barium
700
600
500
400
300
200
100
0
PPB
Jun-00
Jul-00
Aug-00
Sep-00
Oct-00
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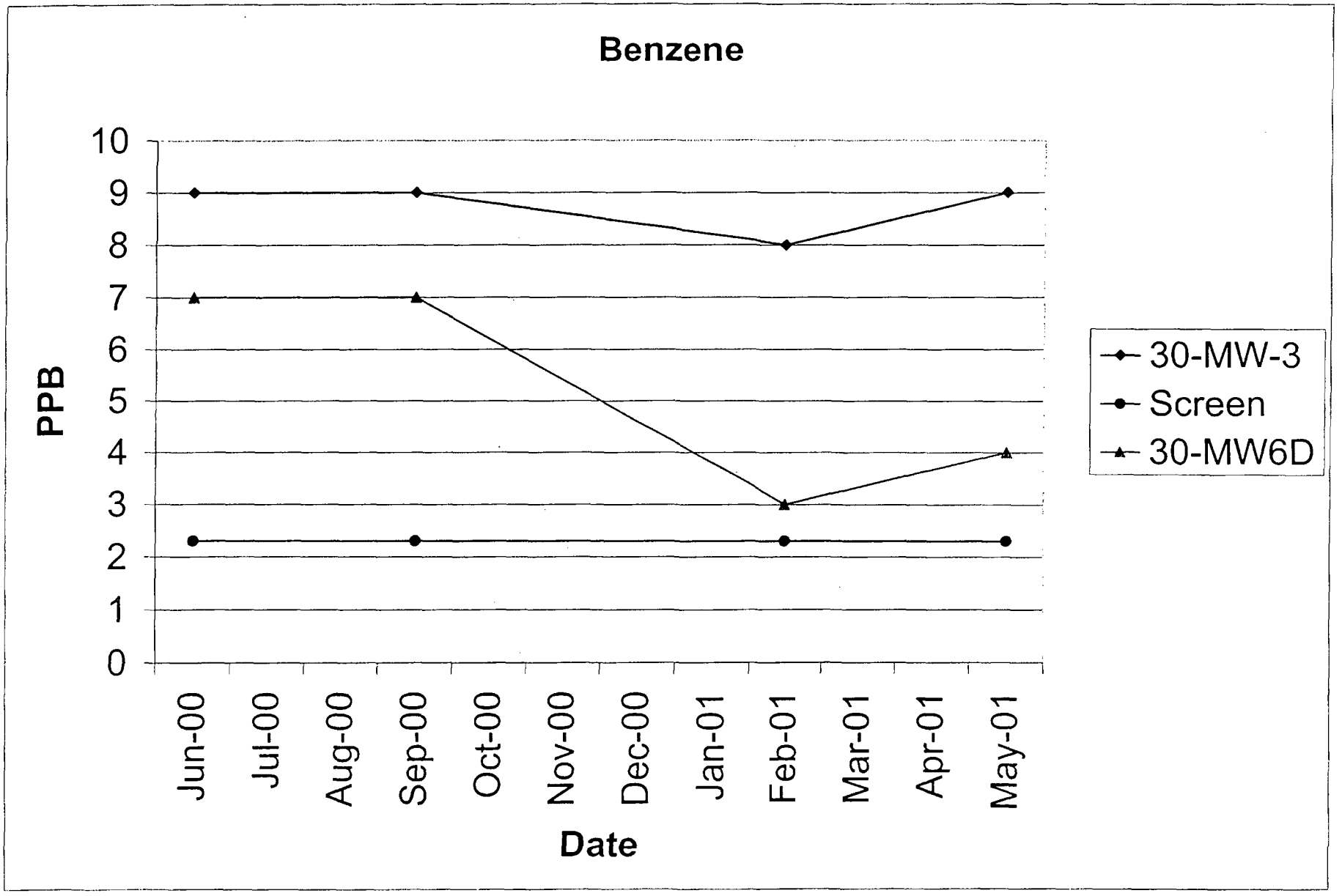
Apr-01
May-01
Date
30-MW2
Screen
30-MW-3
30-MW4


Benzene
PPB
10
9
8
7
6
5
4
3
2
1
0
Jun-00
Jul-00
Aug-00
Sep-00
Oct-00
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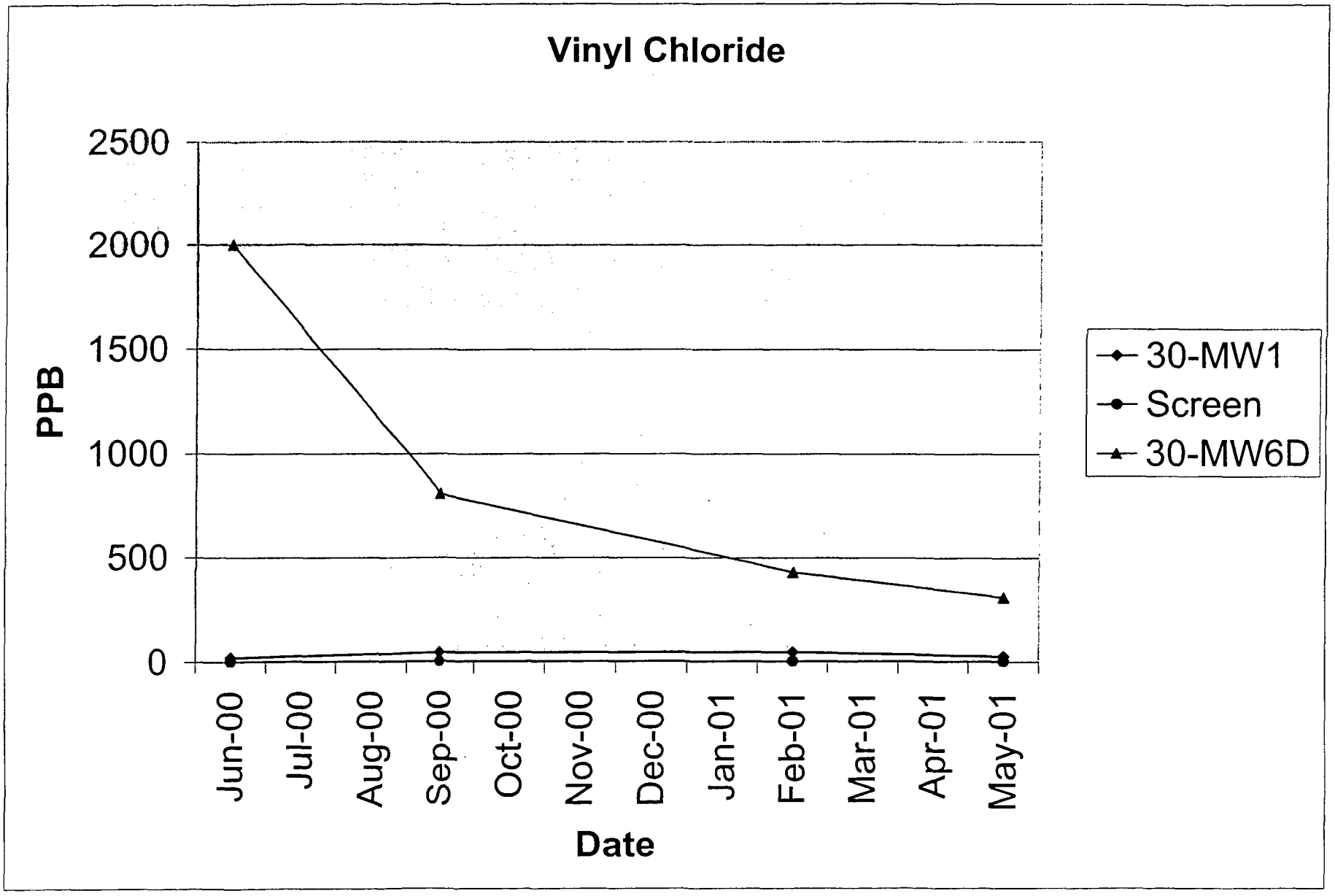
May-01
Date
30-MW-3
Screen
30-MW6D


Vinyl Chloride
PPB
2500
2000
1500
1000
500
0
Jun-00
Jul-00
Aug-00
Sep-00
Oct-00
Nov-00
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Feb-01
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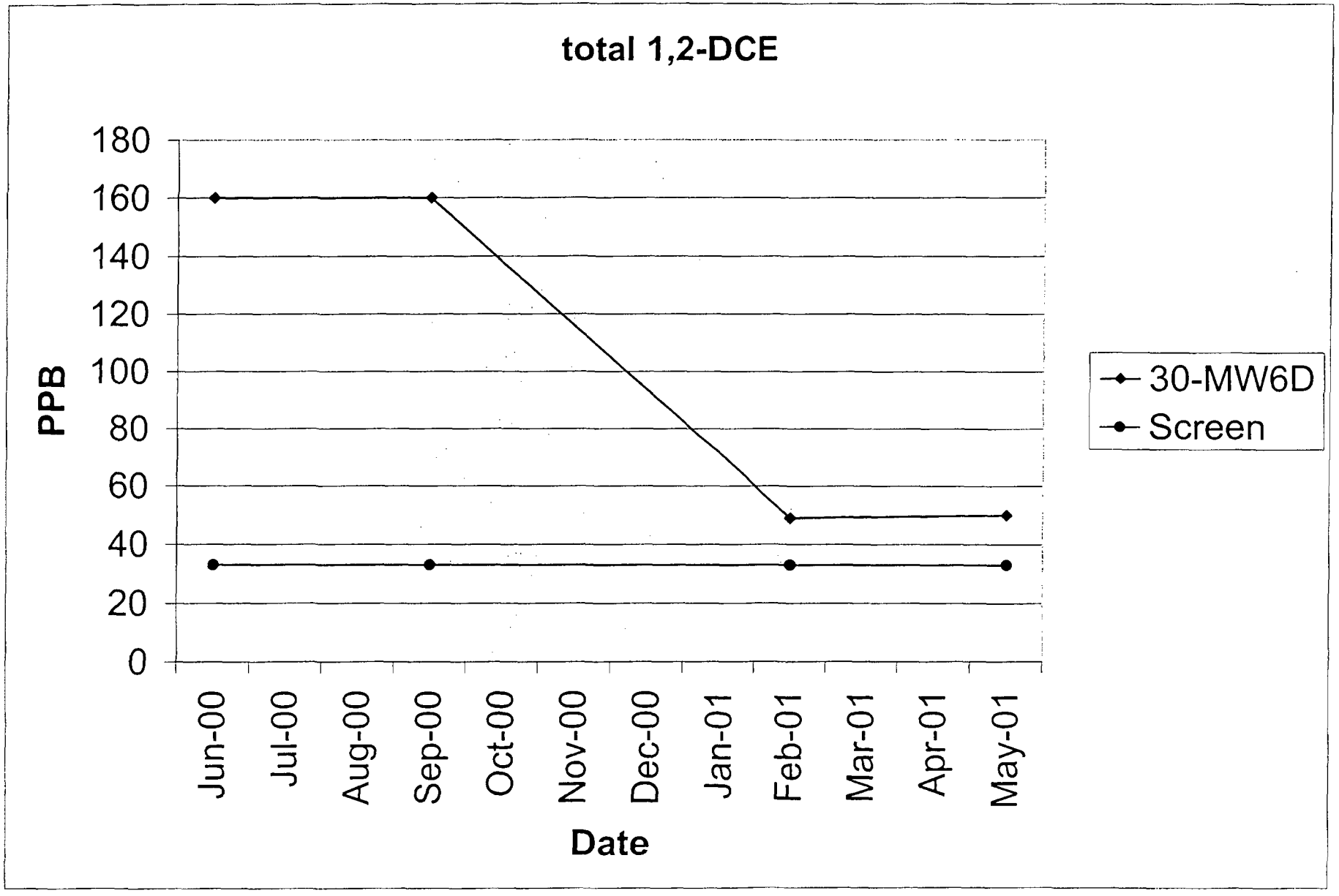
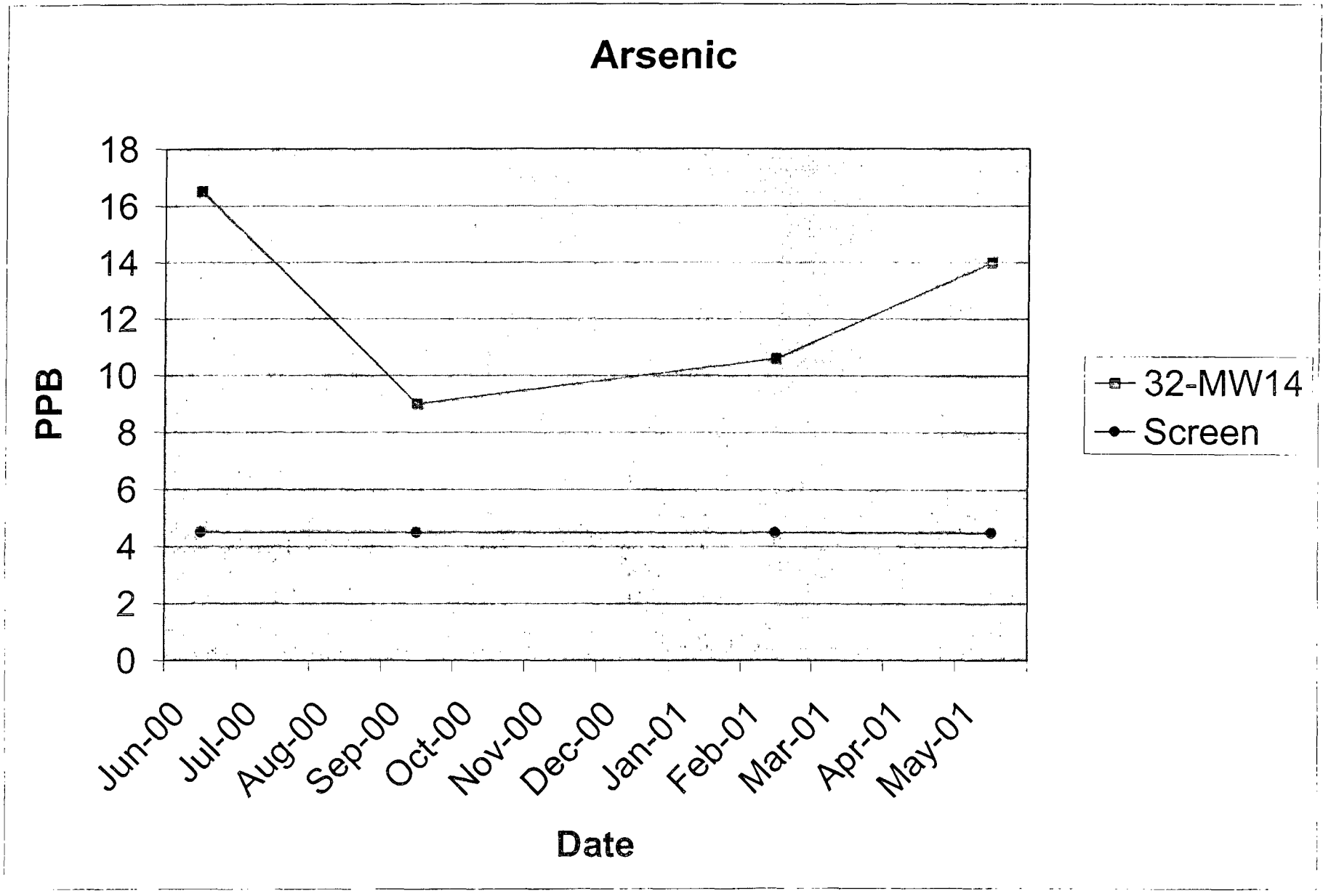
May-01
Date
30-MW1
Screen
30-MW6D

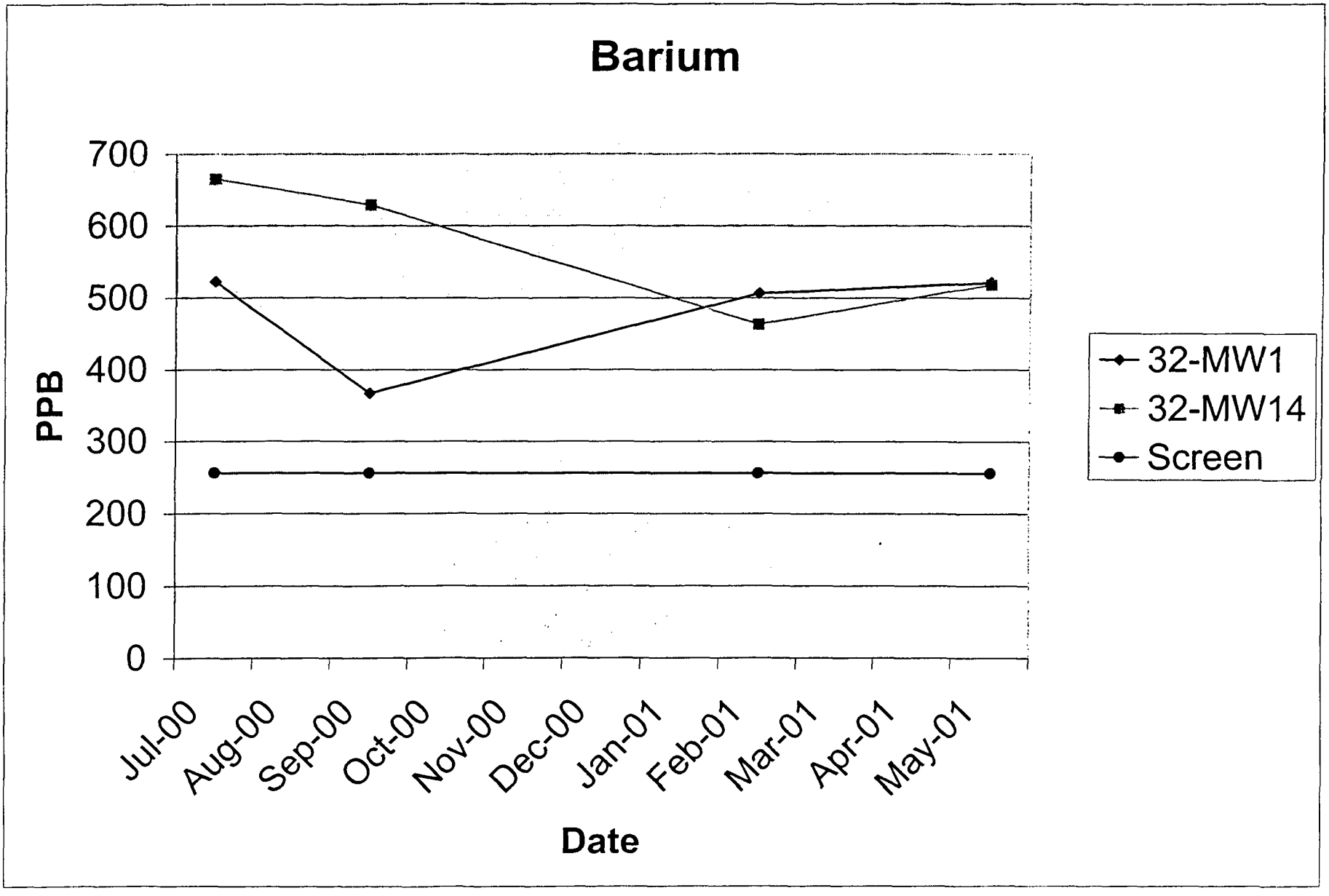

total 1,2-DCE
PPB
180
160
140
120
100
80
60
40
20
0
Jun-00
Jul-00
Aug-00
Sep-00
Oct-00
Nov-00
Dec-00
Jan-01
Feb-01
Mar-01
Apr-01
May-01
Date
30-MW6D
Screen

