INSTALLATION RESTORATION PROGRAM

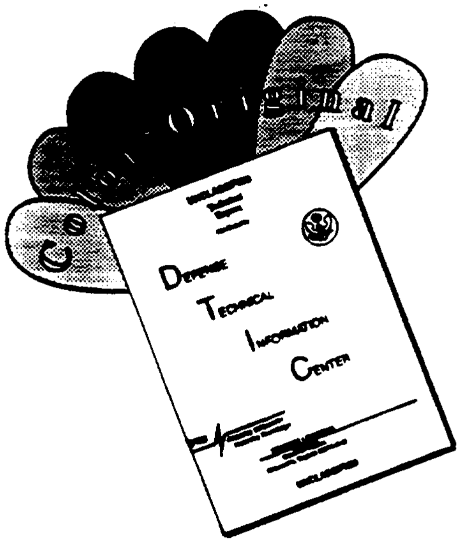
FINAL

REMEDIAL INVESTIGATION REPORT
IRP SITES 8 AND 10

151st AIR REFUELING GROUP
UTAH AIR NATIONAL GUARD
SALT LAKE CITY INTERNATIONAL AIRPORT
SALT LAKE CITY, UTAH

JUNE 1996

STONE & WEBSTER ENVIRONMENTAL TECHNOLOGY & SERVICES
a division of
Stone & Webster Engineering Corporation
For the AIR NATIONAL GUARD under Contract No. DAHA90-94-D-0009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151st AIR REFUELING GROUP
UTAH AIR NATIONAL GUARD
SALT LAKE CITY INTERNATIONAL AIRPORT
SALT LAKE CITY, UTAH

Prepared for

AIR NATIONAL GUARD
Andrews AFB, Maryland

June 1996

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ACRONYMS AND ABBREVIATIONS

AMC	Air Mobility Command
ANG	Air National Guard
ANGRC	Air National Guard Readiness Center
ARAR	Applicable or Relevant and Appropriate Requirement
AST	aboveground storage tank
ARW	Air Refueling Wing
AVGAS	aviation gas
AWQC	ambient water quality criteria
BEC	Base Environmental Coordinator
BGS	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylenes
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act of 1980
CERCLIS	Comprehensive Environmental Response, Compensation and Liability Information System
CES	Civil Engineering Squadron
CSF	cancer slope factor
cfs	cubic feet per second
COCs	chemicals of concern
DD	decision document
DERP	Defense Environmental Restoration Program
DERR	Division of Environmental Response and Remediation
DNAPL	dense nonaqueous phase liquid
DoD	Department of Defense
EO	Executive Order
EPA	United States Environmental Protection Agency
FS	Feasibility Study
FTA	fire training area
GC	gas chromatograph
HEAST	health assessment summary table
HHAG	human health assessment group
HPLC	high pressure liquid chromatograph
HQ	Noncancer Hazard Quotient
ID	inside-diameter
IDW	investigation derived wastes
IRA	Interim Remedial Action
IRP	Installation Restoration Program
JP-4	jet fuel
K_{oc}	organic carbon partition coefficient
LNAPL	light nonaqueous phase liquid
LOAEL	lowest observed adverse effect level
LTM	long-term monitoring
MCL	maximum contaminant level
MCLG	maximum contaminant level goal
μg/kg	microgram per kilogram

ACRONYMS AND ABBREVIATIONS (Continued)

mg/kg	milligram per kilogram
mg/L	milligram per liter
ml	milliliter
NAPL	nonaqueous phase liquid
NFRAP	no further remedial action planned
NOAA	National Oceanic and Atmospheric Administration
NOAEL	no observed adverse effect level
NPDES	National Pollution Discharge Elimination System
NPL	National Priorities List
OD	outside-diameter
PA	Preliminary Assessment
PAHs	polynuclear aromatic hydrocarbons
PCBs	polychlorinated biphenyls
PID	photoionization detector
PMCL	proposed
POL	petroleum, oil, and lubricants
PPE	personal protective equipment
ppm	parts per million
PPM	priority pollutant metals
PVC	polyvinyl chloride
QA/QC	quality assurance/quality control
RCL	recommended soil cleanup level
RCRA	Resource Conservation and Recovery Act
RfD	reference dose
RD	Remedial Design
RI	Remedial Investigation
SAC	Strategic Air Command
SARA	Superfund Amendments and Reauthorization Act of 1986
SI	Site Investigation
SLCIA	Salt Lake City International Airport
Stone & Webster	Stone & Webster Engineering Corporation
SVOCs	semivolatile organic compounds
SWL	static water level
TCE	trichloroethene
TCLP	Toxicity Characteristic Leaching Procedure
TDS	total dissolved solids
TOC	top of casing
TPH	total petroleum hydrocarbon
UANG	Utah Air National Guard
UDEQ	Utah Department of Environmental Quality
USAF	U.S. Air Force
USC	Unified Soil Classification
USDOT	U.S. Department of Transportation
UST	underground storage tank
VOCs	volatile organic compounds

EXECUTIVE SUMMARY

This report presents the results of a Remedial Investigation (RI) conducted at Installation Restoration Program (IRP) Sites 8 and 10, located at the Utah Air National Guard (ANG) Base, Salt Lake City, Utah. This RI was conducted to evaluate the nature and extent of petroleum and halogenated compound contamination identified previously at Site 8 and to assess the extent of petroleum contamination and identify the source and extent of undefined materials that caused site workers to experience adverse symptoms at Site 10.

The RI field investigation included the collection and analysis of soil gas, groundwater, and soil samples, from screening locations and soil borings and existing and newly installed monitoring wells at the sites. Samples were analyzed for volatile organic compounds (VOCs) semi-volatile organic compounds (SVOCs), total petroleum hydrocarbons (TPH) and priority pollutant metals (PPMs). Selected soil and groundwater screening samples from Site 10 were submitted to a fix-based laboratory for polychlorinated biphenyl (PCB) and pesticide analysis. In addition, a free product monitoring well was installed at each site, and aquifer slug tests were performed on the newly installed monitoring wells. The location and datum of the monitoring wells and soil borings were surveyed by a Utah-licensed land surveyor.

IRP SITE 8

In addition to evaluating the extent of previously detected petroleum and halogenated compound contamination detected at Site 8, the horizontal extent of halogenated compounds detected in the groundwater to the north and east of Site 8 was also investigated at the request of the ANG. These areas are located in IRP Sites 1 and 2, which were investigated during the Site Investigation.

Site 8 soils were observed to consist of fine-grained delta and floodplain sediments incorporating clays, silty clays, sandy clays, silty sands, and fine to coarse sands. Groundwater within the first 20 feet of the surface at Site 8 occurs locally as unconfined to semi-confined. The average groundwater velocity based on the May, June, and August groundwater level measurements for Site 8 was calculated as 0.049 ft/day (18.80 ft/yr or 1.75×10^{-5} cm/s).

Trichloroethylene (TCE) was detected in soil samples collected from two soil borings advanced at Site 8. The TCE contamination in soil in these borings appears to be isolated, as TCE was not detected in other soil samples collected in the vicinity of these samples. No Federal/State standards have been established for the clean-up of TCE in soil.

TPH, phenanthrene, and pyrene were detected in a few soil samples collected from directly below the asphalt pavement in F Street. The detection of these compounds in the soil samples is most likely due to asphalt in the samples. Although TPH concentrations exceed the Utah Department of Health Division (UDHD) Level I Recommended Cleanup Level (RCL) of 100 mg/kg, which was established provide guidelines for the cleanup of soils contaminated by releases from underground storage tanks (USTs), it appears that TPH detected in Site 8 soils are unrelated to the presence of USTs at the site. In addition, Site 8 is no longer under the UST program. However, the TPH soil cleanup level could still be used as an ARAR for future cleanup of the site.

Benzene and TPH were detected in groundwater samples collected from Site 8 at maximum concentrations of 719 μg/l and 1,800 μg/l respectively. Benzene concentrations exceeded the Environmental Protection Agency Maximum Contaminant Levels (EPA MCLs) for drinking water and UDEQ Groundwater Quality Standards (GWQS) for groundwater of 5.0 μg/l in several of the groundwater samples. MCLs for TPH in groundwater have not been established. The extent of benzene and TPH detected in groundwater was limited to the former UST area.

Halogenated compounds, including TCE, 1,1,1-trichloroethane (TCA), tetrachloroethene (PCE) and their degradation products (cis-1,2-dichloroethene [c-DCE], trans-1,2-dichloroethene [t-DCE], 1,1-dichloroethane [1,1-DCA], 1,2-dichloroethane [1,2-DCA]) were detected in groundwater samples collected during the investigation at and to the north and east of Site 8 at a maximum concentration of 38,960 μg/l. Of the 87 groundwater samples in which TCE was detected, 61 samples had concentrations that exceeded the EPA MCL and UDEQ GWQS of 5.0 μg/l. The TCE degradation compounds specifically addressed under state and federal standards (1,1-DCA, 1,2-DCA, 1,1-DCE) were all detected in concentrations below the EPA MCL and UDEQ GWQS.

The compounds detected at the highest concentrations were TCE and c-DCE. Three separate areas of TCE and c-DCE contamination in groundwater were identified: the southwestern portion of Site 8, the southern portion of Site 1, and the northern portion of Site 2 in the vicinity of 2nd Street. The highest concentration of TCE detected on Site 8 was 352 μg/l in the area of Site 2. The depth of the TCE plume was not determined during the RI. Concentrations of TCE detected in groundwater screening samples are high enough (i.e., greater than one percent of its solubility limit) in Sites 1 and 2 to suggest that pockets of TCE free product may exist in the groundwater, however, no free product was observed during the course of the Site 8 RI.

Bis(2-ethylhexyl)phthalate was detected in groundwater samples collected from Site 8 at concentrations ranging from 0.08 to 1.7 mg/l, above the EPA's proposed MCL (PMCL) of 0.004 mg/l for drinking water.

A baseline risk assessment was performed at Site 8 in accordance with current EPA guidance. Validated field sampling data and non-validated field screening data were evaluated separately in the risk assessment. The risk assessment concluded that based on current and future use scenarios for all potential receptors, no significant risk exists.

CONCLUSIONS AND RECOMMENDATIONS

Based on this result of the RI, no remedial action is recommended. According to Utah Administrative Code (UAC) R315-101-1(a), risk-based cleanup and closure standards apply to the sites because the sites have not been and will not be cleaned up to background levels. As a precautionary measure, sampling and analyzing groundwater for VOCs on a quarterly basis to monitor the movement of the COCs is recommended at Site 8. In addition, it is recommended that further investigation of the TCE source areas be completed as the total depth of groundwater contamination at Site 8, Site 1, and Site 2 was not determined during this RI.

IRP SITE 10

Site 10 soils consist of fine-grained delta and floodplain sediments incorporating clays, silty clays, sandy clays, silty sands, and fine to coarse sands. Groundwater exists under semi-confined to confined conditions within the first 20 feet of land surface. Groundwater flow direction varied during the investigation from the northwest, north, northeast to the south, southeast, and east with an average velocity of 6.35×10^{-2} ft/day (23.17 ft/yr or 2.24×10^{-5} cm/s).

A portion of the intrusive field investigation was performed in Level B personal protective equipment (PPE) due to the presence of undefined materials. Results of the initial phase of the investigation indicated that the undefined material was hydrogen sulfide gas. Hydrogen sulfide gas is a naturally occurring biodegradation product of organic matter and is suspected to be present at various locations in the subsurface at the Base where floodplain sediments are present. Based on the identification of the undefined material and the results of the air monitoring, the level of PPE was downgraded to Level D after the first day of field work.

Petroleum compounds were detected in soil samples at a maximum concentration of 58.800 mg/kg. Benzene concentrations ranged from 0.390 mg/kg to 3.891 mg/kg in the area near the fuel mixing tank, all of which exceed the UDEQ Level I RCL of 0.2 mg/kg. Concentrations of toluene, ethylbenzene, xylenes and TPH did not exceed the UDEQ Level I RCLs of 100, 70, 1,000, and 100 mg/kg, respectively.

Petroleum compounds were detected in groundwater screening samples collected from two areas of Site 10 at a maximum concentration of 10,043 μg/l. Concentrations of benzene detected exceeded the EPA MCL and UDEQ GWQS of 5.0 μg/l in 19 of the 24 groundwater screening samples in which benzene was detected. Toluene was detected at a concentration which exceeds the EPA MCL and UDEQ GWQS of 1,000 μg/l in two of the 13 groundwater screening samples where it was found. Ethylbenzene was detected at a concentration which exceeds the EPA MCL and UDEQ GWQS of 700 μg/l in two of the 19 groundwater screening samples where it was found. Xylene compounds were detected at a concentration above the EPA MCL and UDEQ GWQS of 10,000 μg/l in one of the 27 groundwater screening samples where it was found.

BTEX compounds were not detected in groundwater samples collected from monitoring wells installed upgradient and downgradient of Site 10. The first area in which petroleum compounds were detected is located north of the existing process recovery tank, where a fuel spill occurred in 1982. The horizontal extent of petroleum contamination detected in this area was limited to the area of Site 10 south of the city drain canal and north of the existing process recovery tank, between the concrete parking pad and the dispenser island.

The second area where petroleum compounds were detected at Site 10 is located directly north of the fuel mixing facility at the Site. The horizontal extent of petroleum contamination detected in this area was limited to the area of Site 10 south of the city drain channel and north of the 5,000-gallon fuel additives tank, between the dispenser island and the eastern edge of E Street. Benzene was detected in soil samples collected in this area at concentrations above the most stringent RCL of 0.2 mg/kg set by the UDHD for leaking underground storage tank (LUST) sites.

CONCLUSIONS AND RECOMMENDATIONS

A baseline risk assessment was performed at Site 10 in accordance with current EPA guidance. Validated field sampling data and non-validated field screening data were evaluated separately in the risk assessment. The risk assessment of Site 10 concluded that based on current and future use scenarios for all potential receptors, no significant risk exists. Therefore, no remedial action is also recommended for Site 10. Sampling and analysis of the groundwater for VOCs on a quarterly basis is recommended to monitor the movement of the COCs. In addition, it is recommended that monthly groundwater level measurements be collected from site wells and the water level in the City Drain Channel be measured for a period of at least a year, to develop a more complete understanding of groundwater flow at Site 10. Evaluation of the total depth of groundwater contamination and further investigation of the areas around the aboveground storage tanks is also recommended.

1.0 INTRODUCTION

This report presents the results from a Remedial Investigation (RI) for two sites at the Utah Air National Guard (UANG) Base located in Salt Lake City, Utah. Stone & Webster Engineering Corporation (Stone & Webster) performed the work for the Air National Guard (ANG) Readiness Center under Task No. 2 of Contract No. DAHA90-94-D-0009.

The two sites investigated are identified as Installation Restoration Program (IRP) Site 8, a former underground storage tank (UST) location, and IRP Site 10, an existing petroleum, oil, and lubricants (POL) yard. The RI was conducted as outlined in the Remedial Investigation/Feasibility Study (RI/FS) Work Plan prepared by Stone & Webster and submitted to and approved by the ANG in May 1995. The field work associated with the RI was performed in June, July, and August 1995.

1.1 INSTALLATION RESTORATION PROGRAM

The Department of Defense (DoD) established the Defense Environmental Restoration Program (DERP) in 1984 to promote and coordinate efforts for the evaluation and clean-up of contamination at DoD installations. Presidential Executive Order (EO) 12580 was issued on January 23, 1987. EO 12580 assigned the responsibility for carrying out DERP to the Secretary of Defense and established the implementation of DERP within the overall framework of the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) and the Superfund Amendments and Reauthorization Act of 1986 (SARA). The IRP was established under DERP to identify, evaluate, investigate, and clean up contamination at DoD installations. The ANG IRP is focused on clean-up of contamination associated with past activities to ensure that threats to public health and the environment are eliminated. The ANG manages the IRP and related activities for ANG Bases.

Figure 1-1 presents a flow diagram that illustrates the significant elements and decision points encountered in the ANG IRP. Specific elements in the IRP flow diagram are defined and described in the following sections.

1.1.1 Preliminary Assessment

The Preliminary Assessment (PA) is the initial evaluation of existing information. The PA process consists of personnel interviews, a records search, and site inspection designed to identify and evaluate past disposal and/or spill sites that might pose a potential and/or actual hazard to public health, public welfare, or the environment. Previously undocumented information is obtained through the interviews. The records search focuses on obtaining useful information from aerial photographs; installation plans; facility inventory documents; lists of hazardous materials used; subcontractor reports; correspondence; Material Safety Data Sheets; federal/state agency scientific reports and statistics; federal administrative documents; federal/state records on endangered species, threatened species, and critical habitats; documents from local government offices; and numerous standard reference sources.

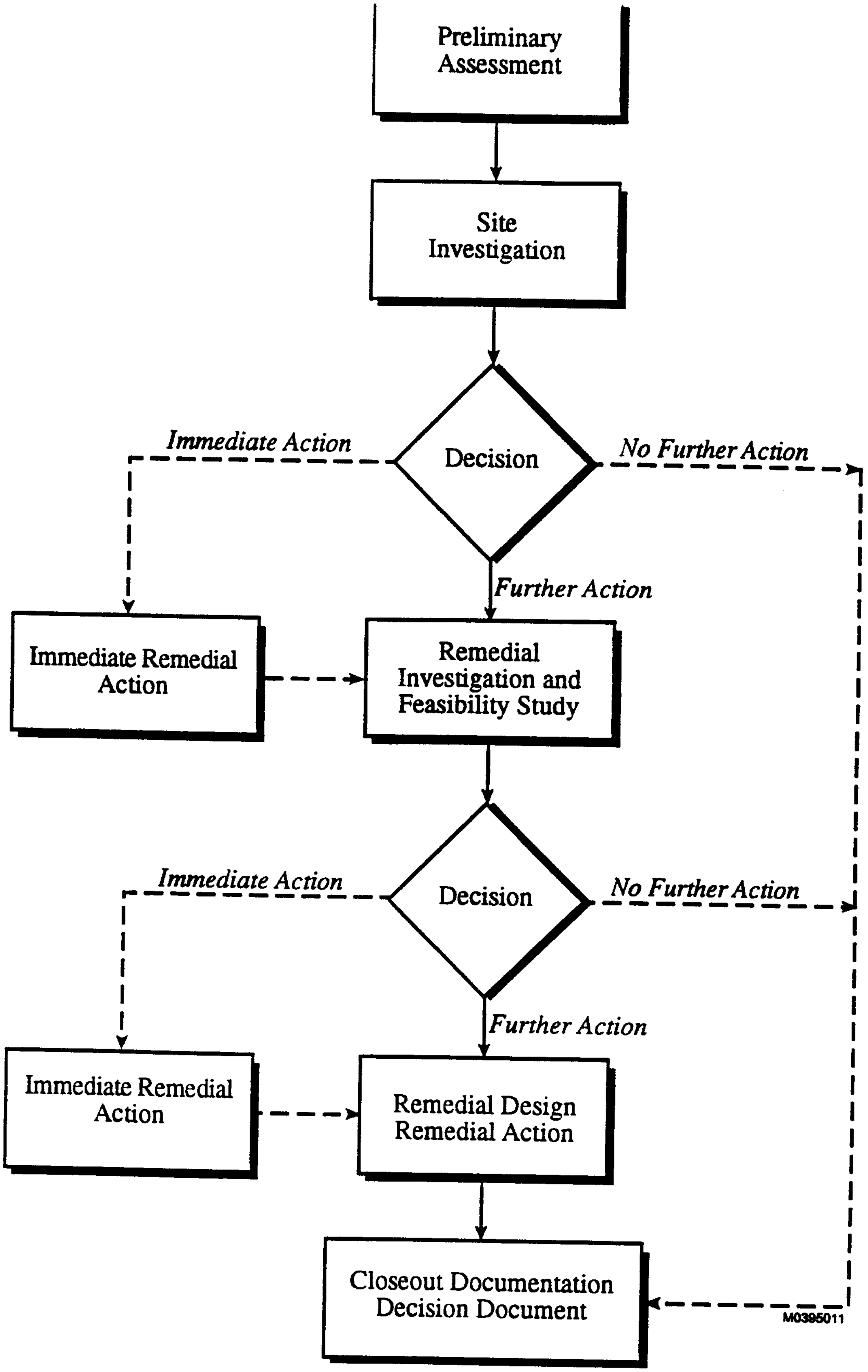

FIGURE 1-1 IRP PROCESS FLOW DIAGRAM, IRP SITES 8 AND 10
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SALT LAKE CITY INTERNATIONAL AIRPORT
SALT LAKE CITY, UTAH

1.1.2 Site Investigation

The Site Investigation (SI) phase consists of field activities designed to confirm the presence or absence of contamination at the potential sites identified in the PA. The activities undertaken during the SI generally fall into three distinct categories: screening, confirmation, and optional activities. Screening activities are conducted to gather preliminary data on each site. Confirmation activities include specific media sampling and laboratory analysis to confirm either the presence or the absence of contamination, levels of contamination, and the potential for contaminant migration. Information obtained during the subsurface investigation is also utilized to define the site hydrology, geology, and soil characteristics. Optional activities include additional data gathering to reach a decision point for a site, such as no further IRP action is warranted, prompt removal of contaminants is necessitated, or further IRP work is required.

The general approach for the design of the SI activities is to sequence the field activities so that data are acquired and used as the field investigation progresses. This determines the absence or presence of contamination in a relatively short period of time, optimizes data collection and data quality, and keeps costs to a minimum.

1.1.3 Remedial Investigation

The objectives of the RI are to determine the nature and extent of contamination at a site, determine the nature and extent of the threat to human health and the environment, and provide a basis for determining the types of response actions to be considered (decision document [DD], feasibility study [FS], remedial design, remedial action [RA]).

The RI consists of field activities designed to quantify and identify the potential contaminant(s), the extent of the contamination, and the pathways of contaminant migration. Field activities may include the use of soil gas, soil, and groundwater surveys, installation of soil borings and/or monitoring wells, and the collection and analysis of water, soil, soil vapor, and/or sediment samples. Careful documentation and quality control procedures in accordance with CERCLA/SARA guidelines ensure the validity of data.

Hydrogeologic studies are conducted to determine the underlying strata, groundwater flow rates, and direction of contaminant migration.

A baseline risk assessment may be conducted that provides an evaluation of the potential threat to human health and the environment in the absence of remedial action. The assessment provides the basis for determining whether remedial action is necessary, justification for performing remedial actions, and what imminent and substantial danger to public health or the environment exists.

The findings from these studies result in the selection of one or more of the following options:

- **No Further Remedial Action Planned (NFRAP)** - Investigations do not indicate harmful levels of contamination that pose a significant threat to human health or the environment. Therefore, no further IRP action is warranted and a DD will be prepared to close out the site.

- **Long-Term Monitoring (LTM)** - Evaluations do not detect sufficient contamination to justify costly remedial actions. LTM may be recommended to detect the possibility of future problems.

- **Feasibility Study (FS)** - Investigation confirms the presence of contamination that may pose a threat to human health and/or the environment, and some sort of remedial action is indicated. The FS is described more fully in the following section.

1.1.4 Feasibility Study

Based on results of the RI, the baseline risk assessment, and a review of state and federal regulatory requirements, an FS will be prepared to develop, screen, and evaluate alternatives for remediation of groundwater and/or soil contamination at the subject sites. The overall objective of the FS is to provide information necessary for remedial alternative development and evaluation to support selection of a remedy that (1) ensures the protection of human health and the environment; (2) attains applicable or relevant and appropriate requirements (ARARs); (3) satisfies the preference for treatment that significantly and permanently reduces toxicity, mobility, or volume of hazardous constituents as a principal element; and (4) is cost-effective.

Activities associated with the FS include the following:

- development of alternatives,
- preliminary screening of remedial alternatives,
- detailed analysis of alternatives,
- comparative analysis of alternatives, and
- FS report.

The end result of the FS is the selection of the most appropriate remedial action with concurrence by state and/or federal regulatory agencies.

1.1.5 Remedial Design

The Remedial Design (RD) involves the development of the design plans, specifications, drawings, and cost estimates required to implement the selected remedial action identified in the FS and approved by state and/or federal regulatory agencies.

1.1.6 Remedial Action

The Remedial Action (RA) is the implementation of the remedial alternative, i.e., cleaning up the site. It refers to the accomplishment of measures to eliminate the hazard or, at a minimum, reduce it to an acceptable limit. In some cases, after the remedial actions have been completed, an LTM system may be installed as a precautionary measure to detect contaminant migration or to document the efficiency of remediation.

1.1.7 Interim Remedial Action

At any point, it may be determined that a former waste disposal site poses an immediate threat to public health or the environment, thus necessitating prompt removal of the contaminants. Interim Remedial Action (IRA), such as limiting access to the site, capping or removing contaminated soils, and/or providing an alternate water supply, may suffice as effective control measures. Sites that require IRA also maintain their IRP status in order to determine the need for additional remedial planning or LTM. IRAs may be implemented during any phase of an IRP project.

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2.0 FACILITY BACKGROUND INFORMATION

The UANG Base is located in Salt Lake City, Salt Lake County, Utah. The Base property is located on the northeast side of the Salt Lake City International Airport (SLCIA) and is leased from Salt Lake City. The Base is within city limits. The location of the Base is shown in Figure 2-1. The Base and adjoining SLCIA occupy an area of approximately 5 square miles. The UANG facilities alone occupy an area of approximately 130 acres. The 151st Air Refueling Wing (ARW) flies and maintains KC-135E aircraft to support its refueling mission under the U.S. Air Force (USAF) Air Mobility Command (AMC).

Land uses around the Base boundary include limited agricultural, commercial, industrial, recreational, and residential uses. The area surrounding the Base consists of commercial airport operations to the west (SLCIA) and to the south, McDonnell Douglas manufacturing operations to the north, and residential neighborhoods to the east. The residential population within a 1-mile radius from the borders of the Base is approximately 8,600 persons. This information was retrieved from 1990 census data for Salt Lake County, Utah Office of Planning and Budget, Department of Demographic/Economic Analysis. The Base population is approximately 300 full-time personnel during the day and approximately 1,600 part-time personnel on training weekends (ES, 1992b). Personnel do not reside at the Base.

2.1 BASE HISTORY

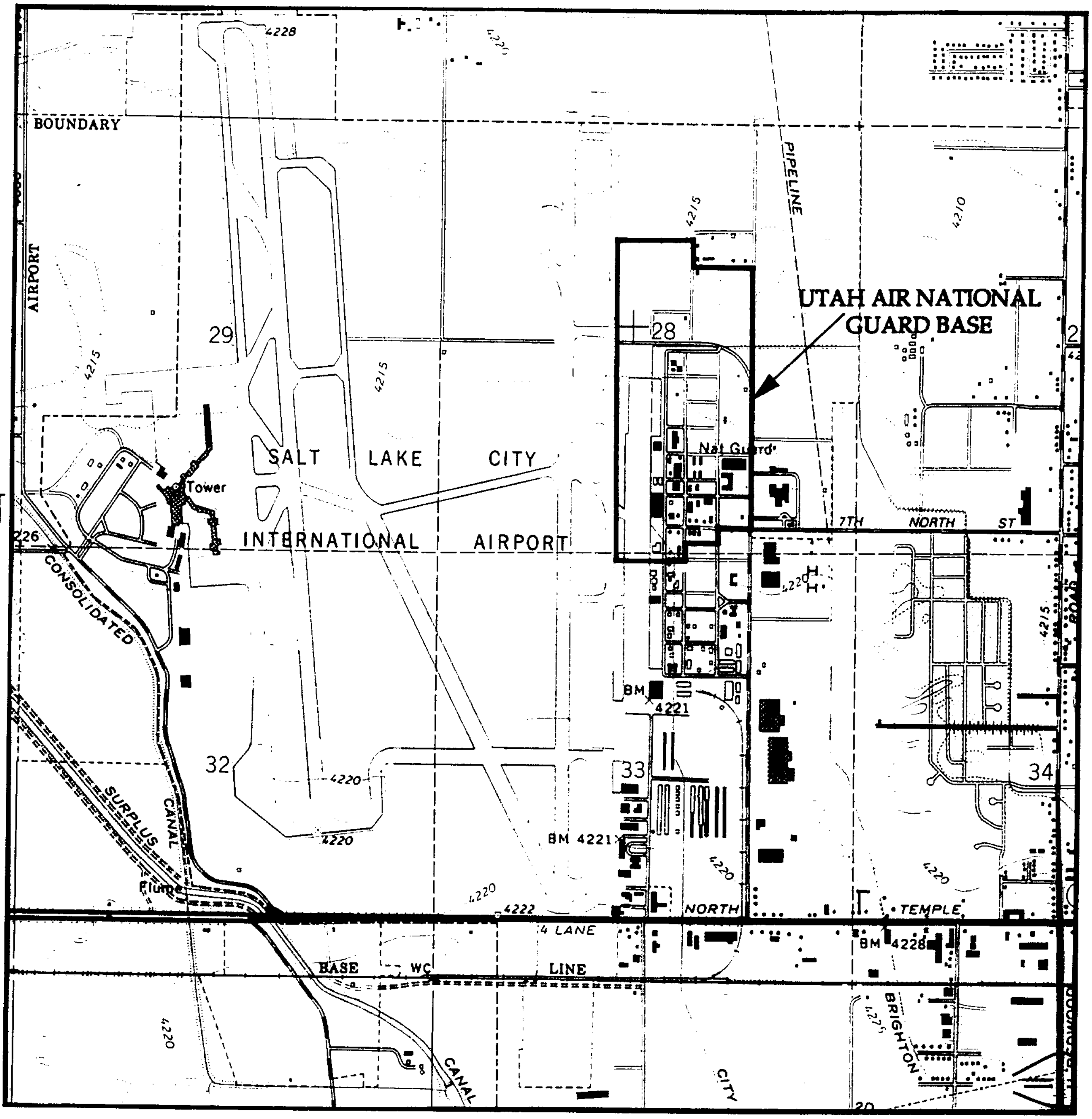
The UANG was founded on November 18, 1946, as the 191st Fighter Squadron, a fighter-bomber unit. Since its inception, the UANG's assigned mission has changed three times and the type of aircraft flown has changed seven times. The UANG has a two-fold mission, serving both the state and federal governments.

In August 1957, the 151st Consolidated Aircraft Maintenance Squadron and the 151st USAF Dispensary were formed. These units were responsible for care and maintenance of all aircraft and for medical care of guardsmen, respectively.

In April 1961, the UANG was reorganized from a jet fighter to an air transport squadron, with C-97 stratofreighter aircraft.

In 1969, the 299th Communications Flight was organized. The unit has been renamed and is now known as the 299th Range Control Squadron. The unit is currently active and provides USAF support in radar control and surveillance services to aircraft operating within the Hill/Wendover/Dugway Range training complex.

In April 1978, the 151st ARW became part of the Strategic Air Command (SAC) and began flying the KC-135 stratotanker. During the early 1980's, the 151st ARW converted to KC-135E aircraft. These large aircraft are used to fuel other aircraft in flight. The air refueling planes participate in flight assignments in Europe as well as for the Pacific Tanker Task Force and many other alerts called by SAC. The 151st ARW is now part of the AMC.



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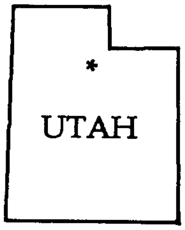

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▯ UTAH AIR NATIONAL GUARD PROPERTY

FIGURE 2-1

LOCATION MAP

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JUNE 1996

In 1986, the 151st Civil Engineering Flight was re-designated as the 151st Civil Engineering Squadron (CES). The 151st CES is responsible for design, development, maintenance, and management of the physical plant and Base facilities.

Today, the UANG consists of 16 units and is an integral part of the overall USAF mission. Its units represent the Air Intelligence Command, the Air Combat Command, the Air Material Command, and the AMC.

2.1.1 Environmental Conditions and History

2.1.1.1 Past Environmental Incidents and Problems

Past Base operations involved the use and disposal of materials and wastes that were subsequently categorized as hazardous. At various sites within the Base, hazardous materials have been spilled or released and hazardous wastes have been disposed. These historical spill areas and disposal sites have been identified through records reviews, personnel interviews, and field surveys and include wastes such as pesticides, oils, solvents, and fuels. The PA Report (HAZWRAP et al., 1989) provides further information on past waste disposal practices and identifies seven initial IRP sites. Three more sites have subsequently been identified. The SI Report (Parsons ES, 1995) further investigates Sites 1 through 7, provides brief information on Sites 8 and 9, and addresses initial data from Site 10. Sites 8 and 10 are described later in this report.

2.1.1.2 Regulatory Records Review

The following information is a review of selected available public records, listings, and data bases concerning environmental conditions at the Base and adjacent properties. In addition to confirmed contaminated sites, the records include reported or suspected sites of contamination. Therefore, the inclusion of the Base or any other property may or may not indicate that the listed property is contaminated or is causing contamination.

- **United States Environmental Protection Agency (EPA)**
  Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS)

  The EPA CERCLIS list contains sites that have been identified as contaminated and those that are suspected sources of contamination. Inclusion on the CERCLIS list does not necessarily mean that the site is either contaminated or is causing contamination. Review of the CERCLIS list indicated that there are no listed facilities located within a 1/2-mile radius of the UANG Base.

- **CERCLA Federal Superfund Sites**

  Review of the EPA Superfund Program National Priorities List (NPL) of sites in Utah indicated that there are four federal Superfund sites located within a 10-mile radius of the UANG Base.

The two EPA Superfund sites closest to the UANG Base are the Petrochem Recycling Corp. and the Rose Park Sludge Pit, both located approximately 1.5 miles north and northeast, respectively, of the UANG Base.

The Petrochem Recycling facility was initially operated as an oil refinery from 1953 to 1978. In 1978, it was converted to a hazardous waste storage/treatment facility that operated until 1988. Chlorinated solvents have been released to both air and groundwater at the site. Other on-site contaminants include polynuclear aromatic hydrocarbons (PAHs), phthalates, pesticides, polychlorinated biphenyls (PCBs), dioxin, furans, and heavy metals such as arsenic, chromium and lead. Groundwater below the facility is unconfined and hydraulically connected to aquifers underlying the Salt Lake Valley. In November 1990, airborne contaminants were detected, threatening an estimated 11,400 people who live and work within a mile of the site. The site is currently being addressed through potentially responsible parties' actions. The site is located hydrologically downgradient of the UANG Base.

The Rose Park Sludge Pit is located in a Salt Lake City Park that includes a baseball field, tennis courts, and a golf course. The area was used from the early 1920's until 1957 for the disposal of petroleum wastes. Refinery sludges in the disposal area were contaminated with PAHs and sulfur dioxide. The area has been capped. The site is being addressed through federal, state, municipal, and potentially responsible parties. The site is located hydrologically downgradient of the UANG Base.

The Portland Cement site is located approximately 3 miles south of the UANG Base.

The Utah Power & Light/American Barrel site is located approximately 3 miles south of the UANG Base.

- **Utah Department of Environmental Quality (UDEQ)**

  According to the UDEQ, there are eight registered USTs located within a 1/2-mile radius of the UANG Base. Table 2-1 presents information on these USTs. In addition, there are two registered USTs and a process recovery UST located at the UANG Base. Information on these USTs is presented in Table 2-2.

A discussion with the Base Environmental Coordinator (BEC) indicated that there are no active landfills within a 2-mile radius of the Base.

Table 2-1
USTs Located Within a 1/2-Mile Radius of the UANG Base
151st ARW, Air National Guard, Salt Lake City, Utah

UDEQ Registration Number	Facility Name/Address	Number of USTs	Status
4-001174	Country Pride Foods 501 N. 2200 West	2	Removed
4-001405	FAA - Salt Lake City Loc. Runway 16, SLC Airport	1	In Use
4-001408	FAA - SLC GS E/G, Runway 16, SLC Airport	1	In Use
4-001404	FAA -SLC RVR E/G 34R Midfield 34-16, SLC Airport	1	In Use
4-000957	Sperry Corporation 322 N. 2200 W.	3	Removed
4-001386	Unisys Corporation 322 N. 2200 W.	5	In Use

Table 2-2
USTs Located at the UANG Base
151st ARW, Air National Guard, Salt Lake City, Utah

Tank Location	Capacity (gallons)	Contents	Year Installed	Material of Construction	Status of Tank
POL	2,000	water/JP-8 (process recovery tank)	1972	steel-welded	active
Motor Pool 208-1	750	used oil	1992	steel	active
Motor Pool 208-2	750	used oil	1992	steel	active

2.1.2 Previous Investigations

Several investigations have been conducted at the UANG Base under the IRP program. These include:

- A basewide PA in 1989. IRP Sites 1 through 7 were identified.
- Sites 8 and 9 were identified in 1992 and placed in the Resource Conservation and Recovery Act (RCRA) UST program.
- SIs for IRP Sites 1 through 7 were completed in 1993.
- IRP Site 10 was added to the basewide SI in 1993.
- Supplemental SI sampling was completed at IRP Site 1 in 1994.
- Site 8 was moved into the IRP in 1994 after halogenated solvent contamination was detected during subsurface investigations following UST removal.
- Site 9 was recommended for close out with no further action planned.

2.1.2.1 Basewide Preliminary Assessment

The PA identified seven IRP sites. Their locations are shown in Figure 2-2. Their associated environmental incidents and problems are identified as follows:

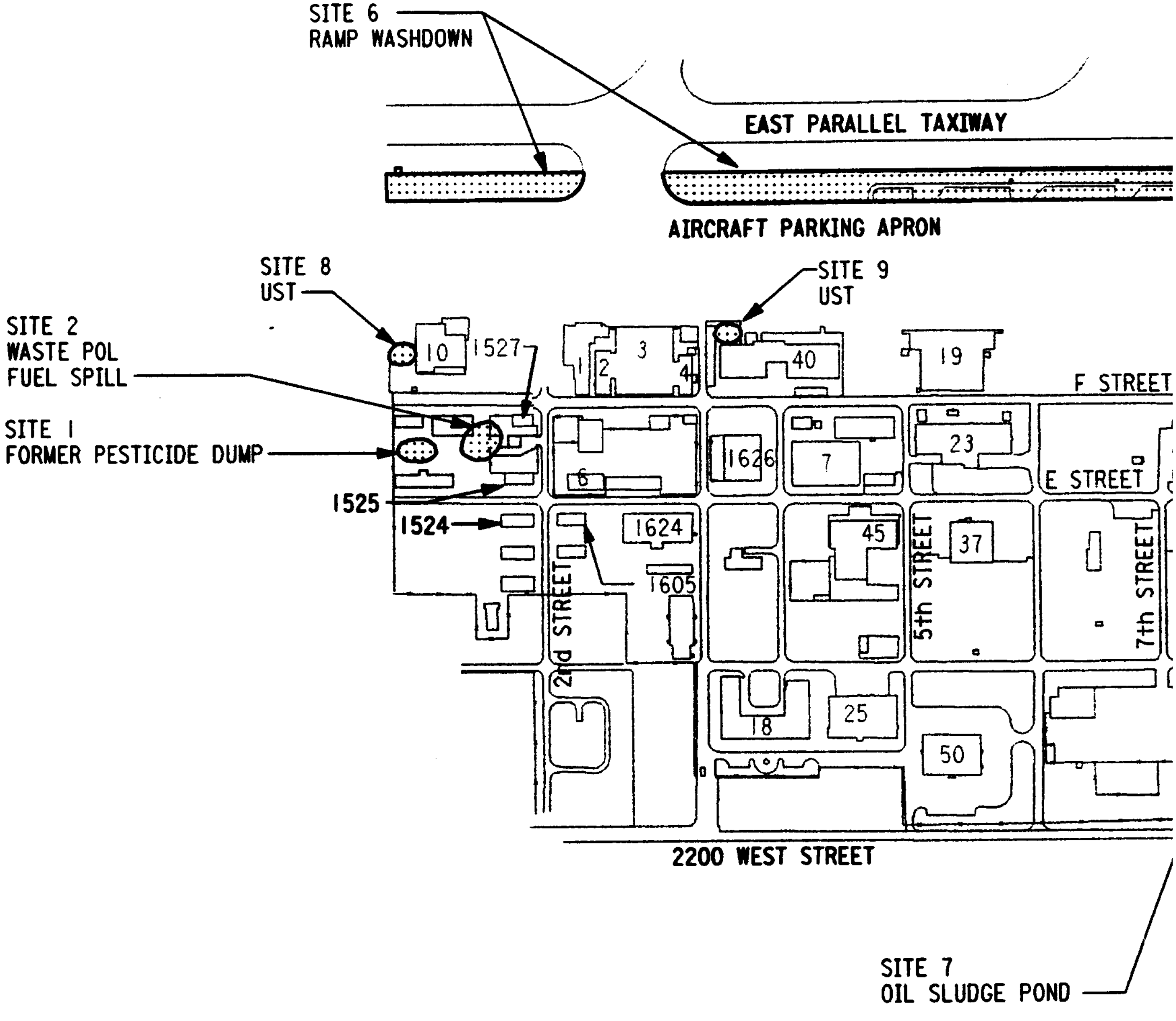
Site 1 - Pesticide Dump: This site was reportedly used for pesticide disposal.

Site 2 - Waste Petroleum, Oil, and Lubricant (POL) Spill near Building 1527: In 1987, a 200-gallon bowser containing waste oils, solvents, and fuels leaked due to a valve failure. The total quantity of material released is unknown.

Site 3 - Drum Burial: This site, adjacent to the existing fire training area (FTA), was reportedly used as a drum burial site. Ten drums, possibly containing "off spec" JP-4 and waste solvents, were crushed and buried on the site.

Site 4 - Fire Training Area 1 (FTA 1): FTA 1 was operated by the Base from 1947 through 1972. Normally, 300 to 500 gallons of fuel were burned, extinguished, and reburned during the fire training exercises. At times, up to 1,300 gallons of fuel and other flammable liquids were burned during the exercises.

Site 5 - Fire Training Area 2 (FTA 2): FTA 2 was operated by the Base from 1973 to 1975. This area was only utilized two or three times. Approximately 150 gallons of JP-4 were burned during each exercise.



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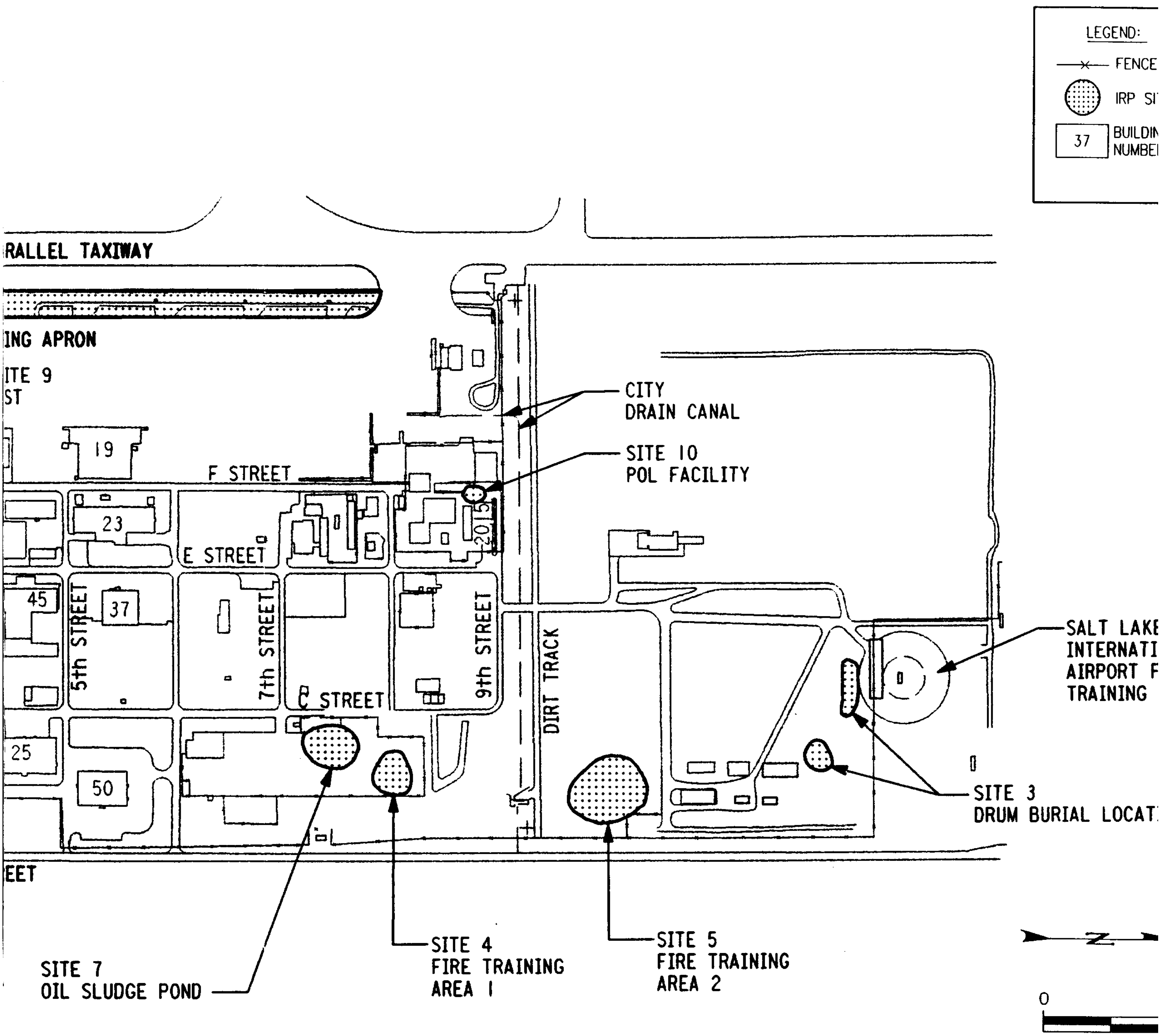

FIGURE

IRP SITE LOCAT

151st ARW, UTAH AIR NA
SALT LAKE CITY INTERNAT
SALT LAKE CITY,

STONE & WEBSTER ENGINEERING
BOSTON, MASS.

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DRAWN BY: G.C. CARTER
CHK'D BY:

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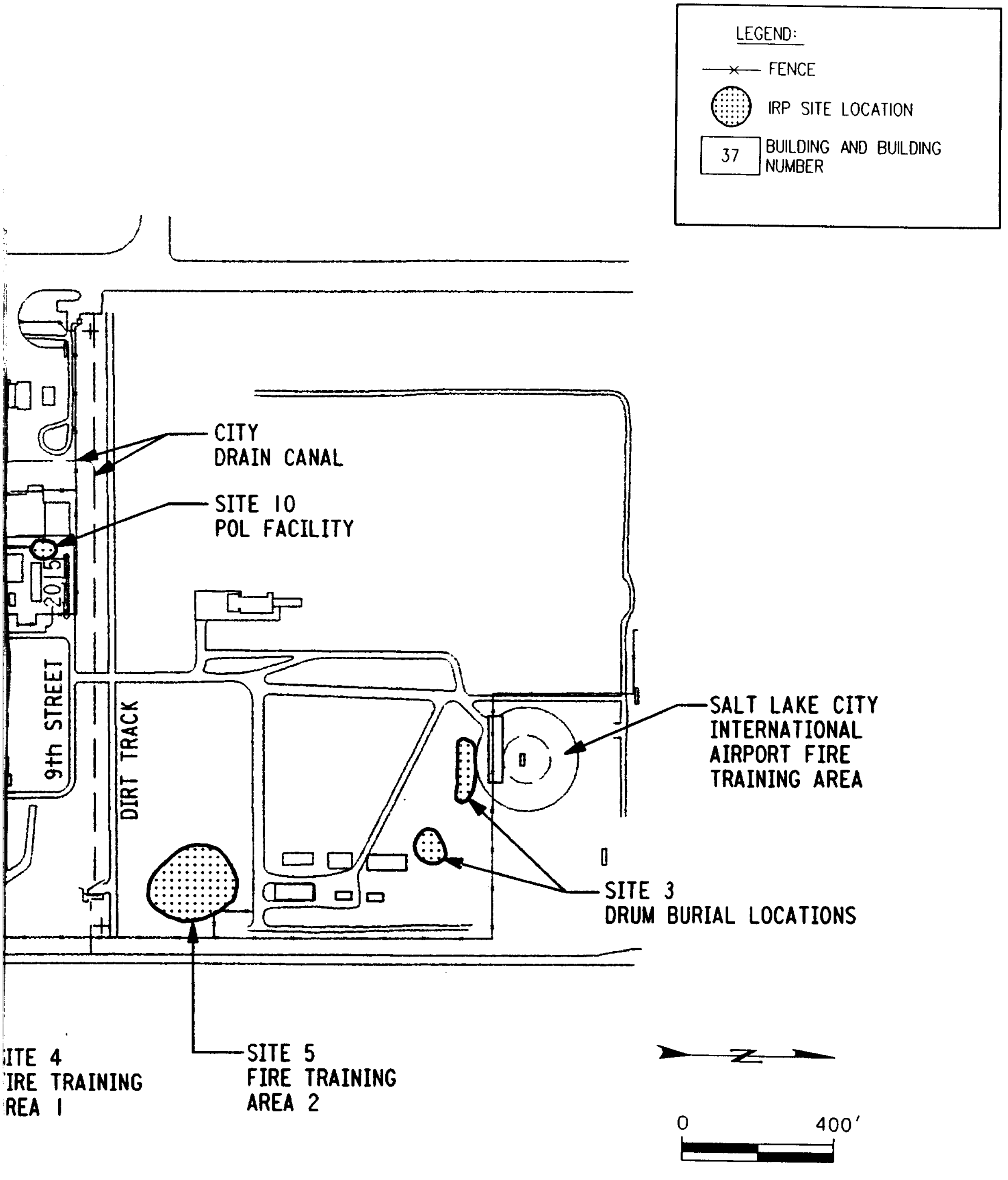

FIGURE 2-2

IRP SITE LOCATION MAP

151st ARW, UTAH AIR NATIONAL GUARD
SALT LAKE CITY INTERNATIONAL AIRPORT
SALT LAKE CITY, UTAH

STONE & WEBSTER ENGINEERING CORPORATION
BOSTON, MASS.

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DRAWN BY: G.C. CARTER
CHK'D BY:
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LEVELS
WORK PKG
PCT

RESP ENGR: K. MARONEY
SUPV: R.J. BOUDREAU

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1 ORIGINAL ISSUE

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Site 6 - Ramp Washdown: Numerous fuel and oil spills occurred on the ramp, especially during the 1950's and 1960's. Spilled materials were washed onto the adjacent grassy area.

Site 7 - Oil Sludge Pond: The oil sludge pond was operated from the mid-1950's until 1972. It was used to dispose of solvents, oils, and other wastes.

The PA recommended all of the above sites for further action.

2.1.2.2 Basewide SI

In 1992 and 1993, the seven sites identified for further action in the PA were examined under the SI. In addition to the seven sites, the City Drain Channel was also studied. UST Sites 8 and 9 were investigated during this same time under the IRP. The Site 10 investigation was initiated in 1994 but was not completed. Brief descriptions of Sites 8, 9, and 10 follow:

Site 8 - Underground Storage Tanks: Two leaking USTs were formerly located at Site 8. The tanks were removed in 1993. Subsequently, halogenated compounds were detected in site soils and groundwater.

Site 9 - Underground Storage Tanks: Site 9 was identified in 1992 and placed in the RCRA UST program.

Site 10 - POL Yard: According to the PA, a 3,500-gallon fuel spill occurred in 1982 due to a valve failure at the on-site process recovery tank.

SI activities consisted of field screening, confirmation activities, and the preparation of an SI report. The following recommendations were made for each of the sites:

Site 1 - Perform confirmation sampling to support a no further action alternative.
Site 2 - Perform additional investigations to further characterize extent of contamination.
Site 3 - Perform additional investigations to further characterize extent of contamination.
Site 4 - Perform confirmation sampling to support a no further action alternative.
Site 5 - Perform confirmation sampling to support a no further action alternative.
Site 6 - The recommended no further action alternative has been supported by performance of additional confirmation sampling. No further response action planned.
Site 7 - Perform RI/FS
Site 8 - Perform RI/FS
Site 9 - No further response action planned.
Site 10 - Perform RI/FS
City Drain Channel - Perform additional investigations to further characterize extent of contamination.

The no further action alternative has been recommended for Sites 1, 4, 5, 6, and 9, and DDs will be prepared for these sites. The remaining sites are at various stages in the IRP process.

No further investigations of the City Drain Channel will be conducted by the UANG Base pending city, state, and airport authority definition of responsibility.

2.2 RI IRP SITE DESCRIPTIONS

IRP Sites 8 and 10 were investigated for this RI. Their locations are shown on Figure 2-2.

2.2.1 IRP Site 8 — Former UST Area

2.2.1.1 Site History

IRP Site 8 is located adjacent to the southern Base boundary. Original investigations at Site 8 were limited to the area located south of the southeast corner of Building 10 where two 2,000-gallon steel-walled USTs were situated end-to-end in a single tank pit. During this RI, the area of investigation extended to the eastern edge of E Street, the northern edge of 2nd Street, the southern Base boundary, and the eastern edge of the aircraft ramp.

According to Base personnel, from 1950 to 1975 the southern tank formerly located at Site 8 contained aviation gas (AVGAS). During the remaining period of use, from 1976 to 1991, the tank contained diesel fuel. From 1950 to 1975 the northern tank also held AVGAS, and from 1976 to 1991 it contained JP-4. Both tanks were estimated to be 41 years old at the time of removal. The USTs and piping were not equipped with cathodic protection.

2.2.1.2 Release History

According to documentation provided in the PA, a 500-gallon fuel spill occurred near Building 10 in 1974 or 1975. The fuel was reported to have been soaked up with straw to prevent migration to the City Drain Channel. All of the fuel reportedly was cleaned up.

In December 1990, both USTs passed tank tightness tests but failed the piping tightness tests (IHI, 1992a). Product lines passed but the vent lines failed. In May 1991, exploratory excavations were performed where the piping entered the tanks and stained soil was observed. The tanks were then taken out of service and the product was removed. The USTs were removed on July 14, 1992. Upon removal, corrosion and holes were observed on the walls of both tanks (IHI, 1992a). The product piping was drained, capped, and left in place as allowed by Utah Administrative Code R311-204-2. The vent lines were removed. The dispensers located west of the tank excavation had been dismantled by the Base prior to the UST removal. The depth of the excavation was estimated to be approximately 10 feet.

Soil samples collected at the time of tank removal indicated that contamination from petroleum was not present in soils beneath the dispenser and product piping. However, benzene at a concentration of 4 milligrams per liter (mg/l) was detected in the single groundwater sample collected in the tank pit. No free product was observed in the tank pit (IHI, 1992a).

The SI at Site 8 was initiated in 1993 to evaluate possible contamination of site soils and groundwater by petroleum leaks from the USTs (ES, 1993). In 1994, an additional SI was performed to further define the extent of contaminated groundwater at this site (ES, 1994).

During the initial investigation for the UST removal, benzene levels in the soil exceeded the UDEQ Division of Environmental Response and Remediation (DERR) recommended cleanup level of 0.3 parts per million (300 μg/kg). During the subsequent SI, soil and groundwater in the vicinity of the tanks were found to be contaminated with total petroleum hydrocarbons (TPH) and benzene. Halogenated compounds (primarily trichloroethene [TCE]) were also detected in some soil and groundwater samples collected to evaluate the extent of the petroleum-related contamination. Due to the presence of the halogenated compounds, regulation of the site was transferred from the DERR UST section to the Utah State CERCLA section. Figure 2-3 shows the locations of data points from the SI sampling program. Figures 2-4 and 2-5 show halogenated compound concentrations, and Figures 2-6 and 2-7 show petroleum compound concentrations detected in soil and groundwater at Site 8.

The extent of petroleum-contaminated groundwater at the site was defined. Also, the extent of petroleum-contaminated soils was determined to be below regulatory clean-up levels. The extent of halogenated compound contaminated soils and groundwater was not fully defined in the SI. The SI recommended the site for further action (RI/FS). The RI/FS was performed to delineate the extent of halogenated solvents in site soils and groundwater and benzene, toluene, ethylbenzene, and xylenes (BTEX) in site soils.

2.2.2 Site 10 — POL Facility

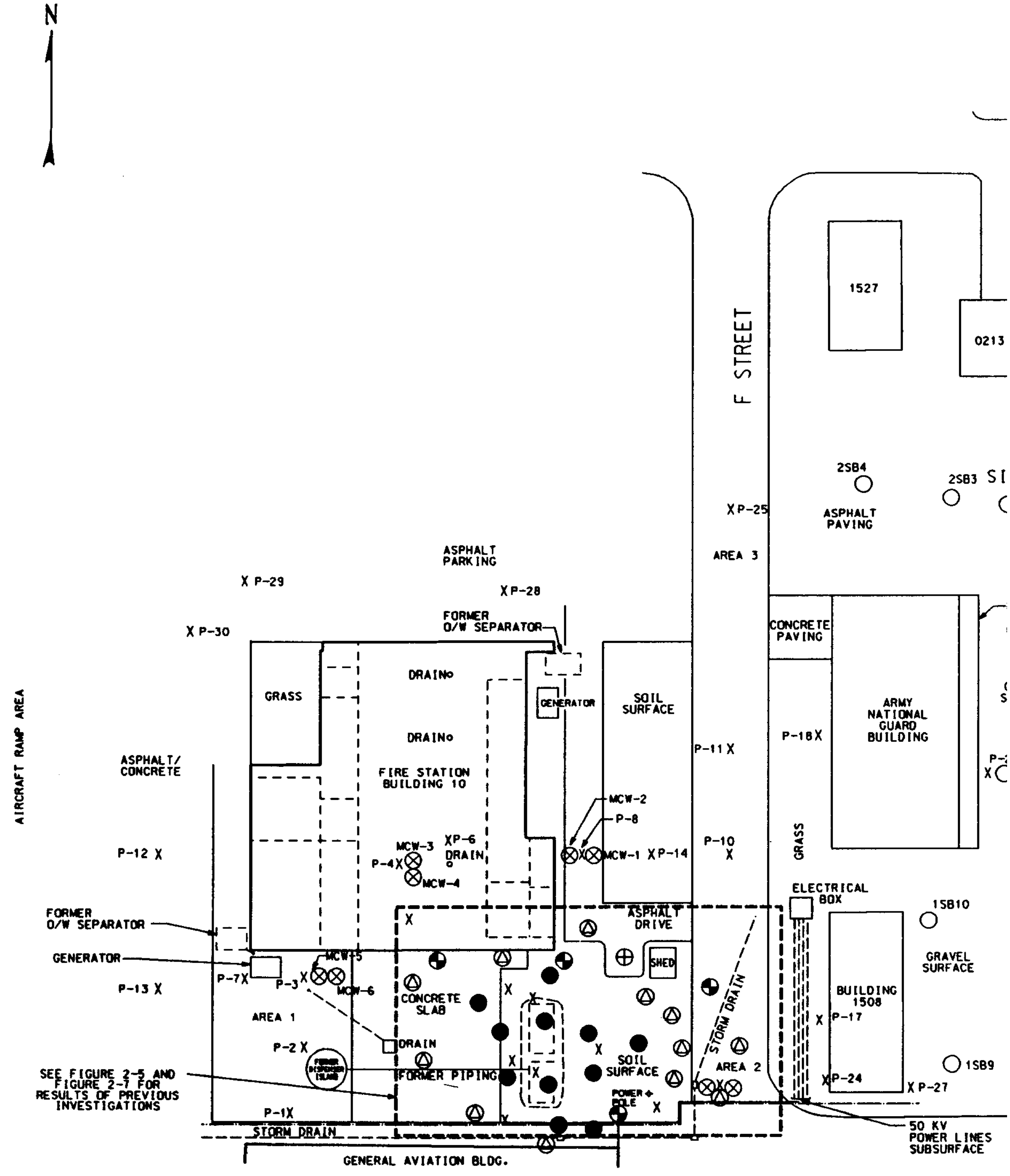
2.2.2.1 Site History

Site 10 is located in the north-central part of the Base adjacent to the City Drain Channel (Figure 2-8). The site is bounded by a chain-linked fence, and most of the site is covered with asphalt and concrete. Two large, cylindrical aboveground storage tanks (ASTs) containing JP-4 aviation fuel are located in the south-central part of the yard. Tank 2011 has a 300,000-gallon capacity and tank 2012 has a 100,000-gallon capacity. Both tanks are located in concrete secondary containment structures which have the capacity to hold 110% of the volume of the tanks. The tanks and containment structures are visually inspected daily. In addition, the volume of fuel in the tanks is measured and reconciled with inventory records on a daily basis. The tanks are equipped with automatic shut-off valves and alarms for overfill prevention. These devices are tested on a semi-annual basis. A smaller 5,000-gallon fuel additives tank (property of Chevron Pipeline Co.) is located north of the ASTs at the eastern boundary of the facility. Two dispensers are located north of the mixing tank, and two dispensers are located in a concrete covered area at the north end of the facility. A process recovery tank is located at the northwest side of the POL yard.

2.2.2.2 Release History

A release from the process recovery tank located at the northwest side of the facility occurred in 1982. The process recovery tank reportedly contained a mixture of JP-4 fuel and water. The PA reported that the release was 3,500 gallons. Site personnel indicated that at least one smaller release has occurred since 1982. Contamination from petroleum was also detected in a construction trench slightly northwest of the process recovery tank in June 1993. The contamination was observed as a sheen on pooled shallow groundwater and also as discoloration in a gravel zone below the level of groundwater. This observation was confirmed by Stone & Webster during the Draft Work Plan comment resolution discussions.

An unidentified contaminant was encountered at Site 10 during routine construction activities in June 1993. A laborer working on the construction activities reported encountering fumes that caused headache and nausea. Two headspace soil samples collected from the construction trench were analyzed with a photoionization detector (PID) and indicated the presence of 252 parts per million (ppm) and 1,248 ppm organic vapor. An SI was initiated at Site 10 in 1994 as a result of this event. Three piezometers and four soil borings were drilled at the site. Samples from three of the soil borings showed contamination with petroleum compounds ranging from 12 ppm TPH to 1,400 ppm TPH. One of the soil samples also contained a low concentration (2.2 ppm) of dichloromethane. Contaminants were not detected in the fourth soil boring at concentrations above the method detection limits. Field activities were stopped after an exposure incident during drilling of one of the soil borings. The SI was discontinued in favor of an RI.



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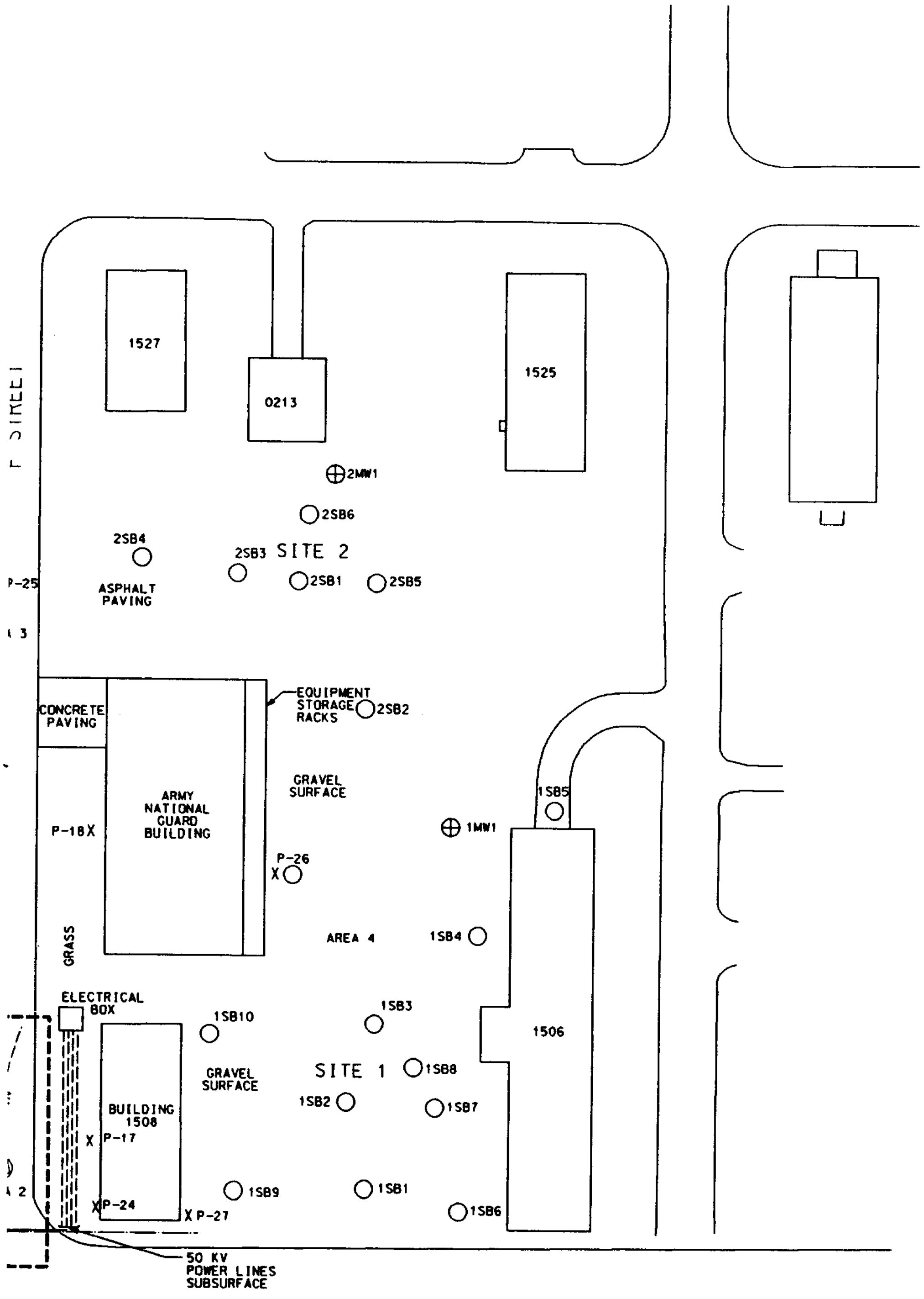

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○ SOIL BORING PARSONS ES
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(JANUARY 1993)

◬ SOIL BORING PARSONS ES
(APRIL 1994)

⊕ MONITORING WELL PARSONS
(JANUARY 1993)

◕ MONITORING WELL PARSONS
(APRIL 1994)

⊗ MICRO-WELL PARSONS ES
(JUNE 1994)

——— PROPERTY BOUNDARY

-·-·-·- FORMER UST AREA

NOTE:

1SBR-1SB10 WERE DRILLED
IN OCTOBER 1994.

0 40'

FIGURE 2-3

PREVIOUS SAMPLE LOCAT
IRP SITE 8

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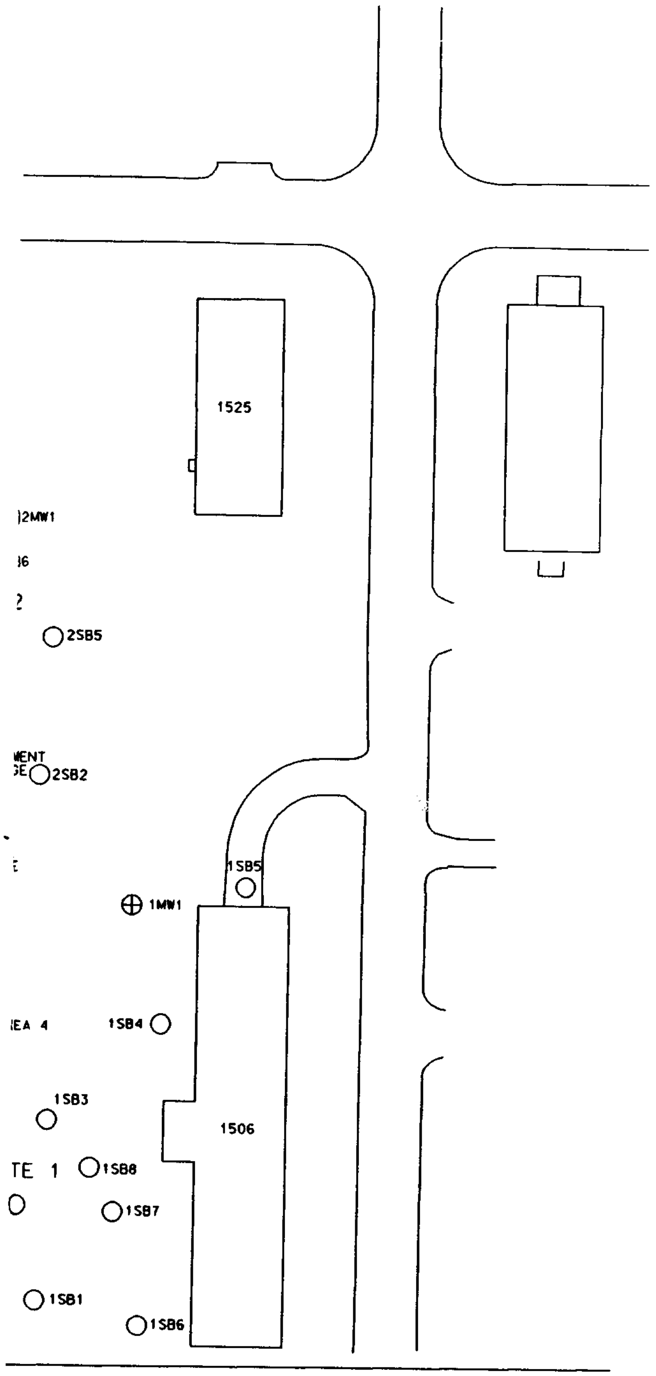

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● SOIL BORING PARSONS ES (JANUARY 1993)
◬ SOIL BORING PARSONS ES (APRIL 1994)
⊕ MONITORING WELL PARSONS ES (JANUARY 1993)
◕ MONITORING WELL PARSONS ES (APRIL 1994)
⊗ MICRO-WELL PARSONS ES (JUNE 1994)

——— PROPERTY BOUNDARY
- - - - FORMER UST AREA

NOTE:

1SBR-1SB10 WERE DRILLED IN OCTOBER 1994.

0 40'

FIGURE 2-3

PREVIOUS SAMPLE LOCATIONS IRP SITE 8

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SALT LAKE CITY, UTAH

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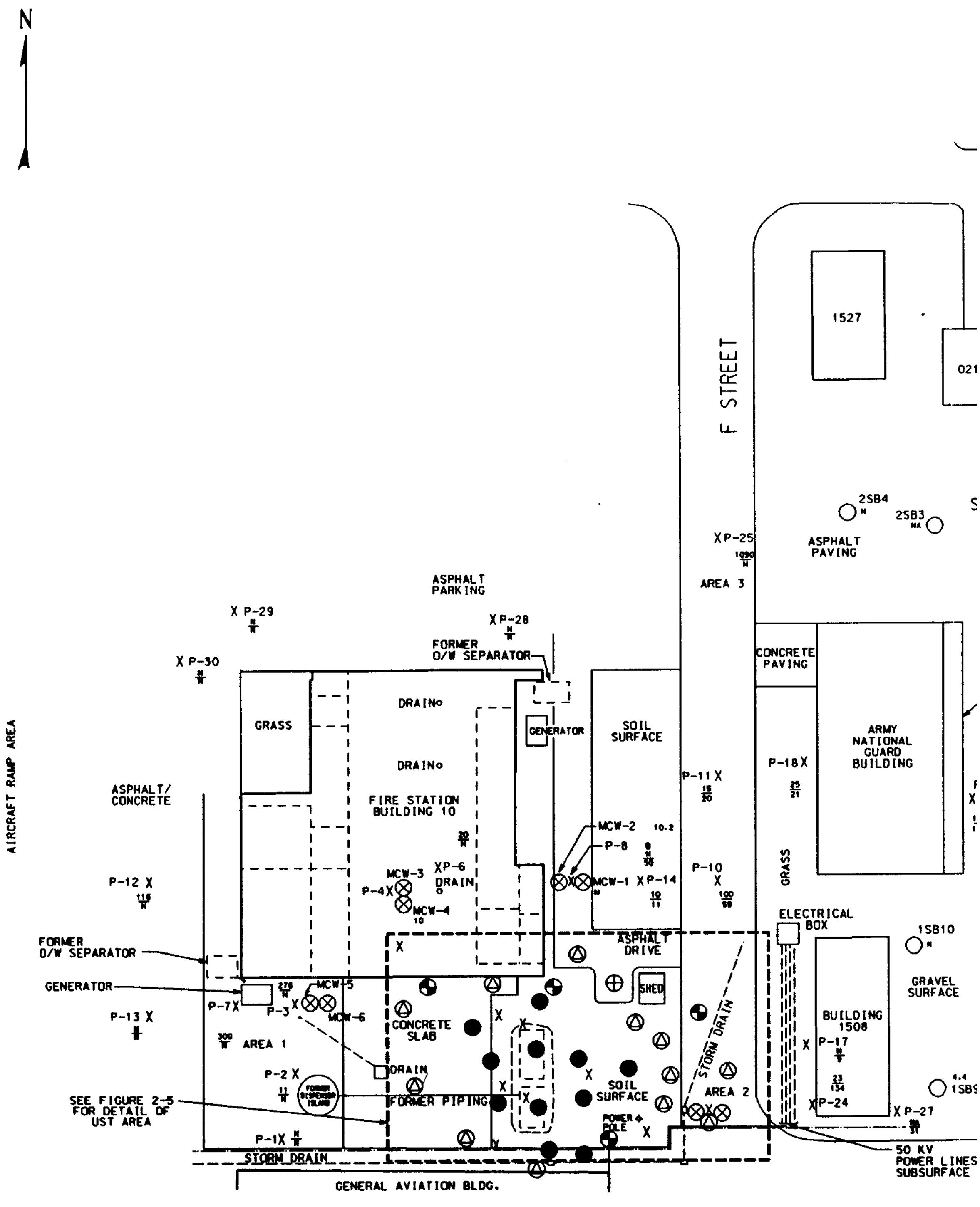

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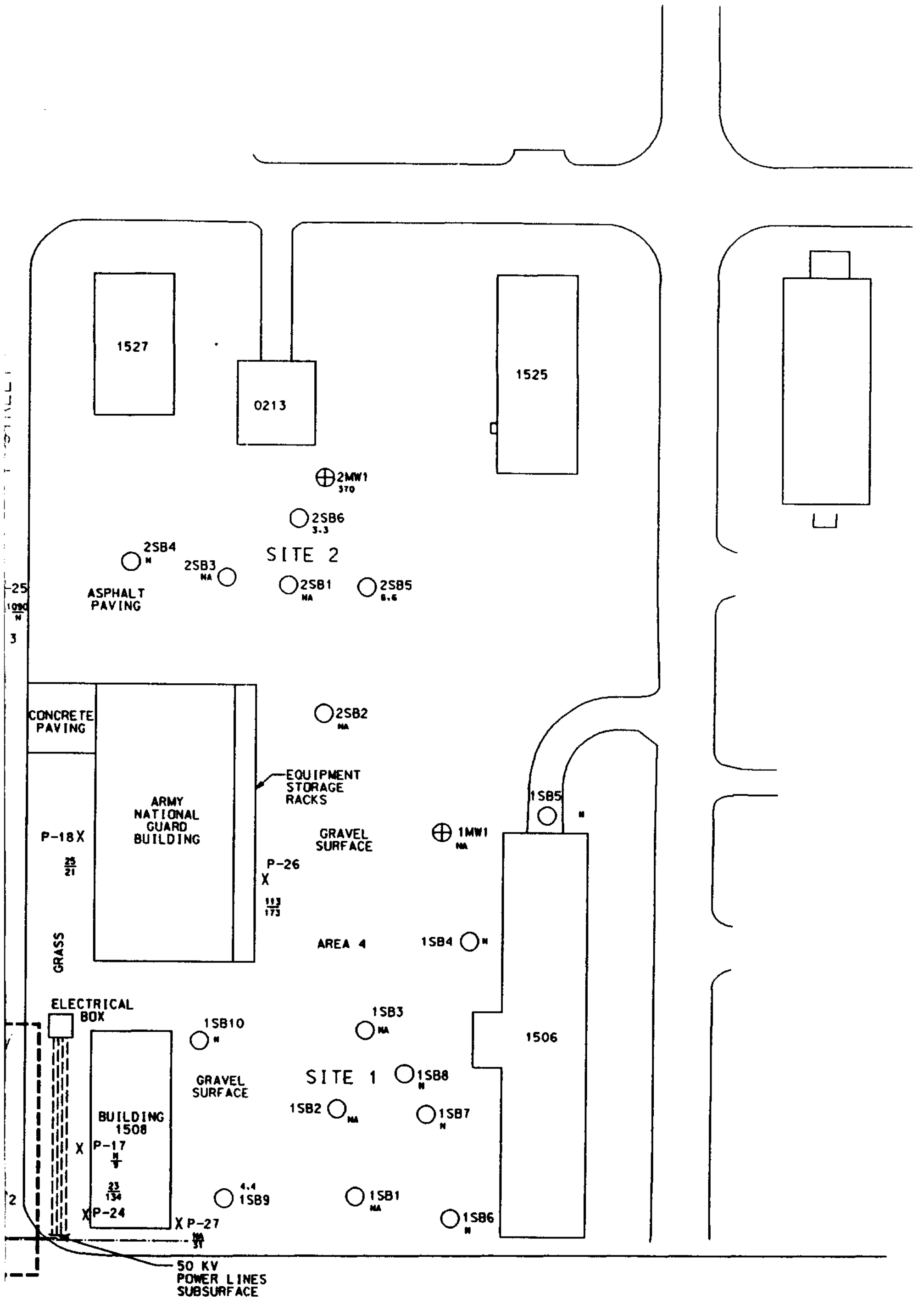

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⊛ SOIL BORING PARSONS ES (APRIL 1994)

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◕ MONITORING WELL PARSONS ES (APRIL 1994)

⊗ MICRO-WELL PARSONS ES (JUNE 1994)

——— PROPERTY BOUNDARY

- - - - FORMER UST AREA

DETECTED COMPOUND CODE:

J	ESTIMATED
N	NOT DETECTED
NA	NOT ANALYZED

NOTES:

1. TRICHLOROETHYLENE (TCE) CONCENTRATIONS SHOWN WHERE DETECTE OTHER DETECTED HALOGENATED COMPOUN NOT SHOWN., UNLESS NOTED.
2. CONCENTRATIONS OF TCE SHOWN IN SHALLOW/DEEP INTERVALS.
3. TCE CONCENTRATIONS IN WATER ARE IN ug/L. TCE CONCENTRATIONS IN SOI ARE IN ug/kg.
4. 1SB4-1SB10 WERE DRILLED IN OCTOBER

0 40'

FIGURE 2-4

PREVIOUS SITE 8 INVESTIGA
HALOGENATED COMPOUND
CONCENTRATIONS
151st ARW, UTAH AIR NATIONAL GU
SALT LAKE CITY INTERNATIONAL AIR
SALT LAKE CITY, UTAH
STONE & WEBSTER ENGINEERING CORPORATI
BOSTON, MASS.

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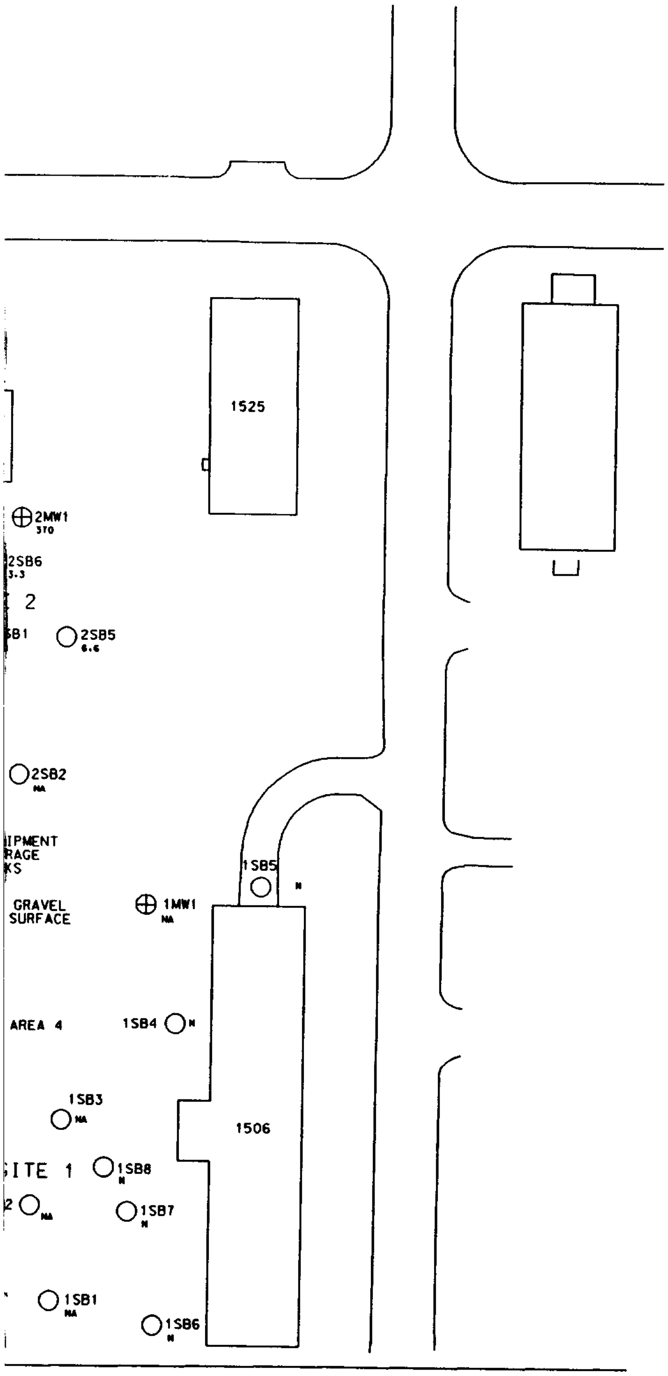

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PREVIOUS SAMPLE LOCATIONS:

X GEOPROBE SAMPLE POINT (15) (SCREENING DATA) (JUNE 1994)
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⊕ MONITORING WELL PARSONS ES (JANUARY 1993)
◕ MONITORING WELL PARSONS ES (APRIL 1994)
⊗ MICRO-WELL PARSONS ES (JUNE 1994)

——— PROPERTY BOUNDARY
-·-·-·- FORMER UST AREA

DETECTED COMPOUND CODE:

J	ESTIMATED
N	NOT DETECTED
NA	NOT ANALYZED

NOTES:

1. TRICHLOROETHYLENE (TCE) CONCENTRATIONS SHOWN WHERE DETECTED. OTHER DETECTED HALOGENATED COMPOUNDS NOT SHOWN., UNLESS NOTED.
2. CONCENTRATIONS OF TCE SHOWN IN SHALLOW/DEEP INTERVALS.
3. TCE CONCENTRATIONS IN WATER ARE IN ug/L. TCE CONCENTRATIONS IN SOIL ARE IN ug/kg.
4. 1SB4-1SB10 WERE DRILLED IN OCTOBER 1994.

0 40′

FIGURE 2-4

PREVIOUS SITE 8 INVESTIGATIONS HALOGENATED COMPOUND CONCENTRATIONS

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SALT LAKE CITY, UTAH
STONE & WEBSTER ENGINEERING CORPORATION
BOSTON, MASS.

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DRAWN BY: G.C. CARTER
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RESP ENGR: K. MARONEY
SUPV: R.J. BOUDREAU
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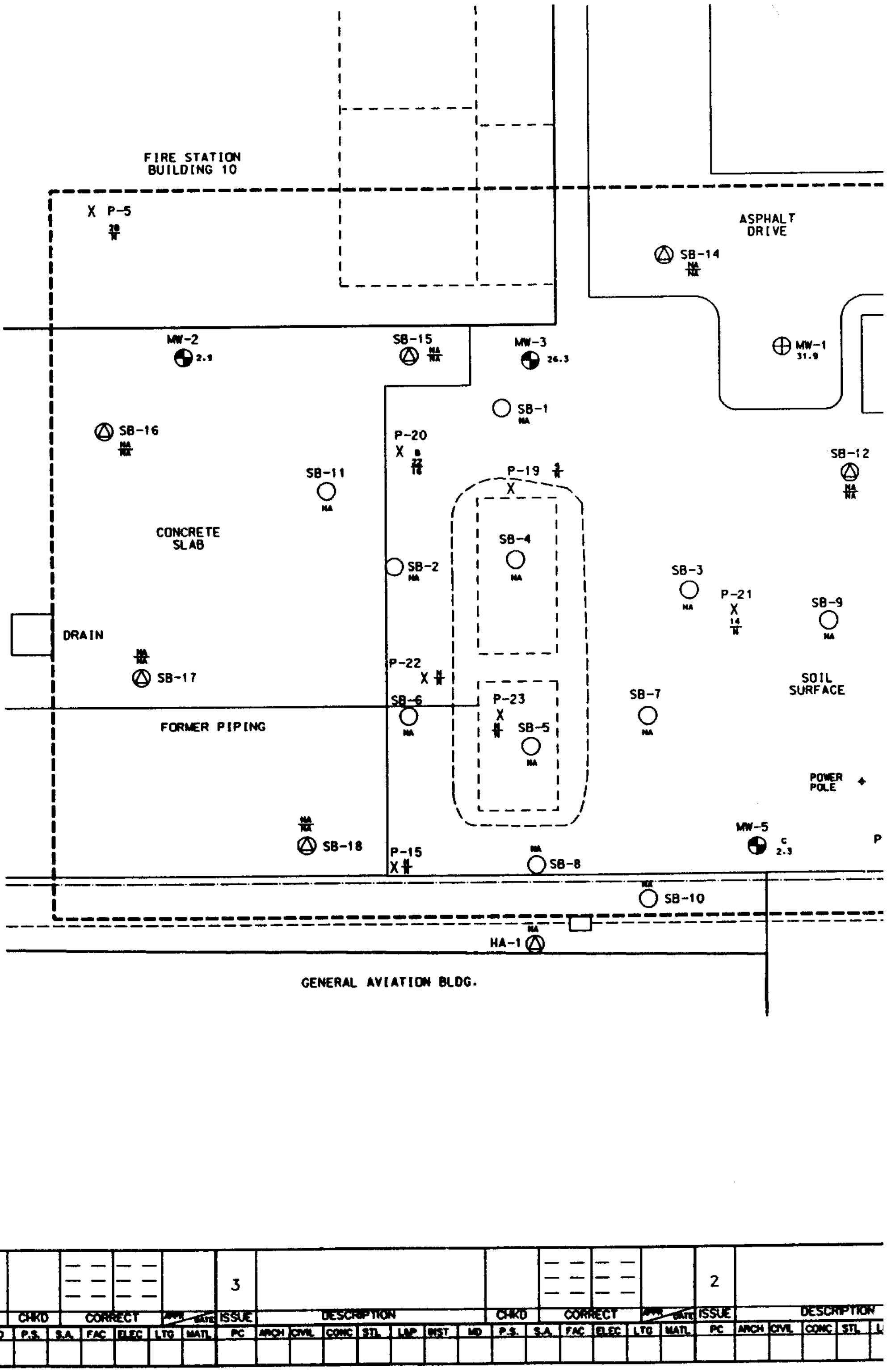

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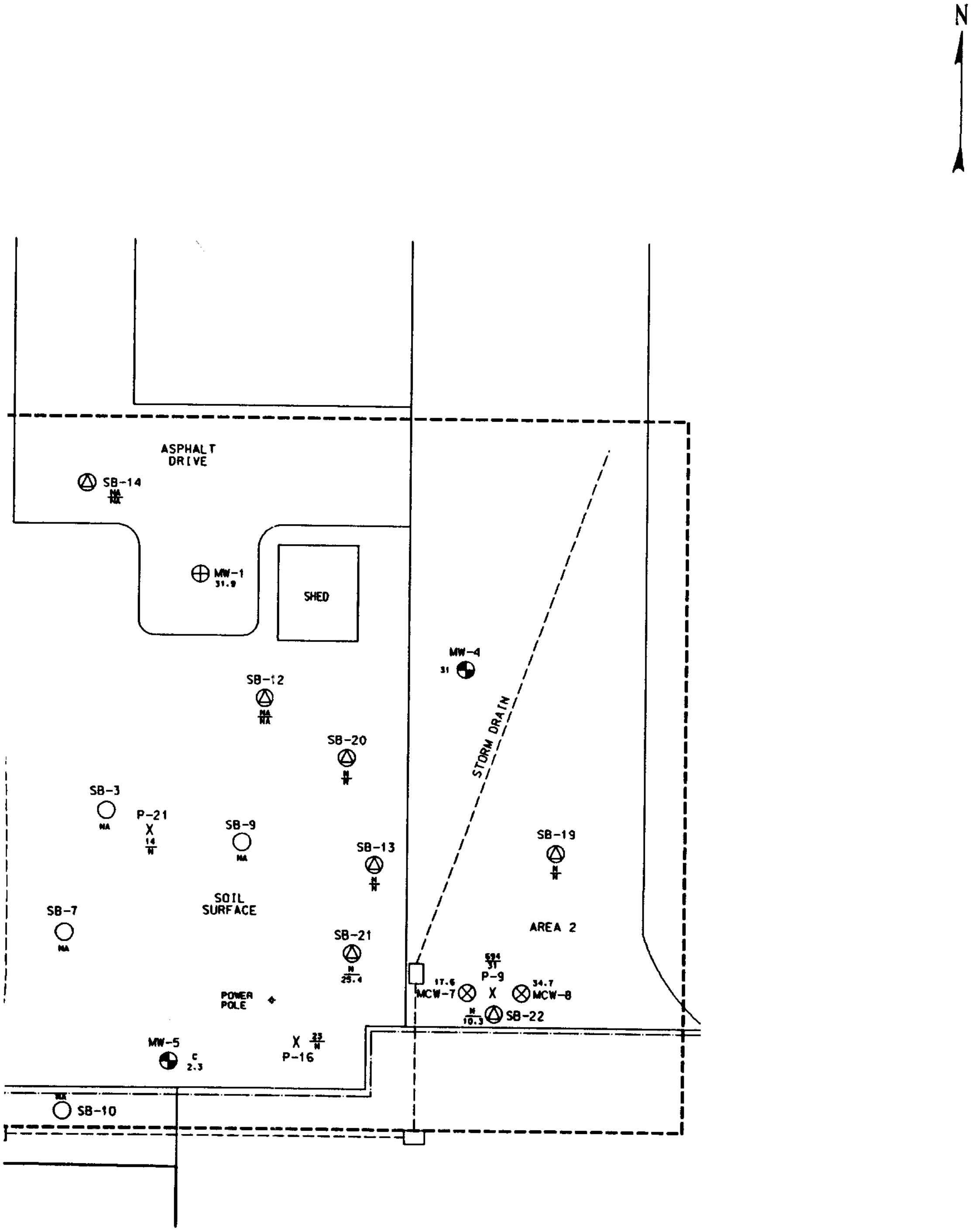

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- ● SOIL BORING PARSONS ES (JANUARY 1993)
- ⊛ SOIL BORING PARSONS ES (APRIL 1994)
- ⊕ MONITORING WELL PARSONS (JANUARY 1993)
- ◕ MONITORING WELL PARSONS (APRIL 1994)
- ⊗ MICRO-WELL PARSONS ES (JUNE 1994)

——— PROPERTY BOUNDARY

- - - - - FORMER UST AREA

DETECTED COMPOUND CODE:

A	CIS 1,2-DICHLOROETHYLENE
B	TRANS 1,2-DICHLOROETHYLE
C	1,1,1-TRICHLOROETHANE
J	ESTIMATED
N	NOT DETECTED
NA	NO HALOGENATED ANALYSIS

NOTES:

1. TRICHLOROETHYLENE (TCE) CONC SHOWN WHERE DETECTED. OTHER HALOGENATED COMPOUNDS NOT SH UNLESS NOTED.
2. CONCENTRATIONS OF COMPOUNDS IN SHALLOW/DEEP INTERVALS.
3. WATER CONCENTRATIONS ARE IN
4. SOIL CONCENTRATIONS ARE IN U

0 15′

FIGURE 2-5

PREVIOUS SITE 8 INVEST UST AREA - HALOGENATED CONCENTRATIONS

151st ARW, UTAH AIR NATION
SALT LAKE CITY INTERNATIONAL
SALT LAKE CITY, UTAH
STONE & WEBSTER ENGINEERING CORP
BOSTON, MASS.

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ELEC LTG MATL PC ARCH CIVIL CONC STL L&P INST MD P.S. S.A. FAC ELEC LTG MATL PC ARCH CIVIL CONC STL L&P INST MD P.S. S.A. FAC ELEC LTG MATL

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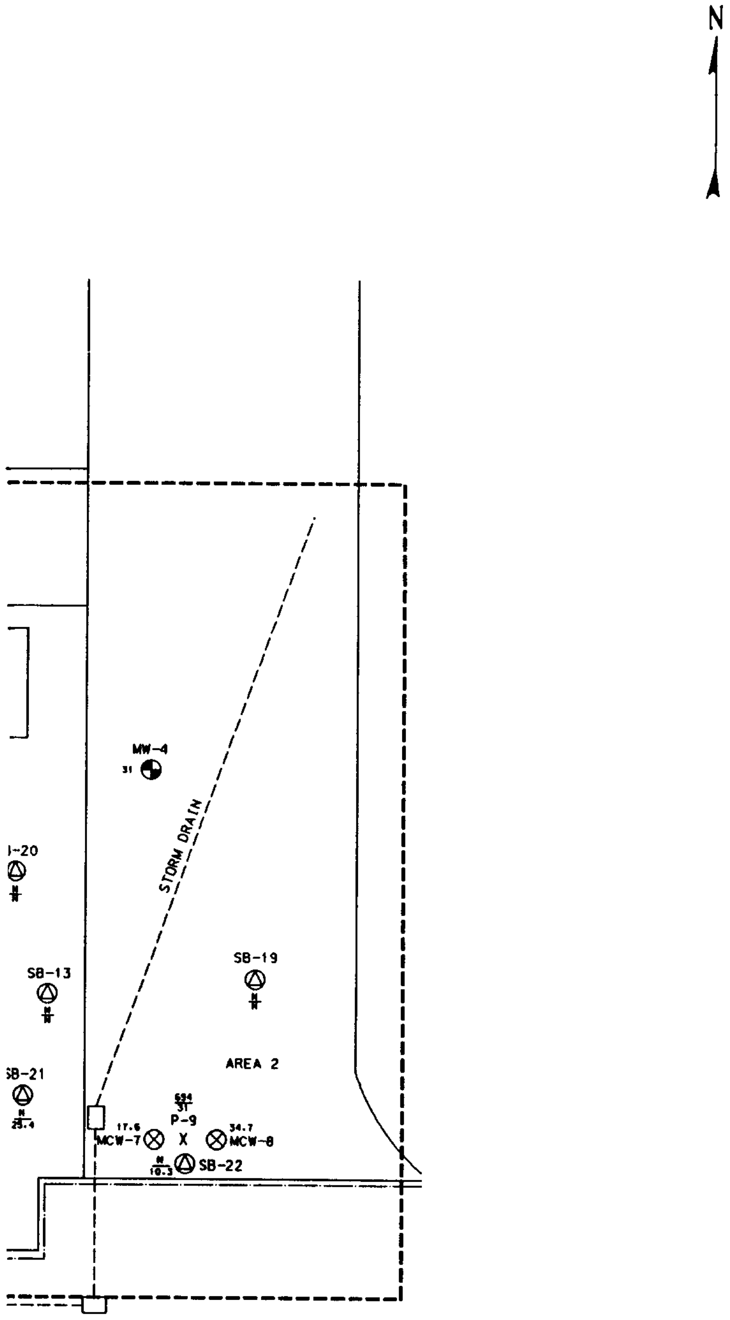

LEGEND:

PREVIOUS SAMPLE LOCATIONS:

- X GEOPROBE SAMPLE POINT (SCREENING DATA) (JUNE 1994)
- ○ SOIL BORING PARSONS ES (NOVEMBER 1992)
- ● SOIL BORING PARSONS ES (JANUARY 1993)
- ◬ SOIL BORING PARSONS ES (APRIL 1994)
- ⊕ MONITORING WELL PARSONS ES (JANUARY 1993)
- ◕ MONITORING WELL PARSONS ES (APRIL 1994)
- ⊗ MICRO-WELL PARSONS ES (JUNE 1994)

——— PROPERTY BOUNDARY

------- FORMER UST AREA

DETECTED COMPOUND CODE:

A	CIS 1,2-DICHLOROETHYLENE
B	TRANS 1,2-DICHLOROETHYLENE
C	1,1,1-TRICHLOROETHANE
J	ESTIMATED
N	NOT DETECTED
NA	NO HALOGENATED ANALYSIS

NOTES:

1. TRICHLOROETHYLENE (TCE) CONCENTRATIONS SHOWN WHERE DETECTED. OTHER DETECTED HALOGENATED COMPOUNDS NOT SHOWN UNLESS NOTED.
2. CONCENTRATIONS OF COMPOUNDS SHOWN IN SHALLOW/DEEP INTERVALS.
3. WATER CONCENTRATIONS ARE IN ug/L.
4. SOIL CONCENTRATIONS ARE IN ug/kg.

0 15′

FIGURE 2-5

PREVIOUS SITE 8 INVESTIGATIONS UST AREA - HALOGENATED COMPOUND CONCENTRATIONS

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DRAWN BY: G.C. CARTER
CHK'D BY:
AREAS LEVELS WORK PKG PCT

RESP ENGR: K. MARONEY
SUPV: R.J. BOUDREAU

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MD P.S. S.A. FAC ELEC LTG MATL PC ARCH CIVIL CONC STL L&P INST MD P.S. S.A. FAC ELEC LTG MATL

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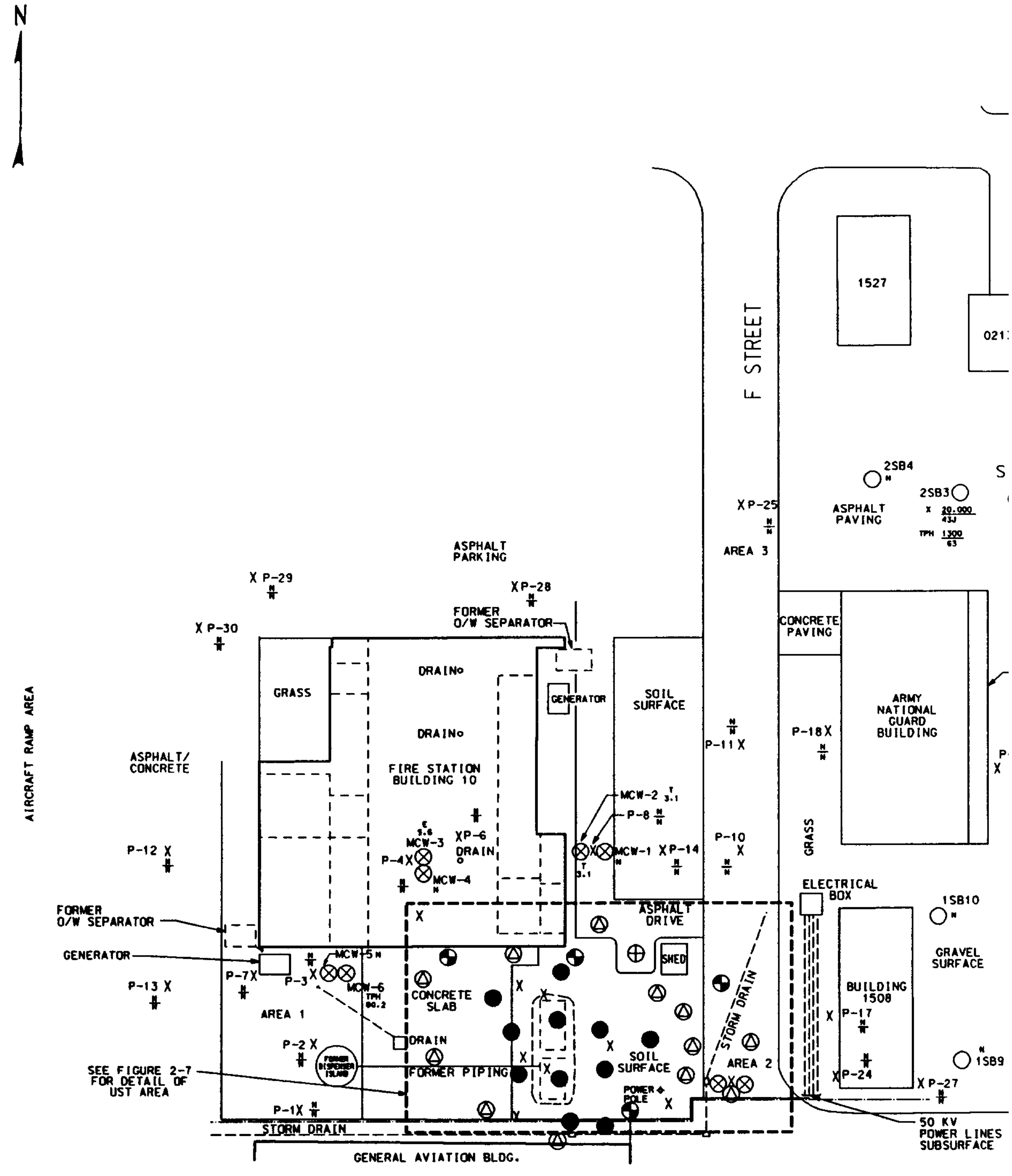

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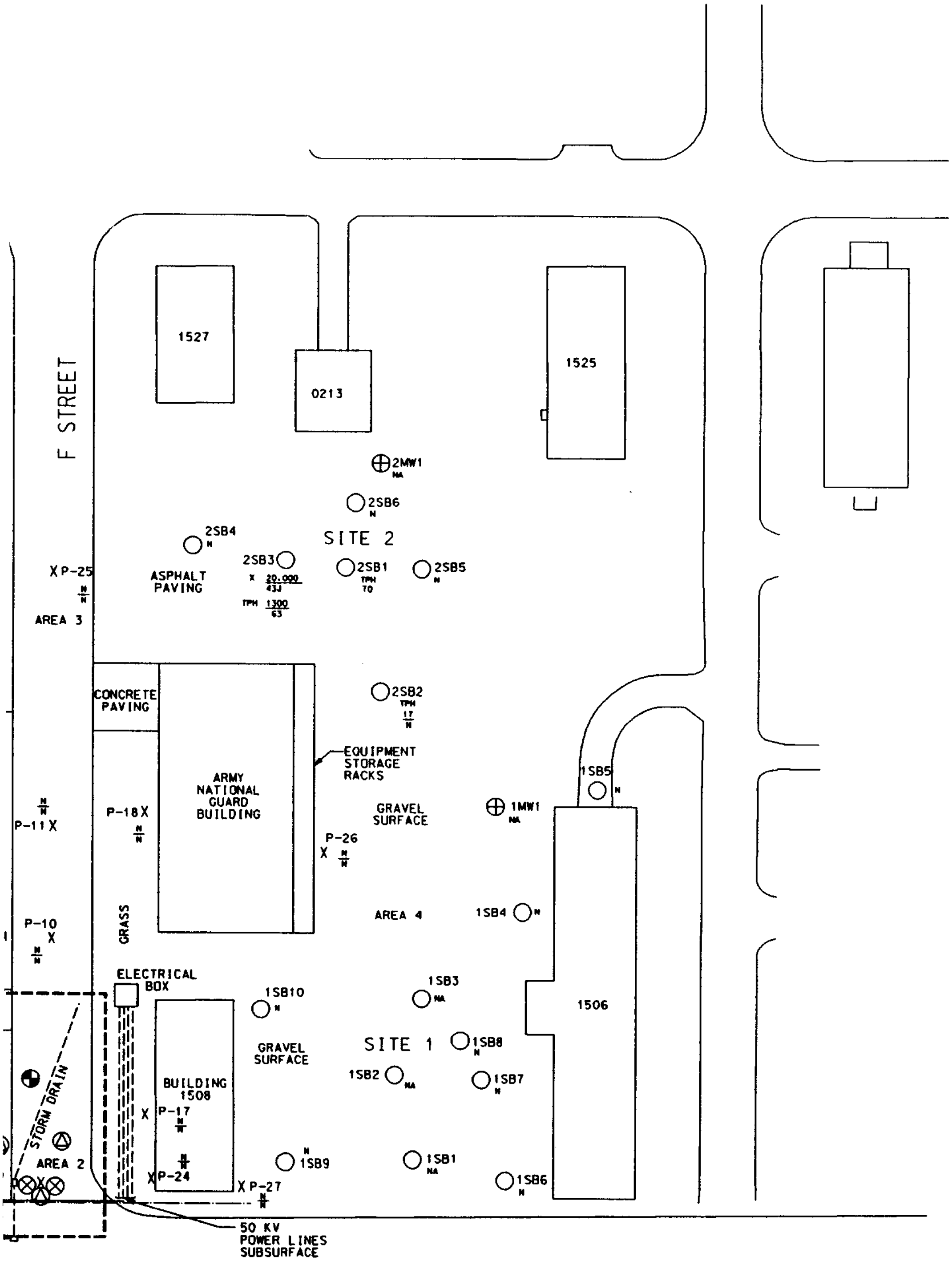

LEGEND:

EXISTING SAMPLE LOCATI

X GEOPROBE SAMPLE POINT (SCREENING DATA) (JUNE

○ SOIL BORING PARSONS ES (DECEMBER 1992)

● SOIL BORING PARSONS ES (JANUARY 1993)

◬ SOIL BORING PARSONS ES (APRIL 1994)

⊕ MONITORING WELL PARSONS (JANUARY 1993)

◐ MONITORING WELL PARSONS (APRIL 1994)

⊗ MICRO-WELL PARSONS ES (JUNE 1994)

——— PROPERTY BOUNDARY

------ FORMER UST AREA

PETROLEUM DESIGNATION:

E	ETHYLBENZENE
T	TOLUENE
X	XYLENE
TPH	TOTAL PETROLEUM HYDROCARBON
N	NOT DETECTED
NA	NOT ANALYZED
J	ESTIMATED

NOTES:

1. BENZENE CONCENTRATIONS SHO DETECTED. OTHER DETECTED P COMPOUNDS NOT SHOWN, UNLES
2. CONCENTRATIONS OF COMPOUND IN SHALLOW/DEEP INTERVALS.
3. WATER CONCENTRATIONS ARE I FOR TPH (mg/L). SOIL CONCE IN ug/L, EXCEPT FOR TPH (m
4. 1SB4-1SB10 WERE DRILLED IN

0 40'

FIGURE 2-

PREVIOUS SITE 8 INVE PETROLEUM COMP CONCENTRATIO

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DRAWN BY: G.C. CARTER
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CHK'D BY:

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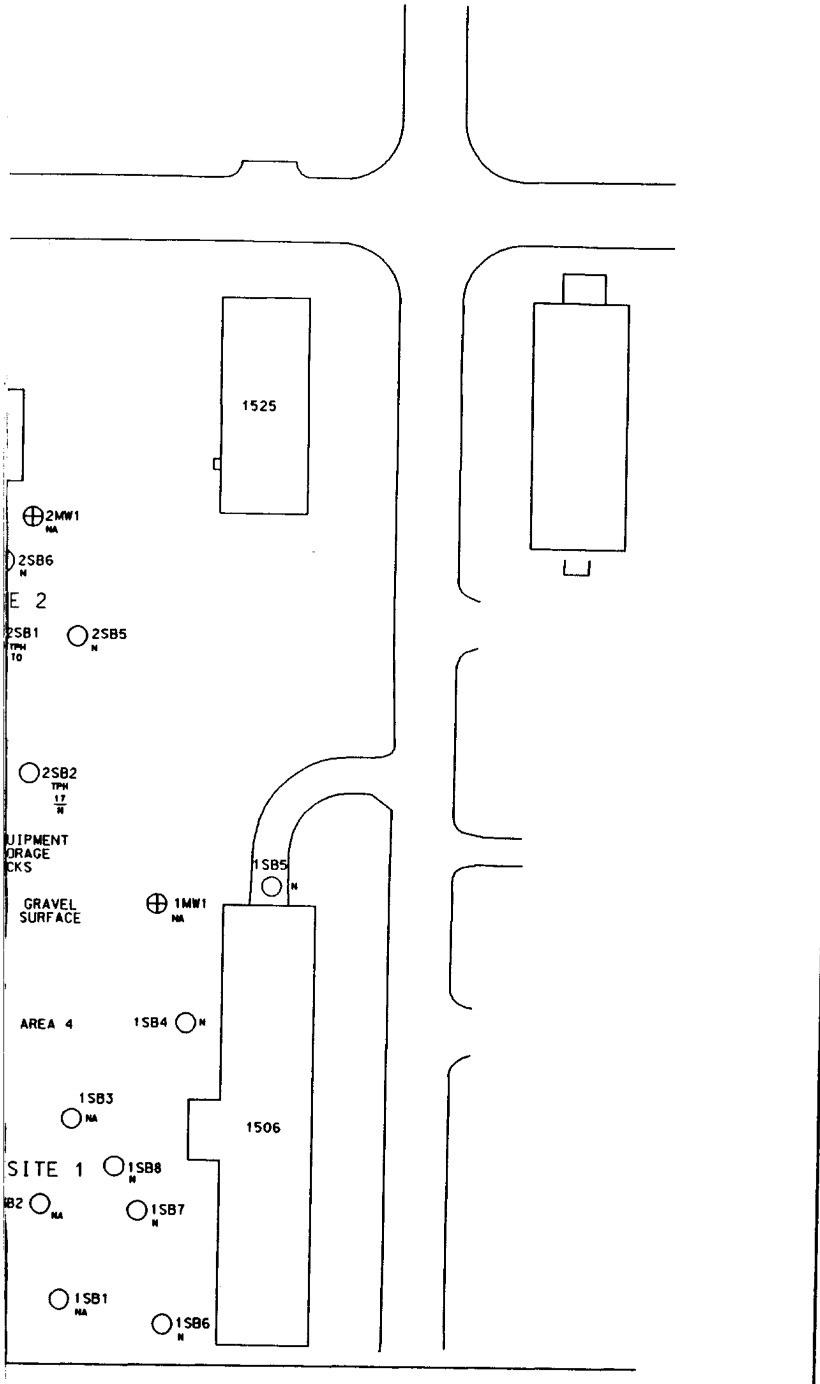

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◬	SOIL BORING PARSONS ES (APRIL 1994)
⊕	MONITORING WELL PARSONS ES (JANUARY 1993)
◐	MONITORING WELL PARSONS ES (APRIL 1994)
⊗	MICRO-WELL PARSONS ES (JUNE 1994)
———	PROPERTY BOUNDARY
- - - -	FORMER UST AREA

PETROLEUM DESIGNATION:

E	ETHYLBENZENE
T	TOLUENE
X	XYLENE
TPH	TOTAL PETROLEUM HYDROCARBON
N	NOT DETECTED
NA	NOT ANALYZED
J	ESTIMATED

NOTES:

1. BENZENE CONCENTRATIONS SHOWN WHERE DETECTED. OTHER DETECTED PETROLEUM COMPOUNDS NOT SHOWN, UNLESS NOTED.
2. CONCENTRATIONS OF COMPOUNDS SHOWN IN SHALLOW/DEEP INTERVALS.
3. WATER CONCENTRATIONS ARE IN ug/L EXCEPT FOR TPH (mg/L). SOIL CONCENTRATIONS ARE IN ug/L, EXCEPT FOR TPH (mg/kg).
4. 1SB4-1SB10 WERE DRILLED IN OCTOBER 1994.

0 40'

FIGURE 2-6

ISSUE ○

HALF-SIZE APP. CARD

PREVIOUS SITE 8 INVESTIGATIONS PETROLEUM COMPOUND CONCENTRATIONS

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SUPV: R.J. BOUDREAU

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DSGN CHK'D BY:	CHK'D BY:				

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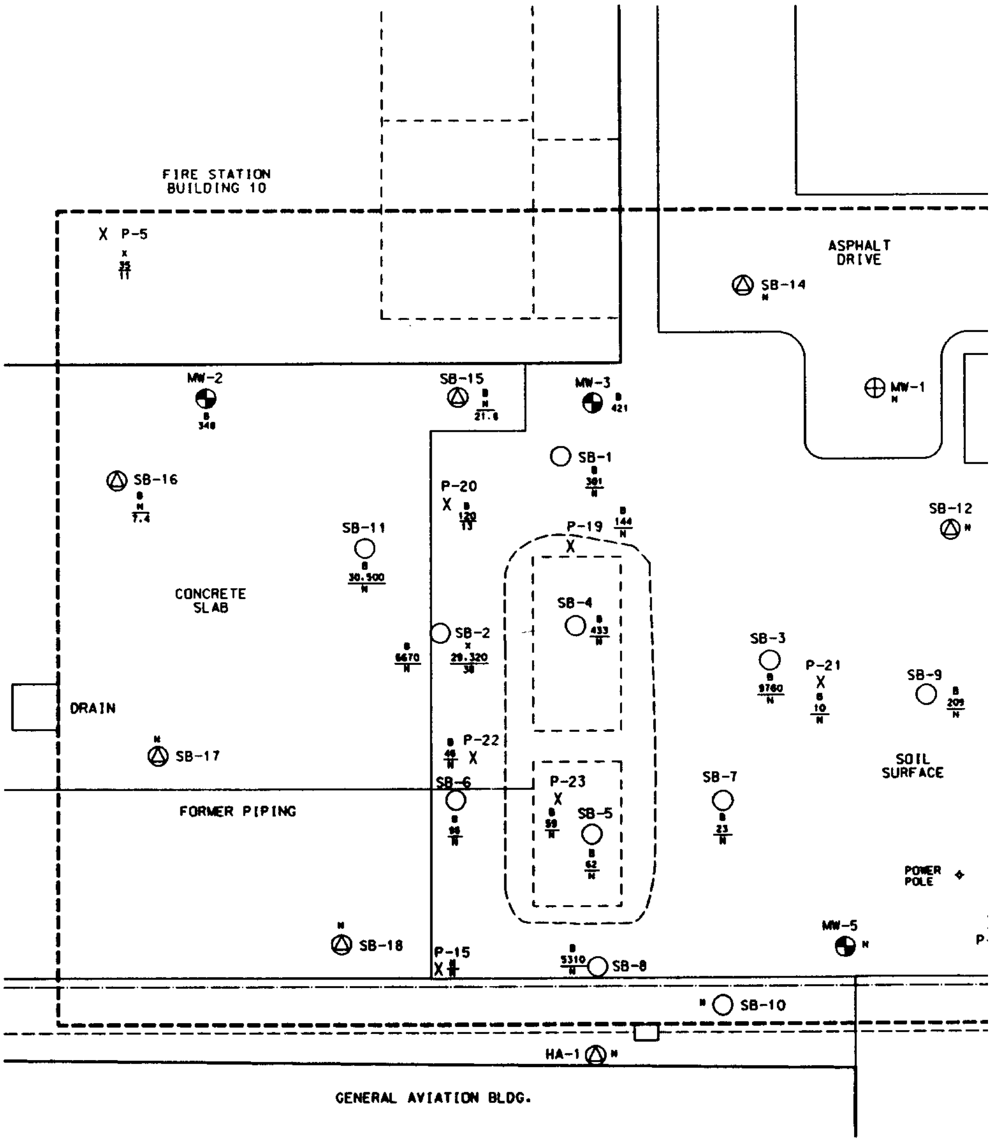

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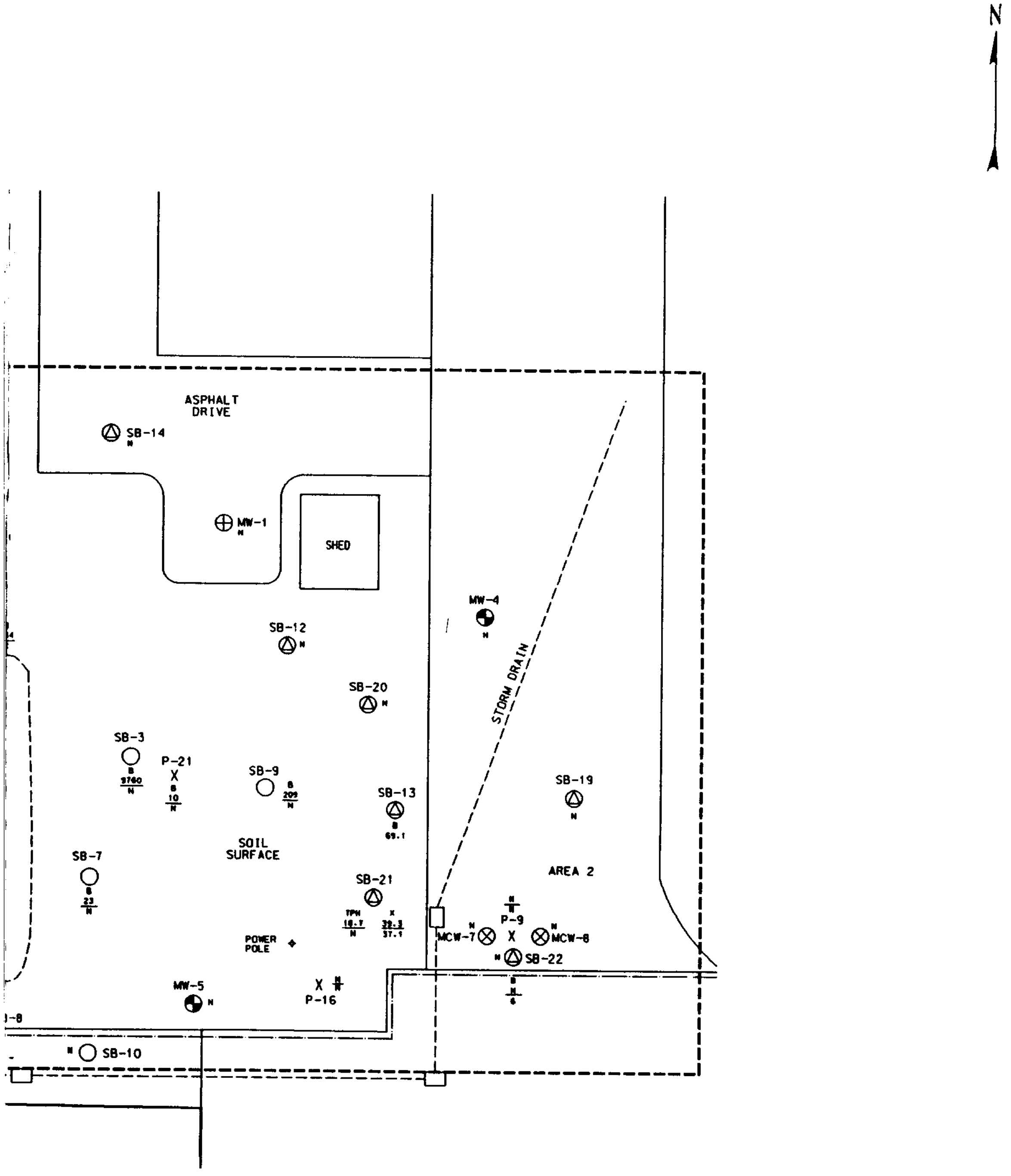

LEGEND:

PREVIOUS SAMPLE LOCATI

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○	SOIL BORING PARSONS ES (NOVEMBER 1992)
●	SOIL BORING PARSONS ES (JANUARY 1993)
△	SOIL BORING PARSONS ES (APRIL 1994)
⊕	MONITORING WELL PARSONS (JANUARY 1993)
◕	MONITORING WELL PARSONS (APRIL 1994)
⊗	MICRO-WELL PARSONS ES (JUNE 1994)
———	PROPERTY BOUNDARY
- - - -	FORMER UST AREA

DETECTED COMPOUND CODE

B	BENZENE
X	XYLENE
TPH	TOTAL PETROLEUM HYDROCARBON
N	NOT DETECTED

NOTES:

1. BENZENE CONCENTRATIONS SHOW WHERE DETECTED. OTHER DETEC PETROLEUM COMPOUNDS NOT SHO UNLESS NOTED.
2. CONCENTRATIONS OF COMPOUNDS SHOWN IN SHALLOW/DEEP INTER
3. WATER CONCENTRATIONS ARE IN ug/L, EXCEPT FOR TPH (mg/L)
4. SOIL CONCENTRATIONS ARE IN ug/kg, EXCEPT TPHS (mg/kg).

0 15′

FIGURE 2-

PREVIOUS SITE 8 INVES
UST AREA - PETROLEUM
CONCENTRATION
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SALT LAKE CITY, UT
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DRAWN BY: G.C. CARTER
CHK'D BY:

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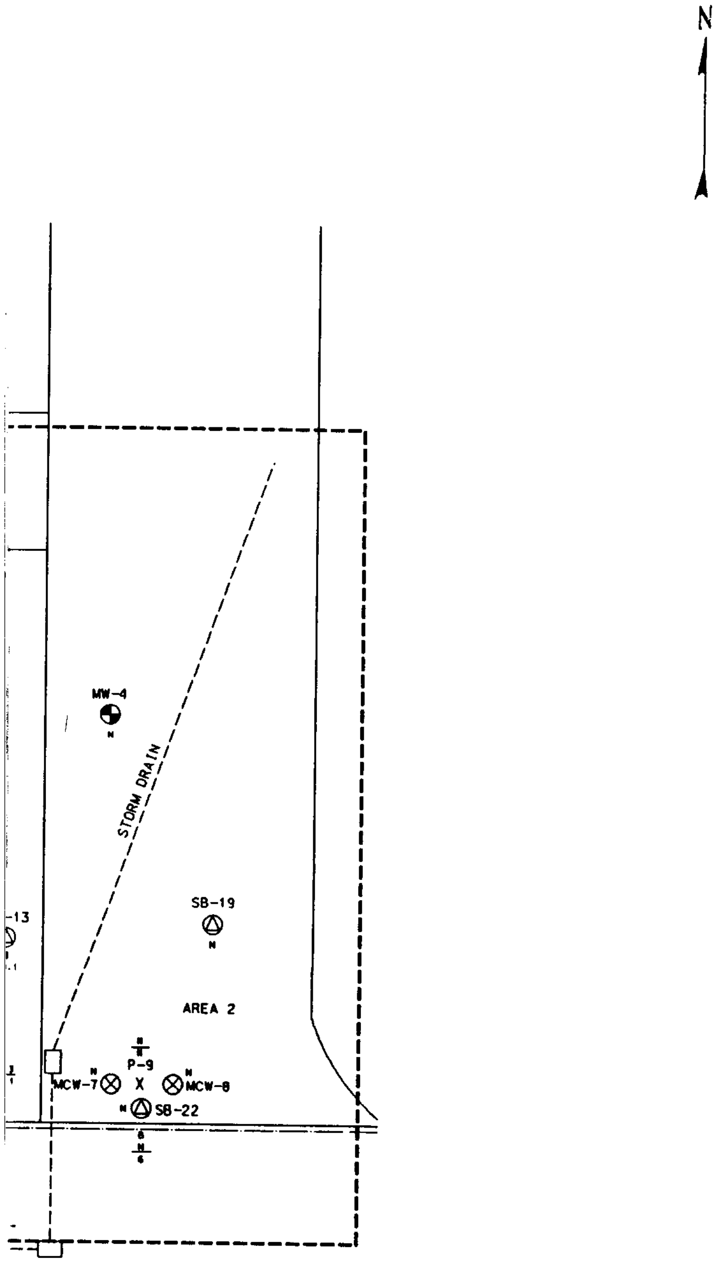

LEGEND:

PREVIOUS SAMPLE LOCATIONS:

X GEOPROBE SAMPLE POINT (SCREENING DATA) (JUNE 1994)

○ SOIL BORING PARSONS ES (NOVEMBER 1992)

● SOIL BORING PARSONS ES (JANUARY 1993)

△ SOIL BORING PARSONS ES (APRIL 1994)

⊕ MONITORING WELL PARSONS ES (JANUARY 1993)

◕ MONITORING WELL PARSONS ES (APRIL 1994)

⊗ MICRO-WELL PARSONS ES (JUNE 1994)

——— PROPERTY BOUNDARY

------ FORMER UST AREA

DETECTED COMPOUND CODE:

B	BENZENE
X	XYLENE
TPH	TOTAL PETROLEUM HYDROCARBON
N	NOT DETECTED

NOTES:

1. BENZENE CONCENTRATIONS SHOWN WHERE DETECTED. OTHER DETECTED PETROLEUM COMPOUNDS NOT SHOWN, UNLESS NOTED.
2. CONCENTRATIONS OF COMPOUNDS SHOWN IN SHALLOW/DEEP INTERVALS.
3. WATER CONCENTRATIONS ARE IN ug/L, EXCEPT FOR TPH (mg/L).
4. SOIL CONCENTRATIONS ARE IN ug/kg, EXCEPT TPHS (mg/kg).

0 15'

FIGURE 2-7

PREVIOUS SITE 8 INVESTIGATIONS
UST AREA - PETROLEUM COMPOUND CONCENTRATIONS
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SALT LAKE CITY, UTAH
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BOSTON, MASS.

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DRAWN BY: G.C. CARTER
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AREAS | LEVELS | WORK PKG | PCT

ISSUE
HALF-SIZE
APP. CARD
RESP ENGR: K. MARONEY
SUPV: R.J. BOUDREAU

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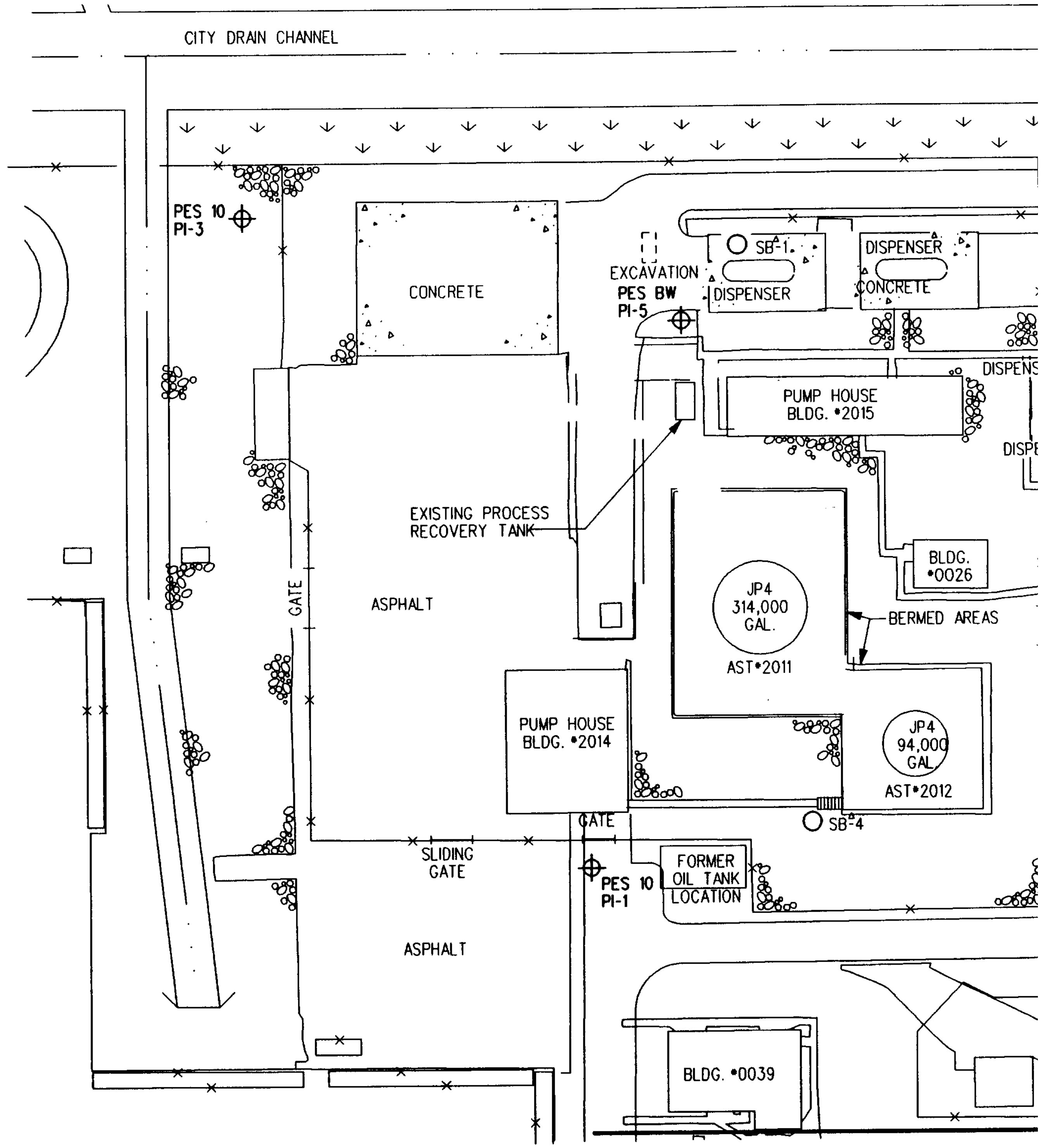

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ISSUE	DESCRIPTION						CHKD		CORRECT		APPR	DATE	ISSUE	DESCRIPTION						CHKD		CORRECT		APPR	DATE	ISSUE	DESCRIPTION							
PC	ARCH	CIVIL	CONC	STL	L&P	INST	MD	P.S.	S.A.	FAC	ELEC	LTG	MATL	PC	ARCH	CIVIL	CONC	STL	L&P	INST	MD	P.S.	S.A.	FAC	ELEC	LTG	MATL	PC	ARCH	CIVIL	CONC	STL		

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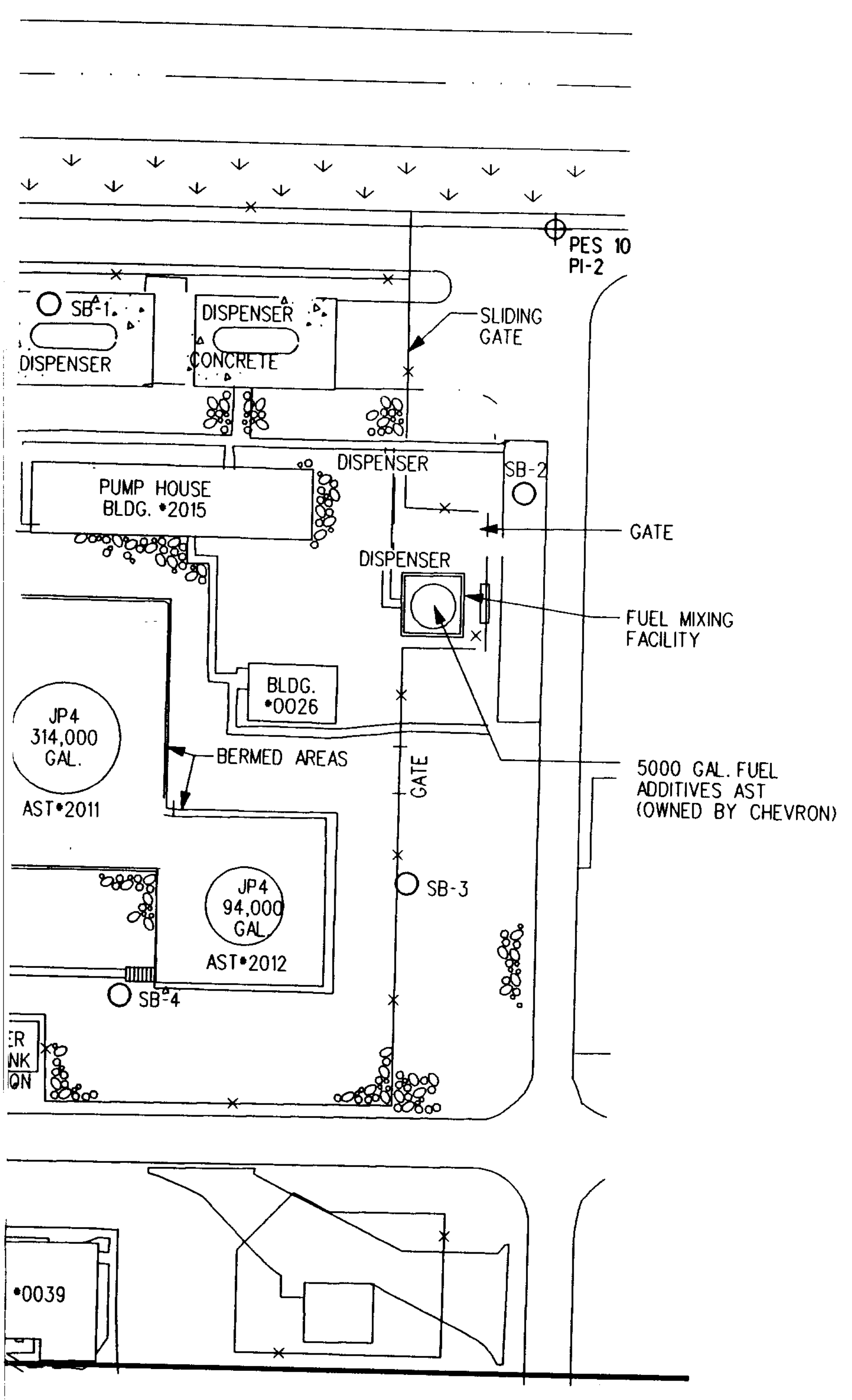

LEGEND
PREVIOUS SAMPL

○ SOIL BORING
PES BW
PI-5 ⊕ PIEZOMETER
PES 10
PI-1,2,3 ⊕ PIEZOMETER
↓ GRASS
GRAVEL
—×— FENCE

0

SCALE

FIGURE

PREVIOUS DATA
IRP SITE

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SALT LAKE CITY,

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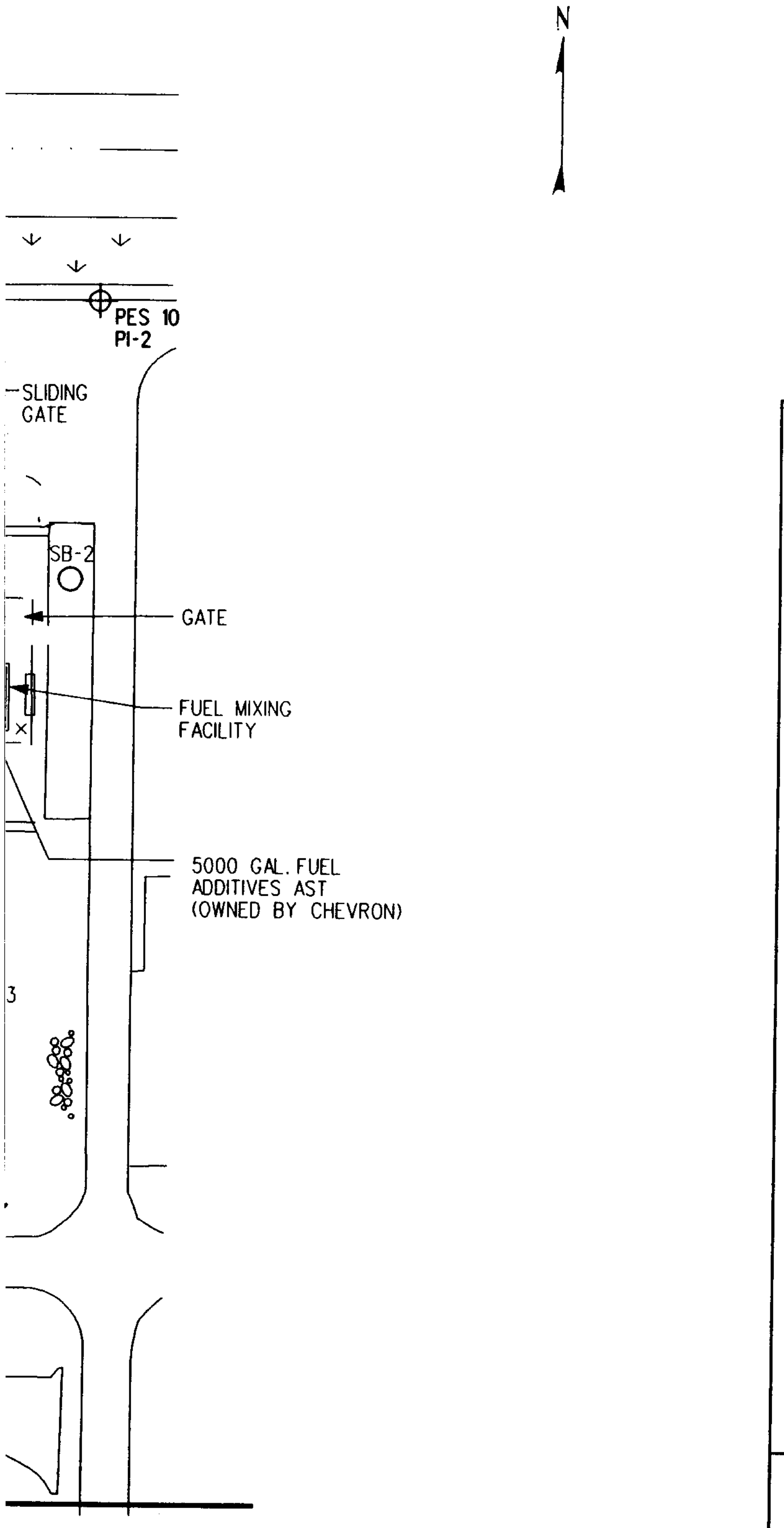

LEGEND
PREVIOUS SAMPLE LOCATIONS:

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PES BW PI-5 ⊕ PIEZOMETER (10/92)
PES 10 PI-1,2,3 ⊕ PIEZOMETER (5/94)
↓ GRASS
∞ GRAVEL
—×— FENCE

0 50'
SCALE

FIGURE 2-8

PREVIOUS DATA POINTS
IRP SITE 10

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SALT LAKE CITY, UTAH

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AREAS LEVELS WORK PKG PCT

RESP ENGR: K. MARONEY
SUPV: R.J. BOUDREAU

ISSUE
HALF-SIZE APP. CARD

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3.0 ENVIRONMENTAL SETTING

In the following sections, the climate, geology, and hydrogeology of the area and the UANG Base are discussed.

