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INSTALLATION RESTORATION PROGRAM

AD-A277 738



FINAL

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Site Investigation Report

Volume 1

Report, Tables, and Figures

November 1992

161st AIR REFUELING GROUP
ARIZONA AIR NATIONAL GUARD
SKY HARBOR INTERNATIONAL AIRPORT
PHOENIX, ARIZONA

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Hazardous Waste Remedial Actions Program
Oak Ridge K-25 Site
Oak Ridge, Tennessee 37831-7606
Managed by MARTIN MARIETTA ENERGY SYSTEMS, INC
For the U.S. DEPARTMENT OF ENERGY under contract DE-AC05-84OR21400

FINAL
 SITE INVESTIGATION REPORT
 161st AIR REFUELING GROUP
 ARIZONA AIR NATIONAL GUARD
 SKY HARBOR INTERNATIONAL AIRPORT
 AND PAPAGO MILITARY RESERVATION
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 REPORT, TABLES, AND FIGURES

Submitted To:

AIR NATIONAL GUARD READINESS CENTER
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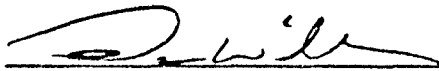
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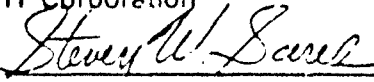
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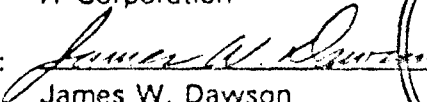
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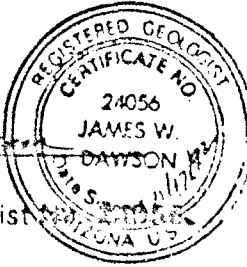
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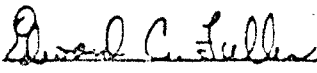
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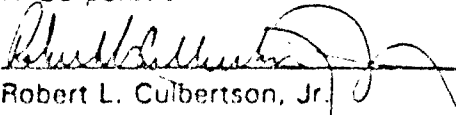
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C	Geophysical Survey Report
D	SOV Survey Report
E	Soil Boring Logs
F	Piezometer and Monitoring Well Completion Diagrams
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VOLUME 3

H	Sample Collection Logs
I	Slug Tests and Analysis
J	Potentiometric Measurements
K	Results of Screening Analyses
L	Tabulation of Soil Analytical Results
M	Tabulation of Water Analytical Results

List of Acronyms

1,1,1-TCA	1,1,1-trichloroethane
1,1-DCA	1,1-dichloroethane
1,1-DCE	1,1-dichloroethene
1,2-DCE	1,2-dichloroethene
107TCS	107th Tactical Control Squadron
111ATCF	111th Air Traffic Control Flight
161AREFG	161st Air Refueling Group
AAL	Arizona Action Level Guidelines
ADEQ	Arizona Department of Environmental Quality
ADHS	Arizona Department of Health Services
ADWR	Arizona Department of Water Resources
AFESC	Air Force Engineering Systems Command
ANG	Air National Guard
ANGRC	Air National Guard Readiness Center
ARARs	Applicable or Relevant and Appropriate Requirements
b	saturated thickness
BP	before present
BGL	below ground level
BTEX	benzene, toluene, ethyl benzene, and xylene
CAA	Clean Air Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CH	inorganic clays of high plasticity
CL	inorganic clays of low to medium plasticity
CLP	Contract Laboratory Program
cm/s	centimeters per second
CPF	carcinogenic potency factors
CRQL	Contract Required Quantitation Limit
CWA	Clean Water Act
DOE	U.S. Department of Energy
DQO	data quality objectives
Ec	electrical conductivity
ECD	electron capture detector

List of Acronyms (Continued)

EM	electromagnetic induction
Energy Systems	Martin Marietta Energy Systems, Inc.
EWA	East Washington Area
FID	flame ionization detector
FT/DAY	feet per day
FS	feasibility study
FSP	field sampling plan
GC	gas chromatography
GP	poorly-graded gravel
GPM	gallons per minute
GPR	ground penetrating radar
HAZWRAP	Hazardous Waste Remedial Actions Program
HBC	Health-Based Acceptable Concentration
HBGL	Health-Based Guidance Level
HMTC	Hazardous Materials Technical Center
HSP	health and safety plan
i	hydraulic gradient
IAG	interagency agreement
IAP	international airport
ID	inside diameter
IRP	Installation Restoration Program
IT	IT Corporation
K	hydraulic conductivity
MCL	maximum contaminant level
mg/kg	milligram per kilogram
mg/L	milligrams per liter
ml	milliliter
MS	matrix spike
MSD	matrix spike duplicate
msl	mean sea level
n	effective porosity
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NCR	nonconformance report

List of Acronyms (Continued)

OD	outside diameter
PA	preliminary assessment
PCE	perchloroethene or tetrachloroethylene
PID	photoionization detector
POL	petroleum, oils, and lubricants
POTW	publicly owned treatment works
ppb	parts per billion
ppm	parts per million
PVC	polyvinylchloride
QA/QC	quality assurance/quality control
QAPP	quality assurance project plan
RfC	reference concentration
RfD	reference dose
RI	remedial investigation
SAP	sampling and analysis plan
SARA	Superfund Amendments and Reauthorization Act
SC	clayey sands
SDWA	Safe Drinking Water Act
SI	site investigation
SOV	soil organic vapor
SM	silty sand
SP	poorly-graded sand
SVOA	semivolatile organic analysis
SVOC	semivolatile organic compound
T	transmissivity
TAL	target analyte list
TBC	to-be-considered
TCL	target compound list
TCE	trichloroethylene or trichloroethene
TDS	total dissolved solids
TIC	tentatively identified compound
TPH	total petroleum hydrocarbons
TSCA	Toxic Substances Control Act

List of Acronyms (Continued) _____

ug/kg	microgram per kilogram
ug/L	microgram per liter
USCS	Unified Soil Classification System
U.S. EPA	U.S. Environmental Protection Agency
UST	underground storage tank
V	velocity
VOA	volatile organic analysis
VOC	volatile organic compound
WQARF	Water Quality Assurance Revolving Fund

Executive Summary

The Air National Guard Readiness Center (ANGRC) implemented a comprehensive Installation Restoration Program (IRP) to assess the extent of suspected contamination at four sites at the Arizona Air National Guard Base (the Base) at Sky Harbor International Airport in Phoenix, Arizona and at one site at the Papago Military Reservation (Papago) approximately four miles northeast of the Base. The Base lies within the East Washington Area (EWA), a state Superfund site designated because of presence of volatile organic compounds (VOCs) in groundwater at various locations throughout the area. During the SI a fifth site at the Base was identified. A Preliminary Assessment (PA) for the Base was completed in 1988. The IRP has progressed to the site investigation (SI) phase, results of which are presented herein.

The ANGRC IRP is designed to accelerate specific phases of the restoration program by generating data of sufficient quality during the SI to support one or more of the following recommendations:

- Generate a decision document recommending no further action
- Initiate a focused feasibility study/remedial measure
- Implement an immediate response
- Initiate a remedial investigation/feasibility study (RI/FS).

SI field activities were conducted from December 4, 1990 to July 12, 1991 and were divided into two tasks: screening activities and confirmation activities. Screening activities identified presence or absence of contamination and served as a basis for subsequent confirmation activities. Screening tasks included conducting geophysical and soil organic vapor (SOV) surveys and installing piezometers to aid in placement of soil borings and monitoring wells, and to discern location of utilities and munitions disposal areas. Only those screening tasks that could aid subsequent confirmation activities were utilized at each site.

Confirmation activities included soil borings and soil sampling, monitoring well installation, hydraulic testing, groundwater sampling, and laboratory analysis of soil and groundwater samples. Borings and wells were strategically placed to characterize each site and to ascertain background groundwater quality at the study area.

A preliminary risk evaluation was performed to determine if there are immediate and substantial hazards resulting from potential exposures to site-related chemicals. Analytical

data were compared with applicable or relevant and appropriate requirements (ARARs) and appropriate risk-based criteria to determine if any immediate action was required and to identify those areas of potential concern.

Site 1. JP-4 Hydrant Area

Geophysical surveys were conducted to ascertain subsurface features prior to drilling and sampling. Soil organic vapor (SOV) surveys were used to detect organic compounds. Four soil borings and one monitoring well were drilled for soil and water samples.

Tetrachloroethylene (PCE), benzene, and dichloroethene (DCE) were detected in SOV data at microgram per liter ($\mu\text{g/L}$) concentrations. Xylene, total petroleum hydrocarbons (TPH), acetone, and bis(2-ethylhexyl) phthalate occurred in soil at levels in the part per billion (ppb) range. TPHs, the primary suspect contaminants, are limited to within 2 feet of the soil surface. Groundwater samples at site contained DCE and TCE concentrations below reporting limits and are not likely related to past releases from Site 1.

Results of the SI are not indicative of significant releases of fuel products from this site. Soil and groundwater chemical concentrations are similar to background concentrations. Risk assessment for the site does not indicate a substantial threat to human health or the environment.

Recommendation - Proceed to a decision document recommending no further action.

Site 2. Hazardous Waste Storage Area

SI activities at Site 2 consisted of geophysical and SOV surveys and drilling of three soil borings and one monitoring well for soil and water samples. SOV analysis at Site 2 detected low $\mu\text{g/L}$ concentrations of DCE and TCE similar to Site 1. Three volatile and five semivolatile organic compounds were detected in laboratory analysis of soil at Site 2; however, detected compounds occurred in isolated localities at ppb concentrations. The metals aluminum and beryllium exceeded health-based guidance levels in soil. Groundwater samples downgradient of Site 2 indicate the presence of 1,1-Dichloroethane (1,1-DCA) and 1,2-Dichloroethene (1,2-DCE) at concentrations similar to background samples; therefore, Site 2 does not appear to contribute to groundwater quality concerns.

Results of the SI for Site 2 do not indicate a substantial threat to human health or the environment; however, elevated metal concentrations in soil are noted. Aluminum and

beryllium are not extensively handled at the site and thus, are thought to be naturally occurring.

Recommendation - Collect additional background soil samples to verify the concentration of natural occurrence of aluminum and beryllium. If metals are naturally occurring, proceed to a decision document recommending no further action; otherwise, expand the SI.

Site 3. Fuel Bladder Area

SI activities at the Site 3 consisted of surface geophysics, soil sampling, and monitoring well installation. Three soil borings and two monitoring wells were drilled and sampled at the site.

Site 3 analyses indicated aromatic VOCs in approximately 30 percent of soil samples, but no widespread contamination is evident. The source of the compounds was not confirmed. The downgradient monitoring well at Site 3 contained DCE and TPH at levels consistent with basewide upgradient concentrations. Several organic compounds were detected in the upgradient well at Site 3 at parts per million (ppm) concentrations; the source has not been confirmed.

Soil and groundwater contamination at Site 3 are not expected to cause a significant risk to human health and the environment. Contaminants in soil do not appear to be migrating into groundwater. The presence of groundwater contaminants in the upgradient well are thought to be associated with Site 6 and will be further investigated with Site 6.

Recommendation - Proceed to a decision document recommending no further action.

Site 4. 107th Tactical Control Squadron (107 TCS)/111 Air Traffic Control Flight (111 ATCF) Hazardous Waste Collection Area (Papago)

Investigation activities at Site 4 consisted of geophysical and SOV surveys, surficial soil sampling, and installation of two monitoring wells and three piezometers for groundwater sampling.

Target compounds at the site were restricted to surface soil and vertical migration is not believed to be significant because the compounds were not detected in shallow ground-water. Several inorganic constituents in soil exhibited concentrations above background. Aluminum concentrations in soil are above health-based guidelines; it is not known if the aluminum

concentration in soil is associated with Site 4 or if it represents undetermined variability in background concentrations. Elevated TPH in surface soil is likely related to vehicle parking activities, and no significant risk to human health or the environment is predicted.

Recommendation - Collect additional background soil samples to determine variability of aluminum in soil and proceed to a decision document recommending no further action, if the aluminum is naturally occurring; otherwise, expand the SI.

Site 5. Ammunition Dump

SI activities consisted of conducting geophysical surveys to ascertain the location of suspected historical ammunition disposal. One well boring provided soil and water samples for analyses.

Based on historical results, target areas for geophysical studies were near the Base fire station and Building 46. No anomalies were identified near the fire station. Several anomalies at Building 46 were attributed to utilities and no large anomalies were detected that would indicate ammunition burial locations. Geophysical surveys do not indicate conclusive evidence of buried material however, lack of stratification in the area may suggest past disturbance. Analyses indicate that acetone, aluminum, and manganese are present in soil at concentrations above background; copper, silver, zinc, and nitrate were detected above background concentrations in groundwater but below levels of risk-based concern.

Recommendation - Because of planned airport runway expansion in the near future that would require excavation, confirmation activities such as excavation of test pits and trenches near previous areas of munitions discovery are recommended.

Site 6. Petroleum, Oil, and Lubricant (POL) Area

During the course of investigating Site 3, aromatic hydrocarbons were detected in the field screening of water samples from a location upgradient to Site 3. The Base POL storage area was identified as a potential source and a soil boring and monitoring well were drilled to evaluate the presence or absence of contaminants at Site 6.

Several VOCs, in ppm concentrations were identified in soil and in groundwater at Site 6. Compounds and concentrations identified are similar to those identified upgradient of Site 3 and are indicative of fuel-related materials. Benzene was detected in groundwater samples at levels greater than 1000 times MCL in April and June 1991.

Recommendation - Drill additional borings and install monitoring wells west, north, and south of the POL area to ascertain vertical and horizontal extent of organic compounds in the soil and groundwater.

1.0 Introduction

1.1 Purpose of Report

1.1.1 Background

The Air National Guard Readiness Center (ANGRC) through the Air Force Engineering and Services Center (AFESC), has entered into an Interagency Agreement (IAG) (No. 1489-1489-A1) with the U.S. Department of Energy (DOE). Under this agreement, the DOE provides technical assistance for implementing the ANGRC Installation Restoration Program (IRP) and related activities. The ANGRC has requested support of the DOE in assessing the extent of suspected contamination at five sites at Arizona Air National Guard 161st Air Refueling Group (161AREFG) facilities at Sky Harbor International Airport (the Base) and Papago Military Reservation (Papago) in Phoenix, Arizona.

Martin Marietta Energy Systems, Inc. (Energy Systems), operating subcontractor for DOE facilities at Oak Ridge, Tennessee, is providing technical assistance to DOE through the Hazardous Waste Remedial Actions Program (HAZWRAP). Energy Systems contracted IT Corporation (IT) to conduct a site investigation (SI) and to provide a SI report that serves as the basis for subsequent IRP activities.

SI field activities began with preparation of plans to acquire field data that satisfy objectives of the SI (IT 1990). Field work commenced December 4, 1990 and was completed July 12, 1991.

1.1.2 Purpose

The SI was conducted to acquire necessary data to either confirm or deny existence of suspected environmental contamination and to provide data needed to support subsequent remedies. Specific objectives of the SI were to:

- Identify site-specific chemical contaminants and their concentrations in soil and groundwater.
- Supplement and refine existing geologic, geochemical, hydrogeologic, and chemical data bases for the study sites.

- Evaluate chemical migration pathways, site hydrogeology, and specifics of groundwater movement that influence migration of site related chemicals.
- Evaluate potential receptors for any migrating contamination.
- Provide data that are adequate for executing one or more of the following:
 - Generating a decision document recommending no further action
 - Recommending initiation of a remedial investigation/feasibility study (RI/FS).
 - Implementing a remedial response
 - Recommending initiation of a focused feasibility study/remedial measure

Four sites at the Base and one site at Papago were targeted for investigation as potentially contaminated as a result of past use and disposal of material and waste that subsequently have been characterized as hazardous. During the site investigation analytical data disclosed that an upgradient site to Site 3, the POL area, was potentially releasing environmental contaminants. The POL area was designated as Site 6. This report documents collection and analysis of data gathered during the SI and presents investigation findings.

1.2 Report Organization

This report is organized to provide a logical description of investigation sites, investigation activities, results, analysis of site related risks to human health and the environment, and conclusions and recommendations. Chapter 1.0 reviews the report purpose, discusses the history of the Base, and provides descriptions of investigation sites. It also includes a summary of previous investigations and discusses regional and local environmental settings.

The SI general approach is presented in Chapter 2.0. This chapter also presents methods used during field efforts to collect site-specific data.

Chapter 3.0 presents and discusses all available data collected during SI field investigations. It also discusses geology and hydrology on a site-by-site and Base-wide basis. Conclusions drawn from data are also presented in this chapter.

Chapter 4.0 presents findings of a preliminary risk assessment, which defines potential chemicals of concern, migration pathways and receptors, and assesses hazards of chemicals of concern. This chapter includes significant findings from both a human health and environmental standpoint.

Chapter 5.0 reviews data and significant SI findings and summarizes conclusions for each site. Recommendations for each site are also included.

1.3 Base Location and History

Sky Harbor International Airport, located within the City of Phoenix, Arizona, is base for the 161AREFG. The Base is located on approximately 51 acres of land leased from the City of Phoenix at the airport (Figure 1-1), specifically, in Maricopia County, Section 13, Township 1 North, Range 3 East. Areas north and west of the Base are occupied primarily by the airport and south and east of the Base are undeveloped lands adjoining the Salt River valley. The Base and Sky Harbor International Airport lie within the East Washington Area (EWA) Arizona State Superfund Site (Kleinfelder, 1989). The location has been occupied continuously since construction of the Base in 1951.

The 161AREFG supports the 107th Tactical Control Squadron (107TCS) and the 111th Air Traffic Control Flight (111ATCF) located at Papago Military Reservation, approximately 4 miles northeast of the Base (Figure 1-1). Papago is also located within the City of Phoenix in a mixed residential and light industrial area within Section 32, Township 2 North, Range 4 East.

1.4 Previous Program Activities

A Preliminary Assessment (PA) of Base operations was completed in July 1988 by the Dynamac Corporation through the Hazardous Materials Technical Center (HMTC, 1988) in accordance with the ANGRC IRP. This is the only previous investigation associated with the sites. The PA identified and evaluated suspected concerns associated with past hazardous waste handling procedures, disposal sites, and releases of materials on the Base and at Papago. Four sites were identified at the Base and one at Papago as being potentially contaminated due to past handling and disposal activities. Site descriptions and findings of the PA are summarized in the following sections.

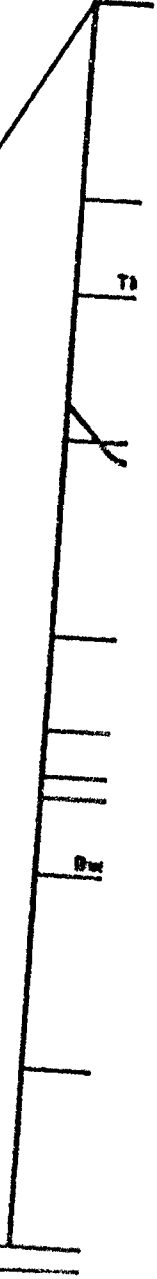
1.5 Site Description

Five sites were targeted for investigation under the SI. Identified Sites 1, 2, 3, and 5 are located at the 161AREFG facility at Sky Harbor International Airport (Figure 1-2). Site 4 is located at Papago Military Reservation (Figure 1-3). Sites are designated as follows:

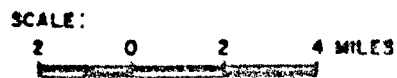
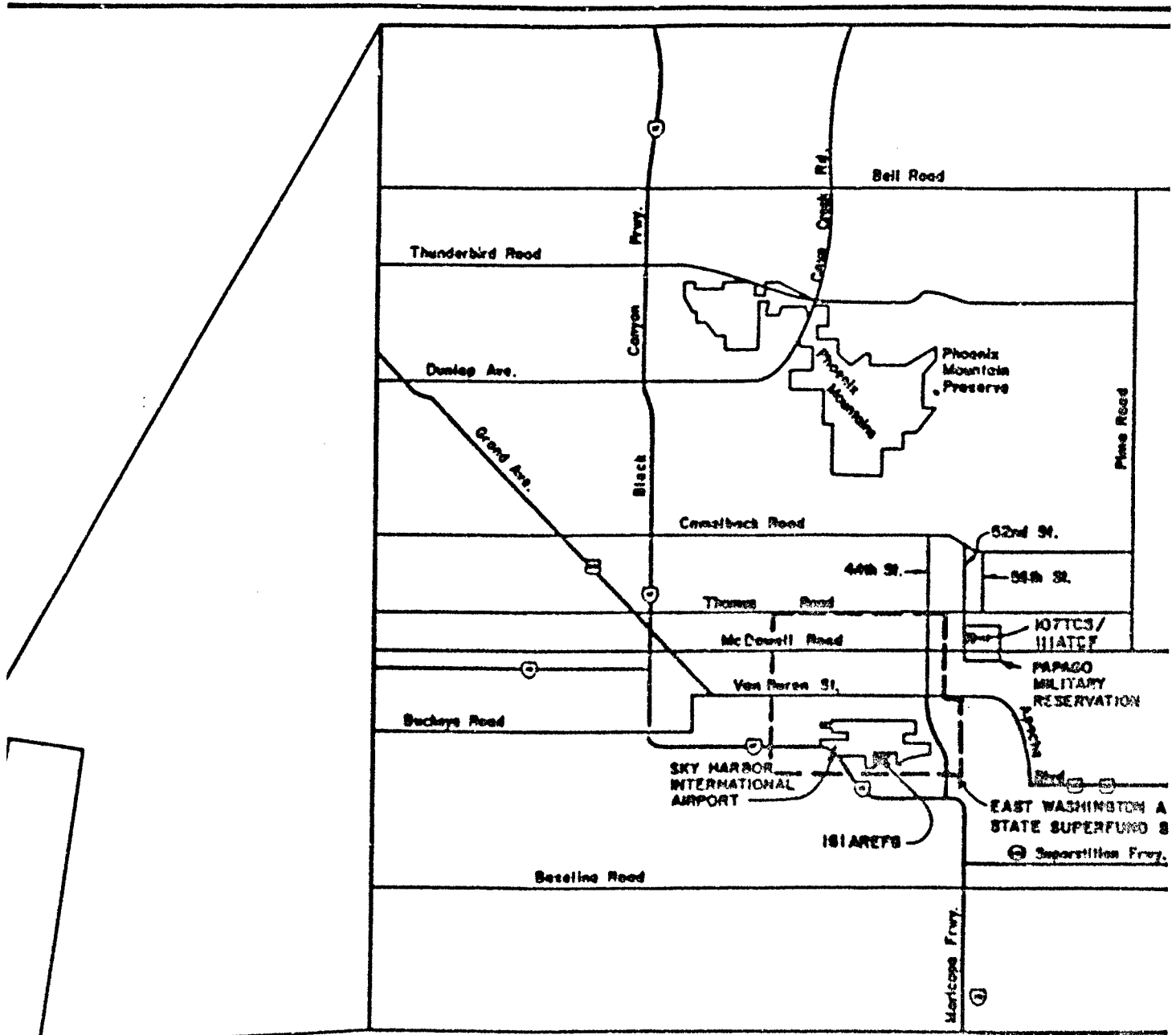
- Site 1 - JP-4 Hydrant System
- Site 2 - Hazardous Waste Storage Area
- Site 3 - Fuel Bladder Area

10

STARTING DATE: 10/30/91	DATE LAST REV.:	DRAFT. CHK. BY: G. PACHECO	INITIATOR: D. WELLEN	DRAWING NO.: 409721-B-C28
DRAWN BY: C. ROBERTSON	DRAWN BY:	ENGR. CHK. BY: D. WELLEN	PROJ. MGR.: D. WELLEN	PROJ. NO.: 409721



SOURCE: SUNSET ROAD ATLAS; KLENFELDER, 1989

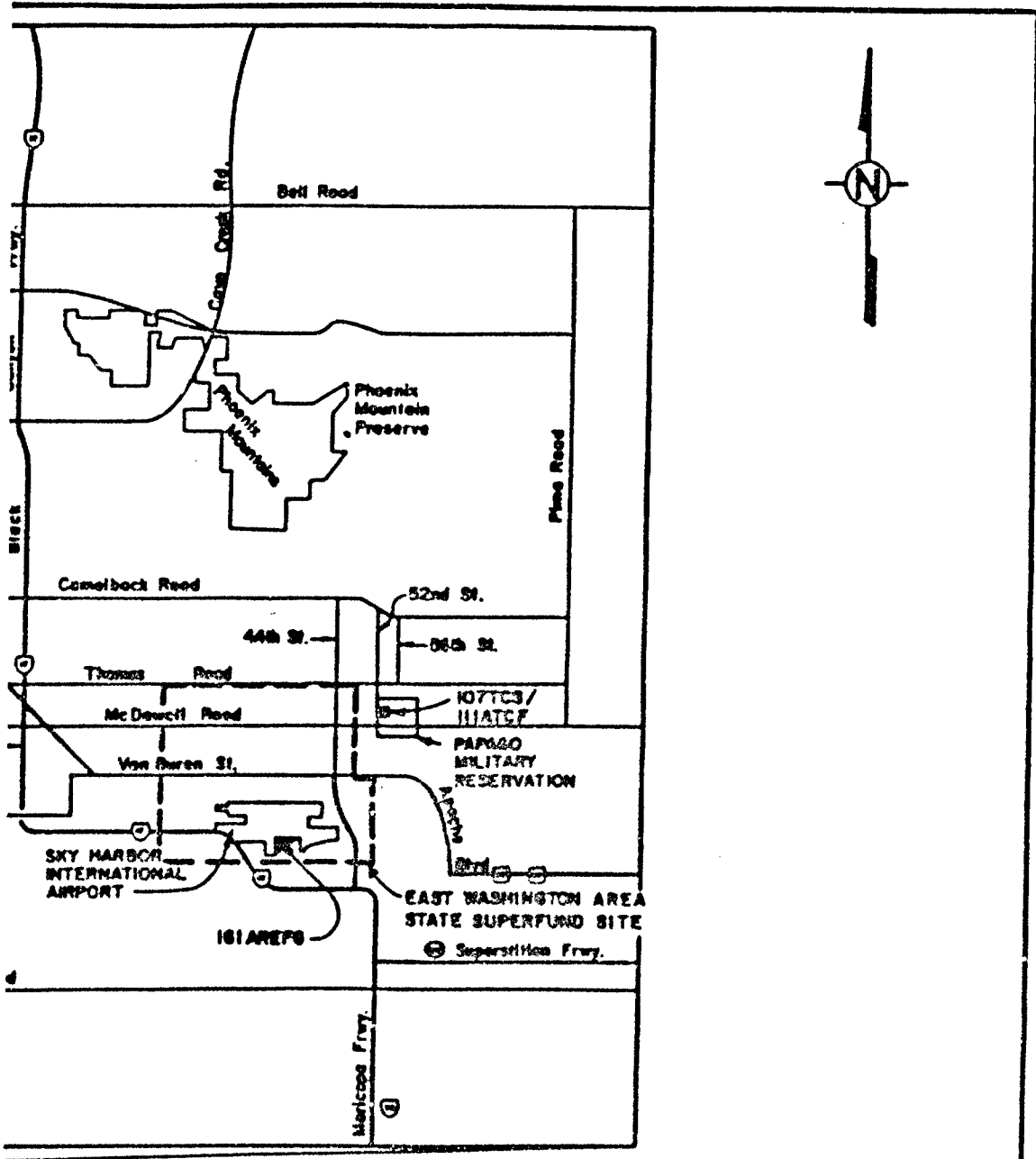


**FIGURE 1—
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SKY HARBOR
IOTTCs/IIIATEF
PAPAGO
PHOENIX, A



3

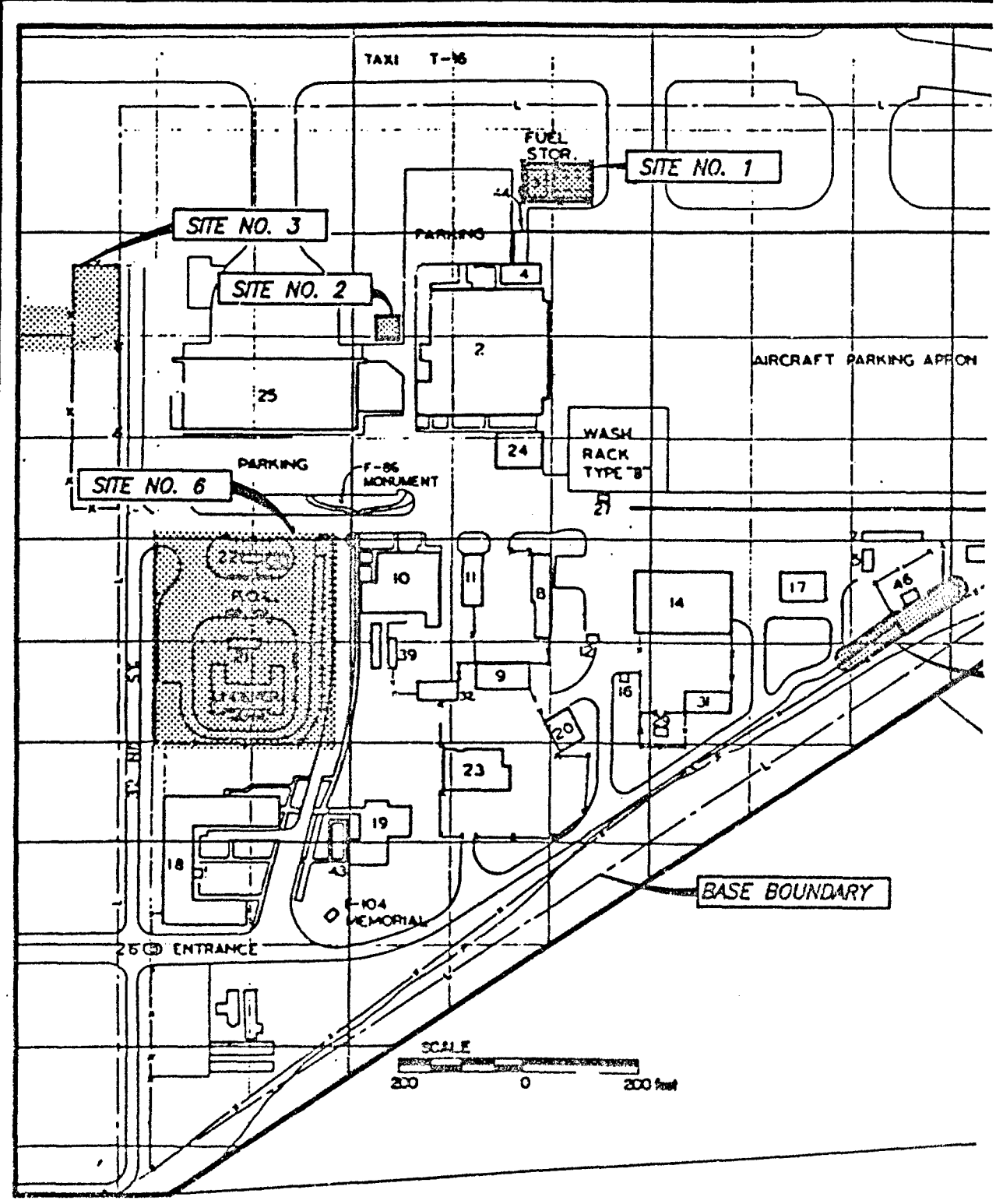


**FIGURE 1-1
VICINITY MAP**

**IGIAREFG, ARIZONA AND
SKY HARBOR IAP
107TCS/111ATCF
PAPAGO
PHOENIX, ARIZONA**



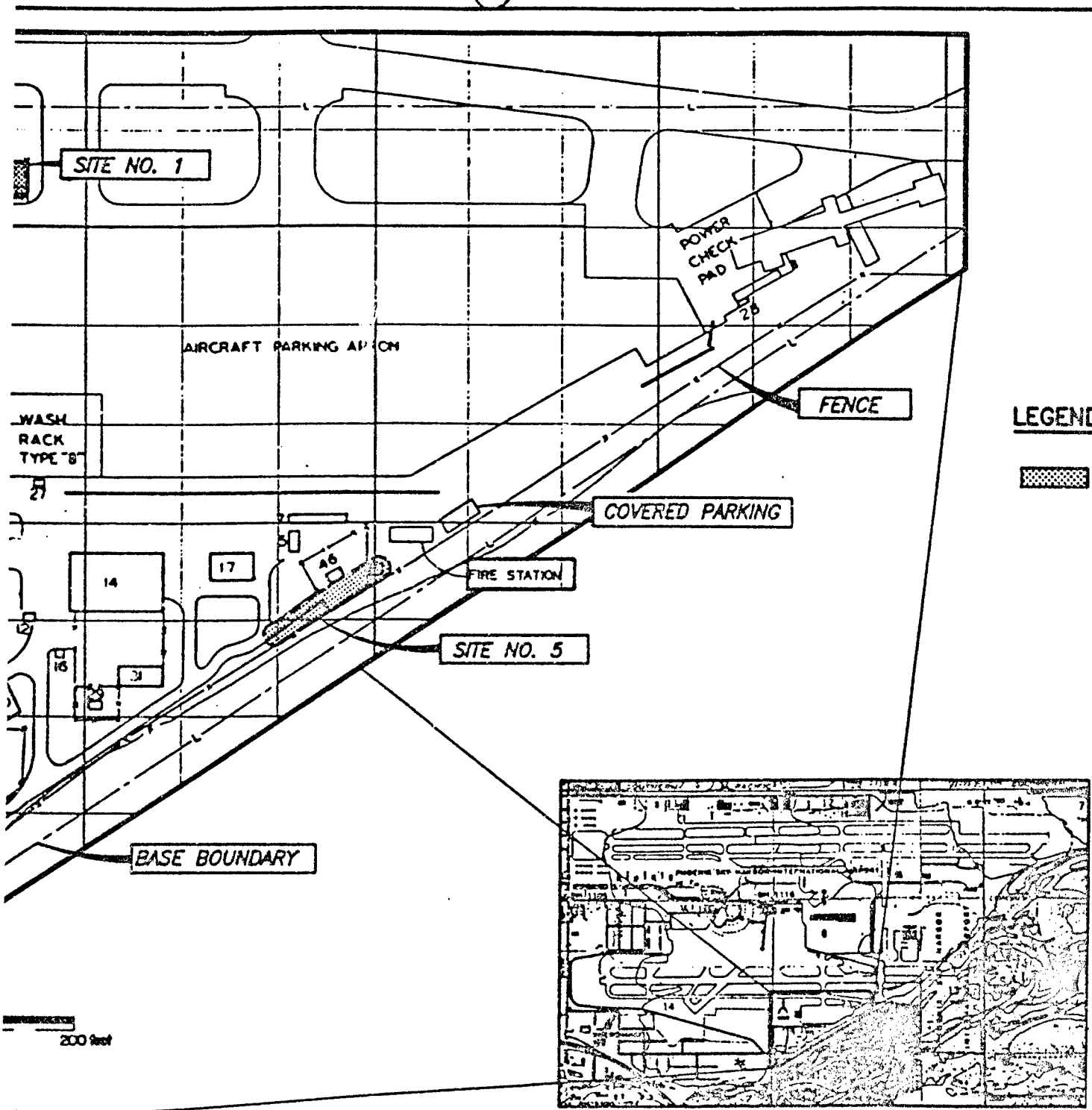
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 PROJ. MGR.: D. WILLEN
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 ENGR. CHK. BY: D. WILLEN
 DATE LAST REV. 03/25/92
 DRAWN BY: C. ROBERTSON
 STARTING DATE: 10/30/91
 DRAWN BY: C. ROBERTSON



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TOPOGRAPHIC SOURCE:
 U.S. GEOLOGICAL SURVEY 7.5 MIN. QUAD.
 PHOENIX, ARIZONA 1962

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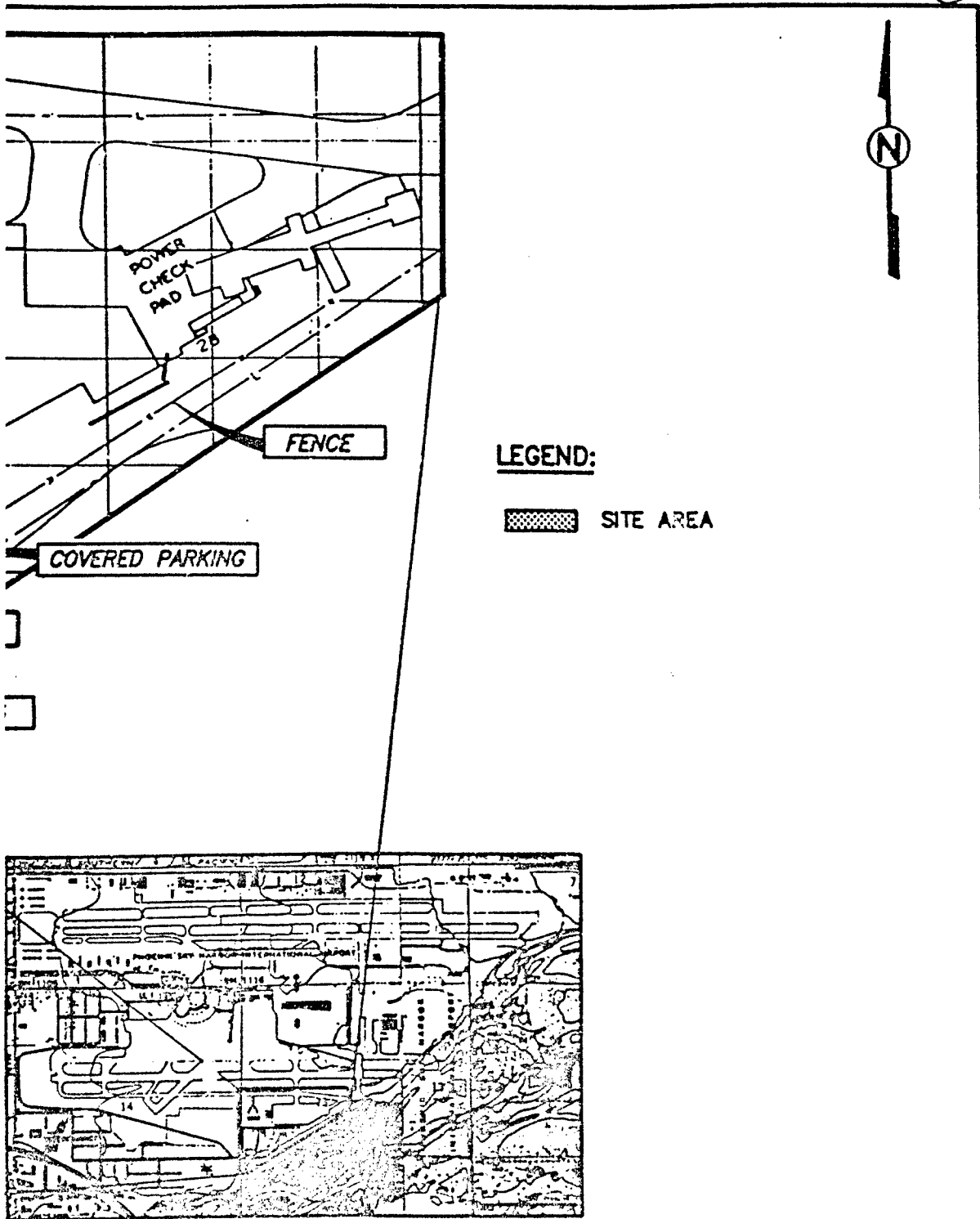


**FIGURE
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(3)



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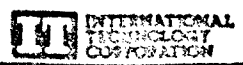
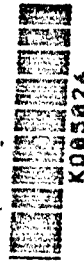
 SITE AREA

FIGURE 1-2
INVESTIGATION SITES, 161 AREFG

161 AREFG, ARIZONA ANG
SKY HARBOR IAP
PHOENIX, ARIZONA

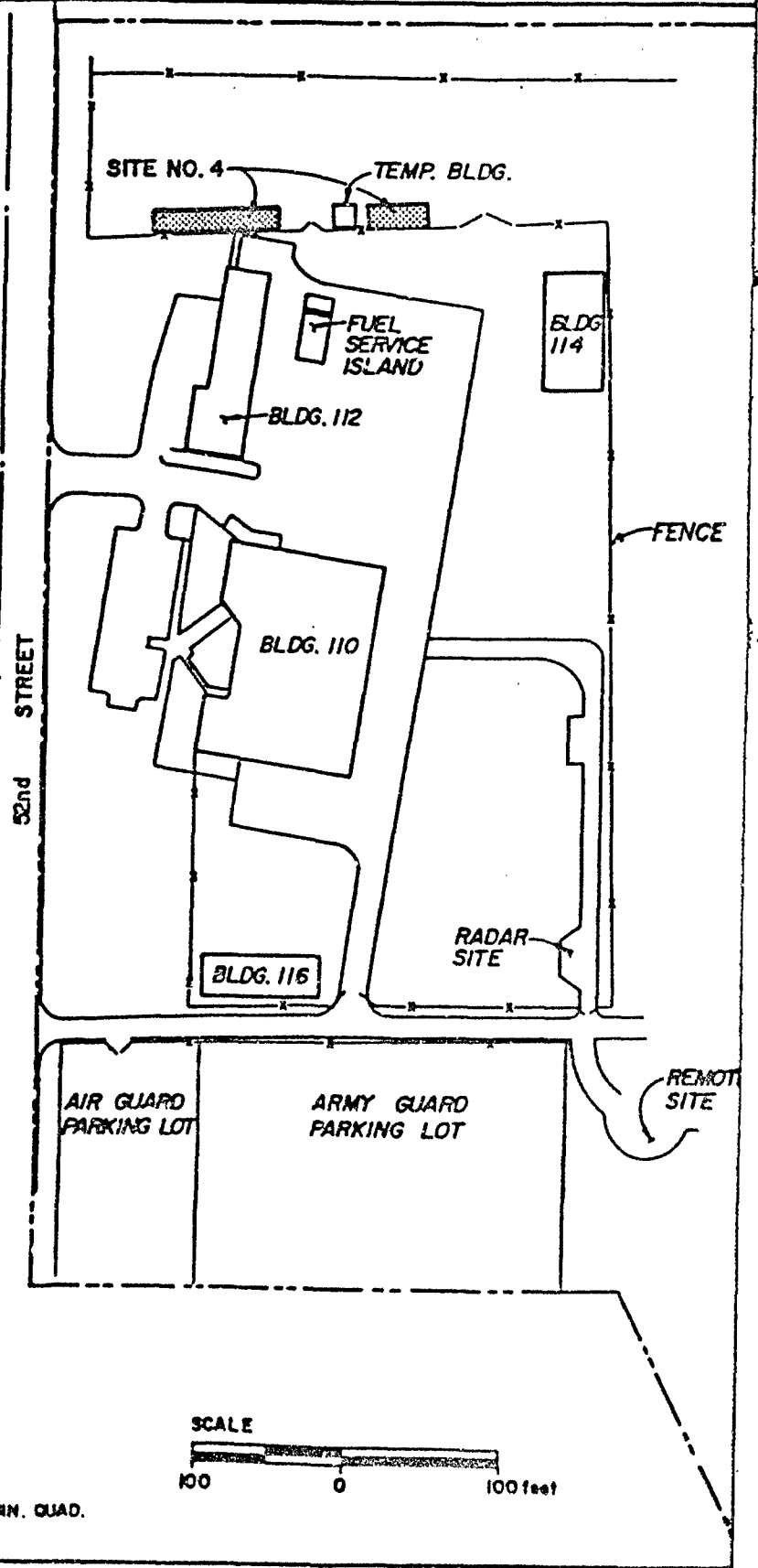


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DRAWN BY: C. ROBERTSON	DRAWN BY: C. ROBERTSON	ENGR. CHK. BY: D. WILLEN	PROJ. MGR.: J. WILLEN	PROJ. NO.: 408721



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TOPOGRAPHIC SOURCE:
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 TEMPE, ARIZONA 1982



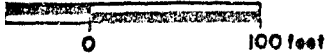
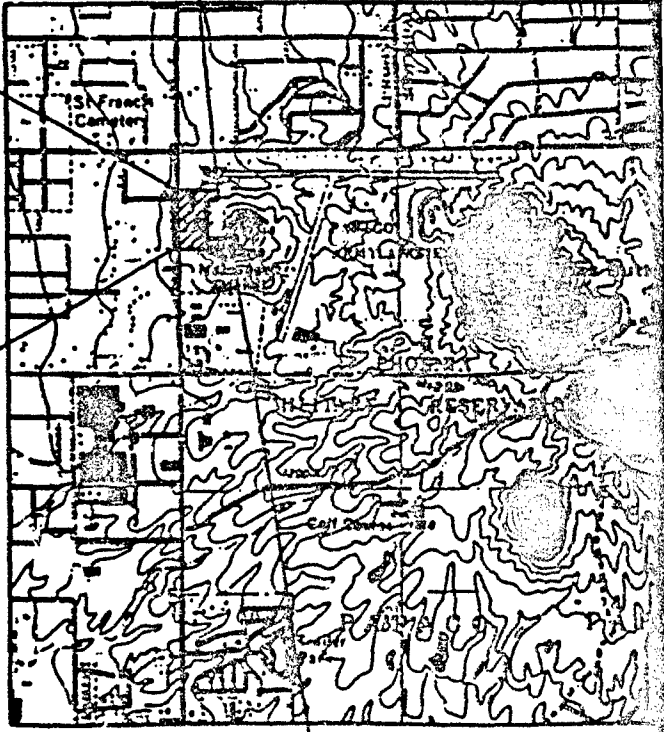
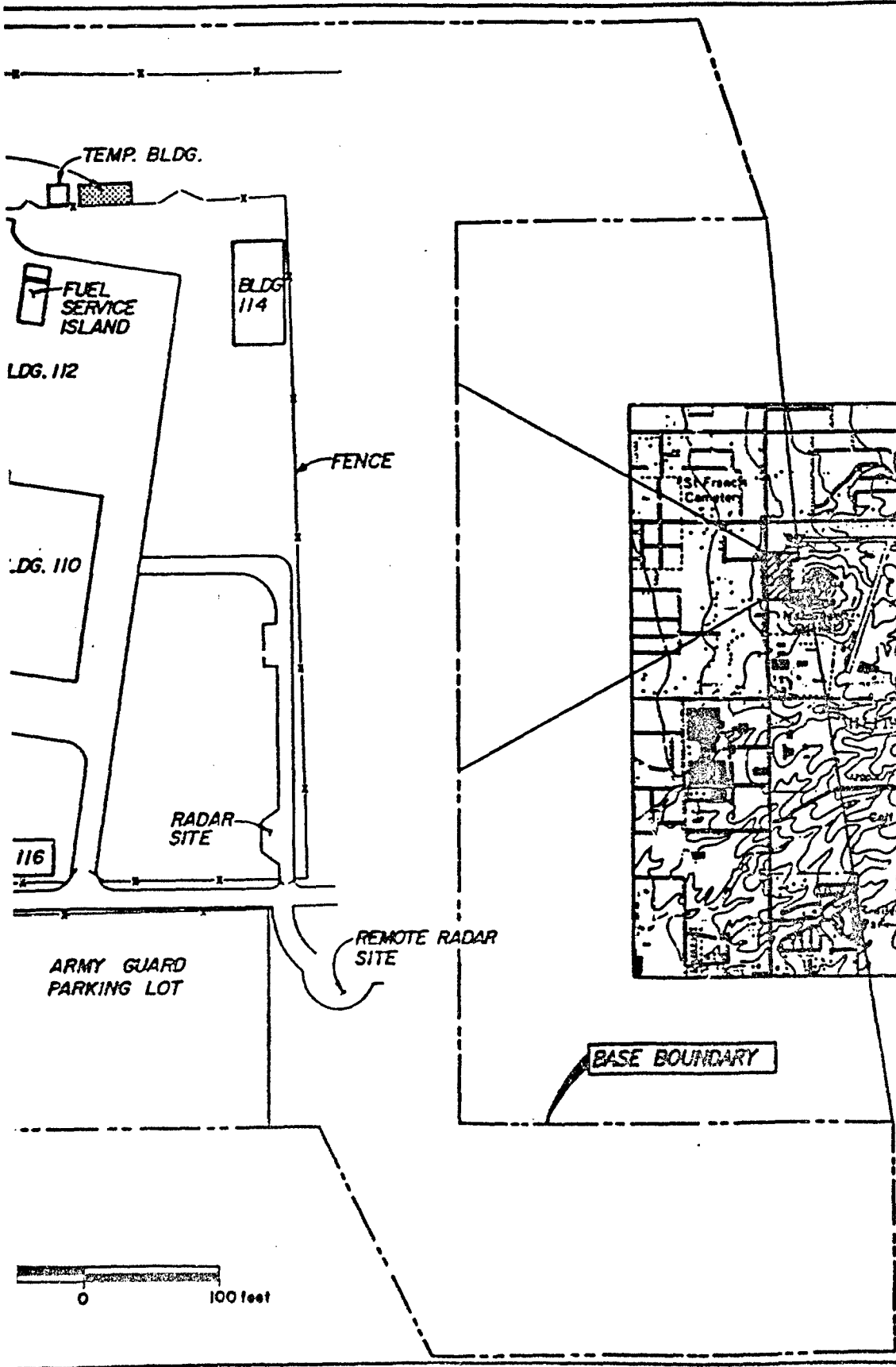
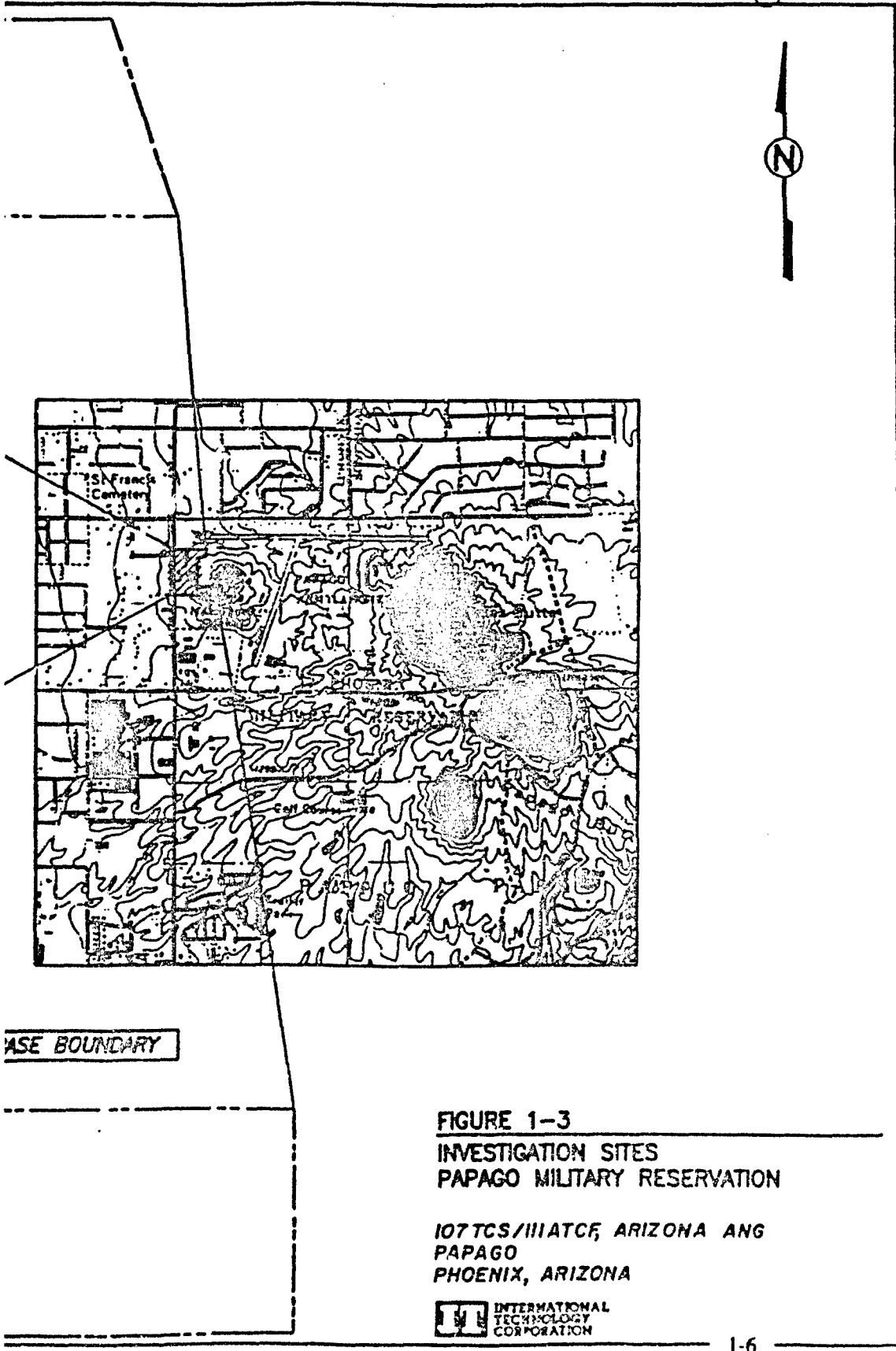


FIGURE 1-
INVESTIGATION
PAPAGO I

107 TCS / III
 PAPAGO
 PHOENIX, AZ



3



BASE BOUNDARY

FIGURE 1-3
INVESTIGATION SITES
PAPAGO MILITARY RESERVATION

107 TCS/III ATCF, ARIZONA ANG
PAPAGO
PHOENIX, ARIZONA



**INTERNATIONAL
TECHNOLOGY
CORPORATION**

- Site 4 - 107th Tactical Control Squadron (107TCS) Hazardous Waste Collection Area
- Site 5 - Ammunition Dump

1.5.1 Site 1 - JP-4 Hydrant Area

Site 1, the JP-4 hydrant system was investigated to determine extent of potential contamination resulting from valve releases and surface spillage within fenced portions of the hydrant system (Figure 1-4). The hydrant system consists of a series of pumps, pipes, and valves located above ground and underground, used in aircraft refueling. According to PA documentation (HMTTC, 1988), small releases may have occurred in the past. The total amount of fuel released is estimated as a small volume (less than 1,100 gallons) although actual amounts are unknown. Constituents of concern at Site 1 are fuel products including volatile and semivolatile organic compounds (VOC and SVOC) and total petroleum hydrocarbons (TPH).

1.5.2 Site 2 - Hazardous Waste Storage Area

Site 2, the hazardous waste storage area, is used to store drums of waste liquids including solvents such as PD-680 (similar to Stoddard solvent), and petroleum, oils, and lubricants (POLs). Site 2 is shown in Figure 1-5. This location is south of the area identified in the PA; although the PA accurately describes the site, its location is incorrectly given. The site consists of a concrete pad partially enclosed on three sides by a brick wall and a chain-link security fence.

Site 2 was identified in the PA because portions of soil next to the concrete pad were visibly stained. The PA estimated a small release of liquids (less than 1,100 gallons) may have occurred throughout 5 to 6 years of operation at the site, although the actual amount is unknown. Constituents of concern at Site 2 are VOCs, SVOCs, and metal contaminants.

1.5.3 Site 3 - Fuel Bladder Area

Site 3 (Figure 1-6) is located adjacent to the west boundary of the Base and is on airport property. This site was used as a temporary storage area for three 30,000-gallon capacity fuel bladders during 1972 and 1973. One of the bladders is suspected to have released an estimated medium volume (1,100 to 4,675 gallons) of fuel during use; however, the actual amount released is unknown. Constituents of concern at Site 3 are VOCs, SVOCs, TPH, and organic lead. The PA identified Site 3 as an area west of Building 25, encompassing portions of a fenced airport-controlled area (Figure 1-6). During SI field activities, a map was discovered depicting temporary fuel storage areas as being located west of areas

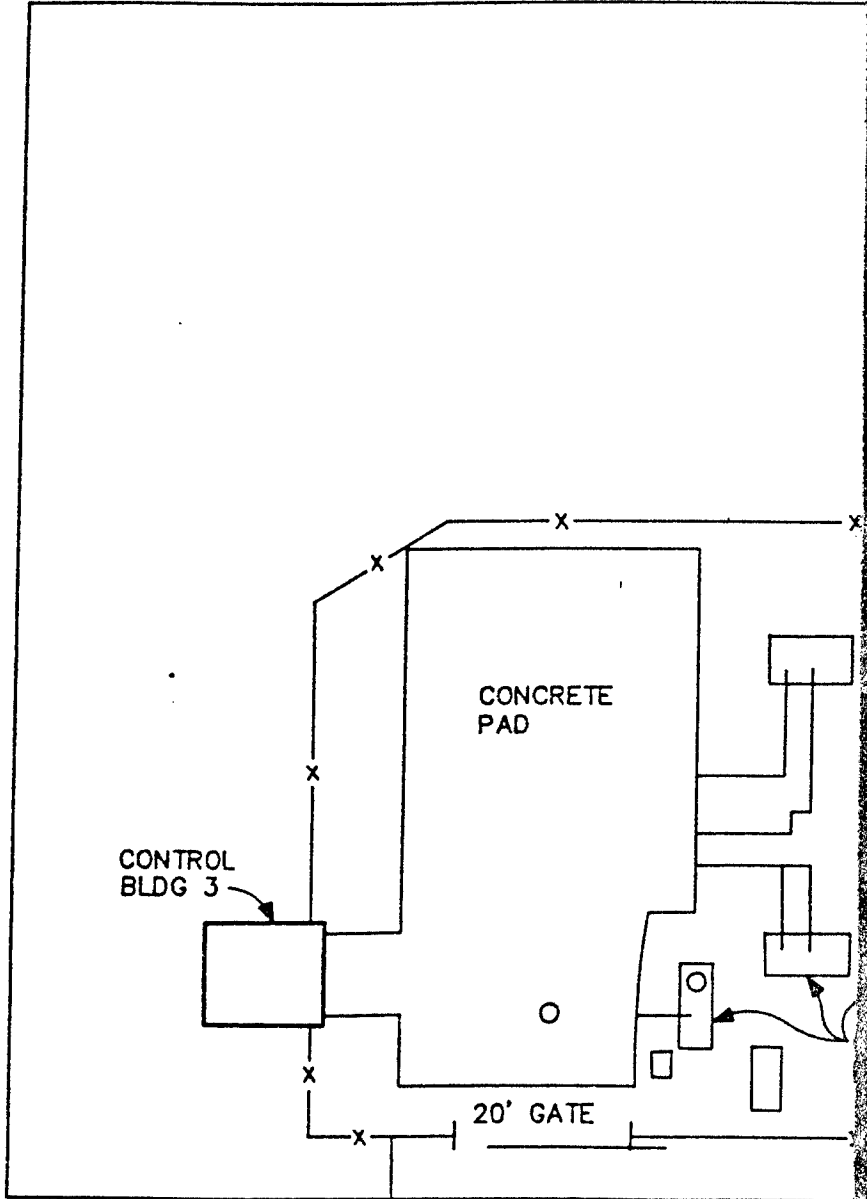
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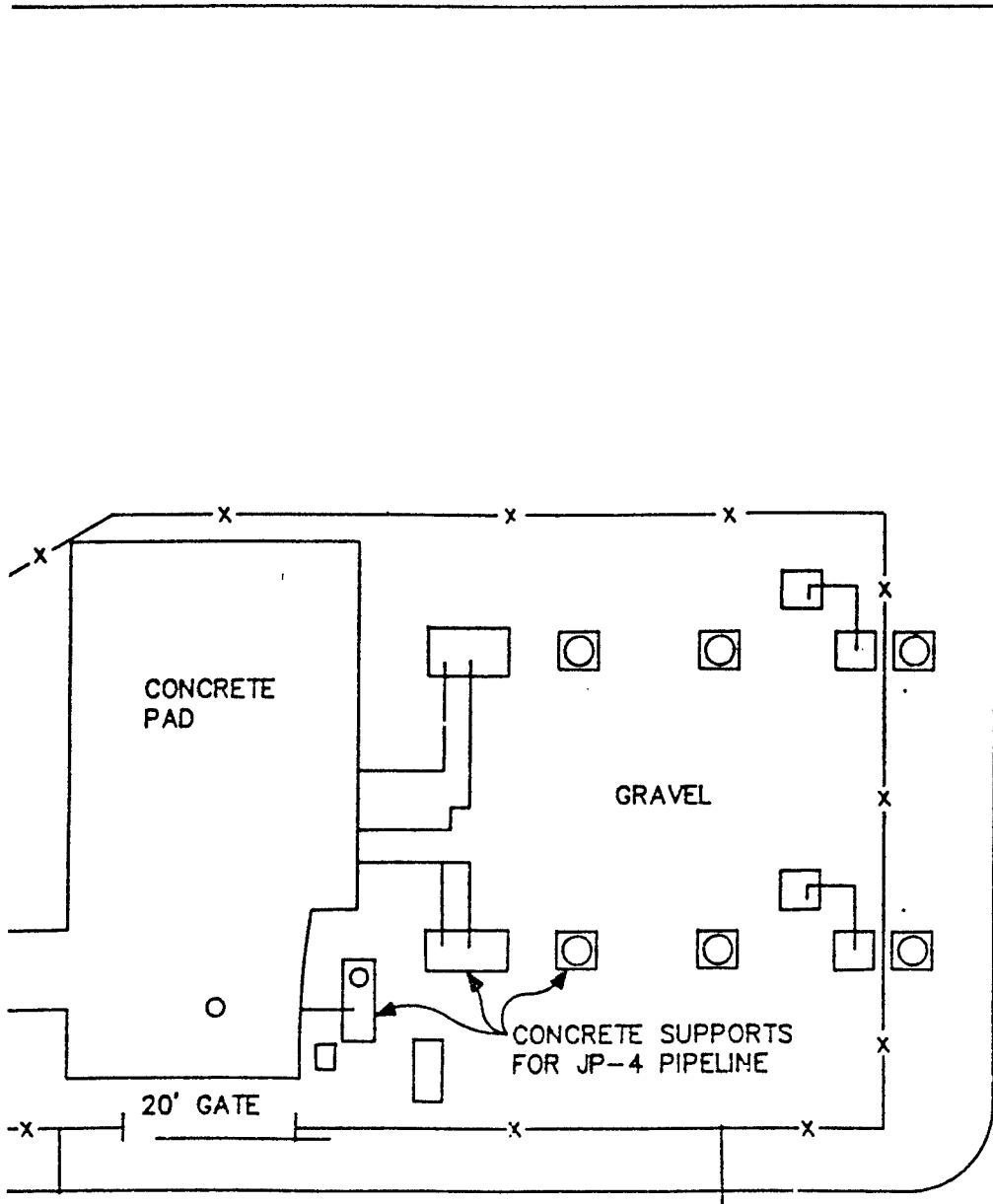
STARTING DATE: 10/30/91
DRAWN BY: BILL SMITH

DRAFT. CHCK. BY: G. PACHECO
ENGR. CHCK BY: D. WILLEN

INITIATOR: D. WILLEN
PROJ. MGR.: D. WILLEN

DWG NO.: 409721-B-C29
PROJ. NO.: 409721





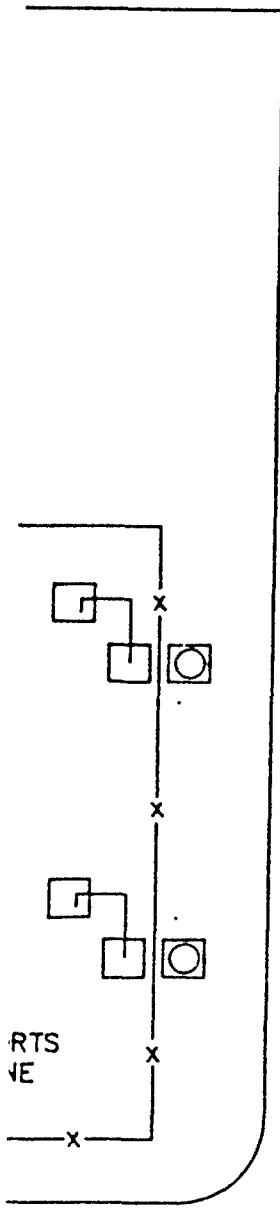
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FIGURE 1-
SITE NO.
JP-4 HYD

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SKY HARBO
PHOENIX, A



3



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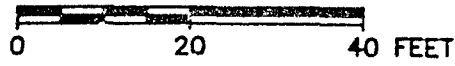


FIGURE 1-4
SITE NO. 1
JP-4 HYDRANT AREA

161AREFG, ARIZONA ANG
SKY HARBOR IAP
PHOENIX, ARIZONA



INTERNATIONAL
TECHNOLOGY
CORPORATION

STARTING DATE: 10/29/91	DATE LAST REV: 3/25/92	DRAFT. CHCK. BY: G. PACHECO	DWG. NO.: 409721-B-C30
DRAWN BY: BILL SMITH	DRAWN BY: J. HUBBARD	ENGR. CHCK BY: D. WILLEN	PROJ. NO.: 409721
		INITIATOR: D. WILLEN	
		PROJ. MGR.: D. WILLEN	



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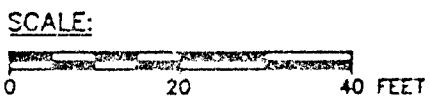
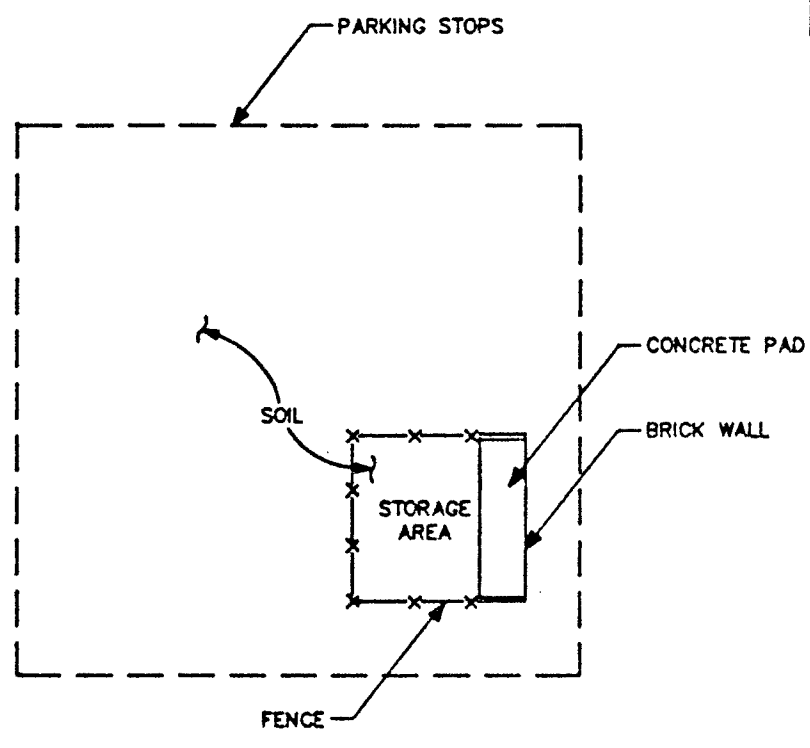
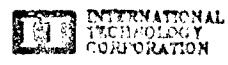


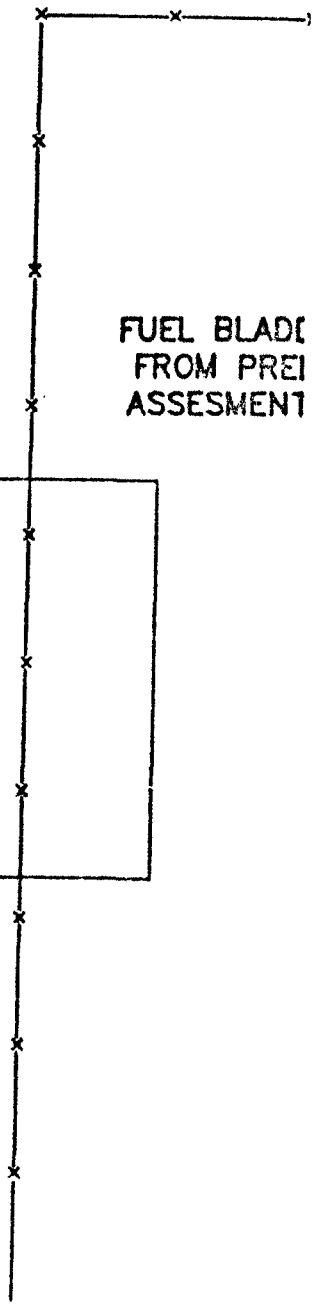
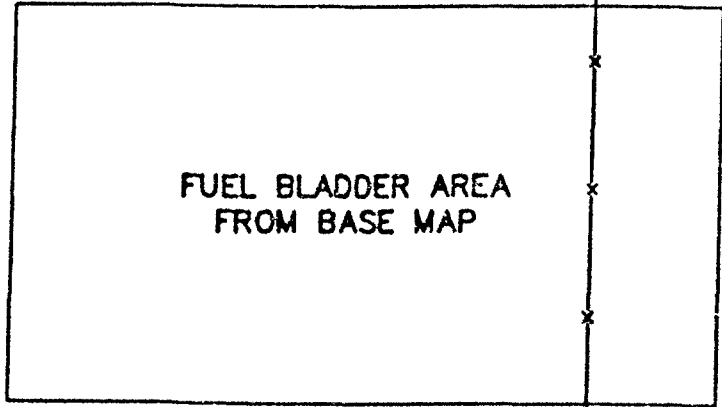
FIGURE 1-5
 SITE NO. 2
 HW STORAGE AREA
 161 AREFG, ARIZONA ANG
 SKY HARBOR IAP
 PHOENIX, ARIZONA





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STARTING DATE: 10/29/91 DRAWN BY: S. TOKAY	DATE LAST REV: DRAWN BY:	DRAFT. CHCK. BY: G. PACHECO ENGR. CHCK BY: D. WILLEN	INITIATOR: D. WILLEN PROJ. MGR.: D. WILLEN	DRAWING NO.: 409721-B-C31 PROJ. NO.: 409721
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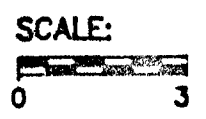
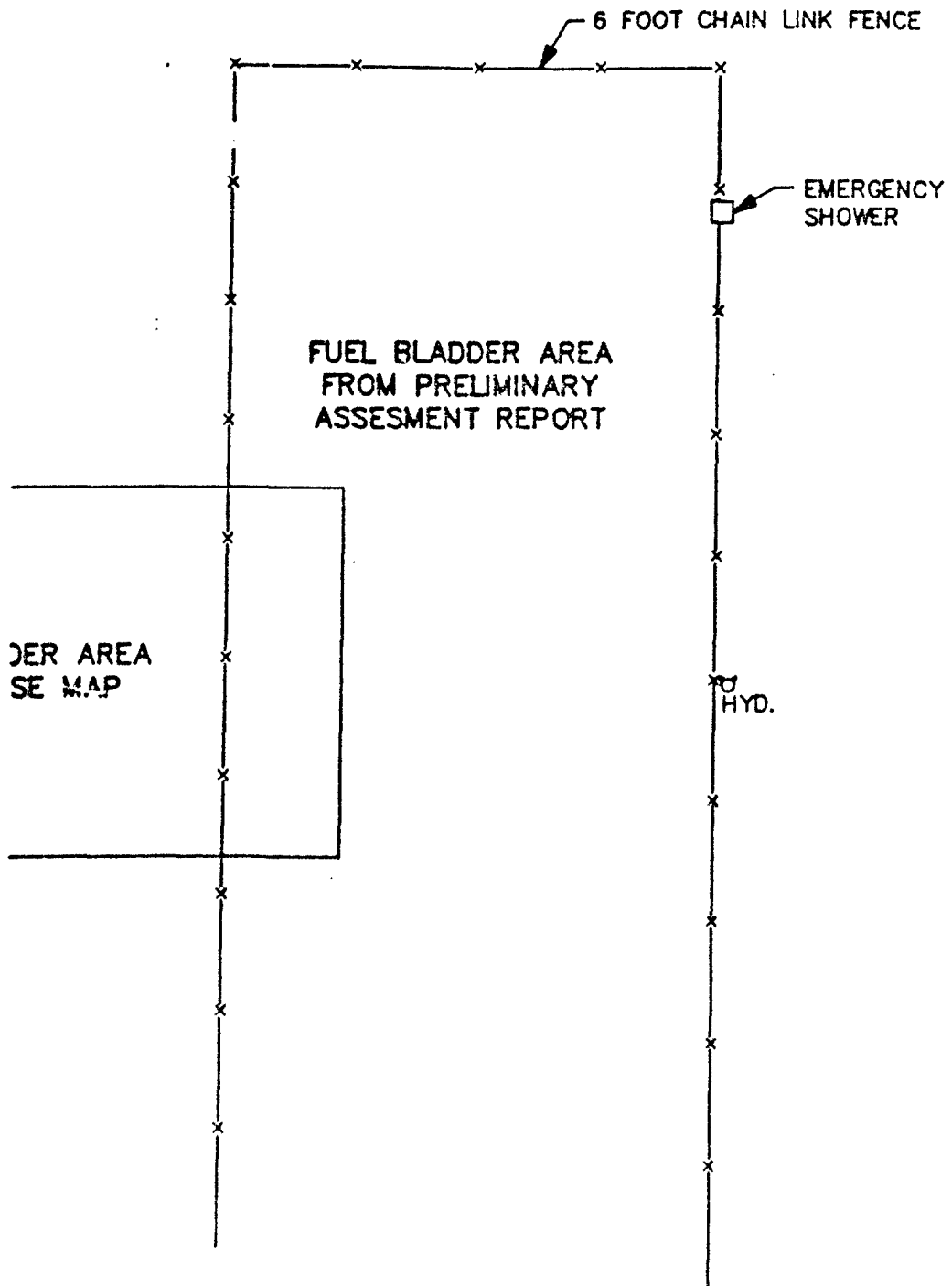
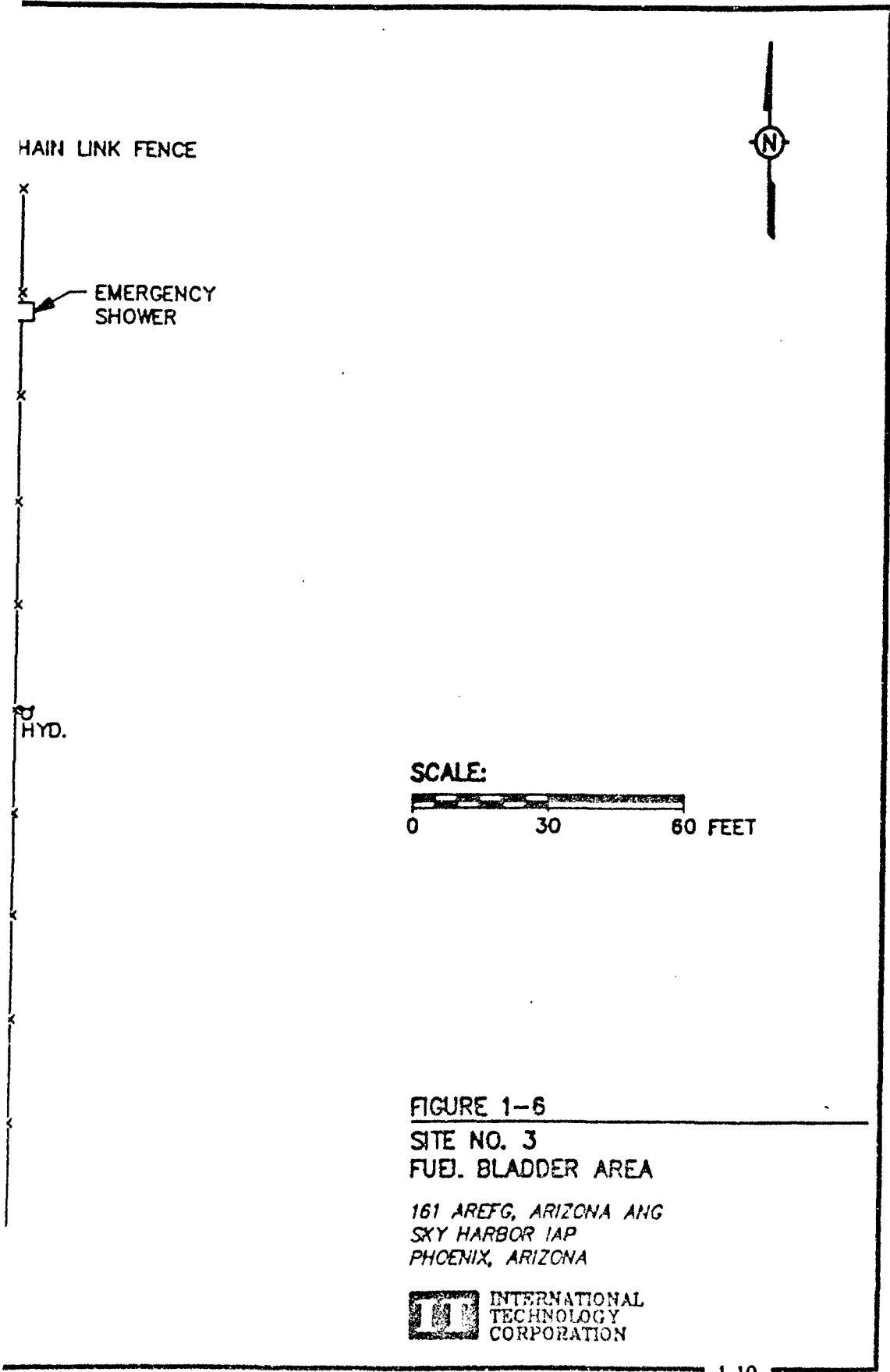


FIGURE 1-6
SITE NO. 3
FUEL BLADDER

161 AREFG, A
SKY HARBOR
PHOENIX, ARI.



3



SCALE:

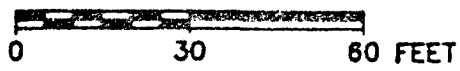


FIGURE 1-6
SITE NO. 3
FUEL BLADDER AREA
161 AREFG, ARIZONA ANG
SKY HARBOR IAP
PHOENIX, ARIZONA

 INTERNATIONAL
TECHNOLOGY
CORPORATION

identified in the PA. To accommodate this variation of site location, soil borings and monitoring wells were positioned so that data were collected from both areas.