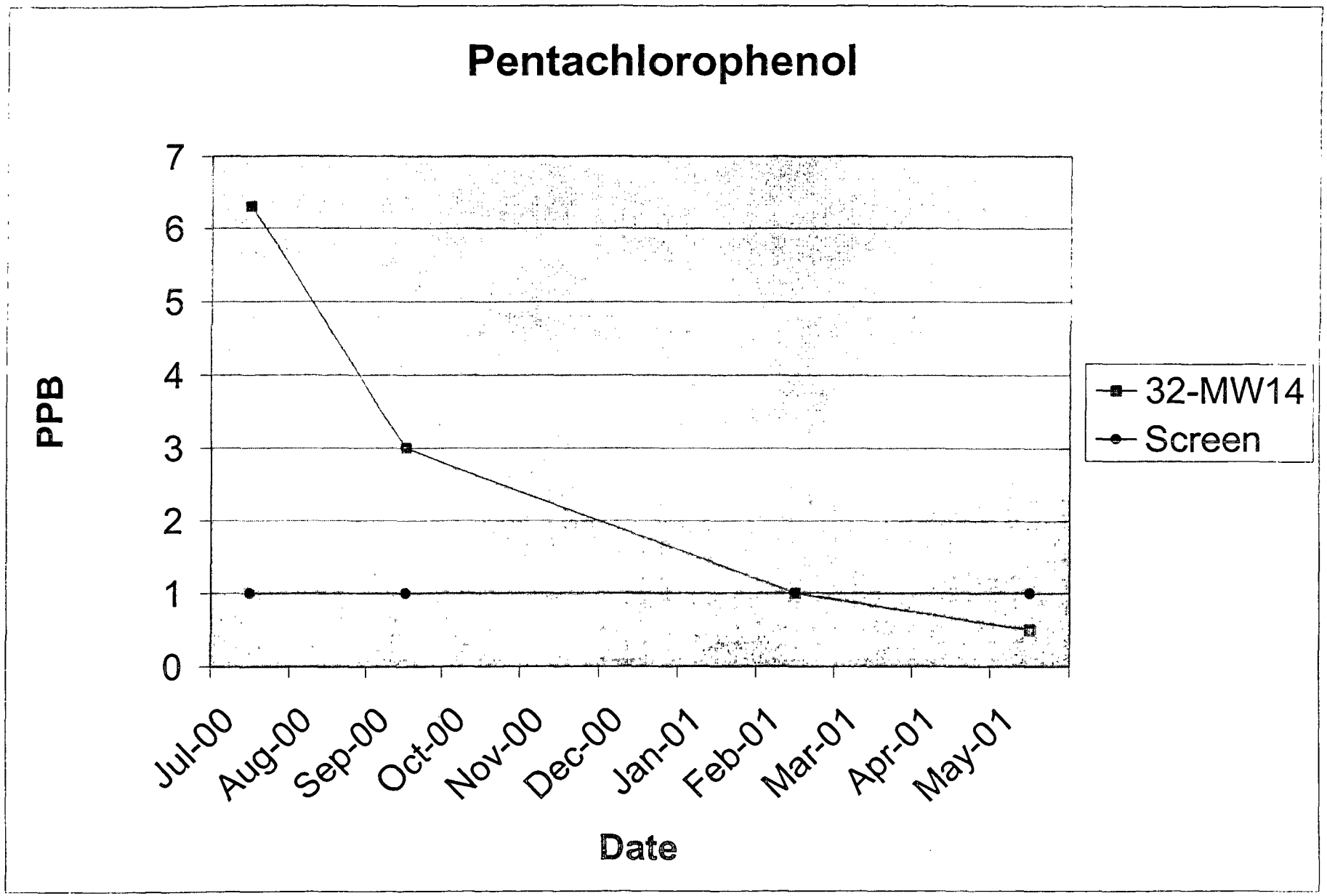
# AOI-32

| ParameterName | Screen Level | AOI | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 32 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Location | 32-MW1 | 32-MW1 | 32-MW1 | 32-MW1 | 32-MW14 | 32-MW14 | 32-MW14 | 32-MW14 |
| | | Depth (ft) | 10.5 | 10.5 | 10.5 | 10.5 | 10 | 10 | 10 | 10 |
| | | Date | 07/10/00 | 09/22/00 | 02/03/01 | 05/09/01 | 06/21/00 | 09/20/00 | 02/03/01 | 05/10/01 |
| | | Units | | | | | | | | |
| **Arsenic** | **4.5** | ug/L | 2.6 J | < 1.8 | < 5.2 | 2.7 J | ***16.5*** | ***9*** | ***10.6*** | ***14*** |
| **Barium** | **256** | ug/L | ***522*** | ***367*** | ***506*** | ***521*** | ***665*** | ***629*** | ***463*** | ***518*** |
| Cadmium | 3.7 | ug/L | < 0.17 J | < 0.17 | < 0.15 J | 1 J | **5 J** | < 1.2 | < 0.15 J | 3.3 J |
| Selenium | 18 | ug/L | < 40 | 2.8 J | 6.6 J | 4 J | < 40 | < 14.5 | < 14.5 | < 1.8 |
| 2-Methylnaphthalene | 110 | ug/L | < 1 | < 2 R | < 2 | < 2 | < 1.5 | < 2 | < 2 | < 1 |
| Acenaphthene | 219 | ug/L | 1 J | 0.2 R | < 2 | < 2 | 0.2 | < 2 | < 2 | 0.3 J |
| Benzo(a)anthracene | 9.2 | ug/L | < 2 | < 2 R | < 2 | < 2 | < 2 | 0.02 J | < 2 J | < 2 |
| Benzo(a)pyrene | 0.2 | ug/L | < 1 | < 2 R | < 2 | < 2 | < 1.5 | < 2 | < 2 | < 1 |
| Chrysene | 9.2 | ug/L | < 1 | < 2 R | < 2 | < 2 | < 1.5 | < 2 | < 2 J | < 1 |
| Dibenzo(a,h)anthracene | 0.92 | ug/L | < 2 | < 2 R | < 3 | < 2 | < 2.5 | < 2 | < 2 | < 2 |
| Naphthalene - SW-846 8270C | 73 | ug/L | 0.9 J | 0.2 R | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 |
| **Pentachlorophenol** | **1** | ug/L | < 1 | < 2 R | < 2 J | < 2 | ***6.3*** | ***3*** | ***1*** | ***0.5*** |
| Phenanthrene | 110 | ug/L | 0.3 J | < 2 R | < 2 | < 2 | 0.1 | < 2 | < 2 | < 1 |
| 1,1,1-Trichloroethane | 73 | ug/L | < 1 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| 1,1,2-Trichloroethane | 1.2 | ug/L | < 1 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 R |
| 1,1-Dichloroethane | 365 | ug/L | < 1 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| 1,1-Dichloroethene | 7 | ug/L | < 1 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| 1,2-Dichloroethane | 5 | ug/L | < 1 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| 1,2-Dichloroethene (total) | 33 | ug/L | < 2 | 2 | < 2 | < 2 | 3 | 2 | < 2 | < 2 |
| Benzene | 2.3 | ug/L | < 1 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| Chloroethane (Ethyl chloride) | 23 | ug/L | < 1 | < 1 | < 2 | < 2 | < 10 | < 1 | < 2 | < 2 |
| Chloromethane (Methyl chloride) | 5.2 | ug/L | < 1 | < 1 | < 2 | < 2 | **10 J** | < 1 | < 2 | < 2 |
| Ethylbenzene | 365 | ug/L | < 1 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| Trichloroethene | 6.1 | ug/L | < 1 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| Vinyl chloride | 2 | ug/L | < 1 | < 1 | < 2 | < 2 | **9 J** | < 1 | < 2 | < 2 |

Note:Screening level exceedences are in bold.
The bolded italic data are graphed.
"Screen" label on graphs = screening level concentration


Arsenic
PPB
18
16
14
12
10
8
6
4
2
0
Jun-00
Jul-00
Aug-00
Sep-00
Oct-00
Nov-00
Dec-00
Jan-01
Feb-01
Mar-01
Apr-01
May-01
Date
32-MW14
Screen


Barium
700
600
500
400
300
200
100
0
PPB
Jul-00
Aug-00
Sep-00
Oct-00
Nov-00
Dec-00
Jan-01
Feb-01
Mar-01
Apr-01
May-01
Date
32-MW1
32-MW14
Screen


Pentachlorophenol
PPB
7
6
5
4
3
2
1
0
Jul-00
Aug-00
Sep-00
Oct-00
Nov-00
Dec-00
Jan-01
Feb-01
Mar-01
Apr-01
May-01
Date
32-MW14
Screen

# AOI-34

| ParameterName | Screen Level | AOI | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Location | 34-B1W1 | 34-B1W1 | 34-B1W1 | 34-B1W1 | 34-B2W2 | 34-B2W2 | 34-B2W2 | 34-B2W2 | 34-MW1 | 34-MW1 | 34-MW1 | 34-MW1 | 34-MW2 |
| | | Depth (ft) | 12.5 | 12.5 | 12.5 | 12.5 | 12.5 | 12.5 | 12.5 | 12.5 | 12 | 12 | 12 | 12 | 14.5 |
| | | Date | 06/24/00 | 09/27/00 | 01/25/01 | 05/01/01 | 06/24/00 | 09/27/00 | 01/25/01 | 05/01/01 | 06/29/00 | 09/21/00 | 01/25/01 | 05/01/01 | 06/24/00 |
| | | Units | | | | | | | | | | | | | |
| Arsenic | 4.5 | ug/L | *5.2* | *6.1* | *4.4* | *0.8* | 4 J | 5.1 J | < 9.6 | < 1.6 | < 20 | 4.2 J | < 6.9 | < 1.6 | 3.4 J |
| **Barium** | 256 | ug/L | *268* | *263* | *246* | *197* | *311* | *356* | *356* | *240* | *283* | *302* | 310 | 292 | 276 |
| Cadmium | 3.7 | ug/L | < 5 | < 0.16 | < 0.15 J | < 0.29 | < 5 | < 0.16 | < 0.15 J | 0.36 J | < 5 | < 0.17 | < 0.15 J | < 0.29 | < 5 |
| Selenium | 18 | ug/L | < 40 | 3.7 J | < 49.1 | 4.5 J | < 40 | 4.1 J | < 45.6 | 3.5 J | < 40 | < 2.1 | < 47 | 3.9 J | < 40 |
| 2-Methylnaphthalene | 110 | ug/L | < 1 J | < 2 | < 2 | < 1 | < 1 J | < 2 | < 1 | < 2 | < 1 | < 2 | < 2 | < 1 | < 1 J |
| Acenaphthene | 219 | ug/L | < 1 | < 2 | < 2 | < 1 | 3 | 2 | 4 | 3 | < 1 | < 2 | < 2 | < 1 | < 1 |
| Benzo(a)anthracene | 9.2 | ug/L | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 |
| Benzo(a)pyrene | 0.2 | ug/L | < 1 | < 2 | < 2 | < 1 | < 1 | < 2 | < 1 | < 2 | < 1 | < 2 | < 2 | < 1 | < 1 |
| Chrysene | 9.2 | ug/L | < 1 | < 2 | < 2 | < 1 | < 1 | < 2 | < 1 | < 2 | < 1 | < 2 | < 2 | < 1 | < 1 |
| Dibenzo(a,h)anthracene | 0.92 | ug/L | < 1 | < 2 | < 3 | < 2 | < 1 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 1 |
| Naphthalene - SW-846 8270C | 73 | ug/L | < 2 J | < 2 | < 2 | < 2 | < 2 J | < 2 | < 2 | < 2 | < 2 | 0.2 J | < 2 | < 2 | < 2 J |
| Pentachlorophenol | 1 | ug/L | < 1 | < 2 | < 2 | < 1 | < 1 | 7 | < 1 | < 2 | < 1 | < 2 | < 2 | < 1 | < 1 |
| Phenanthrene | 110 | ug/L | < 1 | < 2 | < 2 | < 1 | < 1 | < 2 | < 1 | < 2 | < 1 | < 2 | < 2 | < 1 | < 1 |
| 1,1,1-Trichloroethane | 73 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 |
| 1,1,2-Trichloroethane | 1.2 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 |
| 1,1-Dichloroethane | 365 | ug/L | 68 | 38 | 22 | 21 | 26 | 82 J | 94 | 43 | 250 | 240 | 150 | 150 | 150 |
| 1,1-Dichloroethene | 7 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 |
| 1,2-Dichloroethane | 5 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 |
| 1,2-Dichloroethene (total) | 33 | ug/L | 4 J | 4 | 1 J | 0.6 J | < 10 | 1 | 1 J | 1 J | 16 | 32 | 6 | 6 | 4 J |
| **Benzene** | 2.3 | ug/L | *2* | *4* | *2* | *1* | < 5 | 2 J | 1 | 1 | *2* | *4* | *2* | *3* | < 5 |
| **Chloroethane (Ethyl chloride)** | 23 | ug/L | < 10 | 2 | < 2 | < 2 | *12* | *35* | *24* | *16* | < 10 | < 1 | < 2 | < 2 | < 10 |
| Chloromethane (Methyl chloride) | 5.2 | ug/L | < 10 | < 1 | < 2 | < 2 | < 10 J | < 1 | < 2 | < 2 | < 10 | < 1 J | < 2 | < 2 | < 10 J |
| Ethylbenzene | 365 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 |
| Trichloroethene | 6.1 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 | 1 J | 0.6 J | 0.7 J | < 5 |
| **Vinyl chloride** | 2 | ug/L | *170* | *140* | *84* | *37* | *3* | *15* | *44* | *15* | *400* | *260* | *240* | *160* | *32* |

Note: Screening lavel exceedences are in bold.
The bolded italic data are graphed.
"Scr[illegible]able on graphs = screening level concentration

# AOI-34

| ParameterName | Screen Level | AOI | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Location | 34-MW2 | 34-MW2 | 34-MW2 | 34-MW3 | 34-MW3 | 34-MW3 | 34-MW3 | 34-MW3D | 34-MW3D | 34-MW3D | 34-MW3D | 34-MW7D | 34-MW7D |
| | | Depth (ft) | 14.5 | 14.5 | 14.5 | 12.5 | 12.5 | 12.5 | 12.5 | 22 | 22 | 22 | 22 | 16 | 16 |
| | | Date | 09/27/00 | 01/25/01 | 05/02/01 | 06/24/00 | 09/23/00 | 01/24/01 | 05/01/01 | 06/24/00 | 09/23/00 | 01/24/01 | 05/01/01 | 07/12/00 | 09/24/00 |
| | | Units | | | | | | | | | | | | | |
| Arsenic | 4.5 | ug/L | < 4.4 | < 7.5 | 1.7 J | < 20 | < 4.1 | < 4.4 | 1.8 J | ***100*** | ***142*** | ***106*** | ***46.1*** | 2.7 J | < 1.8 |
| Barium | 256 | ug/L | 226 | 248 | 219 | 207 | 215 | 213 | 141 | ***358*** | ***336*** | ***312*** | ***418*** | ***168*** | ***358*** |
| Cadmium | 3.7 | ug/L | 0.73 J | < 0.15 J | < 0.29 | < 5 | < 0.17 | < 0.16 | 0.43 J | < 5 | 1.4 J | 1.2 J | < 0.29 | < 5 | < 0.17 |
| Selenium | 18 | ug/L | < 3.7 | < 27 | 2.1 J | < 40 | 4.9 J | < 3.7 | 4.1 J | < 40 | 2.3 J | 5.8 J | 2.1 J | < 2.4 | 5.5 J |
| 2-Methylnaphthalene | 110 | ug/L | < 2 | < 2 | < 1 | < 1 J | < 2 | < 1 | < 2 | < 1 J | < 1 | NA | < 1 | < 1 | < 2 R |
| Acenaphthene | 219 | ug/L | < 2 | < 2 | < 1 | < 1 | < 2 | < 1 | < 2 | < 1 | < 1 | < 1 | < 1 | 2 | 2 R |
| Benzo(a)anthracene | 9.2 | ug/L | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 R |
| Benzo(a)pyrene | 0.2 | ug/L | < 2 | < 2 | < 1 | < 1 | < 2 | < 1 | < 2 | < 1 | < 1 | < 1 | < 1 | < 1 | < 2 R |
| Chrysene | 9.2 | ug/L | < 2 | < 2 | < 1 | < 1 | < 2 | < 1 | < 2 | < 1 | < 1 | < 1 | < 1 | < 1 | < 2 R |
| Dibenzo(a,h)anthracene | 0.92 | ug/L | < 2 | < 2 | < 2 | < 1 | < 2 | < 2 | < 2 | < 1 | < 2 | < 2 | < 2 | < 2 | < 2 R |
| Naphthalene - SW-846 8270C | 73 | ug/L | < 2 | < 2 | < 2 | < 2 J | < 2 | < 2 | < 2 | < 2 J | < 2 | < 2 | < 2 | < 2 R | < 2 R |
| Pentachlorophenol | 1 | ug/L | < 2 | < 2 | < 1 | < 1 | < 2 | < 1 | < 2 | < 1 | < 1 | NA | < 1 | < 1 | < 2 R |
| Phenanthrene | 110 | ug/L | < 2 | < 2 | < 1 | < 1 | < 2 | < 1 | < 2 | < 1 | < 1 | < 1 | < 1 | < 1 | < 2 R |
| 1,1,1-Trichloroethane | 73 | ug/L | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 1,1,2-Trichloroethane | 1.2 | ug/L | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 1,1-Dichloroethane | 365 | ug/L | 120 | 210 | < 1 | 47 | 29 J | 33 | 37 | < 5 | 15 | 2 | 16 | 30 J | 48 |
| 1,1-Dichloroethene | 7 | ug/L | < 1 | < 1 | < 1 | < 5 | 2 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 1,2-Dichloroethane | 5 | ug/L | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 1,2-Dichloroethene (total) | 33 | ug/L | 5 | 8 | 2 J | 16 | 22 | 12 | 5 | < 10 | 4 | 0.9 J | 3 | < 10 J | 2 |
| Benzene | 2.3 | ug/L | 0.7 J | 1 | < 1 | 1 J | 3 J | 2 | 1 | < 5 | 0.8 J | < 1 | 2 | 1 J | 1 |
| Chloroethane (Ethyl chloride) | 23 | ug/L | < 1 | < 2 | < 2 | < 10 | < 1 | < 2 | < 2 | < 10 | 0.9 J | < 2 | 3 | ***0.5*** | ***35*** |
| Chloromethane (Methyl chloride) | 5.2 | ug/L | < 1 | < 2 | < 2 | < 10 | < 1 | < 2 | < 2 | < 10 J | < 1 J | < 2 | < 2 | < 1 | < 1 |
| Ethylbenzene | 365 | ug/L | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 1 | < 1 |
| Trichloroethene | 6.1 | ug/L | < 1 | < 1 | < 1 | < 5 | 0.7 J | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 1 | < 1 |
| Vinyl chloride | 2 | ug/L | ***32*** | ***86*** | ***1*** | ***150*** | ***3100*** | ***270*** | ***94*** | ***4*** | ***41*** | ***21*** | ***85*** | ***0.5*** | ***7*** |

Note: Screening lavel exceedences are in bold.
*The bolded italic data are graphed.*
"Screen" lable on graphs = screening level concentration

# AOI-34

| ParameterName | Screen Level | AOI | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Location | 34-MW7D | 34-MW7D | 34-MW8 | 34-MW8 | 34-MW8 | 34-MW8 | 34-MW9 | 34-MW9 | 34-MW9 | 34-MW9 |
| | | Depth (ft) | 16 | 16 | 10 | 10 | 10 | 10 | 8 | 8 | 8 | 8 |
| | | Date | 01/24/01 | 05/01/01 | 07/11/00 | 09/24/00 | 01/29/01 | 05/07/01 | 07/10/00 | 09/24/00 | 01/25/01 | 05/02/01 |
| | | Units | | | | | | | | | | |
| **Arsenic** | **4.5** | ug/L | < 4.4 | < 1.6 | ***35.7*** | ***55.1*** | ***43.1*** | ***43.7*** | 2.9 J | 2.8 J | < 5.2 | < 1.6 |
| **Barium** | **256** | ug/L | ***327*** | ***338*** | ***552*** | ***486*** | ***525*** | ***524*** | 125 | 159 | 154 J | 78.4 |
| Cadmium | 3.7 | ug/L | < 0.16 | < 0.29 | < 0.17 J | 0.34 J | < 0.15 J | 2.8 J | < 0.17 J | < 0.17 | < 0.15 J | < 0.29 |
| Selenium | 18 | ug/L | 4.1 J | 2.9 J | < 40 | 2.7 J | < 14.5 J | < 1.8 | < 40 | 6 J | < 58.9 | 2.6 J |
| 2-Methylnaphthalene | 110 | ug/L | < 1 | < 2 | < 1 | < 2 | < 2 | < 2 | < 1 | < 2 R | < 2 | < 0.1 |
| Acenaphthene | 219 | ug/L | 2 | 3 | 0.7 J | 1 J | 0.9 J | 0.9 J | 0.3 J | < 2 R | 0.09 J | < 2 |
| Benzo(a)anthracene | 9.2 | ug/L | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 R | < 2 | < 2 |
| Benzo(a)pyrene | 0.2 | ug/L | < 1 | < 2 | < 1 | < 2 | < 2 | < 2 | < 1 | < 2 R | < 2 | < 2 |
| Chrysene | 9.2 | ug/L | < 1 | < 2 | < 1 | < 2 | < 2 | < 2 | < 1 | < 2 R | < 2 | < 2 |
| Dibenzo(a,h)anthracene | 0.92 | ug/L | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 R | < 3 | < 2 |
| Naphthalene - SW-846 8270C | 73 | ug/L | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 R | < 2 | < 0.2 |
| Pentachlorophenol | 1 | ug/L | < 1 | < 2 | < 1 | < 2 | 2 J | < 2 | < 1 | < 2 R | < 2 | < 2 |
| Phenanthrene | 110 | ug/L | < 1 | 0.3 J | < 1 | < 2 | < 2 | < 2 | < 1 | < 2 R | < 2 | < 0.2 |
| 1,1,1-Trichloroethane | 73 | ug/L | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 1,1,2-Trichloroethane | 1.2 | ug/L | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 1,1-Dichloroethane | 365 | ug/L | 26 | 58 | 24 | 180 | 140 | 85 J | < 1 | < 1 | < 1 | 1 |
| 1,1-Dichloroethene | 7 | ug/L | < 1 | < 1 | < 1 | 2 J | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 1,2-Dichloroethane | 5 | ug/L | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 1,2-Dichloroethene (total) | 33 | ug/L | < 2 | 1 J | 2 | 17 | 5 | 2 J | < 2 | 2 | < 2 | < 2 |
| **Benzene** | **2.3** | ug/L | 1 | 1 | ***3*** | ***6*** | ***5*** | ***5*** | < 1 | < 1 | < 1 | < 1 |
| **Chloroethane (Ethyl chloride)** | **23** | ug/L | ***30*** | ***19*** | 4 | < 1 | < 2 | < 2 | < 1 | < 1 | < 2 | < 2 |
| Chloromethane (Methyl chloride) | 5.2 | ug/L | < 2 | < 2 | < 1 | < 1 | < 2 | < 2 | < 1 | < 1 | < 2 | < 2 |
| Ethylbenzene | 365 | ug/L | < 1 | < 1 | < 1 | < 1 | 0.6 J | < 1 | < 1 | < 1 | < 1 | < 1 |
| Trichloroethene | 6.1 | ug/L | < 1 | < 1 | < 1 | 0.6 J | < 1 | 1 | < 1 | < 1 | < 1 | < 1 |
| **Vinyl chloride** | **2** | ug/L | ***20*** | ***22*** | ***19*** | ***80*** | ***21*** | ***9*** | < 1 | < 1 | < 2 | < 2 |