3.1 CLIMATE

The climate of the Salt Lake Valley area is semi-arid, characterized by moderately cold to cold winters and hot summers. The mean annual temperature is 51.7°F at SLCIA. The average July daily high temperature is 97°F and the summer daytime relative humidity is below 30 percent. The average January temperature is 37°F. The percent possible sunshine, which is a measure of light intensity and incident solar radiation, is 66 percent. These data were obtained from the National Weather Service (personal communication).

Most precipitation at SLCIA occurs as rain during the months of February through May and August through November. During the winter months of December and January, precipitation is mostly in the form of snow. Precipitation is relatively light in June and July. The average annual precipitation for the last 11 years on record (1979 - 1990) is 16.10 inches, with a standard deviation of 5.72 inches. The maximum yearly precipitation for these years was 24.26 inches in 1983, and the minimum yearly precipitation was 9.29 inches in 1988. The years 1988, 1989, and 1990 were drought years. This annual precipitation data is published by the National Oceanic and Atmospheric Administration (NOAA) in Climatological Data.

Average yearly pan evaporation for the Great Salt Lake was 78.5 inches for the period of 1931-1976 (Waddell and Barton, 1980). Utilizing a pan coefficient of 0.7, this corresponds to a surface water evaporation of approximately 55 inches per year (Parsons, 1995). The net evaporation is then approximately 39 inches per year using the average annual precipitation of 16.10 inches.

Average wind speed at the airport is 8.5 miles per hour. Prevailing winds are from the northwest to the southeast. Winds are sometimes from the southwest. This information was obtained from the National Weather Service (personal communication).

3.2 GEOLOGY

The UANG Base is located in the Jordan River Valley, commonly referred to as the Salt Lake Valley. The valley is a structural basin (graben) bounded on the east by the Wasatch Range (horst) and the Wasatch fault zone. The Oquirrh Mountains bound the valley to the west. Refer to Figure 3-1 for locations of features. The horst and graben structure of the Wasatch Range and Salt Lake Valley is the result of basin and range extension along deep-seated, low to mid-angle, normal faults. Utah's present mountains, although influenced by earlier events, are mostly the result of uplift and block-faulting that occurred in the last 25 million years (Hintze, 1973).

The valley topography has been shaped by Pleistocene-era Lake Bonneville, by stream activity, and by deposition of material eroded from the adjacent mountains. Lake bottom sediments form a slightly undulating plain in the center of the valley. The Jordan River flows northward in the center of the valley from Utah Lake to the Great Salt Lake. River deposits consist of fine-

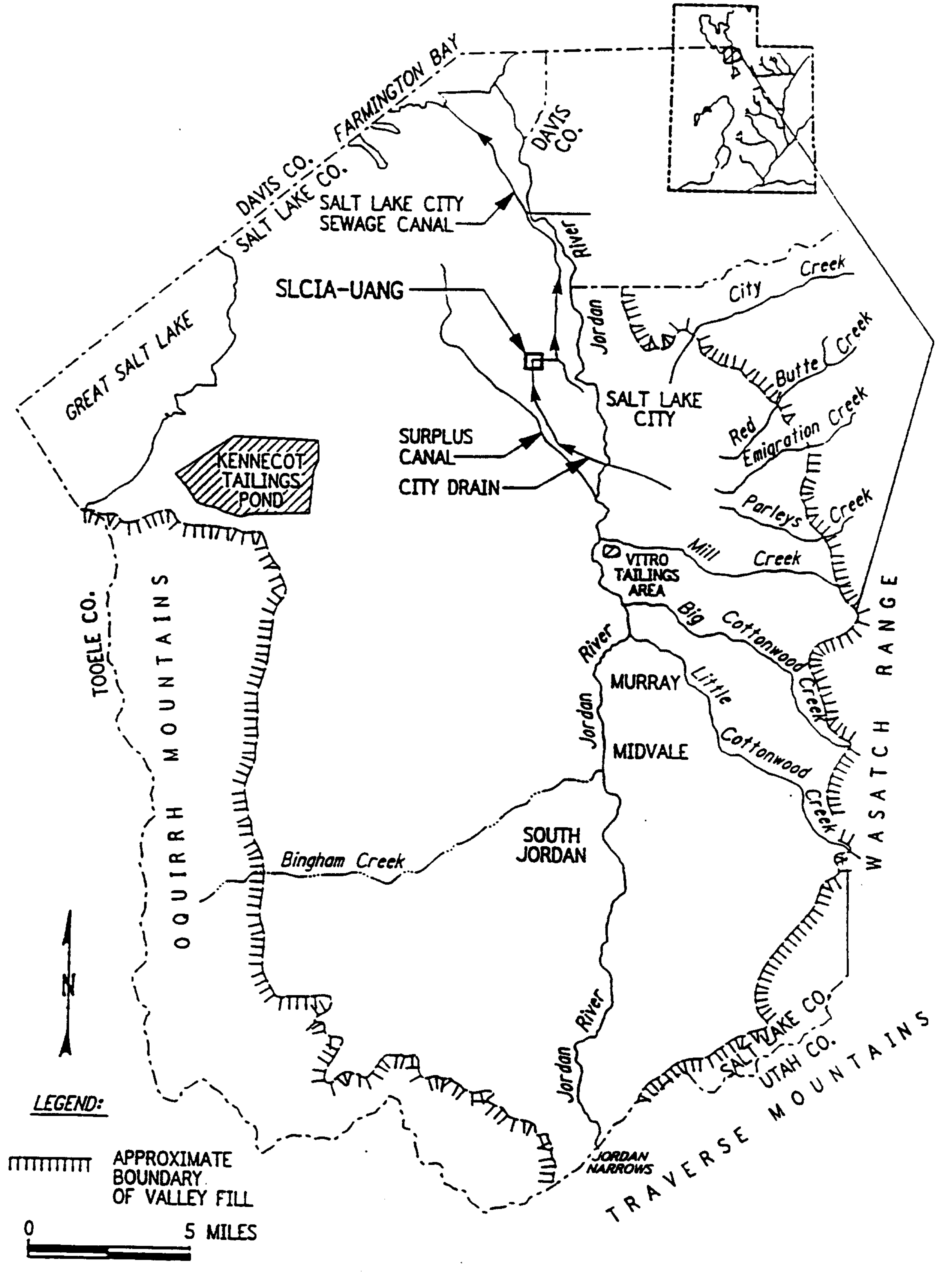

FIGURE 3-1

INDEX MAP OF FEATURES IN SALT LAKE COUNTY, UTAH

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SALT LAKE CITY INTERNATIONAL AIRPORT
SALT LAKE CITY, UTAH**

STONE & WEBSTER ENGINEERING CORPORATION

JUNE 1996

grained flood plain and coarser-grained stream channel sediments. From about 3300 South State Street to the Great Salt Lake, the Jordan River formed a large fan-shaped flood plain and delta

complex (Davis, 1983). The geologic map of Davis (1983) (as modified in Figure 3-2) shows that the UANG Base is located on the recent (Quaternary) Jordan River flood plain and delta complex. Figure 3-3 shows a geologic cross-section of the Salt Lake City area.
The near-surface deposits in the vicinity of the Base are primarily fine-grained. The nearly flat lake and flood plain topography was conducive to the formation of swamps and marshes in the valley. Dark, organic sediments accumulated in the swampy and marshy areas. This resulted in the formation of a black to dark gray organic silt and clay layer beneath most of the base sites in a range of thicknesses. This organic layer, when encountered, is found a depths ranging from 3 to 11 feet below ground surface (BGS). Generally, a layer of moderately well to well sorted, fine to coarse sand of granitic provenance is subjacent to the organic sediment to a depth of approximately 20 feet BGS. The granitic sand is approximately 10 feet thick and vertically extends into a dark gray to greenish-gray clay layer at an average depth of approximately 20 feet BGS. In areas of the Base to the south and west, the dark organic silt and clay and granitic sand sedimentary sequence is absent. Here, the sedimentary deposits are primarily clay mixed with variable amounts of silt and sand, with discrete thin sand zones in some places (ES, 1994).

The relatively impermeable dark gray to greenish-gray clay layer is laterally extensive beneath the Base. The thickness of this clay layer is unknown, however, it is believed to be the uppermost unit of the confining layer that separates the shallow unconfined aquifer from the deeper confined aquifer.

3.3 SOILS

As shown on Figure 3-4, most of the near-surface soils at the Base consist of miscellaneous fill material or made-land (USDA, 1974). The surficial soil is a silty clay loam in the extreme northern end of the Base (USDA, 1974). Soil boring sampling in conjunction with the basewide SI indicates that much of the surface soil in the northern portion of the Base is disturbed and could also be considered made-land or fill (ES, 1994). The Soil Conservation Service gives an infiltration rate of 0.2 to 0.63 inches/hour for the natural silty clay loam that is present in the extreme north end of the Base and in adjacent areas east of the Base. No infiltration data are presently available for the made-land. Infiltration within Sites 8 and 10 is minimal since these areas are primarily covered with asphalt and concrete.

3.4 HYDROGEOLOGY

The Salt Lake Valley structural basin is filled extensively with unconsolidated alluvium that locally attains vertical depths in excess of 2,000 feet (Hely et al., 1971). The unconsolidated valley fill is saturated with water to within a few hundred feet of the surface near the valley margins. The margins of the valley are the principal recharge areas, and the level of saturated alluvium constitutes a deep unconfined aquifer. The approximate boundary of valley fill is shown in Figure 3-1. Local areas of the deep unconfined aquifer have perched water table zones resulting from interbedded deposits of low permeability. In some low-lying areas near the center of the valley, the alluvium is saturated to near-surface. The near-surface sediments in the center and north end of the valley form a shallow unconfined aquifer that is laterally extensive.

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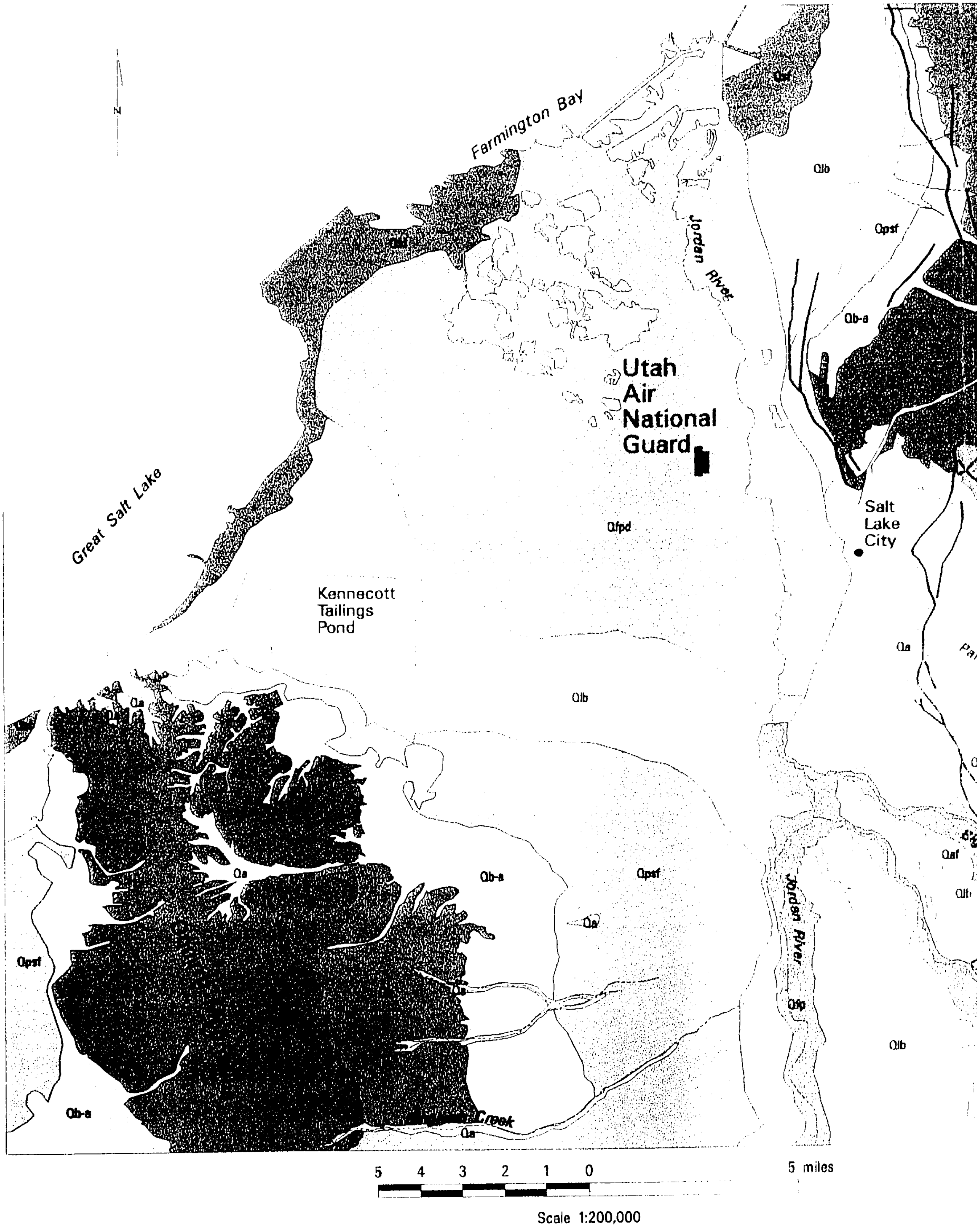
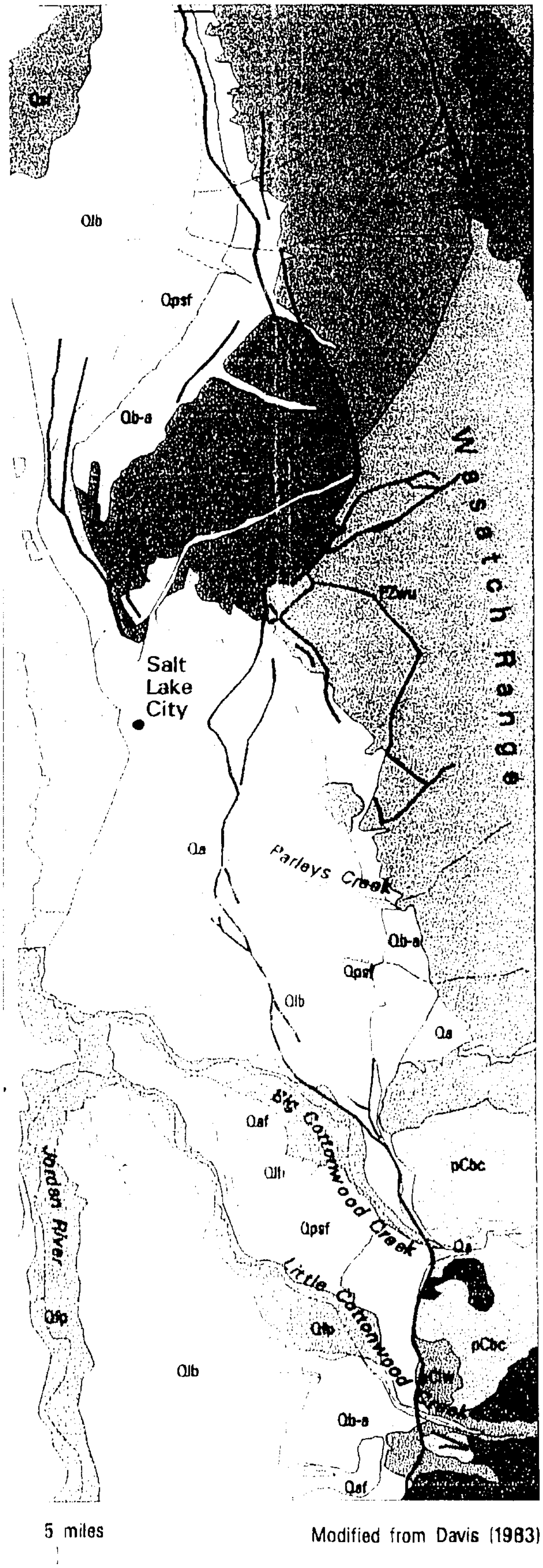

N
Farmington Bay
Great Salt Lake
Jordan River
Utah Air National Guard
Qlb
Qpsf
Qb-a
Qfpd
Salt Lake City
Kennecott Tailings Pond
Qa
Qaf
Qfp
Creek
Jordan River
5 4 3 2 1 0
5 miles
Scale 1:200,000

2

Generalized Geologic Map of Salt Lake City, Utah Area



Modified from Davis (1983)

Explanation

Quaternary

	Qa	Alluvial Deposits; stream alluvium, alluvial fans and locally, mud flows
▓	Qsf	Salt Flat; poorly drained soils with high silt, clay, and salt content
░	Qfp	Floodplains; floodplains along existing streams
☐	Qfpd	Floodplain and Delta Complex; chiefly fine-grained and poorly-drained sediments
☐	Qaf	Abandoned Floodplain and Stream Channel Deposits; chiefly mixtures of silt; sand and gravel
	Qlb	Provo Formation and Younger Lake Bottom Sediments; clays, silts, and, and locally; offshore sand bars
☐	Qpsf	Provo Formation and Younger Shore Facies; chiefly sand and gravel in beach deposits; bars, spits, and deltas
☐	Qb-a	Bonneville and Alpine Formations; chiefly shore facies, and gravel; includes beach deposits; bars, spits, and deltas
▓	Qh	Harkers Alluvium; unconsolidated and poorly sorted boulders, gravel, sand; silt, and clay deposited in pre-Lake Bonneville alluvial fans

Tertiary

■	Tqm	Quartz Monzonite; Bingham and Little Cottonwood stocks
■	Tw	Wasatch Formation; conglomerate beds with lenses of siltstone and fine to coarse sandstone

Paleozoic

░	PZwu	Paleozoic undivided; consists of Cretaceous to Cambrian limestone, sandstone; and shale in Wasatch Range
▓	PZou	Paleozoic undivided; consists of Permian to Mississippian limestone, sandstone; and shale in Oquirrh Mountains

Precambrian

☐	pCbc	Big Cottonwood Formation; quartzite, shale, and siltstone
░	pClw	Little Willow Formation; schist
▓	pCf	Farmington Canyon Complex; gneiss, schist, granite

Contact

—— Fault

River or Stream

GENERALIZED GEOLOGIC MAP OF
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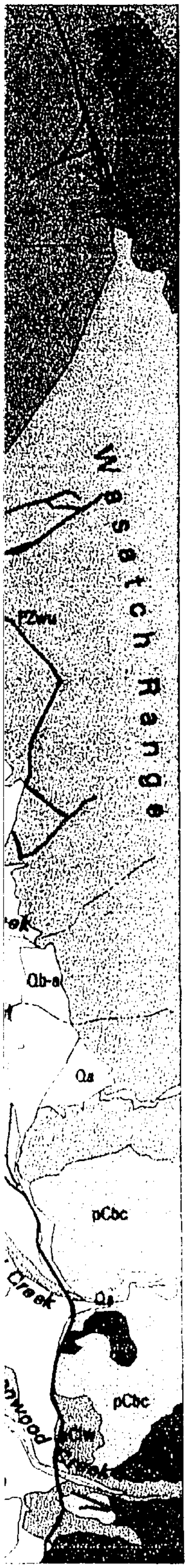
SALT LAKE CITY INTERNATIONA
SALT LAKE CITY, UTA

FIGURE 3-2



d from Davis (1983)

Generalized Geologic Map of Salt Lake City, Utah Area

Explanation

Quaternary

☐ Qa	Alluvial Deposits; stream alluvium, alluvial fans and locally, mud flows
▩ Qsf	Salt Flat; poorly drained soils with high silt, clay, and salt content
▨ Qfp	Floodplains; floodplains along existing streams
☐ Qfpd	Floodplain and Delta Complex; chiefly fine-grained and poorly-drained sediments
☐ Qaf	Abandoned Floodplain and Stream Channel Deposits; chiefly mixtures of silt; sand and gravel
☐ Qlb	Provo Formation and Younger Lake Bottom Sediments; clays, silts, and, and locally; offshore sand bars
☐ Qpsf	Provo Formation and Younger Shore Facies; chiefly sand and gravel in beach deposits; bars, spits, and deltas
☐ Qb-a	Bonneville and Alpine Formations; chiefly shore facies, and gravel; includes beach deposits; bars, spits, and deltas
▩ Qh	Harkers Alluvium; unconsolidated and poorly sorted boulders, gravel, sand; silt, and clay deposited in pre-Lake Bonneville alluvial fans

Tertiary

■ Tqm	Quartz Monzonite; Bingham and Little Cottonwood stocks
▩ Tw	Wasatch Formation; conglomerate beds with lenses of siltstone and fine to coarse sandstone

Paleozoic

▨ PZwu	Paleozoic undivided; consists of Cretaceous to Cambrian limestone, sandstone; and shale in Wasatch Range
▩ PZou	Paleozoic undivided; consists of Permian to Mississippian limestone, sandstone; and shale in Oquirrh Mountains

Precambrian

☐ pCbc	Big Cottonwood Formation; quartzite, shale, and siltstone
▨ pClw	Little Willow Formation; schist
▩ pCf	Farmington Canyon Complex; gneiss, schist, granite

Contact

— Fault

River or Stream

GENERALIZED GEOLOGIC MAP OF SALT LAKE CITY, UTAH AREA
151st ARW, UTAH AIR NATIONAL GUARD
SALT LAKE CITY INTERNATIONAL AIRPORT
SALT LAKE CITY, UTAH

FIGURE 3-2

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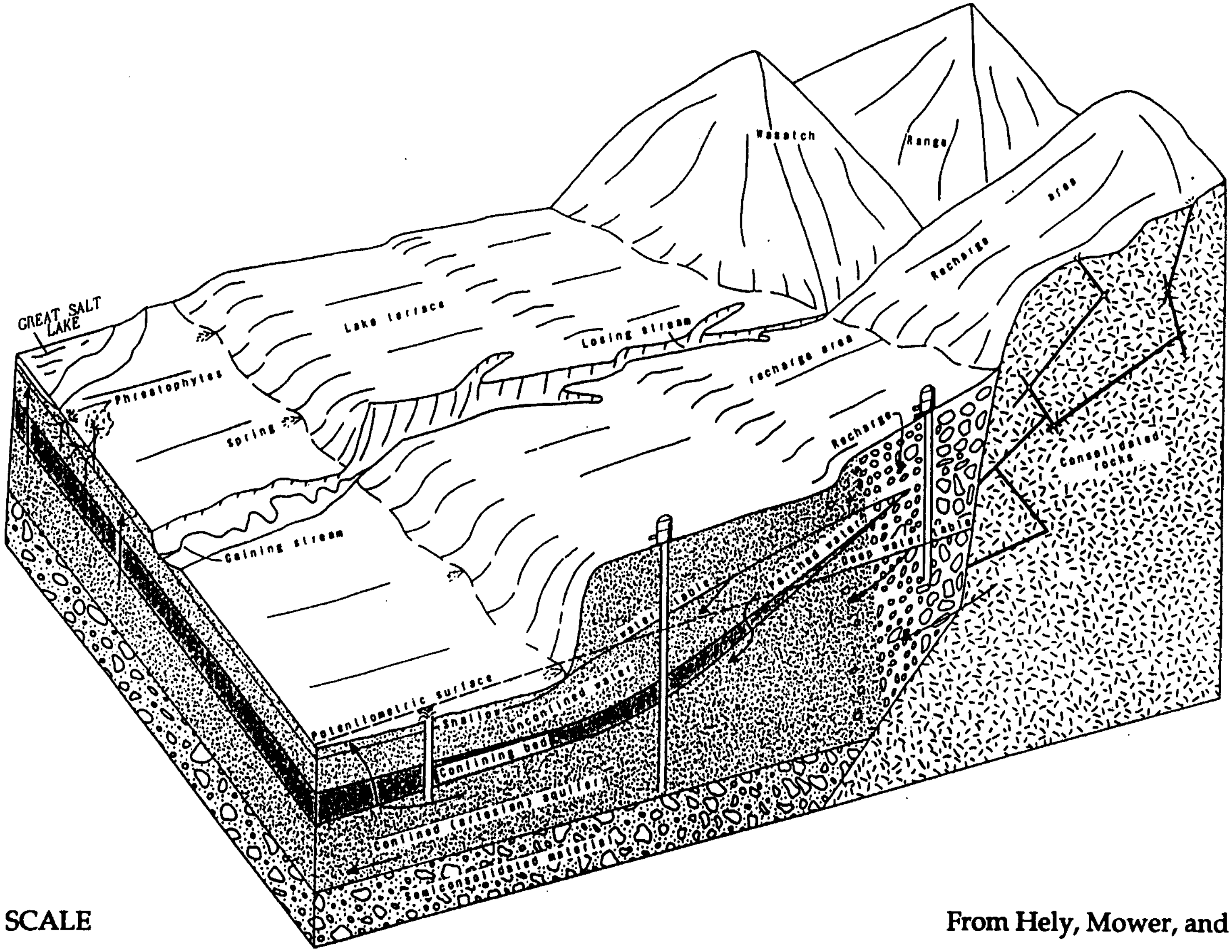

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From Hely, Mower, and Harr (1971)

FIGURE 3-3

GENERALIZED GEOLOGIC CROSS-SECTION

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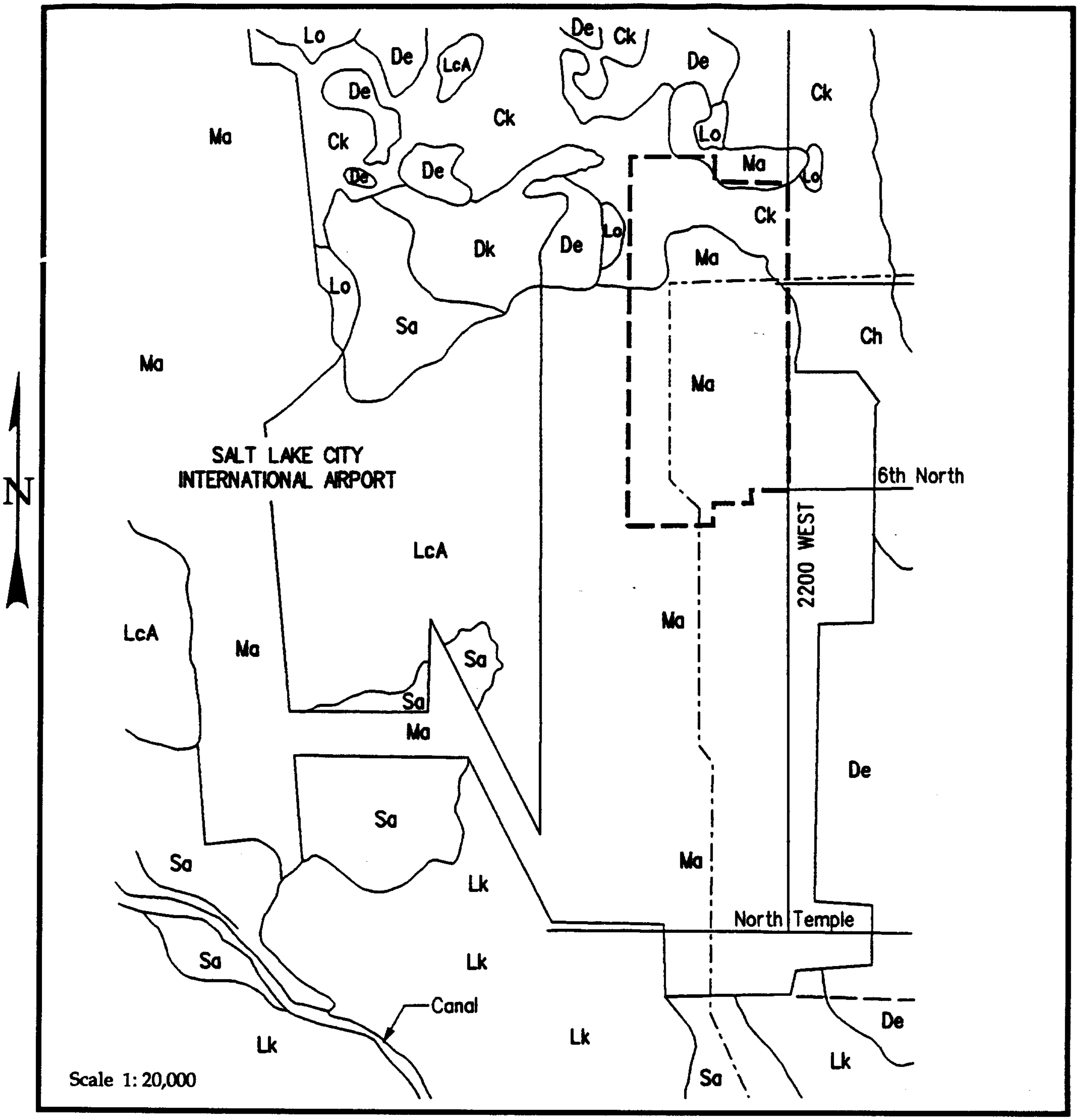

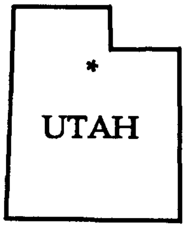

LEGEND:

Ch - Chipman silty clay loam
Ck - Chipman silty clay loam, saline-alkali
De - Decker fine sandy loam
Dk - Decker loam, strongly saline-alkali
LcA - Lasil silt loam
Lk - Leland fine sandy loam
Lo - Loamy borrow pits
Ma - Made land
Sa - Saltair silty clay loam
— — Base Boundary
— - - —City Drain

FIGURE 3-4

SOIL MAP OF THE UANG AREA

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SALT LAKE CITY, UTAH

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The deep confined aquifer is everywhere present beneath the shallow unconfined aquifer. Water moves into the deep confined aquifer from the adjoining deep unconfined aquifer at the valley margins described above.

Surface water within a 1-mile radius of the Base consists of scattered minor wetlands and man-made drainage canals. On a regional scale, the primary surface features in the area of the Base are the Jordan River and the Great Salt Lake. The Jordan River is located about 1 mile east of the Base, and the present Great Salt Lake shoreline is approximately 8 miles west-northwest of the Base. The locations of these features are shown in Figure 3-1.

3.4.1 Local Hydrology

There are no existing streams, lakes, or ponds at the Base. However, the shallow water table seasonally intersects the land surface in the extreme north end of the Base, causing standing water in low areas. The primary surface water feature at the Base is the City Drain Canal, which originates 10 to 12 miles southeast of the Base and flows west and north before it reaches the Base south boundary. From the Base south boundary, the canal flows northwest and then north through Base property to the Base's former northern boundary. The canal then flows east along the Base's former northern boundary. After the canal exits the Base, it flows north to the Great Salt Lake. Figure 3-1 indicates the regional flow direction of the City Drain Canal within the Salt Lake City area.

The City drain channels border the north and west side of the POL facility (Site 10). The City Drain Canal borders the north side and a city drain channel borders the west side of Site 10. The drain channel discharges into the City Drain Canal at the northwest corner of Site 10. The average discharge of the canal is estimated to be 30 cubic feet per second (cfs) to 40 cfs. The canal drains shallow groundwater at the Base and, as a result, affects shallow subsurface groundwater flow at the Base (ES, 1994).

The majority of the Base is asphalt and concrete paved minimizing infiltration of rainfall into soils. Asphalt and concrete paved areas are pitched toward storm water collection drains illustrated in Figure 3-5. The City Drain Channel collects surface runoff from numerous outfalls throughout the Base. It also collects runoff from industries upstream of the Base. A surface drainage map is provided as Figure 3-5.

3.4.1.1 Shallow Unconfined Aquifer

The shallow unconfined aquifer is present beneath the Base. The shallow subsurface unconsolidated deposits beneath the Base consist of fine-grained delta and floodplain sediments and coarse-grained shoreline or stream channel sediments that collectively constitute the shallow unconfined aquifer beneath the Base. These deposits vertically extend into a dark gray to greenish gray clay layer at an average depth of about 20 feet below land surface. The clay layer is laterally extensive in the subsurface beneath the Base and appears to be relatively impermeable. However, the thickness of the clay beneath the Base is unknown (ES, 1994). Approximately 2 miles west of the Base, the shallow unconfined aquifer is about 40 feet to 50 feet thick and is separated from a deeper confined aquifer by relatively impermeable deposits of clay, silt, and fine sand (Waddell et al., 1987a).

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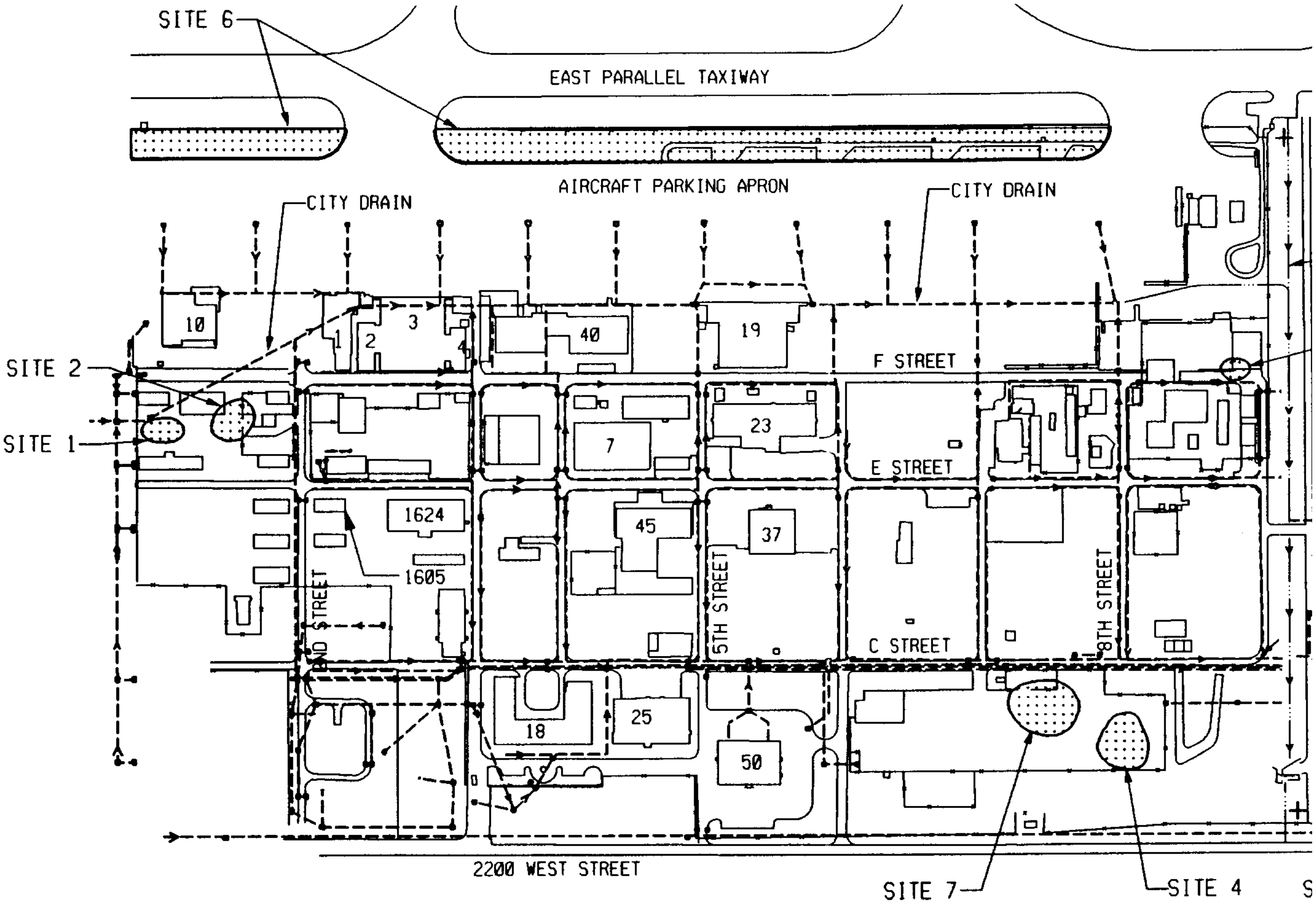

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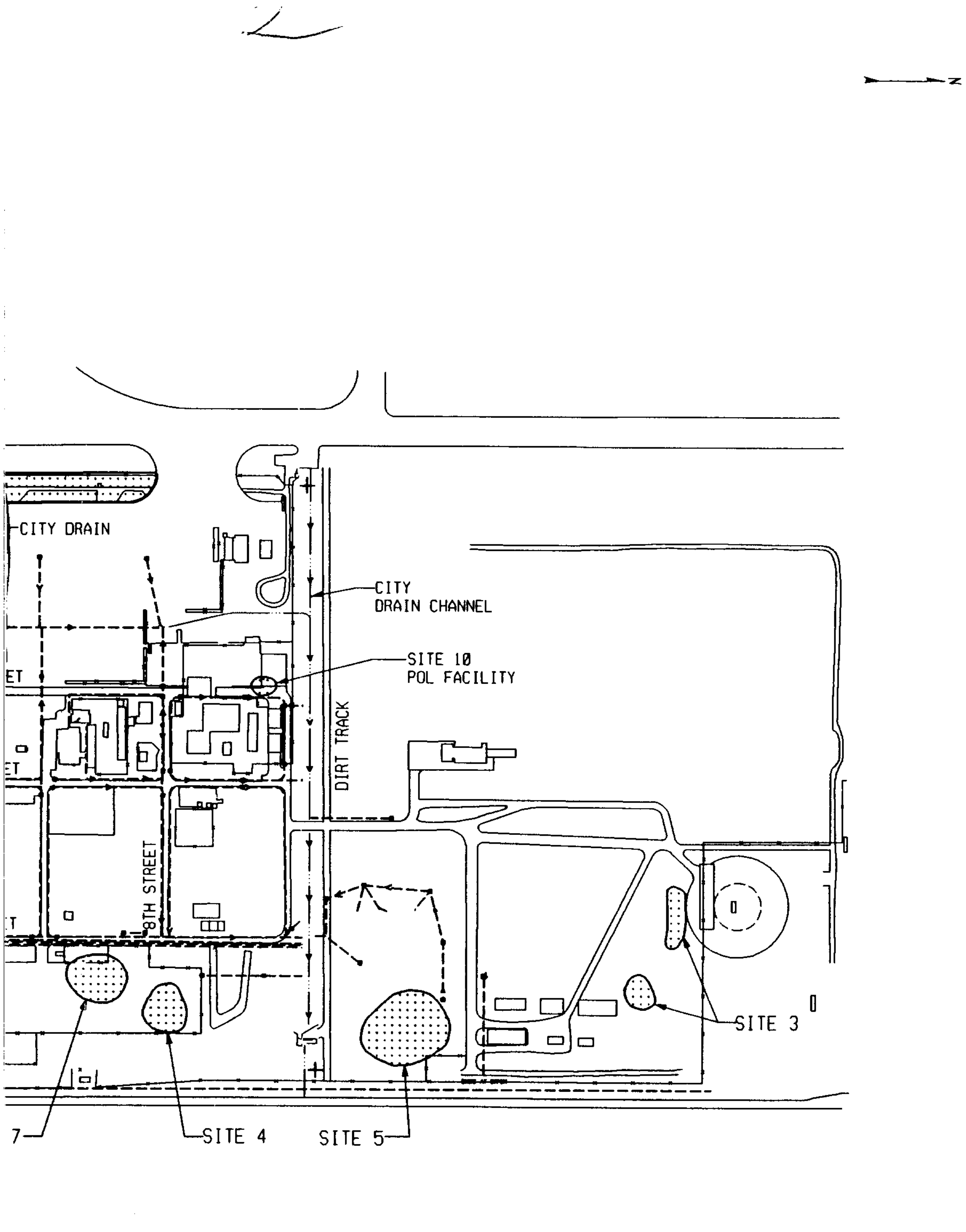

LEGEND

----- STORM DRAIN PIPEL
▫ COLLECTION POINT
(GRATE)
IRP SITE LOCATIO

NOTES:
1. ARROWS SHOW THE DIRE
2. THE SITE IS GRADED T
WATER TO THE NEAREST

FIGURE 3-

SURFACE WATER DRAINA

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STONE & WEBSTER ENGINEERING C
BOSTON, MASS.

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DRAWN BY: G.C. CARTER
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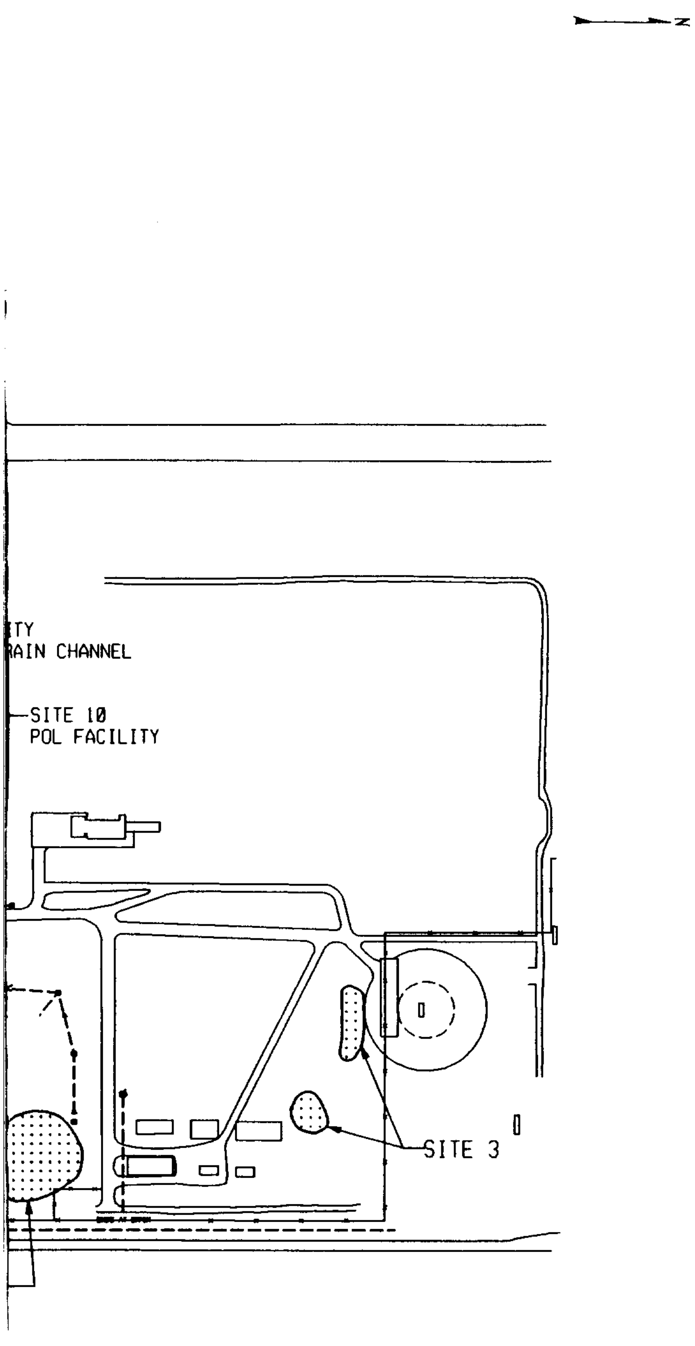

LEGEND

----- STORM DRAIN PIPELINE

□ COLLECTION POINT (GRATE)

▨ IRP SITE LOCATION

NOTES:

1. ARROWS SHOW THE DIRECTION OF FLOW.
2. THE SITE IS GRADED TO DIRECT SURFACE WATER TO THE NEAREST COLLECTION POINT.

0 300'

FIGURE 3-5

SURFACE WATER DRAINAGE SYSTEM

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SALT LAKE CITY INTERNATIONAL AIRPORT
SALT LAKE CITY, UTAH

STONE & WEBSTER ENGINEERING CORPORATION
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DSGN CHK'D BY:
DRAWN BY: G.C. CARTER
CHK'D BY:
AREAS
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ISSUE
HALF-SIZE
APP. CARD
RESP ENGR: K. MARONEY
SUPV: R. J. BOUDREAU

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The hydraulic conductivity of the unconfined aquifer was estimated from slug tests at IRP site monitoring wells during the basewide SI. The hydraulic conductivity of the porous media in the screened interval of shallow monitoring wells showed a wide range of variation. Hydraulic conductivity ranged from a minimum of 0.17 ft/day (6.00×10^{-5} cm/sec) in an area at the south

end of the Base to a maximum of 50.41 ft/day (1.78×10^{-2} cm/sec) in an area at the north end of the Base. The average hydraulic conductivity of 12 monitoring wells at the seven IRP sites is 10.19 ft/day (3.60×10^{-3} cm/sec). This range of values indicates that the shallow aquifer beneath the Base has a high degree of heterogeneity, with a difference in minimum and maximum hydraulic conductivity values of over two orders of magnitude (ES, 1994).

Estimated average linear groundwater velocities ranged from 2.4×10^{-4} ft/day (0.09 ft/yr or 8.5×10^{-8} cm/sec) to 0.25 ft/day (91.25 ft/yr or 8.8×10^{-5} cm/sec) based on average values of hydraulic conductivity, gradient, and aquifer thickness beneath the Base.

The regional groundwater flow direction in the unconfined aquifer is northeasterly toward the Jordan River. However, in the northwest part of the valley in the area of the Base, groundwater flow is generally northwesterly toward the Great Salt Lake (Seiler and Waddell, 1984). Shallow groundwater flow is toward the City Drain Channel from areas of the Base to the north and south of the canal (ES, 1994). In the vicinity of building 1608, the 1994-1995 OPTECH investigation found that groundwater flow was reversed from the general basewide flow direction (OPTECH, 1995). This flow direction was based on water level measurements collected in a limited area around building 1608, and appears to be a localized anomaly.

The shallow unconfined aquifer contains brackish water that ranges from 2,000 to 4,000 mg/l total dissolved solids (TDS) in the area of the Base (Waddell et al., Plate 2, 1987a). The water also contains high concentrations of sodium, chloride, and sulfate. Water level measurements collected from the Base piezometers and monitor wells have shown a depth range of 1 to 7 feet BGS. There are no domestic wells completed in the shallow unconfined aquifer according to the State of Utah Division of Water Rights records (ES, 1994).

The groundwater in this area has not been classified by UDEQ. The characteristics of the shallow aquifer match the criteria for Class III, limited use groundwater. This classification is based on the definition of Class III groundwater as water which exhibits TDS concentrations between 3,000 and 10,000 mg/L, and/or has concentrations of one or more contaminants that exceed the Utah groundwater quality standards. Background concentrations of arsenic detected in groundwater at the Base exceed the Utah groundwater quality standard of 0.05 mg/L.

3.4.1.2 Deep Confined Aquifer System

Deeper valley-fill deposits are comprised of continuous to discontinuous beds of clay, silt, sand, and gravel sediments that collectively form the confined artesian aquifer system (Hely et al., 1971). Interfingered deposits of clay, silt, and fine sand overlie the deep confined principal aquifer and form a confining layer that ranges from about 40 feet to 100 feet in thickness (Hely et al., 1971). The confining layers leak; groundwater flows either up or down through these confining layers depending on localized pumping demands and natural vertical groundwater gradients. The confining layer contains many beds of low permeability material that act collectively as a single bed and retard the vertical movement of groundwater (Hely et al., 1971).

Five deep drilling logs for wells in a 0.5-square-mile area approximately 0.75 mile east of the Base, near the Jordan River, indicate the confining layer thickness ranges from about 40 feet to 70 feet. The general sedimentary sequence in this area is a surface silt or clay to a depth of about 10 feet, sand from 10 feet to a depth of about 20 feet to 30 feet, and clay from 20 feet to 30 feet to a depth ranging from 75 feet to 100 feet BGS. Thereafter, the sequence is a series of interbedded sands and clays of what is interpreted to be the principal confined artesian aquifer. The five wells were screened from about 200 feet to 400 feet BGS. The wells were all flowing wells at the time of construction (1942 to 1979) and the hydrostatic head ranged from 3 feet to 9 feet above land surface (ES, 1994).

There are 32 points of diversion within a 1-mile radius of the Base. Most of the water rights are wells that are used for irrigation, stock watering, and domestic purposes. The wells are concentrated in the area east of the Base and have total depths that range from a minimum of 126 feet BGS to a maximum of 654 feet BGS. All of the domestic wells are completed in the deep confined aquifer according to the State of Utah Division of Water Rights records (ES, 1994).

3.4.2 Surface Water

3.4.2.1 Jordan River

The Jordan River is a meandering river with a gentle gradient. It occupies an approximate 1-mile-wide 100-year flood plain in the center of Utah and Salt Lake Valleys. Flooding is common in the lower reaches of the river during periods of high seasonal run-off. The origin of the river is the north end of Utah Lake in Utah Valley. The 50-mile course of the river is north through Salt Lake Valley from Utah Lake to Farmington Bay. Farmington Bay is a freshwater bay that is a diked portion of the Great Salt Lake. The Jordan River discharges into an estuary of the Farmington Bay Waterfowl Management Area. The locations of these features are shown in Figure 3-1.

Inflow into the Jordan River is regulated by discharges from Utah Lake and upstream diversions; it varies considerably with the available supply in Utah Lake and with the other diversions. During the period 1913-1977, the total inflow of Jordan River water to the Salt Lake Valley area averaged 265,200 acre-feet per year (Price and Jensen, Map 54-B, 1985). The Jordan River is also fed by several Wasatch Range streams. Two stream flow gaging stations for the Jordan River, one approximately 3 miles south and one approximately 3 miles north of the Base, record average discharges of 145 cfs and 141 cfs, respectively, for the period of record. Maximum recorded flows are 348 cfs and 384 cfs, respectively. The minimum recorded flows are 39 cfs and 0 cfs, respectively (Price and Jensen, Map 54-B, 1985).

Jordan River water (including diversions to canals) is generally fresh to saline. Dissolved solids concentrations are commonly in the range of 500 mg/l to 1,500 mg/l, except in the reach between South Jordan and Murray, where dissolved solids concentrations range from 1,000 mg/l to 2,000 mg/l. Most of the river water is diverted upstream of South Jordan, and the higher dissolved solids concentration between this point and Murray reflects more highly mineralized irrigation return flows and groundwater inflow to the river. Downstream of the confluence with Little Cottonwood Creek in Murray, the dissolved solids concentration of the river again is in the 500 mg/l to 1,500 mg/l range, reflecting inflows of fresh water from Little Cottonwood and Big Cottonwood Creeks and other Wasatch Range streams (Price and Jensen, Map 54-B, 1985). Wasatch Range streams are generally from 250 mg/l to 500 mg/l at the canyon mouths.

3.4.2.2 Great Salt Lake

The Great Salt Lake is a briny shallow inland sea with a dissolved solids concentration in excess of 100,000 mg/l (Price and Jensen, Map 54-B, 1985). Arnow (1984) reported TDS as high as 250,000 mg/l in some areas of the lake. This concentration far exceeds the TDS in the oceans. Ninety percent by weight of the TDS concentration is from sodium and chloride (Arnow, 1984). The Great Salt Lake is in a topographically closed basin and has no surface flow outlet. Because water leaves only by evaporation and minerals accumulate, it is one of the saltiest bodies of water on earth. Surface flows that reach the lake through natural streams and man-made drains are generally saline. Principal contributors to the salinity of these surface flows are irrigation return flows, evapotranspiration, urban and suburban runoff, and inflow of municipal and industrial (including mine drainage) effluents (Price and Jensen, Map 54-B, 1985).

3.5 REGIONAL HYDROLOGY

Regional groundwater flow in the principal confined aquifer is generally north for most of Salt Lake Valley (Waddell et al., 1987a). In the area of the Base, groundwater movement in the confined aquifer is generally toward the northwest and is upward leaking through the confining layer. Therefore, it discharges into the shallow unconfined aquifer or discharges into the Great Salt Lake (Waddell et al., 1987a). Groundwater head equipotentials of the principal confined aquifer range from 5 feet to 10 feet above land surface in the area of the Base (Wendell and Price, 1964), indicating an upward vertical hydraulic gradient.

The principal confined aquifer in the area beneath the Base has a TDS concentration between 500 mg/l and 1,000 mg/l (Waddell et al., Plate 1, 1987a). Water in the confined aquifer contains calcium and bicarbonate as the predominant ionic species.

3.6 PREVIOUS HYDROGEOLOGIC INVESTIGATIONS

Several environmental studies conducted at the SLCIA facility have included hydrogeological investigations. Hydrogeological findings are presented in the PA conducted in 1989; the Underground Storage Tank Investigation Report No. 2 at Site 8-Building 10 completed in July 1994; the basewide SI performed in 1993 and 1994; and the UST Subsurface Site Investigation of a UST located adjacent to building 1608 submitted in April 1995. The geologic and hydrogeologic information obtained from these investigations have been utilized in the planning of the drilling, monitoring well, and sampling and analytical program for Sites 8 and 10.

The PA conducted a literature review of regional and local hydrogeological conditions (HAZWRAP, 1989). The investigation did not involve the measurement of hydrogeological parameters at the SLCIA facility. The report provides a general hydrogeological description of the Salt Lake Valley and states that regional groundwater flow beneath the base is toward the east. An abandoned water well on base property is reported to be artesian indicating an upward movement of groundwater within the vicinity of the base.

The Underground Storage Tanks Subsurface Investigation Report No. 2 at Site 8-Building 10 included an investigation of hydrogeological conditions at Site 8 (HAZWRAP, 1994). Groundwater level measurements, obtained from shallow monitoring wells on April 26 and May 6, 1994, indicate that shallow groundwater gradient and flow are toward the north-northwest. The report also indicates that groundwater levels appeared to respond to precipitation and subsequent infiltration.

The SI Report provides the first overall evaluation of site hydrogeological conditions (HAZWRAP, 1995). This report stated that hydrostratigraphic units in the vicinity of the Base consist of an approximately 20-foot-thick to 50-foot-thick (from east to west) shallow unconfined aquifer, confining layer, and a deeper confined aquifer. A 50 to 60-foot thick confining layer consisting of interbedded fine-grained sediments separates the shallow unconfined and deeper confined aquifers. Based on the deep aquifer potentiometric surface, the report states that an upward leaking hydraulic gradient exists through the confining layer from the confined aquifer to the shallow unconfined aquifer.

The SI Report further states that the shallow aquifer properties exhibit a high degree of heterogeneity. Values of hydraulic conductivity range in value of over two orders of magnitude. Hydraulic conductivity is highest at the north end of the Base, north of the City Drain Channel and is relatively low at the south end of the Base. Basewide groundwater levels measured from basewide monitoring wells and piezometers on December 28, 1992 and March 16, 1993 indicated that shallow groundwater gradient and flow is toward the City Drain Channel from portions of the Base north and south of the canal.

The UST Subsurface Site Investigation of a former UST adjacent to building 1608 included a local hydrogeological investigation of the former tank location (OPTECH, 1995). The report concluded that the shallow groundwater flow direction at the site was to the southeast during the November 1994 sampling round with an average gradient of 0.003. Groundwater flow was to the southwest as measured in March 1995 with an average gradient of 0.006. Hydraulic conductivities ranged from 36.6 to 159.8 gal/day/ft^2 (1.7 x 10^{-3} to 7.5 x 10^{-3} cm/sec) with groundwater flow velocity ranging from 26 to 117 ft/yr.

4.0 FIELD PROGRAM

The purpose of the RI was to determine the nature and extent of contamination at IRP Sites 8 and 10. In addition, the threat to human health and the environment was evaluated to provide a basis for determining the types of response actions to be considered at these sites.

This section describes the field activities performed as part of the RI to accomplish the above objectives. The field investigation was conducted from May 30, 1995 to June 30, 1995. The second round of groundwater sampling was conducted from July 31, 1995 to August 11, 1995.

4.1 SUMMARY

The field investigation incorporated soil gas surveys, soil and groundwater screening, advancement of soil borings, collection and chemical analysis of soil samples, installation of groundwater monitoring wells, collection and chemical analysis of groundwater samples, and hydrogeologic testing.

The objective of the soil gas, soil, and groundwater screening was to collect screening information to plan the soil boring and well construction activities. In accordance with established ANG protocols, soil boring locations were placed in areas where the screening samples showed the highest levels of soil contamination and monitoring wells were located where screening samples showed no soil or groundwater contamination to facilitate LTM of site groundwater conditions.

In addition, three rounds of water level measurements were made during the investigation. Water table maps for each round of water table measurements are included in Section 5.0.

4.2 DEVIATIONS FROM THE RI/FS WORK PLAN

There were deviations from the RI/FS Work Plan (Stone & Webster, 1995). The deviations and the rationale for the changes are described below:

- Soil gas samples were collected using a syringe instead of a vacuum pump and tedlar bag assembly. The driving rod and probe assembly was purged with several volumes of soil gas using the syringe. The sampling syringes were an analytically clean, nonporous polymer designed for high purity gas sampling. This change was made based on the standard operating procedures of the subcontractor selected to perform the soil gas survey.
- Piezometers were not installed at Site 10 as the locations of the newly installed monitoring wells and existing piezometers were determined to be adequate to measure groundwater flow direction.

- Only one soil and three groundwater samples from Site 10 were analyzed for PCBs and pesticides as screening activities indicated these compounds were not present in the soil or groundwater at the site and the unknown contaminant was identified as hydrogen sulfide.
- The majority of the field work at Site 10 was performed in Level D personal protective equipment (PPE). The level of protection was downgraded from Level B based on identifying the unknown contaminant as hydrogen sulfide and on site conditions.

4.3 FIELD SCREENING ACTIVITIES

Soil gas, soil, and groundwater screening samples were collected to provide a preliminary assessment of contaminant concentrations. Samples were analyzed with a gas chromatograph (GC). Detection limits for soil gas, soil, and groundwater samples were 1.0 ug/L, 0.005 mg/kg, and 0.5 ug/L, respectively. An initial calibration curve of a minimum of five points was performed on the GC. The calibration curves were prepared by analyzing five concentrations of calibration standards at low, mid, and high levels covering the expected concentration range. The lowest standard concentration was prepared at or near the practical quantitation limit or detection limit and did not exceed 10 times the reporting limit for each compound.

4.3.1 Soil Gas Survey

Soil gas samples were used to assess evidence of soil and soil vapor contamination and contaminant migration and generally served as the basis for selecting soil and groundwater screening sample locations. Soil gas samples were analyzed with a GC.

Soil gas surveys were conducted at each site by collecting soil gas samples through a hollow steel rod and probe assembly. The assembly was mechanically driven into the ground to a specified depth to obtain a soil gas sample above the water table. Depth to water measurements were taken from site wells prior to the initiation of the soil gas survey to determine the approximate depth to water.

After driving the rod and probe assembly to the depth to be sampled, a special stainless-steel and Teflon connection with sampling hose was threaded onto the top of the rod. The rod was then raised with a jack approximately 2 to 3 inches, leaving the disposable aluminum probe tip in the ground. The assembly was then attached to a syringe and purged with several volumes of soil gas. When purging was completed, a sample of soil gas was collected in the syringe.

The sampling syringes were an analytically clean, nonporous polymer, designed for high purity gas sampling. The sample gases were withdrawn from the syringe using a gas-tight glass syringe inserted through the polymer syringe septum and are then injected into a GC for analysis.

4.3.2 Soil Screening

Soil screening samples provided a preliminary assessment of soil contaminant concentrations. Soil screening samples were collected using a Strataprobe, which is a hydraulic drive point sampling system. The Strataprobe utilized 1-inch-outside-diameter (OD), threaded, stainless steel probe rods. An expendable drive point, constructed of machined steel, was placed onto the end of the drive rod and inserted into the subsurface. An expendable drive cap was placed on the opposite end of the rod, and the rod assembly was pushed into the subsurface by the Strataprobe hydraulic ram. The hydraulic ram and rod assembly was pushed to its maximum extension, leaving approximately 3 inches of the rod protruding from the ground subsurface. At this point, the drive cap was removed and the hydraulic ram was retracted to its minimum extension. Then, another 4-foot section of probe rod was added to the tool string. This procedure was continued until a previously determined depth interval was intersected.

Soil samples were collected using the Strataprobe with a standard 2-inch-OD sampler. The sampler's probe point was held in place by a closed piston system (rod). This allowed the sampler to remain sealed while it was driven or pushed to a certain sample interval, thus soil cuttings were not generated. After the system was driven to a discrete sampling depth, the piston stop-pin was manually removed at the surface using extension rods inside the sampling tubes. Then, while the sampler was being pushed to the final sample depth, the piston retracted into the sampler as it was displaced by the soil sample. The soil sample was retained within two 6-inch brass sampling sleeves, 1.5 inches in diameter.

4.3.3 Groundwater Screening

Groundwater screening samples were collected with the Strataprobe through a Screen Point Sampler. The 1.0-inch-OD, 36-inch-long sampler had a 19-inch-long screen encased in a perforated stainless steel sleeve. The Screen Point Sampler was threaded onto the leading edge of the probe rod and was driven into the subsurface using the Strataprobe. Additional probe rods were connected in succession to advance the sampler to depth. O-ring connections kept the sampler sealed during advancement to the desired sampling depth. To obtain a groundwater sample, the sampler was pulled up approximately 2 feet to disengage the expandable drive point and create an open borehole from which to sample. The stainless steel wire screen was then pushed out into the borehole and water was allowed to enter the sampler and connected probe rods. Groundwater samples were collected from the screened area using tubing and a peristaltic pump. Samples were dispensed into 40-milliliter (ml) glass sample containers for analysis.

4.4 CONFIRMATION ACTIVITIES

4.4.1 Soil Borings

Soil borings were advanced with a truck-mounted drill rig using continuous flight hollow-stem augers. The soil borings were advanced using 4-1/4-inch-inside-diameter (ID) augers to total depth. Boreholes were 8-1/4 inches in diameter. Borehole sampling was performed using 2 foot-long, 2.5-inch-ID, stainless steel California style split-spoon samplers with non-reactive stainless steel liners. Soil borings were backfilled to the surface with cement/bentonite grout (97 percent Portland cement and 3 percent bentonite). Soil borings were advanced to the water table.

Soil samples were collected from each boring for logging and for laboratory analysis. The cuttings were logged and screened continuously for geological description and the presence of contamination. One complete set of analytical samples were collected from each core. Sampling intervals within the cores were selected based on visual observation and field screening results using a PID. The zone exhibiting the highest organic vapor reading and/or visible contamination was sampled. The initial sample was capped using Teflon lined lids and retained for volatile organic compound (VOC) analyses. Additional samples were collected for headspace screening from the zones adjacent to the VOC sample. The soil material for the headspace samples was removed from the non-reactive sleeves and was packed into glass jars provided by the geologist.

An experienced geologist was present at the operating drilling rig to log samples, monitor and record well installation procedures of the rig, and prepare the boring logs and well completion diagrams.

Soils were logged and classified according to the Unified Soil Classification (USC) system with respect to type, grain size, color, and mineralogy (when pertinent), and described according to ASTM D2488-69 "Description of Soils (Visual-Manual Procedure)." Silt and clay were identified by various field tests (e.g., powder test, feel test, grit test, shine test). Estimates of plasticity, consistency, density, and soil moisture were qualitatively determined. Qualifiers that were used to describe the relative proportions or percentages of grain sizes are defined as follows: "and," 30 to 50 percent; "some," 12 to 30 percent; "little," 5 to 12 percent; and "trace," 0 to 5 percent of a particular grain size. The Munsell color chart was used for consistent descriptions of color. The complete descriptions of the soil borings and monitoring well borings were documented in field logs (Appendix A).

Headspace screening was performed by placing the selected portion of each sample into a clean glass jar, covering the jar with aluminum foil (shiny side out), and allowing the soil temperature to equilibrate for at least 10 minutes. Duct tape was not used on any sample container. Headspace vapors were screened by inserting the PID probe into the jar through a small hole in the aluminum foil, then recording the maximum reading. The PID was calibrated daily to 100 ppm isobutylene standard gas. Field activities, screening and sampling data, and other appropriate information was recorded in a field notebook and on the field logs.

In the absence of visible contamination or organic vapors, samples were selected from a location within the core that indicated a change in stratum. At least one set of analytical samples obtained from the initial cores was collected from a horizon above the water table. This was to confirm the presence or absence of a source of soil contamination above the level of saturation. Samples were labeled, packed on ice, and transported to the laboratory under proper chain-of-custody procedures. Samples were handled in accordance with the procedures detailed in Section 4.0 of the RI/FS Work Plan (Stone & Webster, 1995).

4.4.2 Monitoring Well Installation and Development

Monitoring wells were installed for both groundwater and free product assessment. Monitoring wells were installed immediately outside the areas of contamination based on the soil gas, soil, and groundwater screening analytical results. Downgradient monitoring wells were located in areas to assess the migration of contamination from the site. Upgradient monitoring wells were placed in areas to assess the influence of contamination from off-site sources.

Floating product wells were installed to determine the presence and thickness of possible floating product at the sites. These well locations were based on the results of the soil borings.

All borings were advanced with a truck-mounted drill rig using continuous flight hollow-stem augers. The borings for the 2-inch-ID monitoring wells were advanced using 4-1/4-inch-ID augers to total depth. Boreholes were 8-1/4 inches in diameter. Borings for the 4-inch-ID extraction wells were advanced with 6-1/4-inch-ID augers to total depth. These boreholes were 10-1/4 inches in diameter.

Well configuration was adjusted as needed to ensure that the screened interval allowed for seasonal fluctuations in the water table. The monitoring wells at Site 8 required longer screened intervals than at Site 10 to allow for both fluctuations in the water table and assessment of the vertical extent of groundwater contamination. The well screens and gravel packs were appropriately sized for the native material found at the Base.

Groundwater monitoring wells were constructed of 2-inch-ID Schedule 40 polyvinyl chloride (PVC) casing and screen. Site 8 monitoring wells were constructed with a 15-foot section of 0.010-inch machine slotted screen and an approximate 5-foot section of casing, threaded and coupled, to a total depth of 20 feet BGS. Site 10 monitoring wells were constructed with a 10-foot section of 0.010-inch machine slotted screen and an approximate 5-foot section of casing, threaded and coupled, to a total depth of 15 feet BGS. Each floating product well was constructed with an 8-foot section of 0.010-inch machine slotted screen and an approximate 3-foot section of casing, threaded and coupled, to a total depth of 11 feet BGS. Each screen was capped with a Schedule 40 PVC threaded bottom cap.

Wells were installed inside the hollow-stem auger flights; the augers maintained the integrity of the borehole during installation and insured that the casings were true to line. Colorado silica sand (20/40) was tremied into the annular space within the auger flights to ensure equal distribution of the filter pack around the well. The filter pack was placed 1 to 2 feet above the top of the screen, depending on the depth to groundwater. A hydrated bentonite seal was placed above the filter pack. The remainder of the annular space was completed with sakrete (a dry mixture of Portland cement and angular, fine to coarse aggregate) to ensure a strong bond with the well casing and to prevent frost heaving. The sakrete surface seal was finished to approximately 6 inches below surface. Dimensions were adjusted to accommodate a high water table but still provide for an adequate surface seal. A construction form was completed for each monitoring well and floating product well.

Surface completions have the same flush-mount configuration as previously used at the Base, since most wells were installed in high-traffic areas. A 1-foot-long, 8-inch-ID steel skirt was placed into the top of the concrete seal, around the casing, and was completed at grade. The top of the casing (TOC) was cut off approximately 2 inches below the top of the skirt. The casing was capped with a keyed-alike, watertight, locking lid. A rust resistant steel manhole cover was placed on the skirt to finish the cover box. Surface pad completions were constructed by either of the two following methods. If the well was installed in a soil surface area, a 2.5-foot by 2.5-foot by 6-inch concrete pad was constructed on the ground surface around the cover box; or, if installed in an asphalt or concrete surface area, a 12-inch-diameter by 6-inch circular pad was constructed within the asphalt or concrete core around the casing. All surface pads were constructed to direct water drainage away from the well and to provide a solid base for the wellhead. Wells were not installed in locations subject to frequent flooding or potential flooding.

Well development was performed 24 to 72 hours after completion. Each 2-inch monitoring well was surged with a surge block or bailer, followed by the removal of groundwater by a bailer. All development equipment was clean and free of contamination before use. Three to five well volumes of water were removed during the development process to ensure that fresh formation water was entering the well. Prior to the removal of three to five well volumes, the temperature, Ph, and specific conductance of the groundwater was measured. Development continued until these parameters stabilized, and the water was relatively clear and free of silt. Stabilization is considered to have occurred after three successive measurements of these parameters are within 10 percent. Development did not exceed 4 hours for an individual well.

The 4-inch wells installed to detect floating product were developed with a surge block. Surging continued until the water beneath the floating product was relatively clear and free of silt. Development did not exceed 4 hours for a floating product well.

After each groundwater and free product monitoring well was developed, a 1-liter water sample was collected in a clear glass jar. The samples were labelled and photographed to show the clarity of the water. These photographs are included as a part of the well logs.

The parameters of temperature, pH, and specific conductance of groundwater were measured with a suitable combination meter that was calibrated daily to the ambient air temperature. Fresh standards purchased during the mobilization phase of the investigation were used for calibration. Calibration was documented in a calibration record book in accordance with the RI/FS Work Plan, Section 4.0 (Stone & Webster, 1995).

Physical characteristics such as color, odor, presence of separate phases, and the duration of development and volume of water removed were documented on well development forms. Recovery times were also noted as a means of qualitatively estimating hydraulic properties of the water-bearing formation. Initial and final static water levels from the TOC were measured with an appropriate electric line or oil/water interface probe. Appropriate development information was also recorded in the field notebook.

4.4.3 Monitoring Well Sampling

After development, monitoring wells were allowed to stabilize a minimum of 48 hours prior to sampling. The initial pH, temperature, specific conductance and the level of the groundwater were measured prior to purging. Three casing volumes of groundwater were then purged from the wells before sampling. Prior to sampling, three consecutive pH, temperature, and specific conductance measurements of the groundwater were obtained. These measurements were used to determine if fresh formation water had entered the well screens. After the measurements stabilized to within a 10 percent variance, a groundwater sample was collected. If the well did not recharge fast enough to permit removal of three casing volumes, the well was bailed dry and sampled as soon as sufficient recharge had occurred. Two rounds of groundwater samples were obtained from each monitoring well. Previously constructed monitoring wells were sampled concurrently with the new wells. Sampling rounds were a minimum of 1 month apart.

Groundwater samples were collected from the monitoring wells using a decontaminated Teflon bailer suspended by polypropylene cord. The groundwater was transferred directly from the bailer to clean sample containers supplied by the laboratory. Samples were labeled, packed on ice, and transported to the laboratory under proper chain-of-custody procedures. Sample handling procedures were followed as detailed in Section 4.0 of the RI/FS Work Plan (Stone & Webster, 1995). Field notes were compiled during well development, purging, and sampling and were documented in the field notebook and on sampling forms. The following items were recorded for each sample taken:

- well designation;
- date of well installation;
- date and time of well development, purging, and sampling;
- static water level (SWL) from top of well casing before development and sampling;
- quantity of fluid in well and annulus prior to development and sampling;
- temperature, pH, and specific conductance measurement data;
- total depth of the well;
- type of bailer used, and capacity;
- volume of water removed and time required;
- number, volume, and required analysis of each sample collected; and
- the SWL after sampling and water level stabilization.

The five existing monitoring wells and four micro-well pairs (eight total wells) installed during the previous investigations at Site 8 were resampled prior to the inception of drilling activities. Groundwater from these existing wells was analyzed for the same suite of analyses as the new proposed wells. Standard procedures for sampling and decontamination previously outlined in the RI/FS Work Plan were strictly followed. An optional second round of sampling of the existing wells was performed during the second round of sampling of the newly installed wells.

4.4.4 Surveying

Horizontal and vertical distances were determined by a site survey. A Utah-registered and licensed land surveyor performed the survey of horizontal and vertical location and datum of the monitoring wells and soil borings. Both ground surface and TOC elevations were measured for all wells. The elevations were measured with an accuracy of +/- 0.01 foot. The horizontal locations were measured with an accuracy of +/- 0.1 foot. The survey was conducted in the

State Planar Coordinate System format in order to correspond with existing survey and digitized data at the Base. Survey data is included in Appendix L.

4.4.5 Specific Media Sampling

4.4.5.1 Field Screening Samples

Soil gas, soil, and groundwater screening samples were analyzed for VOCs, including BTEX, using EPA Methods SW8010 and SW8020.

Soil gas samples were directly injected into a GC equipped with a PID. Soil and groundwater screening samples were extracted using a purge and trap method prior to GC analysis. Method blanks were run at the start of each day and as appropriate depending upon the measured concentrations. Duplicate samples were analyzed at a minimum of 10 percent or when inconsistent data were observed. A quality assurance/quality control (QA/QC) summary and methodology for the soil gas sampling are included in Appendix B.

4.4.5.2 Soil

Soil samples collected from Sites 8 and 10 were analyzed as follows:

- VOCs using EPA Method SW3050/SW8240,
- semivolatile organic compounds (SVOCs) using EPA Method SW3520/SW8270,
- TPH using EPA Method SW3050/SW8015, and
- priority pollutant metals (PPMs) using EPA Method SW3050/SW6010.

In addition, two soil samples from Site 10 were analyzed for PCB/pesticides by EPA Method SW3510/SW8080. The analytical program for the samples is summarized in Table 4-1.

4.4.5.3 Groundwater

Groundwater samples at Sites 8 and 10 were analyzed as follows:

- VOCs using EPA Method SW3050/SW8010/SW8020 (with second column confirmation as needed),
- SVOCs using EPA Method SW3520/SW8270,
- TPH using EPA Method SW3050/SW8015, and
- PPMs using EPA Method SW3050/SW6010.

Three groundwater samples at Site 10 were also analyzed for PCB/pesticides using EPA Method SW3510/SW8080. The analytical program for the samples is summarized in Table 4-1.

4.4.5.4 Quality Control Sampling

Field sampling was monitored by QA/QC trip blanks, field blanks, equipment rinsate blanks, and field duplicates.

Table 4-1
Laboratory Analysis Summary
151st ARW, Air National Guard, Salt Lake City, Utah

Site	Matrix	Field Parameters	Parameters and Test Methods	Quantity of Investigating Samples	Number of Field QA/QC Samples				Matrix Totals
					Trip Blanks	Equip. Blanks	Field Blanks	Field Dups.	
8	Soil	Field Screening using PID	VOCs 8240	26	5	5	4	3	43
			SVOCs 8270	26		5	4	3	38
			TPH 8015	26		5	4		35
			PPMs 6010	26		5	4	3	38
	Ground water	Temperature, pH, Specific Conductivity	VOCs 8010/8020	39	2	1	2	4	48
			SVOCs 8270	39		1	2	4	46
			TPH 8015	39		1	2	4	46
			PPMs 6010	39		1	2	4	46
10	Soil	Field Screening using PID	VOCs 8240	25			1	2	28
			SVOCs 8270	25				2	27
			TPH 8015	25					25
			PPMs 6010	25				2	27
			PCB/Pesticides 8080						
	Ground water	Temperature, pH, Specific Conductivity	VOCs 8010/8020	10	1	1	1	2	15
			SVOCs 8270	10		1	1	2	14
			TPH 8015	10		1	1		12
			PPMs 6010	10		1	1	1	13
			PCB/Pesticides 8080						

A QA/QC trip blank is defined as a sample bottle filled by the laboratory with analyte-free laboratory reagent water, transported to the site, handled like a sample but not opened, and returned to the laboratory for analysis. One trip blank accompanied every sample group (on trip blank per cooler) sent to the laboratory for VOC analysis. Trip blanks were analyzed for VOCs only.

A field blank is defined as water poured into a sample container at the site, handled like a sample, and transported to the laboratory for analysis. Field blanks were prepared separately from water used in the final decontamination rinse (analyte-free, deionized or high pressure liquid chromatograph-grade [HPLC-grade]) and from water used for high-pressure hot water washing (steam cleaning with potable tap water). A field blank was collected for each water source used at both Site 8 and Site 10. For analyte free or HPLC-grade water, a separate blank was collected for each lot number. Field blanks were analyzed for all target analytes. Equipment rinsate blanks are defined as analyte-free, deionized, or HPLC-grade water used for decontamination, poured over field equipment that has been decontaminated. Equipment rinsates were collected at a rate of 10 percent of the samples collected per matrix per event. Matrices for this purpose were considered to be soils and groundwater. If more than one type of equipment was used to obtain samples for a particular matrix, a rinsate blank was collected from each piece of equipment. This rinsate water was collected in a sample bottle and analyzed for the same parameters as the samples collected that day.

A field duplicate is defined as two or more samples collected at a sampling location during a single act of sampling. The total number of field duplicates for each analysis is equal to 10 percent of the samples collected, rounded to the next whole number.

Field duplicates were indistinguishable by the laboratory from other samples. Therefore, one complete sample set was identified with a "coded" or false identifier that was in the same format as other identifiers used with this sample matrix. Both the false and the true identifiers were recorded in the field notebook. On the chain-of-custody forms, the "coded" identifier was used. These coded field duplicates were used to assess the representativeness of the sampling procedure.

4.5 HYDROGEOLOGIC STUDIES

Rising head slug tests were performed in the monitoring wells installed during this investigation. A known volume of water was displaced with a slug ballast lowered into the monitoring well. The water level was allowed to equilibrate to initial conditions, then the ballast was quickly raised from the well. The water level recovery in the well was recorded with an environmental data logger using a level-type pressure transducer. The well time-drawdown recovery data were analyzed to obtain unconfined aquifer hydraulic conductivity values.

4.6 INVESTIGATION DERIVED WASTE

Wastes generated during the investigation were classified as investigation derived wastes (IDW). IDW consisted of drill cuttings and soils from soil borings and well installations; decontamination solutions used to clean nondisposable equipment and PPE; and fluids from well development and purging. The containerization, handling, and disposal of IDW is discussed in the following paragraphs.

Stone & Webster collected, sampled, characterized, and labeled wastes generated during the RI. IDW was handled in an efficient and timely manner, utilizing the most cost-effective method, while minimizing adverse impacts on Base operations.

4.6.1 Drill Cuttings

Soil cuttings from soil borings and well installations were containerized in U.S. Department of Transportation (USDOT) 17H approved 55-gallon drums. A separate drum was used to contain soil cuttings from each soil boring and well. All drums were labeled with the contents, location, date, and other relevant information.

After the completion of the field work, a proposed sampling plan for the IDW was developed and submitted to the UDEQ for approval. The plan proposed dividing the drums of soil into five groups based on similar contaminant concentrations as determined by field measurements and laboratory results of soil samples collected from the borings and monitoring wells, and collecting five composite soil samples, one from each group of drums for Toxicity Characteristic Leaching Procedure (TCLP) organics and metals analysis. A summary of soil drum contents and sampling rationale is provided in Appendix I.

Upon approval by the UDEQ, the IDW was sampled during the week of September 13, 1995. Results of the IDW sampling indicated that contaminants were not present at levels above the maximum TCLP limits. The results of the IDW sampling and a proposal to return the soil back to the site, were submitted to the UDEQ by the BEC on October 17, 1995.

The UDEQ Division of Solid and Hazardous Waste approved of the plan to return the soil to the site on December 5, 1995. A copy of the letter of approval from the UDEQ is included in Attachment I. The soil was returned to the site by UANG personnel on December 12 and December 13, 1995.

4.6.2 Decontamination Water

Decontamination water was containerized in USDOT 17H approved 55-gallon drums for disposal by the Base. Decontamination water from soil gas, soil and groundwater screening was also stored in separate drums. Each drum was labeled with the contents, site designation, well number, and date.

After the completion of the field work, a proposed sampling plan for the IDW, including the decontamination water, was developed and submitted to the UDEQ for approval. The disposal of IDW drums containing decontamination water was coordinated with Mr. Elgin Dyer of the Salt Lake City Water Reclamation Plant. Mr. Dyer requested analytical information on each drum of IDW water to be discharged to the sewer system. Mr. Dyer requested the drums of decontamination water from Sites 8 and 10 be analyzed for the contaminants of concern which were detected on the respective Sites.

The sampling plan proposed the drums of decontamination water from Site 10 (Drums 8, 20a, 21, and 60) be analyzed for BTEX and TPH, and the drums of decontamination water from Site 8 (Drums 3, 7, 28, 55, 62) and from the decontamination pad used for both sites (Drums 56, 57, 58) be analyzed for BTEX, TPH, and halogenated compounds. The proposed analyses were selected based on contaminants that were detected in soil and groundwater samples collected from each site.

Upon approval by the UDEQ, the IDW was sampled during the week of September 13, 1995. Results of the IDW sampling indicated that contaminants were not present at levels above the Salt Lake City Water Reclamation Plant's limits. The results of the IDW sampling and a proposal to discharge the water to the sewer system, were submitted to the UDEQ by the BEC on October 17, 1995.

The UDEQ Division of Solid and Hazardous Waste approved of the plan to discharge the water to the Salt Lake City Wastewater Treatment Plant with prior permission from the pretreatment coordinator on December 5, 1995. The sampling results were submitted to the pretreatment coordinator by the BEC on December 11, 1995. The pretreatment coordinator approved the discharge of the drums of decontamination water to the sewer. A copy of the letters of approval from the UDEQ and the Water Reclamation Plant are included in Attachment I. The decontamination water was discharged to the sewer by UANG personnel on December 12 and December 13, 1995.

4.6.3 Monitoring Well Purge and Development Water

Groundwater removed from the monitoring wells during purging and sampling was containerized in USDOT 17H approved 55-gallon drums for disposal by the Base. Each drum was labeled with the contents, site designation, well number, and date. Development and purge water for each monitoring well was containerized in a separate drum.

After the completion of the field work, a proposed sampling plan for the IDW, including the development and purge water, was developed and submitted to the UDEQ for approval. The disposal of IDW drums containing development and purge water was coordinated with Mr. Elgin Dyer of the Salt Lake City Water Reclamation Plant. Mr. Dyer requested analytical information on each drum of IDW water to be discharged to the sewer system.

The analytical information available collected during the field program on the drums containing development and purge water for the monitoring wells (Drums 1, 2, 4-6, 20, 23-25, 43-46, and 50-54) was sufficient for the Water Reclamation Plant. The analytical data and a proposal to discharge the water to the sewer system, were submitted to the UDEQ by the BEC on October 17, 1995.

The UDEQ Division of Solid and Hazardous Waste approved of the plan to discharge the water to the Salt Lake City Wastewater Treatment Plant with prior permission from the pretreatment coordinator on December 5, 1995. The analytical data was submitted to the pretreatment coordinator by the BEC on December 11, 1995. The pretreatment coordinator approved the discharge of the drums of development and purge water to the sewer system, with the exception of drum numbers 2 and 4, due to the concentration of benzene detected in these drums. A copy of the letters of approval from the UDEQ and the Water Reclamation Plant are included in Attachment I. The decontamination water was discharged to the sewer, except drum numbers 2 and 4, by UANG personnel on December 12 and December 13, 1995.

The BEC is currently working with Advanced Petroleum Recycling to have the contents of drums 2 and 4 taken for recycling.

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5.0 INVESTIGATION FINDINGS

5.1 BASEWIDE GEOLOGIC AND HYDROLOGIC INVESTIGATION RESULTS

5.1.1 Geologic Conditions

The nearly flat lake and floodplain topography of the area that encompasses the UANG Base was conducive to the formation of swamps and marshes in the valley. Dark, organic sediments accumulated in the swampy and marshy areas. Generally, a layer of moderately well to well sorted, fine to coarse sand of granitic provenance is subjacent to the organic sediment to a depth of approximately 20 feet BGS. The near-surface deposits at the UANG Base are primarily fine-grained. In areas of the Base to the south and west, the dark organic silt and clay and granitic sand sedimentary sequence is absent. Here, the sedimentary deposits are primarily clay mixed with variable amounts of silt and sand, with discrete thin sand zones in some places (Parsons ES, 1994).

Basewide soil samples were not collected as part of this investigation. A discussion of site-specific geology and geologic cross-sections for Sites 8 and 10 as determined through RI field activities, are included in Sections 5.3.1 and 5.4.1. Geologic and hydrogeologic information from previous studies conducted at Sites 8 and 10 have been summarized in Section 3.6 and are incorporated into this report, where appropriate.

5.1.2 Hydrologic Conditions

The study areas exist within fluvial and lake deposits. These sediments consisting of cross-bedded sands with variable contents of silt and clay result from deposition on flood plains and levees. Gravel deposits can result from channel lag. Lake deposits result in layers of silt and clay.

The hydraulic conductivities of fluvial and lake deposits are typically heterogeneous (i.e., varies with location) and anisotropic (i.e., varies with direction). The hydraulic conductivity of these deposits can have a variation of as much as two or three orders of magnitude. The sand zones form preferential pathways for groundwater flow and potential contaminant migration. Clay layers form relatively impermeable flow boundaries.

Groundwater levels measured at the Base in March 1993 ranged from 1.30 to 8.21 feet BGS depending on location. Water level measurement data is shown in Table 5-1. For comparison, water level measurements taken in December 1992 and July 1995 are also included in the table. Figure 5-1 is the potentiometric surface map constructed from the measurements taken in March 1993. As shown on Figure 5-1, groundwater flow direction south of the City Drain Channel is to the north-northwest and northeast with an average hydraulic gradient of approximately 0.0014 feet per foot. Groundwater flow direction north of the City Drain Channel is to the south with an average hydraulic gradient of 0.0029 feet per foot (Parsons ES, 1995).

Figure 5-2 is the potentiometric surface map constructed for the measurements taken in July 1995. As shown on Figure 5-2, groundwater flow direction south of the City Drain Channel is to the north-northwest and northeast with an average hydraulic gradient of approximately

Table 5-1
Groundwater Elevations from Basewide Piezometers
151st ARW, Air National Guard, Salt Lake City, Utah

Station	Depth to Groundwater (feet)			Groundwater Elevation (feet)		
	12/28/92	3/16/93	7/19/95	12/28/92	3/16/93	7/19/95
PI-1	5.71	4.34	5.45	4208.95	4210.34	4209.23
PI-2	4.20	1.30	NMD	4208.36	4211.26	NMD
PI-3	5.27	4.58	5.11	4212.01	4212.70	4212.17
PI-4	6.61	4.00	5.30	4208.18	4210.79	4209.42
PI-5	NMD	3.53	4.58	NMD	4210.76	4209.71
PI-6	6.72	5.23	NMD	4211.13	4212.62	NMD
PI-7	10.00	6.38	9.90	4209.57	4213.19	4209.67
PI-8	10.02	8.21	NMD	4208.27	4210.08	NMD
PI-9	10.31	7.18	9.67	4209.73	4212.86	4210.37
PI-10	7.29	5.39	NMD	4211.54	4213.44	NMD

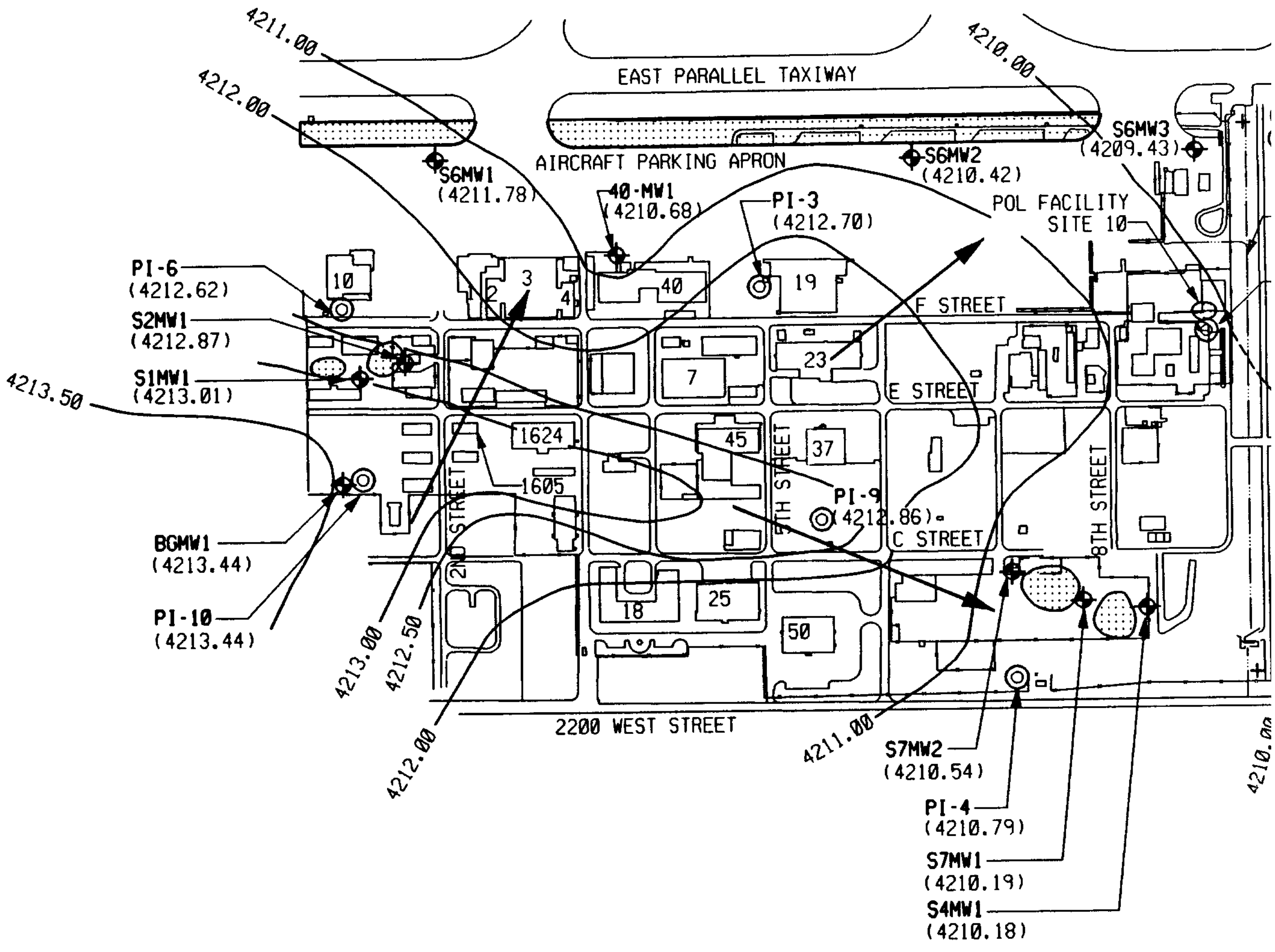
NMD = No measurable data
Source: Parsons ES, 1995

0.0014 feet per foot. Groundwater flow direction north of the City Drain Channel is to the southeast with an average hydraulic gradient of 0.0029 feet per foot.

5.2 BACKGROUND SAMPLING RESULTS

Background levels for VOCs, SVOCs, pesticides/PCBs, and PPMs in soil and groundwater were measured by Parsons ES in January 1993 and August 1995 as part of the basewide SI. In addition to the listed constituents, background soil and groundwater samples were also tested for total recoverable petroleum hydrocarbons (TRPH). The location of the background soil boring and monitoring wells, BGMW1 and BGMW2, are shown on Figure 5-2. Concentrations of VOCs, SVOCs, pesticides/PCBs, and TRPH detected in background soil and groundwater samples are listed in Table 5-2. Background sampling was not conducted as part of this RI for Sites 8 and 10.

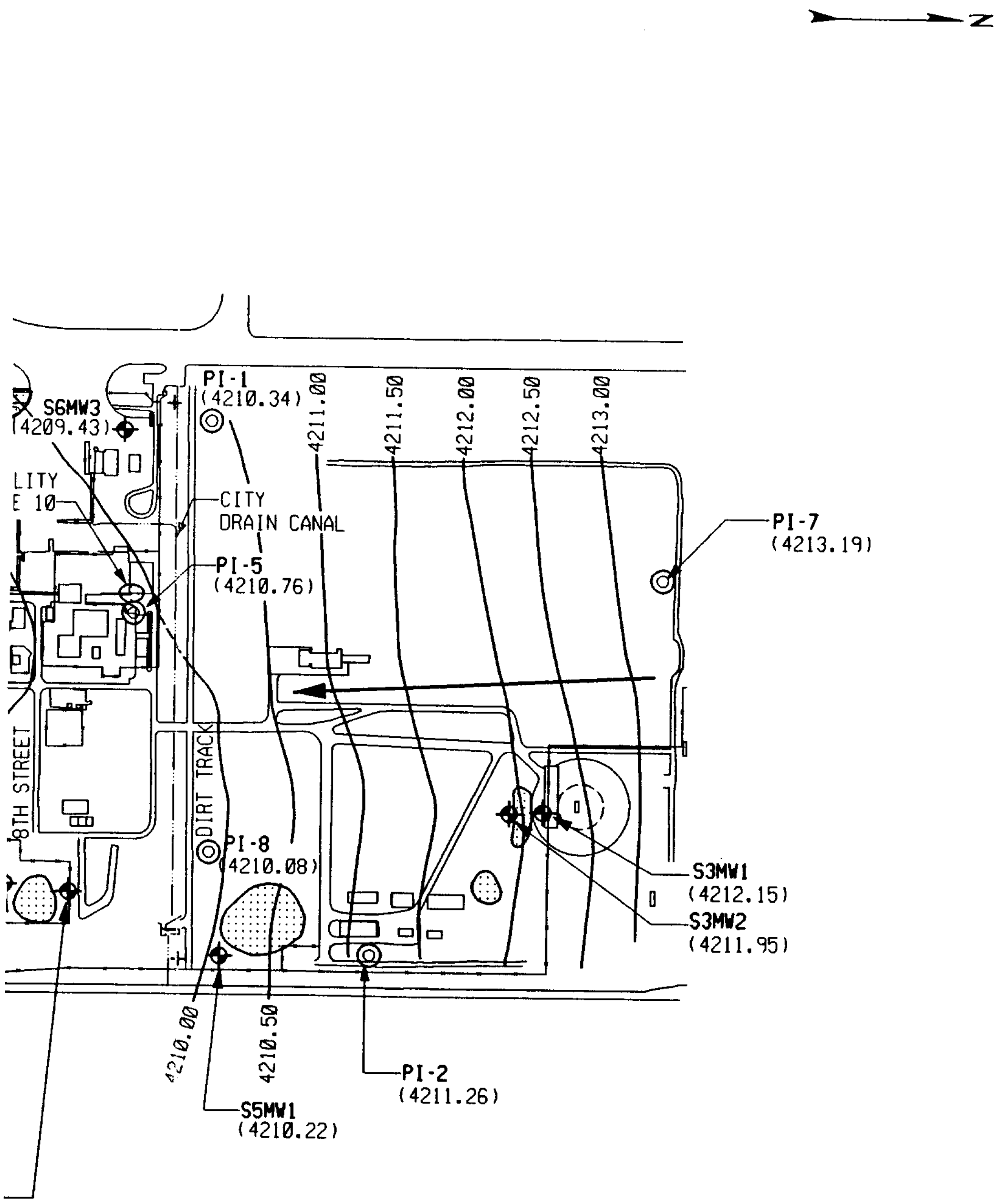
As shown in Table 5-2, toluene was detected in the background soil sample collected from a depth of 0-2 feet BGS in BGMW1 at a concentration of 0.0021 ppm (2.1 μg/kg). Other VOCs were not detected in the background soil samples above the method detection limit of 2.0 μg/kg (0.002 ppm).



POTENTI
FROM

4		CHKD	CORRECT				APPR DATE	3		CHKD	CORRECT				APPR DATE	2	
ISSUE	DESCRIPTION	CHKD	CORRECT				APPR DATE	ISSUE	DESCRIPTION	CHKD	CORRECT				APPR DATE	ISSUE	DESCRIPTION
PC	ARCH CIVIL CONC STL L&P INST MD	P.S.	S.A.	FAC	ELEC	LTG	MATL	PC	ARCH CIVIL CONC STL L&P INST MD	P.S.	S.A.	FAC	ELEC	LTG	MATL	PC	ARCH CIVIL CONC STL

FILE: c:*dan*wang*fig5-1.dgn (cm 005.0113)
DATE: 26-JUNE-96 10:03



LEGEND

PI-1 ◎ (4210.34) PIEZOMETER LOCATION WITH GROUNDWATER ELEVATION (FT-MSL)

S3MW2 ⌖ (42111.95) MONITORING WELL LOCATION WITH GROUNDWATER ELEVATION (FT-MSL)

4210.00 ⁀ APPROXIMATE GROUNDWATER ELEVATION CONTOUR (FT-MSL)

← GROUNDWATER FLOW DIRECTION (3/93)

▨ IRP SITE LOCATION

NOTE:

GROUNDWATER CONTOURS ARE BASED ON WATER LEVELS IN BASEWIDE PIEZOMETERS AND SITE MONITORING WELLS. SITE DESIGNATIONS ARE DENOTED BY MONITORING WELLS, FOR EXAMPLE S2MW1 IS MW1 AT SITE 2.

40MW1 IS A MONITORING WELL FROM THE SITE 9 UST INVESTIGATION (ES, 1993)

0 400'

FIGURE 5-1

POTENTIOMETRIC SURFACE - GROUNDWATER GRADIENT MAP
FROM BASEWIDE PIEZOMETERS AND MONITORING WELLS

BASEWIDE POTENTIOMETRIC MA
16 MARCH 1993

151st ARW, UTAH AIR NATIONAL GUAR
SALT LAKE CITY INTERNATIONAL AIRPO
SALT LAKE CITY, UTAH
STONE & WEBSTER ENGINEERING CORPORATION
BOSTON, MASS.

DRAWING NUMBER 05219.002

ISSUE	DESCRIPTION	CHKD	CORRECT	APPR DATE	ISSUE	DESCRIPTION	CHKD	CORRECT	APPR DATE
2					1	ORIGINAL ISSUE			

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DESIGNED BY: DRAWN BY: G.C. CARTER AREAS LEVELS
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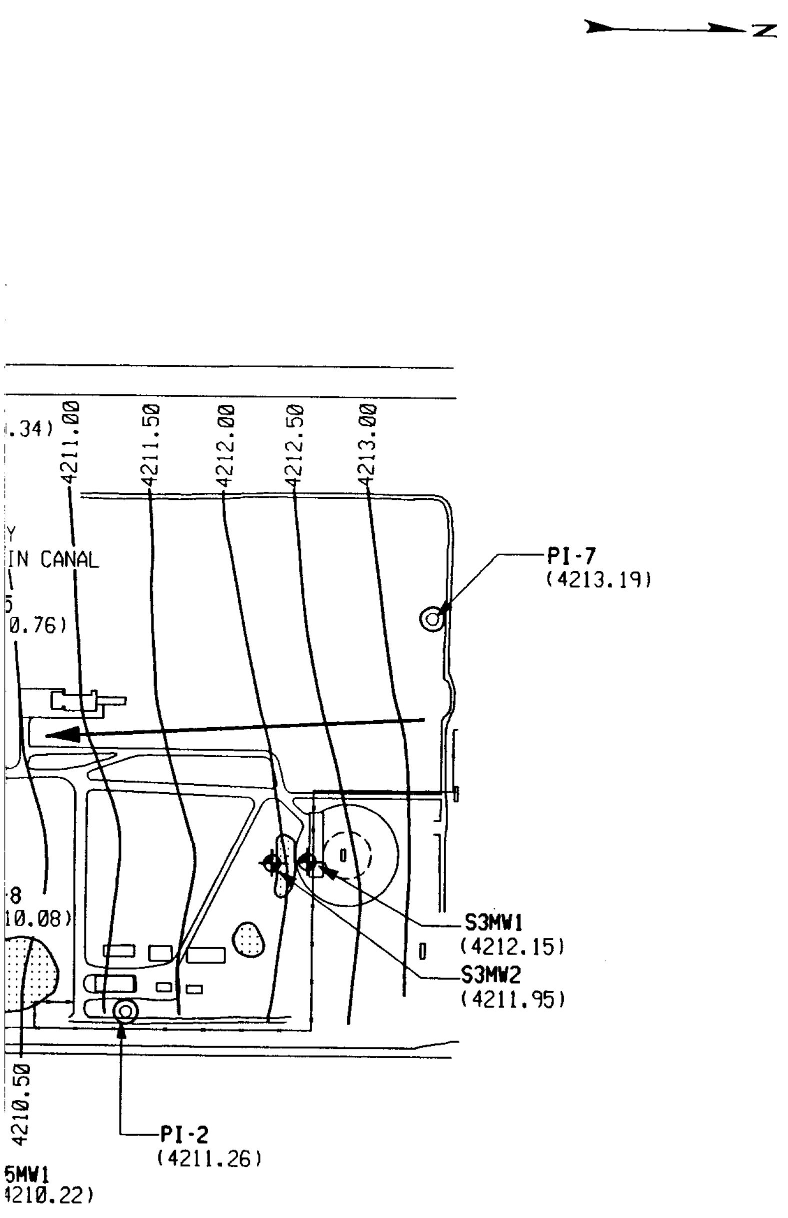

LEGEND

PI-1 ◎ (4210.34) PIEZOMETER LOCATION WITH GROUNDWATER ELEVATION (FT-MSL)

S3MW2 ⌖ (42111.95) MONITORING WELL LOCATION WITH GROUNDWATER ELEVATION (FT-MSL)

4210.00 ⁓ APPROXIMATE GROUNDWATER ELEVATION CONTOUR (FT-MSL)

← GROUNDWATER FLOW DIRECTION (3/93)

▨ IRP SITE LOCATION

NOTE:

GROUNDWATER CONTOURS ARE BASED ON WATER LEVELS IN BASEWIDE PIEZOMETERS AND SITE MONITORING WELLS. SITE DESIGNATIONS ARE DENOTED BY MONITORING WELLS, FOR EXAMPLE S2MW1 IS MW1 AT SITE 2.

40MW1 IS A MONITORING WELL FROM THE SITE 9 UST INVESTIGATION (ES, 1993)

0 400'

FIGURE 5-1

RIC SURFACE - GROUNDWATER GRADIENT MAP
WIDE PIEZOMETERS AND MONITORING WELLS

BASEWIDE POTENTIOMETRIC MAP
16 MARCH 1993

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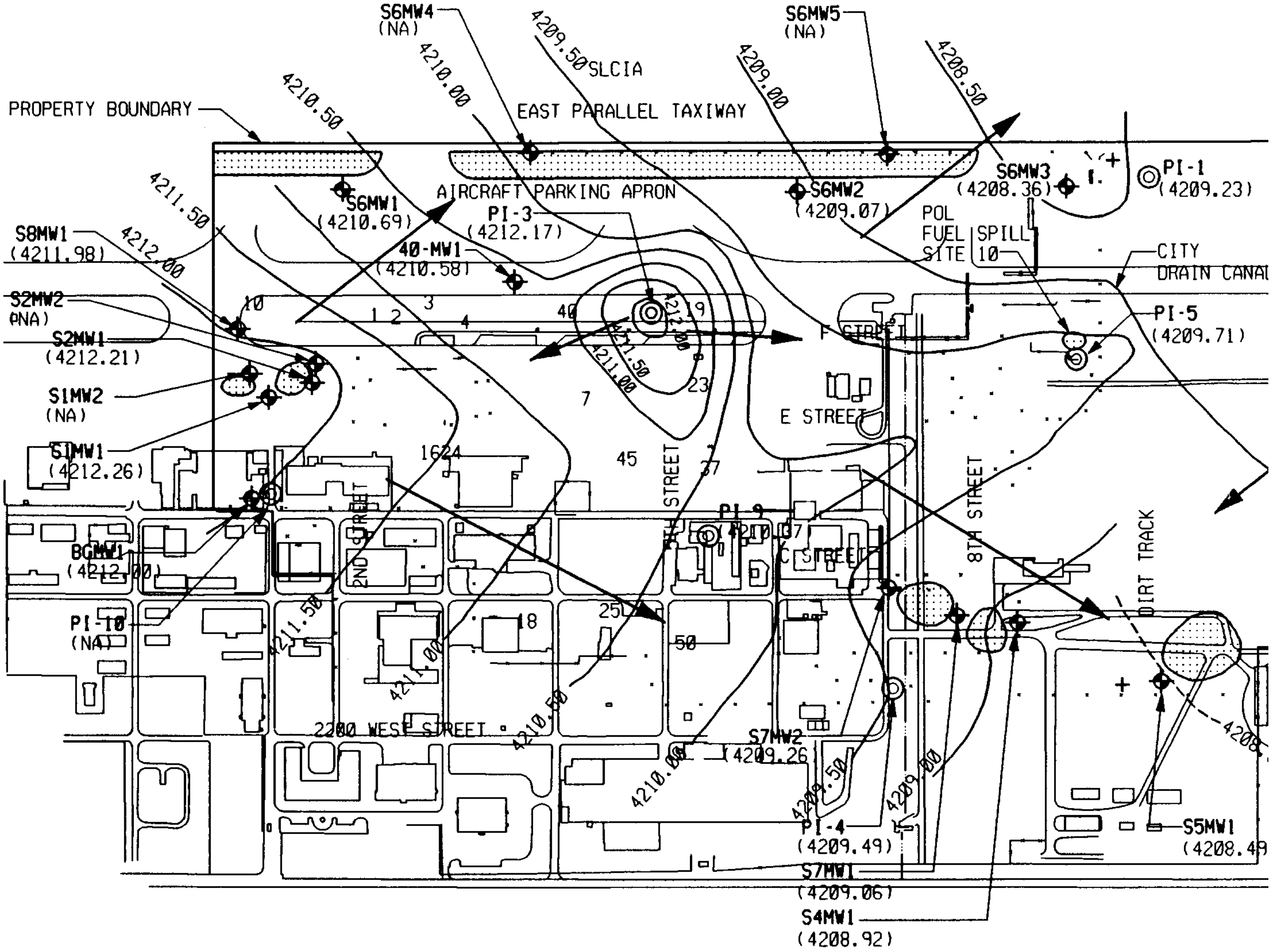

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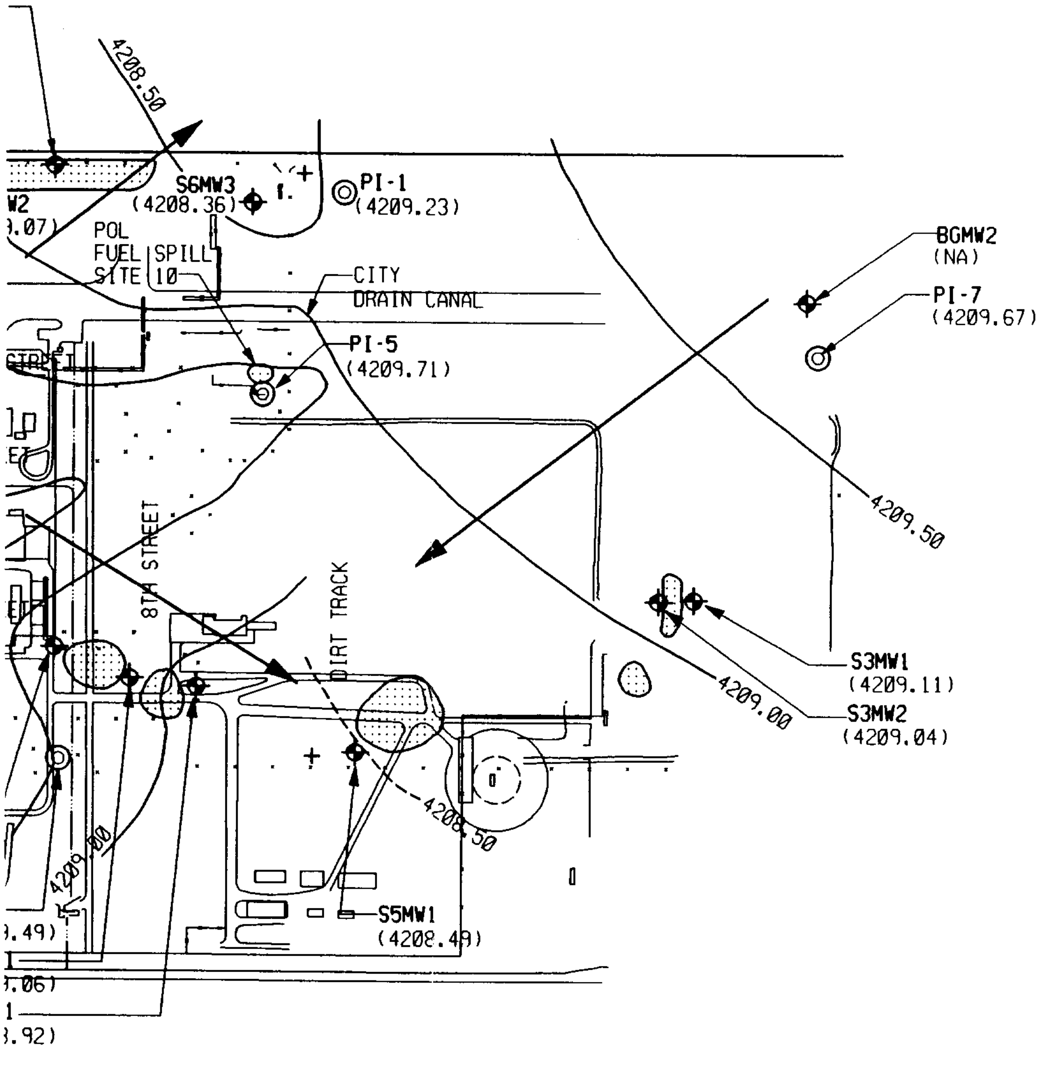

LEGEND

PI-1 ◎ (4209.23) PIEZO
WITH
ELEVA

S3MW2 ⊕ (4209.04) MONIT
WITH
(FT-M

4210.00 APPRO
ELEVA

← GROUN
DIREC

IRP S

NOTE:

GROUNDWATER CONTOURS ARE B
BASEWIDE PIEZOMETERS AND SI
SITE DESIGNATIONS ARE DENOT
FOR EXAMPLE, S2MW1 IS MW1 AT

40 MW1 AND S8MW1 ARE MONITO
THE SITE 8 & 9 UST INVESTIC

PI-2, PI-6 AND PI-8 HAVE BEEN

BGMW2, S1MW2, S2MW2, S6MW4, AN
INSTALLED AUGUST 1995.

0

FIGURE

POTENTIOMETRIC SURFACE -
FROM BASEWIDE PIEZOMETER
19 JULY

151st ARW, UTAH AI
SALT LAKE CITY INTE
SALT LAKE C
STONE & WEBSTER ENGINE
BOSTON, MA

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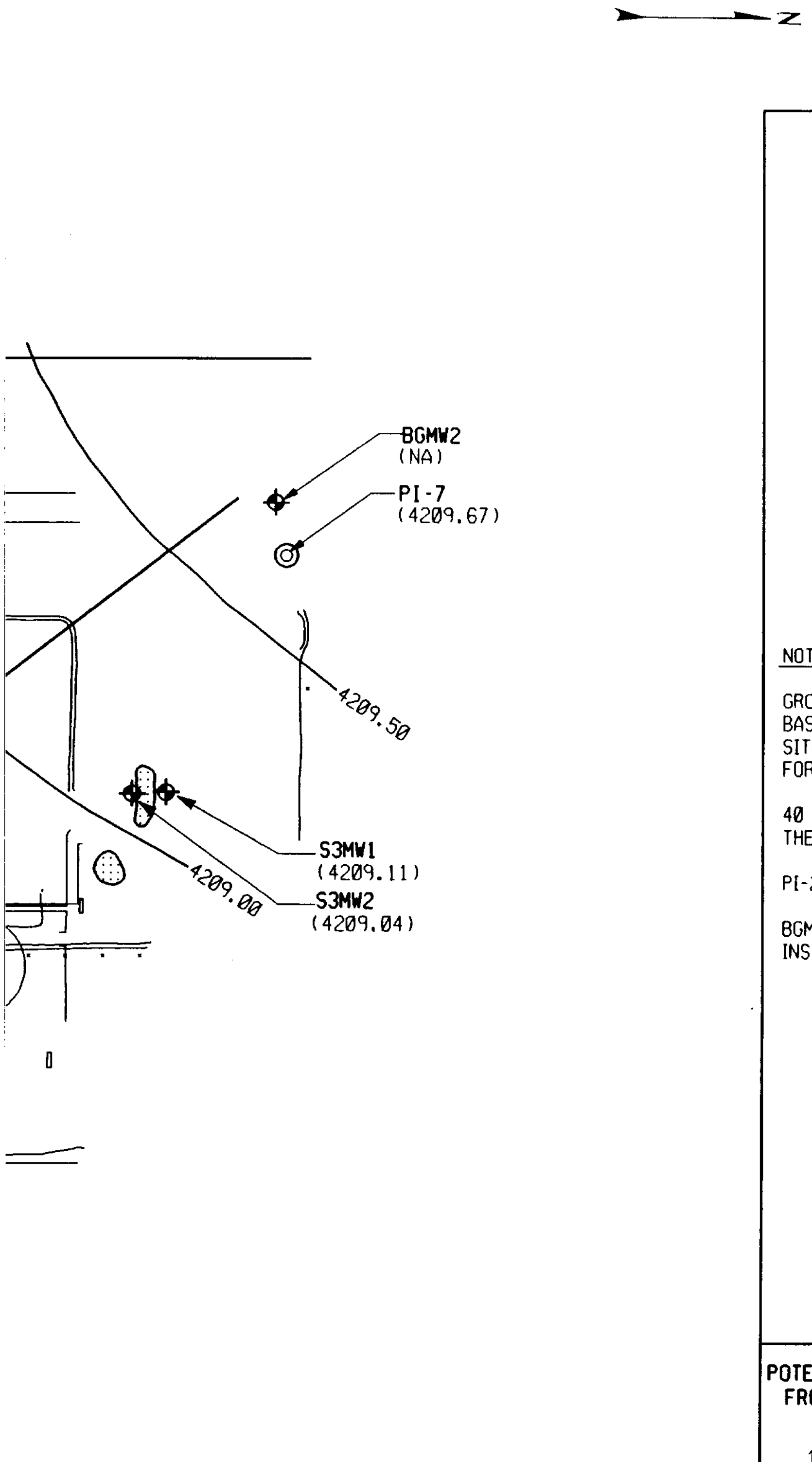

LEGEND

PI-1 ◎ (4209.23)	PIEZOMETER LOCATION WITH GROUNDWATER ELEVATION (FT-MSL)
S3MW2 ⌖ (4209.04)	MONITORING WELL LOCATION WITH GROUNDWATER ELEVATION (FT-MSL)
4210.00 ‿	APPROXIMATE GROUNDWATER ELEVATION CONTOUR (FT-MSL)
←	GROUNDWATER FLOW DIRECTION (7/95)
⬭	IRP SITE LOCATION

NOTE:

GROUNDWATER CONTOURS ARE BASED ON WATER LEVELS IN BASEWIDE PIEZOMETERS AND SITE MONITORING WELLS. SITE DESIGNATIONS ARE DENOTED BY MONITORING WELLS, FOR EXAMPLE, S2MW1 IS MW1 AT SITE 2.

40 MW1 AND S8MW1 ARE MONITORING WELLS FROM THE SITE 8 & 9 UST INVESTIGATIONS (ES, 1993).

PI-2, PI-6 AND PI-8 HAVE BEEN DESTROYED.

BGMW2, S1MW2, S2MW2, S6MW4, AND S6MW5 WERE INSTALLED AUGUST 1995.

0 400'

FIGURE 5-2

POTENTIOMETRIC SURFACE - GROUNDWATER GRADIENT MAP
FROM BASEWIDE PIEZOMETERS AND MONITORING WELLS
19 JULY 1995

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DSGN CHK'D BY:
DRAWN BY: G.C. CARTER
CHK'D BY:

AREAS	LEVELS	WORK PKG	PCT

RESP ENGR: K. MARONEY
SUPV: R.J. BOUDREAU

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Table 5-2
Background Soil and Groundwater Sampling Analytical Results
151st ARW, Air National Guard, Salt Lake City, Utah

Parameter (method)	Analyte	SOIL						GROUNDWATER	
		BGMW 1 0-2 ft BGS	BGMW 1 2-4 ft BGS	BGMW 2 0-2 ft BGS	BGM W2 2-4 ft BGS	BGM W2 4-6 ft BGS	BGMW 2 6-8 ft BGS (dup)	BGMW 1 **	BGMW 2 **
VOCs (μg/kg) (SW8020)	Toluene	2.1	2.0U	ND	ND	ND	ND	ND	ND
SVOCs (μg/kg) (SW8270)	Bis (2-ethylhexyl) phthalate	130J	400U	ND	ND	ND	ND	ND	ND
Pesticides/PCBs (μg/kg) (SW8080)	ND	ND	ND	ND	ND	ND	ND	100UJ	ND
TRPH (mg/kg) (418.1)	Total Recoverable Hydrocarbons	11U	12U	12U	12U	12U	12U	ND	12U
Priority Pollutant Metals* (mg/kg) (SW6010)	Antimony	-	-	4.4R	2.1R	2.1R	2.1R	24U	2.1R
	Arsenic	12.5J	4.8J	4.1J	3.7J	11J	8.4J	250	8.4J
	Beryllium	0.19J	0.36J	0.50	0.37	0.40	0.35	0.63U	0.35
	Cadmium	0.27J	0.36J	0.22	0.26	0.30	0.22	0.97U	0.22
	Chromium	9.7J	9.5J	14U	11U	12U	12U	5.0U	12U
	Copper	8.2	28.1	21J	21J	26J	26J	17	26J
	Mercury	-	-	0.033	0.075	0.067	0.046	0.024J	0.046
	Lead	22.6J	14.3J	14J	9.8J	11J	9.8J	4.8UJ	9.8J
	Nickel	6.0	8.0	9.5U	6.9U	8.9U	7.5U	11U	7.5U
	Selenium	-	-	0.46U	0.46U	0.46U	0.46U	12U	0.46U
	Silver	-	-	0.78	0.51U	0.51U	0.51U	5.5U	0.51U
	Thallium	-	-	0.31J	0.20J	0.21J	0.14U	1.2UJ	0.14U
	Zinc	25.2J	37.2J	52	32	36	29	4.1U	29

U = Compound not present at the detection limit shown
J = Concentration of the compound is estimated
R = Data rejected
dup = Blind duplicate of preceding sample interval BGMW2, 4-6 ft
ND = All analytes were not detected
* Detection limits of the metals were not provided by the analytical laboratory
** Concentration values reported in ug/l for groundwater samples
Source: Parsons ES, 1995

Bis(2-ethylhexyl)phthalate was detected in the background soil sample collected from a depth of 0 to 2 feet BGS in BGMW1 at an estimated concentration of 0.130 ppm (130 μg/kg). Other SVOCs were not detected in the background soil samples above the method detection limit. Pesticides/PCBs and TRPH were not detected above their respective method detection limits in the background samples. Based on the SI, concentrations of PPMs detected in the background soil samples were in the naturally-occurring range.

Parsons ES reported organic analytes were not detected in the background groundwater samples above the method detection limits. TRPH was detected in samples collected from both background monitoring wells at an estimated concentration of 100 μg/l. Of the PPMs detected in groundwater samples, concentrations of arsenic were found to be above the Utah Groundwater Quality Standard (GWQS) of 50 μg/l in the sample collected from BGMW1. The analysis of arsenic in the groundwater sample collected from BGMW2 was rejected based on the QA/QC methods. According to published USGS data, arsenic concentrations in the shallow groundwater in the vicinity of the Base are elevated, with values ranging from 60 to 360 μg/l within a three mile radius of the base (USGS, 1983; and Thiros, 1992). A discussion of the Utah GWQS and other ARARs is provided in Section 6.0 of this report.

5.3 IRP SITE 8 FINDINGS

5.3.1 Geologic and Hydrologic Investigation Results

Data from soil borings and monitoring wells have been used to create geological cross-sections to evaluate IRP Site 8 geologic and hydrogeologic conditions. Soil samples were collected from 18 soil borings to provide data to characterize the subsurface geology. Soil borings were completed to maximum depths ranging from 6 to 20 feet. Groundwater monitoring wells were installed in 7 of the 18 borings. A free product monitoring well was installed in one of the borings. Geological cross-sections have been developed using both soil boring and monitoring well logs to interpret site geological conditions. Figure 5-3 shows the locations of geologic cross-sections at IRP Site 8. Cross-sections depicting the subsurface geology and contamination detected in analytical sampling are shown on Figures 5-4 through 5-8. Soil boring logs for this investigation are presented in Appendix A.

Heterogeneous unconsolidated sediments were encountered at IRP Site 8. These sediments consist of clays, silty clays, sandy clays, silty sands, and fine to coarse sands. The dark organic silt and clay sediment layer was observed in only a few of the borings at Site 8. These fine-grained delta and floodplain sediments are consistent with the geology at other sites investigated at the UANG Base.

Clay is the primary soil type at Site 8. It has a maximum thickness of approximately 8.5 feet and is interspersed with thinner silty or sandy clay, silt, clayey sand, and sand lenses ranging in thickness from 2 inches to 4.5 feet. The clay layers are laterally consistent across most of the site. The silt, clayey sand, and sand lenses interfinger within the clay and are discontinuous. Clay is most predominant at the southwest area of Site 8 and clayey sand and poorly graded sands are most predominant at the southeast area of Site 8.

Most shallow investigated soils are disturbed and are not natural within the first 2 feet of the land surface. Asphalt or concrete was present at the surface of most drilling locations. This material is occasionally underlain by fill material consisting of gravel or clayey gravel. The maximum depth of this material is approximately 2 feet.

The regional confining layer ranges from about 40 to 100 feet thick. Examined on a local scale, the first 20 feet of sediment at Site 8 can be considered as a series of hydraulically conductive zones consisting of sands and gravels separated by confining layers of silt and clay. According

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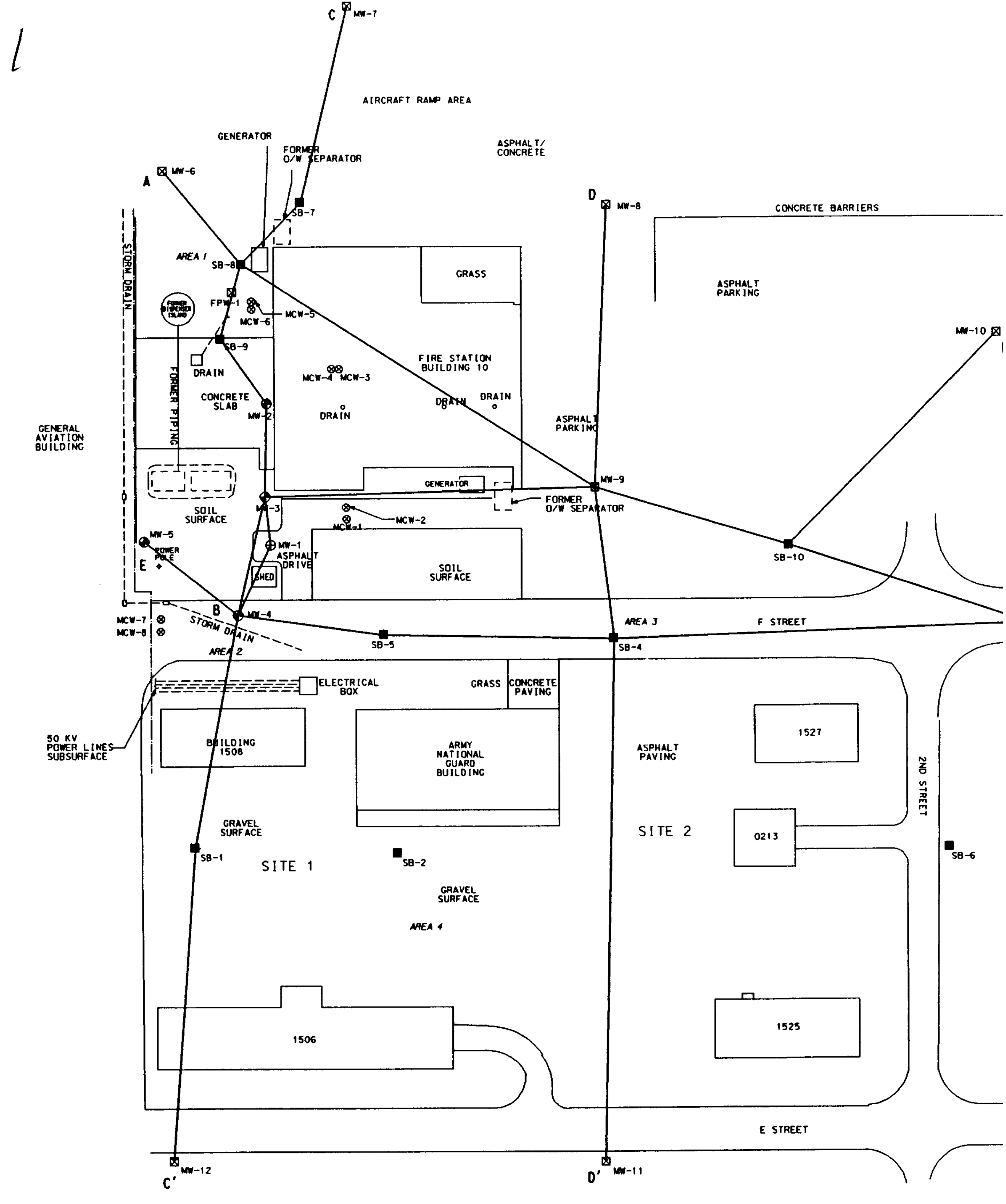

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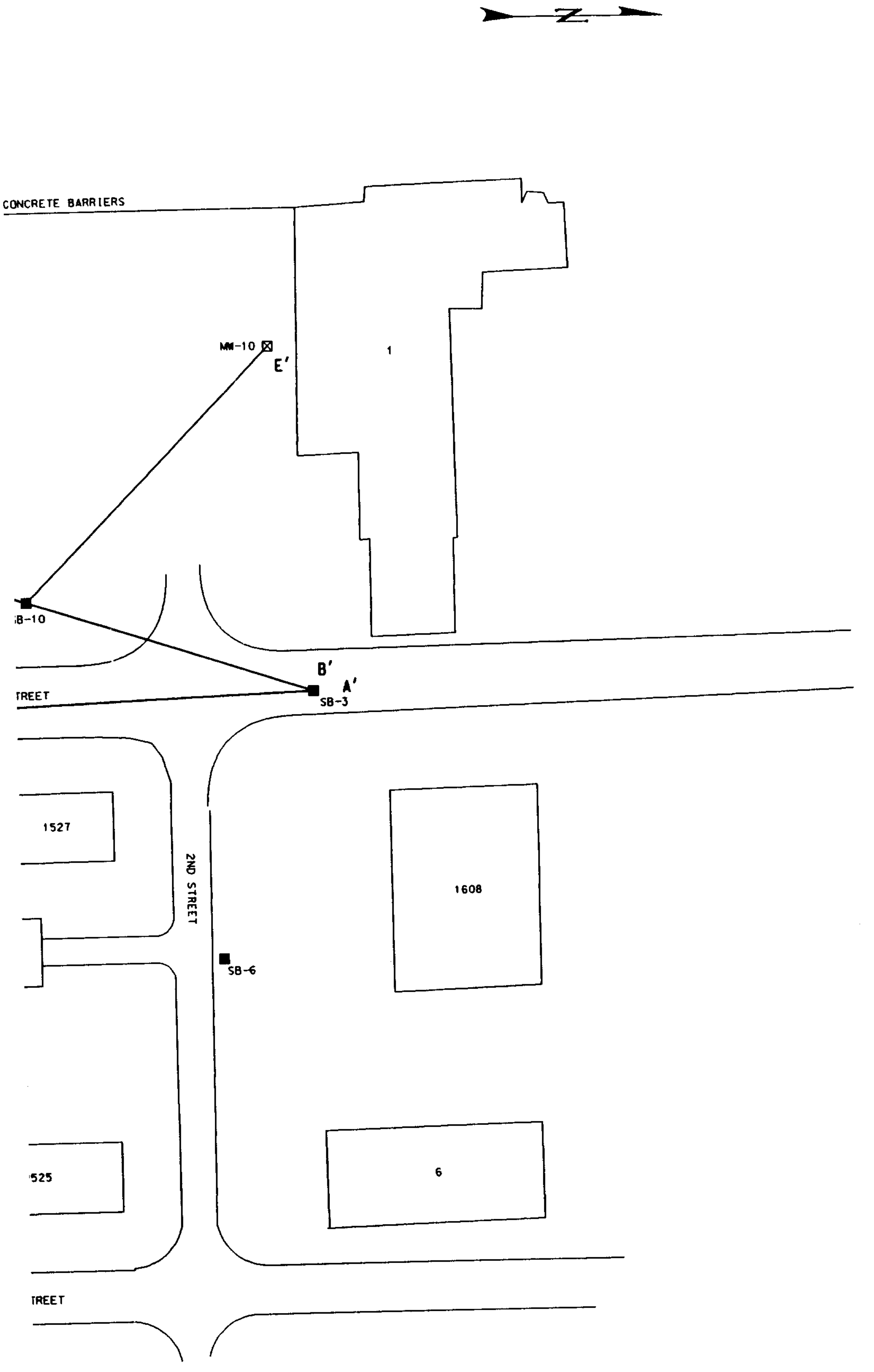

LEGEND:

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◒	MONITORING WELL PARSONS ES (APRIL 1994)
⊗	MICRO-WELL PARSONS ES (JUNE 1994)
☒	MONITORING WELL SWEC (JUNE 1995)
■	SOIL BORING SWEC (JUNE 1995)
———	PROPERTY BOUNDARY

0 50'

FIGURE 5-

LOCATIONS OF GEOL CROSS-SECTIONS A-A', B D-D', AND E-E' FOR IF

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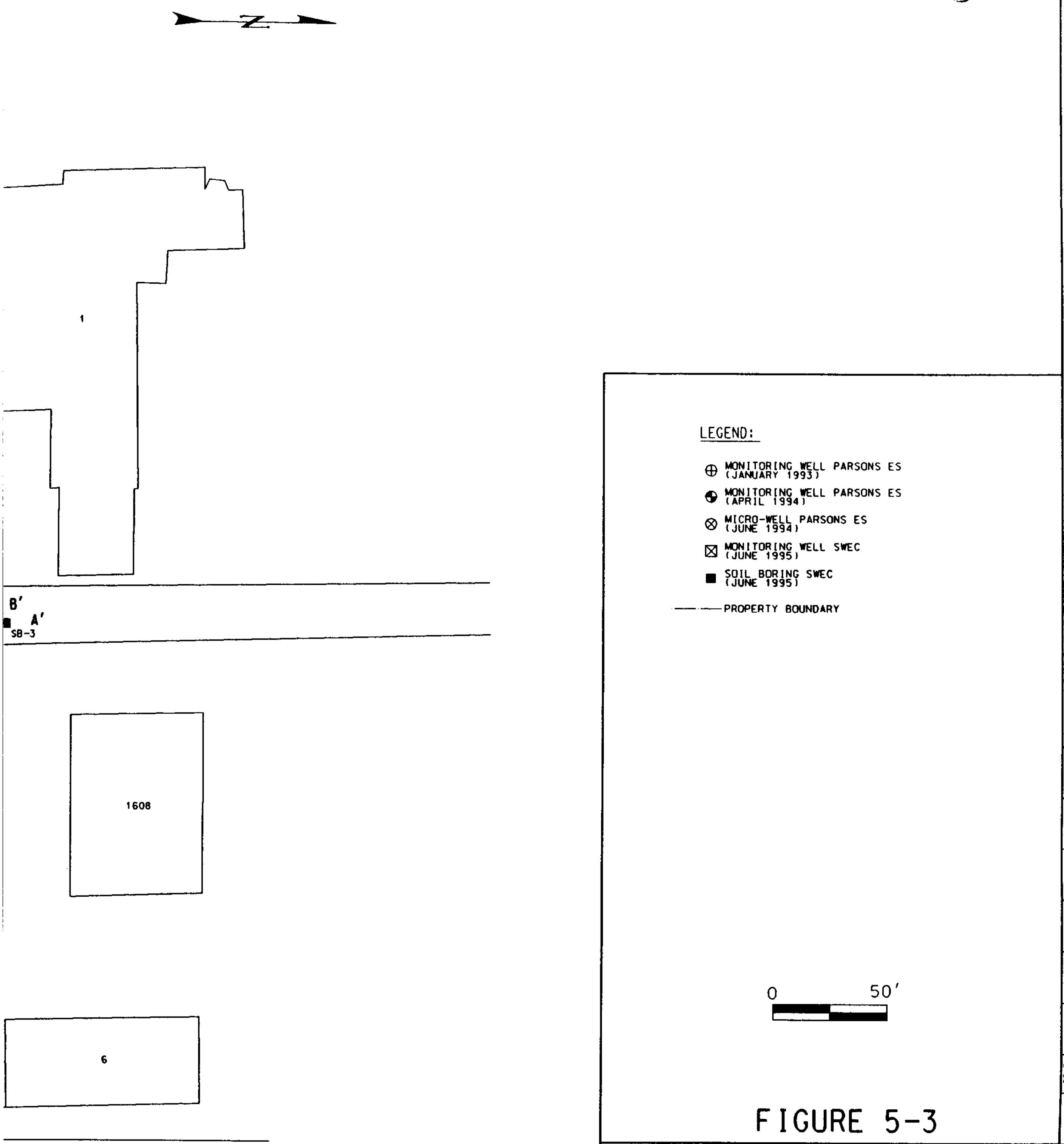

FIGURE 5-3

LOCATIONS OF GEOLOGIC CROSS-SECTIONS A-A', B-B', C-C', D-D', AND E-E' FOR IRP SITE 8

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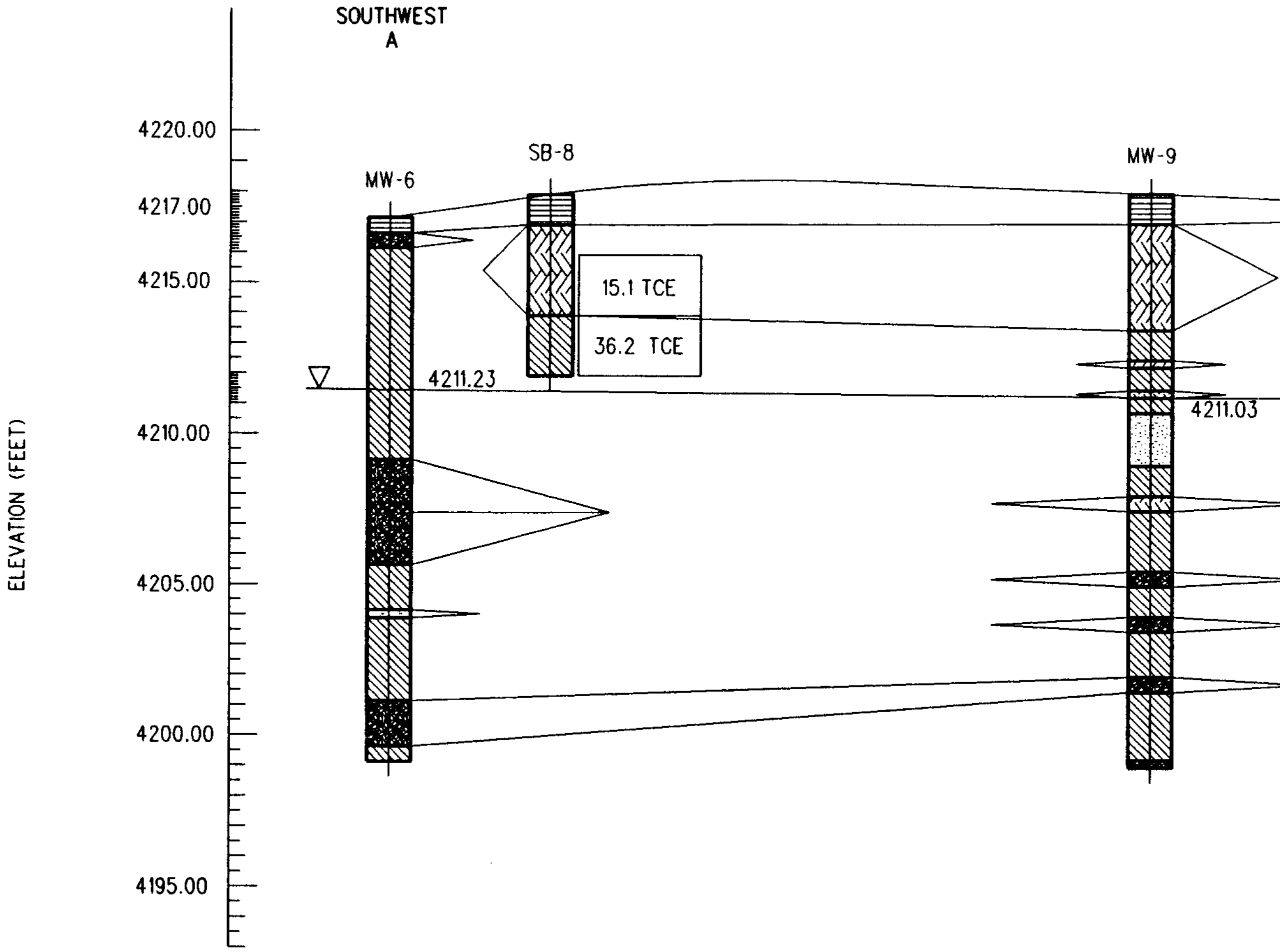

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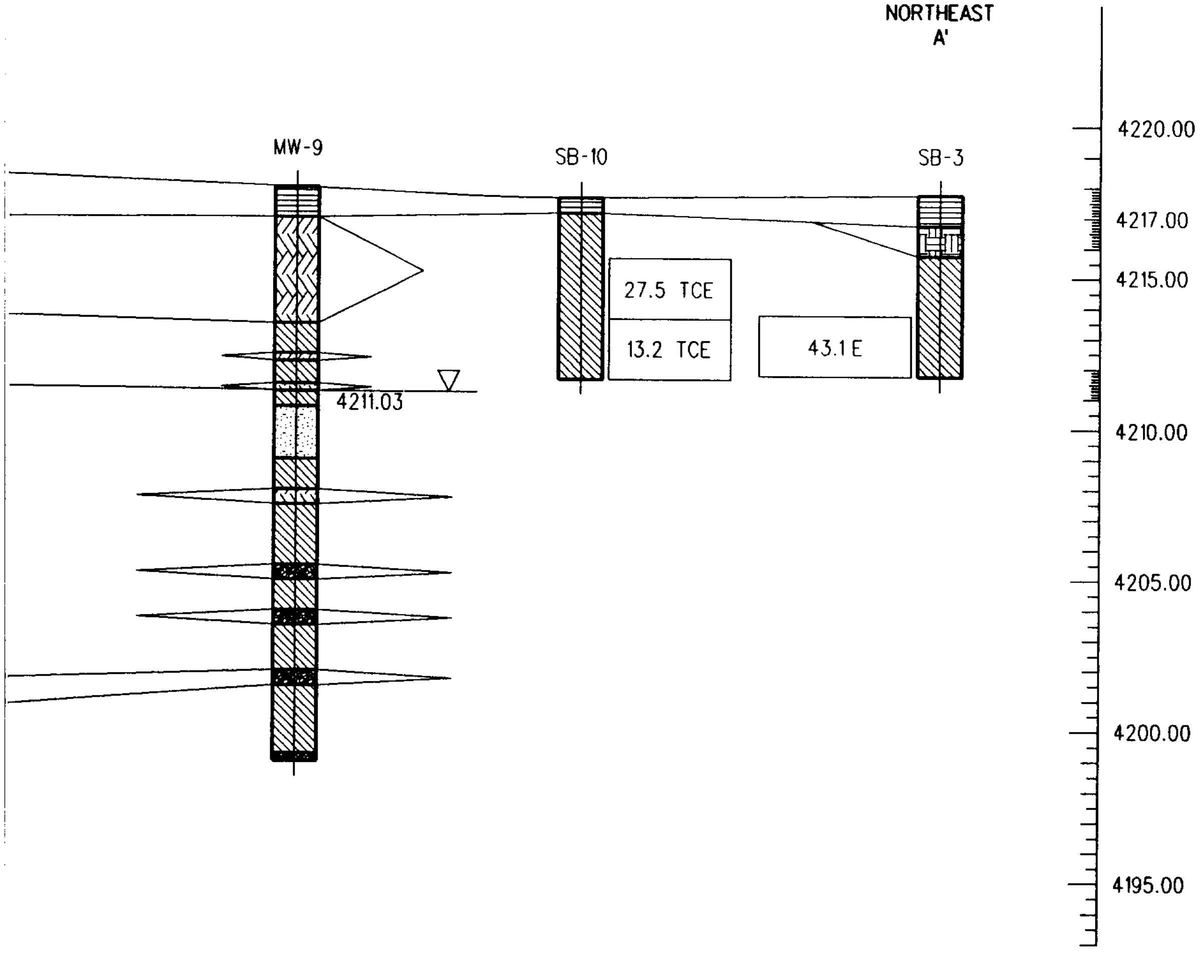

LEGEND:

▤ ASPHAL

▨ CLAYE

▩ SAND, S

░ SILT, M

▧ CLAY, C

▦ FILL

TCE = TRICHLOROET
E - ETHYLBENZE

0 50'

HORIZONTAL SCALE 1" -

VERTICAL SCALE 1" - 5'

▽ - GROUNDWATER E

GROUNDWATER ELEVATIO
READINGS OBTAINED 8/1

FIGURE

GEOLOGIC CROSS-SE
IRP SITE

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SALT LAKE CITY
STONE & WEBSTER ENGINEERI
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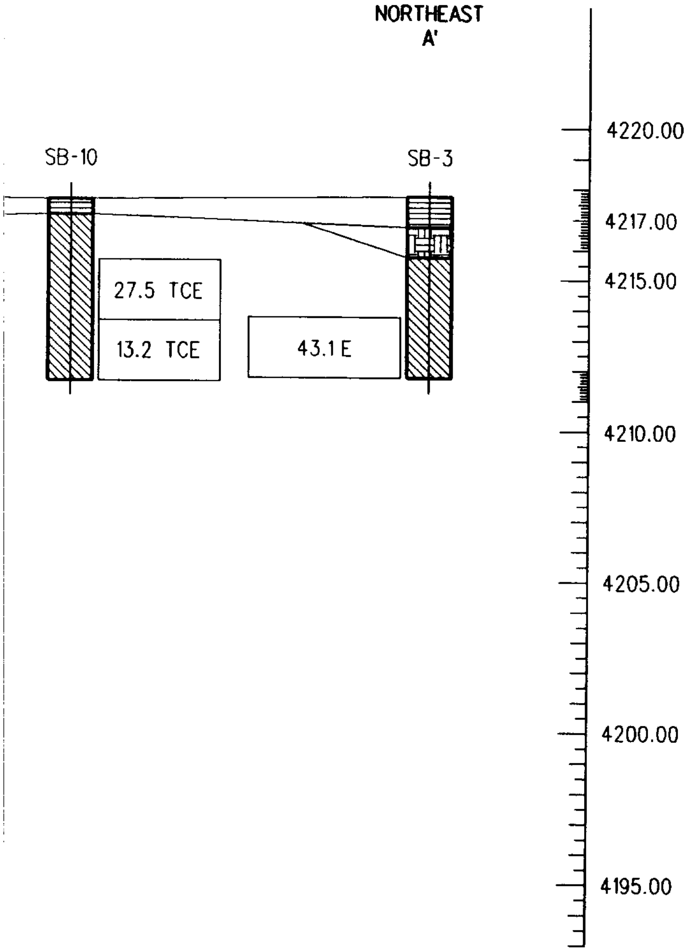

LEGEND:

▤ ASPHALT

▧ CLAYEY SAND, SC

▩ SAND, SW

░ SILT, ML

▨ CLAY, CL

▦ FILL

TCE = TRICHLOROETHENE (ug/kg).
E - ETHYLBENZENE (ug/kg).