1.5.4 Site 4 - 107TCS Hazardous Waste Collection Area

Site 4, the 107TCS hazardous waste collection area, is located at Papago Military Reservation. Site 4 consists of a portion of a graveled, fenced parking lot used to collect liquid wastes in 55-gallon drums (Figure 1-7). During a 1987 site reconnaissance, the storage area was found to be in a location different from that identified in the PA. Due to the uncertainty in actual site location, both sites were investigated. The areas are labeled Site 4A and 4B in Figure 1-7; 4a is currently occupied and 4B is identified in the PA. Materials collected at the site include fuels, solvents, and motor and gear oils. An area surrounding the storage area was visibly stained during the PA, resulting in identification as an investigation site. The amount of material released is unknown but is estimated as a small volume (less than 1,100 gallons).

1.5.5 Site 5 - Ammunition Dump

Site 5, the ammunition dump, consists of an area where 50-caliber ammunition was buried between 1952 and 1958. Trenching operations at the Base in 1980 discovered ammunition at a depth of 6 to 8 feet below the surface; however, the extent is not known. Site 5, identified in the PA, is shown in Figure 1-8. Figure 1-8 also identifies locations where ammunition was discovered during trenching activities. Due to the discrepancy among site locations, Site 5 was expanded to encompass both areas. Compounds of concern at the site include ammunition, metal constituents, and nitrate compounds from propellants. The volume of material disposed at Site 5 is uncertain.

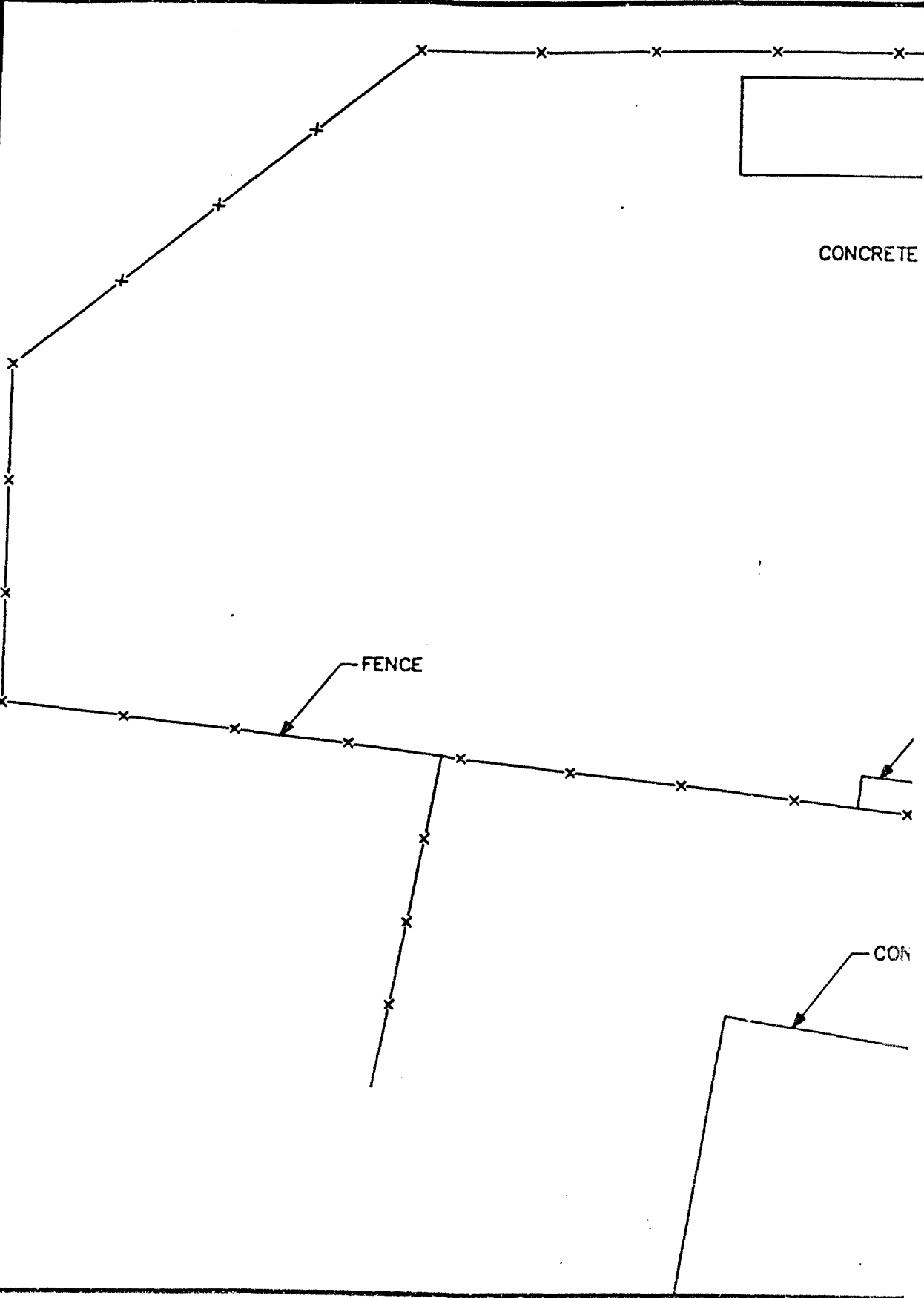
1.5.6 Site 6 - POL Area

Site 6, the petroleum, oil, and lubricant (POL) storage area consists of a series of underground storage tanks, connections, and distribution pipes (Figure 1-9). The site was not identified in the PA for investigation, however, the site was added to the current IRP investigation because of its potential for contamination and being situated upgradient to Site 3. The amount of material released, if any, is unknown.

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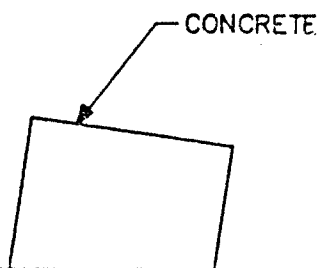
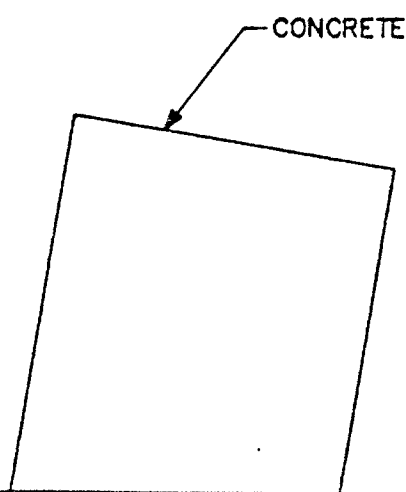
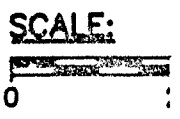
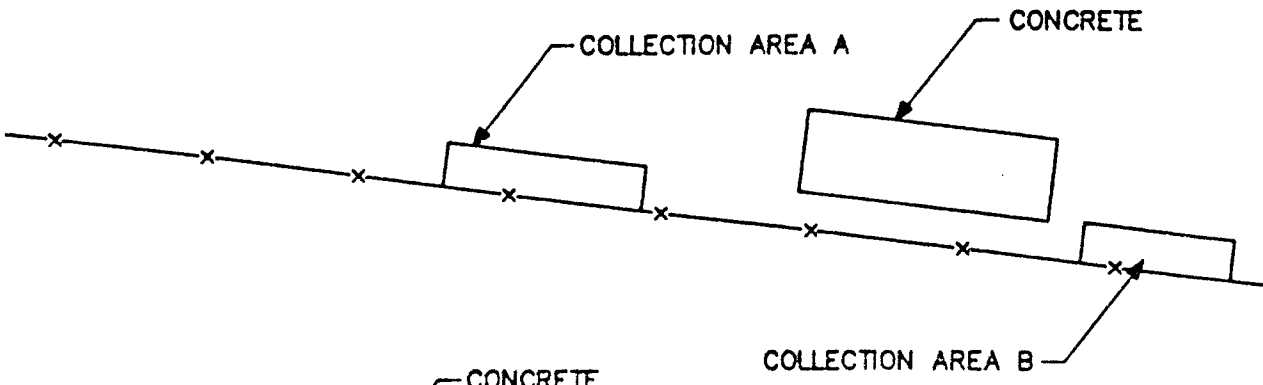
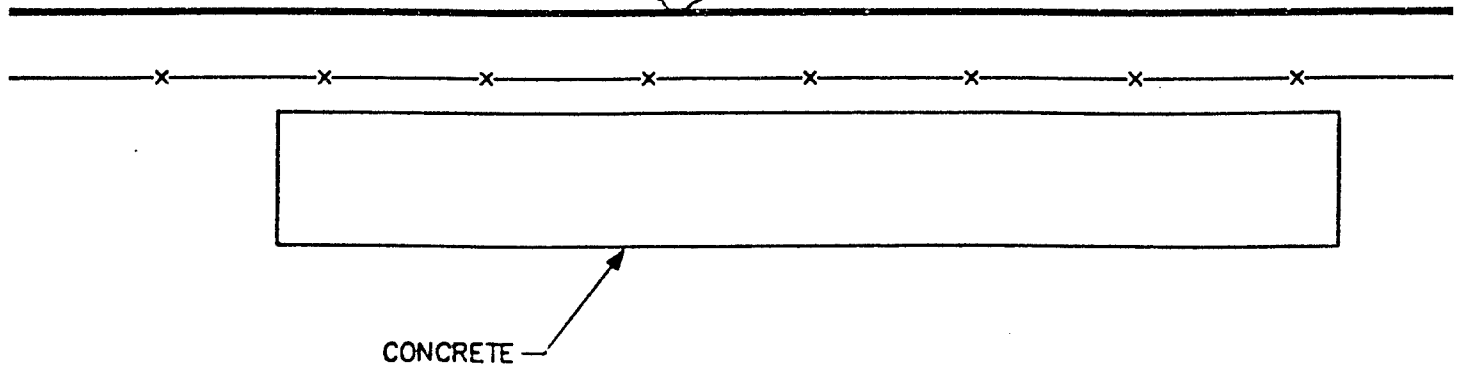


FIGURE 1-
SITE NO. 4
HW COLLE

107 TCS/111
PAPAGO MIL
PHOENIX, AF



3

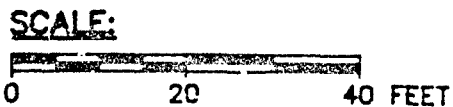
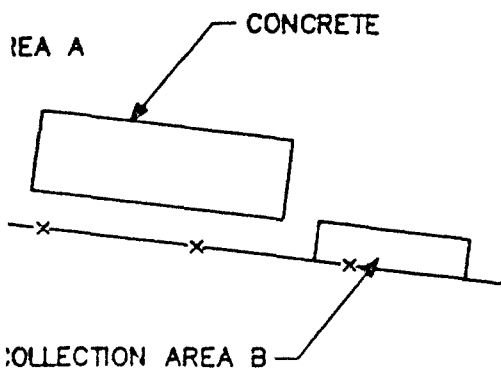
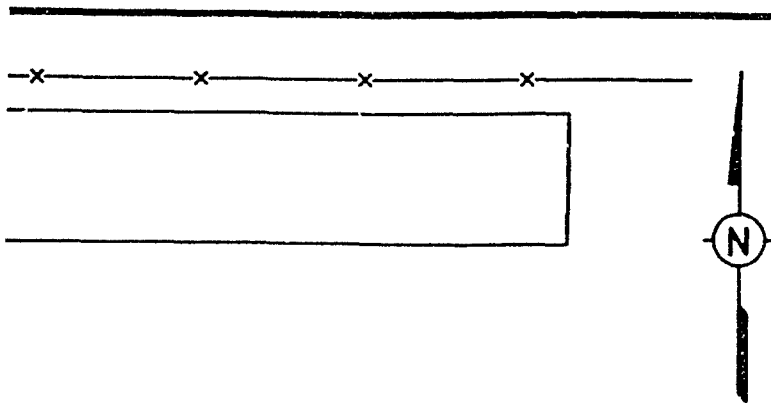


FIGURE 1-7
SITE NO. 4
HW COLLECTION AREA

107 TCS/111 ATCF, ARIZONA ANG
 PAPAGO MILITARY RESERVATION
 PHOENIX, ARIZONA



40972133 11/06/92 8:04am CKR

STARTING DATE: 10/29/91
DRAWN BY: BILL SMITH

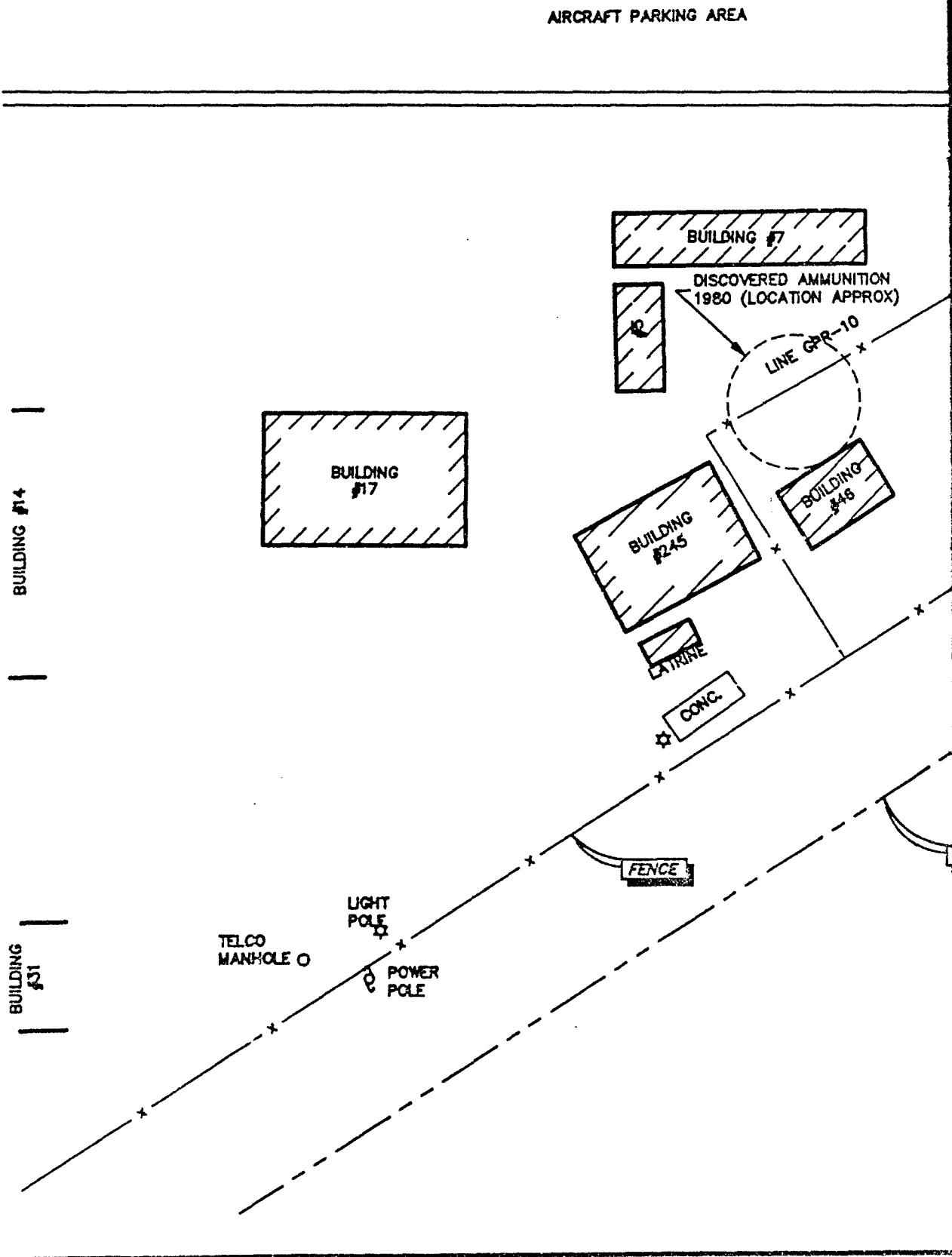
DATE LAST REV.: 11/06/92
DRAWN BY: C. ROBERTSON

DRAFT. CHCK. BY: G. PACHECO
ENGR. CHCK BY: D. MILLEN

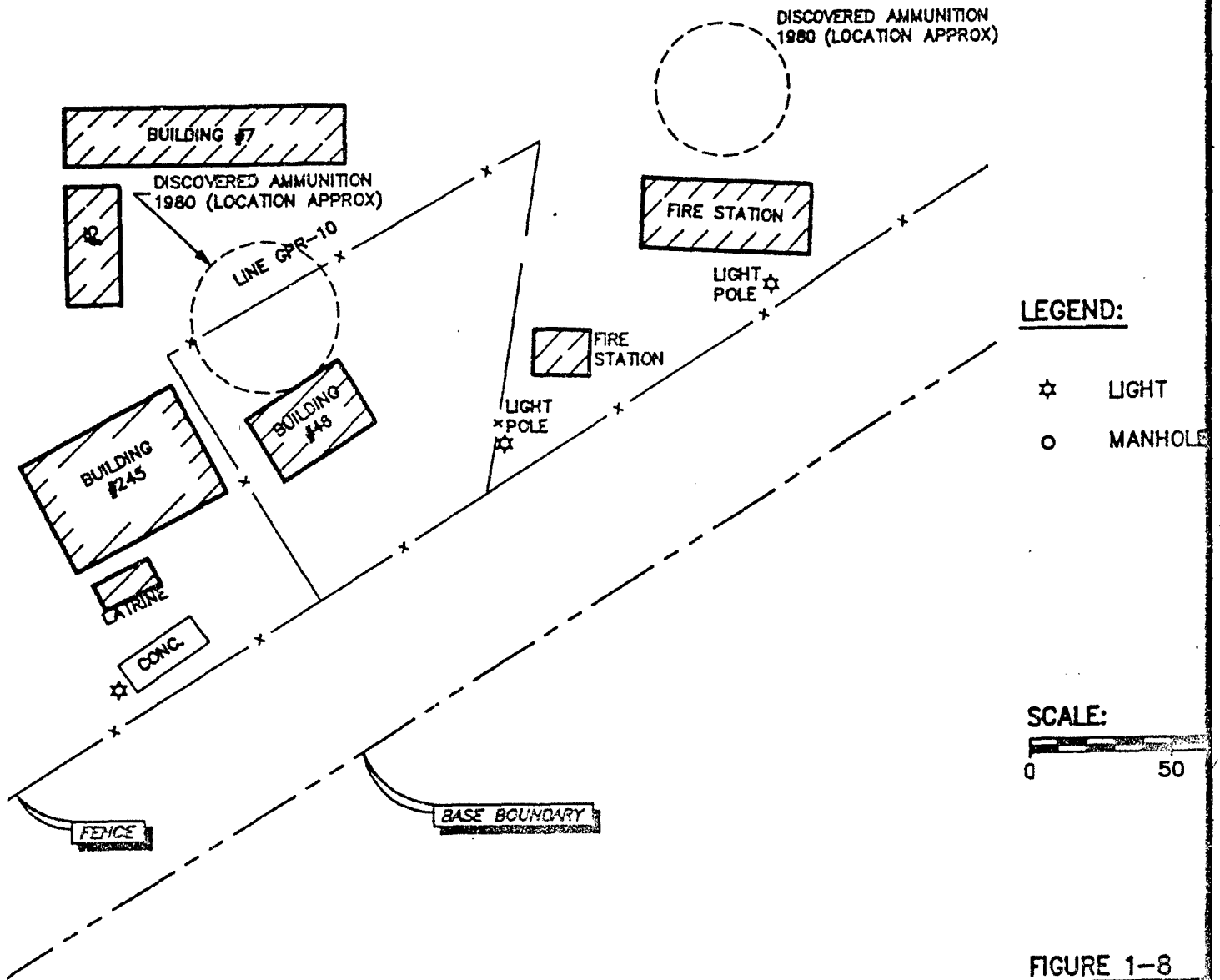
INITIATOR: D. MILLEN
PROJ. MGR.: D. MILLEN

DRAWING NO.: 409721-B-C33
PROJ. NO.: 409721

2



RCRAFT PARKING AREA



LEGEND:

- ☆ LIGHT
- MANHOLE

SCALE:

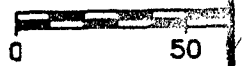
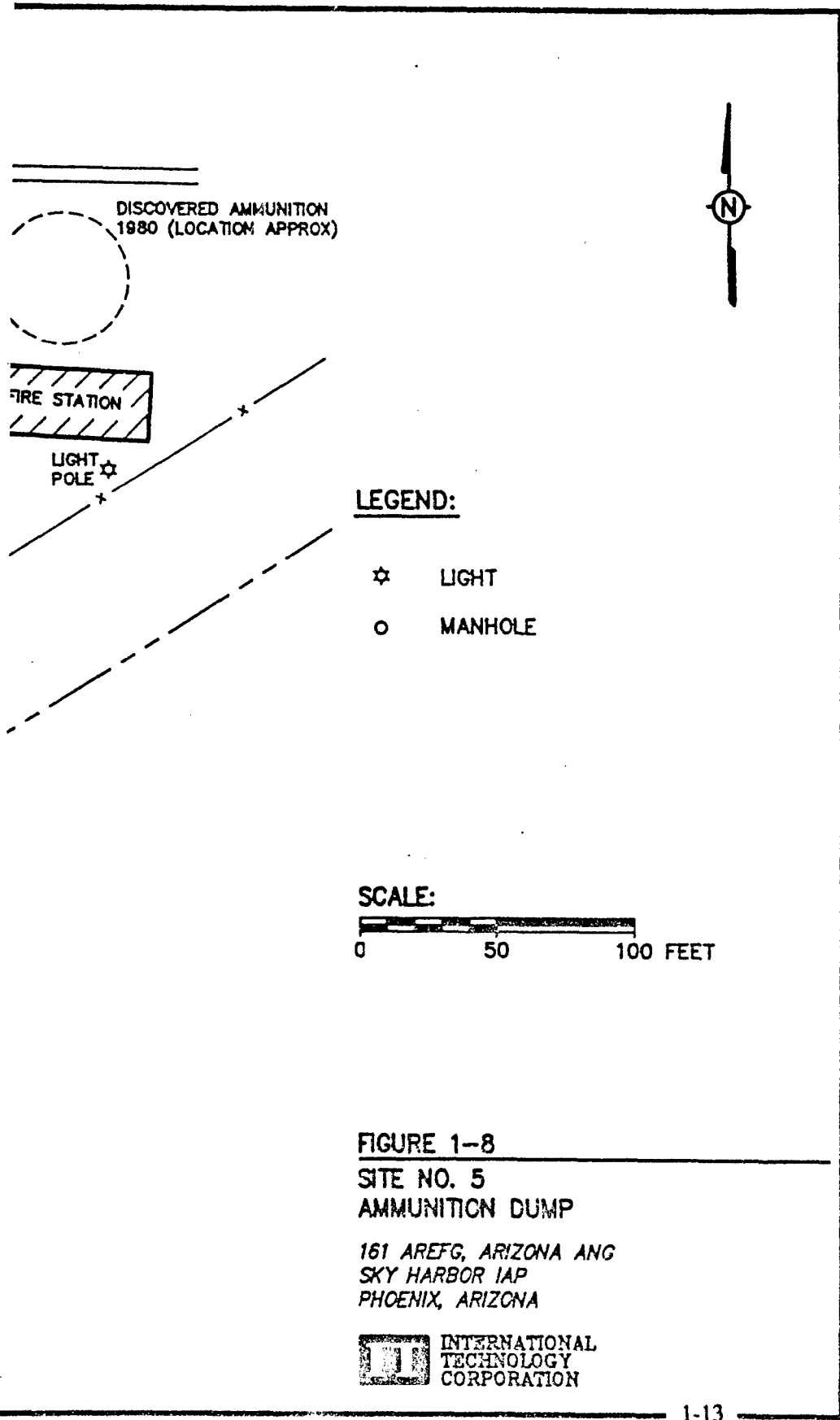


FIGURE 1-8
SITE NO. 5
AMMUNITION D

161 AREFG, ARIZ
SKY HARBOR IAF
PHOENIX, ARIZONA



3



LEGEND:

- ☆ LIGHT
- MANHOLE

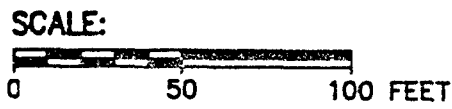
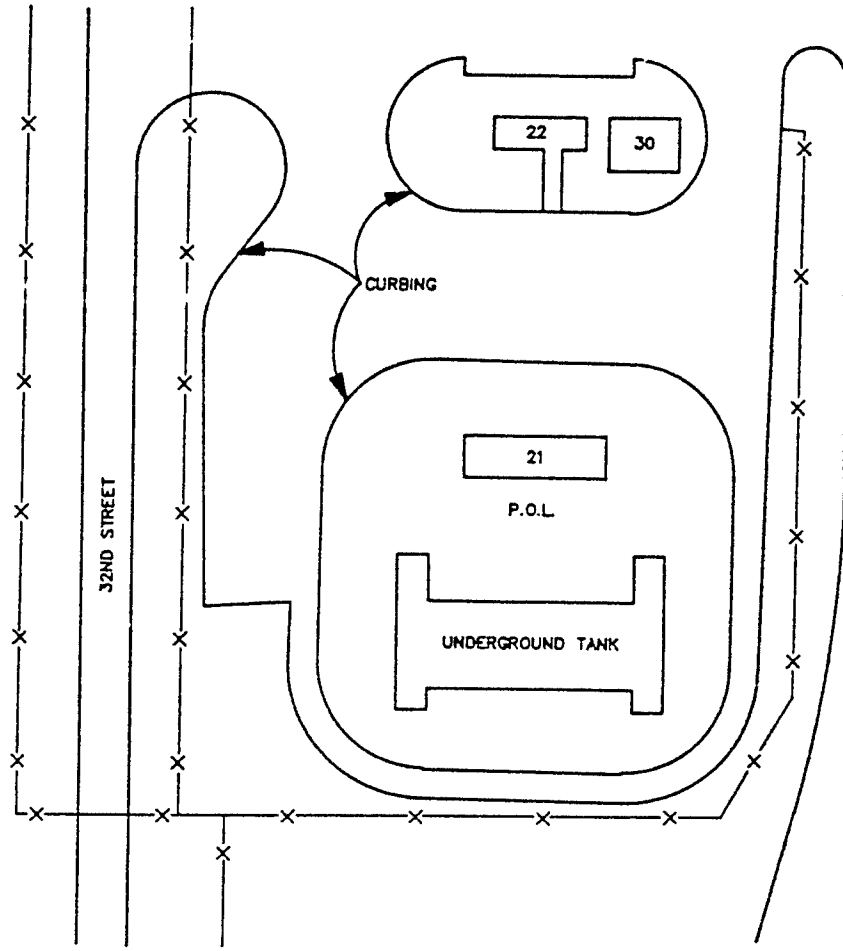


FIGURE 1-8
SITE NO. 5
AMMUNITION DUMP
161 AREFG, ARIZONA ANG
SKY HARBOR IAP
PHOENIX, ARIZONA

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STARTING DATE: 03/24/92	DATE LAST REV:	DRAFT. CHCK. BY: G. PACHECO	INITIATOR: D. WILLEN	DWG. NO.: 409721-A-56
DRAWN BY: S. CARDWELL	DRAWN BY:	ENGR. CHCK BY: D. WILLEN	PROJ. MGR.: D. WILLEN	PROJ. NO.: 409721

40972156 04/15/92 2:56pm CKR



LEGEND:

- X-X- FENCE LINE
- 22 BUILDING NUMBER

SCALE:

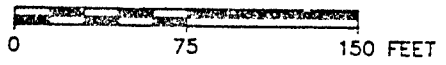


FIGURE 1-9

SITE NO. 6
POL AREA

161 AREFG, ARIZONA ANG
SKY HARBOR IAP
PHOENIX, ARIZONA



1.6 Regional Investigation Area

1.6.1 Environmental Setting

1.6.1.1 Climatology

Phoenix, Arizona is located in the Sonoran Desert and is characterized by warm arid conditions. Temperatures range from very hot in summer, typically higher than 90°F from early May through early October, and over 100°F from early June through early September to cool in winter months, averaging 65° to 66°F in December and January (Ruffner and Bair, 1987). Average annual precipitation is 7.11 inches, occurring primarily in two seasons: from late November to early April associated Pacific storms; and during July and August as convective thunderstorms. Winds are generally easterly and light with mean velocity of 6.3 miles per hour (mph). High winds periodically occur with thunderstorms during summer months and may also occur in spring with Pacific storms. The net precipitation is negative 63 inches per year and maximum rainfall intensity, based on a 1-year, 24-hour rainfall, is 1.5 inches (HMTC, 1988). Average monthly and annual precipitation, temperature, and wind data are presented in Table 1-1.

1.6.1.2 Physiography and Topography

The City of Phoenix lies within the Salt River Valley of the Sonoran Desert Section of the Basin and Range physiographic province (Fenneman, 1931). The Basin and Range is characterized by fault block and volcanic mountain ranges separated by relatively flat alluvial valleys. Phoenix is located on an alluvial valley at an elevation of approximately 1,100 feet above mean sea level (msl). South of Phoenix, approximately 6 miles from the Base, the South Mountains rise to an elevation of 2,500 feet msl. Eighteen miles southwest of the Base, the Estrella Mountains rise to 4,500 feet msl; 30 miles west the White Tank Mountains rise to 4,100 feet msl; and the Superstition Mountains rise to 5,000 feet msl approximately 30 miles to the east (Ruffner and Bair, 1987). The Hieroglyphic Mountains border the valley on the north at an elevation of 3,370 feet msl, and the Camelback Mountains border on the east and northeast rising to 2,700 feet msl (Brown and Pool, 1989).

Salt River is the primary surface drainage system of the area sloping west through Phoenix to a confluence with the Gila River. Salt River is generally dry and flow occurs during prolonged periods of intense precipitation or during releases from upstream reservoirs.

TABLE 1-1
AVERAGE MONTHLY AND ANNUAL
PRECIPITATION, TEMPERATURE AND WIND
SKY HARBOR INTERNATIONAL AIRPORT
PHOENIX, ARIZONA

MONTH	PRECIPITATION (INCHES)	TEMPERATURE (°F)	WIND SPEED (MPH)	WIND DIRECTION
JANUARY	0.73	52.3	5.3	E
FEBRUARY	0.59	56.1	5.9	E
MARCH	0.81	60.6	6.7	E
APRIL	0.27	68.1	7	E
MAY	0.14	77.0	7.1	E
JUNE	0.17	86.5	6.9	E
JULY	0.74	92.3	7.2	E
AUGUST	1.02	89.9	6.7	W
SEPTEMBER	0.64	84.6	6.4	E
OCTOBER	0.63	73.4	5.9	E
NOVEMBER	0.54	60.6	5.4	E
DECEMBER	0.83	53.3	5.2	E
ANNUAL	7.11	71.2	6.3	E

SOURCE:

RUFFNER AND BAIR, 1987

Land surface altitudes at the Base range from 1,110 feet msl along the southern boundary to near 1,120 feet msl in the northeast, sloping gently west (Figure 1-2). South of the Base, an escarpment forms the edge of the Salt River valley. Land surface altitudes at Papago range from 1,348 feet msl on an unnamed butte to approximately 1,220 feet msl in the northwest portion of the area (Figure 1-3).

1.6.1.3 Soil Conditions

Soils at the Base consist primarily of the Carrizo fine sandy loam and the Gilman loam (Figure 1-10) (U.S.D.A. , 1974). Soils along the south perimeter of the Base, adjacent to Salt River are considered alluvial land.

The Carrizo fine sandy loam is a moderately alkaline, excessively drained soil that forms on floodplains and alluvial fans of the Salt River. The surface layer is a brown, fine sandy loam approximately 15 inches thick. The subsoil is light brownish gray, very gravelly sand, approximately 55 inches thick. Permeability of Carrizo soil is very rapid, more than 20 inches per hour (1.41×10^{-2} centimeters per second (cm/s)).

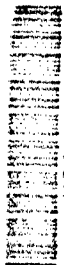
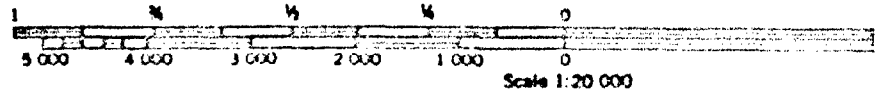
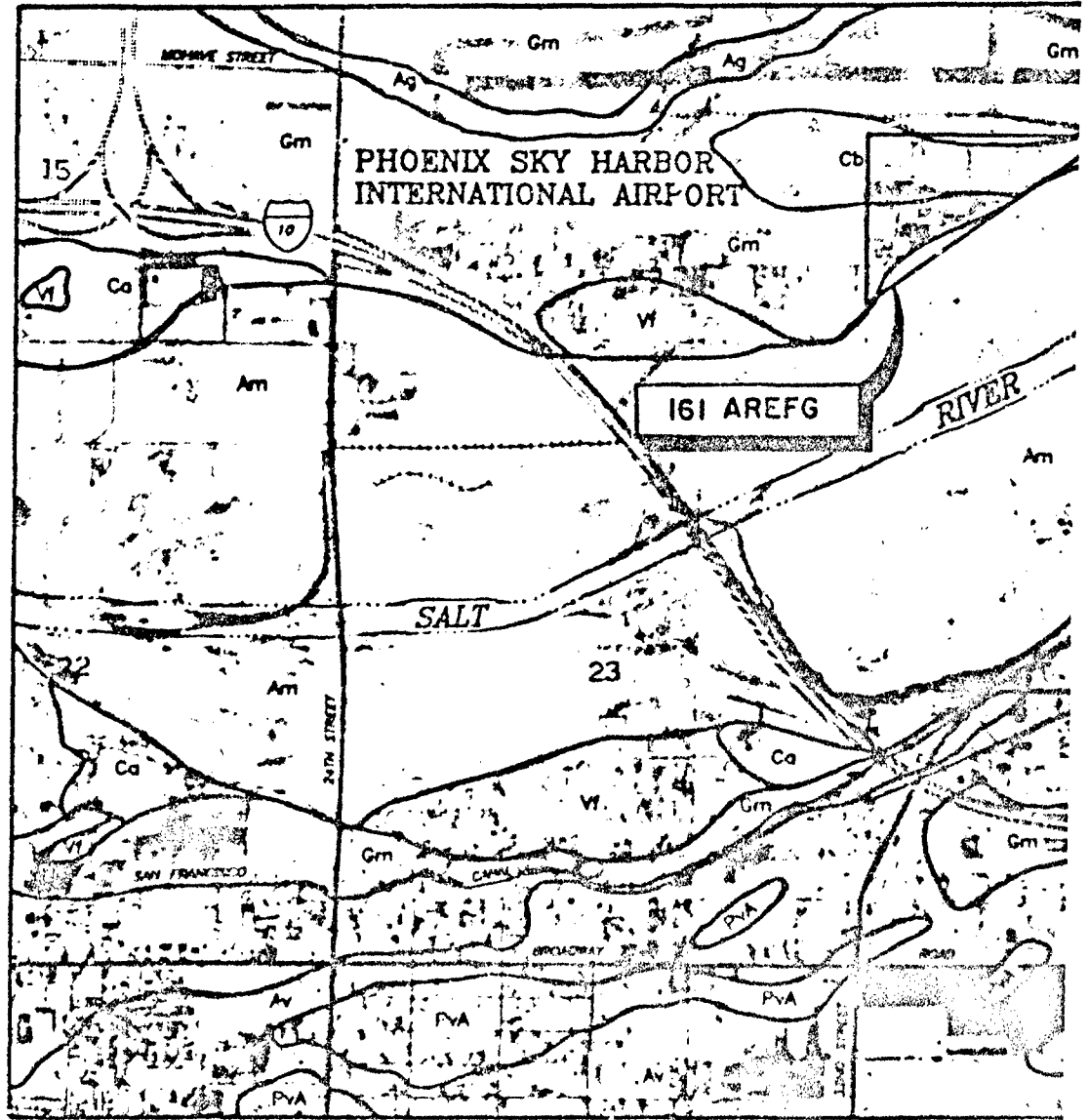
The Gilman loam is a moderately alkaline, well-drained soil that also forms on floodplains and alluvial fans of the Salt River and other large streams. The surface layer of the Gilman soil is pale brown loam approximately 13 inches thick. The subsoil is light yellowish-brown loam approximately 47 inches thick. Permeability of the Gilman soil is moderate, from 0.63 to 2 inches per hour (4.45×10^{-4} to 1.41×10^{-3} cm/s).

Alluvial lands consist of stratified, recently deposited stream sediment in channels of the Salt River, including adjacent areas of alluvial material deposited by the river. These deposits may be up to 1 mile wide. The surface layer of alluvial land ranges in texture from gravelly sand to very gravelly sand to fine loam. Material beneath the surface layer is very gravelly sand to very fine sandy loam and loam and may include large cobbles to boulders. Permeability ranges from rapid to very rapid, from 6.3 to over 20 inches per hour (4.45×10^{-3} to over 1.41×10^{-2} cm/s).

Soils at Papago consist primarily of the Cavelt gravelly loam (Figure 1-11), which is a moderately alkaline, well-drained soil that forms on fans that extend outward from the base of mountains or buttes. The surface layer of Cavelt soil is light yellowish-brown gravelly loam, underlain by light brown gravelly loam to a depth of 10 inches. The subsoil is a white hardpan consisting of pebbles cemented together with calcium carbonate (caliche). The

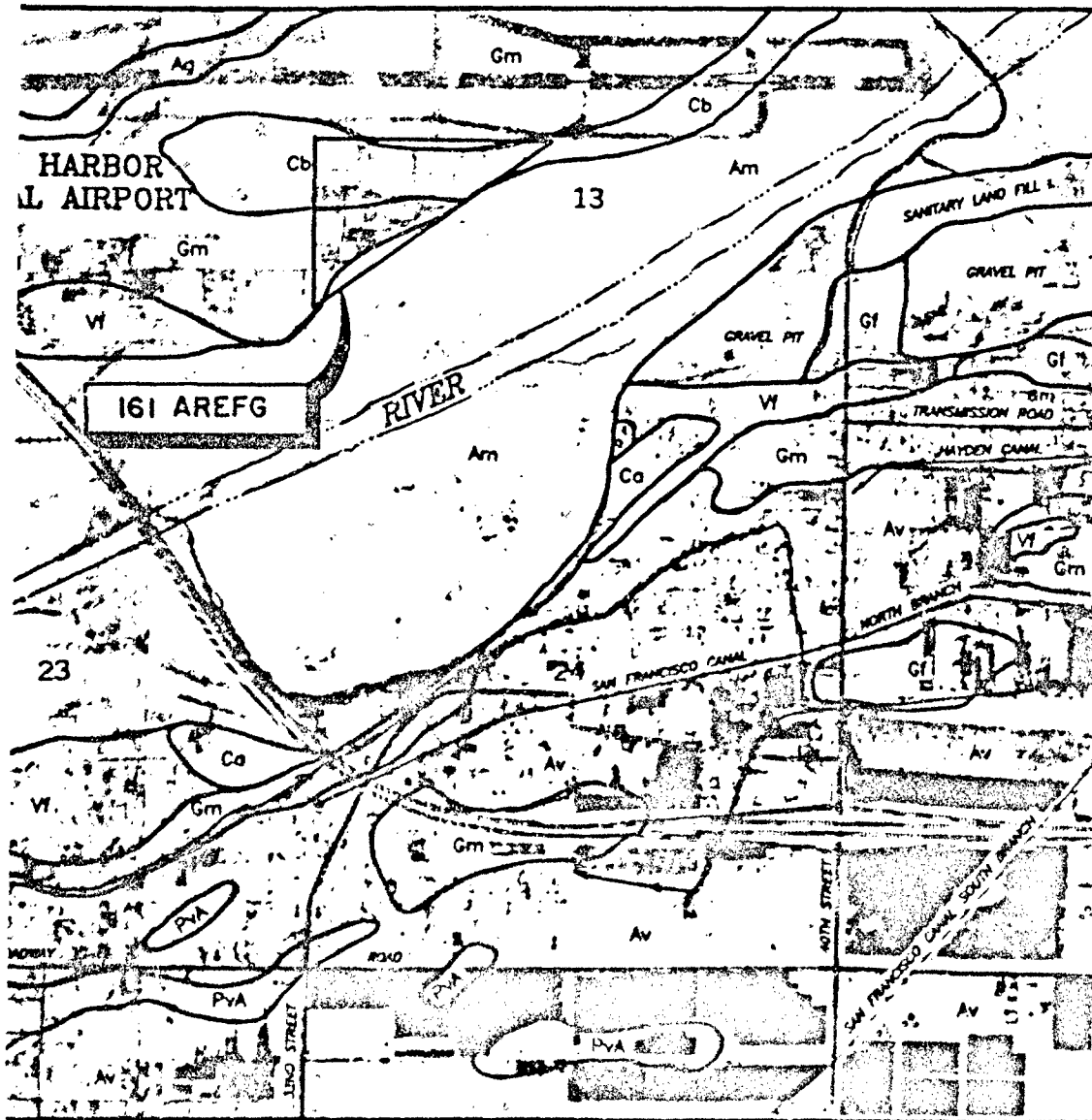
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STARTING DATE: 10/30/81	DATE LAST REV: 03/31/92	DRAFT. CHK. BY: G. PACHECO	INITIATOR: D. MILLEN	DRAWING NO.: 409721-B-C34
DRAWN BY: C. ROBERTSON	DRAWN BY: C. ROBERTSON	ENGR. CHK. BY: D. MILLEN	PROJ. MGR: D. MILLEN	PROJ. NO.: 409721



K005032

SOURCE: U.S.G.A., 1974



LEGEND:

- Am - [Symbol]
- Cb - [Symbol]
- Gm - [Symbol]
- Ag - [Symbol]
- Ca - [Symbol]
- Vf - [Symbol]
- Av - [Symbol]
- PvA - [Symbol]
- Gf - [Symbol]

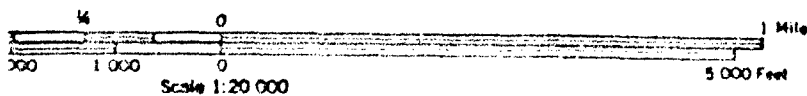
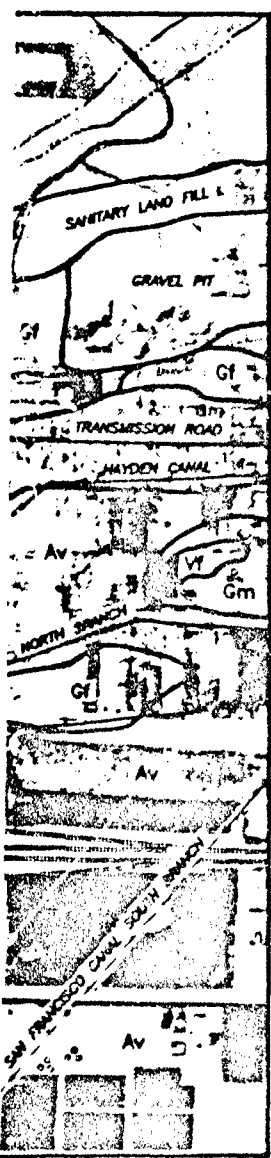


FIGURE 1-1
PREDOMINANT
161 AREFG

161 AREFG, A
 PHOENIX, ARIZ.





LEGEND:

- Am - ALLUVIAL LAND
- Cb - CARRIZO FINE SANDY LOAM
- Gm - GILMAN LOAM
- Ag - AGUALT LOAM
- Ca - CARRIZO GRAVELLY LOAM
- Vf - VINT LOAMY FINE SAND
- Av - AVONDALE CLAY LOAM
- PvA - PINAMT VERY GRAVELLY LOAM
- Gf - GILMAN FINE SANDY LOAM

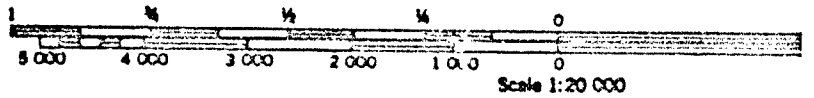
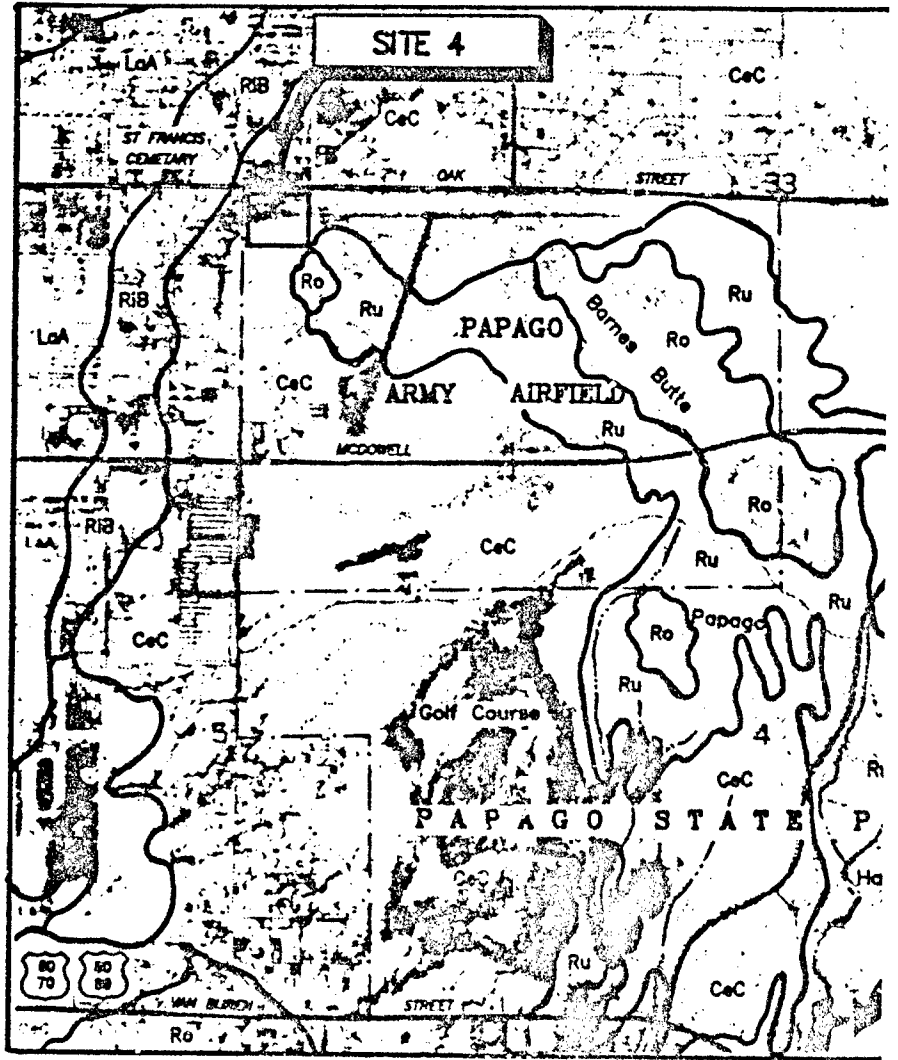
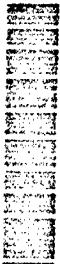
FIGURE 1-10
PREDOMINANT SOIL TYPES
161 AREFG

161 AREFG, ARIZONA AND
 PHOENIX, ARIZONA



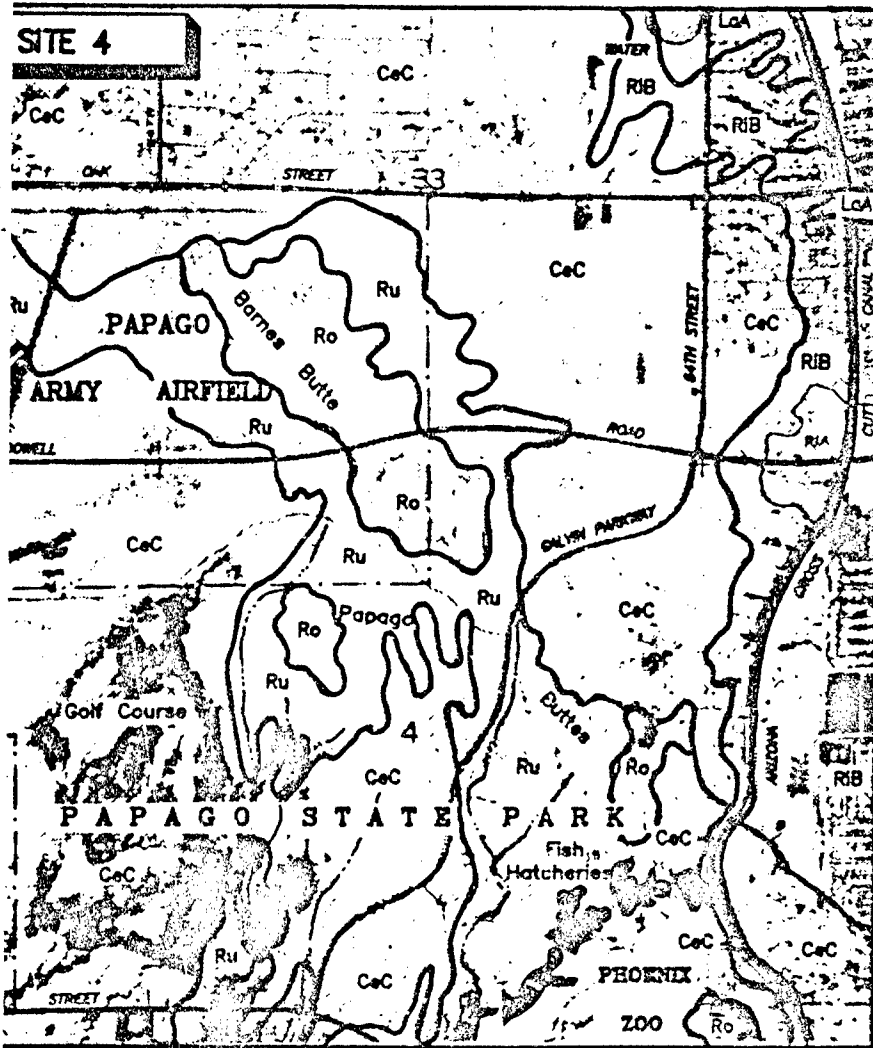
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DRAWN BY: C. ROBERTSON	DRAWN BY: C. ROBERTSON	ENGR. CHCK BY: D. WILLEN	PROJ. MGR.: D. WILLEN	PROJ. NO.: 409721



SOURCE: U.S.D.A., 1974

(2)



LEGEND:

- CeC - C
- Ro - R
- Ru - R
- RiB - R
- LaA - L

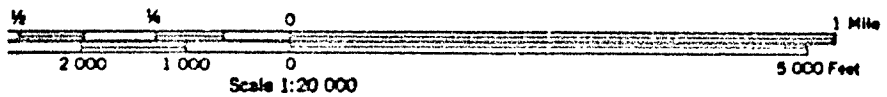


FIGURE 1-1
PREDOMINANT
PAPAGO MILL
107 TCS/111 A
PHOENIX, ARIZ



3



LEGEND:

- CaC - CAVELT GRAVELLY LOAM
- Ro - ROCK LAND
- Ru - ROUGH BROKEN LAND
- RiB - RILLITO GRAVELLY LOAM
- LoA - LAVEEN LOAM

1 Mile
3
Foot

FIGURE 1-11

**PREDOMINANT SOIL TYPES
PAPAGO MILITARY RESERVATION**

107 TCS/111 ATCF, ARIZONA ANG
PHOENIX, ARIZONA



INTERNATIONAL
TECHNOLOGY
CORPORATION

hardpan is approximately 36 inches thick. The substratum is very pale brown gravelly loam approximately 14 inches thick, cemented by calcium carbonate. Permeability is moderate in the upper part of the soil profile (4.45×10^{-4} to 1.41×10^{-4} cm/s) and very slow in the hardpan (less than 4.24×10^{-5} cm/s).

1.6.1.4 Land Use

Land use surrounding the Base is primarily industrial. Sky Harbor International Airport abuts the Base on the north, east, and west sides and the Salt River forms the southern base boundary.

Papago is set in an area of mixed land use. Residential areas occur north and west of the reservation. Light industry is located west and southwest of the site, and areas east and southeast are mixed military reservation and recreational use.

1.6.2 Regional Geology and Hydrogeology

1.6.2.1 Regional Geology

The area surrounding Phoenix is located in the Basin and Range physiographic province and is characterized by large-scale normal faulting, igneous and metamorphic mountain ranges, and deep basins with up to 10,000 feet of sedimentary and volcanic fill. Detailed structure of individual basins has been largely obscured by erosion.

The following discussion of geology and hydrogeology of the area is largely adapted from Brown and Pool (1989). Geologic deposits in the area are divided into six primary units: metamorphic and granitic rocks; extrusive rocks; red unit; and upper, middle, and lower units of the basin fill.

Granitic rocks and schist and gneiss of Precambrian to Tertiary age compose most of surrounding mountain ranges, occur around basin borders, and underlie basin fill. These rocks provide source material for basin fill and form virtually impermeable hydrologic boundaries to the basin.

The red unit consists of reddish-colored, well-cemented breccia, conglomerate, sandstone, and siltstone containing granitic and rhyolitic clasts, more than 600 feet thick and predating Basin and Range disturbance. Particles are derived from pre-Basin and Range uplands with

sizes ranging from clay to boulders. Deposition occurred in playa, alluvial fan, and debris flow environments with locally mafic to felsic extrusive igneous rocks interbedded among sedimentary deposits. The age of red unit deposits is estimated to be 17.5 to 22 million years old.

Crystalline rocks and the red unit are overlain by the lower alluvial unit through faulting or stratigraphic processes. The lower alluvial unit is in turn overlain by the middle alluvial unit and then the upper alluvial unit. The alluvial units record areal subsidence of the basin and filling of more than 10,000 feet of sediments and extrusive igneous rocks.

The lower alluvial unit is divided into two parts, the lower part of the lower unit, and the upper part of the lower unit. The lower part of the lower unit consists of mudstone, siltstone, gypsiferous and anhydrotic mudstone and siltstone, sand, gravel, conglomerate, halite, anhydrite, and interbedded basalt. Thicknesses of deposits range from less than 1,000 feet to more than 10,000 feet. Deposits of the lower part of the lower unit were accumulated in playa, alluvial fan, fluvial, and evaporitic environments prior to 10 million years before present (BP) time.

The upper part of the lower unit consists of silt, clay, mudstone, siltstone, gypsiferous mudstone, gypsum, sand, and gravel ranging in thickness from 0 to more than 1,000 feet. The contact between lower and upper parts of the lower unit is gradational in most areas and is characterized by increased heterogeneity in geophysical and particle size logs.

The middle unit of the basin fill consists of weakly consolidated silt, clay, siltstone, silty sand, and gravel with local moderately to well indurated siltstone. The deposit was accumulated in playa, alluvial fan, and fluvial environments with thicknesses ranging from 0 to approximately 800 feet. Middle unit deposits were accumulated between approximately 8 and 3.3 million years BP. Contacts with the upper part of the lower unit are gradational.

The upper unit of basin fill includes gravel, silt, and sand deposited in channel, floodplain, and alluvial fan environments derived from drainage areas of the Salt, Gila, Agua Fria, and Verde Rivers. Thickness of upper unit deposits range from 0 to 400 feet and the unit forms a gradational contact with the middle unit.

1.6.2.2 Regional Hydrology

Crystalline rocks surrounding the basin are effectively impermeable, forming hydrologic borders to the basin. Groundwater occurs in sedimentary deposits of the Salt River Valley area under leaky confined to unconfined conditions. The red unit is not a regionally important aquifer; however, where locally fractured or faulted, it may yield up to 1,000 gallons per minute (gpm) to wells. The lower alluvial unit of basin fill is generally saturated and under leaky, confined conditions. Transmissivity (T) is estimated to range from 0 to 7,000 feet squared per day with hydraulic conductivity (K) ranging from 3 to 25 feet per day (1.1×10^{-3} to 8.82×10^{-3} cm/s) (Brown and Pool, 1989).

The middle unit is reported to occur under saturated unconfined to leaky confined conditions. Transmissivity is estimated to range from 0 to 20,000 feet squared per day with a K of 4 to 60 feet per day (1.4×10^{-3} to 2.1×10^{-2} cm/s).

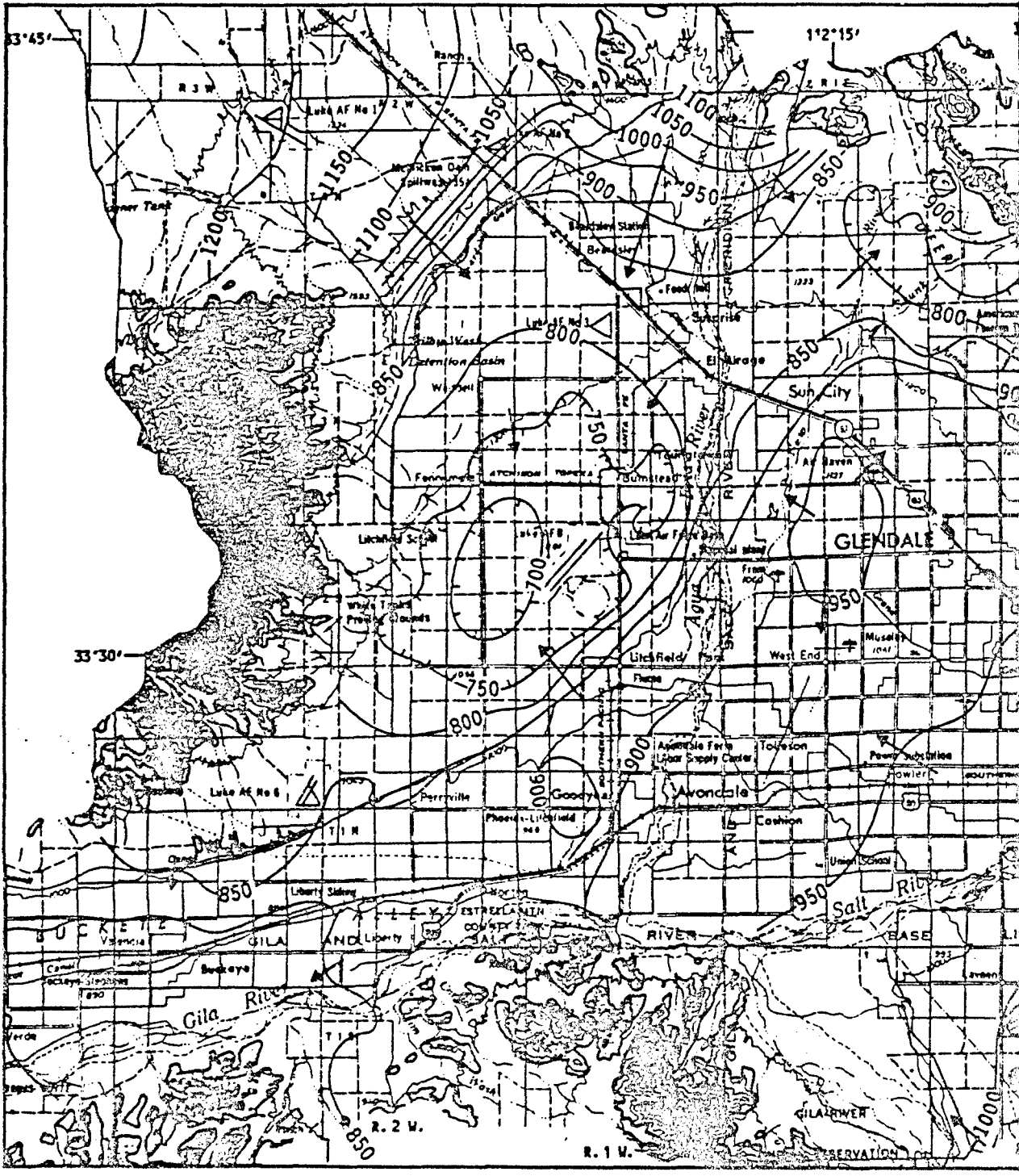
The upper unit occurs generally under unconfined conditions with saturated thickness (b) ranging from 0 to 350 feet. Transmissivity of upper unit deposits is estimated at 20,000 to 150,000 feet squared per day with a K of 180 to 1,700 feet per day (6.35×10^{-2} to 6.0×10^{-1} cm/s) (Brown and Pool, 1989).