Note: Screening lavel exceedences are in bold.
The bolded italic data are graphed.
"Scr[illegible]able on graphs = screening level concentration

# AOI-34

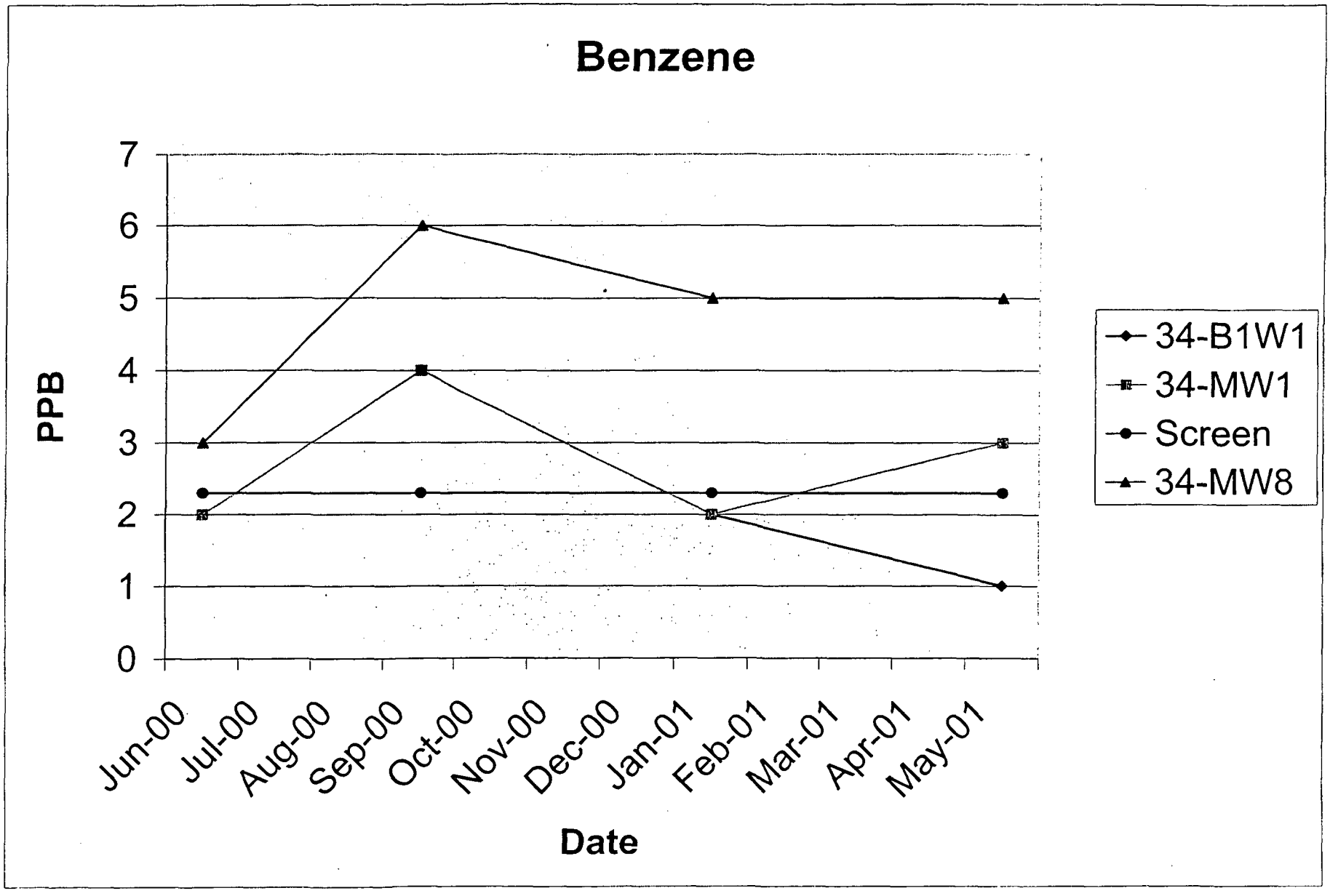
| ParameterName | Screen Level | AOI | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Location | 34-OB-12 | 34-OB-12 | 34-OB-12 | 34-OB-12 | 34-OB-13 | 34-OB-13 | 34-OB-13 | 34-OB-13 | 34-OB-16 | 34-OB-16 | 34-OB-16 | 34-OB-16 | 34-OB-17 |
| | | Depth (ft) | 11 | 11 | 11 | 11 | 10 | 10 | 10 | 10 | 13 | 13 | 13 | 13 | 12 |
| | | Date | 06/25/00 | 09/24/00 | 01/25/01 | 05/02/01 | 06/25/00 | 09/27/00 | 01/25/01 | 05/02/01 | 06/25/00 | 09/23/00 | 01/25/01 | 05/01/01 | 06/28/00 |
| | | Units | | | | | | | | | | | | | |
| Arsenic | 4.5 | ug/L | < 20 | < 1.8 | < 10.4 | < 1.6 | < 20 | < 4.4 | < 5.8 | < 1.6 | 2.8 J | 4.2 J | < 9.6 | < 1.6 | 4.1 J |
| Barium | 256 | ug/L | ***252*** | ***284*** | ***303*** | ***285*** | ***344*** | ***345*** | ***358*** | ***330*** | 162 | 155 | 234 J | 147 | 141 |
| Cadmium | 3.7 | ug/L | < 5 | < 0.17 | < 0.15 J | 1.3 J | < 5 | < 0.16 | < 0.15 J | 1.4 J | < 5 | < 0.17 | < 0.15 J | < 0.29 | < 5 |
| Selenium | 18 | ug/L | < 40 | 5.5 J | < 57.5 | 8.2 J | < 40 | 5.2 J | < 34.7 | 7.6 J | 3.5 J | < 2.1 J | < 22.8 | 2.9 J | < 40 |
| 2-Methylnaphthalene | 110 | ug/L | < 1 J | < 2 | NA | < 0.2 | < 1 J | < 2 | NA | < 0.2 | < 1 J | < 2 J | < 2 | < 2 | < 1 |
| Acenaphthene | 219 | ug/L | < 1 | < 2 | < 1 | 0.1 J | 2 | 2 | 2 | 1 J | < 1 | < 2 J | 0.1 J | < 2 | < 1 |
| Benzo(a)anthracene | 9.2 | ug/L | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 J | < 2 | < 2 | < 2 |
| Benzo(a)pyrene | 0.2 | ug/L | < 1 | < 2 | < 1 | < 2 | < 1 | < 2 | < 1 | < 2 | < 1 | < 2 J | < 2 | < 2 | < 1 |
| Chrysene | 9.2 | ug/L | < 1 | < 2 | < 1 | < 2 | < 1 | < 2 | < 1 | < 2 | < 1 | < 2 J | < 2 | < 2 | < 1 |
| Dibenzo(a,h)anthracene | 0.92 | ug/L | < 1 | < 2 | < 2 | < 2 | < 1 | < 2 | < 2 | < 2 | < 1 | < 2 J | < 2 | < 2 | < 2 |
| Naphthalene - SW-846 8270C | 73 | ug/L | < 2 J | < 2 | < 2 | < 0.1 | < 2 J | < 2 | < 2 | < 0.1 | < 2 J | 0.03 J | < 2 | < 2 | < 2 |
| Pentachlorophenol | 1 | ug/L | < 1 | < 2 | NA | < 2 | < 1 | < 2 | NA | < 2 | < 1 | < 2 J | < 2 | < 2 | < 1 |
| Phenanthrene | 110 | ug/L | 0.4 J | 0.4 J | < 1 | < 0.2 | 0.4 J | 0.3 J | < 1 | < 0.2 | < 1 | < 2 J | < 2 | < 2 | 0.2 J |
| 1,1,1-Trichloroethane | 73 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 |
| 1,1,2-Trichloroethane | 1.2 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 |
| 1,1-Dichloroethane | 365 | ug/L | < 5 | 1 | 1 | 6 | 25 | 39 | 18 | 43 | 3 J | 4 | 3 | 1 | < 5 |
| 1,1-Dichloroethene | 7 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 |
| 1,2-Dichloroethane | 5 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 |
| 1,2-Dichloroethene (total) | 33 | ug/L | < 10 | 2 | < 2 | < 2 | < 10 | 2 | < 2 | 1 J | < 10 | 2 | < 2 | < 2 | < 10 |
| Benzene | 2.3 | ug/L | < 5 | < 1 | < 1 | 0.7 J | < 5 | 1 | 1 | 1 | < 5 | < 1 | < 1 | < 1 | < 5 |
| Chloroethane (Ethyl chloride) | 23 | ug/L | < 10 | < 1 | < 2 | 7 | 6 J | 20 | 19 | 13 | < 10 | 1 | 1 J | < 2 | < 10 |
| Chloromethane (Methyl chloride) | 5.2 | ug/L | < 10 | < 1 | < 2 | < 2 | < 10 J | < 1 | < 2 | < 2 | < 10 J | < 1 J | < 2 | < 2 | < 10 |
| Ethylbenzene | 365 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 |
| Trichloroethene | 6.1 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 |
| Vinyl chloride | 2 | ug/L | ***5*** | ***3*** | ***8*** | ***8*** | ***5*** | ***13*** | ***36*** | ***34*** | < 10 | 2 | 1 J | < 2 | < 10 |

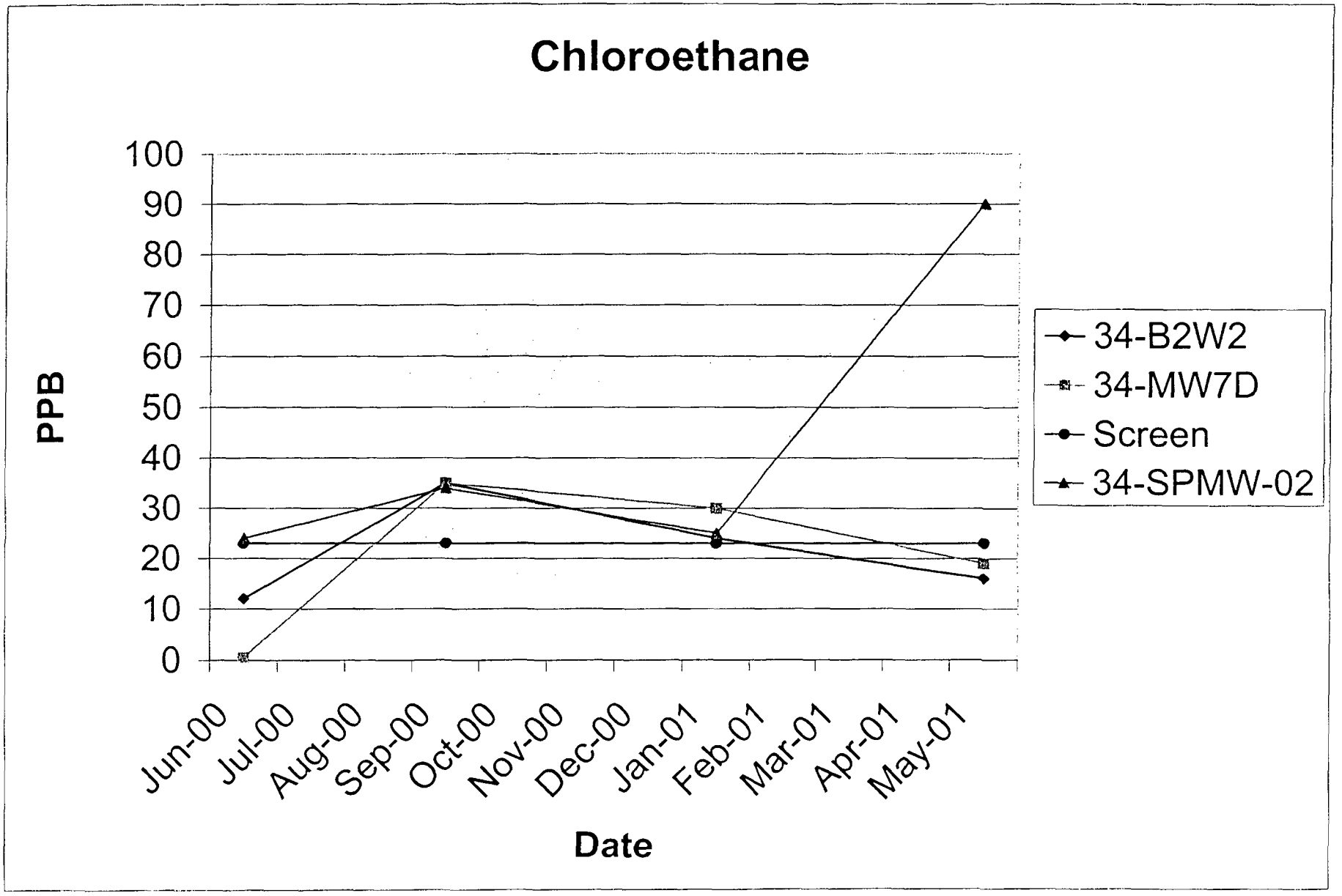
Note: Screening lavel exceedences are in bold.
The bolded italic data are graphed.
"Screen" lable on graphs = screening level concentration

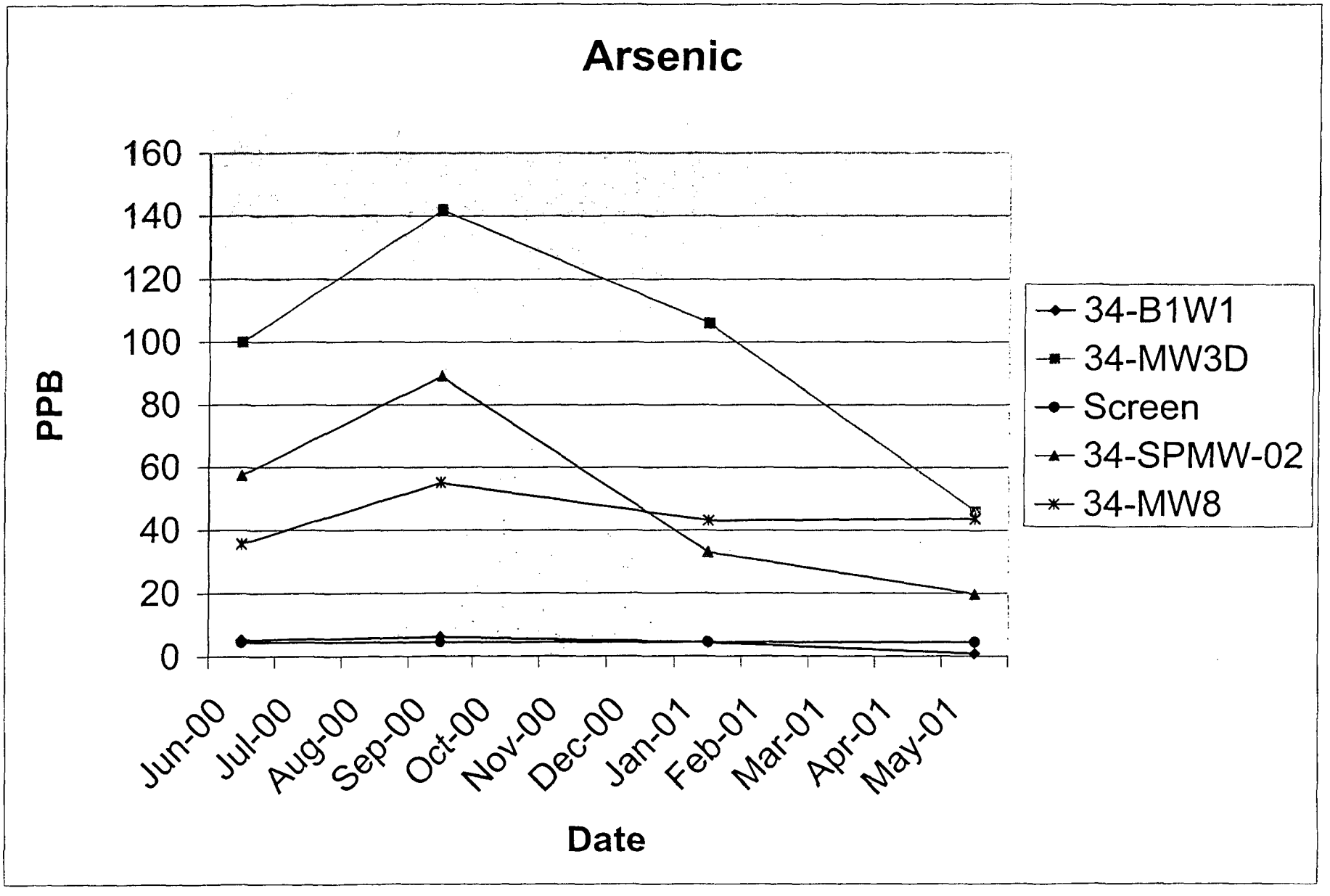
# AOI-34

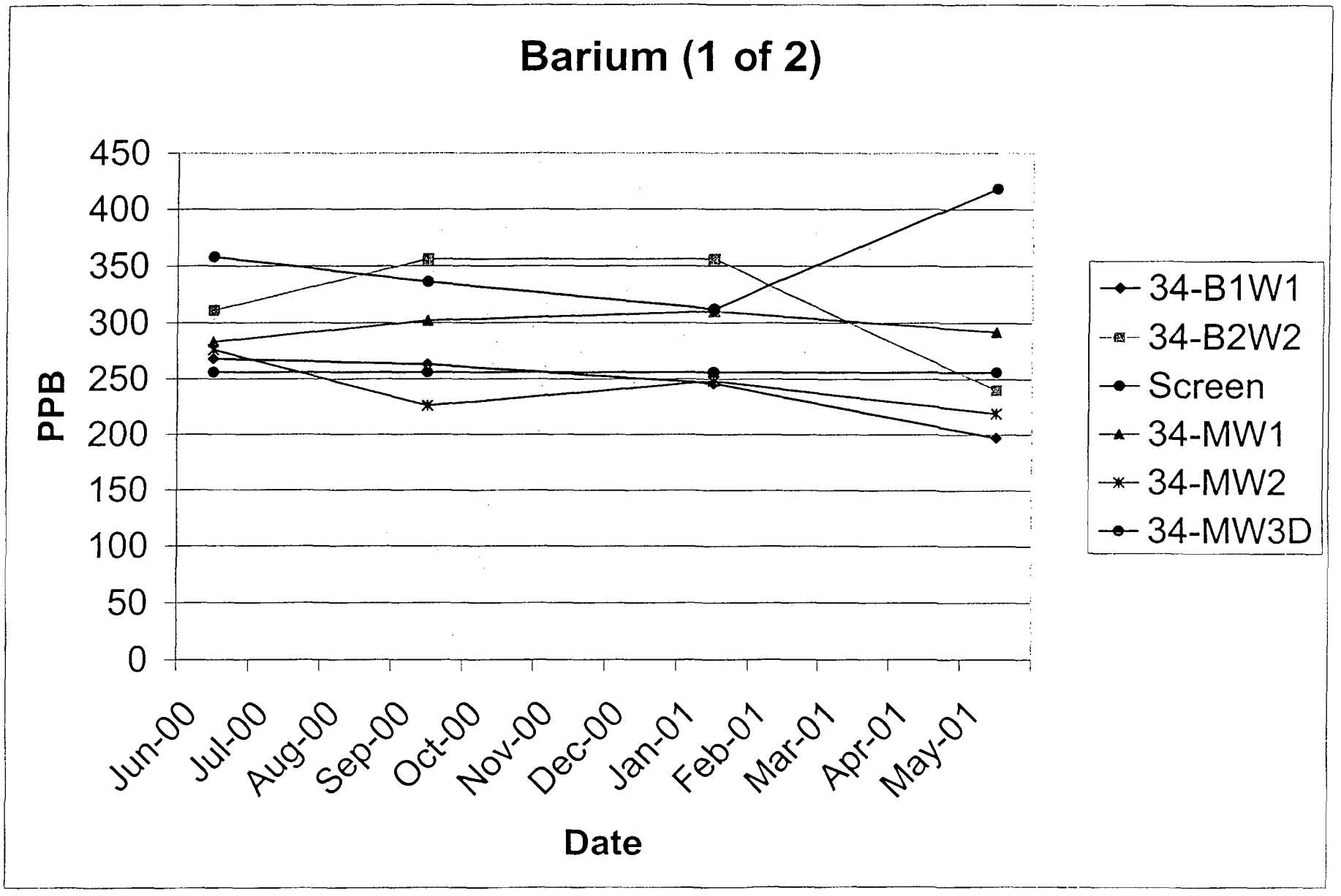
| ParameterName | Screen Level | AOI | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Location | 34-OB-17 | 34-OB-17 | 34-OB-17 | 34-SPMW-02 | 34-SPMW-02 | 34-SPMW-02 | 34-SPMW-02 | 34-SPMW-03 | 34-SPMW-03 | 34-SPMW-03 | 34-SPMW-03 |
| | | Depth (ft) | 12 | 12 | 12 | 13 | 13 | 13 | 13 | 12.5 | 12.5 | 12.5 | 12.5 |
| | | Date | 09/26/00 | 01/25/01 | 05/02/01 | 06/28/00 | 09/27/00 | 01/25/01 | 05/02/01 | 06/24/00 | 09/23/00 | 01/24/01 | 05/02/01 |
| | | Units | | | | | | | | | | | |
| Arsenic | 4.5 | ug/L | 13.5 J | < 7.4 | < 1.6 | *57.4* | *89.2* | *33* | *19.7* | < 20 | < 3.8 | < 4.4 | < 1.6 |
| Barium | 256 | ug/L | 154 J | 158 J | 122 | *360* | *416* | *417* | *494* | 130 | 152 | 185 | 138 |
| Cadmium | 3.7 | ug/L | < 0.17 | < 0.15 J | 0.81 J | < 0.36 | 1.1 J | < 0.15 J | < 0.29 | < 5 | < 0.17 | < 0.16 | 0.29 J |
| Selenium | 18 | ug/L | < 2.1 J | < 14.5 | 4.8 J | < 40 | < 3.7 | < 26.4 | 2.3 J | < 40 | < 2.1 | 5 J | 4.4 J |
| 2-Methylnaphthalene | 110 | ug/L | < 2 | < 2 | < 2 | < 1 | < 2 | < 2 | < 1 | < 1 J | < 2 R | < 1 | < 0.1 |
| Acenaphthene | 219 | ug/L | < 2 | < 2 | < 2 | 0.8 J | 0.5 J | 0.5 J | 1 J | < 1 | < 2 R | < 1 | < 1 |
| Benzo(a)anthracene | 9.2 | ug/L | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 R | < 2 | < 2 |
| Benzo(a)pyrene | 0.2 | ug/L | < 2 | < 2 | < 2 | < 1 | < 2 | < 2 | < 1 | < 1 | < 2 R | < 1 | < 1 |
| Chrysene | 9.2 | ug/L | < 2 | < 2 | < 2 | < 1 | < 2 | < 2 | < 1 | < 1 | < 2 R | < 1 | < 1 |
| Dibenzo(a,h)anthracene | 0.92 | ug/L | < 2 | < 3 | < 2 | < 2 | < 2 | < 3 | < 2 | < 1 | < 2 R | < 2 | < 2 |
| Naphthalene - SW-846 8270C | 73 | ug/L | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 J | < 2 R | 0.06 J | < 0.2 |
| Pentachlorophenol | 1 | ug/L | < 2 | < 2 | < 2 | < 1 | < 2 | < 2 | < 1 | < 1 | < 2.7 J | < 1 | < 1 |
| Phenanthrene | 110 | ug/L | < 2 | < 2 | < 0.1 | < 1 | < 2 | < 2 | < 0.2 | 0.2 J | < 2 R | < 1 | < 0.1 |
| 1,1,1-Trichloroethane | 73 | ug/L | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| 1,1,2-Trichloroethane | 1.2 | ug/L | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| 1,1-Dichloroethane | 365 | ug/L | 0.5 J | 0.6 J | 3 | 2 J | 2 | 3 | 18 | 3 J | 3 | 4 | 7 |
| 1,1-Dichloroethene | 7 | ug/L | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| 1,2-Dichloroethane | 5 | ug/L | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| 1,2-Dichloroethene (total) | 33 | ug/L | 2 | < 2 | < 2 | < 10 | 2 | < 2 | < 2 | < 10 | 0.8 | < 2 | < 2 |
| **Benzene** | **2.3** | ug/L | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | 1 | < 5 | < 1 | < 1 | < 1 |
| **Chloroethane (Ethyl chloride)** | **23** | ug/L | < 1 | < 2 | < 2 | ***24*** | ***34*** | ***25*** | ***90*** | < 10 | 1 J | 1 J | < 2 |
| Chloromethane (Methyl chloride) | 5.2 | ug/L | < 1 J | < 2 | < 2 | < 10 | < 1 | < 2 | < 2 | < 10 | < 1 | < 2 | < 2 |
| Ethylbenzene | 365 | ug/L | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| Trichloroethene | 6.1 | ug/L | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| **Vinyl chloride** | **2** | ug/L | < 1 | < 2 | < 2 | ***5*** | ***2*** | ***3*** | ***20*** | < 10 | 0.6 J | 0.8 J | < 2 |