0 50'

HORIZONTAL SCALE 1" - 50' APPROX.

VERTICAL SCALE 1" - 5' APPROX.

▽ - GROUNDWATER ELEVATION.

GROUNDWATER ELEVATIONS BASED ON READINGS OBTAINED 8/11/95.

FIGURE 5-4

GEOLOGIC CROSS-SECTION A-A'
IRP SITE 8

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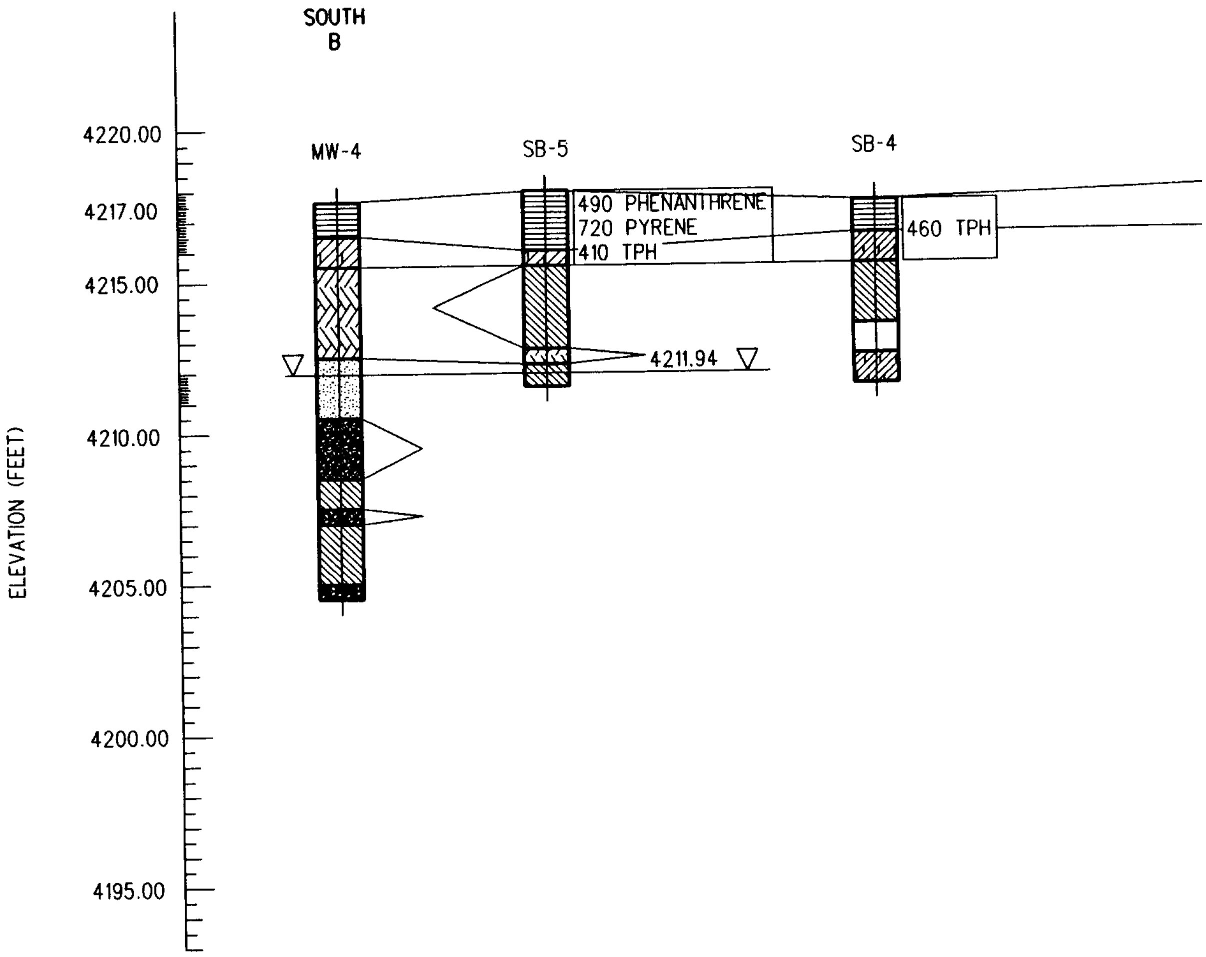

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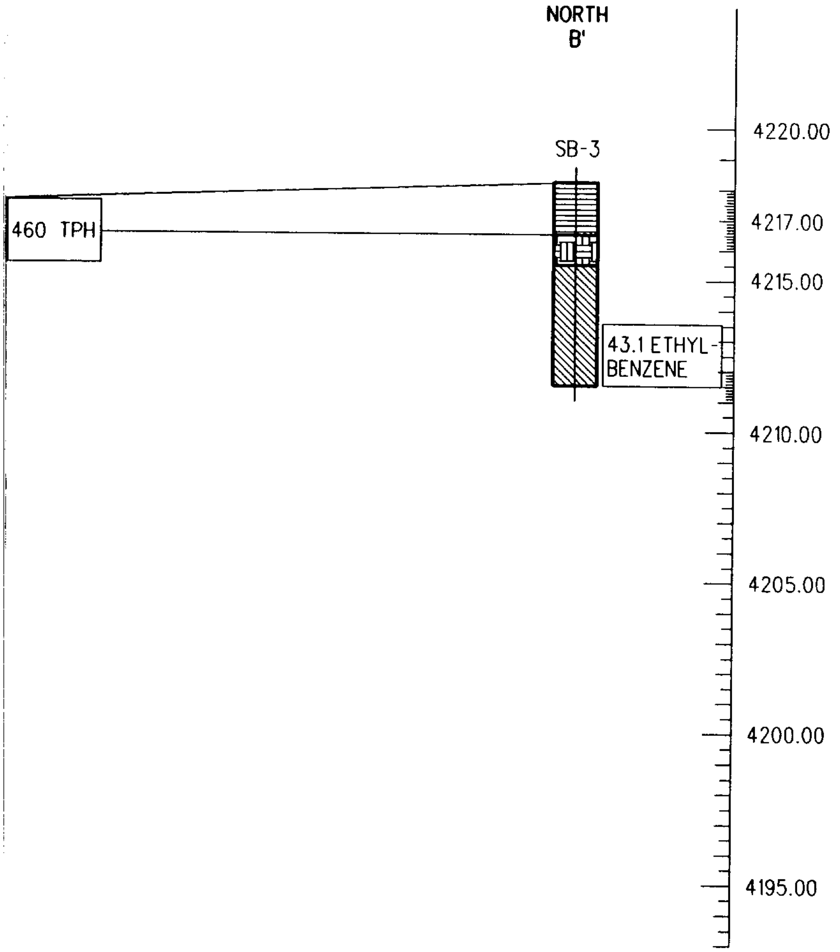

LEGEND:

- ▤ ASPHALT
- ░ CONCRETE
- ▥ SANDY CLAY, CL
- ▓ SAND, SW
- ░ SILT, ML
- ▧ CLAY, CL
- ▨ CLAYEY GRAVEL, (
- ▦ FILL
- ▩ CLAYEY SAND, SC

TPH - TOTAL PETROLEUM HYDROCARBONS
TCE - TRICHLOROETHENE (ug/kg).
E - ETHYLBENZENE (ug/kg).

0 50'

HORIZONTAL SCALE 1" = 50' APPRO

VERTICAL SCALE 1" = 5' APPROX.

▽ - GROUNDWATER ELEVATION.

GROUNDWATER ELEVATIONS BASED
READINGS OBTAINED 8/11/95.

FIGURE 5-5

GEOLOGIC CROSS-SECTION
IRP SITE 8

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SALT LAKE CITY, UTAH
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BOSTON, MASS.

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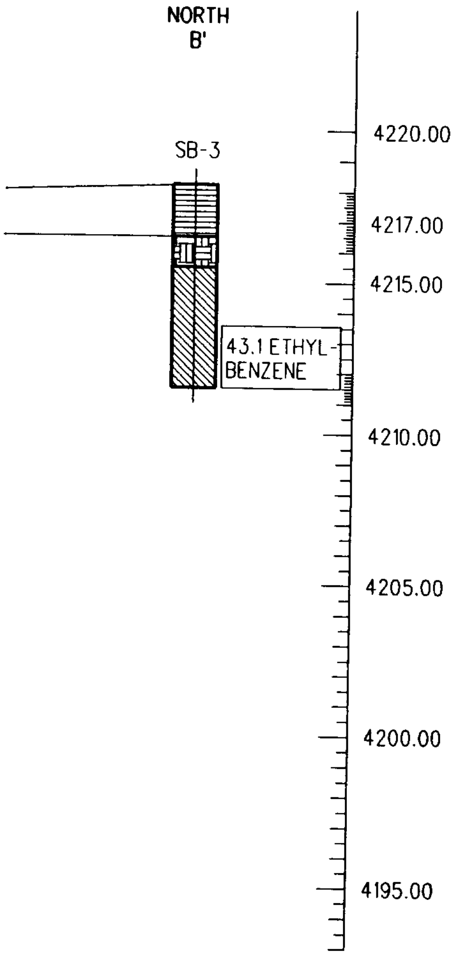

LEGEND:

▤ ASPHALT
░ CONCRETE
▥ SANDY CLAY, CL
▓ SAND, SW
░ SILT, ML
▧ CLAY, CL
▨ CLAYEY GRAVEL, GC
⊞ FILL
▩ CLAYEY SAND, SC

TPH - TOTAL PETROLEUM HYDROCARBONS (mg/kg).
TCE - TRICHLOROETHENE (ug/kg).
E - ETHYLBENZENE (ug/kg).

0 50'

HORIZONTAL SCALE 1" = 50' APPROX.

VERTICAL SCALE 1" = 5' APPROX.

▽ - GROUNDWATER ELEVATION.

GROUNDWATER ELEVATIONS BASED ON READINGS OBTAINED 8/11/95.

FIGURE 5-5

GEOLOGIC CROSS-SECTION B-B'
IRP SITE 8

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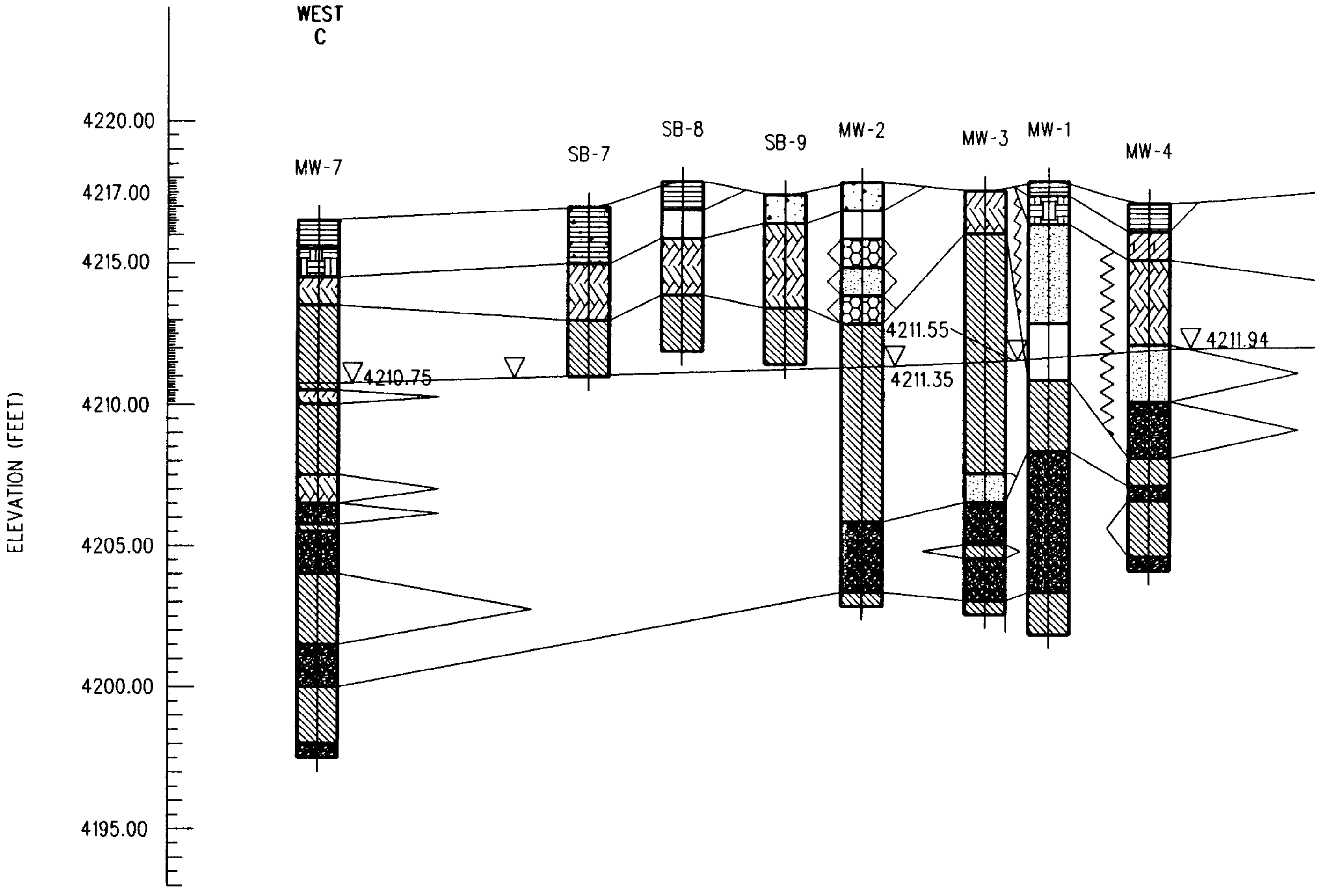

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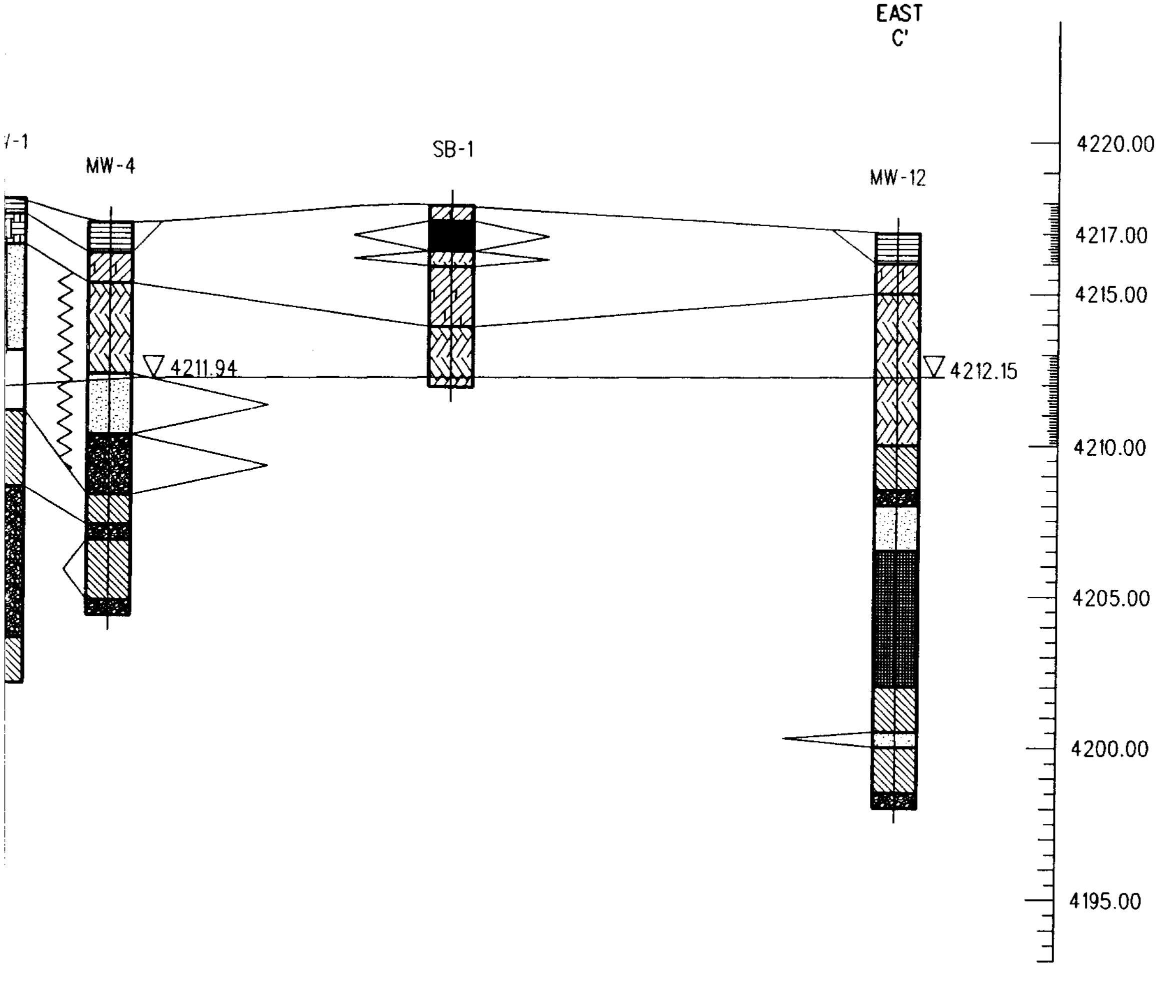

LEGEND:

▤	ASPHALT
▥	SANDY CLAY, CL
▩	SAND, SW
░	SILT, ML
▧	CLAY, CL
▓	POORLY GAP GRADE GRAVELLY SAND, SF
▨	CLAYEY GRAVEL, GC
■	MODERATELY PLAST ORGANIC SILT, OL
⬡	SILTY SAND, SM
▦	FILL
⁘	CONCRETE, CON.
▧	CLAYEY SAND, SC

0 50'

HORIZONTAL SCALE 1" = 50' APPROX

VERTICAL SCALE 1" = 5' APPROX.

▽ = GROUNDWATER ELEVATION.

GROUNDWATER ELEVATIONS BASED C
READINGS OBTAINED 8/11/95.

FIGURE 5-6

GEOLOGIC CROSS-SECTION C-
IRP SITE 8

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DRAWN BY: G. C. CARTER
CHK'D BY:
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LEVELS

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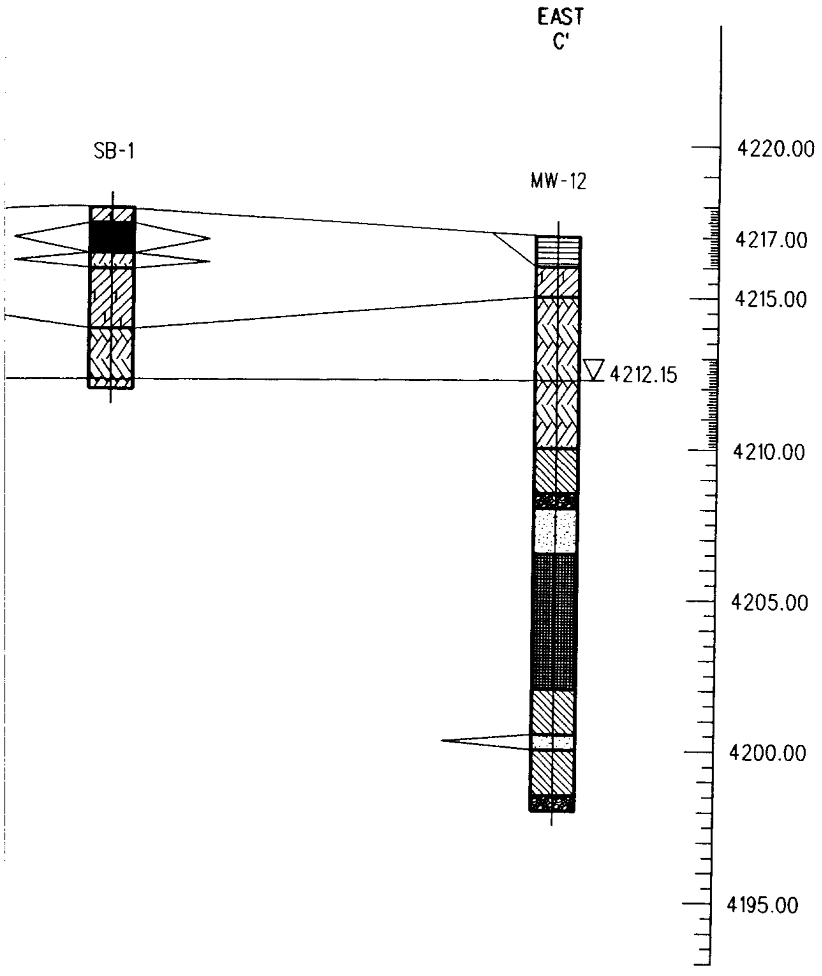

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▤	ASPHALT
▥	SANDY CLAY, CL
▦	SAND, SW
░	SILT, ML
▧	CLAY, CL
▩	POORLY GAP GRADED GRAVELLY SAND, SP
▨	CLAYEY GRAVEL, GC
■	MODERATELY PLASTIC ORGANIC SILT, OL
⬡	SILTY SAND, SM
▦	FILL
⁘	CONCRETE, CON.
▧	CLAYEY SAND, SC

0 50'

HORIZONTAL SCALE 1" = 50' APPROX.

VERTICAL SCALE 1" = 5' APPROX.

▽ = GROUNDWATER ELEVATION.

GROUNDWATER ELEVATIONS BASED ON READINGS OBTAINED 8/11/95.

FIGURE 5-6

GEOLOGIC CROSS-SECTION C-C'
IRP SITE 8
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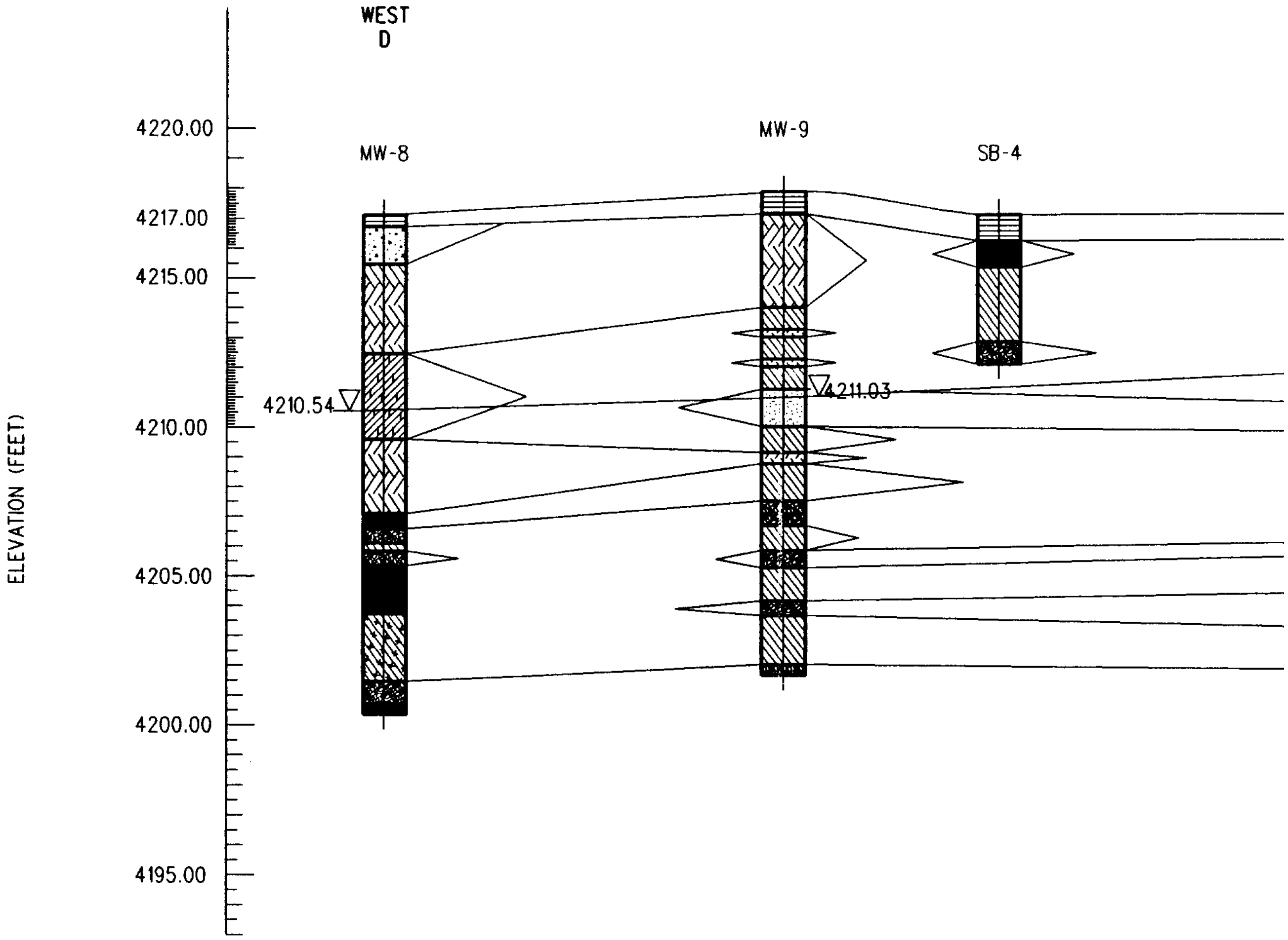

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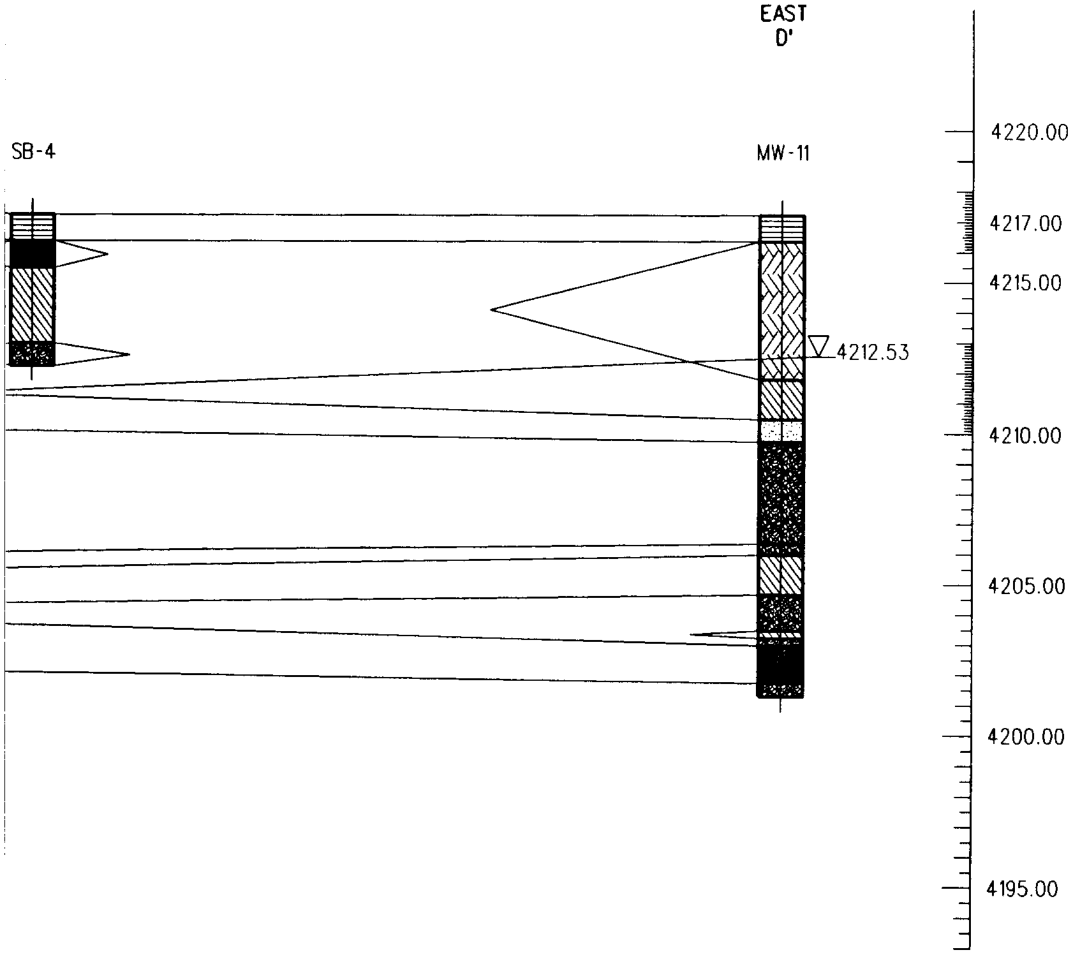

LEGEND:

▤	ASPHALT
▨	CLAYEY SAND, SC
▩	SAND, SW
░	SILT, ML
▧	CLAY, CL
■	WELL GRADED GRAV
⁘	CONCRETE
■	MODERATELY PLAST ORGANIC SILT, OL
⁘	ORGANIC CLAY, OH
▨	CLAYEY GRAVEL, GC

15.1 TCE - SOIL ANALYTICAL RESULT
TCE - TRICHLOROETHENE.
E - ETHYLBENZENE.

0 50'

HORIZONTAL SCALE 1" - 50' APPROX.

VERTICAL SCALE 1" - 5' APPROX.

▽ - GROUNDWATER ELEVATION.

GROUNDWATER ELEVATIONS BASED O
READINGS OBTAINED 8/11/95.

FIGURE 5-7

GEOLOGIC CROSS-SECTION
IRP SITE 8

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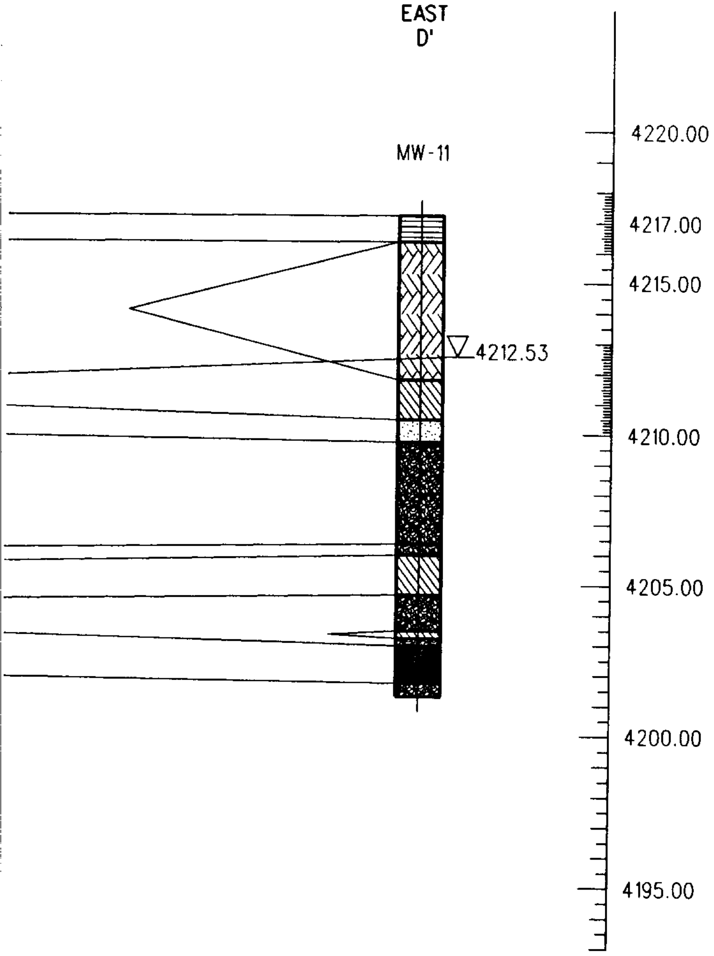

LEGEND:

- ▤ ASPHALT
- ▨ CLAYEY SAND, SC
- ▩ SAND, SW
- ░ SILT, ML
- ▧ CLAY, CL
- ■ WELL GRADED GRAVEL, GW
- ⁘ CONCRETE
- ■ MODERATELY PLASTIC ORGANIC SILT, OL
- ✢ ORGANIC CLAY, OH
- ▨ CLAYEY GRAVEL, GC

15.1 TCE - SOIL ANALYTICAL RESULTS (ug/kg).
TCE - TRICHLOROETHENE.
E - ETHYLBENZENE.

0 50'

HORIZONTAL SCALE 1" = 50' APPROX.

VERTICAL SCALE 1" = 5' APPROX.

▽ - GROUNDWATER ELEVATION.

GROUNDWATER ELEVATIONS BASED ON
READINGS OBTAINED 8/11/95.

FIGURE 5-7

GEOLOGIC CROSS-SECTION D-D'
IRP SITE 8

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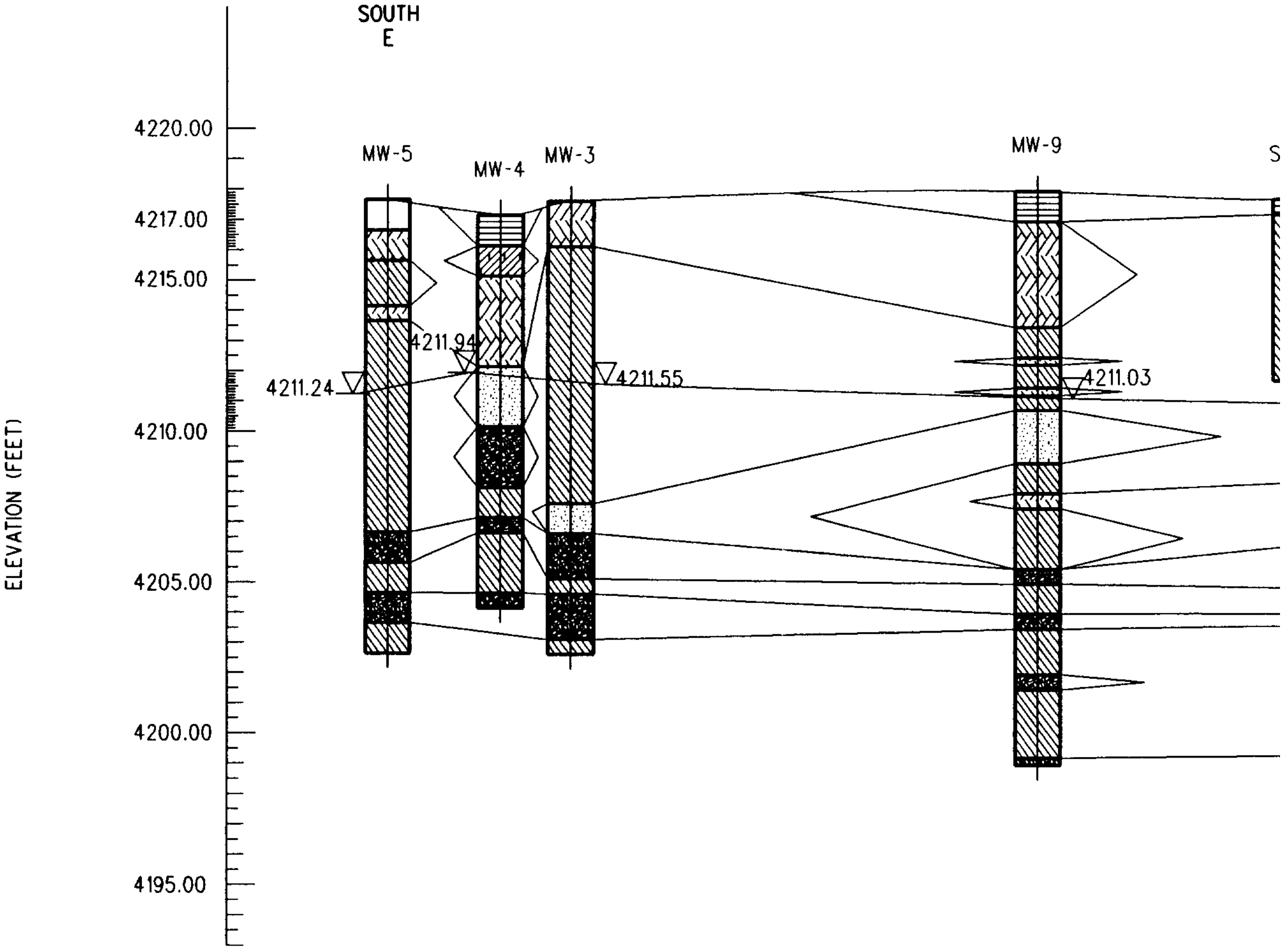

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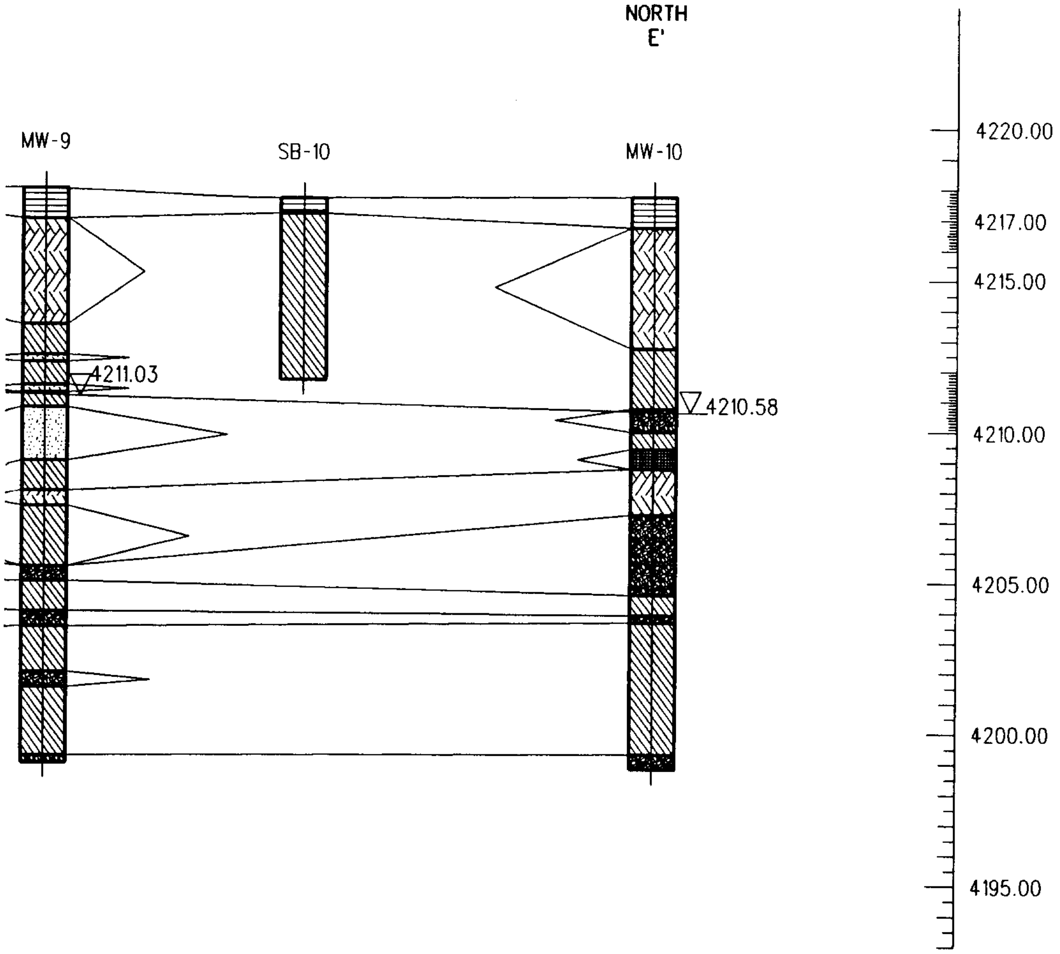

LEGEND:

▤ ASPHALT

▨ CLAYEY SAND, SC

▦ SAND, SW

░ SILT, ML

▧ CLAY, CL

■ POORLY GAP GRADE
GRAVELLY SAND, SP

▨ CLAYEY GRAVEL, GC

15.1 TCE - SOIL ANALYTICAL RESULTS
TCE - TRICHLOROETHENE.
E - ETHYLBENZENE.

0 50'

HORIZONTAL SCALE 1" - 50' APPROX.

VERTICAL SCALE 1" - 5' APPROX.

▽ - GROUNDWATER ELEVATION.

GROUNDWATER ELEVATIONS BASED ON
READINGS OBTAINED 8/11/95.

FIGURE 5-8

GEOLOGIC CROSS-SECTION E
IRP SITE 8

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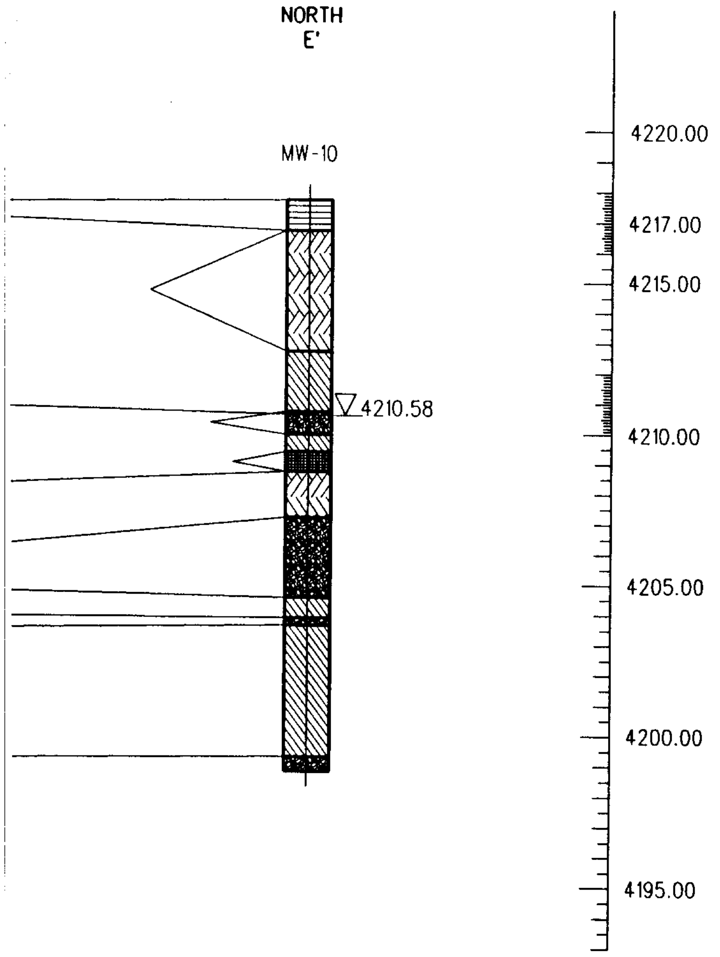

LEGEND:

▤	ASPHALT
▧	CLAYEY SAND, SC
▩	SAND, SW
░	SILT, ML
▨	CLAY, CL
■	POORLY GAP GRADED GRAVELLY SAND, SP
▨	CLAYEY GRAVEL, GC

15.1 TCE - SOIL ANALYTICAL RESULTS (ug/kg).
TCE - TRICHLOROETHENE.
E - ETHYLBENZENE.

0 50'

HORIZONTAL SCALE 1" = 50' APPROX.

VERTICAL SCALE 1" = 5' APPROX.

▽ - GROUNDWATER ELEVATION.

GROUNDWATER ELEVATIONS BASED ON READINGS OBTAINED 8/11/95.

FIGURE 5-8

GEOLOGIC CROSS-SECTION E-E'
IRP SITE 8

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to Davis (1983), the first 20 feet of sediment investigated in this study is part of the regional unconfined aquifer that overlies the regional confined artesian aquifer. Although groundwater occurs in both fine and coarse grained material, its movement preferentially occurs through coarser grained material with higher hydraulic conductivities (i.e., silty sands and sands). The interconnectiveness of the coarser grained material dominates the lateral movement of groundwater.

Based on geologic conditions alone, groundwater within the first 20 feet of the surface at Site 8 occurs locally as unconfined to semi-confined. The degree of local semi-confining aquifer conditions within the initial 20 feet of sediments at Site 8 is unknown. Silts and clays behave as aquitards while sands and gravels behave as aquifers. The degree of interconnectiveness among and between these layers primarily determines unconfined and semi-confined conditions. Although confining characteristics of the shallow aquifer were not directly investigated, site hydrogeology and observations of groundwater levels suggest that unconfined to semi-confined aquifer conditions exist.

No direct hydraulic measurements were conducted during this investigation to determine aquifer confining conditions (e.g., aquifer pump tests). Instead, qualitative field observations have been studied to assess aquifer conditions. Examination of site hydrogeology and groundwater level behavior suggest various semi-confining conditions exist within the local study area. Confining conditions commonly occur when hydraulically conductive zones (sands and gravels) are overlain by confining units of low hydraulic conductivity such as silts and clays. This condition exists at Site 8. Where monitoring wells are installed into the conductive zones (i.e., monitoring wells MW-1 through MW-7, MW-9, and MW-11), groundwater is observed from inches to several feet above the top of the bottom of the conductive zone in the overlying confining layer. This phenomena suggests confining aquifer conditions, however, other unmeasured factors such as infiltration from precipitation or upward leakage from the underlining aquifer may also effect groundwater levels.

Boring logs for the installed monitoring wells qualitatively indicate the depth at which groundwater was initially encountered while drilling. Subsequent measurements of groundwater levels within the wells following installation indicate a significant change in initial groundwater levels in some wells. Groundwater rises of 1.25, 0.93, and 2.15 feet were observed in monitoring wells MW-7, MW-11, and MW-12, respectively. Rises in groundwater levels suggest confining aquifer conditions. However, there is inherent inaccuracies in determining initial groundwater levels from soil core samples collected during drilling. As a result, observed apparent changes in groundwater levels may not be reliable due to errors in determining initial groundwater levels.

Groundwater levels were measured to determine lateral groundwater flow direction and gradient. Three separate groundwater level measurements were obtained from site monitoring wells. Baseline groundwater levels were measured in monitoring wells MW-1 through MW-5 on May 30 and 31 as part of the initial round of sampling the existing site wells. Baseline groundwater level measurements of the newly installed wells (MW-6 through MW-12) were conducted between June 28 and 30. Groundwater level measurements of all site wells were conducted on August 11, 1995 (see Table 5-3). It is important to note that the June 1995 groundwater level measurements did not include readings from monitoring wells MW-1 through MW-5 as the wells were not included as part of the June sampling event. As a result, the August 1995 groundwater level measurements provide a more accurate depiction of groundwater flow at Site 8.

Groundwater potentiometric maps depicting groundwater levels and flow directions are presented in Figures 5-9, 5-10, 5-11, and 5-11a. Figure 5-9 presents groundwater levels and flow directions from measurements in monitoring wells MW1 through MW5 on May 30 and 31, 1995. These five wells are clustered in the immediate vicinity of the former Site 8 USTs and indicates the presence of a north-south trending groundwater divide. Groundwater flow is away from the groundwater divide to the east and west. Groundwater flow directions determined from these five monitoring wells represent only very localized conditions and are not representative of the entire Site 8 area due to the close spacing of the wells.

Groundwater levels and flow directions obtained from a larger number of monitoring wells over a greater area of Site 8 are presented in Figures 5-10 and 5-11. In general, these maps indicate that shallow groundwater flow within the northern portion of the site is towards the west. Groundwater flow within the southern portion of the site is towards the northwest. These flow directions are in general agreement with basewide groundwater flow toward the west-northwest at Site 8. Groundwater level measurements obtained on August 11, 1995 indicate elevated groundwater levels within the vicinity of monitoring wells MW-1, MW-3, MW-4, and MW-5. Local groundwater flow within the area of these monitoring wells is toward the west and southwest. Groundwater flow beyond the vicinity of these monitoring wells returns to a northwest direction consistent with basewide groundwater flow. Figure 5-11a shows the August 1995 groundwater in greater detail in the Site 8 area only.

This local variation in groundwater flow is the result of localized groundwater mounding and may be caused by a combination of various factors. The seasonal rise and lowering of the water table and precipitation and infiltration into a low hydraulically conductive aquifer zone can result in localized groundwater mounding. Monitoring wells MW-1 and MW-5, located within the area of elevated groundwater levels, have the lowest hydraulic conductivities of all monitoring wells measured at IRP Site 8. The lower hydraulic conductivity of this aquifer material results in a slower movement of groundwater into and out of the low hydraulic zone compared to the surrounding areas resulting in a localized mounding of groundwater. The mounded groundwater causes changes in local groundwater flow directions. The low groundwater hydraulic gradient across IRP Site 8 may amplify groundwater measurement error at some monitoring wells resulting in slightly elevated groundwater levels. As a result, potentiometric groundwater level maps based on these readings can misinterpret groundwater flow directions. Finally, barometric effects upon confined hydraulic units can result in higher or lower groundwater levels than surrounding semi-confined or unconfined areas. Confined aquifer systems do not equilibrate to barometric pressure changes as quickly as unconfined aquifer systems. Barometric conditions at the time of the August groundwater measurement may have resulted in elevated levels within the groundwater mounding area.

A qualitative comparison between rainfall events and Site 8 groundwater level measurements was made. The Site 8 June 1995 groundwater level measurements occurred following a period of numerous small rainfall events from April to June 1995. Rainfall amounts greatly decreased between the June and August groundwater level measurements. Therefore, the Site 8 June and August 1995 groundwater level measurements are representative of environmentally wet

Table 5-3
Groundwater Elevations
IRP Site 8
Air National Guard, Salt Lake City, Utah

Sample ID.	Top of Casing Elevation (feet)	Depth to Groundwater (feet)			Groundwater Elevation (feet)		
		May 30 - 31, 1995	June 28-30, 1995	August 11, 1995	May 30-31, 1995	June 28-30, 1995	August 11, 1995
MW1	4217.62	4.75	NR	5.88	4212.87	NC	4211.74
MW2	4217.66	5.50	NR	6.31	4212.16	NC	4211.35
MW3	4217.40	5.05	NR	5.85	4212.35	NC	4211.55
MW4	4216.92	5.06	NR	4.98	4211.86	NC	4211.94
MW5	4217.45	4.77	NR	6.21	4212.68	NC	4211.24
MW6	4216.94	NM	5.93	5.71	NM	4211.01	4211.23
MW7	4216.32	NM	5.68	5.57	NM	4210.64	4210.75
MW8	4216.79	NM	6.42	6.25	NM	4210.37	4210.54
MW9	4217.69	NM	6.79	6.66	NM	4210.90	4211.03
MW10	4217.41	NM	6.87	6.83	NM	4210.54	4210.58
MW11	4216.89	NM	4.41	4.36	NM	4212.48	4212.53
MW12	4216.69	NM	4.61	4.54	NM	4212.08	4212.15

NR = Not recorded

NC = Not calculated

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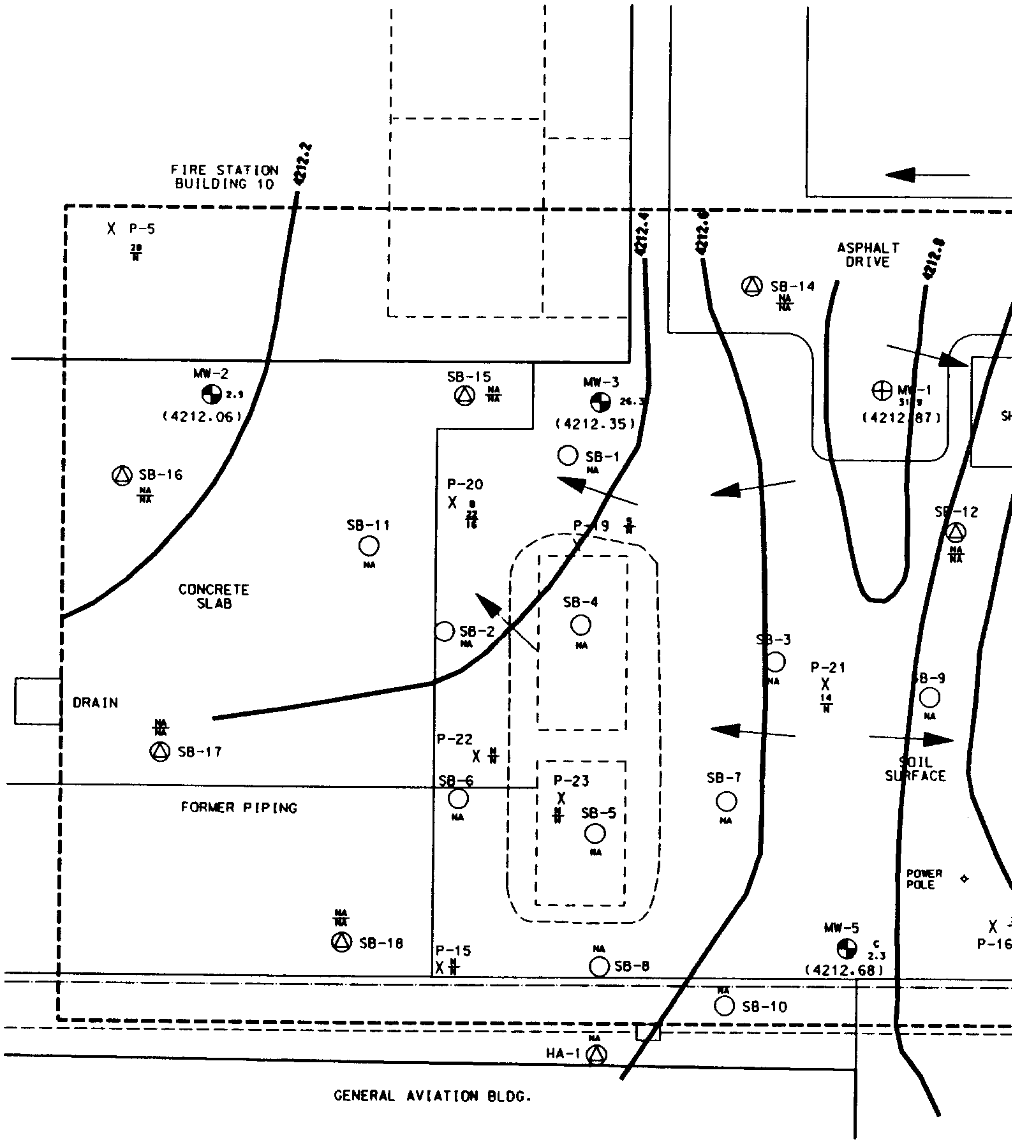

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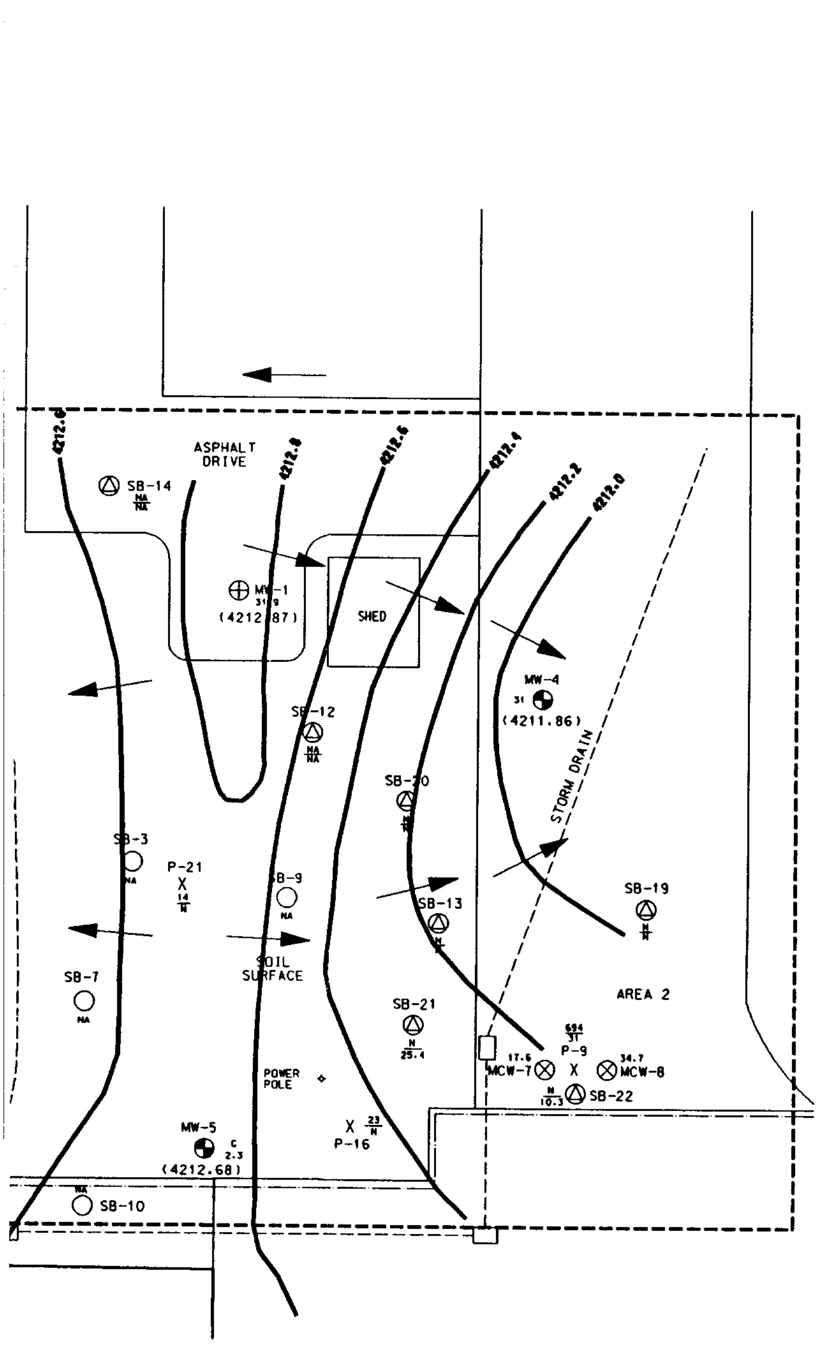

LEGEND:

PREVIOUS SAMPLE LOCATION

X GEOPROBE SAMPLE POINT (SCREENING DATA)

○ SOIL BORING PARSONS ES (NOVEMBER 1992)

● SOIL BORING PARSONS ES (JANUARY 1993)

Ⓐ SOIL BORING PARSONS ES (APRIL 1994)

⊕ MONITORING WELL PARSONS (JANUARY 1993)

◕ MONITORING WELL PARSONS (APRIL 1994)

⊗ MICRO-WELL PARSONS ES (JUNE 1994)

——— PROPERTY BOUNDARY

- - - - FORMER UST AREA

━━━ GROUNDWATER ELEVATION CO (CONTOUR INTERVAL 0.20 f

◀—— GROUNDWATER FLOW DIRECTI

(4212.87) GROUNDWATER ELEVATIO (FEET) MSL

NOTES:

1. DEPTH TO GROUNDWATER MEASUR TAKEN ON MAY 30-31, 1995

0 15′

FIGURE 5-9

SITE 8 INVESTIGAT
MAY 1995
POTENTIOMETRIC M

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SALT LAKE CITY INTERNATIONAL
SALT LAKE CITY, UTAH
STONE & WEBSTER ENGINEERING CORP
BOSTON, MASS.

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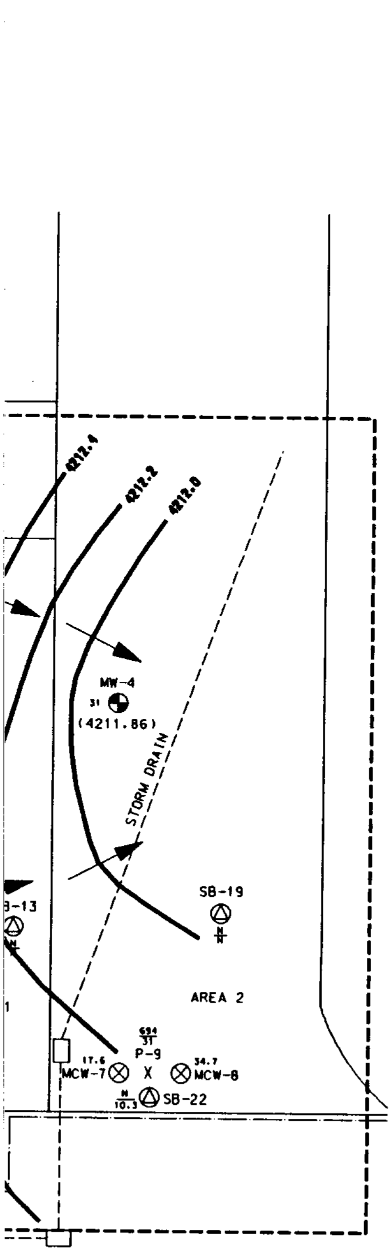

LEGEND:

PREVIOUS SAMPLE LOCATIONS:

X	GEOPROBE SAMPLE POINT (SCREENING DATA)
○	SOIL BORING PARSONS ES (NOVEMBER 1992)
●	SOIL BORING PARSONS ES (JANUARY 1993)
⊗̂	SOIL BORING PARSONS ES (APRIL 1994)
⊕	MONITORING WELL PARSONS ES (JANUARY 1993)
◕	MONITORING WELL PARSONS ES (APRIL 1994)
⊗	MICRO-WELL PARSONS ES (JUNE 1994)
—— ——	PROPERTY BOUNDARY
- - - - - -	FORMER UST AREA
━━━━	GROUNDWATER ELEVATION CONTOUR (CONTOUR INTERVAL 0.20 ft.)
◀——	GROUNDWATER FLOW DIRECTION
(4212.87)	GROUNDWATER ELEVATION MEASUREMENTS (FEET) MSL

NOTES:

1. DEPTH TO GROUNDWATER MEASUREMENTS TAKEN ON MAY 30-31, 1995

0 15′

FIGURE 5-9

SITE 8 INVESTIGATIONS
MAY 1995
POTENTIOMETRIC MAP
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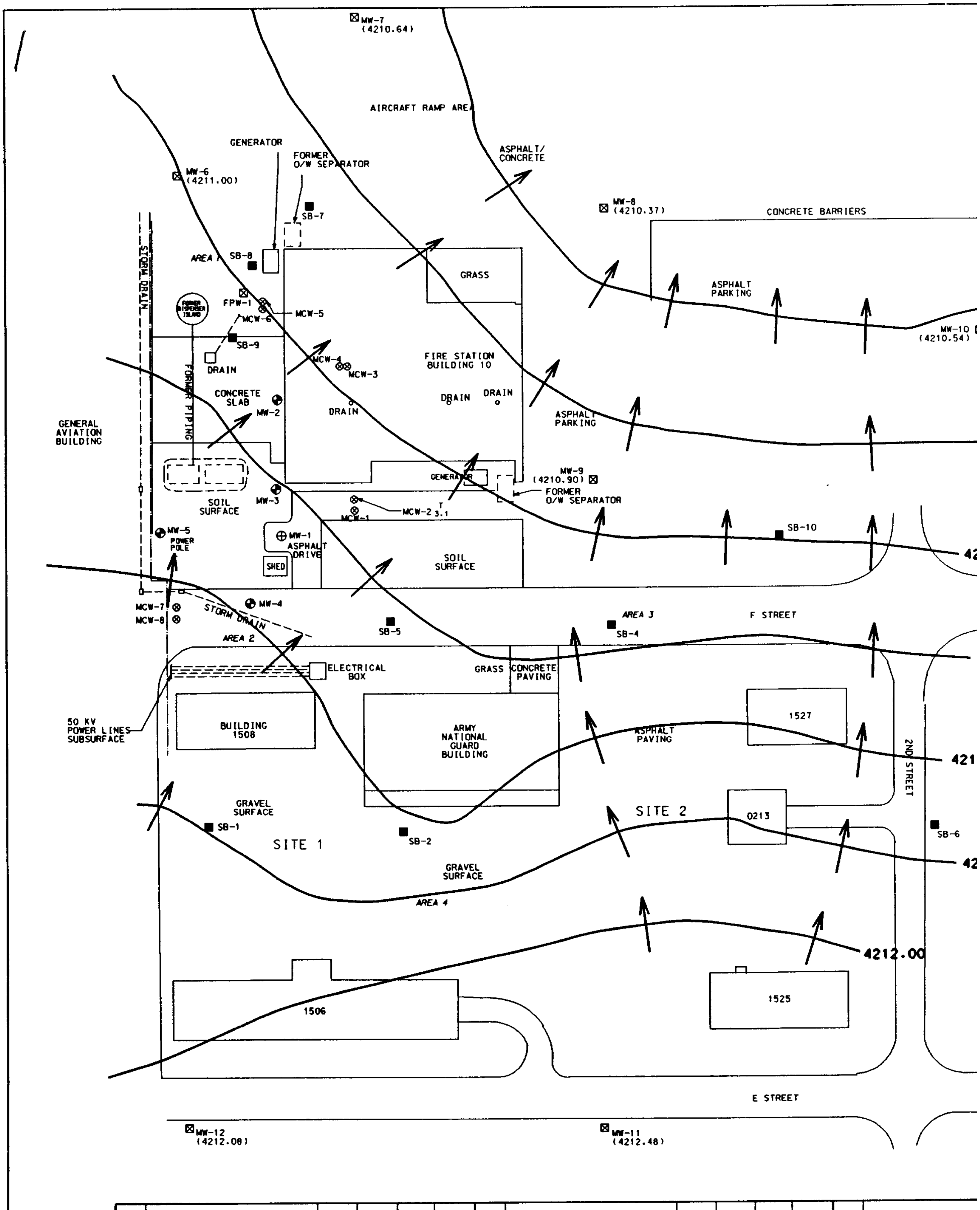

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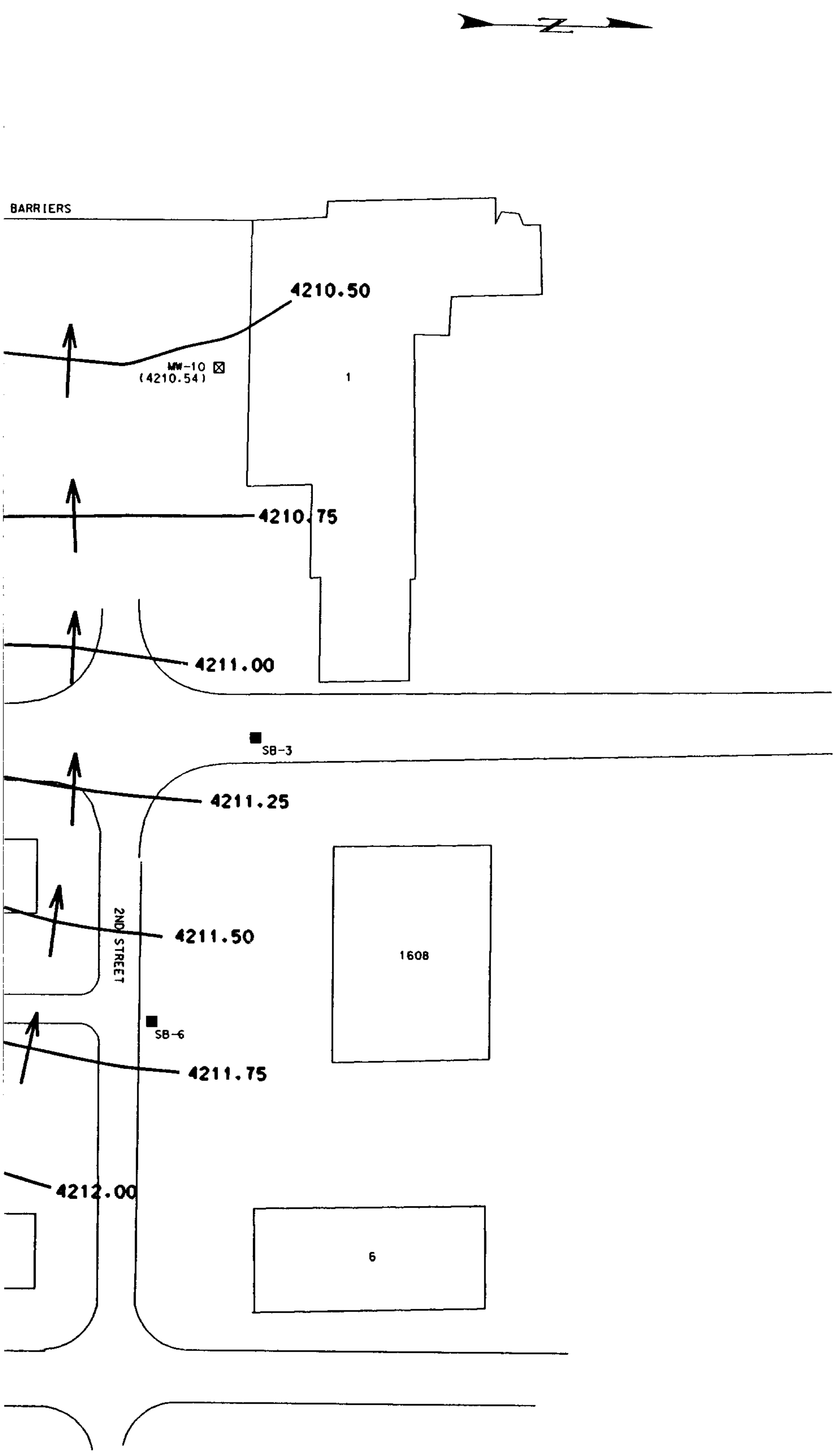

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● MONITORING WELL PARSONS ES (APRIL 1994)

⊗ MICRO-WELL PARSONS ES (JUNE 1994)

☒ MONITORING WELL SWEC (JUNE 1995)

■ SOIL BORING SWEC (JUNE 1995)

——— PROPERTY BOUNDARY

——— GROUNDWATER ELEVATION CONTOUR CONTOUR INTERVAL 0.25ft.

←—— GROUNDWATER FLOW DIRECTION.

(4210.37) GROUNDWATER ELEVATION MEASUREMENT (FEET

NOTES:

1. DEPTH TO GROUNDWATER MEASUREMENTS TAKEN JUNE 28, 29, AND 30, 1995.

0 50'

FIGURE 5-10

JUNE 1995
POTENTIOMETRIC MAP
IRP SITE 8

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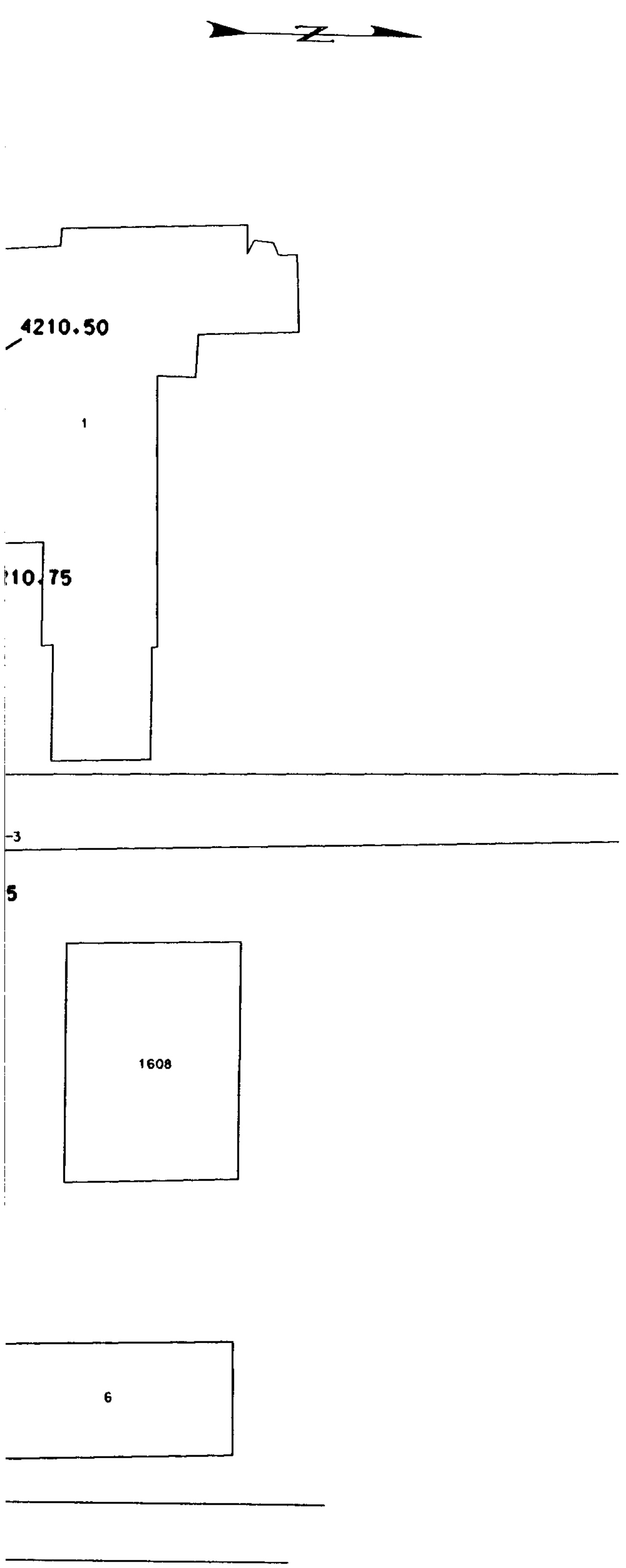

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⊗ MICRO-WELL PARSONS ES (JUNE 1994)

☒ MONITORING WELL SWEC (JUNE 1995)

■ SOIL BORING SWEC (JUNE 1995)

——— PROPERTY BOUNDARY

——— GROUNDWATER ELEVATION CONTOUR CONTOUR INTERVAL 0.25ft.

← GROUNDWATER FLOW DIRECTION.

(4210.37) GROUNDWATER ELEVATION MEASUREMENT (FEET).

NOTES:

1. DEPTH TO GROUNDWATER MEASUREMENTS TAKEN JUNE 28, 29, AND 30, 1995.

0 50′

FIGURE 5-10

JUNE 1995
POTENTIOMETRIC MAP
IRP SITE 8

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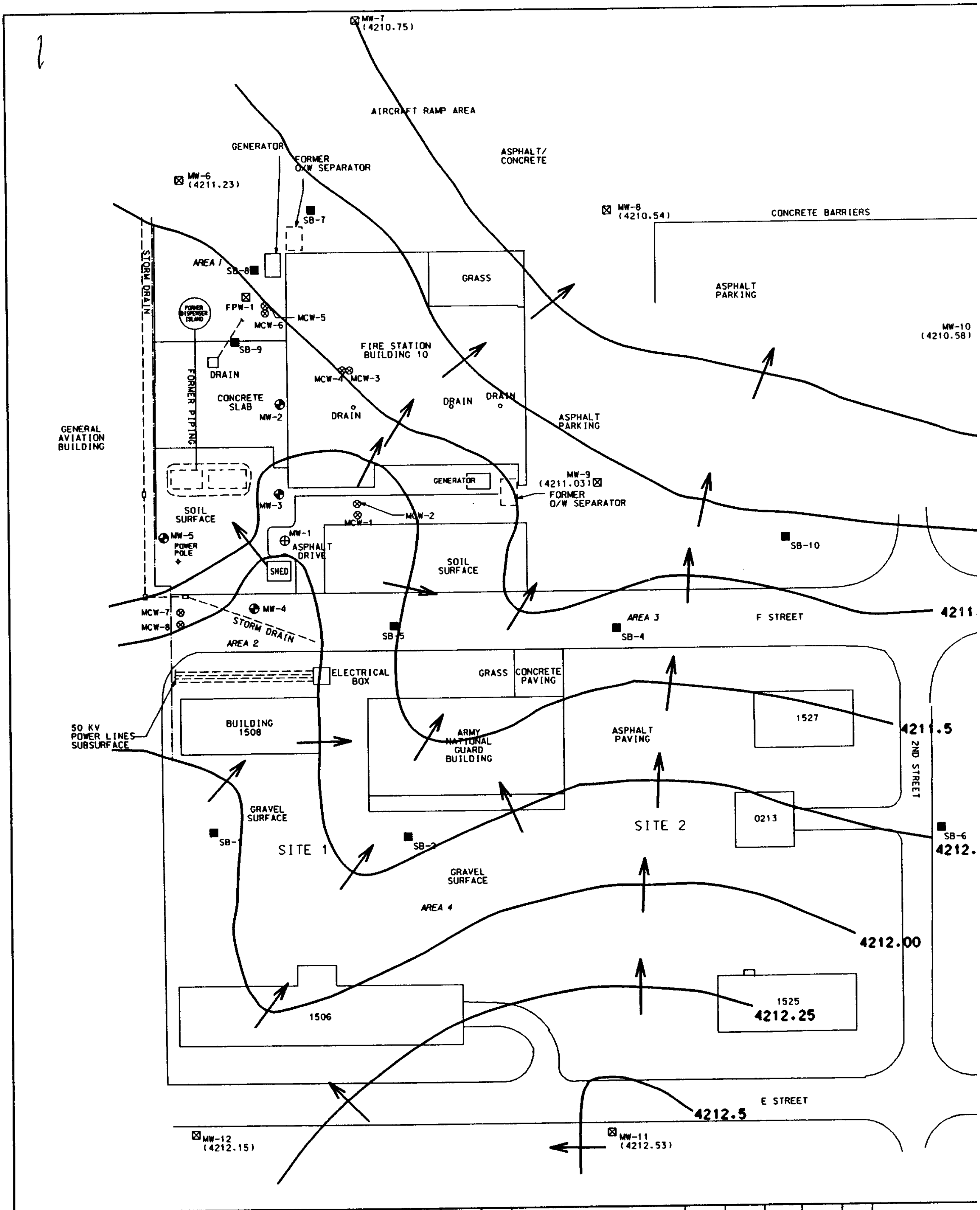

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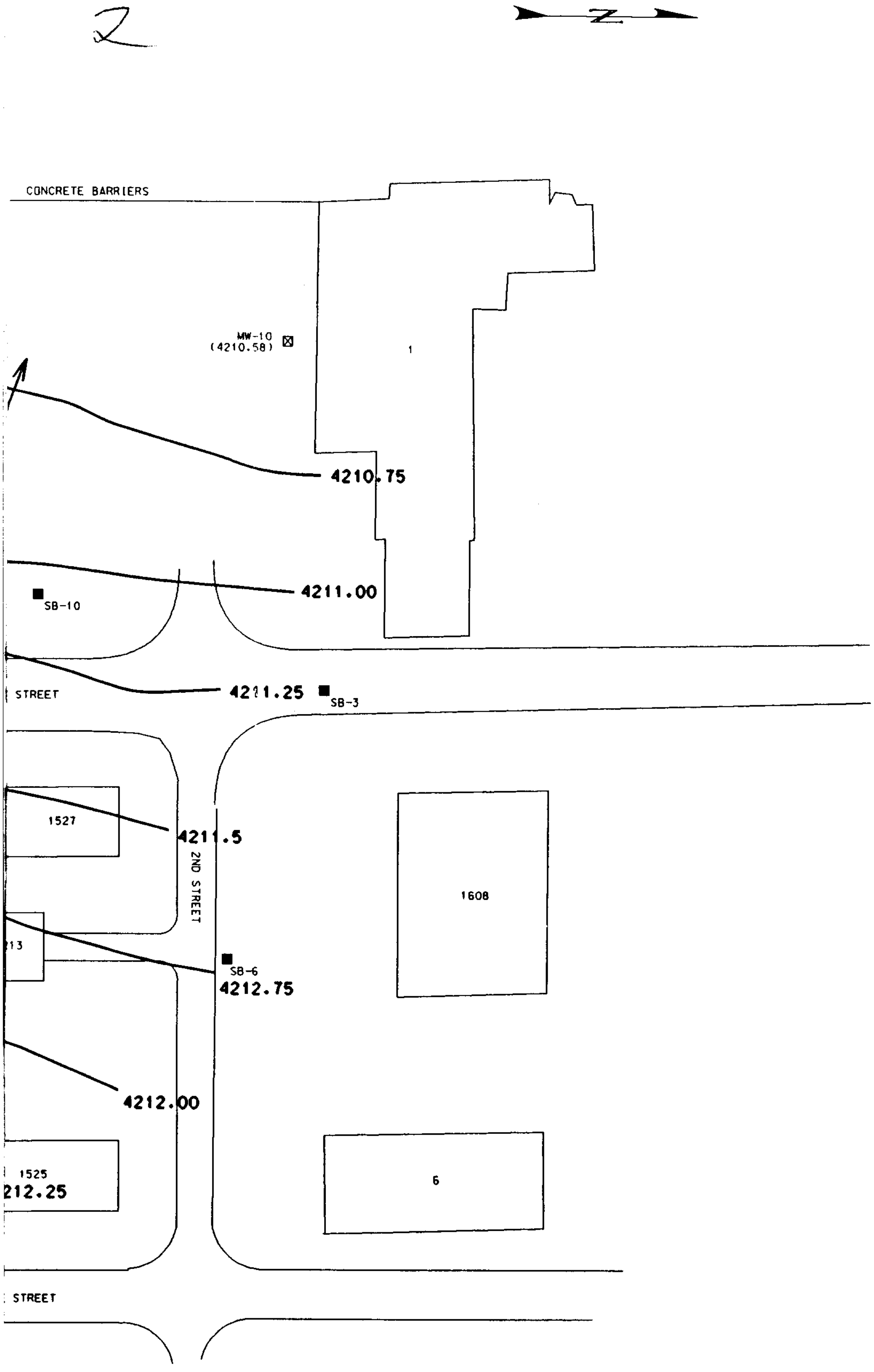

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● MONITORING WELL PARSONS ES (APRIL 1994)
⊗ MICRO-WELL PARSONS ES (JUNE 1994)
☒ MONITORING WELL SWEC (JUNE 1995)
■ SOIL BORING SWEC (JUNE 1995)
PROPERTY BOUNDARY
GROUNDWATER ELEVATION CONTOUR CONTOUR INTERVAL 0.25ft.
← GROUNDWATER FLOW DIRECTION.

NOTES:

1. DEPTH TO GROUNDWATER MEASUREMEN TAKEN AUGUST 11, 1995.

0 50'

FIGURE 5-1

AUGUST 11, 199
POTENTIOMETRIC M
IRP SITE 8

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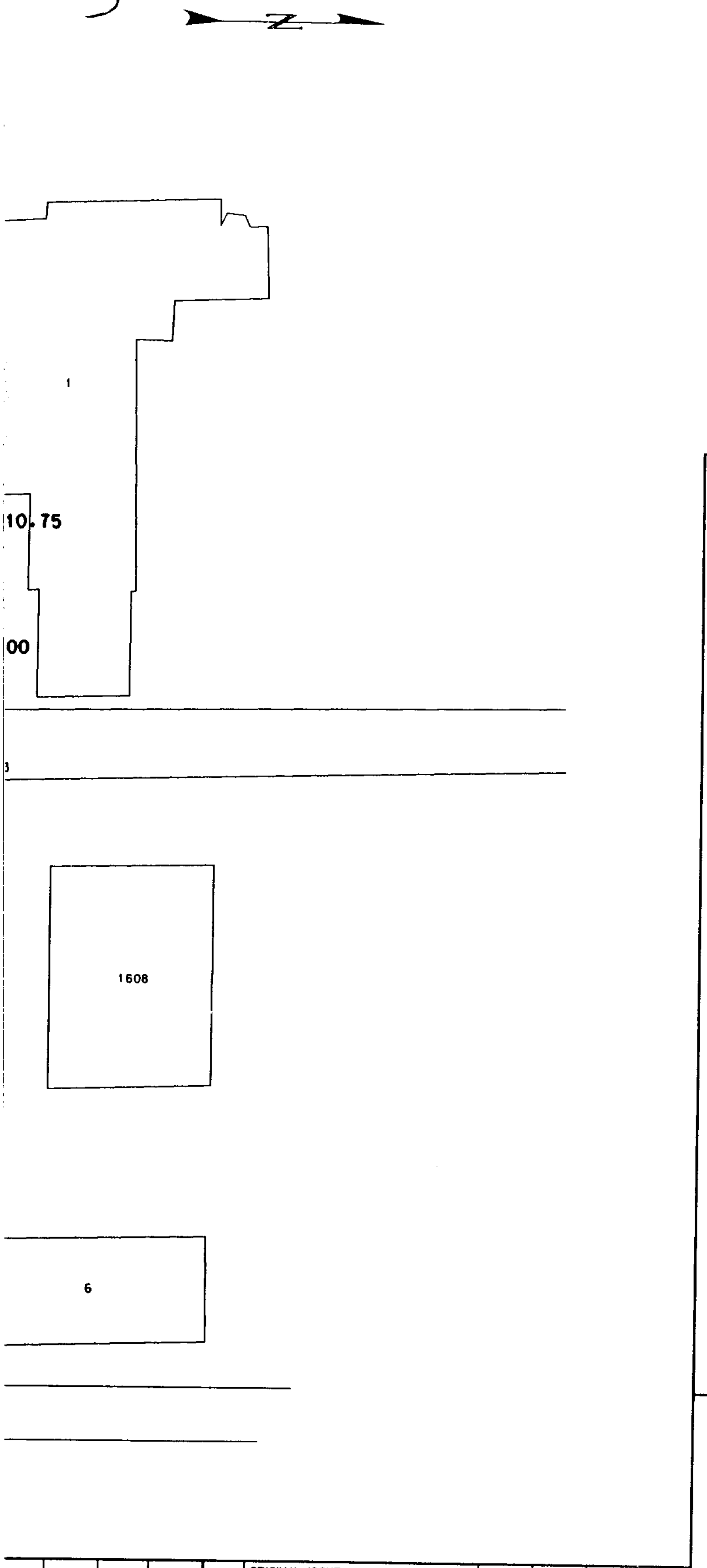

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◕ MONITORING WELL PARSONS ES (APRIL 1994)

⊗ MICRO-WELL PARSONS ES (JUNE 1994)

☒ MONITORING WELL SWEC (JUNE 1995)

■ SOIL BORING SWEC (JUNE 1995)

——— PROPERTY BOUNDARY

——— GROUNDWATER ELEVATION CONTOUR CONTOUR INTERVAL 0.25ft.

⟵ GROUNDWATER FLOW DIRECTION.

NOTES:

1. DEPTH TO GROUNDWATER MEASUREMENTS TAKEN AUGUST 11, 1995.

0 50′

FIGURE 5-11

AUGUST 11, 1995
POTENTIOMETRIC MAP
IRP SITE 8

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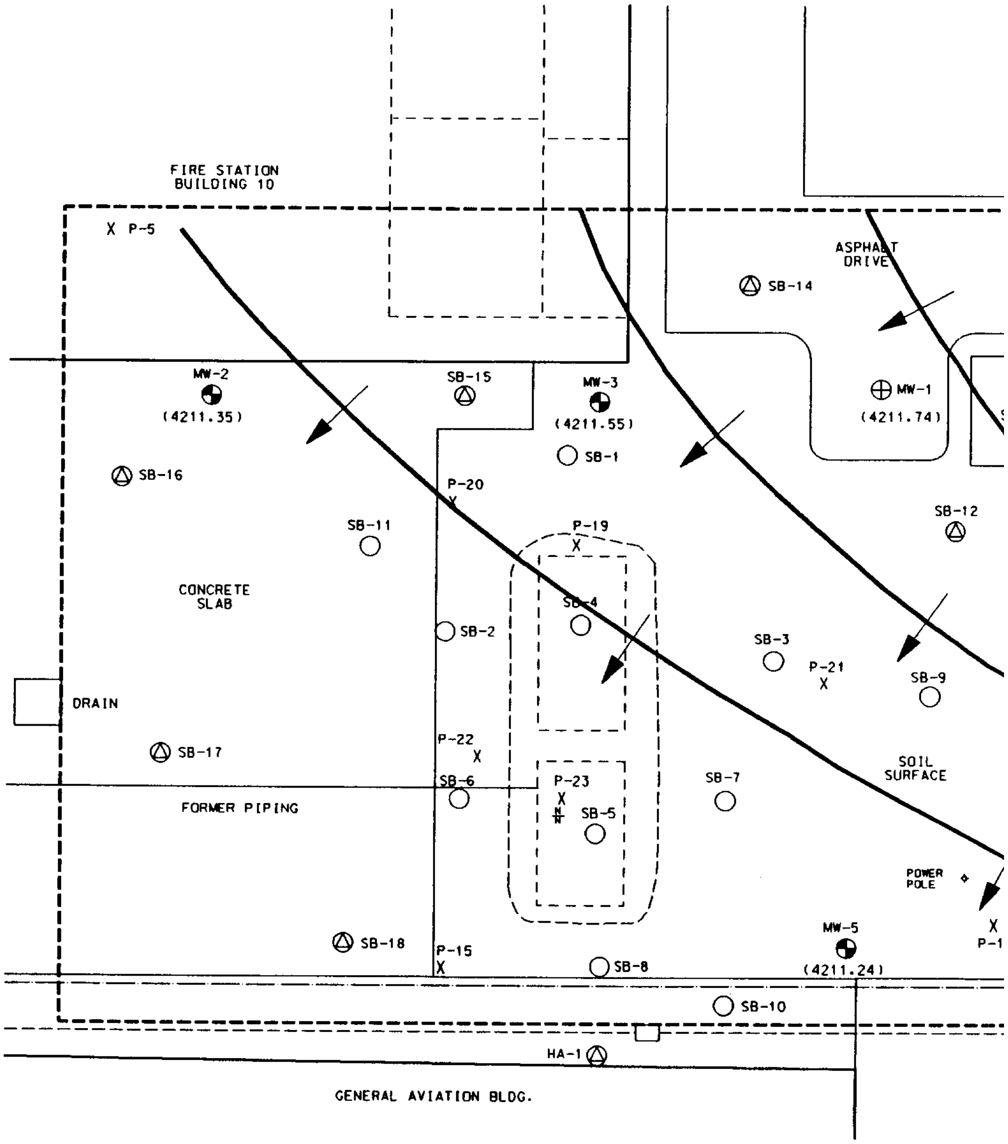

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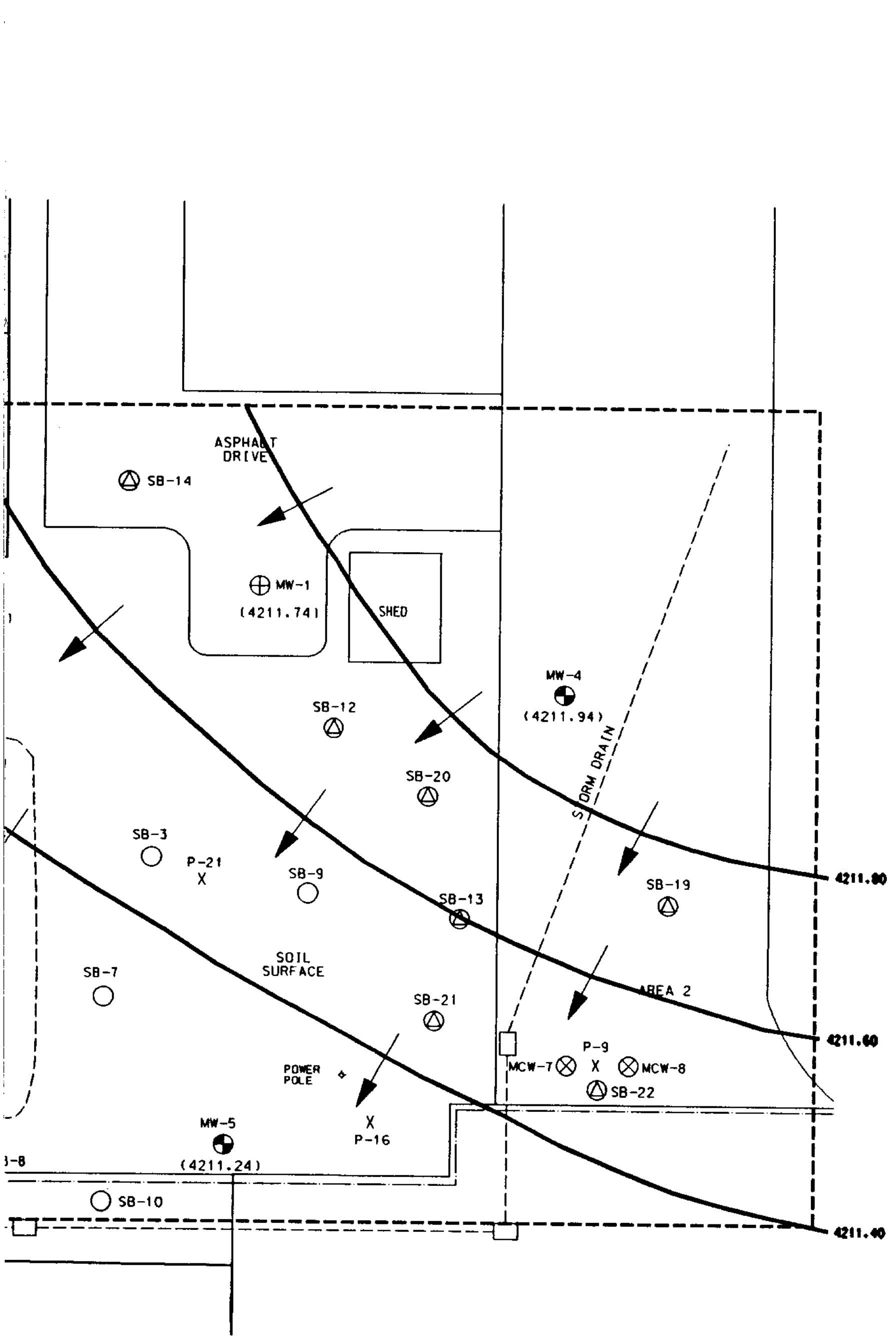

LEGEND:

PREVIOUS SAMPLE LOCATI

X GEOPROBE SAMPLE POINT (SCREENING DATA)

○ SOIL BORING PARSONS ES (NOVEMBER 1992)

● SOIL BORING PARSONS ES (JANUARY 1993)

◬ SOIL BORING PARSONS ES (APRIL 1994)

⊕ MONITORING WELL PARSONS (JANUARY 1993)

◕ MONITORING WELL PARSONS (APRIL 1994)

⊗ MICRO-WELL PARSONS ES (JUNE 1994)

——— PROPERTY BOUNDARY

- - - - - FORMER UST AREA

——— GROUNDWATER ELEVATION C (CONTOUR INTERVAL 0.20

◄—— GROUNDWATER FLOW DIRECT

(4211.94) GROUNDWATER ELEVAT (FEET) MSL

NOTES:

1. DEPTH TO GROUNDWATER MEAS TAKEN ON AUGUST 11, 1995

0 15′

FIGURE 5-1

SITE 8 INVESTIGA
AUGUST 1995
POTENTIOMETRIC

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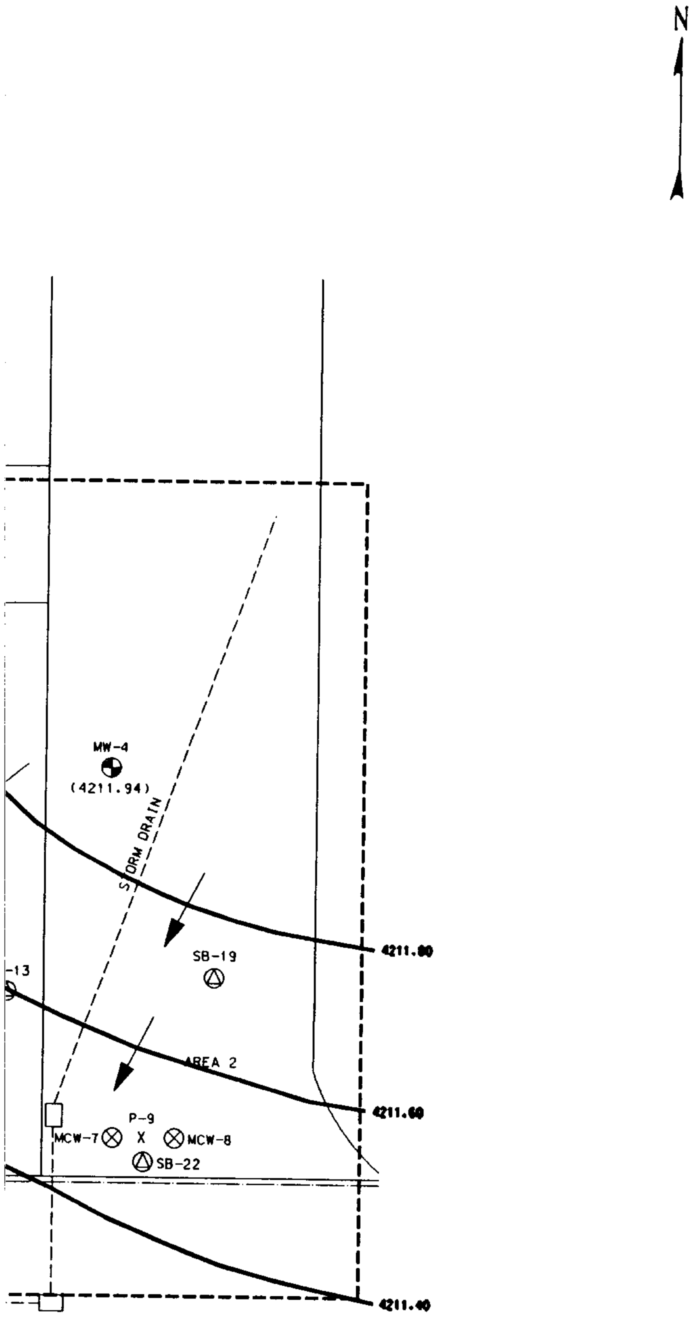

LEGEND:

PREVIOUS SAMPLE LOCATIONS:

- X GEOPROBE SAMPLE POINT (SCREENING DATA)
- ○ SOIL BORING PARSONS ES (NOVEMBER 1992)
- ● SOIL BORING PARSONS ES (JANUARY 1993)
- ⧋ SOIL BORING PARSONS ES (APRIL 1994)
- ⊕ MONITORING WELL PARSONS ES (JANUARY 1993)
- ◕ MONITORING WELL PARSONS ES (APRIL 1994)
- ⊗ MICRO-WELL PARSONS ES (JUNE 1994)

—— — —PROPERTY BOUNDARY

------FORMER UST AREA

——— GROUNDWATER ELEVATION CONTOUR (CONTOUR INTERVAL 0.20 ft.)

◄—— GROUNDWATER FLOW DIRECTION

(4211.94) GROUNDWATER ELEVATION MEASUREMENTS (FEET) MSL

NOTES:

1. DEPTH TO GROUNDWATER MEASUREMENTS TAKEN ON AUGUST 11, 1995

0 15′

FIGURE 5-11A

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SITE 8 INVESTIGATIONS
AUGUST 1995
POTENTIOMETRIC MAP

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conditions and dry conditions, respectively. However, overall Site 8 groundwater levels are lower in June than in August 1995 indicating that near term rainfall and resultant infiltration may not directly affect groundwater levels.

The average lateral groundwater gradients for the May, June, and August measurements at Site 8 are 3.26×10^{-3} and 4.61×10^{-3}, respectively. Based on the August 1995 groundwater level measurements, the groundwater gradient is highest along the south central portion of Site 8 in the vicinity of the mounded area discussed above. The lowest gradients are located along the central and northern portion of the site.

The vertical movement of groundwater at Site 8 was not investigated; however, regional movement of groundwater is upwards from the deeper regionally confined aquifer to the shallow unconfined aquifer.

The direction of groundwater flow north of Site 8, in the vicinity of Building 1608, differs from Site 8. Groundwater flow directions were determined as part of an SSI conducted at Building 1608 located to the north of Site 8. Groundwater flow directions were measured four separate times in the local vicinity of Building 1608 over a one-year period. Ground water flow direction varied from the east, southeast, south, and southwest. These flow directions differ from both Site 8 and basewide flow directions which are generally to the northwest. However, Site 8 and the SSI groundwater flow measurements were obtained at separate times suggesting groundwater flow directions at Site 8 may vary in direction at different times of the year.

The hydraulic conductivity of the shallow saturated soils within IRP Site 8 was investigated by performing slug tests on monitoring wells MW-1, MW-2, and MW-5 through MW-12. The average measured hydraulic conductivity was 3.76 ft/day (1.33×10^{-3} cm/s). Hydraulic conductivity ranged from a minimum of 0.26 ft/day (9.11×10^{-5} cm/s) at monitoring well MW-1 to a maximum of 86.39 ft/day (3.05×10^{-2} cm/s) at monitoring well MW-10. The screened portion of each monitoring well straddled fine to coarse grained zones. As a result, the calculated hydraulic conductivity values represent a composite of both high and low conductive zones. A detailed discussion of the performance, analysis, and results of the slug tests is provided in Appendix C.

The velocity of the shallow groundwater at Site 8 was assessed using calculated hydraulic conductivity, gradient, and effective soil porosity values. An effective porosity value of 0.3 was used to represent an average for both clay and sandy soil material. The average groundwater velocity based on the May, June, and August groundwater level measurements for Site 8 was calculated as 0.049 ft/day (18.80 ft/yr or 1.75×10^{-5} cm/s) using geometric mean hydraulic conductivity and mean gradient values. The minimum and maximum groundwater velocities are 2.82×10^{-2} ft/day (1.03 ft/yr or 9.95×10^{-7} cm/s) at monitoring well MW-1 and 1.33 ft/day (485 ft/yr or 4.68×10^{-4} cm/s) at monitoring well MW-10, respectively. Table 5-4 summarizes hydraulic conductivity and groundwater velocity values for Site 8 monitoring wells.

5.3.2 Screening Results

Soil gas, soil, and groundwater screening samples were collected at various locations around Site 8. The results of the screening sampling are presented in the following sections.

Table 5-4
Hydraulic Conductivities and Groundwater Velocities -IRP Site 8
151st ARW, Air National Guard, Salt Lake City, Utah

Monitoring Well	**Hydraulic Conductivity (cm/s)**	**Groundwater Velocity (ft/yr)**	
		June 28-30, 1995	August 11, 1995
MW 1	9.114×10^{-5}	1.03	1.45
MW 2	2.139×10^{-3}	24.05	34.01
MW 5	6.822×10^{-4}	7.67	10.85
MW 6	1.105×10^{-3}	12.43	17.57
MW 7	1.635×10^{-3}	18.39	26.00
MW 8	1.982×10^{-3}	22.29	31.53
MW 9	9.230×10^{-4}	10.38	14.68
MW 10	3.047×10^{-2}	342.8	484.7
MW 11	8.438×10^{-4}	9.49	13.42
MW 12	1.551×10^{-3}	17.45	24.67
Geometric Mean	1.332×10^{-3}	18.08	

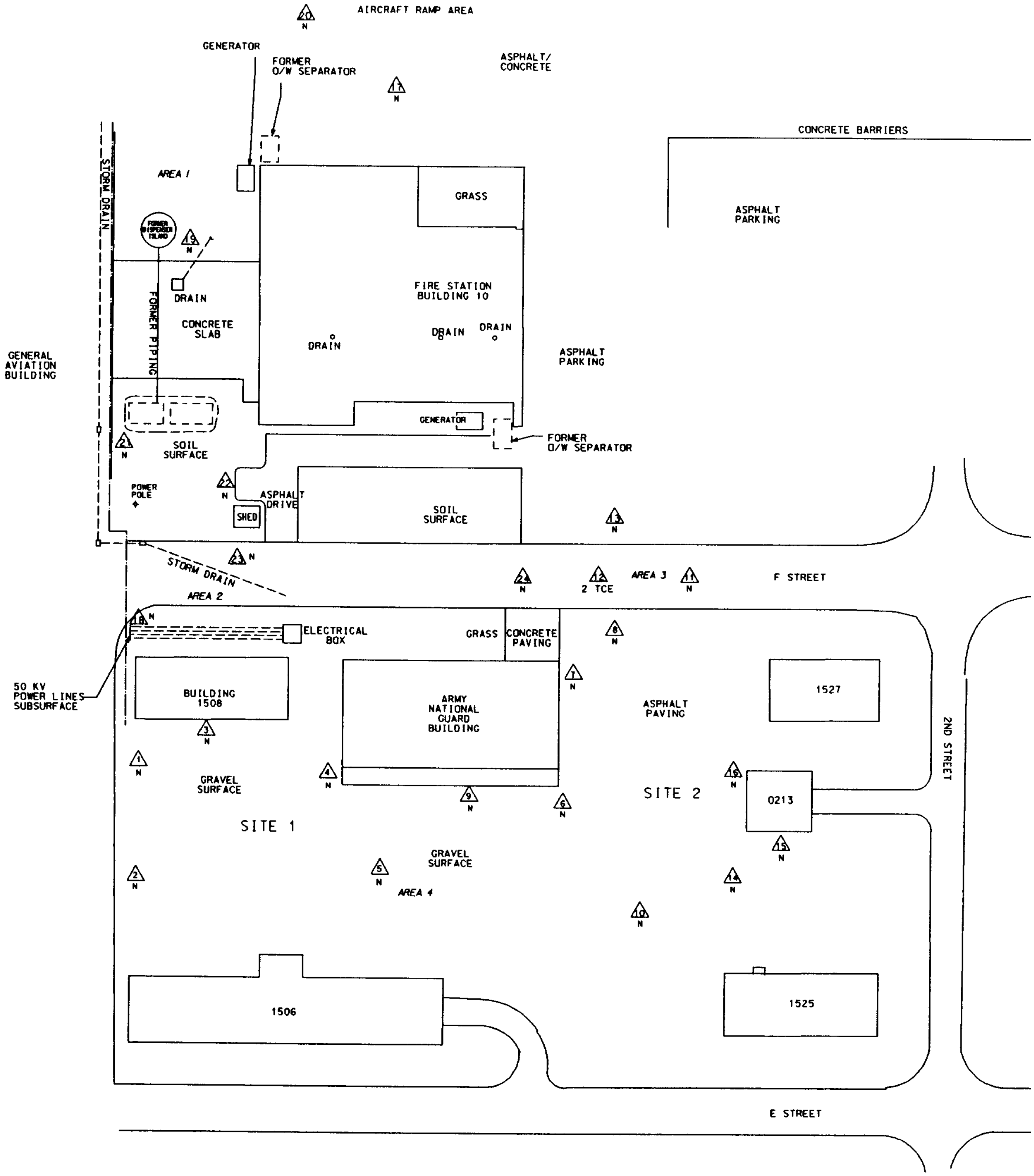
Note: Groundwater velocity based on average hydraulic gradient determined for each date (i.e., 3.26×10^{-3} and 4.61×10^{-3}, respectively) and an effective porosity of 30 percent.

5.3.2.1 Soil Gas Survey Results

A soil gas survey was conducted at Site 8 from May 30 to 31, 1995 by Transglobal Environmental Geochemistry (TEG) of Sacramento, California. TEG collected a total of 24 soil gas samples from various locations around Site 8. The number of soil gas sampling points at Site 8 was reduced from 40 to 24 points, based on VOCs not being detected in the soil gas samples. A field change request form documenting this change is included in Appendix D. Soil gas locations were chosen based on previous studies performed at Site 8. Soil gas sampling locations and results are shown on Figure 5-12.

Soil gas samples were collected directly above the groundwater table, from a depth of 4.0 feet BGS. The depth of soil gas sampling was based on water levels measured in Site 8 monitoring wells.

TCE was detected in soil gas sample S8-SG12, located along F Street, at a concentration of 2.0 micrograms/liter (μg/l). VOCs were not detected in the remaining soil gas samples above the method detection limit of 1.0 μg/l. The non-detection of VOCs in the soil gas samples may be due to the low permeability of the soil at Site 8. A QA/QC Summary for the soil gas sampling is included in Appendix A. TEG's Soil Gas Report is included in Appendix E.



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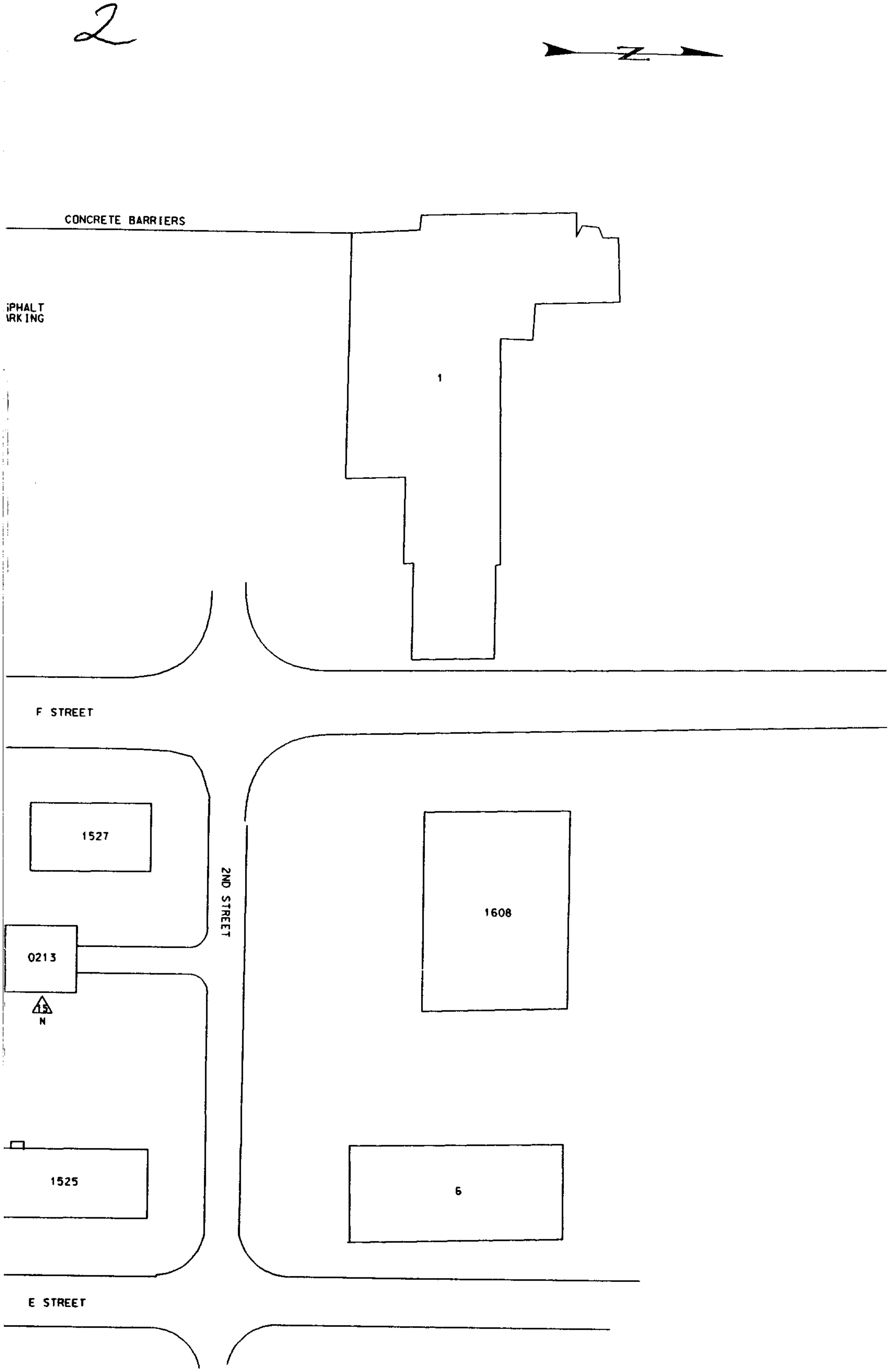

LEGEND:
EXISTING SAMPLE LOCATIONS

△1 SOIL GAS SAMPLING POINT AND DESIGNATIONS SWEC (JUNE 1995)

—— PROPERTY BOUNDARY

NOTES:

1. SOIL VAPOR SAMPLES ANALYZED ORGANIC COMPOUNDS (VOCS), 8010/8020.
2. N = VOCS NOT DETECTED. IN METHOD DETECTION LIMIT OF
3. TCE = TRICHLOROETHENE.

0 50'

FIGURE 5-

SOIL GAS SAMPLING LOCATIONS AND RE IRP SITE 8

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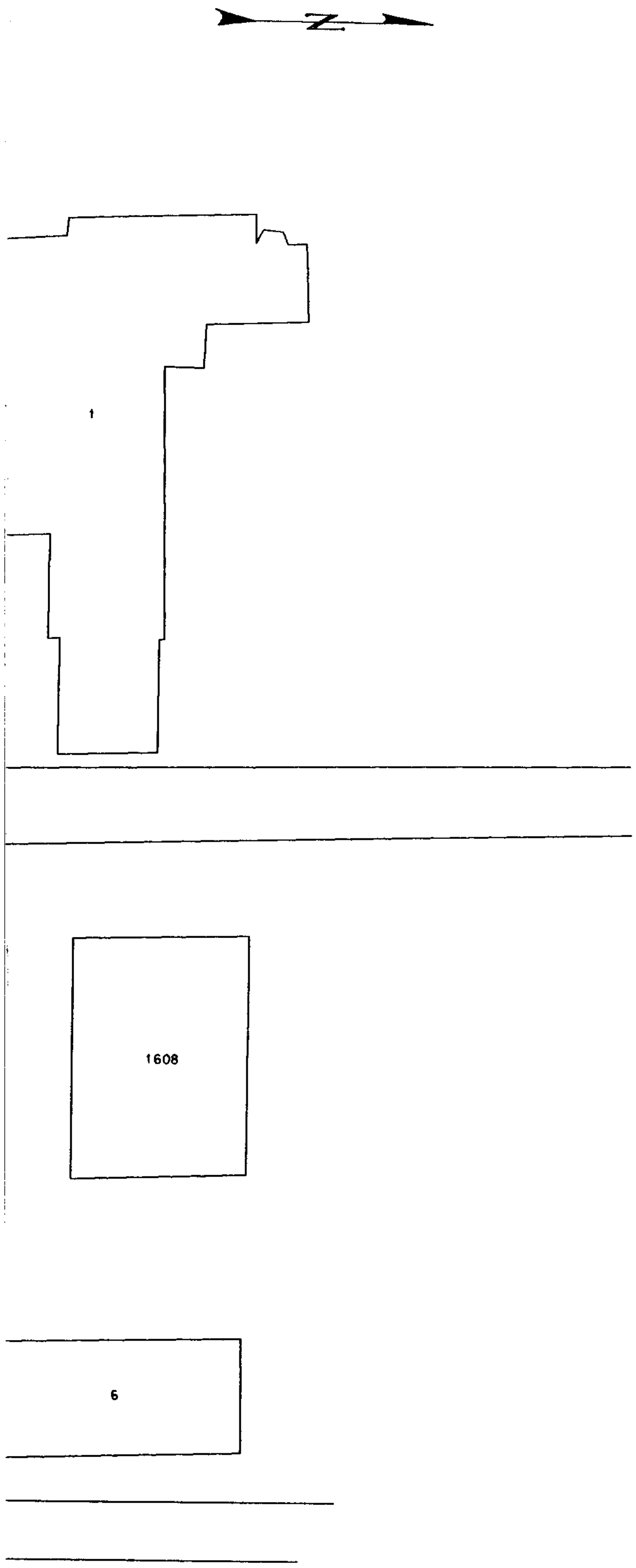

LEGEND:
EXISTING SAMPLE LOCATIONS

△1 SOIL GAS SAMPLING POINTS AND DESIGNATIONS SWEC (JUNE 1995)

—— PROPERTY BOUNDARY

NOTES:

1. SOIL VAPOR SAMPLES ANALYZED FOR VOLATILE ORGANIC COMPOUNDS (VOCS), BY EPA METHOD 8010/8020.
2. N = VOCS NOT DETECTED. IN SAMPLE ABOVE METHOD DETECTION LIMIT OF 1.0mg/L.
3. TCE = TRICHLOROETHENE.

0 50'

FIGURE 5-12

SOIL GAS SAMPLING POINT LOCATIONS AND RESULTS IRP SITE 8

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SUPV: R.J. BOUDREAU
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5.3.2.2 Soil Screening Results

Soil screening was conducted at Site 8 from June 1 to 2, 1995. An additional soil sample was collected from Site 8 for screening on June 13, 1995. A total of 17 soil samples were collected by TEG from various locations around Site 8. Soil samples were collected from depths ranging from 3.2 to 4.5 feet BGS. Soil screening locations and analytical results are shown on Figure 5-13.

TCE was detected in soil samples S8-GP15-S1 and S8-GP16-S1, located just west of the southwest corner of Building 10 and south of 2nd street in the middle of F Street, respectively. The samples had concentrations of 0.006 and 0.005 ppm (0.006 and 0.005 mg/kg), respectively. BTEX compounds were detected in sample S8-GP14-S1 (collected from the former tank area) at concentrations of 0.061, 0.019, 0.101, and 0.373 ppm (0.061, 0.019, 0.101 and 0.373 mg/kg), respectively. VOCs were not detected in the remaining soil samples above the method detection limit of 0.005 mg/kg (0.005 ppm). Results are summarized in Table 5-5. TEG's report is included as Appendix E.

5.3.2.3 Groundwater Screening

Groundwater screening was conducted at Site 8 on June 1, 2, 4, 12, 13, 19, and 20, 1995. A total of 71 groundwater samples were collected by TEG from 37 locations around the site. Shallow groundwater samples were collected from depths ranging from 8 to 12 feet BGS. Deep groundwater samples were collected from depths ranging from 13 to 17 feet BGS. Groundwater sampling depths were adjusted from the proposed depths to correspond with the depths at which contamination had been detected in the groundwater in the past. A field change request form documenting this change is included in Appendix D. Groundwater screening locations are shown on Figure 5-14. The number of groundwater screening point locations at Site 8 was increased from 15 to 37 sampling points. This increase was made in order to delineate the lateral extent of halogenated compounds detected in the groundwater at the site and to the north and east in the areas of Sites 1 and 2.

Halogenated compounds, including chloroform, 1,1-dichloroethane (1,1-DCA), 1,2-dichloroethane (1,2-DCA), cis-1,2-dichloroethene (c-DCE), trans-1,2-dichloroethene (t-DCE), 1,1,1-trichloroethane (TCA), TCE, and tetrachloroethene (PCE) were detected in several groundwater samples collected at Site 8. The compounds detected at the highest concentrations were c-DCE and TCE. Figures 5-15 and 5-16 show the locations and concentrations of c-DCE and TCE detected in shallow groundwater screening samples, respectively. Figures 5-16 and 5-17 show the locations and concentrations of c-DCE and TCE detected in deep groundwater screening samples, respectively.

In 34 of the 71 samples collected, c-DCE was detected at concentrations ranging from 2.6 to 9,916.7 μg/l. TCE was detected in 61 of the 71 samples at concentrations ranging from 1.0 to 38,960 μg/l. As shown on Figures 5-17 and 5-18, the highest concentrations of c-DCE and TCE were detected in the deep groundwater samples collected from the area near the intersection of F Street and 2nd Street.

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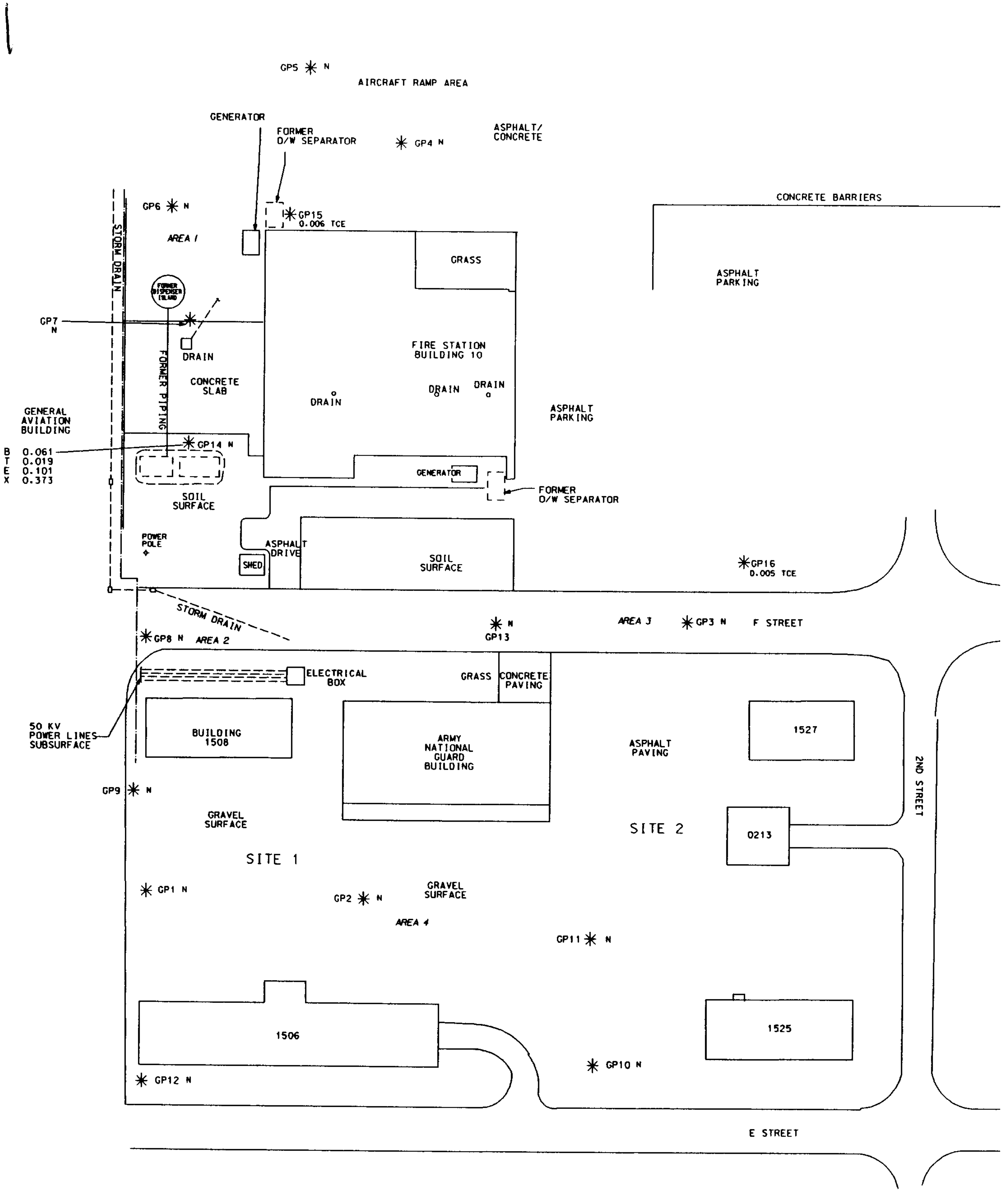

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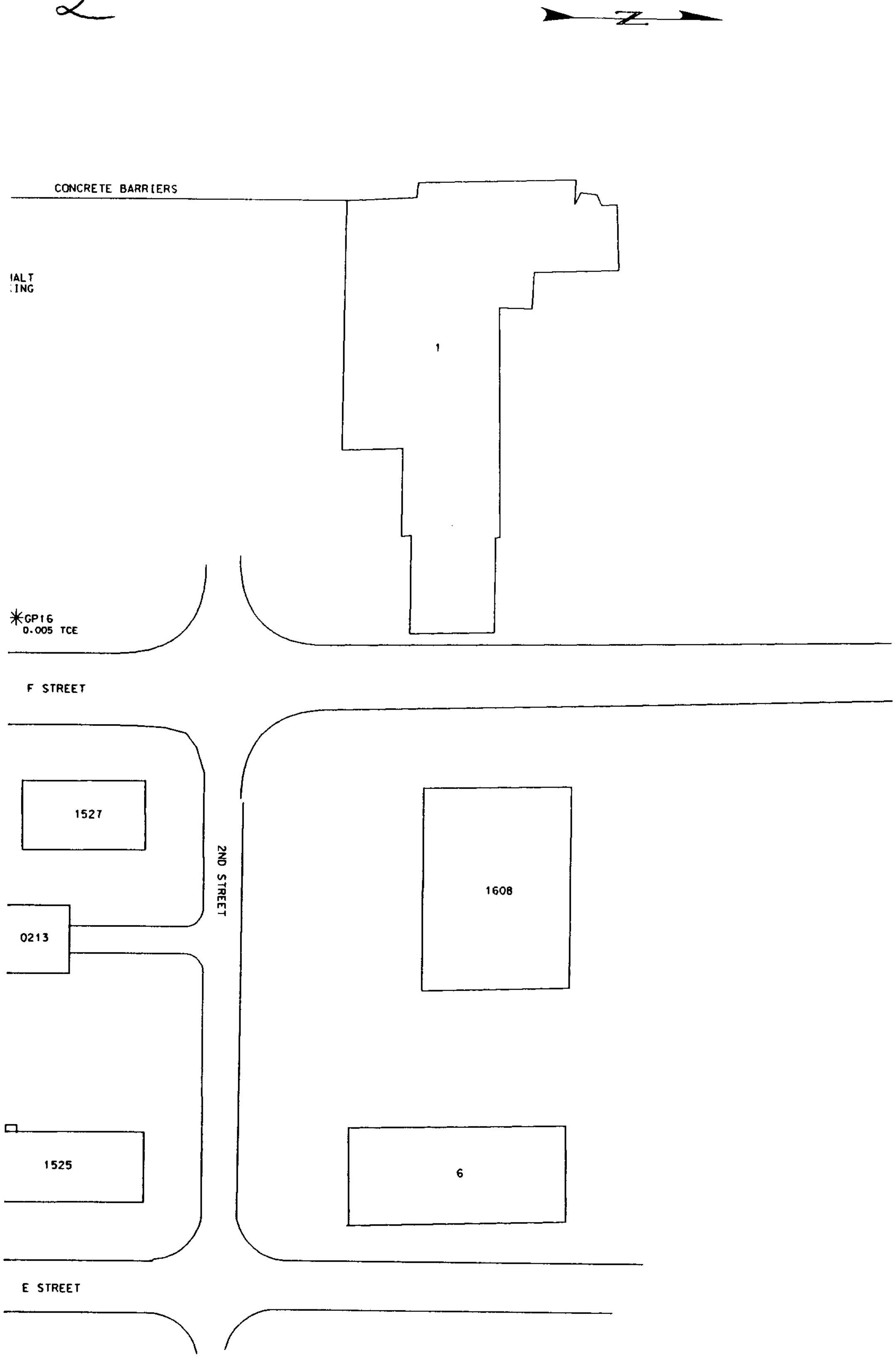

LEGEND:

✳ GEOPROBE POINT - SO
SWEC (JUNE 1995)

—— PROPERTY BOUNDARY

NOTES:

1. SOIL SAMPLES ANALYZED F
METHOD 8010/8020.

2. N = VOC'S NOT DETECTED
METHOD DETECTION LIMIT

3. TCE = TRICHLOROETHENE
B = BENZENE
T = TOLUENE
E = EHYLBENZENE
X = XYLENE

4. CONCENTRATIONS SHOWN IN

0 50

FIGURE 5

SOIL SCREENI
LOCATIONS AND R
IRP SITE 8

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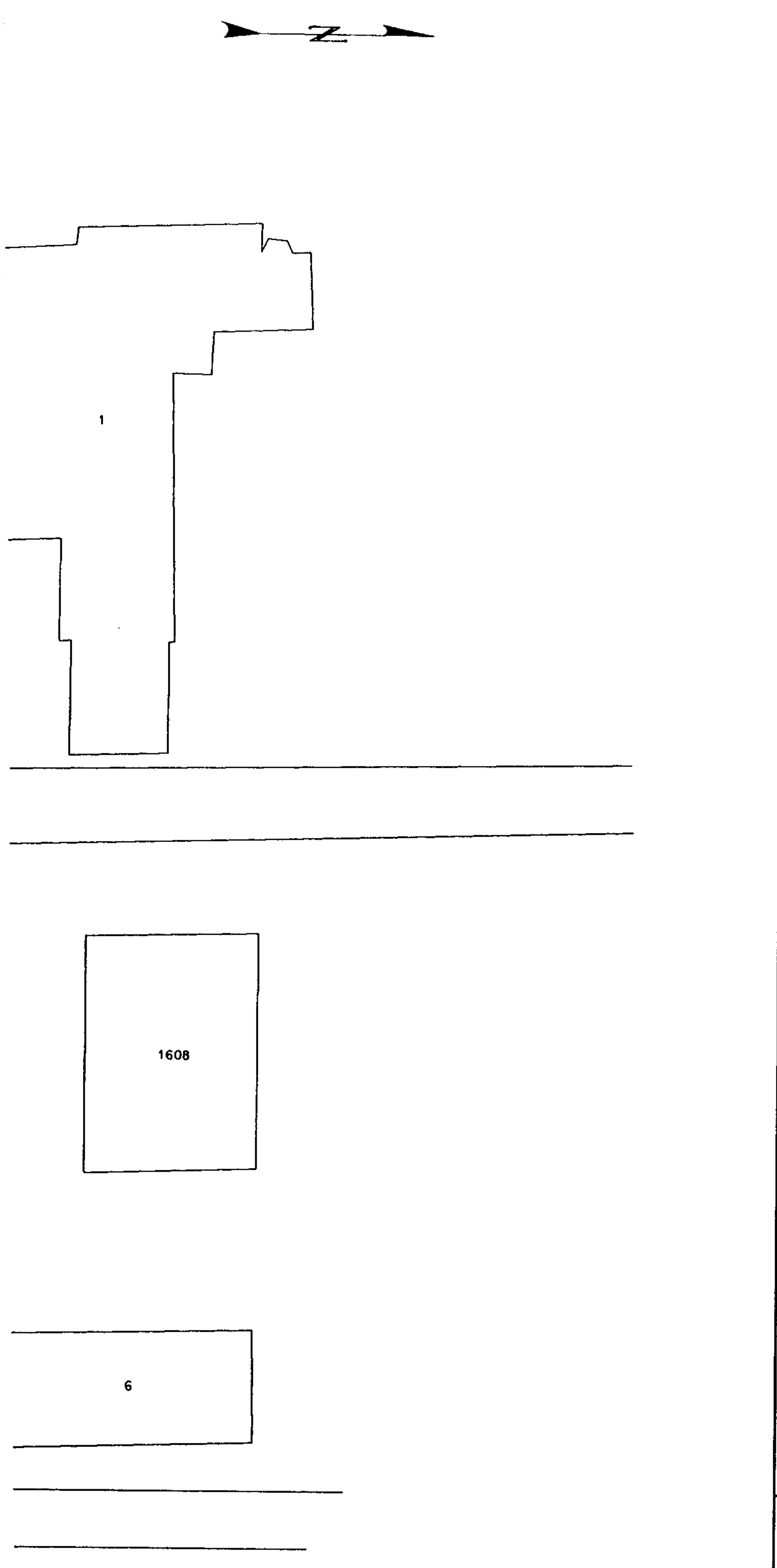

LEGEND:

✳ GEOPROBE POINT - SOIL SCREENING LOCATION SWEC (JUNE 1995)

—·— PROPERTY BOUNDARY

NOTES:

1. SOIL SAMPLES ANALYZED FOR VOC'S BY EPA METHOD 8010/8020.
2. N = VOC'S NOT DETECTED IN SAMPLE ABOVE METHOD DETECTION LIMIT OF 0.005 mg/kg.
3. TCE = TRICHLOROETHENE
   B = BENZENE
   T = TOLUENE
   E = EHYLBENZENE
   X = XYLENE
4. CONCENTRATIONS SHOWN IN mg/kg.