Groundwater recharge in the area is derived from infiltration of precipitation, infiltration of runoff from surrounding mountains, and infiltration of controlled releases from upstream reservoirs on major rivers. Groundwater flow in the Phoenix area is generally from northeast flowing westerly under Salt River toward pumping centers in the basin (Figure 1-12) (U.S. Bureau of Reclamation, 1977). Although the basin is considered to be in overdraft conditions, water levels have locally risen 50 to 70 feet since the mid-1960s due to overall decreases in groundwater use and higher than normal precipitation (Kleinfelder, 1989).

Water quality throughout the area varies with location and depth. Along the Salt River, calcium and sodium are predominant cations and chloride and bicarbonate anions are most prevalent (Brown and Pool, 1989). Total dissolved solids (TDS) content in water near Salt River ranges from 450 to 3,600 milligrams per liter (mg/L). Water with less than 1,000 mg/L is likely due to infiltration of surface water.

1

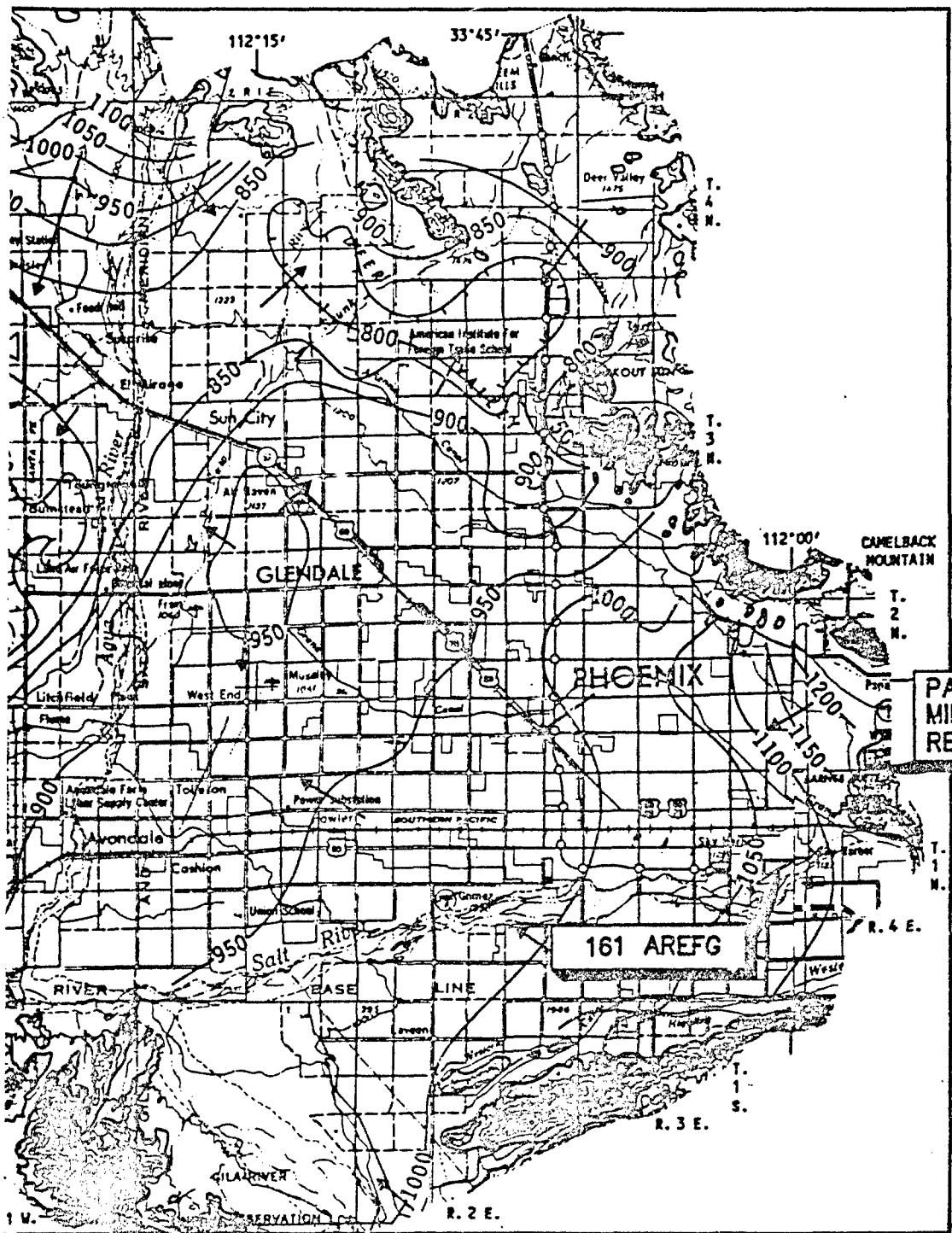
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

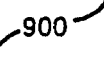



KD05834

SOURCE: BROWN AND POOL 1989
FIGURE 2

2



- LEGEND:**
-  UNCONSOLIDATED DEPOSIT
 -  RED UNIT CRYSTALLINE
 -  900 WATER TABLE (FEET, MSL)
 -  GROUND WATER FLOW

PAPAGO MILITARY RESERVATION

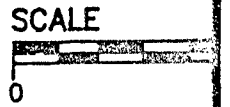
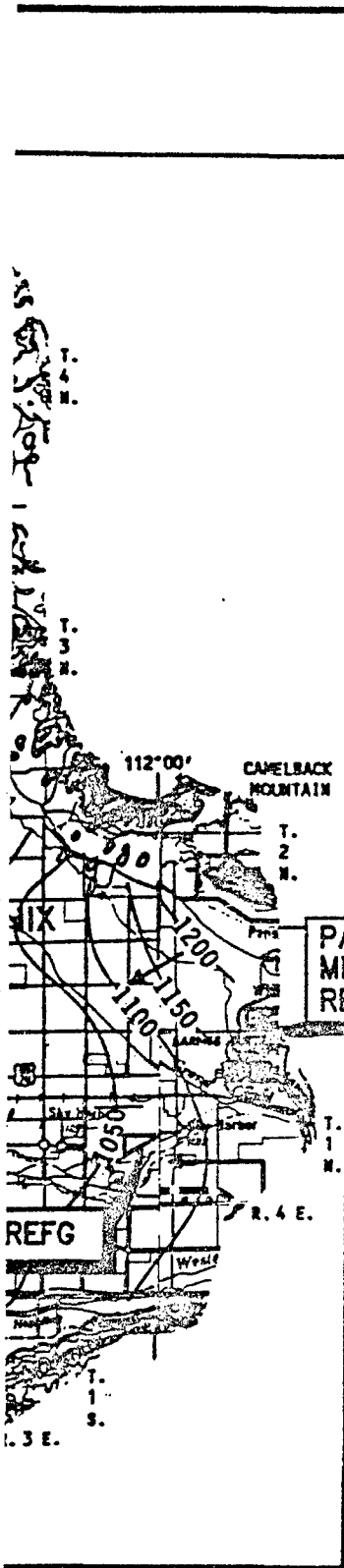


FIGURE 1-12
REGIONAL GROUND WATER
NOVEMBER 1964

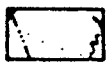

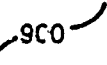
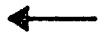
161 AREFG, ARIZONA
 PHOENIX, ARIZONA



3



LEGEND:

-  UNCONSOLIDATED SEDIMENTARY DEPOSITS
-  RED UNIT, ENTRUSIVE ROCKS AND CRYSTALLINE ROCKS
-  900 WATER LEVEL CONTOUR DATUM (FEET, MSL)
-  GROUNDWATER FLOW DIRECTION

**PAPAGO
MILITARY
RESERVATION**

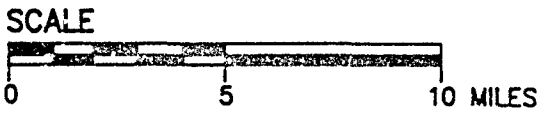


FIGURE 1-12
REGIONAL GROUNDWATER FLOW
NOVEMBER 1984-JANUARY 1985

161AREFG, ARIZONA AND
PHOENIX, ARIZONA



1.6.3 Local Conditions - 161AREFG

1.6.3.1 Geology

The Base is located north of and adjacent to the Salt River and is underlain primarily by coarse channel deposits of sand, gravel, cobbles, and boulders of Holocene age. The deposits are unconsolidated and form part of the upper alluvial unit basin fill deposits. These deposits are heterogeneous both horizontally and vertically and characterize a high energy fluvial system.

Demsey (1989) describes deposits underlying the site as deposits of alluvial fans and large terraces of inferred latest Quaternary age, being 0 to 10,000 years BP in age (Figure 1-13). Surfaces composed of this unit typically include well-sorted silt and sand with local occurrences of gravel to coarser materials. Soil development in the unit is typically minimal.

1.6.3.2 Hydrology

Municipal water supply in the Phoenix area is derived primarily from surface-water reservoirs and from groundwater in basin fill alluvium. Groundwater may occur locally at a depth of approximately 45 feet below the land surface under unconfined conditions at an elevation of approximately 1,040 to 1,050 feet msl (U.S. Bureau of Reclamation, 1977), but may be as deep as 70 to 80 feet below ground level. The groundwater flow direction, consistent with regional setting, is westerly to northwesterly.

1.6.3.3 Surface Water

The Salt River forms the primary surface water body in the basin (Figure 1-13). Airport drainage flows overland and through storm drains to outfalls in the river. Three water supply and drainage canals pass near the Base. The Grand Canal passes approximately 1.5 miles northeast of the Base (Figure 1-13); the San Francisco Canal-North Branch occurs approximately 0.75 miles south of the Base and the Salt River; and the Hayden Canal passes within 1.5 miles east of the Base (Figure 1-10).

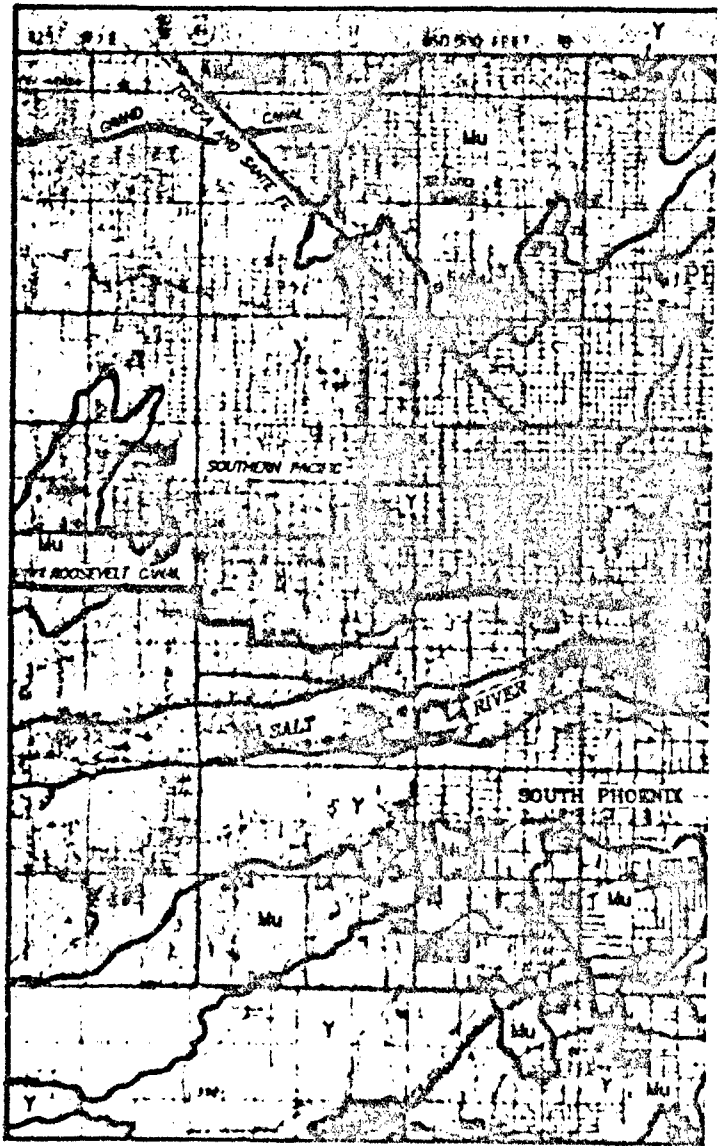
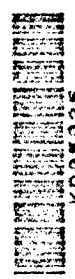
1.6.4 Local Conditions - Papago Military Reservation

1.6.4.1 Geology

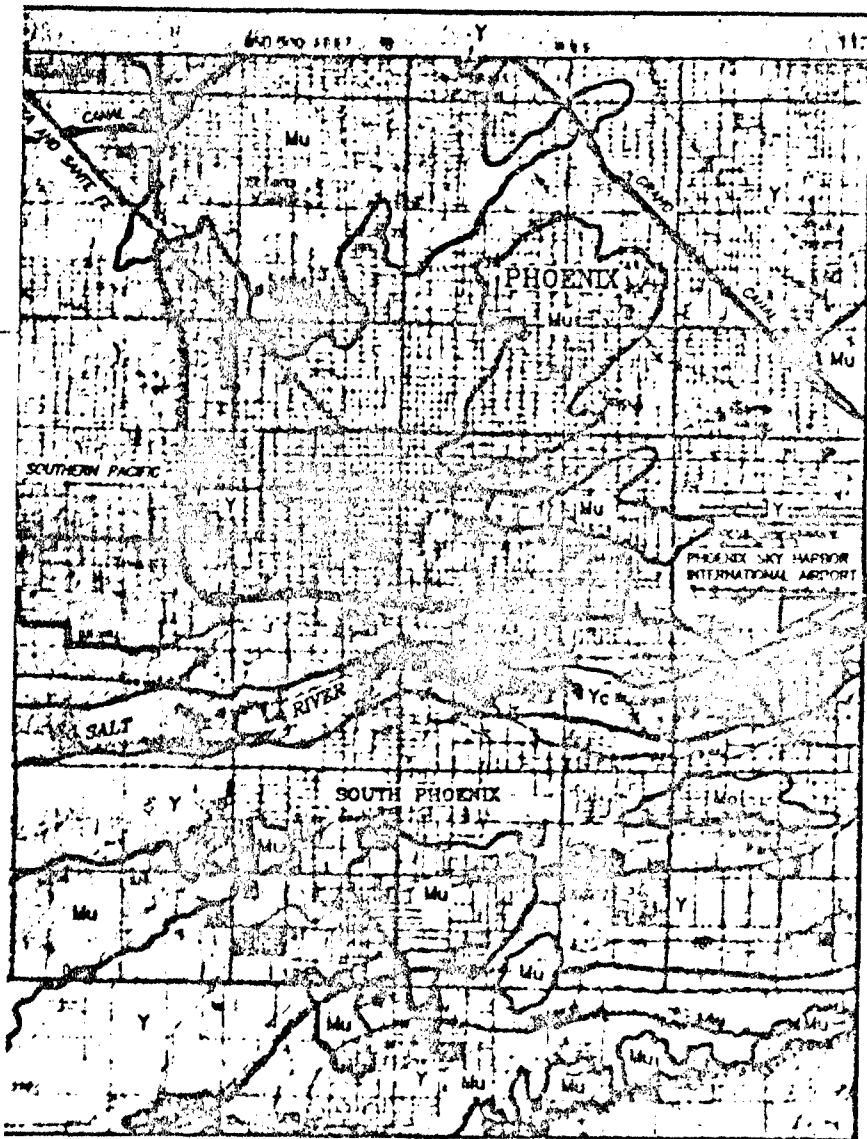
Geologic conditions in the area surrounding Papago are mapped and discussed by Pewe and others (1986). The area is underlain by relatively complex stratigraphic and structural geology, as depicted in Figure 1-14. Because geologic deposits are obscured by surface

1

STARTING DATE: 10/30/81	DATE LAST REV: 03/31/82	DRAFT. CHK. BY: G. PACHECO	INITIATOR: D. WILLEN	DRAWING NO.: 409721-B-C37
DRAWN BY: G. ROBERTSON	DRAWN BY: C. ROBERTSON	ENGR. CHK. BY: D. WILLEN	PROJ. MGR.: D. WILLEN	PROJ. NO.: 409721



SOURCE: DEMSEY, 1989



161 AREFG

LEGEND:

- Y - DEF
QU,
CH,
OF
ALL
BR
- Yc - AC
CH,
MA
- Mu - UNI
OF
PLI
SIL
- Mo - ARI
MIC
DEI

SCALE

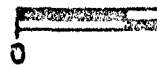


FIGURE 1-
GEOLOGIC
SURFICIAL
161 AREFG,
PHOENIX, AZ





161 AREFG

LEGEND:

- Y - DEPOSITS OF INFERRED LATEST QUATERNARY AGE INCLUDING CHANNELS AND LOW TERRACES OF SMALL DRAINAGES, YOUNG ALLUVIAL FANS AND BROAD TERRACES.
- Yc - ACTIVE AND RECENTLY ACTIVE CHANNEL DEPOSITS OF MAJOR AXIAL DRAINAGES.
- Mu - UNDIFFERENTIATED DEPOSITS OF INFERRED MIDDLE TO LATE PLEISTOCENE AGE COMPOSED OF SILT, SAND, GRAVEL AND COBBLES.
- Mo - AREAS DOMINATED BY INFERRED MIDDLE TO EARLY PLEISTOCENE DEPOSITS.

SCALE

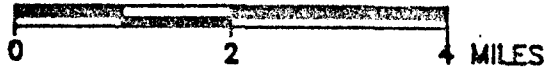


FIGURE 1-13

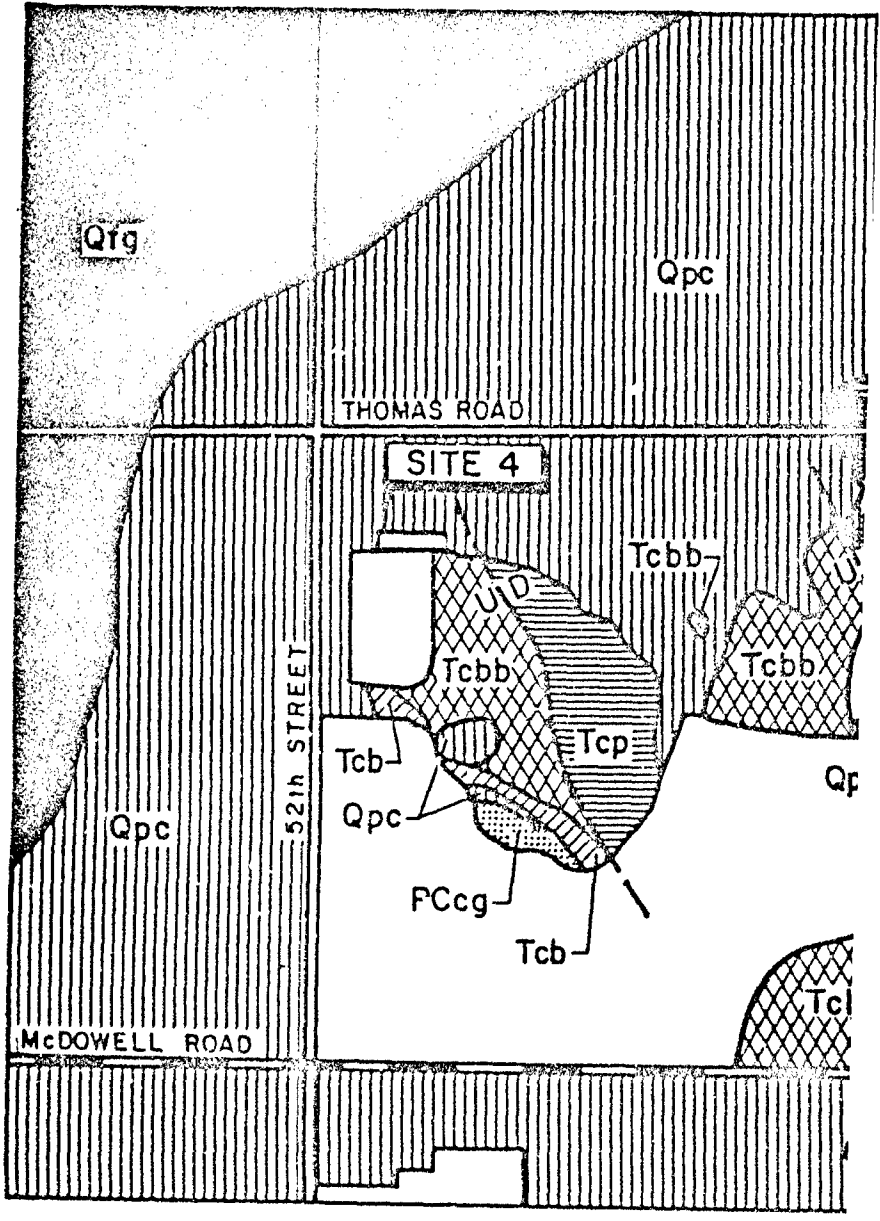
GEOLOGIC MAP AND SURFICIAL FEATURES, 161 AREFG

161 AREFG, ARIZONA AND PHOENIX, ARIZONA




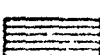
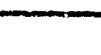


INTERNATIONAL
TECHNOLOGY
CORPORATION

STARTING DATE: 10/30/91	DATE LAST REV:	DRAFT. CHCK. BY: G. PACHECO	INITIATOR: D. WILLEN	DRAWING NO.: 409721-B-C38
DRAWN BY: C. ROBERTSON	DRAWN BY:	ENGR. CHCK BY: D. WILLEN	PROJ. MGR.: D. WILLEN	PROJ. NO.: 409721



LEGEND:

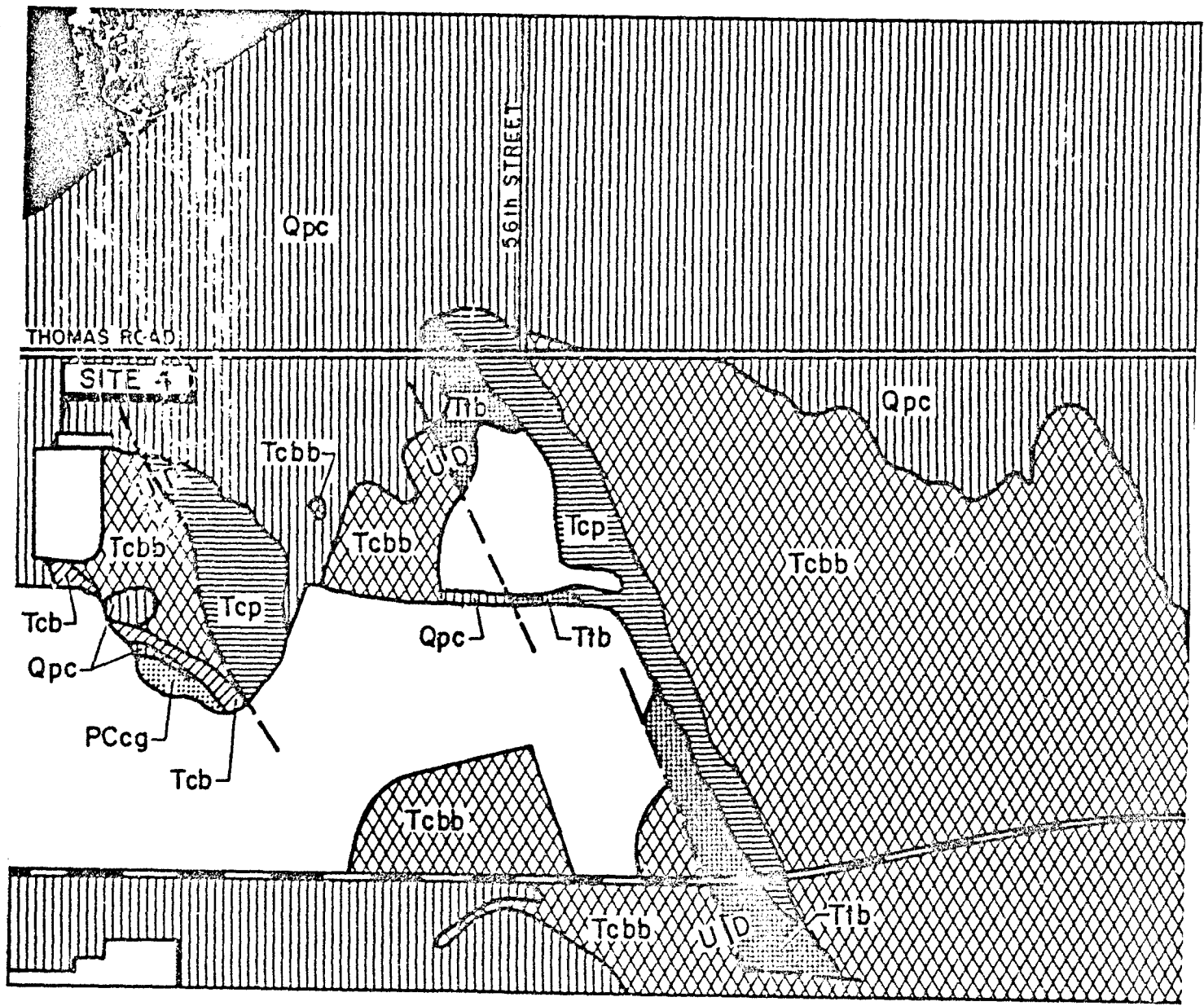
-  Qfg - QUATERNARY FINE ALLUVIUM
-  Qpc - QUATERNARY PEDIMENT COLLUVIUM ALLUVIUM
-  Tcb - TERTIARY-TEMPE BEDS
-  Tcbb - TERTIARY-CAMELSHEAD FORMATION PAPAGO PARK MEMBER
-  Tcp - TERTIARY-CAMELSHEAD FORMATION PAPAGO PARK MEMBER



SOURCE: GEOLOGIC INVESTIGATION
SERIES MAP GI-2-B

K005636

2



3 - QUATERNARY FINE ALLUVIUM

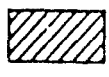
2 - QUATERNARY PEDIMENT COLLUVIUM ALLUVIUM

- TERTIARY-TEMPE BEDS

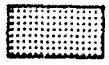
1 - TERTIARY-CAMELSHEAD FORMATION PAPAGO PARK MEMBER



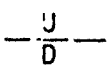
Tcbb - TERTIARY CAMELSHEAD FORMATION BARNES BUTTE BRECCIA



Tcb - TERTIARY CAMELSHEAD FORMATION BASAL MEMBER



PCcg - PRECAMBRIAN-CAMELBACK GRANITE



U/D - FAULT-APPROXIMATE LOCATION U-UPTHROWN

FIGURE 1-1
GEOLOGIC MAP
SURFICIAL I
PAPAGO MOUNTAIN
107 TCS/11

161 AREFG, 1
PHOENIX, ARI



3

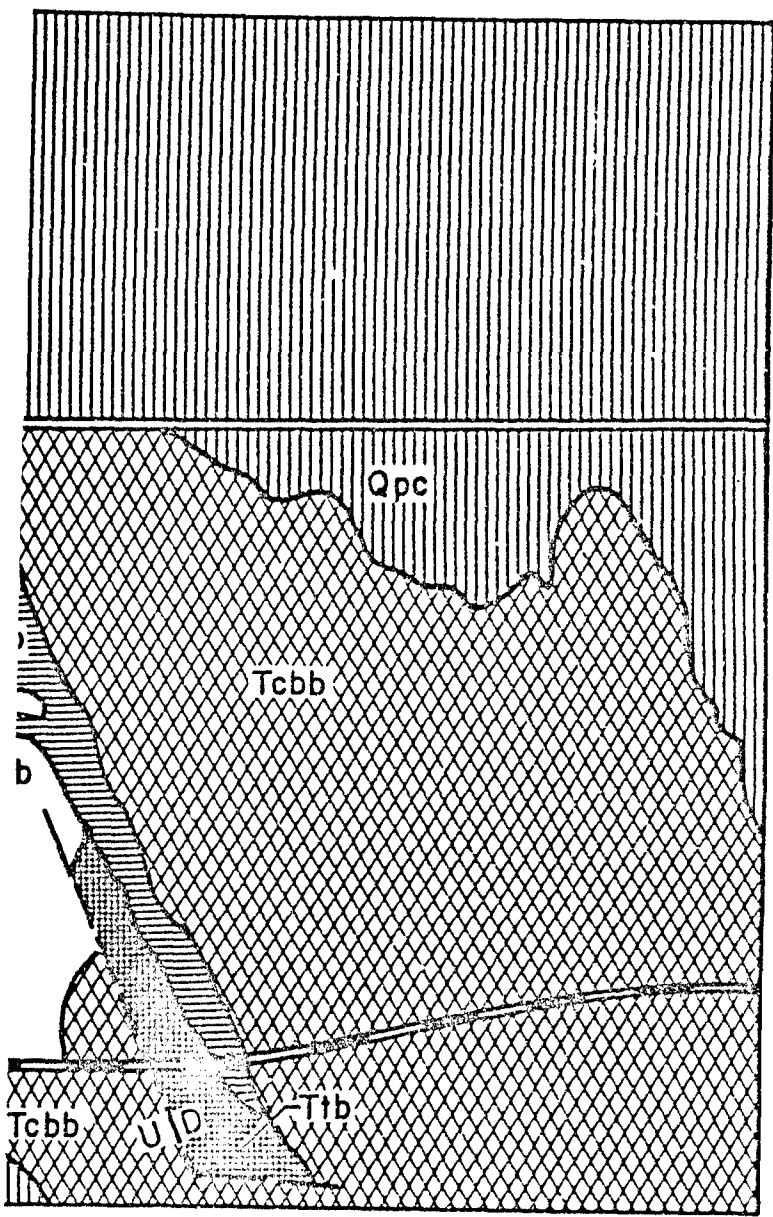


FIGURE 1-14
GEOLOGIC MAP AND
SURFICIAL FEATURES
PAPAGO MILITARY RESERVATION
107 TCS/111 ATCF

TERTIARY CAMELSHEAD FORMATION
 BARNES BUTTE BRECCIA

TERTIARY CAMELSHEAD FORMATION
 BASAL MEMBER

PRECAMBRIAN-CAMELBACK
 GRANITE

161 AREFG, ARIZONA ANG
 PHOENIX, ARIZONA

APPROXIMATE LOCATION
 HROWN



features at the 107TCS, actual locations of geologic contacts are not precisely known. The predominant geologic units in the area are members of the Tertiary Camels Head Formation, including the Basal Member and the Barnes Butte Breccia Member. The Basal Member consists of red to purple to brown sandstone and diamicton, locally interbedded with green to white tuffaceous sandstone and breccia. The Barnes Butte Breccia Member consists of reddish-brown, coarse-grained, poorly sorted and stratified, massive arkosic breccia. These deposits are locally overlain by Quaternary pediment colluvium and alluvium consisting of gray to white strongly-calcified debris on the bedrock surface.

1.6.4.2 Hydrology

Groundwater in the Papago area is discussed by Bales and others (1986). The 107TCS facilities at Papago are on the edge of an area mapped by Bales and others as bedrock containing little or no water, with possibly small amounts of water in highly fractured zones.

During the SI, groundwater was found to occur in the Papago area at a depth of approximately 20 to 25 feet below land surface, flowing generally in a westerly direction, consistent with the regional groundwater flow. Groundwater flow at times may vary from northwest to southwest. Groundwater occurrence is variable and thought to be controlled by the occurrence of fractures and joints in well indurated materials. Stratigraphic deposits in the Papago area are generally considered to not yield useful volumes of water to wells.

1.6.4.3 Surface Water

Papago is located approximately 2.2 miles north of the Salt River. Surface drainage is toward the river. The Arizona Canal occurs approximately 1 mile north of Papago; the Cross-Cut Canal is 1.75 miles east; and the Grand Canal is approximately 2 miles south.

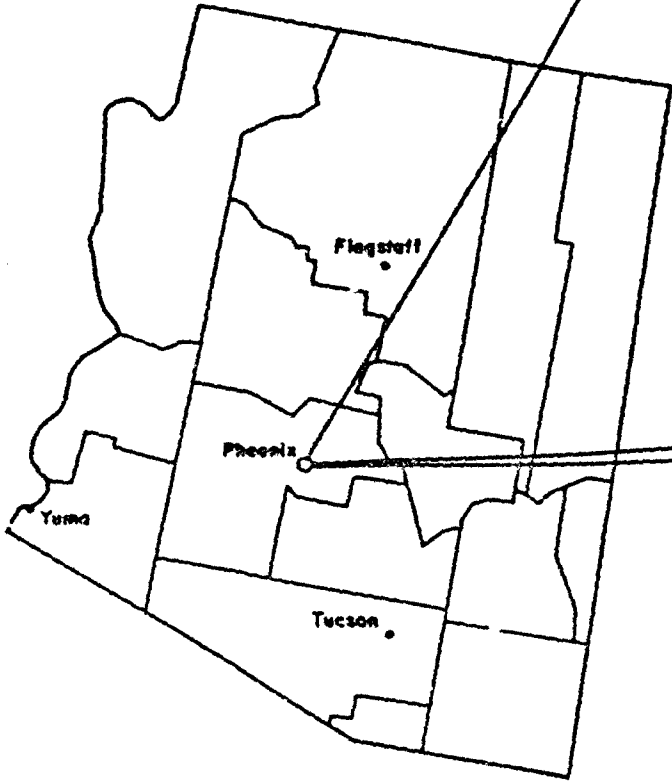
1.6.5 Regional Background Data

In November 1987, the area identified in Figure 1-15 was designated the Eastlake Park State Superfund Site by the Arizona Department of Environmental Quality (ADEQ) (Carty, 1989). The name of the area was subsequently changed to the East Washington Area (EWA). Groundwater within the EWA is locally contaminated with a variety of VOCs over an area of approximately 24 square miles.

The State of Arizona initiated a Phase I RI of the EWA under the Water Quality Assurance Revolving Fund (WQARF), ARS 49-282.B2., .4, and .5, and ARS 49-287.J. The fund was

K085037

STARTING DATE: 10/30/91 DATE LAST REV: 03/25/92 DRAFT. CHK. BY: G. PACHECO INITIATOR: D. WILLEN DRAWING NO.: 408721-B-C39
DRAWN BY: C. ROBERTSON DRAWN BY: C. ROBERTSON ENGR. CHK BY: D. WILLEN PROJ. MGR.: D. WILLEN PROJ. NO.: 408721



Thru
Dr
CENT WASH
Beds

SOURCE: SUNSET ROAD ATLAS; KLEINFELDER, 1989

(2)

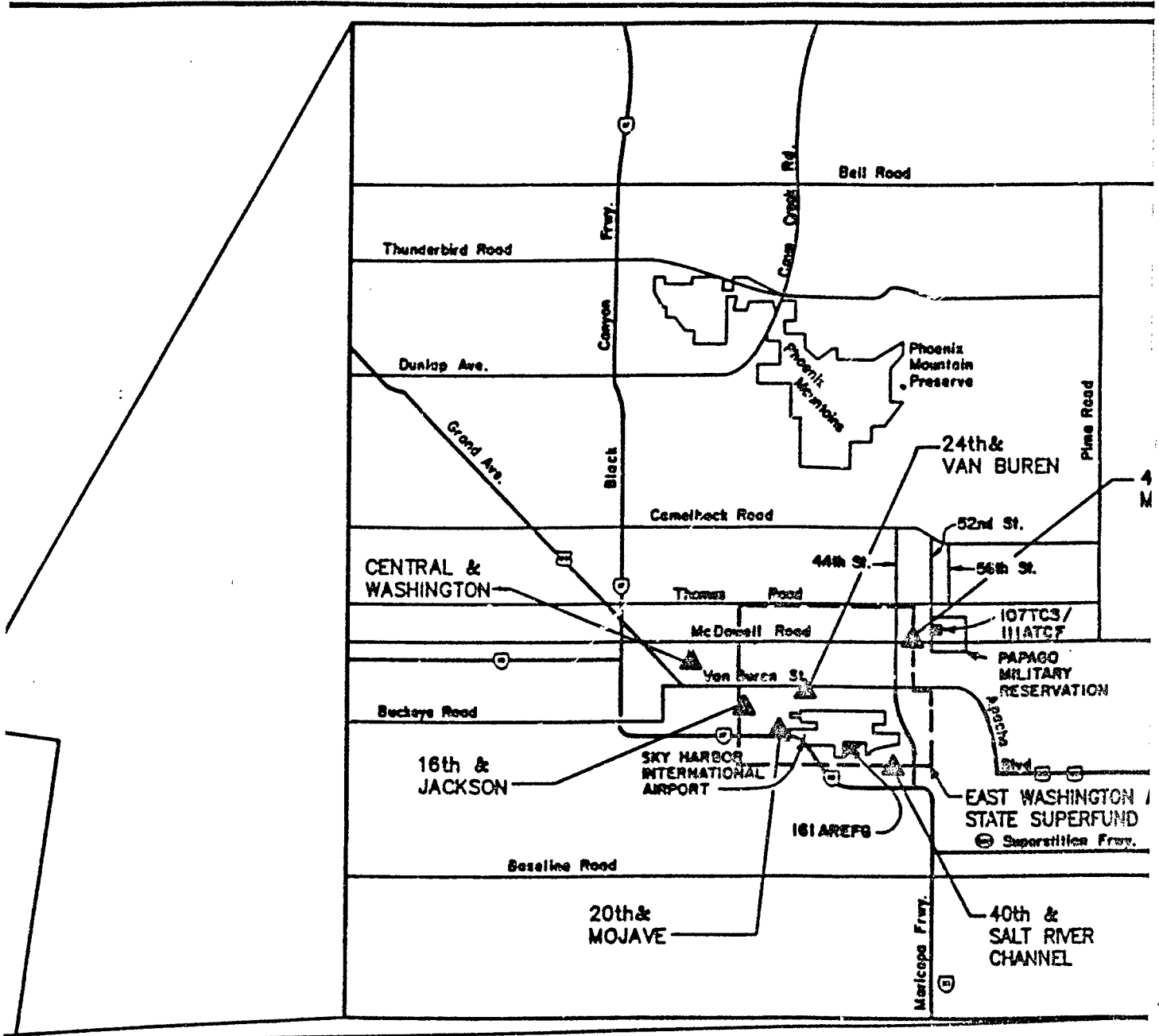
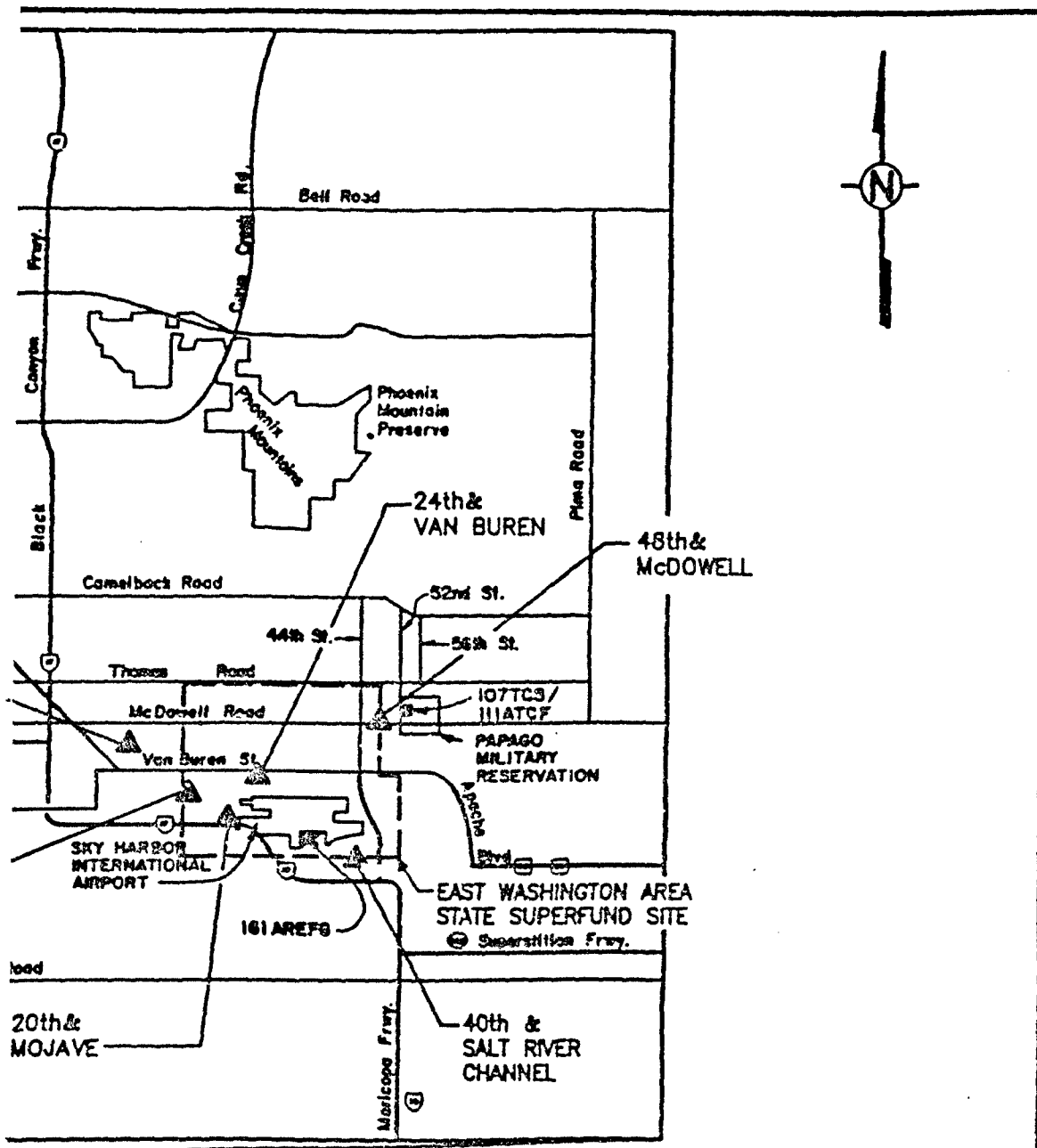


FIGURE 1-1
EAST WASH
VOC DETEC

161AREFG, A
SKY HARBOR
107TCS/III A
PAPAGO
PHOENIX, AZ



3



2 4 MILES

FIGURE 1-15
EAST WASHINGTON AREA
VOC DETECTION SITES

161AREFG, ARIZONA ANG
 SKY HARBOR IAP
 107TCS/111ATCF
 PAPAGO
 PHOENIX, ARIZONA



established by State law and is administered by the Director, Arizona Department of Environmental Quality. Monies are derived from various environmental fees, taxes and penalties to provide for administration of the fund, hazardous waste emergency actions/cleanup, site investigations, water quality monitoring, remedial actions, and other hazardous wastes activities that may threaten the waters of the state.

Phase I of the RI was completed in August 1989 (Kleinfelder, 1989). The Phase I investigation consisted primarily of literature and records research, limited field confirmation activities, and responses to questionnaires sent to industrial facilities. Six areas were identified where VOCs exceeded federal maximum contaminant levels (MCL) or Arizona Department of Environmental Quality (ADEQ) action level guidelines (AAL). The areas, presented in Figure 1-15, are located near 48th Street and McDowell Road; 40th Street and the Salt River Channel; 24th Street and Van Buren Street; 20th Street and Mojave Street; 16th Street and Jackson Street; and Central Avenue and Washington Street. The most commonly detected compounds at these locations were:

- Trichloroethene (TCE)
- Tetrachloroethene (PCE)
- trans-1,2-Dichloroethene (trans-1,2-DCE)
- 1,1-Dichloroethene (1,1-DCE)
- Benzene
- Vinyl chloride
- Chloroform.

Other compounds detected above MCLs or AALs in the EWA include: ethyl benzene, chlorobenzene, toluene, xylenes, methylene chloride, and carbon tetrachloride.

The 40th Street and Salt River Channel area is hydrologically upgradient from the Base as indicated from the regional groundwater flow direction presented in Figure 1-12, although it is on the south side of the Salt River channel. Available water quality information for this site is presented in Table 1-2 and shows that each of the most commonly detected compounds in the EWA previously listed are present above MCLs or AALs in the 40th Street area.

TABLE 1-2
ENVIRONMENTAL CONTAMINANTS
IDENTIFIED AT EAST WASHINGTON AREA
40TH STREET AND SALT RIVER CHANNEL SITE
PHOENIX, ARIZONA

WELL NO: COMPOUND LOCATION:	(A-1-3)13dda TANNER 40th ST.	(A-1-4)18dbc ESTES NB	(A-1-4)18cac ESTES E	(A-1-4)18cbd1 ESTES NW	(A-1-4)18cbd2 ESTES W	(A-1-4)18caa1 BRADLEY
1,1,1-trichloroethane			DET		DET	DET
1,1,2-trichloroethane			DET			DET
1,1-dichloroethane	DET	DET	DET	DET	DET	DET
1,1-dichloroethene		DET	MCL/AAL	DET	DET	MCL/AAL
1,2-dichlorobenzene	DET		DET	DET	DET	DET
1,2-dichloroethane						
1,3-dichlorobenzene			DET			
1,4-dichlorobenzene			DET			
benzene			DET			
chlorobenzene			DET			
chloroethane		DET	DET	DET	MCL/AAL	DET
chloroform			DET	DET	MCL/AAL	DET
ethylbenzene				DET	DET	DET
phthalates				DET	DET	DET
tetrachloroethene		MCL/AAL		DET	DET	DET
toluene						
trans-1,2-dichloroethene	MCL/AAL		DET	DET	DET	MCL/AAL
trichloroethene	MCL/AAL	DET	MCL/AAL	MCL/AAL	MCL/AAL	DET
vinyl chloride	MCL/AAL	MCL/AAL	MCL/AAL	MCL/AAL	MCL/AAL	MCL/AAL
xylenes			DET		DET	

TI-340784*

SOURCE: KLEINFELDER, 1989

DET = Detected in sample

MCL/AAL = Maximum Contaminant Level or Arizona Action Level Guidelines Exceeded

2.0 Field Investigative Program

2.1 General Approach

The SI was conducted as a programmatic, sequential step of the ANGRC IRP because of the potential for contamination of soils and/or groundwater at the sites and migration of suspected contaminants. Objectives of the SI were to collect data and perform site characterization activities to confirm the presence or absence of potential contamination, to identify the nature of contaminants, and to delineate and provide quantification of extent of contamination. The SI was also performed to assess hydrologic conditions beneath each site and the Base as a whole. Field activities were designed such that the data obtained would be sufficient to allow one or more of the following recommendations:

- Generate a decision document recommending no further action
- Begin a focused feasibility study/remedial measure
- Expedite an immediate response
- Expand the study to a RI/FS.

Field activities included screening and confirmation/characterization procedures. Screening activities incorporated the use of methods to indicate presence or absence of contamination, assess initial physical site conditions and were used as a baseline source for subsequent confirmation activities. Screening activities included geophysical operations, soil organic vapor (SOV) surveys, piezometer installation, and field analyses of soil and groundwater samples. Confirmation/characterization activities were designed to confirm presence or absence of contamination, provide a degree of quantification of contaminant magnitude and extent, and further delineate the physical site conditions. These activities included soil boring drilling and sampling, monitoring well installation and sampling, laboratory analyses using U.S. Environmental Protection Agency (U.S. EPA) Contract Laboratory Program (CLP) procedures, hydraulic testing, and land surveying.

Data collected during the SI followed the HAZWRAP Data Quality Objectives (DQOs) and are comparable to EPAs DQOs. Screening data follow DQO level A and B (EPA levels I and II) and are suitable for initial site characterization and monitoring of remedial action activities. DQO level B data are also useful for evaluating remedial alternatives during feasibility studies. Confirmation activities utilized HAZWRAP Level C (EPA level III) and are additionally useful for risk assessment, engineering design of remedial actions, and determination of responsible parties.

2.2 Summary

SI activities were conducted following procedures and rationale established in the Site Investigation Sampling and Analysis Plan (SAP) (IT, 1990), which is composed of the Field Sampling Plan (FSP), Quality Assurance Project Plan (QAPP), and Health and Safety Plan (HSP). The FSP describes rationale, methods, equipment, and testing protocol that were to be followed for all SI activities and was designed to be flexible enough to accommodate investigation findings as it progressed and provide data of sufficient quality on which to base conclusions and recommendations. Documentation of FSP changes are contained in variances and are reviewed by all levels of project personnel prior to implementation. When variances are not approved through program procedures, when field activities are changed without obtaining a variance, or when established procedures are not followed, FSP changes are documented with nonconformance reports (NCRs).

A total of 11 variances to the FSP were approved during the SI. Table 2-1 lists the variances with a brief explanation of subject matter. Copies of all variance reports are provided in Appendix A.

Four NCRs were filed during the SI; Table 2-1 also lists nonconformances and copies of the NCRs are provided in Appendix A. Nonconformances are generally related to equipment calibration failure. The effect of nonconformances on SI data quality is discussed with applicable results.

2.3 Literature Review

A preliminary review of hydrogeologic data for facilities adjacent to the Base was conducted during FSP preparation and prior to beginning SI field work (Appendix B). This review encompassed preliminary evaluation of water level information obtained from ADEQ, the Arizona Department of Water Resources (ADWR), and the City of Phoenix to determine target depth and screening specifications for monitoring wells and piezometers installed during the SI. As a result of the review, the average water level under the Base was estimated to occur at an elevation of approximately 1,040 feet msl or at a depth of 70 feet below ground level (bgl) with fluctuations during prolonged flow in the Salt River of 20 to 25 feet above the average water level.

A similar review for Papago indicated that groundwater would occur approximately 22 feet bgl. Water table fluctuations near Papago are much less dramatic than at the Base; however, changes of up to 5 feet have occurred in response to precipitation.

TABLE 2-1

LIST OF PROJECT VARIANCES AND NONCONFORMANCES
14th AREFQ, PHOENIX, ARIZONA

VARIANCE	DESCRIPTION
NO. 1	USE OF DIFFERENT GC INSTRUMENT. UPGRADED GC TO A LABORATORY QUALITY INSTRUMENT AS OPPOSED TO PLANNED SCREENING INSTRUMENT.
NO. 2	USE OF EVACUATED GLASS VIALS FOR SOV. GLASS VIALS ARE SUPERIOR TO TEDLAR BAG AND ARE FILLED BY ACTIVE SYSTEM GAS.
NO. 3	MODIFICATION OF SITE NO. 3 SAMPLING POINTS. NEW MAP INFORMATION REQUIRED RELOCATION OF SAMPLING POINTS TO CHARACTERIZE SITE.
NO. 4	CHANGE IN ANALYTICAL PROCEDURE AND EQUIPMENT FOR ON-SITE FIELD SCREENING OF SOIL BORINGS SAMPLES. CHANGED TO GC W/PID AND FID USING PURGE AND TRAP TO PROVIDE BETTER QUALIFICATION AND QUANTIFICATION OF TARGET COMPOUNDS.
NO. 5	CHANGE IN PIEZOMETER/WELL SAND PACK. UTILIZED A GRAIN SIZE THAT WAS READILY AVAILABLE AND COMMON TO 8.00 SLOT SIZE SCREEN.
NO. 6	CHANGE IN SOIL CLASSIFICATION AND SAMPLING FORMS. MODIFIED FORMS TO CONFORM WITH HAZWRAP GUIDANCE.
NO. 7	SAMPLE COLLECTION/SHIPMENT. MODIFIED SHIPMENT SCHEDULE TO FIT 10 DAY ON -4 DAY OFF FIELD SCHEDULE.
NO. 8	CHANGE IN ANALYTE TEST. MODIFIED ANALYTE LIST TO CONFORM WITH THE CURRENT EPA-CLP TARGET COMPOUND LIST.
NO. 9	SITE 4 DELETION OF SOIL BORING SAMPLES. CHANGED SOIL SAMPLES TO SURFICIAL SAMPLES AS BORINGS COULD NOT BE DRILLED TO PLANNED DEPTHS DUE TO CALICHE AND BEDROCK.
NO. 10	GROUNDWATER SAMPLING PURGE PROCEDURE. MODIFIED PURGE METHOD FROM SAILER TO PISTON PUMP TO REDUCE TIME AND COST OF SAMPLING.
NO. 11	GROUNDWATER SAMPLING OF 2 IN. PIEZOMETER. MODIFIED PURGE METHOD TO CONFORM WITH HAZWRAP SOP NO. 4 FOR WELL STABILIZATION.

NONCONFORMANCE NUMBER	DESCRIPTION
NO. 1	FIELD GC - POOR RECOVERY WITH INSTRUMENT. GC WAS REPLACED WITH A NEW INSTRUMENT AND BETTER LAMP.
NO. 2	FIELD GC - SHIFTING OF RETENTION TIME & LOSS OF RESOLUTION. IT WAS NECESSARY TO RESAMPLE DUE TO ERRATIC INSTRUMENT BEHAVIOR.
NO. 3	SOIL SAMPLE ANALYSIS. EXCEEDED HOLDING TIMES ON SOME SAMPLES. NO LOSS TO PROJECT RESULTS.
NO. 4	NO SENSITIVITY FOR TCA. PID WAS NOT SENSITIVE TO TCA. DCE VALUES WERE REINTEGRATED AND RESULTS REPORTED WITH QUALIFIER.

Based on review of the information contained in Appendix B, final well and piezometer designs were established in the FSP.

2.4 Field Screening Activities

Initial screening of potential sites was designed to produce HAZWRAP DQO Level A or Level B type data (Level I or II, U.S. EPA, 1987b), which provide relative indicators that necessitate and control subsequent tasks. Level A methods are field screening techniques that are usually not compound specific or quantitative but provide real-time results (e.g., photoionization detector [PID] measurements). Level B methods are specific and quantitative and use more sophisticated portable analytical instruments (e.g., field gas chromatography) that require standards, calibration, and a trained operator.

Preliminary data gathering at individual sites was initiated before any soil or groundwater samples were collected. These screening activities included a geophysical survey, soil organic vapor survey, and piezometer installation. During soil boring and sampling, monitoring well installation, and water sampling, a field laboratory provided Level B analyses of site-related compounds. The following sections describe the procedures and events in each screening activity. Figures 2-1 through 2-5 depict field screening sampling locations for Sites 1 through 5, respectively. Because Site 6 was not identified until the SI was underway, site screening activities were not planned for Site 6.

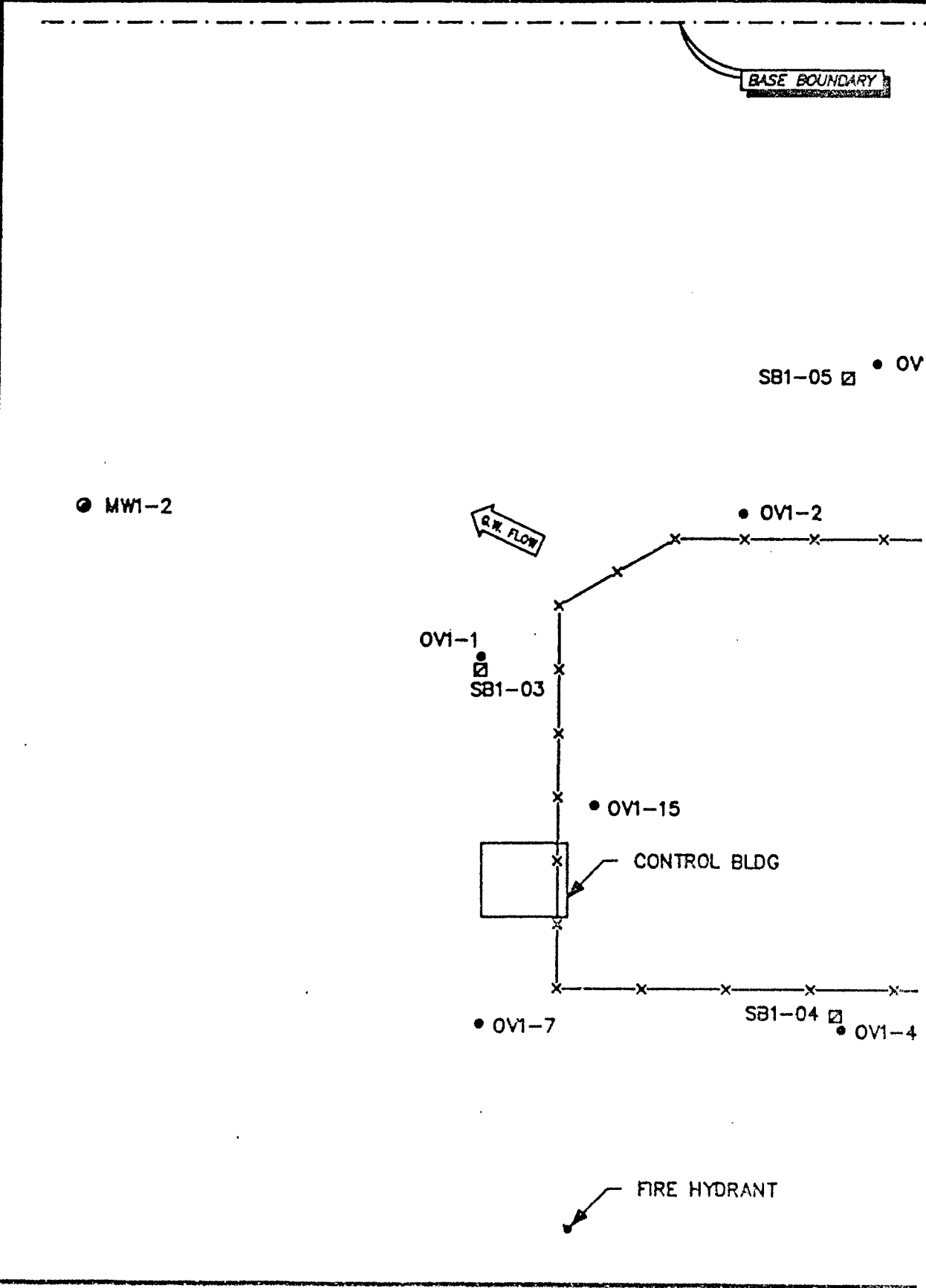
2.4.1 Geophysical Survey

Geophysical surveying was used to identify subsurface obstructions at each proposed SOV sampling location, piezometer, soil boring, and monitoring well site. Potential obstructions at these locations included electrical lines and vaults, water lines, and underground storage tanks (UST) and associated product lines. Surveys were conducted at all five sites and at perimeter background locations. Geophysical surveying was also used at Site 5 to delineate potential areas of ammunition disposal.

Geophysical survey operations were conducted to measure ground conductivity by electromagnetic induction (EM), to measure magnetic field and gradient using line detectors and magnetometers, and to detect subsurface inhomogeneities using ground penetrating radar (GPR). Equipment descriptions, survey procedures, and results are contained in Appendix C. A summary of geophysical survey activities follows.