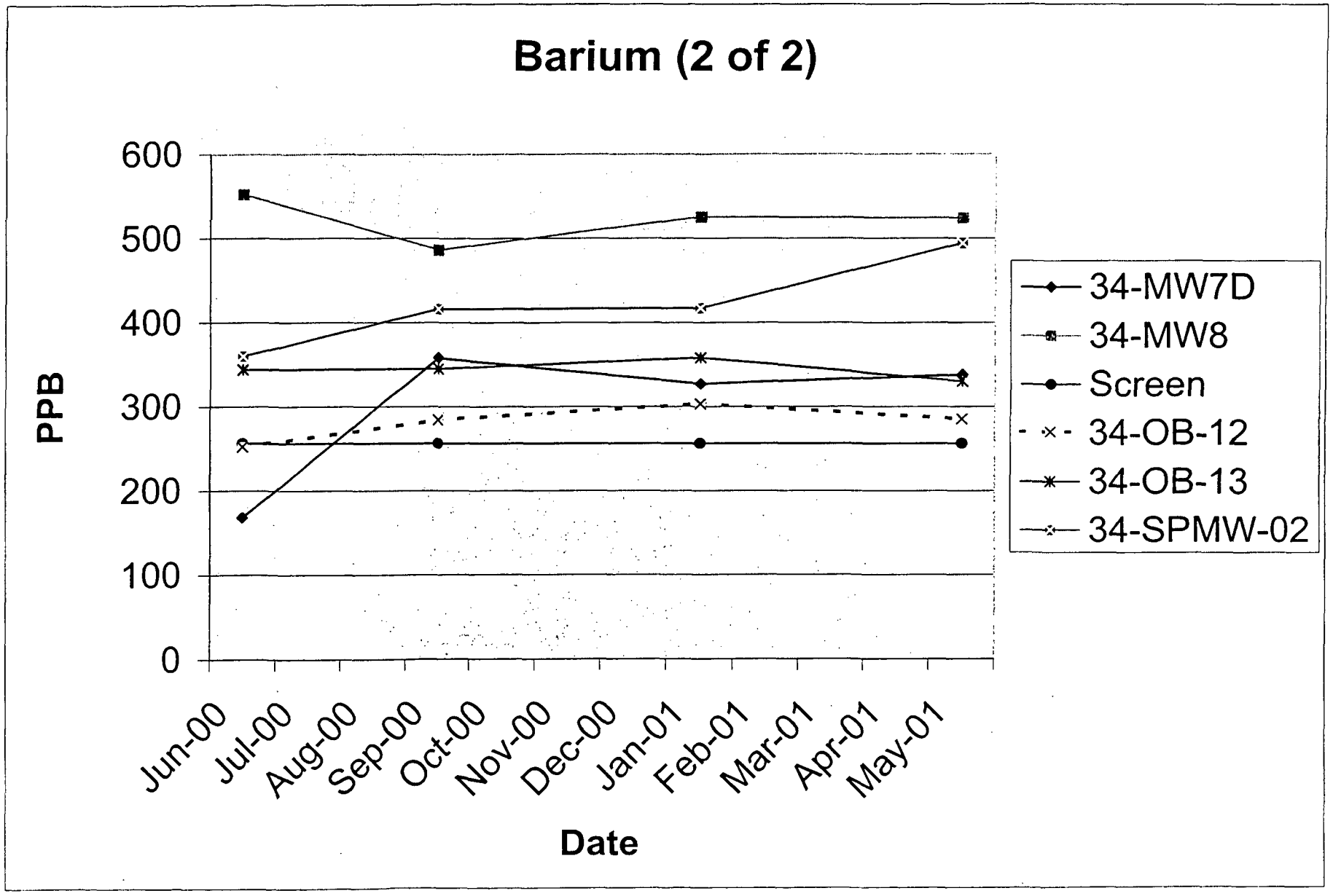
Note: Screening lavel exceedences are in bold.
The bolded italic data are graphed.
"Scr[illegible]able on graphs = screening level concentration

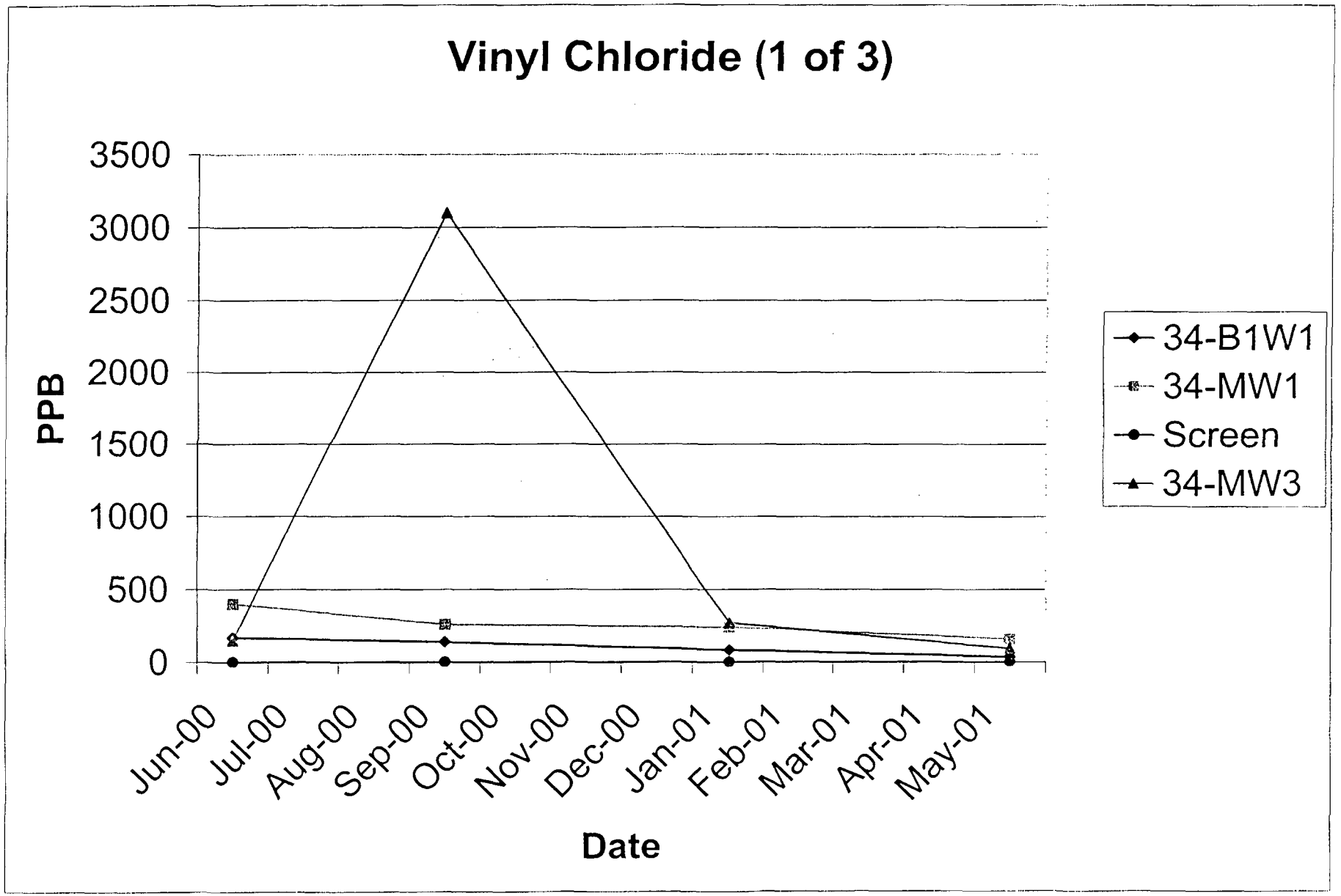

Benzene
PPB
7
6
5
4
3
2
1
0
Jun-00
Jul-00
Aug-00
Sep-00
Oct-00
Nov-00
Dec-00
Jan-01
Feb-01
Mar-01
Apr-01
May-01
Date
34-B1W1
34-MW1
Screen
34-MW8

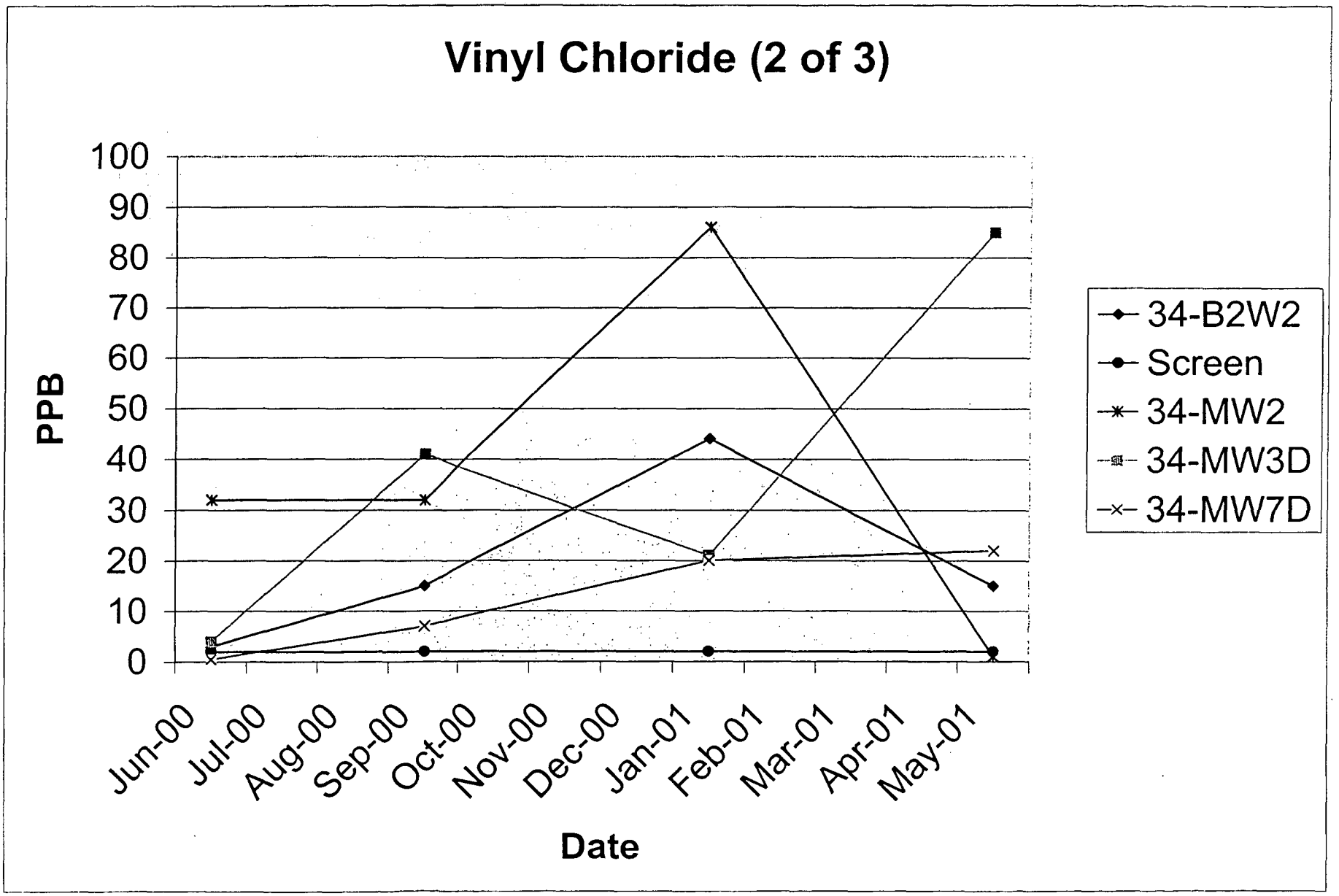

Chloroethane
PPB
100
90
80
70
60
50
40
30
20
10
0
Jun-00
Jul-00
Aug-00
Sep-00
Oct-00
Nov-00
Dec-00
Jan-01
Feb-01
Mar-01
Apr-01
May-01
Date
34-B2W2
34-MW7D
Screen
34-SPMW-02

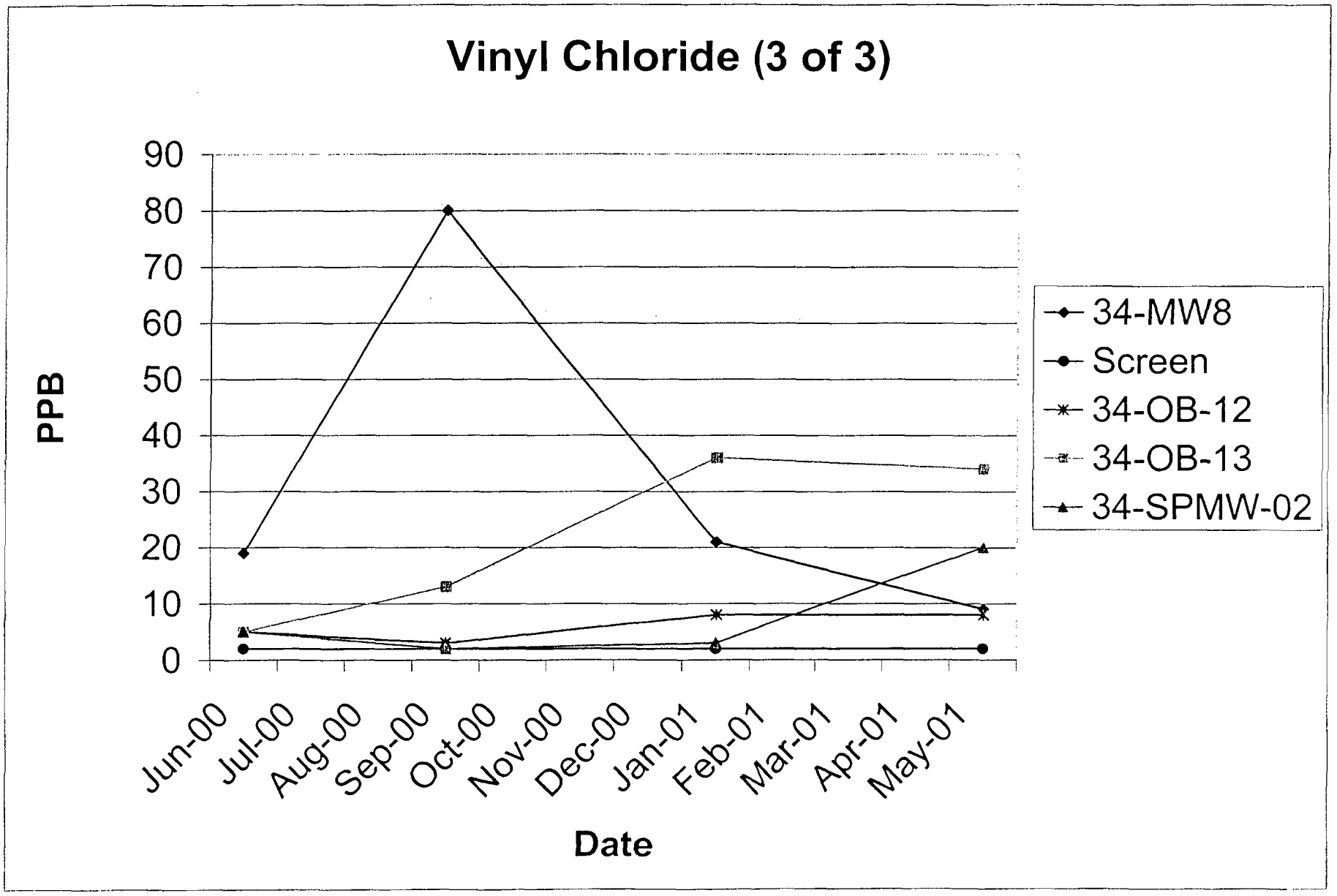

Arsenic
PPB
160
140
120
100
80
60
40
20
0
Jun-00
Jul-00
Aug-00
Sep-00
Oct-00
Nov-00
Dec-00
Jan-01
Feb-01
Mar-01
Apr-01
May-01
Date
34-B1W1
34-MW3D
Screen
34-SPMW-02
34-MW8


Barium (1 of 2)
PPB
450
400
350
300
250
200
150
100
50
0
Jun-00
Jul-00
Aug-00
Sep-00
Oct-00
Nov-00
Dec-00
Jan-01
Feb-01
Mar-01
Apr-01
May-01
Date
34-B1W1
34-B2W2
Screen
34-MW1
34-MW2
34-MW3D


Barium (2 of 2)
PPB
600
500
400
300
200
100
0
Jun-00
Jul-00
Aug-00
Sep-00
Oct-00
Nov-00
Dec-00
Jan-01
Feb-01
Mar-01
Apr-01
May-01
Date
34-MW7D
34-MW8
Screen
34-OB-12
34-OB-13
34-SPMW-02


Vinyl Chloride (1 of 3)
3500
3000
2500
2000
1500
1000
500
0
PPB
Jun-00
Jul-00
Aug-00
Sep-00
Oct-00
Nov-00
Dec-00
Jan-01
Feb-01
Mar-01
Apr-01
May-01
Date
34-B1W1
34-MW1
Screen
34-MW3