0 50'

FIGURE 5-13

SOIL SCREENING
LOCATIONS AND RESULTS
IRP SITE 8

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Table 5-5
Volatile Organic Compounds Detected in Soil Screening Samples
IRP Site No. 8
151st ARW, Utah Air National Guard
Salt Lake City, Utah

SAMPLE NUMBER: COLLECTION DATE:		UANG-S8-GP14-S1 6/04/95	UANG-S8-GP15-S1 6/04/95	UANG-S8-GP16-S1 6/04/95
Trichloroethene	(mg/kg)	ND (0.005)	0.006	0.005
Benzene	(mg/kg)	0.061	ND (0.005)	ND (0.005)
Toluene	(mg/kg)	0.019	ND (0.005)	ND (0.005)
Ethylbenzene	(mg/kg)	0.101	ND (0.005)	ND (0.005)
Total Xylenes	(mg/kg)	0.373	ND (0.005)	ND (0.005)

ND = Not detected above the method detection limit shown in parentheses
Analyses performed in TEG's CA DHS certified mobile lab (#1671)
Soil samples analyzed for VOCs by EPA methods 8010/8020

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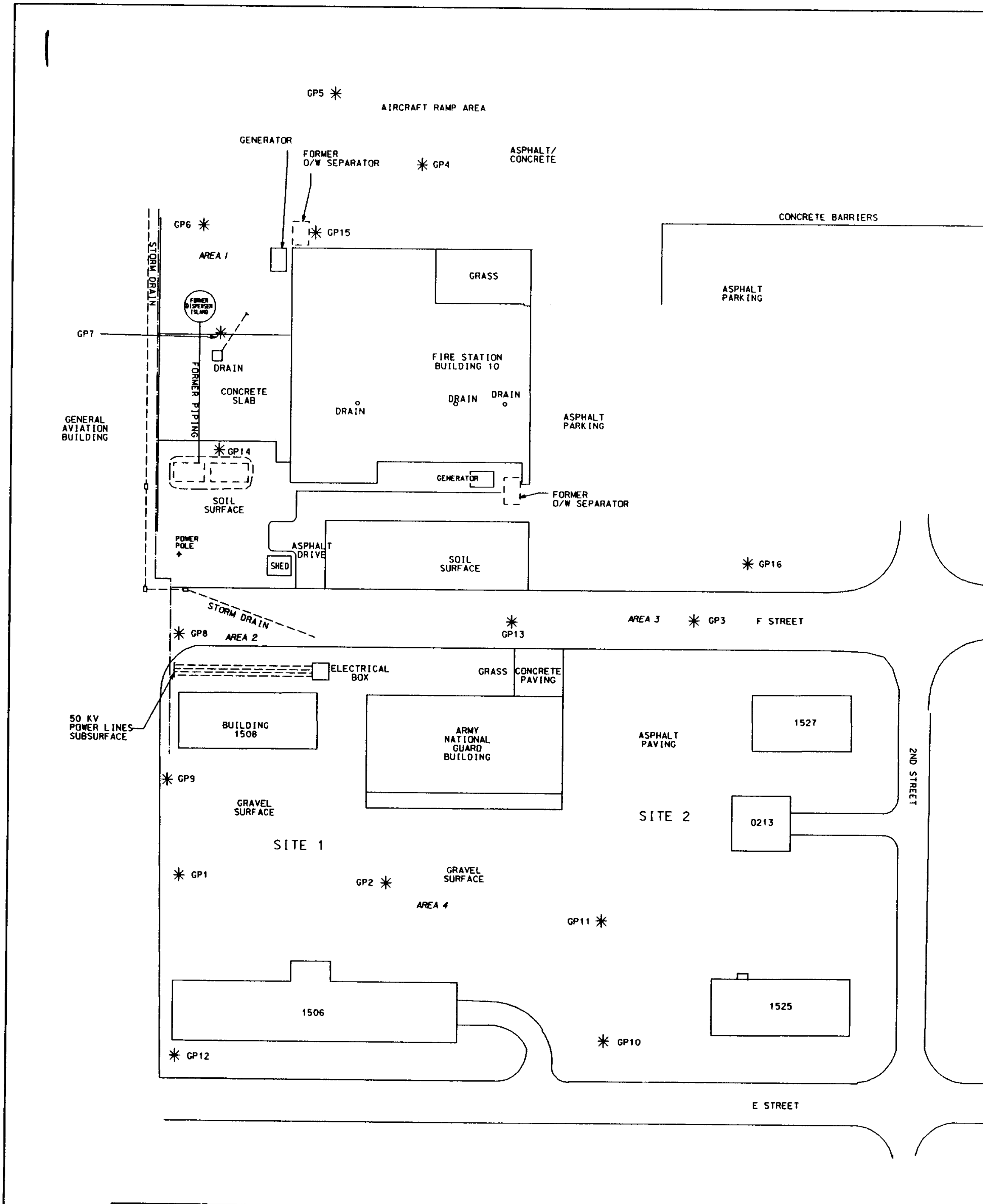

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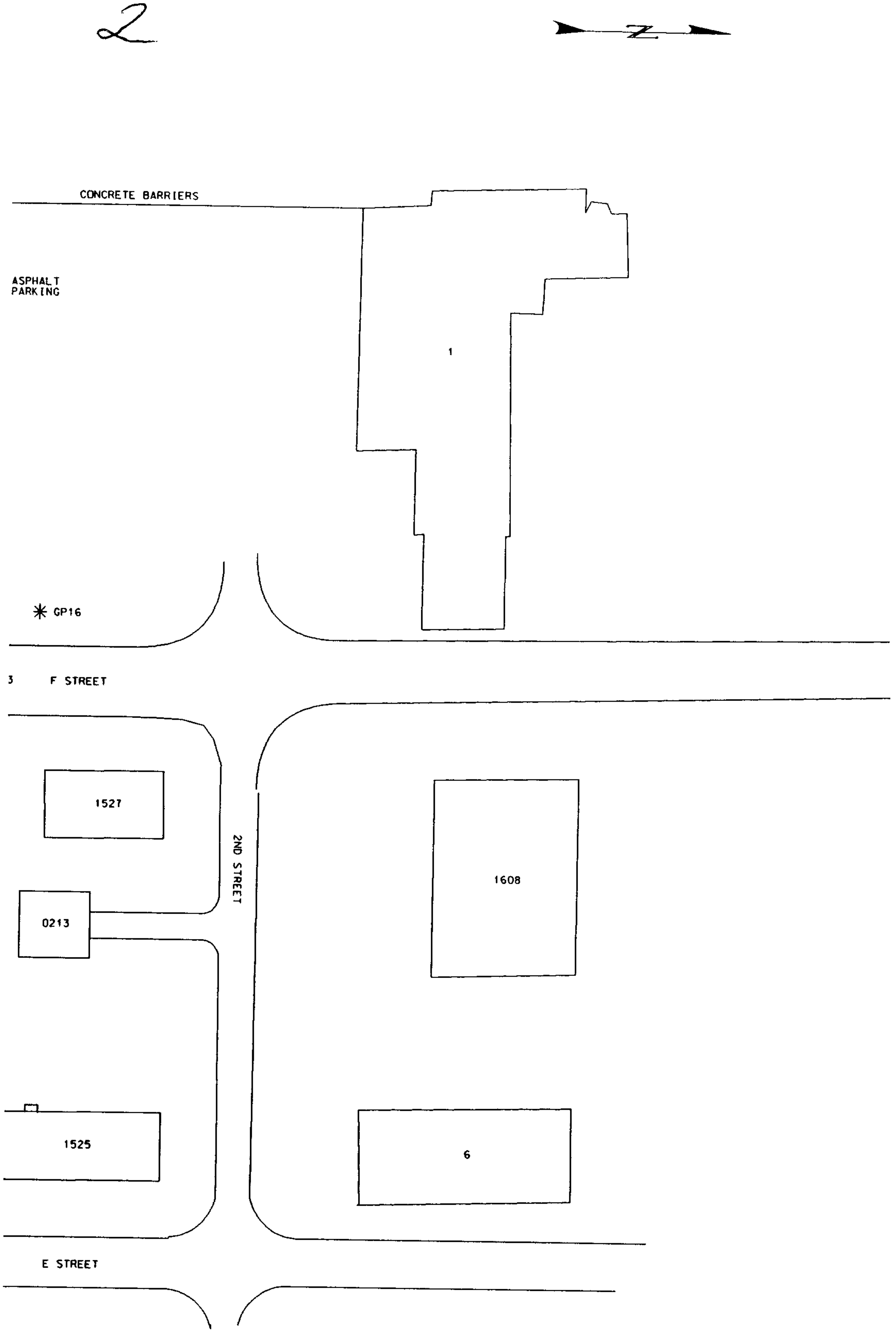

LEGEND:

✳ GEOPROBE POINT - GR
LOCATION (JUNE 1995
—— PROPERTY BOUNDARY

NOTES:

1. SOIL VAPOR SAMPLES ANAL
ORGANIC COMPOUNDS (VOCS
8010/8020.
2. N = VOCS NOT DETECTED.
METHOD DETECTION LIMIT
3. TCE = TRICHLOROETHENE.

0 5

FIGURE 5

GROUNDWATER SCR
SAMPLE LOCAT
IRP SITE 8

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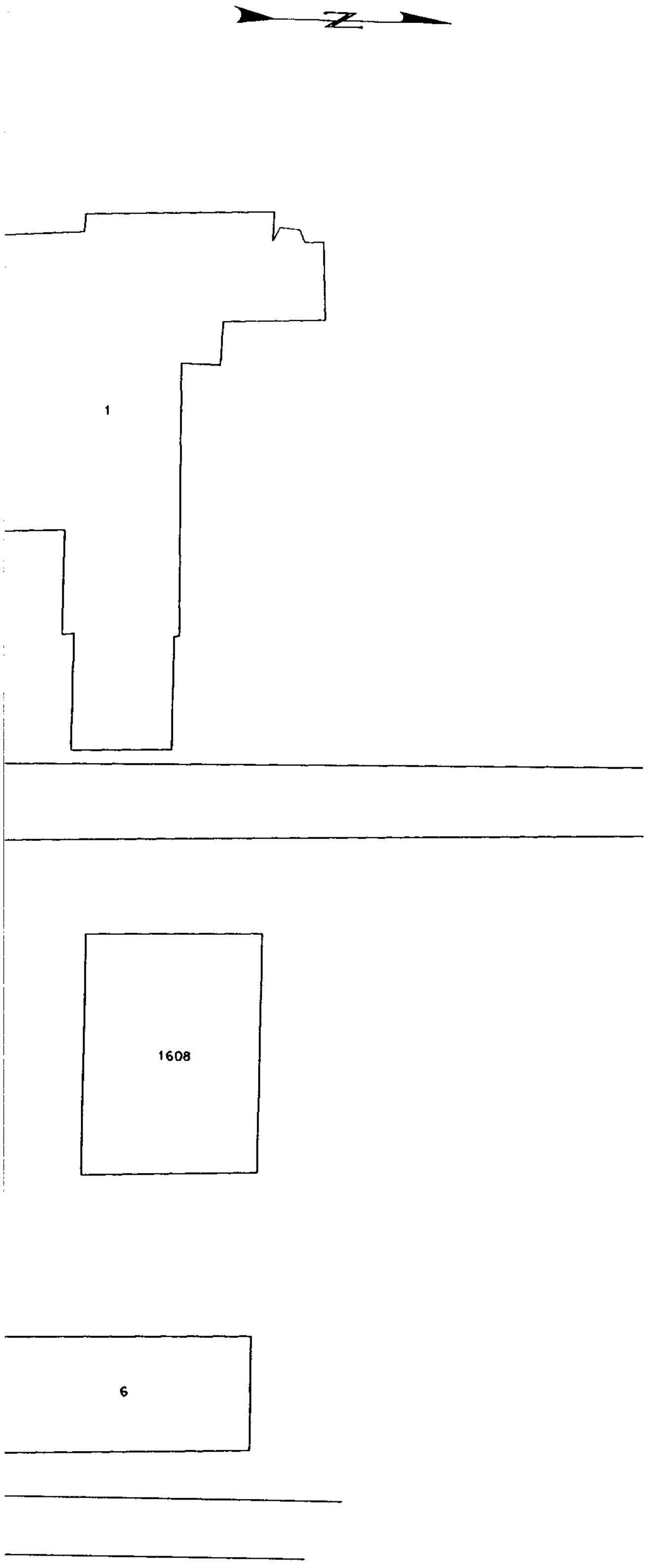

LEGEND:

✳ GEOPROBE POINT - GROUNDWATER SCREENING SAMPLE LOCATION (JUNE 1995)

—·— PROPERTY BOUNDARY

NOTES:

1. SOIL VAPOR SAMPLES ANALYZED FOR VOLATILE ORGANIC COMPOUNDS (VOCS), BY EPA METHOD 8010/8020.
2. N = VOCS NOT DETECTED, IN SAMPLE ABOVE METHOD DETECTION LIMIT OF 1.0mg/L.
3. TCE = TRICHLOROETHENE.

0 50′

FIGURE 5-14

GROUNDWATER SCREENING SAMPLE LOCATIONS IRP SITE 8

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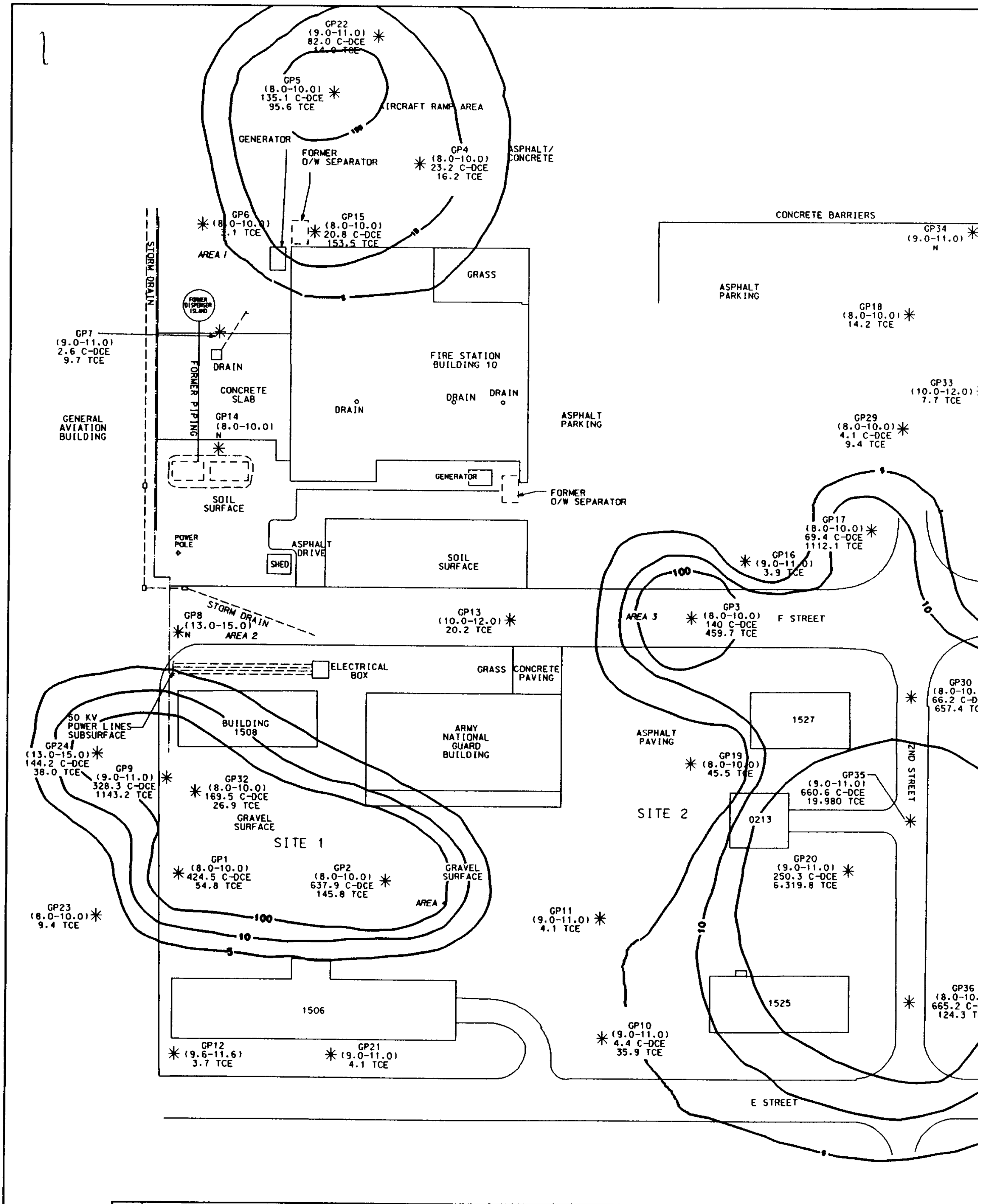

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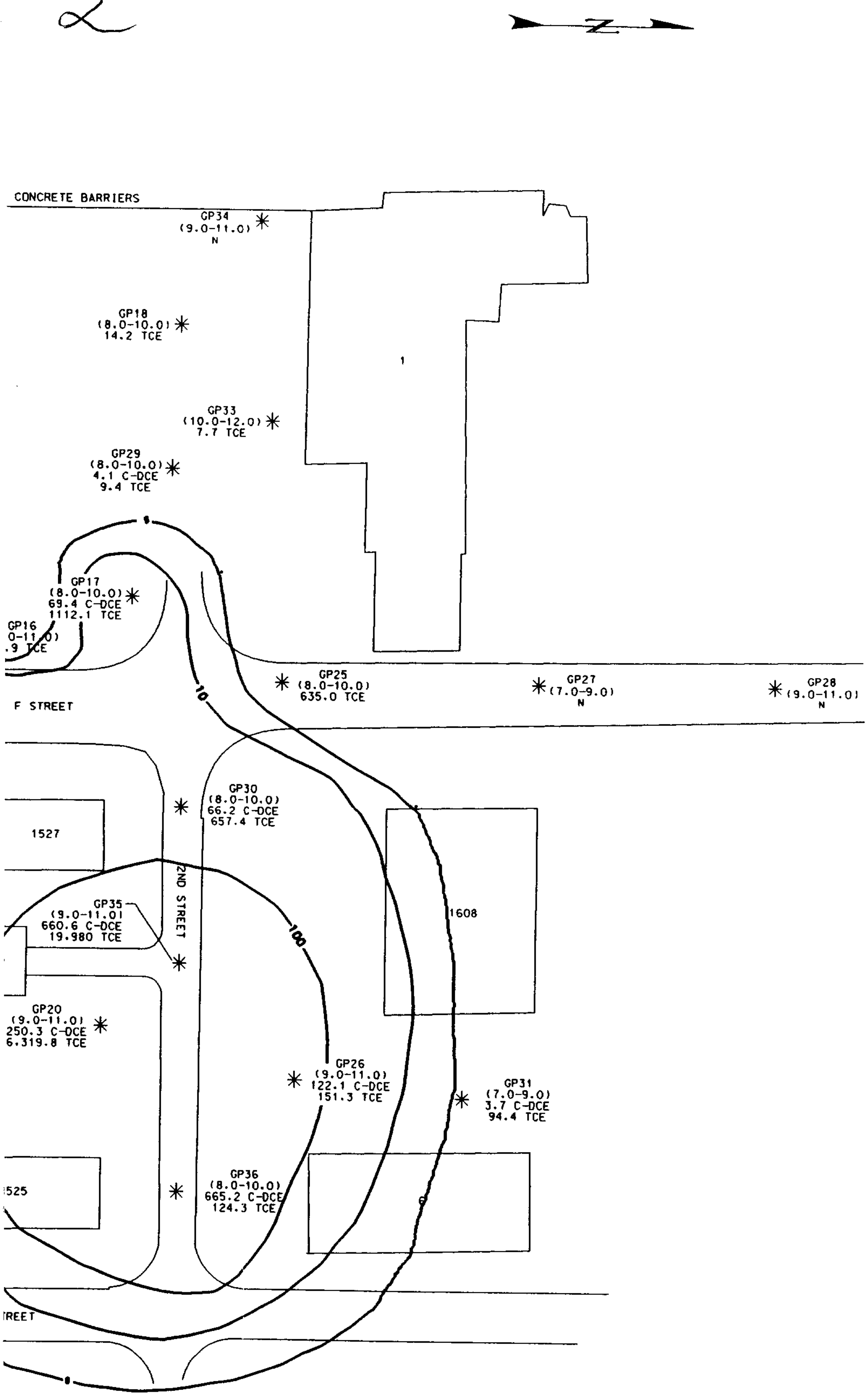

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✳ GP1 (8.0-10.0) 424.5 C-DCE 54.8 TCE	GEOPROBE SWEC (JUNE DEPTH OF SAMPLE BGS COMPOUND AND CONCEN
—·—	PROPERTY BOUNDARY
—10—	C-DCE ISOCONCENTRATION CONTOU

NOTES:

1. CONCENTRATIONS OF CONTAMINANTS S IN ug/L.
2. C-DCE = CIS-1,2 DICHLOROETHENE.
3. TCE = TRICHLOROETHENE.
4. N = C-DCE AND TCE NOT DETECTED I

0 50′

FIGURE 5-15

C-DCE ISOCONCENTRATIONS
SHALLOW GROUNDWATER SCREENIN
IRP SITE 8

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SALT LAKE CITY INTERNATIONAL A
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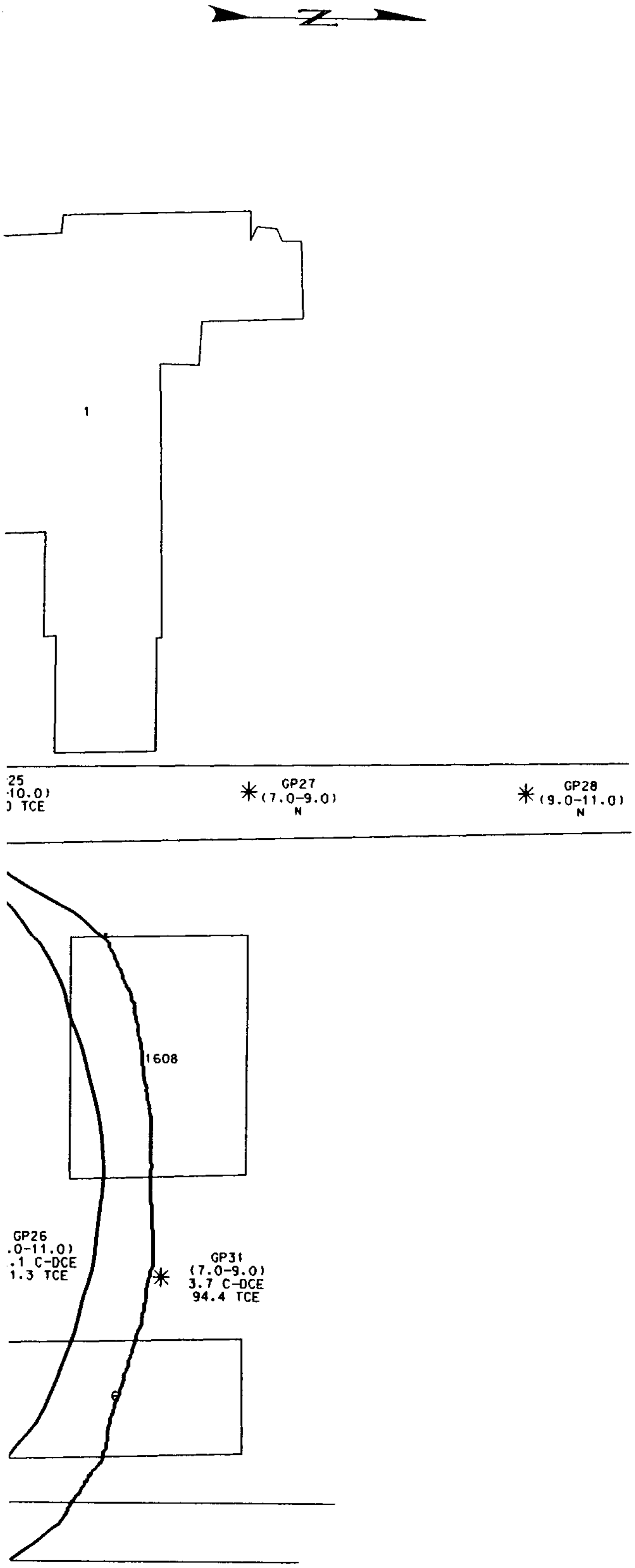

LEGEND:

✳	GP1 (8.0-10.0) 424.5 C-DCE 54.8 TCE	GEOPROBE SWEC (JUNE 1995) DEPTH OF SAMPLE BGS COMPOUND AND CONCENTRATION
——		PROPERTY BOUNDARY
—10—		C-DCE ISOCONCENTRATION CONTOUR LINE (ug/L).

NOTES:

1. CONCENTRATIONS OF CONTAMINANTS SHOWN IN ug/L.
2. C-DCE = CIS-1,2 DICHLOROETHENE.
3. TCE = TRICHLOROETHENE.
4. N = C-DCE AND TCE NOT DETECTED IN SAMPLE.

FIGURE 5-15

C-DCE ISOCONCENTRATIONS IN SHALLOW GROUNDWATER SCREENING SAMPLES IRP SITE 8

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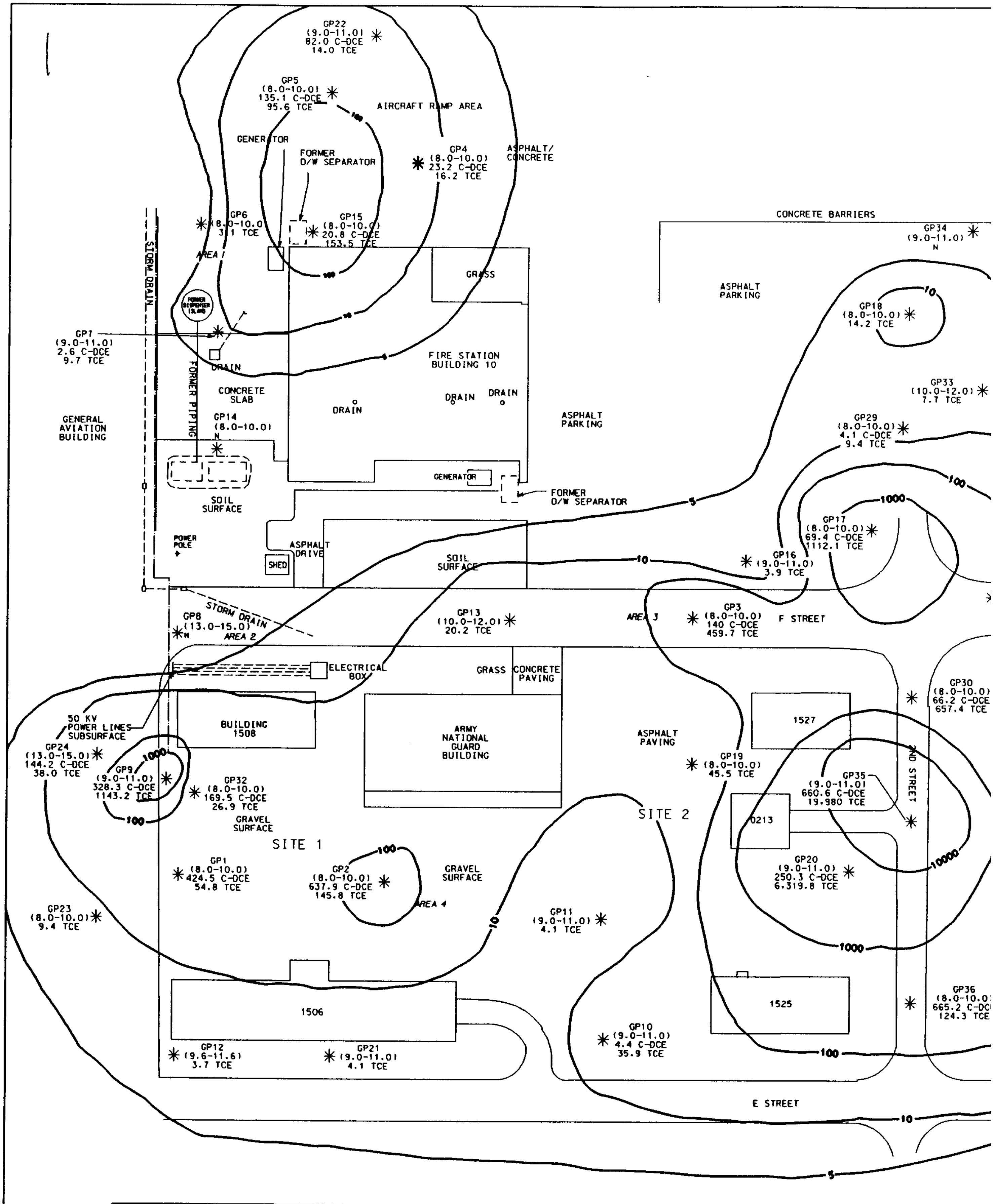

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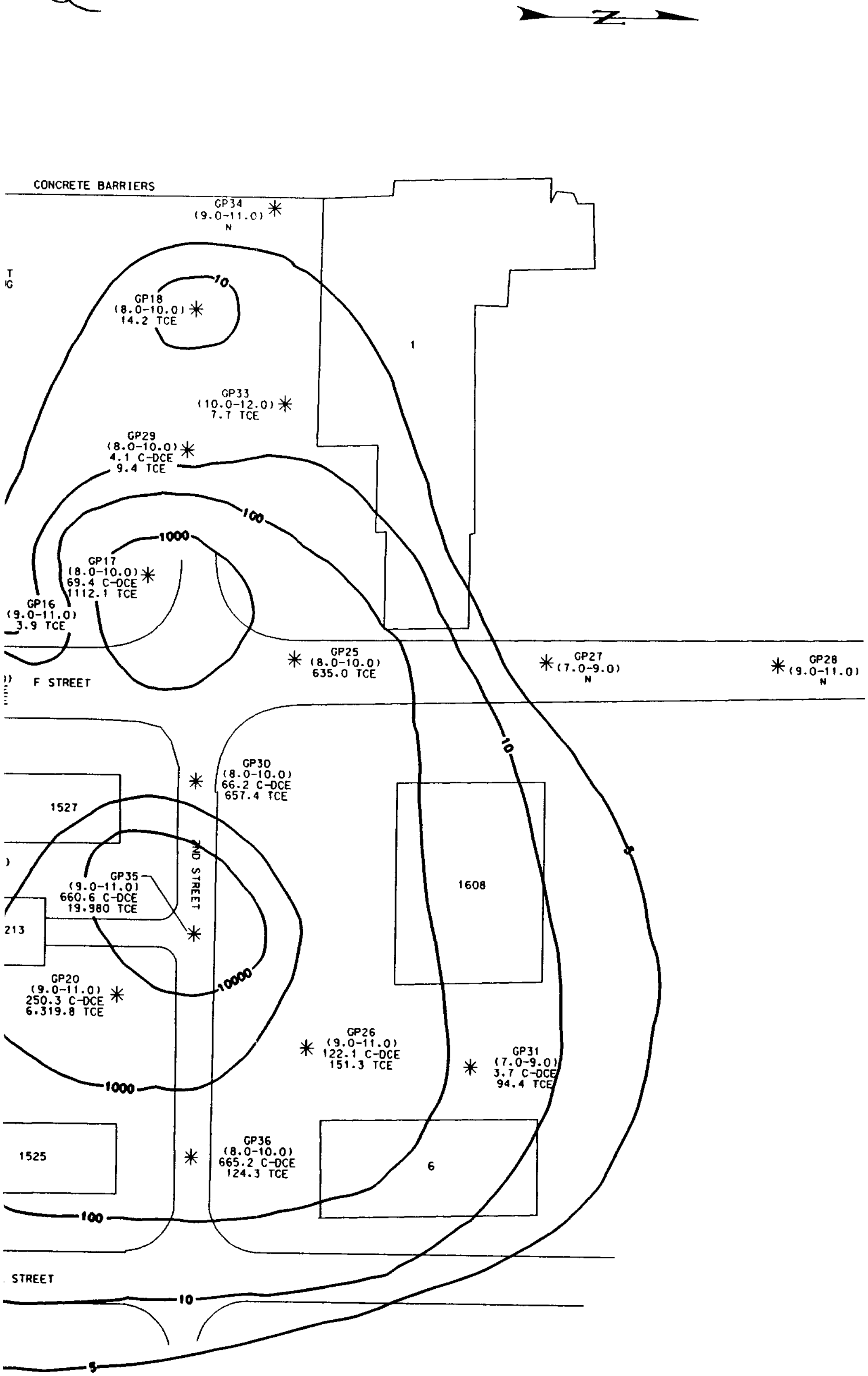

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✳ GP1 (8.0-10.0) 424.5 C-DCE 54.8 TCE	GEOPROBE SWEC (. DEPTH OF SAMPLE COMPOUND AND CO
———	PROPERTY BOUNDARY
—10—	TCE ISOCONCENTRATION CONT

NOTES:

1. CONCENTRATIONS OF CONTAMINANT IN ug/L.
2. C-DCE = CIS-1,2 DICHLOROETHEN
3. TCE = TRICHLOROETHENE.
4. N = C-DCE AND TCE NOT DETECTE

0 50'

FIGURE 5-1

TCE ISOCONCENTRATION SHALLOW GROUNDWATER SCREEN IRP SITE 8

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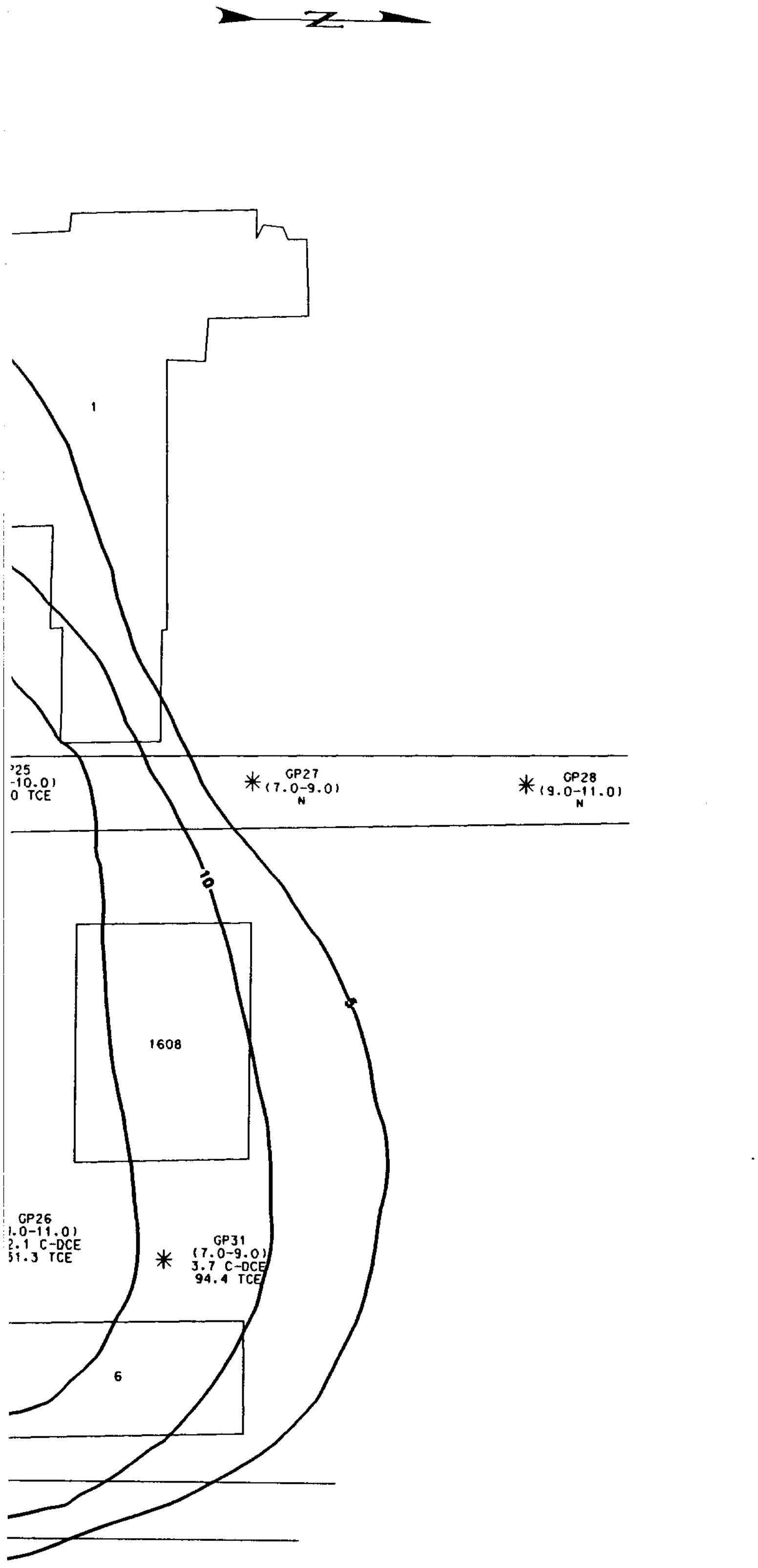

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✳ GP1 (8.0-10.0) 424.5 C-DCE 54.8 TCE	GEOPROBE SWEC (JUNE 1995) DEPTH OF SAMPLE BGS COMPOUND AND CONCENTRATION
——	PROPERTY BOUNDARY
—10—	TCE ISOCONCENTRATION CONTOUR LINE (ug/L).

NOTES:

1. CONCENTRATIONS OF CONTAMINANTS SHOWN IN ug/L.
2. C-DCE = CIS-1,2 DICHLOROETHENE.
3. TCE = TRICHLOROETHENE.
4. N = C-DCE AND TCE NOT DETECTED IN SAMPLE.

0 50′

FIGURE 5-16

TCE ISOCONCENTRATIONS IN
SHALLOW GROUNDWATER SCREENING SAMPLES
IRP SITE 8
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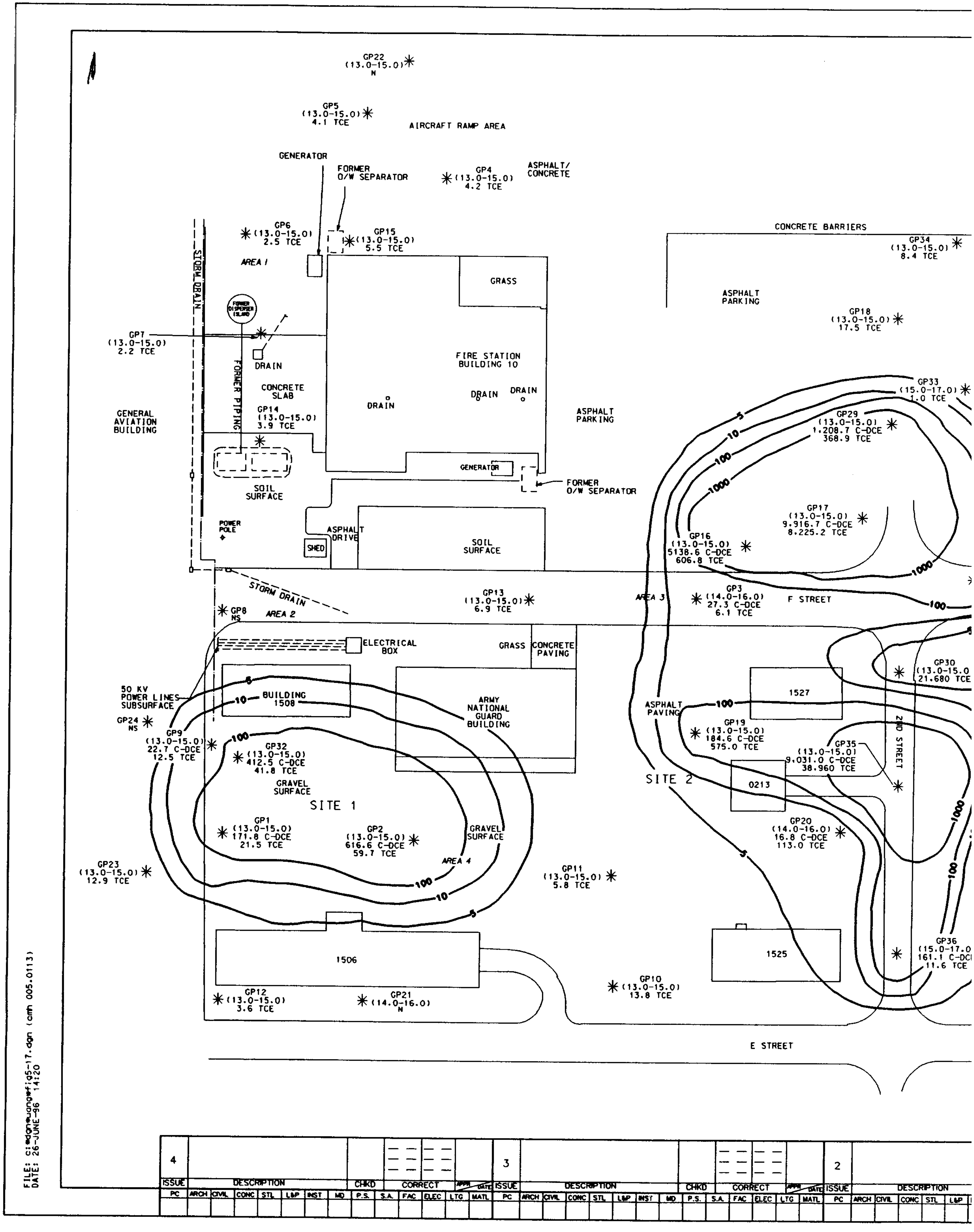

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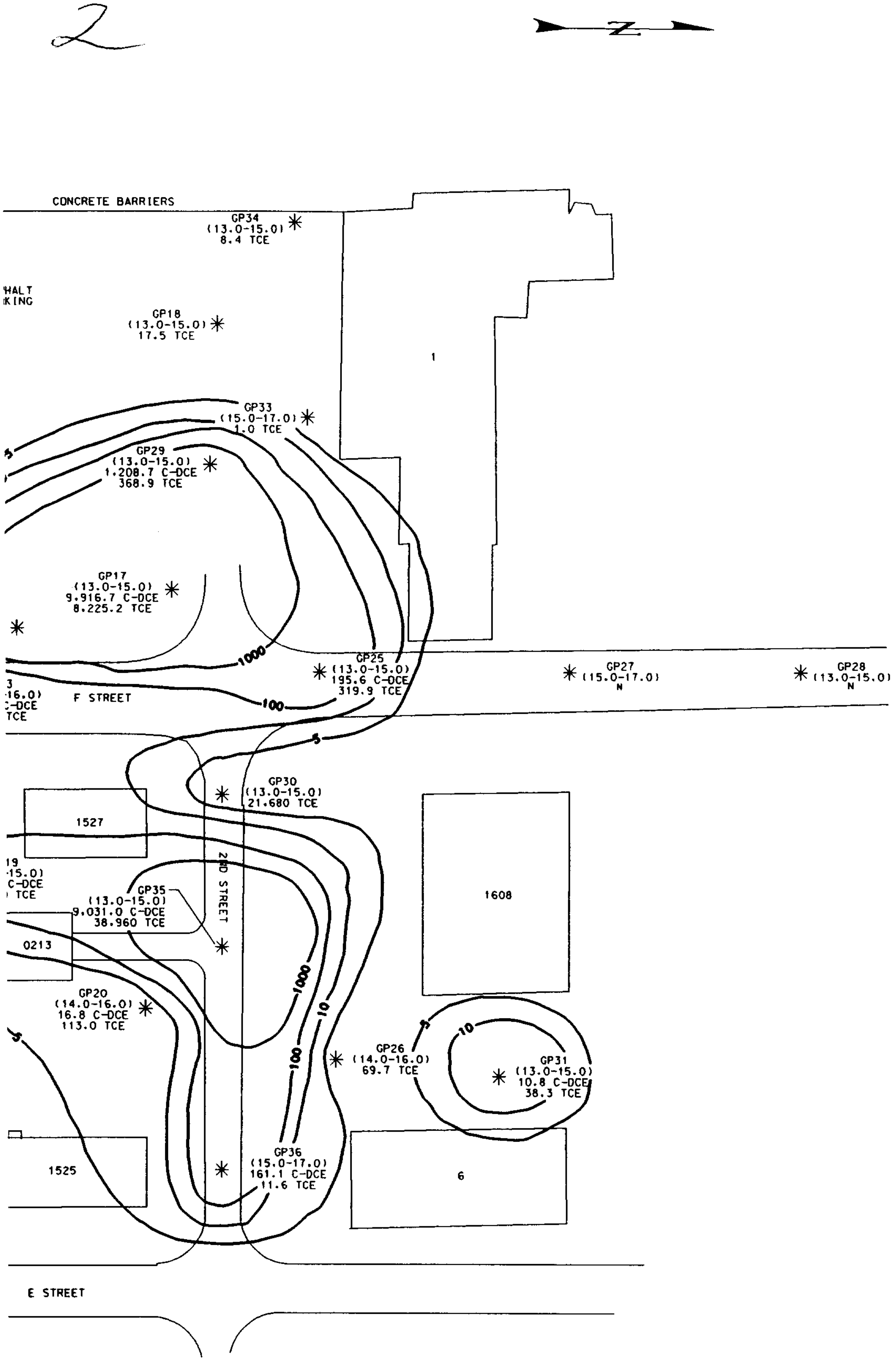

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✳ GP1 (13.0-15.0) 171.8 C-DCE 21.5 TCE	GEOPROBE SWEC (DEPTH OF SAMPLE COMPOUND AND CO
———	PROPERTY BOUNDARY
—10—	C-DCE ISOCONCENTRATION CON

NOTES:

1. CONCENTRATIONS OF C-DCE AND TCE IN ug/L.
2. C-DCE - CIS-1,2 DICHLOROETHENE
   TCE - TRICHLOROETHENE
   N - C-DCE AND TCE NOT DETE
   NS - NOT SAMPLED.

0 50

FIGURE 5

C-DCE ISOCONCENTRA
DEEP GROUNDWATER SCREE
IRP SITE 8

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SALT LAKE CITY,
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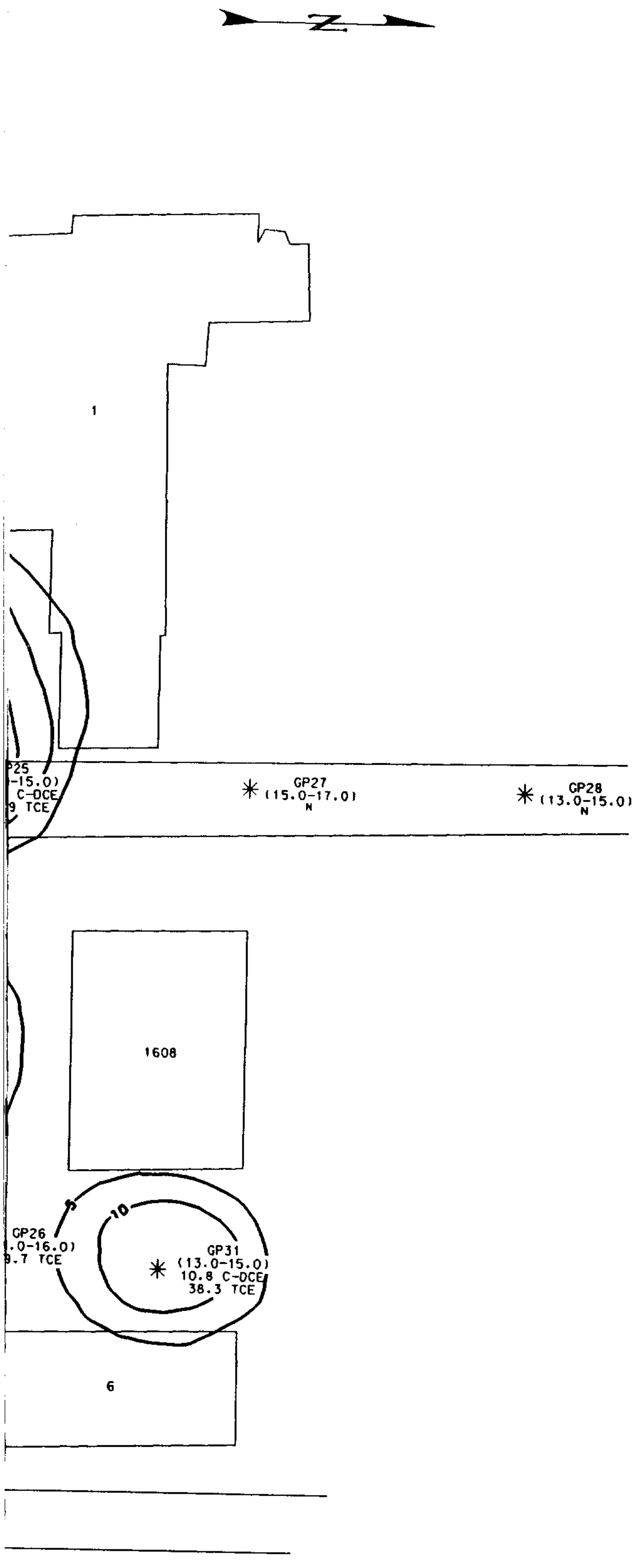

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✳ GP1 (13.0-15.0) 171.8 C-DCE 21.5 TCE	GEOPROBE SWEC (JUNE 1995) DEPTH OF SAMPLE BGS (FT) COMPOUND AND CONCENTRATION
———	PROPERTY BOUNDARY
—10—	C-DCE ISOCONCENTRATION CONTOUR LINE (ug/L).

NOTES:

1. CONCENTRATIONS OF C-DCE AND TCE SHOWN IN ug/L.
2. C-DCE - CIS-1,2 DICHLOROETHENE
   TCE - TRICHLOROETHENE
   N - C-DCE AND TCE NOT DETECTED AT SAMPLE LOCATION.
   NS - NOT SAMPLED.

0 50'

FIGURE 5-17

C-DCE ISOCONCENTRATIONS IN DEEP GROUNDWATER SCREENING SAMPLES IRP SITE 8

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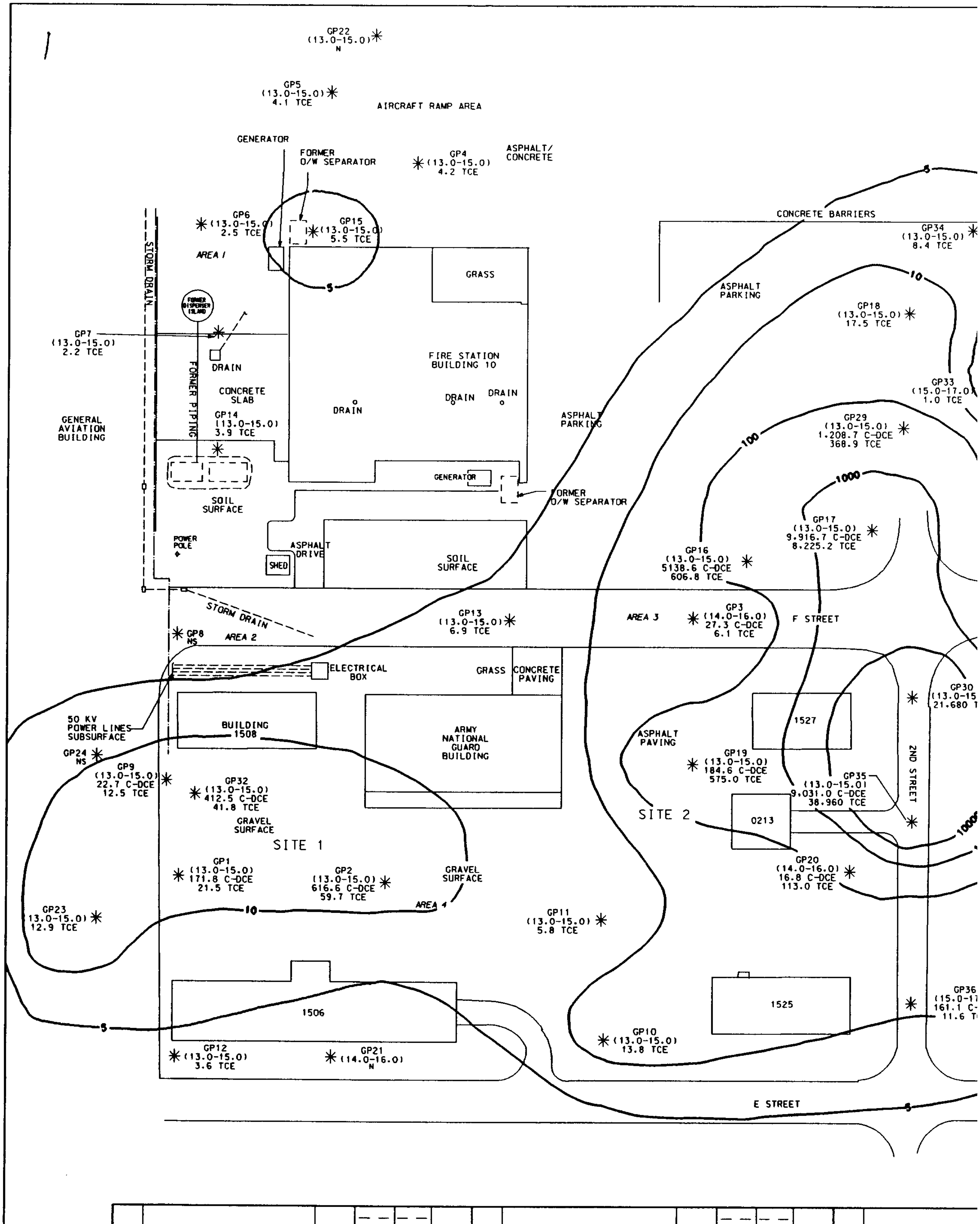

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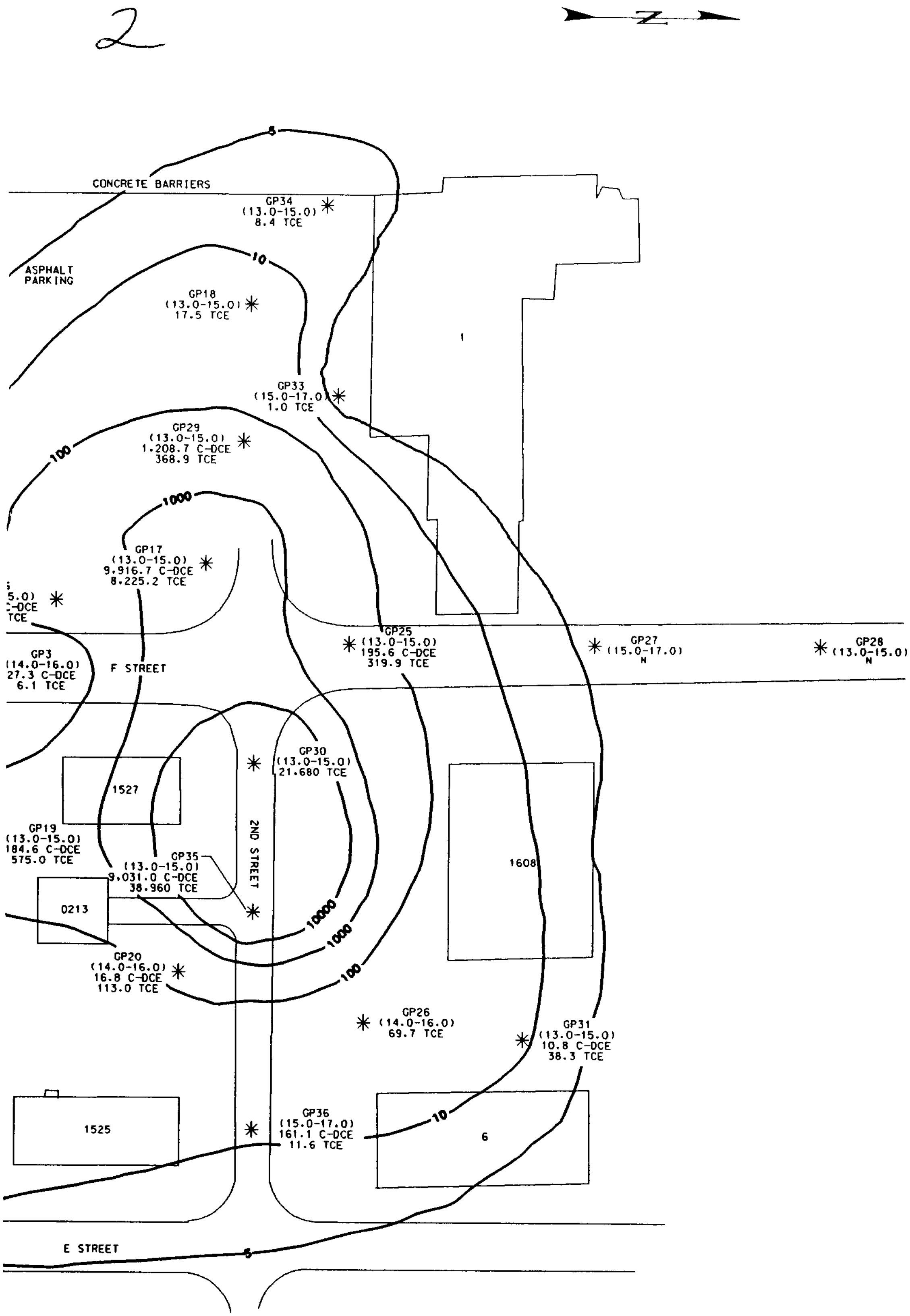

LEGEND:

✳	GP1 (13.0-15.0) 171.8 C-DCE 21.5 TCE	GEOPROBE S DEPTH OF S COMPOUND A
—·—	PROPERTY BOUNDARY	
—10—	TCE ISOCONCENTRATION (	

NOTES:

1. CONCENTRATIONS OF C-DCE AN IN ug/L.
2. C-DCE - CIS-1.2 DICHLORO
   TCE - TRICHLOROETHENE
   N - C-DCE AND TCE NO
   NS - NOT SAMPLED.

0

FIGURE

TCE ISOCONCENT
DEEP GROUNDWATER SC
IRP SIT
151st ARW, UTAH AIR
SALT LAKE CITY INTERN
SALT LAKE CIT
STONE & WEBSTER ENGINEER
BOSTON, MASS.

DRAWING NUMBER 05219.0

DESIGNED BY:
DRAWN BY: G.C. CARTE
DSGN CHK'D BY:
CHK'D BY:

D	CORRECT	APPR DATE	ISSUE	DESCRIPTION	CHKD	CORRECT	APPR DATE	ISSUE	DESCRIPTION	CHKD	CORRECT	APPR DATE
			2					1	ORIGINAL ISSUE			
S.A.	FAC ELEC LTG	MATL	PC	ARCH CIVIL CONC STL L&P INST MD	P.S.	S.A. FAC ELEC LTG	MATL	PC	ARCH CIVIL CONC STL L&P INST MD	P.S.	S.A. FAC ELEC LTG	MATL

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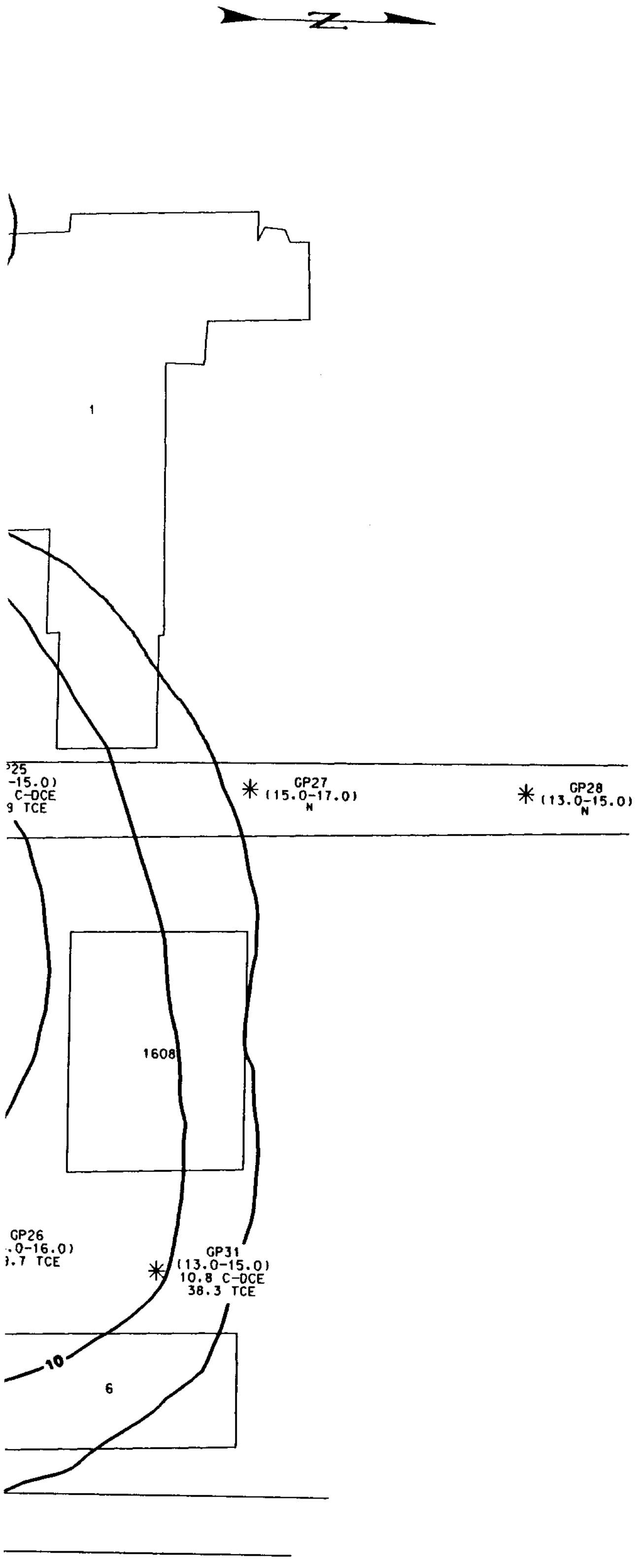

LEGEND:

✳ GP1 (13.0-15.0) 171.8 C-DCE 21.5 TCE	GEOPROBE SWEC (JUNE 1995) DEPTH OF SAMPLE BGS (FT) COMPOUND AND CONCENTRATION
———	PROPERTY BOUNDARY
—10—	TCE ISOCONCENTRATION CONTOUR LINE (ug/L).

NOTES:

1. CONCENTRATIONS OF C-DCE AND TCE SHOWN IN ug/L.
2. C-DCE - CIS-1.2 DICHLOROETHENE

   TCE - TRICHLOROETHENE

   N - C-DCE AND TCE NOT DETECTED AT SAMPLE LOCATION.

   NS - NOT SAMPLED.

0 50′

FIGURE 5-18

TCE ISOCONCENTRATIONS IN DEEP GROUNDWATER SCREENING SAMPLES IRP SITE 8

151st ARW, UTAH AIR NATIONAL GUARD
SALT LAKE CITY INTERNATIONAL AIRPORT
SALT LAKE CITY, UTAH
STONE & WEBSTER ENGINEERING CORPORATION
BOSTON, MASS.

DRAWING NUMBER 05219.002

CHKD	CORRECT	APPR DATE	ISSUE	DESCRIPTION	CHKD	CORRECT	APPR DATE
			1	ORIGINAL ISSUE			

P.S. | S.A. | FAC | ELEC | LTG | MATL | PC | ARCH | CIVIL | CONC | STL | L&P | INST | MD | P.S. | S.A. | FAC | ELEC | LTG | MATL

DESIGNED BY:
DSGN CHK'D BY:
DRAWN BY: G.C. CARTER
CHK'D BY:
AREAS | LEVELS | WORK PKG | PCT

ISSUE
HALF-SIZE
APP. CARD
RESP ENGR: K. MARONEY
SUPV: R.J. BOUDREAU

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In S8-GP9-GW1, S8-GP9-GW2, and S8-GP16-GW2, t-DCE was detected at concentrations of 466.5, 17.6, and 329.6 μg/l, respectively. Samples S8-GP9-GW1 and S8-GP9-GW2 were collected at the same location at interval depths of 9 to 11 and 13 to 15 feet. Sample S8-GP16-GW2 was collected from a depth interval of 13 to 15 feet. In the other groundwater samples, t-DCE was not detected at concentrations above the method detection limit of 0.5 μg/l.

1,1-DCA and 1,2-DCA were detected in three groundwater samples collected from Site 8 at concentrations ranging from 0.5 to 3.6 μg/l. Chloroform was detected in three groundwater samples collected from Site 8 at concentrations ranging from 1.3 to 2.2 μg/l. TCA was detected in 17 of the 71 samples collected at concentrations ranging from 2.3 to 98.7 μg/l. The highest concentrations of TCA were detected in the area around Building 1608.

PCE was detected in 10 of the 71 groundwater screening samples collected from Site 8 at concentrations ranging from 2.5 to 119.1 μg/l. The highest concentrations of PCE were detected in the areas east of Building 1506, near the intersection of F Street and 2nd Street, and northeast of Building 213 and between Buildings 213 and 1527.

Additionally, BTEX compounds were detected in several of the groundwater screening samples collected from Site 8. Benzene was detected in 9 of the 71 samples collected at concentrations ranging from 0.8 to 716.3 μg/l. Toluene was detected in sample S8-GP31-GW2 at a concentration of 174.7 μg/l. Ethylbenzene was detected in 6 of the 71 samples at concentrations ranging from 1.4 to 220.5 μg/l. Xylenes were detected in 6 of the 71 samples at concentrations ranging from 3.3 to 407.0 μg/l. The highest concentrations of BTEX compounds were detected in sample S8-GP14-GW1 collected in the former UST area at a depth of 8 to 10 feet BGS, and in sample S8-GP31-GW1 collected north of Site 8, in the vicinity of Building 1608. Groundwater screening results are summarized in Table 5-6. The locations and concentrations of petroleum compounds detected in the groundwater screening samples are shown on Figure 5-19.

5.3.3 Soil Investigation Findings

Ten soil borings were advanced on and around Site 8 on June 19 to 21, 1995. Borings were advanced by Layne Environmental Services (Layne) of Denver, Colorado. Soil samples were collected from the soil borings for chemical analysis. Soil borings were advanced in areas of highest contamination as determined by the screening results. Soil borings were advanced to the groundwater table, at a depth of approximately 6 feet BGS. Soil boring locations and sampling results are shown on Figure 5-20. Soil samples were submitted to ChemTech Analytical Laboratories (ChemTech) of Murray, Utah for VOC, TPH, SVOC, and PPM analyses.

A total of 26 investigative and three duplicate samples were collected from the 10 soil borings drilled at IRP Site 8. The number of soil samples collected from soil borings was reduced from 30 to 25 due to poor sample recovery and concrete in the top 2 feet of soil in soil borings S8-SB3, S8-SB6, S8-SB7, and S8-SB9. Laboratory data analysis results sheets for the soil samples at Site 8 are included in Appendix F.

Table 5-6
Volatile Organic Compounds Detected in Groundwater Screening Samples
IRP Site No. 8
151st ARW, Utah ANG
Salt Lake City, Utah

SAMPLE NUMBER:		UANG-S8-GP1-GW1	UANG-S8-GP1-GW2	UANG-S8-GP2-GW1	UANG-S8-GP2-GW2	UANG-S8-GP3-GW1	UANG-S8-GP3-GW2	UANG-S8-GP4-GW1	UANG-S8-GP4-GW1	UANG-S8-GP4-GW2	UANG-S8-GP5-GW1
SAMPLE DEPTH (FT):		8-10	13-15	8-10	13-15	8-10	14-16	8-10	8-10	13-15	8-10
COLLECTION DATE:		6/01/95	6/01/95	6/01/95	6/01/95	6/01/95	6/01/95	6/01/95	DUP	6/01/95	6/01/95
1,1 Dichloroethane	(ug/L)	3.6	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)
cis-1,2 Dichloroethene	(ug/L)	424.5	171.8	637.9	616.6	140.0	27.3	23.2	26.6	ND (0.50)	135.1
Chloroform	(ug/L)	ND (0.50)	2.2	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)
1,1,1 Trichloroethane	(ug/L)	8.0	2.3	9.2	8.8	3.0	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)
1,2 Dichloroethane	(ug/L)	1.4	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)
Trichloroethene	(ug/L)	54.8	21.5	145.8	59.7	459.7	6.1	16.2	14.3	4.2	95.6
Tetrachloroethene	(ug/L)	42.8	32.3	92.1	59.8	2.9	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)
Benzene	(ug/L)	0.8	1.5	ND (0.50)	11.1	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)

SAMPLE NUMBER:		UANG-S8-GP5-GW2	UANG-S8-GP6-GW1	UANG-S8-GP6-GW2	UANG-S8-GP7-GW1	UANG-S8-GP7-GW2	UANG-S8-GP9-GW1	UANG-S8-GP9-GW2	UANG-S8-GP9-GW2	UANG-S8-GP10-GW1	UANG-S8-GP10-GW2
SAMPLE DEPTH (FT):		13-15	8-10	13-15	9-11	13-15	9-11	13-15	13-15	9-11	13-15
COLLECTION DATE:		6/01/95	6/01/95	6/01/95	6/02/95	6/02/95	6/02/95	6/02/95	DUP	6/02/95	6/02/95
Trans-1,2 Dichloroethene	(ug/L)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	466.5	17.6	19.9	ND (0.50)	ND (0.50)
cis-1,2 Dichloroethene	(ug/L)	ND (0.50)	ND (0.50)	ND (0.50)	2.6	ND (0.50)	328.3	22.7	25.1	4.4	ND (0.50)
Trichloroethene	(ug/L)	4.1	3.1	2.5	9.7	2.2	1143.2	12.5	19.2	35.9	13.8

Shaded values indicate concentrations above established ARAR values
DUP = duplicate sample
ND = Not detected above the method detection limit shown in parentheses
Analyses performed in TEG's CA DHS certified mobile lab (#1671)
Soil samples analyzed for VOCs by EPA methods 8010/8020

Table 5-6
Volatile Organic Compounds Detected in Groundwater Screening Samples
IRP Site No. 8
151st ARW, Utah ANG
Salt Lake City, Utah

SAMPLE NUMBER: SAMPLE DEPTH (FT): COLLECTION DATE:		UANG-S8-GP11-GW1 9-11 6/02/95	UANG-S8-GP11-GW2 13-15 6/02/95	UANG-S8-GP12-GW1 9.6-11.6 6/02/95	UANG-S8-GP12-GW2 13-15 6/02/95	UANG-S8-GP13-GW1 10-12 6/02/95	UANG-S8-GP13-GW2 13-15 6/02/95	UANG-S8-GP14-GW1 8-10 6/04/95	UANG-S8-GP14-GW2 13-15 6/04/95	UANG-S8-GP15-GW1 8-10 6/04/95	UANG-S8-GP15-GW2 13-15 6/04/95
cis-1,2 Dichloroethene	(ug/L)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	20.8	ND (0.50)
1,1,1 Trichloroethane	(ug/L)	ND (0.50)	ND (0.50)	ND (0.50)	3.6	ND (0.50)	ND (0.50)	ND (0.50)	6.5	4.4	ND (0.50)
Trichloroethene	(ug/L)	4.1	5.8	3.7	3.6	20.2	6.9	ND (0.50)	3.9	153.5	5.5
Benzene	(ug/L)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	627.5	7.7	ND (0.50)	ND (0.50)
Ethylbenzene	(ug/L)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	220.5	ND (0.50)	ND (0.50)	ND (0.50)

SAMPLE NUMBER: SAMPLE DEPTH (FT): COLLECTION DATE:		UANG-S8-GP16-GW1 9-11 6/04/95	UANG-S8-GP16-GW1 9-11 DUP	UANG-S8-GP16-GW2 13-15 6/04/95	UANG-S8-GP17-GW1 8-10 6/12/95	UANG-S8-GP17-GW2 13-15 6/12/95	UANG-S8-GP18-GW1 8-10 6/12/95	UANG-S8-GP18-GW2 13-15 6/12/95	UANG-S8-GP19-GW1 8-10 6/12/95	UANG-S8-GP19-GW2 13-15 6/12/95	UANG-S8-GP20-GW1 9-11 6/12/95
Trans-1,2 Dichloroethene	(ug/L)	ND (0.50)	ND (0.50)	329.6	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)
cis-1,2 Dichloroethene	(ug/L)	ND (0.50)	ND (0.50)	5138.6	69.4	9916.7	ND (0.50)	ND (0.50)	ND (0.50)	184.6	250.3
1,1,1 Trichloroethane	(ug/L)	4.1	5.1	98.7	27.1	ND (0.50)	3.8	ND (0.50)	4.7	ND (0.50)	ND (0.50)
Trichloroethene	(ug/L)	3.9	4.5	606.8	1112.1	8225.2	14.2	17.5	45.5	575.0	6319.8
Tetrachloroethene	(ug/L)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	2.5	119.1

Shaded values indicate concentrations above established ARAR values
DUP = duplicate sample
ND = Not detected above the method detection limit shown in parentheses
Analyses performed in TEG's CA DHS certified mobile lab (#1671)
Soil samples analyzed for VOCs by EPA methods 8010/8020

Table 5-6
Volatile Organic Compounds Detected in Groundwater Screening Samples
IRP Site No. 8
151st ARW, Utah ANG
Salt Lake City, Utah

SAMPLE NUMBER:		UANG-S8-GP20-GW2	UANG-S8-GP21-GW1	UANG-S8-GP22-GW1	UANG-S8-GP22-GW1	UANG-S8-GP23-GW1	UANG-S8-GP23-GW2	UANG-S8-GP24-GW1	UANG-S8-GP25-GW1	UANG-S8-GP25-GW2	UANG-S8-GP26-GW1
SAMPLE DEPTH (FT):		14-16	9-11	9-11	9-11	8-10	13-15	13-15	8-10	13-15	9-11
COLLECTION DATE:		6/12/95	6/13/95	6/13/95	DUP	6/13/95	6/13/95	6/13/95	6/13/95	6/13/95	6/13/95
cis-1,2 Dichloroethene	(ug/L)	16.8	ND (0.50)	82.0	68.2	ND (0.50)	ND (0.50)	144.2	ND (0.50)	195.6	122.1
1,1,1 Trichloroethane	(ug/L)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	46.5	45.9	ND (0.50)	36.9
Trichloroethene	(ug/L)	113.0	4.1	14.0	13.5	9.4	12.9	38.0	635.0	319.9	151.3
Tetrachloroethene	(ug/L)	1.9	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	55.2	40.8	ND (0.50)
Benzene	(ug/L)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	23.1	48.6

SAMPLE NUMBER:		UANG-S8-GP26-GW2	UANG-S8-GP27-GW1	UANG-S8-GP27-GW2	UANG-S8-GP28-GW1	UANG-S8-GP28-GW2	UANG-S8-GP29-GW1	UANG-S8-GP29-GW2	UANG-S8-GP30-GW1	UANG-S8-GP30-GW2	UANG-S8-GP31-GW1
SAMPLE DEPTH (FT):		14-16	7-9	15-17	9-11	13-15	8-10	13-15	8-10	13-15	7-9
COLLECTION DATE:		6/13/95	6/19/95	6/19/95	6/19/95	6/19/95	6/19/95	6/19/95	6/19/95	6/19/95	6/19/95
1,1 Dichloroethane	(ug/L)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	0.5	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)
cis-1,2 Dichloroethene	(ug/L)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	4.1	1208.7	66.2	ND (0.50)	3.7
Chloroform	(ug/L)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	1.3	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)
1,1,1 Trichloroethane	(ug/L)	61.3	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)
1,2 Dichloroethane	(ug/L)	ND (0.50)	ND (0.50)	1.0	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)
Trichloroethene	(ug/L)	69.7	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	9.4	368.9	657.4	21680	94.4
Benzene	(ug/L)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	13.9	ND (0.50)	ND (0.50)	716.3
Toluene	(ug/L)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	174.7
Ethylbenzene	(ug/L)	ND (0.50)	211.6	ND (0.50)	4.6	ND (0.50)	1.4	ND (0.50)	35.4	ND (0.50)	121.8
Total Xylenes	(ug/L)	ND (0.50)	138.4	ND (0.50)	4.0	3.3	ND (0.50)	18.2	12.7	ND (0.50)	407.0

Shaded values indicate concentrations above established ARAR values

DUP = duplicate sample

ND = Not detected above the method detection limit shown in parentheses

Analyses performed in TEG's CA DHS certified mobile lab (#1671)

Soil samples analyzed for VOCs by EPA methods 8010/8020

Table 5-6
Volatile Organic Compounds Detected in Groundwater Screening Samples
IRP Site No. 8
151st ARW, Utah ANG
Salt Lake City, Utah

SAMPLE NUMBER: SAMPLE DEPTH (FT): COLLECTION DATE:		UANG-S8-GP31-GW2 13-15 6/19/95	UANG-S8-GP32-GW1 8-10 6/19/95	UANG-S8-GP32-GW2 13-15 6/19/95	UANG-S8-GP33-GW1 10-12 6/20/95	UANG-S8-GP33-GW1 10-12 DUP	UANG-S8-GP33-GW2 15-17 6/20/95	UANG-S8-GP34-GW2 13-15 6/20/95	UANG-S8-GP35-GW1 9-11 6/20/95	UANG-S8-GP35-GW2 13-15 6/20/95	UANG-S8-GP36-GW1 8-10 6/20/95	UANG-S8-GP36-GW2 15-17 6/20/95
cis-1,2 Dichloroethene	(ug/L)	10.8	169.5	412.5	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	660.6	9031.0	665.2	161.1
Chloroform	(ug/L)	ND (0.50)	ND (0.50)	ND (0.50)	1.7	1.1	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)
1,2 Dichloroethane	(ug/L)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)
Trichloroethene	(ug/L)	38.3	26.9	41.8	7.7	7.4	1.0	8.4	19980	38960	124.3	11.6
Benzene	(ug/L)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	139.3	ND (0.50)

Shaded values indicate concentrations above established ARAR values

DUP = duplicate sample

ND = Not detected above the method detection limit shown in parentheses

Analyses performed in TEG's CA DHS certified mobile lab (#1671)

Soil samples analyzed for VOCs by EPA methods 8010/8020

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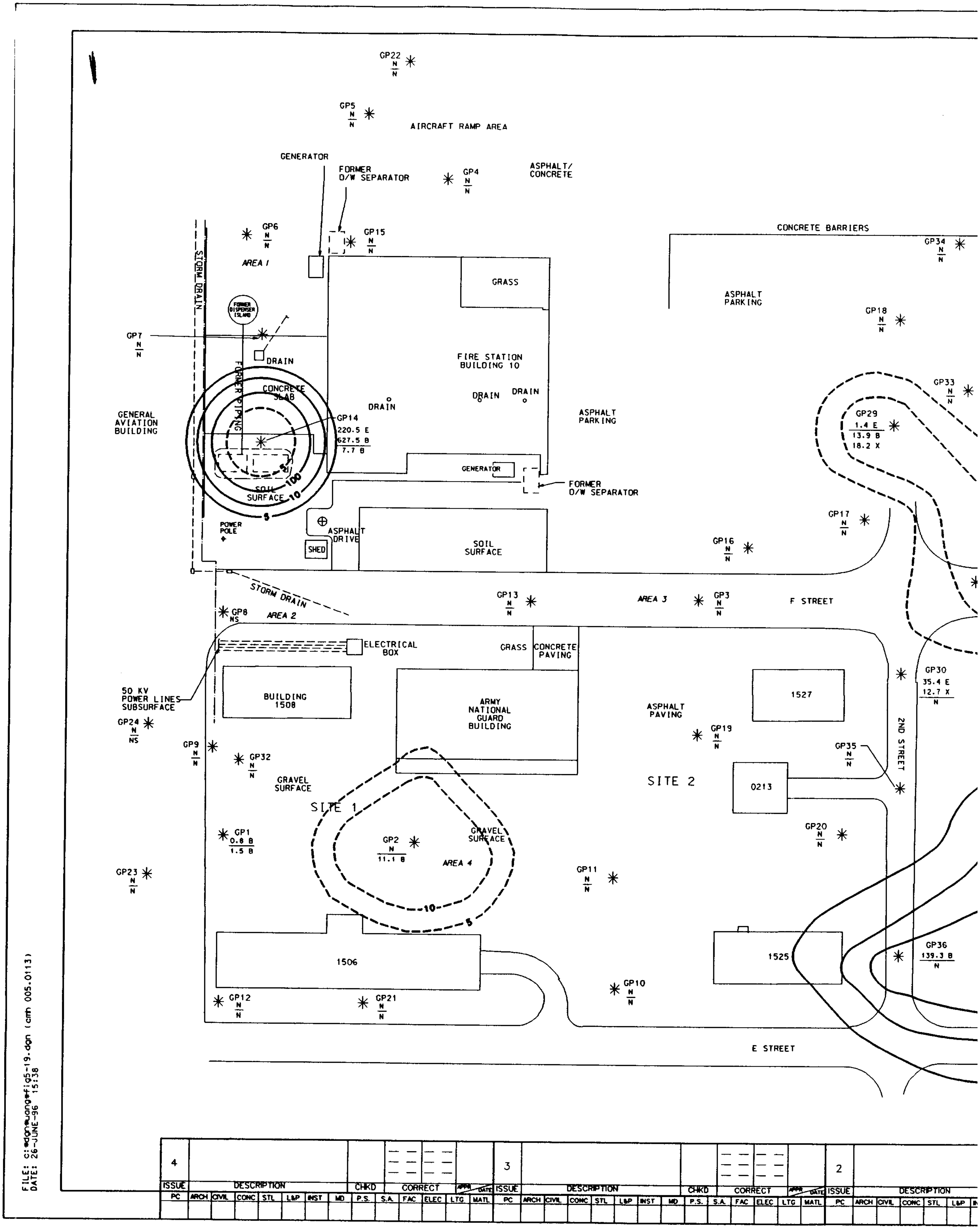

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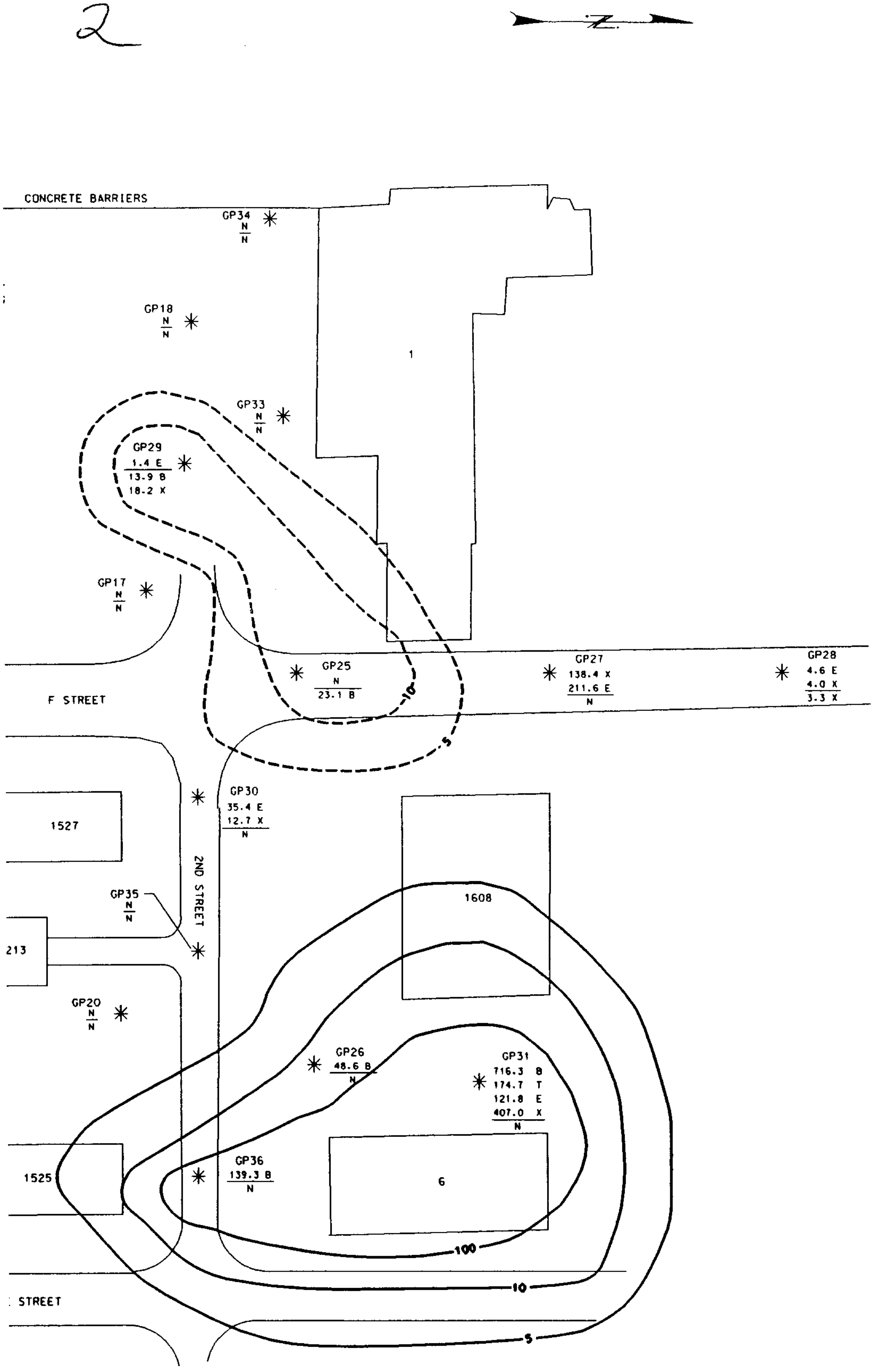

LEGEND:

✳ GEOPROBE SWEC - GROUND
LOCATION (JUNE 1995)

NOTES:

1. PETROLEUM COMPOUND CONCENTR
SHOWN WERE DETECTED.
2. CONCENTRATIONS OF COMPOUNDS
IN SHALLOW/DEEP INTERVALS.
3. CONCENTRATIONS ARE IN ug/L.

B	BENZENE
T	TOLUENE
E	ETHYLBENZENE
X	XYLENE
N	BTEX COMPOUNDS NOT DETECTED IN SAMPLE.
NS	NOT SAMPLED.

--·10--· SHALLOW BENZENE ISOCONCENTRATION

—10— DEEP BENZENE ISOCONCENTRATION CON

0 50'

FIGURE 5-

BTEX COMPOUNDS DE
IN GROUNDWATER SCREENI
IRP SITE 8

151st ARW, UTAH AIR NATI
SALT LAKE CITY INTERNATIO
SALT LAKE CITY, U
STONE & WEBSTER ENGINEERING CO
BOSTON, MASS.

DRAWING NUMBER 05219.002

ISSUE	DESCRIPTION	CHKD	CORRECT	ISSUE	DESCRIPTION	CHKD	CORRECT
2				1	ORIGINAL ISSUE		

ECT APPR DATE ISSUE DESCRIPTION CHKD CORRECT APPR DATE ISSUE DESCRIPTION CHKD CORRECT APPR DATE
ELEC LTG MATL PC ARCH CIVIL CONC STL L&P INST MD P.S. S.A. FAC ELEC LTG MATL PC ARCH CIVIL CONC STL L&P INST MD P.S. S.A. FAC ELEC LTG MATL

DESIGNED BY: DRAWN BY: G.C. CARTER
DSGN CHK'D BY: CHK'D BY:

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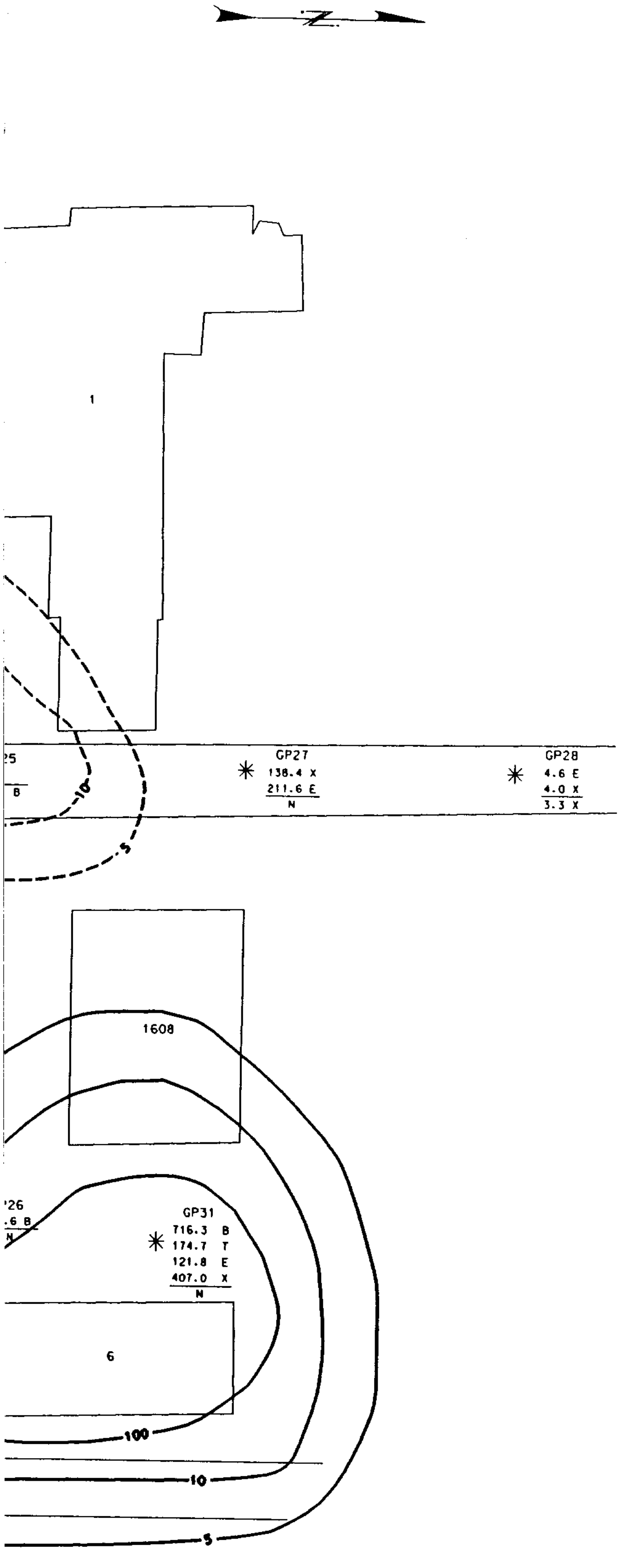

LEGEND:

✳ GEOPROBE SWEC - GROUNDWATER SCREENING LOCATION (JUNE 1995)

NOTES:

1. PETROLEUM COMPOUND CONCENTRATIONS SHOWN WERE DETECTED.
2. CONCENTRATIONS OF COMPOUNDS SHOWN IN SHALLOW/DEEP INTERVALS.
3. CONCENTRATIONS ARE IN ug/L.

B	BENZENE
T	TOLUENE
E	ETHYLBENZENE
X	XYLENE
N	BTEX COMPOUNDS NOT DETECTED IN SAMPLE.
NS	NOT SAMPLED.

--10-- SHALLOW BENZENE ISOCONCENTRATION CONTOUR LINE (ug/L)

—10— DEEP BENZENE ISOCONCENTRATION CONTOUR LINE (ug/L)

0 50′

FIGURE 5-19

BTEX COMPOUNDS DETECTED IN GROUNDWATER SCREENING SAMPLES IRP SITE 8

151st ARW, UTAH AIR NATIONAL GUARD
SALT LAKE CITY INTERNATIONAL AIRPORT
SALT LAKE CITY, UTAH
STONE & WEBSTER ENGINEERING CORPORATION
BOSTON, MASS.

DRAWING NUMBER 05219.002

DESIGNED BY:
DSGN CHK'D BY:
DRAWN BY: G.C. CARTER
CHK'D BY:

AREAS	LEVELS	WORK PKG	PCT

ISSUE
HALF-SIZE
APP. CARD
RESP ENGR: K. MARONEY
SUPV: R.J. BOUDREAU

CHKD	CORRECT	APPR DATE	ISSUE	DESCRIPTION	CHKD	CORRECT	APPR DATE
			1	ORIGINAL ISSUE			

P.S.	S.A.	FAC	ELEC	LTG	MATL	PC	ARCH	CIVIL	CONC	STL	L&P	INST	MD	P.S.	S.A.	FAC	ELEC	LTG	MATL

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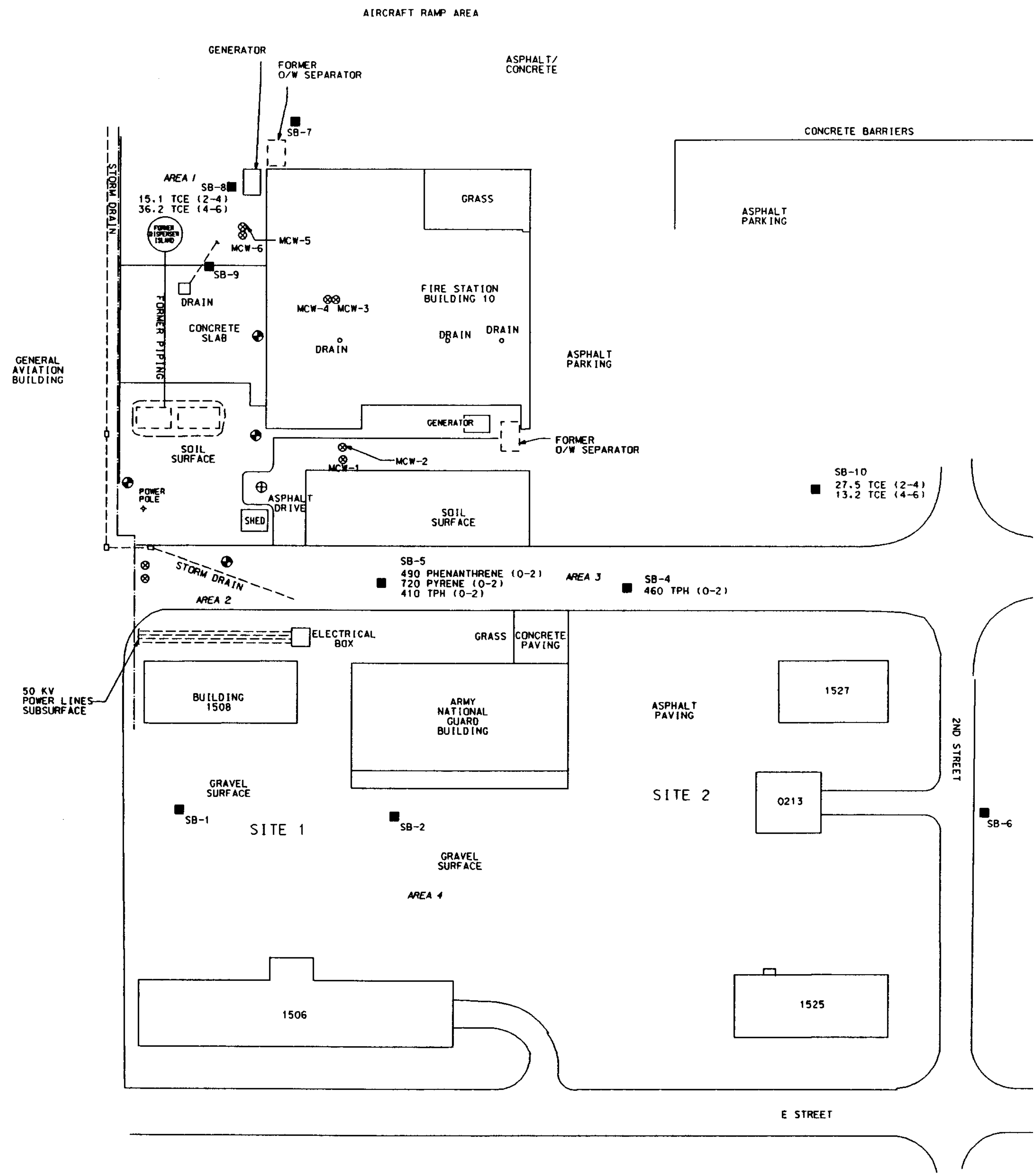

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ISSUE	DESCRIPTION	CHKD	CORRECT	APPR DATE	ISSUE	DESCRIPTION	CHKD	CORRECT	APPR DATE	ISSUE	DESCRIPTION

PC	ARCH	CIVIL	CONC	STL	L&P	INST	MD	P.S.	S.A.	FAC	ELEC	LTG	MATL	PC	ARCH	CIVIL	CONC	STL	L&P	INST	MD	P.S.	S.A.	FAC	ELEC	LTG	MATL	PC	ARCH	CIVIL	CONC	STL

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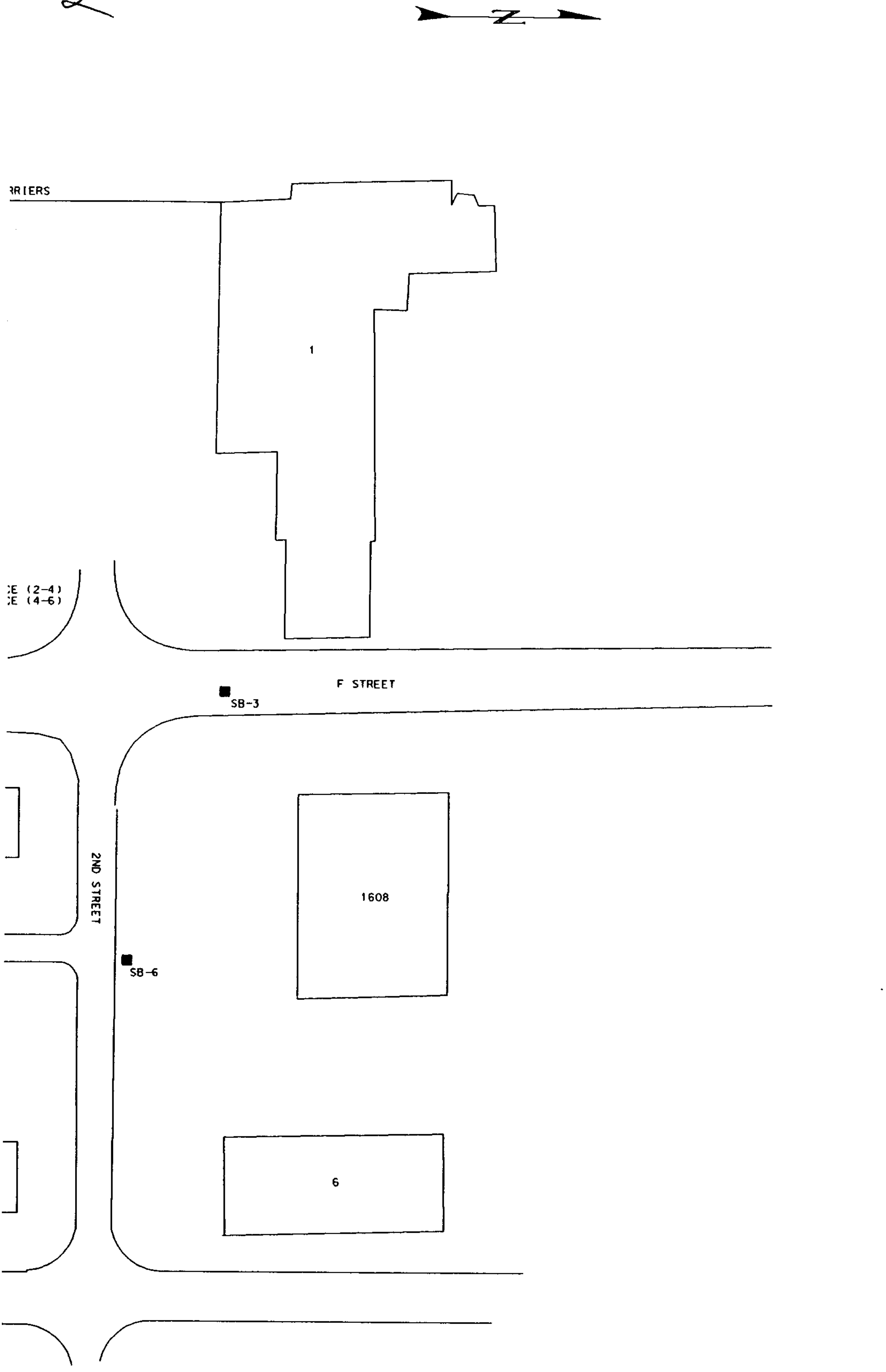

LEGEND:
SAMPLE LOCATIONS

■ SOIL BORING SWEC (JUNE 1995)
—— PROPERTY BOUNDARY
(2-4) SAMPLE DEPTH INTERVAL (FEET)

NOTES:

1. CONCENTRATIONS OF CONTAMINANTS SHOWN IN ug/KG.
2. N - CONTAMINANTS NOT DETECTED ABOVE METHOD DETECTION LIMITS.

TCE = TRICHLOROETHENE
E = ETHYLBENZENE
TPH = TOTAL PETROLEUM HYDROCARBONS

0 50′

FIGURE 5-20

SOIL BORING LOCATIONS AND SAMPLING RESULTS IRP SITE 8

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ISSUE	DESCRIPTION	CHKD	CORRECT	APPR DATE	ISSUE	DESCRIPTION	CHKD	CORRECT	APPR DATE
2					1	ORIGINAL ISSUE			

PC ARCH CIVIL CONC STL L&P INST MD P.S. S.A. FAC ELEC LTG MATL PC ARCH CIVIL CONC STL L&P INST MD P.S. S.A. FAC ELEC LTG MATL

DESIGNED BY:
DRAWN BY: G.C. CARTER
AREAS
LEVELS
DSGN CHK'D BY:
CHK'D BY:

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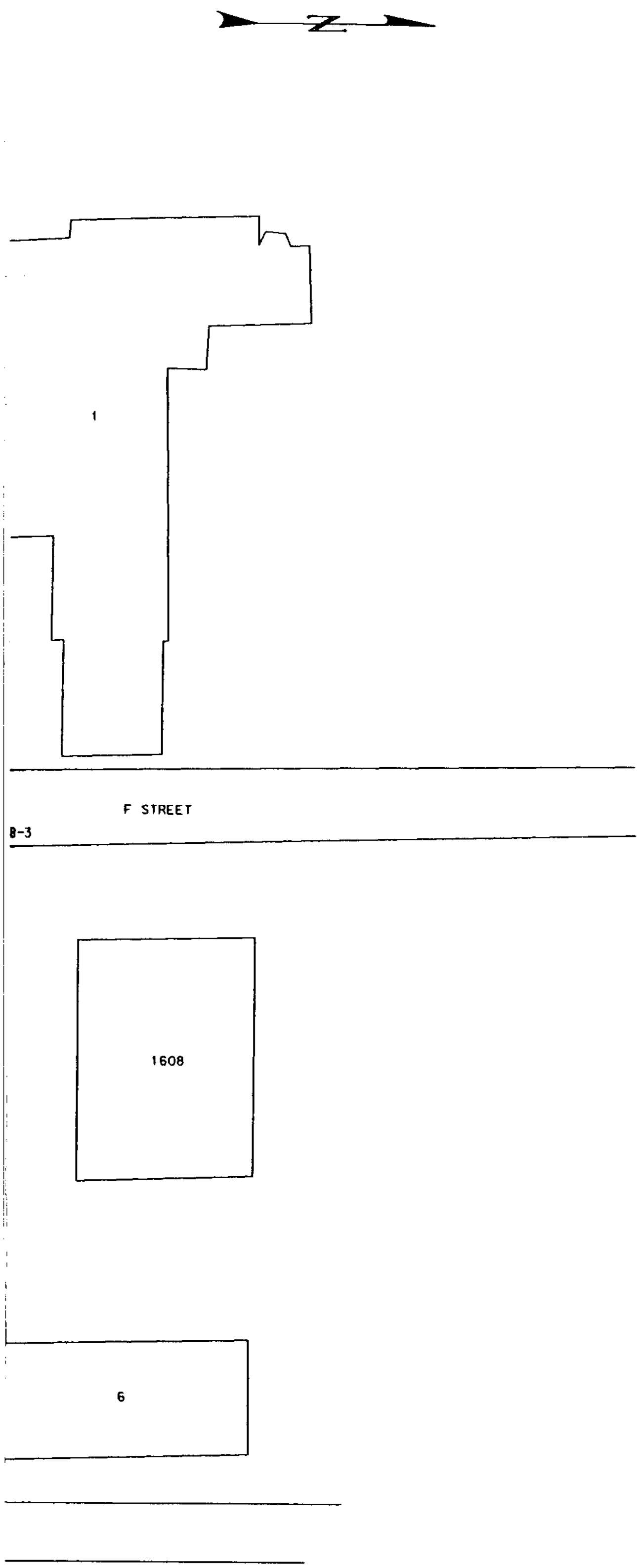

LEGEND:
SAMPLE LOCATIONS

■	SOIL BORING SWEC (JUNE 1995)
——	PROPERTY BOUNDARY
(2-4)	SAMPLE DEPTH INTERVAL (FEET)

NOTES:

1. CONCENTRATIONS OF CONTAMINANTS SHOWN IN ug/KG.
2. N - CONTAMINANTS NOT DETECTED ABOVE METHOD DETECTION LIMITS.

TCE = TRICHLOROETHENE
E = ETHYLBENZENE
TPH = TOTAL PETROLEUM HYDROCARBONS

0 50'

FIGURE 5-20

SOIL BORING LOCATIONS AND SAMPLING RESULTS IRP SITE 8

151st ARW, UTAH AIR NATIONAL GUARD
SALT LAKE CITY INTERNATIONAL AIRPORT
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DSGN CHK'D BY:
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AREAS LEVELS WORK PKG PCT

RESP ENGR: K. MARONEY
SUPV: R.J. BOUDREAU

ISSUE
HALF-SIZE APP. CARD

CHKD	CORRECT	APPR DATE	ISSUE	DESCRIPTION	CHKD	CORRECT	APPR DATE
			1	ORIGINAL ISSUE			

D P.S. S.A. FAC ELEC LTG MATL PC ARCH CIVIL CONC STL L&P INST MD P.S. S.A. FAC ELEC LTG MATL

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5.3.3.1 VOC Analytical Results

TCE was detected in soil samples collected from soil borings S8-SB8 and S8-SB10. TCE was detected in soil boring S8-SB8 at a concentration of 0.0151 ppm (15.1 μg/kg) in the soil sample collected from the interval of 2 to 4 feet BGS and at a concentration of 0.0362 ppm (36.2 μg/kg) in the soil sample collected from a depth of 4 to 6 feet BGS. TCE was also detected in soil samples collected from S8-SB10 at a concentration of 0.0275 ppm (27.5 μg/kg) in the sample collected from a depth of 2 to 4 feet BGS, and at a concentration of 0.0132 ppm (13.2 μg/kg) in the sample collected from a depth of 4 to 6 feet BGS. The distribution of TCE is shown on the geologic cross-sections (Figures 5-4 through 5-8).

5.3.3.2 SVOC Analytical Results

Phenanthrene and pyrene were detected in the soil sample collected from the 0- to 2-foot interval in soil boring S8-SB5 at concentrations of 490 and 720 μg/kg, respectively. SVOCs were not detected in the remaining soil samples at concentrations above the method detection limits.

5.3.3.3 BTEX Analytical Results

Ethylbenzene was detected at a concentration of 0.431 ppm (43.1 μg/kg) in the soil sample collected from the 4- to 6-foot BGS interval at S8-SB3. BTEX compounds were not detected in the remaining soil samples at concentrations above the method detection limits.

5.3.3.4 TPH Analytical Results

TPH was detected in the soil sample collected from 0 to 2 feet in soil boring S8-SB4 at a concentration of 460 ppm (460 mg/kg). TPH was also detected in the sample collected from 0 to 2 feet in S8-SB5 at a concentration of 410 ppm (410 mg/kg). TPH was not detected in the remaining samples at concentrations above the method detection limit.

5.3.3.5 PPM Analytical Results

Several metals were detected in the soil samples collected from Site 8, including mercury, beryllium, cadmium, chromium, copper, nickel, zinc, arsenic, lead, and selenium. A summary of the ranges of concentrations of metals detected in the soil samples is provided in Table 5-7. For comparison, background soil sample concentrations and concentration ranges for metals in the Western U.S. are also included in this table. Detailed results of metals analyses are summarized in Table 5-8. As shown in Table 5-8, cadmium, nickel, zinc, arsenic, lead, and selenium, were detected in concentrations higher than background concentrations for the site. However, concentrations of metals detected were all within the concentration ranges for these metals detected in the western U.S.

5.3.4 Groundwater Investigation Findings

Seven groundwater monitoring wells, designated MW-6 through MW-12, and one free product well, designated FP-1, were installed at Site 8 from June 21 to 26, 1995.

Table 5-7
Concentration Range of Metals Detected in Soil Samples
IRP Site 8
151st ARW, Air National Guard, Salt Lake City, Utah

Metal	Concentrations Detected (mg/kg)	Concentrations Detected in Background Soil Samples - Utah ANG Base (mg/kg)	Concentration Ranges of Elements in Soil Samples in Western U.S. (mg/kg)
Mercury	0.075 - 0.14	0.033- 0.067	0.01 - 4.6
Beryllium	0.2 - 0.29	0.37-0.50	<1 - 15
Cadmium	**0.7 - 2.3**	0.22-0.36	NA
Chromium	6.3 - 15.1	9.5-14	3 - 2,000
Copper	5.2 - 28.8	8.2-28.1	2 - 300
Nickel	**5.4 - 14.7**	6-9.5	<5 - 700
Zinc	**19.3 - 65.1**	25.2-52	10 - 2,100
Arsenic	**4.4 - 20.4**	3.7-12.5	<0.10 - 97
Lead	**7.1 - 30**	9.8-22.6	<10 - 700
Selenium	**1.3**	0.46	<0.01 - 4.3

NA = Not applicable
Source: USGS, 1984.
Bolded concentrations exceed background values by more than 10 percent.

Only one of the three planned floating product wells was installed at Site 8 as floating product was not observed during screening activities. The floating product well was installed in the vicinity of a former oil/water separator where elevated concentrations of TCE (1,290 ug/L) and TPH (80.2 ug/L) had been detected during past investigations. Organic vapors were not detected during the headspace screening of the soil samples collected from the boring in which the floating product well was installed above a concentration of 2.5 ppm. Samples of water were collected from the well and checked for the presence of free product on the day of, and approximately one week after installation. No evidence of free product was observed on the water samples. No additional sampling or testing was performed on this well.

Table 5-8
Metals Detected in Soil Samples
IRP Site No. 8
151st ARW, Utah Air National Guard
Salt Lake City, Utah

SAMPLE ID. ID.	depth (feet)	*Metals (mg/Kg)*								
		Mercury	Beryllium	Cadmium	Chromium	Copper	Nickel	Zinc	Arsenic	Lead
SB-1	0-2	ND (0.05)	ND (0.50)	1	10	20	9.3	52	13	30
SB-1	2-4	ND (0.05)	ND (0.50)	ND (0.50)	11	16	9.2	53	5	24
SB-1	4-6	ND (0.05)	ND (0.50)	2.3	12	22	10	58	13	34
SB-2	0-2	0.086	ND (0.50)	1.2	12	24	11	54	15	20
SB-2	2-4	ND (0.05)	0.2	0.95	12	22	11	63	13	16
SB-2 (DUP)	2-4	0.065	0.22	1.2	13	23	11	58	15	22
SB-2	4-6	0.075	0.29	1.1	14	25	12	58	11	21
SB-3	2-4	ND (0.05)	ND (0.50)	ND (0.50)	8.9	24.2	11.1	44.5	16.2	17.8
SB-3	4-6	ND (0.05)	ND (0.50)	1.3	15.1	28.8	14.7	65.1	20.4	24.5
SB-4	0-2	ND (0.05)	ND (0.50)	ND (0.50)	6.3	5.2	5.4	19.3	7.1	7.1
SB-4	2-4	ND (0.05)	ND (0.50)	0.95	11.4	19.4	10.3	47.9	7.8	18.6
SB-4	4-6	ND (0.05)	ND (0.50)	ND (0.50)	10.3	10.2	7.8	30.4	10.7	12.4
SB-5	0-2	ND (0.05)	ND (0.50)	ND (0.50)	9.5	6.2	10.6	28.2	4.4	8.6
SB-5	2-4	ND (0.05)	ND (0.50)	1	12.6	20.7	11.2	52.4	6.8	16.1
SB-5	4-6	ND (0.05)	ND (0.50)	ND (0.50)	10.5	19.4	10.5	52.2	9.8	14.6
SB-5 (DUP)	4-6	ND (0.05)	ND (0.50)	0.9	15.5	19.2	11.3	49.8	7.1	14.1
SB-6	2-4	ND (0.05)	ND (0.50)	1.2	13.8	27.9	14.1	64.6	11.3	16.8
SB-6	4-6	ND (0.05)	ND (0.50)	1.2	14.3	28.2	14.1	62.4	18.1	19.7
SB-7	2-4	ND (0.05)	ND (0.50)	ND (0.50)	10.7	20.9	10.5	45.4	10.1	11.9
SB-7	4-6	ND (0.05)	ND (0.50)	0.86	11.5	25.6	10.6	54.4	12.6	16.4
SB-8	2-4	ND (0.05)	ND (0.50)	0.73	7.3	11.3	8.2	40.6	5.3	8.2
SB-8	4-6	ND (0.05)	ND (0.50)	1.02	12.9	24.5	11.3	58	8.4	14.5
SB-9	0-2	ND (0.05)	ND (0.50)	0.9	11.1	18.3	11	45.9	8.5	9
SB-9	2-4	ND (0.05)	ND (0.50)	0.7	7.3	13.9	7.7	35.8	8.8	8.6
SB-9	4-6	ND (0.05)	ND (0.50)	0.93	12.2	24.6	12.7	61.1	5.8	17.4
SB-10	0-2	0.14	ND (0.50)	0.95	11.1	22.5	10.3	50.8	7.1	22.6
SB-10	2-4	ND (0.05)	ND (0.50)	0.95	13.6	20.8	11.4	53.9	6.7	19.4
SB-10	4-6	ND (0.05)	ND (0.50)	0.91	11.2	22.4	10.7	49.6	10.3	21.8
SB-10 (DUP)	4-6	ND (0.05)	ND (0.50)	1.15	13.9	27.2	12.9	62.8	10.8	24.9

Shaded areas indicate concentrations detected above established ARAR values

ND = not detected above method detection limit shown in parentheses

Priority Pollutant metals analyzed by EPA method sw6010

DUP = Duplicate

Monitoring well locations are shown on Figure 5-21. The number of monitoring wells installed at Site 8 was increased from 4 to 7 to cover the upgradient and downgradient perimeter of the area where halogenated compounds were detected during screening activities. Monitoring well construction diagrams are included as Appendix G.

Two rounds of groundwater samples were collected from the newly installed wells. The first round was conducted from June 23 to 30, 1995. The second round was conducted from August 2 to 10, 1995. Existing monitoring wells and microwells were sampled from May 30 to June 7, 1995, prior to the installation of the new wells. A second round of sampling the existing monitoring and microwells was performed concurrently with the second round of sampling the newly installed wells in August 1995. Microwell MCW4 was dry during the second round of groundwater sampling and therefore was not sampled. Groundwater samples were submitted to ChemTech for VOC, TPH, SVOC, and PPM analyses.

5.3.4.1 Water Sampling Parameters

Temperature, pH, and specific conductance were measured during groundwater sampling. Values recorded during the first and second rounds of sampling are shown on Table 5-9. Temperature ranged from 56.1 to 70.0°F. The pH varied from 7.95 to 9.10. Specific conductance ranged from 942 to 11,380 micromhos (μmhos). Sampling parameters were recorded on sampling log forms provided in Appendix H. Although elevated temperature, pH, and specific conductance values can, on occasion, be correlated to areas having elevated contaminant concentrations, no such correlation could be made at Site 8.

5.3.4.2 VOC Analytical Results

Chloroform, 1,1-DCA, 1,2-DCA, 1,1-dichloroethene (1,1-DCE), t-DCE, TCA, TCE and vinyl chloride were detected in groundwater samples collected at IRP Site 8. Sample designations and concentrations are shown on Table 5-10.

First Round of Groundwater Sampling

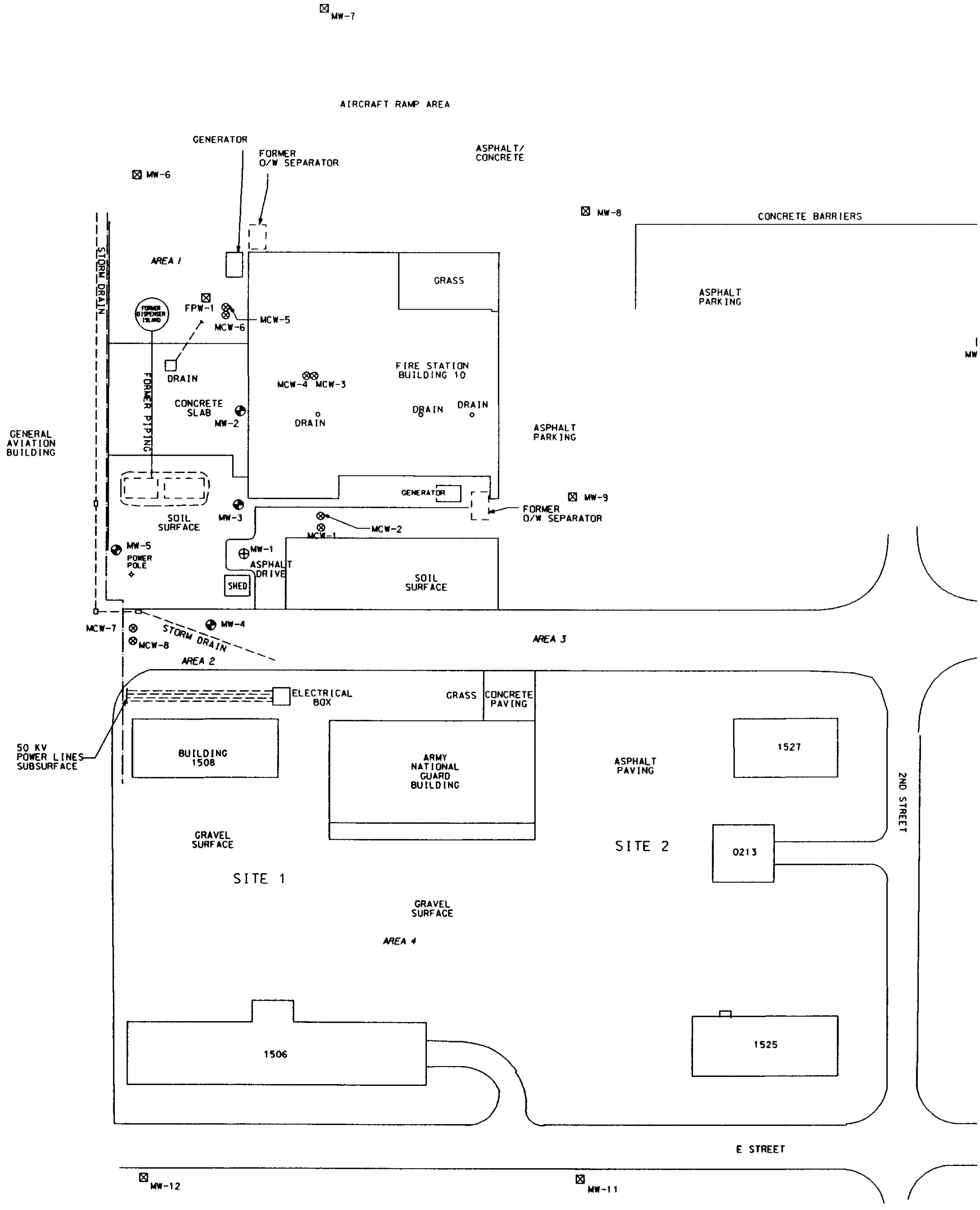
Eight VOCs were detected in groundwater samples collected during the first round of groundwater sampling.

Chloroform, 1,1-DCA, 1,2-DCA, 1,1-DCE, TCE, and vinyl chloride were detected in groundwater samples at concentrations ranging from 1.0 to 11.0 μg/l.

Groundwater samples collected from MW3, MCW5, MCW6, and MCW8 showed t-DCE at concentrations ranging from 1.0 to 28.6 μg/l. The highest concentration of t-DCE was detected in the groundwater sample collected from MCW6.

TCE was detected in 13 groundwater samples at concentrations ranging from 1.2 to 352 μg/l. The highest concentrations of TCE were detected in the groundwater samples collected from MCW5 and MCW6. The extent of TCE detected during the first round of groundwater sampling is shown on Figure 5-22.