STARTING DATE: 03/04/91	DATE LAST REV.: 03/25/92	DRAFT. CHOC. BY: G. PACHECO	DWG. NO.: 408721-8-C08
DRAWN BY: S. CARDWELL	DRAWN BY: S. CARDWELL	ENGR. CHOC. BY: D. WILLEN	PROJ. NO.: 408721
		INITIATOR: D. WILLEN	
		PROJ. MGR.: D. WILLEN	

40872108 03/25/92 3:44pm JNH



(2)

BASE BOUNDARY

SB1-05 □ • OV1-16

OV1-17 •

SET NAIL
N 10011.0774
E 10795.3604

LEGEND:

- x— FENC
- SOIL
- ⊙ MONI
- ORG
- ← AIR FLW

• OV1-2

SB1-02 □

• OV1-12

• OV1-8

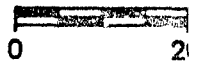
• OV1-11

• OV1-15

CONTROL BLDG

OV1-9 •

SCALE:



OV1-10 •

• OV1-15

SB1-04 □

• OV1-4

OV1-14 •

OV1-3 •

7

FIRE HYDRANT

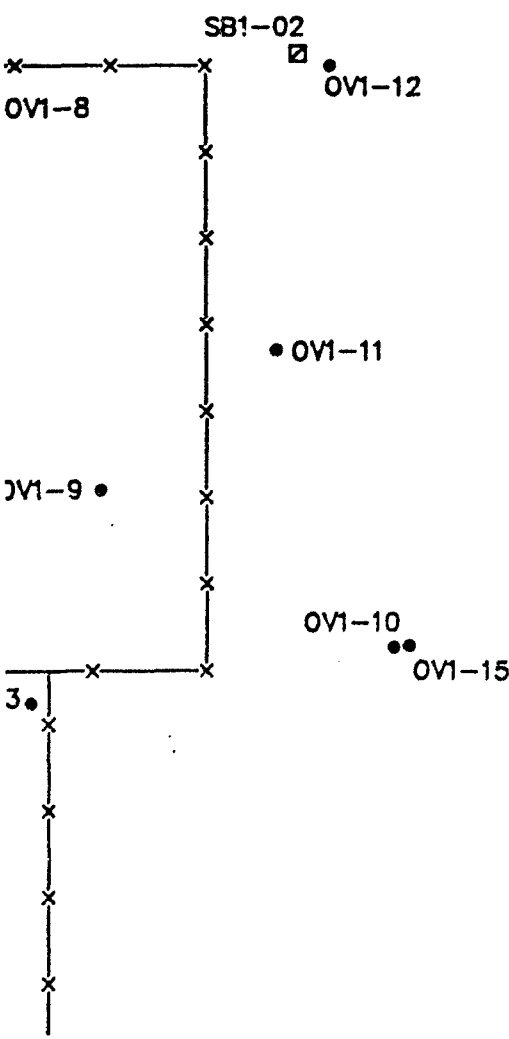
FIGURE 2-1
SITE NO. 1-
HYDRANT A
SAMPLING I

161 AREFG, 1
SKY HARBOR
PHOENIX, ARI





• -17 •
SET NAIL
N 10011.0774
E 10795.3604



LEGEND:

- x— FENCE LINE
- ▣ SOIL BORING
- MONITORING WELL
- ORGANIC VAPOR SAMPLING LOC.
- ← GROUNDWATER FLOW DIRECTION

SCALE:

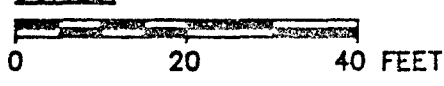


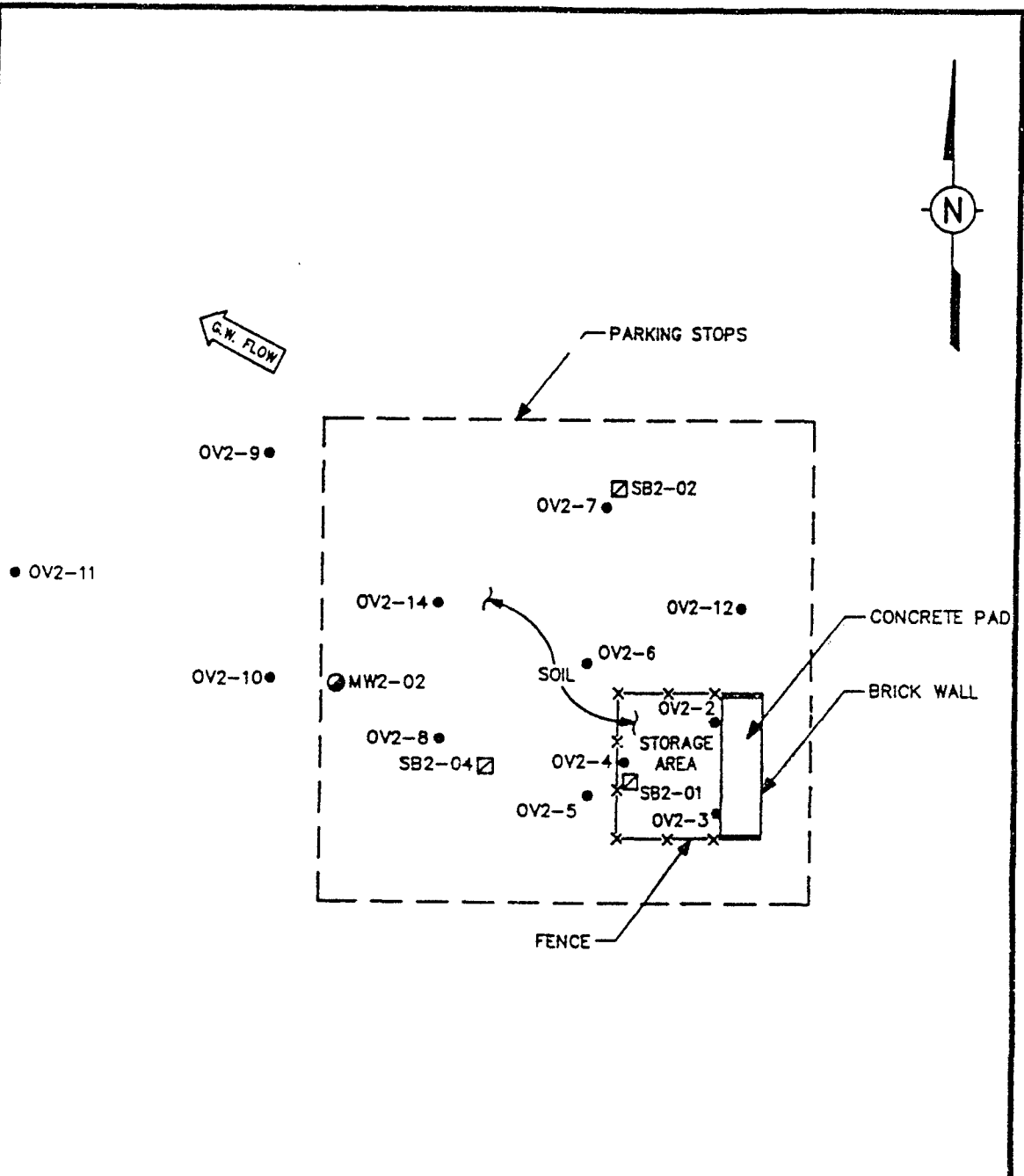
FIGURE 2-1
SITE NO. 1-JP4
HYDRANT AREA
SAMPLING LOCATIONS

161 AREFG, ARIZONA ANG
SKY HARBOR IAP
PHOENIX, ARIZONA



STARTING DATE: 06/24/91 DRAWN BY: S. CARDWELL	DATE LAST REV.: 3/25/92 DRAWN BY: J. HUBBARD	DRAFT. CHCK. BY: G. PACHECO ENGR. CHCK BY: D. MILLEN	INITIATOR: D. MILLEN PROJ. MGR.: D. MILLEN	DWG. NO.: 409721-B-C23 PROJ. NO.: 409721
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40972123 03/25/92 9:07am JWH



LEGEND:

- ☒ SOIL BORING
- MONITORING WELL
- ORGANIC VAPOR SAMPLING LOCATION
- ← G.W. FLOW GROUNDWATER FLOW DIRECTION

SCALE:

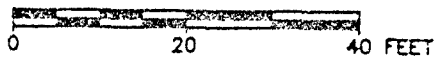


FIGURE 2-2
SITE NO. 2
HW STORAGE AREA
SAMPLING LOCATIONS
 161 AREFG, ARIZONA ANG
 SKY HARBOR IAP
 PHOENIX, ARIZONA



1

STARTING DATE: 06/24/91	DATE LAST REV: 3/25/92	DRAFT. CHCK. BY: G.PACHECO	INITIATOR: D. WILLEN	DRAWING NO.: 408721-B-C24
DRAWN BY: S. TOKAY	DRAWN BY: J. HUBBARD	ENGR. CHCK BY: D. WILLEN	PROJ. MGR.: D. WILLEN	PROJ. NO.: 408721

40872114 03/25/92 3:37pm JMH

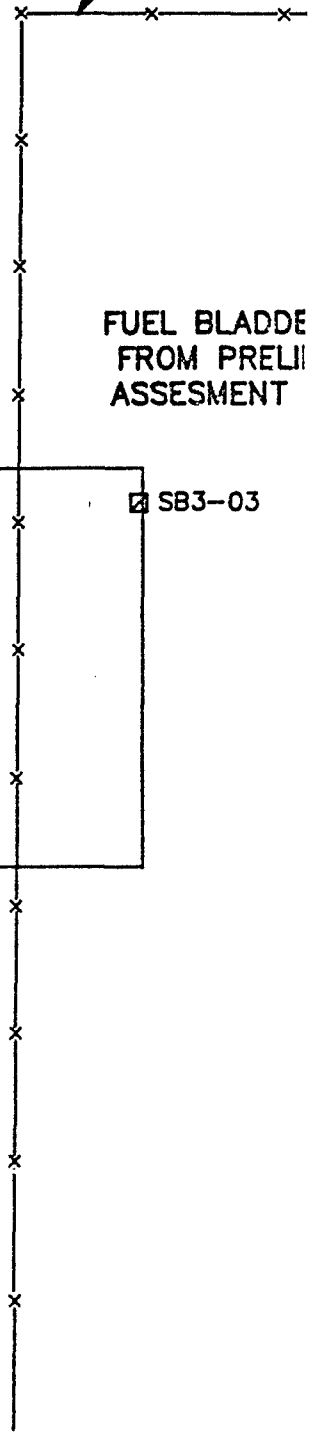
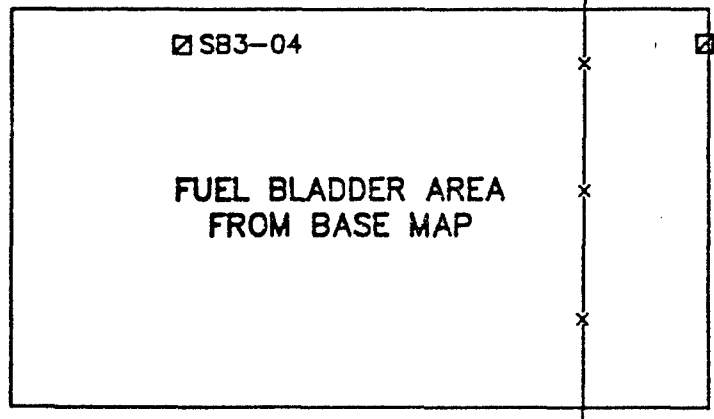
SKY HARBOR AIRPORT PROPERTY

● MW3-02

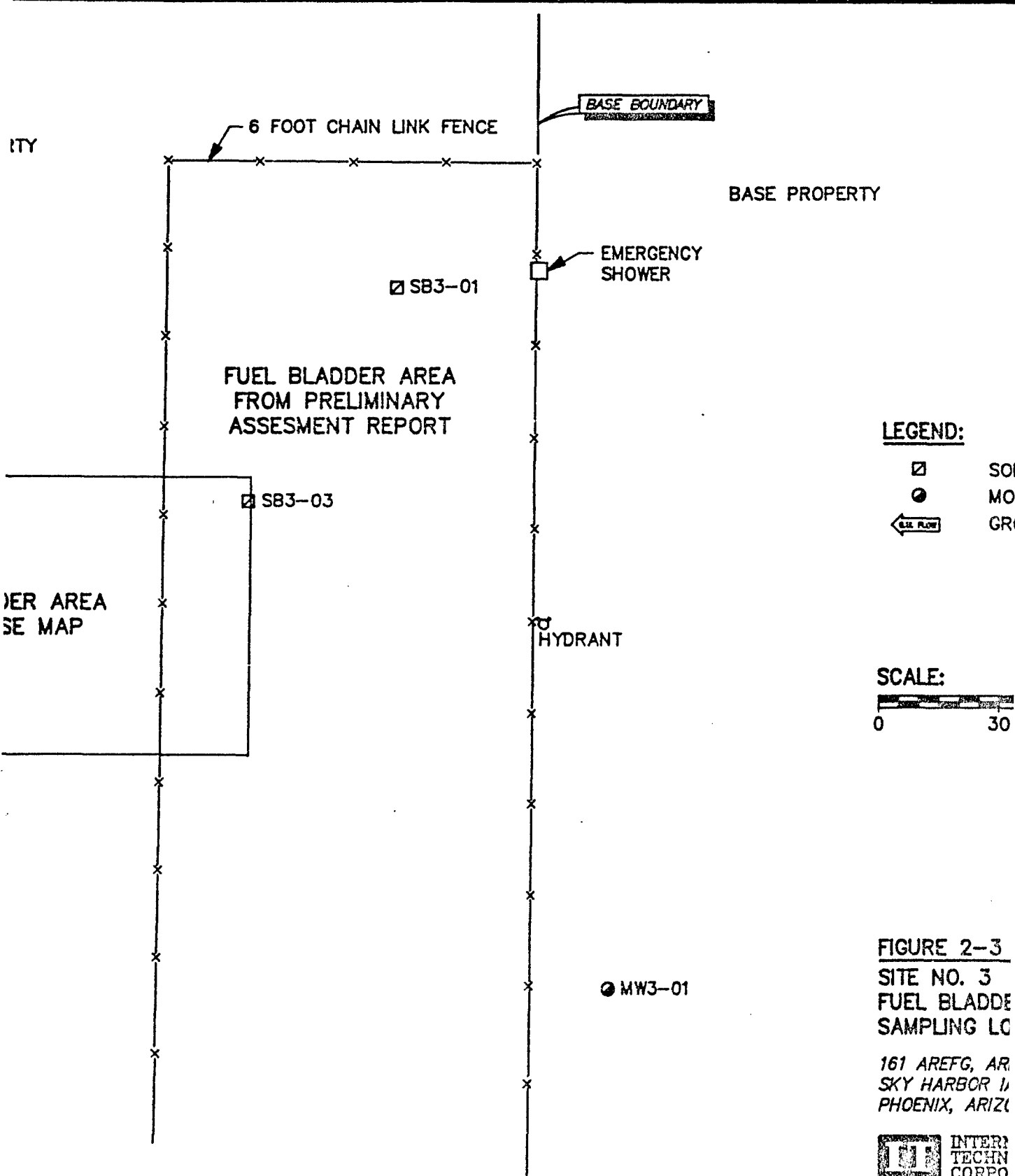


6 FOOT CHAIN

FUEL BLADDER FROM PRELIM ASSESMENT



2



LEGEND:

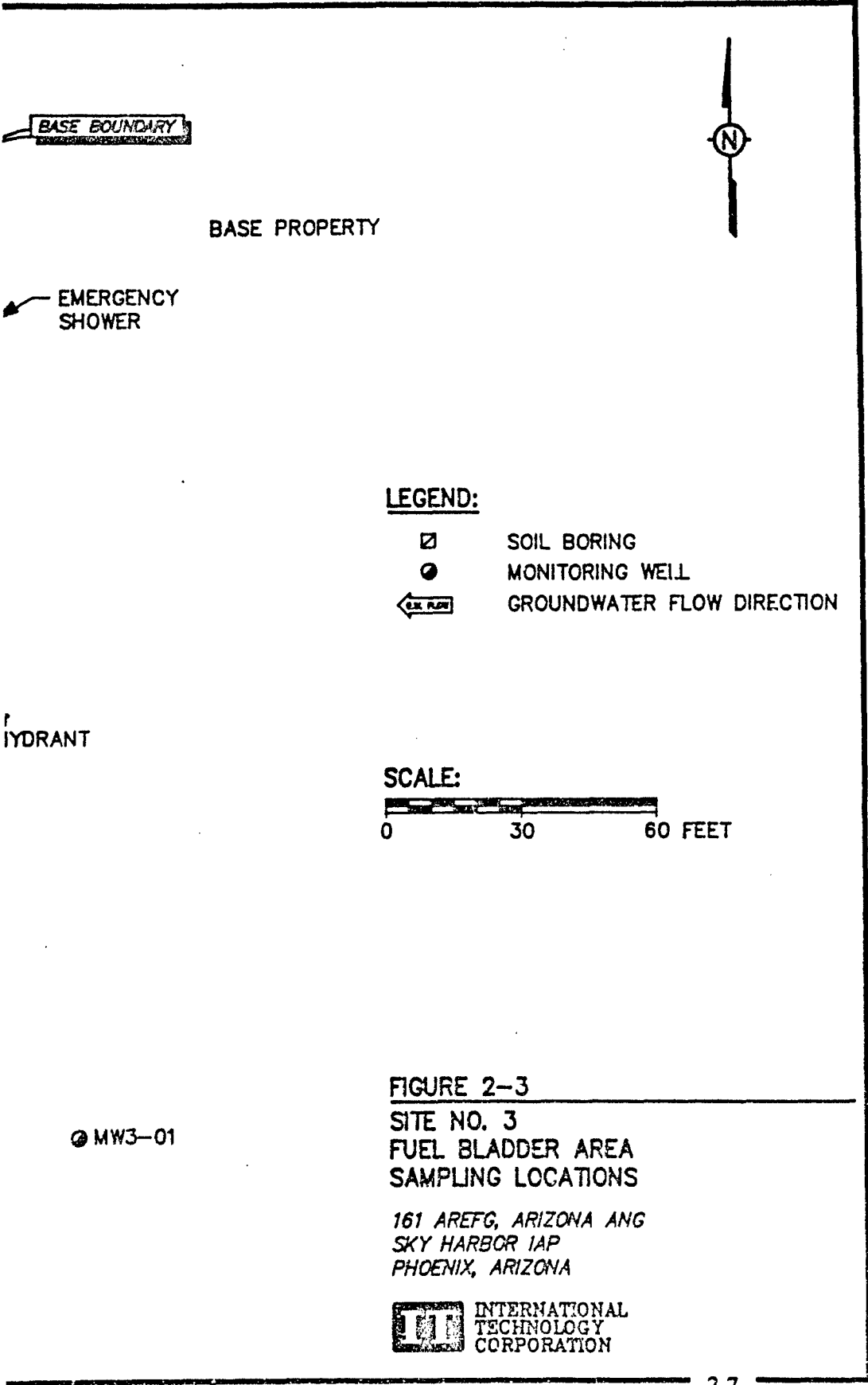
- ☐ SOI
- MOI
- ← GRI

SCALE:

FIGURE 2-3
SITE NO. 3
FUEL BLADDER
SAMPLING LOCATIONS
 161 AREFG, ARIZONA
 SKY HARBOR 1, PHOENIX, ARIZONA



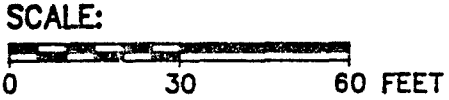
3



FYDRANT

LEGEND:

- ☐ SOIL BORING
- MONITORING WELL
- ← SEE PLAN GROUNDWATER FLOW DIRECTION



● MW3-01

FIGURE 2-3
SITE NO. 3
FUEL BLADDER AREA
SAMPLING LOCATIONS

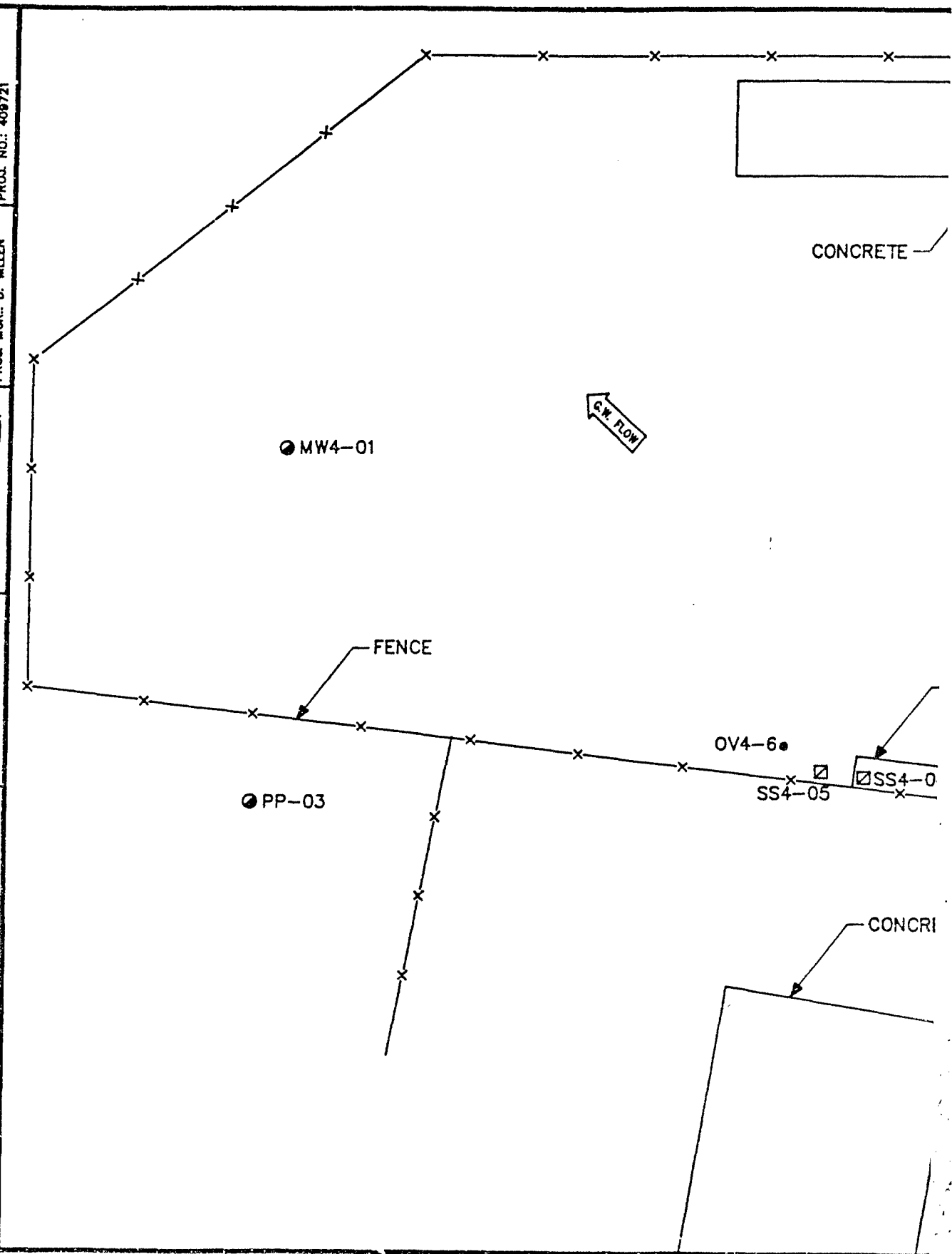
161 AREFG, ARIZONA ANG
 SKY HARBOR IAP
 PHOENIX, ARIZONA



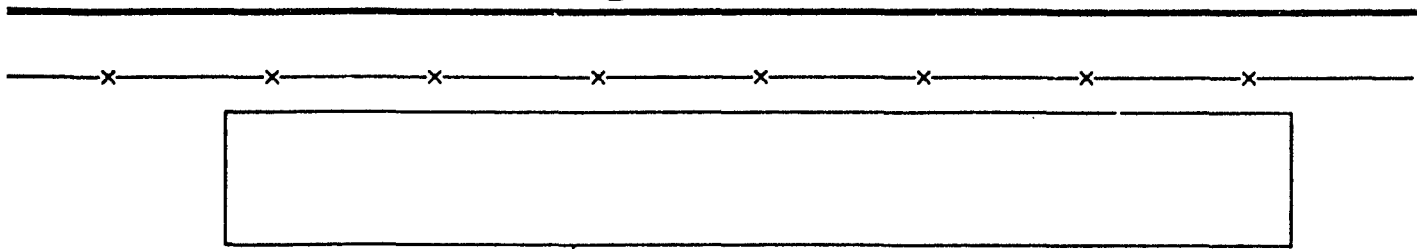
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STARTING DATE: 03/05/91	DATE LAST REV.: 3/25/92	DRAFT. CHK. BY: G. PACHECO	INITIATOR: D. WILLEN	DWG. NO.: 409721-B-C25
DRAWN BY: S. CARDWELL	DRAWN BY: J. HUBBARD	ENGR. CHK. BY: D. WILLEN	PROJ. MGR.: D. WILLEN	PROJ. NO.: 409721

40972125 04/30/92 2:50pm BS



(2)



CONCRETE

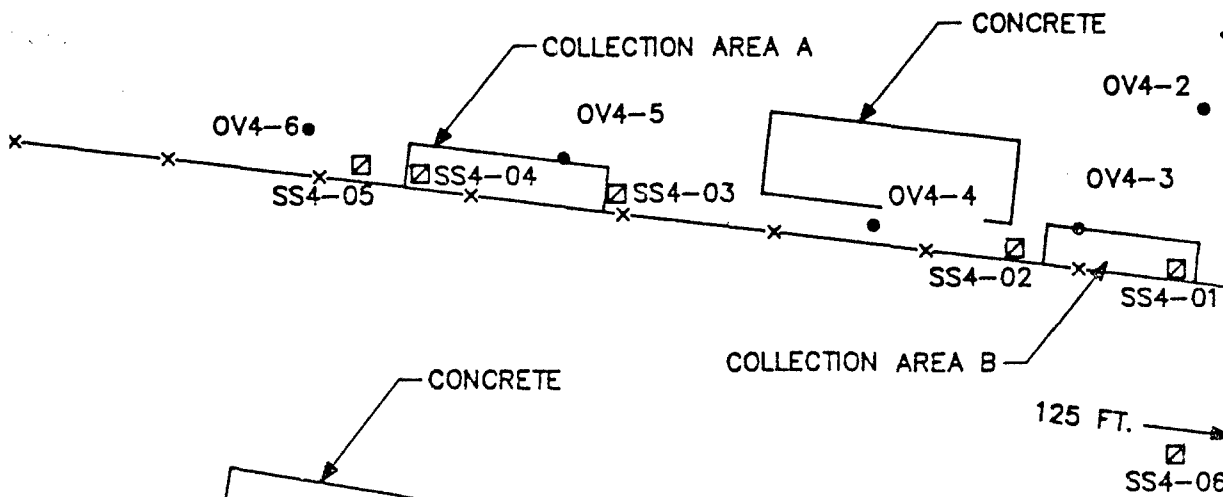


● MW4-0

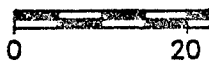
LEGEND:

- ☒ SOIL SA
- MONITOR
- ORGANIC
- ◀ GW FLOW GROUND

● OV4-7



SCALE:

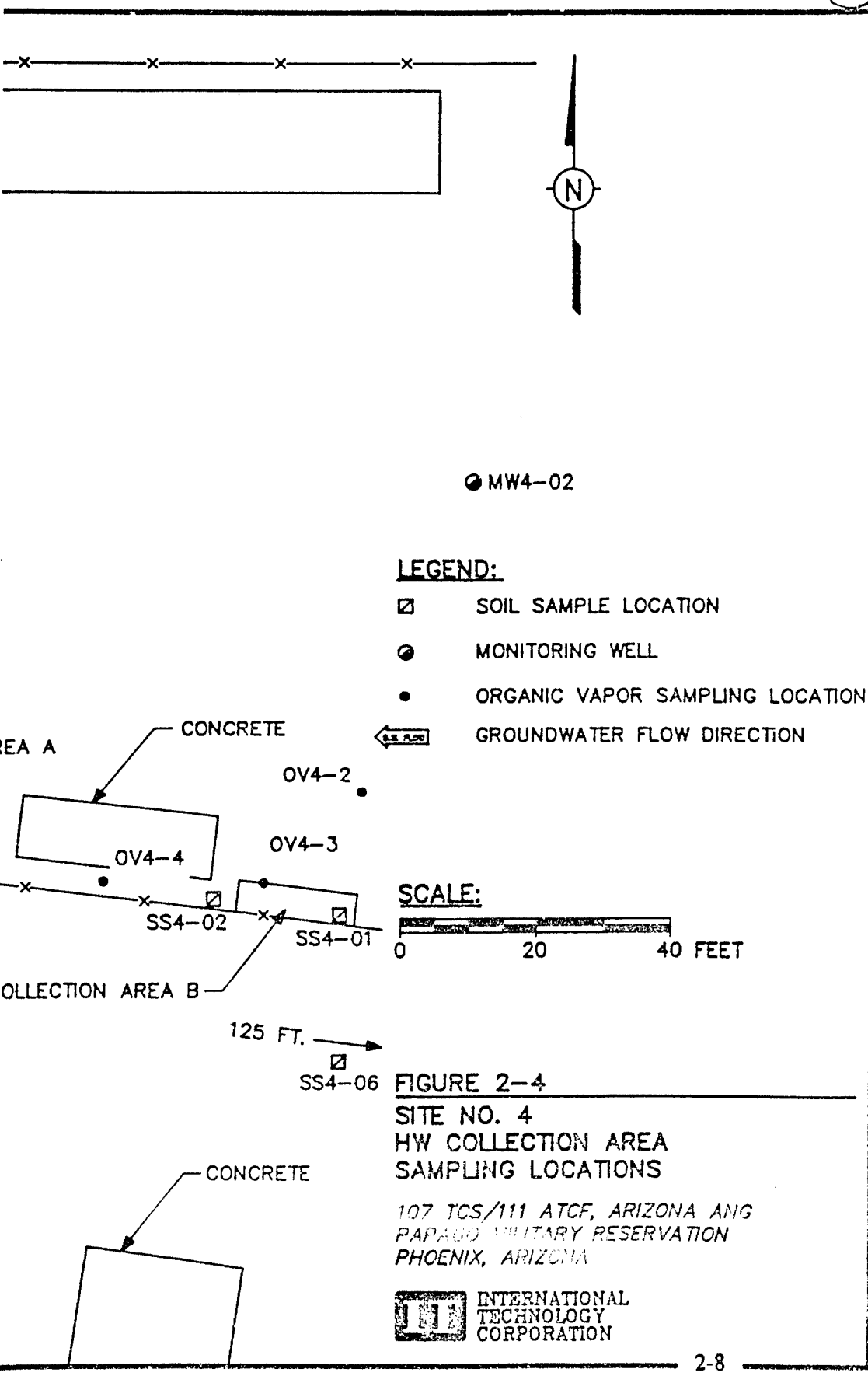


125 FT. →
☒ SS4-06

FIGURE 2-4
SITE NO. 4
HW COLLECTI
SAMPLING LC

107 TCS/111 A
 PAPAGO MILITA
 PHOENIX, ARIZI





LEGEND:

- ☒ SOIL SAMPLE LOCATION
- MONITORING WELL
- ORGANIC VAPOR SAMPLING LOCATION
- ← G.W. FLOW GROUNDWATER FLOW DIRECTION

SCALE:

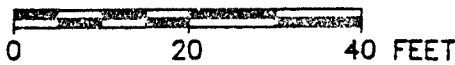


FIGURE 2-4
SITE NO. 4
HW COLLECTION AREA
SAMPLING LOCATIONS

107 TCS/111 ATCF, ARIZONA ANG
 PAPAGO MILITARY RESERVATION
 PHOENIX, ARIZONA



SI REPORT

DRAWING NO.: 409721-B-C22
PROJ. NO.: 409721

INITIATOR: S. SARES
PROJ. MGR.: D. WALLEH

DRAFT. CHK. BY: G. PACHECO
ENGR. CHK. BY: S. SARES

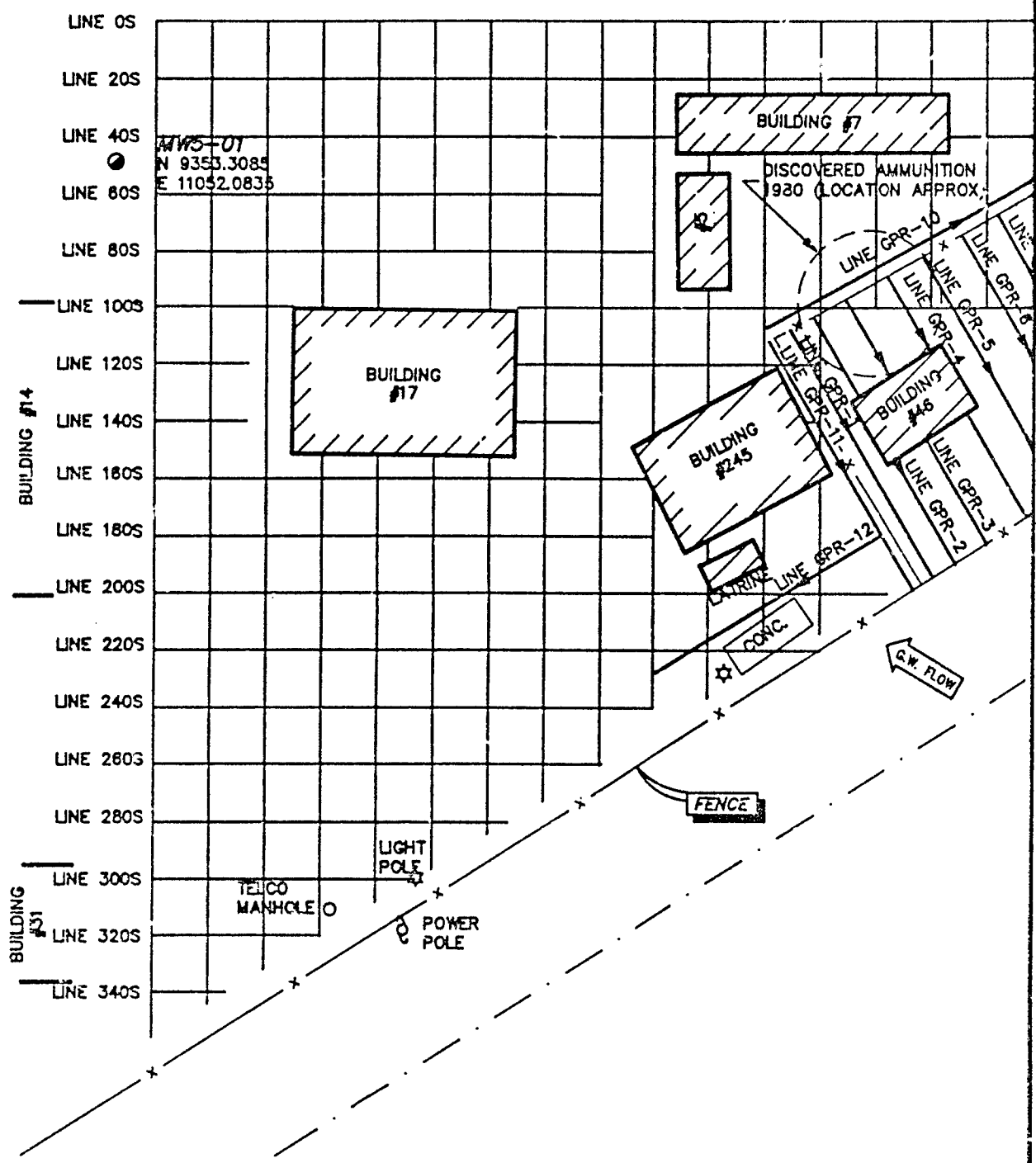
DATE LAST REV.: 11/06/92
DRAWN BY: C. ROBERTSON

STARTING DATE: 08/24/91
DRAWN BY: G. PACHECO

40972122 11/06/92 8:17am CKR

AIRCRAFT PARKING AREA

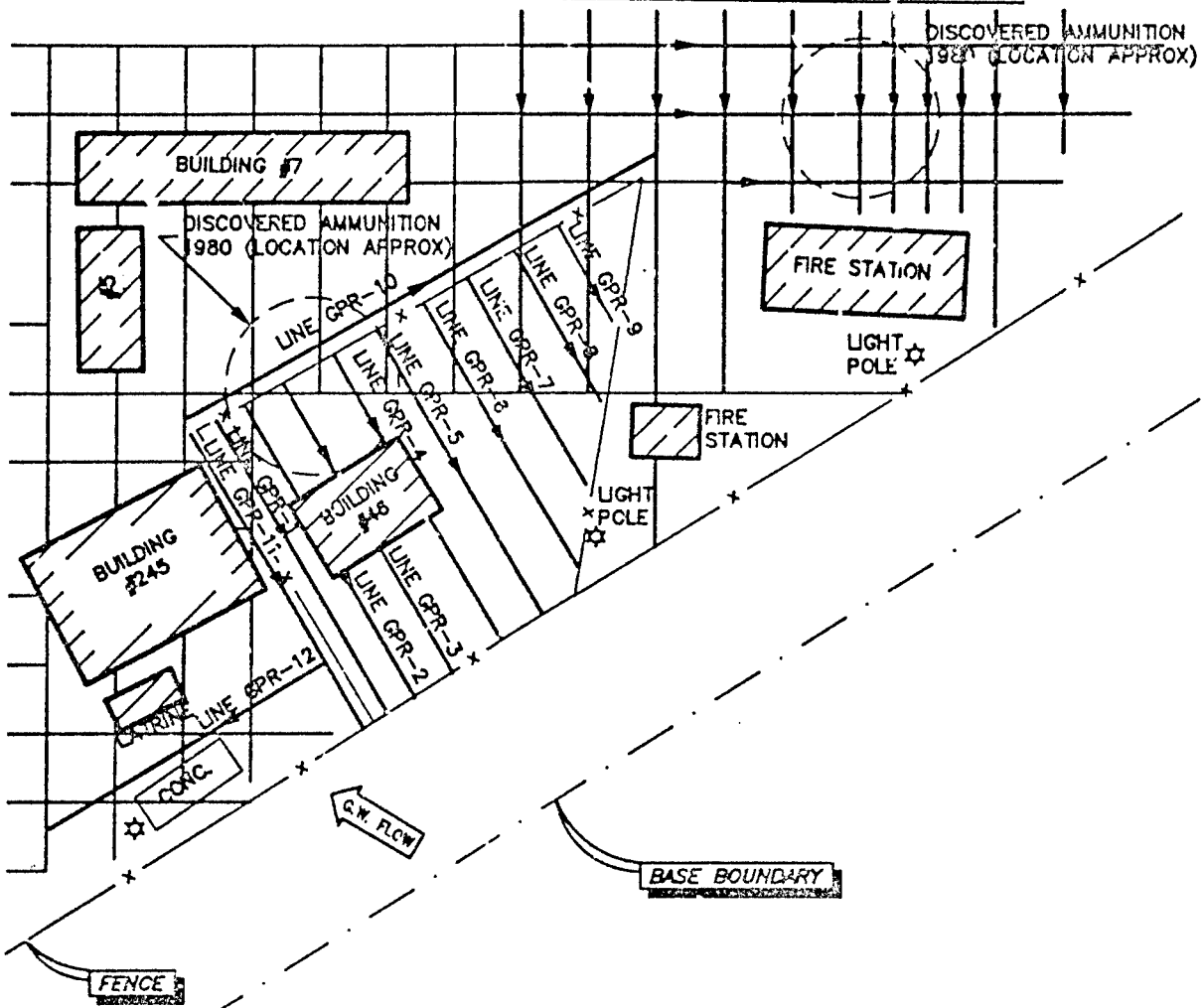
- LINE 0E
- LINE 20E
- LINE 40E
- LINE 60E
- LINE 80E
- LINE 100E
- LINE 120E
- LINE 140E
- LINE 160E
- LINE 180E
- LINE 200E
- LINE 220E
- LINE 240E
- LINE 260E
- LINE 280E
- LINE 300E



2 ✓

RCRAFT PARKING AREA

- LINE 180E
- LINE 200E
- LINE 220E
- LINE 240E
- LINE 260E
- LINE 280E
- LINE 300E
- LINE 320E
- LINE 340E
- LINE 360E
- LINE 380E
- LINE 400E
- LINE 420E
- LINE 430E
- LINE 440E
- LINE 450E
- LINE 460E



- LEGEND:**
- ☆ LIGHT
 - MANHOLE
 - MONITOR
 - GEONICS
 - GPR SUR ANTENNA
 - ← G.W. FLOW

SCALE:

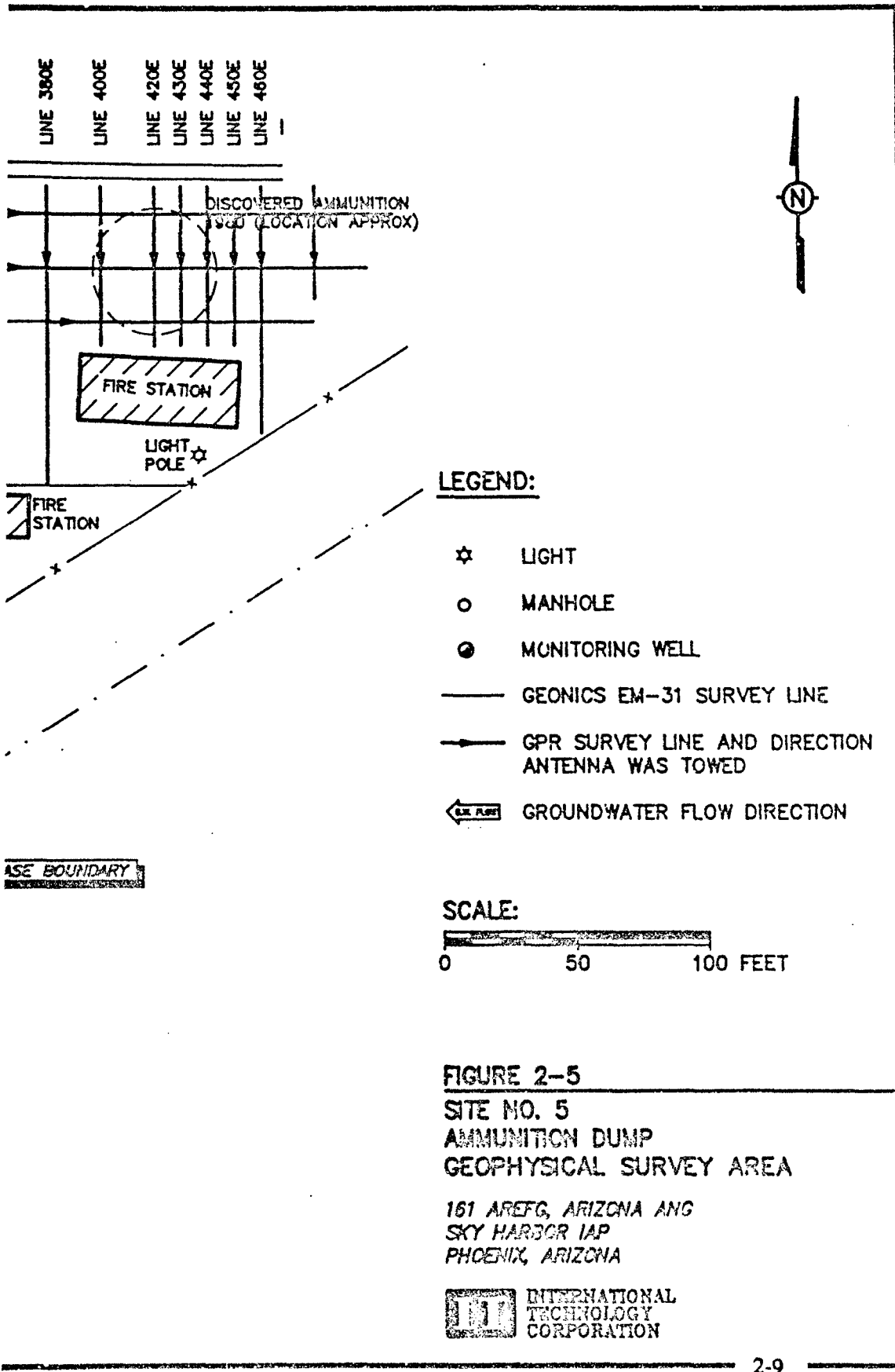
0 50

FIGURE 2-5
SITE NO. 5
AMMUNITION C
GEUPHYSICAL

161 AREFG, ARIZ
 SKY HARBOR IAF
 PHOENIX, ARIZONA

INTERNATIONAL
 TECHNICAL
 CORPORATION

(3) ✓



LEGEND:

- ☆ LIGHT
- MANHOLE
- MONITORING WELL
- GEONICS EM-31 SURVEY LINE
- > GPR SURVEY LINE AND DIRECTION ANTENNA WAS TOWED
- ←> GROUNDWATER FLOW DIRECTION

SCALE:

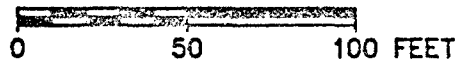


FIGURE 2-5
SITE NO. 5
AMMUNITION DUMP
GEOPHYSICAL SURVEY AREA

161 AREFG, ARIZONA ANG
 SKY HARBOR IAP
 PHOENIX, ARIZONA



Intrusive sampling locations were cleared by tracing utility lines with an industrial line locator and marking locations near each site (Figures 2-1 through 2-5). If a utility was located within 3 feet of a proposed sampling location, the location was moved and the procedure repeated. In areas where nonmetallic pipes or large numbers of pipes were present, two perpendicular GPR profiles were conducted over the sampling point. Again, if subsurface features were located within 3 feet, the sampling point was moved and the procedure repeated.

At Site 5, geophysical surveying was the principal investigative tool. The survey objectives were to identify areas where disposal of ammunition, both loose and in crates, may have occurred. An EM, magnetometer, and as a confirmation tool, GPR were used to conduct the surveys. According to site personnel, the ammunition may have been disposed in trenches or placed on the ground and covered.

As shown in Figure 2-5, approximately 7,630 feet of survey line was collected using EM equipment to identify conductive features in the subsurface. Because of the high density of cultural features in the area, magnetometer use was not feasible and data were not collected. Use of GPR as a primary investigation tool in place of the magnetometer was substituted to provide higher resolution of subsurface inhomogeneities likely to reflect disposal areas. Approximately 2,415 feet of GPR line was collected in areas shown in Figure 2-5.

2.4.2 Soil Organic Vapor Survey

A shallow soil gas investigation was performed by Target Environmental Services, Inc. (Target) under supervision of the SI field supervisor. A total of 33 samples were collected and analyzed in the field for aromatic and halogenated VOCs. Fifteen samples were collected at Site 1 (Figure 2-1), twelve samples were collected at Site 2 (Figure 2-2), and six samples were collected at Site 4 (Figure 2-4). Sampling locations were determined based on guidelines presented in the FSP, adjusted for presence of subsurface structures. The minimum number of samples indicated by the FSP were collected nearest to the area of suspected release. Additional sampling locations were selected based on detected compounds in the field or to provide areal coverage of a site. SOV sampling attempts were abandoned at Site 3 after three unsuccessful attempts to penetrate a cobble layer at the ground surface and destruction of sampling equipment.

SOV sampling procedure varied from that described in the FSP. Variance No. 2 documents the change that involves replacement of the Tedlar[®]-bag sample container with glass vials; the

change in procedure and sample container were initiated to accommodate Target's established procedures and technology. Sampling procedures consisted of pushing or driving a 1-inch diameter steel probe to target sampling depths of 10 feet at the Base and 3 feet at Papago. Locations at Papago were predrilled with an electric hammer drill to approximately 2 feet; then the sampling system was driven to the sample depth. A Teflon[®] line or stainless steel rod was inserted into the casing and isolated from the annulus by an inflatable packer. Ambient air was purged from the system and a sample was collected in a pre-evacuated glass vial. The sample collection system was decontaminated between sampling events using a surfactant wash and deionized water rinse, and purging with laboratory-grade nitrogen.

Samples were analyzed in the field according to modified U.S. EPA Methods 601 and 602, using a gas chromatograph (GC) for halogenated and aromatic VOCs, respectively. The GC, equipped with an electron capture detector (ECD) was used to detect 1,1-DCE, 1,1,1-trichloroethane (1,1,1-TCA), TCE, and PCE. The same GC, using a flame ionization detector (FID), was used to measure benzene, toluene, ethyl benzene, meta- (m) and para- (p) xylenes, and ortho- (o) xylene. A full discussion of SOV survey methodology, analytical procedures, quality assurance/quality control (QA/QC) procedures, and survey data are contained in Appendix D.

Site 1. The SOV survey at this area was used to determine if residual fuel from a surface release was present in a particular area around the hydrant system and to target areas for soil borings and samples. Initial SOV sampling locations were placed around the perimeter of Site 1. Only three samples were collected inside of the hydrant system due to access constraints and the high density of underground pipes and tanks. One additional sampling point, OV1-14 was located to determine the lateral extent of an area of vapor detected in adjacent locations. In general, samples reached the target depth of 10 feet bgl; however, selected samples only reached a depth of 9 feet. Sampling depths are presented in Chapter 3.0 along with SOV results.

Site 2. Six initial SOV locations were placed around the drum storage area to determine areas where surface spills may have infiltrated below the surface. Six additional locations were placed in areas of visual soil staining and at locations adjacent to the site to determine if other surface spillage had occurred. In general, samples reached the target depth of 10 feet.

Site 3. A minimum of 15 SOV samples were scheduled to be collected at Site 3; however, due to the presence of a near surface cobble zone, sampling attempts were unsuccessful.

Hydraulically-pushed and driven sampling rods were first attempted and refused. Upon refusal of the driven rod, pilot holes were drilled with an electric hammer drill, similar to a jack-hammer. The hammer drill holes were extended to approximately 3 feet and driven rod was again attempted and again refused. After the second refusal at three locations, sampling attempts were abandoned.

Site 4. Six SOV samples were collected from Site 4 in areas adjacent to the drum storage areas to determine locations for soil samples. Due to caliche and near-surface bedrock, the sampling rods were driven to the target depths of 2 to 4 feet bgl.

2.4.3 Piezometer Installation

Three piezometers were installed at both the Base and Papago, to determine geologic conditions and the direction of groundwater flow, prior to installation of background and downgradient monitoring wells. Locations of piezometers at the Base (designated PS-01, -02, and -03) and Papago (PP-01, -02, and -03) are shown in Figures 2-6 and 2-7. Piezometer locations were chosen to provide a wide area of coverage in a triangular pattern so that a representative average groundwater flow direction could be calculated at each facility. Upon determining the direction of flow, monitoring wells could be placed either upgradient or downgradient of a given site.

Piezometer borings at the Base were drilled using an AP-1000 percussion drilling rig with 9-5/8 inch outside diameter (OD) dual-wall drill pipe and reverse-air-circulation. Soil samples were not collected during piezometer drilling; however, cuttings were visually logged by the project geologist. Boring logs for piezometers are presented in Appendix E.

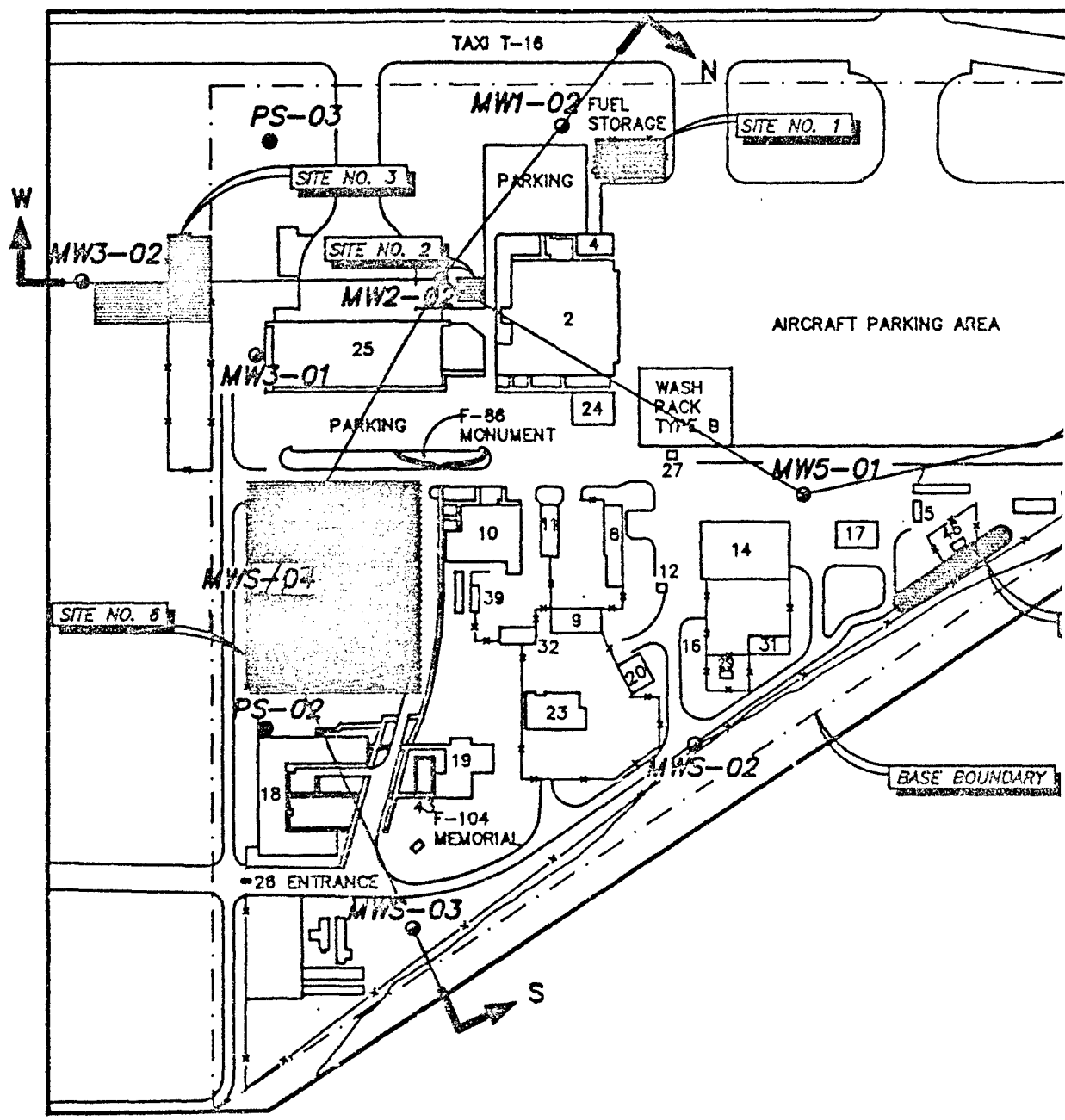
An attempt was made to use percussion drilling for piezometer installation at Papago; however, due to presence of caliche and bedrock at the site, penetration rates were limited to approximately 4 feet per hour. A conversion to conventional air rotary drilling with a 9-inch-diameter bit was made resulting in satisfactory penetration rates for piezometer installation.

Piezometers were completed to approximate depths of 100 feet bgl at the Base and 55 to 71 feet below the surface at Papago. Fifty feet of 2-inch inside diameter, Schedule 40, 0.010 inch-slot polyvinyl chloride (PVC) screen was used at the Base and 20 feet of 2-inch screen at Papago. Typical piezometer designs for the Base and Papago are presented in Figure 2-8; completion diagrams for each piezometer are presented in Appendix F. Total depths and

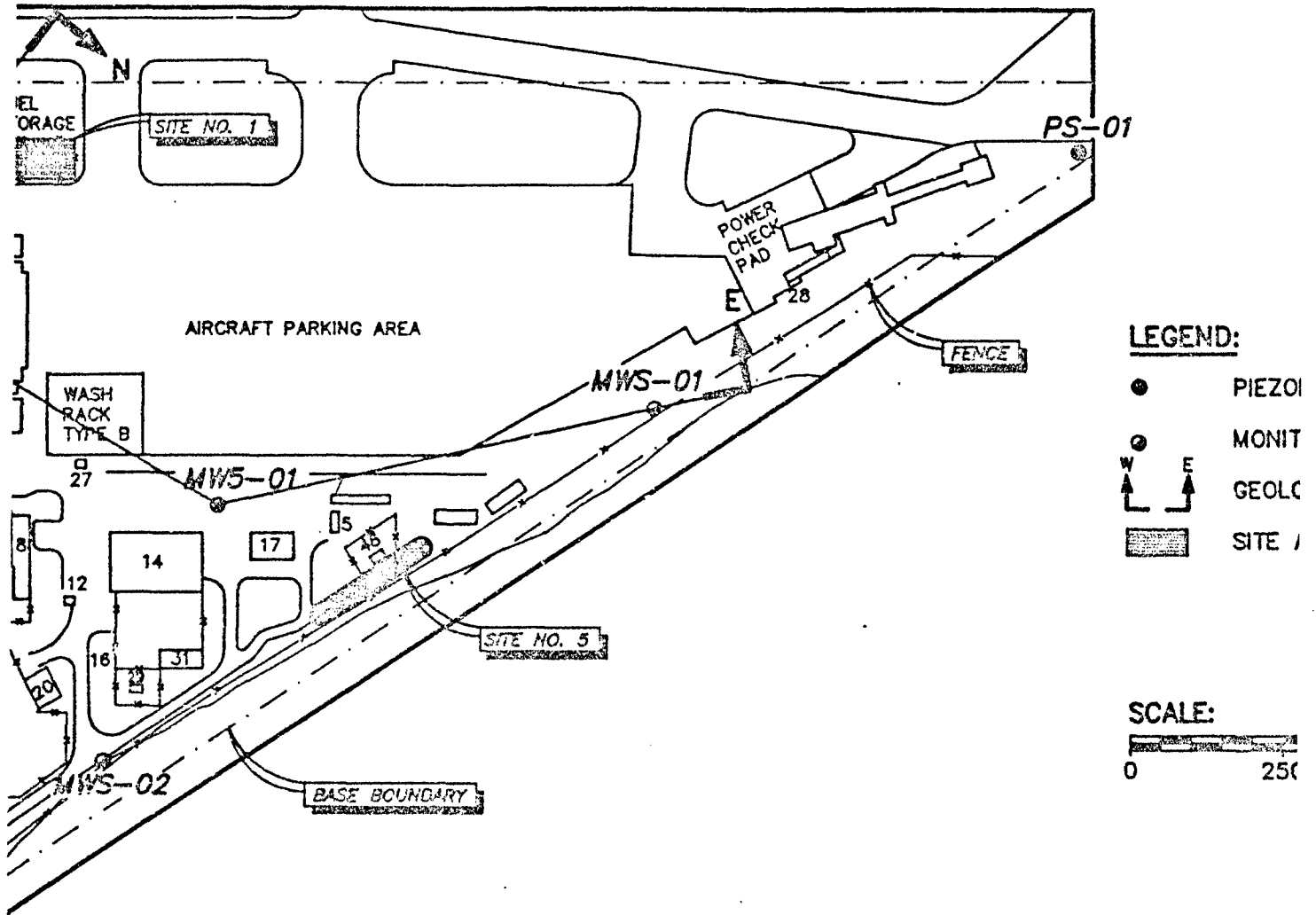
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STARTING DATE: 10/30/91	DATE LAST REV: 3/25/92	DRAFT. CHK. BY: G. PACHECO	INITIATOR: D. WILLEN	DWG. NO.: 409721-8-C40
DRAWN BY: BILL SMITH	DRAWN BY: J. HUBBARD	ENGR. CHK. BY: D. WILLEN	PROJ. MGR.: D. WILLEN	PROJ. NO.: 409721

409721-8 04/20/92 10:07am STC



(2)



LEGEND:

- PIEZO
- ⊙ MONIT
- ⊕ GEOLC
- ▨ SITE

SCALE:

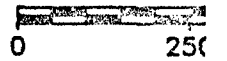
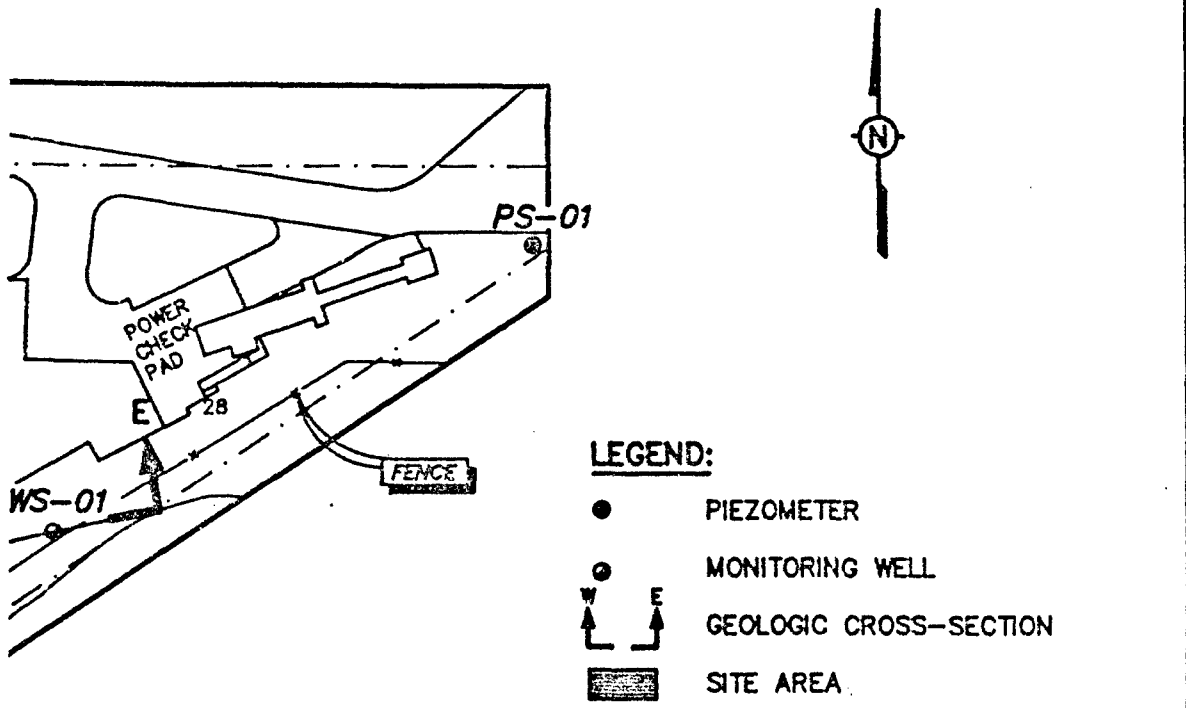


FIGURE 2-6
PIEZOMETER
MONITORING
161 AREFG

161 AREFG, AI
SKY HARBOR
PHOENIX, ARIZ



3



LEGEND:

- PIEZOMETER
- MONITORING WELL
- W E GEOLOGIC CROSS-SECTION
- SITE AREA

SCALE:

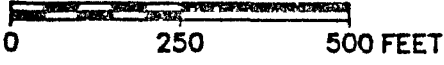


FIGURE 2-6
PIEZOMETER AND
MONITORING WELL LOCATIONS,
161 AREFG

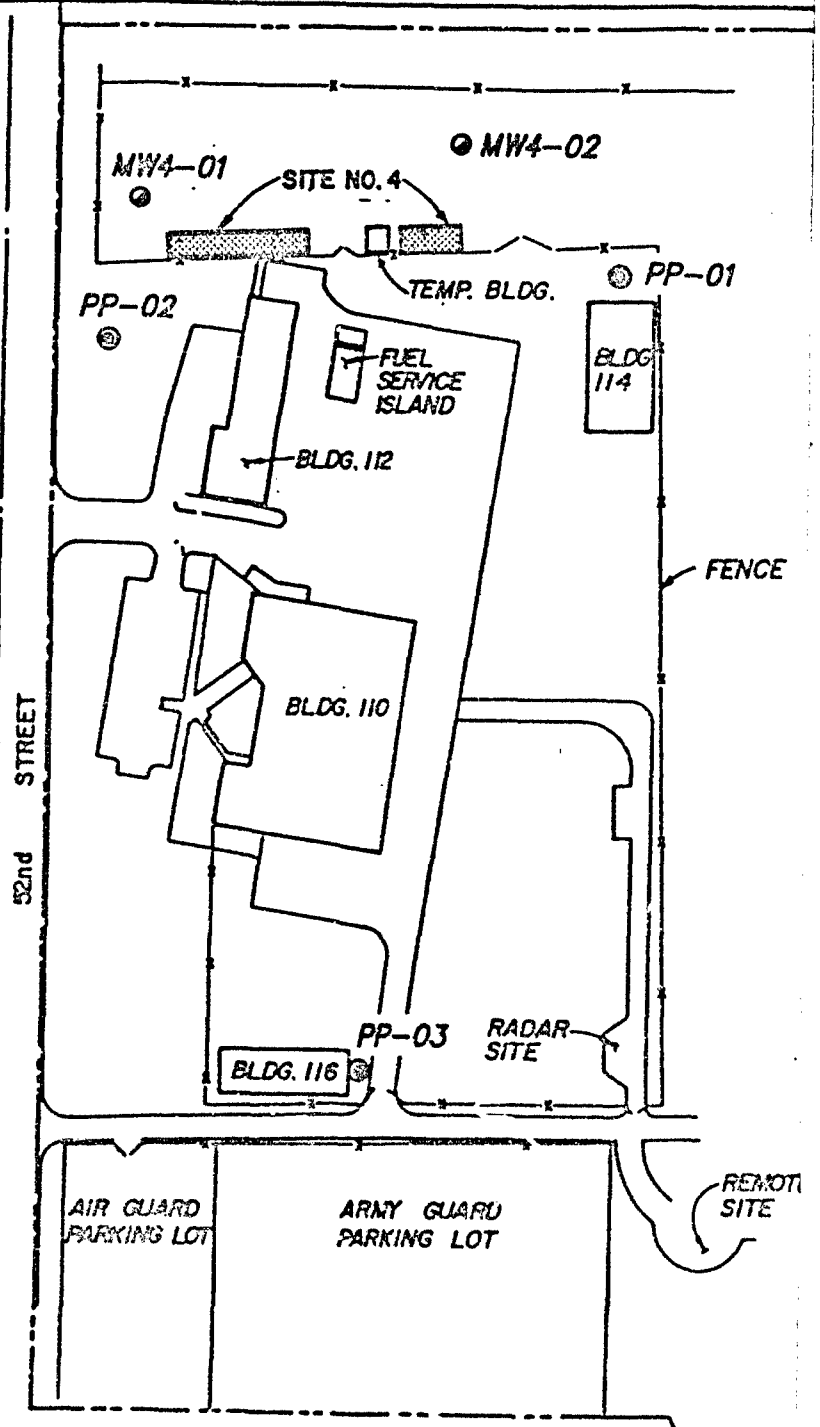
161 AREFG, ARIZONA ANG
SKY HARBOR IAP
PHOENIX, ARIZONA



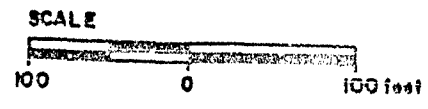
①

K055039

STARTING DATE: 10/30/91	DATE LAST REV.:	DRAFT. CHK. BY: G. PACHECO	INITIATOR: D. WELLEN	DRAWING NO.: 408721-B-C41
DRAWN BY: C. ROSEITSON	DRAWN BY:	ENGR. CHK. BY: D. WILLEN	PROJ. MGR.: D. WILLEN	PROJ. NO.: 408721



TOPOGRAPHIC SOURCE:
 U.S. GEOLOGICAL SURVEY 7.5 MIN. QUAD.
 TEMPE, ARIZONA 1982



(2)

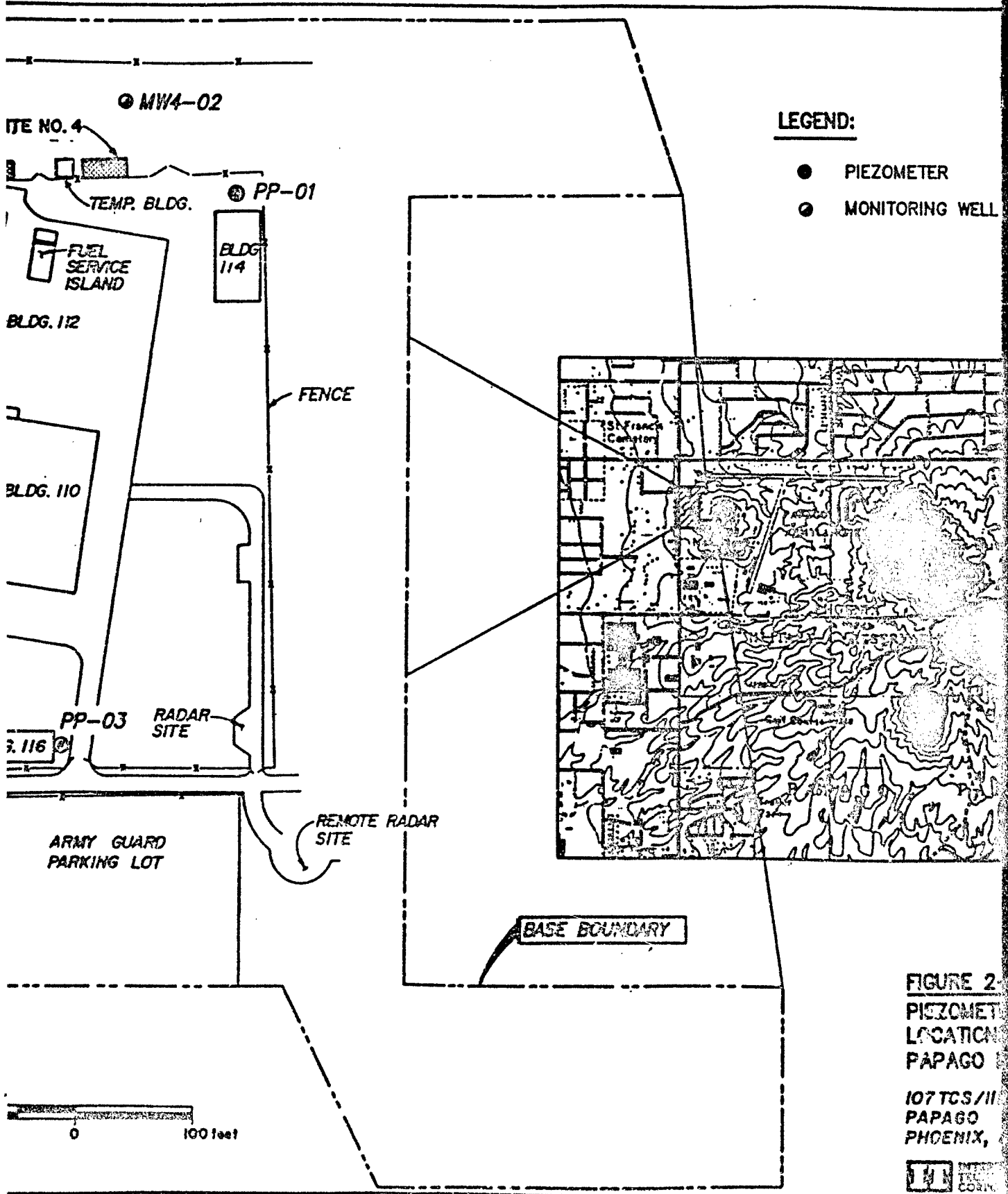


FIGURE 2
PIEZOMET
LOCATION
PAPAGO

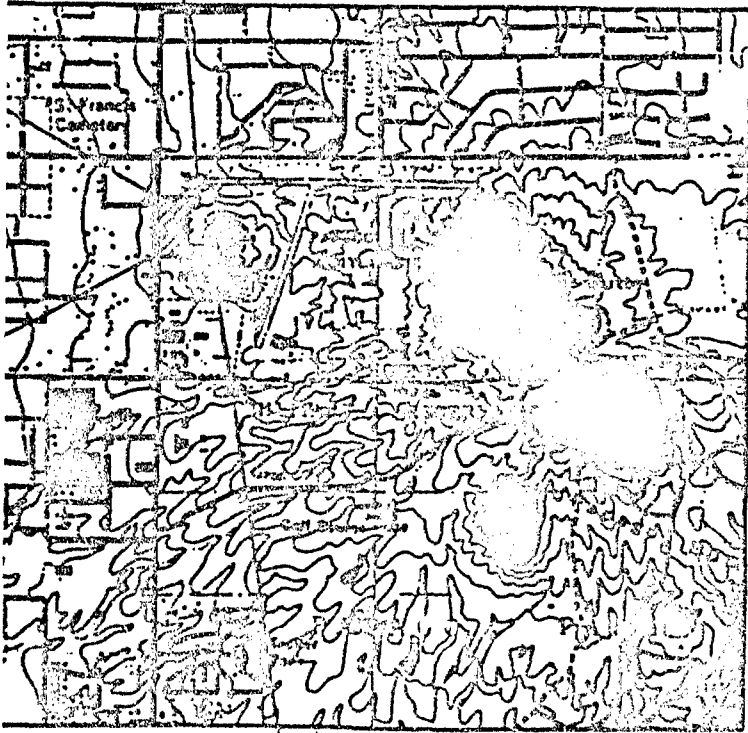
107 TCS / II
PAPAGO
PHOENIX,



3

LEGEND:

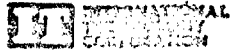
- PIEZOMETER
- MONITORING WELL

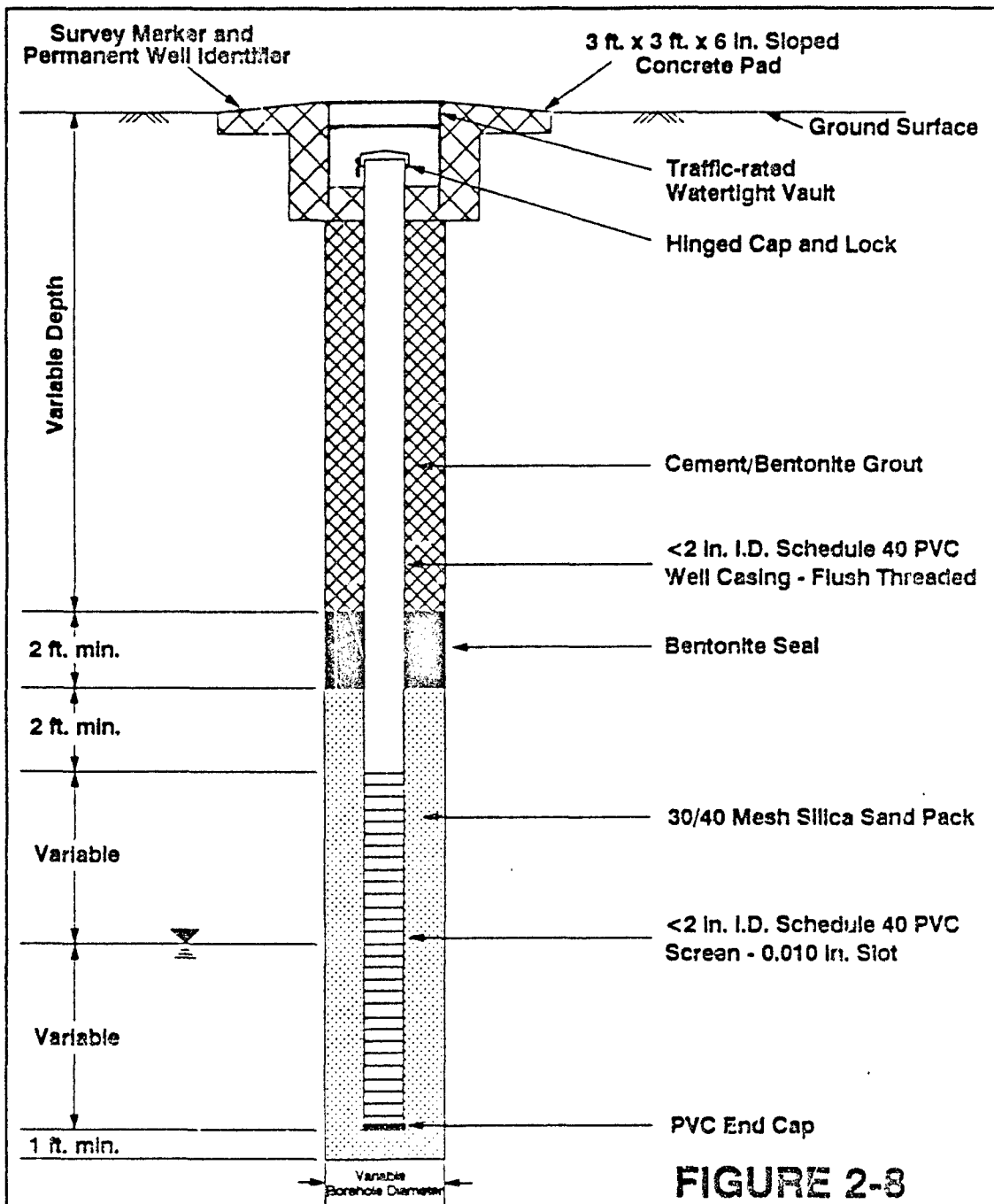


BOUNDARY

FIGURE 2-7
PIEZOMETER AND MONITORING WELL
LOCATIONS
PAPAGO MILITARY RESERVATION

107TCS/111ATCS, ARIZONA AND
PAPAGO
PHOENIX, ARIZONA



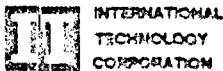


(Not To Scale)

FIGURE 2-8

TYPICAL PIEZOMETER DESIGN

161AREFG, ARIZONA ANG
 SKY HARBOR IAP
 PHOENIX, ARIZONA



completion specifications are provided in Table 2-2. Piezometers were developed after installation by surging and bailing until a clear effluent was obtained. Following development, water levels were measured from surveyed elevations and groundwater flow direction was computed. Development records are presented in Appendix G.