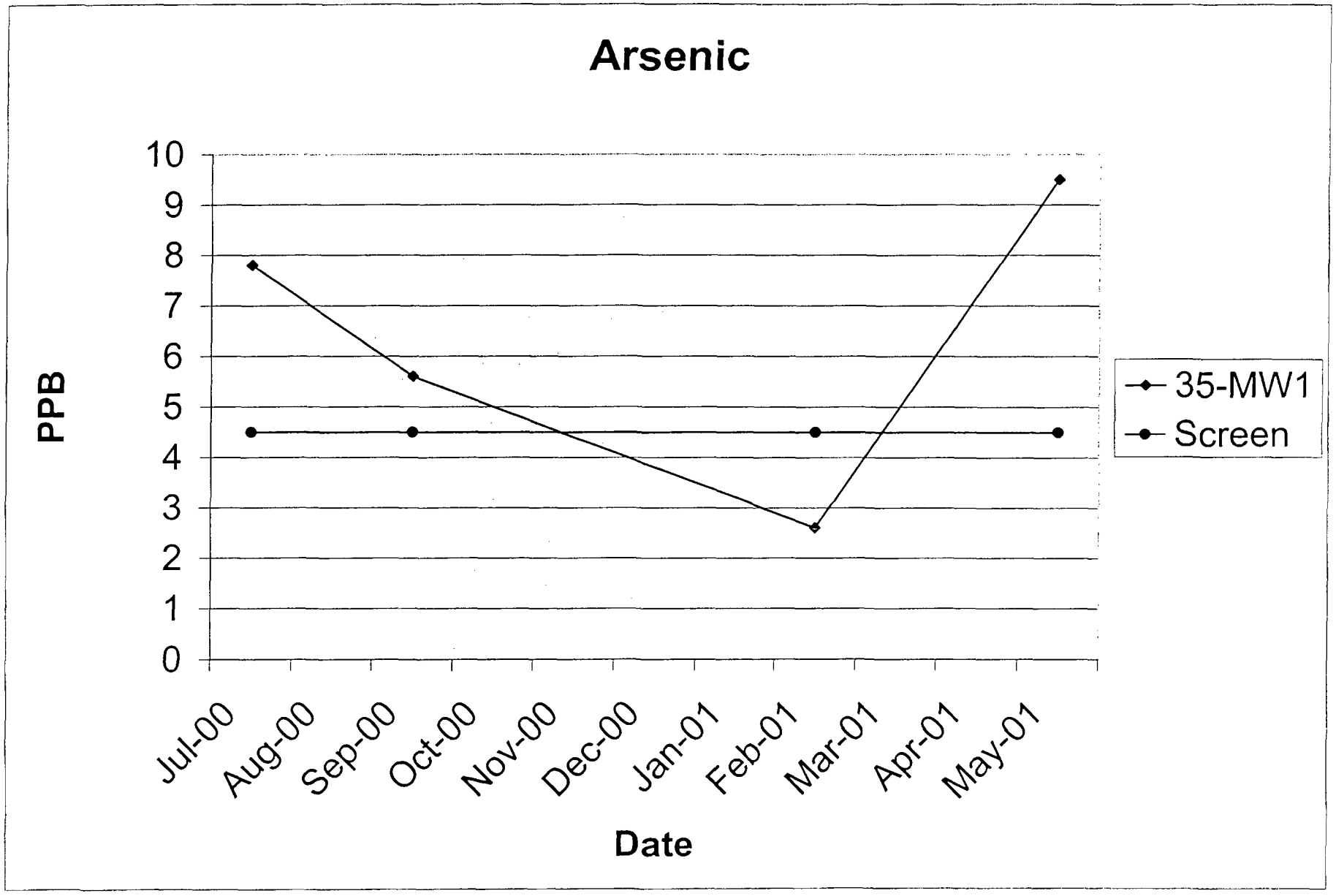

Vinyl Chloride (2 of 3)
PPB
100
90
80
70
60
50
40
30
20
10
0
Jun-00
Jul-00
Aug-00
Sep-00
Oct-00
Nov-00
Dec-00
Jan-01
Feb-01
Mar-01
Apr-01
May-01
Date
34-B2W2
Screen
34-MW2
34-MW3D
34-MW7D

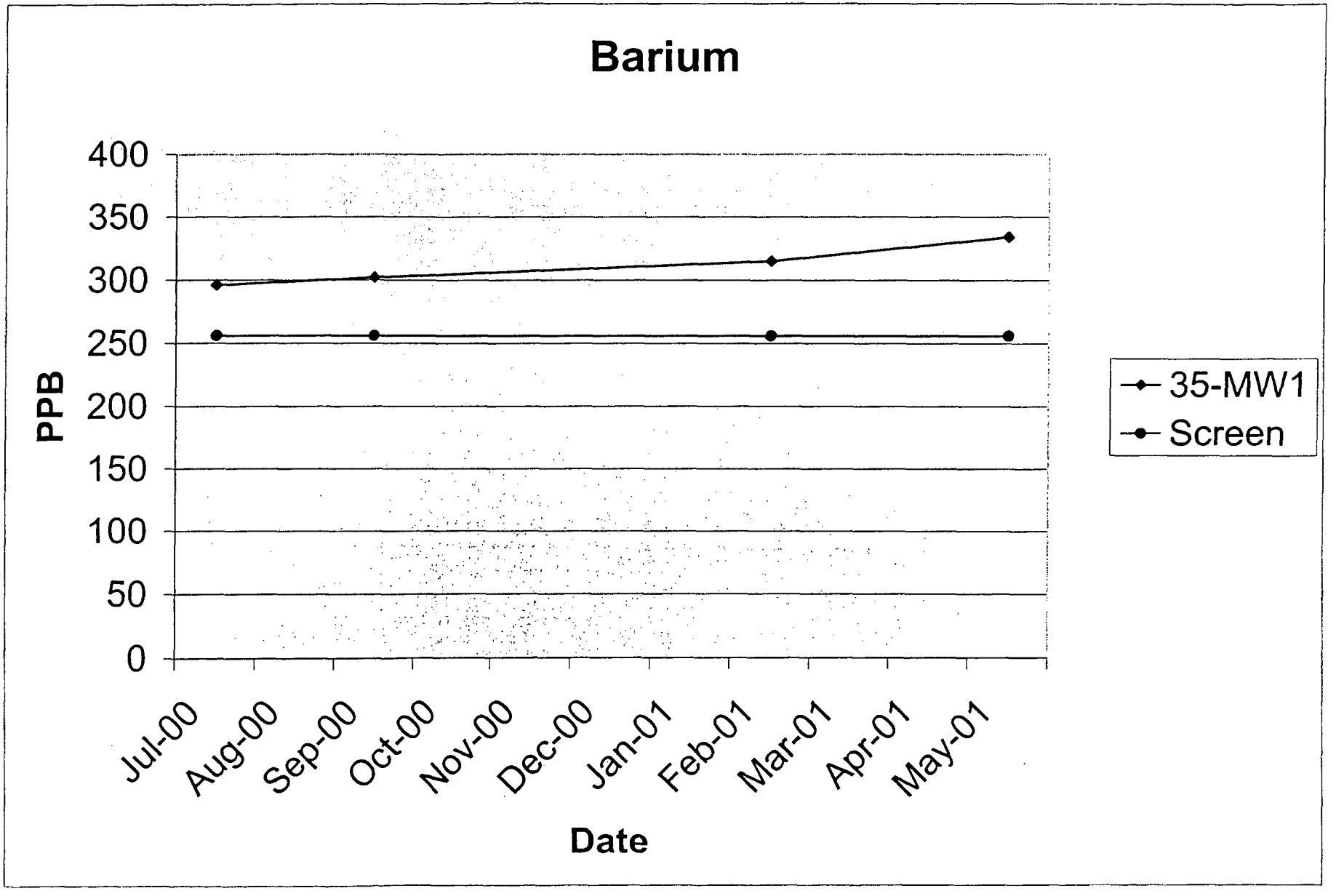

Vinyl Chloride (3 of 3)
PPB
90
80
70
60
50
40
30
20
10
0
Jun-00
Jul-00
Aug-00
Sep-00
Oct-00
Nov-00
Dec-00
Jan-01
Feb-01
Mar-01
Apr-01
May-01
Date
34-MW8
Screen
34-OB-12
34-OB-13
34-SPMW-02

# AOI-35

| ParameterName | Screen Level | AOI | 35 | 35 | 35 | 35 | 35 | 35 | 35 |
|---|---|---|---|---|---|---|---|---|---|
| | | Location | 35-MW1 | 35-MW1 | 35-MW1 | 35-MW1 | 35-MW2 | 35-MW2 | 35-MW2 |
| | | Depth (ft) | 15 | 15 | 15 | 15 | 13.5 | 13.5 | NA |
| | | Date | 07/10/00 | 09/20/00 | 02/01/01 | 05/01/01 | 07/12/00 | 09/20/00 | 05/09/01 |
| | | Units | | | | | | | |
| Arsenic | 4.5 | ug/L | ***7.8*** | ***5.6*** | ***2.6*** | ***9.5*** | < 20 | 2.6 J | 4.6 J |
| ***Barium*** | ***256*** | ***ug/L*** | ***296*** | ***302*** | ***315*** | ***334*** | 159 | 157 | 156 J |
| Cadmium | 3.7 | ug/L | < 0.17 J | < 0.17 | < 0.15 J | 1 J | < 5 | < 0.17 | 1.5 J |
| Selenium | 18 | ug/L | < 40 | < 2.1 | < 14.5 | 6 J | < 40 | < 2.1 | 7.4 J |
| 2-Methylnaphthalene | 110 | ug/L | < 1 | 37 | 0.1 J | < 2 | < 1 J | < 2 | < 2 |
| Acenaphthene | 219 | ug/L | < 1 | 4 | < 1 | < 2 | < 1 | 0.4 J | < 2 |
| Benzo(a)anthracene | 9.2 | ug/L | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 |
| Benzo(a)pyrene | 0.2 | ug/L | < 1 | < 2 | < 1 | < 2 | < 1 | < 2 | < 2 |
| Chrysene | 9.2 | ug/L | < 1 | < 2 | < 1 | < 2 | < 1 | < 2 | < 2 |
| Dibenzo(a,h)anthracene | 0.92 | ug/L | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 |
| Naphthalene - SW-846 8270C | 73 | ug/L | < 2 | < 2 J | < 2 | < 2 | < 2 R | < 2 J | 0.1 J |
| Pentachlorophenol | 1 | ug/L | < 1 | < 2 | < 1 J | < 2 | < 1 | < 2 J | < 2 |
| Phenanthrene | 110 | ug/L | 0.2 J | 6 | < 1 | < 2 | < 1 | < 2 | < 2 |
| 1,1,1-Trichloroethane | 73 | ug/L | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 1,1,2-Trichloroethane | 1.2 | ug/L | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 1,1-Dichloroethane | 365 | ug/L | 0.8 J | 1 | 0.5 J | < 1 | < 1 | < 1 | < 1 |
| 1,1-Dichloroethene | 7 | ug/L | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 1,2-Dichloroethane | 5 | ug/L | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| 1,2-Dichloroethene (total) | 33 | ug/L | < 2 | 2 | < 2 | < 2 | < 2 | 2 | < 2 |
| Benzene | 2.3 | ug/L | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| Chloroethane (Ethyl chloride) | 23 | ug/L | < 1 | < 1 | < 2 | < 2 | < 1 | < 1 | < 2 |
| Chloromethane (Methyl chloride) | 5.2 | ug/L | < 1 | < 1 | < 2 | < 2 | < 1 | < 1 | < 2 |
| Ethylbenzene | 365 | ug/L | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| Trichloroethene | 6.1 | ug/L | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| Vinyl chloride | 2 | ug/L | 0.6 J | 2 | 2 | 2 | < 1 | < 1 | < 2 |

Note: Screening level exceedences are in bold
The bolded italic data are graphed.
"Screen" label on graphs = screening level concentration


Arsenic
PPB
10
9
8
7
6
5
4
3
2
1
0
Jul-00
Aug-00
Sep-00
Oct-00
Nov-00
Dec-00
Jan-01
Feb-01
Mar-01
Apr-01
May-01
Date
35-MW1
Screen


Barium
400
350
300
250
200
150
100
50
0
PPB
Jul-00
Aug-00
Sep-00
Oct-00
Nov-00
Dec-00
Jan-01
Feb-01
Mar-01
Apr-01
May-01
Date
35-MW1
Screen

# AOI-36

| ParameterName | Screen Level | AOI | 36 | 36 | 36 | 36 | 36 | 36 | 36 |
|---|---|---|---|---|---|---|---|---|---|
| | | Location | 36-MW1 | 36-MW1 | 36-MW1 | 36-MW1 | 36-MW2 | 36-MW2 | 36-MW2 |
| | | Depth (ft) | 8 | 8 | 8 | 8 | 10 | 10 | 10 |
| | | Date | 06/26/00 | 09/20/00 | 01/30/01 | 05/02/01 | 06/27/00 | 09/22/00 | 01/30/01 |
| | | Units | | | | | | | |
| **Arsenic** | 4.5 | ug/L | < 20 | < 1.8 | < 5.2 | < 1.6 | 2.6 J | < 8.2 | < 5.2 |
| Barium | 256 | ug/L | 54.4 J | 63.5 | 150 | 155 | 166 J | 221 | 218 |
| Cadmium | 3.7 | ug/L | < 5 | < 0.17 | < 0.15 J | 0.44 J | < 5 | < 0.17 | < 0.15 J |
| Selenium | 18 | ug/L | 4.4 J | < 2.1 | < 31.3 | 5.6 J | < 40 | 3 J | < 41.1 |
| 2-Methylnaphthalene | 110 | ug/L | < 3 J | < 2 | < 2 | < 2 | < 3 J | < 2 J | < 2 |
| Acenaphthene | 219 | ug/L | < 3 J | < 2 | < 2 | < 2 | < 3 J | < 2 J | < 2 |
| Benzo(a)anthracene | 9.2 | ug/L | < 4 | < 2 | < 2 | < 2 | < 4 | < 2 J | < 2 |
| Benzo(a)pyrene | 0.2 | ug/L | < 3 | < 2 | < 2 | < 2 | < 3 | < 2 J | < 2 |
| Chrysene | 9.2 | ug/L | < 3 | < 2 | < 2 | < 2 | < 3 | < 2 J | < 2 |
| Dibenzo(a,h)anthracene | 0.92 | ug/L | < 3 | < 2 | < 2 | < 2 | < 3 | < 2 J | < 2 |
| Naphthalene - SW-846 8270C | 73 | ug/L | < 4 J | < 2 J | < 2 | < 2 | < 4 J | < 2 J | < 2 |
| Pentachlorophenol | 1 | ug/L | < 3 | < 2 | < 2 J | < 2 | < 3 | < 2 J | < 2 J |
| Phenanthrene | 110 | ug/L | < 3 | < 2 | < 2 | < 0.1 | < 3 | < 2 J | < 2 |
| 1,1,1-Trichloroethane | 73 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 |
| 1,1,2-Trichloroethane | 1.2 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 |
| 1,1-Dichloroethane | 365 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 |
| 1,1-Dichloroethene | 7 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 |
| 1,2-Dichloroethane | 5 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 |
| 1,2-Dichloroethene (total) | 33 | ug/L | < 10 | 2 | < 2 | < 2 | < 10 | 8 | 1 J |
| Benzene | 2.3 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 |
| Chloroethane (Ethyl chloride) | 23 | ug/L | < 10 J | < 1 | < 2 | < 2 | < 10 | < 1 | < 2 |
| Chloromethane (Methyl chloride) | 5.2 | ug/L | < 10 J | < 1 | < 2 | < 2 | < 10 J | < 1 | < 2 |
| Ethylbenzene | 365 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 R | < 1 |
| Trichloroethene | 6.1 | ug/L | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 |
| Vinyl chloride | 2 | ug/L | < 10 J | < 1 | < 2 | < 2 | < 10 J | 0.9 J | < 2 |

Note: Screening level exceedences are in bold.
The bolded italic data are graphed.
"S[illegible]n" label on graphs = screening level concentration

# AOI-36

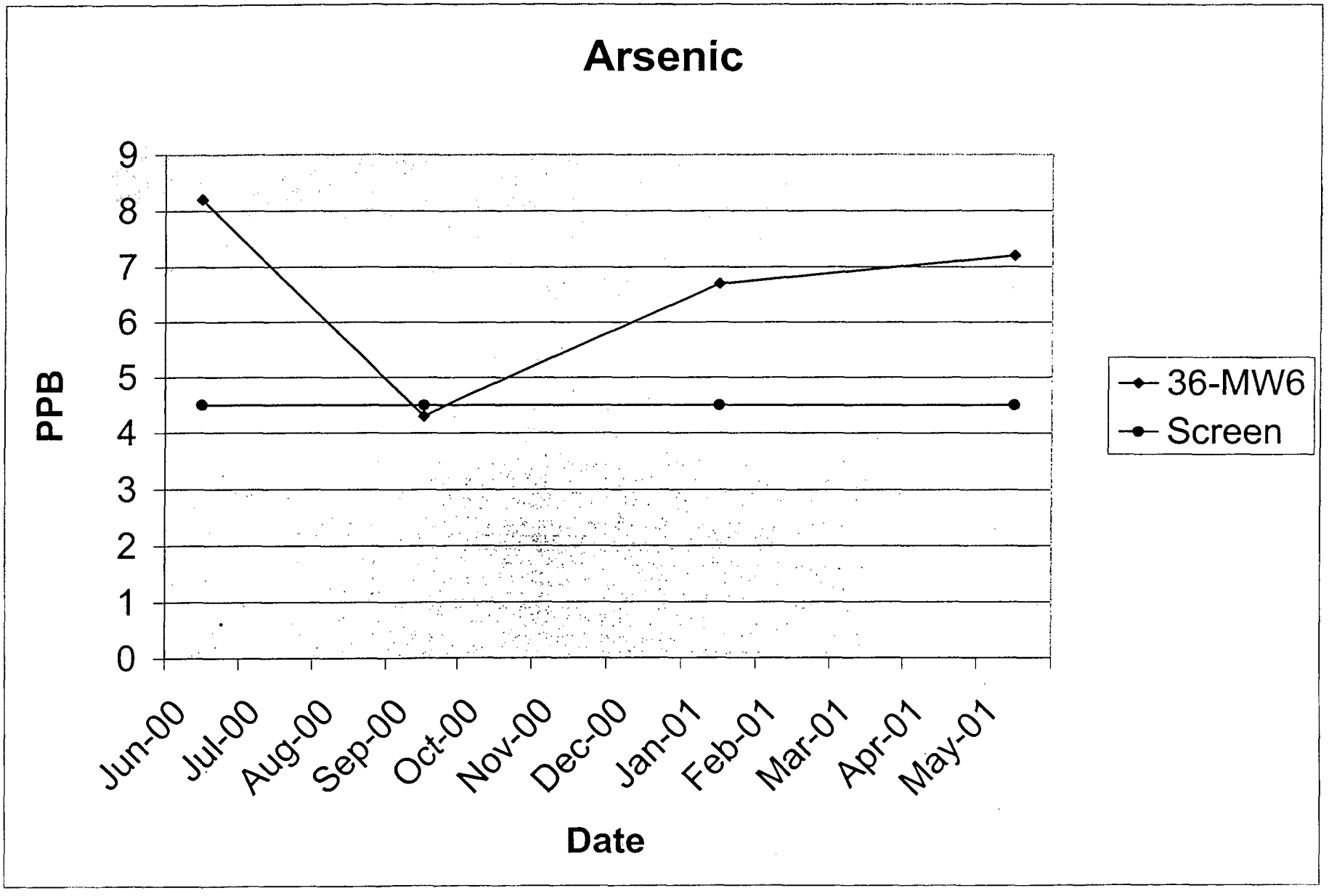
| ParameterName | Screen Level | AOI | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Location | 36-MW2 | 36-MW4 | 36-MW4 | 36-MW4 | 36-MW4 | 36-MW5 | 36-MW5 | 36-MW5 |
| | | Depth (ft) | 10 | NA | 7 | 7 | 7 | 9 | 9 | 9 |
| | | Date | 05/02/01 | 05/03/01 | 06/25/00 | 09/22/00 | 02/01/01 | 06/27/00 | 09/22/00 | 01/30/01 |
| | | Units | | | | | | | | |
| **Arsenic** | **4.5** | ug/L | < 1.6 | 3.8 J | < 20 | < 3.4 | < 5.2 | < 20 | < 1.8 | < 5.2 |
| Barium | 256 | ug/L | 175 | 111 J | 99.9 | 113 | 115 | 138 J | 156 | 150 |
| Cadmium | 3.7 | ug/L | 0.46 J | 0.49 J | < 5 | < 0.17 | < 0.15 J | < 5 | < 0.17 | < 0.15 J |
| Selenium | 18 | ug/L | < 1.8 | 3.3 J | < 40 | 2.2 J | < 14.5 | < 40 | 5 J | < 26.7 |
| 2-Methylnaphthalene | 110 | ug/L | < 1 | < 2 | < 1 J | < 2 | < 1 | < 3 J | < 2 | < 1 |
| Acenaphthene | 219 | ug/L | < 1 | < 2 | < 1 | < 2 | < 1 | < 3 J | < 2 | < 1 |
| Benzo(a)anthracene | 9.2 | ug/L | < 2 | < 2 | < 2 | < 2 | < 2 | < 4 | < 2 | < 2 |
| Benzo(a)pyrene | 0.2 | ug/L | < 1 | < 2 | < 1 | < 2 | < 1 | < 3 | < 2 | < 1 |
| Chrysene | 9.2 | ug/L | < 1 | < 2 | < 1 | < 2 | < 1 | < 3 | < 2 | < 1 |
| Dibenzo(a,h)anthracene | 0.92 | ug/L | < 2 | < 2 | < 1 | < 2 | < 2 | < 3 | < 2 | < 2 |
| Naphthalene - SW-846 8270C | 73 | ug/L | < 2 | < 2 | < 2 J | < 2 | < 2 | < 4 J | < 2 | < 2 |
| Pentachlorophenol | 1 | ug/L | < 1 | < 2 | < 1 | < 2 | < 1 J | < 3 | < 2 | < 1 J |
| Phenanthrene | 110 | ug/L | < 1 | < 2 | < 1 | < 2 | < 1 | < 3 | < 2 | < 1 |
| 1,1,1-Trichloroethane | 73 | ug/L | < 1 | < 1 | < 5 | < 1 | < 1 | < 5 | < 1 | < 1 |
| 1,1,2-Trichloroethane | 1.2 | ug/L | < 1 | < 1 | < 5 | < 1 | < 1 | < 5 | < 1 | < 1 |
| 1,1-Dichloroethane | 365 | ug/L | 27 | < 1 | < 5 | < 1 | < 1 | < 5 | < 1 | < 1 |
| 1,1-Dichloroethene | 7 | ug/L | < 1 | < 1 | < 5 | < 1 | < 1 | < 5 | < 1 | < 1 |
| 1,2-Dichloroethane | 5 | ug/L | < 1 | < 1 | < 5 | < 1 | < 1 | < 5 | < 1 | < 1 |
| 1,2-Dichloroethene (total) | 33 | ug/L | 1 J | < 2 | < 10 | 2 | < 2 | < 10 | 2 | < 2 |
| Benzene | 2.3 | ug/L | < 1 | < 1 | < 5 | < 1 | < 1 | < 5 | < 1 | < 1 |
| Chloroethane (Ethyl chloride) | 23 | ug/L | < 2 | < 2 | < 10 | < 1 | < 2 | < 10 | < 1 | < 2 |
| Chloromethane (Methyl chloride) | 5.2 | ug/L | < 2 | < 2 | < 10 | < 1 | < 2 | < 10 J | < 1 | < 2 |
| Ethylbenzene | 365 | ug/L | < 1 | < 1 | < 5 | < 1 | < 1 | < 5 | < 1 R | < 1 |
| Trichloroethene | 6.1 | ug/L | < 1 | < 1 | < 5 | < 1 | < 1 | < 5 | < 1 | < 1 |
| Vinyl chloride | 2 | ug/L | **11** | < 2 | < 10 | < 1 | < 2 | < 10 | < 1 | < 2 |