1



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PC	ARCH	CIVIL	CONC	STL	L&P	INST	MD	P.S.	S.A.	FAC	ELEC	LTG	MATL	PC	ARCH	CIVIL	CONC	STL	L&P	INST	MD	P.S.	S.A.	FAC	ELEC	LTG	MATL	PC	ARCH	CIVIL	CONC	STL

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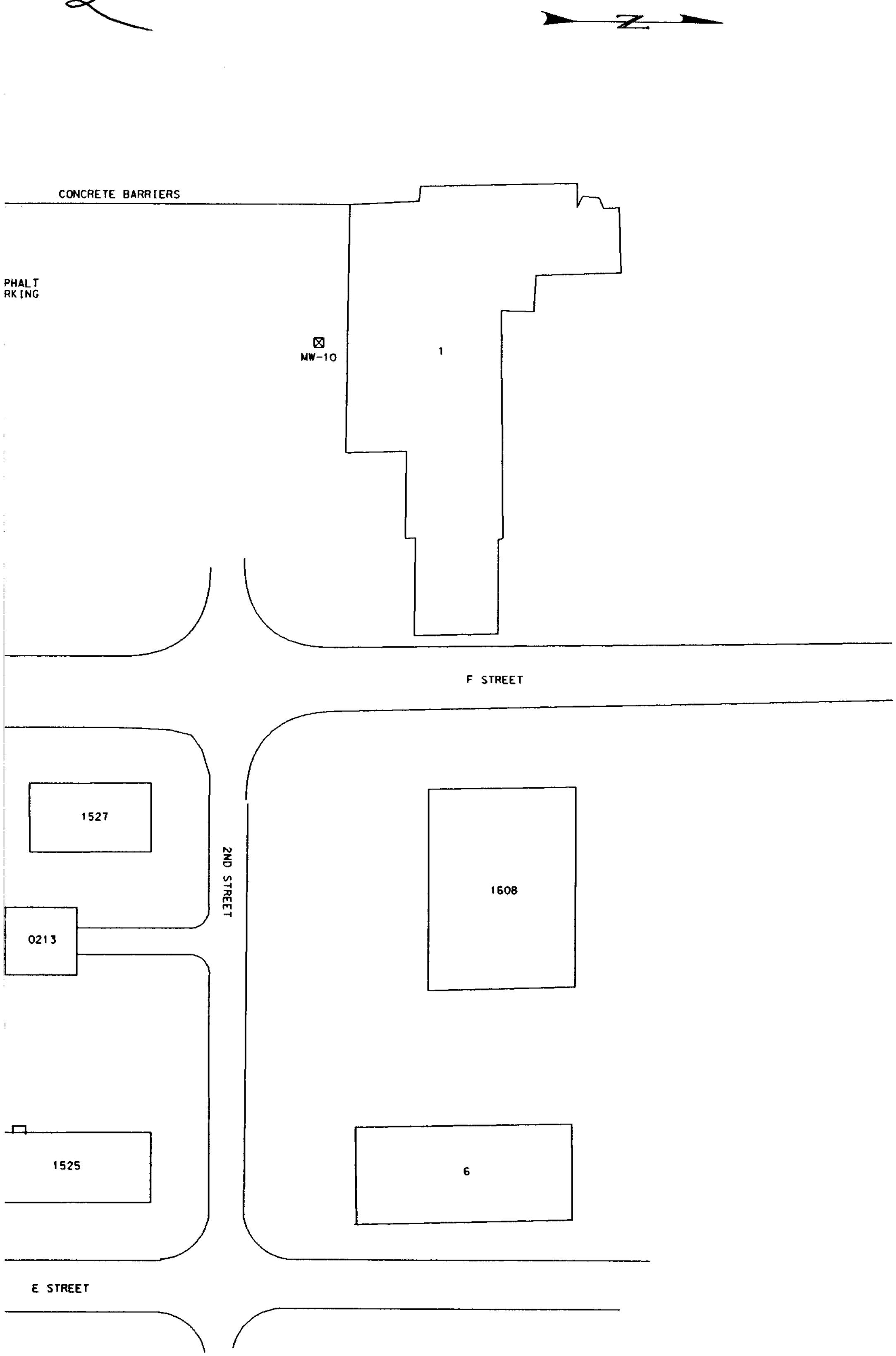

LEGEND:

⊕ MONITORING WELL PAR
(JANUARY 1993)

◐ MONITORING WELL PAR
(APRIL 1994)

⊗ MICRO-WELL PARSONS
(JUNE 1994)

☒ MONITORING WELL SWE
(JUNE 1995)

—·— PROPERTY BOUNDARY

0 50'

FIGURE 5-

MONITORING WELL LO
IRP SITE 8

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ISSUE	DESCRIPTION	CHKD	CORRECT	APPR DATE
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CORRECT: FAC ELEC LTG MATL
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DESCRIPTION: ARCH CIVIL CONC STL L&P INST MD
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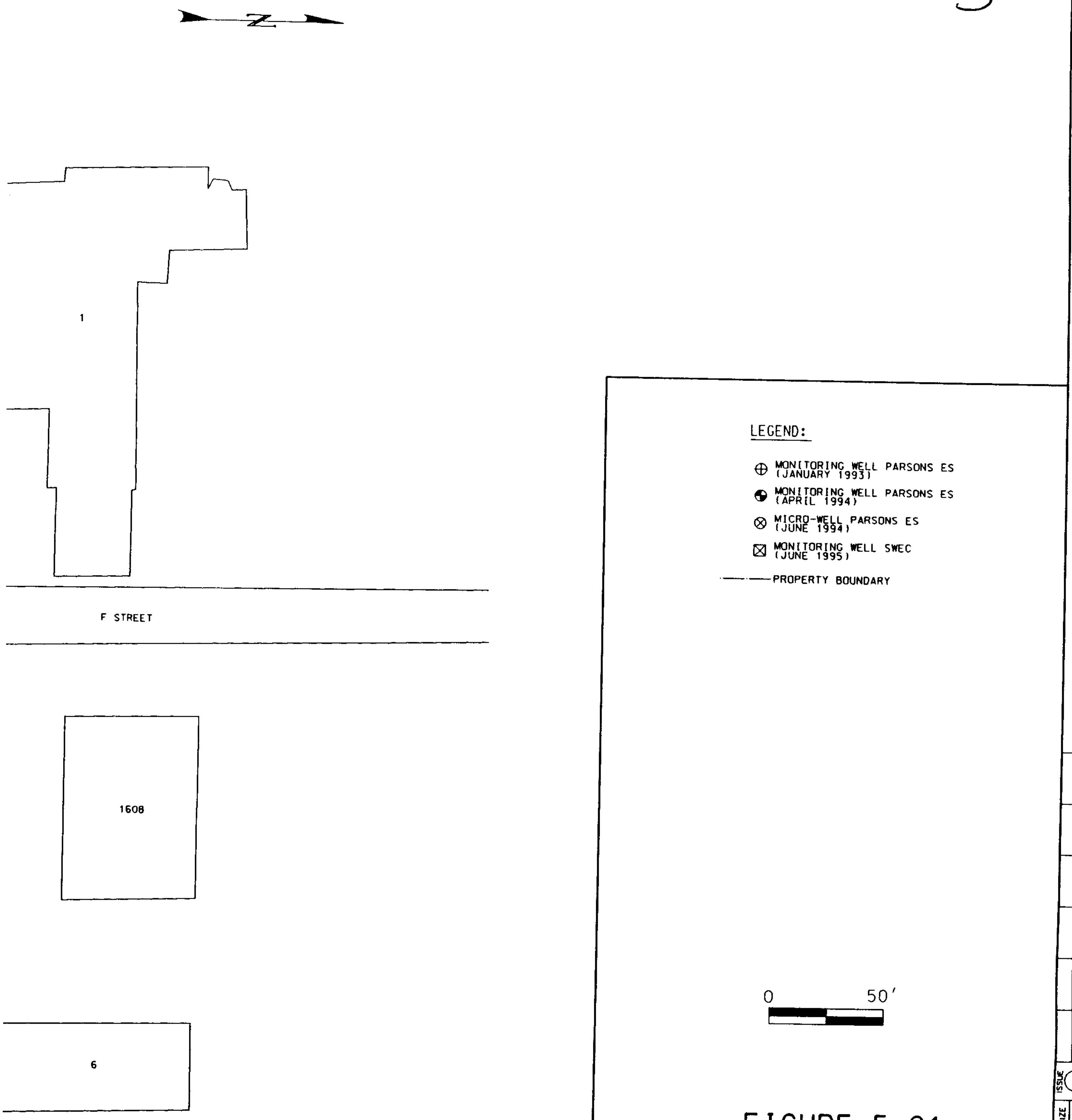

FIGURE 5-21

MONITORING WELL LOCATIONS
IRP SITE 8

151st ARW, UTAH AIR NATIONAL GUARD
SALT LAKE CITY INTERNATIONAL AIRPORT
SALT LAKE CITY, UTAH
STONE & WEBSTER ENGINEERING CORPORATION
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ISSUE	DESCRIPTION
1	ORIGINAL ISSUE

CHKD CORRECT APPR DATE
P.S. S.A. FAC ELEC LTG MATL PC ARCH CIVIL CONC STL L&P INST MD P.S. S.A. FAC ELEC LTG MATL

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Table 5-9
Temperature, pH, and Specific Conductance Measurements
Groundwater Sampling, IRP Site 8
151st ARW, Air National Guard, Salt Lake City, Utah

Monitoring Well	Round	Date	Temperature(°F)	pH	Specific Conductance (μmhos)
MW1	1	5/30/95	56.1	8.50	942
	2	8/09/95	60.6	9.10	2,290
MW2	1	5/30/95	62.4	8.21	5,390
	2	8/10/95	66.9	8.26	MALFUNCTION
MW3	1	5/31/95	57.2	8.71	3,260
	2	8/10/95	62.6	8.82	2,530
MW4	1	5/31/95	58.7	8.95	2,640
	2	8/09/95	65.6	8.86	1,980
MW5	1	5/31/95	55.9	8.62	1,760
	2	8/10/95	60.3	8.82	1,390
MW6	1	6/26/95	63.2	8.46	7,680
	2	8/02/95	66.6	8.62	8,790
MW7	1	6/28/95	64.3	7.95	11,380
	2	8/03/95	70.0	8.40	1,817
MW8	1	6/28/95	65.7	7.97	9,270
	2	8/03/95	66.0	8.50	1,775
MW9	1	6/28/95	63.9	8.48	4,850
	2	8/03/95	63.5	8.56	7,910
MW10	1	6/29/95	64.2	8.46	10,850
	2	8/02/95	68.2	8.40	OFF SCALE
MW11	1	6/29/95	58.1	8.30	4,020
	2	8/02/95	62.4	8.40	1,651
MW12	1	6/30/95	59.7	8.60	2,230
	2	8/03/95	61.5	8.61	2,390
MCW1	1	6/02/95	58.1	8.52	7,440
	2	8/08/95	NM	9.22	8,930
MCW2	1 & 2	NM	NM	NM	NM
MCW3	1	6/02/95	65.8	8.22	14,820
	2	8/07/95	NM	8.20	12,350
MCW4	1	NM	NM	NM	NM
	2	NS	NS	NS	NS
MCW5	1	6/02/95	64.7	9.10	3,650
	2	8/08/95	NM	9.18	2,820
MCW6	1 & 2	NM	NM	NM	NM
MCW7	1	5/31/95	NA	8.40	9,960
	2	NM	NM	NM	NM
MCW8	1	6/06/95	NA	9.26	1,960
	2	NM	NM	NM	NM

NS = Not sampled NM = Not measured

Table 5-10
Volatile Organic Compounds and TPH Detected in Groundwater Samples
IRP Site 8
151ST Utah ARW, Utah Air National Guard
Salt Lake City, Utah

PARAMETER	Round	MW1	MW2	MW3	MW4	MW5	MW8	MW9	MW10
Volatile organic compounds (ug/l)									
Benzene	1	ND (1.0)	719	522	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	2	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Chloroform	1	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	1
	2	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
1,1-Dichloroethane	1	ND (1.0)	5	11	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	2	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
1,1-Dichloroethene	1	ND (1.0)	ND (1.0)	2	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	2	ND (1.0)	ND (1.0)	1.7	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
trans-1,2-Dichloroethene	1	ND (1.0)	ND (1.0)	1	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	2	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Methylene chloride	1	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)
	2	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)
Ethylbenzene	1	ND (2.0)	80	51	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)
	2	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
1,1,1-Trichloroethane	1	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	1 J	ND (1.0)	ND (1.0)	ND (1.0)
	2	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	1.1	ND (1.0)	ND (1.0)	ND (1.0)
Trichloroethene	1	3	9	38	27	ND (1.0)	1.2 *	5.3 *	ND (1.0)
	2	48.3	4.7	34.2	26.7	1.1	ND (1.0)	3.7	ND (1.0)
Vinyl chloride	1	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	2	ND (1.0)	ND (1.0)	1.6	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Xylenes (total)	1	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	2	ND (1.0)	ND (1.0)	1.3	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
TPH	1	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	2	ND (200)	1800	1500	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)

Shaded areas indicate concentrations above established ARAR values
ND = Not detected above the method detection limit shown in parentheses
Water samples analyzed for VOCs by EPA Method 8010/8020
Water samples analyzed for TPH by EPA Method SW8015
U = detection limit has been raised due to data validation criteria

DUP = duplicate sample
NA = Not applicable
* Quantity estimated by laboratory
J - Qualified, estimated value

Table 5-10
Volatile Organic Compounds and TPH Detected in Groundwater Samples
IRP Site 8
151ST Utah ARW, Utah Air National Guard
Salt Lake City, Utah

PARAMETER	Round	MCW1	MCW2	MCW3	MCW5	MCW6	MCW7	MCW8
Volatile organic compounds (ug/l)								
Benzene	1	ND (1.0)	ND (1.0)	ND (1.0)	1	1.7	ND (1.0)	ND (1.0)
	2	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	1.4	ND (1.0)	ND (1.0)
Chloroform	1	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	2	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	1.5	ND (1.0)	ND (1.0)
1,1-Dichloroethane	1	ND (1.0)	ND (1.0)	4.4 J	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	2	ND (1.0)	ND (1.0)	7.3	ND (1.0)	1.1	ND (1.0)	ND (1.0)
1,2-Dichloroethane	1	ND (1.0)	1.9	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	2	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
1,1-Dichloroethene	1	ND (1.0)	ND (1.0)	ND (1.0)	1.4	2.3	ND (1.0)	ND (1.0)
	2	ND (1.0)	ND (1.0)	ND (1.0)	1.4	2.8	ND (1.0)	ND (1.0)
trans-1,2-Dichloroethene	1	ND (1.0)	ND (1.0)	ND (1.0)	3.7	28.6	ND (1.0)	3.5
	2	ND (1.0)	ND (1.0)	ND (1.0)	6.2	20.4	ND (1.0)	2.6
Methylene chloride	1	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)
	2	ND (2.0)	5.5	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)
Ethylbenzene	1	ND (1.0)	ND (1.0)	2.3 J	1.7	1.2	ND (1.0)	ND (1.0)
	2	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Trichloroethene	1	4.4	4.8	3.6 J	164	352	4.7	27.1
	2	5	2	4	144	190	5.2	22.8
Vinyl chloride	1	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	1.2	ND (1.0)	ND (1.0)
	2	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	1.2	ND (1.0)	ND (1.0)
Xylenes (total)	1	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	2.1	ND (1.0)	ND (1.0)
	2	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	2	ND (1.0)	ND (1.0)
TPH	1	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	2	ND (200)	1800	1510	ND (200)	700	ND (200)	ND (200)

Shaded areas indicate concentrations above established ARAR values
ND = Not detected above the method detection limit shown in parentheses
Water samples analyzed for VOCs by EPA Method 8010/8020
Water samples analyzed for TPH by EPA Method SW8015
U = detection limit has been raised due to data validation criteria
NS = Not sampled due to well being dry at time of sampling

DUP - duplicate sample
* Quantity estimated by laboratory
J - Qualified, estimated value
NA = Not applicable

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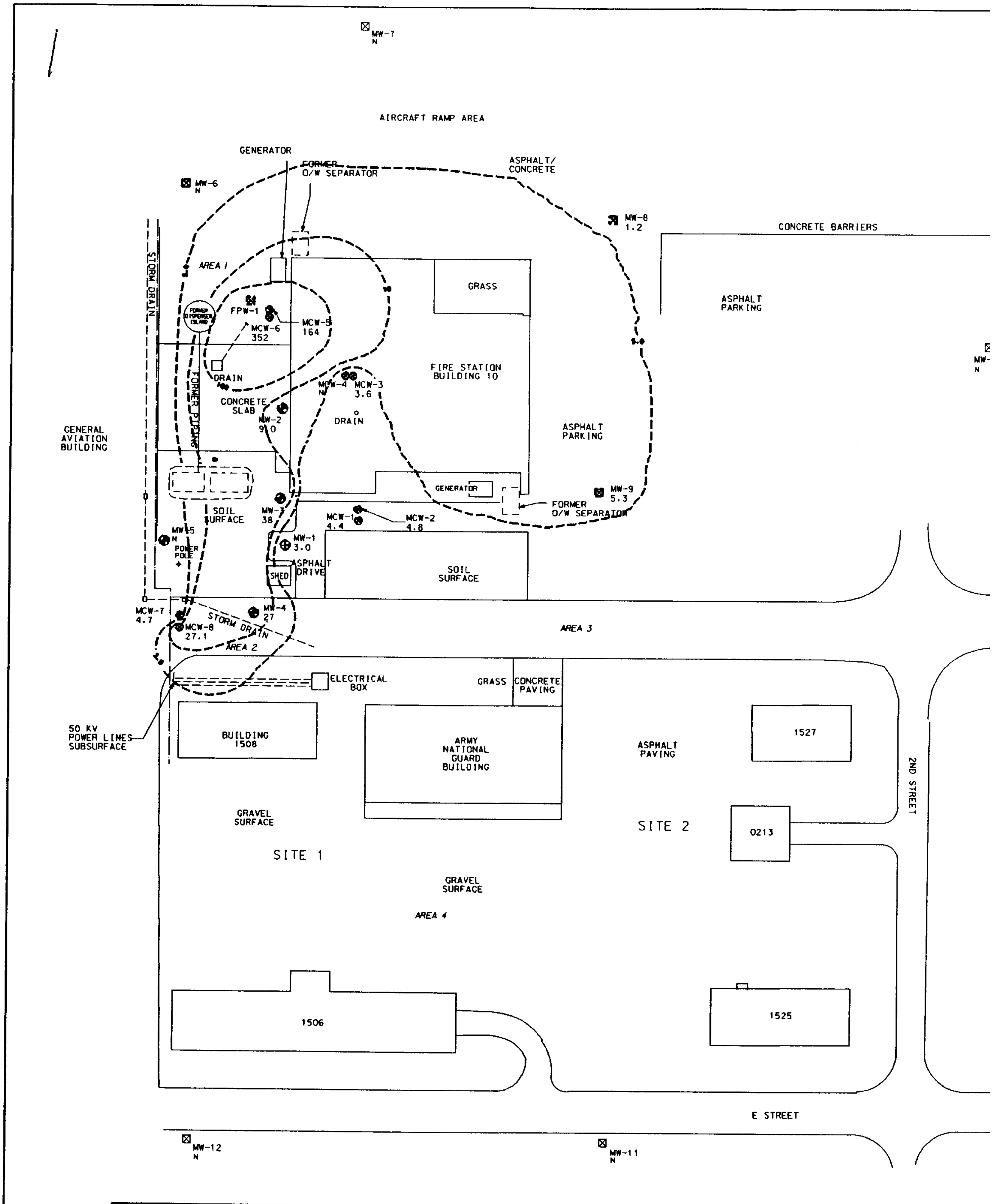

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PC ARCH CIVIL CONC STL L&P INST MD P.S. S.A. FAC ELEC LTG MATL PC ARCH CIVIL CONC STL L&P INST MD P.S. S.A. FAC ELEC LTG MATL PC ARCH CIVIL CONC STL L&P

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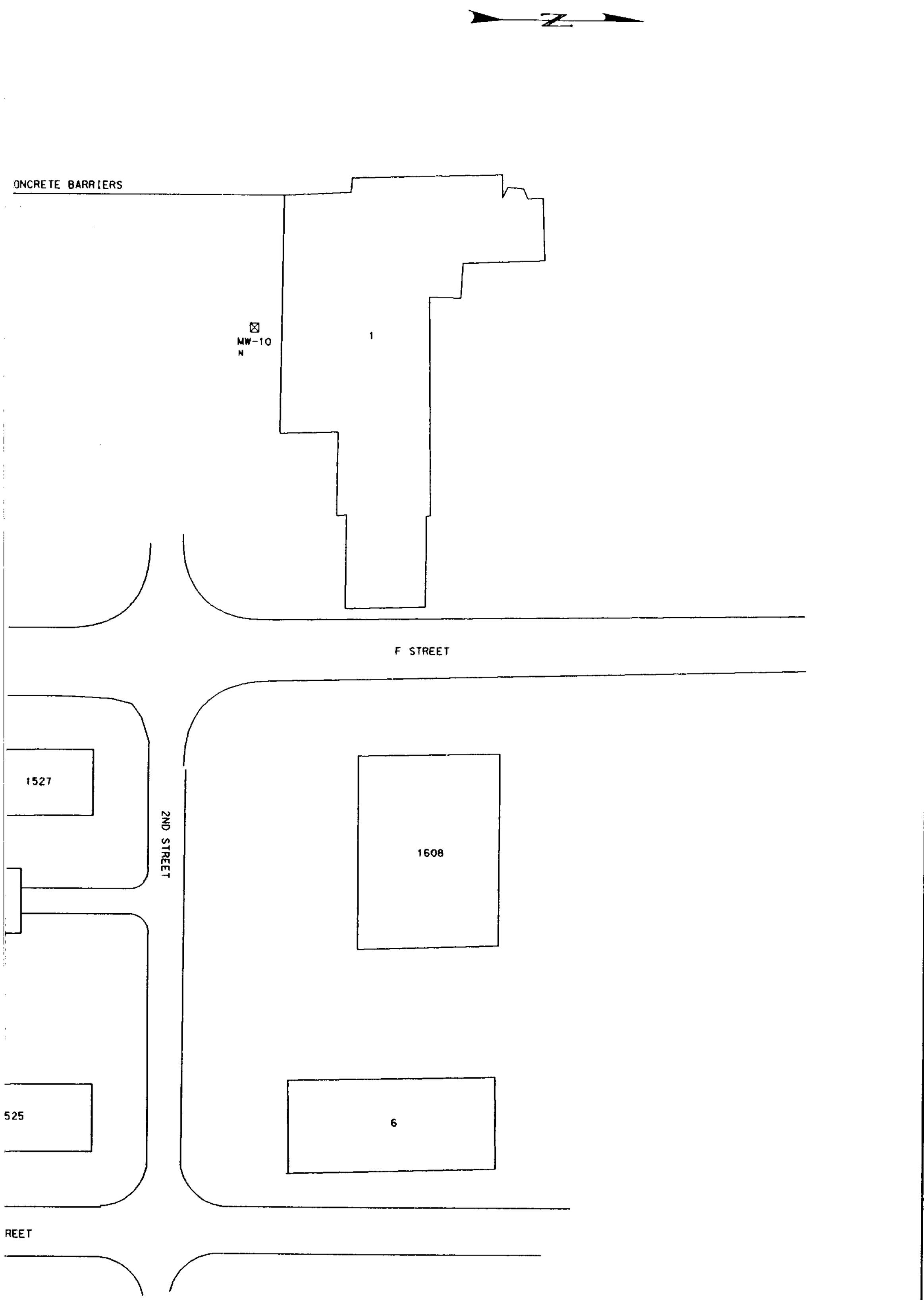

LEGEND:

⊕ MONITORING WELL PARSONS ES (JANUARY 1993)

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⊗ MICRO-WELL PARSONS ES (JUNE 1994)

☒ MONITORING WELL SWEC (JUNE 1995)

——— PROPERTY BOUNDARY

1.2 TRICHLOROEHTENE (TCE) CONCENTRATION ug/L.

— — 1.0 — — ISOCONCENTRATION CONTOUR, ug/L.

N TCE NOT DETECTED ABOVE METHOD DETECTION LIMIT.

NOTES:

1. LABORATORY TCE CONCENTRATIONS WHERE DETECTED. OTHER DETECTED NOT SHOWN.
2. WATER CONCENTRATIONS ARE IN ug
3. GROUNDWATER SAMPLES COLLECTED TO JUNE 30, 1995.

0 50′

FIGURE 5-22

TCE DETECTED IN FIRST R OF GROUNDWATER SAMPL IRP SITE 8

151st ARW, UTAH AIR NATIONAL
SALT LAKE CITY INTERNATIONAL A
SALT LAKE CITY, UTAH
STONE & WEBSTER ENGINEERING CORPORA
BOSTON, MASS.

DRAWING NUMBER 05219.002

		2						1	ORIGINAL ISSUE				
APPR	DATE	ISSUE	DESCRIPTION	CHKD	CORRECT	APPR	DATE	ISSUE	DESCRIPTION	CHKD	CORRECT	APPR	DATE

LTG	MATL	PC	ARCH	CIVIL	CONC	STL	L&P	INST	MD	P.S.	S.A.	FAC	ELEC	LTG	MATL	PC	ARCH	CIVIL	CONC	STL	L&P	INST	MD	P.S.	S.A.	FAC	ELEC	LTG	MATL

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DSGN CHK'D BY:
DRAWN BY: G.C. CARTER
CHK'D BY:
AREAS

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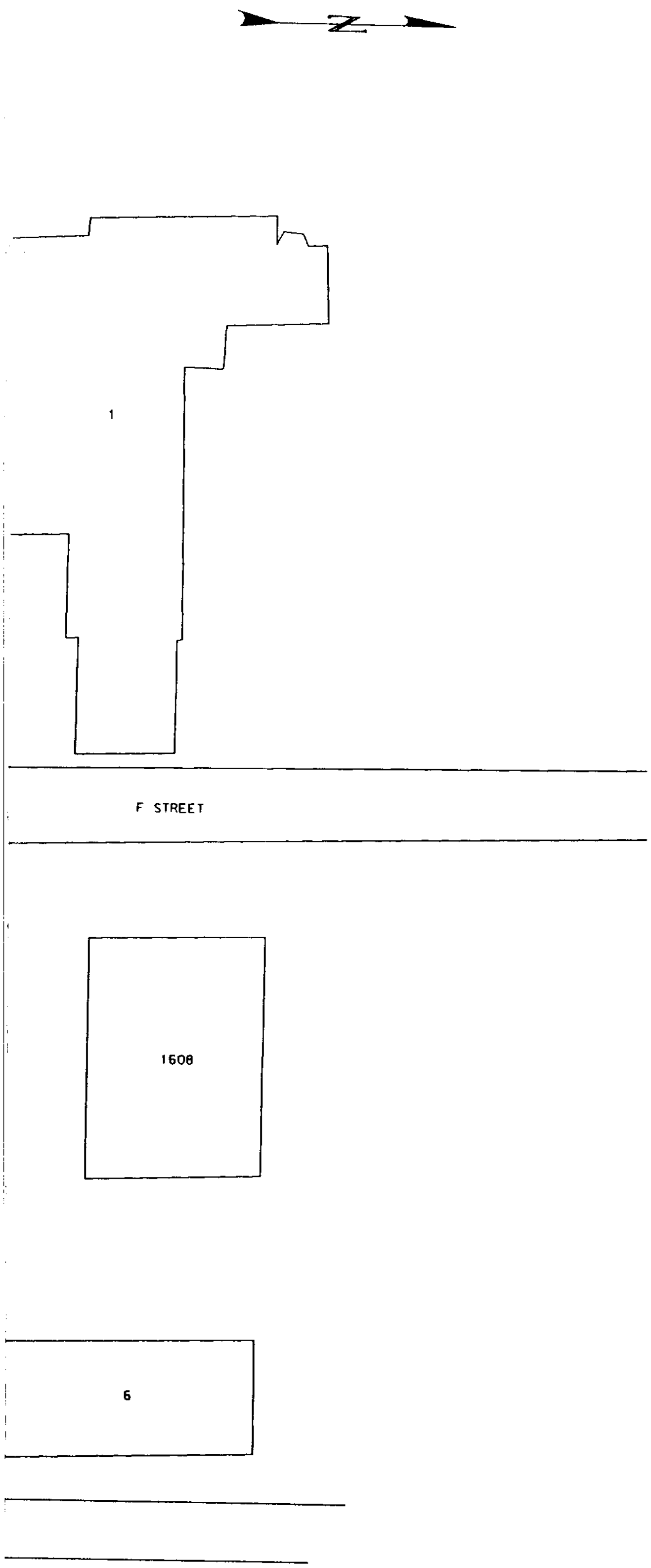

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- ⊕ MONITORING WELL PARSONS ES (JANUARY 1993)
- ◕ MONITORING WELL PARSONS ES (APRIL 1994)
- ⊗ MICRO-WELL PARSONS ES (JUNE 1994)
- ⊠ MONITORING WELL SWEC (JUNE 1995)

——— PROPERTY BOUNDARY

1.2	TRICHLOROEHTENE (TCE) CONCENTRATION ug/L.
— — 1.0 — —	ISOCONCENTRATION CONTOUR, ug/L.
N	TCE NOT DETECTED ABOVE METHOD DETECTION LIMIT.

NOTES:

1. LABORATORY TCE CONCENTRATIONS SHOWN WHERE DETECTED. OTHER DETECTED COMPOUNDS NOT SHOWN.
2. WATER CONCENTRATIONS ARE IN ug/L.
3. GROUNDWATER SAMPLES COLLECTED FROM JUNE 25 TO JUNE 30, 1995.

0 50′

FIGURE 5-22

TCE DETECTED IN FIRST ROUND OF GROUNDWATER SAMPLES IRP SITE 8

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SALT LAKE CITY, UTAH
STONE & WEBSTER ENGINEERING CORPORATION
BOSTON, MASS.

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DRAWN BY: G.C. CARTER
CHK'D BY:

AREAS	LEVELS	WORK PKG	PCT

RESP ENGR: K. MARONEY
SUPV: R.J. BOUDREAU

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ISSUE	DESCRIPTION
1	ORIGINAL ISSUE

CHKD		CORRECT		APPR	DATE	ISSUE	DESCRIPTION							CHKD		CORRECT		APPR	DATE
MD	P.S.	S.A.	FAC	ELEC	LTG	MATL	PC	ARCH	CIVIL	CONC	STL	L&P	INST	MD	P.S.	S.A.	FAC	ELEC	LTG	MATL

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Second Round of Groundwater Sampling

Chloroform, 1,1-DCA, 1,1-DCE, t-DCE, TCA, TCE, and vinyl chloride were detected in groundwater samples collected during the second round of groundwater sampling.

Chloroform, 1,1-DCA, 1,1-DCE, TCA, and vinyl chloride were detected in groundwater samples collected from MCW3, MCW5, and MCW6 at concentrations ranging from 1.1 to 7.3 μg/l.

Groundwater samples collected from MCW5, MCW6, and MCW8 showed t-DCE at concentrations of 6.2, 20.4, and 2.6 μg/l, respectively.

TCE was detected in 13 groundwater samples at concentrations ranging from 1.1 to 190 μg/l. The highest concentrations of TCE were detected in the groundwater samples collected from MCW5 and MCW6. The extent of TCE detected in groundwater during the second round of groundwater sampling is shown on Figure 5-23. VOC analytical results are summarized in Table 5-10.

5.3.4.3 SVOC Analytical Results

Bis(2-ethylhexyl)phthalate and di-n-butyl phthalate were detected in the groundwater samples collected from Site 8. SVOC analytical results are summarized in Table 5-11.

Bis(2-Ethylhexyl)phthalate was detected in groundwater samples collected from MCW2, MCW6, MCW7, and MCW8 at concentrations ranging from 33 to 186 μg/l during the first round of sampling. Bis(2-ethylhexyl)phthalate was detected in the groundwater samples collected from MW9, MW10, MCW2, MCW5, MCW6, and MCW7 at concentrations ranging from 0.015 to 168 μg/l during the second round of groundwater sampling.

Di-n-butyl phthalate was detected in groundwater samples collected from MCW2, MCW7, and MCW8 at concentrations of 14, 75, and 16 μg/l, respectively, during the first round of groundwater sampling. Di-n-butyl phthalate was not detected in groundwater samples collected during the second round of groundwater sampling.

5.3.4.4 BTEX Analytical Results

Benzene, ethylbenzene and xylene were detected in groundwater samples collected at IRP Site 8. Sample designations and concentrations are shown on Table 5-10.

First Round of Groundwater Sampling

Benzene was detected in groundwater samples collected from MW2 and MW3 at concentrations of 719 and 522 μg/l, respectively. Benzene was also detected in lower concentrations of 1.0 and 1.7 μg/l in groundwater samples collected from MCW5 and MCW6, respectively. The extent of benzene detected during the first round of groundwater sampling is shown on Figure 5-24.

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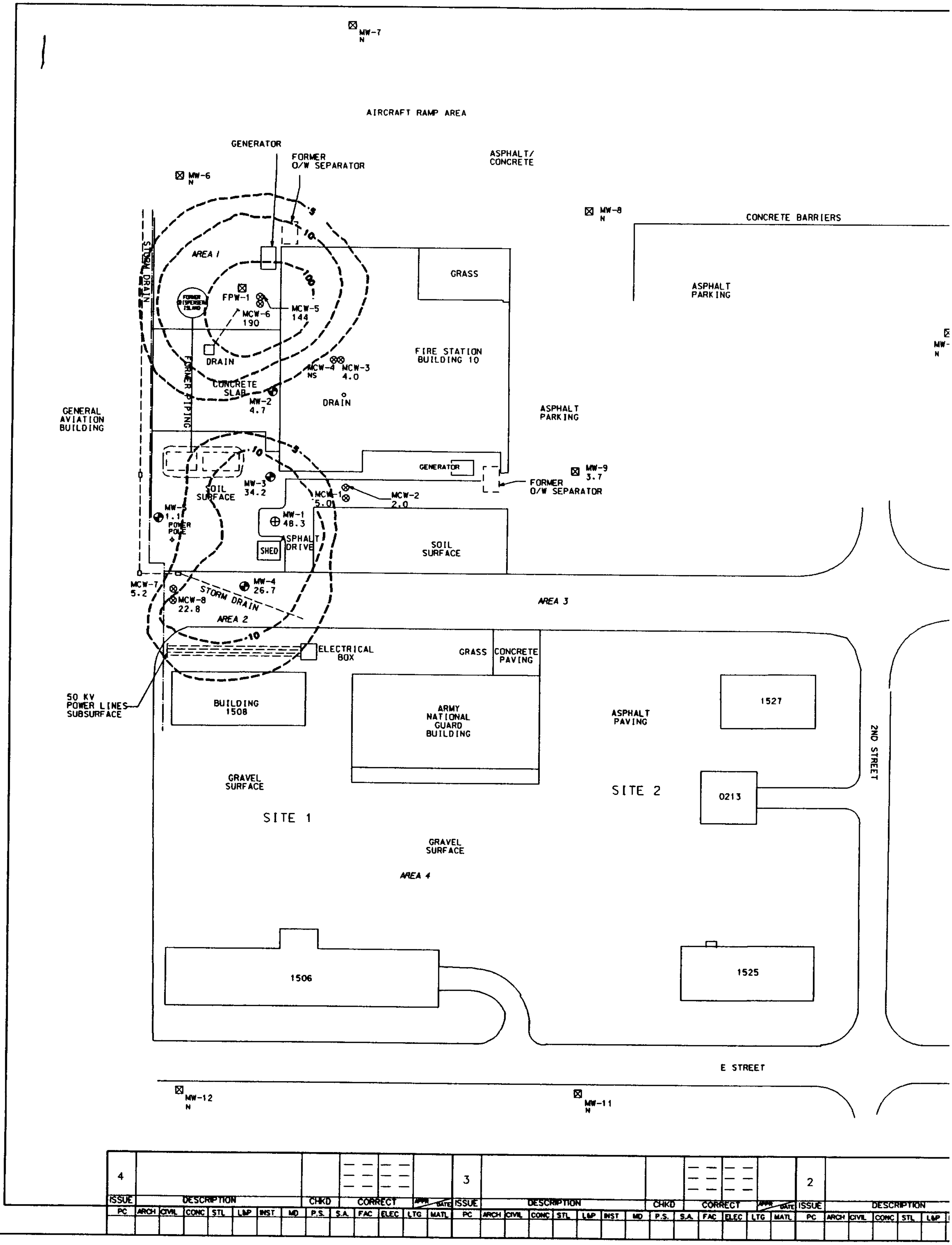

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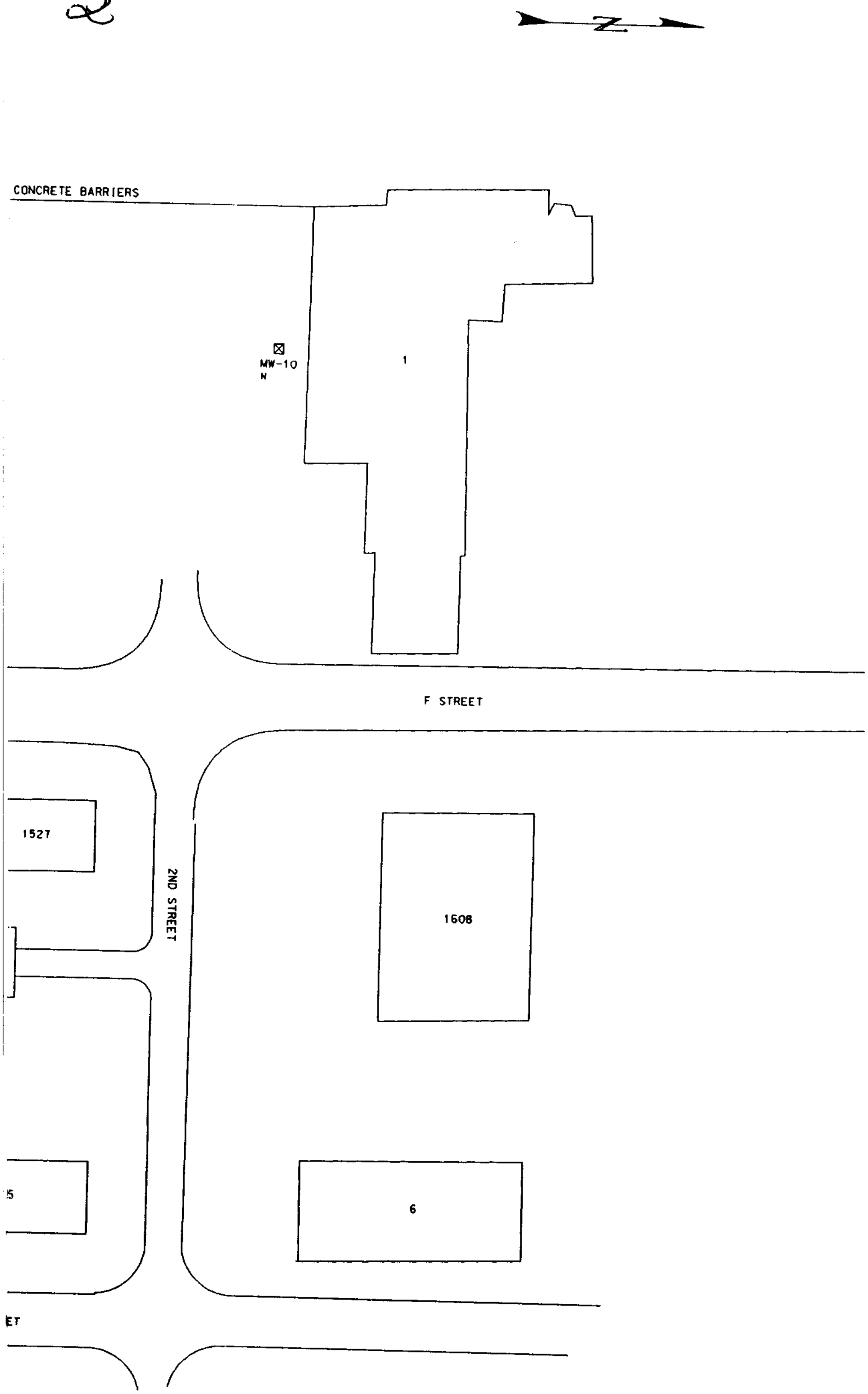

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⊗ MICRO-WELL PARSONS ES (JUNE 1994)

☒ MONITORING WELL SWEC (JUNE 1995)

——— PROPERTY BOUNDARY

— 1.0 — ISOCONCENTRATION CONTOUR, ug/L.

NS NOT SAMPLED.

TCE = TRICHLOROETHENE

N = TCE NOT DETECTED ABOVE MET DETECTION LIMIT.

NOTES:

1. LABORATORY TCE CONCENTRATIONS WHERE DETECTED. OTHER DETECTED IN ug/L NOT SHOWN.

2. GROUNDWATER SAMPLES COLLECTED TO AUGUST 10, 1995.

0 50′

FIGURE 5-23

TCE DETECTED DURING THE S ROUND OF GROUNDWATER SAM IRP SITE 8

151st ARW, UTAH AIR NATIONAL G
SALT LAKE CITY INTERNATIONAL AI
SALT LAKE CITY, UTAH
STONE & WEBSTER ENGINEERING CORPORATIO
BOSTON, MASS.

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CHK'D BY:
AREAS
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		2						1	ORIGINAL ISSUE				
LTG MATL		PC	ARCH CIVIL CONC STL L&P INST MD	P.S. S.A.	FAC ELEC	LTG MATL		PC	ARCH CIVIL CONC STL L&P INST MD	P.S. S.A.	FAC ELEC	LTG MATL	

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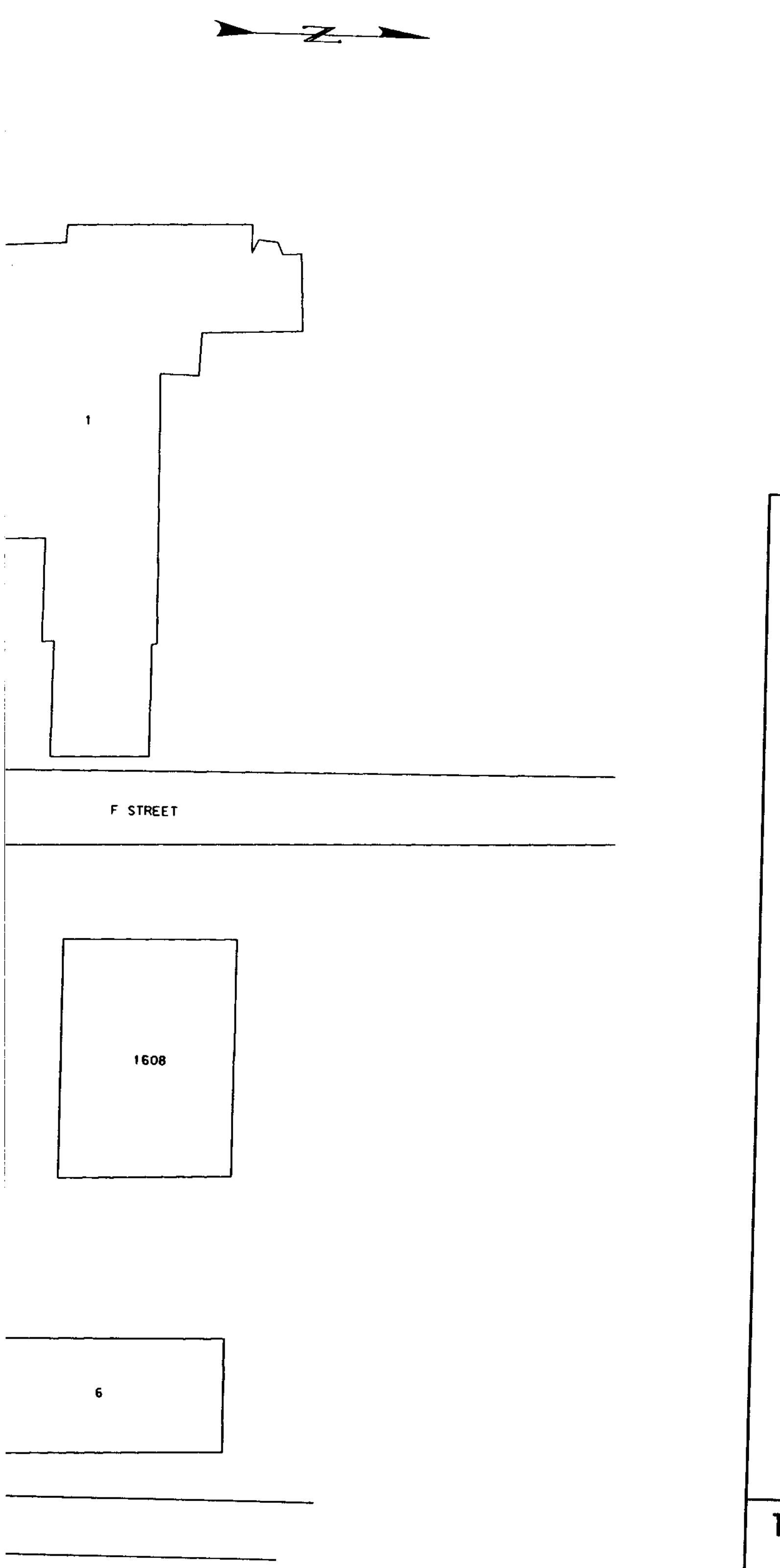

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◕ MONITORING WELL PARSONS ES (APRIL 1994)

⊗ MICRO-WELL PARSONS ES (JUNE 1994)

⊠ MONITORING WELL SWEC (JUNE 1995)

——— PROPERTY BOUNDARY

— — 1.0 — — ISOCONCENTRATION CONTOUR, ug/L.

NS		NOT SAMPLED.
TCE	=	TRICHLOROETHENE
N	=	TCE NOT DETECTED ABOVE METHOD DETECTION LIMIT.

NOTES:

1. LABORATORY TCE CONCENTRATIONS SHOWN WHERE DETECTED. OTHER DETECTED COMPOUNDS IN ug/L NOT SHOWN.
2. GROUNDWATER SAMPLES COLLECTED FROM AUGUST 2 TO AUGUST 10, 1995.

0 50'

ISSUE

HALF-SIZE

APP. CARD

FIGURE 5-23

TCE DETECTED DURING THE SECOND ROUND OF GROUNDWATER SAMPLES IRP SITE 8

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SALT LAKE CITY, UTAH
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BOSTON, MASS.

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RESP ENGR: K. MARONEY
SUPV: R.J. BOUDREAU

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DSGN CHK'D BY:	CHK'D BY:				

ISSUE	DESCRIPTION
1	ORIGINAL ISSUE

CHKD | CORRECT | APPR | DATE | ISSUE | DESCRIPTION | CHKD | CORRECT | APPR | DATE

P.S. | S.A. | FAC | ELEC | LTG | MATL | PC | ARCH | CIVIL | CONC | STL | L&P | INST | MD | P.S. | S.A. | FAC | ELEC | LTG | MATL

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Table 5-11
Semi-Volatile Organic Compounds Detected in Groundwater Samples
IRP Site No. 8
151st ARW, Utah Air National Guard
Salt Lake City, Utah

PARAMETER	Round	MW9	MW10	MW12 (DUP)	MCW2	MCW5	MCW6	MCW7	MCW8
Semi-volatile organic compounds (ug/Kg)									
bis(2-Ethylhexyl)phthalate	1	ND (10)	ND (10)	ND (10)	186	ND (10)	92	33	170
	2	22	0.015	0.013	168	28	72	11	ND (10)
Di-n-Butyl phthalate	1	ND (10)	ND (10)	ND (10)	14	ND (10)	ND (10)	75	16
	2	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)

Shaded areas indicate concentrations above established ARAR values

ND = Not detected above the method detection limit shown in parentheses

Water samples analyzed for SVOCs by EPA Method SW3520/SW8720

U = Detection limit has been raised due to data validation criteria

DUP = duplicate sample

* - Quantity estimated by laboratory

J = estimated value based on data validation criteri

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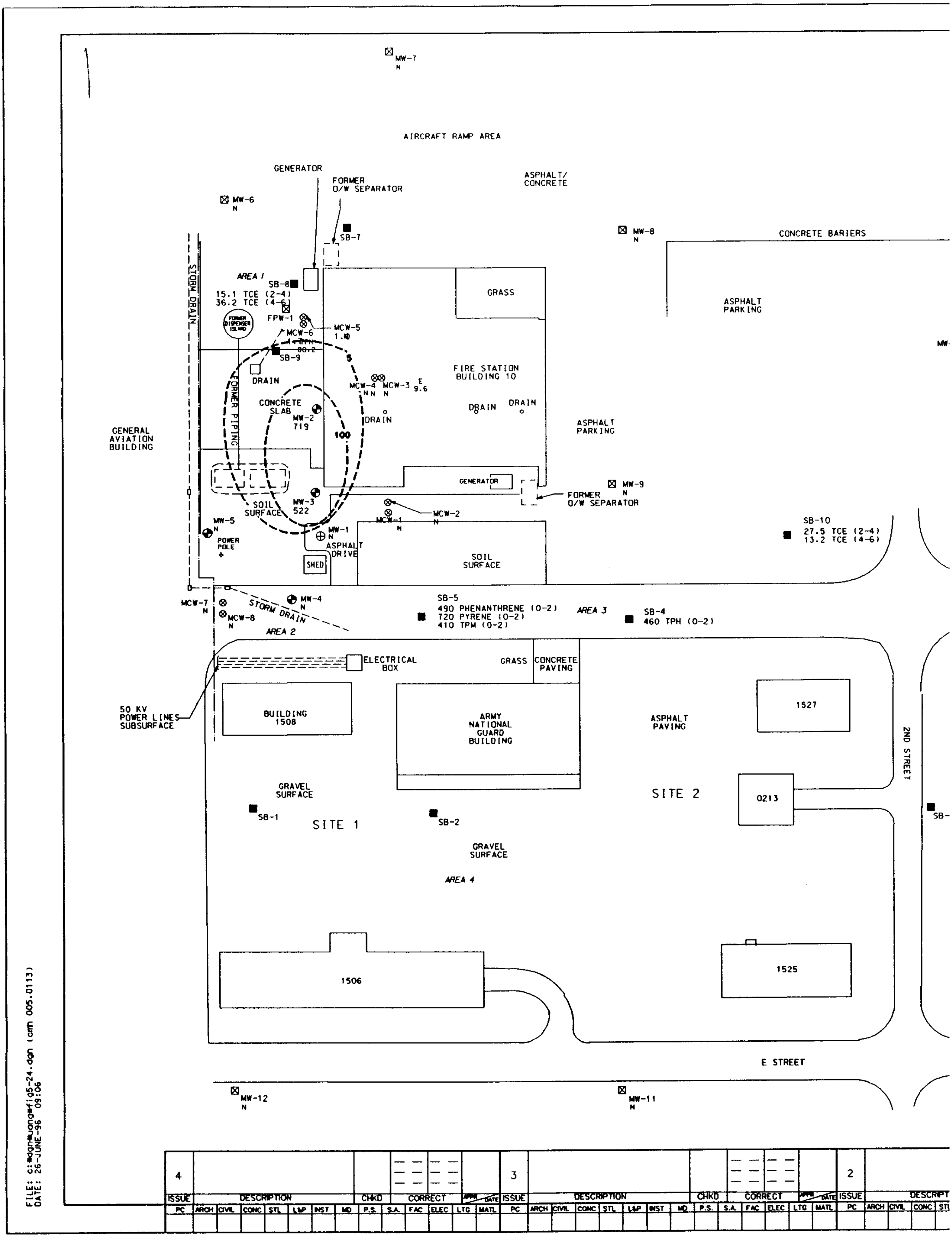

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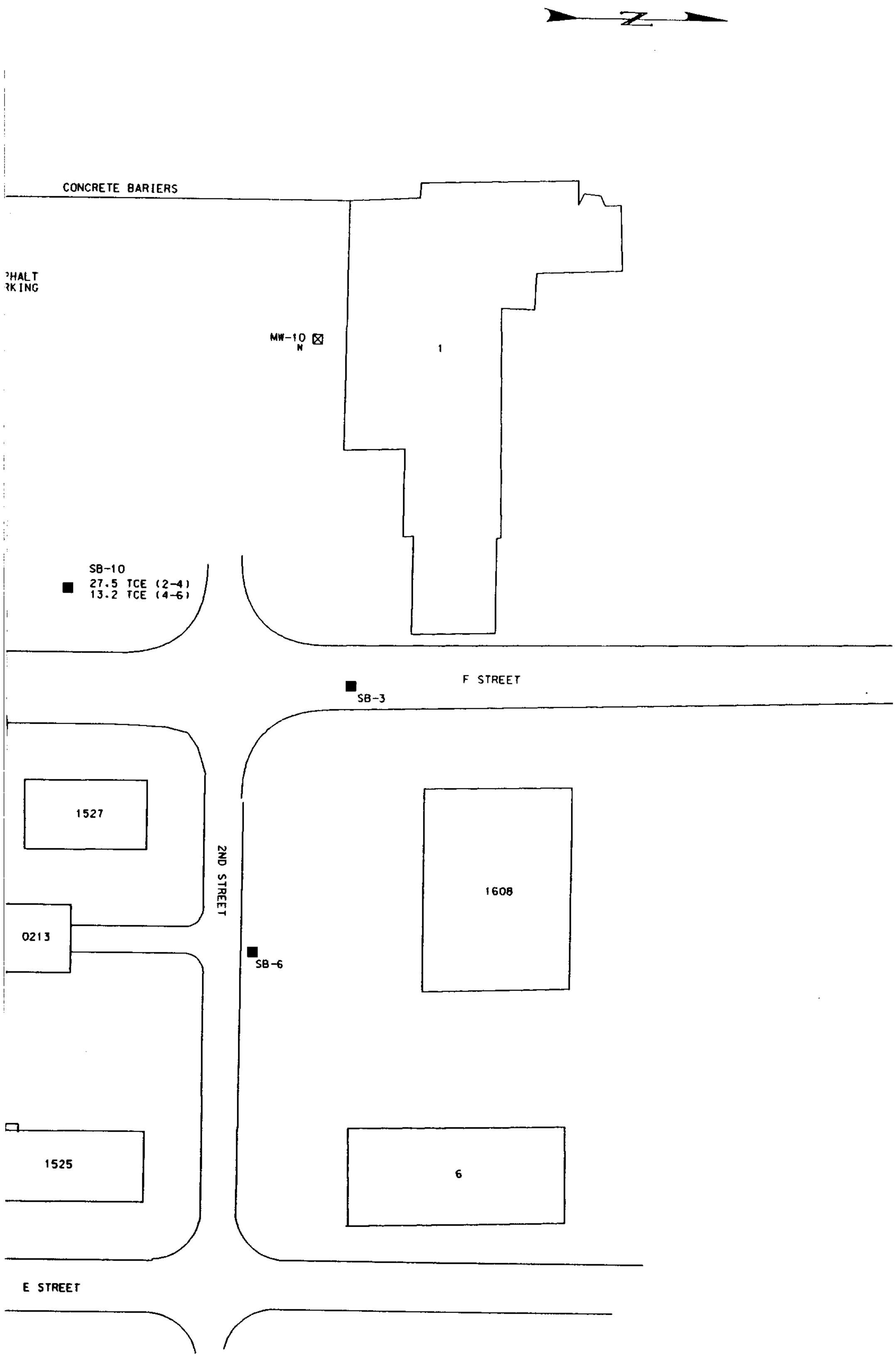

LEGEND:

⊕ MONITORING WELL PARSON
(JANUARY 1993)

◕ MONITORING WELL PARSON
(APRIL 1994)

⊗ MICRO-WELL PARSONS ES
(JUNE 1994)

⊠ MONITORING WELL SWEC
(JUNE 1995)

——— PROPERTY BOUNDARY

719 BENZENE CONCENTRATI

— — 100 — — ISOCONCENTRATION CO

N BENZENE NOT DETECTE
METHOD DETECTION LI

NOTES:

1. BENZENE CONCENTRATIONS
DETECTED. OTHER DETECTE
COMPOUNDS NOT SHOWN. UN

2. GROUNDWATER SAMPLES COLL
JUNE 23 TO JUNE 30, 1995.

0 50'

FIGURE 5-

BENZENE DETECTED IN F
OF GROUNDWATER SA
IRP SITE 8

151st ARW, UTAH AIR NATI
SALT LAKE CITY INTERNATIO
SALT LAKE CITY, U
STONE & WEBSTER ENGINEERING CO
BOSTON, MASS.

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ISSUE	DESCRIPTION	CHKD	CORRECT	APPR / DATE
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AC ELEC LTG MATL PC ARCH CIVIL CONC STL L&P INST MD P.S. S.A. FAC ELEC LTG MATL PC ARCH CIVIL CONC STL L&P INST MD P.S. S.A. FAC ELEC LTG MATL

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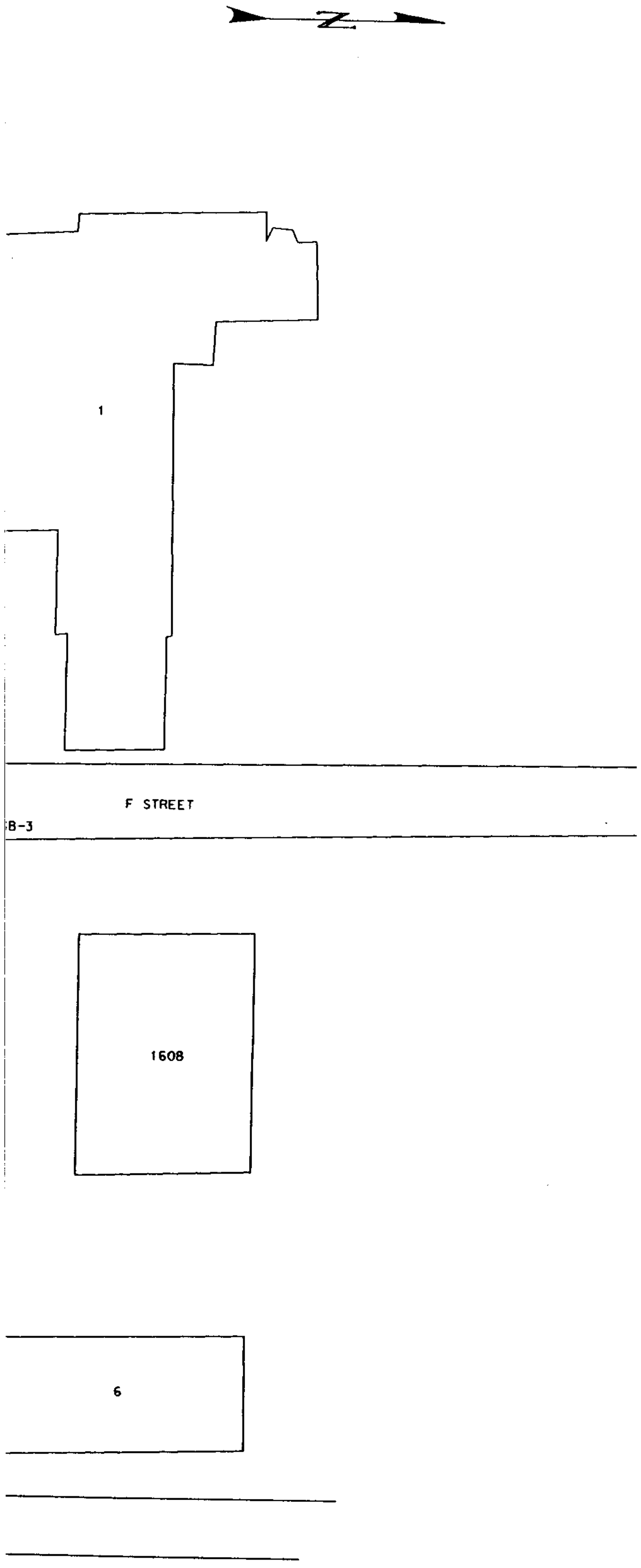

LEGEND:

⊕ MONITORING WELL PARSONS ES (JANUARY 1993)

◉ MONITORING WELL PARSONS ES (APRIL 1994)

⊗ MICRO-WELL PARSONS ES (JUNE 1994)

☒ MONITORING WELL SWEC (JUNE 1995)

——— PROPERTY BOUNDARY

719	BENZENE CONCENTRATION IN ug/L.
— 100 —	ISOCONCENTRATION CONTOUR ug/L.
N	BENZENE NOT DETECTED IN SAMPLE ABOVE METHOD DETECTION LIMIT.

NOTES:

1. BENZENE CONCENTRATIONS SHOWN WHERE DETECTED. OTHER DETECTED PETROLEUM COMPOUNDS NOT SHOWN, UNLESS NOTED.
2. GROUNDWATER SAMPLES COLLECTED FROM JUNE 23 TO JUNE 30, 1995.

0 50′

FIGURE 5-24

BENZENE DETECTED IN FIRST ROUND OF GROUNDWATER SAMPLES IRP SITE 8

151st ARW, UTAH AIR NATIONAL GUARD
SALT LAKE CITY INTERNATIONAL AIRPORT
SALT LAKE CITY, UTAH
STONE & WEBSTER ENGINEERING CORPORATION
BOSTON, MASS.

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ISSUE	DESCRIPTION
1	ORIGINAL ISSUE DRAFT

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P.S. · S.A. · FAC · ELEC · LTG · MATL · PC · ARCH · CIVIL · CONC · STL · L&P · INST · MD · P.S. · S.A. · FAC · ELEC · LTG · MATL

DESIGNED BY:
DSGN CHK'D BY:
DRAWN BY: G.C. CARTER
CHK'D BY:
AREAS · LEVELS · WORK PKG · PCT

RESP ENGR: K. MARONEY
SUPV: R.J. BOUDREAU
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Ethylbenzene was detected in groundwater samples collected from MW2 and MW3 at concentrations of 80 and 51 μg/l, respectively. Ethylbenzene was also detected in groundwater samples collected from MCW5 and MCW6 at lower concentrations of 1.0 and 1.7 μg/l, respectively. Additionally, ethylbenzene was detected in the groundwater sample collected from MCW3 at an estimated concentration of 2.3 μg/l. Xylene was detected in the groundwater sample collected from MCW6 at a concentration of 2.1 μg/l.

Second Round of Groundwater Sampling

Benzene and xylene were detected in groundwater samples collected during the second round of groundwater sampling.

Benzene was detected in the groundwater sample collected from MCW6 at a concentration of 1.4 μg/l. Xylene was detected in groundwater samples collected from MW3 and MCW6 at concentrations of 1.3 and 2.0 μg/l, respectively.

Benzene has also been detected in groundwater north of Site 8 in the vicinity of Building 1608. An SSI conducted at Building 1608 following removal of a JP-4 UST detected benzene concentrations as great as 309 mg/l within groundwater. Groundwater contamination from the former UST at Building 1608 may have contributed to the presence of benzene in the northern vicinity of Site 8 because groundwater flow direction measured at Building 1608 is toward Site 8.

5.3.4.5 TPH Analytical Results

TPH was not detected above the method detection limit of 1,000 μg/l in groundwater samples collected from the IRP Site 8 during the first round of groundwater sampling. TPH was detected in groundwater samples collected from MW2, MW3, and MCW6 during the second round of groundwater sampling at concentrations of 1,800, 1,570, and 700 μg/l, respectively. MW2, MW3, and MCW6 are located adjacent to the southern wall of Building 10 in the vicinity of the former tank area. The laboratory achieved a lower detection limit of 200 μg/l for the second round of groundwater sampling. Based on the concentrations of TPH detected in the second round of groundwater sampling, it is likely that TPH was present in the groundwater samples collected during the first round of groundwater sampling at concentrations slightly below the first round method detection limit of 1,000 μg/l. TPH analytical results are included in Table 5-10.

5.3.4.6 PPM Analytical Results

Eight metals were detected in the groundwater samples collected from Site 8, including mercury, chromium, copper, nickel, zinc, arsenic, lead, and selenium. Mercury was detected in seven groundwater samples collected during the first round of groundwater sampling at concentrations ranging from 0.0002 to 0.00033 mg/l. During the second round of groundwater sampling, mercury was detected in six monitoring wells at concentrations ranging from 0.00026 to 0.00056 mg/l.

Chromium was detected in several groundwater samples collected during both rounds of groundwater sampling at concentrations ranging from 0.012 to 0.139 mg/l. Copper was detected in several groundwater samples collected during both rounds of groundwater sampling at concentrations ranging from 0.01 to 0.318 mg/l. Nickel was detected in several groundwater samples collected during both rounds of groundwater sampling at concentrations ranging from 0.013 to 0.119 mg/l. Zinc was detected in several groundwater samples collected during both rounds of groundwater sampling at concentrations ranging from 0.03 to 0.486 mg/l. The concentration of zinc detected in the groundwater sample collected from MW6 during the second round of groundwater sampling was estimated to be 7.7 mg/l.

Arsenic was detected in several groundwater samples collected during both rounds of groundwater sampling at concentrations ranging from 0.00021 to 1.7 mg/l. Lead was detected in several groundwater samples collected during both rounds of groundwater sampling at concentrations ranging from 0.01 to 0.84 mg/l. Selenium was detected in several groundwater samples collected during both rounds of groundwater sampling at concentrations ranging from 0.003 to 0.08087 mg/l.

Results of metals analysis are summarized in Table 5-12. Laboratory data analysis sheets are included as Appendix F.

5.3.5 Discussion of Results

Soil and groundwater samples were collected from IRP Site 8 and submitted for laboratory analysis to evaluate the extent of petroleum and halogenated compound contamination previously detected at Site 8. For comparative purposes, pertinent ARAR values are discussed in the following subsections. A detailed discussion of the ARAR analysis is presented in Section 6.0 of this report. Composite figures showing contaminant concentrations for the shallow and deep groundwater samples and groundwater flow are included as Plate 1 and Plate 2. These plates are located in pouches at the end of this section.

In general, the extent of petroleum compound contamination was determined to be limited to the Site 8 area. Laboratory analysis of soil and water samples collected from monitoring wells and borings installed downgradient of this area indicated petroleum contamination has not migrated to the north of Site 8. In addition, the collection and analysis of soil and groundwater samples downgradient of Site 8, between Building 10 and Building 1, indicated no additional source areas downgradient of Site 8.

The collection and analysis of soil and groundwater screening samples indicated three areas of halogenated compound contamination. These areas are located at Site 8, Site 1, and the north side of Site 2. Soil and groundwater screening and sampling results indicated the extent of halogenated compound contamination is limited to these areas.

In addition, the small groundwater gradient and variations in groundwater flow direction, discussed in Section 5.3.1 contribute to the slow movement of the contaminants.

Table 5-12
Metals Detected in Groundwater Samples
IRP Site No. 8
151st ARW, Utah Air National Guard
Salt Lake City, Utah

SAMPLE ID.	Roun	Metals (mg/l)						
		Mercury	Chromium	Copper	Nickel	Zinc	Arsenic	Lead
MW1	1	ND (1.00)	0.014	0.016	ND (0.02)	0.074 U	0.085	ND (0.01)
	2	0.00036	ND (0.01)	0.027	ND (0.02)	0.121	0.484	0.013
MW2	1	0.0002	ND (0.014)	0.035	0.022	0.486	0.444	ND (0.01)
	2	0.00054	0.039	0.182	0.053	0.214	0.664	0.053
MW3	1	ND (1.00)	ND (0.014)	0.031	0.013	0.104 U	0.609	ND (0.01)
	2	0.00047	0.044	0.117	0.044	0.234	0.716	ND (0.046)
MW4	1	ND (1.00)	ND (0.014)	0.01	ND (0.02)	0.163	0.375	ND (0.01)
	2	0.00041	0.028	0.07	0.027	0.222	0.511	0.086
MW5	1	ND (1.00)	0.029	0.057	0.02	0.228	0.107	0.034
	DUP	ND (0.0002)	0.035	0.057	0.023	0.242	0.101	0.037
	2	0.00036	0.013	0.109	0.02	0.138	0.197	0.038
MW6	1	0.00028	ND (0.01)	0.025	ND (0.02)	7.7 J	0.46	ND (0.005)
	2	ND (0.0002)	0.034	0.099	0.034	0.196	0.394	0.091
MW7	1	0.00023	ND (0.014)	0.033	ND (0.02)	0.066 J	0.51	0.011
	2	ND (0.0002)	0.026	0.068	0.032	0.131	0.375	0.09
MW8	1	0.00022	ND (0.014)	0.051	ND (0.02)	0.035 J	0.79	0.012
	2	ND (0.0002)	ND (0.01)	0.087	0.014	0.033	1.11	0.02
MW9	1	0.00029	0.012	0.072	0.023	ND (0.074)	1.7	0.022
	2	ND (0.0002)	0.026	0.083	0.033	0.128	0.686	0.041
MW10	1	0.00021	ND (0.014)	0.034	ND (0.02)	0.03	0.84	0.08087
	2	0.00026	0.096	0.263	0.107	0.455	0.626	0.171
MW11	1	ND (1.00)	ND (0.014)	0.017	ND (0.02)	0.019	0.1	ND (0.005)
	2	ND (0.0002)	ND (0.01)	0.02	ND (0.02)	0.044	0.136	0.016
MW12	1	ND (1.00)	ND (0.014)	0.053	ND (0.02)	0.067	0.16	0.021
	2	ND (0.0002)	0.028	0.088	0.028	0.148	0.215	0.061
	DUP	ND (0.0002)	0.024	0.079	0.024	0.13	0.2	0.039
MCW1	1	ND (0.10)	0.039	0.224	0.044	0.187	0.216	ND (0.01)
	2	ND (0.0002)	0.017	0.159	0.031	0.094	0.174	0.141
MCW2	1	ND (0.10)	0.069	0.093	0.04	0.16	1.42	0.46
	2	ND (0.0002)	ND (0.01)	0.034	ND (0.02)	0.054	1.55	ND (0.01)
MCW3	1	ND (0.10)	0.139 J	0.053 J	0.211 J	0.062 J	0.282	ND (0.01)
	DUP	ND (0.0002)	0.012	0.024	0.114	0.023	0.237	ND (0.01)
	2	0.00023	0.029	0.189	0.085	0.094	0.292	0.056
MCW4 *	1	0.00033	0.13	0.6	0.15	0.49	1.61	0.17
MCW5	1	ND (0.10)	0.02	0.061	0.016	0.031	1.52	ND (0.01)
	2	ND (0.0002)	0.102	0.318	0.108	0.306	1.69	0.126
MCW6	1	ND (0.10)	0.033	0.04	0.023	0.068	1.07	0.024
	2	ND (0.0002)	0.014	0.107	ND (0.02)	0.041	1.22	0.016
MCW7	1	ND (0.10)	0.032	0.226	0.067	0.124	0.157	0.133
	2	ND (0.0002)	0.074	0.107	0.119	0.145	0.216	0.225
MCW8	1	ND (0.10)	0.097	0.08	0.068	0.14	0.48	0.058
	DUP	ND (0.0002)	0.012	0.024	0.114	0.023	0.237	ND (0.01)
	2	ND (0.0002)	ND (0.01)	0.021	ND (0.02)	0.048	0.509	0.01

J - Qualified, estimated value

U - Detection limit has been raised to reported level due to Data Validation Qualifications

ND = Not detected above the method detection limit shown in parentheses

Samples analyzed for Priority Pollutant metals by EPA Method SW6010

* - MCW4 not sampled during second round of sampling due to well being dry

5.3.5.1 Soil

VOC Screening Results

Soil gas screening samples were analyzed for VOCs. TCE was detected in one sample located along F Street, at a concentration of 2.0 μg/L.

Soil screening samples were analyzed for VOCs. In soil screening samples, TCE was detected at concentrations of 0.005 and 0.006 mg/kg.

VOC Laboratory Analysis Results

In soil samples, TCE was detected at concentrations ranging from 13.2 to 36.2 μg/kg. The highest concentration of TCE was detected in the soil sample collected from the depth interval of 4 to 6 feet in soil boring S8-SB8, located adjacent to the southwest corner of Building 10. The TCE contamination in soil in this area is isolated as TCE was not detected in other soil samples collected in the vicinity of S8-SB8.

The other soil boring in which TCE was detected was advanced in the southwest corner of the intersection of F Street and 2nd Street. The highest concentration of TCE in this boring was detected in the sample collected from the depth interval of 2 to 4 feet BGS. The TCE contamination in this area is also isolated as TCE was not detected in the soil samples collected in the vicinity of this boring.

No ARARs have been established for the clean-up of TCE in soil.

SVOC Laboratory Analysis Results

The presence of SVOCs in soil gas and soil screening samples was not evaluated.

In soil samples, Phenanthrene and pyrene were detected in the 0- to 2-foot interval of soil boring S8-SB5 at concentrations of 490 and 720 μg/kg, respectively. The detection of these SVOCs is most likely due to this sample containing asphalt as the boring was advanced in F Street.

BTEX Screening Results

BTEX compounds were not detected in soil gas screening samples above the method detection limit of 1.0 μg/L.

Benzene, toluene, ethylbenzene and xylene compounds were detected in one soil screening sample, collected adjacent to the former UST location, at concentrations of 0.061, 0.019, 0.101, and 0.373 mg/kg, respectively. These concentrations are well below the most stringent Utah Department of Health recommended soil cleanup levels (RCLs) for BTEX compounds, i.e. 0.2 mg/kg for benzene, 100 mg/kg for toluene, 70 mg/kg for ethylbenzene, and 1,000 mg/kg for xylenes. BTEX compounds were not otherwise detected in soil screening samples above the method detection limit of 0.005 mg/kg.

BTEX Laboratory Analysis Results

In soil samples, ethylbenzene was detected at a concentration of 43.1 μg/kg (0.043 mg/kg) in one soil sample collected from a depth interval of 4 to 6 feet BGS from a soil boring advanced in F Street between Building 1 and Building 1608. This concentration is below the most stringent RCL of 70 mg/kg set by the Utah Department of Health Division for leaking UST sites. Additionally, the extent of ethylbenzene detected in soil at Site 8 is isolated to this one point.

TPH Laboratory Analysis Results

The presence of TPH in soil screening samples was not evaluated.

TPH was detected at concentrations of 410 and 460 mg/kg in two soil samples collected from Site 8. These concentrations exceed the UDEQ Level I RCL of 100 mg/kg. The detection of TPH in these samples is most likely because the soil samples were collected from a depth interval of 0 to 2 feet BGS in an asphalt-paved road.

Priority Pollutant Metal Laboratory Analysis Results

The presence of metals in soil screening samples was not evaluated.

Metals were not detected in soil samples collected from Site 8 at concentrations outside of the naturally occurring ranges of metals in soil.

5.3.5.2 Groundwater

VOC Screening Results

TCE was detected in groundwater screening samples collected from Site 8 and to the north and east of Site 8 in the areas of Sites 1 and 2 at concentrations ranging from 1 to 38,960 μg/l. Of the 61 samples in which TCE was detected, 13 had concentrations less than the EPA maximum contaminant level (MCL) and UDEQ Groundwater Quality Standard (GWQS) of 5.0 μg/l. The remaining 48 samples had concentrations which exceeded federal and state ARAR values.

TCE degradation products including c-DCE, t-DCE and 1,1-DCA were also detected in groundwater screening samples. The highest concentrations were generally found in deep groundwater screening samples collected from the area near the intersection of F street and 2nd Street. The properties and fate and transport of TCE, TCA, and their degradation products are discussed in Section 7.0 of this document.

Of the compounds specifically addressed under state and federal ARARs, 1,2-DCA was detected in one groundwater screening sample at a concentration of 1.4 μg/L, which falls below the EPA MCL and UDEQ GWQS of 5.0 μg/L.

VOC Laboratory Analysis Results

TCE was detected in 26 of the 40 groundwater samples collected from monitoring wells at Site 8 at concentrations ranging from 1.2 to 352 µg/l. Of these, 13 had concentrations below the EPA MCL and UDEQ GWQS of 5.0 µg/L. The remaining 13 samples had concentrations which exceed federal and state ARAR values.

TCE, TCA, and their degradation products including c-DCE, t-DCE, and 1,1-DCA were detected in groundwater samples at Site 8. Of the compounds specifically addressed under state and federal ARARs, 1,2-DCA was detected in one groundwater sample at a concentration of 1.9 µg/L, which falls below the EPA MCL and UDEQ GWQS of 5.0 µg/L. 1,1-DCE was detected in six groundwater samples at concentrations ranging from 1.4 to 2.8 µg/L. These exceed the EPA MCL and UDEQ GWQS of 7.0 µg/L.

The highest concentrations of TCE, TCA, and associated breakdown products were detected along 2nd Street in the vicinity of Building 1608. Concentration maps compiled from groundwater screening and groundwater laboratory data show three separate plumes of TCE in groundwater at Site 8 and to the north and east. The first plume is located adjacent to the southwestern corner of Building 10. The second plume is located in Area 2, between Buildings 1508 and 1506. The third plume in which the highest concentrations of TCE were detected, is located along 2nd Street across from Building 1608.

SVOC Laboratory Analysis Results

Analysis for SVOCs was not performed on groundwater screening samples.

Most SVOCs were not detected above the method detection limits in groundwater samples collected from Site 8. However, bis(2-ethylhexyl)phthalate was detected in groundwater samples collected from Site 8 at concentrations ranging from 0.08 to 1.7 mg/l. These concentrations are above the EPA's proposed MCL (PMCL) of 0.004 mg/l.

BTEX Screening Results

BTEX compounds were detected in several of the groundwater screening samples collected from Site 8. Benzene was detected in 9 of the 71 samples collected at concentrations ranging from 0.8 to 716.3 µg/l. Two samples had concentrations below the EPA MCL and UDEQ GWQS of 5.0 µg/l.

Toluene was detected in sample S8-GP31-GW2 at a concentration of 174.7 µg/l. This concentration is below the EPA MCL and UDEQ GWQS of 1,000 µg/l.

Ethylbenzene was detected in 6 of the 71 samples at concentrations ranging from 1.4 to 220.5 µg/l. All concentrations are below the EPA MCL and UDEQ GWQS of 700 µg/l.

Xylenes were detected in 6 of the 71 samples at concentrations ranging from 3.3 to 407.0 µg/l. All concentrations detected were below the EPA MCL and UDEQ GWQS of 1,000 µg/l.

The highest concentrations of BTEX compounds were detected in sample S8-GP14-GW1 collected in the former UST area at a depth of 8 to 10 feet BGS, and in sample S8-GP31-GW1 collected north of Site 8, in the vicinity of Building 1608.

BTEX Laboratory Analysis Results

Benzene was detected at concentrations ranging from 1 to 719 μg/l in four of the 20 groundwater samples collected from Site 8 during the first round of groundwater sampling. Two of the four samples had concentrations below the EPA MCL and UDEQ GWQS of 5.0 μg/l. The extent of benzene contamination in groundwater was limited to the former UST area. However, benzene was detected above the method detection limit (1.0 μg/l) in only one sample at a concentration of 1.4 μg/l (below the EPA MCL and UDEQ GWQS of 5.0 μg/l) during the second round of groundwater sampling. During the second round of sampling, groundwater elevations dropped 0.5 to 0.75 ft below the groundwater elevations observed during the first round of sampling. BTEX compounds, which are lighter than water and tend to float near the surface of the groundwater table, may not have been detected in the second round of groundwater sampling due to groundwater elevations dropping below the zone of contamination.

TPH Laboratory Analysis Results

Analysis for TPH was not performed on groundwater screening samples.

TPH was not detected in the groundwater samples collected during the first round of groundwater sampling above the method detection limit of 100 μg/l. However, benzene was detected in two of these samples at concentrations above 100 μg/l. Benzene is in the range of TPH detected by the method used to analyze the groundwater samples. This anomaly may be due to the chemist's interpretation of the chromatograph produced during the analysis. In some cases, the peaks on chromatographs overlap or "piggyback" each other. In these cases, the chemist may interpret the overlapping peaks as background noise, and not include the quantification of the peaks into the final concentration result. This may result in a TPH concentration lower than the sum of individual petroleum hydrocarbons detected in the sample.

TPH was detected in five of the 20 groundwater samples collected during the second round of groundwater sampling. All samples having TPH concentrations were collected from the former UST area at Site 8. TPH concentrations ranged from 700 to 1,800 μg/l.

Priority Pollutant Metal Laboratory Analysis Results

Analysis for PPMs was not performed on groundwater screening samples.

Only two of the PPMs were detected in groundwater samples collected from Site 8 at concentrations greater than 1.0 mg/l. Zinc concentrations ranged from 0.02 to 1.7 mg/l and arsenic concentrations ranged from 0.08 to 1.7 mg/l.

5.4 IRP SITE 10 FINDINGS

5.4.1 Geologic and Hydrologic Investigation Results

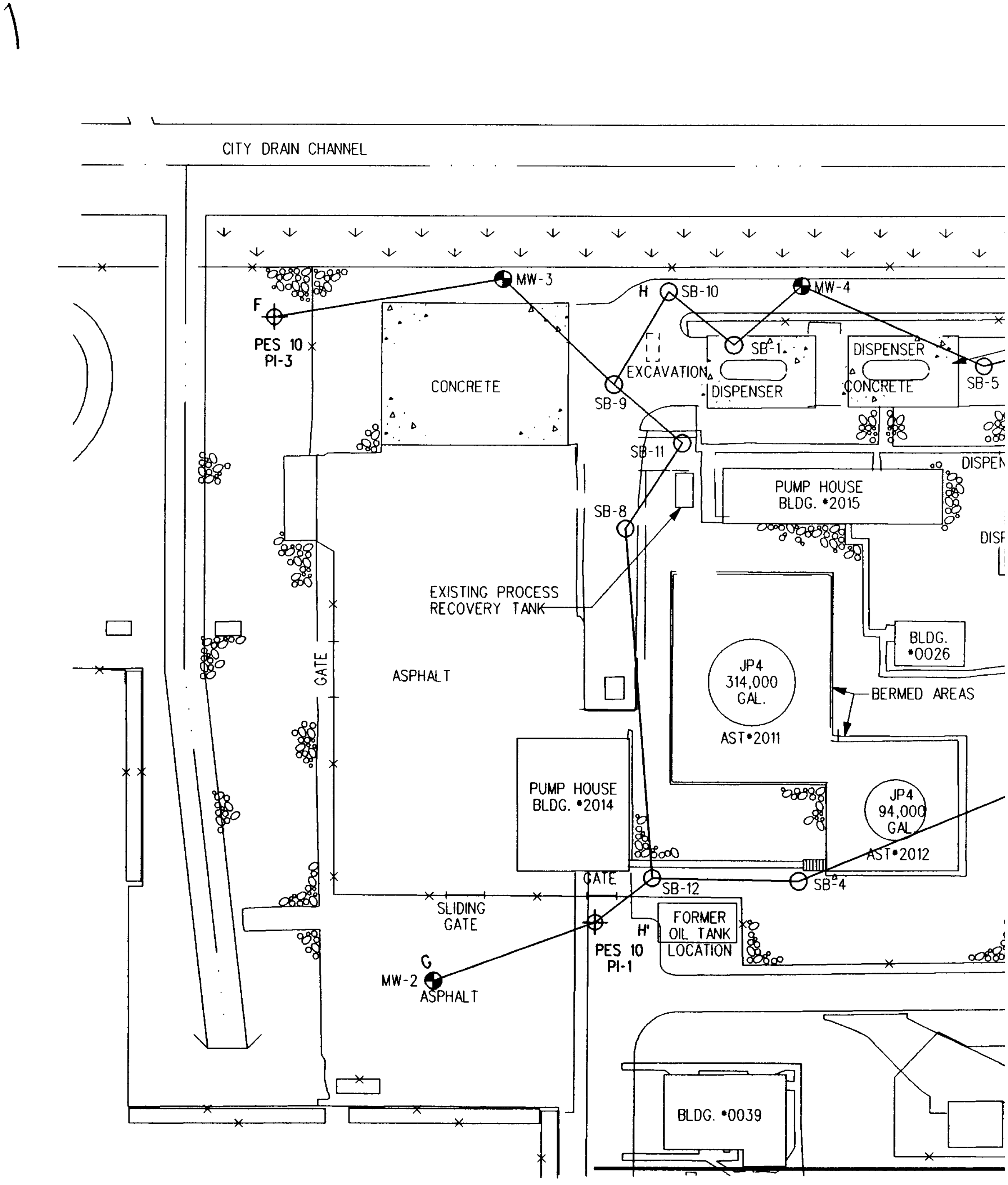
Soil borings and monitoring wells were used to characterize the geology and hydrogeology of IRP Site 10. Fourteen soil borings were completed to a maximum depth of six to 14 feet. Soil samples were collected from these borings to provided data to characterize the subsurface geology. Five groundwater monitoring wells and one free product recovery well were installed in 6 of the 14 borings. Geological cross-sections have been developed using both soil boring and monitoring well logs to interpret site geological conditions. Figure 5-25 shows the locations of geologic cross-sections at IRP Site 10. Cross-sections depicting the subsurface geology and contamination detected in analytical sampling are shown on Figures 5-26 through 5-29. Soil boring logs for this investigation are presented in Appendix A.

The heterogeneous unconsolidated sediments encountered at IRP Site 10 are generally similar to IRP Site 8. The sediments consist of clays, silty clays, sandy clays, silty sands, and fine to coarse sands. The dark organic sediment layer was observed in many of the IRP Site 10 borings. As discussed in Section 5.4.2, hydrogen sulfide was detected at Site 10 in a sample collected from the depth at which the dark organic sediment layer was observed. These fine-grained delta and floodplain sediments are consistent with the geology at other sites investigated at UANG Base.

No one soil type is dominant within the shallow subsurface at Site 10. Clay layers are generally consistent laterally across portions of the site. Layers and lenses of silt, clayey sand, and sand interfinger within the clay and are discontinuous. Cross-section F-F' illustrates the presence of a consistent fine grain zone containing clay and silt along the northern boundary of Site 10 (see Figure 5-26). A sizable sand lens, grading from a clayey sand to a well graded sand, exists in the vicinity of piezometer PI-2 and monitoring well MW-5. The grades of sand in this lens are discontinuous, or poorly GAP graded. The southern portion of the site is dominated by silty and sandy soils as illustrated in cross-section G-G' (see Figure 5-27). Clay is not as predominant in the southern portion of the site, compared to the northern portion of the Site. A fairly continuous sandy layer is present across the entire site at a depth of approximately 11 to 12 feet.

Soil investigated within 0.5 to 3.5 feet BGS is comprised of fill material. The fill material consists of gravel or clayey gravel. Asphalt was present at the surface at some drilling locations.

Groundwater within the first 14 feet of the surface at Site 10 occurs locally under unconfined to semi-confined conditions. According to Davis (1983), the first 20 feet of sediment investigated in this study is part of the regional unconfined aquifer that overlies the regional confined artesian aquifer. The regional confining layer located between the regional confined and unconfined aquifer ranges in thickness from about 40 to 100 feet. However, examined on a local scale, the first 14 feet of unconsolidated sediment of the shallow aquifer at IRP Site 10 can be considered as a series of productive hydraulic sand zones separated by semi-confining layers of silts and clays. Sands behave as aquifers while silts and clays behave as aquitards. The degree of interconnectiveness among and between the productive and confining layers primarily determines unconfined and semi-confined conditions.



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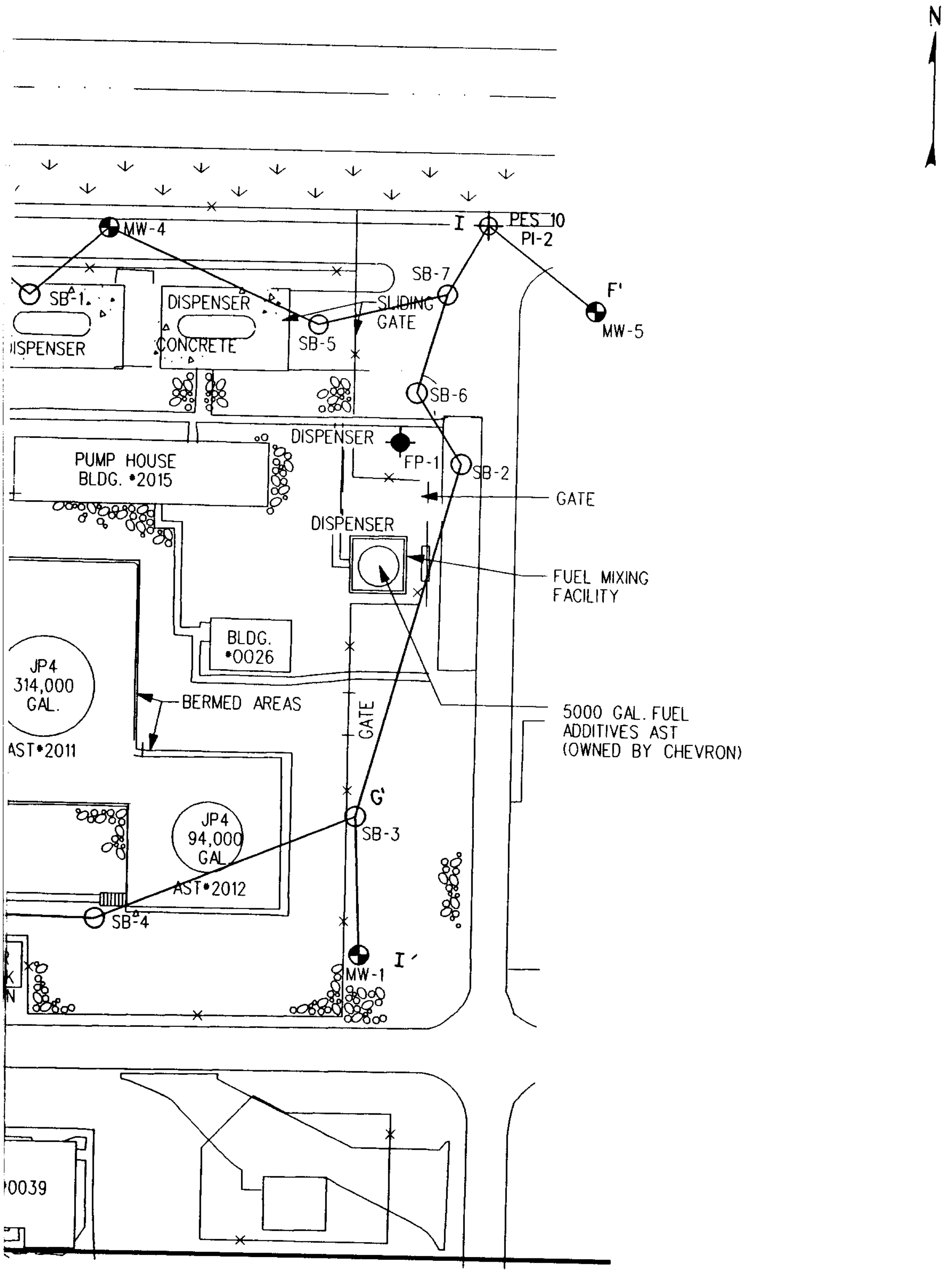

LEGEND:

○ SOIL BORING (
⌖ PIEZOMETER (5
● MONITORING WE
◆ FREE PRODUCT MONITORING WE
↓ GRASS
GRAVEL
—×— FENCE

CONTOUR INTERVA

B	BENZENE
E	ETHYLBENZENE
T	TOLUENE
X	XYLENE

0

SCALE

FIGURE

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CROSS-SECTIONS F-F'
AND I-I' IRP S
151st ARW, UTAH AIR NATION
SALT LAKE CITY INTERNATION
SALT LAKE CITY, UT
STONE & WEBSTER ENGINEERING
BOSTON, MASS.

DRAWING NUMBER 05219.00

DESIGNED BY:
DRAWN BY: G.C. CARTER
DSGN CHK'D BY:
CHK'D BY:

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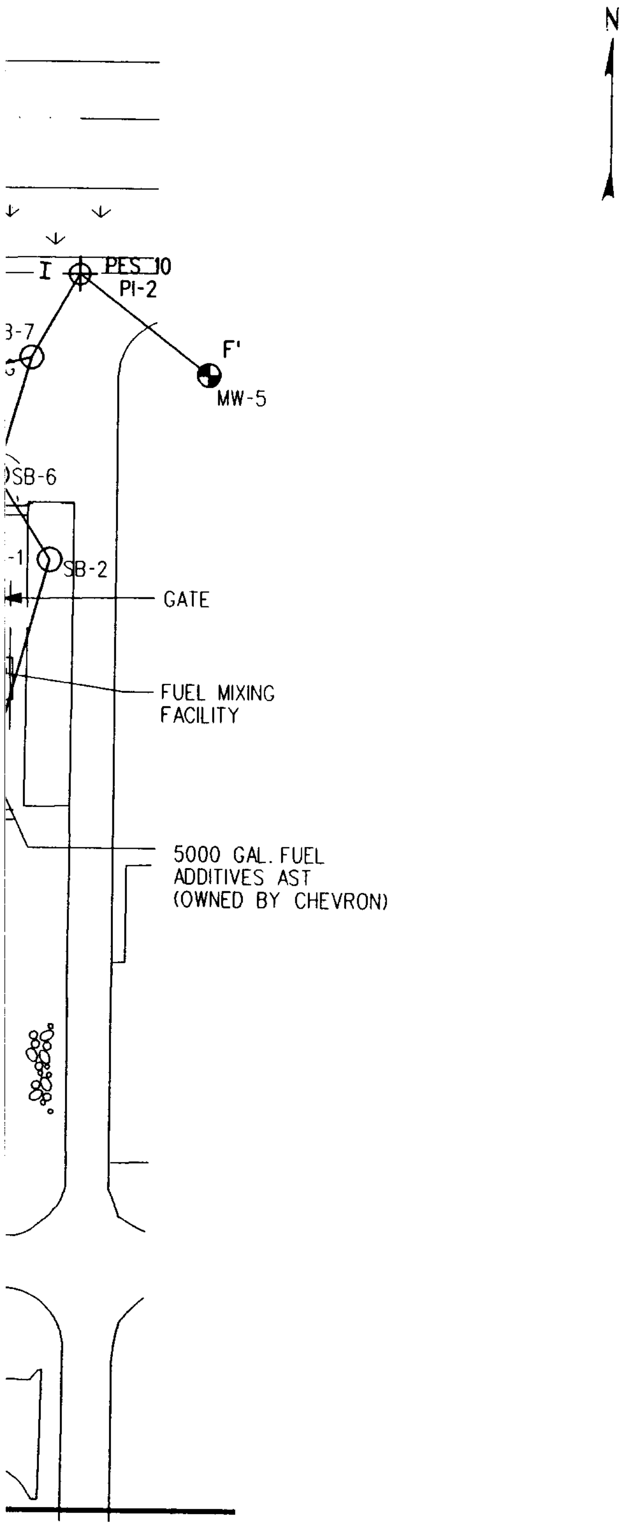

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- ○ SOIL BORING (10)
- ⊕ PIEZOMETER (5)
- ◐ MONITORING WELL (6)
- ◆ FREE PRODUCT MONITORING WELL
- ↓ GRASS
- ∞ GRAVEL
- —×— FENCE

CONTOUR INTERVAL 0.2 FEET

B BENZENE
E ETHYLBENZENE
T TOLUENE
X XYLENE

0 50'
SCALE

FIGURE 5-25

LOCATIONS OF GEOLOGIC
CROSS-SECTIONS F-F', G-G, H-H'
AND I-I' IRP SITE 10
151st ARW, UTAH AIR NATIONAL GUARD
SALT LAKE CITY INTERNATIONAL AIRPORT
SALT LAKE CITY, UTAH
STONE & WEBSTER ENGINEERING CORPORATION
BOSTON, MASS.

DRAWING NUMBER 05219.002

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DESIGNED BY:
DSGN CHK'D BY:
DRAWN BY: G.C. CARTER
CHK'D BY:
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ISSUE
HALF-SIZE
APP. CARD
RESP ENGR: K. MARONEY
SUPV: R.J. BOUDREAU

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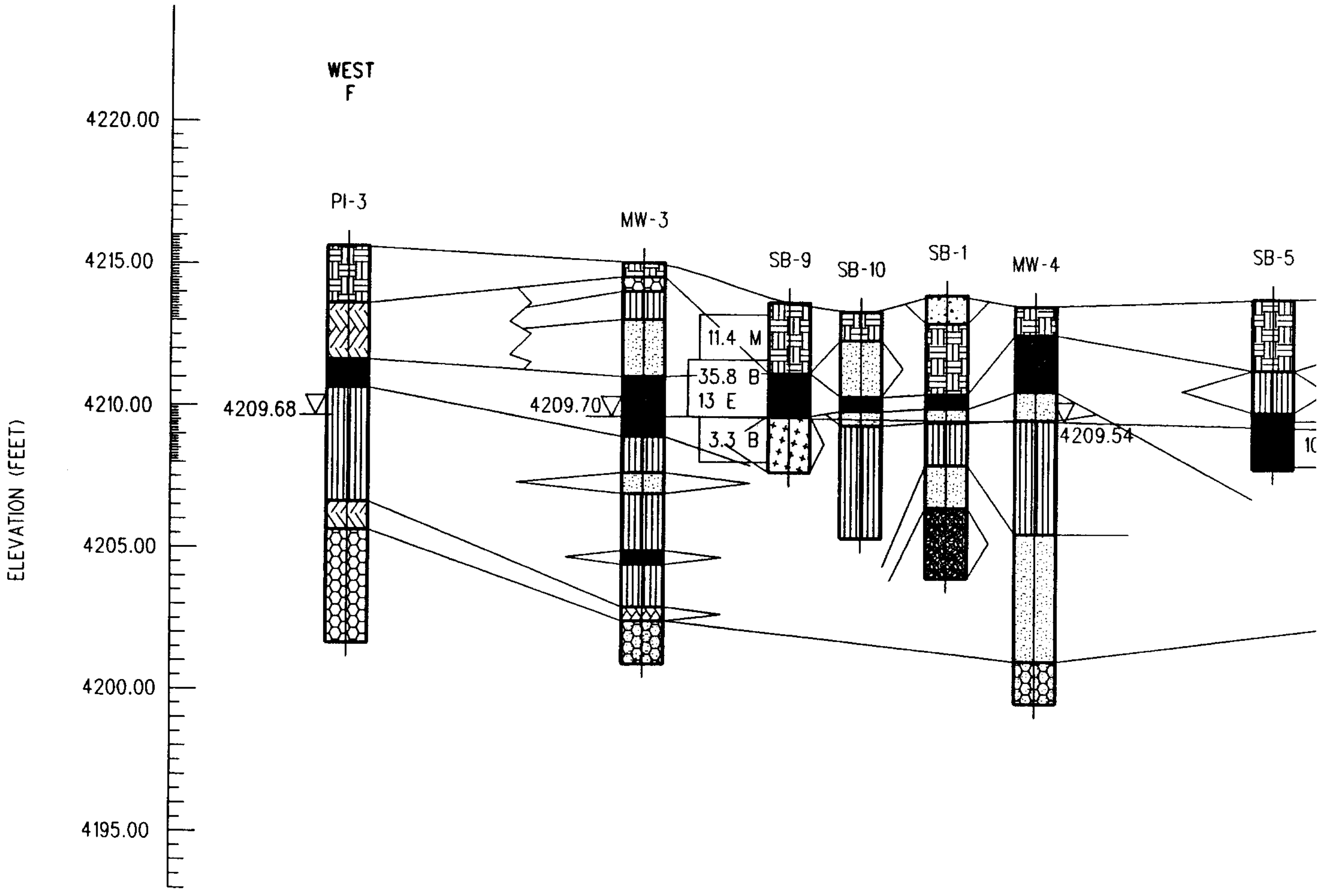

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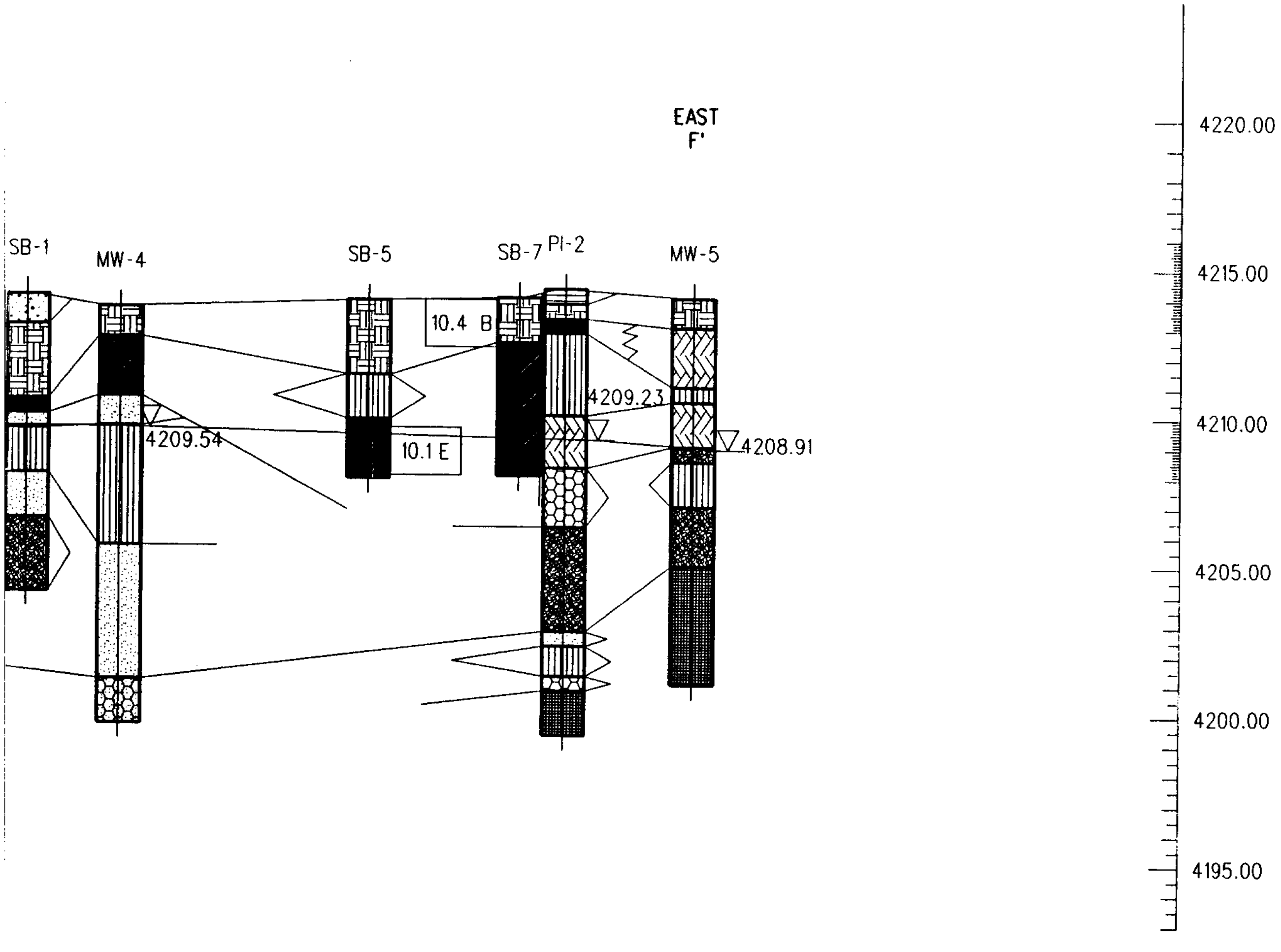

LEGEND:

▤ ASPHAL
▥ SANDY
▩ SAND, S
░ SILT, ML
▧ CLAY, CL
▦ FILL
⁘ CONCRE
■ MODERA
ORGANIC
✢ ORGANIC
⬡ SILTY S
▓ POORLY
GRAVELL
▨ CLAYEY

SOIL ANALYTICAL RESULT
B - BENZENE
E - ETHYLBENZENE
X - XYLENE
M - METHYLENE CH

0 50'

HORIZONTAL SCALE 1" -

VERTICAL SCALE 1" - 5' A

TPH - TOTAL PETROLEUM

▽ - GROUNDWATER ELE

GROUNDWATER ELEVATION
READINGS OBTAINED 8/11/

FIGURE

GEOLOGIC CROSS-SE
IRP SITE

151st ARW, UTAH AIR NA
SALT LAKE CITY INTERNAT
SALT LAKE CITY,
STONE & WEBSTER ENGINEERIN
BOSTON, MASS.

DRAWING NUMBER 05219.00

ISSUE	DESCRIPTION
2	
1	ORIGINAL ISSUE

CORRECT APPR DATE ISSUE DESCRIPTION CHKD
S.A. FAC ELEC LTG MATL PC ARCH CIVIL CONC STL L&P INST MD P.S.

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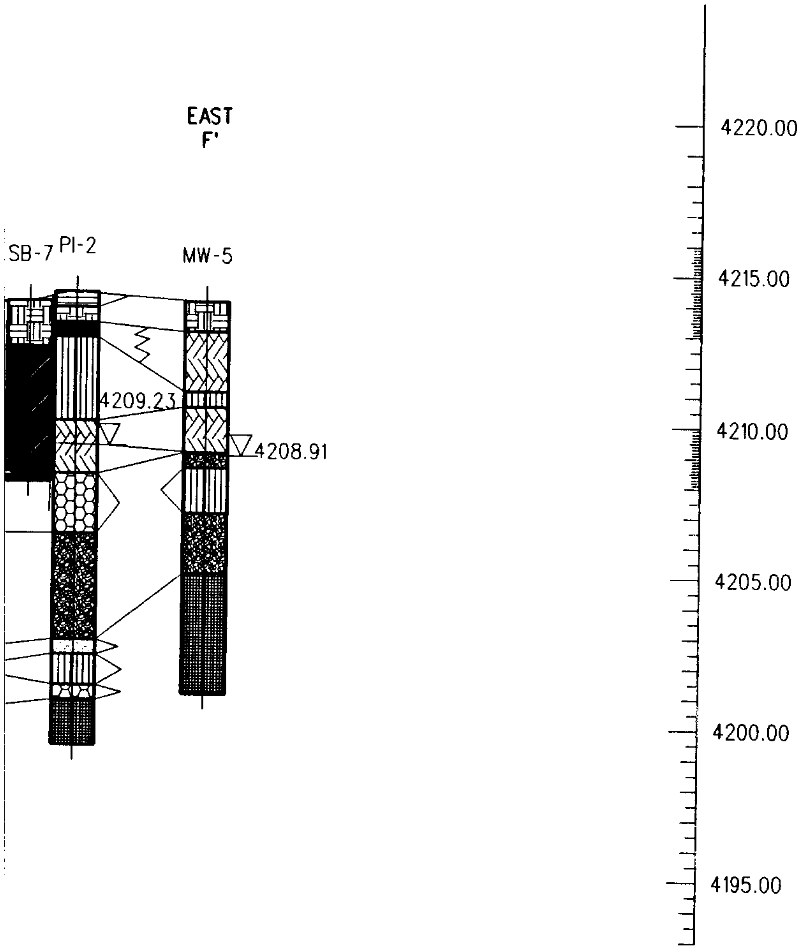
DRAWN BY: G.C. CARTER
CHK'D BY:



LEGEND:

- ▤ ASPHALT
- ▥ SANDY CLAY, CL
- ▦ SAND, SW
- ░ SILT, ML
- ▧ CLAY, CL
- ▩ FILL
- ⁘ CONCRETE
- ■ MODERATELY PLASTIC ORGANIC SILT, OL
- ✢ ORGANIC CLAY, OH
- ⬡ SILTY SAND, SM
- ▓ POORLY GAP GRADED GRAVELLY SAND, SP
- ▨ CLAYEY SAND, SC

SOIL ANALYTICAL RESULTS (ug/kg)
B - BENZENE
E - ETHYLBENZENE
X - XYLENE
M - METHYLENE CHLORIDE

0 50'

HORIZONTAL SCALE 1" - 50' APPROX.

VERTICAL SCALE 1" - 5' APPROX.

TPH - TOTAL PETROLEUM HYDROCARBONS

▽ - GROUNDWATER ELEVATION.

GROUNDWATER ELEVATIONS BASED ON READINGS OBTAINED 8/11/95.

FIGURE 5-26

ISSUE
HALF-SIZE
APP. CARD

GEOLOGIC CROSS-SECTION F-F'
IRP SITE 10

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DRAWN BY: G.C. CARTER
CHK'D BY:
AREAS
LEVELS
WORK PKG
PCT

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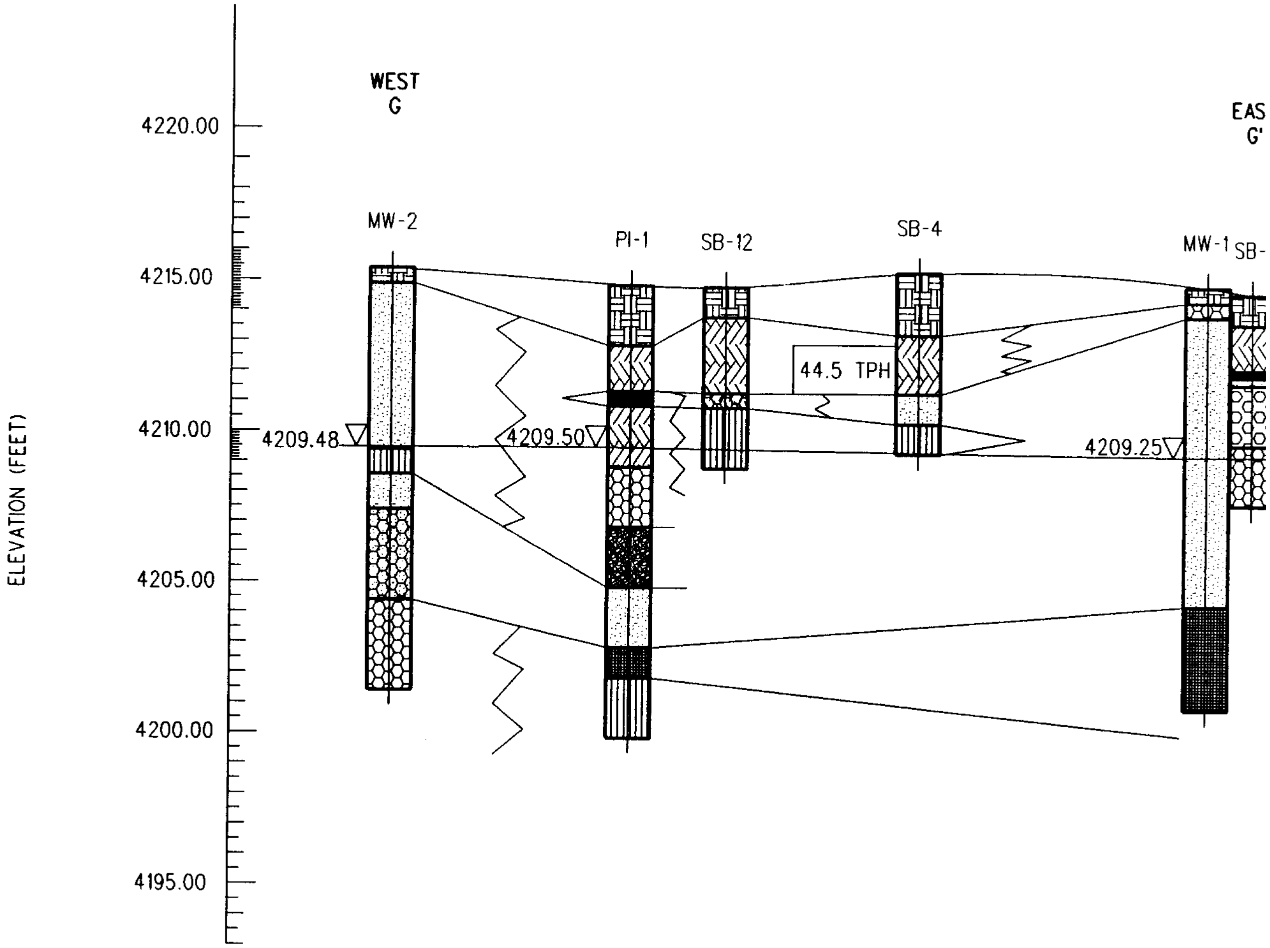

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ISSUE	DESCRIPTION	CHKD	CORRECT	APPR DATE	ISSUE	DESCRIPTION	CHKD	CORRECT	APPR DATE	ISSUE	DESCRIPTION

PC ARCH CIVIL CONC STL L&P INST MD P.S. S.A. FAC ELEC LTG MATL PC ARCH CIVIL CONC STL L&P INST MD P.S. S.A. FAC ELEC LTG MATL PC ARCH CIVIL CONC STL

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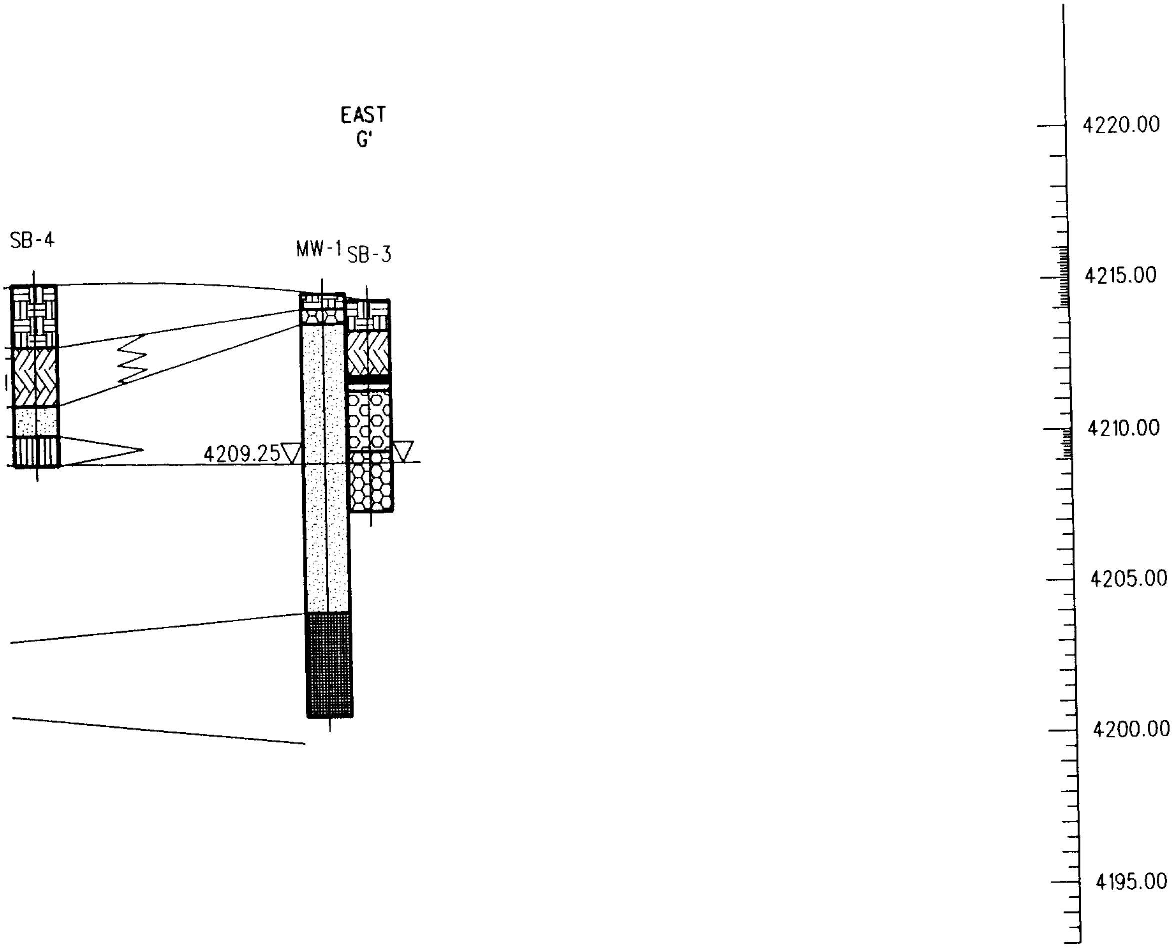

LEGEND:

▨	CLAYEY SAND, SC
▩	SAND, SW
░	SILT, ML
▧	CLAY, CL
▓	POORLY GAP GRADED GRAVELLY SAND, SP
▦	FILL
◌	INORGANIC SILTS, MACACE FINE SANDS OR SILTS, EL
⬡	SILTY SAND, SM
■	MODERATELY PLASTIC ORGANIC SILT, OL
▥	SANDY CLAY, CL

SOIL ANALYTICAL RESUL
TPH = TOTAL PETROLEU

0 50'

HORIZONTAL SCALE 1" -

VERTICAL SCALE 1" - 5

▽ - GROUNDWATER E

GROUNDWATER ELEVATI
READINGS OBTAINED 8/

FIGURE

GEOLOGIC CROSS-S
IRP SITE

151st ARW, UTAH AIR
SALT LAKE CITY INTERN
SALT LAKE CIT
STONE & WEBSTER ENGINEE
BOSTON, MASS

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CHK'D BY:

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3

LEGEND:

▨ CLAYEY SAND, SC

▩ SAND, SW

░ SILT, ML

▧ CLAY, CL

▦ POORLY GAP GRADED
GRAVELLY SAND, SP

⊞ FILL

⬡ INORGANIC SILTS, MACACEOUS OR DIATOMACEOUS
FINE SANDS OR SILTS, ELASTIC SILTS, MH

⬡ SILTY SAND, SM

■ MODERATELY PLASTIC
ORGANIC SILT, OL

▥ SANDY CLAY, CL

SOIL ANALYTICAL RESULTS (ug/kg)
TPH = TOTAL PETROLEUM HYDROCARBONS

0 50'

HORIZONTAL SCALE 1" - 50' APPROX.

VERTICAL SCALE 1" - 5' APPROX.

▽ - GROUNDWATER ELEVATION.

GROUNDWATER ELEVATIONS BASED ON
READINGS OBTAINED 8/11/95.

FIGURE 5-27

GEOLOGIC CROSS-SECTION G-G'
IRP SITE 10

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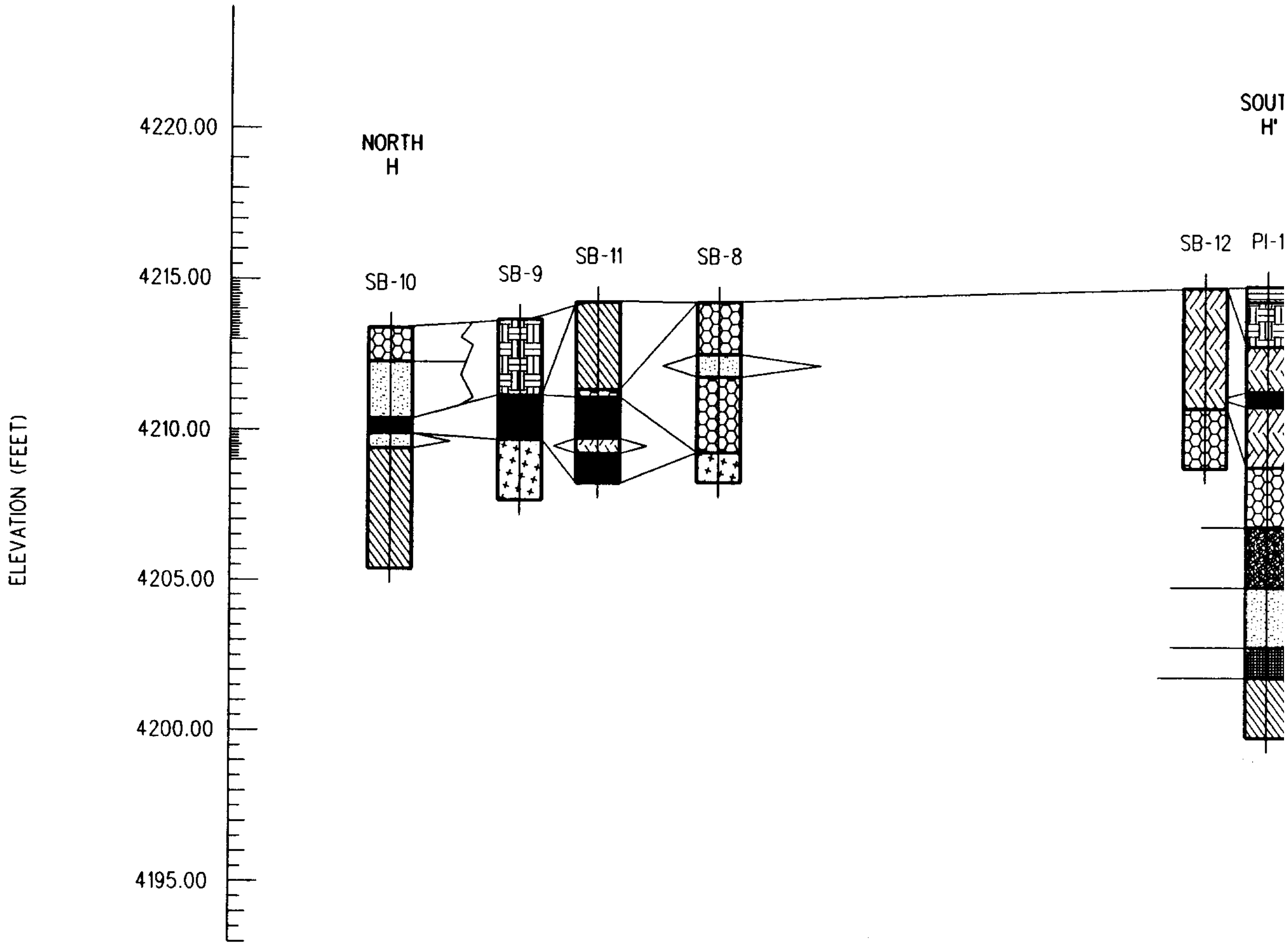

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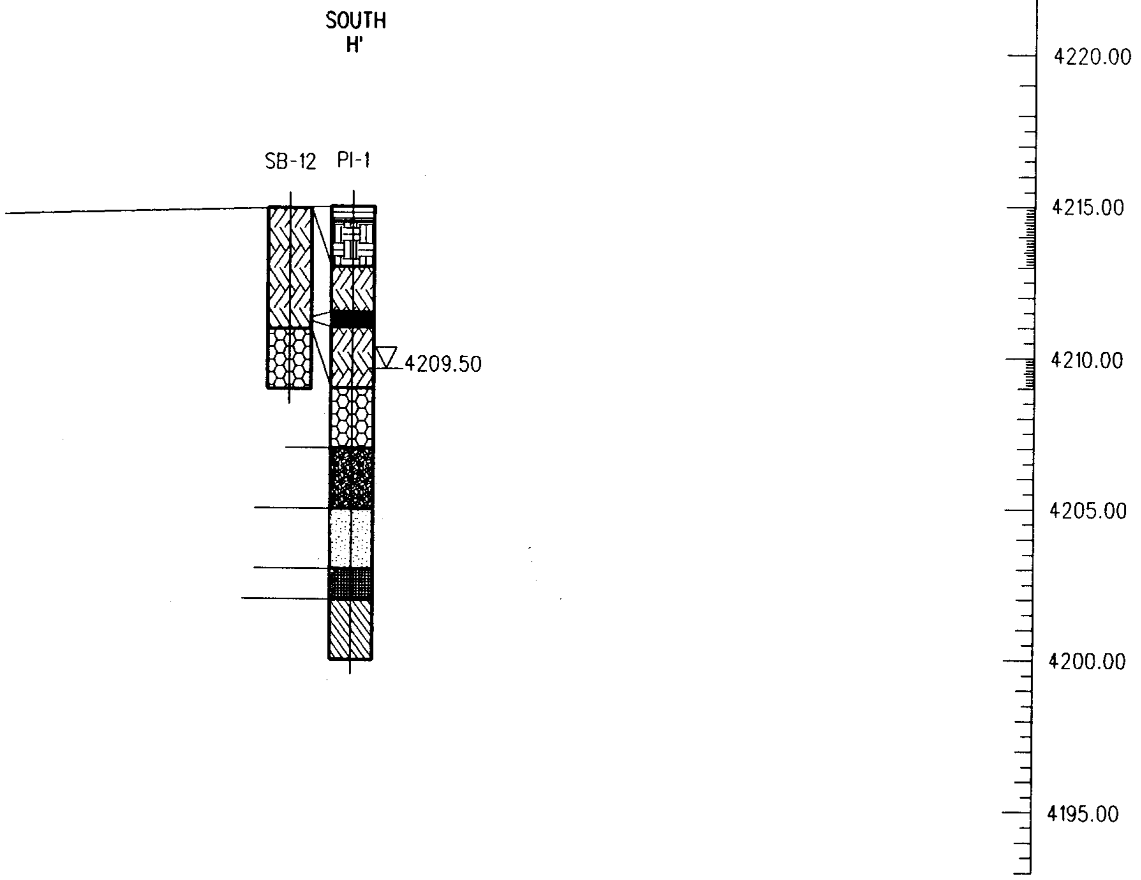

LEGEND:

▤	ASPHALT
▨	CLAYEY SAN
▩	SAND, SW
░	SILT, ML
▧	CLAY, CL
▦	POORLY GAP GRAVELLY S
■	MODERATELY ORGANIC SIL
⁘	ORGANIC CLA
⬡	SILTY SAND,
▥	FILL

SOIL ANALYTIVAL RESULTS (u
B = BENZENE
E = ETHYLBENZENE
X = XYLENE
M = METHYLENE CHLOR

0 50'

HORIZONTAL SCALE 1" = 50' A

VERTICAL SCALE 1" = 5' APPR

TPH = TOTAL PETROLEUM HY

▽ = GROUNDWATER ELEVAT

GROUNDWATER ELEVATIONS B
READINGS OBTAINED 8/11/95.

FIGURE 5-

GEOLOGIC CROSS-SECT
IRP SITE 10
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SALT LAKE CITY, UT
STONE & WEBSTER ENGINEERING CO
BOSTON, MASS.

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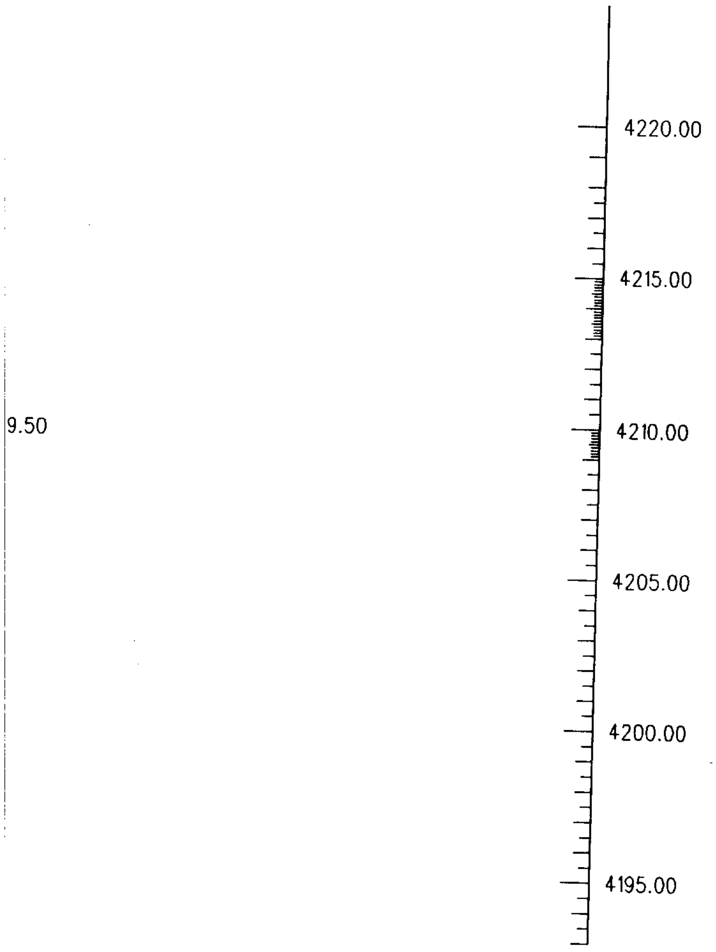

LEGEND:

▤ ASPHALT

▧ CLAYEY SAND, SC

▦ SAND, SW

░ SILT, ML

▨ CLAY, CL

▩ POORLY GAP GRADED GRAVELLY SAND, SP

■ MODERATELY PLASTIC ORGANIC SILT, OL

✣ ORGANIC CLAY, OH

⬡ SILTY SAND, SM

⊞ FILL

SOIL ANALYTIVAL RESULTS (ug/kg)
B = BENZENE
E - ETHYLBENZENE
X - XYLENE
M - METHYLENE CHLORIDE

0 50'

HORIZONTAL SCALE 1" - 50' APPROX.

VERTICAL SCALE 1" = 5' APPROX.

TPH - TOTAL PETROLEUM HYDROCARBONS

▽ = GROUNDWATER ELEVATION.

GROUNDWATER ELEVATIONS BASED ON
READINGS OBTAINED 8/11/95.

FIGURE 5-28

GEOLOGIC CROSS-SECTION H-H'
IRP SITE 10

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BOSTON, MASS.

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						1	ORIGINAL ISSUE												

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RESP ENGR: K. MARONEY
SUPV: R. J. BOUDREAU

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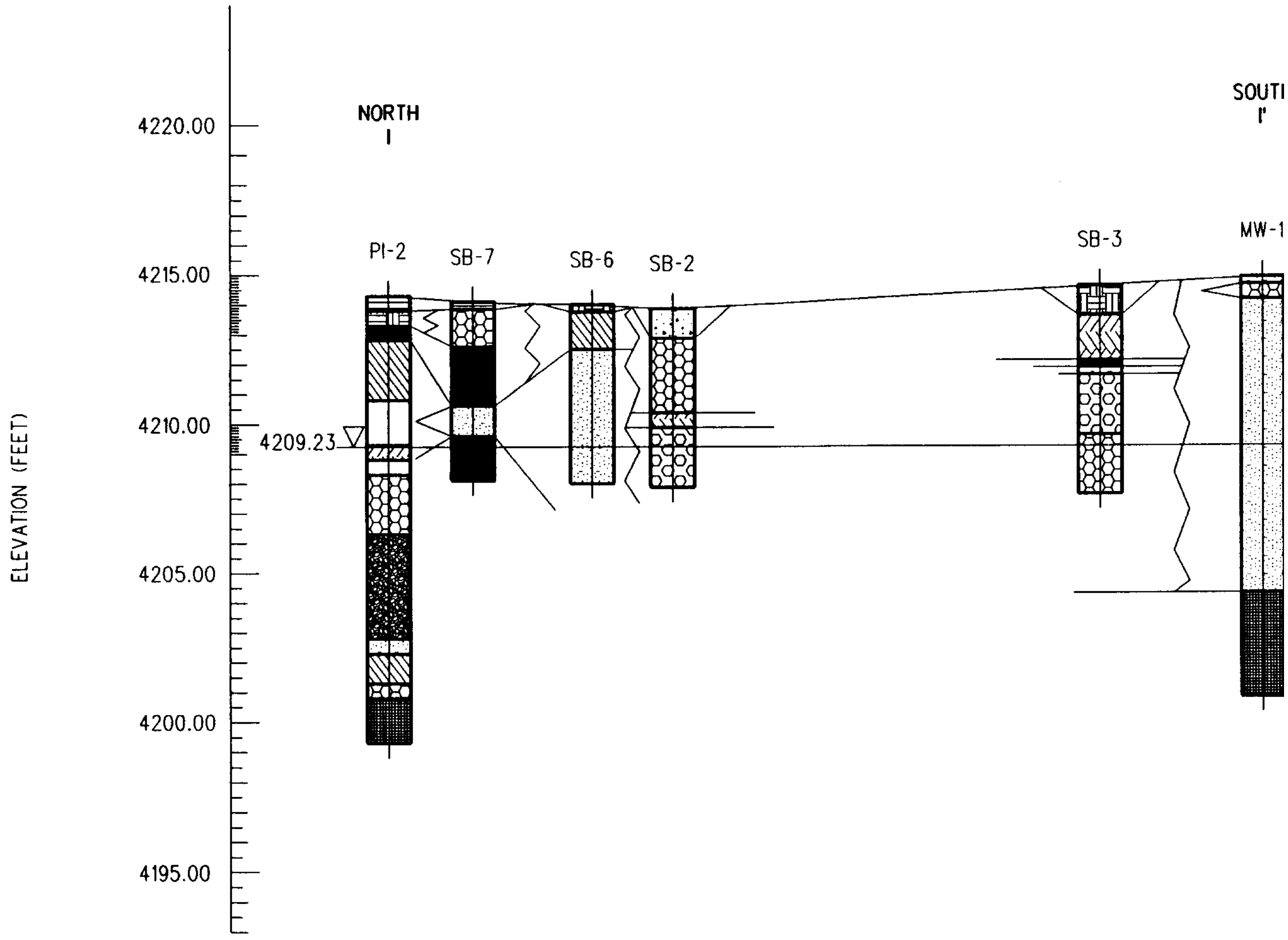

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PC	ARCH	CIVIL	CONC	STL	L&P	INST	MD	P.S.	S.A.	FAC	ELEC	LTG	MATL	PC	ARCH	CIVIL	CONC	STL	L&P	INST	MD	P.S.	S.A.	FAC	ELEC	LTG	MATL	PC	ARCH	CIVIL	CONC	STL	L&P

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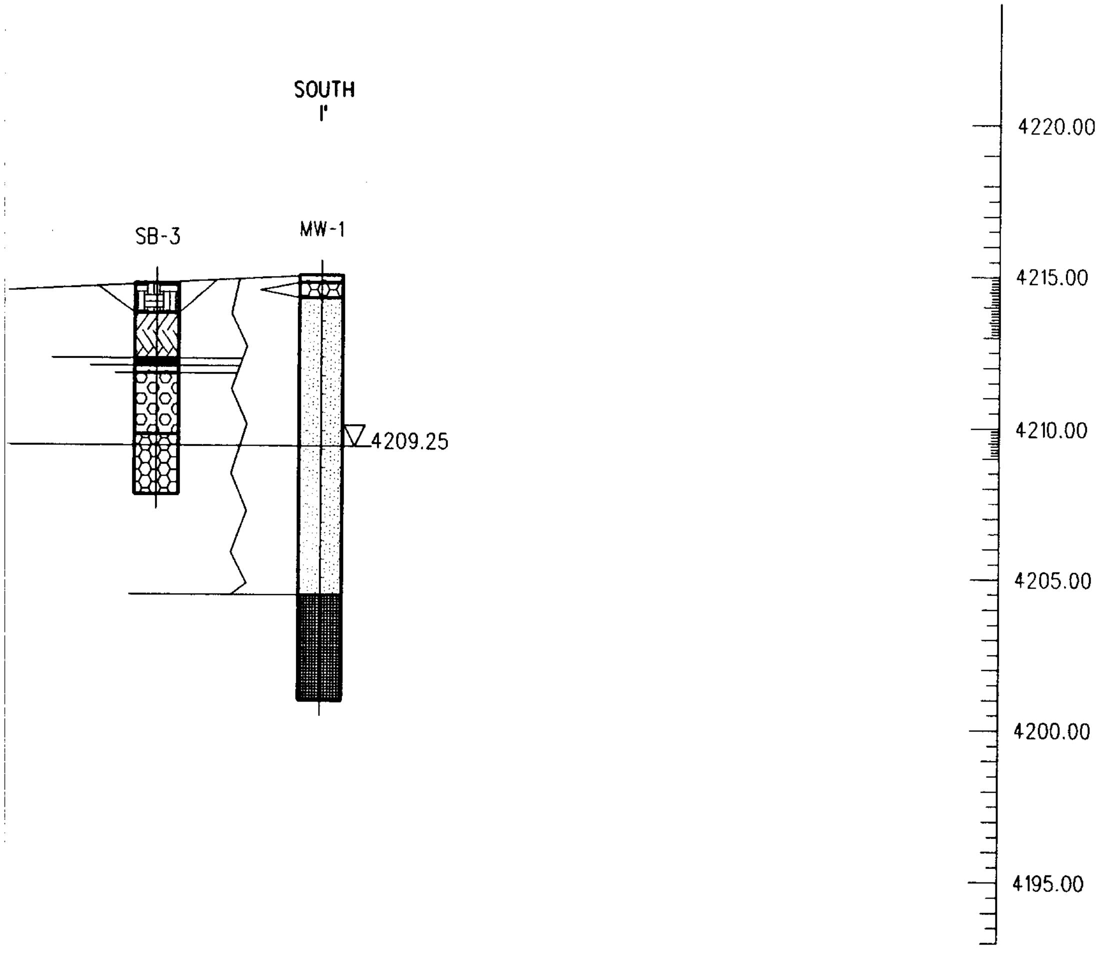

LEGEND:

▤ ASPHALT

▨ CLAYEY SAND, SC

▩ SAND, SW

░ SILT, ML

▧ CLAY, CL

▦ POORLY GAP GRADED GRAVELLY SAND, SP

▥ FILL

○ INORGANIC SILTS, MACACEOUS OR FINE SANDS OR SILTS, ELASTIC SI

⬡ SILTY SAND, SM

▒ CONCRETE

■ MODERATELY PLASTIC ORGANIC SILT, OL

SOIL ANALYTICAL RESULTS (ug/kg
B = BENZENE
E = ETHYLBENZENE
X = XYLENE
M = METHYLENE CHLORIDE

0 50'

HORIZONTAL SCALE 1" = 50' APPRO

VERTICAL SCALE 1" = 5' APPROX.

▽ = GROUNDWATER ELEVATION.

GROUNDWATER ELEVATIONS BASED
READINGS OBTAINED 8/11/95.

FIGURE 5-2

GEOLOGIC CROSS-SECTION
IRP SITE 10

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SALT LAKE CITY INTERNATIONAL
SALT LAKE CITY, UTAH
STONE & WEBSTER ENGINEERING CORPOR
BOSTON, MASS.

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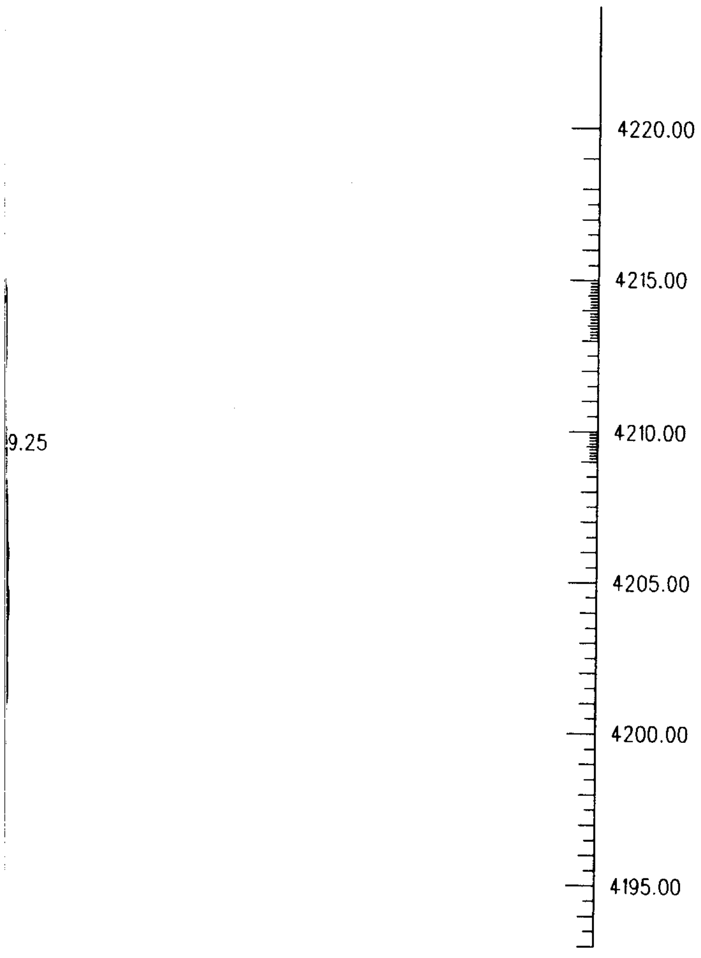

LEGEND:

▤ ASPHALT

▧ CLAYEY SAND, SC

▩ SAND, SW

░ SILT, ML

▨ CLAY, CL

▦ POORLY GAP GRADED GRAVELLY SAND, SP

▥ FILL

○ INORGANIC SILTS, MACACEOUS OR DIATOMACEOUS FINE SANDS OR SILTS, ELASTIC SILTS, MH

⬡ SILTY SAND, SM

░ CONCRETE

■ MODERATELY PLASTIC ORGANIC SILT, OL

SOIL ANALYTICAL RESULTS (ug/kg)
B = BENZENE
E - ETHYLBENZENE
X - XYLENE
M - METHYLENE CHLORIDE

0 50'

HORIZONTAL SCALE 1" - 50' APPROX.

VERTICAL SCALE 1" - 5' APPROX.

▽ - GROUNDWATER ELEVATION.

GROUNDWATER ELEVATIONS BASED ON READINGS OBTAINED 8/11/95.

FIGURE 5-29

GEOLOGIC CROSS-SECTION I-I'
IRP SITE 10

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STONE & WEBSTER ENGINEERING CORPORATION
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P.S. S.A. FAC ELEC LTG MATL PC ARCH CIVL CONC STL L&P INST MD P.S. S.A. FAC ELEC LTG MATL

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HALF-SIZE
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RESP ENGR: K. MARONEY
SUPV: R.J. BOUDREAU

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Confining characteristics of the shallow aquifer were not directly investigated, however site hydrogeology and observations of groundwater levels suggest that unconfined to semi-confined aquifer conditions may exist locally. Confining conditions commonly occur when hydraulically conductive zones (sands and gravels) are overlain by confining units of low hydraulic conductivity such as silts and clays. This condition exists at Site 10. Where monitoring wells can be interpreted as installed into the conductive zones, based on boring logs (i.e., monitoring wells MW-1, and MW-3 through MW-5), groundwater levels are observed above the base of the overlying confining layer. This phenomena is often indicative of confining conditions.

The interconnectiveness of the coarser grained material dominates the lateral movement of shallow groundwater. Although groundwater occurs in both fine and coarse grained material, its movement preferentially occurs through coarser grained material with higher hydraulic conductivities (i.e., silty sands and sands).

Groundwater levels were measured to determine lateral groundwater flow direction and gradient. Three separate groundwater level measurements, obtained from site monitoring wells, were conducted on June 22 and 27 and on August 11, 1995 (see Table 5-13). The two June 1995 groundwater level measurements did not include measurements from piezometers PI-1 through PI-3 and therefore do not present the most complete depiction of groundwater movement. The August 1995 groundwater measurement is most representative of lateral groundwater flow because it includes measurements from all monitoring wells and piezometers from the IRP Site 10 area. Groundwater potentiometric maps depicting groundwater levels and flow directions are presented in Figures 5-30, 5-31, and 5-32.

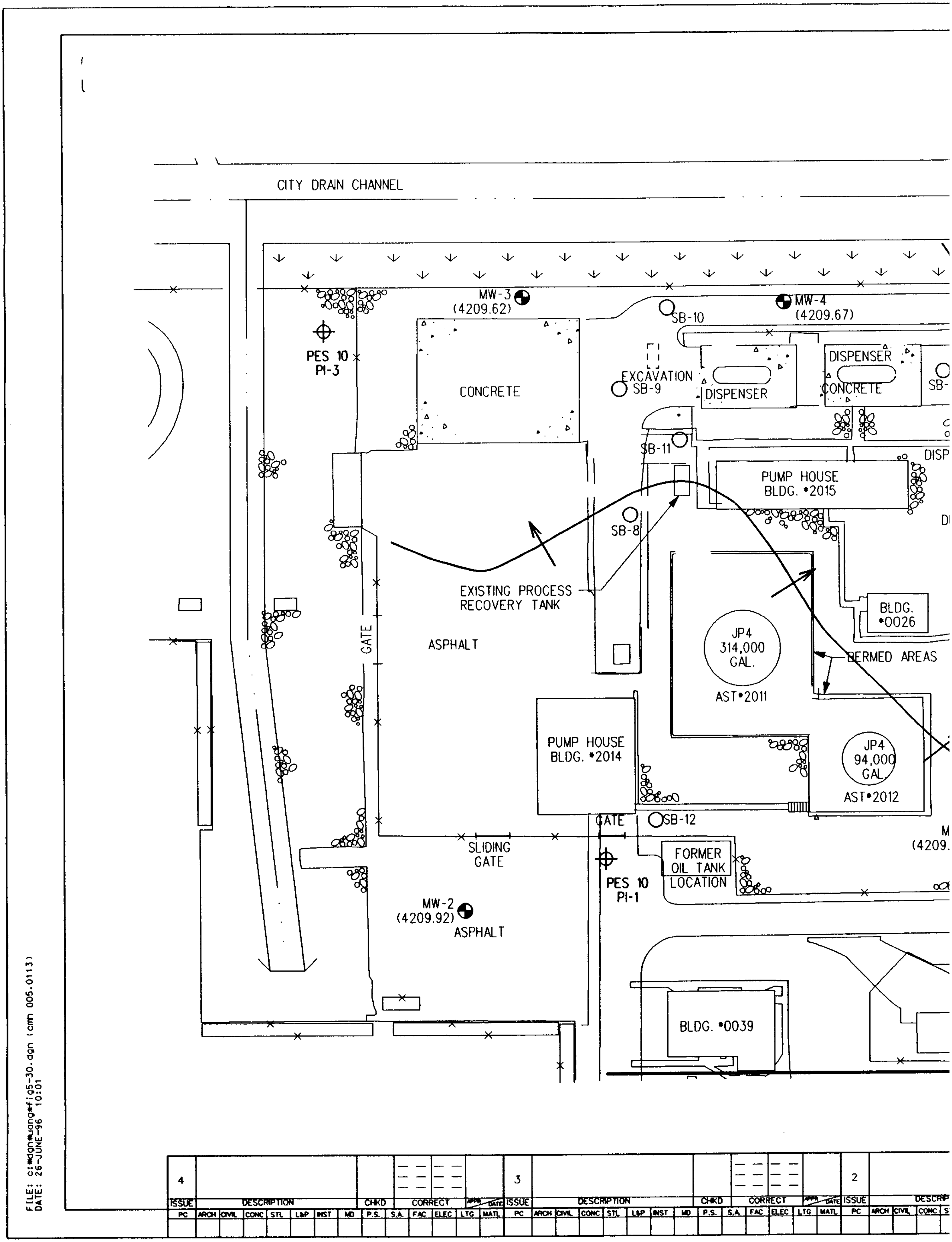
The three sets of groundwater level measurements collected at Site 10 indicated different patters of groundwater flow. Groundwater level measurements obtained on June 22 and 27, 1995 indicate groundwater flow directions to the northwest, north, and northeast (see Figures 5-30 and 5-31). The presence of a groundwater divide is suggested existing down the center of Site 10 along a north-south trending axis. The August 11, 1995 groundwater level indicates a groundwater flow direction toward the east, southeast, and south (see Figure 5-32). Monitoring well MW-5 consistently records the lowest groundwater level. The hydraulic gradient across the site is uniformly low, varying less than a foot across the entire site. The average groundwater gradients for the June and August measurements at Site 10 are 9.10×10^{-4}, 2.05×10^{-3} and 2.39×10^{-3}, respectively. The groundwater gradient is highest in the northeast portion of the facility in the vicinity of piezometer PI-2 and monitoring well MW-5. The lowest gradients are located in the northwest portion of Site 10 in the vicinity of piezometer PI-3 and monitoring well MW-3.