2.4.4 Field Screening Laboratory

A field laboratory was utilized on site to provide Level B screening information as the SI progressed. Screening data were used to provide analysis of all samples collected to economize the number of samples sent to conventional laboratories and to select samples for Level C analysis based on Level B results. Soil and water samples were analyzed for 1,1-DCE, 1,1,1-TCA, TCE, PCE, benzene, toluene, ethyl benzene, and total xylenes by GC using modified Methods 601 and 602.

Field instrumentation consisted of a SRI Model 8610 GC with on-board integrator and purge and trap, wide-bore capillary column, PID, and FID. The equipment used varies from FSP-specified equipment as a laboratory-grade instrument was substituted in place of a field instrument and a FID was used in addition to the PID. The variance record for instrumentation change is contained in Appendix A.

At the beginning of the project and after changes to operation settings, the GC was calibrated for each analyte using a five-point calibration curve. Standard and blank analyses were run at the beginning and end of each day to document proper instrument operation. A minimum of 5 percent duplicate and matrix spike/matrix-spike duplicates (MS/MSD) were analyzed to assess accuracy and precision of results.

Soil samples were delivered to the field laboratory the day of collection under chain-of-custody. Samples were stored in a cooler with ice or in a refrigerator during the period between sampling and analysis. An aliquot of each soil sample was removed from the center of the brass sleeve, placed in a test vial and weighed, and mixed with approximately 10 milliliters (mL) of reagent grade water. The sample was then placed in the purge and trap unit for analysis. Water samples were handled in the same manner except that samples were collected in 40 mL vials and placed directly into the purge and trap unit.

Due to a voltage irregularity in the PID lamp, the field laboratory ability to detect TCA was impaired. During QC checks of the instrumentation, it was discovered that TCA was not being detected as originally identified in instrument calibration procedures. The difficulty

TABLE 2-2

SUMMARY OF PIEZOMETER
SPECIFICATIONS
16th ARBERO AND PAPAGO, PHOENIX, ARIZONA

	PS-01 DEPTH	PS-01 ELEVATION	PS-02 DEPTH	PS-02 ELEVATION	PS-03 DEPTH	PS-03 ELEVATION	PP-01 DEPTH	PP-01 ELEVATION	PP-02 DEPTH	PP-02 ELEVATION	PP-03 DEPTH	PP-03 ELEVATION
NORTHING		9822.40		8992.99		9916.67		13666.88		13072.75		13675.97
EASTING		12315.52		10050.94		10066.64		6114.89		5919.85		5744.84
SURFACE ELEVATION	NA	1120.08	NA	1114.16	NA	1114.13	NA	1245.52	NA	1251.37	NA	1239.72
CASING ELEVATION	0.30	1119.78	0.30	1113.86	0.30	1113.83	0.30	1245.22	0.30	1251.07	0.30	1239.42
BOTTOM OF GROUT	44.0	1076.1	44.6	1069.6	43.3	1070.8	39.5	1206.0	30.2	1221.2	45.0	1194.7
BOTTOM OF BENTONITE	46.5	1073.6	46.7	1067.5	45.8	1068.3	42.0	1203.5	33.0	1218.4	47.5	1192.2
BOTTOM OF FINE SAND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BOTTOM OF FILTER PACK	100.5	1019.6	100.7	1013.5	99.7	1014.4	65.0	1180.5	55.5	1195.9	71.5	1168.2
TOP OF SCREEN	49.5	1070.6	49.7	1064.5	48.7	1065.4	44.0	1201.5	34.5	1216.9	49.0	1190.7
BOTTOM OF SCREEN	99.5	1020.6	99.7	1014.5	98.7	1015.4	64.0	1181.5	54.5	1196.9	69.0	1170.7
TOTAL DEPTH (Measured)	98.4	1021.4	99.9	1014.0	98.4	1015.4	64.2	1181.0	54.2	1196.9	69.0	1170.5
WATER LEVEL (2/2/91)	77.12	1042.66	75.68	1038.18	76.19	1037.64	31.22	1214.00	37.37	1213.70	28.10	1211.32

All Measurements in Feet.
Depth Measured from Surface
Except Total Depth and Water Level
Measured from top of casing.

was traced to the PID lamp having insufficient voltage to detect TCA molecules. Data from the FID were evaluated to provide results for TCA at higher detection limits. Typical field laboratory detection limits for other compounds are approximately tens of parts per billion (ppb); however, TCA results have detection limits approximately 100 to 1,000 ppb. NCRs documenting these difficulties are presented in Appendix A.

2.5 Confirmation and Delineation Activities

Investigative confirmation activities at each site consisted of collecting and analyzing soil and groundwater samples for HAZWRAP DQO Level C analysis (Level III, U.S. EPA, 1987b). Soil borings were drilled to collect samples, and monitoring wells were installed, developed, and purged prior to sampling. Level C analyses were conducted using routine U.S. EPA CLP methods for volatile organic analyses (VOA), semivolatile organic analyses (SVOA), and Target Analyte List (TAL) metals. Level C analyses generate results suitable for site characterization, risk assessment, feasibility studies, and remedial design. Analytes quantified under each test conducted during the SI and U.S. EPA Contract Required Quantitation Limits (CRQLs) are presented in Table 2-3.

The following sections discuss methods, equipment, and other protocol used during confirmation activities during the SI. Sampling program results are presented in Chapter 3.0.

2.5.1 Soil Borings and Sampling

A number of soil borings and monitoring wells were drilled and sampled at Sites 1, 2, 3, and 5. Soil samples were collected from soil borings and monitoring well borings. The sampling program began with the minimum numbers of borings and samples planned in the FSP and additional borings were completed to provide spatial coverage and coverage of areas of SOV compound detection. Soil borings were not conducted at Site 4 due to geologic conditions and refusal of the percussion drilling casing.

All soil samples were analyzed in the field laboratory for selected halogenated and aromatic VOCs described in Section 2.4.4. The surface sample and total depth sample were selected from each boring for Level C laboratory analysis; a third sample from each boring, exhibiting the highest concentration of field analyzed compounds, was also selected for Level C analysis.

TABLE 2-3

**LISTING OF TARGET COMPOUNDS AND
CONTRACT REQUIRED QUANTITATION LIMITS
161st AREFG, PHOENIX, ARIZONA**

COMPOUND	CAS NUMBER	DETECTION LIMIT LOW WATER (UG/L)	DETECTION LIMIT LOW SOIL (UG/KG)
VOLATILES			
Chloromethane	74-87-3	10	10
Bromomethane	74-83-9	10	10
Vinyl Chloride	75-01-4	10	10
Chloroethane	75-00-3	10	10
Methylene Chloride	75-09-2	5	5
Acetone	67-64-1	10	10
Carbon Disulfide	75-15-0	5	5
1,1-Dichloroethene	75-35-4	5	5
1,2-Dichloroethane	75-35-3	5	5
trans-1,2-Dichloroethene	156-60-5	5	5
Chloroform	67-66-3	5	5
1,2-Dichloroethane	107-06-2	5	5
2-Butanone	78-93-3	10	10
1,1,1-Trichloroethane	71-55-6	5	5
Carbon Tetrachloride	56-23-5	5	5
Vinyl Acetate	108-05-4	10	10
Bromodichloromethane	75-27-4	5	5
1,1,2,2-Tetrachloroethane	79-34-5	5	5
1,2-Dichloropropane	78-87-5	5	5
trans-1,3-Dichloropropene	10061-02-6	5	5
Trichloroethene	79-01-6	5	5
Dibromochloromethane	124-48-1	5	5
1,1,2-Trichloroethane	79-00-5	5	5
Benzene	71-43-2	5	5
cis-1,2-Dichloropropene	10061-01-5	5	5
Bromoform	75-25-2	5	5
2-Hexanone	591-78-6	10	10
4-Methyl-2-pentanone	108-10-1	10	10
Tetrachloroethene	127-18-4	5	5
Toluene	108-88-3	5	5
Chlorobenzene	108-90-7	5	5
Ethyl Benzene	100-41-4	5	5
Styrene	100-42-5	5	5
Total Xylenes		5	5

TABLE 2-3 (CONTINUED)

LISTING OF TARGET COMPOUNDS AND
CONTRACT REQUIRED QUANTITATION LIMITS
161st AREFG, PHOENIX, ARIZONA

COMPOUND	CAS NUMBER	DETECTION LIMIT LOW WATER (UG/L)	DETECTION LIMIT LOW SOIL (UG/KG)
SEMIVOLATILES			
Phenol	108-95-2	10	330
bis(2 Chloroethyl) ether	111-44-4	10	330
2-Chlorophenol	95-57-8	10	330
1,3-Dichlorobenzene	541-73-1	10	330
1,4-Dichlorobenzene	106-46-7	10	330
Benzyl Alcohol	100-51-6	10	330
1,2-Dichlorobenzene	95-50-1	10	330
2-Methylphenol	95-48-7	10	330
bis(2-Chloroisopropyl)ether	39638-32-9	10	330
4-Methylphenol	106-44-5	10	330
N-nitroso-Dipropylamine	621-64-7	10	330
Hexachloroethane	67-72-1	10	330
Nitrobenzene	98-95-3	10	330
Isophorone	78-59-1	10	330
2-Nitrophenol	88-75-5	10	330
2,4-Dimethylphenol	105-67-9	10	330
Benzoic Acid	65-85-0	50	1600
bis (2-Chloroethoxy) methane	111-91-1	10	330
2,4-Dichlorophenol	120-83-2	10	330
1,2,4-Trichlorobenzene	120-82-1	10	330
Naphthalene	91-20-3	10	330
4-Chloroaniline	106-47-8	10	330
Hexachlorobutadiene	87-68-3	10	330
4-Chloro-3-methylphenol	59-50-7	10	330
2-Methylnaphthalene	91-57-6	10	330
Hexachlorocyclopentadiene	77-47-4	10	330
2,4,6-Trichlorophenol	88-06-2	10	330
2,4,5-Trichlorophenol	95-95-4	50	1600
2-Chloronaphthalene	91-58-7	10	330
2-Nitroaniline	88-74-4	50	1600
Dimethyl Phthalate	131-11-3	10	330
Acenaphthylene	208-96-8	10	330
3-Nitroaniline	99-09-2	50	1600

TABLE 2-3 (CONTINUED)

LISTING OF TARGET COMPOUNDS AND
CONTRACT REQUIRED QUANTITATION LIMITS
161st AREFG, PHOENIX, ARIZONA

COMPOUND	CAS NUMBER	DETECTION LIMIT LOW WATER (UG/L)	DETECTION LIMIT LOW SOIL (UG/KG)
<i>SEMIVOLATILES (CONTINUED)</i>			
Acenaphthene	83-32-9	10	330
2,4-Dinitrophenol	51-28-5	50	1600
4-Nitrophenol	100-02-7	50	1600
Dibenzofuran	132-64-9	10	330
2,4-Dinitrotoluene	121-14-2	10	330
2,6-Dinitrotoluene	606-20-2	10	330
Diethylphthalate	84-66-2	10	330
4-Chlorophenyl Phenyl ether	7655-72-3	10	330
Flourene	86-73-7	10	330
4-Nitroaniline	100-01-6	50	1600
4,6-Dinitro-2-Methylphenol	534-52-1	50	1600
N-nitrosodiphenylamine	86-30-6	10	330
4-Bromophenyl Phenyl ether	101-55-3	10	330
Hexachlorobenzene	118-74-1	10	330
Pentachlorophenol	87-86-5	50	1600
Phenanthrene	85-01-8	10	330
Anthracene	120-12-7	10	330
Di-n-butylphthalate	84-74-2	10	330
Fluoranthene	206-44-0	10	330
Pyrene	129-00-0	10	330
Butyl Benzyl Phthalate	85-68-7	10	330
3,3-Dichlorobenzidine	91-94-1	20	660
Benzo(a)anthracene	56-55-3	10	330
bis(2-Ethylhexyl)phthalate	117-81-7	10	330
Chrysene	218-1-9	10	330
Di-n-octyl Phthalate	117-84-0	10	330
Benzo (b) fluoranthene	205-99-2	10	330
Benzo (k) fluoranthene	207-08-9	10	330
Benzo (a) pyrene	50-32-8	10	330
Indeno (1,2,3-cd) pyrene	193-39-5	10	330
Dibenz (a,h) anthracene	53-70-3	10	330
Benzo(g,h,i)perylene	191-24-2	10	330

2.5.1.1 Procedures and Equipment

All drilling activities at the Base were performed using an AP-1000 percussion drilling rig with 9-5/8 inch outside diameter (OD) dual-wall drill pipe and crowd-in type bit with reverse-air-circulation. Drilling progressed by advancing the drill pipe through percussion and removing cuttings by reverse air circulation. Soil samples were collected with a split spoon sampler, in advance of drilling, at 5-foot-depth intervals beginning at the ground surface for chemical analysis; leftover soil from the sampler was visually described on boring logs. Boreholes were logged primarily from collected soil samples and additional information gained from the retrieved soil cuttings. Cuttings were removed from the borehole immediately prior to collecting the driven sample.

Soil samples for chemical analysis were collected with an 18-inch long, 2-inch inside diameter (ID) split-barrel sampler containing three 6-inch-long brass sleeves equipped with a sand retention basket. The sampler was lowered to the borehole bottom and driven with a 140 pound hammer 18 inches or until refusal. Refusal was defined as a penetration rate of 50 hammer blows per inch of sampler advancement. All soil samples, with the exception of one from MBS-04, were collected from above the water table.

Samples were retrieved and the lower two sleeves were removed, lined with Teflon film, sealed with plastic caps and tape, labeled, and placed in a cooler with water or gel ice packs. One of the sleeves was shipped to a conventional laboratory for Level C analyses or archive. A second sleeve was held for field analysis and the top sleeve was discarded.

Sample recovery was fair to poor in most borings. The sampler was often refused due to large cobbles or boulders, and coarse-grained sediments periodically were not retained in the sampler. In cases where partial samples were collected, available sample was held for field screening analysis; if soil was retained in the second sleeve, a full sleeve was shipped to the conventional laboratory. All soil samples were labeled according to the FSP and were shipped to the laboratory within 24 hours of collection by overnight courier. Samples collected on weekends were stored in a refrigerator in a locked room with custody tape until the following Monday when they were shipped accordingly. Request for Analysis and Chain-of-Custody forms accompanied each shipment. Samples were analyzed for parameters indicated in Table 2-4. Tables 2-5 through 2-10 summarize samples collected, percent recovery of sample, and samples analyzed in field and conventional laboratories for background and site samples. Boring logs are presented in Appendix E; sample collection logs are presented in Appendix H.

TABLE 2-4
SOIL ANALYTICAL PROGRAM SUMMARY
161st AREFG, PHOENIX, ARIZONA

SITE NUMBER	DESCRIPTION	SOIL BORINGS	TESTING PROGRAM
NA	Background Borings	MBS-01 MBS-02 MBS-03	VOA, SVOA, Metals, NO2/NO3, Organic Lead, TPH VOA, SVOA, Metals, NO2/NO3, Organic Lead, TPH VOA, SVOA, Metals, NO2/NO3, Organic Lead, TPH
1	Hydrant Area	SB1-02 SB1-03 SB1-04 SB1-05 MB1-02	VOA, SVOA, TPH VOA, SVOA, TPH VOA, SVOA, TPH VOA, SVOA, TPH VOA, SVOA, TPH
2	HW Storage Area	SB2-01 SB2-02 SB2-04 MB2-02	VOA, SVOA, Metals, TPH VOA, SVOA, Metals, TPH VOA, SVOA, Metals, TPH VOA, SVOA, Metals, TPH
3	Fuel Bladder Area	SB3-01 SB3-03 SB3-04 MB3-01 MB3-02	VOA, SVOA, Organic Lead, TPH VOA, SVOA, Organic Lead, TPH VOA, SVOA, Organic Lead, TPH VOA, SVOA, Organic Lead, TPH VOA, SVOA, Organic Lead, TPH
4	HW Collection Area	SS4-01 SS4-02 SS4-03 SS4-04 SS4-05 SS4-06	VOA, SVOA, Metals, TPH VOA, SVOA, Metals, TPH VOA, SVOA, Metals, TPH VOA, SVOA, Metals, TPH VOA, SVOA, Metals, TPH VOA, SVOA, Metals, TPH
5	Ammunition Disposal Area	MBS-01	Metals, NO2/NO3
6	POL Area	MBS-04	VOA, SVOA, Organic Lead, TPH

VOA = CLP Volatile Organic Analysis

SVOA = CLP Semivolatile Organic Analysis

METALS = CLP Target Analyte List metals analysis

NO3/NO2 = Nitrate/Nitrite analysis

ORGANIC LEAD = California total organic lead analysis

TPH = Total Petroleum Hydrocarbon analysis

TABLE 2-5

SUMMARY OF SOIL SAMPLES COLLECTED AND
SUBMITTED FOR ANALYSIS
BACKGROUND LOCATIONS
161st ARBFG, PHOENIX, ARIZONA

BORING	DEPTH INTERVAL (FEET)	BLOW COUNT	PERCENT RECOVERY	HEADSPACE MEASUREMENT (PPM)	FIELD ANALYSIS	LEVEL III ANALYSIS
MBS-01	0-2	4,10,12	100	0.2	X	X
	5-7	10,50	10	0	X	
	10-12	8,10,50	10	0		
	15-17	50	0			
	20-22	50	0			
	25-27	50	0			
	30-32	50	0			
	35-37	50	0			
	40-42	50	0			
	45-47	50	0			
	50-52	50	0			
	55-57	50	0			
	60-62	22,22,25	35	0		X
	65-67	50	0			
70-72	50	0				
MBS-02	0-2	16,22,26	100	0	X	X
	5-7	10,15,20	50	0	X	X
	10-12	10,6,6	70	0	X	X
	15-17	50	10	0	X	
	20-22	50	0			
	25-27	50	10	0	X	
	30-32	50	0			
	35-37	50	0			
	40-42	50	10	0	X	
	45-47	50	10	0	X	
	50-52	50	10	0	X	
	55-57	50	0			
	60-62	50	0			
	65-67	50	0			
70-72	50	0				

TABLE 2-5

(cont.)

SUBMITTED FOR ANALYSIS

BACKGROUND LOCATIONS

161st AREFG, PHOENIX, ARIZONA

BORING	DEPTH INTERVAL (FEET)	BLOW COUNT	PERCENT RECOVERY	HEADSPACE MEASUREMENT (PPM)	FIELD ANALYSIS	LEVEL III ANALYSIS
MBS-03	0-2	20,50	65	0	X	X
	5-7	6,9,13	30	0	X	X
	10-12	4,10,40	0			
	15-17	50	0			
	20-22	50	0			
	25-27	50	0			
	30-32	50	0			
	35-37	50	0			
	40-42	50	0			
	45-47	50	0			
	50-52	50	10	0	X	
	55-57	50	0			
	60-62	50	0			
	65-67	50	0			
	70-72	50	0			
	75-77	40,50	10		X	X
	MBS-04	0-2	7,10,10	40	0	X
5-7		50	0			
10-12		50	0			
15-17		25,10,18	80	0	X	X
20-22		50	20		X	
25-27		50	20		X	
30-32		50	0			
35-37		50	0			
40-42		50	10	160	X	
45-47		50	10	190	X	
50-52		50	10	220	X	
55-57		50	0			
60-62		50	0			
65-67		27,50	20	300	X	
70-72		50	10	300	X	
99-101						X

TABLE 2-6
SUMMARY OF SOIL SAMPLES COLLECTED AND
SUBMITTED FOR ANALYSIS
SITE 1
161st AREFO, PHOENIX, ARIZONA

BORING	DEPTH INTERVAL (FEET)	BLOW COUNT	PERCENT RECOVERY	HEADSPACE MEASUREMENT (PPM)	FIELD ANALYSIS	LEVEL C ANALYSIS
MB1-02	0-2	12,17,20	100	0	X	X
	5-7	50	0			
	10-12	50	0			
	15-17	50	20	0	X	
	20-22	50	0			
	25-27	50	0			
	30-32	50	0			
	35-37	10,15,28	50	0		X
	40-42	50	0			
	45-47	50	0			
	50-52	50	40	0	X	
	55-57	50	30	0	X	
	60-62	50	40	0		
	65-67	50	0			
	70-72	50	0			
75-77	50	50	0		X	
SB1-02	0-2	5,11,16	100	0	X	X
	5-7	9,12,14	30			X
	10-12	50	0			
	15-17	50	5	3.5	X	
	20-22	50	0			
	25-27	7,15,50	30	0	X	X
	30-32	10,50	0			
	35-37	50	0			
	40-42	50	0			
	45-47	50	0			
	50-52	50	10	0	X	
	55-57	50	0			
	60-62	50	0			
	65-67	50	0			
	70-72	50	0			
SB1-03	0-2	15,12,13	95	0	X	X
	5-7	13,12,18	0			
	10-12	8,10,16	50	0		
	15-17	50	10			
	20-22	8,14,22	50	0		X
	25-27	50	0			
	30-32	50	0			
	35-37	16,16,50	75	0		X
	40-42	50	0			
	45-47	50	0			
	50-52	50	0			
	55-57	21,25,23	95	0		X
	60-62	50	0			
	65-67	50	0			
	70-72	50	0			

TABLE 2-6
(cont.)
SUMMARY OF SOIL SAMPLES COLLECTED AND
SUBMITTED FOR ANALYSIS
SITE 1
161st AREFG, PHOENIX, ARIZONA

BORING	DEPTH INTERVAL (FEET)	BLOW COUNT	PERCENT RECOVERY	HEADSPACE MEASUREMENT (PPM)	FIELD ANALYSIS	LEVEL C ANALYSIS
SB1-04	0-2	12,20,24	75	0.2	X	X
	5-7	10,16,35	95	0	X	
	10-12	18,19,20	95	0	X	X
	15-17	50	0			
	20-22	50	10	0		
	25-27	50	0			
	30-32	6,10,50	10	0	X	
	35-37	50	0			
	40-42	50	5	0		
	45-47	50	0			
	50-52	50	0			
	55-57	13,23,22	75	0		X
	60-62	50	0			
65-67	50	0				
70-72	50	0				
SB1-05	0-2	13,13,10	100	0	X	X
	5-7	14,18,22	100	0.2	X	
	10-12	18,14,20	100	1		
	15-17	8,19,23	0	1		
	20-22	50	0			
	25-27	50	0		X	
	30-32	21,24,32	50	1		X
	35-37	18,50	50	0		
	40-42	25,47,50	50	0		
	45-47	50	30	0	X	
	50-52	20,50	0			
	55-57	50	0			
	60-62		0	0		
65-67	50	0		X	X	
70-72	60	0				

TABLE 2-7
 SUMMARY OF SOIL SAMPLES COLLECTED AND
 SUBMITTED FOR ANALYSIS
 SITE 2
 161st AREFG, PHOENIX, ARIZONA

BORING	DEPTH INTERVAL (FEET)	BLOW COUNT	PERCENT RECOVERY	HEADSPACE MEASUREMENT (PPM)	FIELD ANALYSIS	LEVEL III ANALYSIS
MB2-02	0-2		90	0	X	X
	5-7	6,13,14	50	0	X	
	10-12	6,26,50	10	0	X	
	15-17	50	0			
	20-22	50	0			
	25-27	50	0			
	30-32	30,25,50	40	0	X	X
	35-37	50	0			
	40-42	50	0			
	45-47	50	5	0	X	
	50-52	50	5	0	X	
	55-57	50	0			
	60-62	50	0			
	65-67	50	5	0	X	
70-72	17,30,50	60	0	X	X	
SB2-01	0-2	4,7,9	60	0.2	X	X
	5-7	4,7,8	25	0		
	10-12	10,14,13	15	0		
	15-17	50	24	0		
	20-22	50	0			
	25-27	50	0			
	30-32	50	0			
	35-37	50	0			
	40-42	50	0			
	45-47	50	0			
	50-52	50	40	0	X	X
	55-57	50	25	0	X	X
	60-62	50	5	0	X	
	65-67	50	0			
70-72	50	0				

TABLE 2-7
(cont.)
SUMMARY OF SOIL SAMPLES COLLECTED AND
SUBMITTED FOR ANALYSIS
SITE 2
161st AREFG, PHOENIX, ARIZONA

BORING	DEPTH INTERVAL (FEET)	BLOW COUNT	PERCENT RECOVERY	HEADSPACE MEASUREMENT (PPM)	FIELD ANALYSIS	LEVEL III ANALYSIS
SB2-02	0-2	8,9,5	95	0	X	X
	5-7	6,7,10	95	0	X	
	10-12	8,10,16	60	0	X	X
	15-17	50	0			
	20-22	50	0	0		
	25-27	50	0			
	30-32	50	0			
	35-37	50	0			
	40-42	40,50	75	0	X	
	45-47	50	0			
	50-52	13,50	70	0	X	
	55-57	50	40	0		
	60-62	50	0			
	65-67	50	0			
70-72	19,26	90	0	X	X	
SB2-04	0-2	5,4,4	95	0	X	X
	5-7	5,8,16	40	0		
	10-12	50	0			
	15-17	29,41,50	75	0	X	X
	20-22	50	0			
	25-27	50	0			
	30-32	50	0			
	35-37	50	0			
	40-42	50	0			
	45-47	50	0			
	50-52	50	10	0	X	
	55-57	50	90	0		X
	60-62	50	0			
	65-67	50	0			
70-72	7,16,22	80	0.6	X	X	

TABLE 2-8
SUMMARY OF SOIL SAMPLES COLLECTED AND
SUBMITTED FOR ANALYSIS
SITE 3
161st AREFG, PHOENIX, ARIZONA

BORING	DEPTH INTERVAL (FEET)	BLOW COUNT	PERCENT RECOVERY	HEADSPACE MEASUREMENT (PPM)	FIELD ANALYSIS	LEVEL C ANALYSIS
MB3-01	0-2	12,10,11	75	0	X	X
	5-7	5,6,8	100	0	X	
	10-12	30,29,50	30	0		
	15-17	50	0			
	20-22	50	0			
	25-27	50	0			
	30-32	50	0			
	35-37	50	45	0	X	
	40-42	50	20	0	X	
	45-47	50	0			
	50-52	50	40	0	X	X
	55-57	36,50	10	0	X	
	60-62	32,50	30	0	X	X
	65-67	50	0			
	70-72	50	0			
	99-101				X	
MB3-02	0-2	12,12,32	90	0	X	X
	5-7	20,27,50	90	0	X	X
	10-12	32,50	0			
	15-17	50	0			
	20-22	50	0			
	25-27	50	0			
	30-32	50	0			
	35-37	50	0			
	40-42	50	0			
	45-47	50	0			
	50-52	11,50	0			
	55-57	50	0			
	60-62	50	0			
	65-67	50	0			
	70-72	50	0			
SB3-01	0-2	32,26,27	90	0	X	X
	5-7	50	0			
	10-12	50	0			
	15-17	50	0			
	20-22	50	0			
	25-27	50	0		X	
	30-32	50	0			
	35-37	50	0		X	
	40-42	50	0	110		
	45-47	50	0		X	
	50-52	27,50	40		X	X
	55-57	29,50	0			
	60-62	50	0	34	X	
	65-67	50	0	188		
	70-72	50	10	150	X	X

TABLE 2-8 (cont.)
 SUMMARY OF SOIL SAMPLES COLLECTED AND
 SUBMITTED FOR ANALYSIS
 SITE 3
 16th AREFG, PHOENIX, ARIZONA

BORING	DEPTH INTERVAL (FEET)	BLOW COUNT	PERCENT RECOVERY	HEADSPACE MEASUREMENT (PPM)	FIELD ANALYSIS	LEVEL C ANALYSIS
SB3-03	0-2	22,25,34	50	0	X	X
	5-7	25,50	50	0		
	10-12	27,32,50	90	0	X	X
	15-17	50	0			
	20-22	13,24,31	50	0	X	X
	25-27	50	0			
	30-32	50	0			
	35-37	50	0		X	
	40-42	50	20	0	X	
	45-47	50	0			
	50-52	50	0			
	55-57	50	0		X	
	60-62	50	0			
	65-67	50	0			
70-72	50	0				
75-77	50	0		X		
SB3-04	0-2	10,17,14	80	0	X	X
	5-7	14,25,27	80	0	X	X
	10-12	50	30	0	X	
	15-17	50	70	0		X
	20-22	50	20	0	X	
	25-27	50	0			
	30-32	50	0			
	35-37	50	20	0	X	
	40-42	50	10	0	X	
	45-47	50	0			
	50-52	50	0		X	
	55-57	50	0			
	60-62	50	0			
	65-67	50	0			
70-72	50	10	0	X		

TABLE 2-9

SUMMARY OF SOIL SAMPLES COLLECTED AND
SUBMITTED FOR ANALYSIS

SITE 4

161st AREFG, PHOENIX, ARIZONA

BORING	DEPTH INTERVAL (FEET)	BLOW COUNT	PERCENT RECOVERY	HEADSPACE MEASUREMENT (PPM)	FIELD ANALYSIS	LEVEL C ANALYSIS
SS4-01	0-2					X
SS4-02	0-2					X
SS4-03	0-2					X
SS4-04	0-2					X
SS4-05	0-2					X
SS4-06	0-2					X

TABLE 2-10

SUMMARY OF SOIL SAMPLES COLLECTED AND
SUBMITTED FOR ANALYSIS

SITE 5

161st AREFG, PHOENIX, ARIZONA

BORING	DEPTH INTERVAL (FEET)	BLOW COUNT	PERCENT RECOVERY	HEADSPACE MEASUREMENT (PPM)	FIELD ANALYSIS	LEVEL C ANALYSIS
MB5-01	0-2	6,9,8	90	0	X	X
	5-7	8,9,10	80	0	X	X
	10-12	15,50	0			
	15-17	50	0			
	20-22	50	5	0	X	
	25-27	50	5	0	X	
	30-32	50	0			
	35-37	50	0			
	40-42	50	0			
	45-47	50	5	0	X	
	50-52	50	0			
	55-57	50	10	0	X	
	60-62	20,30,18	30	0	X	
	65-67	50	0			
	70-72	50	30	0		X
75-77	50	20	0	X		

Field QC samples were also collected to assess the validity of environmental sample data. Duplicate samples were taken at a frequency on average of one per ten samples and MS and MSD samples were collected on an average of one per twenty samples. MS/MSD samples were provided by submitting two sleeves of sample for analysis, and the laboratory spiked the samples.

All sampling and drilling equipment was decontaminated according to procedures in the FSP. Brass sample liners and plastic caps were cleaned prior to placement in the split-barrel samplers. Equipment rinsate QC samples were collected each day of sampling and shipped to the laboratory for analysis and archives. Rinsates were collected by pouring the final decontamination rinse through a cleaned split-spoon sampler containing liners. Analytical parameters for rinsate samples were chosen to match environmental sample analyses collected on a given day.

Soil cuttings were collected in bins as drilling progressed and stored on plastic sheeting at a central location on the Base until further action could be authorized for their disposal. Disposable protective clothing and other items used during these activities were disposed as site trash.

Selected soil borings were backfilled with a bentonite/cement grout to the land surface. Grout was pumped to the bottom of the borehole through drill-pipe casing as it was withdrawn. Boreholes in which grout had settled or infiltrated were topped off with grout the following day. Remaining soil borings were completed as monitoring wells.

2.5.1.2 Background Borings

Three background soil borings were drilled and converted to background monitoring wells along the southeast edge of the Base. Soil samples from background borings are labeled MBS-01, -02, and -03. These designations are followed by the depth of sample collection and a sleeve number such that a sample numbered MBS-01-5-7-01 indicates background boring No. 1, 5- to 7-foot bgl depth, and the first sleeve in the sampler. Table 2-5 presents a list of samples collected from background borings and those submitted for field and laboratory analyses. Samples from background borings were analyzed for all compounds of interest as indicated in Table 2-4. When background borings were converted to background monitoring wells, the boring number was changed from MBS-XX to MWS-XX (Figure 2-6).

Sampler refusal was common in all background borings; thus, sample recovery for analyses was poor. As indicated in Table 2-5, a minimum of 15 sample attempts were made in each boring; MBS-01 encountered refusal 10 times, MBS-02 12 times, MBS-03 13 times, and MBS-04 13 times. Samples were recovered from near the bottom of each boring with the exception of MBS-02 where the deepest sample recovered was from a depth of 10 to 12 feet bgl.

Site 1. Four soil borings and one monitoring well borehole were each drilled to a total depth of 70 feet bgl. Locations are given in Figure 2-1 and are similar to those proposed in the FSP. SB1-04 was relocated approximately 50 feet east of the planned location to provide samples from an area of SOV detection. SB1-03 was relocated approximately 15 feet west of the planned location due to access constraints. MW1-02 was relocated approximately 40 feet north so that it would be directly downgradient of Site 1.

Samples from Site 1 soil borings are numbered MBS-01, MBS-02, etc.; samples from the monitoring well are numbered MB1-02. Depth and sleeve number designations are the same as discussed for background borings. Table 2-6 presents a listing of sample attempts, samples recovered for field analysis, and samples recovered for laboratory analysis. Laboratory analytes for Site 1 are listed in Table 2-4.

Sample recovery at Site 1 was slightly better than the background borings. As indicated in Table 2-6, refusal was encountered between 8 and 14 times in each boring. Samples were recovered for Level C analysis from maximum depths of 77, 22, 57, 57, and 67 feet bgl, which was adequate to assess vertical contaminant migration.

Site 2. Three soil borings and one monitoring well borehole were each drilled to a total depth of 70 feet bgl (Figure 2-2). SB2-01 was relocated to the approximate planned location of SB2-05, inside of the fenced area. Due to the proximity of proposed sampling locations, only one soil boring was placed within the fenced portion of Site 2. MW2-02 was relocated approximately 50 feet southeast to be directly downgradient of the site and to be closer to the area of a suspected release.

Samples are designated SB2-XX and MB2-02 for soil boring samples and monitoring well borehole samples, respectively. Table 2-7 presents a summary of samples collected and analyzed. Table 2-4 lists the testing program.

Sampler refusal was encountered between 10 and 14 times in borings at Site 2. Samples were recovered for Level C analyses from maximum depths of 70, 72, 55, and 72 feet bgl which was adequate for assessment of vertical contaminant migration.

Site 3. Three soil borings and two monitoring well boreholes were drilled to depths from 72 to 100 feet at the locations shown in Figure 2-3. Wells were installed to 100 feet and borings to 74 feet. Each of the sampling locations was relocated to provide coverage of the expanded site. SB3-01 is within the original PA site location, SB3-03 is in an overlap area between the PA site and the east side of the revised site location, and SB3-04 is located in the west side of the revised site location. MW3-01 provides upgradient groundwater samples and MW3-02 provides downgradient groundwater samples.

Table 2-8 presents a summary of samples collected and analyzed. The analytical program is summarized in Table 2-4. Sampler refusal occurred between 12 and 13 times in each boring at Site 3. Samples were recovered from maximum depths of 62, 7, 67, 22, and 15 feet bgl. The adequacy of these sampling depths for assessing the vertical distribution of contaminants in soil is discussed in Section 3.5.

Site 4. Soil borings were not drilled as planned due to subsurface conditions. Driven samplers and drilling equipment were refused during attempts to install piezometers, making the likelihood of soil sampling success very low. A field decision was made to substitute collection of six surface soil samples for the soil borings (SS4-01 through SS4-06). Soil samples were collected from the locations depicted in Figure 2-4 using a stainless steel trowel. Five samples were collected adjacent to areas 4A and 4B. The sixth sample, SS4-06, was collected from a background location northeast of the investigation sites.

Surface gravel was removed from each sampling location with a shovel, and samples were collected by scraping soil into containers. Because all soil samples collected were shipped for Level C analyses, field screening was not conducted. Samples were analyzed for parameters indicated in Table 2-4.

Site 5. Soil borings were not planned for Site 5 in the FSP due to safety concerns. One monitoring well boring (MB5-01) was drilled downgradient of the site, as indicated in Figure 2-5. The well was relocated approximately 200 feet north of the planned location to be downgradient of the site and to be a safe distance from suspected disposal areas. Samples collected from the boring are listed in Table 2-10. Samples were shipped for Level C

analyses as indicated in Table 2-4. The sampler was refused 12 times in the Site 5 boring; however, a sample was obtained from the 72 foot bgl depth.

Site 6

As mentioned previously, Site 6 was not originally in the FSP but was added to the IRP because target compounds were detected upgradient of Site 3. A soil boring, MBS-04, was drilled and sampled west of Building 21, following FSP procedures. The boring was converted to a monitoring well (MWS-04, Figure 2-9).

2.5.2 Monitoring Well Installation

Monitoring wells were installed at each site as part of the SI to determine groundwater quality in uppermost water-bearing zones, both upgradient and downgradient of the sites (Figures 2-6 and 2-7). Three background wells (MWS-01, -02, and -03) were installed at the upgradient edge of the Base to serve as Base-wide background wells, indicating groundwater quality flowing into the study area. One well was installed downgradient at Site 1 (MW1-02), Site 2 (MW2-02), Site 3 (MW3-02), Site 4 (MW4-01), and Site 5 (MW5-01). One additional well was placed upgradient of Site 3 (MW3-01) and Site 4 (MW4-02) due to site-specific concerns. One monitoring well (MWS-04) at Site 6 was placed up- and side-gradient of Site 3, based on field screening data presented in Section 3.2.1.2 to assess water quality at Site 6.

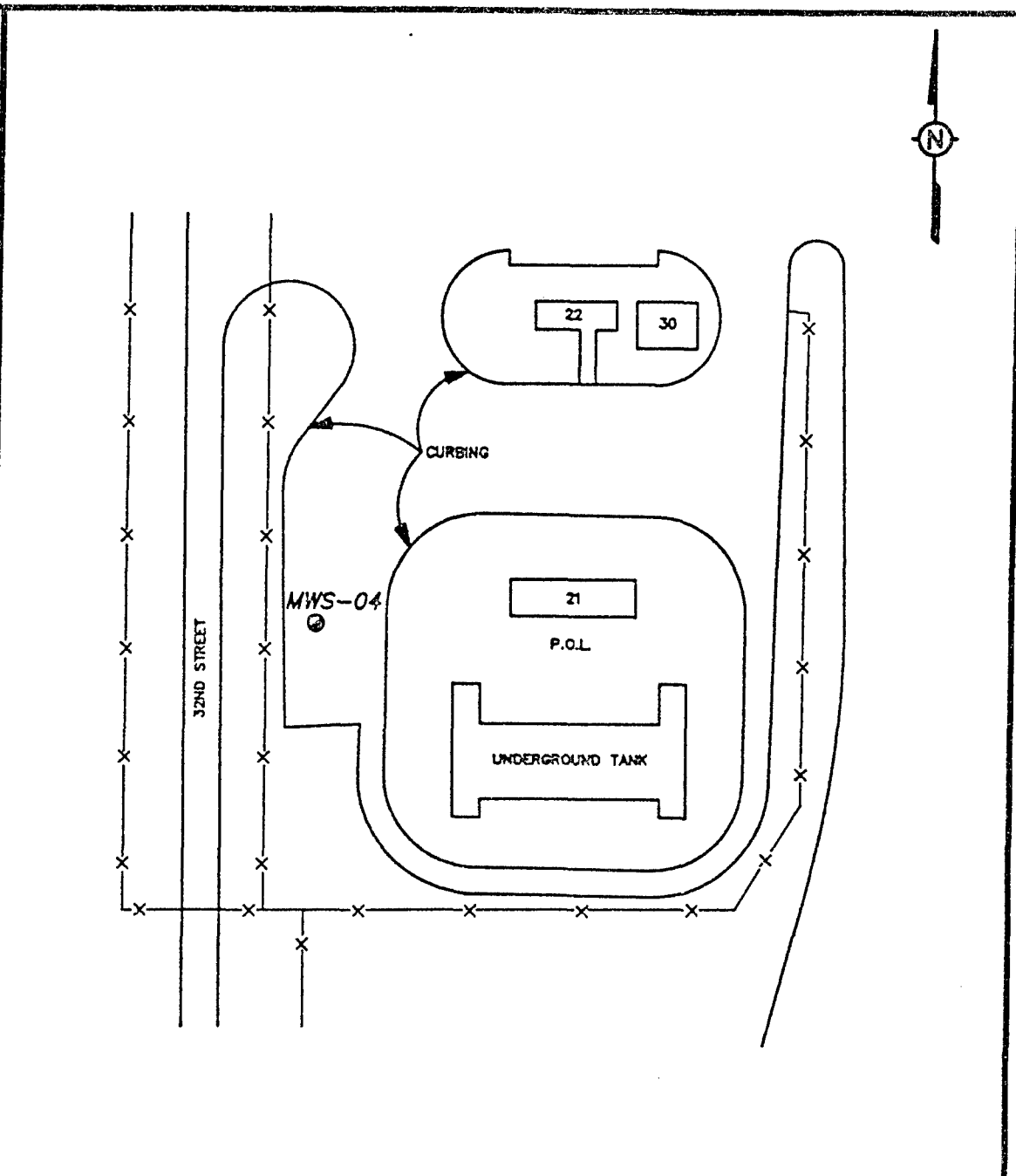
2.5.2.1 Drilling and Installation

Soil borings at the Base were deepened to approximately 100 feet bgl, or approximately 25 feet below the ambient water table for construction of monitoring wells. Drilling procedures utilized the dual-wall percussion method and reverse-air-circulation. Monitoring well drilling at Papago was completed using conventional air rotary techniques with a 9-inch diameter tricone bit.

Well construction consisted of installing 50 feet of 4-inch ID, schedule 40 flush-threaded PVC well screen with 0.010-inch factory slot and PVC casing to the surface. Twenty feet of screen was used at Papago. Casing and screen were decontaminated following procedures specified in the FSP prior to placement downhole. Screen and casing were installed through the center of the dual-wall drill pipe and 30-40 mesh silica sand was placed in lifts as the drill pipe was withdrawn from the borehole. Sand was placed to a minimum of 2 feet above the top of the well screen. A two foot layer of 70 mesh silica sand was placed on top of the filter pack. Two feet of bentonite pellets were placed on top of the sand and hydrated. The

STARTING DATE: 03/24/92	DATE LAST REV.:	DRAFT. CHCK. BY: U. PACHECO	INITIATOR: D. WILLEN	DWG. NO.: 409721-A-55
DRAWN BY: S. CARDWELL	DRAWN BY:	ENGR. CHCK BY: D. WILLEN	PROJ. MGR.: D. WILLEN	PROJ. NO.: 409721

40972155 04/15/92 3:15pm CKR



LEGEND:

- x-x- FENCE LINE
- [22] BUILDING NUMBER
- ⊙ MONITORING WELL

SCALE:

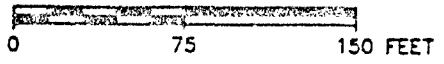


FIGURE 2-9

SITF. NO. 6
PCL AREA
WELL/SAMPLING LOCATION

161 AREFG, ARIZONA ANG
SKY HARBOR IAP
PHOENIX, ARIZONA



remainder of the annulus was backfilled to the surface with bentonite cement grout pumped through the casing-drill pipe annulus as the drill pipe was removed. Wells were completed in much the same manner at Papago, the primary difference being that materials were placed into an open borehole rather than within the drill pipe.

All construction materials were tagged during installation with a weighted line to ensure proper construction. Wells were completed with subgrade water-tight valve boxes to minimize traffic hazards. A typical well construction diagram is presented in Figure 2-10, and completion specifications are presented in Table 2-11. Construction diagrams for each well are presented in Appendix F.

2.5.2.2 Well Development

Well development was accomplished by bailing and surging a minimum of 48 hours after completion. Bailing at the Base was accomplished using a Smeal T-4 pulling unit with sand line and a PVC bailer. Well development at Papago was accomplished in much the same manner except that development was accomplished by hand. During development, measurements of pH, temperature, electrical conductivity (Ec), and turbidity of produced water were conducted. A summary of final development measurements is presented in Table 2-12.

Decontamination procedures were followed on all downhole equipment used in development to obviate the potential for introduction of contaminants into boreholes. Water produced during decontamination, purging and development was containerized in storage tanks on site, sampled, and held until discharge authorization was obtained from the City of Phoenix.

2.5.2.3 Groundwater Sampling

One round of groundwater sampling was conducted on all monitoring wells and one piezometer, PS-02, during the period between April 8 and 19, 1991. A second confirmation sampling was conducted on the same wells between June 24 and 30, 1991.

Each well was sampled according to procedures established in the FSP with variances contained in Appendix A. Wells were sampled in order of increasing contamination as indicated by field analysis of development water and the first round of groundwater samples. Prior to purging and sampling, depth to water and total depth measurements were conducted to calculate the well-bore volume. Three well-bore volumes of water were purged prior to sampling. Purging was accomplished using a 2-inch-diameter stainless-steel piston pump with polypropylene tubing. The pump was decontaminated following FSP procedures prior

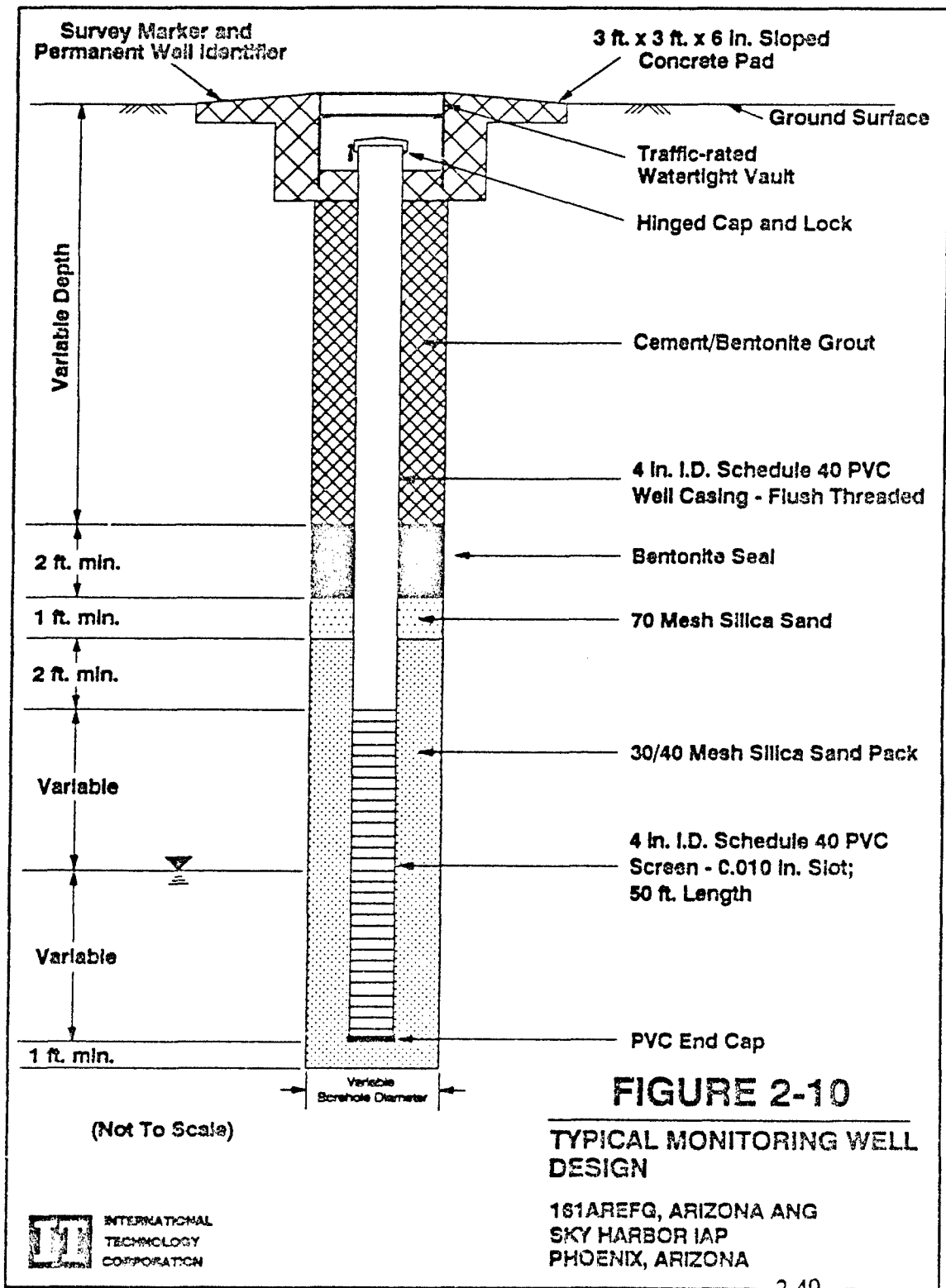


TABLE 2-II

SUMMARY OF MONITORING WELL
SPECIFICATIONS
161st AREFG, PHOENIX, ARIZONA

	MWS-01 DEPTH	MWS-01 ELEVATION	MWS-02 DEPTH	MWS-02 ELEVATION	MWS-03 DEPTH	MWS-03 ELEVATION
NORTHING		9484.29		8941.36		8620.48
EASTING		11768.37		10847.55		10430.88
SURFACE ELEVATION	NA	1118.70	NA	1115.91	NA	1116.14
CASING ELEVATION	0.30	1118.40	0.30	1115.61	0.30	1115.84
BOTTOM OF GROUT	44.50	1074.2	43.5	1072.4	41.5	1074.6
BOTTOM OF BENTONITE	46.50	1072.2	45.5	1070.4	45.0	1071.1
BOTTOM OF FINE SAND	48.00	1070.7	47.5	1068.4	47.0	1069.1
BOTTOM OF FILTER PACK	101.00	1017.7	101.0	1014.9	101.0	1015.1
TOP OF SCREEN	50.00	1068.7	50.0	1065.9	49.5	1066.6
BOTTOM OF SCREEN	100.00	1018.7	100.0	1015.9	99.5	1016.6
TOTAL DEPTH (Measured)	99.80	1018.6	99.9	1015.7	99.8	1016.0
WATER LEVEL (2/20/91)	77.62	1040.78	75.57	1040.04	76.80	1039.04

All Measurements in Feet.

Depth Measured from Surface

Except Total Depth and Water Level

Measured from top of casing.

TABLE 2-11
(cont.)

SUMMARY OF MONITORING WELL
SPECIFICATIONS
161st AREFG, PHOENIX, ARIZONA

	MWS-04 DEPTH	MWS-04 ELEVATION	MW1-02 DEPTH	MW1-02 ELEVATION	MW2-02 DEPTH	MW2-02 ELEVATION
NORTHING		9224.57		9992.28		9801.70
EASTING		10052.99		10606.30		10386.43
SURFACE ELEVATION	NA	1114.97	NA	1116.34	NA	1114.50
CASING ELEVATION	0.30	1114.67	0.30	1116.04	0.30	1114.20
BOTTOM OF GROUT	36.0	1079.0	41.5	1074.8	44.0	1070.5
BOTTOM OF BENTONITE	39.0	1076.0	45.0	1071.3	46.0	1068.5
BOTTOM OF FINE SAND	40.0	1075.0	NA	NA	47.0	1067.5
BOTTOM OF FILTER PACK	101.0	1014.0	101.0	1015.3	101.5	1013.0
TOP OF SCREEN	50.0	1065.0	49.8	1066.5	50.5	1064.0
BOTTOM OF SCREEN	100.0	1015.0	99.8		100.5	1015.5
TOTAL DEPTH (Measured)	99.8	1014.9	99.3	1016.7	99.9	1014.3
WATER LEVEL: (2/20/91)	NA	NA	77.64	1038.40	75.97	1038.23

All Measurements in Feet.
Depth Measured from Surface
Except Total Depth and Water Level
Measured from top of casing.

TABLE 2-11
(cont.)
SUMMARY OF MONITORING WELL
SPECIFICATIONS
161st AREFG PHOENIX, ARIZONA

	MW3-01	MW3-01	MW3-02	MW3-02	MW4-01	MW4-01
	DEPTH	ELEVATION	DEPTH	ELEVATION	DEPTH	ELEVATION
NORTHING		9611.01		9774.44		13733.39
EASTING		10082.74		9815.91		5749.44
SURFACE ELEVATION	NA	1115.07	NA	1112.44	NA	1238.17
CASING ELEVATION	0.30	1114.77	0.30	1112.14	0.30	1237.87
BOTTOM OF GROUT	41.5	1073.6	40.5	1071.9	15.5	1222.7
BOTTOM OF BENTONITE	44.5	1070.6	43.0	1069.4	18.0	1220.2
BOTTOM OF FINE SAND	46.0	1069.1	44.5	1067.9	19.0	1219.2
BOTTOM OF FILTER PACK	101.0	1014.1	101.0	1011.4	51.0	1187.2
TOP OF SCREEN	50.0	1065.1	50.0	1062.4	21.5	1216.7
BOTTOM OF SCREEN	100.0	1015.1	100.0	1012.4	41.5	1196.7
TOTAL DEPTH (Measured)	99.4	1015.4	99.7	1012.5	42.9	1195.0
WATER LEVEL (2/20/91)	NA	NA	NA	NA	42.43	1195.44

All Measurements in Feet.

Depth Measured from Surface

Except Total Depth and Water Level

Measured from top of casing.

TABLE 2-11
(cont.)

SUMMARY OF MONITORING WELL
SPECIFICATIONS
161st AREFG, PHOENIX, ARIZONA

	MW4-02 DEPTH	MW4-02 ELEVATION	MW5-01 DEPTH	MW5-01 ELEVATION
NORTHING		13732.21		9345.98
EASTING		5959.36		11050.01
SURFACE ELEVATION	NA	1241.99		1117.10
CASING ELEVATION	0.30	1241.69	0.30	1116.80
BOTTOM OF GROUT	20.0	1222.0	42.0	1075.1
BOTTOM OF BENTONITE	22.0	1220.0	44.0	1073.1
BOTTOM OF FINE SAND	23.0	1219.0	46.0	1071.1
BOTTOM OF FILTER PACK	51.0	1191.0	101.0	1016.1
TOP OF SCREEN	24.5	1217.5	50.0	1067.1
BOTTOM OF SCREEL	44.5	1197.5	100.0	1017.1
TOTAL DEPTH (Measured)	50.6	1191.1	100.7	1016.1
WATER LEVEL (2/20/91)	27.83	1213.83	76.84	1039.95

All Measurements in Feet.

Depth Measured from Surface
Except Total Depth and Water Level
Measured from top of casing

TABLE 2-12
SUMMARY OF WELL DEVELOPMENT FIELD MEASUREMENTS
161st AREFG, PHOENIX, ARIZONA

WELL	VOLUME REMOVED (GALLONS)	TURBIDITY (NTU)	TEMPERATURE (°C)	PH	ELECTRICAL CONDUCTIVITY (UMOHS/CM)
MWS-01	200	13.8	21.7	6.65	1070
MWS-02	200	21.5	23.6	7.23	1140
MWS-03	220	19.5	21.7	7.15	1230
MWS-04	220	25.2	23.1	6.78	1050
PS-01	27	NM	22.4	6.93	940
PS-02	32	NM	21.1	7.37	1080
PS-03	55	NM	20.9	7.36	1050
MW1-02	440	14.2	NM	6.84	1073
MW2-02	200	25.8	22.3	7.21	1150
MW3-01	215	41.1	23.7	6.77	1000
MW3-02	210	18.1	22.2	6.83	1110
MW5-01	210	64	23.6	7.26	1030
MW4-02	45	197	26.2	7.45	960
PP-01	16	NM	22.6	7.20	1620
PP-02	41	NM	24.5	7.34	2020
PP-03	10	NM	23.6	7.32	1330

NM = Parameter not measured

to introduction into a well. During both purging and sampling, measurements of pH, Ec, temperature, organic vapor, and turbidity were recorded to evaluate chemical stability of the purged water. Field parameters (Table 2-13) stabilized normally within one well-bore volume.

Two variances were obtained to the FSP groundwater sampling procedures to accommodate a low recharge well (MW4-01) and a small diameter well (PS-02). The low recharge well was purged to dryness by bailing and then sampled when sufficient water had accumulated to collect a sample. The piezometer was purged of one borehole volume and sampled after field indicator parameters stabilized.

Groundwater samples were collected immediately after purging using a decontaminated fluorocarbon resin bailer. Samples were bailed from the water surface after the purge pump was withdrawn. Samples were decanted directly into laboratory-prepared containers with preservatives. Samples for metals were placed in a laboratory-prepared and -provided polypropylene bottle, without preservative, and filtered through a 0.45 micron membrane into acidified containers. Chemical analyses differed from site to site due to the different nature of the chemicals of concern. Table 2-14 presents a list of analyses, sample containers, and preservatives for each site.

Samples were sealed, labeled, and placed on ice in a cooler immediately after sampling. Samples were cooled to approximately 4°C, repackaged with gel ice, and shipped by overnight carrier to laboratories for analysis. Chain-of-Custody and Request for Analyses forms accompanied each sample.

Quality control samples were collected in the field during each round of sampling. Duplicate samples were collected from well MW3-02 during the first and confirmation rounds of sampling. As with soil samples, equipment rinsates were collected from sampling bailers each day of sampling to assess decontamination procedures.

2.5.2.4 Slug Tests

Slug tests were performed in selected wells at the 161AREFG after completion of the second round of sampling. The purpose was to gather hydraulic data representative of the site. A pressure transducer connected to a data logger was inserted to the bottom of the well and the static water level (above the transducer) was recorded. A slug, 3.5-inch OD by 10 feet long, was lowered into the water column. After the water had returned to near static level, the

TABLE 2-13

GROUNDWATER SAMPLING FIELD MEASUREMENTS
161st AREFG PHOENIX, ARIZONA

WELL	DATE SAMPLED	ORGANIC VAPOR (ppm)	VOLUME REMOVED (GALLONS)	TURBIDITY (NTU)	TEMP. (°C)	PH	ELECTRICAL CONDUCTIVITY (UMHOS/CM)
MWS-01	15 APR 91	0	180	46	23.5	6.85	1250
	25 JUN 91	0.2	157	16.76	23.6	6.91	1080
MWS-02	12 APR 91	70	167	14.5	22.5	7.32	1140
	29 JUN 91	0.4	165	37.4	23.7	7.14	1130
MWS-03	10 APR 91	0	167	16.6	22.5	6.94	1280
	29 JUN 91	1	163	97.5	22.7	7.03	1160
MWS-04	11 APR 91	40	160	35.1	22.9	7.03	1190
	29 JUN 91	72	158	26.7	23.3	7.07	1190
PS-02	09 APR 91	80	57	31	22.2	7.11	1320
	30 JUN 91	50	57	>200	22.6	6.98	1150
MW1-02	18 APR 91	0	161	8.15	24.9	7.08	1110
	25 JUN 91	0.2	160	4.81	23.7	7.01	1150
MW2-02	10 APR 91	0	162	39	23	6.97	1190
	26 JUN 91	0.2	165	126.5	23	7.01	1100
MW3-01	11 APR 91	NM	157	51.5	22.5	7.27	1230
	29 JUN 91	56	157	10.5	23.6	7.06	1150
MW3-02	16 APR 91	190	180	55.2	24.2	6.88	1340
	28 JUN 91	1.8	168	19.65	23.4	7.08	1150
MWS-01	16 APR 91	0	178	6.34	23.5	6.90	1260
	26 JUN 91	0.2	165	3.2	23.1	6.99	1070
MW4-01	08 APR 91	0	13.5	12.22	25.6	6.95	2640
	28 JUN 91	0.2	28	27.2	24.8	7.1	2650
MW4-02	16 APR 91	0	35	9.5	27.2	6.96	960
	27 JUN 91	NM	28	6.5	26.6	7.38	1050

NM - Not Measured

12-13a.cwpj

TABLE 2-14

GROUNDWATER ANALYTICAL PROGRAM SUMMARY
161st AREFG PHOENIX, ARIZONA

SITE NUMBER	DESCRIPTION	MONITORING WELLS	TESTING PROGRAM
NA	Background Wells	MWS-01 MWS-02 MWS-03 PS-02	VOA, SVOA, Metals, NO2/NO3, Organic Lead, TPH, VC VOA, SVOA, Metals, NO2/NO3, Organic Lead, TPH, VC VOA, SVOA, Metals, NO2/NO3, Organic Lead, TPH, VC VOA, SVOA, Organic Lead, TPH, VC
1	Hydrant Area	MW1-02	VOA, SVOA, TPH, VC
2	HW Storage Area	MW2-02	VOA, SVOA, Metals, TPH, VC
3	Fuel Bladder Area	MW3-01 MW3-02	VOA, SVOA, Organic Lead, TPH, VC VOA, SVOA, Organic Lead, TPH, VC
4	HW Collection Area	MW4-01 MW4-02	VOA, SVOA, Metals, TPH, VC VOA, SVOA, Metals, TPH, VC
5	Ammunition Disposal Area	MW5-01	Metals, NO2/NO3
6	POL Area	MWS-04	VOA, SVOA, Organic Lead, TPH, VC

VOA = CLP Volatile Organic Analysis
 SVOA = CLP Semivolatile Organic Analysis
 METALS = CLP Target Analyte List metals analysis
 NO3/NO2 = Nitrate/Nitrite analysis
 ORGANICLEAD = California total organic lead analysis
 TPH = Total Petroleum Hydrocarbon analysis
 VC = Vinyl Chloride by Gas Chromatography

slug was withdrawn and water levels were recorded. Data from the tests were transferred to diskette and analyzed in accordance with the FSP. Slug test data and analyses for wells MWS-01 and MW1-02 are presented in Appendix I.

2.6 Disposal of Wastes from Field Activities

2.6.1 Drilling Activities

All potentially contaminated wastes generated during drilling activities were containerized on site. Soil cuttings from each borehole were segregated and placed on, and covered with, polyethylene sheeting. Water produced from drilling was placed into 250-gallon tanks. Other wastes such as protective clothing and used plastic sheeting were disposed as trash.

2.6.2 Decontamination Activities

A decontamination pad was constructed to collect washwater. The pad was sloped to collect water in a 2-foot deep sump. The pad was lined with three layers of 10-mil PVC sheeting and was located adjacent to Site 3, north of Building 25 (Figure 1-2). Most washwater was allowed to evaporate; water that had not evaporated by the end of each day was pumped into 250-gallon storage tanks. A letter of approval for a one-time discharge was obtained from the City of Phoenix for disposal of waste water from the holding tanks to the sanitary sewer system and publicly owned treatment works (POTW).

2.6.3 Monitoring Well Development and Sampling Activities

Groundwater produced from wells and piezometers during development and sampling was placed either into 250-gallon storage tanks or 55-gallon type 17-E drums, sealed, and labeled. The drums were stored in a fenced area at the Base until the letter of approval was received from the City of Phoenix that authorized discharge to the POTW. Decontamination solutions containing hexane and methanol water mixtures were contained into two 55-gallon drums and stored at the Base for subsequent disposal.

3.0 Nature and Significance of Results

3.1 Geology and Hydrogeology

3.1.1 161AREFG

3.1.1.1 Geology

As discussed in Section 1.5.2, the geology beneath the Base is characterized by fluvial deposits related to the Salt River. These deposits have been shown to be vertically and horizontally heterogeneous with beds being localized in extent.

Results of Base-wide geologic investigations are summarized in the geologic cross section presented in Figure 3-1. Stratigraphic intervals delineated on the figure were defined in terms of the Unified Soil Classification System (USCS). Inherent in this classification system are subdivisions of sediment types encompassing a broad range of grain sizes. For example, the symbol SM describes sediment admixtures of clay, silt, sand, and gravel of varying percentages. This symbol can therefore be used to describe a variety of sediment types and facies. The only true definitive symbols in the classification system are those used for clean sands (SP and SC), clean gravels (GP), and clays (CL and CH).

As a result of these broad subdivisions, the Base-wide cross section presented in Figure 3-1 depicts sediment bodies correlative across the entire base. The sediment groupings may be representative of different facies and may not realistically be used to reconstruct the discrete geologic systems operating at the time of deposition.

Due to the poor recovery of sediment samples from discrete depth intervals, geologic interpretation of stratigraphy at the Base is tenuous. Zones of sampler refusal or poor sample recovery are interpreted as representative of gravel or cobble deposits. Tentative correlations of sand bodies and zones of poor sample recovery are made across the site. Typical of alluvial environments, lenses of sand and gravel are common.