Note: Screening level exceedences are in bold.
The bolded italic data are graphed.
"Screen" label on graphs = screening level concentration

# AOI-36

| ParameterName | Screen Level | AOI | 36 | 36 | 36 | 36 | 36 |
|---|---|---|---|---|---|---|---|
| | | Location | 36-MW5 | 36-MW6 | 36-MW6 | 36-MW6 | 36-MW6 |
| | | Depth (ft) | 9 | 10 | 10 | 10 | 10 |
| | | Date | 05/03/01 | 06/27/00 | 09/22/00 | 01/30/01 | 05/03/01 |
| | | Units | | | | | |
| **Arsenic** | **4.5** | ug/L | 2 J | ***8.2*** | ***4.3*** | ***6.7*** | ***7.2*** |
| Barium | 256 | ug/L | 155 J | 93.5 J | 77.4 | 77.9 | 103 J |
| Cadmium | 3.7 | ug/L | 0.45 J | < 5 | < 0.17 | < 0.15 J | < 0.29 |
| Selenium | 18 | ug/L | 6 J | 3.8 J | 3.9 J | < 39.5 | 2.4 J |
| 2-Methylnaphthalene | 110 | ug/L | < 2 | < 1 | < 2 | < 2 | < 2 |
| Acenaphthene | 219 | ug/L | < 2 | < 1 | < 2 | < 2 | < 2 |
| Benzo(a)anthracene | 9.2 | ug/L | < 2 | < 2 | < 2 | < 2 | < 2 |
| Benzo(a)pyrene | 0.2 | ug/L | < 2 | < 1 | < 2 | < 2 | < 2 |
| Chrysene | 9.2 | ug/L | < 2 | < 1 | < 2 | < 2 | < 2 |
| Dibenzo(a,h)anthracene | 0.92 | ug/L | < 2 | < 1 | < 2 | < 2 | < 2 |
| Naphthalene - SW-846 8270C | 73 | ug/L | < 2 | < 2 | < 2 | < 0.3 | < 2 |
| Pentachlorophenol | 1 | ug/L | < 2 | < 1 | < 2 | < 2 J | < 2 |
| Phenanthrene | 110 | ug/L | < 2 | < 1 | < 2 | < 2 | < 2 |
| 1,1,1-Trichloroethane | 73 | ug/L | < 1 | < 5 | < 1 | < 1 | < 1 |
| 1,1,2-Trichloroethane | 1.2 | ug/L | < 1 | < 5 | < 1 | < 1 | < 1 |
| 1,1-Dichloroethane | 365 | ug/L | < 1 | < 5 | < 1 | < 1 | < 1 |
| 1,1-Dichloroethene | 7 | ug/L | < 1 | < 5 | < 1 | < 1 | < 1 |
| 1,2-Dichloroethane | 5 | ug/L | < 1 | < 5 | < 1 | < 1 | < 1 |
| 1,2-Dichloroethene (total) | 33 | ug/L | < 2 | < 10 | 0.7 | 0.8 J | 0.7 J |
| Benzene | 2.3 | ug/L | < 1 | < 5 | < 1 | < 1 | < 1 |
| Chloroethane (Ethyl chloride) | 23 | ug/L | < 2 | < 10 | < 1 | < 2 | < 2 |
| Chloromethane (Methyl chloride) | 5.2 | ug/L | < 2 | < 10 | < 1 | < 2 | < 2 |
| Ethylbenzene | 365 | ug/L | < 1 | < 5 | < 1 | < 1 | < 1 |
| Trichloroethene | 6.1 | ug/L | < 1 | < 5 | < 1 | < 1 | < 1 |
| Vinyl chloride | 2 | ug/L | < 2 | < 10 | < 1 | < 2 | < 2 |

Note: Screening level exceedences are in bold.
The bolded italic data are graphed.
"S[illegible]n" label on graphs = screening level concentration


Arsenic
PPB
9
8
7
6
5
4
3
2
1
0
Jun-00
Jul-00
Aug-00
Sep-00
Oct-00
Nov-00
Dec-00
Jan-01
Feb-01
Mar-01
Apr-01
May-01
Date
36-MW6
Screen

# AOI-38

| Parameter/Name | Screen Level | AOI | 38 | 38 | 38 | 38 | 38 | 38 | 38 | 38 | 38 | 38 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Location | 38-MW12 | 38-MW12 | 38-MW12 | 38-MW12 | 38-MW2 | 38-MW2 | 38-MW2 | 38-MW2 | 38-MW2 | 38-MW3 |
| | | Depth (ft) | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| | | Date | 07/11/00 | 09/20/00 | 01/26/01 | 06/03/01 | 06/22/00 | 06/27/00 | 06/20/00 | 01/26/01 | 06/04/01 | 06/22/00 |
| | | Units | | | | | | | | | | |
| Arsenic | 4.5 | ug/L | < 20 | 2.1 J | < 4.4 | 5.6 J | NA | < 20 | < 1.8 | < 4.4 | < 1.6 | < 20 |
| Barium | 256 | ug/L | *793* | *316* | *292* | *297* | NA | 124 J | 111 | 110 | 112 | 234 |
| Cadmium | 3.7 | ug/L | < 0.17 J | < 0.17 | < 0.16 | < 0.29 | NA | < 5 | < 0.17 | < 0.16 | < 0.29 | < 0.22 J |
| Selenium | 18 | ug/L | < 40 | < 2.1 | 10.6 J | < 1.8 | NA | < 40 | 4.1 J | < 3.7 | 4.8 J | < 40 |
| 2-Methylnaphthalene | 110 | ug/L | 36 | < 1 | NA | 22 | < 2 | NA | < 1 | NA | < 2 | < 2 |
| Acenaphthene | 219 | ug/L | 1 J | < 1 | 1 J | 1 J | < 2 | NA | < 1 | < 2 | < 2 | < 2 |
| Benzo(a)anthracene | 9.2 | ug/L | < 2 | < 2 | < 2 | < 2 | < 2 | NA | < 2 | < 2 | < 2 | < 2 |
| Benzo(a)pyrene | 0.2 | ug/L | < 1 | < 1 | < 1 | < 1 | < 2 | NA | < 1 | < 2 | < 2 | < 2 |
| Chrysene | 9.2 | ug/L | < 1 | < 1 | < 1 | < 1 | < 2 | NA | < 1 | < 2 | < 2 | < 2 |
| Dibenzo(a,h)anthracene | 0.92 | ug/L | < 2 | < 2 | < 2 | < 2 | < 2 | NA | < 2 | < 2 | < 2 | < 2 |
| Naphthalene - SW-846 8270C | 73 | ug/L | 37 | < 2 J | 33 | 18 | < 2 | NA | < 2 | < 2 | < 2 | < 2 |
| Pentachlorophenol | 1 | ug/L | < 1 | < 1 | NA | 3 | < 2 | NA | < 1 | NA | < 2 | < 2 |
| Phenanthrene | 110 | ug/L | 0.8 J | < 1 | 2 | 1 J | < 2 | NA | < 1 | < 2 | < 2 | < 2 |
| **1,1,1-Trichloroethane** | 73 | ug/L | *NA* | *2200* | *2200* | *4100* | < 5 | NA | < 1 | < 1 | < 1 | < 5 |
| **1,1,2-Trichloroethane** | 1.2 | ug/L | *NA* | *0.5* | *1* | *4* | < 5 | NA | < 1 | < 1 | < 1 | < 5 |
| **1,1-Dichloroethane** | 365 | ug/L | *NA* | *1200* | *870* | *1200* | < 5 | NA | < 1 | < 1 | < 1 | < 5 |
| **1,1-Dichloroethene** | 7 | ug/L | *NA* | *50* | *170* | *350* | < 5 | NA | < 1 | < 1 | < 1 | < 5 |
| 1,2-Dichloroethane | 5 | ug/L | NA | < 1 | < 1 | 1 | < 5 | NA | < 1 | < 1 | < 1 | < 5 |
| **1,2-Dichloroethene (total)** | 33 | ug/L | *NA* | *3500* | *3000* | *5300* | < 10 | NA | 2 | < 2 | < 2 | < 10 |
| **Benzene** | 2.3 | ug/L | NA | 3 | 2 | 2 | < 5 | NA | < 1 | < 1 | < 1 | < 5 |
| **Chloroethane (Ethyl chloride)** | 23 | ug/L | *NA* | *170* | *190* | *160* | < 10 | NA | < 1 | < 2 | < 2 | < 10 |
| Chloromethane (Methyl chloride) | 5.2 | ug/L | NA | < 1 | < 2 J | < 2 | < 10 J | NA | < 1 | < 2 | < 2 | < 10 J |
| Ethylbenzene | 365 | ug/L | NA | 8 | 6 | 7 | < 5 | NA | < 1 | < 1 | < 1 | < 5 |
| **Trichloroethene** | 6.1 | ug/L | *NA* | *91* | *370* | *430* | < 5 | NA | < 1 | < 1 | < 1 | < 5 |
| **Vinyl chloride** | 2 | ug/L | *NA* | *710* | *820* | *550* | < 10 J | NA | < 1 | < 2 | < 2 | < 10 J |

Note: Screening level exceedences are in bold.
The b[illegible]d italic data are graphed.
"Sc[illegible]el on graphs = screening level concentration

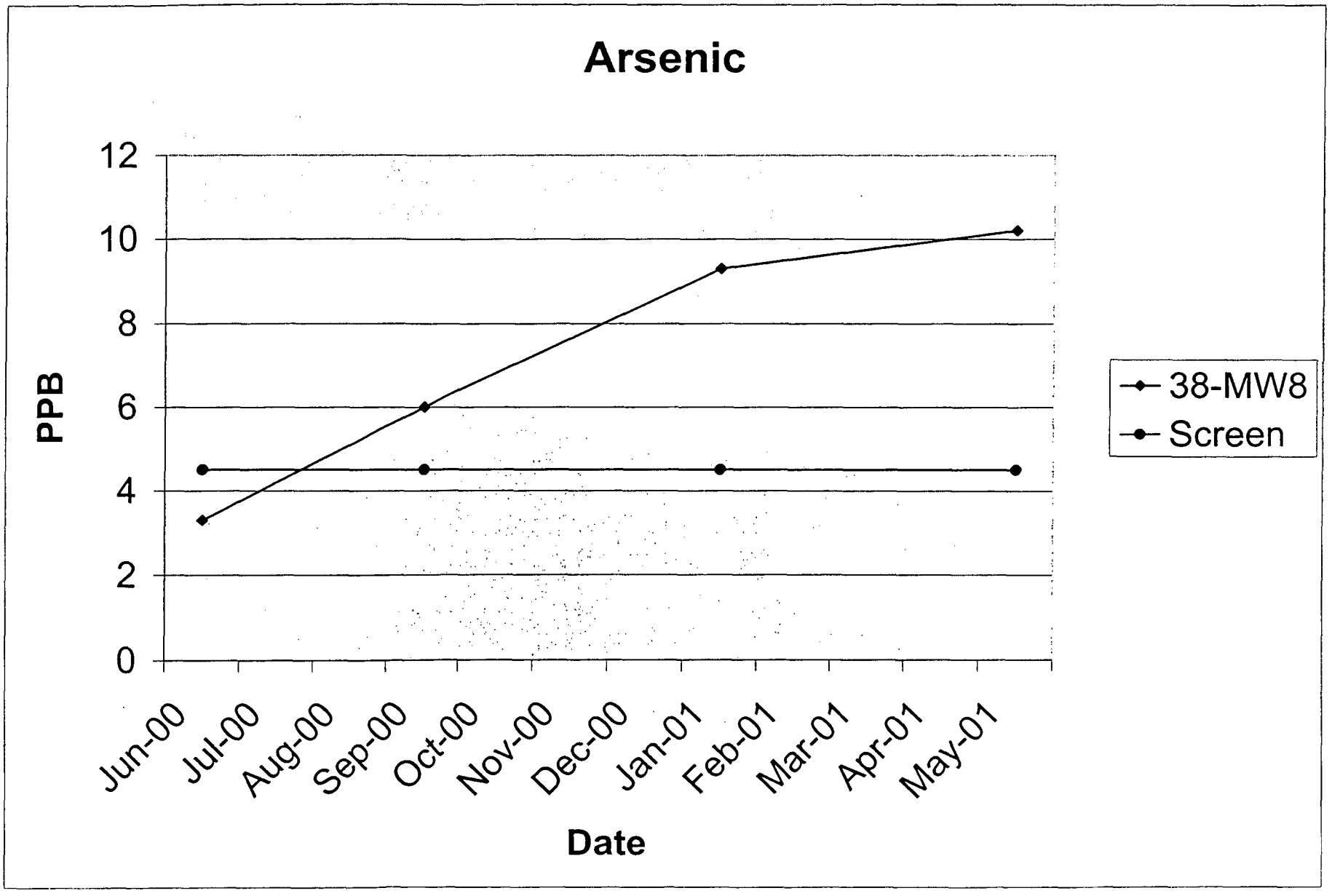
| ParameterName | Screen Level | AOI | 38 | 38 | 38 | 38 | 38 | 38 | 38 | 38 | 38 | 38 | 38 | 38 | 38 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Location | 38-MW3 | 38-MW3 | 38-MW3 | 38-MW4 | 38-MW4 | 38-MW4 | 38-MW4 | 38-MW5 | 38-MW5 | 38-MW5 | 38-MW5 | 38-MW7 | 38-MW7 |
| | | Depth (ft) | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 11 | 11 |
| | | Date | 09/23/00 | 01/26/01 | 05/04/01 | 06/22/00 | 09/21/00 | 01/29/01 | 05/08/01 | 06/22/00 | 09/20/00 | 01/26/01 | 05/03/01 | 06/23/00 | 09/20/00 |
| | | Units | | | | | | | | | | | | | |
| Arsenic | 4.5 | ug/L | < 3.2 | < 4.4 | < 1.6 | < 20 | < 1.8 | < 5.2 | < 1.6 | < 20 | < 1.8 | < 4.4 | 2.1 J | < 20 | < 1.8 |
| Barium | 256 | ug/L | 160 | 240 | 260 | *434* | *374* | *414* | *436* | *336* | *340* | *327* | *330* | *279* | *316* |
| Cadmium | 3.7 | ug/L | < 0.17 | < 0.16 | < 0.29 | < 0.22 J | < 0.17 | < 0.15 J | 4.2 J | < 0.22 J | < 0.17 | < 0.16 | < 0.29 | < 0.22 J | < 0.17 |
| Selenium | 18 | ug/L | 3.5 J | < 3.7 | 2 J | 37 J | 2.1 J | < 14.5 J | 3.6 J | < 40 | < 2.1 | < 3.7 | 3 J | < 40 | < 2.1 |
| 2-Methylnaphthalene | 110 | ug/L | < 2 | NA | < 2 | 7 | 0.2 J | 5 | 2 | 0.7 J | 3 | NA | 0.9 J | 3 | 0.07 J |
| Acenaphthene | 219 | ug/L | < 2 | < 2 | < 2 | 2 | 0.2 J | 2 | 2 | 2 | 2 | 2 | 3 | 1 J | < 2 |
| Benzo(a)anthracene | 9.2 | ug/L | < 2 | < 2 | < 2 | < 2 | < 2 J | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 |
| Benzo(a)pyrene | 0.2 | ug/L | < 2 | < 2 | < 2 | < 2 | < 2 J | < 2 | < 2 | < 2 | 1 J | < 2 | < 2 | < 2 | < 2 |
| Chrysene | 9.2 | ug/L | < 2 | < 2 | < 2 | < 2 | < 2 J | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 |
| Dibenzo(a,h)anthracene | 0.92 | ug/L | < 2 | < 2 | < 2 | < 2 | < 2 J | < 2 | < 2 | < 2 | 0.3 J | < 2 | < 2 | < 2 | < 2 |
| Naphthalene - SW-846 8270C | 73 | ug/L | < 2 | < 2 | < 2 | < 2 | < 2 J | < 2 | < 2 | 0.2 J | 0.9 J | 0.2 J | 0.1 J | 3 | < 2 J |
| Pentachlorophenol | 1 | ug/L | < 2 | NA | < 2 | < 2 | < 2 J | 2 J | < 2 | < 2 | < 2 | NA | 3 | < 2 | < 2 |
| Phenanthrene | 110 | ug/L | < 2 | < 2 | < 2 | 0.3 J | 0.5 J | 0.2 J | 0.2 J | < 2 | 0.7 J | < 2 | < 2 | 0.7 J | < 2 |
| 1,1,1-Trichloroethane | 73 | ug/L | < 1 | 0.5 J | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 |
| 1,1,2-Trichloroethane | 1.2 | ug/L | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 R | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 |
| 1,1-Dichloroethane | 365 | ug/L | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | 3 J | 5 |
| 1,1-Dichloroethene | 7 | ug/L | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 |
| 1,2-Dichloroethane | 5 | ug/L | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 |
| 1,2-Dichloroethene (total) | 33 | ug/L | 2 | 0.7 J | < 2 | < 10 | 2 | < 1 | < 2 | < 10 | 2 | < 2 | < 2 | < 10 | 2 |
| Benzene | 2.3 | ug/L | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | 2 J | 1 | 1 | 1 | 3 | 2 |
| Chloroethane (Ethyl chloride) | 23 | ug/L | < 1 | < 2 | < 2 | < 10 | < 1 | < 2 | < 2 | < 10 | 2 | 2 J | < 2 | *18* | *15* |
| Chloromethane (Methyl chloride) | 5.2 | ug/L | < 1 | < 2 J | < 2 | < 10 J | < 1 | < 2 | < 2 | < 10 J | < 1 | < 2 | < 2 | < 10 J | < 1 |
| Ethylbenzene | 365 | ug/L | < 1 R | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 |
| Trichloroethene | 6.1 | ug/L | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 |
| Vinyl chloride | 2 | ug/L | < 1 | < 2 | < 2 | < 10 J | < 1 | < 2 | < 2 | < 10 J | < 1 | < 2 | < 2 | < 10 J | 2 |