The August 11, 1995 groundwater level measurements indicate different groundwater flow directions than the June 1995 measurements, which are to the northwest, north, and northeast. The August 1995 groundwater flow direction is toward the east, southeast, and south. The observed differences in Site 10 groundwater flow directions between June 1995 and August 1995 are due to differing hydrologic conditions. The amount of infiltration due to precipitation and variations in water levels in the adjacent City Drain Channel may affect local groundwater levels at Site 10. However these factors were not directly measured as part of the investigation and their effect can only be speculated.

Table 5-13
Groundwater Elevations
IRP Site 10
151st ARW, Air National Guard, Salt Lake City, Utah

Sample ID.	Top of Casing Elevation (ft)	Depth to Water (feet)			Groundwater Elevation (feet)		
		August 11, 1995	June 22, 1995	June 27, 1995	August 11, 1995	June 22, 1995	June 27, 1995
MW1	4214.65	5.40	4.88	5.02	4209.25	4209.77	4209.63
MW2	4215.14	5.66	5.22	5.31	4209.48	4209.92	4209.83
MW3	4214.83	5.13	5.21	5.22	4209.70	4209.62	4209.61
MW4	4213.40	3.86	3.73	3.71	4209.54	4209.67	4209.69
MW5	4213.84	4.93	4.42	4.66	4208.91	4209.42	4209.18
PI-1	4214.68	5.18	NR	NR	4209.50	NC	NC
PI-2	4213.81	4.58	NR	NR	4209.23	NC	NC
PI-3	4215.41	5.73	NR	NR	4209.68	NC	NC

NR = Not recorded
NC = Not calculated


CITY DRAIN CHANNEL
MW-3
(4209.62)
MW-4
(4209.67)
SB-10
PES 10
PI-3
CONCRETE
EXCAVATION
SB-9
DISPENSER
DISPENSER
CONCRETE
SB-
SB-11
DISP
PUMP HOUSE
BLDG. •2015
SB-8
D
EXISTING PROCESS
RECOVERY TANK
GATE
ASPHALT
BLDG.
•0026
JP4
314,000
GAL.
AST•2011
BERMED AREAS
PUMP HOUSE
BLDG. •2014
JP4
94,000
GAL.
AST•2012
GATE
SB-12
M
(4209.
SLIDING
GATE
FORMER
OIL TANK
LOCATION
PES 10
PI-1
MW-2
(4209.92)
ASPHALT
BLDG. •0039
4
ISSUE
DESCRIPTION
CHKD
CORRECT
APPR DATE
3
ISSUE
DESCRIPTION
CHKD
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APPR DATE
2
ISSUE
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MD
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S.A.
FAC
ELEC
LTG
MATL
PC
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CONC
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P.S.
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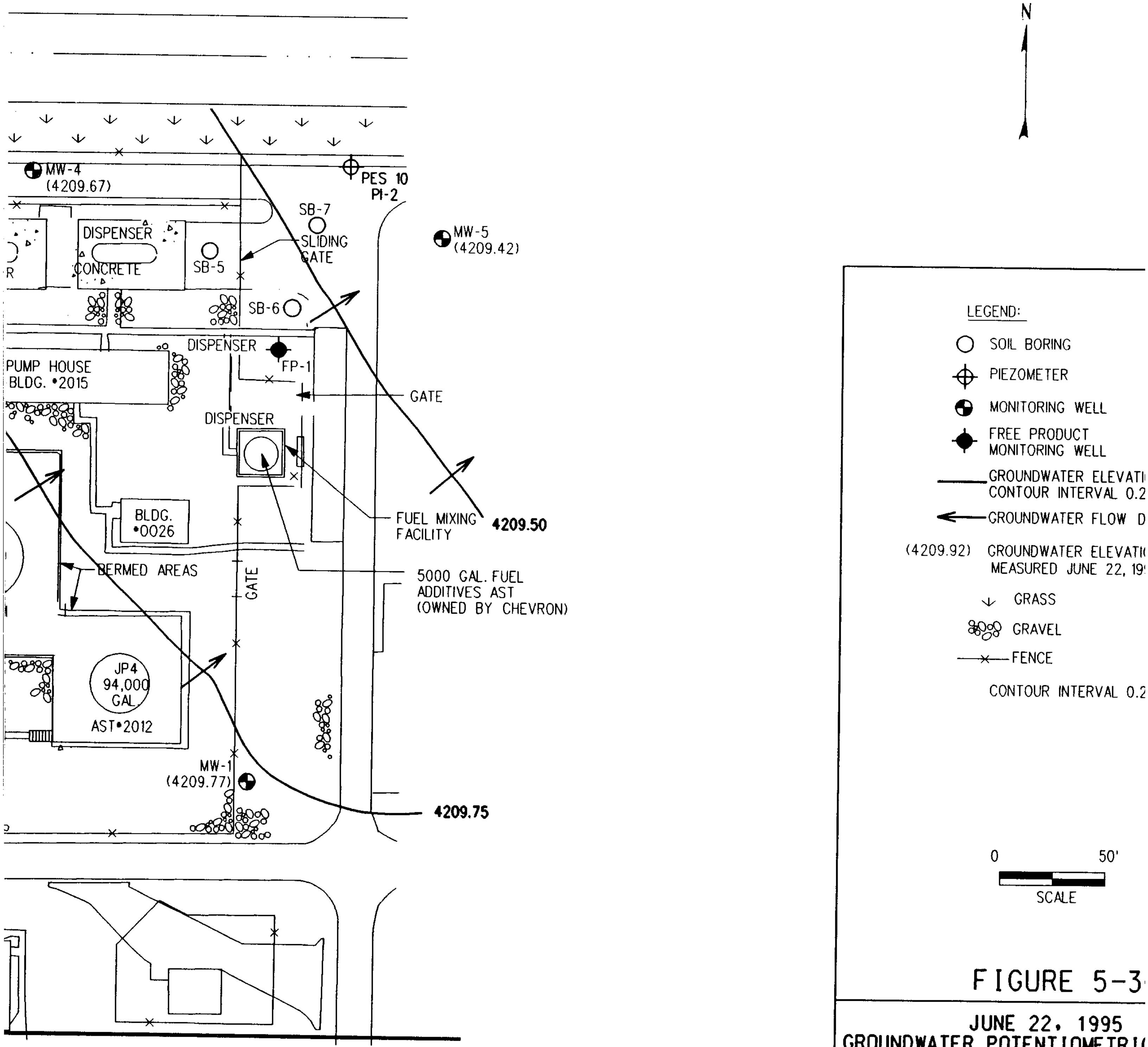

FIGURE 5-3

JUNE 22, 1995
GROUNDWATER POTENTIOMETRI
IRP SITE 10
151st ARW, UTAH AIR NATIONAL G
SALT LAKE CITY INTERNATIONAL A
SALT LAKE CITY, UTAH
STONE & WEBSTER ENGINEERING CORPO
BOSTON, MASS.
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CHK'D BY:
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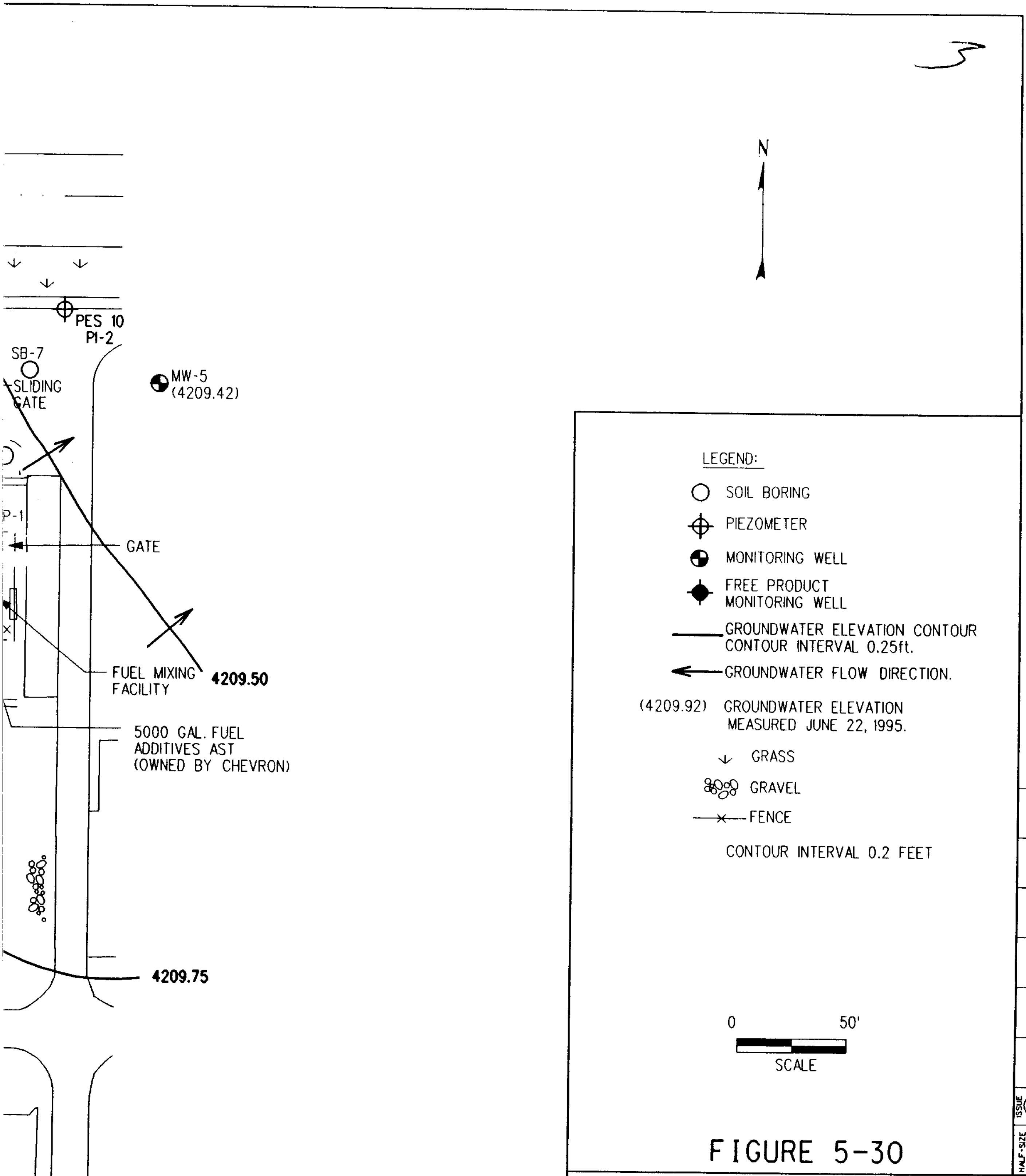

FIGURE 5-30

JUNE 22, 1995
GROUNDWATER POTENTIOMETRIC SURFACE
IRP SITE 10
151st ARW, UTAH AIR NATIONAL GUARD
SALT LAKE CITY INTERNATIONAL AIRPORT
SALT LAKE CITY, UTAH
STONE & WEBSTER ENGINEERING CORPORATION
BOSTON, MASS.

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DSGN CHK'D BY:
DRAWN BY: G.C. CARTER
CHK'D BY:

AREAS	LEVELS	WORK PKG	PCT

RESP ENGR: K. MARONEY
SUPV: R.J. BOUDREAU

ISSUE
HALF-SIZE
APP. CARD

CHKD	CORRECT	APPR	DATE	ISSUE	DESCRIPTION	CHKD	CORRECT	APPR	DATE
				1	ORIGINAL ISSUE				

P.S.	S.A	FAC	ELEC	LTG	MATL	PC	ARCH	CIVIL	CONC	STL	L&P	INST	MD	P.S.	S.A	FAC	ELEC	LTG	MATL

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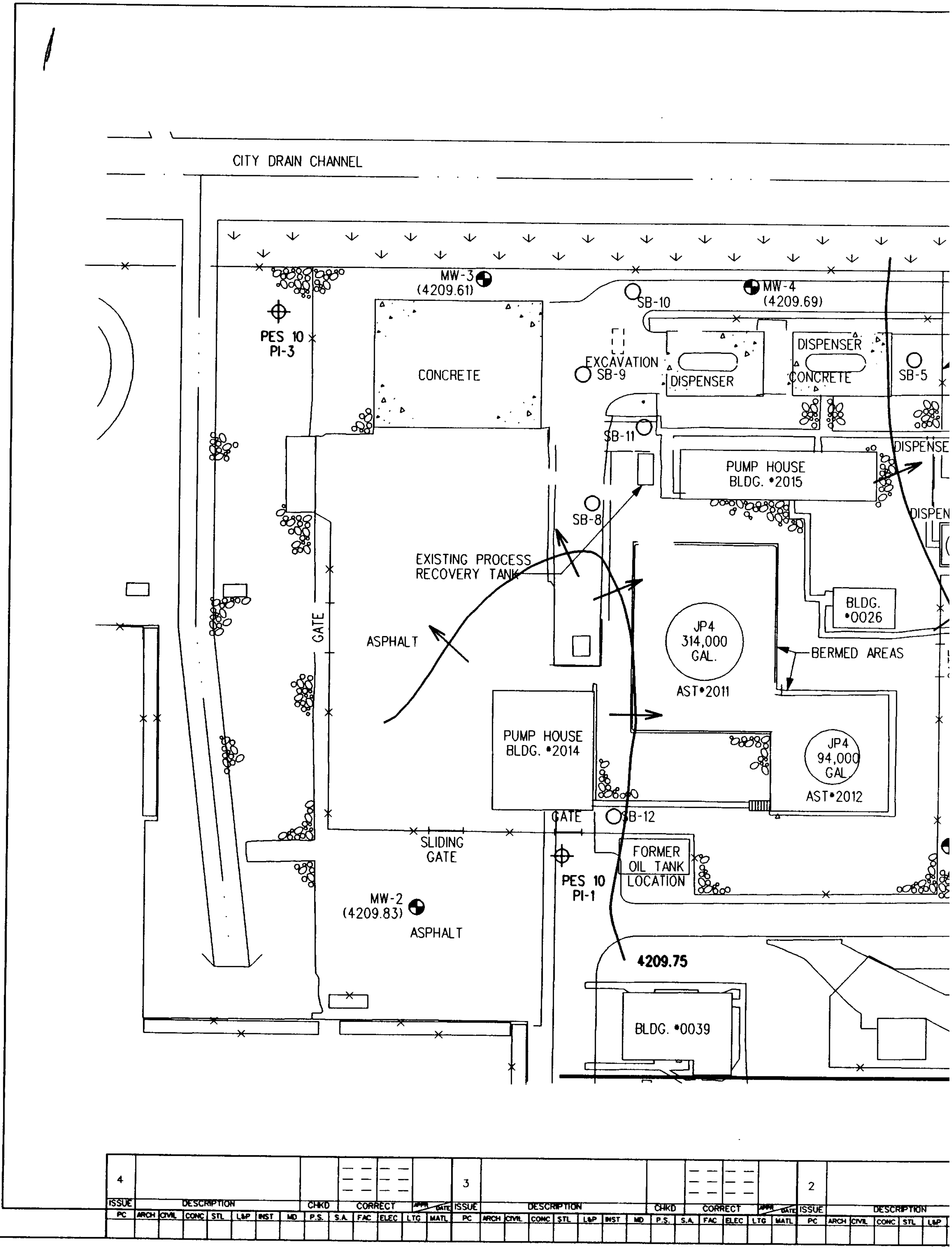

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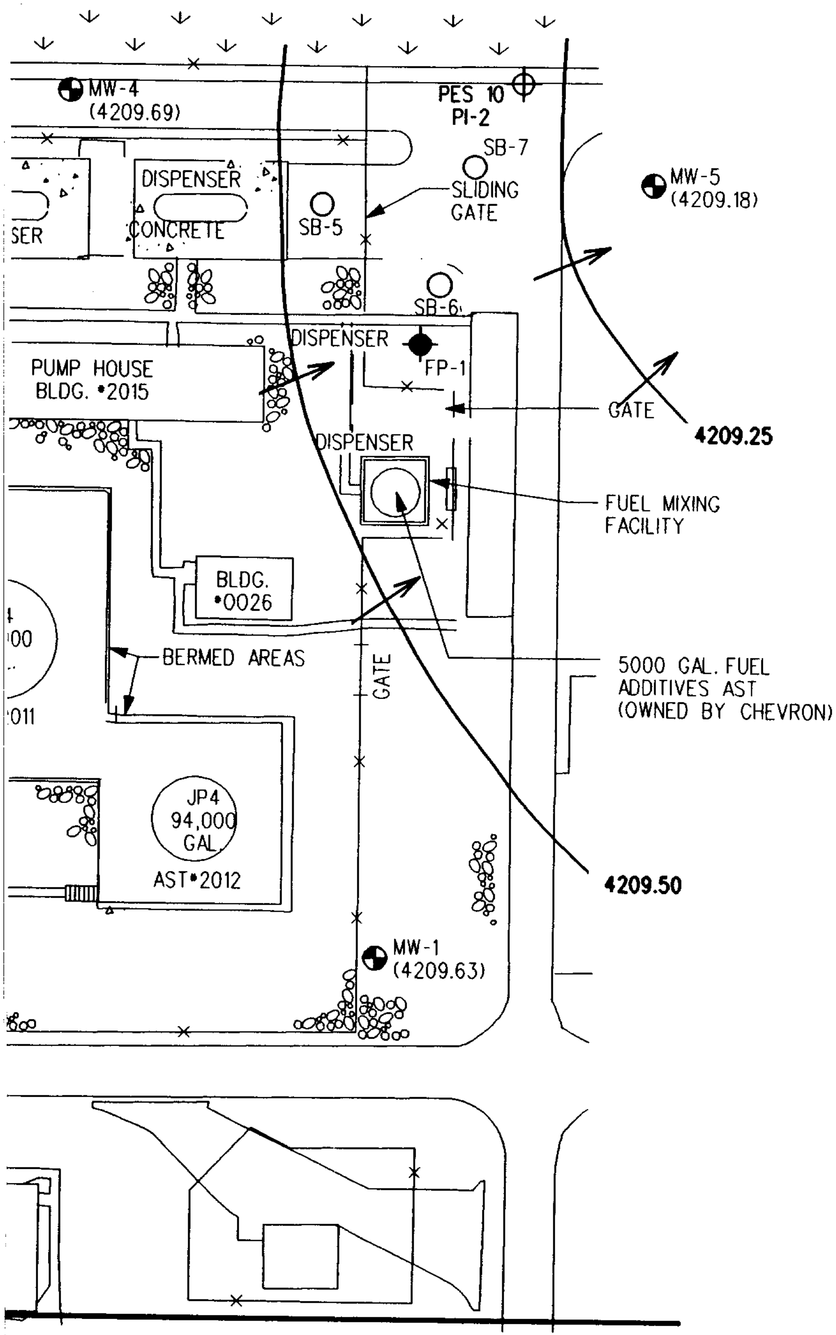

LEGEND:

○	SOIL BORING (10)
⊕	PIEZOMETER (5)
◐	MONITORING WELL (6
◆	FREE PRODUCT MONITORING WELL
———	GROUNDWATER ELEV CONTOUR INTERVAL
⟵	GROUNDWATER FLOW
(4209.83)	GROUNDWATER ELEV MEASURED JUNE 27,
↓	GRASS
∞	GRAVEL
—×—	FENCE

CONTOUR INTERVAL

0 50'

SCALE

FIGURE 5-

JUNE 27, 1995
GROUNDWATER POTENTIOMETR
IRP SITE 10

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SALT LAKE CITY INTERNATIONAL
SALT LAKE CITY, UTAH
STONE & WEBSTER ENGINEERING COR
BOSTON, MASS.

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DRAWN BY: G.C. CARTER
DSGN CHK'D BY:
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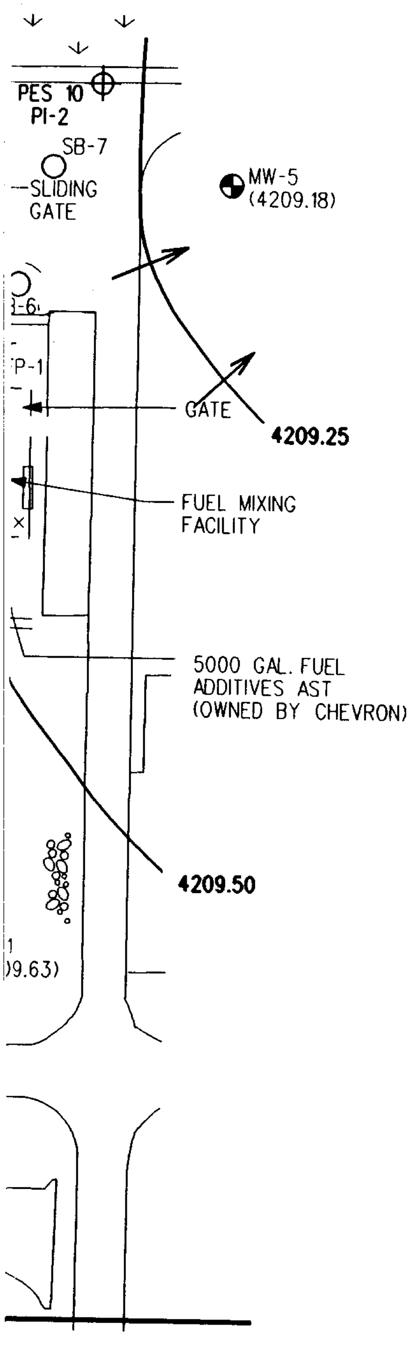

LEGEND:

○ SOIL BORING (10)

⌖ PIEZOMETER (5)

◑ MONITORING WELL (6)

◆ FREE PRODUCT MONITORING WELL

——— GROUNDWATER ELEVATION CONTOUR CONTOUR INTERVAL 0.25ft.

← GROUNDWATER FLOW DIRECTION.

(4209.83) GROUNDWATER ELEVATION MEASURED JUNE 27, 1995.

↓ GRASS

ꝏ GRAVEL

—×— FENCE

CONTOUR INTERVAL 0.2 FEET

0 50'

SCALE

FIGURE 5-31

JUNE 27, 1995
GROUNDWATER POTENTIOMETRIC SURFACE
IRP SITE 10
151st ARW, UTAH AIR NATIONAL GUARD
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SALT LAKE CITY, UTAH
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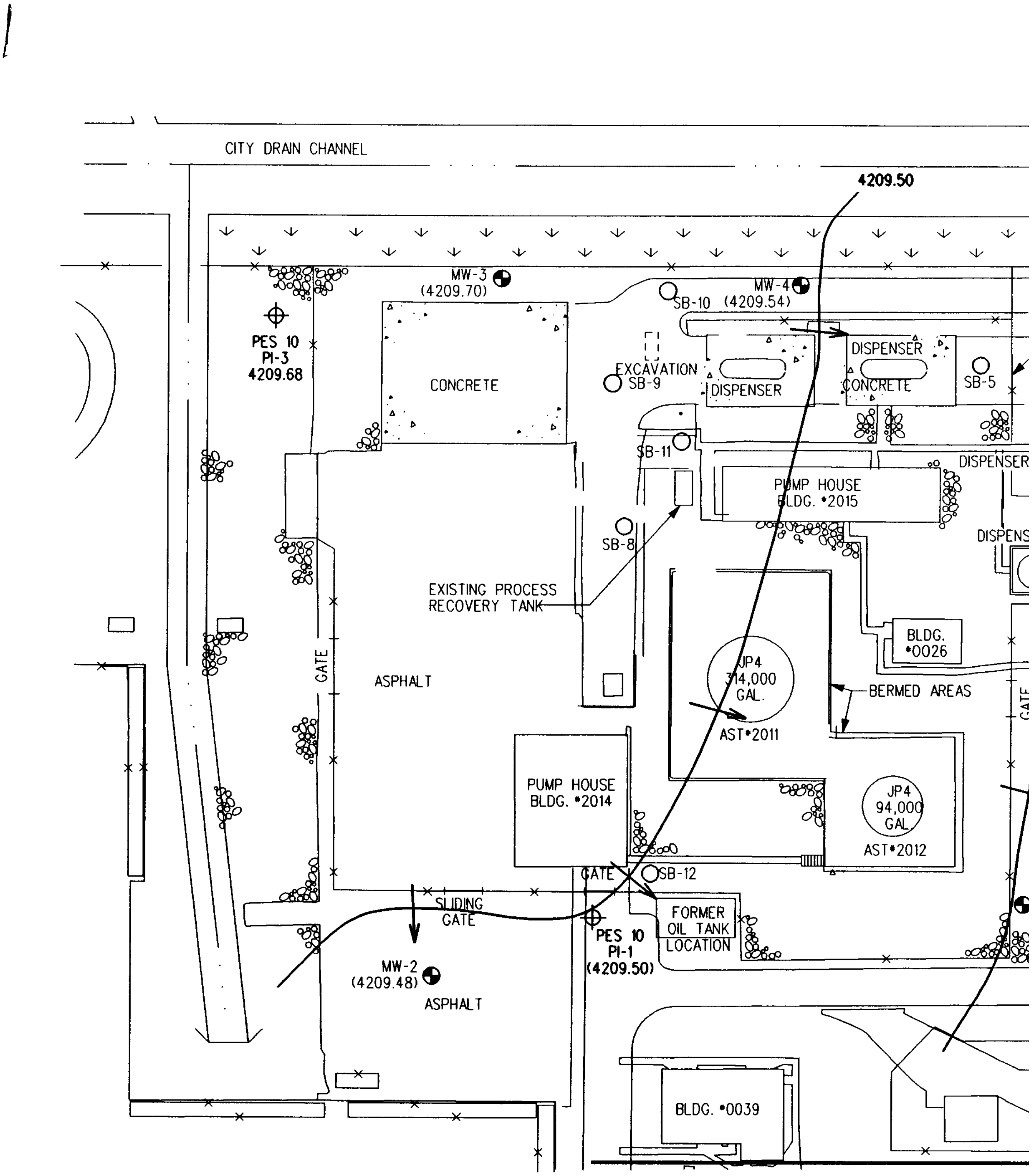

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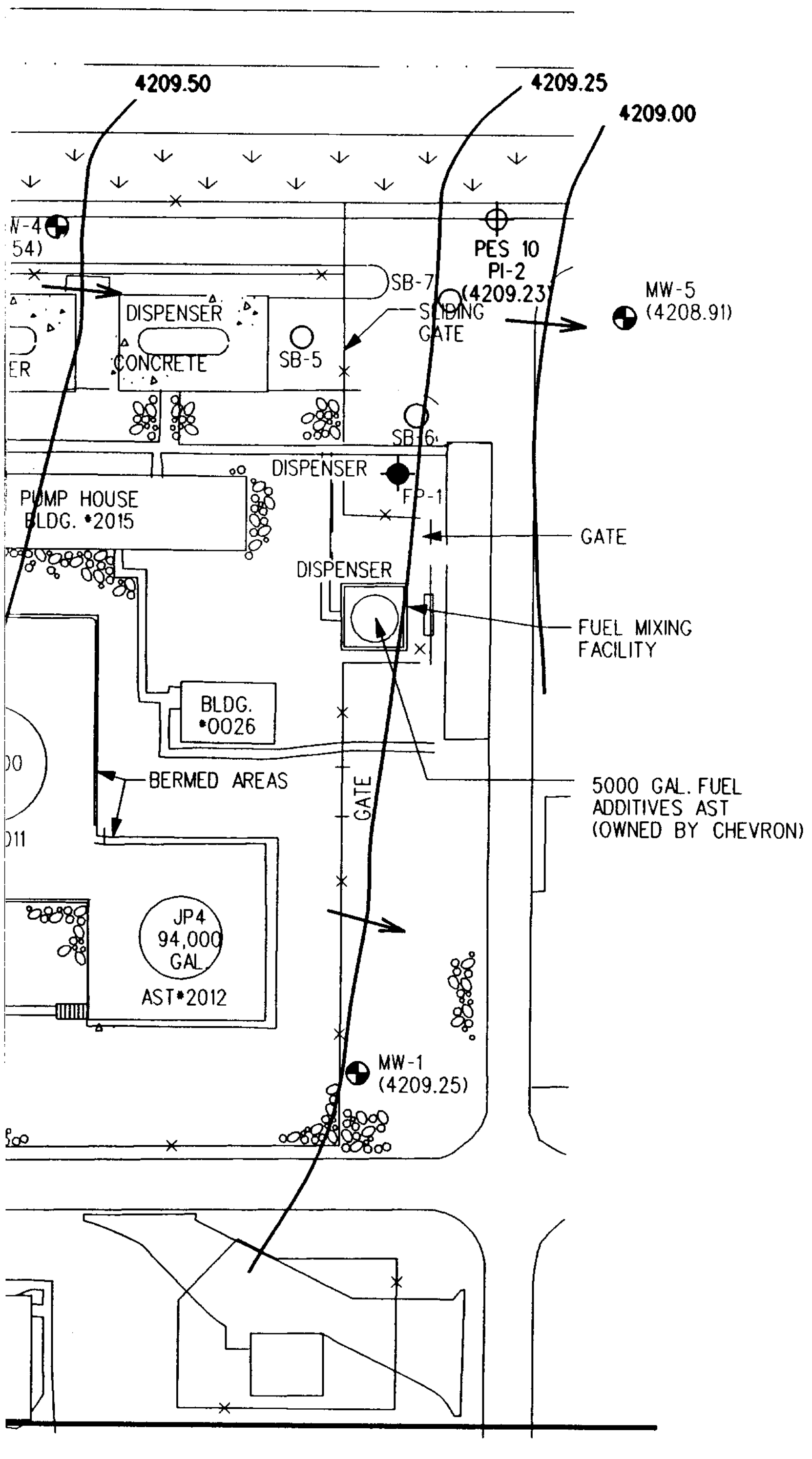

LEGEND:

○ SOIL BORING (10)

⊕ PIEZOMETER (5)

◐ MONITORING WELL (6)

◆ FREE PRODUCT MONITORING WELL

—— GROUNDWATER ELEVA
CONTOUR INTERVAL 0

← GROUNDWATER FLOW

(4209.48) GROUNDWATER ELEVA
MEASURED AUGUST 11

↓ GRASS

GRAVEL

—×— FENCE

CONTOUR INTERVAL 0

B BENZENE
E ETHYLBENZENE
T TOLUENE
X XYLENE

0 50'
SCALE

FIGURE 5-

AUGUST 11, 199
GROUNDWATER POTENTIOMETR
IRP SITE 10
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SALT LAKE CITY INTERNATIONAL
SALT LAKE CITY, UTAH
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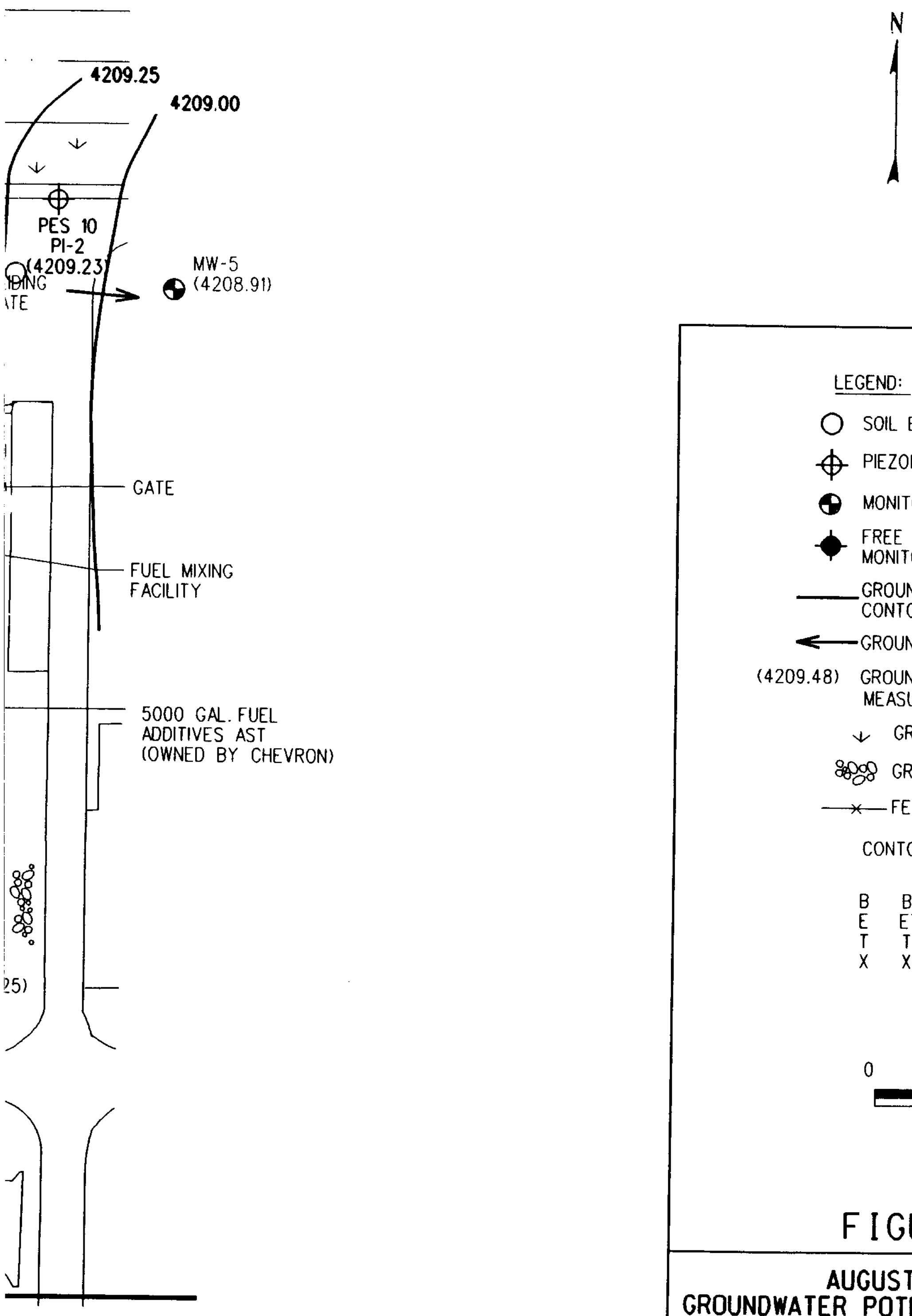

LEGEND:

○ SOIL BORING (10)

⊕ PIEZOMETER (5)

◐ MONITORING WELL (6)

● FREE PRODUCT MONITORING WELL

—— GROUNDWATER ELEVATION CONTOUR
CONTOUR INTERVAL 0.25ft.

← GROUNDWATER FLOW DIRECTION.

(4209.48) GROUNDWATER ELEVATION
MEASURED AUGUST 11, 1995.

↓ GRASS

GRAVEL

—×— FENCE

CONTOUR INTERVAL 0.2 FEET

B BENZENE
E ETHYLBENZENE
T TOLUENE
X XYLENE

0 50'
SCALE

FIGURE 5-32

AUGUST 11, 1995
GROUNDWATER POTENTIOMETRIC SURFACE
IRP SITE 10

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A qualitative comparison between rainfall events and Site 10 groundwater level measurements was made. As indicated for Site 8, Site 10 June and August 1995 groundwater level measurements are representative of environmentally wet conditions and dry conditions, respectively. However, unlike Site 8, Site 10 groundwater levels are higher in June than in August 1995 indicating that near term rainfall and resultant infiltration may affect groundwater levels. Rainfall may also affect water levels within the City Drain Channel which may influence groundwater levels at Site 10. The vertical movement of groundwater at Site 10 was not investigated; however, regional movement of groundwater is upwards from the deeper regionally confined aquifer to the shallow unconfined aquifer.

The hydraulic conductivity of the shallow sediments within IRP Site 10 was investigated by performing slug tests on monitoring wells 1 through 5. The geometric mean hydraulic conductivity was 10.67 ft/day (3.77 x 10^{-3} cm/s). Hydraulic conductivity ranged from a minimum of 3.14 ft/day (1.11 x 10^{-3} cm/s) at monitoring well MW-2 to a maximum of 34.96 ft/day (1.23 x 10^{-2} cm/s) at monitoring well MW-5. The screened portion of each monitoring well straddled fine to coarse grained zones. As a result, the calculated hydraulic conductivity values represent a composite of both high and low conductive zones. A detailed discussion of the performance, analysis, and results of the slug tests is provided in Appendix C.

The velocity of the shallow groundwater at Site 10 was assessed using calculated hydraulic conductivity, gradient, and effective soil porosity values. An effective porosity value of 0.30 was used to represent an average for both clay and sandy soil material. The average groundwater velocity for Site 10, based on all three groundwater level measurements, is calculated as 6.35 x 10^{-2} ft/day (23.17 ft/yr or 2.24 x 10^{-5} cm/s) using mean hydraulic conductivity and gradient values. The minimum and maximum groundwater velocities for the three groundwater measurements are 9.51 x 10^{-3} ft/day (3.47 ft/yr or 3.35 x 10^{-6} cm/s) for monitoring well MW-2 and 2.79 x 10^{-1} ft/day (101.7 ft/yr or 9.83 x 10^{-5} cm/s) for monitoring well MW-5, respectively. Table 5-14 summarizes hydraulic conductivity and groundwater velocity values for Site 10 monitoring wells. The vertical movement of groundwater at Site 10 was not investigated; however, regional movement of groundwater is upwards (Waddell et al., 1987a).

The small groundwater gradients, variations in flow direction, and low hydraulic conductivities are consistent with the slow velocity for groundwater at the site. In addition, based on the results of the groundwater sampling and analysis, contaminants appear to be moving very slowly and in a number of directions based on changing groundwater flow directions.

The average groundwater gradients for the June and August measurements at Site 10 are 9.10 x 10^{-4}, 2.05 x 10^{-3} and 2.39 x 10^{-3}, respectively. The groundwater gradient is highest in the northeast portion of the facility in the vicinity of piezometer PI-2 and monitoring well MW-5. The lowest gradients are located in the northwest portion of Site 10 in the vicinity of piezometer PI-3 and monitoring well MW-3.

5.4.2 Unidentified Contaminant

A portion of the RI was performed in an area where an unidentified contaminant had resulted in a backhoe operator and Site Investigation sampling teams experiencing various symptoms,

Table 5-14
Hydraulic Conductivities and Groundwater Velocities
IRP Site 10
151st ARW, Air National Guard, Salt Lake City, Utah

SITE 10				
Monitoring Well	Hydraulic Conductivity (cms)	Groundwater Velocity (ft/yr)		
		June 22, 1995	June 27, 1995	August 11, 1995
MW 1	3.657×10^{-3}	11.48	25.86	30.15
MW 2	1.106×10^{-3}	3.47	7.83	9.12
MW 3	8.819×10^{-3}	27.69	62.37	72.72
MW 4	1.721×10^{-3}	5.40	12.17	14.19
MW 5	1.233×10^{-2}	38.72	87.23	101.70
Geometric Mean	3.765×10^{-3}	23.17		

Note: Groundwater velocity based on average hydraulic gradient determined for each date (i.e., 9.10×10^{-4}, 2.05×10^{-3}, and 2.39×10^{-3}, respectively) and an effective porosity of 30 percent.

including headache, abdominal pains, and blurred vision. The backhoe operator experienced these symptoms in June 1993 when excavating soil from a depth directly above the groundwater table, at approximately six feet BGS. The sampling team experienced these symptoms in May 1994 when sampling saturated soil from a soil boring designated SB-1 located approximately 50 feet west of the location where the backhoe operator was working, from a depth below the groundwater table, at approximately eight to ten feet BGS. The groundwater table at the time was recorded to be approximately 5 feet BGS. The backhoe operation was not part of the Site Investigation. Because of the presence of the undefined contaminant, the field work was performed in Level B PPE. The locations of the backhoe operator's excavation and SB-1 are shown on Figure 5-19.

In order to minimize the field work to be performed in Level B, steps were taken to identify the unidentified contaminant prior to the initiation of the intrusive field work. During a soil gas survey at the site, volatile organics were not detected at concentrations that would cause the symptoms described in the exposure report. However, a sulfur odor was detected by site personnel during the survey.

Inhalation of low concentrations of hydrogen sulfide gas is known to cause a loss of smelling sense, labored breathing, headache, clouding of vision, dizziness, confusion, vomiting, and shortness of breath. The gas is released whenever sulfur-containing organic matter, including natural organic matter and most fuels, undergoes decomposition by bacteria. Based on the odor detected, the effects of hydrogen sulfide exposure being similar to the symptoms experienced by the sampling teams, and the history of the site being a structural basin (potential source of hydrogen sulfide gas), the unidentified contaminant was suspected to be hydrogen sulfide gas.

Hydrogen sulfide is a colorless gas at ordinary temperatures and liquifies at low temperatures (below -62°C) or elevated pressures. The solubility of hydrogen sulfide in water is relatively low, at 4 grams per liter.

To confirm the contaminant as hydrogen sulfide gas, two soil gas samples were collected in the area where the exposure incident occurred. The soil gas sampling probes were driven to a depth directly above the groundwater table, at approximately six feet BGS. The depth of sample collection was determined based on the depths reported in the exposure incident report, and on the depth to groundwater measured prior to sample collection. Soil gas samples can not be collected at depths below the groundwater table. A sample of soil gas was drawn through the probe into a syringe and tested for hydrogen sulfide with a Dreager tube. Hydrogen sulfide was detected in one of the soil gas samples at a concentration of 30 ppm. Soil gas samples were not collected for off-base laboratory analysis.

In addition to the soil gas sample, three samples of groundwater were collected from the area where the exposure incident occurred. Two groundwater samples were collected from the top of the water column at a depth interval of four to six feet BGS. An additional groundwater sample was collected from a depth interval of eight to ten feet BGS, the same interval in which the sample which caused the adverse symptoms was collected. The groundwater samples were submitted to the fix-based laboratory for analysis for PCBs and pesticides by EPA method 8080. In addition, one of the shallow groundwater samples was submitted to the fix-based laboratory for volatile organic analysis by EPA method 624. PCBs and pesticides were not detected in the groundwater samples at concentrations above the method detection limits. VOCs were not detected in the shallow groundwater sample at concentrations believed to be high enough to cause the above described symptoms.

Based on the screening results, the intrusive investigation was initiated in the area suspected of the highest concentration of hydrogen sulfide. The investigation was initiated in Level B and utilized a hydrogen sulfide gas meter to monitor the air.

Based on the identification of the contaminant and the results of the air monitoring, the level of PPE was downgraded to Level D after the first day of field work.

5.4.3 Screening Results

Soil gas, soil, and groundwater screening samples were collected at various locations around Site 10. The results of the screening sampling are presented in the following sections.

5.4.3.1 Soil Gas Screening Results

TEG conducted a soil gas survey at Site 10 from June 5 to 7, 1995. An additional soil sample was collected from Site 10 for screening on June 10, 1995. TEG collected a total of 41 soil gas samples from various locations around the site. Soil gas locations were chosen based on previous studies. The locations of the sampling points are shown on Figure 5-33.

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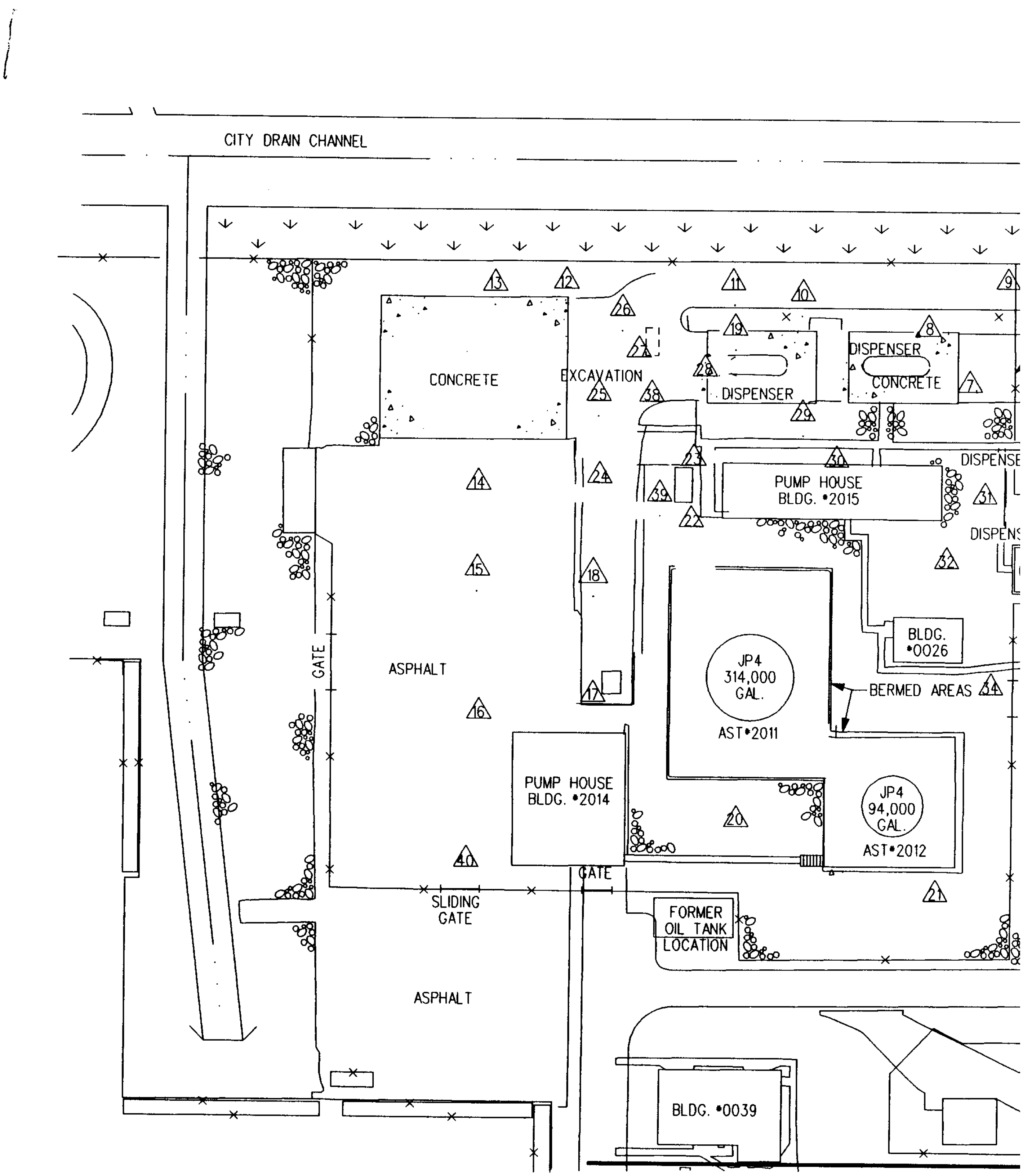

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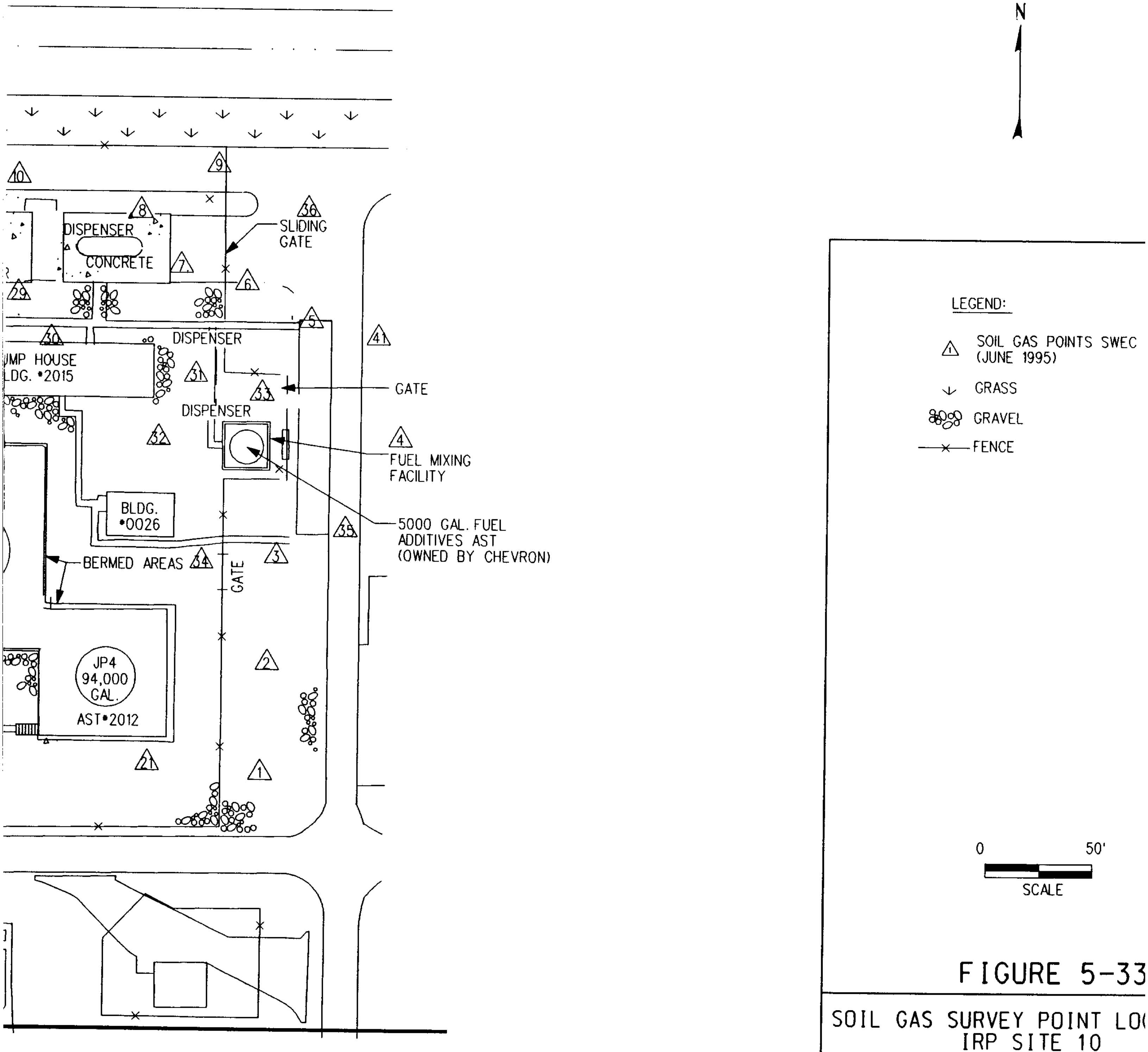

FIGURE 5-33

SOIL GAS SURVEY POINT LO
IRP SITE 10

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SALT LAKE CITY INTERNATIONAL AIR
SALT LAKE CITY, UTAH

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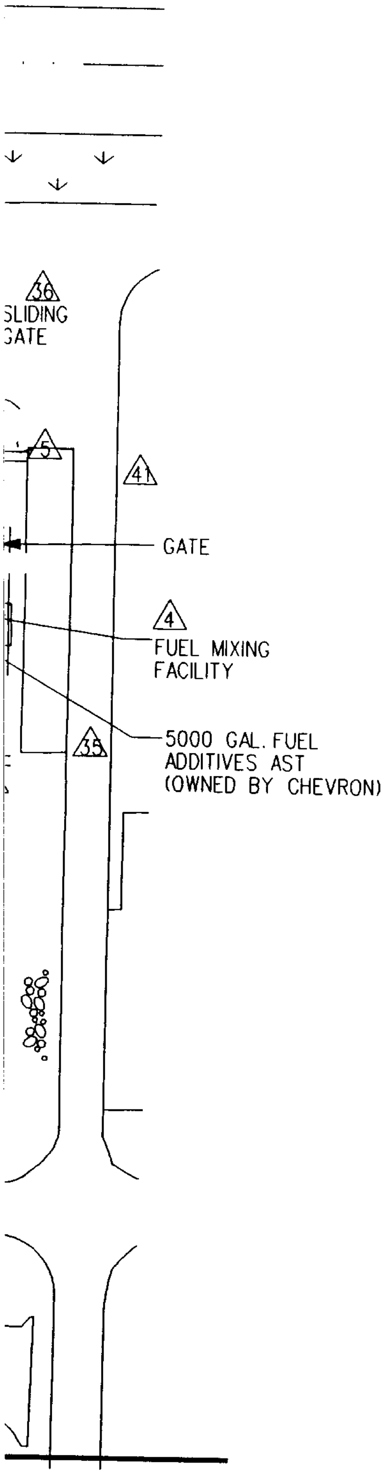

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LEGEND:

△ SOIL GAS POINTS SWEC (JUNE 1995)

↓ GRASS

ꝏ GRAVEL

—×— FENCE

0 50'

SCALE

FIGURE 5-33

SOIL GAS SURVEY POINT LOCATIONS
IRP SITE 10

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Soil gas samples were collected from depths ranging from 2.5 to 4.0 feet BGS. The depth of soil gas sampling was based on water levels measured in site wells.

BTEX compounds were detected in several soil gas samples. Benzene was detected in 25 of the 41 samples at concentrations ranging from 1.1 to 4,976.2 μg/l. Toluene was detected in 18 of the 41 samples at concentrations ranging from 3.6 to 2,646.3 μg/l. Ethylbenzene was detected in 15 of the 41 samples at concentrations ranging from 1.2 to 261.9 μg/l. Xylenes were detected in 16 of the 41 samples at concentrations ranging from 6.0 to 1,040.6 μg/l. The highest concentrations of BTEX compounds were detected in samples collected from the area of excavation and the northeast corner of the Site. Figures 5-34 through 5-38 show the extent of BTEX compounds detected in the soil gas screening samples.

Halogenated compounds were not detected in the soil gas samples above the method detection limit of 1.0 μg/l. Soil gas screening results are summarized in Table 5-15. TEG's report is included in Appendix E.

5.4.3.2 Soil Screening Results

Soil screening was conducted at Site 10 from June 7 to 9, 1995. A total of 20 soil samples were collected by TEG from various locations around the Site. Soil samples were collected from depths ranging from 3.5 to 4.5 feet BGS. Soil screening locations are shown on Figure 5-39.

Soil samples were screened by TEG for VOCs in their mobile laboratory. One soil sample, designated GP2-S1, was collected from the area where the exposure incident occurred and was submitted to ChemTech for PCB and pesticide analysis. After the unidentified contaminant of concern at Site 10 was identified as hydrogen sulfide, and not a PCB or pesticide, no more soil screening samples were analyzed for PCBs/pesticides. This is documented on a field change request form included in Appendix D.

Halogenated compounds were not detected in the soil samples at concentrations above the method detection limit of 0.005 mg/kg. BTEX compounds were detected in several samples collected from the site. Benzene was detected in 3 of the 20 samples at concentrations ranging from 0.39 to 3.891 mg/kg. Toluene was detected in 4 of the 20 samples at concentrations ranging from 0.935 to 5.913 mg/kg. Ethylbenzene was detected in 8 of the 20 samples at concentrations ranging from 0.634 to 8.100 mg/kg. Xylenes were detected in 11 of the 20 samples at concentrations ranging from 0.142 to 58.819 mg/kg. The highest concentrations of BTEX compounds were detected in samples collected from the area of excavation and from the area at the northeast corner of the site.

PCBs and pesticides were not detected in soil sample GP2-S1 above the method detection limits. Soil screening analytical results for VOCs are summarized in Table 5-16. TEG's report is included in Appendix E. Laboratory data analysis sheets for the PCB and pesticide analysis of sample GP2-S1 is included in Appendix F.

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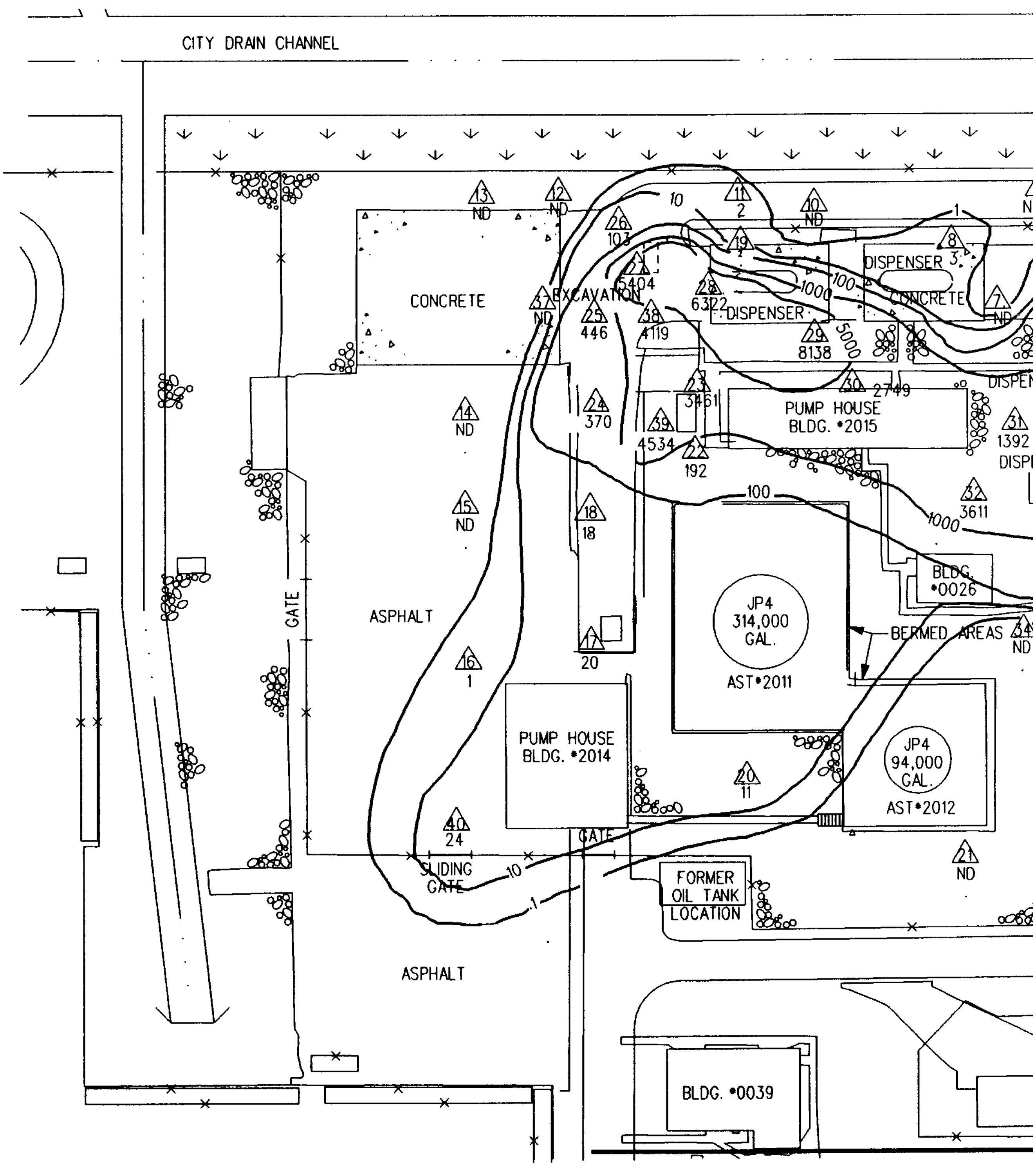

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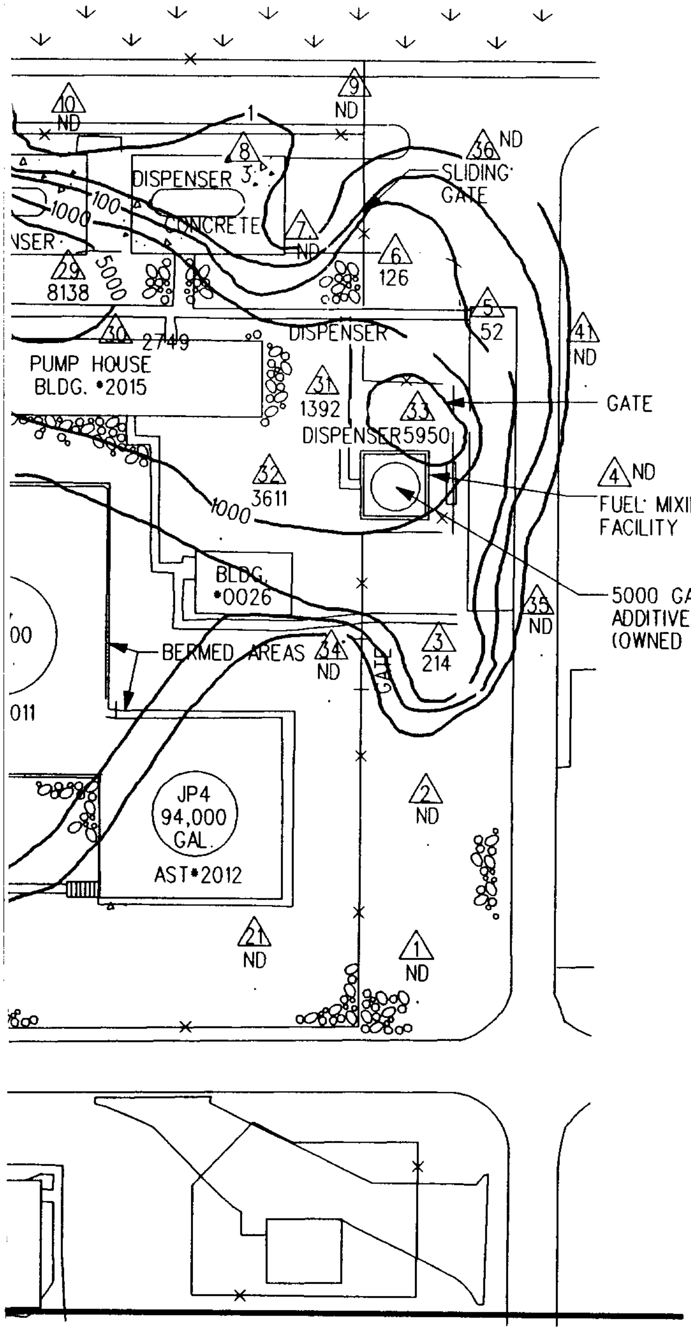

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LEGEND:

△	SOIL GAS POINTS SW (JUNE 1995)
↓	GRASS
▨	GRAVEL
—×—	FENCE
213	TOTAL BTEX CONCEN
— ND —	TOTAL BTEX ISOCENT CONTOUR (ug/L)
ND	TOTAL BTEX NOT DE VAPOR SAMPLE

NOTES:

BTEX CONCENTRATIONS TO THE NEAREST ug/L.

0 50'
SCALE

FIGURE 5-

TOTAL BTEX DETEC
DURING SOIL GAS SU
IRP SITE 10

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SALT LAKE CITY, UTAH

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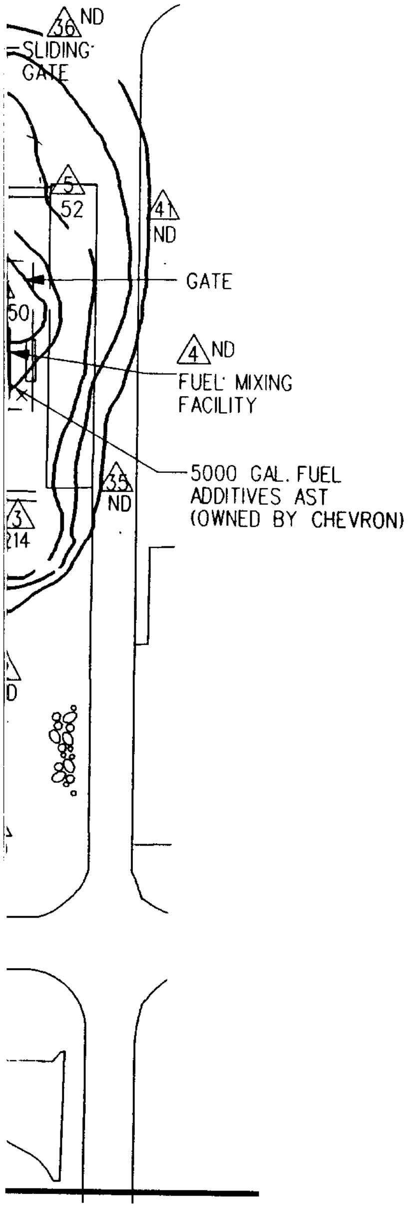

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LEGEND:

△	SOIL GAS POINTS SWEC (JUNE 1995)
⏚	GRASS
∘∘∘	GRAVEL
—×—	FENCE
213	TOTAL BTEX CONCENTRATION (ug/L)
— ND —	TOTAL BTEX ISOCENTRATION CONTOUR (ug/L)
ND	TOTAL BTEX NOT DETECTED IN VAPOR SAMPLE

NOTES:

BTEX CONCENTRATIONS ROUNDED TO THE NEAREST ug/L.

0 50'

SCALE

FIGURE 5-34

TOTAL BTEX DETECTED DURING SOIL GAS SURVEY IRP SITE 10

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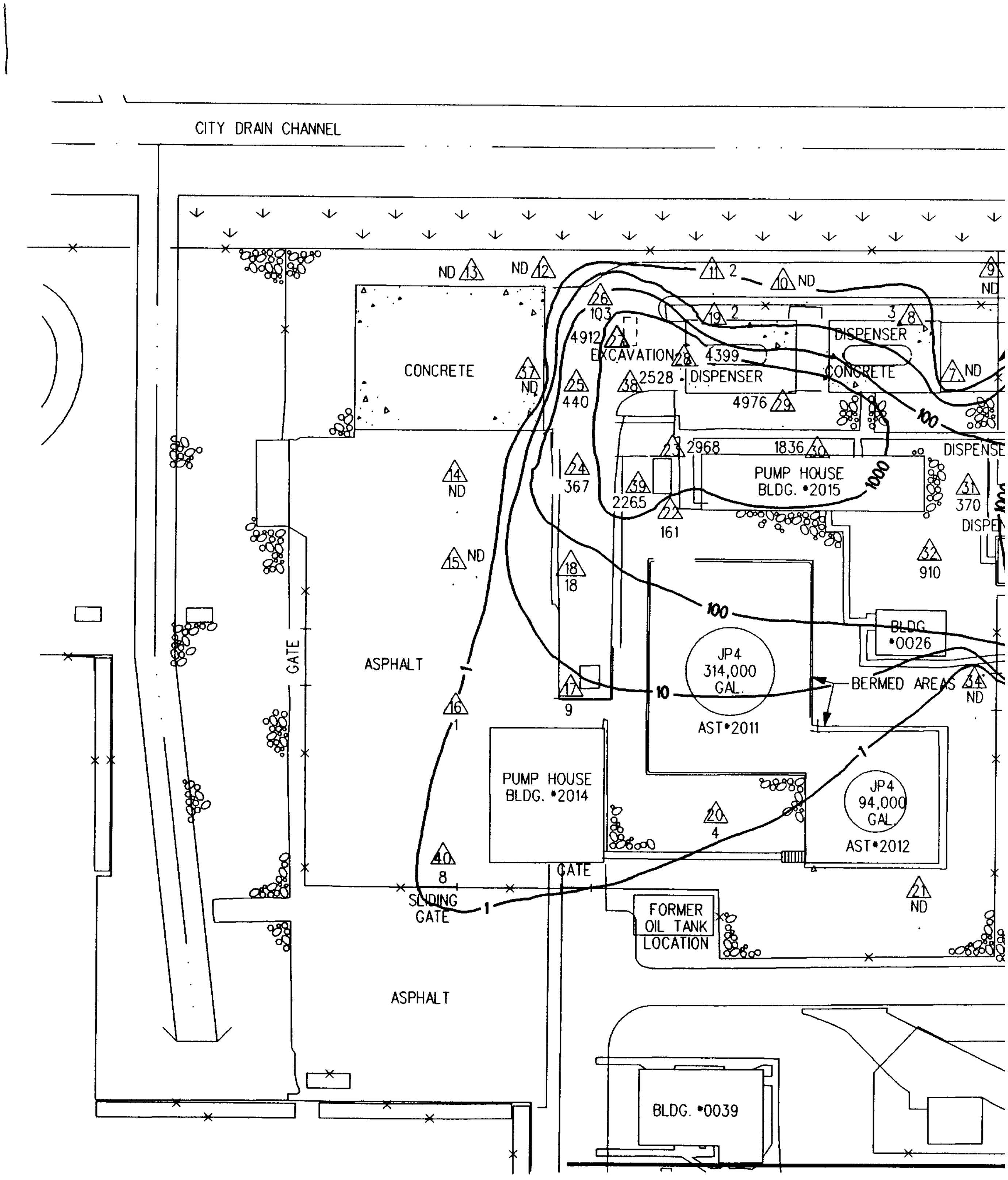

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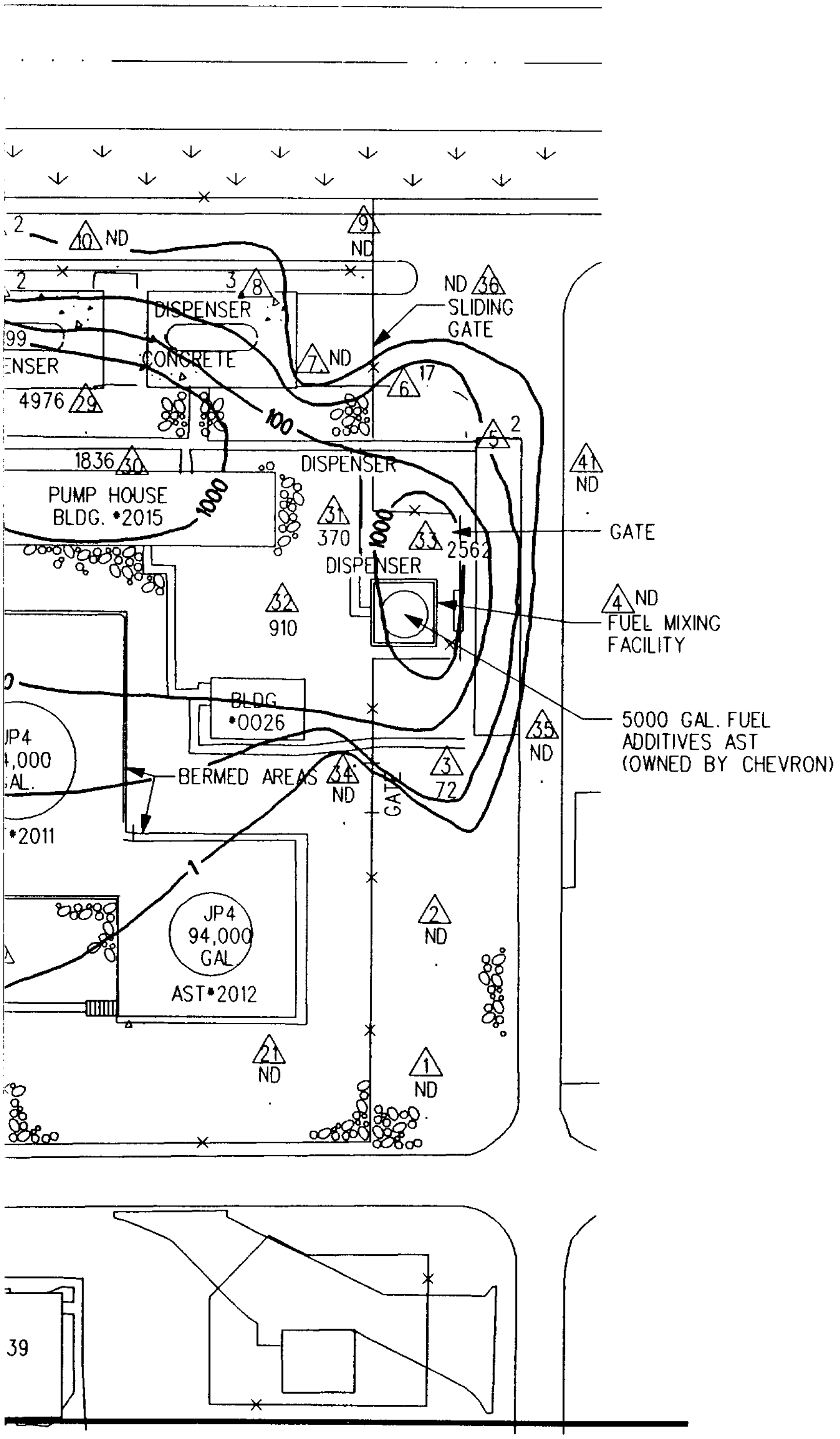

LEGEND:

△ SOIL GAS POINTS
(JUNE 1995)

↓ GRASS

GRAVEL

—×— FENCE

72 BENZENE CO

— 100 — BENZENE ISO
CONTOUR, ug

ND BENZENE NO
VAPOR SAMP

NOTES:

BENZENE CONCENTRAT
TO THE NEAREST ug/

FIGURE 5

BENZENE DETEC
DURING SOIL GAS
IRP SITE 1

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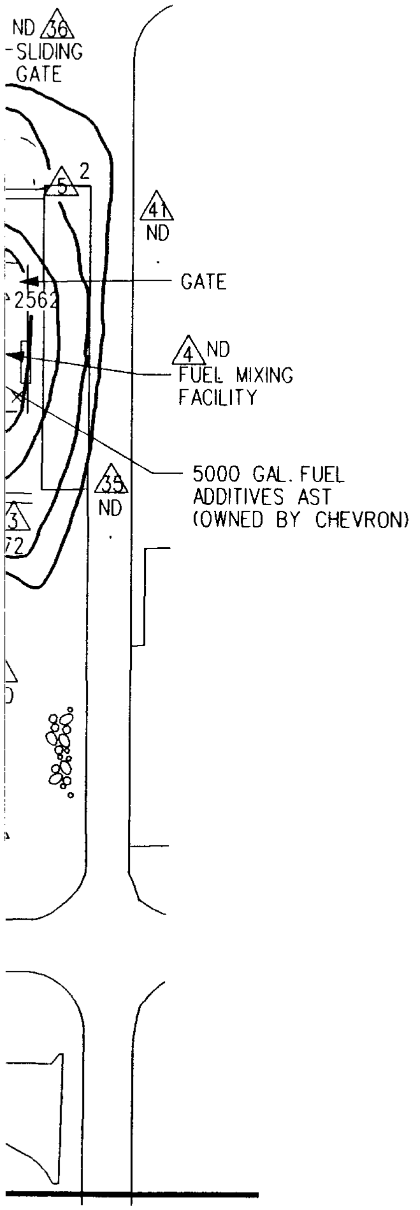
FAC ELEC	LTG MATL		PC	ARCH CIVIL	CONC STL	L&P INST	MD		P.S. S.A.	FAC ELEC	LTG MATL		PC	ARCH CIVIL	CONC STL	L&P INST	MD P.S. S.A.

3



LEGEND:

△ SOIL GAS POINTS SWEC (JUNE 1995)

↓ GRASS

GRAVEL

—×— FENCE

72	BENZENE CONCENTRATION, ug/L.
— 100 —	BENZENE ISOCONCENTRATION CONTOUR, ug/L.
ND	BENZENE NOT DETECTED IN VAPOR SAMPLE.

NOTES:

BENZENE CONCENTRATIONS ROUNDED TO THE NEAREST ug/L.

0 50'
SCALE

FIGURE 5-35

BENZENE DETECTED DURING SOIL GAS SURVEY IRP SITE 10

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SALT LAKE CITY, UTAH
STONE & WEBSTER ENGINEERING CORPORATION
BOSTON, MASS.

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DSGN CHK'D BY:
DRAWN BY: G.C. CARTER
CHK'D BY:
AREAS LEVELS WORK PKG PCT

RESP ENGR: K. MARONEY
SUPV: R.J. BOUDREAU

ISSUE
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1 ORIGINAL ISSUE

CHKD CORRECT APPR DATE ISSUE DESCRIPTION CHKD CORRECT APPR DATE
MD P.S. S.A. FAC ELEC LTG MATL PC ARCH CIVIL CONC STL L&P INST MD P.S. S.A. FAC ELEC LTG MATL

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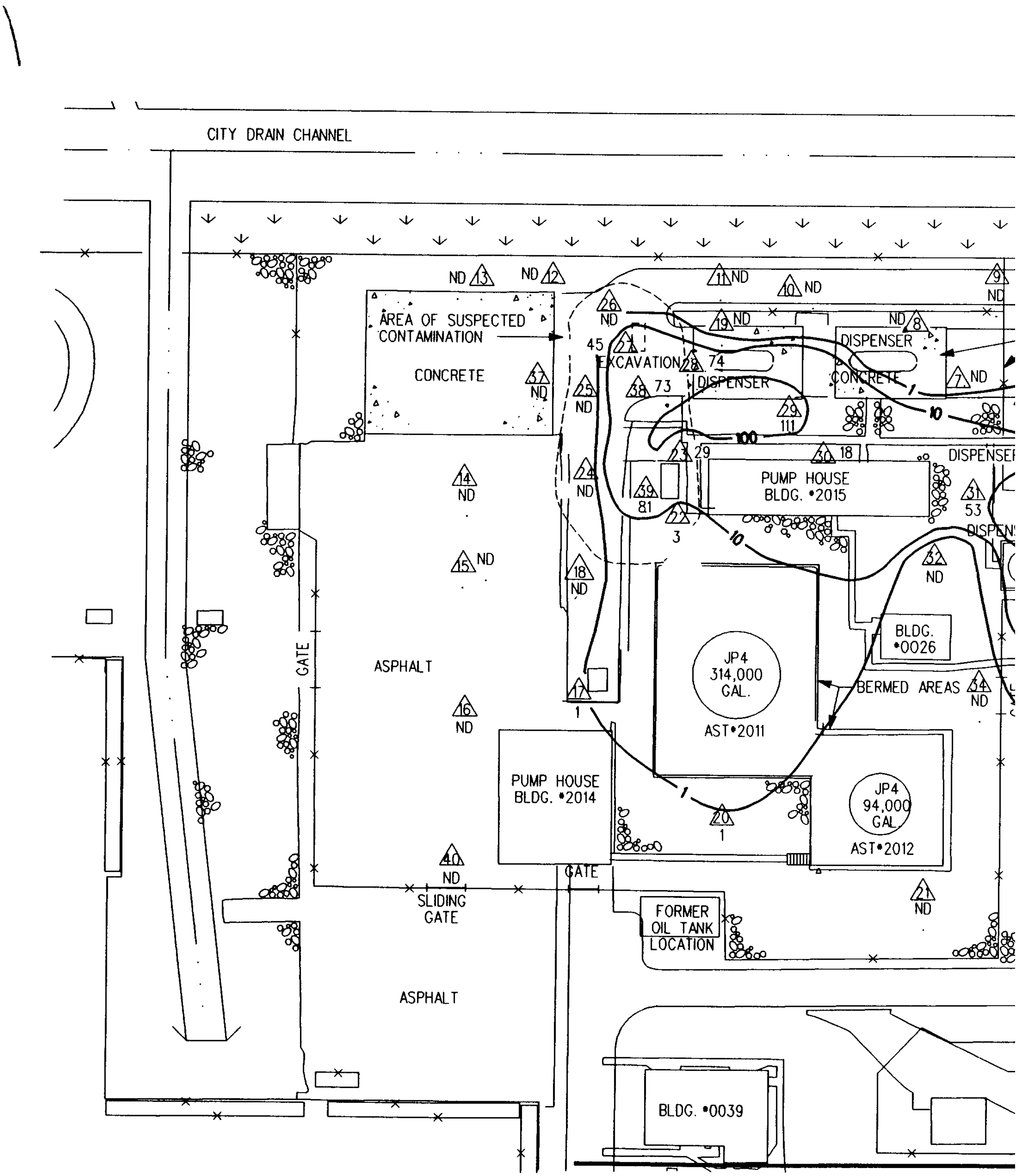

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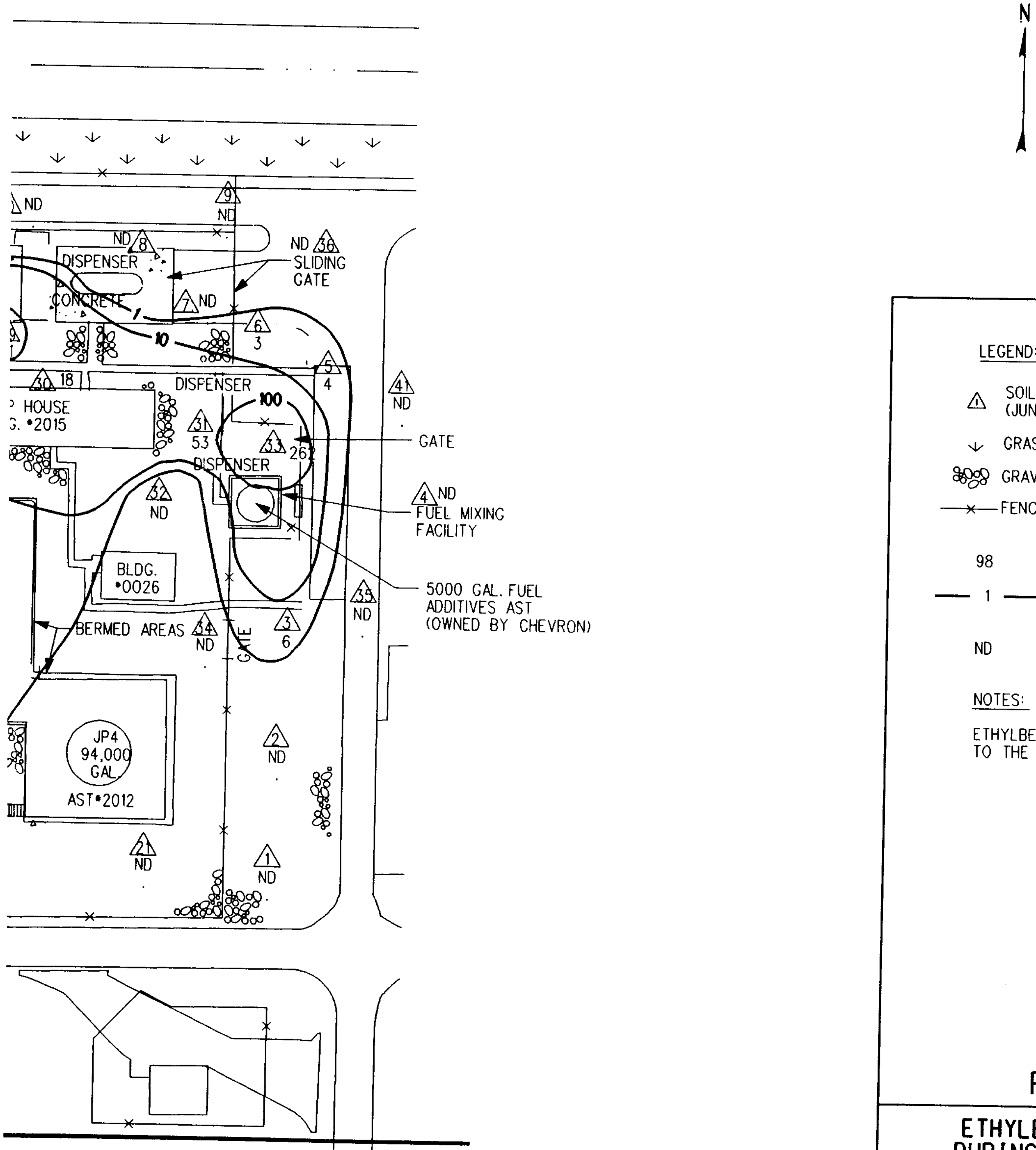
ISSUE	DESCRIPTION	CHKD	CORRECT APPR DATE	ISSUE	DESCRIPTION	CHKD	CORRECT APPR DATE	ISSUE	DESCRIPTION
PC ARCH CIVIL CONC STL L&P INST MD		P.S. S.A. FAC ELEC LTG MATL		PC ARCH CIVIL CONC STL L&P INST MD		P.S. S.A. FAC ELEC LTG MATL		PC ARCH CIVIL CONC STL L&P	



LEGEND:

△	SOIL GAS POINTS SWEC (JUNE 1995)
↓	GRASS
⁂	GRAVEL
—×—	FENCE
98	ETHYLBENZENE CONCENTR
— 1 —	ETHYLBENZENE ISOCONCEN CONTOUR, ug/L.
ND	ETHYLBENZENE NOT DETE VAPOR SAMPLE.

NOTES:

ETHYLBENZENE CONCENTRATIONS RO TO THE NEAREST ug/L.

0 50'

SCALE

FIGURE 5-36

ETHYLBENZENE DETECTE DURING SOIL GAS SURVE IRP SITE 10

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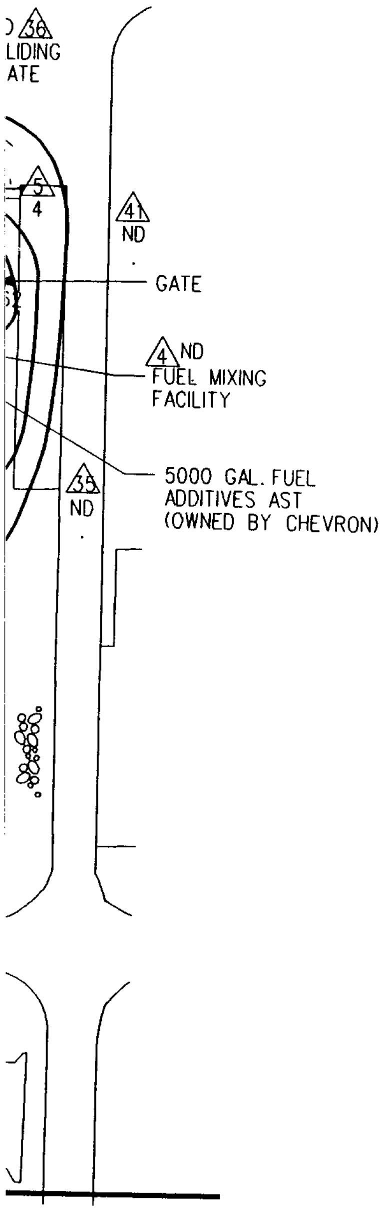
APPR DATE	ISSUE	DESCRIPTION	CHKD	CORRECT	APPR DATE	ISSUE	DESCRIPTION	CHKD	CORRECT	APPR DATE
	2					1	ORIGINAL ISSUE			

LTG MATL PC ARCH CIVIL CONC STL L&P INST MD P.S. S.A. FAC ELEC LTG MATL PC ARCH CIVIL CONC STL L&P INST MD P.S. S.A. FAC ELEC LTG MATL

3



LEGEND:

△	SOIL GAS POINTS SWEC (JUNE 1995)
↓	GRASS
⁂	GRAVEL
—×—	FENCE
98	ETHYLBENZENE CONCENTRATION IN ug/L.
— 1 —	ETHYLBENZENE ISOCONCENTRATION CONTOUR, ug/L.
ND	ETHYLBENZENE NOT DETECTED IN VAPOR SAMPLE.

NOTES:

ETHYLBENZENE CONCENTRATIONS ROUNDED TO THE NEAREST ug/L.

0 50'
SCALE

FIGURE 5-36

ETHYLBENZENE DETECTED
DURING SOIL GAS SURVEY
IRP SITE 10
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SALT LAKE CITY, UTAH
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SUPV: R.J. BOUDREAU

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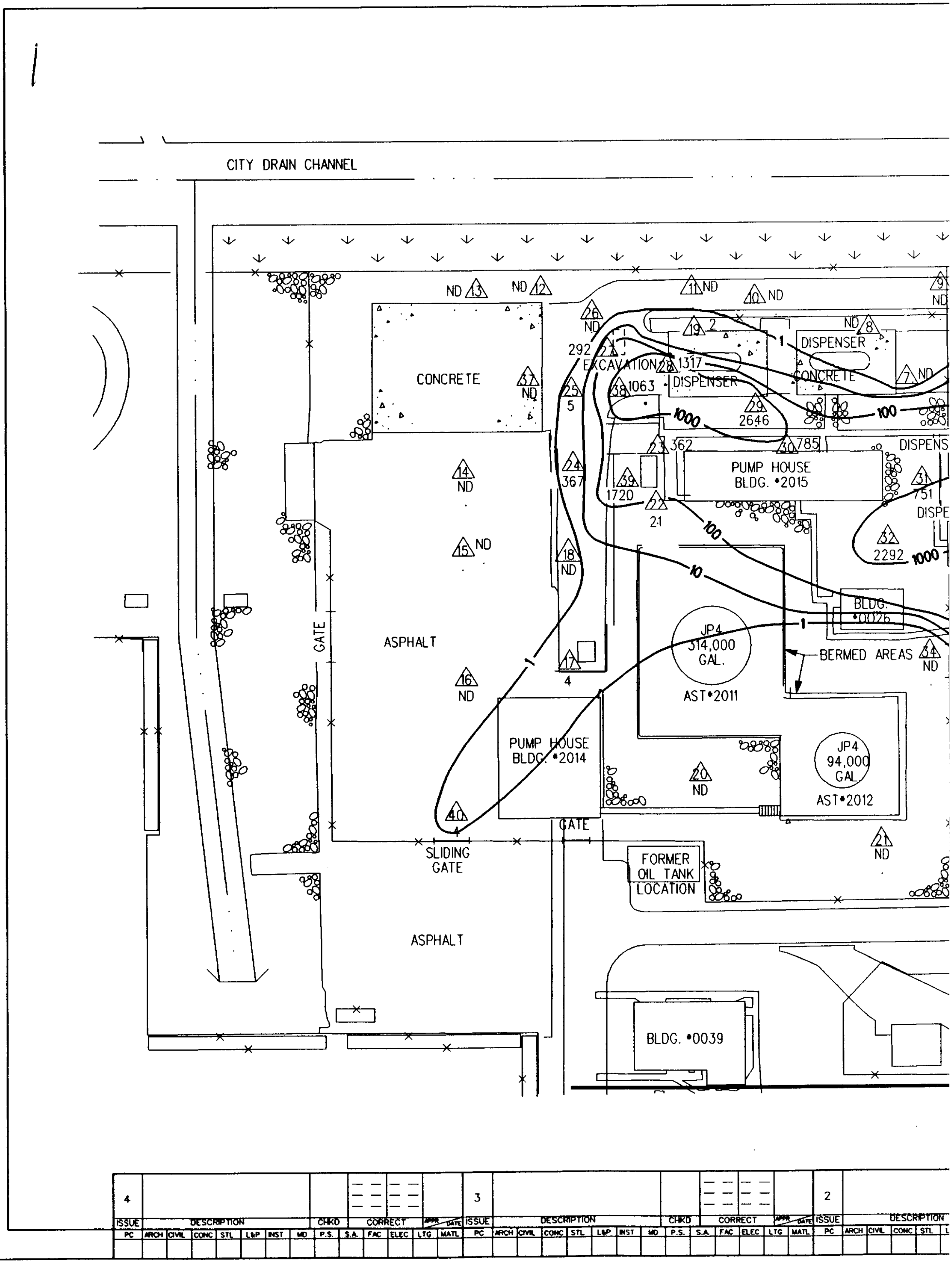

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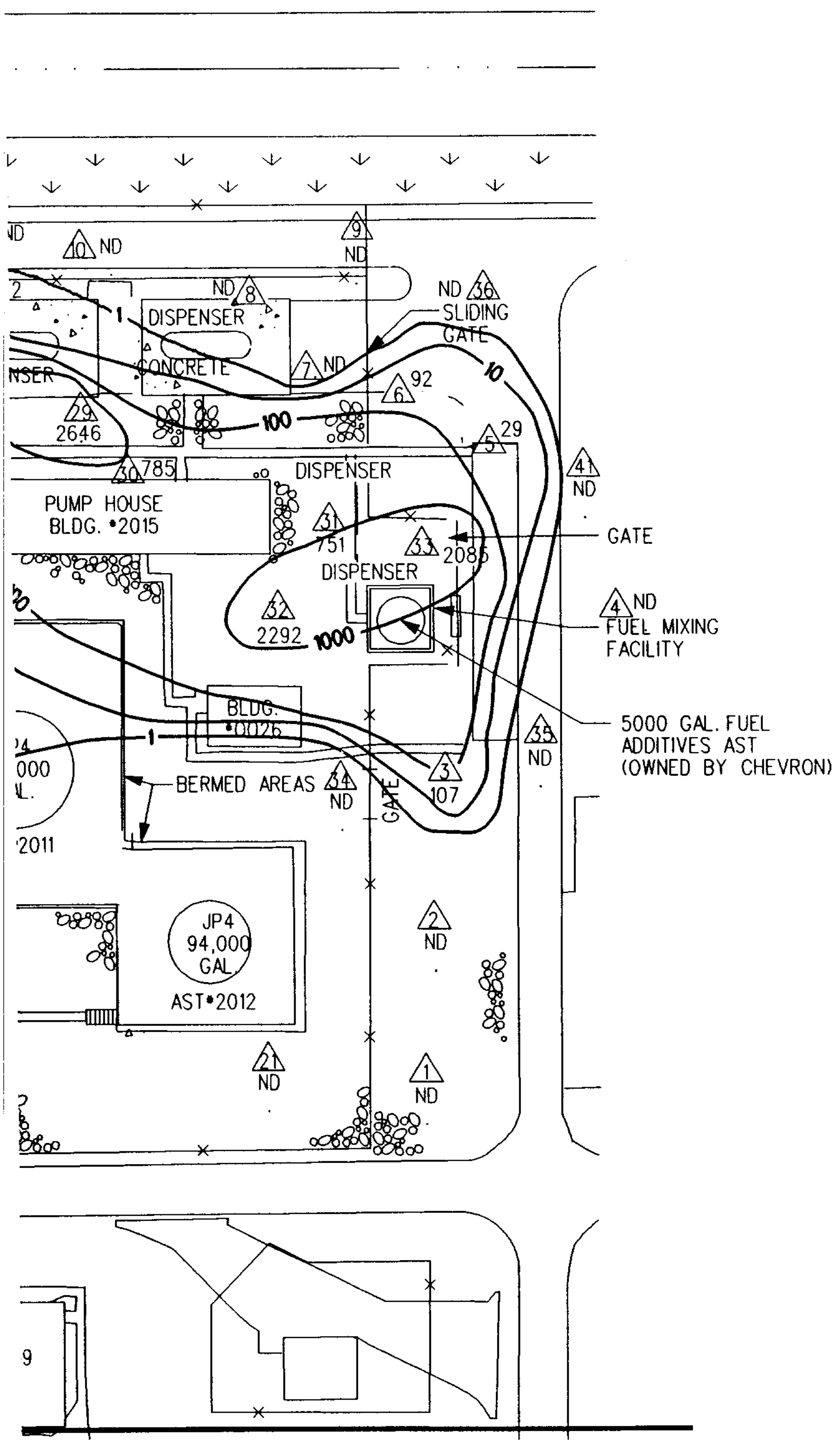

LEGEND:

△	SOIL GAS POINTS S (JUNE 1995)
↓	GRASS
ஃ	GRAVEL
—×—	FENCE
92	TOLUENE CO
— 100 —	TOLUENE ISO CONTOUR, ug
ND	TOLUENE NO VAPOR SAMP

NOTES:

TOLUENE CONCENTRAT TO THE NEAREST ug/

0 5

SCALE

FIGURE 5

TOLUENE DETEC DURING SOIL GAS IRP SITE 1

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SALT LAKE CITY INTERNATION
SALT LAKE CITY, UT
STONE & WEBSTER ENGINEERING
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DRAWN BY: G.C. CARTER
DSGN CHK'D BY:
CHK'D BY:

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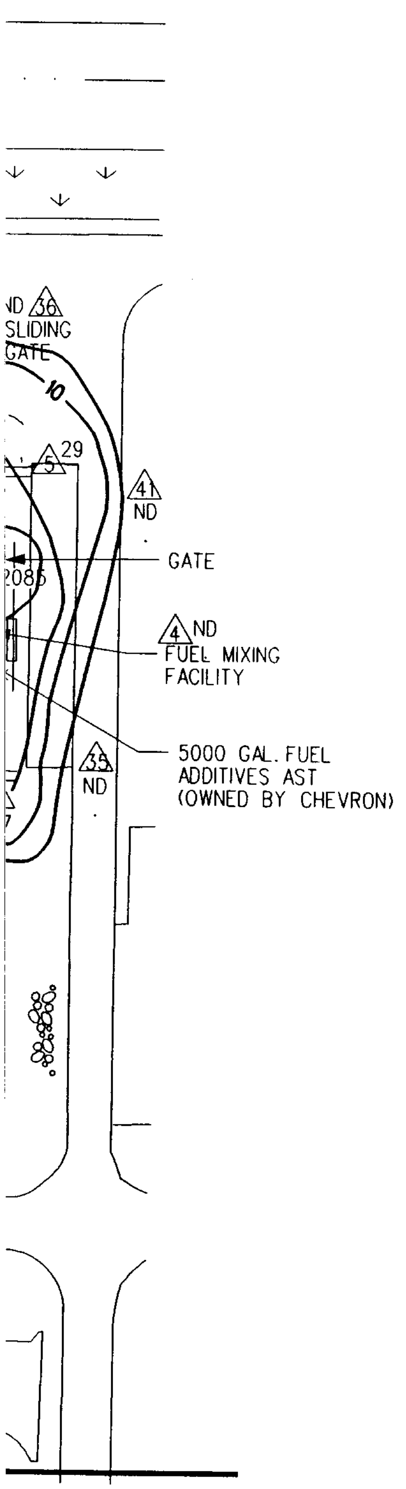
			2						1	ORIGINAL ISSUE				

FAC	ELEC	LTG	MATL	PC	ARCH	CIVIL	CONC	STL	L&P	INST	MD	P.S.	S.A.	FAC	ELEC	LTG	MATL	PC	ARCH	CIVIL	CONC	STL	L&P	INST	MD	P.S.	S.A.	FAC	ELEC	LTG	MATL

3



LEGEND:

△	SOIL GAS POINTS SWEC (JUNE 1995)
⩛	GRASS
○○	GRAVEL
—×—	FENCE
92	TOLUENE CONCENTRATION, ug/L.
— 100 —	TOLUENE ISOCONCENTRATION CONTOUR, ug/L.
ND	TOLUENE NOT DETECTED IN VAPOR SAMPLE.

NOTES:

TOLUENE CONCENTRATIONS ROUNDED TO THE NEAREST ug/L.

0 50'
SCALE

FIGURE 5-37

TOLUENE DETECTED DURING SOIL GAS SURVEY IRP SITE 10

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BOSTON, MASS.

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DRAWN BY: G.C. CARTER
CHK'D BY:
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LEVELS
WORK PKG
PCT

RESP ENGR: K. MARONEY
SUPV: R.J. BOUDREAU
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APP. CARD

1 ORIGINAL ISSUE

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APPR DATE
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DESCRIPTION
CHKD
CORRECT
APPR DATE

P.S. S.A. FAC ELEC LTG MATL PC ARCH CIVIL CONC STL L&P INST MD P.S. S.A. FAC ELEC LTG MATL

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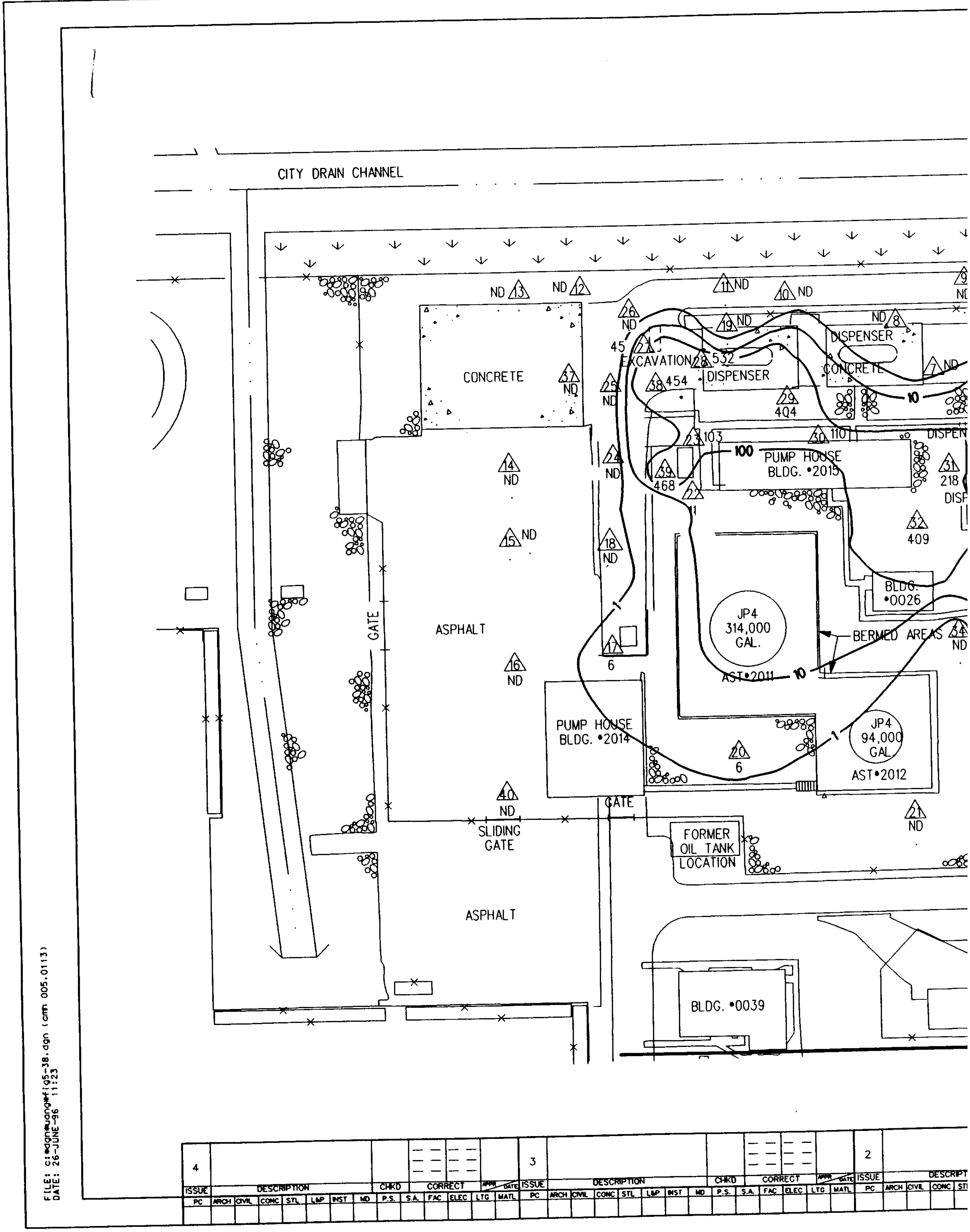

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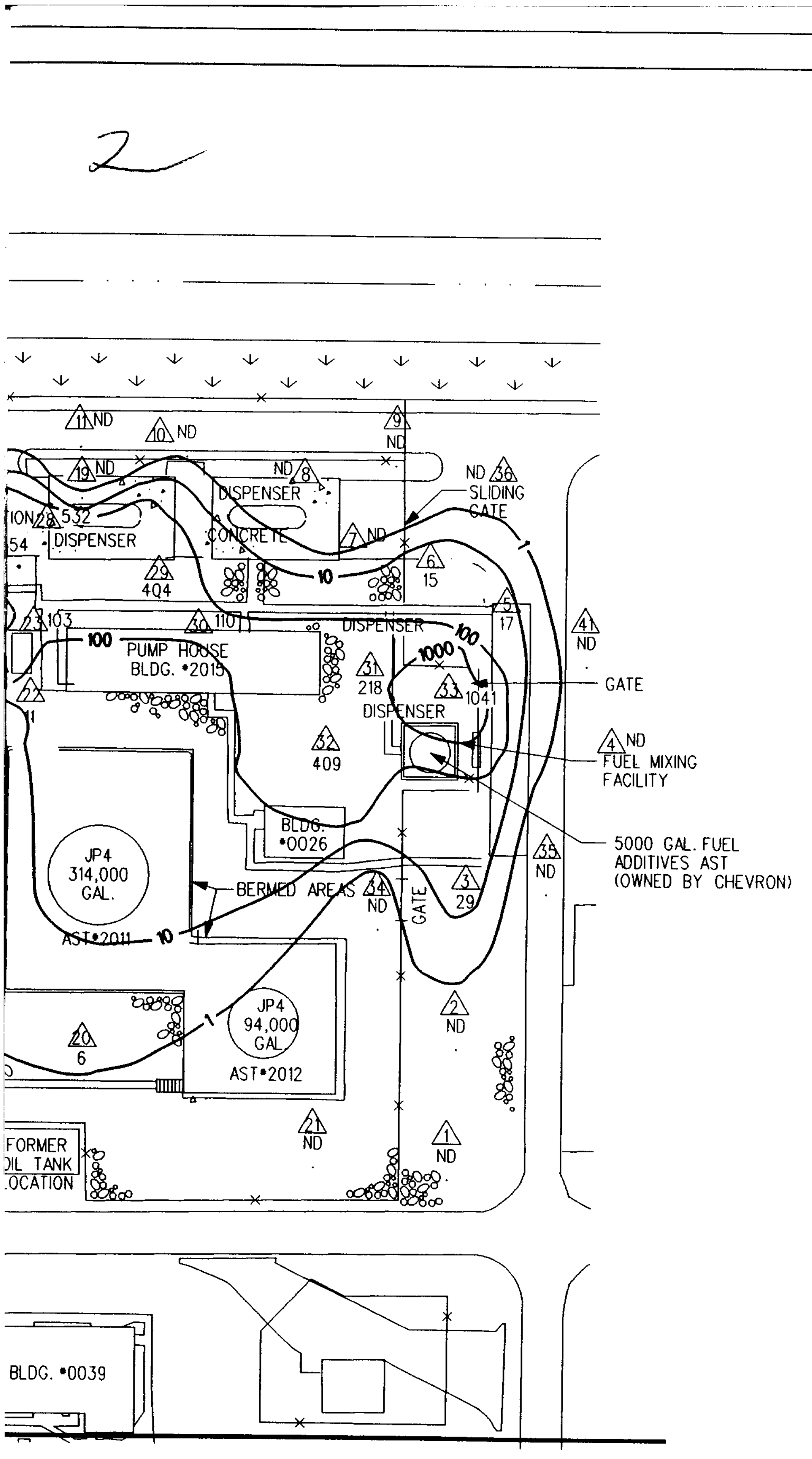

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LEGEND:

△	SOIL GAS POIN (JUNE 1995)
↓	GRASS
🝖	GRAVEL
—×—	FENCE
98	XYLENE
—— 1 ——	XYLENE CONTOU
ND	XYLENE VAPOR

NOTES:

XYLENE CONCENTR
TO THE NEAREST

0

FIGU

XYLENE
DURING SOIL
IRP S

151st ARW, UTAH AI
SALT LAKE CITY INT
SALT LAKE
STONE & WEBSTER ENG
BOSTON,

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CHK'D BY:

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MD | P.S. | S.A. | FAC | ELEC | LTG | MATL | PC | ARCH | CIVIL | CONC | STL | L&P | INST

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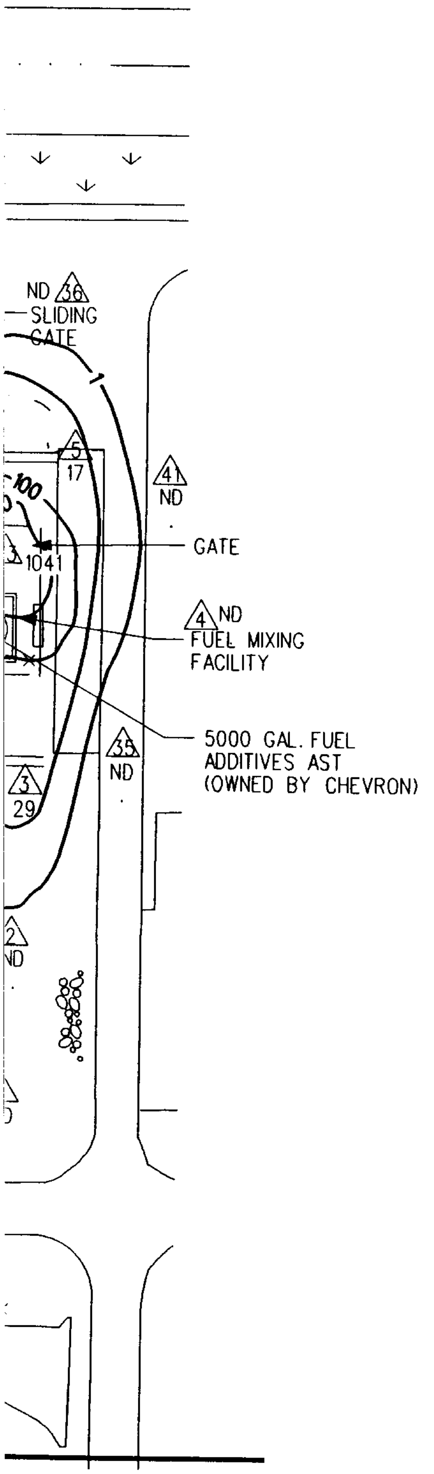

LEGEND:

△	SOIL GAS POINTS SWEC (JUNE 1995)
↓	GRASS
⁂	GRAVEL
—×—	FENCE
98	XYLENE CONCENTRATION, ug/L.
— 1 —	XYLENE ISOCONCENTRATION CONTOUR.
ND	XYLENE NOT DETECTED IN VAPOR SAMPLE.

NOTES:

XYLENE CONCENTRATIONS ROUNDED TO THE NEAREST ug/L.

0 50'
SCALE

FIGURE 5-38

XYLENE DETECTED DURING SOIL GAS SURVEY IRP SITE 10

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SUPV: R.J. BOUDREAU

CHKD	CORRECT	APPR / DATE	ISSUE	DESCRIPTION	CHKD	CORRECT	APPR / DATE
			1	ORIGINAL ISSUE			

MD P.S. S.A. FAC ELEC LTG MATL PC ARCH CIVIL CONC STL L&P INST MD P.S. S.A. FAC ELEC LTG MATL

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Table 5-15
Volatile Organic Compounds Detected in Soil Gas Samples
IRP Site No. 10
151st ARW, Utah Air National Guard
Salt Lake City, Utah

SAMPLE NUMBER:		S10-SG3	S10-SG3 DUP	S10-SG5	S10-SG6	S10-SG8	S10-SG11	S10-SG16
COLLECTION DATE:		6/05/95	6/05/95	6/05/95	6/05/95	6/05/95	6/06/95	6/06/95
DEPTH (feet):		4.0	4.0	3.0	3.0	4.0	3.0	3.0
Benzene	(ug/L)	71.9	61.5	1.6	16.7	2.7	1.8	1.1
Toluene	(ug/L)	107.1	97.7	28.5	91.8	ND (1.0)	ND (1.0)	ND (1.0)
Ethylbenzene	(ug/L)	5.7	4.8	4.2	2.7	ND (1.0)	ND (1.0)	ND (1.0)
Total Xylenes	(ug/L)	29.2	24.2	17.4	15.2	ND (1.0)	ND (1.0)	ND (1.0)

SAMPLE NUMBER:		S10-SG17	S10-SG18	S10-SG18 DUP	S10-SG19	S10-SG20	S10-SG22	S10-SG23
COLLECTION DATE:		6/06/95	6/06/95	6/06/95	6/06/95	6/06/95	6/06/95	6/06/95
DEPTH (feet):		3.0	3.0	3.0	4.0	4.0	3.0	3.0
Benzene	(ug/L)	8.9	18.0	12.5	2.0	3.5	160.6	2967.6
Toluene	(ug/L)	3.6	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	21.4	361.9
Ethylbenzene	(ug/L)	1.3	ND (1.0)	ND (1.0)	ND (1.0)	1.2	3.0	29.1
Total Xylenes	(ug/L)	6.0	ND (1.0)	ND (1.0)	ND (1.0)	6.2	11.6	102.7

SAMPLE NUMBER:		S10-SG24	S10-SG25	S10-SG26	S10-SG27	S10-SG28	S10-SG29	S10-SG30
COLLECTION DATE:		6/06/95	6/06/95	6/06/95	6/06/95	6/07/95	6/07/95	6/07/95
DEPTH (feet):		3.0	3.0	3.0	3.5	3.5	3.5	4.0
Benzene	(ug/L)	366.8	440.2	103.2	4911.7	4399.4	4976.2	1835.6
Toluene	(ug/L)	3.1	5.4	ND (1.0)	291.9	1317.1	2646.3	785.2
Ethylbenzene	(ug/L)	ND (1.0)	ND (1.0)	ND (1.0)	45.3	73.7	111.2	18.2
Total Xylenes	(ug/L)	ND (1.0)	ND (1.0)	ND (1.0)	155.0	531.7	404.4	110.3

SAMPLE NUMBER:		S10-SG31	S10-SG32	S10-SG33	S10-SG38	S10-SG39	S10-SG40	S10-SG40 DUP
COLLECTION DATE:		6/07/95	6/07/95	6/07/95	6/07/95	6/07/95	6/07/95	6/07/95
DEPTH (feet):		3.5	3.5	3.5	4.0	4.0	3.5	3.5
Benzene	(ug/L)	370.1	910.0	2562.7	2528.1	2264.9	8.0	17.4
Toluene	(ug/L)	751.4	2292.3	2084.9	1062.9	1719.7	3.6	6.8
Ethylbenzene	(ug/L)	52.7	ND (1.0)	261.9	73.4	81.3	ND (1.0)	ND (1.0)
Total Xylenes	(ug/L)	217.5	408.9	1040.6	454.1	468.3	ND (1.0)	ND (1.0)

Shaded values indicate concentrations above established ARAR values

DUP = duplicate sample

ND = not detected above the method detection limit

Analyses performed in TEG's mobile lab

Samples analyzed for VOCs by EPA methods SW8010 and SW8020

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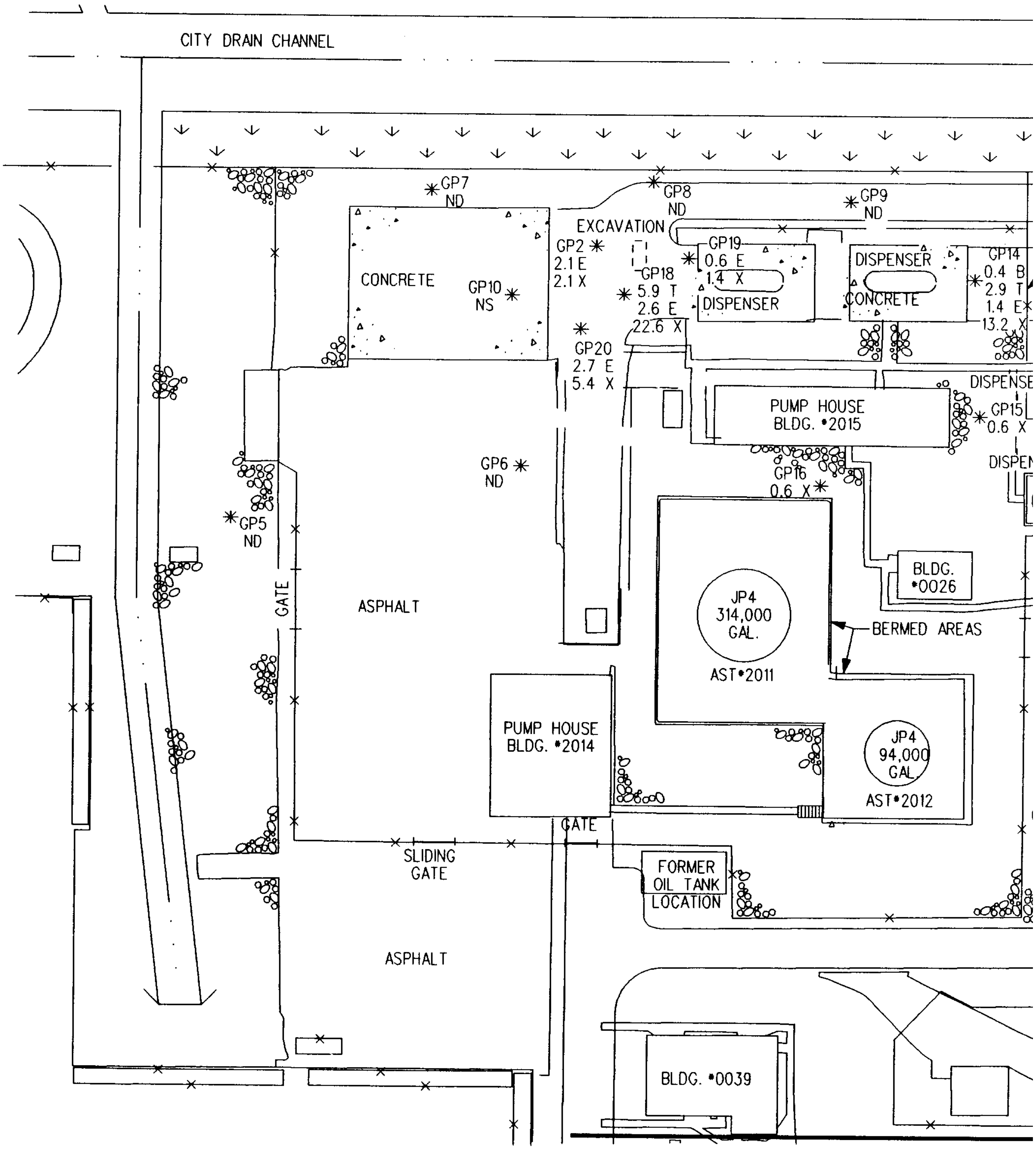

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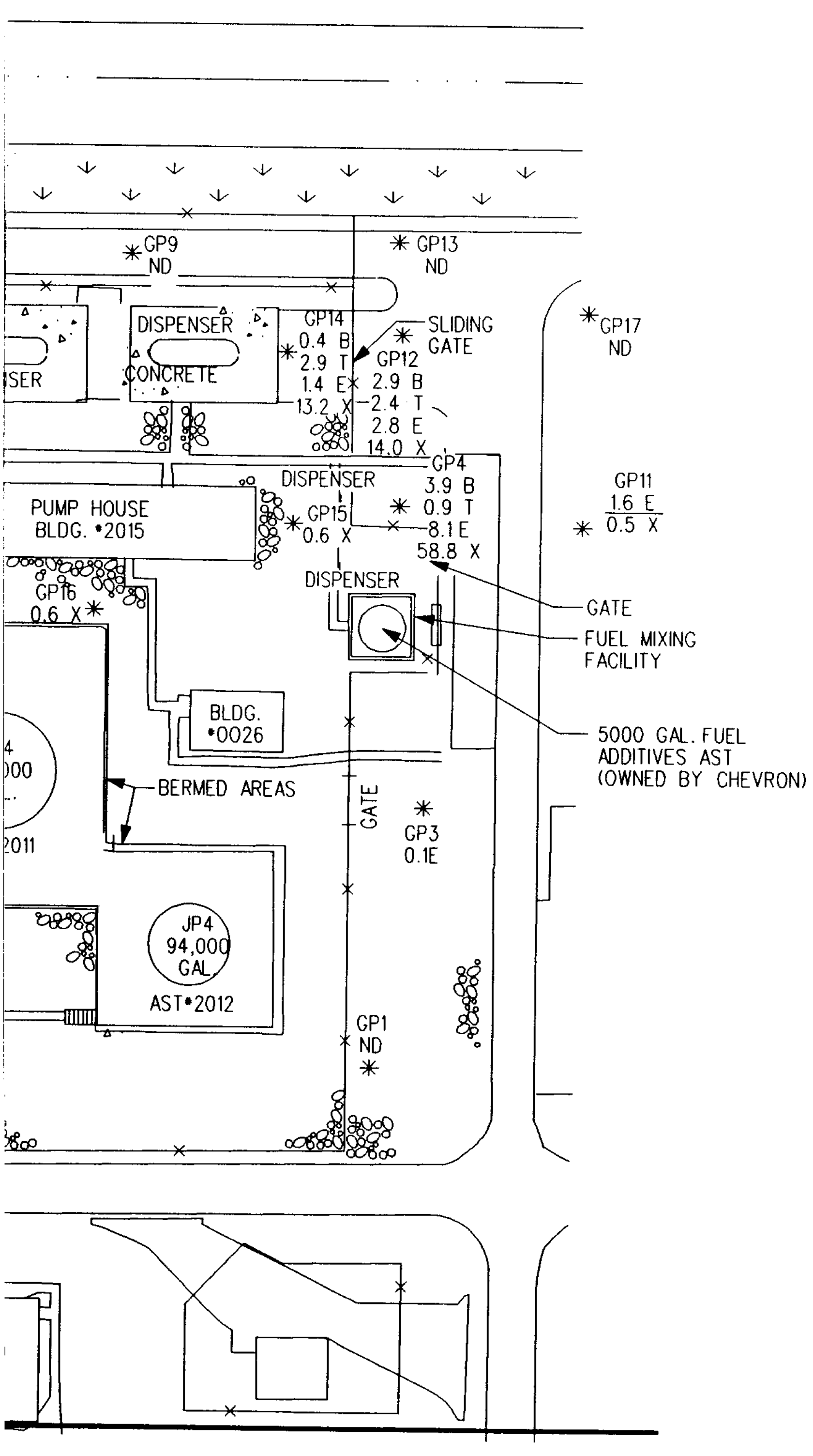
ISSUE	DESCRIPTION							CHKD	CORRECT			APPR DATE	ISSUE	DESCRIPTION							CHKD	CORRECT			APPR DATE	ISSUE	DESCRIPTION
PC	ARCH	CIVIL	CONC	STL	L&P	INST	MD	P.S.	S.A.	FAC	ELEC	LTG	MATL	PC	ARCH	CIVIL	CONC	STL	L&P	INST	MD	P.S.	S.A.	FAC	ELEC	LTG	MATL

2



LEGEND:

✳	SOIL SCREENING SAMPLING POINTS SWEC (JULY 1995)
↓	GRASS
	GRAVEL
—×—	FENCE
NS	NOT SAMPLED.
ND	VOLATILE ORGANIC COMPO NOT DETECTED IN SOIL S SAMPLE.
B	BENZENE
T	TOLUENE
E	ETHYLBENZENE
X	XYLENE

NOTES:

CONCENTRATIONS ROUNDED TO NEAREST 0.1 mg/kg.

0 50'

SCALE

FIGURE 5-

SOIL SCREENIN SAMPLING LOCATIONS AN IRP SITE 10

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SALT LAKE CITY INTERNATIONAL
SALT LAKE CITY, UTAH
STONE & WEBSTER ENGINEERING COR
BOSTON, MASS.

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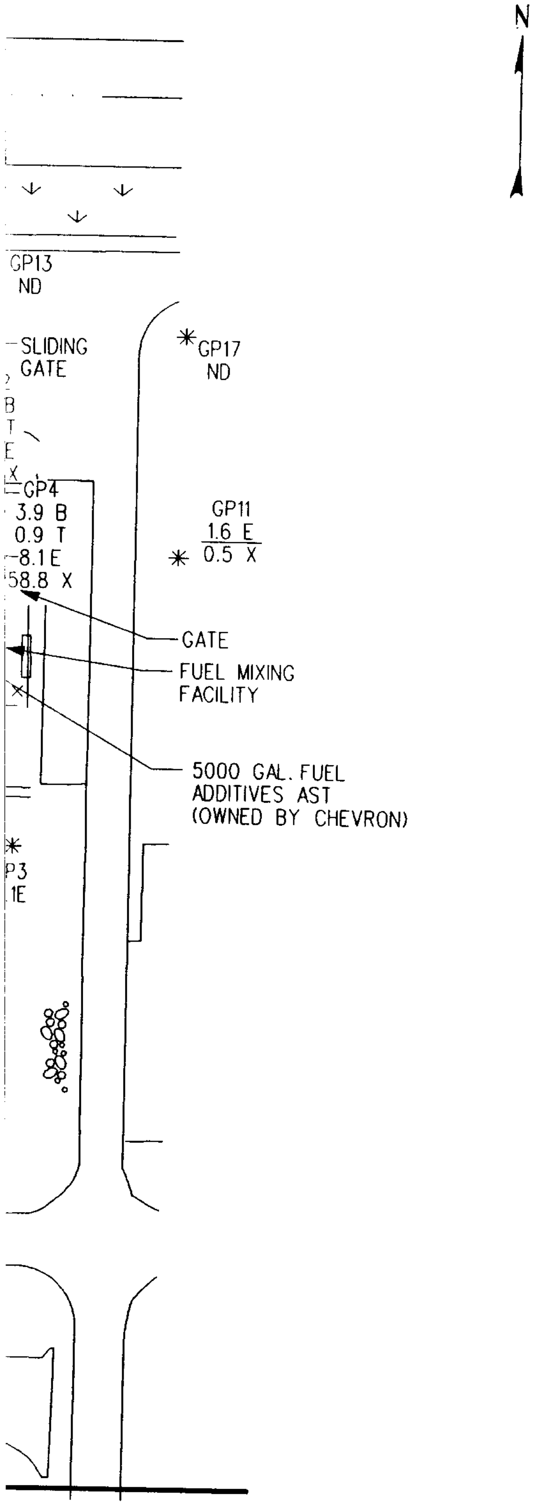
DESIGNED BY:
DRAWN BY: G.C. CARTER
AREA
DSGN CHK'D BY:
CHK'D BY:

ORRECT	APPR DATE	ISSUE	DESCRIPTION	CHKD	CORRECT	APPR DATE	ISSUE	DESCRIPTION	CHKD	CORRECT	APPR DATE
		2					1	ORIGINAL ISSUE			
AC ELEC LTG	MATL	PC	ARCH CIVIL CONC STL L&P INST MD	P.S. S.A.	FAC ELEC LTG	MATL	PC	ARCH CIVIL CONC STL L&P INST MD	P.S. S.A.	FAC ELEC LTG	MATL



LEGEND:

✳ SOIL SCREENING SAMPLING POINTS SWEC (JULY 1995)

↓ GRASS

○ GRAVEL

—×— FENCE

NS	NOT SAMPLED.
ND	VOLATILE ORGANIC COMPOUNDS NOT DETECTED IN SOIL SCREENING SAMPLE.
B	BENZENE
T	TOLUENE
E	ETHYLBENZENE
X	XYLENE

NOTES:

CONCENTRATIONS ROUNDED TO THE NEAREST 0.1 mg/kg.

0 50'

SCALE

FIGURE 5-39

SOIL SCREENING SAMPLING LOCATIONS AND RESULTS IRP SITE 10

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BOSTON, MASS.

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RESP ENGR: K. MARONEY
SUPV: R.J. BOUDREAU

CHKD	CORRECT	APPR DATE	ISSUE	DESCRIPTION	CHKD	CORRECT	APPR DATE
			1	ORIGINAL ISSUE			

P.S. S.A. FAC ELEC LTG MATL PC ARCH CIVIL CONC STL L&P INST MD P.S. S.A. FAC ELEC LTG MATL

DESIGNED BY:
DSGN CHK'D BY:
DRAWN BY: G.C. CARTER
CHK'D BY:
AREAS
LEVELS
WORK PKG
PCT

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Table 5-16
Volatile Organic Compounds Detected in Soil Screening Samples
IRP Site No. 10
151st ARW, Utah Air National Guard
Salt Lake City, Utah

SAMPLE NUMBER: COLLECTION DATE:		UANG-S10-GP2-S1 6/08/95	UANG-S10-GP3-S1 6/08/95	UANG-S10-GP4-S1 6/08/95	UANG-S10-GP11-S1 6/09/95	UANG-S10-GP12-S1 6/09/95	UANG-S10-GP14-S1 6/09/95
Benzene	(mg/kg)	ND (0.005)	ND (0.005)	3.891	ND (0.005)	2.855	0.390
Toluene	(mg/kg)	ND (0.005)	ND (0.005)	0.935	ND (0.005)	2.369	2.948
Ethylbenzene	(mg/kg)	2.111	ND (0.005)	8.100	1.604	2.826	1.443
Total Xylenes	(mg/kg)	2.143	0.142	58.819	0.543	14.045	13.179

SAMPLE NUMBER: COLLECTION DATE:		UANG-S10-GP15-S1 6/09/95	UANG-S10-GP16-S1 6/09/95	UANG-S10-GP18-S1 6/09/95	UANG-S10-GP19-S1 6/09/95	UANG-S10-GP20-S1 6/09/95	UANG-S10-GP20-S1 DUP
Benzene	(mg/kg)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)
Toluene	(mg/kg)	ND (0.005)	ND (0.005)	5.913	ND (0.005)	ND (0.005)	ND (0.005)
Ethylbenzene	(mg/kg)	ND (0.005)	ND (0.005)	2.602	0.634	2.686	2.710
Total Xylenes	(mg/kg)	0.552	0.582	22.613	1.379	5.408	3.940

Shaded values indicate concentrations above established ARAR values

DUP = duplicate sample

ND = Not detected above the method detection limit shown in parentheses

Analyses performed in TEG's CA DHS certified mobile lab (#1671)

Soil samples analyzed for VOCs by EPA methods 8010/8020

5.4.3.3 Groundwater Screening Results

Groundwater screening was conducted at Site 10 on June 8 and 9, 1995. TEG collected a total of 35 groundwater samples from 20 locations. Shallow groundwater samples were collected from depths ranging from 8 to 12 feet BGS. Deep groundwater samples were collected from depths ranging from 13 to 17 feet BGS. Groundwater screening locations are shown on Figure 5-40.

Groundwater samples were screened by TEG for VOCs in their mobile laboratory. Three groundwater screening samples (GP19-GW1, GP19-GW2, and GP2-GW1) were submitted to ChemTech for PCB and pesticide analysis. These groundwater samples were collected from two locations within the area where the exposure incident occurred, with a shallow and a deep groundwater sample collected from one location. The quantity of groundwater screening samples sent to the fixed-base laboratory for PCB and pesticide analysis was reduced from all soil screening samples to three. This field change was made due to the identification of the unidentified contaminant of concern at Site 10 to be hydrogen sulfide, not a PCB or pesticide. A field change request form documenting this change is included in Appendix D.

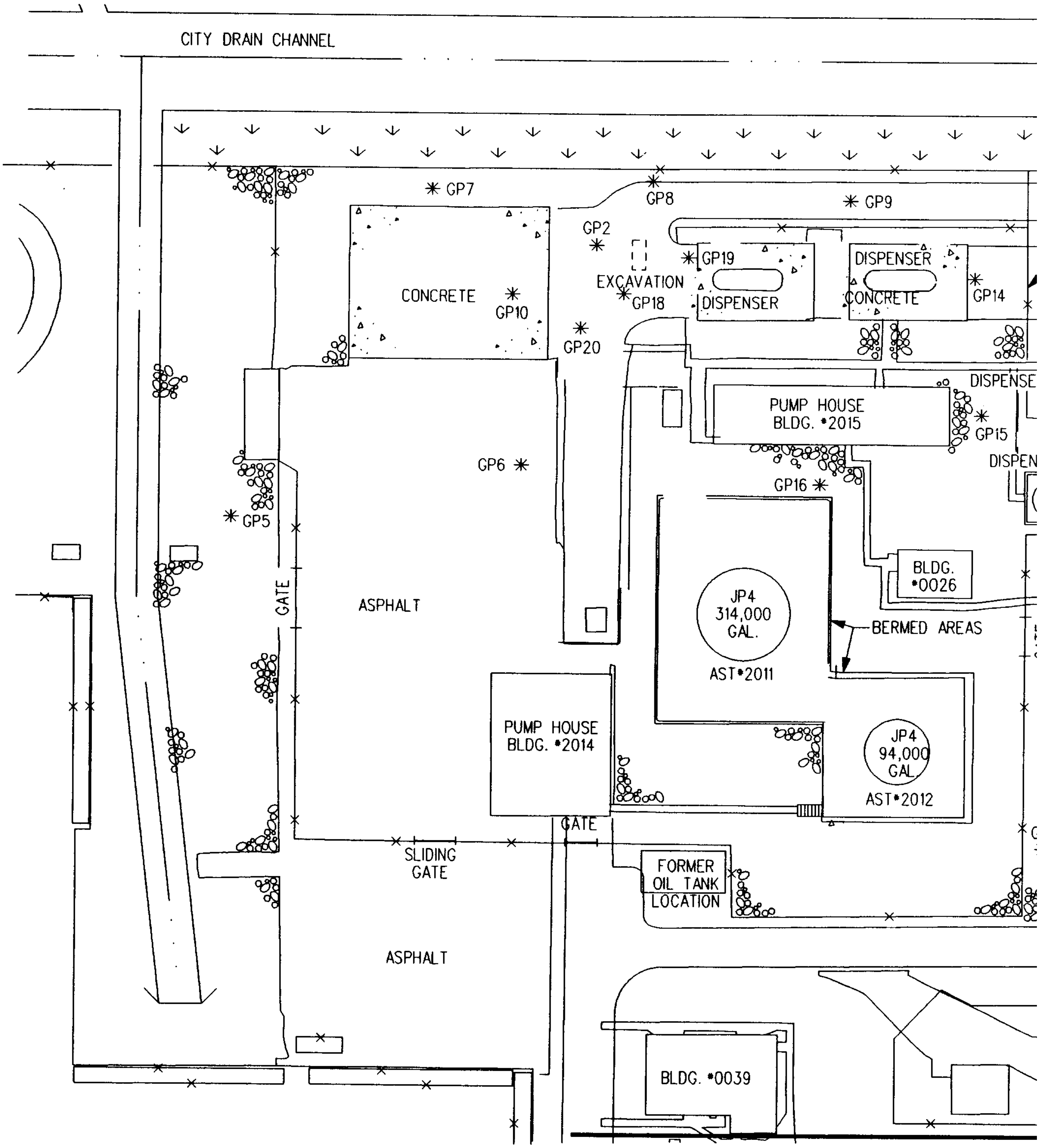
Halogenated compounds, including 1,1-DCA, c-DCE, TCA, and TCE, were detected in several groundwater samples collected at Site 10. 1,1-DCA was detected in one sample at a concentration of 0.9 μg/l. Concentrations of c-DCE were found in two samples at concentrations of 1.4 and 3.6 μg/l. TCA was detected in two samples at concentrations of 0.6 and 1.2 μg/l. TCE was detected in two samples at concentrations of 0.5 and 0.8 μg/l.

BTEX compounds were detected in several groundwater screening samples collected at Site 10. Benzene was detected in 21 of the 35 samples at concentrations ranging from 1.2 to 10,043.0 μg/l. Figures 5-41 and 5-42 show the areal extent of benzene detected in the shallow and deep groundwater screening samples. Toluene was detected in 12 of the 35 samples at concentrations ranging from 5.3 to 3,504.5 μg/l. Ethylbenzene was detected in 16 of the 35 samples at concentrations ranging from 1.4 to 3,826.2 μg/l. Xylenes were detected in 24 of the 35 samples at concentrations ranging from 2.8 to 22,867.0 μg/l. The highest concentrations of BTEX compounds were detected in samples collected from the area of the excavation and from the area directly north of the fuel mixing facility. Figures 5-43 and 5-44 show the horizontal extent of total BTEX compounds detected in the shallow and deep groundwater screening samples.

PCBs/pesticides were not detected in the groundwater samples above the method detection limits. VOC analytical results of groundwater screening samples are summarized in Table 5-17. Laboratory data analysis sheets for the PCB and pesticide analysis of the groundwater screening samples is included in Appendix F.