3.1.1.2 Hydrogeology

The objective of the hydrogeologic portion of the SI was to characterize the initial section of the uppermost water bearing unit. During the monitoring period of January 19, 1991 through June 30, 1991 groundwater occurred at the Base under unconfined conditions at

1

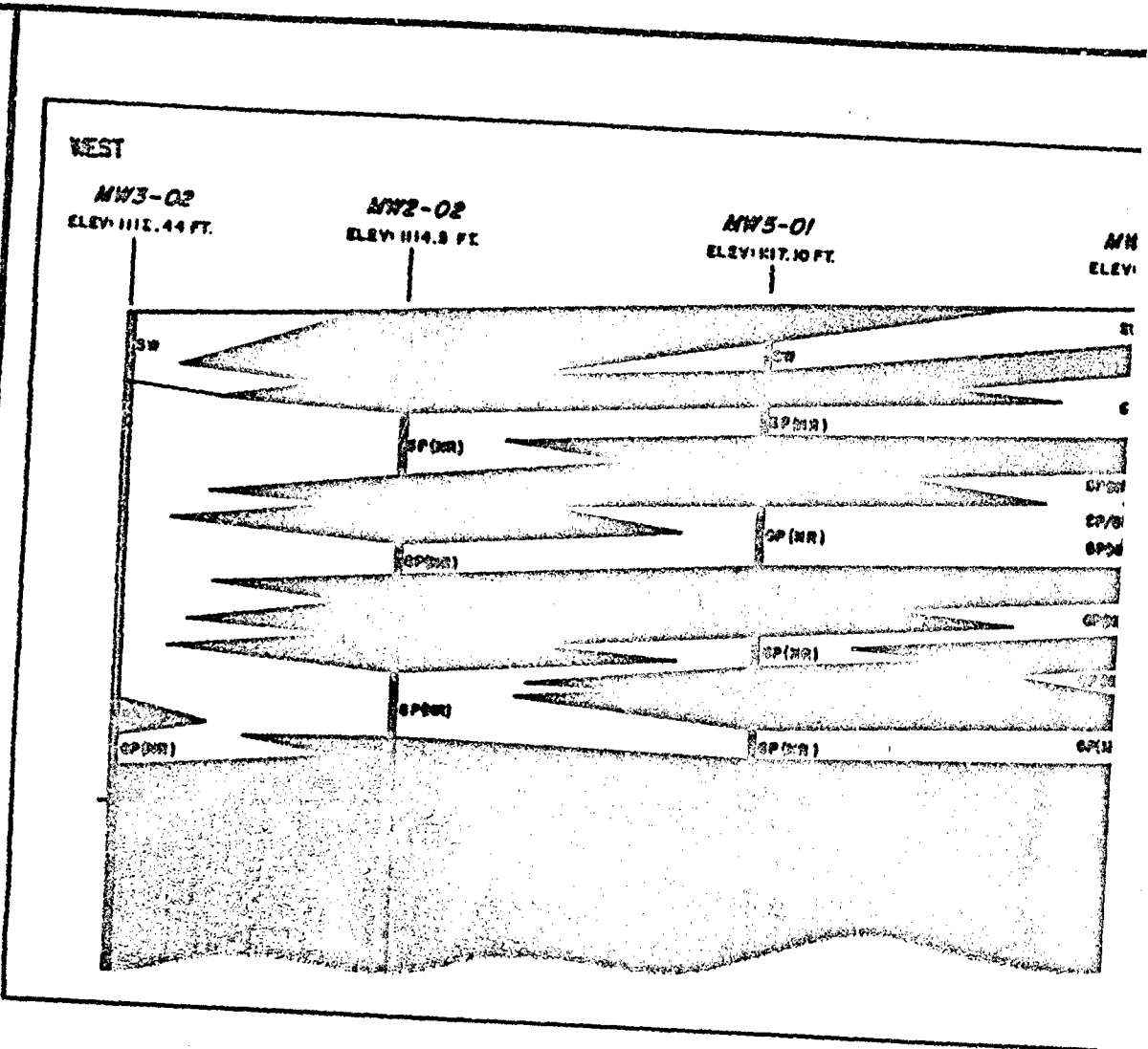
DRAWING NO: 409721-B-042
PROJ. NO: 409721

DRAFT. CHKD. BY: G. PACIENCO
ENGR. CHKD. BY: D. MALLEN
ESTIMATOR: D. WELLEN
PROJ. MGR.: D. WELLEN

DATE LAST REV:
DRAWN BY:

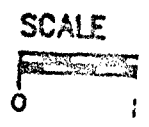
STARTING DATE: 10/30/91
DRAWN BY: C. ROBERTSON

K095848

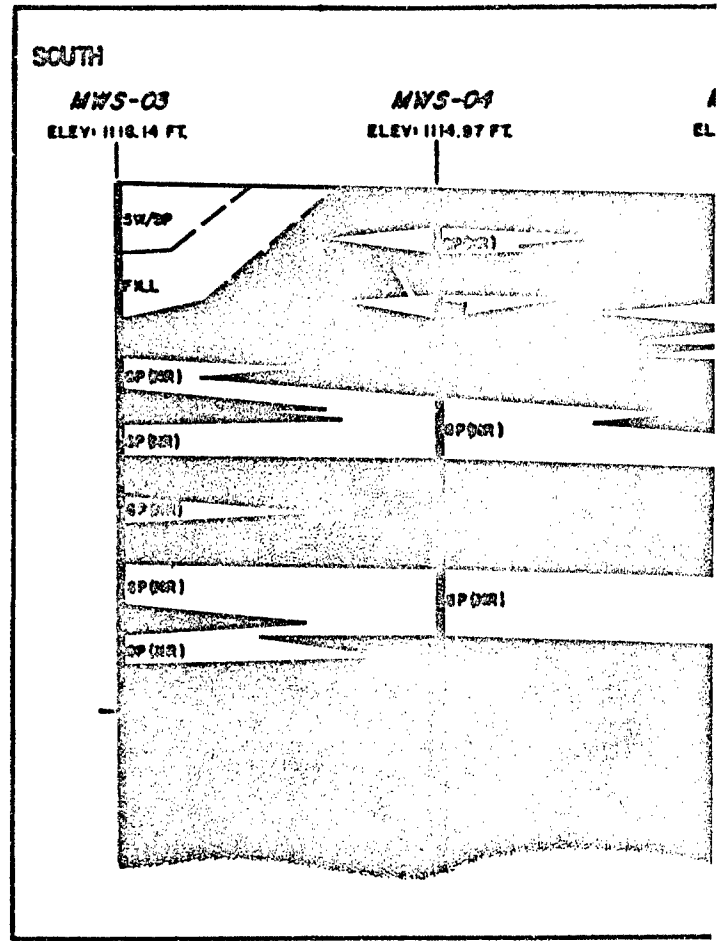
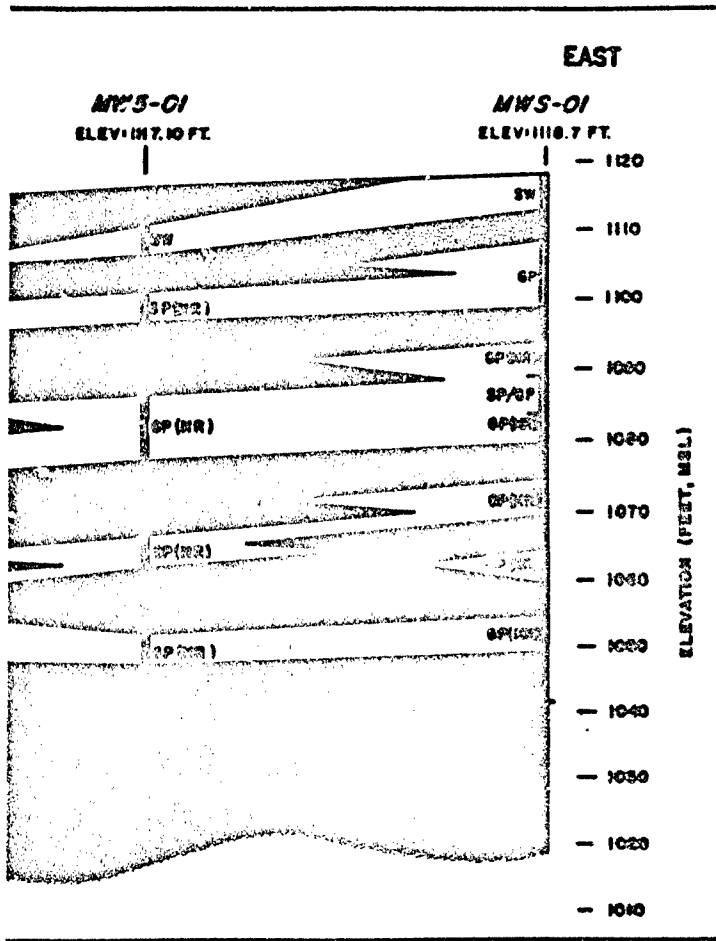


LEGEND:

- GP - POORLY-GRADED GRAVEL
- SP - POORLY-GRADED SAND
- SW - WELL-GRADED SAND
- SM - SILTY SAND
- NR - NO RECOVERY
- ▽ - WATER TABLE
- ~ - INFERRED STRATIGRAPHIC CONTACT



(2)



SCALE

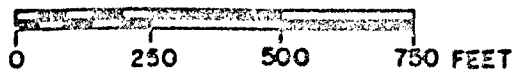


FIGURE 3-1
GEOLOGIC C

161 AREFC, A
SKY HARBOR
PHOENIX, ARI



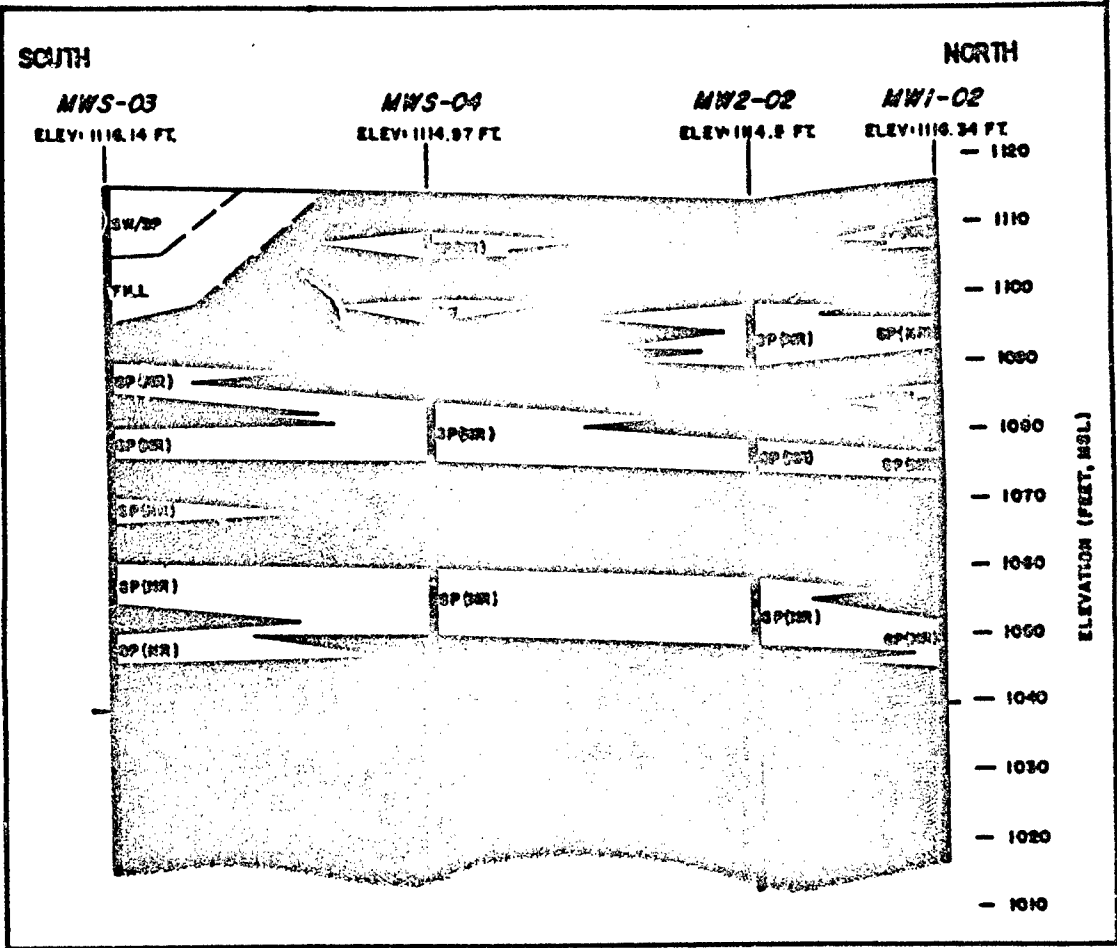
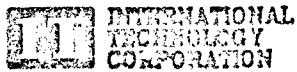


FIGURE 3-1
GEOLOGIC CROSS SECTIONS

161 AREFG, ARIZONA ANG
 SKY HARBOR IAP
 PHOENIX, ARIZONA



750 FEET

depths ranging from 66 to 83 feet below land surface, depending on location and water table fluctuations. These depths correspond to water-table elevations of 1,048 to 1,032 feet msl. Samples of aquifer materials collected during drilling indicate that the uppermost portion of the aquifer consists of medium-to coarse-grained sand and gravel.

Appendix J contains a listing of water level measurements conducted during the investigation; hydrographs of monitoring wells at the Base are presented in Figures 3-2 and 3-3. The hydrographs depict a general rising trend in all wells and piezometers at the Base beginning between days 50 and 70 of the monitoring period (March to April); this is tentatively correlated with the occurrence of flow in the Salt River, south of the site. During the June 1991 measurement period, water levels remained above January through March levels. Heavy rains increased water levels in March 1992.

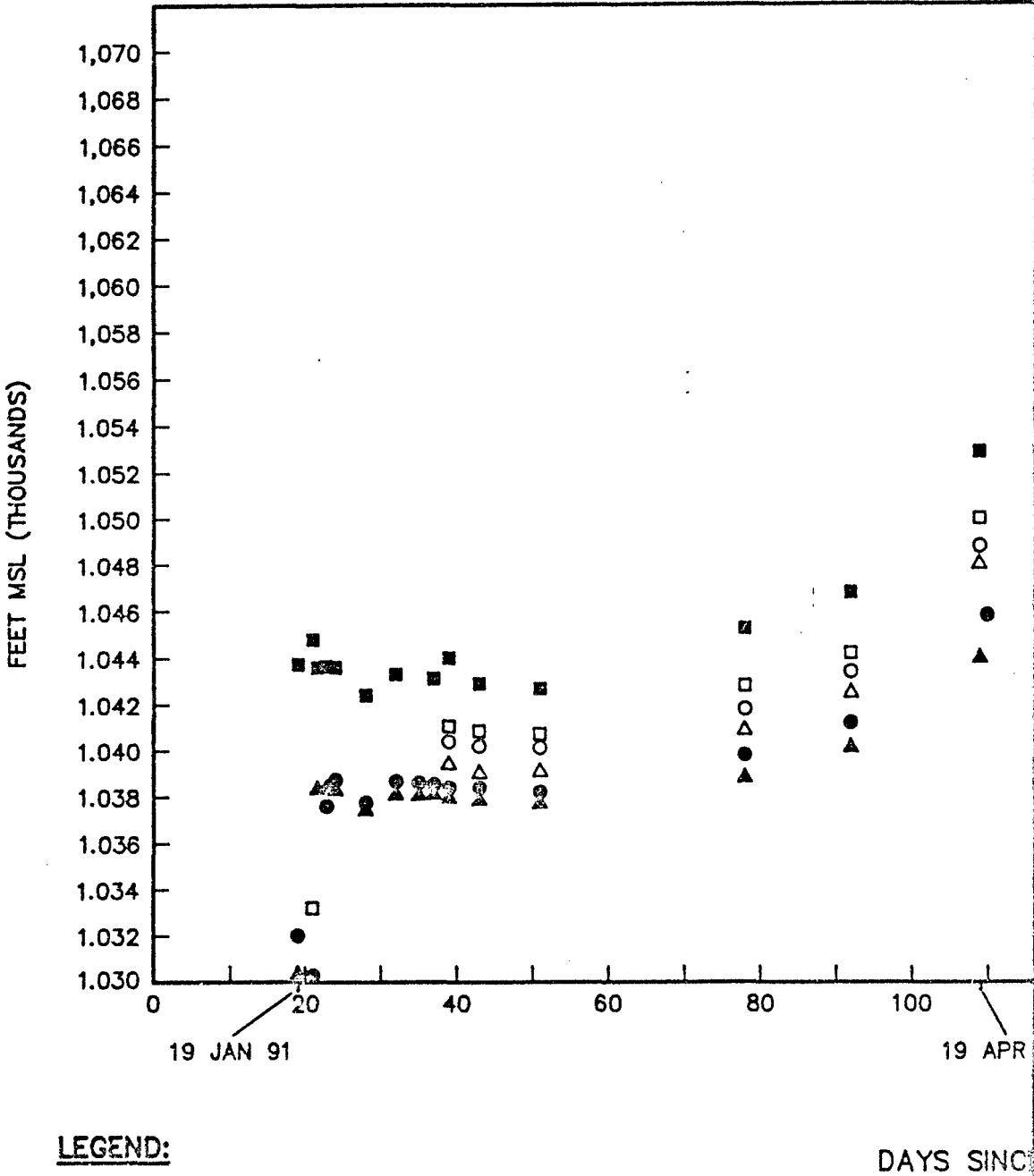
Figures 3-4 through 3-6A present potentiometric maps for measurement dates of February 20, April 18-19, and June 30, 1991, and March 26, 1992, respectively. February measurements were taken at the completion of the first phase of field activities, prior to flow in the river. April measurements were collected prior to the first round of groundwater sampling. June measurements were collected prior to the confirmation groundwater sampling. The February map, in general, depicts a groundwater flow direction to the northwest and a hydraulic gradient of approximately 0.002 foot/foot. The April map depicts a similar northwest flow direction with a hydraulic gradient of approximately 0.005 foot per foot. The change in gradient is likely associated with river flow conditions. The June map also depicts a northwest groundwater flow direction and a hydraulic gradient of approximately 0.0025 foot per foot. The gradient in March 1992 was approximately 0.005 foot per foot and the flow direction maintained a northwesterly direction.

Hydraulic conductivity of the upper alluvial unit has been measured to be approximately 180 to 1,700 feet per day or 6×10^{-2} to 6×10^{-1} cm/s (Brown and Pool, 1989). Slug tests at the Base also indicate high K values, ranging from 7.4×10^{-3} cm/s (MW2-02) to 6.3×10^{-2} cm/s (MWS-01).

Review of boring logs contained in Appendix E indicates that the most prevalent aquifer materials are coarse sand and gravel. Published values of porosity for these materials range from 25 to 50 percent (Freeze and Cherry, 1979). Using the hydraulic gradients and K values previously discussed, an average interstitial groundwater flow velocity can be calculated using the following equation:

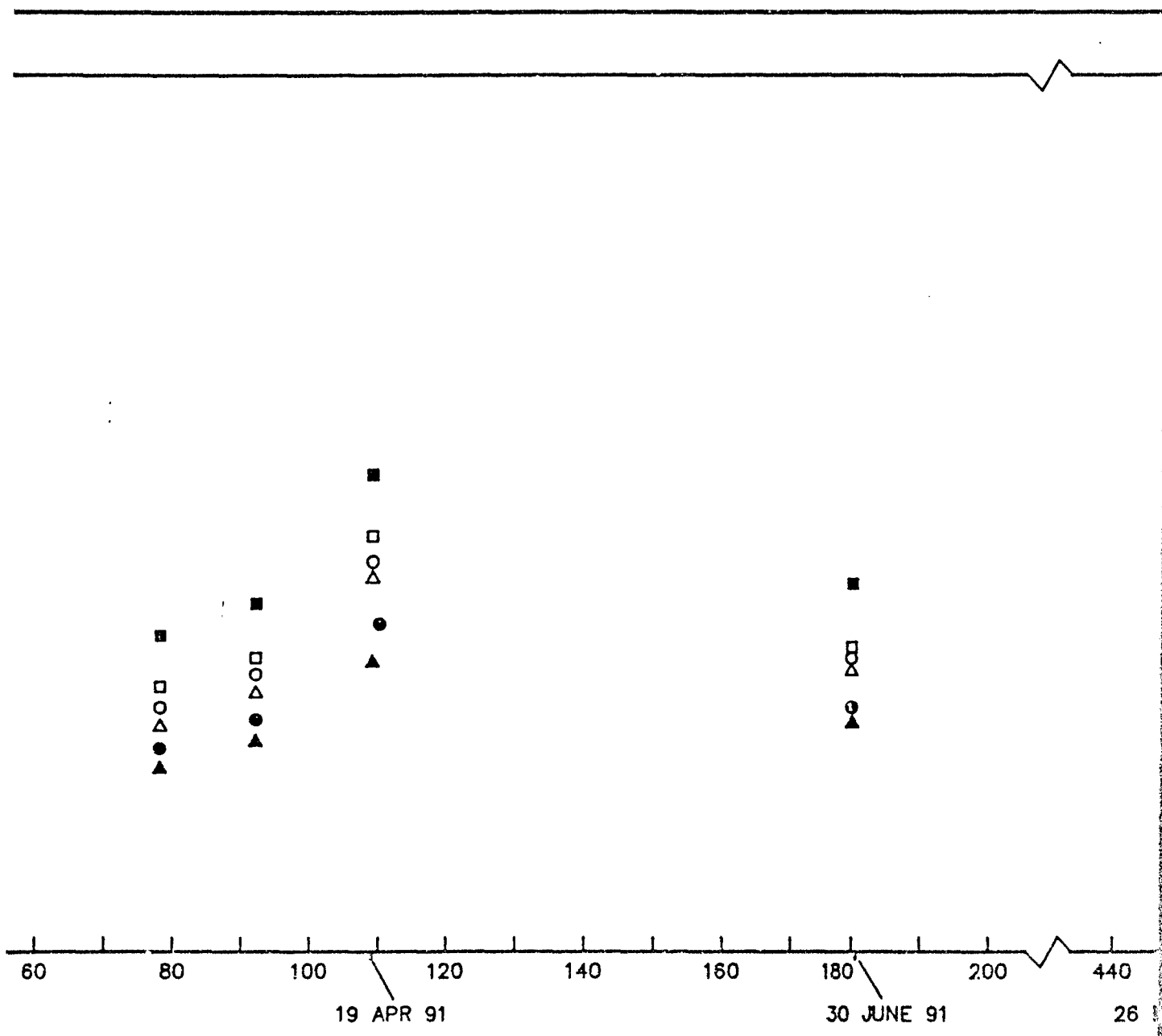
STARTING DATE: 09/24/92	DATE LAST REV:	DRAFT. CHCK. BY: R. PITTS	INITIATOR: D. WILLEN	DWG. NO.: 409721-8-70
DRAWN BY: G.P.	DRAWN BY:	ENGR. CHCK. BY: D. WILLEN	PROJ. MGR.: D. WILLEN	PROJ. NO.: 409721

40972170 09/24/92 3:28pm GWP



- LEGEND:**
- PS-01
 - PS-02
 - ▲ PS-03
 - MWS-01
 - MWS-02
 - △ MWS-03

(2)



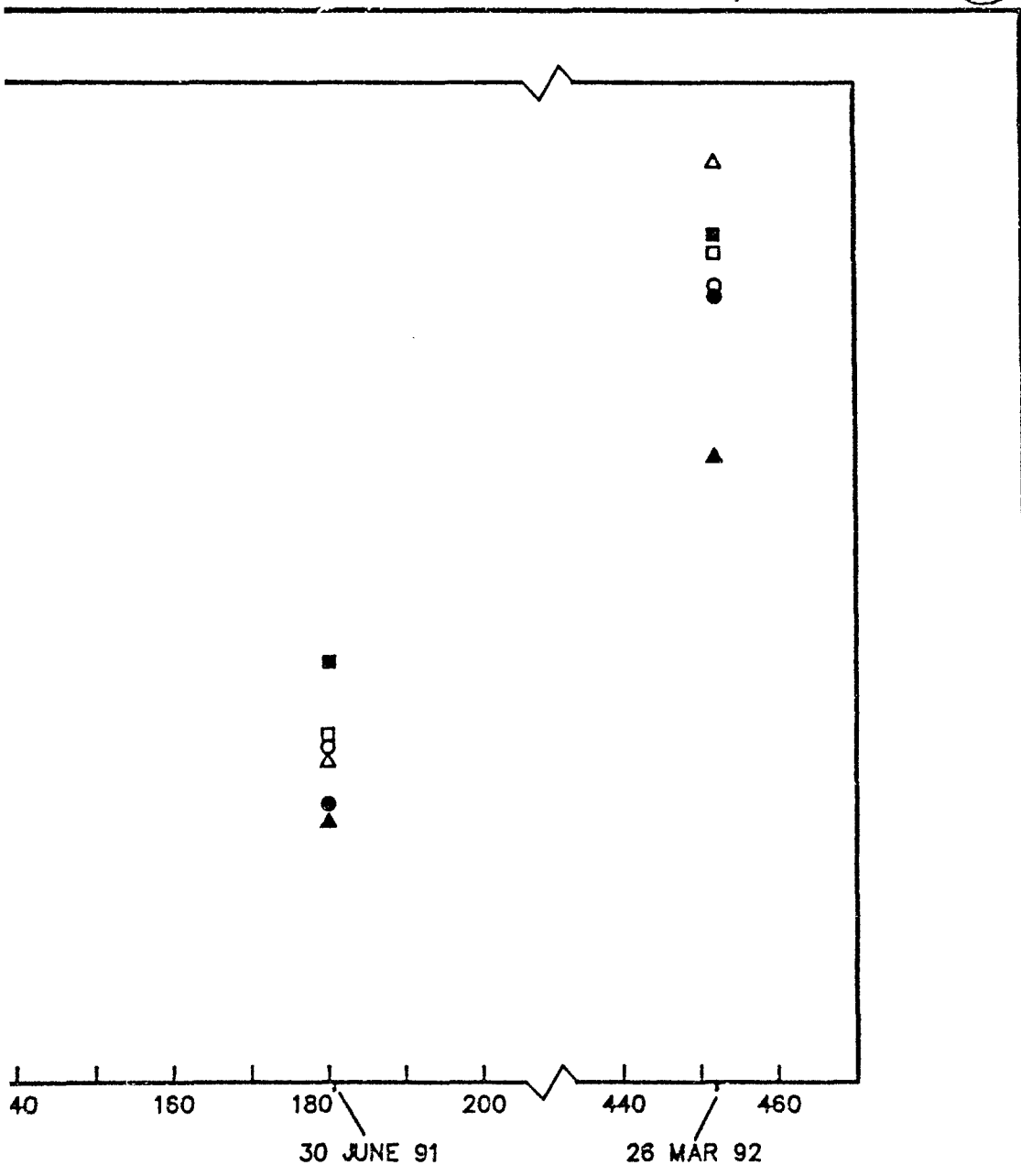
DAYS SINCE 1 JANUARY 1991

FIGURE 3-2
HYDROGRAPH
MONITORING AT
161 AREFG

161 AREFG, ARIZONA
SKY HARBOR IAP
PHOENIX, ARIZONA



3



1991

FIGURE 3-2
HYDROGRAPH OF BACKGROUND
MONITORING WELLS AND PIEZOMETERS,
161 AREFG

161 AREFG, ARIZONA ANG
SKY HARBOR IAP
PHOENIX, ARIZONA

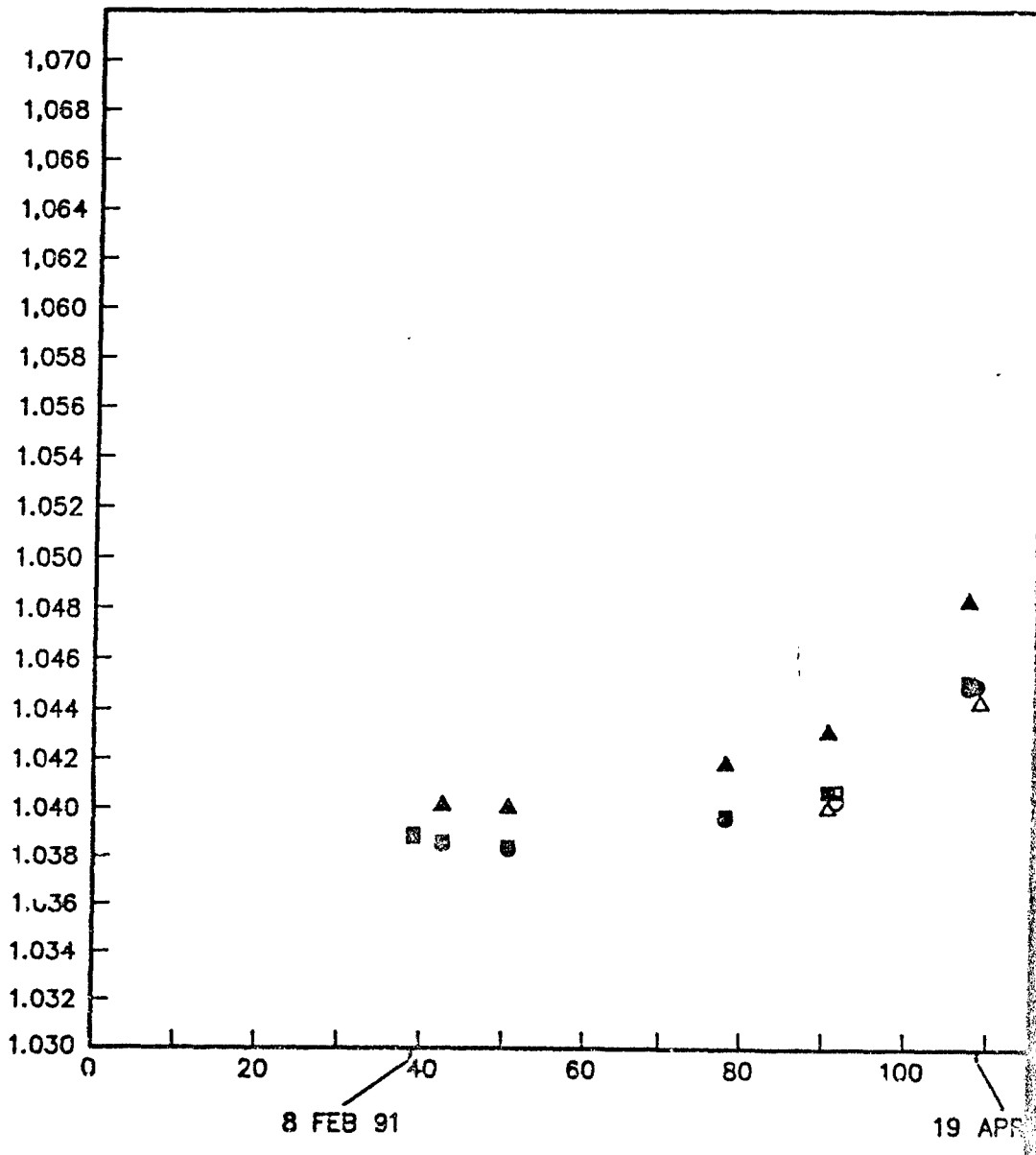


1

STARTING DATE: 01/24/92	DATE LAST REV:	DRAFT. CHGC BY: R. PITTS	ITERATOR: D. WILLEN	DWL NO.: 409721-B-71
DRAWN BY: S.P.	DRAWN BY:	ENGR. CHGC BY: D. WILLEN	PROJ. MGR.: D. WILLEN	PROJ. NO.: 409721

40972171 08/24/92 3:23pm 019P

FEET MSL (THOUSANDS)



LEGEND:

- MW1-02
- MW2-02
- ▲ MW5-01
- MW3-04
- MW3-01
- △ MW3-02

DAYS SINCE 1 JANU

(2)

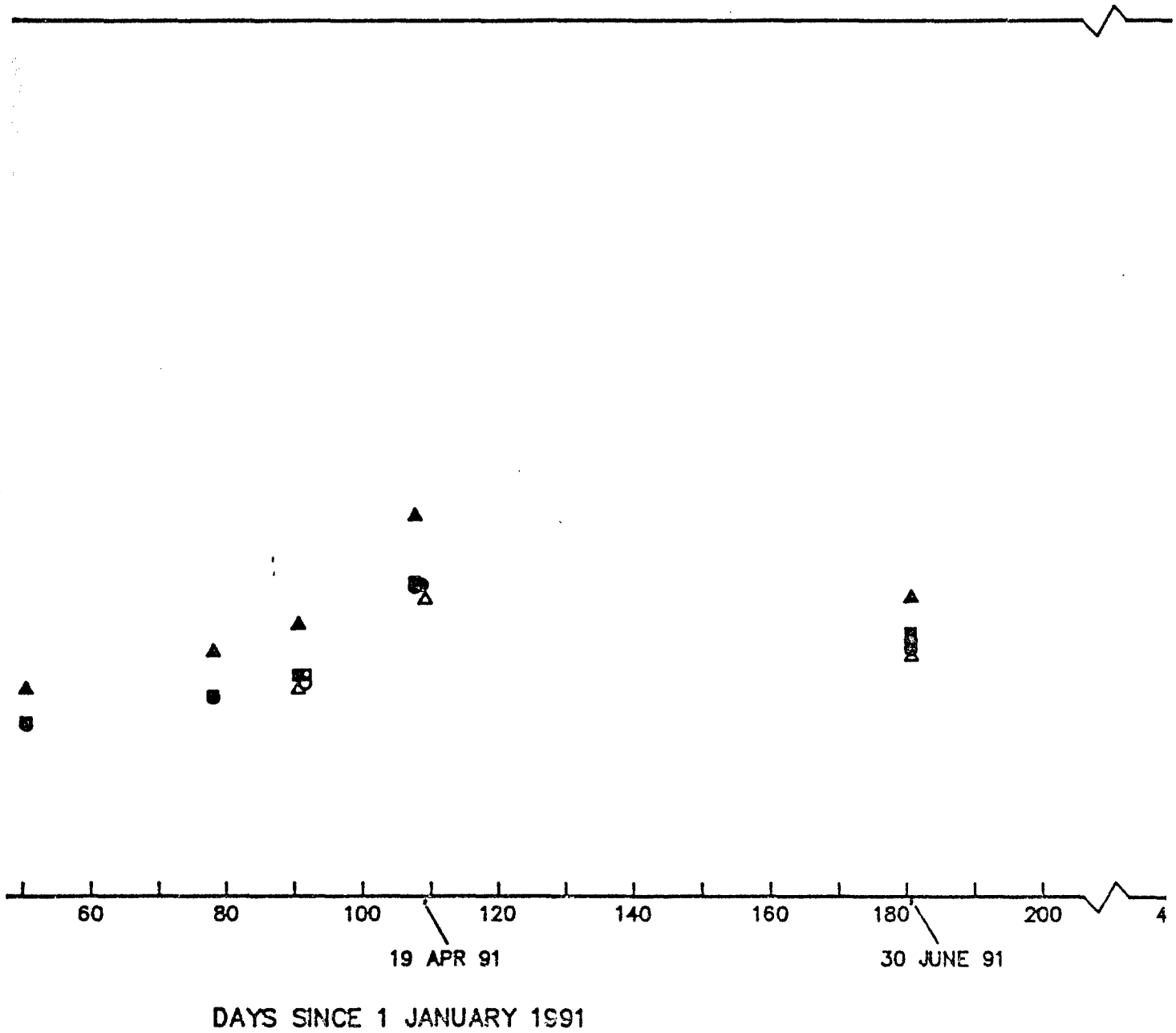
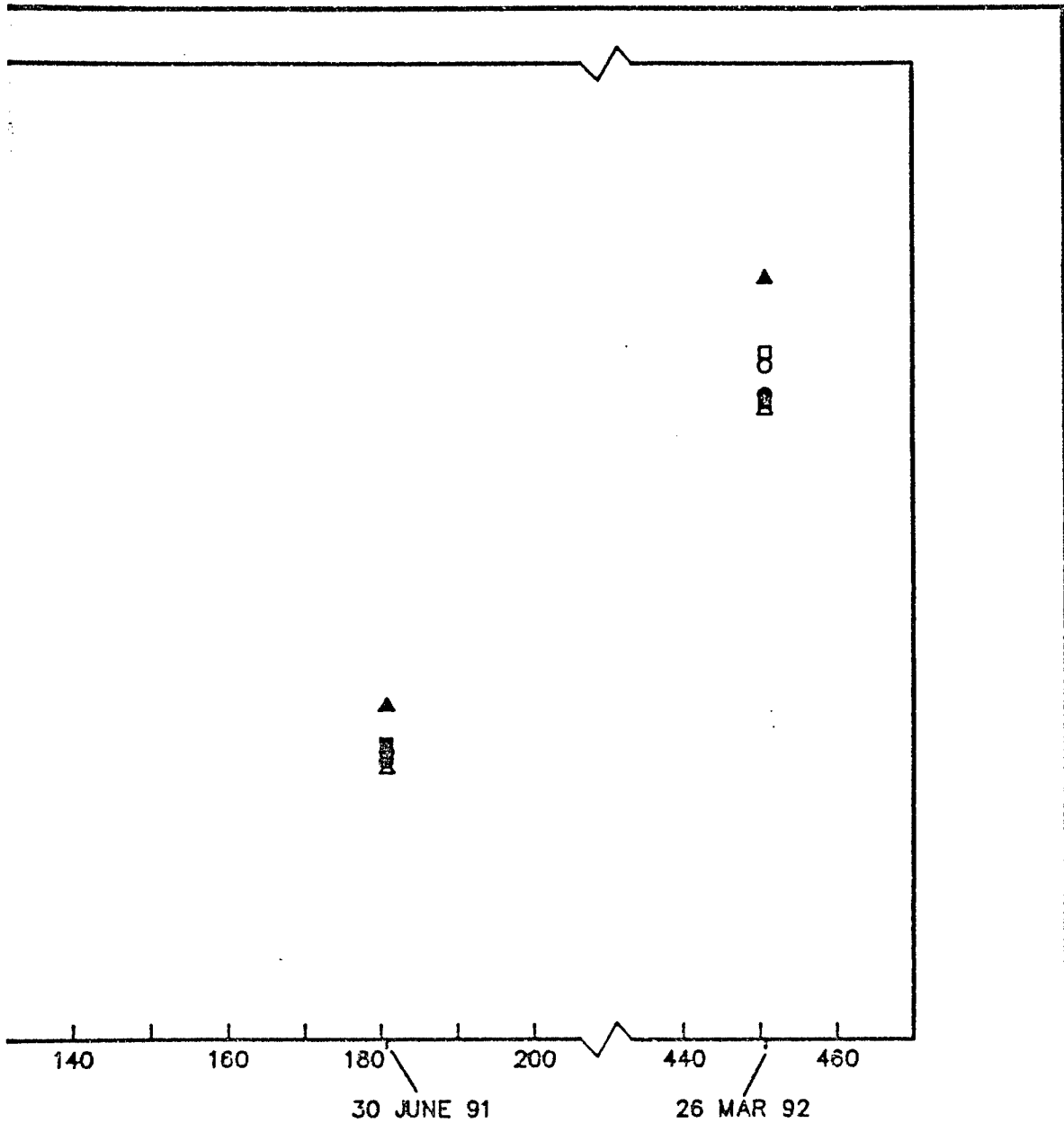


FIGURE 3-
HYDROGRA
MONITORING
161 AREFG

161 AREFG, A
SKY HARBOR
PHOENIX, ARIZ.



3



1

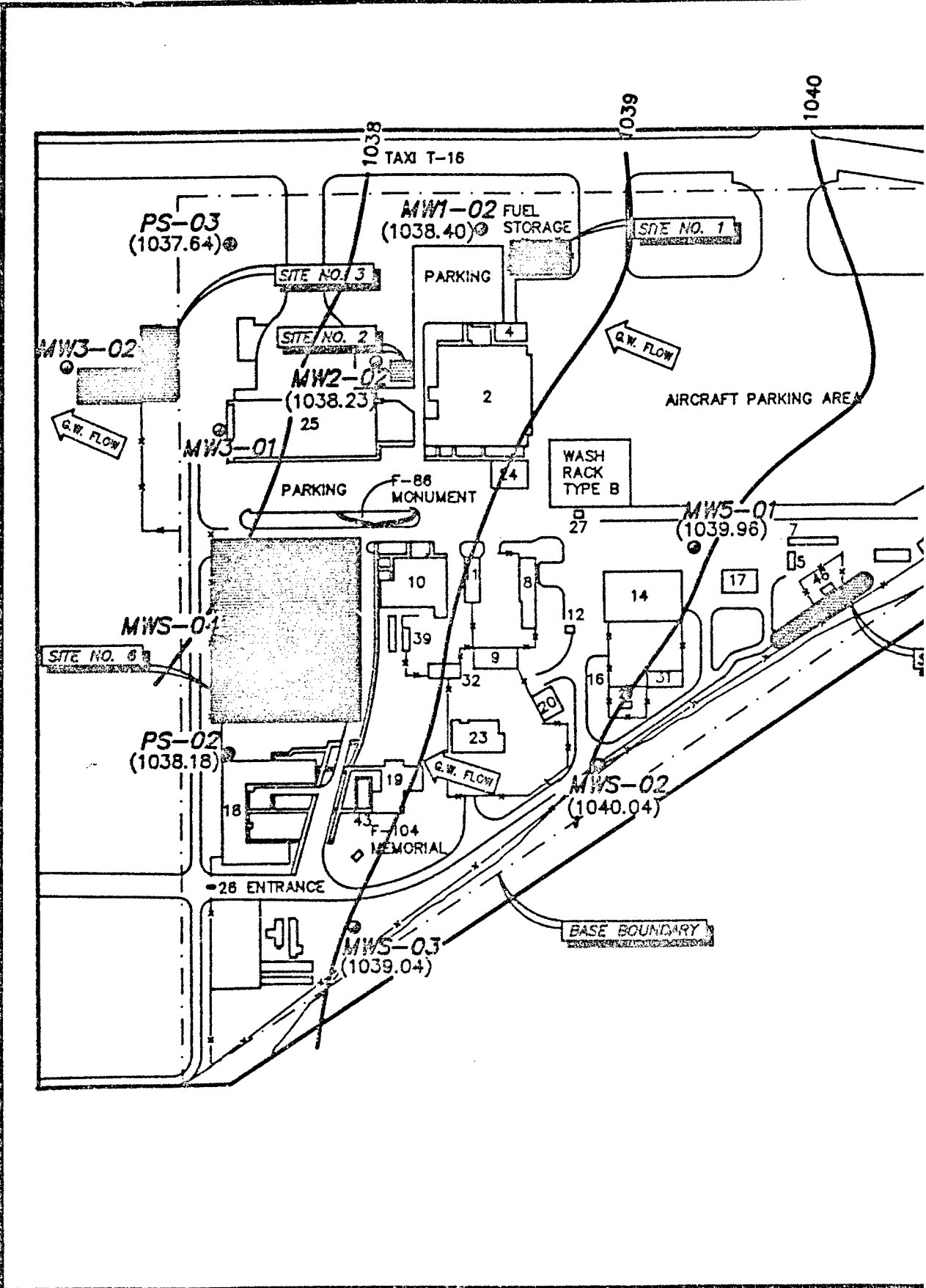
FIGURE 3-3
HYDROGRAPH OF DOWNGRADIENT
MONITORING WELLS
161 AREFG

161 AREFG, ARIZONA ANG
SKY HARBOR IAP
PHOENIX, ARIZONA

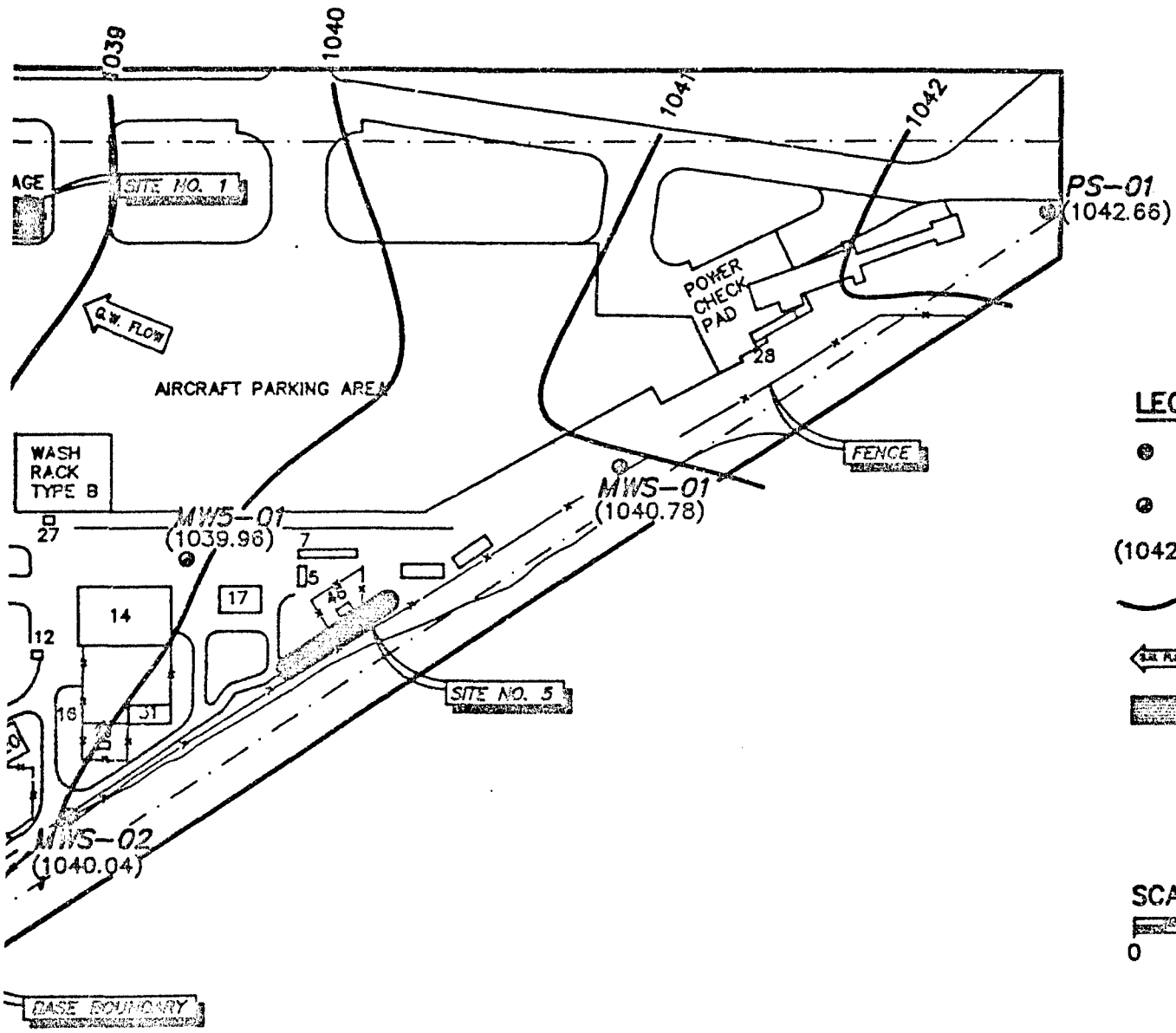


DWG. NO.: 409721-B-C45
 PROJ. NO.: 409721
 DRAFT. CHK. BY: G. PACHECO
 INITIATOR: D. WILLEN
 ENGR. CHK. BY: D. WILLEN
 DATE LAST REV: 03/25/92
 DRAWN BY: S. CARDWELL
 STARTING DATE: 10/29/91
 DRAWN BY: S. TOKAY

409721-45 04/30/92 2:45pm 85



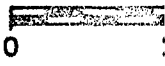
2



LEGEND:

- PIE
- MO
- (1042.66) GRI
- ~ PO
- ← G.W. FLOW
- SIT

SCALE:



**FIGURE 3-
POTENTIAL
20 FEB 91**

161 AREFG,
SKY HARDO
PHOENIX, A



(3)

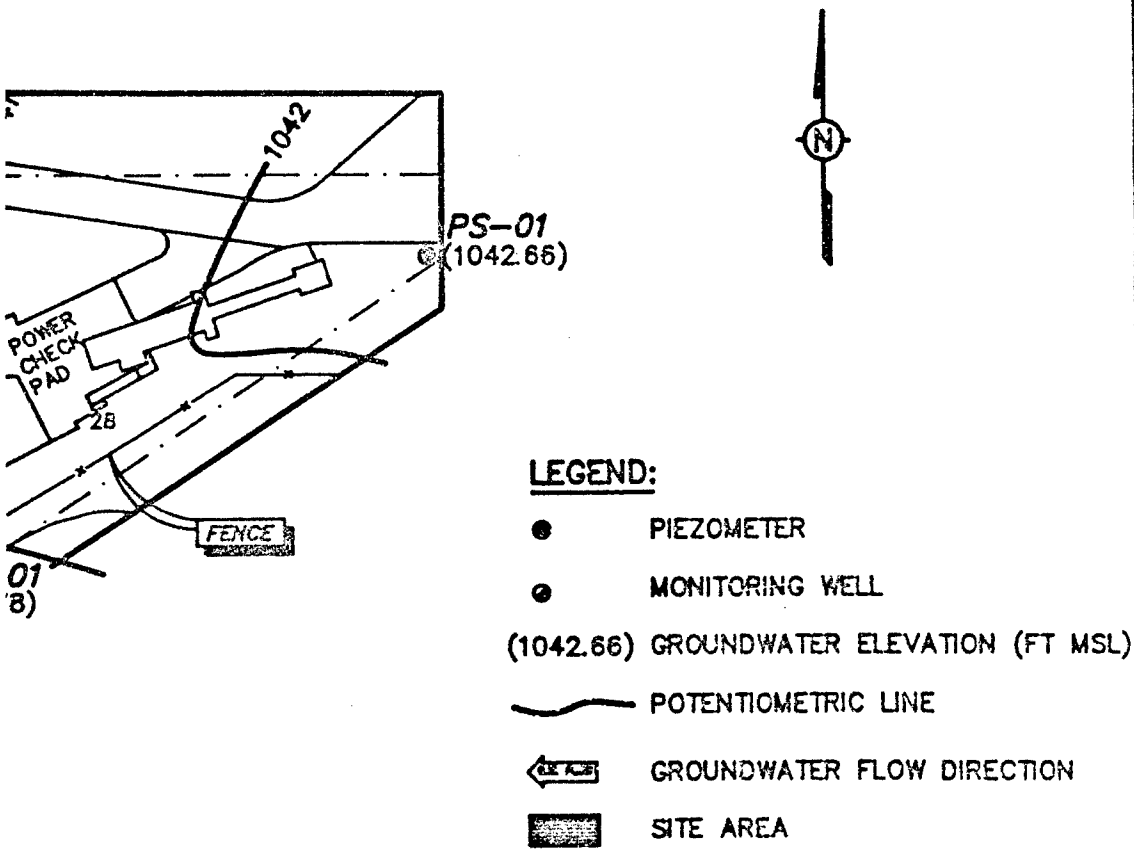
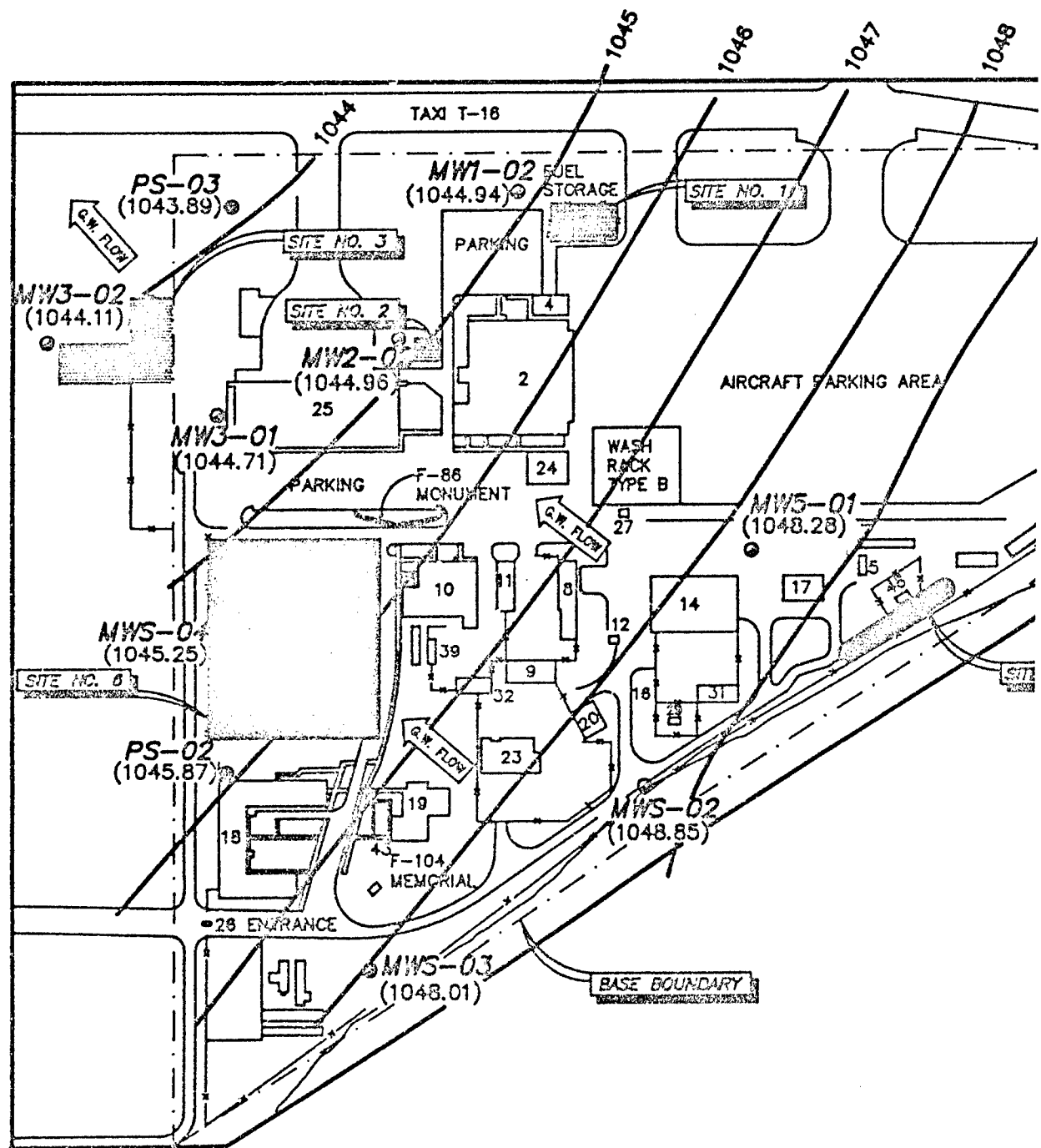


FIGURE 3-4
POTENTIOMETRIC SURFACE
20 FEB 91

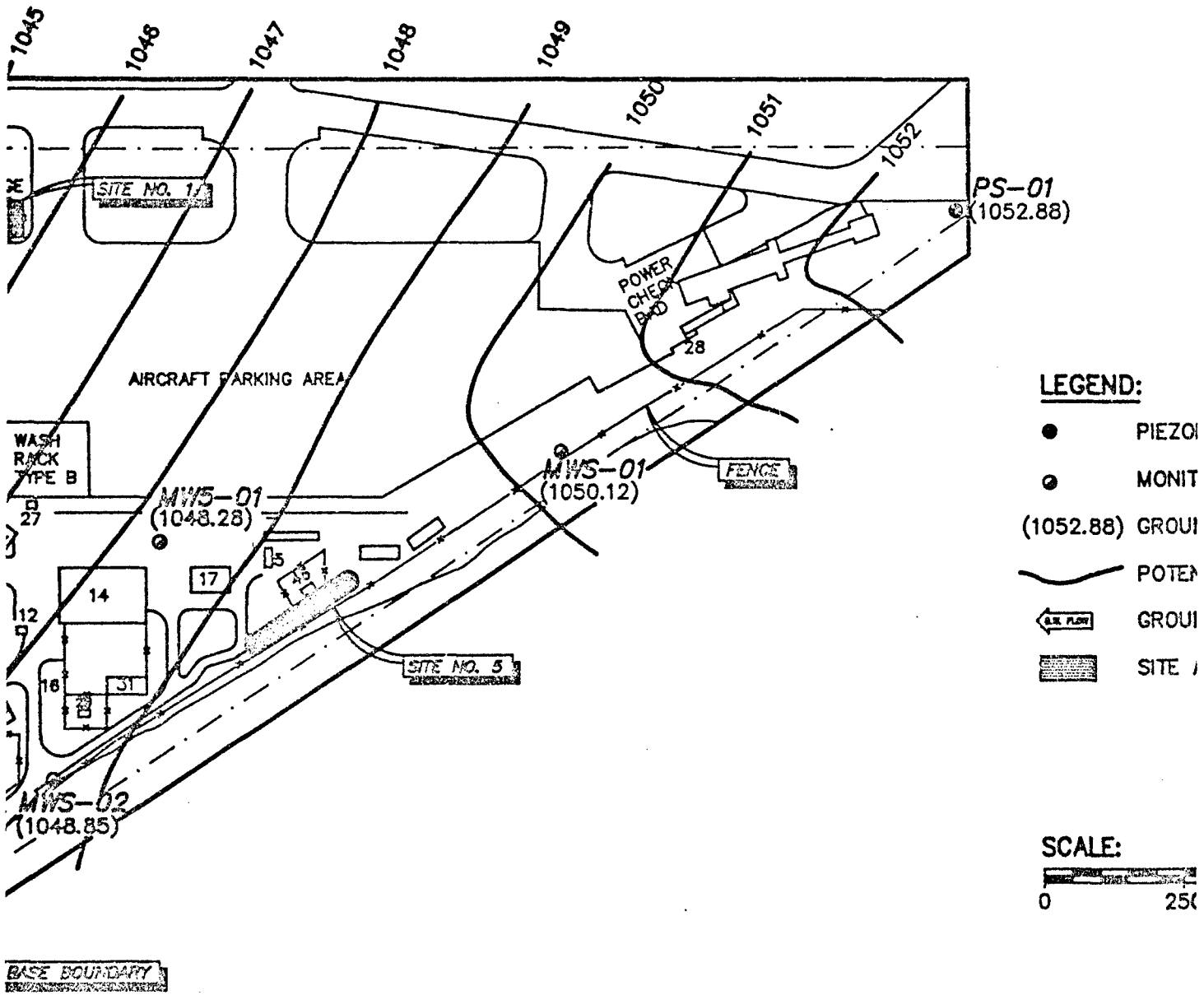
161 AREFG, ARIZONA ANG
 SKY HARBOR IAP
 PHOENIX, ARIZONA



DWG. NO.: 409721-B-048
 PROJ. NO.: 409721
 DRAFT. CHK. BY: G. PACHECO
 INITIATOR: D. WILLEN
 ENGR. CHK. BY: D. WILLEN
 PROJ. MGR.: D. WILLEN
 DATE LAST REV: 03/25/92
 DRAWN BY: S. CARDEWELL
 STARTING DATE: 12/29/91
 DRAWN BY: S. TOKAY
 409721-6 03/25/92 3:41pm JMW



(2)



LEGEND:

- PIEZO
- MONIT
- (1052.88) GROU
- ~ POTEN
- ← G.R. FLOW
- ▨ SITE

SCALE:

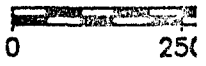
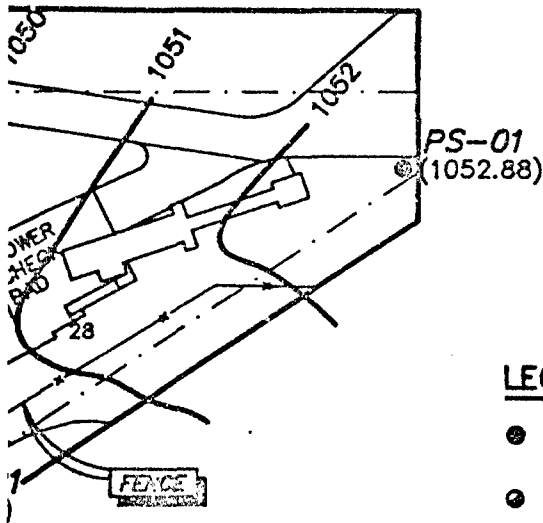


FIGURE 3-5
POTENTIOMET
18,19 APR 9

161 AREFG, AI
SKY HARBOR
PHOENIX, ARIZ



(3)



LEGEND:

- PIEZOMETER
- MONITORING WELL
- (1052.88) GROUNDWATER ELEVATION (FT MSL)
- POTENTIOMETRIC LINE
- ← G.W. FLOW GROUNDWATER FLOW DIRECTION
- SITE AREA

SCALE:

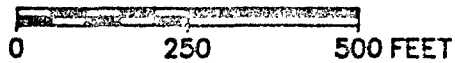


FIGURE 3--5
POTENTIOMETRIC SURFACE
18,19 APR 91

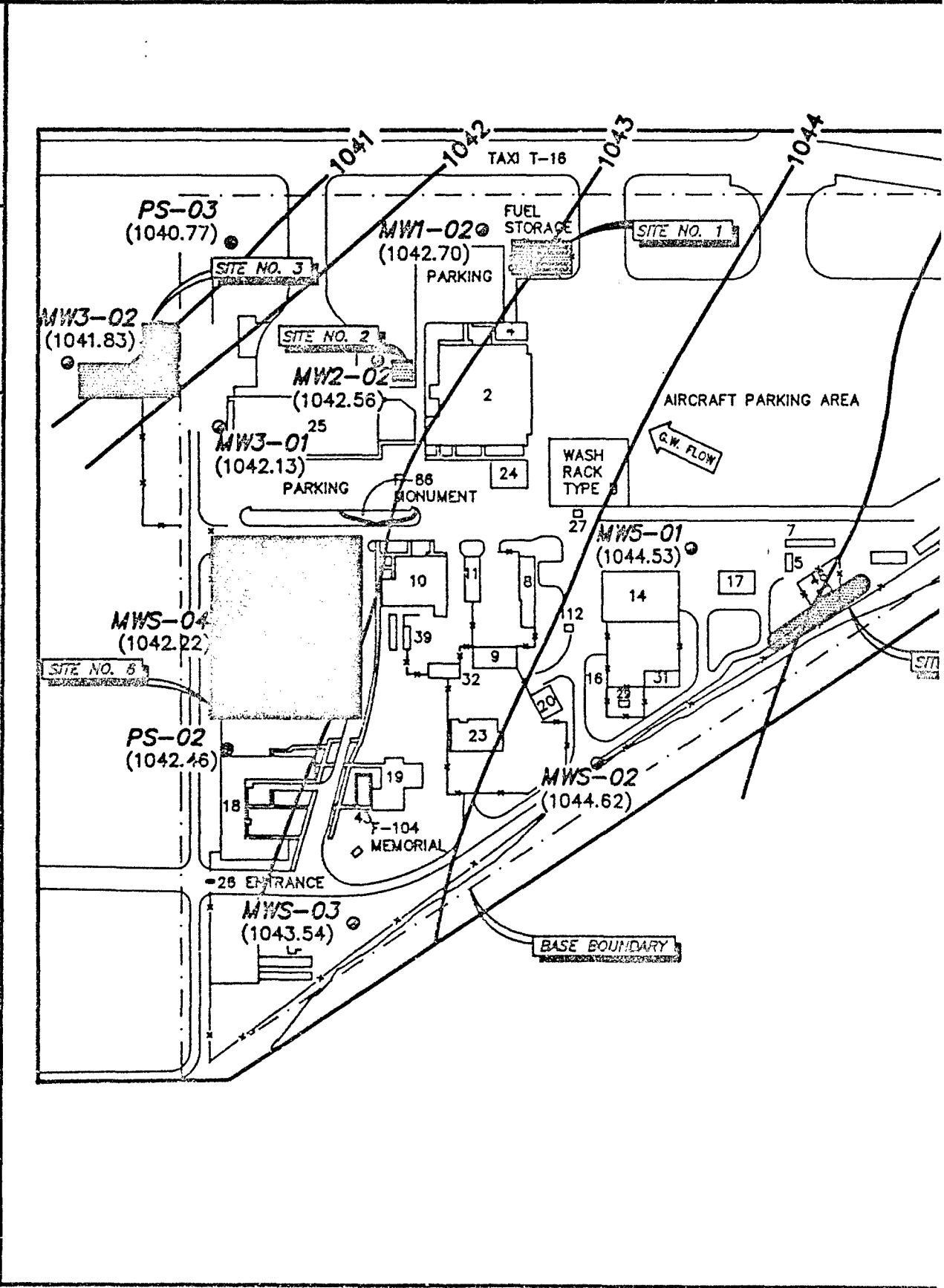
161 AREFG, ARIZONA ANG
SKY HARBOR IAP
PHOENIX, ARIZONA



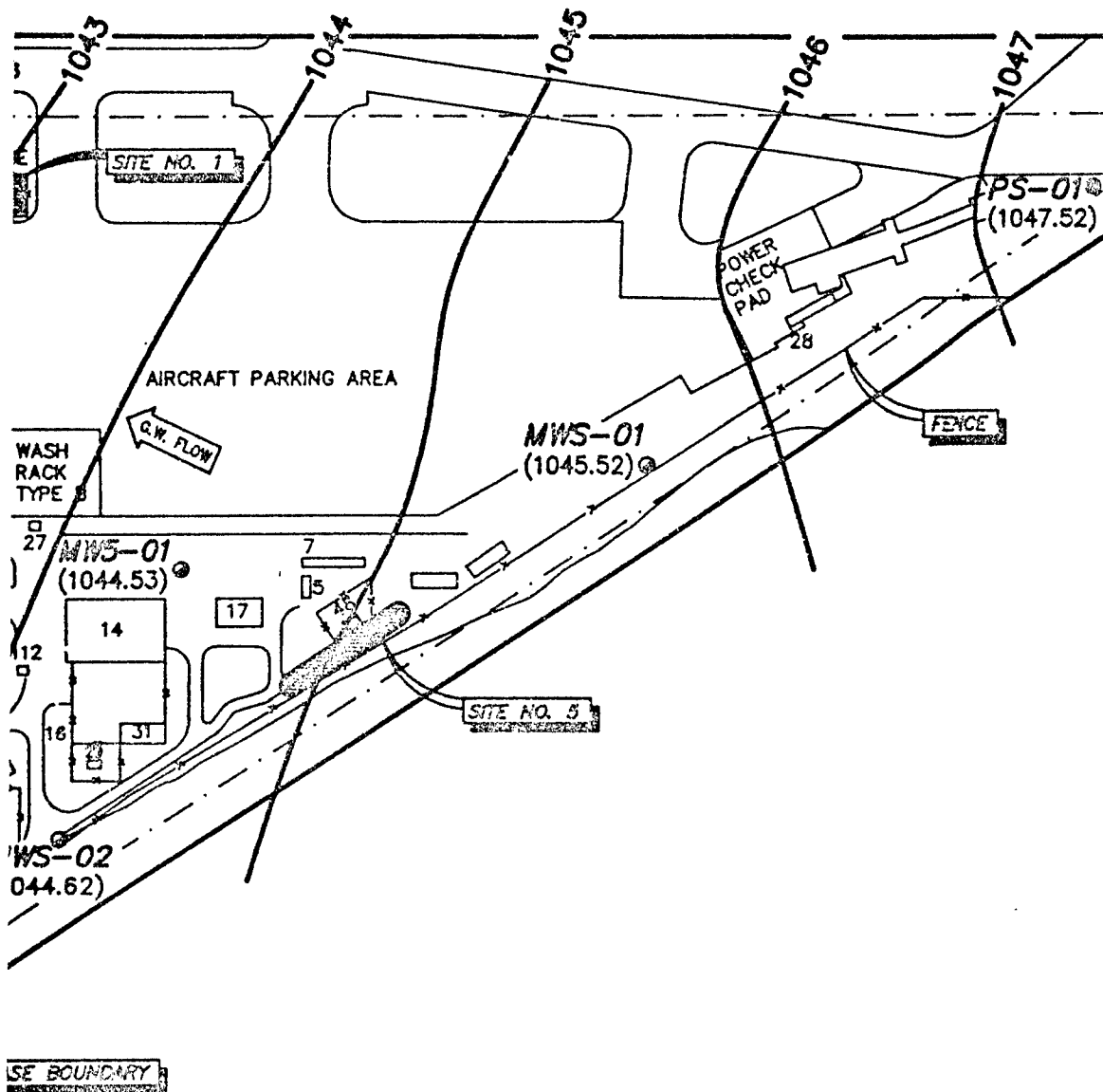
U

STARTING DATE: 10/30/81	DATE LAST REV: 3/25/92	DRAFT. CHK. BY: G. PACHECO	DWG. NO.: 409721-B-C47
DRAWN BY: S. CARDWELL	DRAWN BY: J. HUBBARD	ENGR. CHK. BY: D. WILLEN	PROJ. NO.: 409721
		INITIATOR: D. WILLEN	
		PROJ. MGR.: D. WILLEN	

40972147 05/08/92 9:25am STC



(2)



LEGEND:

- PII
- ⊙ MC
- (1045.52) GF (F)
- 1047 PC
- ← A.W. FLOW GF
- ▨ SI

SCALE:

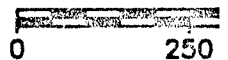
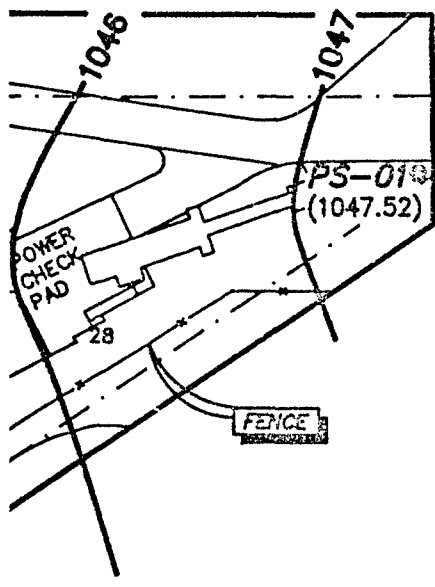


FIGURE 3-6
POTENTIOMET
30 JUNE 91

161 AREFG, ARI
SKY HARBOR 1A
PHOENIX, ARIZ



(3)



LEGEND:

- PIEZOMETER
- MONITORING WELL
- (1045.52) GROUNDWATER ELEVATION (FTMSL)
- 1047 POTENTIOMETRIC LINE
- ← G.W. FLOW GROUNDWATER FLOW DIRECTION
- SITE AREA

SCALE:

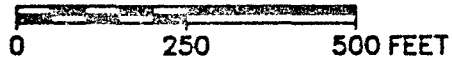


FIGURE 3-6
POTENTIOMETRIC SURFACE
30 JUNE 91

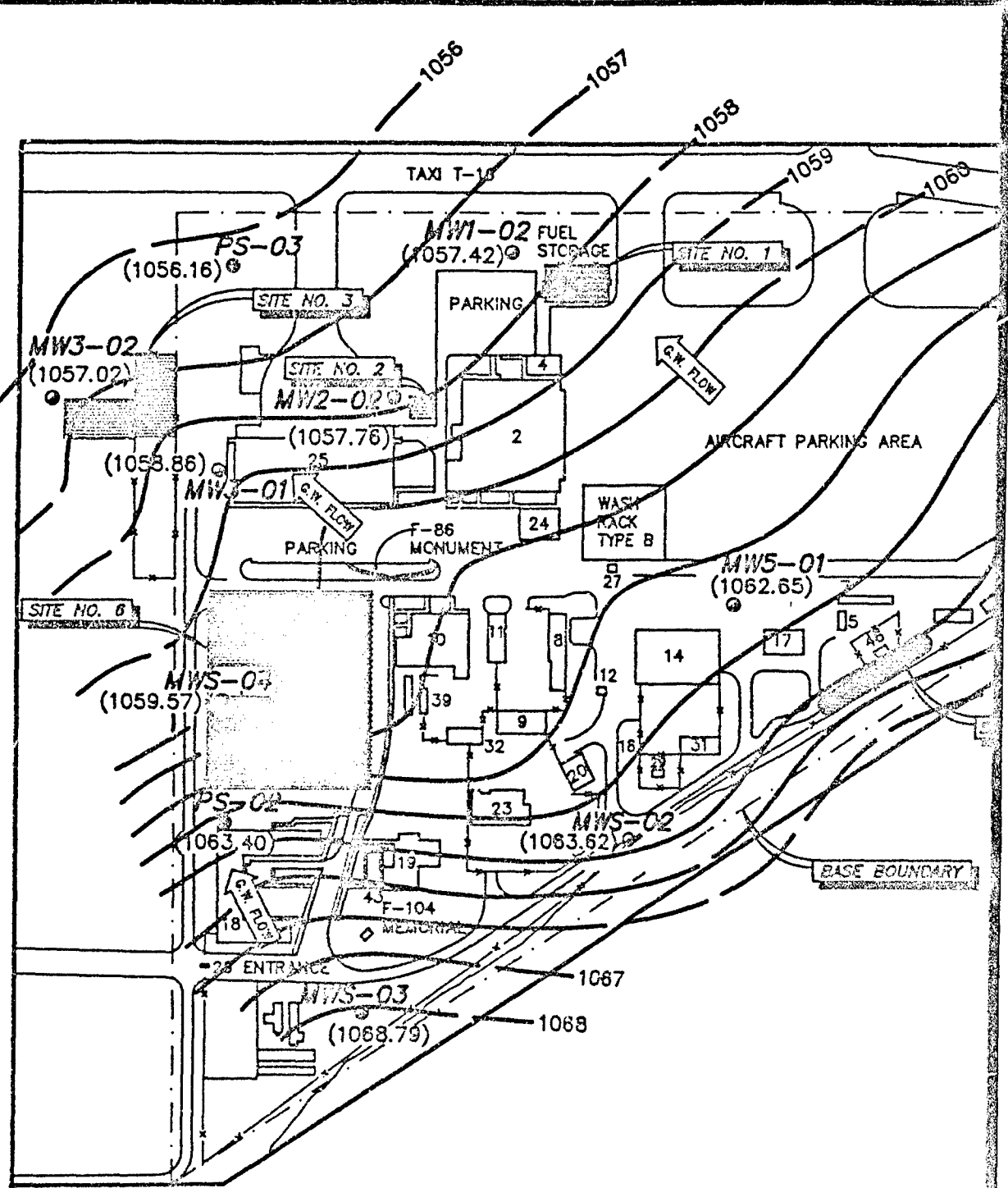
161 AREFG, ARIZONA ANG
 SKY HARBOR IAP
 PHOENIX, ARIZONA



(1)

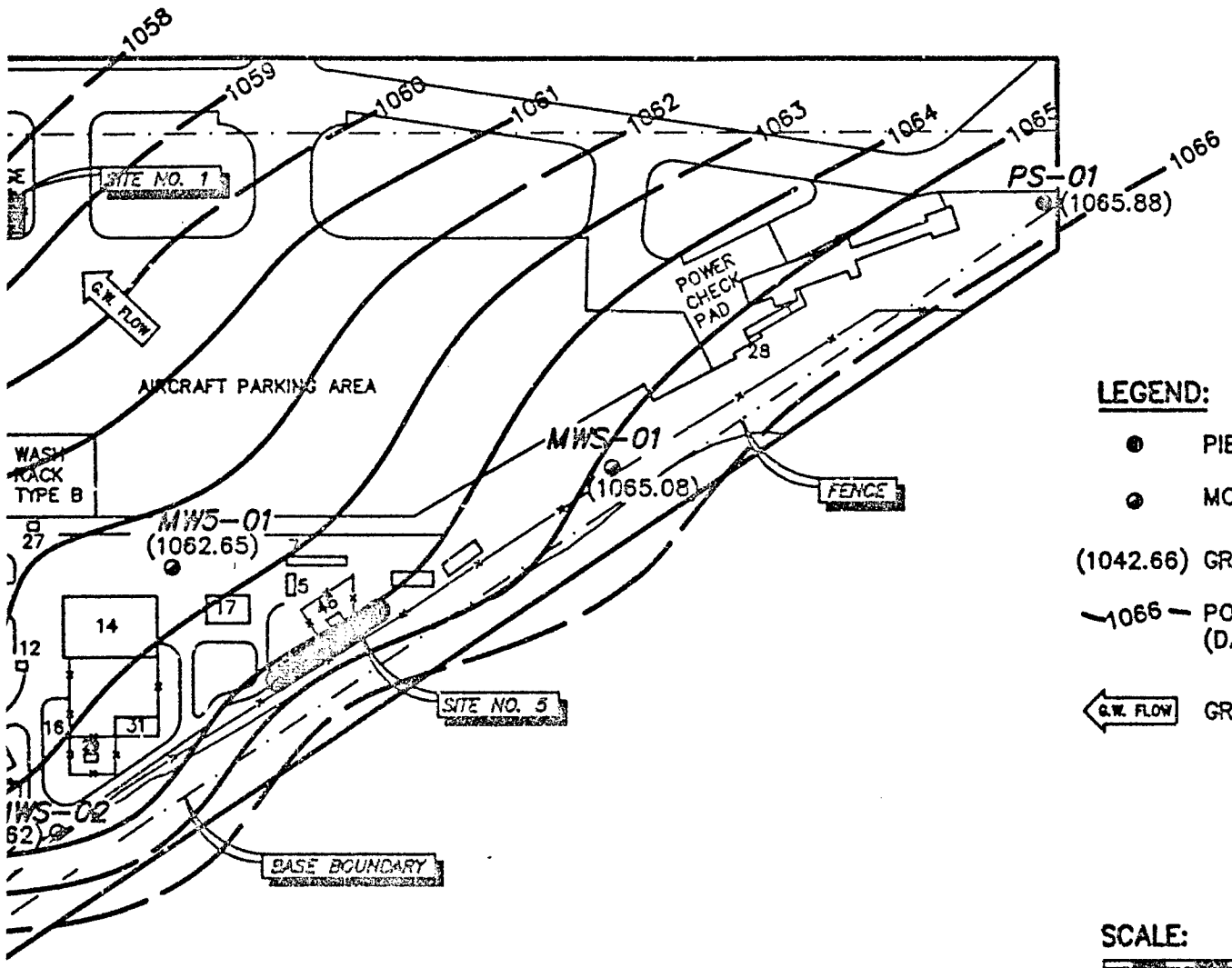
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 PROJ. NO.: 409721
 INITIATOR: D. WILLEN
 PROJ. MGR.: D. WILLEN
 DRAFT. CHCK. BY: R. PITTS
 ENGR. CHCK. BY: D. WILLEN
 DATE LAST REV.:
 DRAIN BY:
 STARTING DATE: 9/24/92
 DRAWN BY: C. ROBERTSON

409721-08 09/24/92 10:00am CKR



(2)

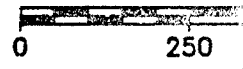
057



LEGEND:

- PIEZOMETER
- MONITOR
- (1042.66) GROUNDWATER
- 1066- POTENTIAL (DASHED)
- ← G.W. FLOW GROUNDWATER

SCALE:



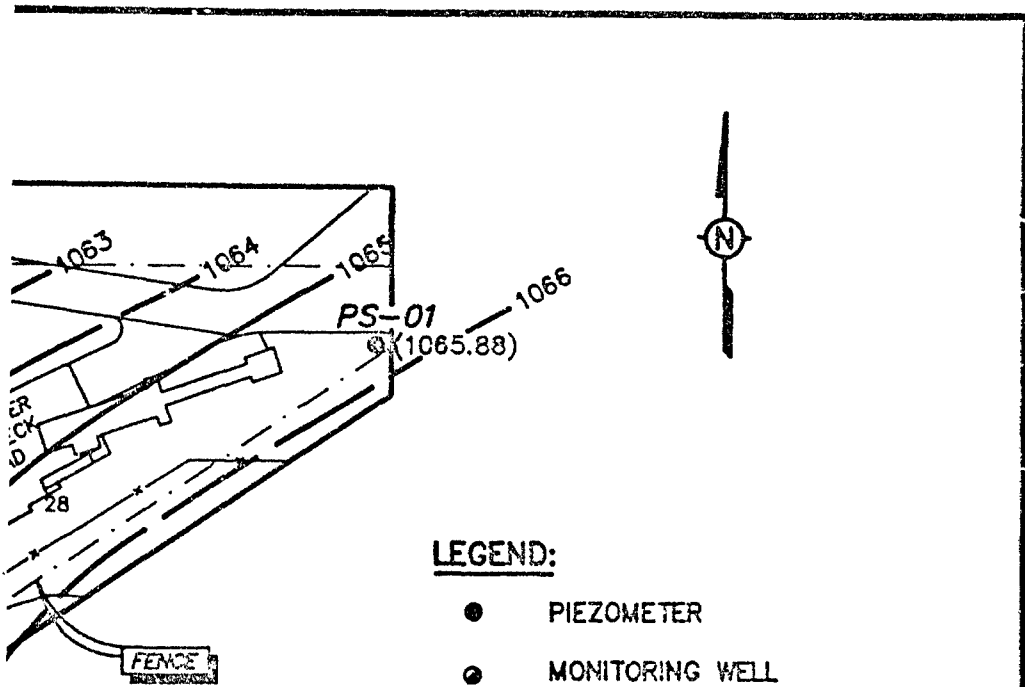
1067

FIGURE 3-6A
POTENTIOMETRIC
26 MAR 92

161 AREFG, ARIZ
SKY HARBOR IAF
PHOENIX, ARIZONA



(3)



LEGEND:

- PIEZOMETER
- MONITORING WELL

(1042.66) GROUNDWATER ELEVATION (FT MSL)

—1066— POTENTIOMETRIC LINE
(DASHED WHERE APPROXIMATE)

← G.W. FLOW GROUNDWATER FLOW DIRECTION

SCALE:

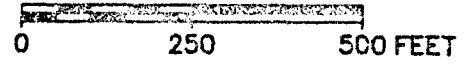
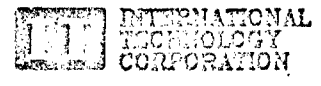


FIGURE 3-6A
POTENTIOMETRIC SURFACE
26 MAR 92

161 AREFG, ARIZONA ANG
SKY HARBOR IAP
PHOENIX, ARIZONA



(2)

$$V = (Ki)/n$$

where:

- V = Average velocity (L/T)
- K = Hydraulic conductivity (L/T)
- i = Hydraulic gradient (dimensionless)
- n = Effective porosity (dimensionless)

The minimum groundwater flow velocity is thus calculated to be approximately 3.0×10^{-5} cm/s (31 ft/yr) to a maximum of 1.3×10^{-3} cm/s (1,304 ft/yr). These velocities represent an average rate through various materials along a selected flow path. Groundwater will flow at different rates and directions depending on local variations in grain size and hydraulic conductivity. Table 3-0 provides the hydraulic conductivities and groundwater velocities for the Base.

3.1.2 Papago Military Reservation

3.1.2.1 Geology

As discussed in Section 1.5.4, Papago Military Reservation is set in an area of intermixed sedimentary and volcanic deposits. Borings from piezometers and monitoring wells indicate the presence of caliche to a depth of approximately 10 feet bgl and volcanic breccia underlying the caliche. These geologic data are consistent with the presence of Quaternary alluvium and colluvium and the Barnes Butte Member of the Tertiary Camels Head Formation underlying the site. A diagrammatic geological cross section of the Papago area is presented in Figure 3-7.

3.1.2.2 Hydrology

Two monitoring wells and three piezometers were installed during the SI at Papago Military Reservation (Figure 2-7). Groundwater occurs at a depth of approximately 27 to 37 feet below ground level, corresponding to an elevation of 1,211 to 1,214 feet msl. Water occurs under unconfined conditions in very low to moderately permeable bedrock. Figure 3-8 presents a hydrograph of monitoring wells and piezometers at Papago; individual water-level measurements are presented in Appendix J.

Observations made during drilling and development of piezometers and monitoring wells suggest that groundwater flow at Papago is primarily controlled by fractures in well-indurated deposits. As depicted in the hydrograph, PP-03 and MW4-01 required more than one week

TABLE 3-0
HYDRAULIC CONDUCTIVITIES AND GROUNDWATER
VELOCITIES AT SKY HARBOR ANGB AND PAPAGO
161 AREFG, PHOENIX, ARIZONA

WELL	HYDRAULIC CONDUCTIVITY FT/YR ^a	VELOCITY FT/YR	HYDRAULIC CONDUCTIVITY CM/S ^b	VELOCITY CM/S
SKY HARBOR				
MW1-02	54,836	1,097	5.3×10^{-2}	1.1×10^{-3}
MW2-02	7,674	31	7.4×10^{-3}	3.0×10^{-6}
MW3-01	57,711	1,154	5.5×10^{-2}	1.1×10^{-3}
MW3-02	46,989	940	4.5×10^{-2}	9.0×10^{-4}
MW5-01	17,502	350	1.7×10^{-2}	3.4×10^{-4}
MWS-01	65,183	1,304	6.3×10^{-2}	1.3×10^{-3}
MWS-02	29,234	585	2.8×10^{-2}	5.6×10^{-4}
MWS-03	.			
MWS-04	28,908	578	2.8×10^{-2}	5.6×10^{-4}
PAPAGO				
MW4-01	148	6	1.4×10^{-4}	5.6×10^{-6}
MW4-02	31	0.1	3.0×10^{-5}	6.0×10^{-8}

- FT/YR = feet/year
- CM/S = centimeters/second
- Note, MWS-03 was not slug tested due to construction disturbance.

1

DRAWING NO: 409721-B-040
PROJ. NO: 409721

INITIATOR: D. WELLEN
PROJ. MGR.: D. WELLEN

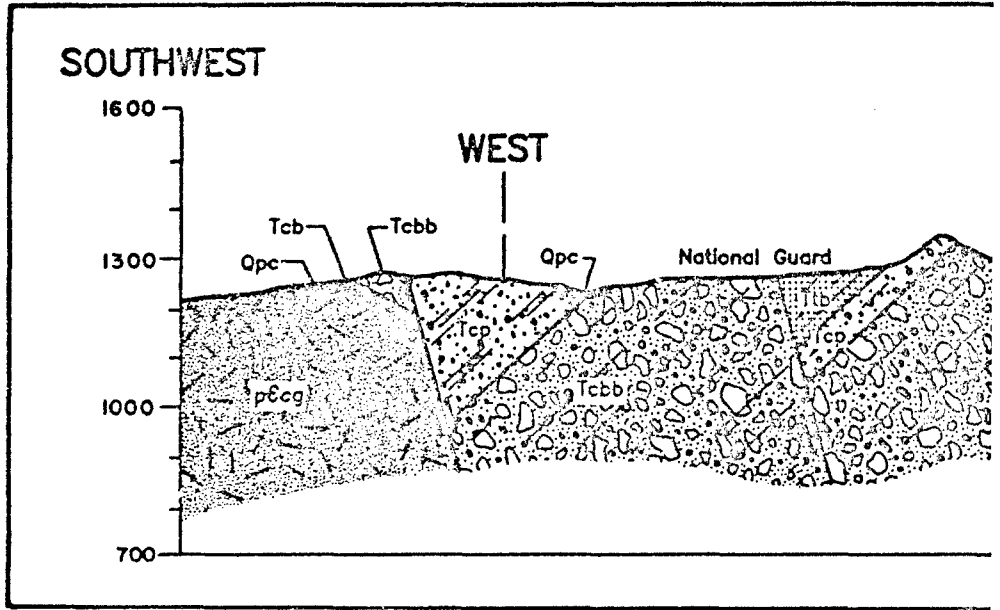
DRAFT. CHK. BY: G. PACIECO
ENGR. CHK. BY: D. WELLEN

DATE LAST REV: 03/31/82
DRAWN BY: C. ROBERTSON

STARTING DATE: 10/30/81
DRAWN BY: C. ROBERTSON

1

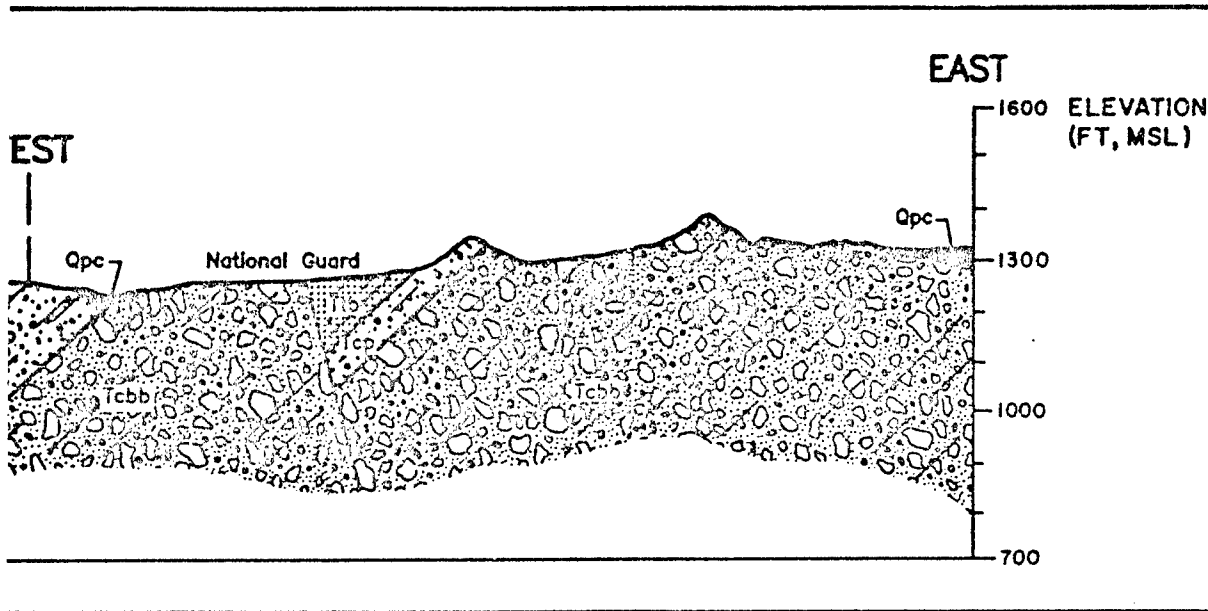
K095046



LEGEND:

- QPC - PEDIMENT COLLUVIUM ALLUVIUM
- TTb - TEMPE BEDS
- Tcp - CAMELS HEAD FORMATION - PAPAGO PARK MEMBER
- Tcbb - CAMELS HEAD FORMATION - BARNES BUTTE BRECCIA MEMBER
- Tcb - CAMELS HEAD FORMATION - BASAL MEMBER
- pfcg - CAMELBACK GRANITE

SOURCE: PEWE AND OTHERS, 1985



ALLUVIUM

ON - PAPAGO PARK MEMBER

NON - BARNES BUTTE BRECCIA MEMBER

ON - BASAL MEMBER

FIGURE 3-7
GEOLOGICAL
PAPAGO MII

107 TCS/111
PHOENIX, ARI



(3)

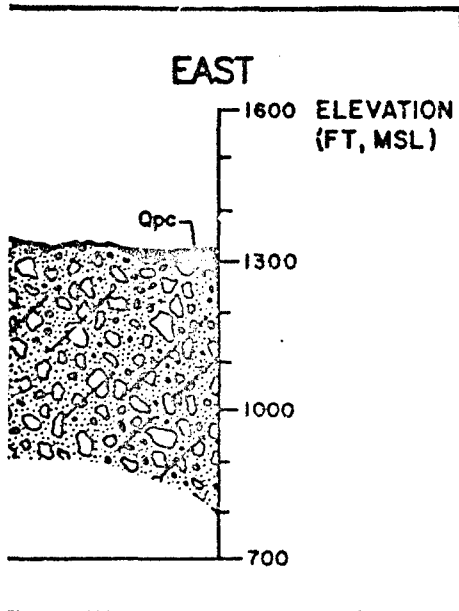


FIGURE 3-7
GEOLOGICAL CROSS SECTION
PAPAGO MILITARY RESERVATION
107 TCS/111 ATCF, ARIZONA ANG
PHOENIX, ARIZONA

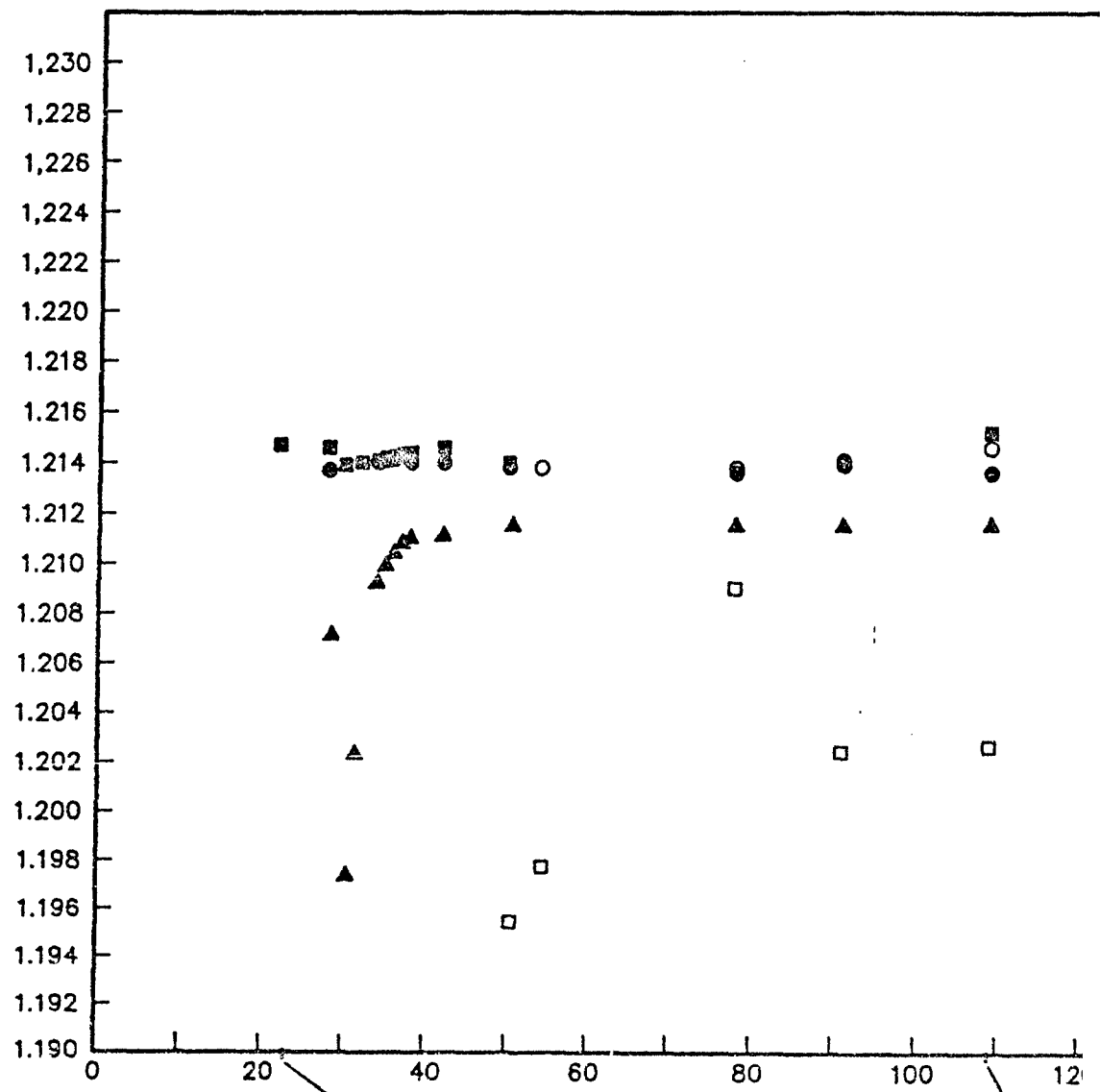
 **INTERNATIONAL
TECHNOLOGY
CORPORATION**

1

STARTING DATE: 08/24/92	DATE LAST REV.:	DRAFT. CHK. BY: R. PITTS	INITIATOR: D. WILLEN	DWG. NO.: 409721-B-72
DRAWN BY: G.P.	DRAWN BY:	ENGR. CHK. BY: D. WILLEN	PROJ. MGR.: D. WILLEN	PROJ. NO.: 409721

40972172 09/15/92 4:37pm GWP

FEET MSL (THOUSANDS)



LEGEND:

- PP-01
- PP-02
- ▲ PP-03
- MW4-01
- MW4-02

19 APR 91
DAYS SINCE 1

(2)

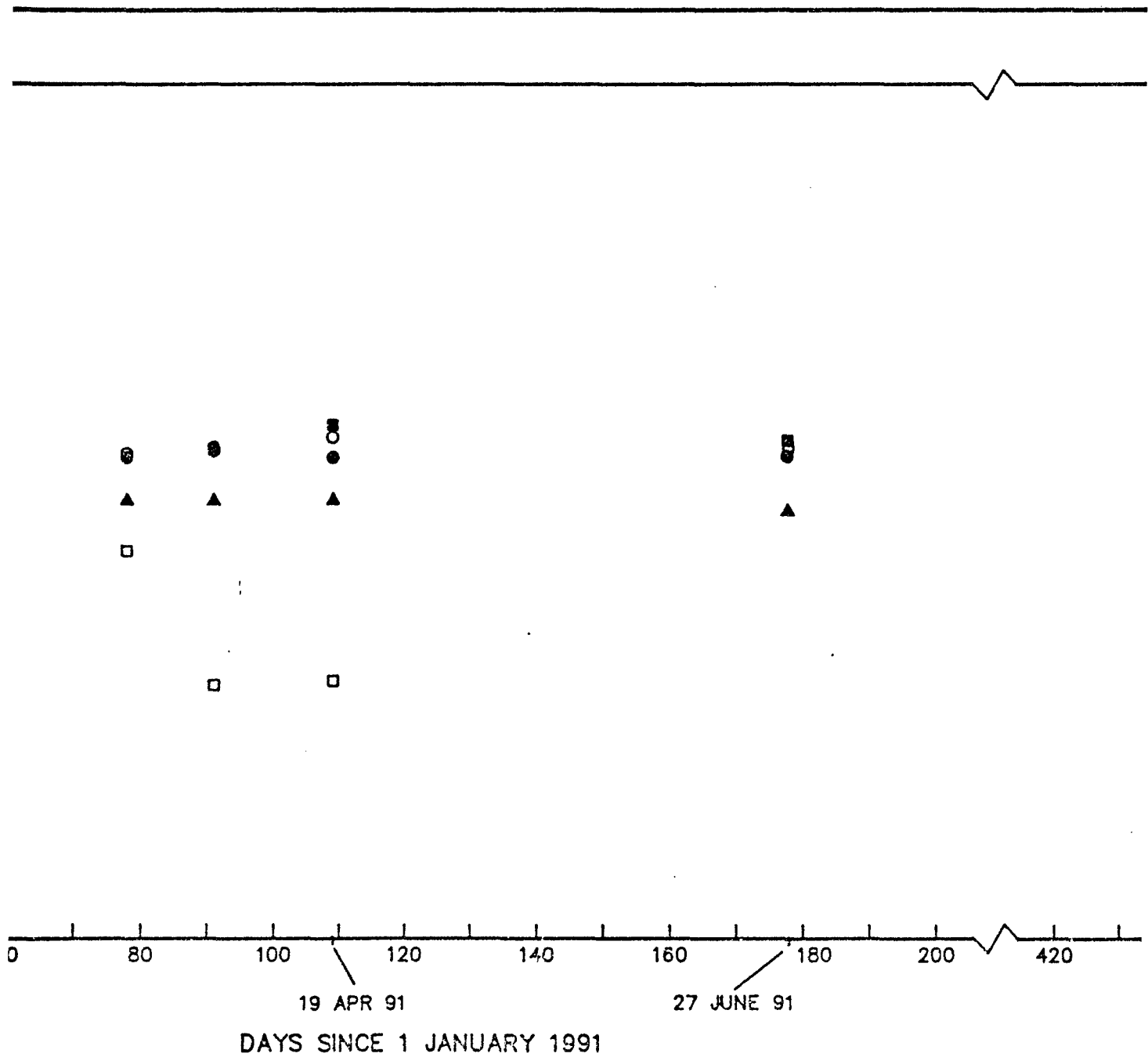
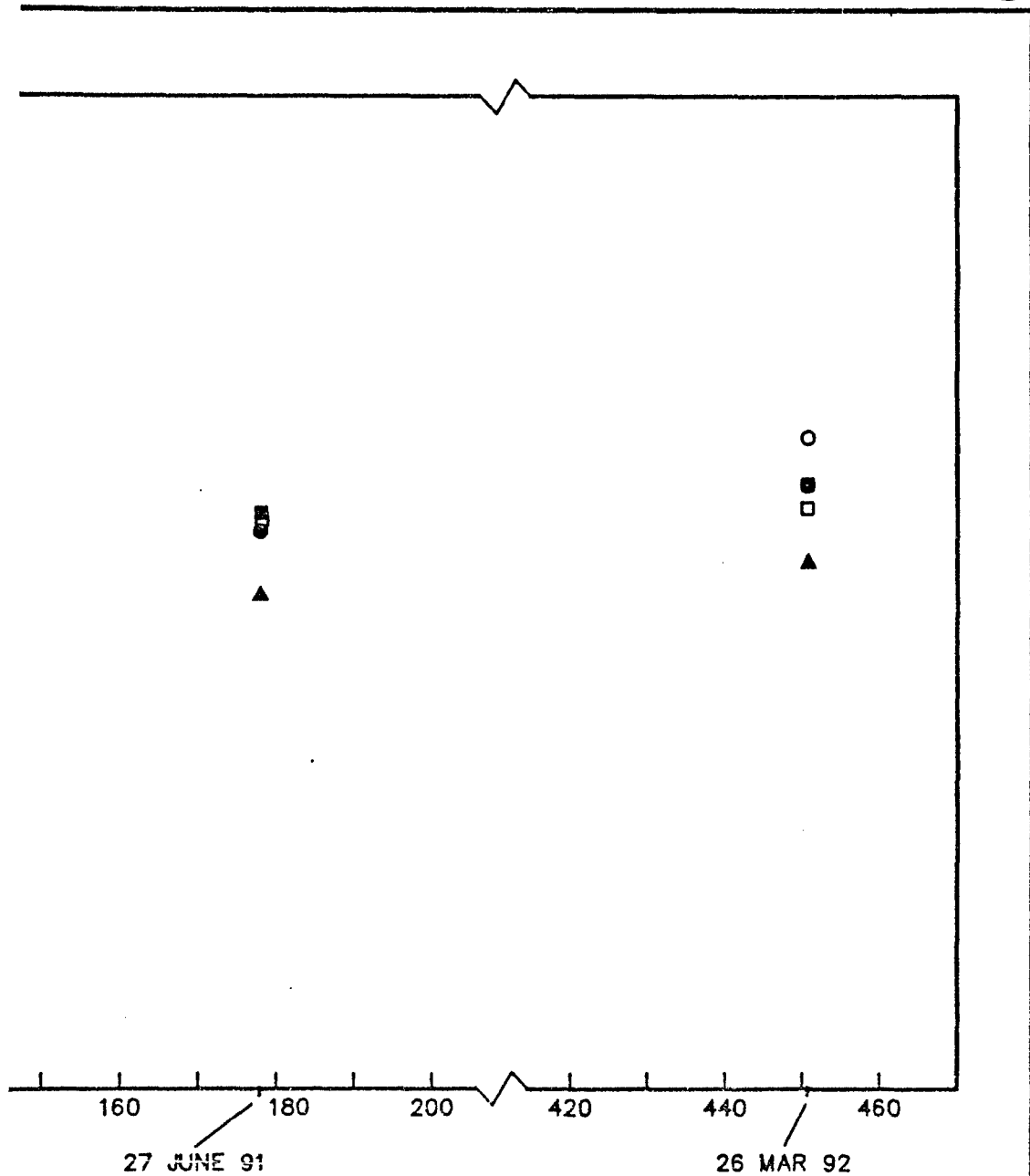


FIGURE 3-8
HYDROGRAPH
AND MONITRI
PAPAGO MILIT.

161 AREFG, ARIZI
SKY HARBOR IAP
PHOENIX, ARIZON



(3)



91

FIGURE 3-8
HYDROGRAPH OF PIEZOMETERS
AND MONITORING WELLS
PAPAGO MILITARY RESERVATION

161 AREFG, ARIZONA ANG
SKY HARBOR IAP
PHOENIX, ARIZONA



for water levels to recover to elevations similar to those observed in surrounding wells and their eventual static levels following development and sampling. Other wells and piezometers produce water readily.

Groundwater flow direction at Papago is generally northwesterly or southwesterly, depending on measurement points used to calculate the flow direction. A westerly-oriented wedge-like groundwater mound also causes groundwater to flow northwesterly and southwesterly. The hydraulic gradient is approximately 0.001 foot/foot to 0.01 foot/foot. Groundwater flow conditions for February, April, and June 1991, and additionally in March 1992, are provided in Figures 3-9 through 3-10B, respectively.

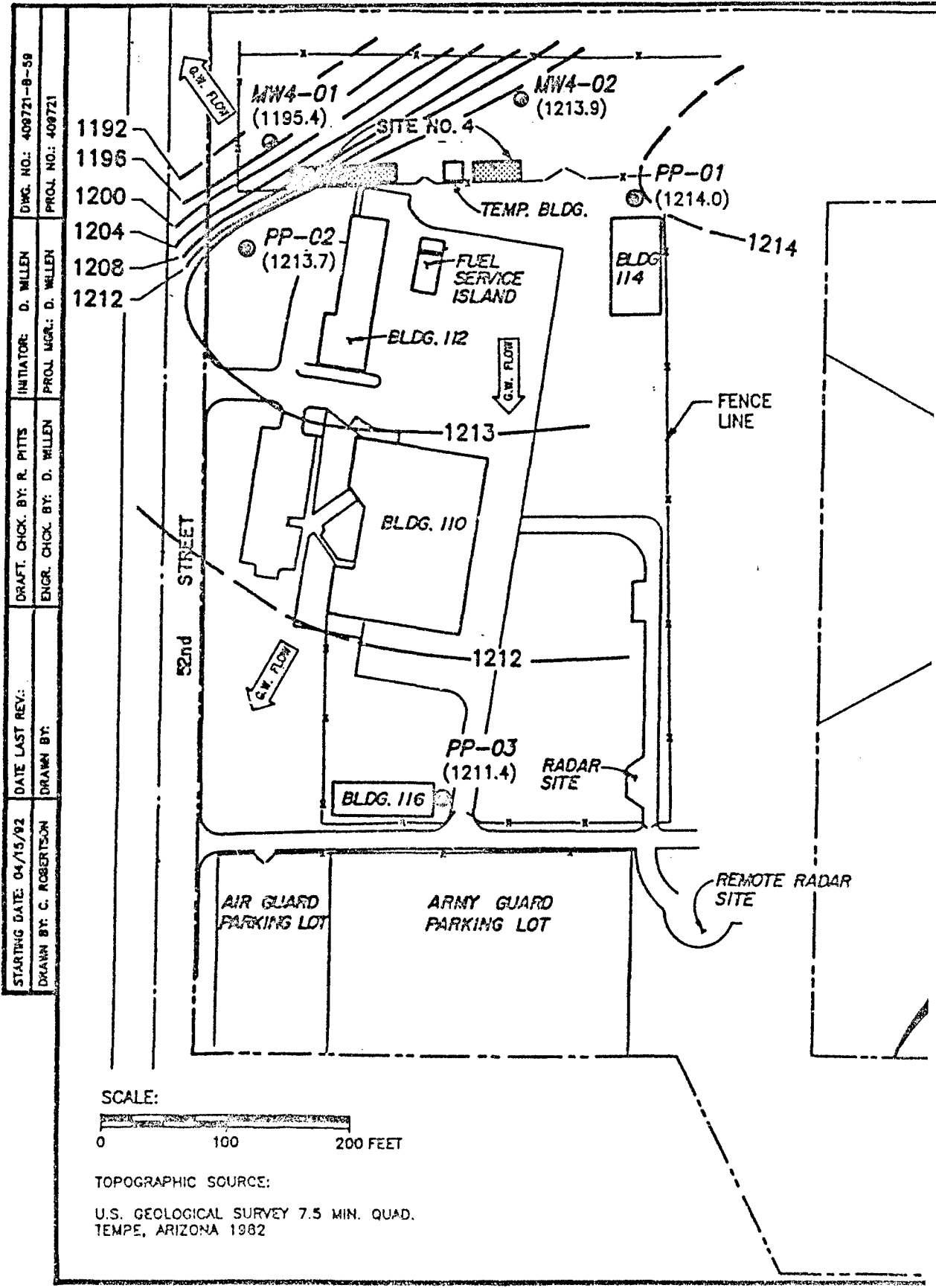
Hydraulic conductivity at Papago is extremely slow and slug tests required long recovery times. As indicated in Table 3-0, the minimum groundwater flow velocity is approximately 6.0×10^{-8} cm/s (0.1 ft/yr) to a maximum of 5.6×10^{-8} cm/s (6 ft/yr).

3.2 Background Sampling Results

To evaluate the significance of concentrations of detected compounds at each investigation site, a background soil and groundwater characterization effort was conducted. Background soil samples were collected away from known waste management units and groundwater samples were collected from locations upgradient of facilities at both the 161AREFG and at Papago. Soil sampling depths varied due to the geology and are discussed in Section 3.2.1 (161AREFG) and Section 3.2.2 (Papago).

Analytical Data Discussion. The following sections discuss the results of chemical analytical data obtained as a result of soil and groundwater samples collected at the Base and Papago during the SI. Analytical data have been validated based on guidelines established by the U.S. EPA and described in the documents "Functional Guidelines for Evaluating Organic Analyses" (U.S. EPA, 1988a) and "Functional Guidelines for Evaluating Inorganic Analyses" (U.S. EPA, 1988b). Thus, results presented herein have been evaluated in conjunction with respective field and lab QC samples. The validation includes adding data qualifiers to alert data users of conditions in the laboratory setting that may have affected sample data. This might include conditions such as method blank contamination or instrument calibration inconsistencies. These conditions are not new to chemical analytical laboratories, but as a result of the data validation process, data users may be ensured that data are valid and accurate to the highest degree possible as indicated by the unique qualifiers. Following are definitions of the data qualifiers used by laboratories and in the validation process:

1



(2)

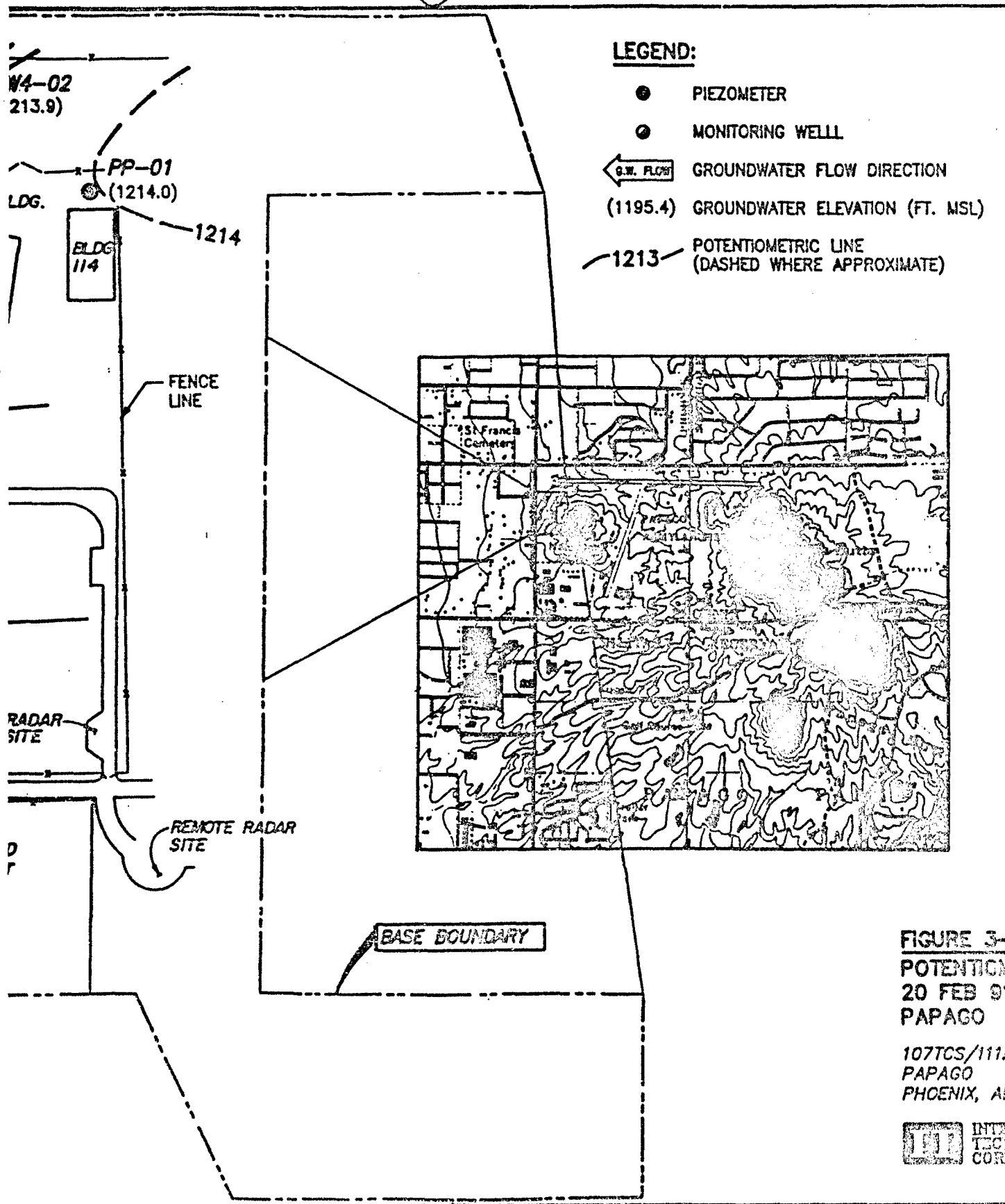


FIGURE 3-
POTENTIAL
20 FEB 91
PAPAGO

107TCS/111
 PAPAGO
 PHOENIX, AZ



(3)

LEGEND:

● PIEZOMETER

⊙ MONITORING WELL

← G.W. FLOW GROUNDWATER FLOW DIRECTION

(1195.4) GROUNDWATER ELEVATION (FT. MSL)

— 1213 — POTENTIOMETRIC LINE
(DASHED WHERE APPROXIMATE)

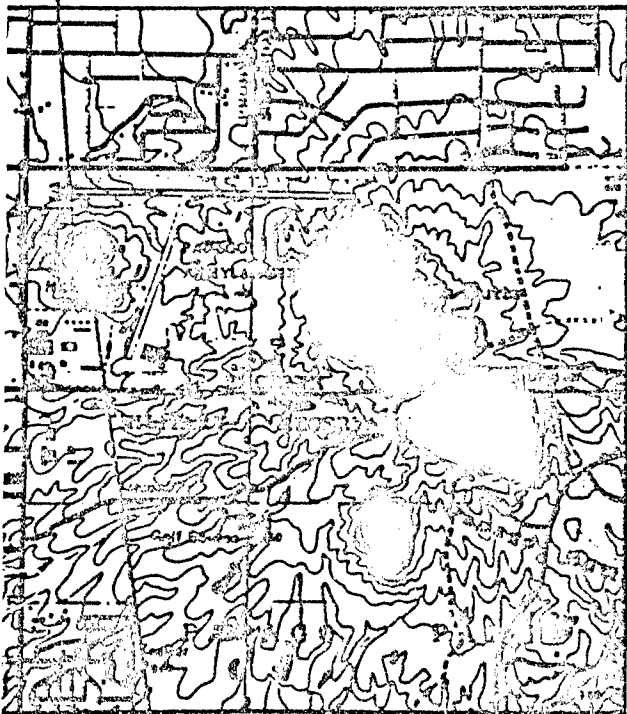


FIGURE 3-9

POTENTIOMETRIC SURFACE

20 FEB 91

PAPAGO

107TCS/111ATCF, ARIZONA ANG

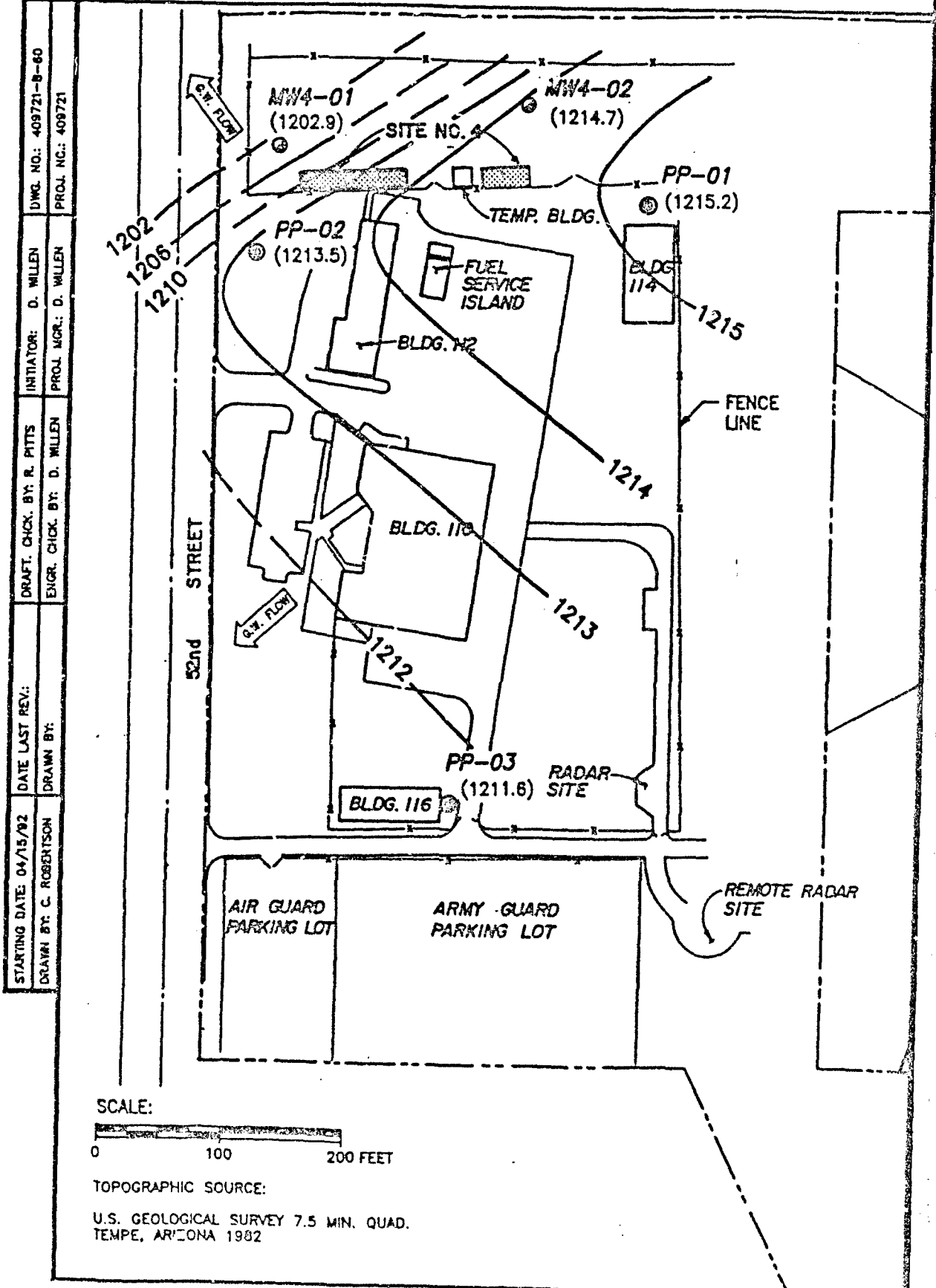
PAPAGO

PHOENIX, ARIZONA



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1



(2)

LEGEND:

- PIEZOMETER
- MONITORING WELL

← G.W. FLOW → GROUNDWATER FLOW DIRECTION
 (1202.9) GROUNDWATER ELEVATION (FT. MSL)

— 1215 — POTENTIOMETRIC LINE
 (DASHED WHERE APPROXIMATE)

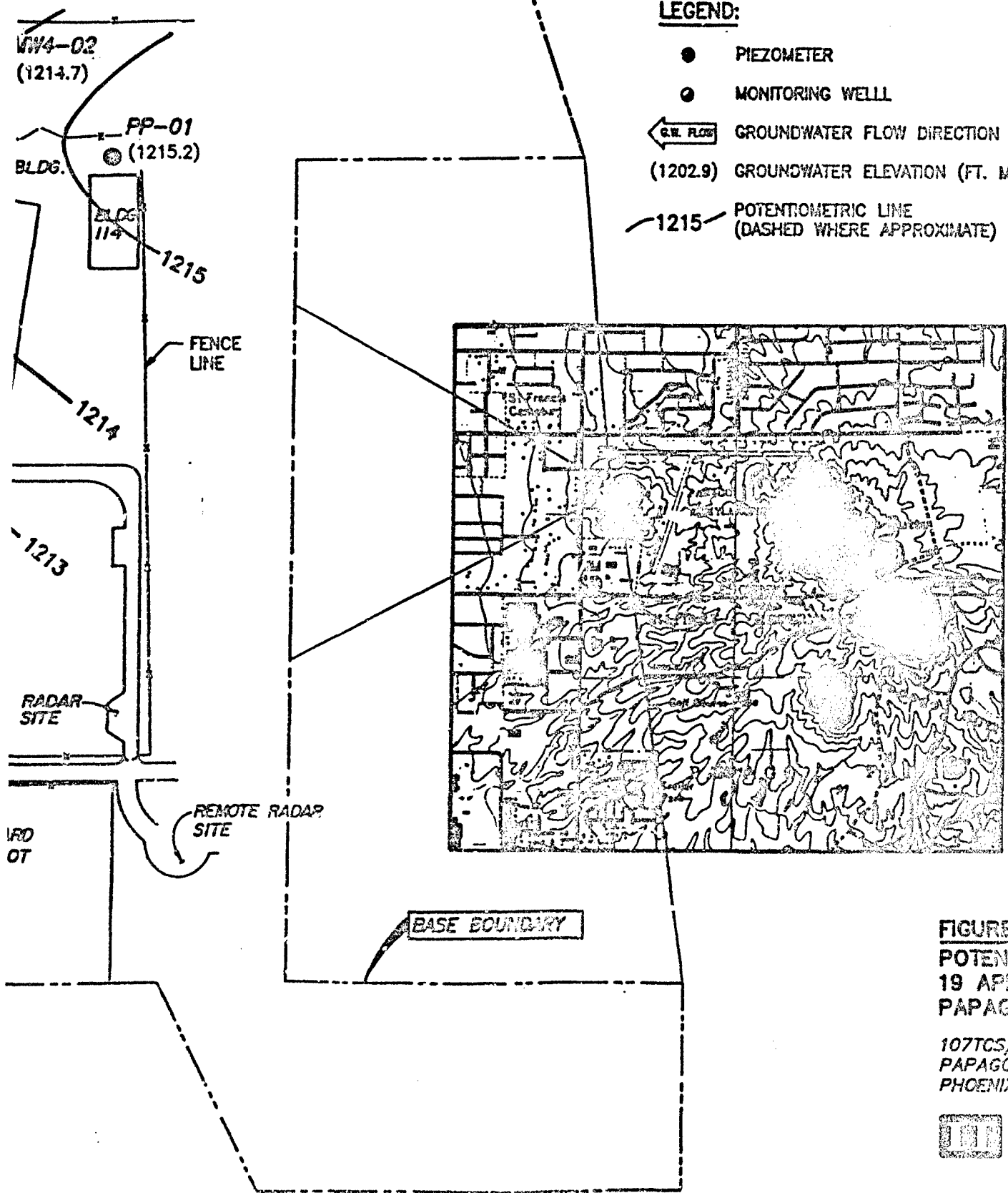


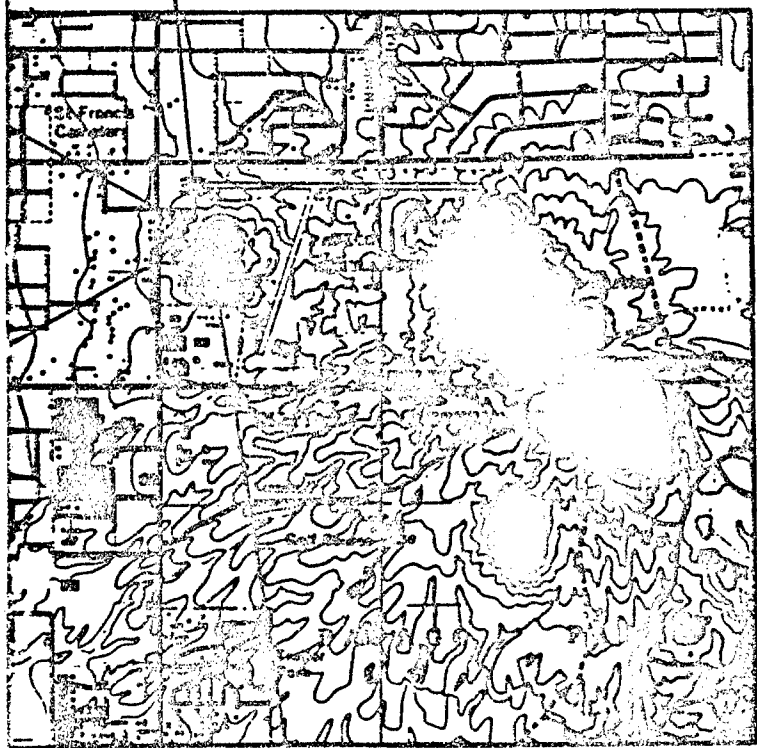
FIGURE 3
POTENTIAL
19 APR
PAPAGO
 107TCS/1
 PAPAGO
 PHOENIX,



(3)

LEGEND:

- PIEZOMETER
- MONITORING WELL
- ← G.W. FLOW GROUNDWATER FLOW DIRECTION
- (1202.9) GROUNDWATER ELEVATION (FT. MSL)
- 1215— POTENTIOMETRIC LINE
(DASHED WHERE APPROXIMATE)



BOUNDARY

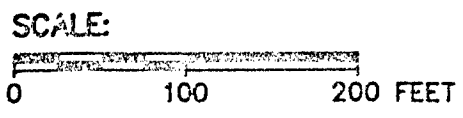
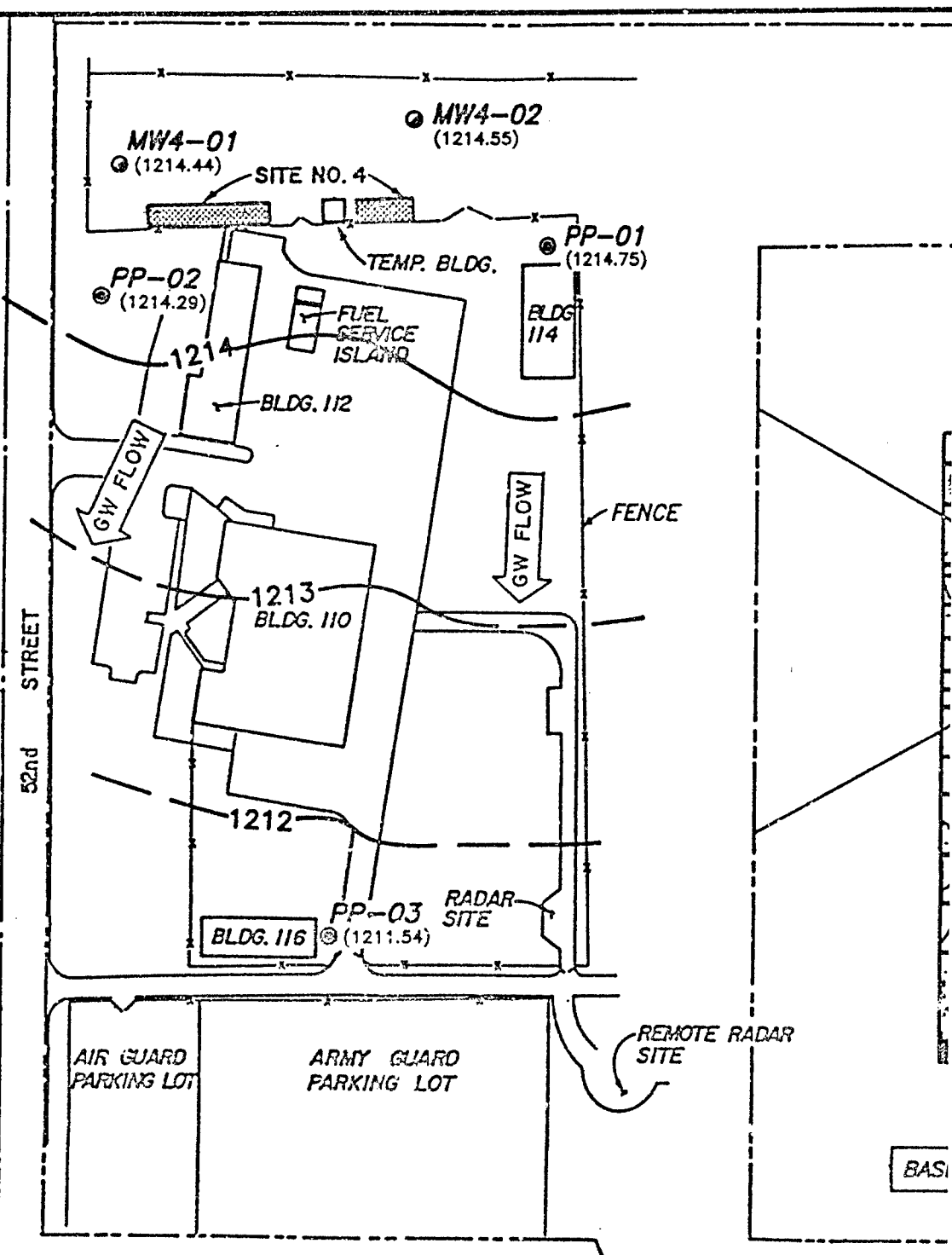
FIGURE 3-10
POTENTIOMETRIC SURFACE
19 APR 91
PAPAGO

107TCS/111ATCF, ARIZONA ANG
PAPAGO
PHOENIX, ARIZONA



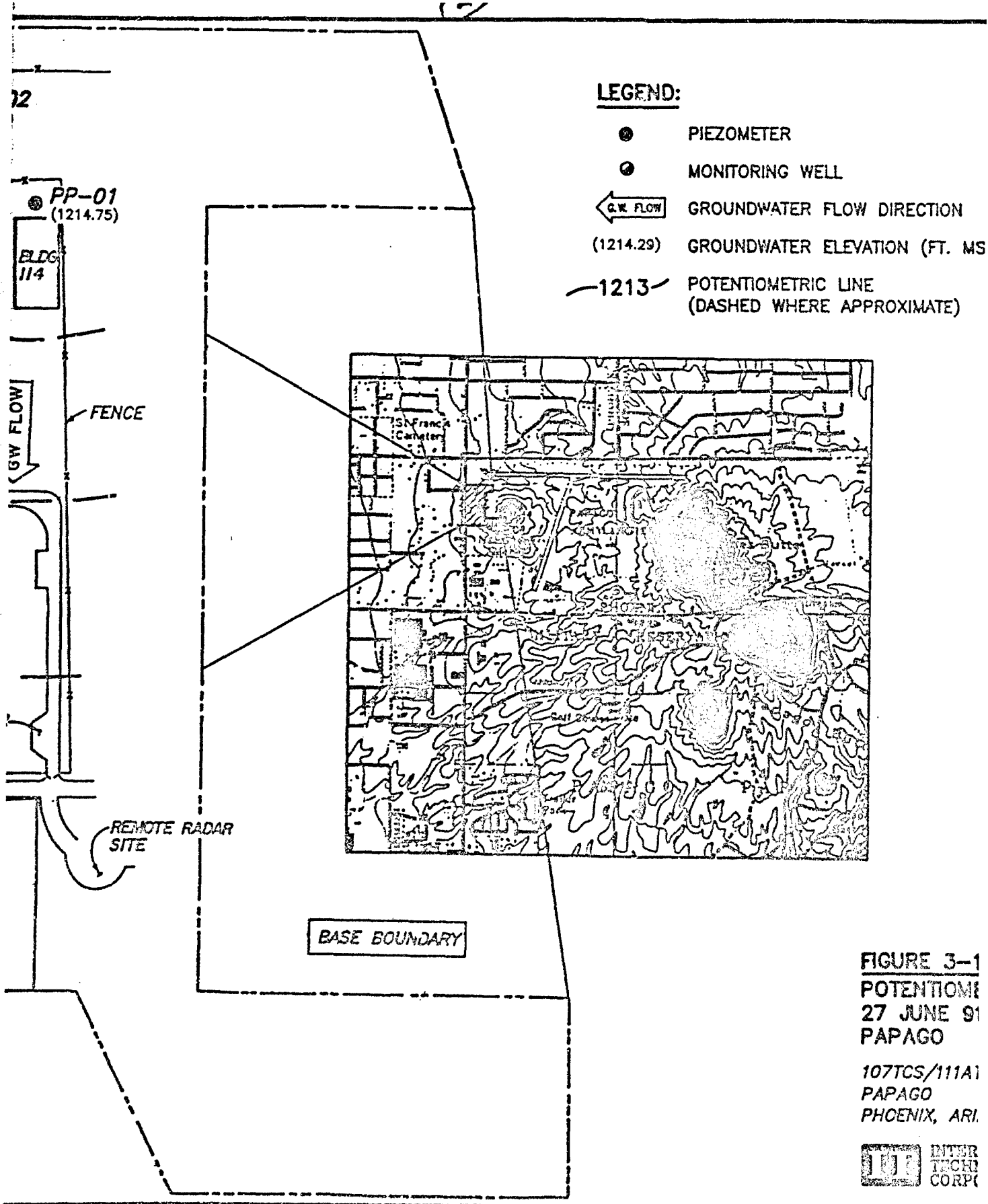
INTERNATIONAL
TECHNOLOGY
CORPORATION

STARTING DATE: 9/24/02	DATE LAST REV:	DRAFT. CHCK. BY: R. PITTS	INITIATOR: D. MILLEN	DWG. NO.: 409721-B-09
DRAWN BY: C. ROBERTSON	DRAWN BY:	ENGR. CHCK. BY: D. MILLEN	PROJ. MGR.: D. MILLEN	PROJ. NO.: 409721



TOPOGRAPHIC SOURCE:
 U.S. GEOLOGICAL SURVEY 7.5 MIN. QUAD.
 TEMPE, ARIZONA 1982

BASI



LEGEND:

- PIEZOMETER
- MONITORING WELL
- ← G.W. FLOW GROUNDWATER FLOW DIRECTION
- (1214.29) GROUNDWATER ELEVATION (FT. MS)
- 1213- POTENTIOMETRIC LINE (DASHED WHERE APPROXIMATE)

FIGURE 3-1
POTENTIOMETRIC
27 JUNE 91
PAPAGO

107TCS/111A1
 PAPAGO
 PHOENIX, ARI.



LEGEND:

● PIEZOMETER

● MONITORING WELL

← G.W. FLOW GROUNDWATER FLOW DIRECTION

(1214.29) GROUNDWATER ELEVATION (FT. MSL)

—1213— POTENTIOMETRIC LINE
(DASHED WHERE APPROXIMATE)

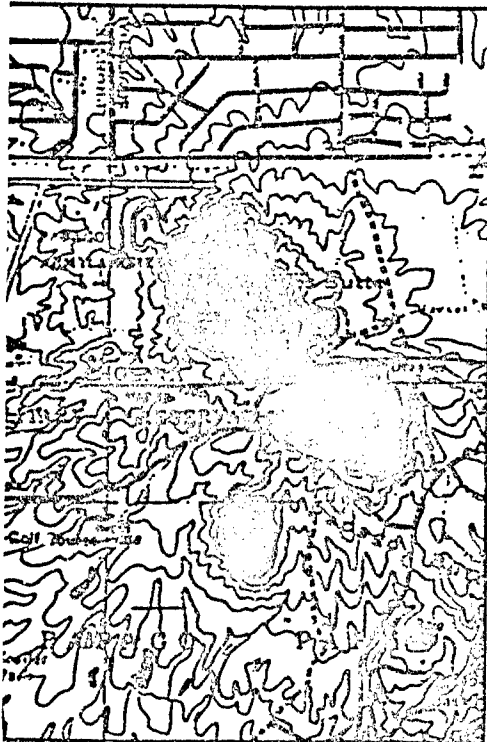
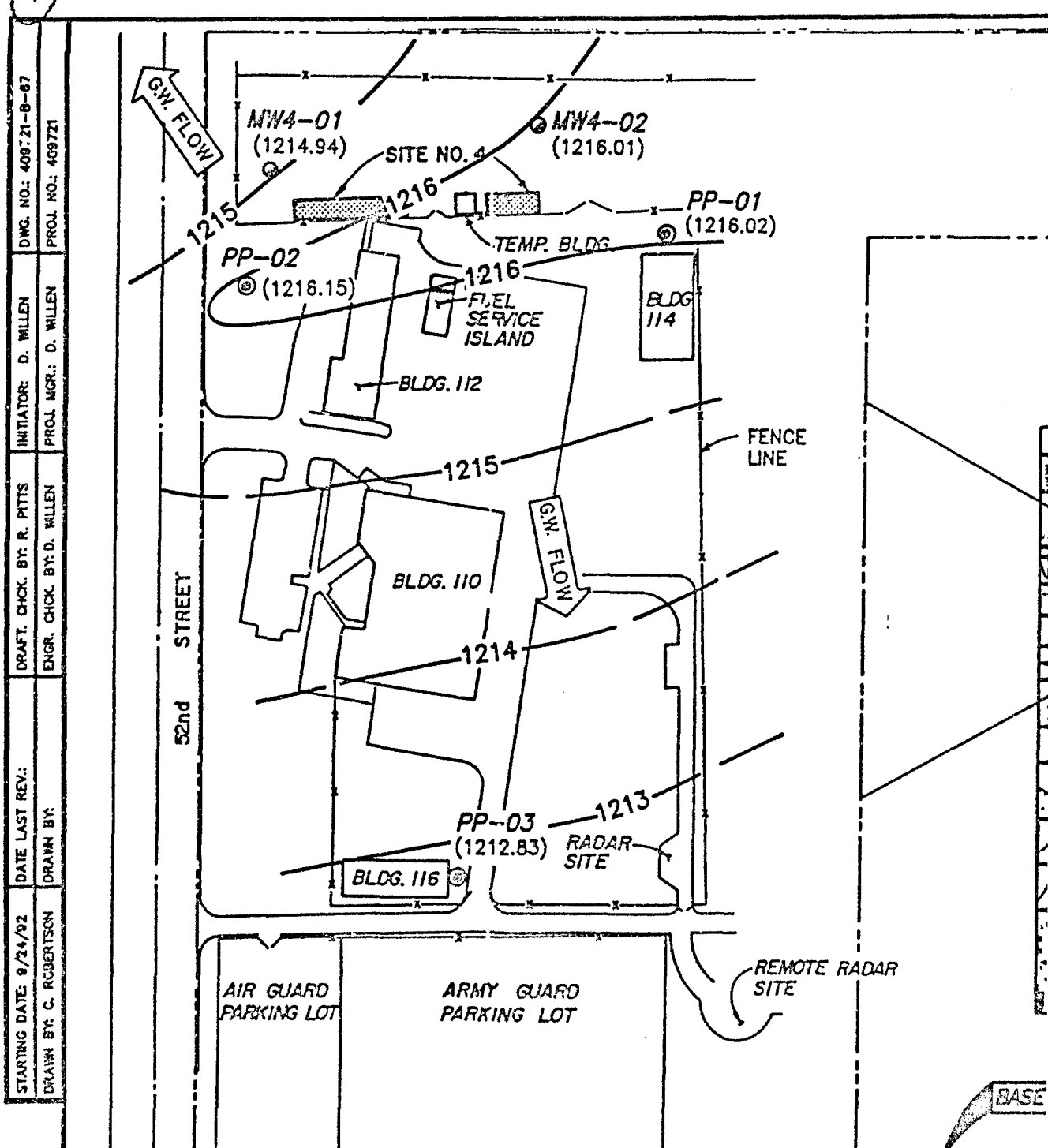


FIGURE 3-10A
POTENTIOMETRIC SURFACE
27 JUNE 91
PAPAGO

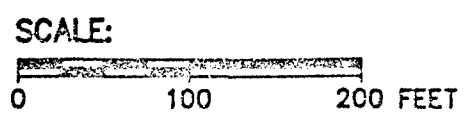
107TCS/111ATCF, ARIZONA ANG
PAPAGO
PHOENIX, ARIZONA



**INTERNATIONAL
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CORPORATION**



STARTING DATE: 9/24/92	DATE LAST REV:	DRAFT. CHK. BY: R. PITTS	INITIATOR: D. WILLEN	DWG. NO.: 409721-B-07
DRAWN BY: C. ROBERTSON	DRAWN BY:	ENGR. CHK. BY: D. WILLEN	PROJ. MGR.: D. WILLEN	PROJ. NO.: 409721



TOPOGRAPHIC SOURCE:
 U.S. GEOLOGICAL SURVEY 7.5 MIN. QUAD.
 TEMPE, ARIZONA 1982

BASE

(2)

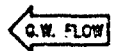
LEGEND:



PIEZOMETER



MONITORING WELL



GROUNDWATER FLOW DIRECTION

(1214.94)

GROUNDWATER ELEVATION (FT. MSI)

—1215—

POTENTIOMETRIC LINE
(DASHED WHERE APPROXIMATE)

2
)

PP-01
(1216.02)

BLDG
114

FENCE LINE

3

REMOTE RADAR SITE

BASE BOUNDARY

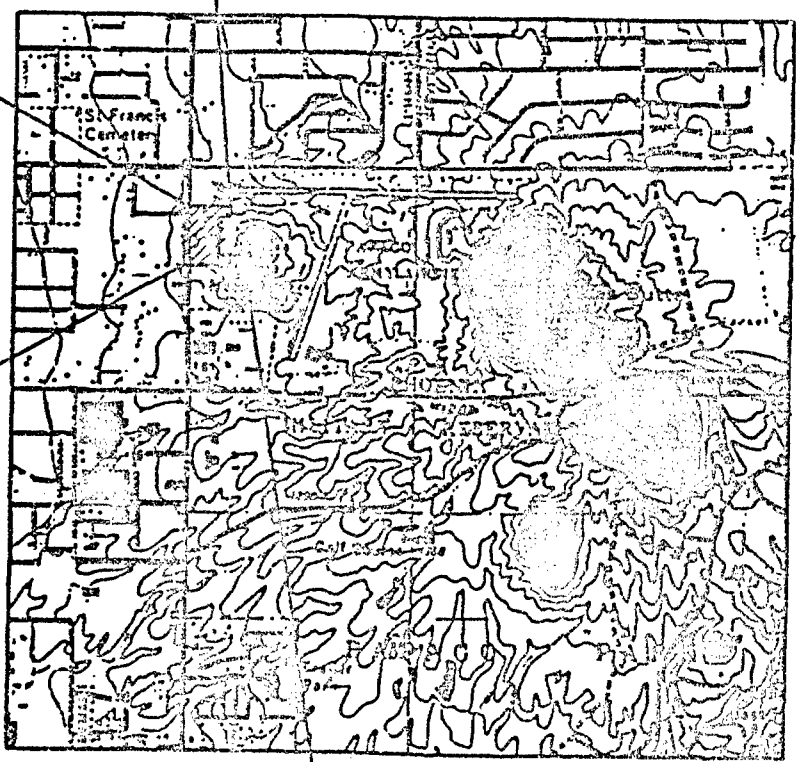


FIGURE 3-1
POTENTIOMETRIC
26 MAR 92
PAPAGO

107TCS/111A1
PAPAGO
PHOENIX, ARIZ.