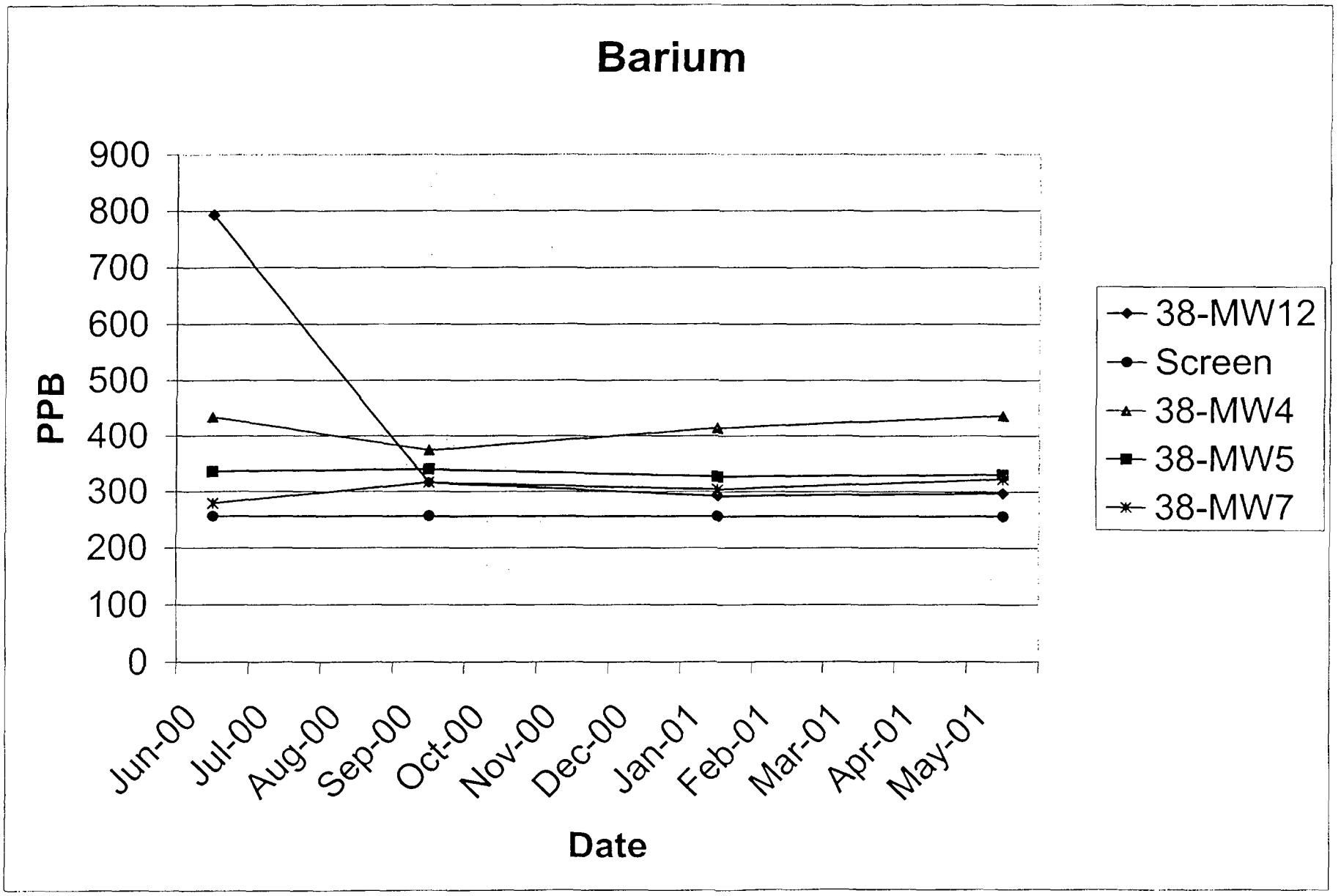
Note: Screening level exceedences are in bold.
The bolded italic data are graphed.
"Screen" label on graphs = screening level concentration

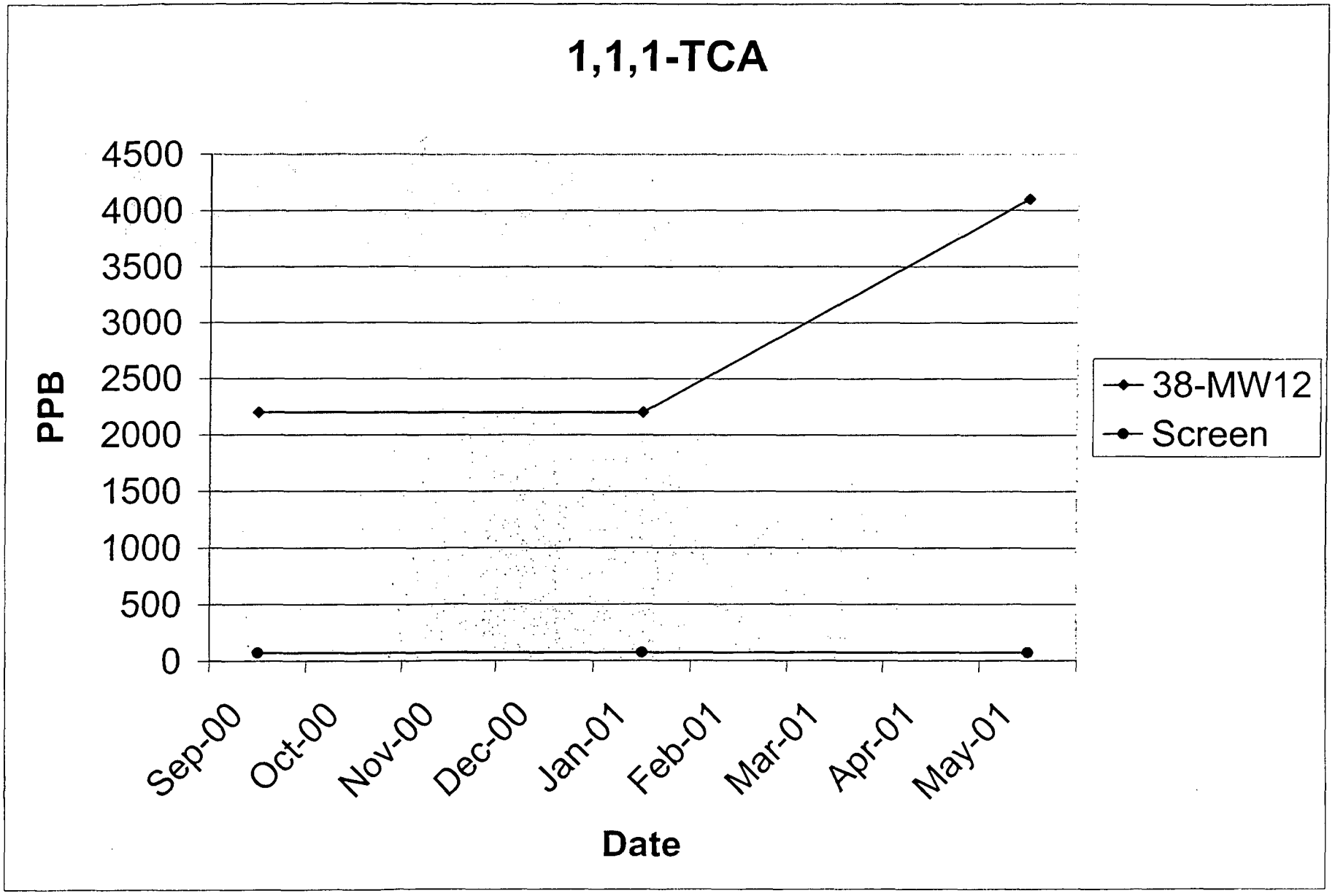
# AOI-38

| | Screen Level | AOI | 38 | 38 | 38 | 38 | 38 | 38 | 38 | 38 | 38 | 38 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Location | 38-MW7 | 38-MW7 | 38-MW8 | 38-MW8 | 38-MW8 | 38-MW8 | 38-MW9 | 38-MW9 | 38-MW9 | 38-MW9 |
| | | Depth (ft) | 11 | 11 | 11 | 11 | 11 | 11 | 9 | 9 | 9 | 9 |
| | | Date | 01/26/01 | 05/04/01 | 06/24/00 | 09/20/00 | 01/29/01 | 05/04/01 | 06/23/00 | 09/20/00 | 01/29/01 | 05/04/01 |
| Parameter Name | | Units | | | | | | | | | | |
| Arsenic | 4.5 | ug/L | < 4.4 | < 1.6 | 3.3 | ***6*** | ***9.3*** | ***10.2*** | < 20 | < 1.8 | < 5.2 | 2.3 J |
| Barium | 256 | ug/L | ***304*** | ***322*** | 135 | 145 | 142 | 121 | 133 | 135 | 124 | 117 |
| Cadmium | 3.7 | ug/L | < 0.16 | < 0.29 | < 5 | < 0.17 | < 0.16 | < 0.29 | < 0.22 J | < 0.17 | < 0.15 J | < 0.29 |
| Selenium | 18 | ug/L | < 3.7 | < 1.8 | < 40 | 2.6 J | 7.6 J | 2.1 J | < 40 | < 2.1 | < 14.5 J | < 1.8 |
| 2-Methylnaphthalene | 110 | ug/L | 2 | 6 | 1 J | 0.1 J | < 1 | < 2 | < 2 | < 2 J | < 2 | < 2 |
| Acenaphthene | 219 | ug/L | 1 J | 2 | < 1 | < 2 | < 1 | 0.7 J | < 2 | < 2 J | < 2 | < 2 |
| Benzo(a)anthracene | 9.2 | ug/L | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 | < 2 J | < 2 | < 2 |
| Benzo(a)pyrene | 0.2 | ug/L | < 1 | < 2 | < 1 | < 2 | < 1 | < 2 | < 2 | < 2 J | < 2 | < 2 |
| Chrysene | 9.2 | ug/L | < 1 | < 2 | < 1 | < 2 | < 1 | < 2 | < 2 | < 2 J | < 2 | < 2 |
| Dibenzo(a,h)anthracene | 0.92 | ug/L | < 2 | < 2 | < 1 | < 2 | < 2 | < 2 | < 2 | < 2 J | < 2 | < 2 |
| Naphthalene - SW-846 8270C | 73 | ug/L | 0.4 J | 3 | < 2 J | 0.06 J | < 2 | < 2 | < 2 | < 2 J | < 2 | < 2 |
| Pentachlorophenol | 1 | ug/L | ***2 J*** | < 2 | < 1 | < 2 | ***2 J*** | < 2 | < 2 | < 2 J | < 2 J | < 2 |
| Phenanthrene | 110 | ug/L | 0.3 J | 1 J | 0.5 J | 0.1 J | < 1 | < 2 | < 2 | < 2 J | < 2 | < 2 |
| 1,1,1-Trichloroethane | 73 | ug/L | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| 1,1,2-Trichloroethane | 1.2 | ug/L | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| 1,1-Dichloroethane | 365 | ug/L | 8 | 6 | 2 J | 1 | 1 J | 0.6 J | 9 | 10 | 5 | 7 |
| 1,1-Dichloroethene | 7 | ug/L | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 J | < 1 |
| 1,2-Dichloroethane | 5 | ug/L | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| 1,2-Dichloroethene (total) | 33 | ug/L | < 2 | < 2 | < 10 | 2 | < 2 | < 2 | 2 J | 2 | 1 | 2 J |
| Benzene | 2.3 | ug/L | ***3*** | ***4*** | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | 0.6 J |
| Chloroethane (Ethyl chloride) | 23 | ug/L | ***25*** | ***43*** | < 10 | < 1 | < 2 | < 2 | < 10 J | 2 | 3 | 6 |
| Chloromethane (Methyl chloride) | 5.2 | ug/L | < 2 J | < 2 | < 10 J | < 1 | < 2 J | < 2 | < 10 J | < 1 | < 2 | < 2 |
| Ethylbenzene | 365 | ug/L | < 1 | 2 | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 |
| Trichloroethene | 6.1 | ug/L | < 1 | < 1 | < 5 | < 1 | < 1 | < 1 | < 5 | < 1 | < 1 | 1 |
| Vinyl chloride | 2 | ug/L | 1 J | < 2 | < 10 | < 1 | 0.9 J | 1 J | 9 | 9 | 7 | 7 |

Note: Screening level exceedences are in bold.
The bolded italic data are graphed.
"Sc[illegible]bel on graphs = screening level concentration


Arsenic
PPB
12
10
8
6
4
2
0
Jun-00
Jul-00
Aug-00
Sep-00
Oct-00
Nov-00
Dec-00
Jan-01
Feb-01
Mar-01
Apr-01
May-01
Date
38-MW8
Screen


Barium
900
800
700
600
500
400
300
200
100
0
PPB
Jun-00
Jul-00
Aug-00
Sep-00
Oct-00
Nov-00
Dec-00
Jan-01
Feb-01
Mar-01
Apr-01
May-01
Date
38-MW12
Screen
38-MW4
38-MW5
38-MW7


1,1,1-TCA
PPB
4500
4000
3500
3000
2500
2000
1500
1000
500
0
Sep-00
Oct-00
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Jan-01
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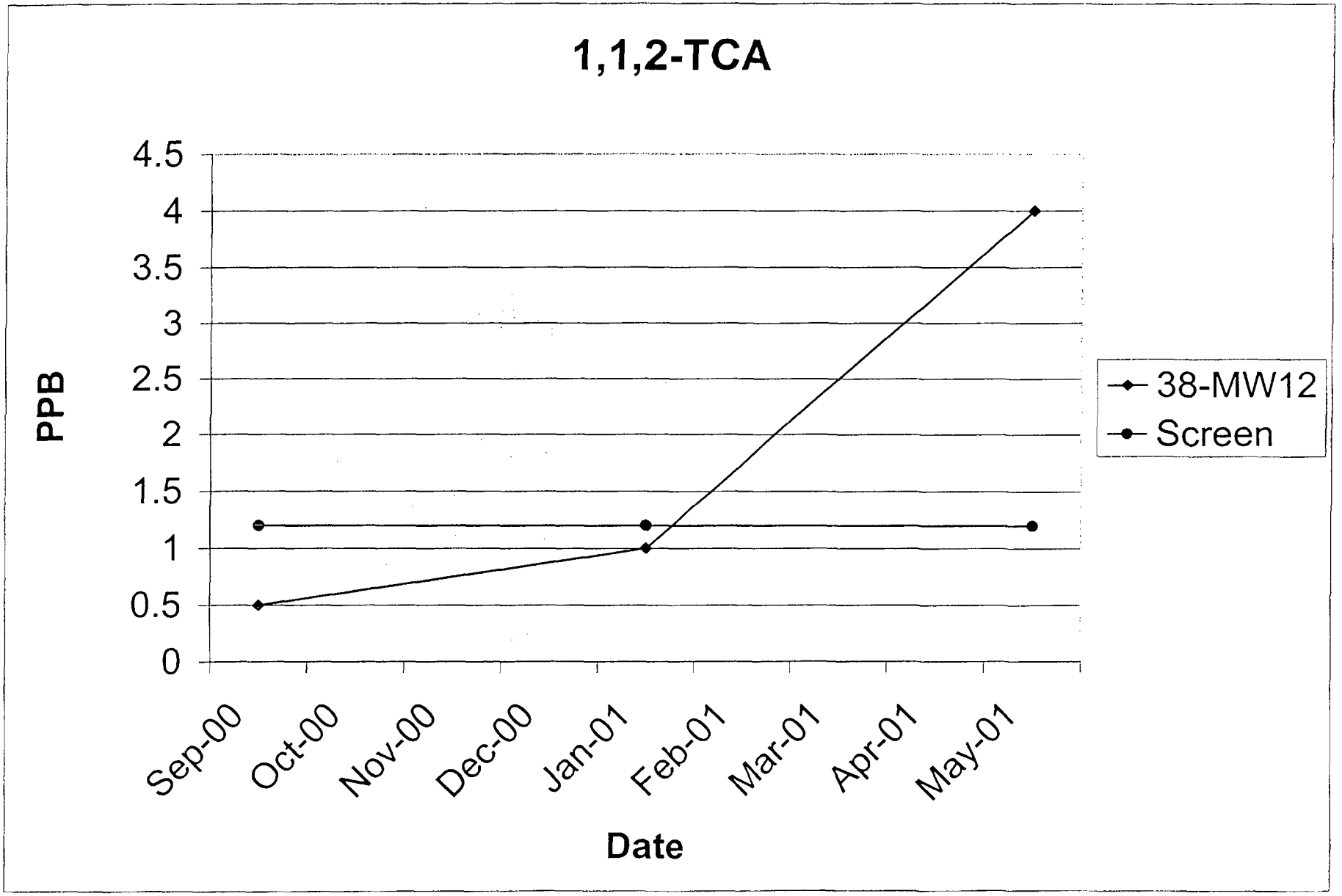
May-01
Date
38-MW12
Screen


1,1,2-TCA
PPB
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Sep-00
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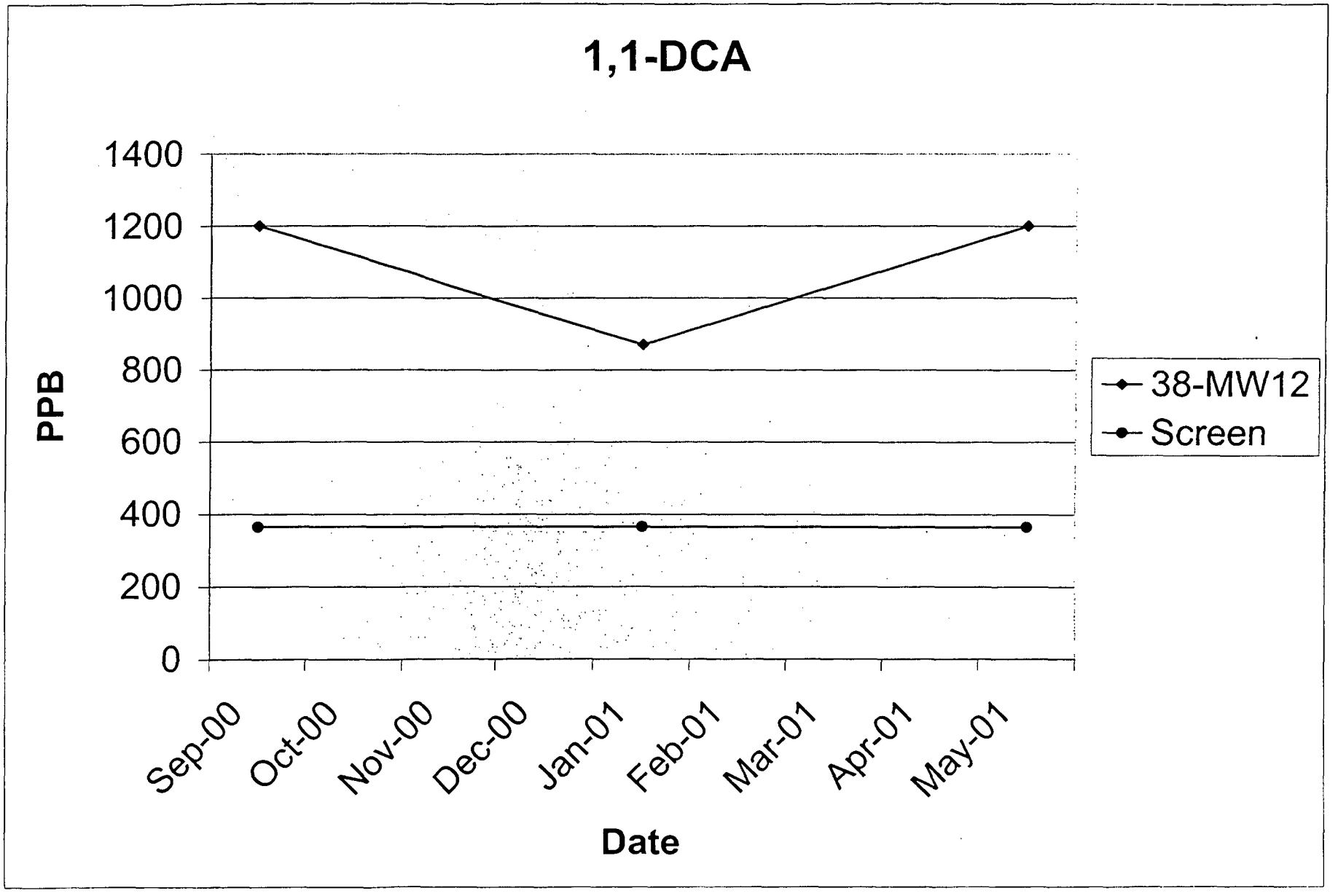
Apr-01
May-01
Date
38-MW12
Screen


1,1-DCA
1400
1200
1000
800
600
400
200
0
PPB
Sep-00
Oct-00
Nov-00
Dec-00
Jan-01
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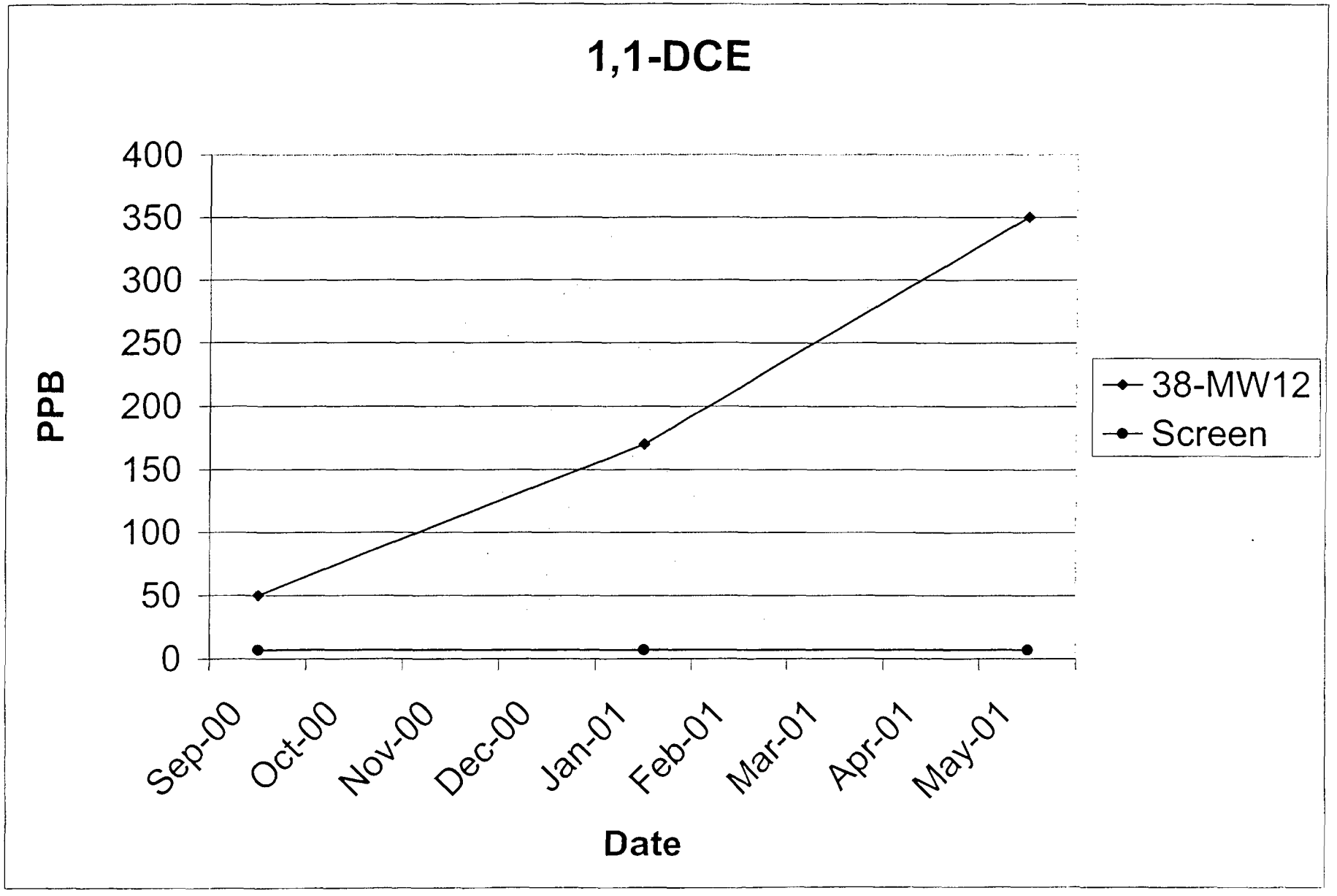
Apr-01
May-01
Date
38-MW12
Screen