5.4.4 Soil Investigation Findings

Eight soil borings were advanced on and around Site 10 on June 13, 14, and 21, 1995. The number of soil borings at Site 10 was decreased from 10 to 8 due to the limited area of soil contamination delineated during screening activities. Borings were advanced by Layne. Soil samples were collected from the soil borings for chemical analysis. Soil borings were advanced



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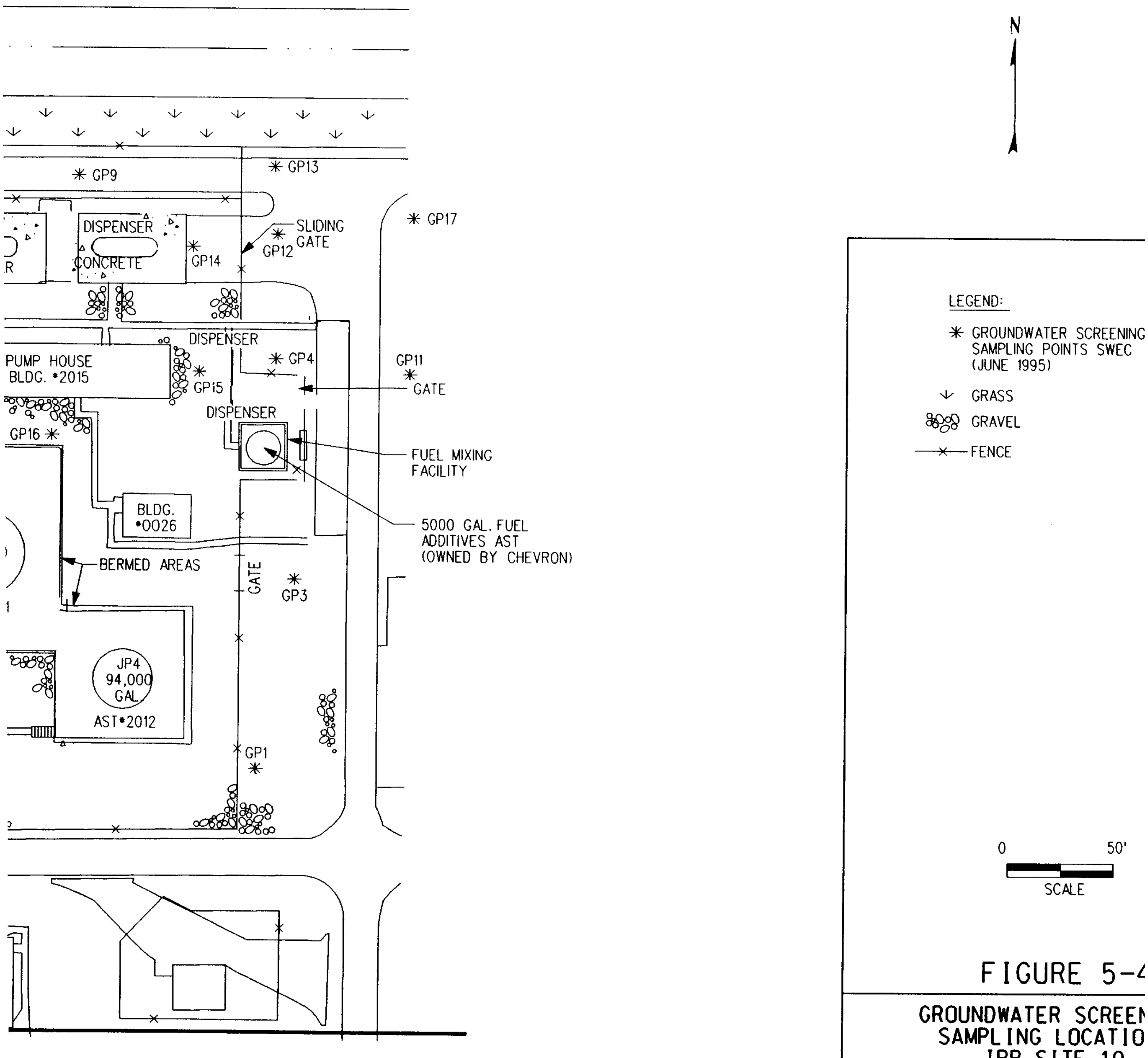

FIGURE 5-4

GROUNDWATER SCREEN
SAMPLING LOCATIO
IRP SITE 10

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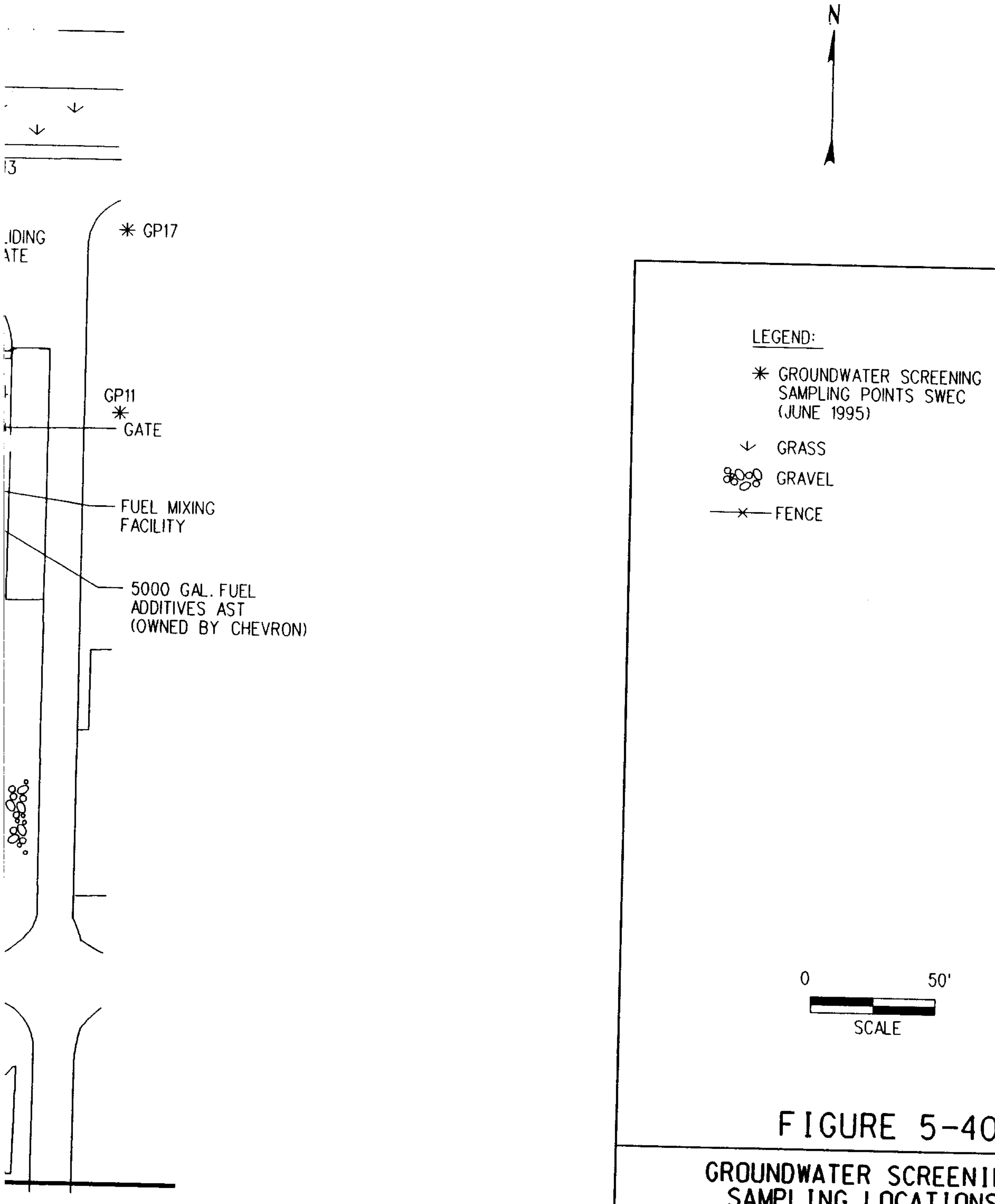

FIGURE 5-40

GROUNDWATER SCREENING SAMPLING LOCATIONS IRP SITE 10

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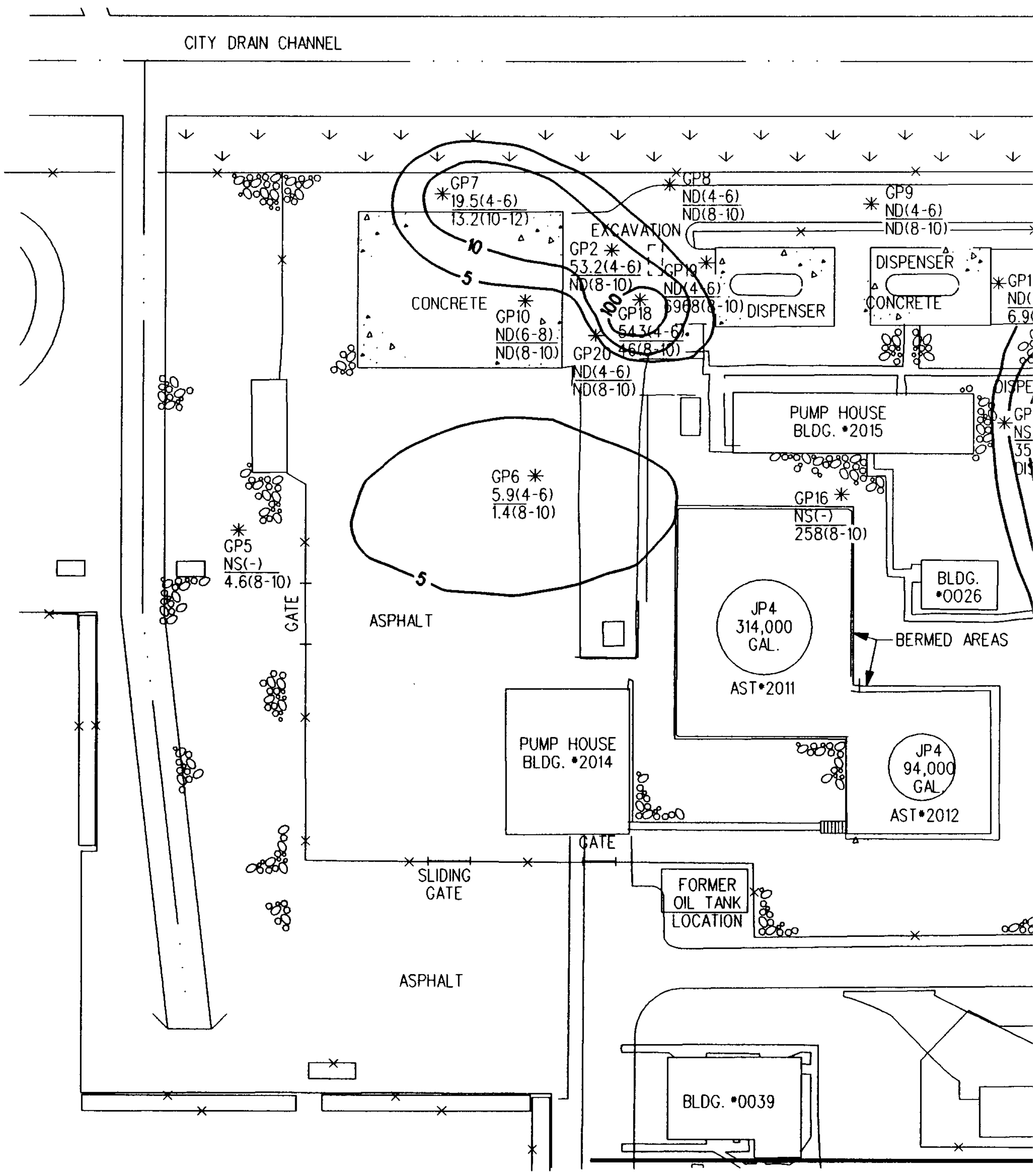

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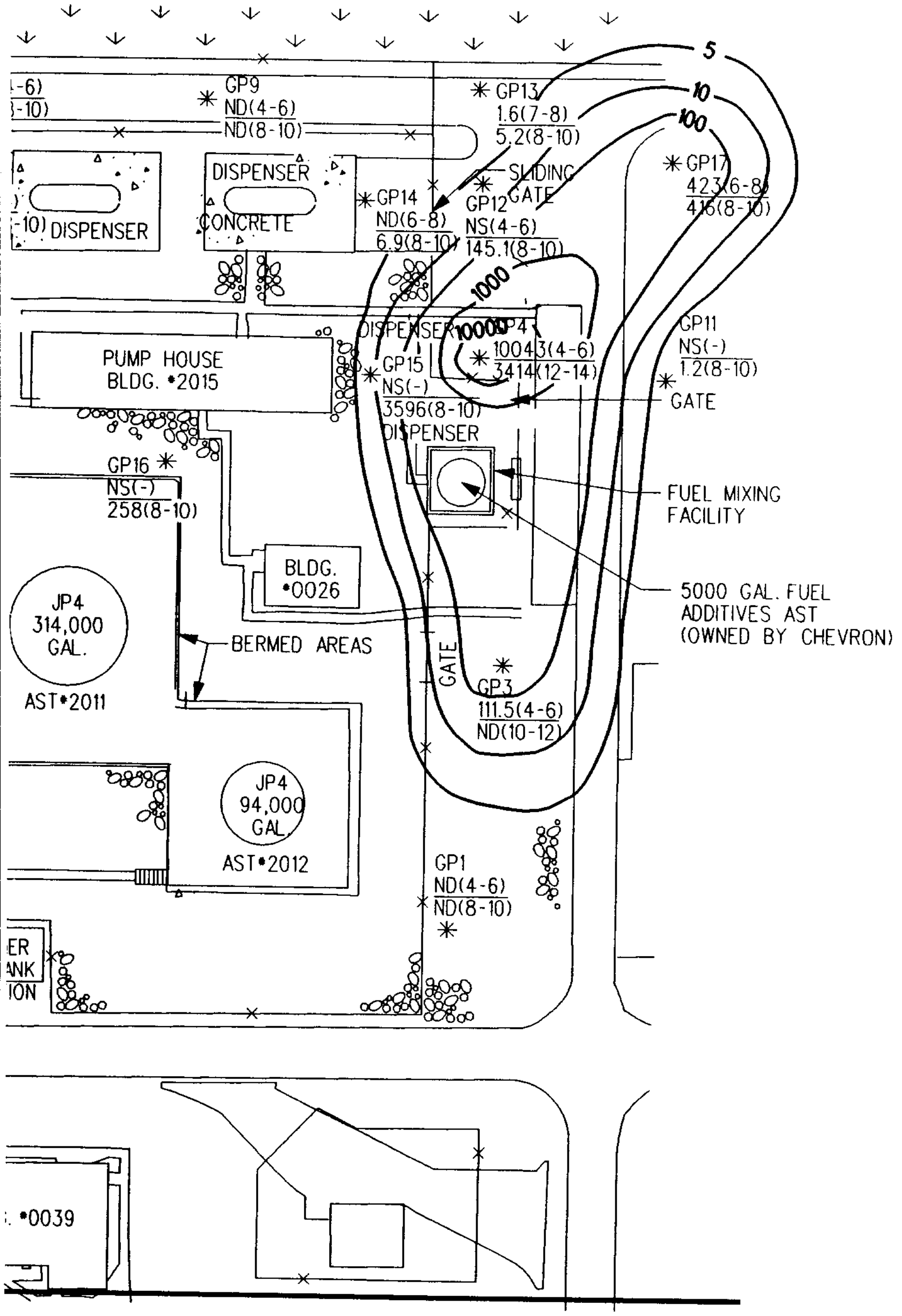

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LEGEND:

✳	GEOPROBE POINTS SWEC (JUNE 1995)
↓	GRASS
ဝဝ	GRAVEL
—×—	FENCE
NS	NOT SAMPLED.
ND	BENZENE NOT DETECTE
5.9(4-6)	SHALLOW BENZENE CO DEPTH (ft.)
1.4(8-10)	DEEP BENZENE CONCEN DEPTH (ft.)
—10—	BENZENE ISOCONCEN CONTOUR, ug/L.

NOTES:

BENZENE ISOCONCENTRATION
CONCENTRATION FROM SHALL

0

SCALE

FIGURE

BENZENE DETECT
SHALLOW GROUNDWAT
IRP SITE
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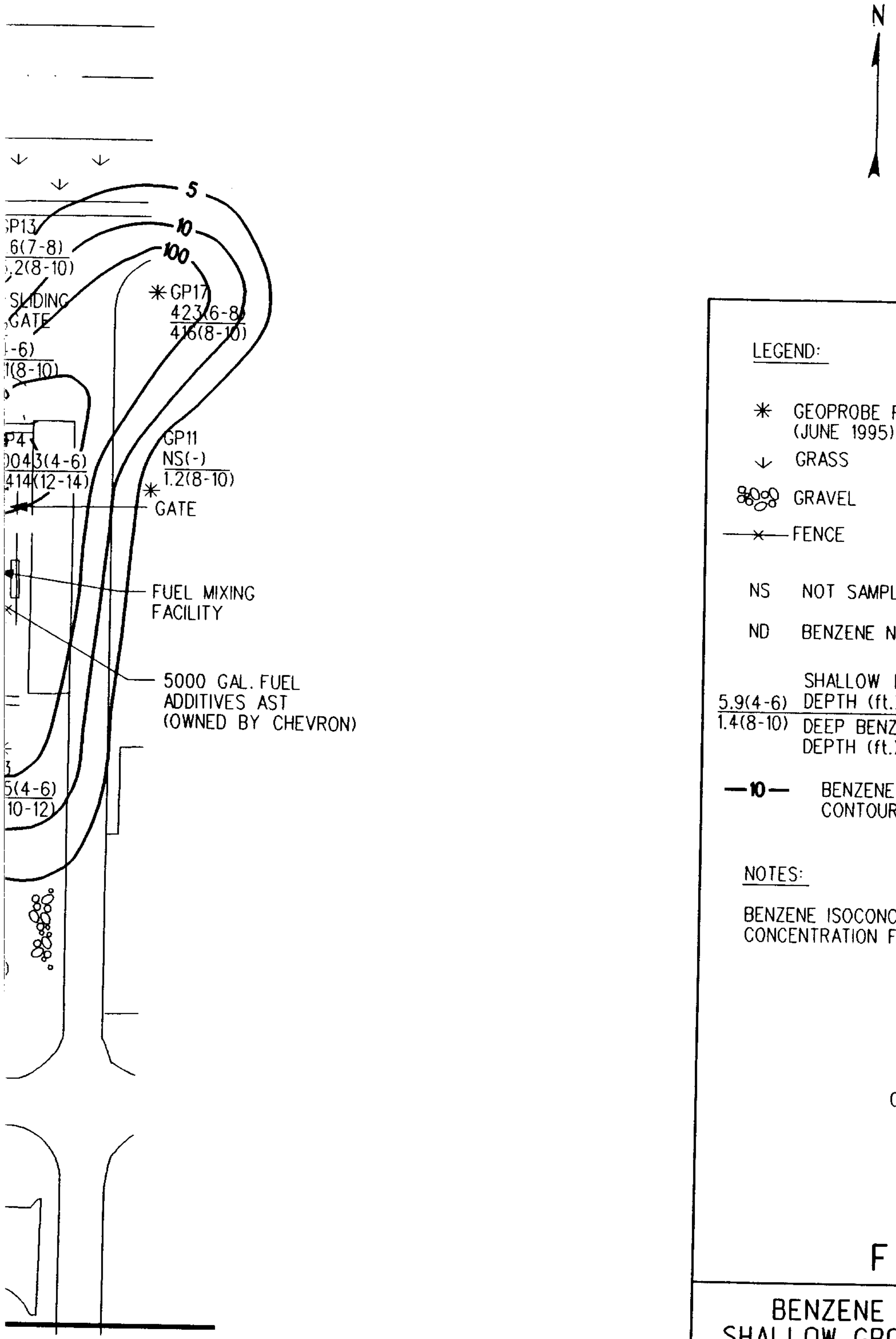

LEGEND:

✳	GEOPROBE POINTS SWEC (JUNE 1995)
↓	GRASS
⁂	GRAVEL
—×—	FENCE
NS	NOT SAMPLED.
ND	BENZENE NOT DETECTED.
5.9(4-6)	SHALLOW BENZENE CONCENTRATION (ug/L) AND DEPTH (ft.)
1.4(8-10)	DEEP BENZENE CONCENTRATION (ug/L) AND DEPTH (ft.)
—10—	BENZENE ISOCONCENTRATION CONTOUR, ug/L.

NOTES:

BENZENE ISOCONCENTRATION LINES BASED ON CONCENTRATION FROM SHALLOW SAMPLES.

0 50'
SCALE

FIGURE 5-41

BENZENE DETECTED DURING
SHALLOW GROUNDWATER SCREENING
IRP SITE 10
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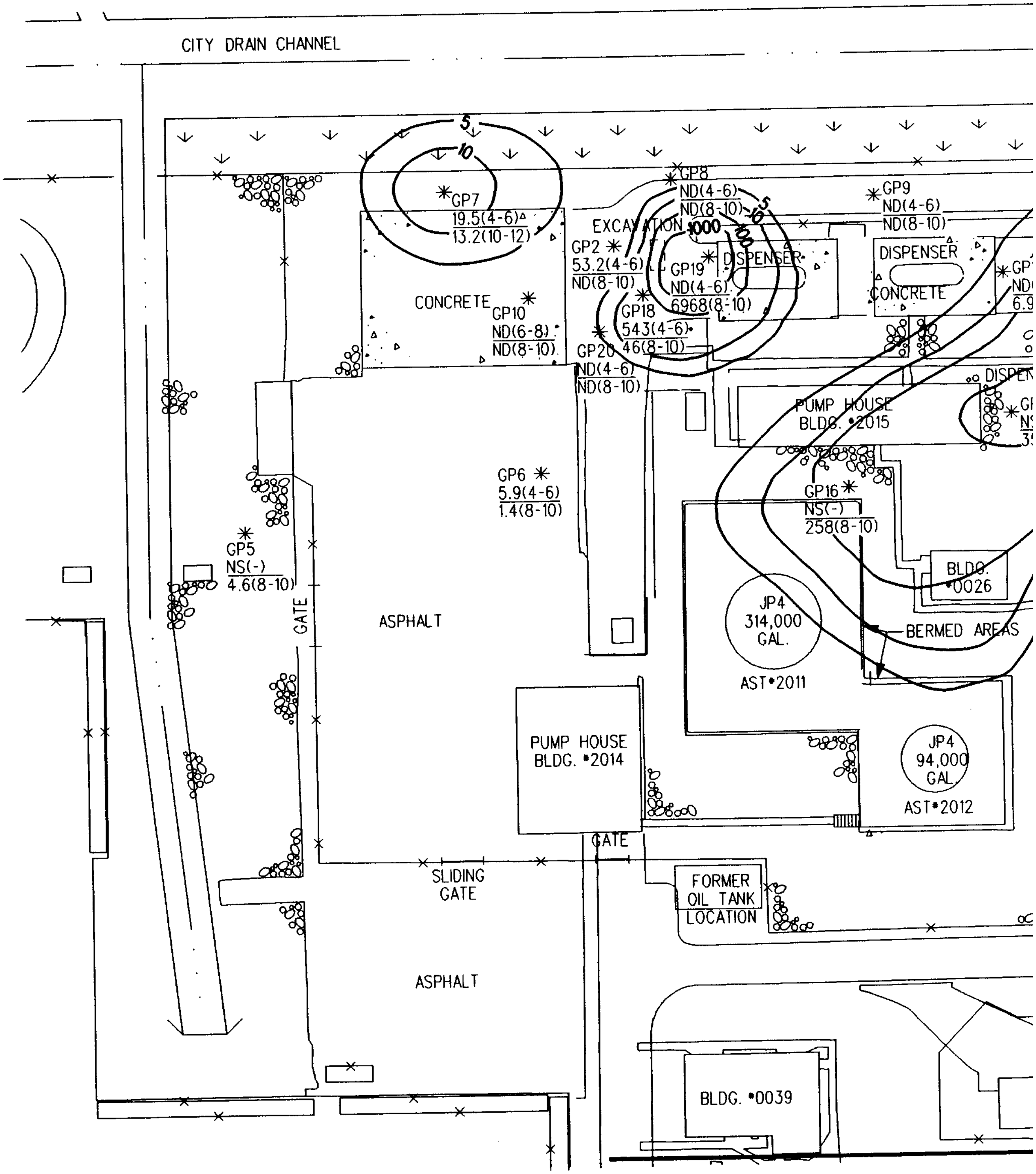

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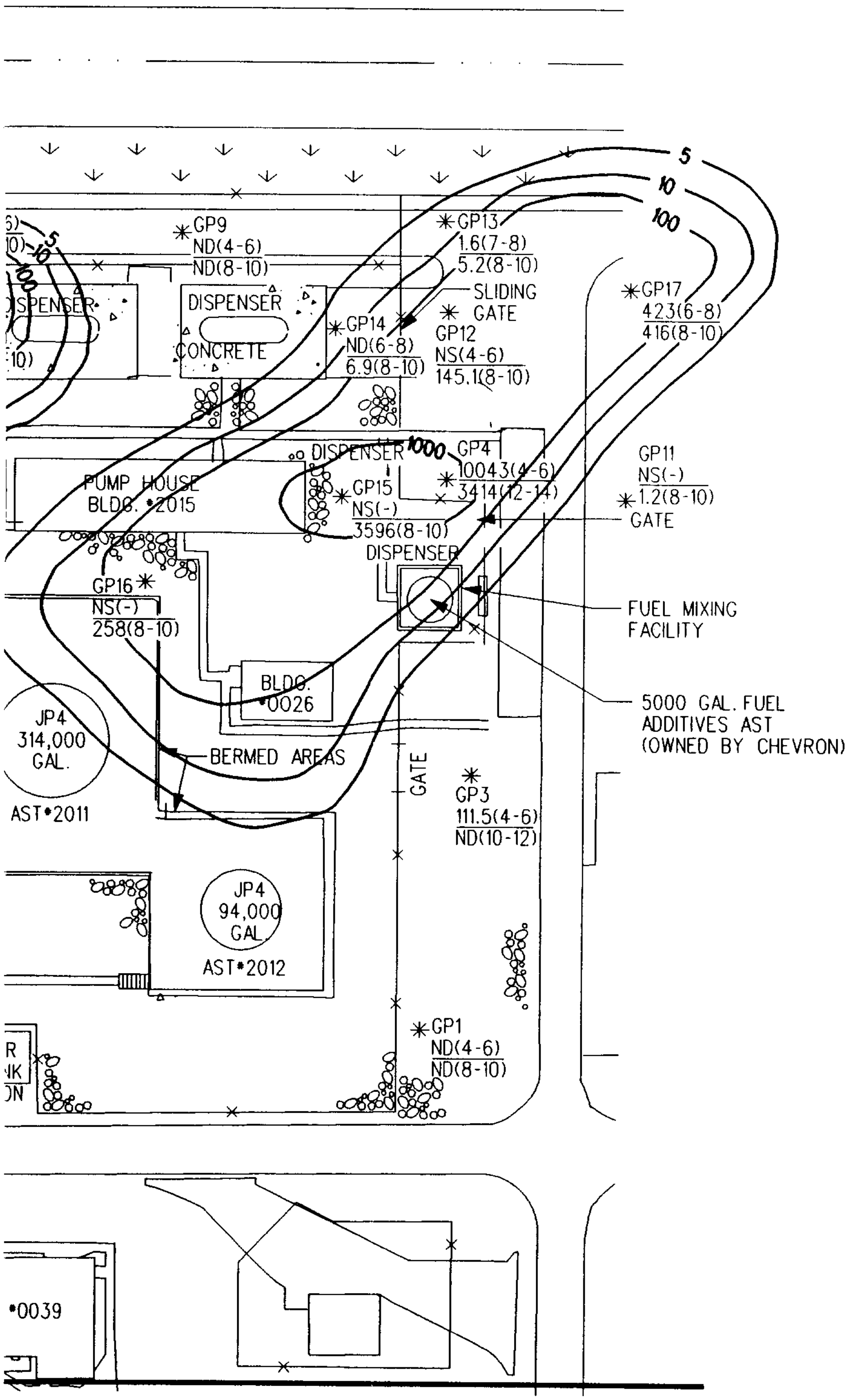

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✳	GEOPROBE POINTS SWEC (JUNE 1995)
⩛	GRASS
⸰	GRAVEL
—×—	FENCE
NS	NOT SAMPLED.
ND	BENZENE NOT DETECTE
5.9(4-6)	SHALLOW BENZENE CO DEPTH (ft.)
1.4(8-10)	DEEP BENZENE CONCEN DEPTH (ft.)
—10—	BENZENE ISOCONCENTR CONTOUR, ug/L.

NOTES:

BENZENE ISOCONCENTRATION
CONCENTRATION FROM DEEP

0

SCALE

FIGURE

BENZENE DETECT
DEEP GROUNDWATE
IRP SITE

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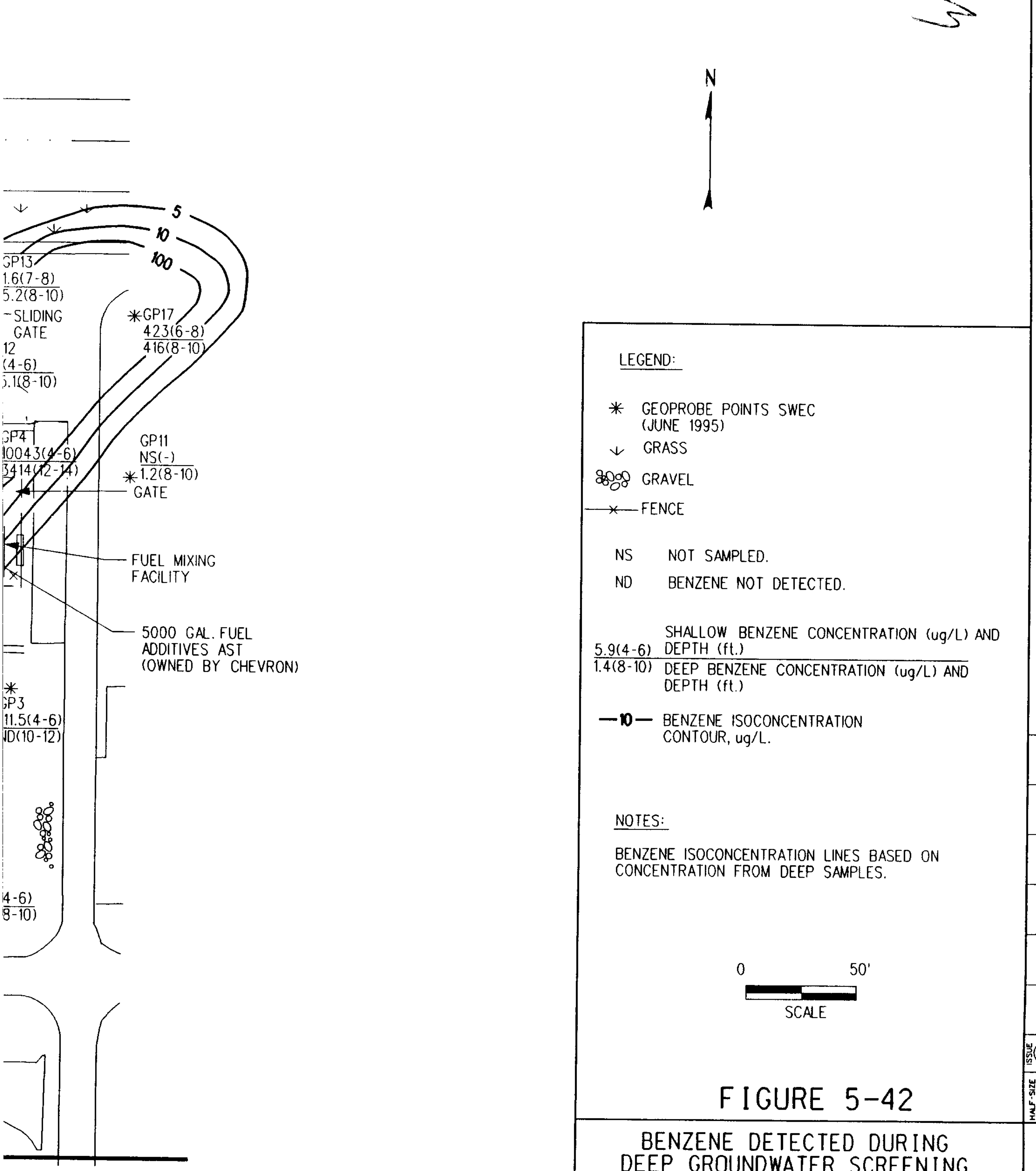

LEGEND:

✳	GEOPROBE POINTS SWEC (JUNE 1995)
↓	GRASS
∞	GRAVEL
—×—	FENCE
NS	NOT SAMPLED.
ND	BENZENE NOT DETECTED.
5.9(4-6)	SHALLOW BENZENE CONCENTRATION (ug/L) AND DEPTH (ft.)
1.4(8-10)	DEEP BENZENE CONCENTRATION (ug/L) AND DEPTH (ft.)
—10—	BENZENE ISOCONCENTRATION CONTOUR, ug/L.

NOTES:

BENZENE ISOCONCENTRATION LINES BASED ON CONCENTRATION FROM DEEP SAMPLES.

0 50'
SCALE

FIGURE 5-42

BENZENE DETECTED DURING DEEP GROUNDWATER SCREENING IRP SITE 10

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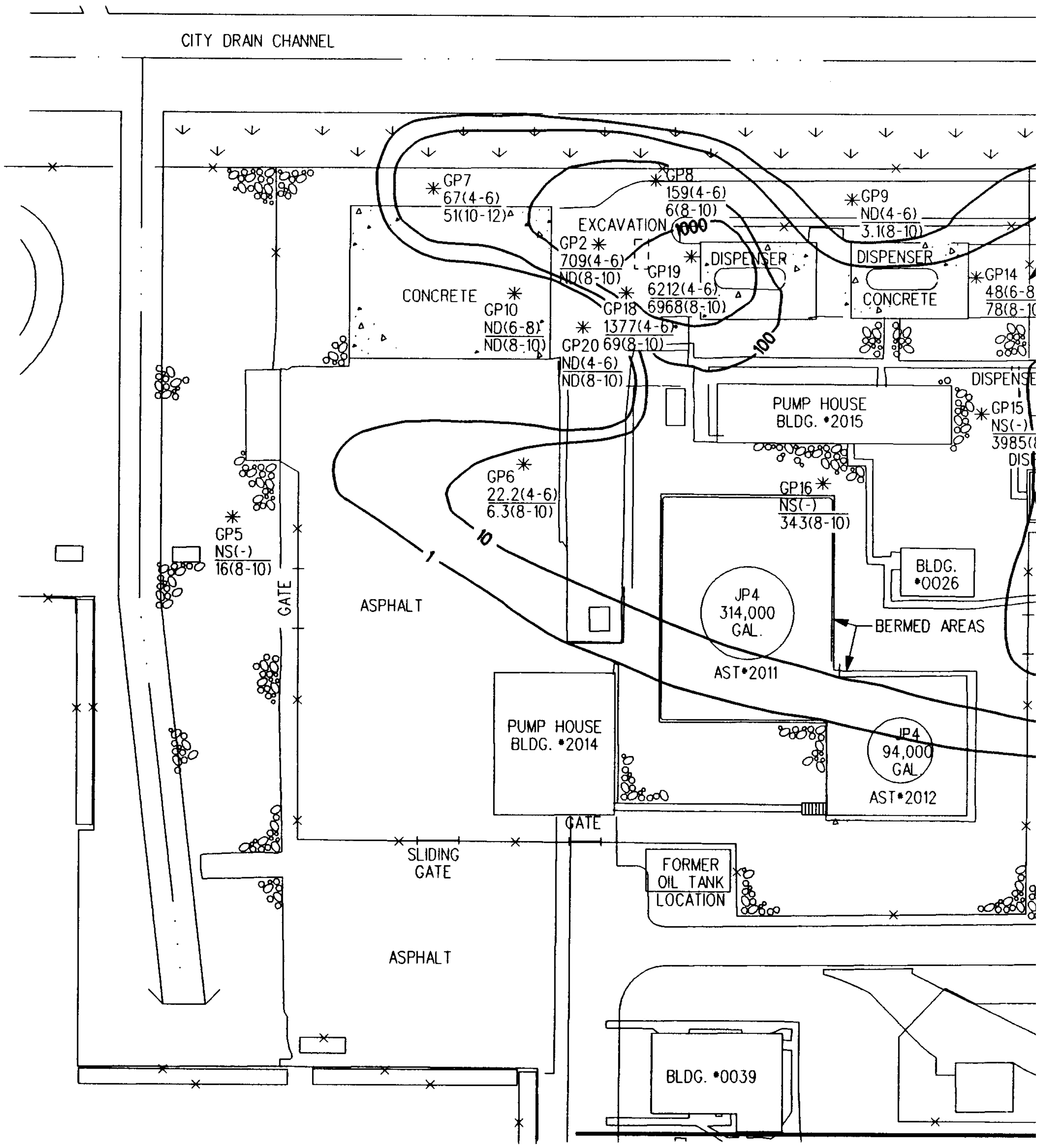

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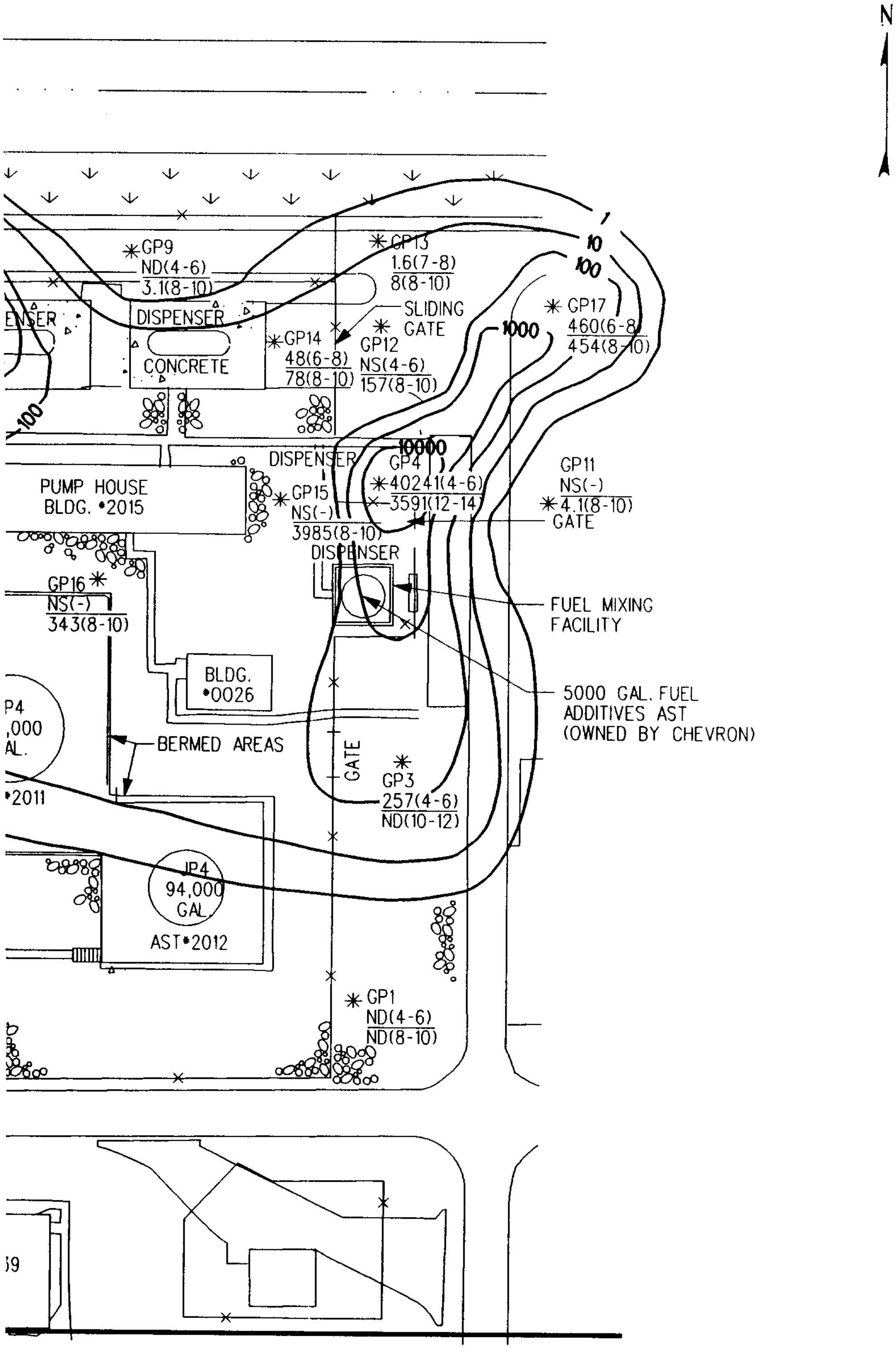

LEGEND:

✳	GROUNDWATER SCREENING SAMPLING POINTS SWEC (JUNE 1995)
↓	GRASS
⁂	GRAVEL
—×—	FENCE
BTEX	BENZENE, TOLUENE, ETH
22.2(4-6)	SHALLOW BETX CONCE DEPTH (ft.)
6.3(8-10)	DEEP BETX CONCENTRA DEPTH (ft.)
NS	NOT SAMPLED.
ND	NOT DETECTED.
—10—	BTEX ISOCONCENTRAT CONTOUR, ug/L.

NOTES:

BTEX ISOCONCENTRATION LINES BAS CONCENTRATION FROM SHALLOW S

0 5

SCALE

FIGURE 5

TOTAL BTEX DETECTED
GROUNDWATER SCREENI
IRP SITE 1
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SALT LAKE CITY, UT
STONE & WEBSTER ENGINEERING
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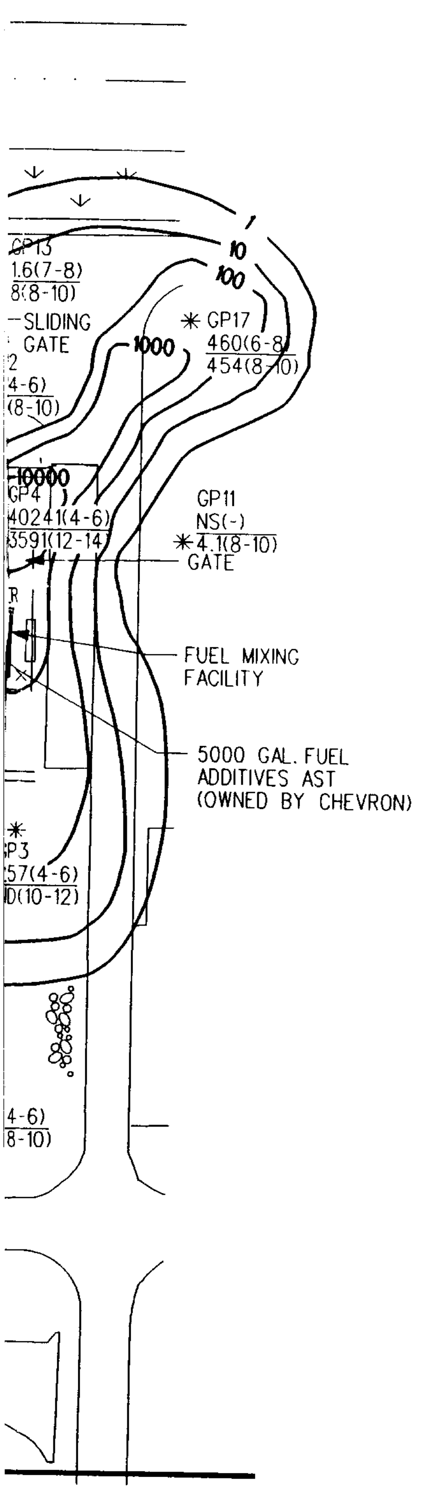

LEGEND:

✳	GROUNDWATER SCREENING SAMPLING POINTS SWEC (JUNE 1995)
ⱽ	GRASS
∘∘∘	GRAVEL
—×—	FENCE
BTEX	BENZENE, TOLUENE, ETHYLBENZENE
22.2(4-6)	SHALLOW BETX CONCENTRATION (ug/L) AND DEPTH (ft.)
6.3(8-10)	DEEP BETX CONCENTRATION (ug/L) AND DEPTH (ft.)
NS	NOT SAMPLED.
ND	NOT DETECTED.
—10—	BTEX ISOCONCENTRATION CONTOUR, ug/L.

NOTES:

BTEX ISOCONCENTRATION LINES BASED ON CONCENTRATION FROM SHALLOW SAMPLES.

0 50'
SCALE

FIGURE 5-43

TOTAL BTEX DETECTED IN SHALLOW
GROUNDWATER SCREENING SAMPLES
IRP SITE 10
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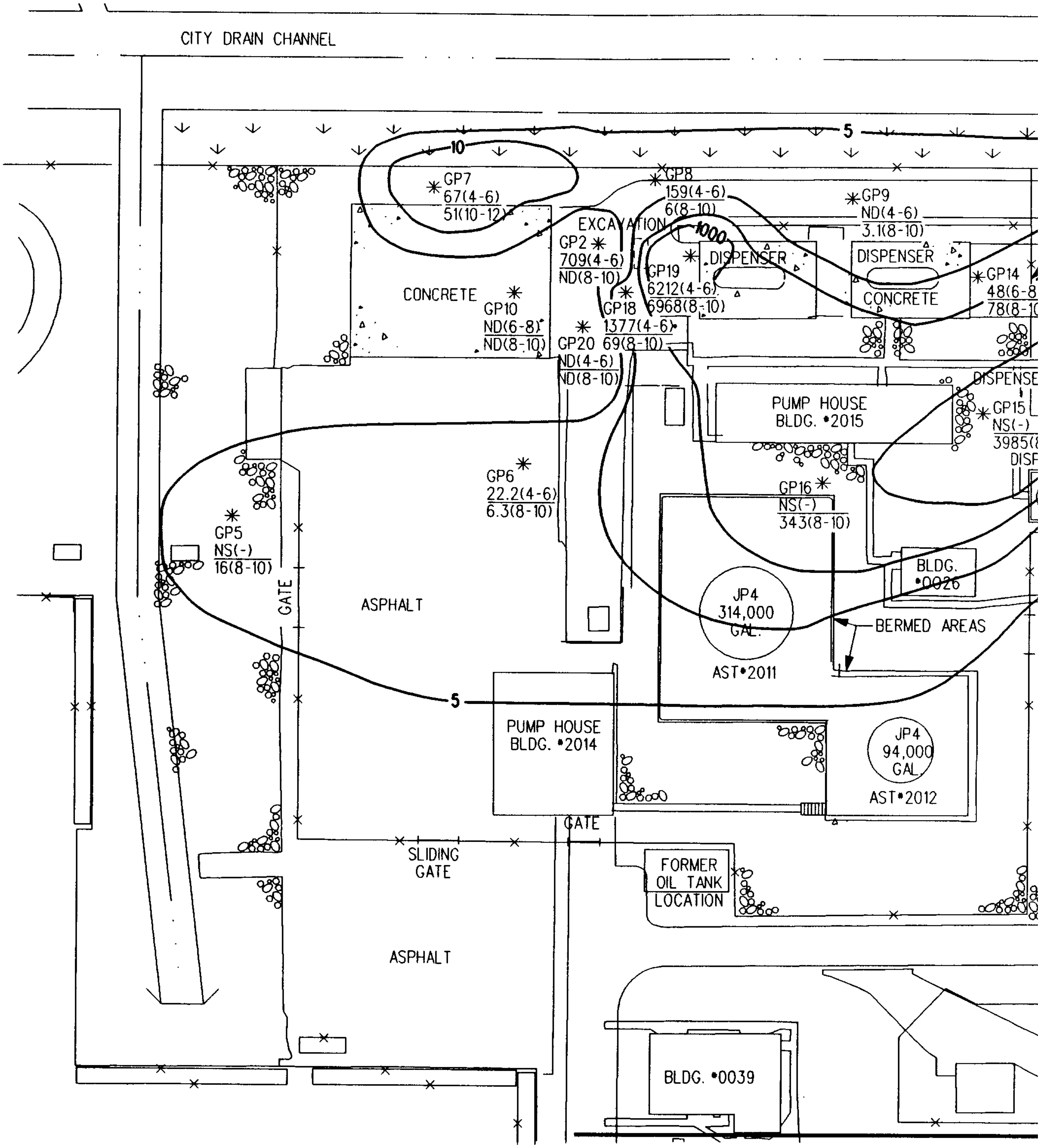

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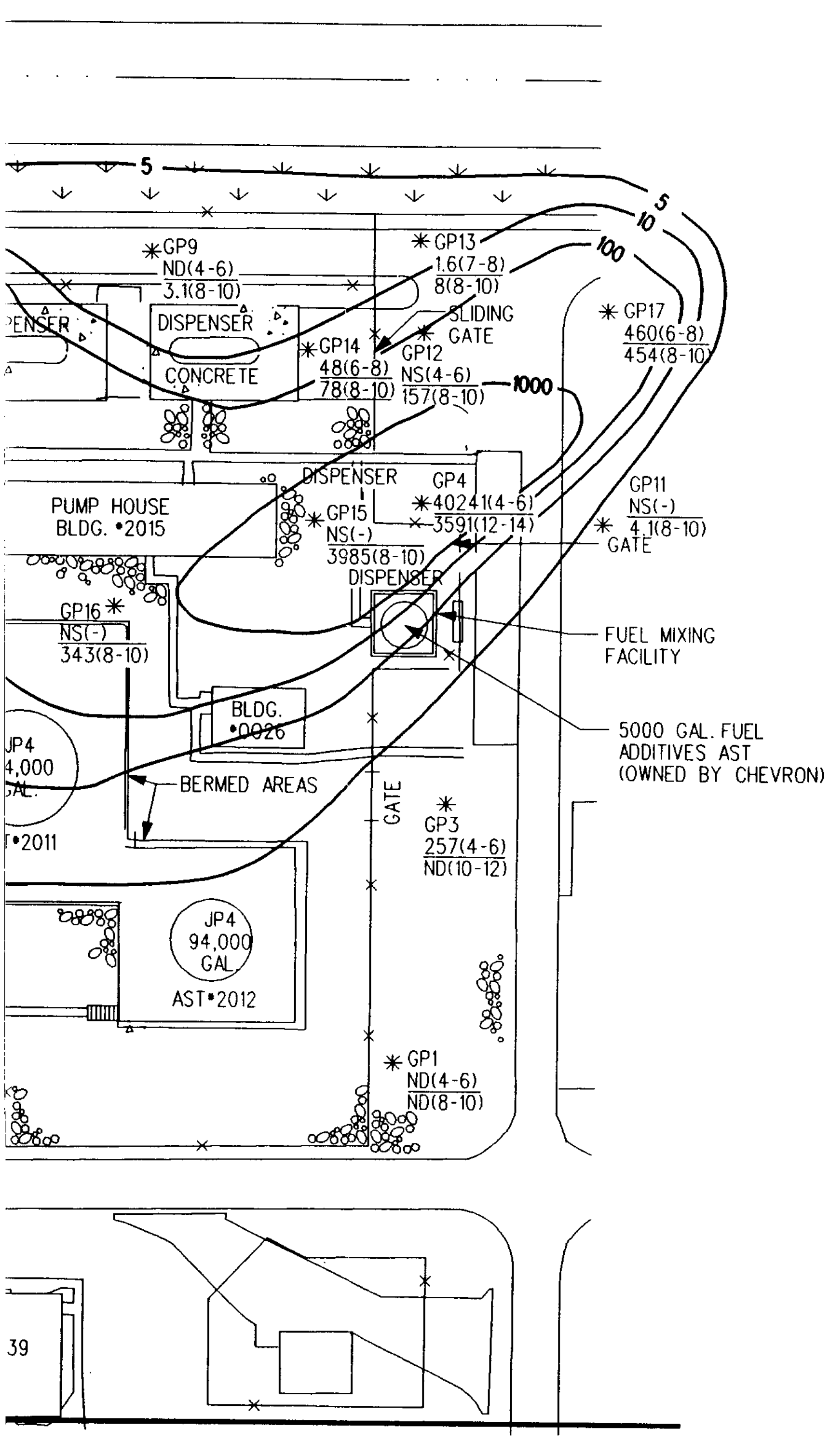

LEGEND:

✱	GROUNDWATER SCREENING SAMPLING POINTS SWEC (JUNE 1995)
↓	GRASS
○○	GRAVEL
—×—	FENCE
BTEX	BENZENE, TOLUENE, ETH
22.2(4-6)	SHALLOW BETX CONCENT DEPTH (ft.)
6.3(8-10)	DEEP BETX CONCENTRATI DEPTH (ft.)
NS	NOT SAMPLED.
ND	NOT DETECTED.
—10—	BTEX ISOCONCENTRATI CONTOUR, ug/L.

NOTES:

BTEX ISOCONCENTRATION LINES BAS
CONCENTRATION FROM SHALLOW S

0 5
SCALE

FIGURE 5

TOTAL BTEX DETECTE
GROUNDWATER SCREENI
IRP SITE 1
151st ARW, UTAH AIR NATION
SALT LAKE CITY INTERNATION
SALT LAKE CITY, UT
STONE & WEBSTER ENGINEERING C
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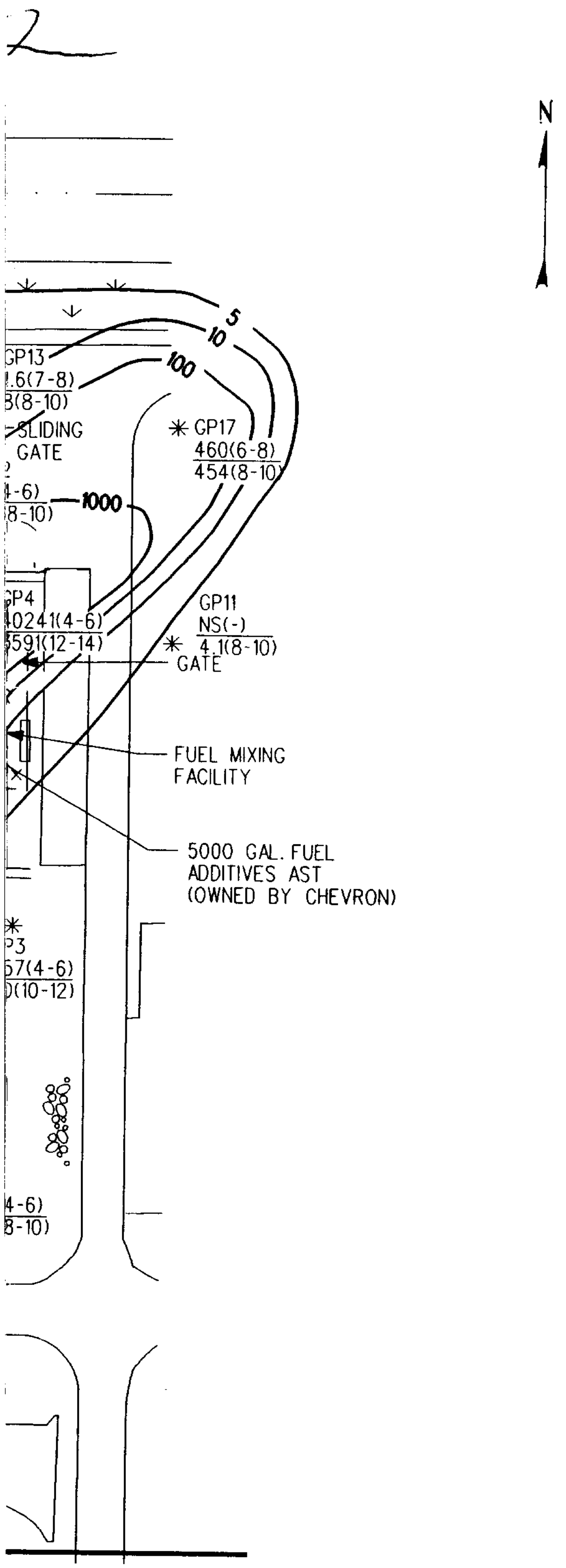

LEGEND:

✳	GROUNDWATER SCREENING SAMPLING POINTS SWEC (JUNE 1995)
↓	GRASS
⁂	GRAVEL
—×—	FENCE
BTEX	BENZENE, TOLUENE, ETHYLBENZENE
22.2(4-6)	SHALLOW BETX CONCENTRATION (ug/L) AND DEPTH (ft.)
6.3(8-10)	DEEP BETX CONCENTRATION (ug/L) AND DEPTH (ft.)
NS	NOT SAMPLED.
ND	NOT DETECTED.
—10—	BTEX ISOCONCENTRATION CONTOUR, ug/L.

NOTES:

BTEX ISOCONCENTRATION LINES BASED ON CONCENTRATION FROM SHALLOW SAMPLES.

0 50'
SCALE

FIGURE 5-44

TOTAL BTEX DETECTED IN DEEP GROUNDWATER SCREENING SAMPLES IRP SITE 10

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			1	ORIGINAL ISSUE			

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Table 5-17
Volatile Organic Compounds Detected in Groundwater Screening Samples
IRP Site 10
151st ARW, Utah Air National Guard
Salt Lake City, Utah

SAMPLE NUMBER: COLLECTION DATE:		UANG-S10-GP2-GW1 6/08/95	UANG-S10-GP3-GW1 6/08/95	UANG-S10-GP4-GW1 6/08/95	UANG-S10-GP4-GW2 6/08/95	UANG-S10-GP5-GW1 6/08/95	UANG-S10-GP5-GW1 DUP	UANG-S10-GP6-GW1 6/08/95	UANG-S10-GP6-GW2 6/08/95	UANG-S10-GP7-GW1 6/08/95	UANG-S10-GP7-GW2 6/08/95
1,1 Dichloroethane	(ug/L)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	0.9
cis-1,2 Dichloroethene	(ug/L)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	1.4
1,1,1 Trichloroethane	(ug/L)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	1.2
Trichloroethene	(ug/L)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	0.5
Benzene	(ug/L)	53.2	111.5	10043.0	3413.6	4.6	2.1	5.9	1.4	19.5	13.2
Toluene	(ug/L)	16.8	31.9	3504.5	36.0	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)
Ethylbenzene	(ug/L)	600.1	18.1	3826.2	46.4	1.6	1.5	1.9	1.4	5.4	4.5
Total Xylenes	(ug/L)	39.2	95.4	22867.0	95.1	9.6	4.5	14.4	3.5	41.8	32.9

SAMPLE NUMBER: COLLECTION DATE:		UANG-S10-GP7-GW2 DUP	UANG-S10-GP8-GW1 6/08/95	UANG-S10-GP8-GW2 6/08/95	UANG-S10-GP9-GW2 6/08/95	UANG-S10-GP11-GW1 6/09/95	UANG-S10-GP12-GW2 6/09/95	UANG-S10-GP13-GW1 6/09/95	UANG-S10-GP13-GW2 6/09/95	UANG-S10-GP14-GW1 6/09/95	UANG-S10-GP14-GW2 6/09/95
1,1 Dichloroethane	(ug/L)	0.8	ND (0.50)	0.8	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)
cis-1,2 Dichloroethene	(ug/L)	1.3	ND (0.50)	0.6	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	0.8	ND (0.50)	ND (0.50)
1,1,1 Trichloroethane	(ug/L)	0.8	ND (0.50)	0.7	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	0.9	ND (0.50)	ND (0.50)
Trichloroethene	(ug/L)	ND (0.50)	ND (0.50)	0.6	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	0.5	0.5	ND (0.50)
Benzene	(ug/L)	8.9	ND (0.50)	ND (0.50)	ND (0.50)	1.2	145.1	1.6	5.2	ND (0.50)	6.9
Toluene	(ug/L)	ND (0.50)	12.0	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	33.9	40.2
Ethylbenzene	(ug/L)	3.4	57.0	2.4	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	9.8
Total Xylenes	(ug/L)	24.4	89.7	3.4	3.1	2.9	12.2	ND (0.50)	2.8	14.5	20.7

Shaded areas indicate concentrations that exceed established ARAR values

DUP = duplicate sample

ND = Not detected above the method detection limit shown in parentheses

Analyses performed in TEG's CA DHS certified mobile lab (#1671)

Soil samples analyzed for VOCs by EPA methods 8010/8020

Table 5-17
Volatile Organic Compounds Detected in Groundwater Screening Samples
IRP Site 10
151st ARW, Utah Air National Guard
Salt Lake City, Utah

SAMPLE NUMBER: COLLECTION DATE:		UANG-S10-GP14-GW2 DUP	UANG-S10-GP15-GW1 6/09/95	UANG-S10-GP16-GW1 6/09/95	UANG-S10-GP17-GW1 6/09/95	UANG-S10-GP17-GW2 6/09/95	UANG-S10-GP18-GW1 6/09/95	UANG-S10-GP18-GW2 6/09/95	UANG-S10-GP19-GW1 6/09/95	UANG-S10-GP19-GW2 6/09/95
cis-1,2 Dichloroethene	(ug/L)	ND (0.50)	3.9	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)
1,1,1 Trichloroethane	(ug/L)	ND (0.50)	0.6	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)
Trichloroethene	(ug/L)	ND (0.50)	0.8	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)
Benzene	(ug/L)	6.6	3595.8	258.1	422.5	416.3	542.9	45.4	ND (0.50)	6968.1
Toluene	(ug/L)	32.5	35.8	5.3	ND (0.50)	ND (0.50)	422.6	5.4	1428.7	ND (0.50)
Ethylbenzene	(ug/L)	6.8	84.5	23.1	ND (0.50)	ND (0.50)	146.9	ND (0.50)	1641.7	ND (0.50)
Total Xylenes	(ug/L)	18.5	268.9	56.9	37.3	37.7	264.3	18.0	3141.2	ND (0.50)

Shaded areas indicate concentrations that exceed established ARAR values
DUP = duplicate sample
ND = Not detected above the method detection limit shown in parentheses
Analyses performed in TEG's CA DHS certified mobile lab (#1671)
Soil samples analyzed for VOCs by EPA methods 8010/8020

in areas of highest contamination as determined by the screening results. Soil samples were submitted to ChemTech for analysis. Soil samples were analyzed for VOCs, SVOCs, TPH, and PPMs. Soil boring locations and sampling results are shown on Figure 5-45.

Additionally, two soil samples, S10-SB9-2-4 and S10-SB9-4-6, were analyzed for PCBs and pesticides. Soil samples submitted for PCB and pesticide analysis were collected from depth intervals of 2 to 4 and 4 to 6 feet, respectively. The depth of sample collection was determined based on the depths reported in the exposure incident report, and on the depth to groundwater measured prior to sample collection. The number of soil samples submitted for PCB and pesticide analysis was reduced from all soil samples to two after the unidentified contaminant of concern at Site 10 was identified as hydrogen sulfide, not a PCB or pesticide. A field change request form documenting this change is included in Appendix D.

A total of 25 investigative and three duplicate samples were collected from the 8 soil borings drilled at IRP Site 10. The number of soil samples collected from soil borings advanced at Site 10 was reduced from 30 to 25, since the number of soil borings were reduced from 10 to 8.

5.4.4.1 VOC Analytical Results

Methylene chloride was detected in the soil sample collected from S10-SB9 at a concentration of 11.4 μg/kg. This sample was collected from a depth of 0 to 2 feet BGS.

A summary of VOCs detected in soil samples collected from Site 10 is provided in Table 5-18.

5.4.4.2 SVOC Analytical Results

Bis(2-ethylhexyl)phthalate was detected in the soil sample collected from S10-SB5 at a depth of 0 to 2 feet BGS at a concentration of 570 μg/kg.

Di-n-butyl phthalate was detected in four of the soil borings at concentrations ranging from 380 to 1,890 μg/kg. The highest concentration of di-n-butyl phthalate was detected in the soil sample collected from S10-SB5 from a depth of 0 to 2 feet BGS.

2-Methylnaphthalene was detected at a concentration of 640 μg/kg in the soil sample collected from SB6 at a depth of 4 to 6 feet BGS.

Naphthalene was detected at a concentration of 350 μg/kg in the soil sample collected from the 4- to 6-foot interval of S10-SB11.

Pyrene was detected in the soil sample collected from the 2- to 4-foot interval in soil boring S10-SB12 at a concentration of 410 μg/kg. SVOC analytical results are summarized in Table 5-19.

5.4.4.3 BTEX Analytical Results

Benzene was detected in soil samples collected from soil borings S10-SB6, S10-SB7, S10-SB9, and S10-SB11 at concentrations ranging from 3.3 to 3,050 μg/kg. The highest concentration of

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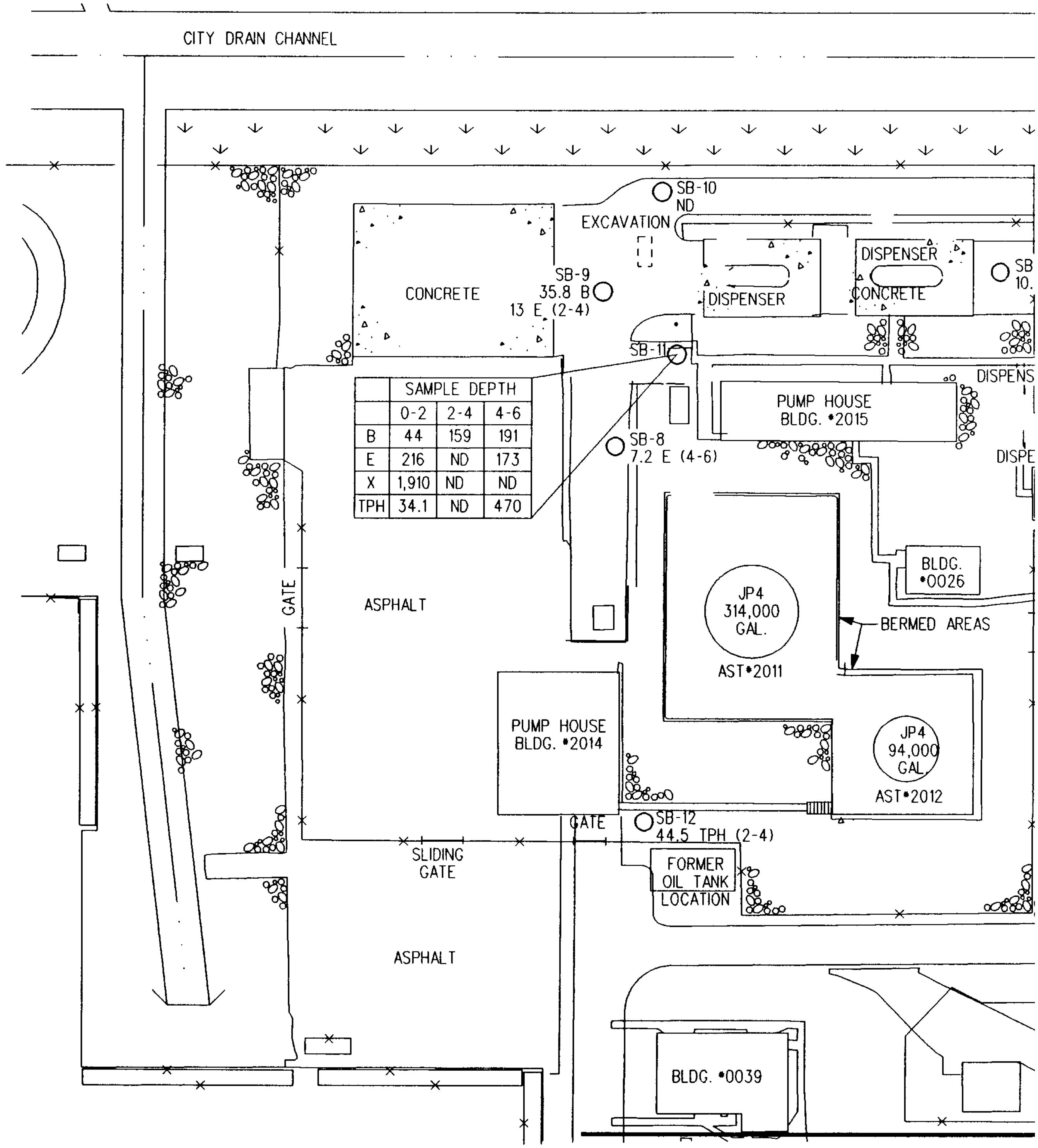

	SAMPLE DEPTH		
	0-2	2-4	4-6
B	44	159	191
E	216	ND	173
X	1,910	ND	ND
TPH	34.1	ND	470

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DATE: 26-JUNE-96 11:32

ISSUE	DESCRIPTION	CHKD	CORRECT	APPR DATE	ISSUE	DESCRIPTION	CHKD	CORRECT	APPR DATE	ISSUE	DESCRIPTION
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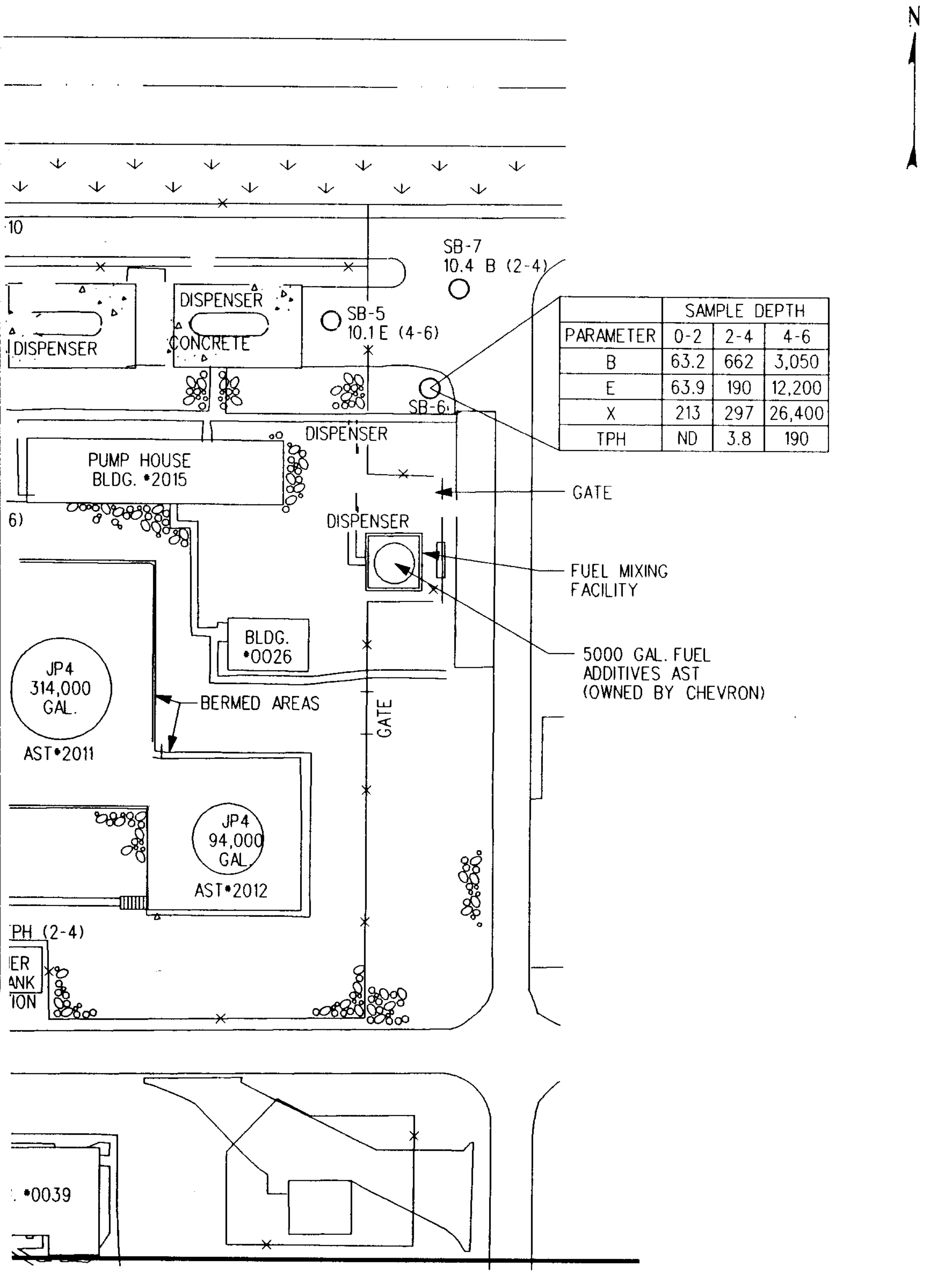
PC ARCH CIVIL CONC STL L&P INST MD P.S. S.A. FAC ELEC LTG MATL PC ARCH CIVIL CONC STL L&P INST MD P.S. S.A. FAC ELEC LTG MATL PC ARCH CIVIL CONC STL

2



	SAMPLE DEPTH		
PARAMETER	0-2	2-4	4-6
B	63.2	662	3,050
E	63.9	190	12,200
X	213	297	26,400
TPH	ND	3.8	190

LEGEND:

○ SOIL BORING
↓ GRASS
GRAVEL
—×— FENCE

TPH	TOTAL PETR
BTEX	BENZENE, TO XYLENE.
	TOTAL BTEX
NS	NOT SAMPLE
ND	NOT DETECT
(2-4)	SAMPLE DEP

0
SCAL

FIGURE

SOIL BORING LO
VOC ANALYTICA
IRP SIT
151st ARW, UTAH AIR N
SALT LAKE CITY INTERN
SALT LAKE CIT
STONE & WEBSTER ENGINEE
BOSTON, MASS

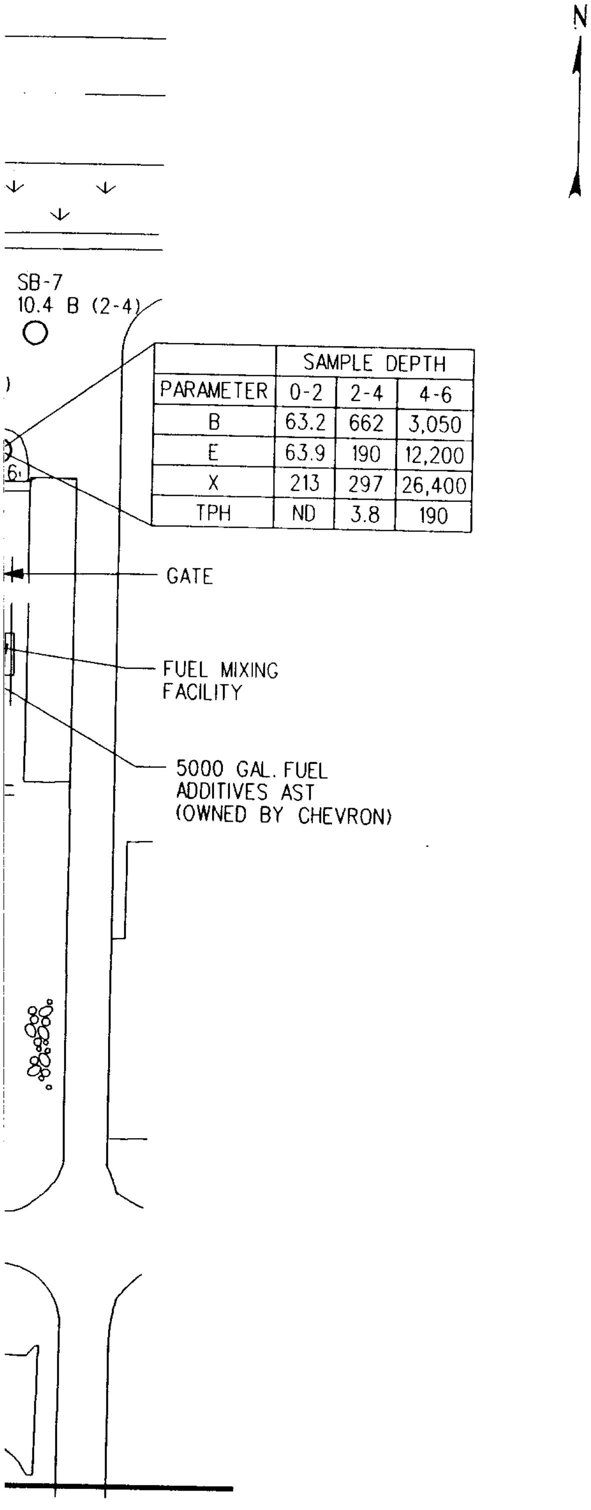
DRAWING NUMBER 05219.C

DESIGNED BY:
DRAWN BY: G.C. CART
DSGN CHK'D BY:
CHK'D BY:

ISSUE	DESCRIPTION	CHKD	CORRECT	APPR DATE
2				
1	ORIGINAL ISSUE			

KD S. S.A. FAC ELEC LTG MATL PC ARCH CIVIL CONC STL L&P INST MD P.S. S.A. FAC ELEC LTG MATL PC ARCH CIVIL CONC STL L&P INST MD P.S. S.A. FAC ELEC LTG MATL

3



PARAMETER	SAMPLE DEPTH 0-2	2-4	4-6
B	63.2	662	3,050
E	63.9	190	12,200
X	213	297	26,400
TPH	ND	3.8	190

LEGEND:

○ SOIL BORING
↓ GRASS
∞ GRAVEL
—×— FENCE

TPH	TOTAL PETROLEUM HYDROCARBONS.
BTEX	BENZENE, TOLUENE, ETHYLBENZENE XYLENE.
	TOTAL BTEX IN SOIL SAMPLES, ug/Kg.
NS	NOT SAMPLED.
ND	NOT DETECTED.
(2-4)	SAMPLE DEPTH.

0 50'
SCALE

FIGURE 5-45

SOIL BORING LOCATIONS AND VOC ANALYTICAL RESULTS IRP SITE 10

151st ARW, UTAH AIR NATIONAL GUARD
SALT LAKE CITY INTERNATIONAL AIRPORT
SALT LAKE CITY, UTAH
STONE & WEBSTER ENGINEERING CORPORATION
BOSTON, MASS.

DRAWING NUMBER 05219.002

DESIGNED BY:
DSGN CHK'D BY:
DRAWN BY: G.C. CARTER
CHK'D BY:
AREAS LEVELS WORK PKG PCT
RESP ENGR: K. MARONEY
SUPV: R.J. BOUDREAU
HALF-SIZE APP. CARD ISSUE

ISSUE	DESCRIPTION
1	ORIGINAL ISSUE

CHKD CORRECT APPR DATE ISSUE DESCRIPTION CHKD CORRECT APPR DATE
P.S. S.A. FAC ELEC LTG MATL PC ARCH CIVIL CONC STL L&P INST MD P.S. S.A. FAC ELEC LTG MATL

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Table 5-18
Volatile Organic Compounds and TPH Detected in Soil Samples
IRP Site No. 10
151st ARW, Utah Air National Guard
Salt Lake City, Utah

PARAMETER	SB-5	SB-6	SB-6	SB-6	SB-7	SB-8	SB-9	SB-9
depth	4-6 ft	0-2 ft	2-4 ft	4-6 ft	2-4 ft	4-6 ft	0-2 ft	2-4 ft
Volatile organic compounds (ug/Kg)								
Benzene	ND (5.0)	63.2	662	3,050	10.4	ND (5.0)	ND (5.0)	35.8
Methylene chloride	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	11.4	ND (5.0)
Ethylbenzene	10.1	63.9	190	12,200	ND (5.0)	7.2	ND (5.0)	13
Xylenes	ND (5.0)	213	297	26,400	ND (5.0)	ND (5.0)	ND (5.0)	41.2 J
TPH (mg/Kg)	ND (1.0)	ND (1.0)	3.8	190	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)

PARAMETER	SB-9 (DUP	SB-9	SB-11	SB-11	B-11 (DUP	SB-11	SB-12
depth	2-4 ft	4-6 ft	0-2 ft	2-4 ft	2-4 ft	4-6 ft	2-4 ft
Volatile organic compounds (ug/Kg)							
Benzene	25.8	3.3	44	159	164	191	ND (5.0)
Methylene chloride	9.6	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)
Ethylbenzene	ND (5.0)	ND (5.0)	216	55 J	7.4	173	ND (5.0)
Xylenes	13.8	ND (5.0)	1,910	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)
TPH (mg/Kg)	ND (1.0)	ND (1.0)	34.1	ND (1.0)	NA	470	44.5

Shaded areas indicate concentrations above established ARAR values
DUP = duplicate
ND = Not detected above the method detection limit shown in parentheses
Soil samples analyzed for VOCs by EPA Method 8010/8020
J - Qualified, estimated value
NA = not analyzed

Table 5-19
Semi-Volatile Organic Compounds Detected in Soil Samples
IRP Site No. 10,
151st ARW, Utah Air National Guard
Salt Lake City, Utah

PARAMETER	SB-5	SB-5	SB-6	SB-6	SB-7	SB-7	SB-11	SB-11	SB-12
depth	0-2 ft	2-4 ft	2-4 ft	4-6 ft	0-2 ft	2-4 ft	0-2 ft	4-6 ft	2-4 ft
Semi-volatile organic compounds (ug/Kg)									
bis(2-Ethylhexyl)phthalate	570	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)
Di-n-Butyl phthalate	1,890	380	460	ND (330)	460	560	510	ND (330)	ND (330)
2-Methylnaphthalene	ND (330)	ND (330)	ND (330)	640	ND (330)	ND (330)	ND (330)	1,050	ND (330)
Naphthalene	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	350	ND (330)
Pyrene	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	410

Shaded areas indicate concentrations above established ARAR values
DUP = duplicate sample
ug/kg = micrograms per kilogram
ND = Not detected above the method detection limit shown in parentheses
Samples analyzed for SVOCs by EPA Method SW8270

benzene was detected in the soil sample collected from S10-SB6, located adjacent to the northern side of the fuel mixing facility, at a depth of 4 to 6 feet BGS.

Ethylbenzene was detected in soil samples collected from six of the soil borings at concentrations ranging from 7.2 to 12,200 μg/kg. The highest concentration of benzene was detected in the soil sample collected from S10-SB6 at a depth of 4 to 6 feet BGS.

Xylenes were detected in soil samples collected from three of the soil borings at concentrations ranging from 41.2 to 26,400 μg/kg. The highest concentration of benzene was detected in the soil sample collected from S10-SB6 at a depth of 4 to 6 feet BGS.

A summary of BTEX compounds detected in soil samples collected from Site 10 is provided in Table 5-18.

5.4.4.4 TPH Analytical Results

TPH was detected in soil samples collected from S10-SB6 at the interval depths of 2 to 4 and 4 to 6 feet BGS at concentrations of 3.8 and 190 mg/kg, respectively. Additionally, TPH was detected in S10-SB11 at 0 to 2 and 4 to 6 feet BGS at concentrations of 34.1 and 470 mg/kg, respectively. TPH was also detected in the soil sample collected from 2 to 4 feet BGS in S10-SB12 at a concentration of 44.5 mg/kg. TPH was not detected in the other soil samples collected at the site above the method detection limit of 1.0 μg/kg. TPH analysis results are summarized in Table 5-18.

5.4.4.5 PCB/Pesticide Analytical Results

PCBs and pesticides were not detected in the soil samples submitted for these analyses above the method detection limits.

5.4.4.6 PPM Analytical Results

Several metals were detected in the soil samples collected from Site 10, including mercury, cadmium, chromium, copper, nickel, zinc, arsenic, lead, and selenium. Metals detected and the ranges of concentrations are shown in Table 5-20. Results of all metals analysis are summarized in Table 5-21. Laboratory data analysis sheets are included in Appendix F.

5.4.5 Groundwater Investigation Findings

Five groundwater monitoring wells, designated MW-1 through MW-5, and one free product well, designated FP-1, were installed at Site 10 from June 15 to 19, 1995. Only one of the three planned floating product wells was installed at Site 10 as a sheen of floating product was observed in only one area during screening activities. The floating product well was installed in the vicinity of the 5,000-gallon fuel additives AST (owned by Chevron) where a sheen of floating product and elevated concentrations of BTEX compounds (40,241 ug/L total BTEX in GP4) were detected in groundwater screening samples and the highest concentrations of benzene, ethylbenzene, xylenes, and TPH (3,050, 12,200, 26,400, and 190,000 ug/kg) were detected in soil samples during the investigation. Samples of water were collected from the well and

Table 5-20
Concentration Range of Metals Detected in Soil Samples
IRP Site 10
151st ARW, Air National Guard, Salt Lake City, Utah

Metal	Concentrations Detected (mg/kg)	Concentrations Detected in Background Soil Samples - Utah ANG Base (mg/kg)	Concentration Ranges of Elements in Soil Samples in Western U.S. (mg/kg)*
Mercury	**0.048 - 0.98**	0.033-0.067	0.01 - 4.6
Cadmium	**0.51 - 1.9**	0.22-0.36	NA
Chromium	5 - 18	9.5-14	3 - 2,000
Copper	**6.4 - 55**	8.2-28.1	2 - 300
Nickel	**3.5 - 15.6**	6-9.5	<5 - 700
Zinc	**24 - 1,200**	25.2-52	10 - 2,100
Arsenic	2.4 - 12	3.7-12.5	<0.10 - 97
Lead	**6.1 - 190**	9.8-22.6	<10 - 700
Selenium	0.54 - 0.84	0.46	<0.01 - 4.3

NA = Not applicable
* Taken from USGS, 1984.
Bolded concentrations exceed background values by more than 10 percent.

checked for the presence of free product on the day of, and approximately one week after installation. No evidence of free product was observed on the water samples. No additional sampling or testing was performed on this well. Five of the six planned monitoring wells were installed at Site 10. The five wells were located to sufficiently monitor the upgradient and downgradient areas of the Site. Monitoring well locations are shown on Figure 5-46.

Two rounds of groundwater samples were collected from the newly installed wells. The first round was conducted from June 26 to 27, 1995. The second round was conducted from July 31 to August 1, 1995.

5.4.5.1 Water Sampling Parameters

Temperature, pH, and specific conductance were measured during groundwater sampling. Values recorded during the first and second rounds of sampling are shown on Table 5-22.

Table 5-21
Metals Detected in Soil Samples
IRP Site No. 10
151st ARW, Utah Air National Guard
Salt Lake City, Utah

SAMPLE ID. ID.	depth (feet)	*Metals (mg/Kg)*								
		Mercury	Cadmium	Chromium	Copper	Nickel	Zinc	Arsenic	Lead	Selenium
SB-5	0-2	ND (0.05)	0.68	12	8.9	7.3	24	4.5	7.3	ND (0.50)
SB-5	2-4	0.6	1.9	18	52	13	1,200	10	190	0.84
SB-5	4-6	0.86	1.9	17	55	14	840	11	130	0.54
SB-6	0-2	0.98	1.1	10	21	9.4	43	8.8	23	0.59
SB-6	2-4	0.57	1.5	18	16	12	60	7.4	18	0.56
SB-6	4-6	0.96	1.2	13	22	11	51	9.1	18	ND (0.50)
SB-7	0-2	ND (0.05)	ND (0.50)	12	13	8.7	52	4.3	13	ND (0.50)
SB-7	2-4	0.44	1.2	12	20	9.9	51	6.9	15	ND (0.50)
SB-7	4-6	ND (0.05)	1.2	11	21	9.3	41	5.1	18	ND (0.50)
SB-8	0-2	ND (0.05)	0.92	9.4	11	7.5	32	4.1	12	ND (0.50)
SB-8	2-4	ND (0.05)	0.99	10	14	8	37	6.4	12	ND (0.50)
SB-8	4-6	ND (0.05)	0.9	9.3	23	8.3	35	15	21	ND (0.50)
SB-9	0-2	0.066	0.7	7.8	8.2	7.2	35	5.2	7.4	ND (0.50)
SB-9	2-4	ND (0.05)	ND (0.50)	5	6.4	3.5	16	0.93*	6.1	ND (0.50)
SB-9	4-6	0.048	1.4	12	26	11	53	7.3	19	ND (0.50)
SB-9 (DUP)	4-6	ND (0.05)	1.8	17	29	15	73	8.8	22	ND (0.50)
SB-10	0-2	ND (0.05)	0.72	7.9	7.6	7.3	33	7.8	21	ND (0.50)
SB-10	2-4	0.14 J	ND (0.50)	6.5 J	13	5.4	24	7.1 J	19 J	ND (0.50)
SB-10 (DUP)	2-4	0.063	1.1	12	21	7.8	36	13	31	ND (0.50)
SB-10	4-6	ND (0.05)	0.77	9.6	14	7.4	36	2.4	11	0.61
SB-10	6-8	ND (0.05)	1.6	14	38	14	72	5.9	23	ND (0.50)
SB-11	0-2	0.22	1.1	8.6	20	8.2	51	12	22	ND (0.50)
SB-11	2-4	0.1	0.99	16	19	11	42	12	27	ND (0.50)
SB-11	4-6	ND (0.05)	1.2	12	19	9.9	51	11	17	ND (0.50)
SB-12	0-2	0.1	0.75	9.9	16.9	9.1	42.6	9.9	14.2	ND (0.50)
SB-12	2-4	ND (0.05)	0.51	13.3	13.9	8.7	42.4	10.6	18	ND (0.50)
SB-12	4-6	ND (0.05)	1.12	15.7	34.2	15.6	75.6	5.6	22.5	ND (0.50)

mg/kg = milligrams per kilogram
ND = not detected above method detection limit shown in parentheses
* - Quantity estimated by analytical laboratory
J - Qualified, estimated value

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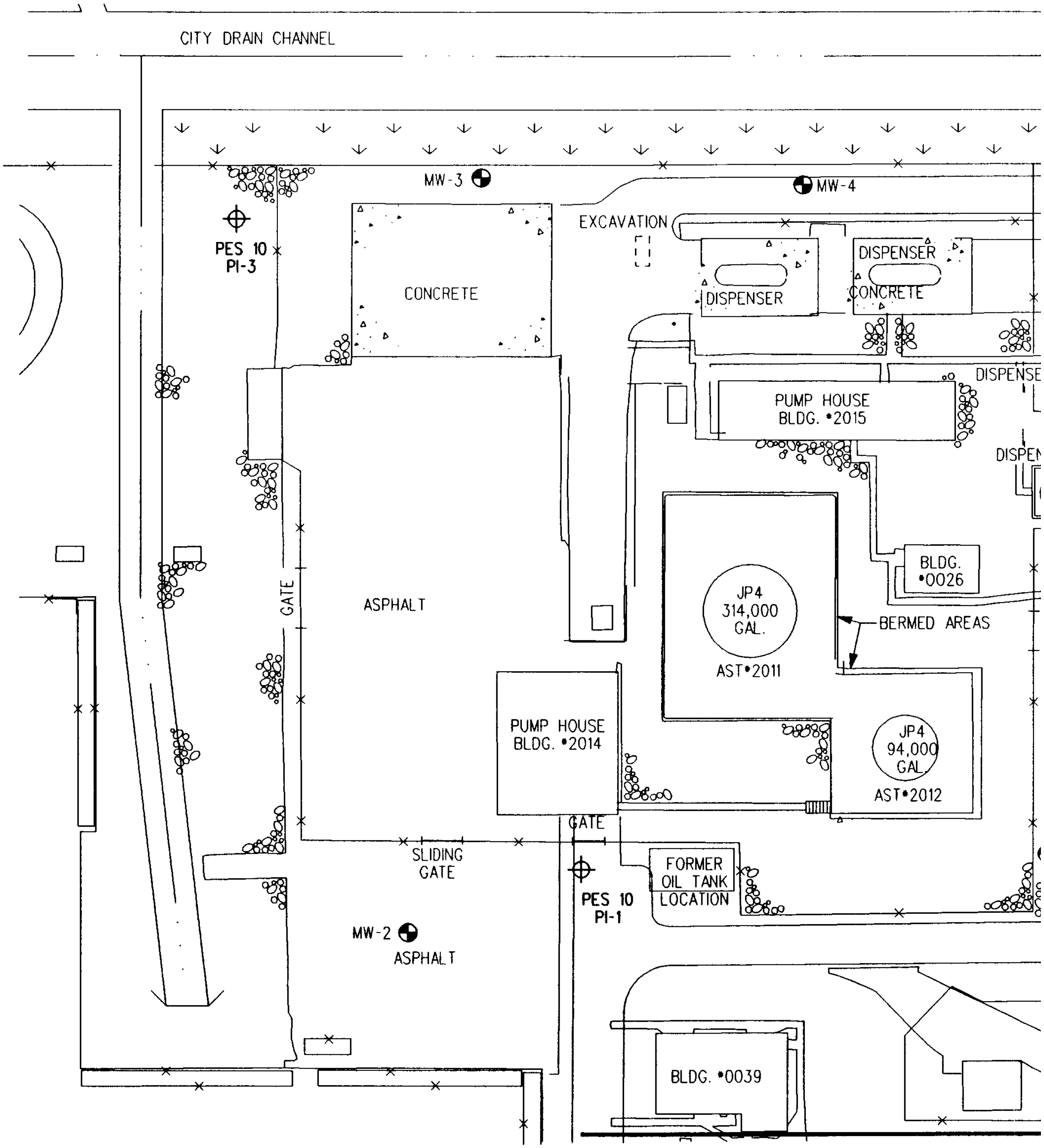
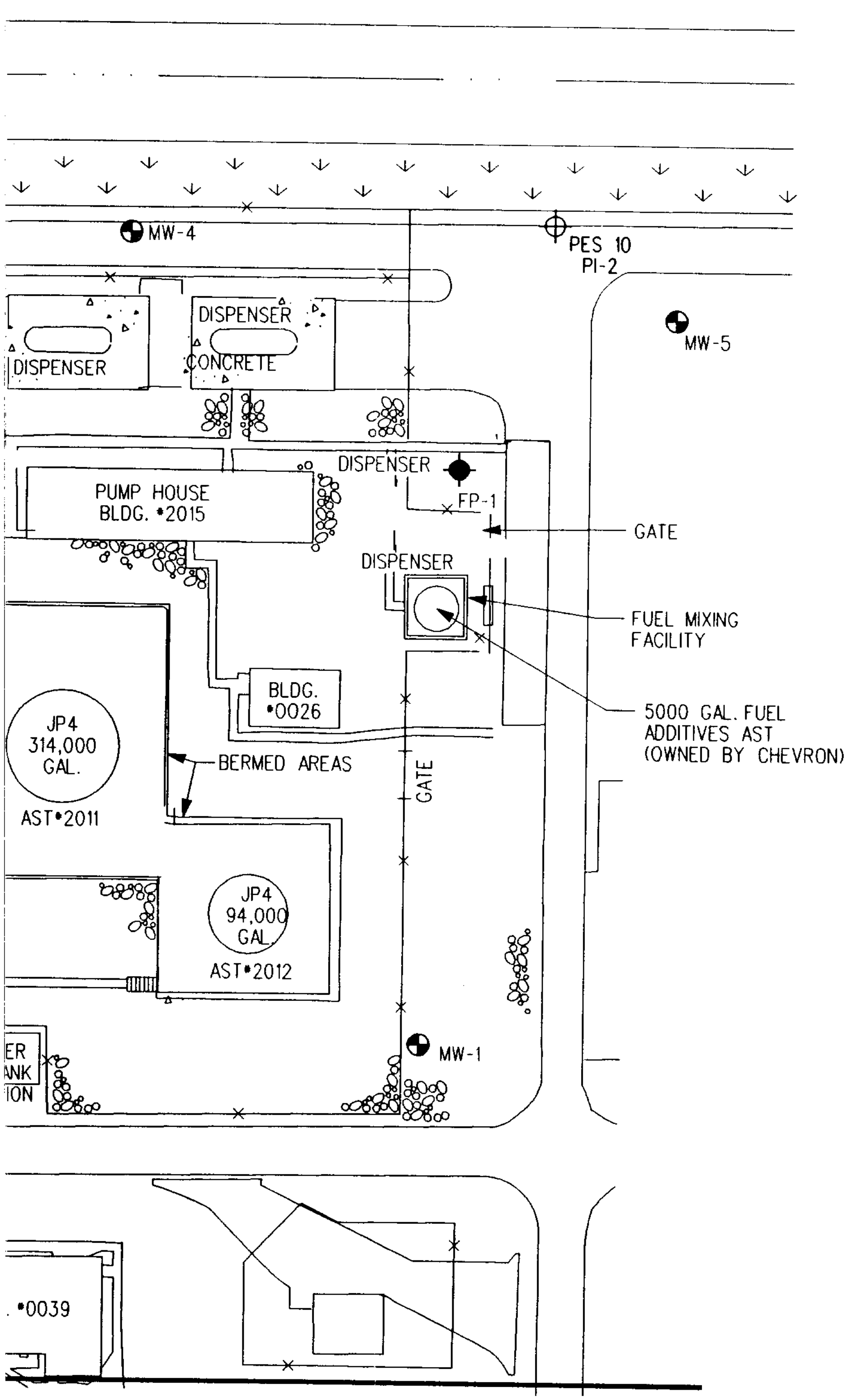


4						3						2	
ISSUE	DESCRIPTION	CHKD	CORRECT	APPR DATE		ISSUE	DESCRIPTION	CHKD	CORRECT	APPR DATE		ISSUE	DESCRIPTION

PC ARCH CIVIL CONC STL L&P INST MD P.S. S.A. FAC ELEC LTG MATL PC ARCH CIVIL CONC STL L&P INST MD P.S. S.A. FAC ELEC LTG MATL PC ARCH CIVIL CONC STL L&P

FILE: c:*dgn*wang*fig5-46.dgn (am 005.0113)
DATE: 26-JUNE-96 11:36

2



LEGEND:

⊕ PIEZOMETER

◑ MONITORING W

◆ FREE PRODUC
MONITORING W

↓ GRASS

GRAVEL

—×— FENCE

0

SCALE

FIGURE

MONITORING WELL
IRP SITE

151st ARW, UTAH AIR NA
SALT LAKE CITY INTERNA
SALT LAKE CITY

STONE & WEBSTER ENGINEERI
BOSTON, MASS.

DRAWING NUMBER 05219.0

			2					1	ORIGINAL ISSUE
KD	CORRECT	APPR DATE	ISSUE	DESCRIPTION	CHKD	CORRECT	APPR DATE	ISSUE	DESCRIPTION
S.A	FAC ELEC LTG	MATL	PC	ARCH CIVIL CONC STL L&P INST MD	P.S. S.A	FAC ELEC LTG	MATL	PC	ARCH CIVIL CONC STL L&P INST MD

DESIGNED BY:
DSGN CHK'D BY:
DRAWN BY: G.C. CARTER
CHK'D BY:

3

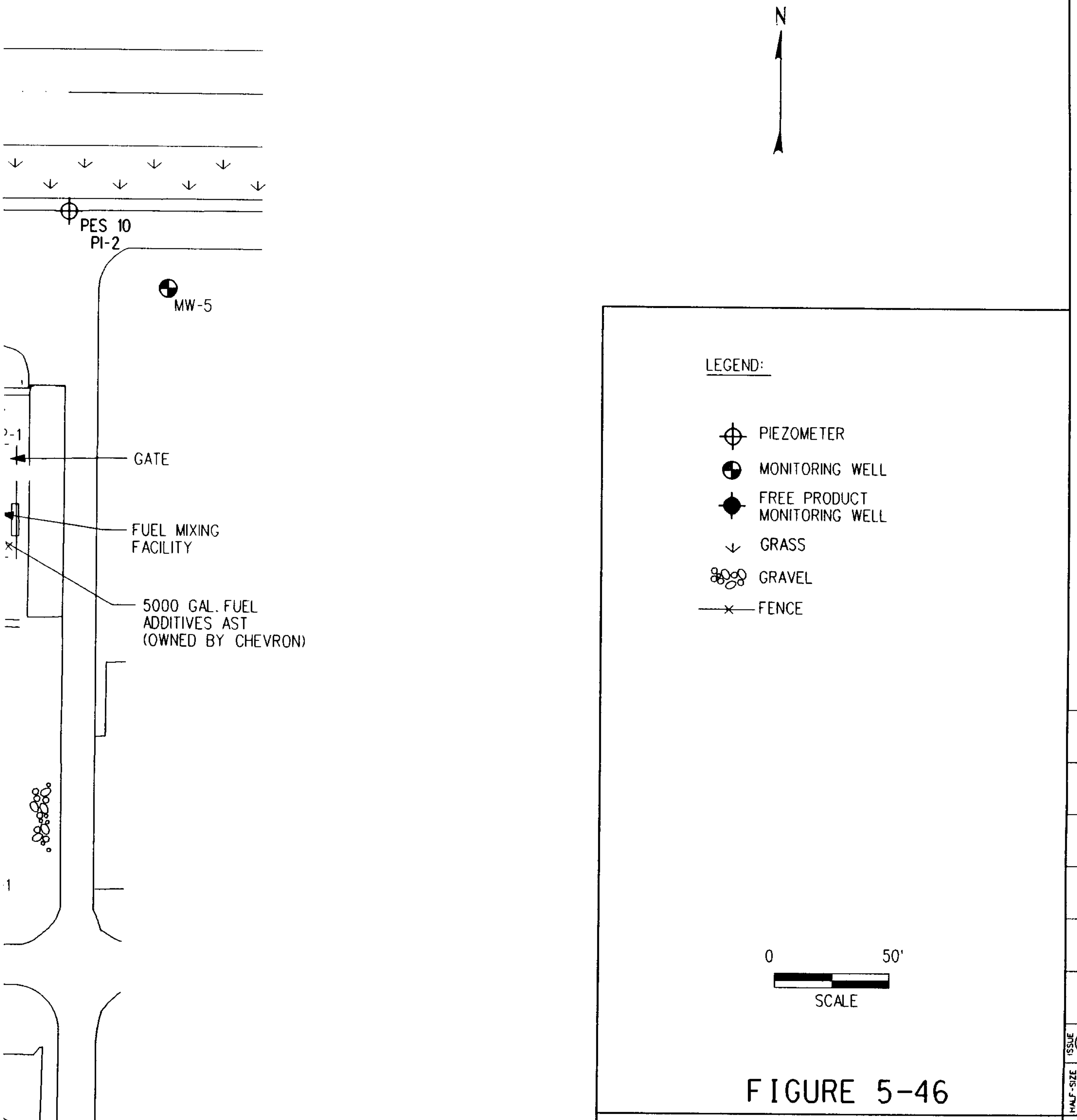


FIGURE 5-46

MONITORING WELL LOCATIONS
IRP SITE 10

151st ARW, UTAH AIR NATIONAL GUARD
SALT LAKE CITY INTERNATIONAL AIRPORT
SALT LAKE CITY, UTAH

STONE & WEBSTER ENGINEERING CORPORATION
BOSTON, MASS.

DRAWING NUMBER 05219.002

CHKD		CORRECT			APPR DATE		ISSUE	DESCRIPTION						CHKD		CORRECT			APPR DATE	
							1	ORIGINAL ISSUE												
P.S.	S.A.	FAC	ELEC	LTG	MATL		PC	ARCH	CIVIL	CONC	STL	L&P	INST	MD	P.S.	S.A.	FAC	ELEC	LTG	MATL

DESIGNED BY:
DSGN CHK'D BY:
DRAWN BY: G.C. CARTER
CHK'D BY:

AREAS	LEVELS	WORK PKG	PCT

ISSUE
HALF-SIZE
APP. CARD
RESP ENGR: K. MARONEY
SUPV: R. J. BOUDREAU

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Table 5-22
Temperature, pH, and Specific Conductance Measurements
Groundwater Sampling, IRP Site 10
151st ARW, Air National Guard, Salt Lake City, Utah

Monitoring Well	Round	Date	Temperature(°F)	pH	Specific Conductance (μmhos)
MW1	1	6/27/95	61.3	8.45	7,290
	2	7/31/95	59.8	7.72	787
MW2	1	6/27/95	62.5	7.51	1,720
	2	7/31/95	63.3	7.50	1,637
MW3	1	6/27/95	61.2	7.73	3,270
	2	8/01/95	56.9	7.79	3,500
MW4	1	6/27/95	60.1	7.67	3,820
	2	8/01/95	58.3	7.60	3,830
MW5	1	6/27/95	61.4	7.76	2,560
	2	8/01/95	61.2	7.82	3,190

Temperature ranged from 56.9 to 62.5°F. The pH varied from 7.50 to 8.45. Specific conductance ranged from 787 to 7,290 μmhos.

5.4.5.2 VOC Analytical Results

1,1-DCA was detected in groundwater samples collected from monitoring wells MW3 and MW5 at estimated concentrations of 0.6 and 0.5 μg/l, respectively, during the first round of groundwater sampling. 1,1-DCA was not detected in groundwater samples collected during the second round of groundwater sampling at Site 10.

Trichlorofluoromethane was detected in groundwater samples collected from monitoring wells MW4 and MW5 at concentrations of 5.1 and 2.7 μg/l, respectively, during the first round of groundwater sampling, and at concentrations of 3.2 and 2.3 μg/l during the second round of groundwater sampling. VOCs were not detected in groundwater samples collected from the other wells during either round of groundwater sampling at concentrations above the method detection limit of 1.0 μg/l.

5.4.5.3 SVOC Analytical Results

SVOCs were not detected in the groundwater samples collected during the first round of groundwater sampling at concentrations above the method detection limits, which ranged from 10 to 50 μg/kg.

Bis(2-ethylhexyl)phthalate was detected in the groundwater sample collected from monitoring well MW5 at a concentration of 18 μg/l during the second round of sampling. No other SVOCs were detected during the second round of groundwater sampling at the site at concentrations above the method detection limits, which ranged from 10 to 50 μg/kg.

5.4.5.4 BTEX Analytical Results

BTEX compounds were detected in groundwater screening samples collected from two areas of Site 10 at concentrations above EPA maximum contaminant levels (MCLs) and Utah Groundwater Quality Standards (GWQS).

BTEX compounds were not detected in groundwater samples collected from monitoring wells installed upgradient and downgradient of Site 10. Based on the analysis of the groundwater screening samples, the areas where petroleum compounds were detected in groundwater correspond with the areas where petroleum compounds were detected in the soil.

5.4.5.5 TPH Analytical Results

TPH was not detected above the method detection limit of 1.0 mg/l in groundwater samples collected from Site 10 during either round of groundwater sampling.

5.4.5.6 PPM Analytical Results

Seven metals were detected in the groundwater samples collected from Site 10, including mercury, chromium, copper, nickel, zinc, arsenic, and lead. Mercury was detected in groundwater samples collected from MW4 and MW5 at concentrations of 0.00026 and 0.00022 mg/l, respectively, during the first round of groundwater sampling. Mercury was not detected in the groundwater samples collected during the second round of groundwater sampling above the method detection limit of 0.0002 mg/l.

Chromium was detected in groundwater samples collected from MW1 through MW5 at concentrations ranging from 0.014 to 0.088 mg/l during the second round of groundwater sampling. Chromium was not detected above the method detection limit of 0.01 mg/l during the first round of groundwater sampling.

Copper was detected in groundwater samples collected from MW2 and MW4 at concentrations of 0.011 and 0.012 mg/l during the first round of groundwater sampling. Copper was detected in groundwater samples collected from MW1 through MW5 at concentrations ranging from 0.033 to 0.229 mg/l during the second round of groundwater sampling.

Nickel was detected in the groundwater sample collected from MW5 at a concentration of 0.013 mg/l during the first round of groundwater sampling. Nickel was detected in the groundwater samples collected from MW1 through MW5 during the second round of sampling at concentrations ranging from 0.02 to 0.086 mg/l.

Zinc was detected in all of the monitoring wells sampled at Site 10 during both rounds of groundwater sampling at concentrations ranging from 0.027 to 0.451 mg/l.

Arsenic was detected in groundwater samples collected from MW1 and MW5 at concentrations of 0.076 and 0.018 mg/l during the first round of groundwater sampling. Arsenic was detected in the groundwater samples collected from MW1 through MW5 during the second round of sampling at concentrations ranging from 0.047 to 0.339 mg/l.

Lead was detected in groundwater samples collected from MW4 and MW5 at concentrations of 0.0083 and 0.014 mg/l during the first round of groundwater sampling. Lead was detected in the groundwater samples collected from MW1 through MW5 during the second round of sampling at concentrations ranging from 0.016 to 0.142 mg/l.

Results of metals analysis are summarized in Table 5-23. Laboratory data analysis sheets are included as Appendix F.

5.4.6 Discussion of Results

An ILS was conducted at IRP Site 10 to identify the source and extent of undefined materials that caused adverse symptoms experienced by site workers and to assess the extent of petroleum-contaminated soil and groundwater previously detected at the site.

Sampling locations at Site 10 were placed to define the extent of petroleum contamination at the site. Some physical structures at Site 10 limited the placement of sample locations, as it was not safe to sample near or in these structures. These physical structures included the concrete berms in which the ASTs are placed, and the above-ground piping that transports jet fuel from the ASTs to the fuel island. Samples were not collected within the concrete berms due to the concern of lessening the integrity of the berm. Samples were not collected adjacent to the above-ground jet fuel lines to reduce the possibility of damaging these lines. In these cases, samples were collected upgradient, cross-gradient, and downgradient of these structures to determine if these areas were potential source areas.

Composite figures showing contaminant concentrations for the shallow and deep groundwater samples and groundwater flow are included as Plates 3 through 6. These plates can be found in pockets at the end of this section.

The undefined contaminant was identified to be hydrogen sulfide gas. Hydrogen sulfide was first suspected to be the undefined contaminant based on a sulfur odor being detected in groundwater samples by site personnel and the history of the site being a structural basin. This suspicion was confirmed by the screening of a soil gas sample collected from the area where the exposure incident occurred. Using a Dreager tube, hydrogen sulfide was found in the soil gas sample at a concentration of 30 ppm. Hydrogen sulfide gas is a naturally occurring biodegradation product of organic matter and is suspected to be present at various locations in the subsurface at the Base where floodplain sediments are present.

The extent of petroleum-contaminated soil and groundwater delineated by the RI is described in the following sections. For comparative purposes, pertinent ARAR values are discussed in the following subsections. A detailed discussion of the results of the ARAR Analysis is presented in Section 6.0 of this report. In general, the hydrogeology at the site reveals contaminants will move very slowly and in a number of directions based on changing

Table 5-23
Metals Detected in Groundwater Samples
IRP Site No. 10
151st ARW, Utah Air National Guard
Salt Lake City, Utah

SAMPLE ID.	Round	*Metals (mg/l)*						
		Mercury	Chromium	Copper	Nickel	Zinc	Arsenic	Lead
MW01	1	ND (0.0002)	ND (0.01)	ND (0.01)	ND (0.02)	0.03	0.076	ND (0.005)
	2	ND (0.0002)	0.014	0.033	0.02	0.118	0.056	0.016
MW02	1	ND (0.0002)	ND (0.01)	0.011	ND (0.02)	0.043	ND (0.05)	ND (0.005)
	2	ND (0.0002)	0.038	0.091	0.043	0.201	0.102	0.055
MW03	1	ND (0.0002)	ND (0.01)	ND (0.01)	ND (0.02)	0.027	ND (0.05)	ND (0.005)
	2	ND (0.0002)	0.058	0.182	0.074	0.336	0.047	0.088
MW04	1	0.00026	ND (0.01)	0.012	ND (0.02)	0.041	ND (0.05)	0.0083
	2	ND (0.0002)	0.088	0.229	0.086	0.451	0.112	0.142
MW05	1	0.00022	ND (0.01)	ND (0.01)	0.013	0.067	0.18	0.014
	DUP	ND (0.0002)	ND (0.01)	ND (0.01)	0.012	0.048	0.017	0.0088
	2	ND (0.0002)	0.056	0.099	0.065	0.346	0.339	0.085

DUP = duplicate sample
ND - Not detected above the method detection limit shown in parentheses
Water samples analyzed for Priority Pollutant Metals by EPA Method SW6010
mg/l = milligrams per liter

groundwater flow directions. Also, the RI shows contaminants have not migrated far from the locations where spills or leaks occurred.

5.4.6.1 Soil

VOCs

No VOCs were detected in soil gas samples collected at Site 10. VOCs were also not detected in soil screening samples. VOCs were detected in Site 10 soil samples at concentrations which ranged from 0.5 μg/kg to 3.6 μg/kg. Concentrations of TCE detected in four samples ranged from 0.5 to 0.6 μg/kg.

SVOCS

Analysis for SVOCs was not performed for soil gas or soil screening samples collected at Site 10.

In soil samples, Bis(2-ethylhexyl)phthalate was detected at a concentration of 570 μg/kg.

Di-n-butyl phthalate was detected in six soil samples at concentrations ranging from 380 to 1,890 μg/kg. Pyrene was detected in one soil sample at a concentration of 410 μg/kg. Naphthalene was detected at a concentration of 350 μg/kg in one sample, below the Level I RCL of 2,000 μg/l. 2-methylnaphthalene was detected in one soil sample at a concentration of 640 μg/kg.

BTEX

BTEX compounds were detected in 26 of the 41 soil gas samples collected. In general, BTEX compounds in soil gas were concentrated in two areas, one north of the process recovery tank and the other north of the fuel mixing facility. Of the BTEX compounds, benzene had the greatest concentrations, the maximum amount of benzene detected being 4,921 μg/kg in a sample collected just south of the northwest fuel dispenser.

BTEX compounds were detected in 11 of the 18 soil screening samples collected at site 10. Benzene was not detected in soil screening samples collected in the vicinity of the process recovery tank. Benzene concentrations ranged from 0.390 mg/kg to 3.891 mg/kg in the area near the fuel mixing tank, all of which exceed the UDEQ Level I RCL of 0.2 mg/kg. Concentrations of toluene, ethylbenzene and xylenes did not exceed the UDEQ Level I RCLs of 100, 70 and 1,000 mg/kg, respectively.

Petroleum compounds (benzene, toluene, ethylbenzene, xylene, and TPH) were detected in soil samples collected from two areas of Site 10. The first area in which petroleum compounds were detected is located north of the existing process recovery tank, where a fuel spill occurred in 1982. The horizontal extent of petroleum contamination detected in this area was limited to the area of Site 10 south of the City Drain Channel and north of the existing process recovery tank, between the concrete parking pad and the dispenser island. The vertical extent of petroleum compounds detected in this area extended to the groundwater table, approximately 6 feet BGS.

The concentrations of BTEX compounds detected in the vicinity of the process recovery tank did not exceed UDEQ Level I RCLs.

The second area where petroleum compounds were detected at Site 10 is located directly north of the fuel mixing facility. The horizontal extent of petroleum contamination detected in this area was limited to the area of Site 10 south of the City Drain Channel and north of the 5,000-gallon fuel additives tank, between the dispenser island and the eastern edge of E Street. The vertical extent of petroleum compounds detected in this area extended to the groundwater table, approximately 6 feet BGS. Benzene was detected in soil samples collected in this area at concentrations above the most stringent soil RCL of 0.2 mg/kg set by the Utah Department of Health Division for leaking UST sites.

TPH

Analysis for TPH was not performed on soil gas or soil screening samples. TPH analysis was performed by the fix-based laboratory on soil samples collected from soil borings.

TPH was detected in five of the 24 soil samples at concentrations ranging from 0.0038 to 0.470 mg/kg, all below the UDEQ Level I RCL of 100.0 mg/kg.

Metals

Metals were not detected in soil samples collected from IRP Site 10 at concentrations outside of the naturally occurring ranges of metals in soil.

5.4.6.2 Groundwater

The results of the groundwater sampling and analysis is consistent with the hydrogeology at the site. The analysis revealed that contaminants move very slowly and in a number of directions based on changing groundwater flow directions.

VOCs

Low concentrations of VOCs, not including BTEX compounds, were detected in six of the 35 groundwater screening samples. All concentrations were below the EPA MCL and UDEQ GWQS levels.

Trace amounts of VOCs were detected in three of the five groundwater samples collected in on-site monitoring wells. State and federal ARARs have not been established for the VOCs detected (1,1-DCA and trichlorofluoromethane).

SVOCs

SVOCs were not detected in groundwater samples collected from Site 10 at concentrations above UDEQ MCLs. However, bis(2-ethylhexyl)phthalate was detected in a groundwater sample collected from Site 10 at a concentration of 18 μg/l, which is slightly above the EPA proposed MCL of 4.0 μg/l.

BTEX

BTEX compounds were detected in groundwater screening samples collected from two areas of Site 10 at concentrations above EPA MCLs and Utah GWQS. A sheen of floating product was observed on the groundwater samples GP4 and GP12. GP4 was collected from a depth of 4 to 6 feet BGS in a location directly north of the fuel additives mixing AST. GP12 was collected from a depth of 3.5 to 4.5 feet BGS at a location approximately 50 feet north of GP4. GP12 was not analyzed for BTEX compounds as the floating product would foul the column in the GC. Sample locations are shown on Figure 5-40.

The extent of the sheen was observed to be limited to the area between the gate to the fuel dispensing island and the fuel additives mixing area as sheens were not observed on groundwater samples collected from screening points located north, south, east, and west of GP4 and GP12 (GP3, GP11, GP13, GP14, and GP17).

BTEX compounds were not detected in groundwater samples collected from monitoring wells installed upgradient and downgradient of Site 10. Based on the analysis of the groundwater screening samples, the areas where petroleum compounds were detected in groundwater correspond with the areas where petroleum compounds were detected in the soil. BTEX compounds were not detected in monitoring wells MW-3 and MW-5 installed close to areas where BTEX compounds were detected in groundwater screening samples. MW-3 is located approximately 15 feet east of GP-7, and MW-5 is located approximately 12 feet southeast of GP17. The location of MW-5 was selected to monitor the northeastern edge of contamination. The placement of MW-5 was restricted by the numerous utility lines in this area of the site. This anomaly may be due to the complex geology at the site with the contaminants moving through selected soil lenses. In addition, the groundwater screening samples were collected from a discreet 2-foot depth interval, close to the top of the groundwater table. The groundwater samples collected from the monitoring wells are collected from a 2-inch diameter well with 10 feet of screen. This screen allows a 10-foot column of water to contribute to the sample.

TPH

No analysis was performed for TPH in groundwater screening samples. TPH analysis was performed by the fix-based laboratory on groundwater samples collected from site monitoring wells. TPH was not detected in any of these groundwater samples.

Metals

Metals were not detected in groundwater samples collected from Site 10 above EPA MCLs and Utah GWQS.

5.5 QA/QC SUMMARY

The objective of the QAPP was to provide quality control/ quality assurance, (QA/QC) guidance for sampling and analytical activities. The QAPP outlines the necessary sampling protocols and QA/QC samples to be collected in order to validate the data. This QA/QC Summary reviews the validation results for the investigations conducted at the sites.

The data has been validated according to the EPA Functional Guidelines for Evaluation of Organic and Inorganic Data. The validated results have been presented in tables for each site. The final validated data is presented with data qualifiers. The qualifiers are applied based upon the findings. The data summary is separated into two sections, one for each Site 8 and Site 10.

5.5.1 Site 8 Validation Results

Site 8 samples were submitted for Volatile Organic, Semi-Volatile Organic, Total Petroleum Hydrocarbon and Priority Pollutant Metals analyses. The results of the validation are outlined for organic and inorganic analyses.

5.5.1.1 Organic Data Validation

Data Completeness: The data packages were complete.

Holding Times: The holding times were met for all analyses.

GC/MS Tuning: The GC/MS tuning was met for all applicable analyses.

Calibrations:
<u>Volatile Organic Analyses</u> — For the VOCs (bromoethane, 2-chloroethylvinyl ether, chlorobenzene, chloroethane and chloromethane) the percent difference was greater than the acceptable limit. The non-detect results were reported as estimated non-detect (UJ).

<u>Semi-Volatile Organic Analyses</u> — For the semi-volatile compounds (benzoic acid and 2,4-dinitrophenol) the percent difference was greater than the acceptable limit. The non-detect results were reported as estimated non-detect (UJ).

<u>Total Petroleum Hydrocarbons</u> — The calibrations for the TPH analyses were all met.

Blanks: Rinsate blank (RB-1) contained methylene chloride at 1.0 ppb. All associated samples were non-detect for this compound and data qualifications were not made.

Laboratory Blanks (6/5/95) contained bis (2-ethyl hexyl) phthalate in two analyses at 1.26 ppb and 1.31 ppb. All associated samples were non-detect for this compound and data qualifications were not made.

Rinsate blank (RB-2) contained methylene chloride at 0.8 ppb and chloroform at 0.5 ppb. All associated samples were non-detect for these compounds and data qualifications were not made.

Rinsate blank (RB-2) contained benzoic acid and bis (2-ethyl hexyl) phthalate at 2.35 ppb and 2.19 ppb, respectively. All associated samples were non-detect for these compounds and data qualifications were not made.

Trip blank (TB-2) contained methylene chloride at 0.5 ppb and 1,2-dichloropropane at 0.8 ppb. All associated samples were non-detect for these compounds and data qualifications were not made.

Trip blank (TB-3) contained methylene chloride at 72 ppb and chloroform at 6.9 ppb. All associated samples were non-detect for these compounds and data qualifications were not made.

Trip blank (TB-5) contained 1,2-DCA at 5.9 ppb. All associated samples were non-detect for these compounds and data qualifications were not made.

Field blank (FB-2) contained chloroform at 23.1 ppb. All associated samples were non-detect for these compounds and data qualifications were not made.

All other field and laboratory blanks were reported as non-detect.

Surrogate Recoveries: All surrogate recoveries were within acceptable limits.

Matrix Spike/Matrix Spike Duplicate: VOCs (1,1-DCA and trans 1,2-DCE) were above the RPD limits. The associated positive sample results for MCW 3-2 and MCW 6-2 for the compound 1,1-DCA were qualified and reported as estimated (J). The associated positive sample results for MCW 5-2, MCW 6-2 and MCW 8-2 for the compound trans 1,2-DCE were qualified and reported as estimated (J).

Field Duplicates: Samples MW 5 and MW 6 were submitted as duplicate samples. The 1,1,1-TCA results were reported as estimated (J) due to field duplicate precision. Samples MCW 3 and MCW 9 were submitted as duplicate samples. The 1,1-DCA, 1,1-DCE and ethylbenzene results were reported as estimated (J) due to field duplicate precision.

5.5.1.2 Inorganic Data Validation

Data Completeness: The data packages were complete.

Holding Times: The holding times were met.

Calibrations: The calibrations were met.

Blanks: The laboratory blank (CCB-6/5/95) contained zinc at 0.032 ppm. MW 1 and MW 3 were the samples associated with this blank. The associated sample results were reported as raised (U) to be the detection limit for this compound. The laboratory blank (CCB-6/27/95) contained zinc 0.018 ppm. RB-2 was the sample associated with this blank. The associated sample result was reported as raised (U) to be the detection limit for this compound. No other data qualifications were made.

ICP Interference Check Results: The ICP interference check results were all met.

Matrix Spike Recoveries: The MS percent recovery for antimony was lower than the acceptable range, the following sample results were reported as estimated non-detects (UJ): SB-1 (0-2'), SB-1 (2-4'), SB-1 (4-6'), SB-2 (0-2'), SB-2 (2-4'), SB-2 (2-4') duplicate, SB-2 (4-6'), SB-3 (2-4'), SB-3 (4-6'), SB-4 (0-2'), SB-4 (2-4'), SB-4 (4-6'), SB-5 (0-2'), SB-5 (2-4'), SB-5 (4-6'), SB-5 (4-6') duplicate, SB-6 (2-4'), SB-6 (4-6'), SB-7 (2-4'), SB-7 (4-6'), SB-8 (2-4'), SB-8 (4-6'), SB-9 (0-2'), SB-9 (2-4'), SB-9 (4-6'), SB-10 (0-2'), SB-10 (2-4'), SB-10 (4-6'), SB-10 (4-6') duplicate.

Field Duplicates: Samples MW 5 and MW 6 were submitted as duplicate samples. The duplicate results were all met.

Samples MCW 3 and MCW 9 were submitted as duplicate samples. The duplicate results demonstrated higher than acceptable RPDs. The results for MCW 3 and MCW 9 were reported as estimated (J) for chromium, copper, nickel and zinc.

Samples MW 7 and MW 13 were submitted as duplicate samples. The duplicate results demonstrated higher than acceptable RPDs. The positive results for MW 6, MW 7, MW 8 and MW 13 were reported as estimated (J) for zinc.

Samples MW 12-2 and MW 13-2 were submitted as duplicate samples. The duplicate results demonstrated higher than acceptable RPDs. The results for MW 6-2, MW 7-2, MW 8-2, MW 9-2, MW 10-2, MW 11-2, MW 12-2 and MW 13-2 were reported as estimated (J) for lead.

Laboratory Control Sample Results: All LCS results were met.

Furnace AA Results: All furnace AA results were met.

5.5.2 Site 10 Validation Results

Site 10 samples were submitted for volatile organic, semi-volatile organic, pesticide/PCBs, TPH and PPM analyses. The results of the validation are outlined for organic and inorganic analyses.

5.5.2.1 Organic Data Validation

Data Completeness: The data packages were complete.

Holding Times: The holding times were met for all analyses.

GC/MS Tuning: The GC/MS tuning was met for all applicable analyses.

Calibrations:
Volatile Organic Analyses — For the VOCs (chloroethane, 2-chloroethylvinyl ether and chlorobenzene) the percent difference was greater than the acceptable limit. The non-detect results were reported as estimated non-detect (UJ).

Semi-Volatile Organic Analyses — For the semi-volatile compound (2,4-dinitrophenol) the percent difference was greater than the acceptable limit. The non-detect results were reported as estimated non-detect (UJ).

Pesticide/PCB Analyses — The calibrations for the P/PCB analyses were all met.

Total Petroleum Hydrocarbons — The calibrations for the TPH analyses were all met.

Blanks: All blank criteria were met.

Field Duplicates: Samples SB-9 (2-4') and SB-9D (2-4') were submitted as duplicate samples. The xylene results were reported as estimated (J) due to field duplicate precision.

Samples SB-11 (2-4') and SB-11D (2-4') were submitted as duplicate samples. The ethylbenzene results were reported as estimated (J) due to field duplicate precision.

Samples MW 5-2 and MW 6-2 were submitted as duplicate samples. The bis (2-ethyl hexyl) phthalate results were reported as estimated (J) due to field duplicate precision.

5.5.2.2 Inorganic Data Validation

Data Completeness: The data packages were complete.

Holding Times: The holding times were met.

Calibrations: The calibrations were met.

Blanks: The laboratory blank (CCB-6/27/95) contained zinc 0.018 ppm. FB-3 and RB-5 were the samples associated with this blank. The associated sample result was reported as raised (U) to be the detection limit for this compound. No other data qualifications were made.

ICP Interference Check Results: The ICP interference check results were all met.

Matrix Spike Recoveries: The MS percent recovery for antimony was lower than the acceptable range, the following sample results were reported as estimated non-detects (UJ): SB-5 (0-2'), SB-5 (2-4'), SB-5 (4-6'), SB-6 (0-2'), SB-6 (2-4'), SB-6 (4-6'), SB-7 (0-2'), SB-7 (2-4'), SB-7 (4-6'), SB-8 (0-2'), SB-8 (2-4'), SB-8 (4-6'), SB-9 (0-2'), SB-9 (2-4'), SB-9 (4-6'), SB-9D (2-4') duplicate, SB-9D (4-6') duplicate, SB-10 (0-2'), SB-10 (2-4'), SB-10D (2-4') duplicate, SB-10 (4-6'), SB-10 (6-8'), SB-11 (0-2'), SB-11 (2-4'), SB-11D (2-4') duplicate, SB-11 (4-6'), SB-12 (0-2'), SB-12 (2-4'), SB-12 (4-6').

Field Duplicates: Samples SB-10 (2-4') and SB-10D (2-4') were submitted as duplicate samples. The results demonstrated higher than acceptable RPDs. The results for SB-10 (2-4'), SB-10D (2-4') were reported as estimated (J) for chromium, mercury, arsenic and lead.

Samples MW 1-2 and MW 2-2 were submitted as duplicate samples. The results demonstrated higher than acceptable RPDs. The results for MW 1-2, MW 2-2, MW 3-2, MW 4-2, MW 5-2 and MW 6-2 were reported as estimated (J) for chromium, copper, nickel, zinc, arsenic and lead.

Laboratory Control Sample Results: All LCS results were met.

Furnace AA Results: All furnace AA results were met.

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6.0 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

During any environmental investigation, a variety of federal, state, and local regulations or requirements may govern specific actions. This section provides a brief summary of potential ARARs that have been identified.

6.1 INTRODUCTION

This was conducted pursuant to CERCLA and in conformance with the guidelines, criteria, and considerations set forth in the National Oil and Hazardous Substance Pollution Contingency Plan and SARA. Consistent with the CERCLA/SARA/NCP framework is the requirement that the Remedial Action process must comply with all legally applicable or relevant and appropriate requirements. Investigations at Site 8 were initiated under the State of Utah DERR Underground Storage Tank (UST) Division. During the course of UST investigations, halogenated compounds were detected in soils in the vicinity of Site 8. This resulted in the transfer of administration of the Site from the UST Division to the CERCLA division.

Applicable requirements are those federal and state requirements that would apply to conditions at a CERCLA site under any circumstance. Federal statutes that are specifically cited in CERCLA include the Toxic Substance Control Act (TSCA), the Safe Drinking Water Act (SDWA), the Clean Air Act (CAA), the Clean Water Act (CWA), and the Marine Protection Research and Sanctuaries Act. Relevant and appropriate requirements are those federal and state human health and environmental requirements that apply to circumstances sufficiently similar to those encountered at CERCLA sites. Relevant and appropriate requirements are intended to carry the same weight as legally applicable requirements.

The EPA provides general guidance on the overall application of ARAR concepts into the A/FS process (EPA, 1987a; EPA, 1988b; EPA, 1989). In accordance with this guidance, ARARs are to be progressively identified and applied on a site-specific basis as the /FS proceeds. The initial step in the process entails the survey of all potential ARARs for the Remedial Action process at the subject site. The next step in the ARAR process is the integration of statutory and regulatory requirements with site-specific factors to evaluate whether a site is currently in compliance with all public health and environmental standards. The application of specific ARARs to the investigation process is directly affected by the field investigation. The confirmation of contamination at a site, the identification of the specific contaminant(s), and subsequent laboratory analysis and quantification affect the application of ARARs. Similarly, suspected sources of contamination, historical site usage, and the known or potential effects of contaminant matrices are interrelated with federal, state, and local ARARs. Action- and location-specific ARARs are determined when potential remediation alternatives are considered.

The degree to which site-specific factors are incorporated into the ARAR development process varies considerably. In the case of hazardous chemicals, evaluation of site-specific factors is an integral part of the ARAR process even when prerequisites based on statutory or regulatory requirements exist. Action- and location-specific ARARs are determined when any required remediation options are being considered. Groundwater ARARs are considered to be pertinent because some chemicals of potential concern in soils may impact groundwater.

6.2 SUMMARY OF POTENTIAL ARARs

A series of hazardous waste management directives are potentially applicable to the investigation of IRP Sites 8 and 10 at the UANG Base in Salt Lake City, Utah. ARARs may be expanded as part of the RI/FS field investigation and the analysis of sampling data.

The following paragraphs provide a preliminary summary of key ARARs that may be relevant to RI activities at the installation.

6.2.1 Resource Conservation and Recovery Act

Federal RCRA regulations governing hazardous waste management provide both action- and chemical-specific ARARs that may apply to IRP activities at the UANG Base.

Waste Identification. Materials excavated or removed from the site (e.g., drill cuttings, contaminated soil, and contaminated groundwater) would be regulated as hazardous waste if they meet the federal definition provided in 40 CFR 261.

Waste Generation and Transport. RI activities or remedial alternatives involving the movement or removal of hazardous waste trigger RCRA hazardous waste generator requirements provided in 40 CFR 262. When hazardous waste is shipped off-site in regulated amounts, the manifesting and transport procedures in 40 CFR 263 must be followed. As applicable, the UANG Base will sign all hazardous waste manifests as the generator of the waste.

Land Disposal Restrictions. RCRA regulations in 40 CFR 268 set forth Land Disposal Restrictions (also known as Land Ban Requirements) for RCRA wastes. These restrictions were required by the Hazardous and Solid Waste Amendments (HSWA) of 1984 to RCRA to prohibit the continued land disposal of hazardous wastes beyond specified dates. However, wastes treated in accordance with chemical-specific treatment standards provided in 40 CFR 268 Subpart D may be land-disposed as provided therein. The Land Disposal Restrictions potentially affect the storage and disposal of hazardous wastes generated during RI or subsequent remedial activities and may be considered both action-and chemical-specific ARARs.

Treatment, Storage, and Disposal Facilities. If remedial alternatives for the site involve the construction or off-site use of RCRA treatment, storage, or disposal (TSD) facilities, regulations provided in 40 CFR 264 become action-specific ARARs. Various subsections of 40 CFR 264 govern standards and procedures for the operation of hazardous waste TSD facilities. For example, a common disposal practice is to create a waste pile of contaminated soil as part of the remediation process. Federal RCRA standards for waste piles, including their design, operating requirements, monitoring and inspection, closure, and post-closure care, are promulgated in 40 CFR 264 Subpart L. Other subparts control tank systems, surface impoundments, land treatment units, landfills, incinerators, and miscellaneous TSD units.

6.2.2 Safe Drinking Water Act

Federal regulations pursuant to the SDWA govern the quality, usage, and discharge of groundwater. MCLs specified in 40 CFR Sections 141.11 through 141.16 are legally enforceable federal drinking water standards established by the EPA. Maximum contaminant level goals (MCLGs) specified in 40 CFR Sections 141.50 through 141.51 are nonenforceable, health-based goals for drinking water. MCLGs are set at levels at which no adverse health effects may arise. MCLs are set as close as practical to MCLGs. For noncarcinogens, MCLs are nearly always set at the MCLG. Although investigations to date at Sites 8 and 10 indicate that drinking water sources have not been impacted, should the RI indicate that drinking water sources are being impacted, the use of MCLs and/or MCLGs could be required.

6.2.3 Clean Water Act

The federal CWA and pursuant regulations provide potential location-, chemical-, and action-specific ARARs for IRP activities at the UANG Base.

Ambient Water Quality Criteria (AWQC). The EPA has promulgated AWQC for surface and groundwater through 40 CFR 131. Aligned with the federal CWA criteria, the standard governing AWQC presents scientific data and guidance on the environmental effects of pollutants, rather than only establishing regulatory requirements. As a result, decision-makers evaluating remedial alternatives may compare their water quality data to federal data and guidance. Candidate Remedial Actions involving contaminated surface water or groundwater must be evaluated within the context of follow-on water usage and the circumstances of the actual or potential release before implementation. As a general statement, AWQC are applied when evaluating clean-up levels for groundwater.

National Pollutant Discharge Elimination System (NPDES). The Utah ANG Base is currently in the process of obtaining an NPDES permit for the control and testing of surface water runoff from Base stormwater discharge systems. A Stormwater Pollution Prevention Plan has been developed and is being coordinated for approval with the State of Utah. The permit may provide action- and chemical-specific ARARs. Until the permit is in place, all RI activities at Sites 8 and 10 will follow Best Management Practices.

6.2.4 Occupational Safety and Health Act (OSHA)

All site operations are governed by OSHA standards for health and safety under 29 CFR 1910. The Health and Safety Officer for the RI/FS field investigation will ensure all site workers meet the requirements of the Site-specific Health and Safety Plan, possess and use all required PPE, and take all precautions to eliminate exposure to unsafe or unhealthful situations. Other applicable OSHA ARARs include health and safety for federal service contracts (29 CFR 1926) and recordkeeping and reporting under 29 CFR 1904.

6.2.5 Hazardous Materials Transportation Act

If material containing hazardous wastes is to be transported off-site, USDOT hazardous material transportation requirements in 49 CFR Sections 171 through 179, pursuant to the federal Hazardous Materials Transportation Act, may be action-specific ARARs for RI activities. These requirements are supplemental to RCRA transporter requirements in 40 CFR 263.