1,1-DCE
PPB
400
350
300
250
200
150
100
50
0
Sep-00
Oct-00
Nov-00
Dec-00
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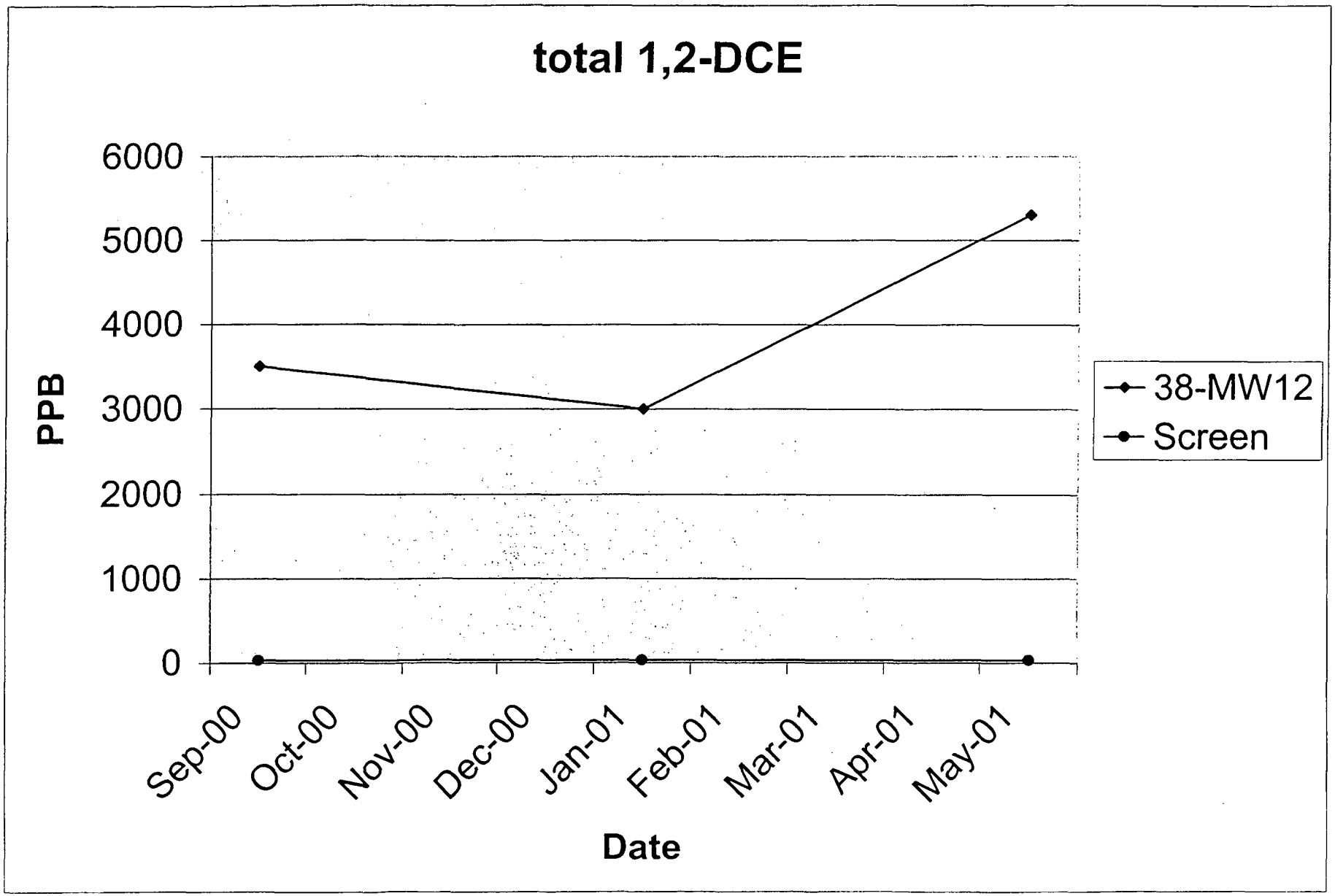
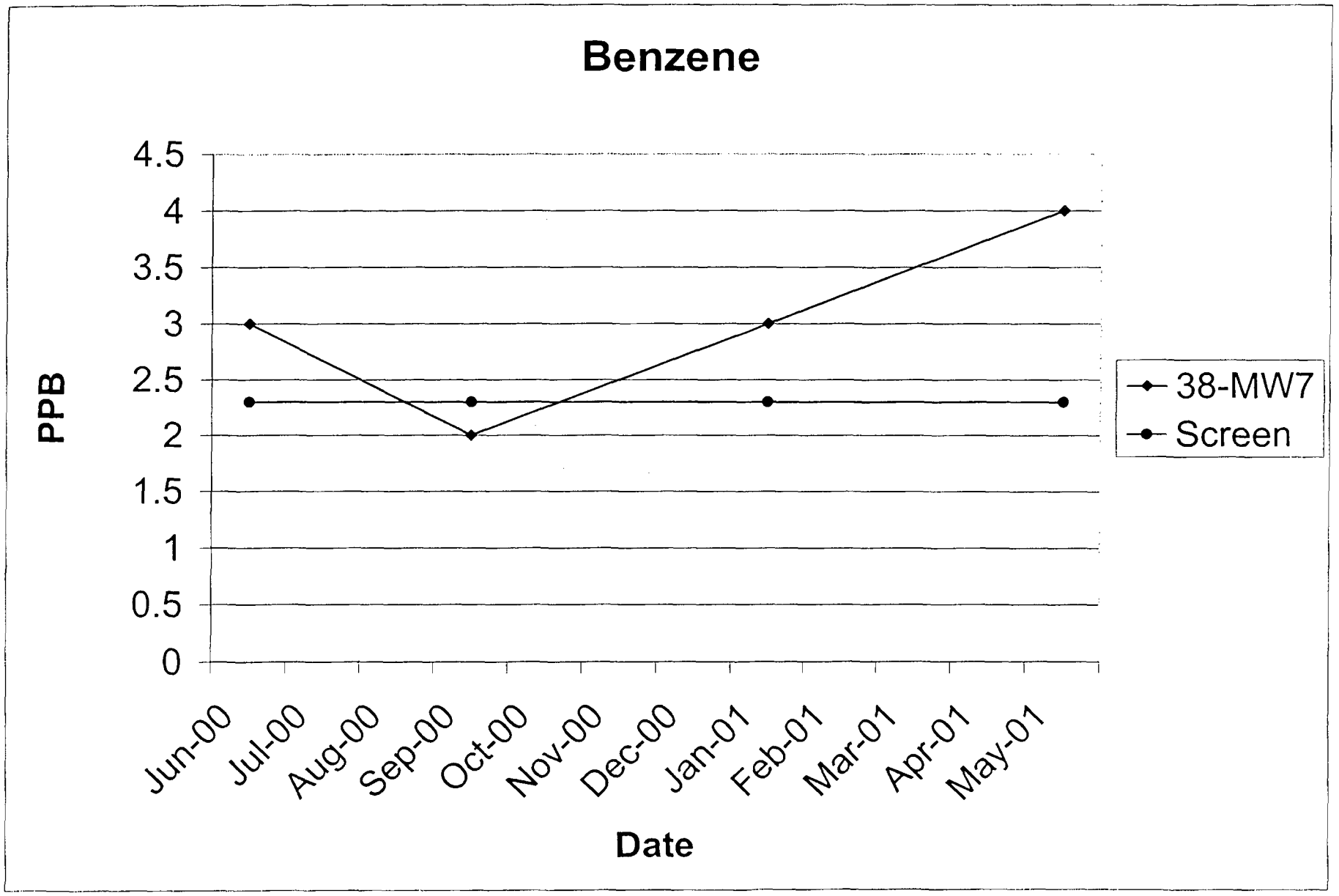
Apr-01
May-01
Date
38-MW12
Screen


total 1,2-DCE
6000
5000
4000
3000
2000
1000
0
PPB
Sep-00
Oct-00
Nov-00
Dec-00
Jan-01
Feb-01
Mar-01
Apr-01
May-01
Date
38-MW12
Screen


Benzene
PPB
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Jun-00
Jul-00
Aug-00
Sep-00
Oct-00
Nov-00
Dec-00
Jan-01
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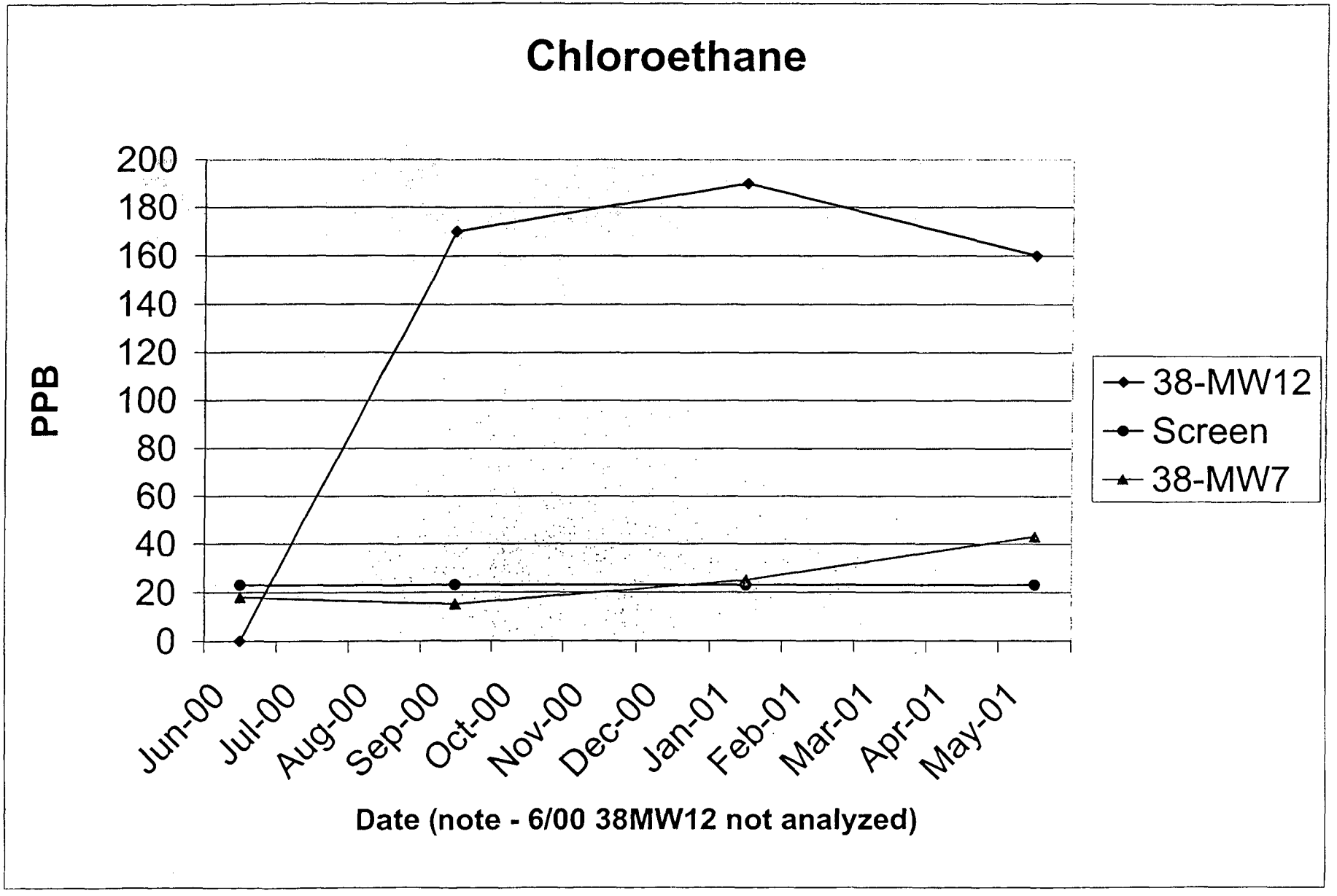
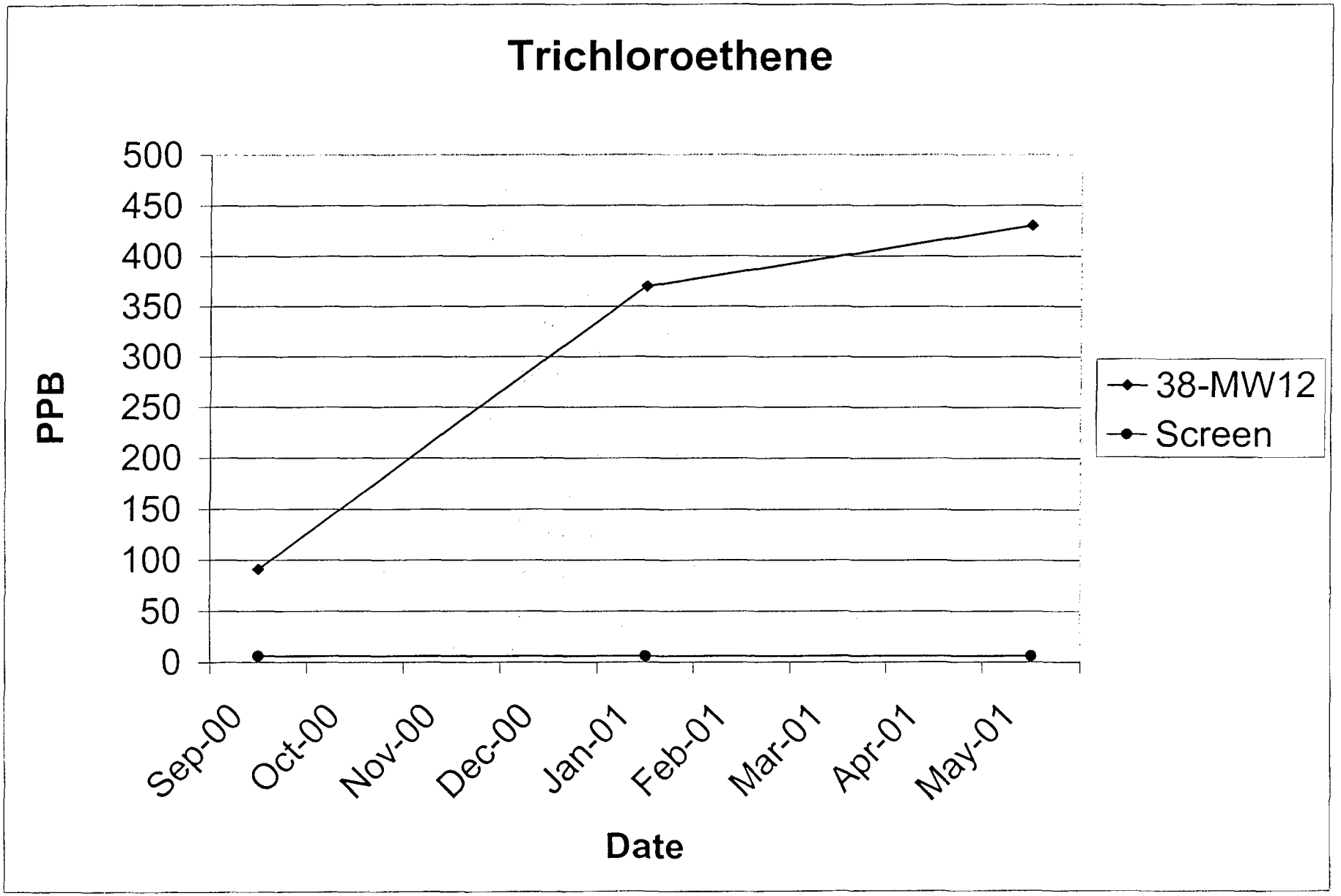
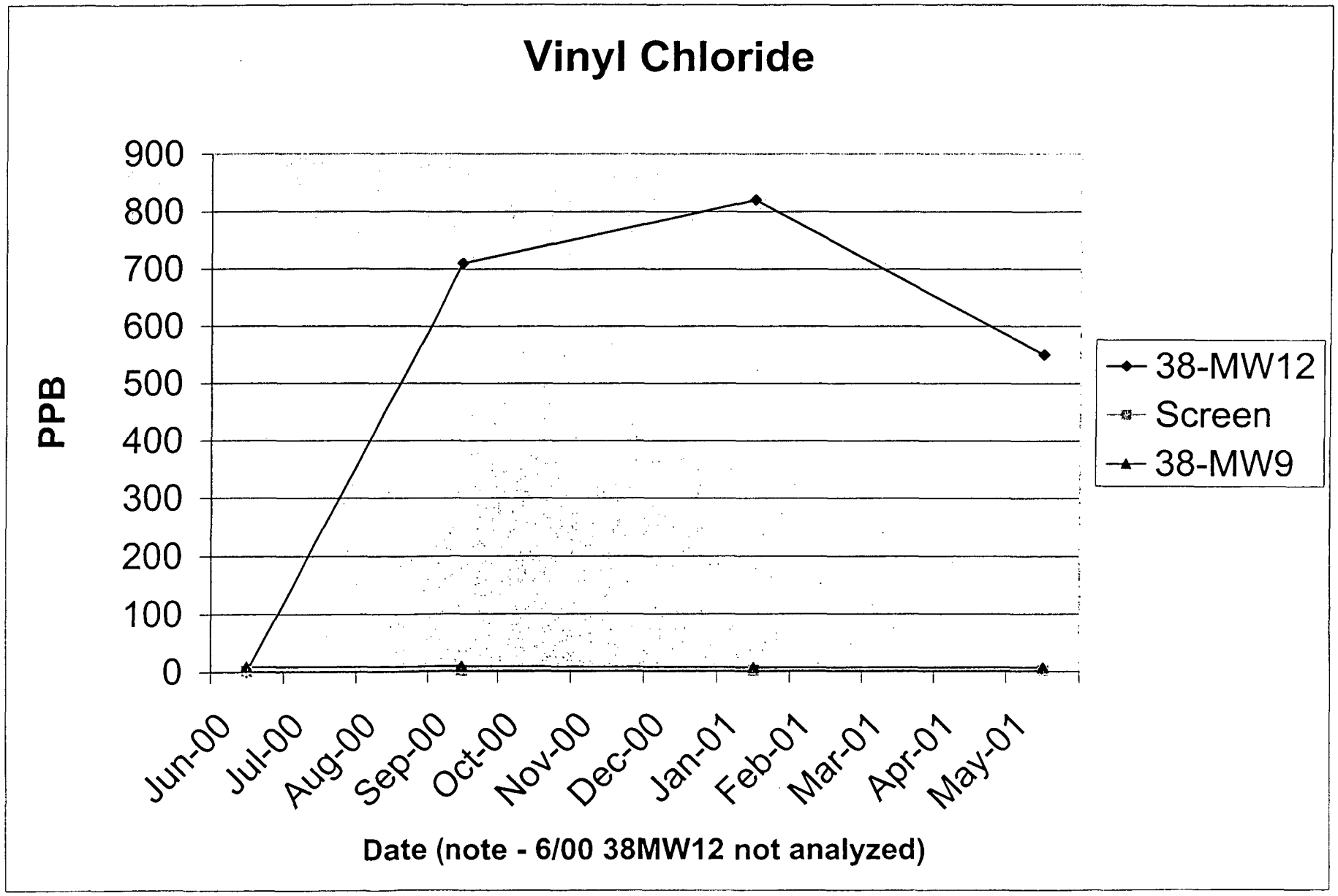
Mar-01
Apr-01
May-01
Date
38-MW7
Screen


Chloroethane
PPB
200
180
160
140
120
100
80
60
40
20
0
Jun-00
Jul-00
Aug-00
Sep-00
Oct-00
Nov-00
Dec-00
Jan-01
Feb-01
Mar-01
Apr-01
May-01
Date (note - 6/00 38MW12 not analyzed)
38-MW12
Screen
38-MW7


Trichloroethene
PPB
500
450
400
350
300
250
200
150
100
50
0
Sep-00
Oct-00
Nov-00
Dec-00
Jan-01
Feb-01
Mar-01
Apr-01
May-01
Date
38-MW12
Screen


Vinyl Chloride
PPB
900
800
700
600
500
400
300
200
100
0
Jun-00
Jul-00
Aug-00
Sep-00
Oct-00
Nov-00
Dec-00
Jan-01
Feb-01
Mar-01
Apr-01
May-01
Date (note - 6/00 38MW12 not analyzed)
38-MW12
Screen
38-MW9