6.2.6 Clean Air Act

The federal CAA may provide action- and chemical-specific ARARs for IRP activities, including subsequent field investigations and remedial actions such as soil excavation or incineration. All remediation activities must comply with National Primary and Secondary Ambient Air Quality Standards found in 40 CFR 50. Rules governing particulate matter less than 10 microns in size (PM_{10}) are contained in 40 CFR 50 and are important from the standpoint of the potential detrimental effects of such particles on the lungs. All field activities involving air emissions must ensure compliance with the PM_{10} standard.

6.2.7 Federal Guidance to be Considered

In addition to federal and state regulatory requirements that may be applicable or relevant and appropriate to IRP activities, federal nonregulatory criteria must be considered. These chemical-specific ARARs, used to help characterize risks and to set clean-up goals, include the following:

- EPA Risk Reference Doses
- EPA Health Advisories
- EPA Carcinogen Assessment Group Potency Factors
- EPA guidance manual on water-related fate of 129 priority pollutants

6.2.8 State Requirements

In addition to federal ARARs, the following State of Utah regulations may be applicable or relevant and appropriate to RI activities and potential remedial alternatives at the UANG Base.

Utah State Air Conservation Act. The State of Utah governs air emissions and air quality under Chapter 2 of Title 19 of the Utah State Code.

Utah State Water Quality Act. The State of Utah governs water quality under Chapter 5 of Title 19 of the Utah State Code.

Utah State Hazardous Substance. Rules and criteria for the identification, storage, treatment, transportation, and disposal of hazardous wastes are established in these regulations under Chapter 6 of Title 19 of the Utah State Code. All hazardous wastes that are generated, transported, treated, or disposed of within the State of Utah are subject to specific regulatory control. These regulations also govern detection of releases, notification and reporting requirements, corrective actions, and closures, among other subjects. The ARARs associated with these regulations can become action-specific standards. For example, RI activities that involve the movement or removal of hazardous wastes will trigger the application of these regulations. Pertinent parts of the code may include the following:

Part 1 – Solid and Hazardous Waste Act
Part 2 – Hazardous Waste Facilities Siting Act
Part 3 – Hazardous Substances Mitigation Act
Part 4 – Underground Storage Tank Act

In addition to the state requirements, the State of Utah Department of Health has created guidelines for estimating Numeric Cleanup levels for petroleum contaminated soil at UST release sites. These guidelines are recommended by the state, but do not establish absolute standards. these guidelines are not considered ARARs for the sites, as the sites are not in the UST program. However, these guidelines were used in the performance of the risk assessment as they provide contaminant concentrations which the state of Utah may consider harmful to human health and the environment. The Level I recommended cleanup levels derived by this guideline are provided in Table 6-1. The level of cleanup is determined based on the environmental sensitivity of the site. As a conservative approach, the Level I cleanup levels were referenced and used in the risk assessment.

6.2.9 Site-Specific ARARs

Table 6-2 identifies potential chemical- and action-specific ARARs. There are no wetlands either on-site or immediately downgradient of the sites, therefore federal, state, or local wetlands ARARs do not apply. Since the City Drain Canal is located downgradient of Site 10, some federal, state, or local ARARs may be applicable as stated previously.

Based on previous investigations and historical usage of Sites 8 and 10, chemical-specific ARARs, shown in Table 6-1, were applied to investigate groundwater and soils from potential contaminant sources involving halogenated compounds, SVOCs, and BTEX compounds.

Table 6-1
Primary Federal and State ARAR Values for Chemicals of Concern 151st ARW, Air National Guard, Salt Lake City, Utah

Parameter	EPA MCL (μg/l)	EPA PMCL (μg/l)	UDEQ MCL* (μg/l)	UDEQ GWQS (μg/l)	Level I Recommended Cleanup Level (μg/kg)
Matrix	Water	Water	Water	Water	Soil
1,2-Dichloroethane	5.0	NE	0.94	5.0	NE
1,1-Dichloroethane	NE	NE	NE	NE	NE
1,1-Dichloroethene	7.0	NE	0.033	7.0	NE
Trichloroethene	5.0	NE	2.7	5.0	NE
Dichloromethane	NE	5.0	0.19	NE	NE
Di-n-butyl phthalate	NE	NE	34,000	NE	NE
Trichlorofluoromethane	NE	NE	NE	NE	NE
Bis-2-ethylhexyl phthalate	NE	4.0	15,000	NE	NE
Phenanthrene	NE	NE	0.0028	NE	NE
Pyrene	NE	NE	0.0028	NE	NE
Benzene	5.0	NE	0.66	5.0	200
Toluene	1,000	NE	14,300	1,000	100,000
Ethylbenzene	700	NE	1,400	700	70,000
Xylenes	10,000	NE	NE	10,000	1,000,000
TPH	NE	NE	NE	NE	100,000
Arsenic	50	-	0.002	50	Risk-Based
Cadmium	5.0	5.0	10	5.0	Risk-Based
Chromium III	100	100	50	100	Risk-Based
Lead	15	5.0	0.144	15	Risk-Based

NE = Not established due to insufficient data.
PMCL = proposed maximum contaminant level
μg/l = micrograms per liter
* Human health criteria applied for consumption of water and aquatic organisms

MCL = maximum contaminant level
UDEQ = Utah Department of Environmental Quality
GWQS = Groundwater Quality Standard

Table 6-2

Potential Chemical- and Action-Specific Applicable or Relevant and Appropriate Requirements and Requirements to be Considered for Sites 8 and 10

Utah ANG Base, Salt Lake City, Utah

Chemical-Specific	Site	Matrix		No Action Alternative
		Soil	GW	
TCE	8	Y	Y	Federal/State^3 standard of 5 μg/l will not be met for groundwater. The risk assessment indicates no significant risk for this compound.
1,1-DCA	Both	-	Y	No Federal/State ARAR values have been established. The risk assessment indicates no significant risk associated with this compound.
1,1-DCE	8	-	Y	Federal/State^3 standard of 7 μg/l will not be met for groundwater. The risk assessment indicates no significant risk for this compound.
cis 1,2-DCE	8	-	Y	No Federal/State ARAR values have been established. The risk assessment indicates no significant risk associated with this compound.
TCA	Both	-	Y	No Federal/State ARAR values have been established. The risk assessment indicates no significant risk associated with this compound.
Benzene	Both	Y^1	Y	Federal/State standard of 5 μg/l will not be met for groundwater. A waiver is justified based on results of risk assessment. Soil concentrations are below State of Utah Level I RCL of 200 μg/kg at Site 8. RCLs will not be met for soils at Site 10, however, the risk assessment indicates no significant risk associated with this compound
Toluene	Both	Y	Y^2	Federal/State standard of 1,000 μg/l will not be met for groundwater at Site 10. A waiver is justified based on results of risk assessment. Soil concentrations are below State of Utah Level I RCLs.
Ethylbenzene	10	Y	Y	Federal/State standard of 700 μg/l will not be met for groundwater at Site 10. A waiver is justified based on results of risk assessment. Soil concentrations are below State of Utah Level I RCLs.
Xylene	10	Y	Y	Federal/State standard of 10,000 μg/l will not be met for groundwater at Site 10. A waiver is justified based on results of risk assessment. Soil concentrations are below State of Utah Level I RCLs.
bis(2-ethylhexyl) Phthalate	Both	Y^1	Y^2	Proposed Federal MCL of 4.0 μg/l will not be met for groundwater. No waiver is required.

Table 6-2
Potential Chemical- and Action-Specific Applicable or Relevant and Appropriate Requirements and Requirements to be Considered for Sites 8 and 10
Utah ANG Base, Salt Lake City, Utah

Chemical-Specific	Site	Matrix		No Action Alternative
		Soil	GW	
Phenathrene	8	Y	-	No Federal/State ARAR values have been established for groundwater. The risk assessment indicates no significant risk associated with this compound.
Pyrene	8	Y	-	No Federal/State ARAR values have been established for groundwater. The risk assessment indicates no significant risk associated with this compound.
Methylene Chloride	10	Y	-	No Federal/State ARAR values have been established for soil. The risk assessment indicates no significant risk associated with this compound.
di-n-butyl phthalate	10	Y	-	No Federal/State ARAR values have been established for soil. The risk assessment indicates no significant risk associated with this compound.
2-methyl naphthalene	10	Y	-	No Federal/State ARAR values have been established for soil. The risk assessment indicates no significant risk associated with this compound.
Arsenic	Both	-	Y	Federal/State MCL of 0.05 mg/l for groundwater will not be met. Background data indicates naturally occurring concentrations significantly above Federal/State MCLs. The risk assessment indicates no significant risk associated with this compound.
Lead	Both	Y	Y^2	Federal/State MCL of 0.015 mg/l for groundwater will not be met. The risk assessment indicates no significant risk associated with this compound.
Chromium III	8	-	Y	Federal/State MCL of 0.01 mg/l for groundwater will not be met. The risk assessment indicates no significant risk associated with this compound.

Table 6-2
Potential Chemical- and Action-Specific Applicable or Relevant and Appropriate Requirements and Requirements to be Considered for Sites 8 and 10
Utah ANG Base, Salt Lake City, Utah

Action-Specific	Site	Matrix		No Action Alternative
		Soil	GW	
I. Resource Conservation and Recovery Act (RCRA) Subpart F				
A. Solid Waste Disposal	Both	Y	-	
II. Clean Water Act				
A. NPDES	Both	-	Y	Utah ANG Base is in the process of obtaining a UPDES permit, which will comply with NPDES requirements.
B. Water Quality Standards	Both	-	Y	Compliance will occur by meeting UPDES limitations
III. Land Disposal Restrictions for Certain "California List" Hazardous Waste	Both	Y	-	Utah ANG Base disposes of any solid waste generated at Sites 8 and 10 in compliance with RCRA and other applicable standards.
IV. Utah Air Conservation Act	-			Regulations do not currently pertain to either site.
V. Utah Water Quality Act	Both	-	Y	Risk assessment indicates use of risk based standards is acceptable.
VI. Utah Hazardous Substances	Both	Y	Y	Risk assessment indicates use of risk based standards is acceptable.

Notes:

1.Not present in Site 8 soils.
2.Not present in Site 10 GW.
3.Utah groundwater quality standards are to be considered and are not ARAR's according to R317-6.15 Corrective Action.

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7.0 CONTAMINANT FATE AND TRANSPORT

This section discusses the general concepts and various chemical and physical properties that affect the fate and transport of contaminants in the environment. Predictions about the future concentration and extent of contaminants from current conditions are based on these concepts.

7.1 INTRODUCTION

This section examines the mechanisms and processes that affect the fate and transport of contaminants. Collected soil and groundwater samples were analyzed for VOCs, SVOCs, PPMs and BTEX. In addition, selected soil and groundwater samples were analyzed for PCBs and Pesticides. Screening samples included an evaluation of VOCs in soil gas, soils and groundwater. Only Chemicals of Concern (COCs) i.e., those that were detected at concentrations that exceed regulatory action levels or quantification limits (for compounds for which regulatory levels have not been set) are addressed in this section. The COCs for each site are as follows:

Site 8 Screening Samples:

VOCs:
Benzene
c-DCE
TCA
TCE
Toluene

Site 8 Samples:

VOCs:
Benzene
1,1-DCA
1,1-DCE
TCE

SVOCs:
Bis(2-ethylhexyl)phthalate
Phenanthrene
Pyrene

PPMs:
Arsenic
Cadmium
Lead
Chromium III

Site 10 Screening Samples:

VOCs:
Benzene
Toluene
Ethylbenzene
Xylene
TCA

Site 10 Samples:

VOCs:
Benzene
Methylene chloride
Trichlorofluoromethane

SVOCs:
Bis(2-ethylhexyl)phthalate
Di-n-butyl phthalate
2-Methyl naphthalene

PPMs:
Arsenic
Cadmium
Lead

Only those COCs that were detected above defined ARAR values will be discussed herein. Where appropriate, the discussion of fate and transport will focus on indicator chemicals. An indicator chemical is that substance within a group or family of contaminants that best characterizes the behavior of the group as a whole.

7.2 FACTORS AFFECTING CONTAMINANT FATE AND TRANSPORT

Various factors of the contaminant, and media where found, affect fate and transport. These properties include chemical and physical properties of the contaminant, multiphase contaminant partitioning, transport mechanisms, and biodegradation.

7.2.1 Chemical and Physical Properties of Contaminants

The physical and chemical properties of the COCs affect their fate and transport in the environment. The following properties can potentially affect the movement of contaminants through the vadose zone and the groundwater:

- Henry's Constant,
- aqueous solubility,
- organic carbon partition coefficient (K_{oc}), and
- vapor pressure.

7.2.1.1 Henry's Constant

Henry's Constant reflects the ability of a compound to volatilize from water. The greater the Henry's Constant, the more a given compound will likely volatilize from contaminated groundwater or soil porewater and move to the gas/air phase in the vadose zone. In general, a compound having a Henry's Constant of greater than 1.0×10^{-3} will readily volatilize from water and thus may be detected in soil gas in the vadose zone.

7.2.1.2 Aqueous Solubility

Aqueous solubility is the maximum concentration that a compound can attain when dissolved in water at 25°C. The aqueous solubility limit is the maximum concentration of a compound that can be found in water. Therefore, if the concentration of a compound in an aqueous solution is equal to it's solubility limit then it is possible that the compound may exist nearby in higher concentrations as free product (i.e., in undissolved form). In general, free product of a given compound is suspected to exist if concentrations of a compound in groundwater approaches as little as 1 percent of it's solubility limit. The less soluble a chemical, the less it is expected to migrate with aqueous advective flow.

7.2.1.3 Organic Carbon Partition Coefficient (K_{oc})

The movement of dissolved organic compounds in groundwater may be slowed by adsorption onto stationary soil material. These hydrophobic organic compounds have a tendency to be attracted to non-polar or organic surfaces in soil and have a low aqueous solubility. The tendency of a compound to adsorb to the organic portion of the soil matrix is known as the organic carbon partition coefficient (K_{oc}). The higher the K_{oc}, the more the compound is adsorbed by the organic carbon exchange sites in the soil; this lessens the amount of compound available for transport in the aqueous phase. Table 7-1 shows the qualitative relationship between K_{oc} values and compound mobility in the environment.

Table 7-1
K_{oc} vs. Chemical Mobility
151st ARW, Air National Guard, Salt Lake City, Utah

Mobility Class	K_{oc} Value
I - Immobile	> 10,000
II - Low Mobility	500 - 2,000
III - Intermediate Mobility	150 - 500
IV - Mobile	50 - 150
V - Very Mobile	< 50

Source: Adapted from Dragun, 1988
K_{oc} = organic carbon partition coefficient

The movement of organic compounds within groundwater is retarded by sorption onto the organic or mineral fraction of the soil. The mobility of organic solvents in groundwater depends primarily on the K_{oc} value of the compound, the solubility of the chemical, and the organic content of the saturated soil.

7.2.1.4 Vapor Pressure

Vapor pressure is a measure of the volatilization potential of a compound. It is defined as the pressure of vapor in equilibrium with a pure liquid at a given temperature. The higher the vapor pressure the more likely the compound will enter the vapor phase.

7.2.2 Multiphase Contaminant Partitioning

The extent to which contaminants will partition into various phases is dependant upon the chemical properties of the contaminant and the properties of the aquifer matrix. Contaminants in the vadose zone can exist in up to four phases: sorbed to the soil matrix, dissolved in soil gas, solubilized in porewater, or as free product. Contaminants in groundwater can exist in up to three phases: sorbed on the soil matrix, dissolved in the groundwater, or as free product. Contaminants partition into soil gas in the vadose zone when they have high vapor pressures as indicated by Henry's Constants. Contaminants with high organic carbon partition coefficients will generally sorb onto soils. Light or dense free product contaminants occur when vapor pressures are low. Contaminants with high water solubilities readily dissolve into porewater or groundwater.

7.2.2.1 Nonaqueous Phase Liquids

Nonaqueous phase liquids (NAPLs) may be present in unsaturated and/or saturated zones. Two classifications of NAPLs exist, light and dense, based on the unit weight of the NAPL compared to the unit weight of water. Light NAPLs (LNAPLs) are lighter than water and are found floating atop the water table. Dense NAPLs (DNAPLs) are denser than water and are found at the bottom of the aquifer.

LNAPLs consist of petroleum fuels (i.e., gasoline, diesel, and oil) and unchlorinated aliphatic and aromatic hydrocarbons such as benzene, xylene, naphthalene, hexane, ketones, and ethers. LNAPLs do not sink and mainly occur at or near the top of the water table. At Site 8, benzene is considered to be an LNAPL.

DNAPLs consist mainly of halogenated compounds such as PCE, TCA, methylene chloride, carbon tetrachloride, and trichlorotrifluoroethane, pentachlorophenol, coal tar wastes, and pesticides. These type of chemicals can present a long-term potential for groundwater contamination because of their toxicity, limited solubility, and migration potential in both dissolved and free product phases.

DNAPLs may also present a long term problem if it becomes immobilized in the vadose zone. When trapped, the DNAPL may volatilize and vapors sink through the vadose zone to the water table where it may dissolve into groundwater. Infiltration of precipitation may also carry trapped DNAPLs to the water table.

Once within the saturated zone, DNAPLs will sink through the aquifer material until a fine grain zone barrier is encountered. Vertical migration is limited and lateral spreading of the DNAPL occurs usually settling in depressions on top of the confining layer. The trapped DNAPL will remain slowly dissolving into groundwater over a long period of time. DNAPLs at Sites 8 and 10 include 1,1-DCA, 1,1-DCE, TCE and trichlorofluoromethane.

7.2.3 Groundwater Transport Mechanisms

Groundwater transport mechanisms include advection, molecular diffusion and hydrodynamic dispersion. The three mechanisms are discussed below.

7.2.3.1 Advection

Advection is the primary transport mechanism for chemicals in groundwater. Advection results from the mean flow of groundwater that moves under the influence of gravity and/or pressure.

7.2.3.2 Molecular Diffusion

The equalization of a solute in a solution occurs through molecular diffusion. Molecular diffusion is the process by which high concentration zones of solute move to low concentration zones by acting in all directions where any concentration gradient occurs. Differential concentrations are the motivating force for molecular diffusion. Diffusion coefficients for chemicals in groundwater are much smaller than that of water. As a result, molecular diffusion in groundwater is generally ignored because it is a much slower process compared to advection.

7.2.3.3 Hydrodynamic Dispersion

Hydrodynamic dispersion is the spreading of a chemical mass (dispersion) as a result of variation in magnitude and direction of local groundwater velocity along complex flow paths. Local variations in the groundwater mean flow path velocity, resulting from inhomogeneity at both the microscopic and macroscopic scale, is the driving force for dispersion. As a result, a chemical in groundwater will gradually spread and occupy an ever increasing volume of the flow domain, larger than what would be expected based on average flow alone. The effect of dispersion on the spread of compounds in groundwater becomes greater with decreasing hydraulic gradients.

Dispersion occurs along both the direction of flow (longitudinal dispersion) and perpendicular (transverse dispersion) to flow. Longitudinal dispersion is generally one order of magnitude less than advection. Transverse dispersion is much smaller; the ratio of longitudinal to transverse dispersion ranges from 5 to 20.

7.2.4 Biodegradation

Many organic contaminants can degrade through one or more biological chemical reactions. Reduction, hydrolysis, elimination reactions and oxidation are discussed below.

7.2.4.1 Reduction

Reduction is the process where electrons become attached to an ion or molecule. This reaction can occur in soil and groundwater systems that are anaerobic. In general, an organic chemical will undergo chemical reduction if the electrical potential of the soil or groundwater system is less than the electrical potential of the chemical in question.

7.2.4.2 Hydrolysis

When an organic chemical reacts with water or a hydroxide ion to form a hydrolyzed organic compound the process is know as hydrolysis. The main factors that affect the rate of hydrolysis in a soil or groundwater system are the pH of soil particle surfaces, the occurrence of metals in the soil, the adsorption of the organic chemical by the soil, and the soil water content.

7.2.4.3 Elimination Reactions

Elimination reactions consist of the loss of two leaving groups from adjacent atoms within a molecule resulting in the formation of a new double or triple bond. The reaction is controlled by the presence of metals, the adsorption of the organic chemical, and the soil water content.

7.2.4.4 Oxidation

Oxidation is the process of decreasing the number of electrons attached to an ion or molecule. This process results in an organic reaction where the formation of free radicals react with other organic molecules to form additional free radicals. Free radicals are electron-deficient and are biased toward reacting with electron-donating substances such as aromatics.

7.3 FATE AND TRANSPORT AT SITES 8 AND 10

Table 7-2 presents a summary of the CoCs for Sites 8 and 10 and the chemical and physical properties that influence their fate and transport.

Table 7-2
Summary of Chemical and Physical Properties
For Chemicals of Concern at Sites 8 and 10
151st ARW, Air National Guard, Salt Lake City, Utah

Chemical		Aqueous Solubility (mg/l)	Henry's Law Constant (atm-m^3/mole)	Organic Carbon Partition Coefficient (K_{oc}, ml/g)	Vapor Pressure (mm HG @ 20°C)
VOCs	Benzene	1,790	5.43x10^{-3}	84.98	95.19
	1,1-Dichloroethane	5,060	5.87x10^{-3}	38.85	227
	1,1-Dichloroethene	-	-	19.03	-
	cis-1,2-Dichloroethene	-	-	-	-
	Methylene chloride	13,000	2.68x10^{-3}	11.2	-
	Trichloroethene	1,100	1.03x10^{-3}	165.71	69
	1,1,1-Trichloroethane	-	-	-	-
	Trichlorofluoromethane	1,800	9.7x10^{-2}	213.47	802.8
SVOCs	Bis(2-ethylhexyl)phthalate	0.3	1.1x10^{-5}	81,159.72	6.45x10^{-6}
	Di-n-butyl phthalate	11.2	4.6x10^{-7}	33,062.87	1.4x10^{-5}
	2-Methyl naphthalene	-	-	-	-
	Phenanthrene	-	-	-	-
	Pyrene	-	-	-	-
PPMs	Arsenic	-	-	-	0
	Cadmium	-	-	-	0
	Lead	-	-	-	0

7.4 DISCUSSION OF SITE 8 INDICATOR CHEMICAL FATE AND TRANSPORT

This discussion will focus on the fate and transport of Indicator Chemicals at Site 8. Indicator Chemicals are those chemicals that met the following criteria:

- Chemical of Concern
- Present in concentrations above defined ARAR levels

At Site 8 only benzene and trichloroethene were detected at concentrations above ARAR levels. Benzene and TCE will be considered to be indicator chemicals for discussion purposes.

7.4.1 Indicator Chemical Properties - Site 8

Benzene and TCE have Henry's Constants above 1 x 10^{-3}, moderate to high vapor pressures, high solubility and organic carbon partition coefficients that correlate to Classes III and IV (intermediately mobile and mobile) mobility classes, respectively. This suggests that these compounds will readily volatilize, easily dissolve into groundwater, and that they will not easily sorb onto organics in the soil. The contaminants will tend to be leachable and will therefore have the ability to mobilize through site groundwater.

7.4.2 Partitioning of Indicator Chemicals - Site 8

At Site 8 and along 2nd Street to the north and west, within the vadose zone, a trace of benzene was detected in one soil sample and TCE was detected in one soil gas sample and in two soil screening samples. Below the water table, benzene and TCE were detected in both groundwater screening samples and groundwater samples. Table 7-3 presents maximum concentrations of each indicator chemical in its matrix.

7.4.3 Indicator Chemical Groundwater Transport

Benzene is present in groundwater at Site 8 south of the fire station. The main mechanism for transport of benzene appears to be advection and diffusion. The distribution of benzene around the area where the highest concentrations were detected suggests that it is moving in the direction of groundwater flow, however, since the groundwater gradient at Site 8 is relatively flat, diffusion may play as important a role as advection for the transport of benzene.

Benzene's K_{oc} value indicates that it has a limited ability to sorb onto organics in the soil. Only a trace amount of benzene was detected in a single soil screening sample.

Benzene concentrations can be expected to decrease over time as the area of contamination spreads. The spread of contamination can be assumed to be consistent with the average groundwater velocity at the site.

TCE concentrations in groundwater were detected at three locations within the area investigated during the Site 8 RI. One location was within the confines of Site 8 itself, where maximum TCE concentrations were found to be 153.5 μg/l at GP 15 located northwest of the southwest corner of the fire station. The other two locations for TCE contamination were found on Sites

Table 7-3
Maximum Indicator Chemical Concentrations - Site 8
151st ARW, Air National Guard, Salt Lake City, Utah

	Matrix	Indicator Chemical	
		Benzene	TCE
VADOSE	Soil Gas (μg/l)	ND	2.0
	Soil (Screening) (μg/kg)	61	ND
	Soil (μg/kg)	ND	27.5
GW	Groundwater (Screening) (μg/l)	716.3	38,960
	Groundwater (μg/l)	719	352

ND = Not detected

1 and 2. At Site 1, the maximum TCE concentration was 1,143.2 μg/l at GP 9, located along the southern boundary of the base east of Building 1508. At Site 2, the maximum TCE concentration was 38,960 μg/l at GP 35 located in the center of 2nd Street, due north of Building 0213.

Concentrations of TCE in groundwater screening samples are high enough (i.e., greater than one percent of its solubility limit) in Sites 1 and 2 to suggest that pockets of TCE free product may exist in the groundwater, however, no free product was observed during the course of the Site 8 RI. The highest concentrations of TCE were generally found at depths of 13 to 25 feet BGS, which is consistent with TCE being a DNAPL. The movement of dissolved and free product TCE is likely to continue downwards through the saturated soil zone. Its movement will be retarded by local confining units, however, if sand lenses are interconnected, the TCE may continue its downward migration until it is arrested by contact with the regional confining layer. Dissolved TCE will also be transported by groundwater generally at rates at or below the average groundwater velocity. Although TCE would tend to be sorbed onto organic materials present in the site soils, geologic information presented in sections 5.1.1 and 5.3.1 of this report suggests that near surface soils at Site 8 may have a relatively low proportion of organic material in comparison to soils elsewhere in the Salt Lake Valley. Retardation of the TCE contaminant front due to sorption should therefore not be considered a factor at Site 8.

7.4.4 Indicator Chemical Biodegradation - Site 8

Although biodegradation of benzene may be occurring, no data was collected to evaluate this process.

Biodegradation of TCE is occurring at Site 8 as evidenced by the presence of TCE degradation products, such as 1,1-DCE and 1,1-DCA.

7.5 DISCUSSION OF SITE 10 INDICATOR CHEMICALS FATE AND TRANSPORT

This discussion will focus on the fate and transport of Indicator Chemicals at Site 8. Indicator Chemicals are those chemicals that met the following criteria:

- Chemical of Concern
- Present in concentrations above defined ARAR levels

At Site 10, only benzene was detected at a concentration above ARAR levels. Benzene will therefore be considered to be an indicator chemical for discussion purposes.

7.5.1 Indicator Chemical Properties - Site 10

Benzene has a Henry's Constant above 1×10^{-3}, a high vapor pressure, high solubility and an organic carbon partition coefficient with correlates to Class IV mobility, i.e., mobile. This suggests that benzene will readily volatilize, easily dissolve into groundwater and that it will not easily sorb onto organics in the soil. Benzene will tend to be leachable and will therefore have the ability to mobilize though the site groundwater.

7.5.2 Partitioning of Indicator Chemicals - Site 10

At Site 10, within the vadose zone, benzene was detected in soil gas and in soil screening samples. Below the water table, benzene was detected in both groundwater screening samples and groundwater samples. Table 7-4 presents maximum concentrations of benzene detected in each investigated matrix.

The relatively high concentrations of benzene (ranging from 1.1 to 4,976 μg/l) detected in soil gas indicates that it could still be actively vaporizing. However, because the majority of the surface area of Site 10 is paved, any chemicals that volatilize into soil gas will tend to remain trapped beneath the relatively impermeable pavement and will not escape to the atmosphere.

Since benzene was also detected in soil screening samples at concentrations ranging from 3.3 to 3,050 μg/kg, these relatively high concentrations suggest that some sorption onto site soils is taking place. As discussed in Sections 5.1.1 and 5.4.1, near surface soils at Site 10 are likely to consist of organic silts and clays. The presence of benzene in site soils within the vadose zone indicates that some retardation of the contaminant front may be occurring.

7.5.3 Indicator Chemical Groundwater Transport - Site 10

In groundwater screening samples collected at Site 10, benzene concentrations ranged from 1.4 to 10,043 μg/l. However, benzene was not detected in any of the groundwater samples collected from site monitoring wells. This seeming contradiction is largely due to placement requirements for monitoring wells, which at Site 10, placed the wells beyond the leading edge of contamination as established by the groundwater screening data.

Table 7-4
Maximum Indicator Chemical Concentrations - Site 10
151st ARW, Air National Guard, Salt Lake City, Utah

	Matrix	Indicator Chemical
		Benzene
VADOSE	Soil Gas (μg/l)	4,976
	Soil (Screening) (μg/kg)	3,890
	Soil (μg/kg)	3,050
GW	Groundwater (Screening) (μg/l)	10,043
	Groundwater (μg/l)	ND

ND = Not Detected

Since the highest concentration of benzene detected in groundwater screening samples (10,043 μg/l) is approaching one percent of benzene's solubility limit (17,800 μg/l), there is a possibility that free product could exist at the site. Free product was not observed during the course of the Site 10 RI.

As shown on Figure 5-35, the benzene contamination at Site 10 is centered in two locations: near the excavation in the northwest corner of the site and by the dispenser located in the northeastern portion of the site. The movement of benzene is generally in the direction of groundwater flow. It can be anticipated that dissolved benzene will migrate at a rate consistent with the average groundwater flow velocity. Although retardation due to benzene uptake in site soils may slow the movement of the contaminant front, the shallow groundwater gradient suggests that such effects are small.

7.5.4 Indicator Chemical Biodegradation

Although biodegradation of benzene may be occurring, no data was collected to evaluate these processes.

8.0 BASELINE RISK ASSESSMENT

The baseline risk assessment for UANG Sites 8 and 10 evaluates potential risks to human health posed by COCs in soil and groundwater as documented in this RI. Concentrations of COCs detected in site media are used to estimate exposures to human receptors at the site under current and potential future land use scenarios. Exposures are compared to established EPA concentrations to identify acceptable risk levels for adverse health effects and cancer causing potential. EPA determines acceptable concentrations for individual chemicals based on noncarcinogenic (reference doses) and carcinogenic (cancer slope factors [CSF]) effects to quantify risk from chemicals in site media. The results of this analysis will assist in determining if risks at Site 8 or Site 10 are significant and if so support the need to reduced concentrations of COCs by initiating remedial action.

The baseline human health assessment was performed in accordance with current EPA guidance. The assessment conforms with:

- Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual, Part A (EPA, 1989);
- Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual, Standard Default Exposure Factors, Interim Final, March 25, 1991 (EPA, 1991);
- Superfund Exposure Assessment Manual, EPA/540/1-88/001 (EPA, 1988a);
- Exposure Factors Handbook, EPA Office of Health and Environmental Assessment, EPA/600/8-89/043 (EPA, 1989c); and
- Dermal Exposure Assessment: Principles and Applications, EPA/600/8-91/011B (EPA, 1992).

This human health risk assessment follows the outline presented in Risk Assessment Guidance for Superfund, Volume I, Part A (EPA, 1989), although information presented elsewhere in this is not repeated in this section. For example, site background information is presented in Section 2.0, data collection, sample locations, sampling methods and QA/QC methods are presented in Section 4.0, data uncertainty is addressed in Section 8.7, a full characterization of the exposure setting, including discussion of climate, vegetation and soil type are presented in Section 3.0.

This assessment was conducted using EPA's four step process (EPA, 1989). This process integrates information to characterize actual or potential risks to possible receptors. The following steps are addressed for each site:

- Hazard Identification — involves reviewing compounds detected in soil and groundwater media and identifying the most toxic, prevalent, mobile, and/or persistent compounds. Based on this analysis and a comparison to regional background levels, COCs are selected for inclusion in the quantitative analysis of the risk assessment;

- Toxicity Assessment — presents relationship between magnitude of exposure (dose) and occurrence of specific health effects (response) for each COC. Both potential carcinogenic and noncarcinogenic effects are considered;

- Exposure Assessment — evaluates likelihood, magnitude, and frequency of exposure to COCs. Pathways and routes by which human receptors may contact groundwater, surface, and subsurface soil contaminants are identified, the frequency and duration of route-specific exposures are evaluated, and estimates are made of average daily doses or intakes for each COC; and

- Risk Characterization — quantifies increased probability of developing cancer or suffering an adverse noncarcinogenic effect as a result of exposure to site COCs. Construction and potential future industrial use scenarios are examined in this section. Potential uncertainty factors are also discussed.

Sites 8 and 10 were evaluated separately and will be discussed in separate subsections of this risk assessment.

8.1 Site Background

Detailed discussion of background and past history of UANG and Sites 8 and 10 are included in Section 2.0. For the purposes of this risk assessment the following relevant background information is presented.

8.1.1 Site 8

Two USTs were removed from Site 8 in 1992. Water samples collected at the time of tank removal indicated that benzene was present at a concentration of 4 mg/l. The site was later evaluated to determine the extent of soil and groundwater contamination by petroleum products (ES, 1993).

Sampling associated with the identified the presence of VOCs, SVOCs, and inorganic compounds in concentrations greater than background and at concentrations indicating areas of compound release and subsurface migration.

8.1.2 Site 10

The POL Yard consists of an active pumping station and ASTs surrounded by crushed stone and concrete berms. A 3,500-gallon spill of JP-4 and water occurred at the site in 1982. Evidence of petroleum contaminated soil and groundwater was observed in a construction trench.

Sampling associated with the identified the presence of VOCs, SVOCs, and inorganic compounds in concentrations greater than ARARs.

8.2 Hazard Identification

Laboratory analytical data were used to select COCs based on the frequency and concentration detected in each media for each constituent. Data considered were the result of field sampling conducted at Sites 8 and 10. Stone & Webster validated these data using EPA validation protocol. Validated analytical data are presented in Appendix K.

For this risk assessment validated laboratory results were reviewed and adjusted in accordance with EPA guidance (EPA, 1989): data with U or UJ codes (representing nondetects and nondetects with estimated quantitation limits, respectively) had their concentration values halved; data with J codes (representing detects in which quantitation limits reported are estimates) were left unchanged. No other adjustments were made. The adjusted data are presented in Appendix K. Original laboratory analytical data are presented in Appendices E and F.

The adjusted data were averaged within categories used to characterize the site during the RI. The three categories used were groundwater, surface soil, and subsurface soil. Within each category, summary statistics for the minimum, average, and maximum concentrations and the frequency of detection for each analyte. Arithmetic averaging of concentrations was done to account for the heterogeneous nature of the area. Frequency of detection was expressed in "Times Sought" (the number of samples analyzed) and "Times Detected" (the number of samples in which the constituent was detected).

Contaminants were eliminated from consideration in the risk evaluation if they were:

- detected in less than 10 percent of the samples collected from the media;
- detected in a maximum concentration that was less than the most conservative ARAR for the chemical; or
- detected in a maximum concentration less than background for the Base and the region (western United States) (USGS, 1984).

At Site 8 summary statistics are presented in Table 8-1 for groundwater, Table 8-2 for surface soil and Table 8-3 for subsurface soil. Site 8 COCs were determined to be: phenanthrene and pyrene in surface soil; cadmium in surface and subsurface soil; benzene, 1,1-DCA, 1,1-DCE, bis (2-ethylhexyl) phthalate, arsenic, and chromium III in groundwater; and TCE and lead in surface and subsurface soil and groundwater.

Summary statistics for Site 10 sampling results are provided in Table 8-4 for groundwater, Table 8-5 for surface soil, and Table 8-6 for subsurface soil. At Site 10, COCs were determined to be: methylene chloride and bis(2-ethylhexyl) phthalate in surface soil; benzene in subsurface soil; di-n-butyl phthalate, 2-methyl naphthalene, cadmium, and lead in surface and subsurface soil; 1,1-DCA, trichlorofluoromethane, and arsenic in groundwater.

Table 8-1
Groundwater Sample Analysis Summary
IRP Site 8
151st ARW, Air National Guard, Salt Lake City, Utah

Chemicals of Concern	Sample Designation (Round)														
	MW1 (1)	MW2 (1)	MW3 (1)	MW4 (1)	MW5 (1)	MW6 (1)	MW6 (2)	MW7 (1)	MW7 (2)	MW8 (1)	MW8 (2)	MW9 (1)	MW9 (2)	MW10 (1)	MW10 (2)
VOCs (mg/l)															
Benzene	0.0005	0.719	0.522	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
1,1-Dichloroethane	0.0005	0.005	0.011	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
1,1-Dichloroethene	0.0005	0.0005	0.002	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
Trichloroethene	0.009	0.009	0.038	0.027	0.0005	0.0005	0.0005	0.0005	0.0005	0.0012	0.0005	0.0053	0.0037	0.0005	0.0005
SVOCs (mg/l)															
bis(2-ethylhexyl)Phthalate	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.022	0.005	1.5E-05
Metals (mg/l)															
Arsenic	0.085	0.444	0.609	0.375	0.107	0.46	0.394	0.51	0.375	0.79	1.11	1.7	0.686	0.0002	0.626
Lead	0.005	0.005	0.005	0.005	0.034	0.005	0.091	0.011	0.09	0.012	0.02	0.022	0.041	0.84	0.171
Chromium (III)	0.014	0.007	0.007	0.007	0.029	0.035	0.034	0.007	0.026	0.007	0.005	0.012	0.026	0.007	0.096

Notes:

Fish Concentration = Cfish = Cgw x BCF
Cgw = mean concentration in ground water
BCF = Biologic Concentration Factor = chemical specific (in l/kg) (SCDM)
Dilution assumed for ground water volatilization to surface(outdoor air) = 0.0001
Hc = Henry's Law Constant = chemical specific (in atm*m3/mol)
R = Universal Gas Constant = 8.21E-5 atm*m3/mol*K
T = temperature = 293K
Concentration in Vapor = Cair = Cgw x Hc x (1/(R x T)

Table 8-1
Groundwater Sample Analysis Summary
IRP Site 8
151st ARW, Air National Guard, Salt Lake City, Utah

Chemicals of Concern	Sample Designation (Round)														
	MW11 (1)	MW11 (2)	MW12 (1)	MW12 (2)	MCW1 (1)	MCW1 (2)	MCW2 (1)	MCW2 (2)	MCW3 (1)	MCW3 (2)	MCW4 (1)	MCW5 (1)	MCW5 (2)	MCW6 (1)	MCW6 (2)
VOCs (mg/l)															
Benzene	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.001	0.0005	0.0017	0.0014
1,1-Dichloroethane	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0044	0.0073	0.0005	0.0005	0.0005	0.0005	0.0011
1,1-Dichloroethene	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0014	0.0014	0.0023	0.0028
Trichloroethene	0.0005	0.0005	0.0005	0.0005	0.0044	0.005	0.0048	0.002	0.0036	0.004	0.0005	0.164	0.144	0.352	0.19
SVOCs (mg/l)															
bis(2-ethylhexyl)Phthalate	0.005	0.005	0.005	0.005	0.005	0.005	0.186	0.168	0.005	0.005	0.005	0.005	0.028	0.092	0.072
Metals (mg/l)															
Arsenic	0.1	0.136	0.16	0.215	0.216	0.174	1.42	1.55	0.282	0.292	1.61	1.52	1.69	1.07	1.22
Lead	0.005	0.016	0.021	0.061	0.005	0.141	0.46	0.005	0.005	0.056	0.17	0.005	0.126	0.024	0.016
Chromium (III)	0.007	0.005	0.007	0.028	0.039	0.017	0.069	0.005	0.139	0.029	0.13	0.02	0.102	0.033	0.014

Notes:

Fish Concentration = Cfish = Cgw x BCF
Cgw = mean concentration in ground water
BCF = Biologic Concentration Factor = chemical specific (in l/kg) (SCDM)
Dilution assumed for ground water volatilization to surface(outdoor air) = 0.0001
Hc = Henry's Law Constant = chemical specific (in atm*m3/mol)
R = Universal Gas Constant = 8.21E-5 atm*m3/mol*K
T = temperature = 293K
Concentration in Vapor = Cair = Cgw x Hc x (1/(R x T)

Table 8-1
Groundwater Sample Analysis Summary
IRP Site 8
151st ARW, Air National Guard, Salt Lake City, Utah

Chemicals of Concern	Sample Designation (Round)				Times Sought	Times Detected	Summary Statistics		
	MCW7 (1)	MCW7 (2)	MCW8 (1)	MCW8 (2)			Minimum Detected Concentration w/ ND = 1/2DL	Mean Detected Concentration w/ ND = 1/2DL	Maximum Detected Concentration w/ ND = 1/2DL
VOCs (mg/l)									
Benzene	0.0005	0.0005	0.0005	0.0005	36	34	0.0000	0.0370	0.719
1,1-Dichloroethane	0.0005	0.0005	0.0005	0.0005	36	34	0.0000	0.0013	0.011
1,1-Dichloroethene	0.0005	0.0005	0.0005	0.0005	36	33	0.0000	0.0007	0.0028
Trichloroethene	0.0047	0.0052	0.0271	0.0228	36	34	0.0000	0.0304	0.352
SVOCs (mg/l)									
bis(2-ethylhexyl)Phthalate	0.033	0.011	0.17	0.005	35	20	0	0.0281	0.186
Metals (mg/l)									
Arsenic	0.157	0.216	0.48	0.509	34	34	0	0.63	1.7
Lead	0.133	0.225	0.058	0.01	34	34	0	0.09	0.84
Chromium (III)	0.032	0.074	0.097	0.005	34	34	0	0.03	0.14

Notes:

Fish Concentration = Cfish = Cgw x BCF
Cgw = mean concentration in ground water
BCF = Biologic Concentration Factor = chemical specific (in l/kg) (SCDM)
Dilution assumed for ground water volatilization to surface(outdoor air) = 0.0001
Hc = Henry's Law Constant = chemical specific (in atm*m3/mol)
R = Universal Gas Constant = 8.21E-5 atm*m3/mol*K
T = temperature = 293K
Concentration in Vapor = Cair = Cgw x Hc x (1/(R x T)

Table 8-1
Groundwater Sample Analysis Summary
IRP Site 8
151st ARW, Air National Guard, Salt Lake City, Utah

Chemicals of Concern	Biologic Concentration Factors Food Chain Fresh Water (l/kg)	Fish Concentration based on Mean (mg/kg)	Vapor Concentration based on Mean (mg/m^3)
VOCs (mg/l)			
Benzene	5,000	1.85E+02	8.36E-04
1,1-Dichloroethane	5	6.37E-03	3.11E-05
1,1-Dichloroethene	50	3.62E-02	0.00E+00
Trichloroethene	50	1.52E+00	1.30E-03
SVOCs (mg/l)			
bis(2-ethylhexyl)Phthalate	50,000	1.40E+03	1.28E-06
Metals (mg/l)			
Arsenic	ND	ND	ND
Lead	ND	ND	ND
Chromium (III)	ND	ND	ND

Notes:

Fish Concentration = Cfish = Cgw x BCF
Cgw = mean concentration in ground water
BCF = Biologic Concentration Factor = chemical specific (in l/kg) (SCDM)
Dilution assumed for ground water volatilization to surface(outdoor air) = 0.00
Hc = Henry's Law Constant = chemical specific (in atm*m3/mol)
R = Universal Gas Constant = 8.21E-5 atm*m3/mol*K
T = temperature = 293K
Concentration in Vapor = Cair = Cgw x Hc x (1/(R x T)
ND = Not determined

Table 8-2
Surface Soil Sample Analysis Summary
IRP Site 8
151st ARW, Air National Guard, Salt Lake City, Utah

Chemicals of Concern	Sample Designation (Depth)						Times Sought	Times Detected	Minimum Detected Concentration w/ ND=1/2 DL	Mean Detected Concentration w/ ND=1/2 DL	Maximum Detected Concentration w/ ND=1/2 DL
	SB-1 (0-2 ft)	SB-2 (0-2 ft)	SB-4 (0-2 ft)	SB-5 (0-2 ft)	SB-9 (0-2 ft)	SB-10 (0-2 ft)					
SVOCs (mg/kg)											
Phenanthrene	0.165	0.165	0.165	0.49	ND(0.33)	0.165	6	5	0	0.23	0.49
Pyrene	0.165	0.165	0.165	0.72	ND(0.33)	0.165	6	5	0	0.28	0.72
Metals (mg/kg)											
Cadmium	1	1.2	0.25	0.25	0.9	0.95	6	6	0.25	0.76	1.2
Lead	30	20	7.1	8.6	9	22.6	6	6	7.1	16.22	30

Notes:

ERR = no values for Koc available to estimate Cair

Fish Concentration = Cfish = Cgw x BCF

Cgw = mean concentration in ground water

BCF = Biologic Concentration Factor = chemical specific (in l/kg) (SCDM)

Concentration in Vapor = Cair = Cgw x Hc x (1/(R x T)

Cgw = Csoil x (1/(Koc x foc))

Hc = Henry's Law Constant = chemical specific (in atm*m^3/mol)

R = constant = 8.21E-5 atm*m^3/mol*K

T = temperature = 293K

Koc = organic carbon partition coefficient = chemical specific

foc = soil organic carbon content, assume = 0.6

ND = Not detected above detection limit shown in parentheses

Table 8-2
Surface Soil Sample Analysis Summary
IRP Site 8
151st ARW, Air National Guard, Salt Lake City, Utah

Chemicals of Concern	Western US Background (mg/kg)	Mean Concentration in Fugitive Dust* (mg/m^3)	Concentration in Vapor based on mean in soil (mg/m^3)	Indoor Air Concentration dilution factor (mg/m^3)	Outdoor Air Concentration dilution factor (mg/m^3)
SVOCs (mg/kg)					
Phenanthrene	NA	1.15E-06	NC	NC	NC
Pyrene	NA	1.38E-06	NC	NC	NC
Metals (mg/kg)					
Cadmium	NA	3.79E-06	NA	NA	NA
Lead	<10-700	8.11E-05	NA	NA	NA

Notes:
ERR = no values for Koc available to estimate Cair
Fish Concentration = Cfish = Cgw x BCF
Cgw = mean concentration in ground water
BCF = Biologic Concentration Factor = chemical specific (in l/kg) (SCDM)
Concentration in Vapor = Cair = Cgw x Hc x (1/(R x T)
Cgw = Csoil x (1/(Koc x foc))
Hc = Henry's Law Constant = chemical specific (in atm*m^3/mol)
R = constant = 8.21E-5 atm*m^3/mol*K
T = temperature = 293K
Koc = organic carbon partition coefficient = chemical specific
foc = soil organic carbon content, assume = 0.6
* Assume 5 mg soil/m^3 air
NC = Not calculated
NA = Not available

Table 8-3
Subsurface Soil Sample Analysis Summary
IRP Site 8
151st ARW, Air National Guard, Salt Lake City, Utah

Chemicals of Concern	Sample Designation (Depth)														
	SB-1 (2-4 ft)	SB-1 (4-6 ft)	SB-2 (2-4 ft)	SB-2 (4-6 ft)	SB-3 (2-4 ft)	SB-3 (4-6 ft)	SB-4 (2-4 ft)	SB-4 (4-6 ft)	SB-5 (2-4 ft)	SB-5 (4-6 ft)	SB-6 (2-4 ft)	SB-6 (4-6 ft)	SB-7 (2-4 ft)	SB-7 (4-6 ft)	SB-8 (2-4 ft)
VOCs (mg/kg)															
Trichloroethene	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.003	0.003	0.0025	0.0025	0.003	0.0025
Metals (mg/kg)															
Cadmium	0.25	2.3	0.95	1.1	0.97	1.3	0.95	0.25	1	1	1.2	1.2	0.9	0.86	0.73
Lead	24	34	16	21	17.8	24.5	18.6	12.4	16.1	14.6	16.8	19.7	11.9	16.4	8.2

Table 8-3
Subsurface Soil Sample Analysis Summary
IRP Site 8
151st ARW, Air National Guard, Salt Lake City, Utah

Chemicals of Concern	Sample Designation (Depth)					Times Sought	Times Detected	Summary Statistics			Western US Background (mg/kg)	Mean Concentration i Fugitive Dust (mg/m^3)
	SB-8 (4-6 ft)	SB-9 (2-4 ft)	SB-9 (4-6 ft)	SB-10 (2-4 ft)	SB-10 (4-6 ft)			Minimum Detected Concentration w/ND=1/2 DL	Mean Detected Concentration w/ND=1/2 DL	Maximum Detected Concentration w/ND=1/2 DL		
VOCs (mg/kg)												
Trichloroethene	0.0025	0.0025	0.0025	0.0275	0.0132	19	20	0.0025	0.0043	0.0025		2.14E-08
Metals (mg/kg)												
Cadmium	1.02	0.7	0.93	0.95	0.91	19	20	0.25	0.97	2.3		4.87E-06
Lead	14.5	8.6	17.4	19.4	21.8	19	20	8.2	17.69	34	<10-700	8.84E-05

Table 8-4
Groundwater Sampling Analytical Summary
IRP Site 10
151st ARW, Air National Guard, Salt Lake City, Utah

Chemicals of Concern	Sample					Times Sought	Times Detected	Summary Statistics			Biologic Concentration Factors Food Chain Fresh Water (l/kg)	Fish Concentration based on Mean (mg/kg)	Oudoor Air Vapor Concentration based on Mean (mg/m^3)
	MW01	MW02	MW03	MW04	MW05			Minimum Detected Concentration w/ ND = 1/2	Mean Detected Concentration w/ ND = 1/2	Maximum Detected Concentration w/ ND = 1/2			
VOCs (mg/l)													
1,1-Dichloroethane	0.0005	0.0005	0.0006	0.0005	0.0005	5	5	0.0005	0.0005	0.0006	5	0.0026	1.27E-05
Trichlorofluoromethane	0.0005	0.0005	0.0005	0.0051	0.0027	5	5	0.0005	0.0019	0.0051	50	0.093	7.50E-04
Metals (mg/l)													
Arsenic	0.076	0.025	0.025	0.025	0.18	5	5	0.025	0.0662	0.18	5	0.331	0

Notes:

Fish Concentration = Cfish = Cgw x BCF
Cgw = mean concentration in ground water
BCF = Biologic Concentration Factor = chemical specific (in l/Kg) (SCDM)
Concentration in Vapor = Cair = Cgw x Hc x (1/(R x T)
Hc = Henry's Law Constant = chemical specific (in atm*m3/mol)
R = constant = 8.21E-5 atm*m3/mol*K
T = temperature = 293K
Dilution assumed for ground water volatilization to surface (outdoor air) = 0.0001

Table 8-5
Surface Soil Analytical Summary
IRP Site 10
151st ARW, Air National Guard, Salt Lake City, Utah

Chemicals of Concern	Sample Designation (Depth)								Times Sought	Times Detected
	SB-5 0-2 ft	SB-6 0-2 ft	SB-7 0-2 ft	SB-8 0-2 ft	SB-9 0-2 ft	SB-10 0-2 ft	SB-11 0-2 ft	SB-12 0-2 ft		
VOCs (mg/kg)										
Methylene chloride	0.0025	0.0025	0.0025	0.0025	0.0114	0.0025	0.0025	0.0025	8	8
SVOCs (mg/kg)										
bis(2-ethylhexyl)Phthalate	0.57	0.165	0.165	0.165	0.165	0.165	0.165	0.165	8	8
di-n-Butyl phthalate	1.89	0.165	0.46	0.165	0.165	0.165	0.51	0.165	8	8
2-Methyl naphthalene	0.165	0.165	0.165	0.165	0.165	0.165	0.165	0.165	0.165	0.165
Metals (mg/kg)										
Cadmium	0.68	1.1	0.25	0.92	0.7	0.72	1.1	0.75	8	7
Lead	7.3	23	13	12	7.4	21	22	14.2	8	8

Notes:

Fish Concentration = Cfish = Cgw x BCF
Cgw = mean concentration in ground water
BCF = Biologic Concentration Factor = chemical specific (in l/Kg) (SCDM)
Concentration in Vapor = Cair = Cgw x Hc x (1/(R x T)
Cgw = Csoil x (1/(Koc x foc))

Hc = Henry's Law Constant = chemical specific (in atm*m3/mol)
R = Universal Gas Constant = 8.21E-5 atm*m3/mol*K
T = temperature = 293K
Koc = organic carbon partition coefficient = chemical specific
foc = soil organic carbon content, assume = 0.6

Table 8-5
Surface Soil Analytical Summary
IRP Site 10
151st ARW, Air National Guard, Salt Lake City, Utah

Chemicals of Concern	Summary Statistics							
	Minimum Detected Concentration w/ ND = 1/2DL	Mean Detected Concentration w/ ND = 1/2DL	Maximum Detected Concentration w/ ND = 1/2DL	Western US Background (mg/kg)	Mean Concentration in Fugitive Dust* (mg/m^3)	Concentration in Vapor based on mean in soil (mg/m^3)	Indoor Air Concentration dilution factor (mg/m^3)	Outdoor Air Concentration dilution factor (mg/m^3)
VOCs (mg/kg)								
Methylene chloride	0.0025	0.004	0.0114		1.81E-08	5.99E-02	5.99E-06	5.99E-05
SVOCs (mg/kg)								
bis(2-ethylhexyl)Phthalate	0.165	0.216	0.57		1.08E-06	2.02E-06	2.02E-10	2.02E-09
di-n-Butyl phthalate	0.165	0.461	1.89		2.30E-06	4.44E-07	4.44E-11	4.44E-10
2-Methyl naphthalene	0.165	0.165	0.165		NC	NC	0	0
Metals (mg/kg)								
Cadmium	0.25	0.85	1.1		4.26E-06	NC	0	0
Lead	7.3	14.99	23	<10-700	7.49E-05	NC	0	0

* Assume 5 mg soil/m^3 air

NC = Not calculated

Table 8-6
Subsurface Soil Analytical Summary
IRP Site 10
151st ARW, Air National Guard, Salt Lake City, Utah

Chemicals of Concern	Sample Designation (Depth)												
	SB-5 (2-4 ft)	SB-5 (4-6 ft)	SB-6 (2-4 ft)	SB-6 (4-6 ft)	SB-7 (2-4 ft)	SB-7 (4-6 ft)	SB-8 (2-4 ft)	SB-8 (4-6 ft)	SB-9 (2-4 ft)	SB-9 (4-6 ft)	SB-10 (2-4 ft)	SB-10 (4-6 ft)	SB-10 (6-8 ft)
VOCs (mg/kg)													
Benzene	0.0025	0.0025	0.662	3.050	0.0104	0.0025	0.0025	0.0025	0.0358	0.0033	0.0025	0.0025	0.0025
SVOCs (mg/kg)													
di-n-Butyl phthalate	0.38	0.165	0.46	0.165	0.56	0.165	0.165	0.165	0.165	0.165	0.165	0.165	0.165
2-Methyl naphthalene	0.165	0.165	0.165	0.64	0.165	0.165	0.165	0.165	0.165	0.165	0.165	0.165	0.165
Metals (mg/kg)													
Cadmium	1.9	1.9	1.5	1.2	1.2	1.2	0.99	0.9		1.4		0.77	1.6
Lead	190	130	18	18	15	18	12	21	6.1	19	19	11	23

Table 8-6
Subsurface Soil Analytical Summary
IRP Site 10
151st ARW, Air National Guard, Salt Lake City, Utah

Chemicals of Concern	Sample Designation (Depth)				Times Sought	Times Detected	Summary Statistics			
	SB-11 (2-4 ft)	SB-11 (4-6 ft)	SB-12 (2-4 ft)	SB-12 (4-6 ft)			Minimum Detected Concentration w/ ND = 1/2DL	Mean Detected Concentration w/ ND = 1/2DL	Maximum Detected Concentration w/ ND = 1/2DL	Mean Concentration in Fugitive Dust* (mg/m^3)
VOCs (mg/kg)										
Benzene	0.159	0.191	0.0025	0.0025	17	17	0	0.243	3.05	1.22E-06
SVOCs (mg/kg)										
di-n-Butyl phthalate	0.165	0.165	0.165	0.165	18	17	0	0.22	0.56	1.09E-06
2-Methyl naphthalene	0.165	1.050	0.165	0.165	18	17	0	0.25	1.05	1.23E-06
Metals (mg/kg)										
Cadmium	0.99	1.2	0.51	1.12	17	15	0	1.23	1.9	6.13E-06
Lead	27	17	18	22.5	17	17	0	34.39	190	1.72E-04

* Assume 5 mg constituent/m^3 air

Table 8-7 lists the COCs included in the quantitative portion of the baseline risk assessment for Sites 8 and 10.

8.3 Toxicity Assessment

This section presents information that relates constituent exposure (dose) to anticipated health effects (response) for each COC identified in Section 8.2. Health criteria derived from dose-response data are used in this risk assessment to estimate the noncarcinogenic and carcinogenic risks associated with exposure to COCs.

8.3.1 Noncarcinogenic Dose-Response

Compounds with known or potential noncarcinogenic effects are assumed to have a dose below which no adverse effect occurs. This dose is a threshold and is called the no observed adverse effect level (NOAEL). The lowest dose at which an adverse effect occurs is called the lowest observed adverse effect level (LOAEL). By applying uncertainty factors to the NOAEL or the LOAEL, reference doses (RfDs) for chronic exposures to contaminants with noncarcinogenic effects have been developed by the EPA.

Uncertainty factors account for uncertainties associated with the dose-response value such as the effects of using an animal study to derive a human dose-response value, extrapolating from high to low doses, and evaluating sensitive subpopulations. For compounds with noncarcinogenic effects, the RfD provides reasonable certainty that the specified exposure dose is below the threshold and that no noncarcinogenic health effects are expected to occur even if daily exposures were to occur for a lifetime.

8.3.2 Carcinogenic Dose-Response

The cancer slope factor is the measure of the cancer causing potential of a chemical. These factors are derived by EPA from animal bioassay experiments and/or epidemiological studies. The derivation is such that estimates of risks obtained from use of CSFs is designed to be conservative and represents an upper bound on the risk.
CSFs derived for ingestion routes of exposure are also used for the dermal absorption route. The oral slope factor is an upper bound on the ratio of increase in cancer risk to lifetime average daily ingested dose rate. Inhalation slope factors represent an upper bound estimate of increased lifetime cancer risk via daily inhalation of a specific compound.

The EPA Human Health Assessment Group (HHAG) classifies contaminants according to their carcinogenic potentials. Five classifications have been developed:

Group A	Human Carcinogen: sufficient evidence of carcinogenicity in humans;
Group B	Probable Human Carcinogen: B1 - limited evidence of carcinogenicity in humans; B2 - sufficient evidence of carcinogenicity in animals with inadequate or lack or evidence in humans;
Group C	Possible Human Carcinogen: limited evidence of carcinogenicity in animals and inadequate or lack of human data;

Table 8-7
Chemicals of Concern
IRP Sites 8 and 10
151st ARW, Air National Guard, Salt Lake City, Utah

VOCs	
	Benzene
	Ethylbenzene
	Toluene
	Xylenes
	1,1-Dichloroethane
	1,1-Dichloroethene
	Methylene chloride
	Trichloroethene
	Trichlorofluoromethane
SVOCs	
	bis(2-ethylhexyl)Phthalate
	di-n-Butyl phthalate
	2-Methyl naphthalene
	Phenanthrene
	Pyrene
Metals	
	Arsenic
	Cadmium
	Lead

Group D	Not classified: no data to evaluate or evidence for carcinogenicity in humans and inadequate evidence in animals at best; and
Group E	No Evidence of Carcinogenicity to Humans: no evidence for carcinogenicity, in at least two adequate animals tests in different species or in both epidemiologic and animal studies.

Information was gathered for each COC from the Integrated Risk Information System (IRIS) database (1994) (provided by the EPA and used as the primary source). The Health Effects Assessment Summary Table (HEAST) (1993) is used as a secondary source.

Tables 8-8 and 8-9 summarize the toxicity values and potential noncarcinogenic and carcinogenic effects, respectively, attributed to chemicals considered under this risk assessment. Table 8-8 presents noncarcinogenic effects of COCs in a quantitative manner and describes confidence levels, critical effects, uncertainty and modifying factors, and sources of the data. Table 8-9 presents toxicity values and carcinogenic effects for COCs including slope factors, weight of evidence classification, type of cancer, and the data source.

8.4 Exposure Assessment

The exposure assessment evaluates likelihood, magnitude, and frequency of exposure to the COCs at each site. In the exposure assessment, pathways and routes by which onsite and offsite receptors may contact contaminants are identified.

Physical characteristics of the site were examined in order to assess pathways by which human onsite receptors may be exposed to COCs in site soil and groundwater. Exposure scenarios were developed based on demographics, land use, and human behavior patterns under a reasonable worst case scenario. Estimates of exposure dose are calculated for each exposure pathway and receptor population under both present and potential future site conditions.

8.4.1 Characterization of Exposure Setting

Physical characteristics of the site and available information on possible human receptors on the site were assessed to determine which parameters might influence exposure to site contaminants and to help identify exposure pathways.

8.4.2 Physical Setting Characterization

A detailed description of the site is provided in Section 2.2.1. This section provides a summary of those site features relevant to defining the potential exposure pathways.

Site 8 contains the UANG fire station (Building 10) where several people are stationed full time. There is a small gym at the site that Base personnel often use for 1 hour daily workouts. Site 8 is equipped with a gas grill and picnic tables where Base workers were observed to take lunch. There is also a small (10-person) classroom at the site used for training.

Table 8-8
Chemicals of Concern, Noncarcinogenic Toxicity Values
IRP Sites 8 and 10
151st ARW, Air National Guard, Salt Lake City, Utah

Chemicals of Concern	Chronic RfD (mg/(kg*day)) Ingestion	Inhalation	Confidence Level	Critical Effect	Source	Uncertainty and Modifying Factors
VOCs						
Benzene	ND	ND	ND	ND	ND	ND
1,1-Dichloroethane	1.0E-01	1.4E-01	ND	ND	b	ND
1,1-Dichloroethylene	9.0E-03	ND	medium	hepatic lesions	a	UF=1000 MF=1
Methylene chloride	6.0E-02	8.6E-01	ND	ND	a,b	ND
Trichloroethene	ND	ND	ND	ND	b	ND
Trichlorofluoromethane	3.0E-01	2.0E-01	medium	survival and histopathology	a,b	UF=1000 MF=1
SVOCs						
bis(2-ethylhexyl)Phthalate	2.0E-02	ND	medium	increased liver weight	a	UF=1000 MF=1
di-n-Butyl phthalate	1.0E-01	ND	low	increased mortality	a	UF=1000 MF=1
2-Methyl naphthalene	ND	ND	ND	ND	ND	ND
Phenanthrene	ND	ND	ND	ND	ND	ND
Pyrene	3.0E-02	ND	low	kidney effects	a	UF=3000 MF=1
Metals						
Cadmium	5.1E-04	ND	high	significant proteinuria	a,b	UF=10 MF=1
Lead	ND	ND	ND	ND	ND	ND
Arsenic	ND	ND	ND	ND	ND	ND

Notes a = IRIS 1995
b = US EPA Superfund Chemical Data Matrix, July 1994.
* = cross-assigned from naphthalene
ND = Not determined

Table 8-9
Chemicals of Concern, Carcinogenic Toxicity Values
IRP Sites 8 and 10
151st ARW, Air National Guard, Salt Lake City, Utah

Chemicals of Concern	Slope Factor (SF) (/mg/(kg*day))		Drinking Water Unit Risk (/ug/l)	Inhalation Unit Risk (/ug/m^3)	Weight of Evidence Classification	Type of Cancer	Source
	Ingestion	Inhalation					
VOCs							
Benzene	2.9E-02	2.9E-02	8.3E-07	8.3E-06	A	leukemia	a
1,1-Dichloroethane	ND	ND	ND	ND	C	ND	a
1,1-Dichloroethylene	6.0E-01	1.8E-01	1.7E-05	5.0E-05	C	adrenal pheochromocytomes, kidney adenocarcinomas	a
Methylene chloride	7.5E-03	1.6E-03	2.1E-07	4.7E-07	B2	hepatocellular adenomas/carcinomas	a
Trichloroethene	1.1E-02	6.0E-03	ND	ND	ND	ND	b
Trichlorofluoromethane	ND	ND	ND	ND	ND	ND	ND
SVOCs							
bis(2-ethylhexyl)Phthalate	1.4E-02	ND	4.0E-07	ND	B2	liver, hepatocellular carcinoma and adenoma	a
di-n-Butyl phthalate	ND	ND	ND	ND	D	ND	a
2-Methyl naphthalene	ND	ND	ND	ND	D	ND	*
Phenanthrene	ND	ND	ND	ND	D	ND	a
Pyrene	ND	ND	ND	ND	D	ND	a
Metals							
Cadmium	ND	6.3E+00	ND	1.8E-03	B1	lung, trachea, bronchus, and cancer deaths	a
Lead	ND	ND	ND	ND	B2	ND	a
Arsenic	ND	ND	ND	ND	ND	ND	ND

Notes: a = IRIS 1995
b = US EPA Superfund Chemical Data Matrix, July 1994.
* = cross-assigned from naphthalene
ND = Not determined

Since the removal of USTs at Site 8, the surface soil remains exposed. No pavement, grass, or landscaping have been replaced and therefore this area may permit the generation of airborne dust. The UANG plans to repave the site in the future.

Site 10 contains the UANG POL Yard with an active refueling station and ASTs. At Site 10, exposed surface soil may permit the generation of airborne dust. The UANG plans to repave the whole site in the future.

8.4.3 Potential Receptor Populations and Exposure Pathways

Demographics and land use information are assessed to determine present and potential future populations that work or may otherwise spend time in or near Sites 8 or 10. Exposure pathways for both Sites 8 and 10, considered in this risk assessment are summarized in Table 8-10.

8.4.3.1 Site 8

Current Use/Onsite Worker

Between two and five people were reported to work 40 hours per week, manning the fire station at Site 8. An onsite worker may be exposed to COCs via inhalation of volatile compounds from soil and groundwater in indoor and outdoor air, ingestion of COCs that adsorb to soil particulates transported as fugitive dust, or via dermal contact to COCs in surface soil.

Future Use/Onsite Worker

According to the UANG, future land use for the site will remain the same as current use. Therefore, the same exposures to COCs for current use will occur for onsite workers in the future use scenario.

Current Use/Maintenance Worker

The maintenance worker scenario represents an individual who spends part of every work day at the site (assumed 10 out of 40 hours per week). While on site, the maintenance worker may be exposed via inhalation of volatile COCs in soil and groundwater in indoor and outdoor air, via inhalation and ingestion of COCs that adsorb to soil particulates transported as fugitive dust, or via dermal contact to COCs in surface soil.

Future Use/Maintenance Worker

According to the UANG, future land use for the site will remain the same as current use. Therefore, the same exposures to COCs for current use will occur for maintenance workers in the future use scenario.

Table 8-10
Exposure Pathways Considered for Potential Receptors
IRP Sites 8 and 10
151st ARW, Air National Guard
Salt Lake City, Utah

Exposure Pathway	Potential Receptors							Rationale for Pathway Selection
	Maintenance Worker		Onsite Worker		Construction Worker	Occasional Offsite User		
	Current	Future	Current	Future	Future	Current	Future	
Surface Soil								
Inhalation of surface soil volatiles in indoor air	yes	yes	yes	yes	NA	NA	NA	Receptors may contact indoor air at the sites
Inhalation of surface soil volatiles in outdoor air	yes	yes	yes	yes	yes	NA	NA	Outdoor workers may contact outdoor air at the sites
Inhalaltion of fugitive dust	yes	yes	yes	yes	yes	NA	NA	Outdoor workers may contact fugitive dust
Incidental Ingestion	yes	yes	yes	yes	yes	NA	NA	Outdoor workers may contact surface soil
Dermal Contact	yes	yes	yes	yes	yes	NA	NA	Outdoor workers may contact surface soil
Groundwater								
Dermal Contact with groundwater	NA	NA	NA	NA	yes	NA	NA	Construction workers may contact groundwater in excavations
Ingestion of fish from local surface water	NA	NA	NA	NA	NA	yes	yes	Occasional users may eat fish caught in the surface water bodies
Inhalation of groundwater volatiles in outdoor air	yes	yes	yes	yes	yes	NA	NA	Outdoor workers may contact outdoor air at the sites
Subsurface Soil								
Inhalation of fugitive dust from subsurface soil	NA	NA	NA	NA	yes	NA	NA	Construction workers may contact fugitive dust in excavations
Incidental Ingestion of subsurface soil	NA	NA	NA	NA	yes	NA	NA	Construction workers may contact subsurface soil in excavations
Dermal Contact with subsurface soil	NA	NA	NA	NA	yes	NA	NA	Construction workers may contact subsurface soil in excavations

NA = Not applicable

Future Use/Construction Worker

The UANG has proposed that the entire site be repaved in the future. These activities in addition to buried utility maintenance are reflected in the potential future construction worker scenario for the site. It was assumed that construction workers would experience exposures to COCs similar to those for onsite and maintenance workers in addition to exposures to COCs through direct contact with groundwater and subsurface soils, inhalation of fugitive dust from subsurface soil, and incidental ingestion of subsurface soils as a result of working in excavations.

Current and Future Use/Offsite Users

Under the reasonable worst case scenario, it was assumed that the residents residing near the UANG Base may use the storm water drain canal for recreation and sport fishing. Based on information that identified the presence of carp in the canal downgradient of the site, although unlikely, it was assumed that it is possible for that recreational users may wade in the canal and consume the fish they catch.

8.4.3.2 Site 10

Current Use/Onsite Worker

The UANG employs five people at Site 10, 40 hours per week, maintaining and operating the refueling station. An onsite worker may be exposed via inhalation of COCs that volatilize to indoor and outdoor air from soil and groundwater, via inhalation and ingestion of COCs that adsorb to soil particulates transported as fugitive dust, or via dermal contact to surface soil.

Other Scenarios

Scenarios for the future use onsite worker, the current use maintenance worker, the future use maintenance worker, the future use construction worker, and the current and future use offsite user for Site 10 are consistent with the scenarios for Site 8, as discussed above.

8.4.4 Fate and Transport of Contaminants

Chemical fate and transport is controlled by physical and chemical properties of both the constituent and the media in which the chemical was found. Relevant physical and chemical properties for COCs are presented in Table 8-11. The table lists key parameters influencing constituent behavior in the environment.

Parameter values were derived under certain control conditions and therefore do not necessarily reflect site conditions. However, these properties can be used as a relative guide to estimate the likelihood of a constituent to persist, partition, or migrate in the environment. Those contaminants with relatively high octanol-water coefficient (K_{ow}) and organic carbon partition coefficient (K_{oc}) values will tend to adsorb to soil and persist for longer time periods. Contaminants with higher solubilities will be more mobile within groundwater and soil moisture, and contaminants with higher Henry's Law constants will tend to partition to air more readily.

Table 8-11
Physical and Chemical Properties - Chemicals of Concern
IRP Sites 8 and 10
151st ARW, Air National Guard, Salt Lake City, Utah

Chemicals of Concern	Molecular Weight	Water Solubility @ 25° C (mg/l)	Vapor Pressure @ 25° C (mm Hg)	Henry's Law Constant (atm-m^3/mol)	Log Octanol-Water Partition Coefficient Log K_{ow}	Source
VOCs						
Benzene	78.11	1791	95.2	5.43E-03	2.13	a
1,1-Dichloroethane	98.96	5060	227.0	5.87E-03	1.79	a
1,1-Dichloroethene	97.00	2250	NA	NA	1.84	e
Methylene chloride	84.94	13000	434.9	2.68E-03	1.25	a
Trichloroethene	131.40	1100	69.0	1.03E-02	2.42	a
Trichlorofluoromethane	137.38	1080	802.8	9.70E-02	2.53	a
SVOCs						
bis(2-ethylhexyl)Phthalate	390.54	0.3	6.45E-06	1.10E-05	5.11	a
di-n-Butyl phthalate	278.34	11.2	1.40E-05	4.60E-07	4.72	a
2-Methyl naphthalene	142.20	25.4	NA	NA	4.11	e
Phenanthrene	178.23	NA	NA	NA	NA	e
Pyrene	202.26	NA	NA	NA	NA	e
Metals						
Arsenic	74.90	NA	0	NA	NA	b,c
Cadmium	112.40	NA	0	NA	NA	b,c
Lead	207.20	NA	0	NA	NA	b,c

References:

(a) Howard, P.H. 1990. Handbook of Environmental Fate and Exposure Data for Organic Chemicals, Lewis Publisher

(b) ENVIROFATE database.

(c) CONCAWE, 4/79, Protection of Groundwater from 0.1 Pollution referenced in USEPA, 3/90, Basic Pump-and-Treat Groundwater Remediation Technology, EPA/600/8-90/003.

(d) Chevron USA, Inc. 1988, Product Salesfax Digest referenced in USEPA, 1990 (see ref b.)

(e) Superfund Public Health Evaluation Manual USEPA, 1986

Note: Values used for xylene correspond to 1,4-xylene.
NA = Not Available

These properties were used to estimate the exposure point concentrations of contaminants that partition from groundwater to air and surface soil to air. The migration of contaminants from groundwater to air at the capillary fringe was modeled using the following relationship:

$$C_{air} = C_{gw} \text{ x } H_c \text{ x } (1/(R \text{ x } T)) \text{ x } CF_{lm3}$$

where:

C_{air} = concentration of contaminant in air (in mg/m^3)
C_{gw} = concentration of contaminant in groundwater (in mg/l)
H_c = Henry's law constant (in atm*m^3/mol)
R = universal gas constant = 8.21E-5 atm*m^3/mol*K
T = temperature (in Kelvin) = 293 K
CF_{lm3} = conversion factor = 1000 l/m^3

The migration of contaminants from soil to groundwater as pore water above the saturated zone was modeled using the following relationship:

$$C_{gw} = C_{soil} \text{ x } (1/(K_{oc} \text{ x } f_{oc}))$$

where:

C_{gw} = concentration of contaminant in groundwater (in mg/l)
C_{soil} = concentration of contaminant in soil (in mg/kg)
K_{oc} = organic carbon partition coefficient (in kg/l)
f_{oc} = soil organic carbon content (unitless)

A value of 0.6 was assigned to f_{oc}, representing the clayey silty soil that is found at the site. These relationships were used to model the partitioning of contaminants based on the mean detected concentration of contaminants in each media.

Estimated concentrations of contaminants in indoor and outdoor air breathing zones were modeled assuming dilution of contaminants from the air at the capillary zone (based on groundwater contaminant concentrations) and in pore spaces in the soil (based on surface soil contaminant concentrations).

Air concentrations at pore spaces in the soil were assumed to be diluted by 0.01 percent to indoor air. This dilution is based on the assumption that 1 percent of the air present at pore spaces in soil migrates to the surface, and 1 percent of the air present at the surface migrates through the foundation of onsite buildings. Air concentrations at pore spaces in the soil were assumed to be diluted by 0.1 percent to outdoor air. This dilution is based on the assumption that 0.1 percent of the air present at pore spaces in soil migrates to the surface into the breathing zone of outdoor workers.

Air concentrations at the capillary zone were assumed to be diluted by 0.0001 percent to indoor air. This dilution is based on the assumption that 0.1 percent of the air present at the capillary zone migrates to the surface, and 0.1 percent of the air present at the surface migrates through the foundation of onsite buildings (this assumes a 1 percent dilution into the building and a 1 percent dilution into the breathing zone). Air concentrations at the capillary zone were assumed to be diluted by 0.01 percent to outdoor air. This dilution is based on the assumption that 1 percent of the air present at the capillary zone migrates to the surface, and 1 percent of the air present at the surface moves into the breathing zone.

Fugitive dust contaminant concentrations were estimated based on the generation of the maximum allowable OSHA nuisance level for particulate dust (5 mg_{soil}/m^3_{air}) using the following relationship:

$$C_{fd} = C_{soil} \times 5\ mg_{soil}/m^3_{air} \times CF_{km}$$

where:
C_{fd} = contaminant concentration in fugitive dust
5 mg_{soil}/m^3_{air} = OSHA nuisance level for fugitive dust in air
CF_{km} = conversion factor = 1 kg/1000 mg

Concentrations of contaminants in fish were modeled based on the mean concentration detected in groundwater at the site and the biologic concentration factor as presented in Table 8-1 for Site 8, and Table 8-4 for Site 10. Fish concentrations were therefore estimated using the following relationship:

$$C_{fish} = C_{gw} \times BCF \times CF_{lkg}$$

where:
C_{fish} = contaminant concentration in fish
C_{gw} = contaminant concentration in groundwater
BCF = biologic concentration factor
CF_{lkg} = conversion factor = 1 l/1 kg

Exposure point concentrations estimated using these relationships are presented in Table 8-1 for groundwater, Table 8-2 for surface soil, and Table 8-3 for subsurface soil at Site 8. Exposure point concentrations used in the Site 10 risk assessment are presented in Table 8-4 for groundwater, Table 8-5 for surface soil, and Table 8-6 for subsurface soil.

8.4.5 Exposure Parameters

Table 1 in Appendix K summarizes the exposure parameters included in the intake calculations.

Risk assessment guidelines developed by the EPA (EPA, 1988a)(EPA, 1989)(EPA, 1991) were used for selection of exposure parameters, in addition to consideration of site-specific factors discussed above. For all exposures, the concentration of each chemical used to estimate risk to receptors is the media specific average concentration of the chemical detected at the site.

The same exposure frequencies were used in intake calculations for all routes of exposure (dermal contact, inhalation, and ingestion) for both noncarcinogenic and carcinogenic risk estimates. For the current and future use scenarios for onsite workers and the future use scenario for construction workers, an exposure frequency of 250 days per year is used, representing an occupational exposure frequency of 5 days per week for 50 weeks per year (EPA, 1991). For the current and future use scenario for maintenance workers, an exposure frequency of 63 days per year was used, corresponding to 2 hours per day, 5 days per week (one quarter of the onsite worker exposure). The exposure frequency for the offsite user was conservatively assumed to be 52 days per year. This represents a frequency of onsite visits once a week for 52 weeks per year (i.e., this assumes that use would be consistent regardless of seasonal and inclement weather).

Exposure duration for the future construction workers was estimated at 2 years. This duration is considered conservative, based on the extent of proposed future construction at Site 8.

For the current and future use scenario of the offsite user, exposure duration was anticipated to be 10 years, while the current and future onsite and maintenance workers are expected to have an exposure duration of 25 years (EPA, 1991). These exposure durations are also conservative.

A body weight of 70 kg was used for the current and future construction worker and the current and future onsite and maintenance workers. This weight was based on the standard for an adult male (EPA, 1989b). For purposes of conservatism, the offsite user for this analysis represents a young adult, age 15 years old, weighing 50 kg. One of the assumptions of this risk assessment is that there will be no exposures to children. Therefore, using the 50-kg youth is representative of a more conservative value than that of the average adult (at 70 kg).

For calculation of intake via dermal absorption, a soil contact rate of 500 mg/day was based on the following (EPA, 1989b):

$$\text{Soil contact rate} = AF \times SA$$

where:

AF = soil to skin adherence factor = 0.5 mg/cm^2

SA = skin surface area exposed = 1000 cm^2, or 50% of the total potential exposed area

For calculation of intake via dermal absorption from surface water, the following equation was used (EPA, 1992):

$$\text{Dermal Absorbed Dose (mg/cm}^2\text{*day)} = K_p \times C_w \times CF_{lcm3} \times t_{event}$$

where:

K_p = permeability coefficient from water (cm/hr)

C_w = concentration of contaminant in water (mg/l)

CF_{lcm3} = conversion factor from l to cm^3 = 1000 l/m^3 x m^3/1,000,000 cm^3

t_{event} = duration of event (hr/day)

Averaging time for all routes of exposure is 25,550 days for carcinogenic risk. This is based on the standard lifetime exposure of 70 years, 365 days per year. Averaging time for noncarcinogenic risk varies according to the exposure duration. It is derived by multiplying the exposure duration by 365 days/year (EPA, 1994). These values are detailed in Table 1, Appendix K.

For all exposure scenarios, inhalation intake calculations were based on an inhalation rate of 20 m^3/day (EPA, 1991).

Estimates of risk from incidental ingestion were based on a soil ingestion rate of 50 mg/day for onsite and maintenance workers, and 100 mg/day for construction workers (EPA, 1991).

Offsite users were assumed to ingest 0.054 mg of locally caught fish per day (Superfund Chemical Data Matrix, 1994).

Relative absorption factors used in intake calculations vary depending on the route of exposure and specific COC. Values used for relative absorption are detailed in Table 2, Appendix K. For inhalation intakes, the relative absorption factors are always equal to one, based on an assumption of 100 percent absorption via inhalation (EPA, 1989b).

8.4.6 Estimation of Potential Exposure Doses

The exposure point concentration is the amount of constituent in an environmental medium (i.e., soil) to which one may be exposed (i.e., the measured concentration in the soil). Exposure point concentration is expressed in units of mass per unit volume (mg/m^3) or mass per unit weight (mg/kg or mg/l). It is necessary to distinguish exposure point concentration from the "exposure dose." Exposure dose refers to resulting human exposure from a particular concentration in the medium and is expressed in units of mg/kg/day.

The concentration of each COC was averaged separately for groundwater, surface soil, and subsurface soil at each site. For purposes of this risk assessment, soil exposures are evaluated in two separate groups, surface soil (0 to 2 feet in depth) and subsurface soil (2 to 6 feet in depth). Arithmetic average concentrations are used for these calculations as discussed with the explanation of data validation.

In order to quantitatively assess the risk posed by one or more contaminants in a media, the exposure dose of each constituent was estimated. The general equation used to calculate an exposure dose is the total amount of constituent exposure divided by body weight and period over which exposure is to be averaged:

$$I = \frac{CA \times IR \times ET \times EF \times ED \times RAF}{BW \times AT}$$

where:

I = intake (mg/kg/day)
CA = concentration of constituent in soil (air for inhalation)
IR = intake (contract) rate
RAF = relative absorption factor (unitless) (for dermal contact and ingestion)
ET = exposure time (hours per day)
EF = exposure frequency (days/year)
ED = exposure duration (years)
BW = body weight (kg)
AT = averaging time (days)

Results of intake calculations for each pathway are presented in Appendix K.

8.5 Field Screening Analysis

Field screening data were also evaluated in this risk assessment. Screening data collected during field sampling at UANG were not validated and therefore are presented separately in this assessment. Groundwater and subsurface soil screening samples collected at Sites 8 and 10 were considered because they may be more representative estimates of COC concentrations at the site. Maximum detected concentrations in field screening data from Sites 8 and 10 were evaluated.

VOCs were detected at both sites in concentrations exceeding those present in validated laboratory data.

Field screening data collected from Site 8 identified the following COCs: c-DCE, TCA, TCE, and benzene in groundwater; and TCE and toluene in subsurface soil. Site 8 field screening data are presented in Table 8-12 for groundwater and Table 8-13 for subsurface soil. Field screening data collected from Site 10 identified the following COCs: TCA in groundwater; and benzene, toluene, ethyl benzene, and xylenes in groundwater and subsurface soil. Site 10 screening data are presented in Table 8-14 for groundwater and Table 8-15 for subsurface soil.

Estimations of risk using screening data are presented in Appendix K, Tables 1 through 20. These results are discussed in the risk characterization section of this assessment.

8.6 Risk Characterization

The risk characterization process estimates magnitude of potential human health risks associated with exposure to COCs. This step combines the results of both the toxicity assessment and the exposure assessment to estimate potential risks to human health.

8.6.1 Noncarcinogenic Risk Characterization Methodology

A measure of noncarcinogenic effect of exposure to a hazardous constituent is defined by EPA as the Noncancer Hazard Quotient (HQ). EPA defines the HQ as the ratio of absorbed dose of a constituent and the RfD. The HQ for a site is an aggregate summary measure of risk estimated for the site. It is the sum of all HQs calculated for any individual exposed at the site.

$$HQ = I/RfD$$

where:

HQ = Noncancer Hazard Quotient
I = Intake
RfD = Reference dose

A hazard index for the site that is less than unity (1.0) indicates absence of noncarcinogenic health effects. A hazard index exceeding unity does not necessarily imply a noncancer health effect, but does indicate necessity for further assessment of component hazard quotients, and consideration of different end points in the toxicity assessment.

Oral RfDs were used to evaluate noncarcinogenic risk associated with dermal exposure to COCs. It was assumed in the case of noncarcinogenic effects that doses absorbed via the skin exhibit the same systemic toxic effects as observed via the oral exposure route.

8.6.2 Carcinogenic Risk Characterization Methodology

Lifetime cancer risk is an estimate of the increases in cancer risk that may be caused by conditions at the site. Risk characterization involves estimating an upper bound probability that cancer will occur in the potentially exposed population as a result of exposure to COCs.

Table 8-12
Groundwater Screening Samples Analytical Summary
IRP Site 8
151st ARW, Air National Guard, Salt Lake City, Utah

Chemicals of Concern	Sample Designation (Round)																
	GP4 (1)	GP4 (2)	GP5 (1)	GP5 (2)	GP6 (1)	GP6 (2)	GP7 (1)	GP7 (2)	GP8 (1)	GP13 (1)	GP13 (2)	GP14 (1)	GP14 (2)	GP15 (1)	GP15 (2)	GP22 (1)	GP22 (2)
Volatile Organic Compounds (mg/l)																	
cis-1,2 Dichloroethene	0.0232	0.0003	0.1351	0.0003	0.0003	0.0003	0.0026	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0208	0.0003	0.0820	0.0003
1,1,1 Trichloroethane	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0065	0.0044	0.0003	0.0003	0.0003
Trichloroethene	0.0162	0.0042	0.0956	0.0041	0.0031	0.0025	0.0097	0.0022	0.0003	0.0202	0.0069	0.0003	0.0039	0.1535	0.0055	0.0140	0.0003
Benzene	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.6275	0.0077	0.0003	0.0003	0.0003	0.0003

Table 8-12
Groundwater Screening Samples Analytical Summary
IRP Site 8
151st ARW, Air National Guard, Salt Lake City, Utah

Chemicals of Concern	Times Sought	Times Detected	Summary Statistics			Biologic Concentration Factors Food Chain Fresh Water (l/kg)	Fish Concentration based on Mean (mg/kg)	Vapor Concentration based on Mean (mg/m^3)
			Minimum Detected Concentration w/ ND = 1/2DL	Mean Detected Concentration w/ ND = 1/2DL	Maximum Detected Concentration w/ ND = 1/2DL			
Volatile Organic Compounds (mg/l)								
cis-1,2 Dichloroethene	19	17	0.0003	0.0157	0.1351	5	7.84E-02	2.20E-04
1,1,1 Trichloroethane	19	17	0.0003	0.0009	0.0065	5	4.31E-03	2.87E-05
Trichloroethene	19	17	0.0003	0.0201	0.1535	50	1.01E+00	8.62E-04
Benzene	19	17	0.0003	0.0376	0.6275	5,000	1.88E+02	8.48E-04

Notes:
Fish Concentration = Cfish = Cgw x BCF
Cgw = mean concentration in ground water
BCF = Biologic Concentration Factor = chemical specific (in l/kg) (SCDM)
Concentration in Vapor = Cair = Cgw x Hc x (1/(R x T) x dilution factor
Hc = Henry's Law Constant = chemical specific (in atm*m^3/mol)
R = constant = 8.21E-5 atm*m^3/mol*K
T = temperature = 293K
Dilution assumed for ground water volatilization to surface air = 0.0001

Table 8-13
Subsurface Soil Screening Samples Analytical Summary
IRP Site 8
151st ARW, Air National Guard, Salt Lake City, Utah

Chemicals of Concern	Sample Designation (Depth)		Times Sought	Times Detected	Summary Statistics			
	GP14 S1 (3.5-4 ft)	GP15 S1 (4.0-4.5 ft)			Minimum Detected Concentration w/ND=1/2 DL	Mean Detected Concentration w/ND=1/2 DL	Maximum Detected Concentration w/ND=1/2 DL	Mean Concentration in Fugitive Dust* (mg/m^3)
<u>Volatile Organic Compounds (mg/kg)</u>								
Trichloroethene	0.003	0.006	2	2	0.003	0.004	0.006	2.13E-08
Toluene	0.019	0.003	2	2	0.003	0.011	0.019	5.38E-08

* Assume 5 mg constituent/m3 air

Table 8-14
Groundwater Screening Samples Analytical Summary
IRP Site 10
151st ARW, Air National Guard, Salt Lake City, Utah

Chemicals of Concern	Sample Designation (Round)												
	GP2 (1)	GP3 (1)	GP4 (1)	GP4 (2)	GP5 (1)	GP6 (1)	GP6 (2)	GP7 (1)	GP7 (2)	GP8 (1)	GP8 (2)	GP9 (2)	GP11 (1)
Volatile Organic Compounds (mg/l)													
1,1,1 Trichloroethane	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.0012	0.00025	0.0007	0.00025	0.00025
Benzene	0.0532	0.1115	10.043	3.4136	0.0046	0.0059	0.0014	0.0195	0.0132	0.00025	0.00025	0.00025	0.0012
Toluene	0.0168	0.0319	3.5045	0.036	0.00025	0.00025	0.00025	0.00025	0.00025	0.012	0.00025	0.00025	0.00025
Ethylbenzene	0.6001	0.0181	3.8262	0.0464	0.0016	0.0019	0.0014	0.0054	0.0045	0.057	0.0024	0.00025	0.00025
Total Xylenes	0.0392	0.0954	22.867	0.0951	0.0096	0.0144	0.0035	0.0418	0.0329	0.08974	0.0034	0.0031	0.0029

Table 8-14
Groundwater Screening Samples Analytical Summary
IRP Site 10
151st ARW, Air National Guard, Salt Lake City, Utah

Chemicals of Concern	Sample Designation (Round)												
	GP12 (2)	GP13 (1)	GP13 (2)	GP14 (1)	GP14 (2)	GP15 (1)	GP16 (1)	GP17 (1)	GP17 (2)	GP18 (1)	GP18 (2)	GP19 (1)	GP19 (2)
Volatile Organic Compounds (mg/l)													
1,1,1 Trichloroethane	0.00025	0.00025	0.0009	0.00025	0.00025	0.0006	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025
Benzene	0.1451	0.0016	0.0052	0.00025	0.0069	3.5958	0.2581	0.4225	0.4163	0.5429	0.0454	0.00025	6.9681
Toluene	0.00025	0.00025	0.00025	0.0339	0.0402	0.0358	0.0053	0.00025	0.00025	0.4226	0.0054	1.4287	0.00025
Ethylbenzene	0.00025	0.00025	0.00025	0.00025	0.0098	0.0845	0.0231	0.00025	0.00025	0.1469	0.00025	1.6417	0.00025
Total Xylenes	0.0122	0.00025	0.0028	0.0145	0.0207	0.2689	0.0569	0.0373	0.0377	0.2643	0.018	3.1412	0.00025

Table 8-14
Groundwater Screening Samples Analytical Summary
IRP Site 10
151st ARW, Air National Guard, Salt Lake City, Utah

Chemicals of Concern	Times Sought	Times Detected	Summary Statistics			Biologic Concentration Factors Food Chain Fresh Water (l/kg)	Fish Concentration based on Mean (mg/kg)	Vapor Concentration based on Mean (mg/m^3)
			Minimum Detected Concentration w/ ND = 1/2DL	Mean Detected Concentration w/ ND = 1/2DL	Maximum Detected Concentration w/ ND = 1/2DL			
Volatile Organic Compounds (mg/l)								
1,1,1 Trichloroethane	26	26	0.00025	0.0003	0.0012	5	1.71E-03	1.14E-05
Benzene	26	26	0.00025	1.0029	10.043	5,000	5.01E+03	4.29E-02
Toluene	26	26	0.0000114	0.2145	26	50	1.07E+01	6.85E-03
Ethylbenzene	26	26	0.00025	0.2490	5015	50	1.24E+01	0.00E+00
Total Xylenes	26	26	0.0000114	1.0451	50	500	5.23E+02	0.00E+00

Notes:

Fish Concentration = Cfish = Cgw x BCF

Cgw = mean concentration in ground water

BCF = Biologic Concentration Factor = chemical specific (in l/Kg) (SCDM)

Concentration in Vapor = Cair = Cgw x Hc x (1/(R x T)

Hc = Henry's Law Constant = chemical specific (in atm*m3/mol)

R = constant = 8.21E-5 atm*m3/mol*K

T = temperature = 293K

Dilution assumed for ground water volatilization to surface air = 0.0001

Table 8-15
Subsurface Soil Screening Samples Analytical Summary
IRP Site 10
151st ARW, Air National Guard, Salt Lake City, Utah

Chemicals of Concern	Sample Designation (Depth)										
	GP2 S1 (4.0-4.5)	GP3 S1 (4.0-4.5)	GP4 S1 (4.0-4.5)	GP11 S1 (4.0-4.5)	GP12 S1 (4.0-4.5)	GP14 S1 (4.0-4.5)	GP15 S1 (4.0-4.5)	GP16 S1 (4.0-4.5)	GP18 S1 (4.0-4.5)	GP19 S1 (4.0-4.5)	GP20 S1 (4.0-4.5)
Volatile Organic Compounds (mg/lg)											
Benzene	0.003	0.003	3.891	0.003	2.855	0.390	0.003	0.003	0.003	0.003	0.003
Toluene	0.003	0.003	0.935	0.003	2.369	2.948	0.003	0.003	5.913	0.003	0.003
Ethylbenzene	2.111	0.003	8.100	1.604	2.826	1.443	0.003	0.003	2.602	0.634	2.686
Total Xylenes	2.143	0.142	58.819	0.543	14.045	13.179	0.552	0.582	22.613	1.379	5.408

Table 8-15
Subsurface Soil Screening Samples Analytical Summary
IRP Site 10
151st ARW, Air National Guard, Salt Lake City, Utah

Chemicals of Concern	Times Sought	Times Detected	Summary Statistics			
			Minimum Detected Concentration w/ ND = 1/2DL	Mean Detected Concentration w/ ND = 1/2DL	Maximum Detected Concentration w/ ND = 1/2DL	Mean Concentration in Fugitive Dust* (mg/m^3)
Volatile Organic Compounds (mg/lg)						
Benzene	11	11	0.003	0.651	3.891	3.25E-06
Toluene	11	11	0.003	1.108	5.913	5.54E-06
Ethylbenzene	11	11	0.003	2.001	8.100	1.00E-05
Total Xylenes	11	11	0.142	10.855	58.819	5.43E-05

* Assume 5 mg soil/m^3 air

CSFs for compounds with potential carcinogenic effects are multiplied by the estimated lifetime average daily doses to predict an upper bound estimate of the likelihood, over and above the background cancer rate, that an exposed individual will develop cancer in his or her lifetime.

The CSF is generally defined as the upper 95 percent confidence limit of the slope of the dose-response curve and is the result of the application of a low dose extrapolation procedure. While oral slope factors are available for many of the COCs, no dermal slope factors currently exist. Therefore, oral slope factors were applied in dermal risk calculations.

Total incremental lifetime cancer risk is calculated for each exposure pathway by summing the risk for each individual constituent of concern. Total incremental lifetime cancer risk to an individual is calculated by summing cancer risk estimates for each exposure pathway for a particular receptor.

$$\text{Cancer Risk} = \text{CDI} \times \text{CSF}$$

where:
CDI = chronic daily intake of constituent over 70 years
CSF = cancer slope factor for constituent

Mathematical models used to extrapolate animal data to humans are statistical models that yield a distribution of cancer potency estimates. Due to uncertainty in the cancer potency estimation, regulatory agencies use the "upper-bound" estimate of the cancer potency to avoid the possibility of underestimating risk to humans. Therefore, actual cancer risk is likely to be lower than estimated risk.

Tables 8-16 and 8-17 summarize the non-cancer risk and cancer risk from each exposure pathway for both present and future land use scenarios.

8.6.3 Risk Interpretation

EPA has not defined what constitutes a significant or insignificant level of risk, although the agency has designated an overall risk-based cleanup goal for Superfund sites, specifically a total excess lifetime cancer risk of 1.00E-4 to 1.00E-6 (EPA, 1989). This risk is interpreted as increasing the odds of a person contracting cancer by one person in 10,000 to one person in one million people over the course of a lifetime. The NCP and the State of Utah specify an acceptable cancer risk range for Superfund sites of approximately 1.00E-4 to 1.00E-6 per environmental medium (EPA, 1989 and Utah, 1995). This may be interpreted as a goal to which cancer risk is to be reduced for a particular site.

Like the incremental cancer risk estimates, the HQ describes an incremental level of concern for noncarcinogenic effects. For noncarcinogenic compounds, the EPA Region 8 office states that HQ values less than 1 are acceptable and HQ values greater that 10 are of concern such that they are likely to warrant remediation (EPA, 1989). The State of Utah guidance states that if the HQ is less than 1 no remediation plan is required (Utah, 1995).

8.6.4 Risk Characterization for Receptors

Table 8-16 summarizes the carcinogenic and noncarcinogenic risks identified at Site 8.

8.6.4.1 Site 8

Onsite Worker

Under the current and future onsite worker scenarios, estimated noncarcinogenic risks are within acceptable limits. The total estimated hazard quotient for the current scenario is 8.44E-04 and for the future scenario is 7.50E-4. The total estimated increased cancer risks are 3.92E-06 for both the current and future scenarios. This increased risk is interpreted as increasing the risk of a current or future site worker contracting cancer over the course of a lifetime by approximately four in one million. The majority of these risks result from the inhalation of cadmium in fugitive dust and benzene in groundwater vapor.

Maintenance Worker

Under the current and future maintenance worker scenarios, estimated carcinogenic and noncarcinogenic risks are within acceptable limits. The total estimated hazard quotient for both the current and future use scenarios is 1.88E-4. The total estimated increased cancer risk for the current and future use scenarios is 9.87E-07 (increase in risk by approximately 10 in 10,000,000).

Construction Worker

Estimated carcinogenic and noncarcinogenic risks to current and future construction workers at Site 8 are within acceptable limits. The total estimated increased cancer risk for both the current and future scenarios is 4.85E-07 (increase risk in cancer cases by 5 in 10,000,000). The total estimated hazard quotient is 1.67E-03.

Offsite User

The estimated total cancer and noncancer risks downgradient of the site posed by contaminants at Site 8 are within acceptable levels. The total hazard quotient is 1.17E-08. The total increased cancer risk is 1.19E-10 (increase risk of cancer by 1 in 10 billion).

Risks identified using soil and groundwater screening data at Site 8 are within acceptable limits for carcinogenic and noncarcinogenic risks.

8.6.4.2 Site 10

Table 8-17 summarizes the carcinogenic and noncarcinogenic risks identified at Site 10.

Table 8-16
Summary Results of Intake Calculations for Site 8
151st ARW, Air National Guard
Salt Lake City, Utah

Table Number	Exposure Scenario	Site Number	Exposure Pathway	Risk Type	Total Increased Cancer Risk	Hazard Quotient
1	Current Onsite Worker	8	Inhalation	Noncarcinogenic		0.00E+00
2		8	Indoor Air	Carcinogenic	0.00E+00	
3		8	Inhalation	Noncarcinogenic		0.00E+00
4		8	Outdoor Air	Carcinogenic	0.00E+00	
5		8	Inhalation	Noncarcinogenic		0.00E+00
6		8	Fugitive Dust	Carcinogenic	1.67E-06	
7		8	Ingestion	Noncarcinogenic		8.26E-04
8		8	Surface Soil	Carcinogenic	0.00E+00	
9		8	Dermal	Noncarcinogenic		2.25E-06
10		8	Surface Soil	Carcinogenic	0.00E+00	
11		8	Inhalation	Noncarcinogenic		1.55E-05
12		8	GW Vapor	Carcinogenic	2.25E-06	
	Total				3.92E-06	8.44E-04
13	Future Onsite Worker	8	Inhalation	Noncarcinogenic		0.00E+00
14		8	Indoor Air	Carcinogenic	0.00E+00	
15		8	Inhalation	Noncarcinogenic		0.00E+00
16		8	Outdoor Air	Carcinogenic	0.00E+00	
17		8	Inhalation	Noncarcinogenic		0.00E+00
18		8	Fugitive Dust	Carcinogenic	1.67E-06	
19		8	Ingestion	Noncarcinogenic		7.32E-04
20		8	Surface Soil	Carcinogenic	0.00E+00	
21		8	Dermal	Noncarcinogenic		2.25E-06
22		8	Surface Soil	Carcinogenic	0.00E+00	
23		8	Inhalation	Noncarcinogenic		1.55E-05
24		8	GW Vapor	Carcinogenic	2.25E-06	
	Total				3.92E-06	7.50E-04
25	Current Maintenance Worker	8	Inhalation	Noncarcinogenic		0.00E+00
26		8	Indoor Air	Carcinogenic	0.00E+00	
27		8	Inhalation	Noncarcinogenic		0.00E+00
28		8	Outdoor Air	Carcinogenic	0.00E+00	
29		8	Inhalation	Noncarcinogenic		0.00E+00
30		8	Fugitive Dust	Carcinogenic	4.21E-07	
31		8	Ingestion	Noncarcinogenic		1.84E-04
32		8	Surface Soil	Carcinogenic	0.00E+00	
33		8	Dermal	Noncarcinogenic		5.67E-07
34		8	Surface Soil	Carcinogenic	0.00E+00	
35		8	Inhalation	Noncarcinogenic		3.91E-06
36		8	GW Vapor	Carcinogenic	5.66E-07	
	Total				9.87E-07	1.88E-04

Table 8-16
Summary Results of Intake Calculations for Site 8
151st ARW, Air National Guard
Salt Lake City, Utah

Table Number	Exposure Scenario	Site Number	Exposure Pathway	Risk Type	Total Increased Cancer Risk	Hazard Quotient
37	Future Maintenance	8	Inhalation	Noncarcinogenic		0.00E+00
38	Worker	8	Indoor Air	Carcinogenic	0.00E+00	
39		8	Inhalation	Noncarcinogenic		0.00E+00
40		8	Outdoor Air	Carcinogenic	0.00E+00	
41		8	Inhalation	Noncarcinogenic		0.00E+00
42		8	Fugitive Dust	Carcinogenic	4.21E-07	
43		8	Ingestion	Noncarcinogenic		1.84E-04
44		8	Surface Soil	Carcinogenic	0.00E+00	
45		8	Dermal	Noncarcinogenic		5.67E-07
46		8	Surface Soil	Carcinogenic	0.00E+00	
47		8	Inhalation	Noncarcinogenic		3.91E-06
48		8	GW Vapor	Carcinogenic	5.66E-07	
	Total				9.87E-07	1.88E-04
49	Future Construction	8	Inhalation	Noncarcinogenic		0.00E+00
50	Worker	8	Outdoor Air	Carcinogenic	0.00E+00	
51		8	Inhalation	Noncarcinogenic		0.00E+00
52		8	Fugitive Dust	Carcinogenic	1.34E-07	
53		8	Ingestion	Noncarcinogenic		7.32E-04
54		8	Surface Soil	Carcinogenic	0.00E+00	
55		8	Dermal	Noncarcinogenic		2.25E-06
56		8	Surface Soil	Carcinogenic	0.00E+00	
57		8	Inhalation	Noncarcinogenic		0.00E+00
58		8	GW Vapor	Carcinogenic	1.37E-03	
59		8	Inhalation	Noncarcinogenic		1.24E-06
60		8	GW Vapor	Carcinogenic	1.80E-07	
61		8	Inhalation	Noncarcinogenic		0.00E+00
62		8	Subsurface Dust	Carcinogenic	1.71E-07	
63		8	Ingestion	Noncarcinogenic		9.34E-04
64		8	Subsurface Soil	Carcinogenic	6.55E-13	
65		8	Dermal	Noncarcinogenic		0.00E+00
66		8	Subsurface Soil	Carcinogenic	0.00E+00	
	Total				1.37E-03	1.67E-03
67	Current Offsite	8	Ingestion	Noncarcinogenic		1.17E-08
68	Receptor	8	Fish	Carcinogenic	1.19E-10	
69	Future Offsite	8	Ingestion	Noncarcinogenic		1.17E-08
70	Receptor	8	Fish	Carcinogenic	1.19E-10	
	Total				2.38E-10	2.34E-08

Onsite Worker

Under the current and future onsite worker scenarios, estimated carcinogenic and noncarcinogenic risks are within acceptable limits. The total estimated hazard quotient for current and future onsite workers is 1.02E-03. The total estimated increased cancer risk for the current and future scenarios is 1.89E-06 (increased cancer risk by approximately 2 in one million), indicating no significant increase in potential risk to future onsite workers.

Maintenance Worker

Under the current and future maintenance worker scenarios, estimated carcinogenic and noncarcinogenic risks are within acceptable limits. The total estimated hazard quotient for the current and future use scenarios is 2.80E-4. The total estimated increased cancer risk for the current and future use scenarios is 4.75E-7 (increased cancer risk by approximately 5 in 10,000,000), indicating no significant increase in potential risk to future onsite workers.

Construction Worker

Estimated carcinogenic and noncarcinogenic risks to future construction workers are within acceptable limits. The total estimated increased cancer risk to future construction workers is 2.29E-03 (increasing the risk by approximately 2 in 1,000 over the course of a lifetime), indicating no significant increase in potential risk to future construction workers.

Offsite User

The estimated total cancer and noncancer risks downgradient of the site posed by contaminants at Site 10 are within acceptable levels. The total hazard quotient is 4.00E-12. The total increased cancer risk is 1.19E-10 (increasing risk by approximately 1 in 10 billion), indicating no significant increase in potential risk to future onsite workers.

Risks identified using soil and groundwater screening data at Site 10 are within acceptable risk limits for carcinogenic and noncarcinogenic risks.

8.7 Uncertainty Discussion

Carcinogenic and noncarcinogenic risk estimates presented in this report are not intended to be calculations of absolute risk. Uncertainties prevent the exact determination of risk to possible receptor populations. This risk assessment provides a basis for determining whether soil remediation or groundwater treatment or containment need to be considered to assure reasonably safe circumstances for use of the sites. Specific sources of uncertainty for this assessment are described below:

- Uncertainty is introduced by utilizing a finite data set characterizing Sites 8 and 10. The investigation program was developed to provide representative information on site conditions as related to past waste source and disposal activities.

Table 8-17
Summary Results of Intake Calculations for Site 10
151st ARW, Air National Guard
Salt Lake City, Utah

Table Number	Exposure Scenario	Site Number	Exposure Pathway	Risk Type	Total Increased Cancer Risk	Hazard Quotient
1	Current Onsite Worker	10	Inhalation	Noncarcinogenic		4.88E-07
2		10	Indoor Air	Carcinogenic	6.88E-10	
3		10	Inhalation	Noncarcinogenic		1.37E-05
4		10	Outdoor Air	Carcinogenic	6.88E-09	
5		10	Inhalation	Noncarcinogenic		4.12E-09
6		10	Fugitive Dust	Carcinogenic	1.88E-06	
7		10	Ingestion	Noncarcinogenic		7.32E-04
8		10	Surface Soil	Carcinogenic	5.32E-10	
9		10	Dermal	Noncarcinogenic		3.91E-06
10		10	Surface Soil	Carcinogenic	2.87E-10	
11		10	Inhalation	Noncarcinogenic		2.68E-04
12		10	GW Vapor	Carcinogenic	0.00E+00	
	Total				1.89E-06	1.02E-03
13	Future Onsite Worker	10	Inhalation	Noncarcinogenic		4.88E-07
14		10	Indoor Air	Carcinogenic	6.88E-10	
15		10	Inhalation	Noncarcinogenic		1.37E-05
16		10	Outdoor Air	Carcinogenic	6.88E-09	
17		10	Inhalation	Noncarcinogenic		4.12E-09
18		10	Fugitive Dust	Carcinogenic	1.88E-06	
19		10	Ingestion	Noncarcinogenic		8.26E-04
20		10	Surface Soil	Carcinogenic	5.32E-10	
21		10	Dermal	Noncarcinogenic		3.91E-06
22		10	Surface Soil	Carcinogenic	2.87E-10	
23		10	Inhalation	Noncarcinogenic		2.64E-04
24		10	GW Vapor	Carcinogenic	0.00E+00	
	Total				1.89E-06	1.11E-03
25	Current Maintenance Worker	10	Inhalation	Noncarcinogenic		1.23E-07
26		10	Indoor Air	Carcinogenic	1.73E-10	
27		10	Inhalation	Noncarcinogenic		3.44E-06
28		10	Outdoor Air	Carcinogenic	1.73E-09	
29		10	Inhalation	Noncarcinogenic		1.04E-09
30		10	Fugitive Dust	Carcinogenic	4.73E-07	
31		10	Ingestion	Noncarcinogenic		2.08E-04
32		10	Surface Soil	Carcinogenic	0.00E+00	
33		10	Dermal	Noncarcinogenic		9.86E-07
34		10	Surface Soil	Carcinogenic	7.24E-11	
35		10	Inhalation	Noncarcinogenic		6.76E-05
36		10	GW Vapor	Carcinogenic	0.00E+00	
	Total				4.75E-07	2.80E-04

Table 8-17
Summary Results of Intake Calculations for Site 10
151st ARW, Air National Guard
Salt Lake City, Utah

Table Number	Exposure Scenario	Site Number	Exposure Pathway	Risk Type	Total Increased Cancer Risk	Hazard Quotient
37	Future Maintenance Worker	10	Inhalation	Noncarcinogenic		1.23E-07
38		10	Indoor Air	Carcinogenic	1.73E-10	
39		10	Inhalation	Noncarcinogenic		3.44E-06
40		10	Outdoor Air	Carcinogenic	1.73E-09	
41		10	Inhalation	Noncarcinogenic		1.04E-09
42		10	Fugitive Dust	Carcinogenic	4.73E-07	
43		10	Ingestion	Noncarcinogenic		2.08E-04
44		10	Surface Soil	Carcinogenic	1.34E-10	
45		10	Dermal	Noncarcinogenic		9.86E-07
46		10	Surface Soil	Carcinogenic	7.24E-11	
47		10	Inhalation	Noncarcinogenic		6.76E-05
48		10	GW Vapor	Carcinogenic	0.00E+00	
	Total				4.75E-07	2.80E-04
49	Future Construction Worker	10	Inhalation	Noncarcinogenic		1.37E-05
50		10	Outdoor Air	Carcinogenic	5.51E-10	
51		10	Inhalation	Noncarcinogenic		4.12E-09
52		10	Fugitive Dust	Carcinogenic	1.50E-07	
53		10	Ingestion	Noncarcinogenic		8.26E-04
54		10	Surface Soil	Carcinogenic	8.52E-11	
55		10	Dermal	Noncarcinogenic		3.91E-06
56		10	SurfaceSoil	Carcinogenic	2.30E-11	
57		10	Inhalation	Noncarcinogenic		2.68E+00
58		10	GW Vapor	Carcinogenic	0.00E+00	
59		10	Inhalation	Noncarcinogenic		2.68E-04
60		10	GW Vapor	Carcinogenic	0.00E+00	
61		10	Inhalation	Noncarcinogenic		0.00E+00
62		10	Subsurface Dust	Carcinogenic	2.16E-07	
63		10	Ingestion	Noncarcinogenic		1.18E-03
64		10	Subsurface Soil	Carcinogenic	9.86E-11	
65		10	Dermal	Noncarcinogenic		0.00E+00
66		10	Subsurface Soil	Carcinogenic	4.93E-10	
	Total				3.67E-07	2.68E+00
67	Current Offsite Receptor	10	Ingestion	Noncarcinogenic		1.17E-08
68		10	Fish	Carcinogenic	1.19E-10	
69	Future Offsite Receptor	10	Ingestion	Noncarcinogenic		4.00E-12
70		10	Fish	Carcinogenic	0.00E+00	
	Total				1.19E-10	1.17E-08

- In addition to validated field sampling data, unvalidated screening data were used in this assessment. The utility of these data has not been documented through validation and therefore use of screening data introduces uncertainty to associated risk estimates.

- This risk assessment is based on worst case scenarios (i.e., fugitive dust concentration in air assumed to be equal to the OSHA nuisance standard for dust) and therefore may result in the quantification of overestimated risks.

- The intake calculations require a number of different exposure assumptions. Exposure parameters were based on EPA accepted default values, which include some uncertainty. These values are conservative.

- Exposure scenarios evaluate the risks associated with exposure of receptors to contaminants identified in site media, only. Occupational exposures to onsite workers were not evaluated in this assessment.

- Exposure point concentrations were based on the mean concentration of a contaminant detected. This introduces uncertainty to the result of this assessment because the actual concentration of contaminants at a specific location at the site may vary from the mean.

- Exposure point concentrations were estimated based on assumptions of contaminant migration between different media and biologic concentrations in fish. These calculations were based on chemical-specific properties of the chemicals at steady state and assumptions about the environment (i.e., f_{oc}).

- Uncertainty is introduced by not considering constituent attenuation in this assessment. This may result from valence changes of constituent species in soil and groundwater due to oxidation-reduction conditions.

8.8 Summary of Risk

This assessment of UANG Base Sites 8 and 10 determined that based on current and future use scenarios for all potential receptors, no significant risk exists. Validated field sampling data and non-validated field screening data were evaluated separately in this risk assessment. Based on assumptions for both sites estimated risk values were found to be within acceptable ranges. The highest noncarcinogenic risks identified by hazard quotients were less than 1.0. Increased cancer risks were estimated within the 1.00E-4 to 1.00E-6, acceptable range.

8.9 Ecological Screening

The site conceptual model presented in the RI work plan considered ecological risk. Pathways and exposures were not developed for ecological risk assessment due to the following:

- The focus of the investigation was Sites 8 and 10, both of which are small areas relative to the overall developed area at the installation.

- Sites 8 and 10 are predominantly occupied by buildings or paved areas and are active Base Support areas.

- There are small areas of sparse vegetation on both Sites 8 and 10 that are covered by grass and weeds.

- The available information regarding wildlife at the base and in surrounding areas indicate limited wildlife habitats (Stone & Webster, 1995).

- Based on groundwater analytical data from wells downgradient of source areas at Sites 8 and 10, contaminants have not migrated beyond the site limits.

8.10 Conclusions

This risk assessment considers the reasonable worst case exposure scenarios for receptors at UANG Sites 8 and 10. Based on this conservative evaluation of risk using available data, receptors at UANG Sites 8 and 10 will have no significant risk above accepted risk levels as defined by EPA (EPA, 1989). The uncertainties in this assessment discussed in Section 8.7 explain assumptions that may affect the risk estimates. However, the information available and the analysis completed indicate that there is no significant risk to receptors from exposures to COCs detected in site media.

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9.0 CONCLUSIONS

An RI was conducted at IRP Sites 8 and 10, located at the 151st ANG, Salt Lake City, Utah. Soil gas, soil, and groundwater samples were collected from the sites to evaluate the nature and extent of COCs previously identified at the sites. According to Utah Administrative Code (UAC) R315-101-1(a), risk-based cleanup and closure standards apply to the sites because the sites are not recommended to be cleaned up to background levels. Concentrations of COCs detected at Sites 8 and 10 were evaluated based on the risk assessment performed as part of this RI. In addition, the shallow unconfined aquifer underlying the UANG Base meets the Class III, limited use groundwater criteria as background constituents at the sites were detected in concentrations above the Utah groundwater standards.

9.1 IRP Site 8

The RI was conducted at IRP Site 8 to evaluate the extent of petroleum and halogenated compound contamination in soil and groundwater previously detected at the Site. In addition, the horizontal extent of halogenated compounds detected in the groundwater to the north and east of Site 8, in the areas of Sites 1 and 2, was delineated at the request of the ANG.

In general, the extent of petroleum compound contamination was determined to be limited to the Site 8 area. Laboratory analysis of soil and water samples collected from monitoring wells and borings installed downgradient of this area indicated petroleum contamination has not migrated to the north of Site 8. In addition, the collection and analysis of soil and groundwater samples downgradient of Site 8, between Building 10 and Building 1, indicated no additional source areas downgradient of Site 8.

The collection and analysis of soil and groundwater screening samples indicated three areas of halogenated compound contamination. These areas are located at Site 8, Site 1, and the north side of Site 2. Soil and groundwater screening and sampling results indicated the extent of halogenated compound contamination is limited to these areas.

9.1.1 Field Screening

TCE was detected in one of the 24 soil vapor samples collected from Site 8 at a concentration of 2.0 ug/l. According to calculations performed in the risk assessment, this concentration of trichloroethene in soil vapor does not pose a significant potential risk to human health. VOCs were not detected in the remaining soil vapor samples at concentrations above the method detection limit of 1.0 ug/l.

TCE was detected in 2 soil screening samples collected from areas east of Site 8, along F Street, at concentrations of 0.006 and 0.005 mg/kg. According to calculations performed in the risk assessment, these concentrations of trichloroethene in soil do not pose a significant potential risk to human health.

BTEX compounds were detected in one soil screening sample collected from the former UST area at Site 8 at concentrations of 0.061, 0.019, 0.101, and 0.373 mg/kg. These concentrations are below the most stringent RCLs set by the Utah Department of Health Division for leaking underground storage tank sites. VOCs were not detected in the remaining soil screening samples collected from Site 8 and the area to the east of Site 8 above the method detection limit.

Halogenated compounds, including PCE, TCE, TCA, and their degradation products (c-DCE, t-DCE, 1,1-DCA, 1,2-DCA) were detected in groundwater screening samples collected during the investigation at Site 8 and to the north and east of Site 8 in the areas of Sites 1 and 2. The compounds detected at the highest concentrations were TCE and c-DCE. Three separate plumes of TCE and c-DCE in groundwater were identified: the southwestern portion of Site 8, the southern portion of Site 1, and the northern portion of Site 2 in the vicinity of 2nd Street. The highest concentration of TCE detected on Site 8 was 153.5 ug/l. The highest concentrations of TCE were detected in the area of Site 2. According to calculations performed in the risk assessment, the concentrations of TCE in groundwater detected at Site 8 and in the vicinity of Sites 1 and 2 do not pose a significant potential risk to human health.

BTEX compounds were detected in groundwater screening samples collected from Site 8 in the area of the former UST excavation and in the area north of Site 2 in the vicinity of Building 1608. Risks identified using groundwater screening data at Site 8 do not exceeded acceptable limits for carcinogenic or noncarcinogenic exposures to workers at the site.

9.1.2 Soil

Ethylbenzene was detected in one soil sample collected from a depth interval of 4 to 6 feet BGS from a soil boring advanced northeast of Site 8, in F Street between Building 1 and Building 1608 at a concentration of 43.1 ug/kg, well below the RCL of 70,000 ug/kg set by the Utah Department of Health Division for leaking underground storage tank sites. In addition, ethylbenzene was not detected in soil samples collected from other locations around Site 8 during this RI.

TPH was detected in two soil samples collected from Site 8 at concentrations of 410 and 460 mg/kg. The detection of TPH in these samples is most likely due to asphalt in the sample as the soil samples were collected from a depth interval of 0-2 feet BGS in an asphalt-paved road. According to calculations performed in the risk assessment, the concentrations of TPH in soil detected at Site 8 do not pose a significant potential risk to human health.

TCE was detected in soil samples collected from two soil borings at Site 8 at concentrations ranging from 13.2 to 36.2 ug/kg. Based on the results of the risk assessment performed for the site, the concentrations of TCE in soil detected at Site 8 do not pose a significant potential risk to human health.

Phenanthrene and pyrene were detected in one soil sample collected from Site 8 at concentrations up to 720 ug/kg. The detection of these SVOCs is most likely due to this sample containing asphalt as the boring was advanced in F Street. Based on the risk assessment, these concentrations of SVOCs in soil were calculated to not pose a potential significant risk to human health.

Metals were not detected in soil samples collected from Site 8 at concentrations outside of the naturally occurring ranges of metals in soil.

9.1.3 Groundwater

Benzene was detected in groundwater samples collected from Site 8 at concentrations ranging from 1 to 719 ug/l. The extent of benzene contamination in groundwater was limited to the former UST area. Based on the risk assessment, the concentrations of benzene detected in the groundwater at Site 8 do not pose a significant potential risk to human health.

TPH was detected in groundwater samples collected from the former UST area at Site 8 at concentrations up to 1,800 ug/l. Based on risk assessment calculations, the concentrations of TPH detected in groundwater at Site 8 do not pose a potential significant risk to human health. Free product was not observed during the field investigation.

TCE ad TCE degradation products including c-DCE, t-DCE, TCA, and 1,1-DCA were detected in groundwater samples collected from monitoring wells at Site 8 at concentrations ranging from 1.0 to 352 ug/l. Based on risk assessment calculations, the concentrations of TCE and TCE degradation products detected in groundwater samples collected from Site 8 monitoring wells do not pose a significant potential risk to human health.

Most SVOCs were not detected above the method detection limits in groundwater samples collected from Site 8. However, bis(2-ethylhexyl)phthalate was detected in groundwater samples collected from Site 8 at concentrations ranging from 0.08 to 1.7 mg/l which were assessed to not pose a significant potential risk to human health.

Only two of the PPMs were detected in groundwater samples collected from Site 8 at concentrations greater than 1.0 mg/l. Zinc concentrations ranged from 0.02 to 1.7 mg/l and arsenic concentrations ranged from 0.08 to 1.7 mg/l. Based on risk assessment calculations, the concentrations of zinc and arsenic detected in groundwater samples collected from Site 8 monitoring wells do not pose a significant potential risk to human health.

Based on the analytical results, contaminants in groundwater do not appear to be migrating off of Site 8. The contaminants appear to be moving slowly and spreading out. This is due to hydrology and geology of the site producing a slow groundwater velocity.

9.1.4 Hydrogeologic Findings

Site 8 soils, investigated to a depth of 20 feet, consist of fine-grained delta and floodplain sediments incorporating clays, silty clays, sandy clays, silty sands, and fine to course sands. A persistent clay layer of up to 8.5 feet thick across the site is discontinuous with silt, clayey sand, and sand lenses ranging in thickness from inches to 4.5 feet. Clay predominates in the southwest and clayey sand and poorly graded sands predominate in the southeast area of Site 8. Up to two feet of disturbed soils consisting of gravel or clayey gravel fill material exist beneath asphalt or concrete across most of the site.

Groundwater within the first 20 feet of the surface at Site 8 occurs locally as unconfined to semi-confined. The degree of local semi-confining aquifer conditions within the initial 20 feet of sediments at Site 8 is unknown. The various types of heterogenous and anisotropic fine grained sediments provide a series of locally hydraulically conductive zones (sands) separated by confining layers (clay). Groundwater flows generally toward the northwest across Site 8 at an average velocity of 0.81 ft/day (2.85 x 10^{-5} cm/s) for predominantly sand sediments and 0.48 ft/day (1.71 x 10^{-5} cm/s) for predominantly clay sediments. Locally, groundwater flow within the vicinity of MW-1, MW-3, MW-4, and MW-5 is toward the west and southwest. The flat groundwater gradient varies between 3.91 x 10^{-3} to 4.61 x 10^{-3} with highest gradients occurring in the south central portion and lowest gradients in the central and northern portion of the site. The hydraulic conductivity, derived from slug test results, range from 2.39 ft/day (8.45 x 10^{-4} cm/s) to 86.39 ft/day (3.05 x 10^{-2} cm/s) with a geometric mean of 5.69 ft/day (3.30 x 10^{-3} cm/s). Due to the low groundwater velocities, the movement of COCs within groundwater is expected to be slow. This is evident in that the contamination from Site 8 has not migrated off of Site 8.

9.1.5 Risk Assessment

A baseline risk assessment was performed at Site 8 in accordance with current EPA guidance. Quantitative estimates of potential incremental carcinogenic and noncarcinogenic risks from soil constituents were made for potential exposures to on-site receptor populations associated with both current and potential future use of the Sites.

The risk assessment of Site 8 assessed that based on current and future use scenarios for all potential receptors, no significant risk exists. Validated field sampling data and non-validated field screening data were evaluated separately in this risk assessment. Based on assumptions discussed in Section 8.1.3 for Site 8, estimated risk values were found to be within acceptable ranges. The highest noncarcinogenic risks were identified by hazard quotients were less than 1.0. Acceptable increased cancer risks were within the 1.0E-4 to 1.0E-6 range.

9.2 IRP Site 10

An RI was conducted at IRP Site 10 to identify the source and extent of undefined materials which caused adverse symptoms experienced by site workers and to assess the extent of petroleum-contaminated soil and groundwater previously detected at the Site.

The undefined contaminant was determined to be hydrogen sulfide gas. The extent of petroleum-contaminated soil and groundwater delineated by the RI. In cases where physical structures limited the placement of sample locations, samples were collected upgradient, cross-gradient, and downgradient of these structures to determine if these areas were potential source areas.

9.2.1 Undetermined Contaminant

The undefined contaminant was determined to be hydrogen sulfide gas. Hydrogen sulfide gas was detected at a concentration of 30 ppm in a soil gas sample collected from the area where the exposure incident occurred. Hydrogen sulfide gas is a naturally occurring biodegradation product of organic matter and is suspected to be present at various locations in the subsurface at the Base where floodplain sediments are present. Monitoring of breathing zone air for the presence of hydrogen sulfide gas should be conducted during subsurface construction work performed at the Site.

9.2.2 Field Screening

BTEX compounds were detected in soil gas samples collected from Site 10 at concentrations ranging from 1.1 to 4,976.2 ug/l. The highest concentrations of BTEX compounds in soil gas were detected in samples collected from two areas at Site 10: the area of excavation in the northwest portion of the site, and directly north of the fuel mixing tank in the northeast corner of the Site. Other VOCs were not detected in the soil gas samples above the method detection limit of 1.0 ug/l.

BTEX compounds were also detected in soil screening samples collected from Site 10. Benzene, toluene, and ethylbenzene were detected in soil screening samples at concentrations up to 5.913 mg/kg. Xylenes were detected in soil screening samples at concentrations up to 58.819 mg/kg. The highest concentrations of BTEX compounds were detected in samples collected in the area of the excavation and in the northeast corner of the Site. These areas correspond to the areas where BTEX compounds were detected in soil gas samples.

BTEX compounds were detected in several of the groundwater screening samples collected at Site 10. Benzene, toluene, and ethylbenzene were detected in groundwater screening samples at concentrations up to 10,043.0 ug/l. Xylenes were detected in samples at concentrations up to 22,867.0 ug/l. Based on the analysis of the groundwater screening samples, the areas where petroleum compounds were detected in groundwater correspond with the areas where petroleum compounds were detected in the soil screening and soil gas samples. Based on the results of the risk assessment, the concentrations of BTEX compounds detected in groundwater screening samples at Site 10 do not pose a significant risk to human health. A slight sheen (<0.1 inch) was observed on two of the groundwater screening samples (GP4 and GP12) collected. Free-phase petroleum product was not observed on other samples collected during the field investigation.

Halogenated compounds including 1,1-DCA, c-DCE, TCA, and TCE were detected in groundwater screening samples collected at Site 10. 1,1-DCA, c-DCE, TCA, and TCE were detected in groundwater screening samples collected from Site 10 at concentrations up to 3.9 ug/l. Based on risk assessment calculations, the concentrations of halogenated compounds detected in groundwater screening samples do not pose a potential significant risk to human health.

9.2.3 Soil

Petroleum compounds (benzene, ethylbenzene, xylene, and TPH) were detected in soil samples collected from two areas of Site 10. The first area in which petroleum compounds were detected is located north of the existing process recovery tank, where a fuel spill occurred in 1982. The horizontal extent of petroleum contamination detected in this area was limited to the area of Site 10 south of the city drain canal and north of the existing process recovery tank, between the concrete parking pad and the dispenser island. The vertical extent of petroleum compounds detected in this area extended to the groundwater table, approximately 6 feet BGS.

The second area where petroleum compounds were detected at Site 10 is located directly north of the fuel mixing facility at the Site. The horizontal extent of petroleum contamination detected in this area was limited to the area of Site 10 south of the city drain canal and north of the 5,000-gallon fuel additives tank, between the dispenser island and the eastern edge of E Street. The vertical extent of petroleum compounds detected in this area extended to the groundwater table, approximately 6 feet BGS. Benzene was detected in soil samples collected in this area at concentrations above the most stringent RCL of 0.2 mg/kg set by the Utah Department of Health Division for leaking underground storage tank (LUST) sites. Other VOCs were not detected at Site 10 at concentrations above the RCLs.

Five SVOCs - bis(2-ethylhexyl)phthalate, di-n-butyl phthalate, pyrene, naphthalene, and 2-methylphenol were detected in soil samples collected at Site 10 at concentrations ranging from 350 to 1,890 ug/kg. Based on the risk assessment performed for the Site, the concentrations of these SVOCs detected at Site 10 were evaluated and do not pose a significant potential risk to human health.

Metals were not detected in soil samples collected from IRP Site 10 at concentrations outside of the naturally occurring ranges of metals in soil.

9.2.4 Groundwater

Trichlorofluoromethane was detected in groundwater samples collected from two monitoring wells at concentrations less than 10 ug/l. Based on risk assessment calculations, the concentrations of trichlorofluoromethane detected in the groundwater samples do not pose a potential significant risk to human health. VOCs were not detected in groundwater samples collected from the other wells at concentrations above the method detection limit of 1.0 ug/l. Free-phase petroleum product was observed as a sheen on two samples collected during the groundwater screening program. Free-phase petroleum product was not observed on samples collected from the groundwater monitoring wells.

BTEX compounds were not detected two monitoring wells installed close (12 to 15 feet away) to areas where BTEX compounds were detected in groundwater screening samples. This anomaly may be due to the complex geology at the site with the contaminants moving through selected soil lenses. In addition, the groundwater screening samples were collected from a discreet 2-foot depth interval, close to the top of the groundwater table. The groundwater samples collected from the monitoring wells are collected from a 2-inch diameter well with 10 feet of screen. This screen allows a 10-foot column of water to contribute to the sample.

SVOCs were not detected in groundwater samples collected from Site 10 at concentrations above the method detection limits with the exception of bis(2-ethylhexyl)phthalate which was detected in a groundwater sample collected from Site 10 at a concentration of 18 ug/l, which was calculated not to pose a risk to human health.

Metals detected in groundwater samples collected from Site 10 were not above 0.5 mg/l and do not pose a significant potential risk to human health based on the risk assessment.

9.2.5 Hydrogeologic Findings

Site 10 soils, investigated to a depth of 14 feet, consist of fine-grained delta and floodplain sediments incorporating clays, silty clays, sandy clays, silty sands, and fine to coarse sands similar to Site 8. Layers and lenses of silt, clayey sand, and sand lenses are discontinuous within clay. A fairly continuous sand layer at a depth of 11 to 12 feet is present across the site. The site is dominated by silty and sandy soils in the southern portion and by clay in the northern portion. Up to 3.5 feet of disturbed soils consisting of gravel or clayey gravel fill material exists across most of the site. Asphalt was present at the surface at some locations.

Groundwater exists under semi-confined to confined conditions within the first 20 feet of land surface. The various types of heterogenous and anisotropic fine grained sediments provide a series of locally hydraulically conductive zones (sands) separated by confining layers (clay). Groundwater flow direction varied during the investigation from the northwest, north, northeast to the south, southeast, and east. Site 10 groundwater moves at an average velocity of 0.10 ft/day (3.63×10^{-5} cm/s) for predominantly sand sediments and 0.061 ft/day (2.18×10^{-5} cm/s) for predominantly clay sediments. The flat groundwater gradient varies between 9.10×10^{-4} to 2.39×10^{-3} with highest gradients occurring in the northeast and lowest gradients in the northwestern portions of the site. The hydraulic conductivity, derived from slug test results, range from 2.98 ft/day (1.05×10^{-3} cm/s) to 34.96 ft/day (1.23×10^{-2} cm/s) with a geometric mean of 17.39 ft/day (6.13×10^{-3} cm/s).

The August 1995 and June 1995 groundwater level measurements indicated different groundwater flow directions. The observed differences in Site 10 groundwater flow directions between June 1995 and August 1995 are due to differing hydrologic conditions. The amount of infiltration due to precipitation and variations in water levels in the adjacent City Drain Channel may affect local groundwater levels at Site 10. However these factors were not directly measured as part of the investigation and their effect can only be speculated. A qualitative comparison between rainfall events and Site 10 groundwater level measurements was made. As indicated for Site 8, Site 10 June and August 1995 groundwater level measurements are representative of environmentally wet conditions and dry conditions, respectively. However, unlike Site 8, Site 10 groundwater levels are higher in June than in August 1995 indicating that near term rainfall and resultant infiltration may affect groundwater levels. Rainfall may also affect water levels within the City Drain Channel which may influence groundwater levels at Site 10.

The hydrogeology at the site and the chemical analysis results of the RI reveals contaminants move very slowly and in a number of directions based on changing groundwater flow directions. Also, the RI shows contaminants have not migrated far from the source areas (the areas with the highest concentrations), and are not present above detection limits along the north side of the site.

9.2.6 Risk Assessment

A baseline risk assessment was performed at Site 10 in accordance with current EPA guidance. Quantitative estimates of potential incremental carcinogenic and noncarcinogenic risks from soil constituents were made for potential exposures to on-site receptor populations associated with both current and potential future use of the Sites.

The risk assessment of Site 10 assessed that based on current and future use scenarios for all potential receptors, no significant risk exists. Validated field sampling data and non-validated field screening data were evaluated separately in this risk assessment. Based on assumptions discussed in Section 8.1.3 for Site 10, estimated risk values were found to be within acceptable ranges. The highest noncarcinogenic risks were identified by hazard quotients were less than 1.0. Acceptable increased cancer risks were within the 1.0E-4 to 1.0E-6 range.

10.0 RECOMMENDATIONS

10.1 Site 8

The risk assessment of Site 8 assessed that based on current and future use scenarios for all potential receptors, no significant risk exists. Based on this result of the RI, no remedial action is recommended. As a precautionary measure, sampling and analyzing groundwater for VOCs on a quarterly basis to monitor the movement of the COCs is recommended at Site 8. As stated in Section 9.0, due to the low groundwater velocities, the movement of COCs within groundwater is expected to be slow. Periodic sampling and analysis of the groundwater will allow the in-situ monitoring of contaminant movement and concentrations to ensure a level of no significant risk at the site is maintained. The purpose of the monitoring program is to evaluate if contaminant migration is occurring at the site or if the site has stabilized. Should the monitoring program be implemented, it is recommended the program be re-evaluated after a period of two years based on the information collected.

It is recommended that monthly groundwater level measurements be collected for a period of at least a year, to develop a more complete understanding of groundwater flow at Site 8. In addition, the vertical groundwater gradient should be investigated by installing at least one additional piezometer into the lower aquifer zone as part of the year long groundwater level monitoring program.

In addition, it is recommended that further investigation of the TCE source areas be completed as the total depth of groundwater contamination at Site 8, Site 1, and Site 2 was not determined during this RI.

10.2 Site 10

The risk assessment of Site 10 assessed that based on current and future use scenarios for all potential receptors, no significant risk exists. Therefore, no remedial action is also recommended for Site 10. Sampling and analysis of the groundwater for VOCs on a quarterly basis is recommended to monitor the movement of the COCs. The purpose of the monitoring program is to evaluate if contaminant migration is occurring at the site or if the site has stabilized. Should the monitoring program be implemented, it is recommended the program be re-evaluated after a period of two years based on the information collected. In addition, it is recommended that monthly groundwater levels be measured from site wells and the water level in the City Drain Channel be measured for a period of at least a year, to develop a more complete understanding of groundwater flow at Site 10. Evaluation of the vertical groundwater gradient and the total depth of groundwater contamination may require the installation of deep monitoring wells or piezometers.

In addition, further investigation of the areas around the aboveground storage tanks is recommended.

This recommendation is protective of public health and the environment because prior results and sampling showed no contamination above the detection limits on the north side of the site, indicating contaminants have not migrated to the City Drain Channel. The hydrogeology at the site reveals contaminants will move very slowly and in a number of directions based on changing groundwater flow directions. Also, the RI shows contaminants have not migrated far from the locations where spills or leaks occurred.

Through the recommended periodic monitoring any changes in contaminant movement that would result in contaminants moving to the City Drain Channel or beyond the limits of Site 10 to the north or east would be detected. In the event such movement is detected there are remedial actions that could be implemented in a time frame of less than 12 months.

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