LEGEND:

- PIEZOMETER
- ⊙ MONITORING WELL
- ← G.W. FLOW GROUNDWATER FLOW DIRECTION
- (1214.94) GROUNDWATER ELEVATION (FT. MSL)
- 1215- POTENTIOMETRIC LINE
(DASHED WHERE APPROXIMATE)

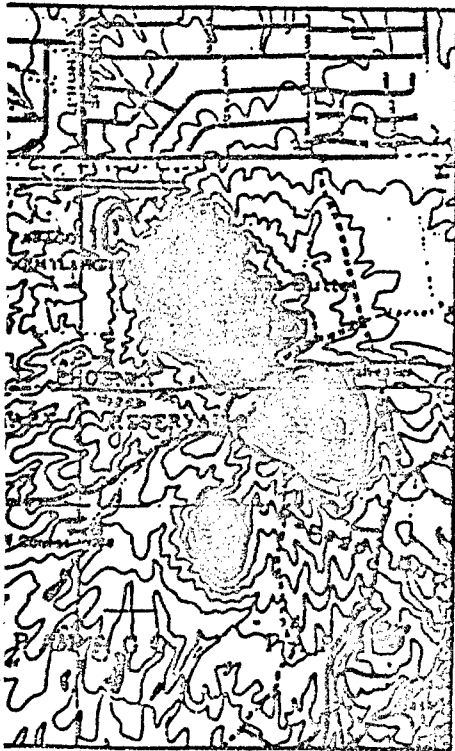


FIGURE 3-10B
POTENTIOMETRIC SURFACE
26 MAR 92
PAPAGO

107TCS/111ATCF, ARIZONA ANG
PAPAGO
PHOENIX, ARIZONA



- U - The material was analyzed for, but was not detected. The associated value is the sample quantitation limit.
- J - The associated numerical value is an estimated quantity.
- R - The data are unusable (compound may or may not be present). Resampling and reanalysis is necessary for verification.
- UJ - The material was analyzed for but was not detected. The sample quantitation limit is an estimated quantity.
- D - Compound analyzed at a secondary dilution factor.

Chemical analytical data for the SI have been summarized in tables throughout the text; they do not include tentatively identified compounds (TIC). Water sample numbers specify sampling location by the first two sets of alphanumeric characters: MWS-XX indicates a background well; MW1-XX, MW2-XX, MW3-XX, MW4-XX, and MW5-XX indicate monitoring wells at Sites 1, 2, 3, 4, and 5, respectively; PS-XX indicates a piezometer at the Base; and PP-XX indicates a piezometer at Papago. Soil samples are similarly numbered as discussed in Section 2.5.1.

3.2.1 161AREFG

Background soil samples at the 161AREFG were collected from monitoring well boreholes as drilling progressed. Soil samples were collected at 5-foot intervals during drilling. In general, sample recovery was poor due to the subsurface lithology. Each sample collected was screened at the field laboratory for target compounds, and three samples, when available, were sent to a laboratory for Level C analyses. Soil samples submitted for analyses and their respective depth-intervals are presented in Table 2-5.

Because target compounds were detected in a field screening of water samples from PS-02, a fourth background soil boring was installed west of Building 21 at the newly designated Site 6. The boring was designated MBS-04 and was drilled and sampled with procedures common to the other borings. The boring was subsequently converted to a monitoring well MWS-04 (Figure 2-9). Soil samples were field screened and three were selected for Level C analyses.

Background groundwater quality samples were collected from monitoring wells located along the upgradient edge of the base to characterize water quality moving on site. Samples from

piezometers were also collected for field screening to more fully characterize groundwater quality of the Base.

3.2.1.1. Soils

Field Screening. Results of field screening of samples from background soil borings are presented in Appendix K. No target compounds were detected in samples from MBS-01, -02, or -03 at screening detection limits. One sample from MBS-03, 5- to 7-foot depth interval, indicated the presence of non-target hydrocarbons at greater retention times than target compounds; however, the concentration and identity of this compound were not determined during field screening. This sample was submitted for laboratory Level C analysis. Field screening of remaining background soil samples did not indicate presence of other target compounds; therefore, soil samples selected for laboratory analysis were based on available recovered samples.

Samples from MBS-04 did not contain target compounds from the surface to 25 feet bgl; however, five target compounds were detected from depths of 40 to 71 feet bgl. Benzene, toluene, ethylbenzene, xylenes, and TCE were consistently detected below 40 feet.

Piezometer borehole soil samples for field screening analysis were collected from the drill cuttings after completion of drilling activities. Samples of cuttings from PS-01 indicated the presence of low concentrations of xylenes below detection limits. Samples from PS-02 indicated similar estimated concentrations of xylenes and toluene. Due to the presence of these constituents, additional samples were collected from cuttings and submitted for Level C laboratory analysis for waste disposal considerations. Because samples are from cuttings and not from discrete-depths, interpretations of chemical origin in the subsurface based on these data cannot be made.

Confirmation Analysis. Soil samples from each background boring were submitted for Level C laboratory analysis. Boreholes were located away from known sources of target compounds so that analyses representative of the site soils could be obtained. Background soil samples were analyzed for all constituents of concern at the Base. Appendix L contains a tabulation of all background-soil target-compound analyses. Detected compounds are summarized in Table 3-1.

TABLE J-1

SUMMARY OF DETECTED COMPOUNDS
BACKGROUND SOIL BORINGS
14th ARBP, PHOENIX, ARIZONA

SAMPLE NUMBER: BORING: DEPTH (FT):	MBS-01-0-1-01		MBS-01-00-01-01		MBS-02-0-2-01		MBS-02-5-7-01		MBS-02-10-12-01	
	MBS-01-0-1-01	MBS-01-00-01-01	MBS-01-00-01-01	MBS-01-00-01-01	MBS-02-0-2-01	MBS-02-0-2-01	MBS-02-5-7-01	MBS-02-5-7-01	MBS-02-10-12-01	MBS-02-10-12-01
	0-1	0-1	0-1	0-1	0-2	0-2	5-7	5-7	10-12	10-12
DETECTED COMPOUND	UNITS	RANGE								
VOLATILE ORGANIC COMPOUNDS										
Acetone	ug/g	10U	10400	3230	4230	3430	9340			
Benzene	ug/g	5U	115	932	413	41	0.7			
Ethylbenzene	ug/g	5U	0.49 J	0.36 J		0.2 J	145			
Toluene	ug/g	5U-1J	26400	2170	8770	6770	0.55 J			
Total Xylenes	ug/g	5U	34.1 J	16.3 J	12.9	11.2	51.1			
			10.8	4.6 J	5.9 J	5.3 J	14.3			
			22 J	35 J	17.5 J	89.2 J	53.8 J			
			10900	8459	10700	9550	30900			
			6.8 J	3.4 J	6.4 J	6.3 J	6.3 J			
			8420	2250	3620	3230	10200			
			313 J	230 J	218 J	218 J	342 J			
			32.2	15.3	17.4	18.3	31.1			
			1760 J	561 J	626 J	581.2	1340 J			
			1.8 J	0.61-2.4J		0.61 J	2.6 J			
			704 J	127 J	295 J	305 J	530 J			
			0.2 J		0.2 J					
			46 J	19.3 J	32.9 J	32.3 J	104 J			
			39.9 J	47.4 J	33.8 J	43.4 J	76.4 J			
Nitrate/Nitrite	mg/g	0.8-60	54	0.8	3.7	2	44			
TPH	mg/g	1U-9000			4800		9800			
Organic Lead	mg/g	10U								

J = Concentration is estimated below reporting limit
E = Concentration is estimated above calibration range

TABLE J-1
(cont.)

SUMMARY OF DETECTED COMPOUNDS
BACKGROUND SOIL BORINGS
1614 AREFG, PHOENIX, ARIZONA

SAMPLE NUMBER: BORING: DEPTH (FT):	MBS-03-0-2-01 MBS-03 0-2	MBS-03-1-7-01 MBS-03 3-7	SC-PS1-1 PS-01 NA	SC-PS2-1 PS-02 NA	SC-PS3-1 PS-03 NA
DETECTED COMPOUND	UNITS	RANGE			
VOLATILE ORGANIC COMPOUNDS					
Acetone	ug/g	10U			
Benzene	ug/g	5U			
Ethylbenzene	ug/g	5U			
Toluene	ug/g	5U-11			
Total Xylenes	ug/g	5U			
SEMI-VOLATILE COMPOUNDS					
2-Methylnaphthalene	ug/g	330U			
Naphthalene	ug/g	330U			
Phenanthrene	ug/g	330U			
Pyrene	ug/g	330U			
INORGANIC COMPOUNDS					
Aluminum	mg/g	3030-10400	9250		
Arsenic	mg/g	4-8.23	8.3		
Barium	mg/g	53.9-1853	105.3		
Beryllium	mg/g	0.2-0.551	0.43		
Calcium	mg/g	2170-33500	18500.3		
Chromium	mg/g	11.2-51.1	22.1		
Cobalt	mg/g	4.6-14.3	8.73		
Copper	mg/g	17.5-97.83	41.63		
Iron	mg/g	8490-30300	16900		
Lead	mg/g	3.4-18.43	15.33		
Magnesium	mg/g	2290-10100	6469.3		
Manganese	mg/g	218-4683	277.3		
Nickel	mg/g	34.6-31.1	17.6		
Potassium	mg/g	561-17003	1520.3		
Silver	mg/g	0.41-2.43	1.63		
Sulfure	mg/g	127-7263	557.3		
Thallium	mg/g	0.23			
Vanadium	mg/g	19.3-1043	43.73		
Zinc	mg/g	33.8-79.6	45.3		
Nitrate/Nitrite	mg/g	0.8-60	60		
TPH	mg/g	10-9800	75		
Organic Lead	mg/g	10U			

Organic Compounds. No target organic compounds were detected in samples submitted from MBS-01; however, either acetone or methylene chloride was detected in each background soil sample submitted for analysis. Data validation procedures have associated these detections with laboratory blank sample detections and thus, acetone and methylene chloride are not indicated as environmental contaminants.

The TPH content of MBS-02 was measured to be 4,800 and 9,800 milligrams per kilogram (mg/kg or parts per million [ppm]) at surface to 2-foot bgl and 5- to 7-foot bgl intervals, respectively. TPH was not detected in the MBS-02 sample from 10 to 12 feet bgl. One $\mu\text{g}/\text{kg}$ of toluene was estimated to also be present in the 5- to 7-foot depth sample and 6 $\mu\text{g}/\text{kg}$ of acetone was detected in the 10- to 12-foot-depth sample.

TPH was detected in samples from MBS-03, at the surface and 5- to 7-foot bgl interval in concentrations of 75 and 38 mg/kg, respectively. Samples from below this depth were not available for submittal to the laboratory due to low recovery (Table 2-5).

Level C confirmation analyses of background soil borings MBS-01, -02, and -03 indicate that elevated concentrations of TPH are present in the surface to 5-foot bgl interval. TPH does not appear to be pervasive to greater depths in borings MBS-01 and -02. The source of TPH in background borings is undetermined but may be related to past weed control practices or chemical characteristics of fill material.

Three samples were submitted for laboratory analysis from MBS-04. Due to low recovery (Table 2-5), samples with the highest field screening results did not have sufficient volume to be sent to the laboratory. Samples from the surface, total depth (99 to 100 feet), and the 15- to 16.5-foot bgl interval were submitted for analysis. The total depth sample contained benzene (5 $\mu\text{g}/\text{kg}$), ethylbenzene (80 $\mu\text{g}/\text{kg}$), toluene (26 $\mu\text{g}/\text{kg}$), and xylenes (190 $\mu\text{g}/\text{kg}$). TCE, detected in the screening laboratory, was not confirmed in the environmental sample. TPH was measured at 35 and 67 mg/kg in the surface and total depth sample but was not detected in the 15-foot depth sample. No other VOCs were detected in the validated results. SVOCs, phenanthrene and pyrene, were detected in the surface sample of MBS-04 at estimated concentrations of 43 and 53 $\mu\text{g}/\text{kg}$, respectively. 2-Methylnaphthalene and naphthalene were detected in the total depth sample at estimated concentrations of 490 and 110 $\mu\text{g}/\text{kg}$, respectively.

Soil cuttings from piezometers at the Base were analyzed for VOCs and TPH for waste disposal considerations. No target compounds were detected in the samples.

Inorganic Compounds. Table 3-1 presents results of inorganic analyses of individual background soil samples and the range of detected concentrations for each analyte. Concentrations of common rock forming elements such as aluminum, calcium, iron, magnesium, and potassium ranged in the thousands to tens of thousands mg/kg. Less common metals such as barium, chromium, cobalt, lead, nickel, vanadium, and zinc were detected in the tens to hundreds mg/kg and arsenic, beryllium, silver, and thallium were detected at less than 10 µg/kg. Mercury was not detected in background soil samples at a detection limit of 0.2 mg/kg. Concentrations of inorganic analytes presented in Table 3-1 are thought to be representative of naturally occurring soil constituent concentrations and not related to anthropogenic activities. These values serve as a basis for comparison with other site-related data.

3.2.1.2 Groundwater

Based on the groundwater flow directions presented in Figures 3-4 through 3-6, wells MWS-01, -02, and -03 are designated upgradient background wells for the Base. Results of groundwater analyses from these wells are assumed to be representative of water quality in the general geographic area under the Base.

Screening Analysis. Results of field screening of groundwater samples from background monitoring wells and piezometers are summarized in Figure K-1 at the end of Appendix K. Water samples for field screening were collected following development of each well and piezometer. Field screening detected each target compound except PCE.

MWS-01, the eastern most background well, contained toluene and TCE. Non-target light hydrocarbons were also detected but were not quantified or identified. A second sampling of MWS-01 did not confirm the presence of any target compounds.

MWS-02 contained benzene, TCE, toluene, and xylenes. DCE and ethylbenzene were also detected, but at estimated concentrations below detection limits. TCA was also estimated to be present, however, difficulties with detection of TCA in the screening laboratory make this determination uncertain.

MWS-03, the western most background well, contained TCE and toluene. DCE and TCE were estimated at concentrations below detection limits in a second sample from the well. Low retention time, non-target compounds were also detected in MW3-02, but were not identified or quantified in the screening laboratory.

The piezometers (PS), used in the background hydrogeologic investigation to determine groundwater flow, were also used for screening groundwater. Target analytes were not detected in field screening of groundwater from PS-01. Samples from PS-02 contained the highest concentration of compounds of any of the site groundwater samples. PS-02 contained DCE, benzene, ethylbenzene, and total xylenes. A second sample from PS-02 contained higher concentrations of target compounds. PS-03 did not contain target compounds above detection limits; however, TCE was estimated to occur below detection limits.

Field screening results of background hydrogeologic investigation wells and piezometers suggest the presence of low ppb concentrations of target compounds at the upgradient base boundary and higher (tens to hundreds ppb) concentrations in the vicinity of PS-02. Based on the field screening results, each background monitoring well was sampled for Level C analyses. In addition, PS-02 was sampled for Level C analyses.

During background hydrogeologic investigations, field screening of groundwater samples indicated the presence of mg/L concentrations of benzene in samples from PS-02. An additional well, MWS-04 at Site 6, was placed north of PS-02 between the piezometer and Site 3 to aid in the assessment of the extent of benzene in groundwater.

Confirmation Analyses. Two episodes of groundwater monitoring were performed on background wells, as well as the remaining monitoring wells. The objective of the first episode of sampling was to detect chemicals of concern and the second served to confirm results. Groundwater samples from the three background wells MWS-01, -02, and -03 (Figure 2-6) were analyzed for all constituents associated with an investigation site (Table 2-14). A summary of detected compounds and the range of occurrence for groundwater samples is presented in Table 3-2; results of laboratory analyses are presented in Appendix M. Results of laboratory analyses indicate presence of low microgram per liter ($\mu\text{g/L}$) concentrations of halogenated and aromatic volatile organic compounds and the presence of several cations in $\mu\text{g/L}$ to milligram per liter (mg/L) concentrations. No semivolatile Target Compound List (TCL) chemicals were detected above quantitation limits in these wells.

TABLE 3-2
SUMMARY OF DETECTED COMPOUNDS
BACKGROUND MONITORING WELLS
165th ABBOT, PHOENIX, ARIZONA

DETECTED COMPOUND	UNITS	RANGE	LOCATION:					
			DATE	MWS-01 APR-91	MWS-01 JUN-91	MWS-02 APR-91	MWS-02 JUN-91	MWS-03 APR-91
VOCs								
1,1-Dichloroethane	ug/l	5U - 2I						2 J
1,2-Dichloroethane	ug/l	5U - 1I		1 J				1U
Benzene	ug/l	5U - 230D				66	230 D	
Toluene	ug/l	5U - 1I				1 J		
Trichloroethane	ug/l	5U - 9				9	2 J	
1,1,1-Trichloroethane	ug/l	5U - 1I				6	3 J	11
SVOCs								
Pbocid	ug/l	10U - 3J					3 J	
INORGANIC COMPOUNDS								
Aluminum	ug/l	60U - 128J					128 J	105 J
Ammonia	ug/l	4.6J - 8U		5.4 J		6.7 J	8 J	5.4 J
Barium	ug/l	48.5J - 126J		50.7 J		68.6 J	126 J	70.9 J
Cadmium	ug/l	59400 - 85200		59400		71500	66400	80300
Copper	ug/l	10U - 28.4						
Iron	ug/l	11.9 - 51.8		12.4 J		21.2 J	34.3 J	51.8 J
Manganese	ug/l	20600 - 33400		22600		24800	27500	32900
Nickel	ug/l	2U - 1460		15.5		329	1460	8.7 J
Mercury	ug/l	0.2U - 0.21				0.21		
Fluoride	ug/l	4350 - 6810		4890 J		6810	5130	5500
Silver	ug/l	5U - 6.8J				6.8 J		
Sulfate	ug/l	107000 - 138000		136000		122000	122000	113000
Zinc	ug/l	18.6J - 64.8		27.8		46	24.3 J	28.4 J
Nitrate	ug/l	2U - 2.7		2.6		2.4		2.7
Nitrite	ug/l	2U						
TPH	ug/l	1U - 2				2		2.1

Lab: 11-10-92

U = Compound not detected
 J = Estimated value detected and reported below the contract required detection limit.
 E = Estimated value quantitated exceeding upper calibration range.
 D = Reported from dilution

Organic Analyses. Well MWS-01 contained an estimated 1 µg/L of 1,2-dichloroethylene (1,2-DCE) in the initial sampling. No TCL VOCs were detected in the confirmation sampling.

MWS-03 contained 11 µg/L of TCE as well as estimated concentrations of 2 µg/L and 1 µg/L of 1,1-DCE and 1,2-DCE, respectively, in the initial sampling. No TCL VOCs were detected in the confirmation sampling. The detected contaminants and concentrations are similar to others observed in the EWA described in Section 1.5.5.

MWS-02 contained 66 µg/L of benzene, 9 µg/L xylenes, and 6 µg/L TCE in the initial sampling. Also, an estimated 1 µg/L of toluene was reported in the sample. The same compounds were detected in the confirmation sampling; the confirmation sample contained 230 µg/L of benzene, an estimated 2 µg/L of total xylenes, and an estimated 3 µg/L of TCE, which is thought to be indicative of conditions in the EWA. The source of aromatic compounds, however, is not known and may be related to off-Base contribution or to higher concentrations of similar compounds found in PS-02 and MWS-04.

PS-02 was sampled and analyzed with Level C methods for background constituents due to the presence of benzene and other compounds in the screening analyses. As shown in Table 3-3, seven target compounds were detected in groundwater samples from PS-02 in the initial sample. Eight compounds were confirmed in the second sampling. One notable difference among results of the two sampling events is the apparent increase in benzene concentration from an estimated 820 µg/L in the initial sampling to 6,200 µg/L in the confirmation sample.

Inorganic Analyses. Inorganic analyses were conducted on samples from MWS-01, -02, and -03. Several cations (calcium, magnesium, manganese, potassium, and sodium) were detected in the mg/L range. Arsenic, barium, iron, and zinc were consistently detected in concentrations of less than 1 mg/L. Aluminum, copper, and silver were not consistently detected in samples. Nitrate occurred in groundwater samples at concentrations less than 2 to 2.7 µg/L. These analytes are thought to be naturally occurring and not associated with environmental contaminants. Because MWS-04 and PS-02 were sampled for the purpose of delineating organic contaminants, inorganic parameters were not analyzed.

TABLE 3-3

SUMMARY OF DETECTED COMPOUNDS
 PS-02
 161st AREFG, PHOENIX, ARIZONA

		LOCATION: DATE:	PS-02 APR-91	PS-02 JUN-91
DETECTED COMPOUND	UNITS			
VOCs				
1,1-Dichloroethane	ug/l			
1,1-Dichloroethene	ug/l		1J	
1,2-Dichloroethylene	ug/l		2J	
Benzene	ug/l		820 D	6200 D
Ethylbenzene	ug/l		25	430 D
Toluene	ug/l		2J	2 J
Total Xylenes	ug/l		29	260 D
Trichloroethene	ug/l		9	
SVOCs -				
2-Methylnaphthalene	ug/l			10
4-Methylphenol	ug/l			
Naphthalene	ug/l			29
Phenol	ug/l			21
INORGANIC COMPOUNDS			NOT ANALYZED	NOT ANALYZED
TPH	mg/l			3.1
Organic Lead	ug/l			

U = Compound Not Detected

J = Estimated value

E = Estimated value

D = Reported from dilution

OLDTELJ-4ALOTUSPC

3.2.2 Papago Military Reservation

Background soil and groundwater samples were collected from the Papago Military Reservation. Due to adverse subsurface conditions, described previously, the number and location of soil samples was modified from that anticipated by the FSP. One surface background soil sample was collected from a location near PP-02, east of Site 4 at Papago. One background monitoring well was installed, upgradient of Site 4, to assess groundwater quality in the area. In addition, three piezometers were installed and sampled for field screening analyses to provide additional water quality data. Background sampling locations at Papago are shown in Figures 2-4 and 2-7. Because background data at Papago are specific to Site 4, results of background soil and water sampling are presented in Section 3.6 along with Site 4 data.

3.3 Site 1 - JP-4 Hydrant Area

3.3.1 Screening Activity Results

3.3.1.1 Geophysical Survey

Geophysical survey activities related to Site 1 were limited to delineation of subsurface structures for clearance of intrusive sampling locations. In general, sampling locations were cleared using a line locator and GPR. Discussion of methods and results are presented in the geophysical survey report contained in Appendix C.

3.3.1.2. SOV Survey

Target SOV compounds were detected at Site 1 in concentrations ranging from total SOV (sum of benzene, toluene, ethylbenzene, and xylenes [BTEX]; DCE; TCA; PCE; and TCE) of 18.5 $\mu\text{g}/\text{L}$ to all compounds being nondetected. Results for specific analytes at each sampling point and analytical detection limits are summarized in Table 3-4. The distribution of total SOV content at Site 1 is depicted in Figure 3-11. There does not appear to be a site-wide pattern to the SOV concentrations.

PCE accounts for most of the detected compounds. PCE was detected in all environmental field samples as well as in all field blank samples. PCE was not detected in analytical blank samples. This suggests that detected PCE may be an artifact from sampling equipment.

PCE ranged in concentration from 0.62 $\mu\text{g}/\text{L}$ in sample OV1-7 to 6.7 $\mu\text{g}/\text{L}$ in sample OV1-8. PCE in blank samples ranged from 0.11 $\mu\text{g}/\text{L}$ to 0.42 $\mu\text{g}/\text{L}$. To assess equipment PCE contribution to environmental samples, the minimum PCE blank concentration for each day

TABLE 3-4

SOV SURVEY RESULTS
SITE 1

FIELD SAMPLE NUMBER:	OVI-1	OVI-2	OVI-3	OVI-4	OVI-5
SITE:	1	1	1	1	1
POINT:	1	2	3	4	FIELD
DEPTH (FT):	10	9	10	10	BLANK
MATRIX:	SOIL VAPOR	SOIL VAPOR	SOIL VAPOR	SOIL VAPOR	SOIL VAPOR
SAMPLE DATE:	15-JAN-91	15-JAN-91	15-JAN-91	15-JAN-91	15-JAN-91
GENZENE (UG/L):	1 U	13	1 U	1 U	1 U
TOLUENE (UG/L):	1 U	1 U	1 U	1 U	1 U
ETHYLBENZENE (UG/L):	1 U	1 U	1 U	1 U	1 U
M- & P- XYLENES (UG/L):	1 U	1 U	1 U	1 U	1 U
O- XYLENE (UG/L):	1 U	1 U	1 U	1 U	1 U
TOTAL FID VOC (UG/L):	1.5	12	1 U	1 U	7.7
DCE (UG/L):	1 U	1 U	1.4	2.2	1 U
TCA (UG/L):	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
PCE (UG/L):	6	5.2	6	4.2	0.42*
TCE (UG/L):	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
TOTAL DETECTED (UG/L):	7.5	18.5	7.4	6.4	NA

NOTES

- U = NOT DETECTED AT CONCENTRATION GIVEN
- B = DETECTED IN FIELD BLANK, CONCENTRATION IS LESS THAN 3X THE BLANK CONCENTRATION
- * = LOWEST DAILY BLANK CONCENTRATION
- DCE = 1,1-DICHLOROETHENE
- TCA = 1,1,1-TRICHLOROETHANE
- PCE = TETRACHLOROETHENE
- TCE = TRICHLOROETHENE
- TOTAL FID VOC = SUM OF PEAK AREA FROM FID USING TOLUENE INSTRUMENT RESPONSE FACTOR

TABLE 3-4
(cont.)
SOV SURVEY RESULTS
SITE 1

FIELD SAMPLE NUMBER:	OVI-4	OVI-7	OVI-8	OVI-9	OVI-10
SPTS:	1	1	1	1	1
POINT:	FIELD	7	8	9	10
DEPTH (FT):	BLANK	10	10	10	10
MATRIX:	SOIL VAPOR	SOIL VAPOR	SOIL VAPOR	SOIL VAPOR	SOIL VAPOR
SAMPLE DATE:	14-JAN-91	16-JAN-91	16-JAN-91	16-JAN-91	16-JAN-91
BENZENE (UG/L)	1 U	1 U	1 U	1 U	1 U
TOLUENE (UG/L)	1 U	1 U	1 U	1 U	1 U
ETHYLBENZENE (UG/L)	1 U	1 U	1 U	1 U	1 U
M- & P- XYLENES (UG/L)	1 U	1 U	1 U	1 U	1 U
O- XYLENE (UG/L)	1 U	1 U	1 U	1 U	1 U
TOTAL FID VOC (UG/L)	1 U	1 U	1 U	1 U	1 U
DCE (UG/L)	1 U	1 U	1 U	1 U	1 U
TCA (UG/L)	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
PCE (UG/L)	0.03 *	0.62	6.7	5.7	2.1
TCB (UG/L)	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
TOTAL DETECTED (UG/L)	NA	0.62	7.8	5.7	2.1

NOTES

- U = NOT DETECTED AT CONCENTRATION GIVEN
- B = DETECTED IN FIELD BLANK, CONCENTRATION IS LESS THAN 5X THE BLANK CONCENTRATION
- * = LOWEST DAILY BLANK CONCENTRATION
- DCE = 1,1-DICHLOROETHENE
- TCA = 1,1,1-TRICHLOROETHANE
- PCE = TETRACHLOROETHENE
- TCE = TRICHLOROETHENE
- TOTAL FID VOC = SUM OF PEAK AREA FROM FID USING TOLUENE INSTRUMENT RESPONSE FACTOR

TABLE 3-4
(cont.)
SOV SURVEY RESULTS
SITE 1

FIELD SAMPLE NUMBER:	OVI-11	OVI-12	OVI-13	OVI-14	OVI-15
SITE:	1	1	1	1	1
POINT:	11	12	FIELD	14	15
DEPTH (FT):	7	7	BLANK	16	4
MATRIX:	SOIL VAPOR	SOIL VAPOR	SOIL VAPOR	SOIL VAPOR	SOIL VAPOR
SAMPLE DATE:	16-JAN-91	16-JAN-91	16-JAN-91	17-JAN-91	17-JAN-91
SENZENE (UG/L):	1U	1U	1U	1U	1U
TOLUENE (UG/L):	1U	1U	1U	1U	1U
ETHYLBENZENE (UG/L):	1U	1U	1U	1U	1U
M- & P-XYLENES (UG/L):	1U	1U	1U	1U	1U
O-XYLENE (UG/L):	1U	1U	1U	1U	1U
TOTAL FID VOC (UG/L):	1U	1U	1U	1U	1U
DCE (UG/L):	1U	1U	1U	1U	1U
TCA (UG/L):	0.1U	0.1U	0.1U	0.1U	0.1U
PCE (UG/L):	2.6	2.1	0.11	4.8	1.8
TCE (UG/L):	0.1U	0.1U	0.1U	0.1U	0.1U
TOTAL DETECTED (UG/L):	2.6	2.1	NA	4.8	1.8

NOTES

- U = NOT DETECTED AT CONCENTRATION GIVEN
- B = DETECTED IN FIELD BLANK, CONCENTRATION IS LESS THAN 5X THE BLANK CONCENTRATION
- * = LOWEST DAILY BLANK CONCENTRATION
- DCE = 1,1-DICHLOROETHENE
- TCA = 1,1,1-TRICHLOROETHANE
- PCE = TETRACHLOROETHENE
- TCE = TRICHLOROETHENE
- TOTAL FID VOC = SUM OF PEAK AREA FROM FID USING TOLUENE INSTRUMENT RESPONSE FACTOR

TABLE 3-4
(cont.)
SOV SURVEY RESULTS
SITE 1

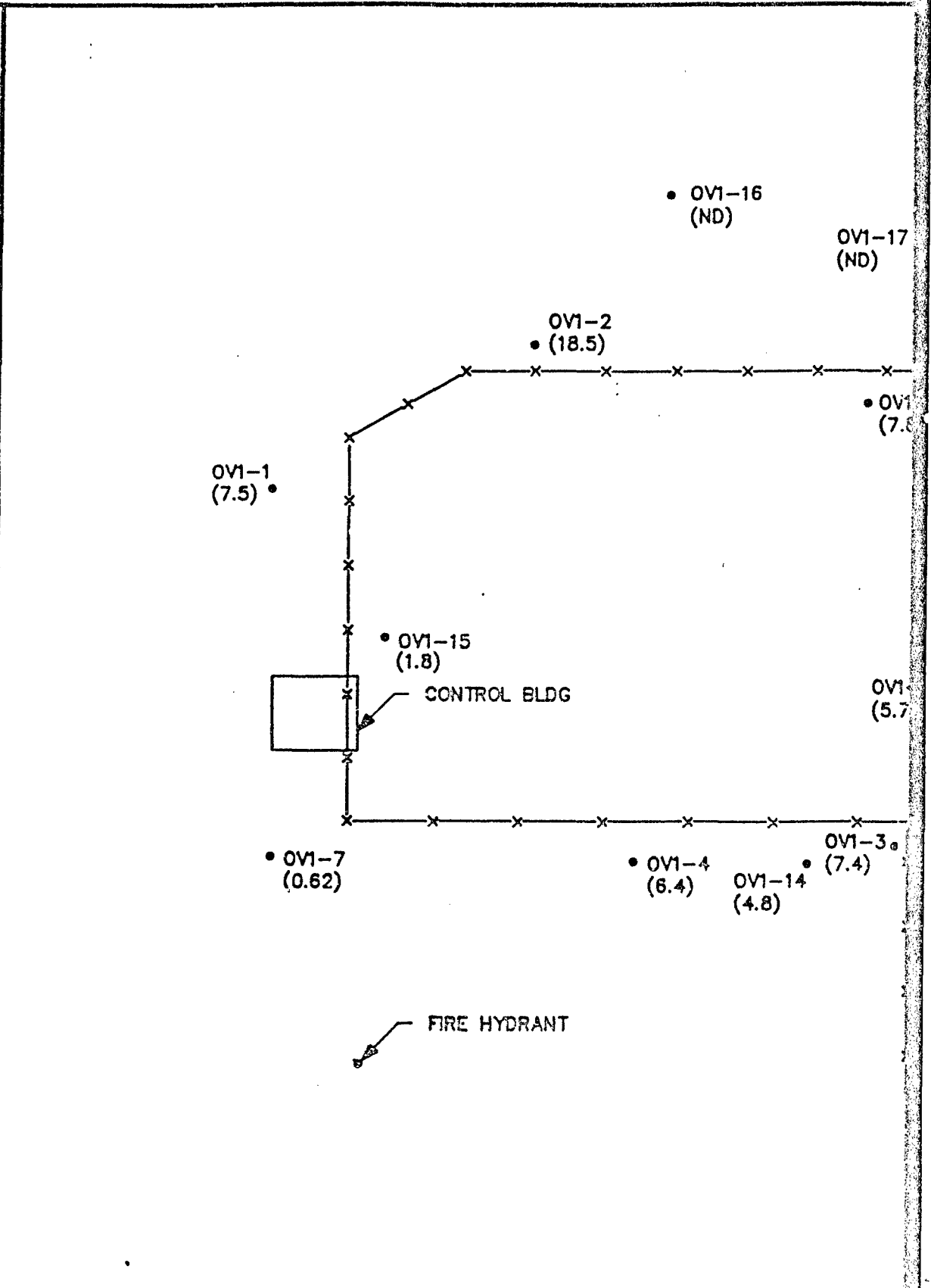
FIELD SAMPLE NUMBER:	OVI-15R	OVI-16	OVI-17	OVI-18
SITE:	1	1	1	1
POINT:	15	16	17	FIELD
DEPTH (FT):	4	4	4	BLANK
MATRIX:	SOIL VAPOR	SOIL VAPOR	SOIL VAPOR	SOIL VAPOR
SAMPLE DATE:	17-JAN-91	17-JAN-91	17-JAN-91	17-JAN-91
BENZENE (UG/L):	1 U	1 U	1 U	1 U
TOLUENE (UG/L):	1 U	1 U	1 U	1 U
ETHYLBENZENE (UG/L):	1 U	1 U	1 U	1 U
M- & P- XYLENES (UG/L):	1 U	1 U	1 U	1 U
O-XYLENE (UG/L):	1 U	1 U	1 U	1 U
TOTAL FID VOC (UG/L):	1 U	1 U	1 U	1 U
DCE (UG/L):	1 U	1 U	1 U	1 U
TCA (UG/L):	0.1 U	0.1 U	0.1 U	0.1 U
PCE (UG/L):	1.9	0.75 B	0.83 B	0.36
TCE (UG/L):	0.1 U	0.1 U	0.1 U	0.1 U
TOTAL DETECTED (UG/L):	1.9	U	U	NA

NOTES

- U = NOT DETECTED AT CONCENTRATION GIVEN
- B = DETECTED IN FIELD BLANK, CONCENTRATION IS LESS THAN 5X THE BLANK CONCENTRATION
- * = LOWEST DAILY BLANK CONCENTRATION
- DCE = 1,1-DICHLOROETHENE
- TCA = 1,1,1-TRICHLOROETHANE
- PCE = TETRACHLOROETHENE
- TCE = TRICHLOROETHENE
- TOTAL FID VOC = SUM OF PEAK AREA FROM FID USING TOLUENE INSTRUMENT RESPONSE FACTOR

1

40972114	04/23/02	Q 35-000	STC	STARTING DATE: 03/29/01	DATE LAC / REV: 3/25/02	DRAFT. CHCK. BY: J. HUBBARD	ENG. NO.: 409721-B-C14
				DRAWN BY: S. TOKAY	DRAWN BY: J. HUBBARD	ENGR. CHCK. BY: D. WILLEN	PROJ. NO.: 409721
						ITERATOR: D. WILLEN	
						PROJ. MGR.: D. WILLEN	



2

• OV1-16
(ND)

• OV1-17
(ND)

SET NAIL
N 10011.0774
E 10795.3604

OV1-2
(18.5)

• OV1-8
(7.8)

• OV1-12
(2.1)

LEGEND:
—x— FENC
• TOT.
(ND) LOC.
NOT

DG

• OV1-9
(5.7)

• OV1-11
(2.6)

• OV1-10
(2.1)

• OV1-15
(1.8)

• OV1-4
(8.4)

• OV1-14
(4.8)

• OV1-3
(7.4)

WT

SCALE:
0 2

FIGURE 3
SOV DISTR

161 AREFG,
SKY HARDG
PHOENIX, AZ



3

SET NAIL
N 10011.0774
E 10795.3604



•
OV1-12
(2.1)

•
OV1-11
(2.6)

•
OV1-10
(2.1) ••
OV1-15
(1.8)

LEGEND:

- x— FENCE LINE
- TOTAL ORGANIC VAPOR SAMPLING LOC. (MICROGRAMS/LITER)
- (ND) NOT DETECTED

SCALE:

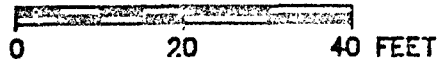


FIGURE 3-11
SOV DISTRIBUTION SITE NO. 1

161 AREFG, ARIZONA ANG
SKY HARBOR IAP
PHOENIX, ARIZONA



was multiplied by five and the resultant concentration was used as a threshold, above which PCE in environmental samples is considered to be representative of site conditions. The blank samples used for each day of sampling are noted with an asterisk (*) in Table 3-4. Although not specifically applied to SOV activities, this method of data assessment is consistent with methods recommended by the U.S. EPA for assessment of blank contaminants in water and soil samples (U.S. EPA, 1989).

This data analysis method yields two samples in which PCE may be attributed to blank contamination, OV1-16 and OV1-17. The remaining samples have PCE above five times the daily field blank minimum and may represent environmental contaminants; however, PCE has not been documented to have been used at the site and therefore, PCE concentrations should be viewed as questionable.

Benzene was detected at Site 1 at a concentration of 1.3 $\mu\text{g/L}$ in sample OV1-2. DCE was detected in samples OV1-3 and OV1-4 at concentrations of 1.4 and 2.2 $\mu\text{g/L}$, respectively. Finally, total FID volatiles of 1.5, 12, and 1.1 $\mu\text{g/L}$ were detected in samples OV1-1, OV1-2, and OV1-8, respectively.

SOV concentrations at Site 1 are all less than 20 $\mu\text{g/L}$ and the spatial distribution does not exhibit a pattern typical of a point source. The SOV screening does not display results typical of a fuel release at the site.

3.3.1.3 Soil Sampling

Four soil borings and one monitoring well boring were drilled at Site 1 to provide soil samples for chemical analysis. Sampling locations are shown in Figure 2-1. Results of field screening of soil samples from Site 1 are presented in Appendix K. No soil samples contained detectable concentrations of target compounds. One sample from soil boring SB1-02, surface to 2-foot depth interval, contained xylenes below detection limits. This sample also contained a nontarget compound in the heavy hydrocarbon range; however, the compound was not quantified or identified.

One soil sample from SB1-05 contained a non-target compound at the 65-foot depth interval. The sample was in the heavy hydrocarbon range but was not quantified or identified.

Based on the field screening results, the two samples discussed above were selected for Level C analyses. Additional samples from each boring were selected for Level C analyses based

on sampling zones providing adequate sample recovery. Table 2-6 presents a tabulation of soil samples sent for Level C analysis.

The absence of PCE in field screening of soil samples is noteworthy due to the repeated detection of PCE in SOV analyses. This suggests that PCE in SOV survey analyses is likely to be related to sampling equipment contamination and not environmental concentrations.

3.3.1.4 Groundwater Sampling

One monitoring well was installed at Site 1 in a position downgradient of the site (MW1-02) (Figure 2-1). Water samples from MW1-02 were collected after development and screened in the field laboratory. Results of this analysis are presented in Figure K-1 in Appendix K. The water sample did not contain target compounds above detection limits; however, DCE, TCE, and toluene were estimated below detection limits.

These compounds and associated concentrations are comparable to background groundwater sample field-screening results; thus, it is likely that the compounds did not originate from Site 1 and a site-specific upgradient well was not installed. Background water quality is provided by the MWS-series wells.

3.3.2 Confirmation and Delineation Activity Results

3.3.2.1 Soil Sampling

Three samples from each boring at Site 1 were submitted for Level C analyses of VOCs, SVOCs, and TPH (Tables 2-4 and 2-6). Table 3-5 presents a summary of detected compounds. Tabulation of all soil sample results for Site 1 is contained in Appendix L. Samples SB1-02-5-7 and SB1-02-25-27 could not be analyzed for VOCs due to a high percentage of gravel and cobble-sized material in the samples.

The only VOC detected in Site 1 soil samples was acetone with the highest concentration of 26 $\mu\text{g}/\text{kg}$ in the 20-21 foot depth sample from SB1-03. Although detection of acetone was not associated with laboratory blank detection, the lack of a source and common detection of acetone in blank samples associated with the project suggests that the presence of acetone in samples is not from environmental contaminants.

TABLE 3-5

SUMMARY OF DETECTED COMPOUNDS
 SITE 1 SOIL BORINGS
 14th ARBFO, PHOENIX, ARIZONA

SAMPLE NUMBER	SBI-02-0-2-01	SBI-02-5-7-01	SBI-02-25-27-01	SBI-03-0-2-01	SBI-03-20-21-01
BORING	SBI-02	SBI-02	SBI-02	SBI-03	SBI-03
DEPTH (FT)	0-2	5-7	25-27	0-2	20-21

DETECTED
 COMPOUND UNITS

VOLATILE ORGANIC COMPOUNDS

Aroclor

ug/g

NOT ANALYZED

NOT ANALYZED

26

SEMI-VOLATILE COMPOUNDS

Benzo(a)pyrene

ug/g

NOT ANALYZED

NOT ANALYZED

ug/g

26

J = Concentration is estimated below reporting limit

E = Concentration is estimated above calibration range

44481-10000

TABLE 3-5
(CONT.)
SUMMARY OF DETECTED COMPOUNDS
SITE 1 SOIL BORINGS
161st AREDO, PHOENIX, ARIZONA

SAMPLE NUMBER	SBI-03-35-37-01	SBI-03-35-37-02	SBI-03-55-57-01	SBI-03-55-57-02	SBI-04-0-2-01
BORING	SBI-03	SBI-03	SBI-03	SBI-03	SBI-04
DEPTH (FT)	35-37	35-37	55-57	55-57	0-2
DETECTED COMPOUND	UNITS				
VOLATILE ORGANIC COMPOUNDS	ug/g				
Acetone	20				
Semi-VOLATILE COMPOUNDS	ug/g				
Bis(2-ethylhexyl) phthalate	130				
PH	mg/L				

J = Concentration is estimated below reporting limit
E = Concentration is estimated above calibration range

04/01/81-184/01/81C

TABLE 3-5
(cont.)

SUMMARY OF DETECTED COMPOUNDS
SITE 1 SOIL BORINGS
161N ARBFG, PHOENIX, ARIZONA

SAMPLE NUMBER	SBI-04-10-12-01	SBI-04-55-57-01	SBI-04-55-57-02	SBI-05-01-01	SBI-05-30-35-01
SORING	SBI-04	SBI-04	SBI-04	SBI-05	SBI-05
DEPTH (FT)	10-12	55-57	55-57	0-1	30-35
DETECTED COMPOUND	UNITS				
VOLATILE ORGANIC COMPOUNDS					
Acetone	ug/g				
SEMI-VOLATILE COMPOUNDS					
1,2-dichloroethane	ug/g				
TPH	mg/g				

NOT ANALYZED

J - Concentration is estimated below reporting limit
E - Concentration is estimated above calibration range

TABLE 3-5
(cont.)

SUMMARY OF DETECTED COMPOUNDS
SITE 1: SOIL BORINGS
161st AREFO, PHOENIX, ARIZONA

SAMPLE NUMBER	531-85-65-79-01	MB1-02-0-2-01	MB1-02-0-2-02	MB1-02-35-37-01	MB1-02-75-77-01
BORING	531-85	MB1-02	MB1-02	MB1-02	MB1-02
DEPTH (FT)	65-79	0-2	0-2	35-37	75-77
DETECTED COMPOUND	UNITS				
VOLATILE ORGANIC COMPOUNDS					
Acetone				13	16
SEMIVOLATILE COMPOUNDS					
Benzene				80 J	
THM			16		

J = Concentration is estimated below reporting limit
E = Concentration is estimated above calibration range

MLPTM-VOLATILE

The SVOC bis(2-ethylhexyl)phthalate was detected in the 35- to 37-foot bgl sample from monitoring well boring MB1-02 at an estimated concentration of 80 $\mu\text{g}/\text{kg}$. The compound was not detected in other samples from the site.

TPH detections occurred in four soil samples from Site 1 above the quantitation limit of 1 mg/kg. SB1-02 surface sample contained 26 mg/kg, SB1-04 surface sample contained 330 mg/kg, SB1-05 30- to 35-foot depth sample contained 14 mg/kg, and MB1-02 surface sample contained 16 mg/kg.

3.3.2.2 Groundwater Sampling

One monitoring well, MW1-02, was installed downgradient of Site 1 (Figure 2-1). The well was sampled and analyzed for VOCs, SVOCs, and TPH; a summary of detected compounds is presented in Table 3-6 and results of all analyses are presented in Appendix M. Two compounds were identified in the initial sample and are estimated below quantitation limits. 1,2-DCE and TCE were estimated to be present at 3 and 1 $\mu\text{g}/\text{L}$, respectively. The confirmation sampling detected the same compounds at 5 $\mu\text{g}/\text{L}$ and an estimated 2 $\mu\text{g}/\text{L}$, respectively.

3.3.3 Geologic and Hydrogeologic Investigation Results

Soil borings and monitoring well borings drilled at Site 1 indicate the presence of sandy to gravelly deposits under the site. Deposits of fine-grained materials that may preclude vertical migration of contaminants were not identified in any of the five borings at the site. The nature of deposits under Site 1 is consistent with the remainder of the Base.

Groundwater occurs in the Site 1 well approximately 76 to 77 feet bgl. Based on potentiometric maps of the Base, MW1-02 is located directly downgradient of Site 1. A slug test was conducted on MW1-02, resulting in a calculated hydraulic conductivity of 5.3×10^{-2} cm/s.

3.3.4 Data Gaps

SOV and soil boring distribution around Site 1 provide coverage to detect probable releases from the site associated with surface spillage. Soil sample recovery at Site 1 was not as high as anticipated during project plan preparation and thus, gaps in geologic, stratigraphic, and chemical results have occurred relative to a 100 percent complete data set. However, because soil samples were recovered from below 50 to 55 feet in all borings except SB1-02,

TABLE 3-6

**SUMMARY OF DETECTED COMPOUNDS
SITE 1 MONITORING WELLS
161st AREFG, PHOENIX, ARIZONA**

		LOCATION:	MW1-02	MW1-02
		DATE:	APR-91	JUN-91
DETECTED COMPOUND	UNITS			
VOCs				
1,2-Dichloroethylene	ug/l	3 J	5	
Trichloroethene	ug/l	1 J	2 J	
SVOCs				
INORGANIC COMPOUNDS				
		NOT ANALYZED	NOT ANALYZED	NOT ANALYZED
TPH				

010413-860407p

mg/l

U = Compound not detected

J = Estimated value

E = Estimated value

and the lack of environmental contaminants in recovered samples, sample recovery is thought to be sufficient on which to base conclusions regarding distribution of site-related contaminants. Groundwater chemical-data for Site 1 are complete with no data gaps identified.

3.3.5 Conclusions

SOV data indicate the presence of PCE, benzene, and DCE in soil vapor at Site 1. Field screening of soil samples indicated one sample from SB1-02 contained low ppb concentrations of xylenes and Level C analysis of soil samples indicated the presence of TPH, acetone, and bis(2-ethylhexyl)phthalate in soils. Based on these results, detection of TPH in soils at Site 1 are considered to be the primary environmental contaminants related to the site. The horizontal and vertical extent of TPH in the soil is limited to the surface to 2-foot bgl interval in SB1-02, SB1-04, and MB1-02. Samples from SB1-04 and MB1-02 provide direct evidence that TPH does not exist throughout the soil column at detectable concentrations. Although Level C results below a depth of 2 feet bgl are not available from SB1-02, field screening data suggest associated target compounds are not present below the 2-foot bgl interval. One occurrence of TPH was detected below the surface to 2-foot bgl interval. SB1-05-30-35 contained 14 mg/kg of TPH; samples from below this depth did not indicate the presence of TPH. Given the data presented, it is unlikely that past environmentally-significant releases of target compounds have occurred from Site 1.

Three compounds were detected above background concentrations in soil samples at Site 1:

- Acetone
- Bis(2-ethylhexyl)phthalate
- TPH.

Occurrences of these compounds are localized and do not indicate widespread contamination. Acetone and bis(2-ethylhexyl)phthalate are common laboratory contaminants (U.S. EPA, 1989); however, these compounds were not detected in associated blank samples and, therefore, must be treated as environmental contaminants.

Groundwater at Site 1 does not contain site-related compounds. 1,2-DCE and TCE were identified in concentrations at or below detection limits in both water samples. Given the low concentrations, the lack of detection of either compound in soil samples, and detection of the same compounds in similar concentrations in background wells during the initial groundwater sampling, it is unlikely that the occurrence of 1,2-DCE and TCE in groundwater are related to Site 1.

3.4 Site 2 - 161AREFG Hazardous Waste Storage Area

3.4.1 Screening Activity Results

3.4.1.1 Geophysical Survey

Geophysical survey activities related to Site 2 were limited to delineation of subsurface structures for clearance of intrusive sampling locations. In general, sampling locations were cleared using a line locator and GPR. Discussion of methods and results are presented in the Geophysical survey report contained in Appendix C.

3.4.1.2 SOV Survey

Total SOV concentrations at Site 2 range from 6.9 $\mu\text{g/L}$ at location OV2-2 to 1.2 $\mu\text{g/L}$ at OV2-8. Results of specific analytes at each sampling point and analytical detection limits are shown in Table 3-7 and the spatial distribution of total SOV content is depicted in Figure 3-12. Generally, total SOV concentrations are very low and are slightly higher in the storage area vicinity; however, they are not indicative of a large release.

DCE was detected in eight samples ranging in concentration up to a maximum of 1.7 $\mu\text{g/L}$. PCE was detected in all environmental samples, ranging from 1.3 to 5.6 $\mu\text{g/L}$. As with Site 1, PCF is also associated with field blank detection and should be viewed as questionable. No aromatic target compounds were identified in Site 2 SOV.

3.4.1.3 Soil Sampling

Three soil borings and one monitoring well boring were drilled to provide soil samples at Site 2 (Figure 2-2). Results of field screening of soil samples from Site 2 are presented in Appendix K. Target compounds were not detected in any sample from soil borings. One sample from the monitoring well boring (MB2-02) surface to 2-foot depth interval contained benzene and xylenes at estimated concentrations below detection limits. This sample also detected nontarget heavy hydrocarbons; however, the compounds were not quantified or identified.

The surface sample from MB2-02 was slated for Level C analyses, as well as three samples each from borings SB2-01, -02, and -04. Note also that soil samples from SB2-01 did not contain detectable concentrations of halogenated compounds identified in the SOV survey.

TABLE 3-7

SOV SURVEY RESULTS
SITE 2
161st AREFG, PHOENIX, ARIZONA

FIELD SAMPLE NUMBER:	OV2-1	OV2-2	OV2-3	OV2-4	OV2-5
SITE:	2	2	2	2	2
POINT:	FIELD	2	3	4	5
DEPTH (FT):	BLANK	10	10	10	10
MATRIX:	SOIL VAPOR	SOIL VAPOR	SOIL VAPOR	SOIL VAPOR	SOIL VAPOR
SAMPLE DATE:	15-JAN-91	15-JAN-91	15-JAN-91	15-JAN-91	15-JAN-91
BENZENE (UG/L):	1U	1U	1U	1U	1U
TOLUENE (UG/L):	1U	1U	1U	1U	1U
ETHYLBENZENE (UG/L):	1U	1U	1U	1U	1U
M- & P-XYLENES (UG/L):	1U	1U	1U	1U	1U
O-XYLENE (UG/L):	1U	1U	1U	1U	1U
TOTAL FID VOC (UG/L):	1U	1U	1U	1U	1U
DCE (UG/L):	1U	1.3	1.6	1.7	1.6
TCA (UG/L):	0.1U	0.1U	0.1U	0.1U	0.1U
PCE (UG/L):	4	5.6	4.5	3.2	4
TCE (UG/L):	0.1U	0.1U	0.1U	0.1U	0.1U
TOTAL DETECTED (UG/L):	NA	6.9	6.1	4.9	5.6

NOTES

- U = NOT DETECTED AT CONCENTRATION GIVEN
- B = DETECTED IN FIELD BLANK, CONCENTRATION IS LESS THAN 5X THE BLANK CONCENTRATION
- * = LOWEST DAILY BLANK CONCENTRATION
- DCE = 1,1-DICHLOROETHENE
- TCA = 1,1,1-TRICHLOROETHANE
- PCE = TETRACHLOROETHENE
- TCE = TRICHLOROETHENE
- TOTAL FID VOC = SUM OF PEAK AREA FROM FID USING TOLUENE INSTRUMENT RESPONSE FACTOR

048813-91a/wjpe

TABLE 3-7

(cont.)

SOV SURVBY RESULTS

SIB 2

161st AREFG, PHOENIX, ARIZONA

FIELD SAMPLE NUMBER:	OV2-6	OV2-7	OV2-8	OV2-9	OV2-10	OV2-10R
SITE:	2	2	2	2	2	2
POINT:	6	7	8	9	10	10
DEPTH (FT):	10	9	10	10	9	9
MATRIX:	SOIL VAPOR	SOIL VAPOR	SOIL VAPOR	SOIL VAPOR	SOIL VAPOR	SOIL VAPOR
SAMPLE DATE:	15-JAN-91	15-JAN-91	15-JAN-91	15-JAN-91	15-JAN-91	15-JAN-91
BENZENE (UG/L):	1U	1U	1U	1U	1U	1U
TOLUENE (UG/L):	1U	1U	1U	1U	1U	1U
ETHYLBENZENE (UG/L):	1U	1U	1U	1U	1U	1U
M- & P- XYLENES (UG/L):	1U	1U	1U	1U	1U	1U
O-XYLENE (UG/L):	1U	1U	1U	1U	1U	1U
TOTAL FID VOC (UG/L):	1.1	1.5	1.2	1.2	1.2	1.2
DCE (UG/L):	1.2	1.5	1.2	1.2	1.2	1.2
TCA (UG/L):	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U
PCE (UG/L):	1.9B	2.1B	1.5B	2.6	2.4	2.4
TCE (UG/L):	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U
TOTAL DETECTED (UG/L):	2.3	1.5	1.2	2.6	2.4	2.4

NOTES

U = NOT DETECTED AT CONCENTRATION GIVEN

B = DETECTED IN FIELD BLANK, CONCENTRATION IS LESS THAN 5X THE BLANK CONCENTRATION

* = LOWEST DAILY BLANK CONCENTRATION

DCE = 1,1-DICHLOROETHENE

TCA = 1,1,1-TRICHLOROETHANE

PCE = TETRACHLOROETHENE

TCE = TRICHLOROETHENE

TOTAL FID VOC = SUM OF PEAK AREA FROM FID USING TOLUENE INSTRUMENT RESPONSE FACTOR

TABLE 3-7

(cont.)

SOV SURVEY RESULTS

SITE 2

161st AREFG, PHOENIX, ARIZONA

FIELD SAMPLE NUMBER:	OV2-11	OV2-12	OV2-13	OV2-14	OV2-14R	OV2-15
SITE:	2	2	2	2	2	2
POINT:	11	12	FIELD	14	14	FIELD
DEPTH (FT):	9	10	BLANK	10	10	BLANK
MATRIX:	SOIL VAPOR	SOIL VAPOR	SOIL VAPOR	SOIL VAPOR	SOIL VAPOR	SOIL VAPOR
SAMPLE DATE:	15-JAN-91	15-JAN-91	15-JAN-91	16-JAN-91	16-JAN-91	16-JAN-91
BENZENE (UG/L):	1U	1U	1U	1U	1U	1U
TOLUENE (UG/L):	1U	1U	1U	1U	1U	1U
ETHYLBENZENE (UG/L):	1U	1U	1U	1U	1U	1U
M- & P- XYLENES (UG/L):	1U	1U	1U	1U	1U	1U
O- XYLENE (UG/L):	1U	1U	1U	1U	1U	1U
TOTAL FID VOC (UG/L):	1U	1U	1U	1U	1U	1U
DCE (UG/L):	1U	1.5	1U	1U	1U	1U
TCA (UG/L):	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U
PCE (UG/L):	3.3	2.6	1.3	2.7	2.5	0.45
TCE (UG/L):	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U
TOTAL DETECTED (UG/L):	3.3	4.1	NA	2.7	2.5	NA

48111-1-91

NOTES

U = NOT DETECTED AT CONCENTRATION GIVEN

B = DETECTED IN FIELD BLANK, CONCENTRATION IS LESS THAN 5X THE BLANK CONCENTRATION

* = LOWEST DAILY BLANK CONCENTRATION

DCE = 1,1-DICHLOROETHENE

TCA = 1,1,1-TRICHLOROETHANE

PCE = TETRACHLOROETHENE

TCE = TRICHLOROETHENE

TOTAL FID VOC = SUM OF PEAK AREA FROM FID USING TOLUENE INSTRUMENT RESPONSE FACTOR

STARTING DATE: 03/05/91	DATE LAST REV: 3/25/92	DRAFT. CHK. BY: J. HUBBARD	DWG. NO.: 409721-B-C09
DRAWN BY: S. CARDWELL	DRAWN BY: J. HUBBARD	ENGR. CHK. BY: D. WILLEN	PROJ. NO.: 409721
INITIATOR: D. WILLEN		PROJ. MGR.: D. WILLEN	

40972100 04/23/92 0:38pm STC

LEGEND:

- TOTAL ORGANIC VAPOR SAMPLING LOCATION (MICROGRAMS/LITER)

SCALE:

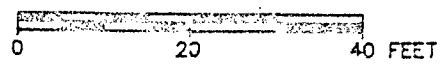
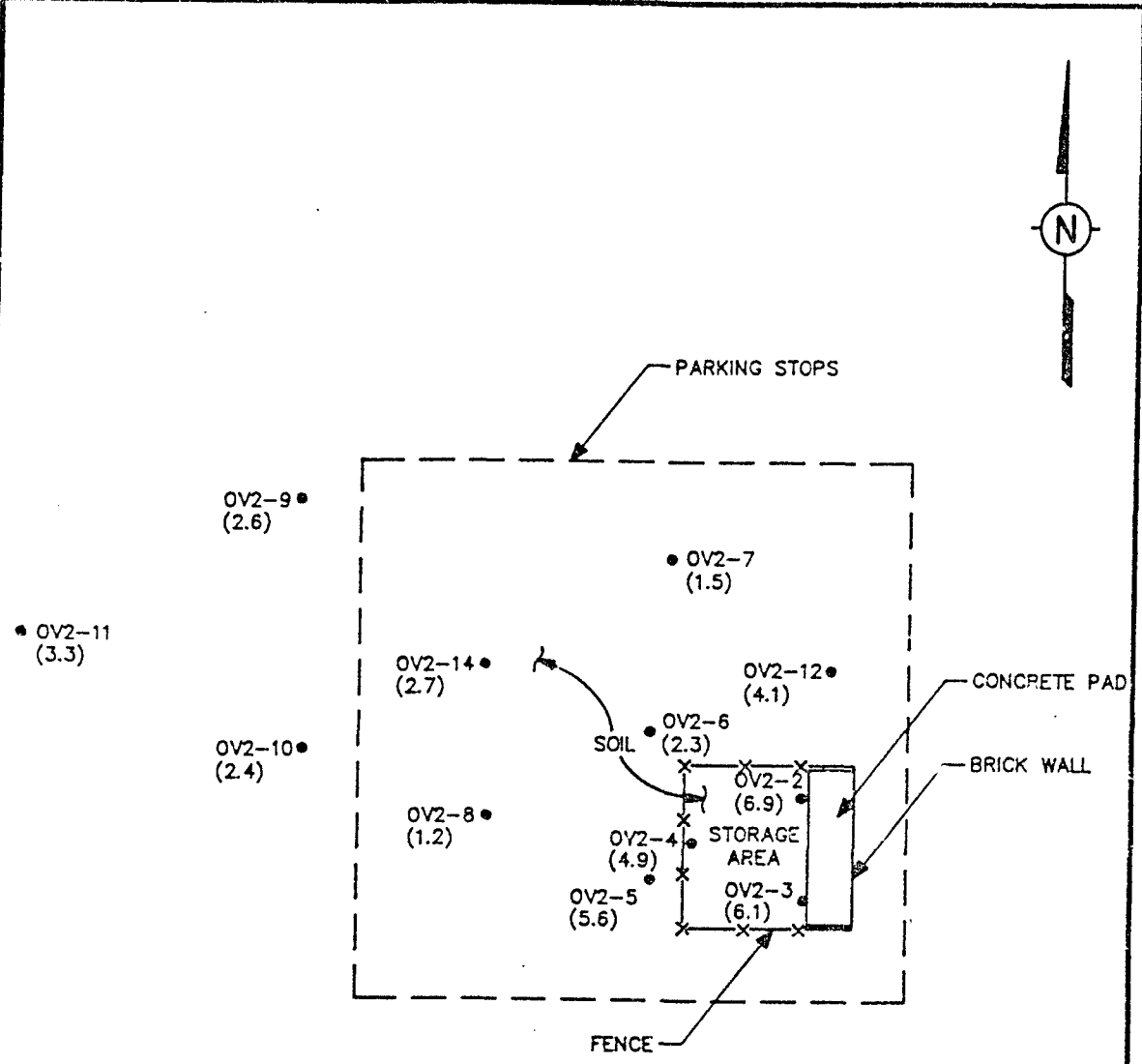


FIGURE 3-12
SOV DISTRIBUTION SITE NO. 2

161 AREFG, ARIZONA ANG
SKY HARBOR IAP
PHOENIX, ARIZONA



3.4.1.4 Groundwater Sampling

One sample of groundwater was collected for field screening after well installation and development; results of the screening analysis are presented in Figure K-1 in Appendix K. The sample from MW2-02 contained TCE, toluene, and xylenes. Additionally, DCE, benzene, and ethylbenzene were detected below detection limits at estimated concentrations. Similar to Site 1, these compounds and concentrations are comparable to background values, and given the lack of soil contaminants present at the site, an upgradient monitoring well was not installed.

3.4.2 Confirmation and Delineation Activity Results

3.4.2.1 Soil Sampling

Three samples from each soil boring and monitoring well at Site 2 were submitted for Level C analysis. Samples were selected based on site related contaminants indicated by field screening and available recovered sample. Table 2-7 lists samples submitted for Level C analyses. Sample SB2-01-50-52 was not analyzed for SVOCs due to insufficient sample volume.

Organic Analysis. Table 3-8 presents detected compounds from Site 2 samples. Acetone, chlorobenzene, and toluene were each detected in a sample. Chlorobenzene was identified in the 55- to 57-foot depth sample from SB2-01 at an estimated concentration of one $\mu\text{g}/\text{kg}$. This sample also contained an estimated 1 $\mu\text{g}/\text{kg}$ of toluene. Neither of these compounds was detected in samples above the 55- to 57-foot depth; deeper samples were not recovered in sufficient volume for laboratory analysis. Acetone was detected in SB2-04 at the 55- to 57-foot and 70- to 72-foot bgl intervals at concentrations of 17 and 14 $\mu\text{g}/\text{kg}$, respectively. The detections were not associated with detections in blank samples.

Five SVOCs were detected in soil samples from the site. Benzoic acid was identified in an estimated concentration of 100 $\mu\text{g}/\text{kg}$ in the surface sample from SB2-01. Diethylphthalate was identified at an estimated concentration of 52 $\mu\text{g}/\text{kg}$ in the 10- to 12-foot depth sample from SB2-02. Benzo(a)pyrene and benzo(k)fluoranthene were detected in the surface sample from the monitoring well boring, and bis(2-ethylhexyl) phthalate was detected in the 70- to 72-foot depth sample from the monitoring well boring.

TPH detections of 210 and 30 mg/kg were identified in surface samples from SB2-01 and MB2-02, respectively. TPH was not detected in deeper samples from the borings.

TABLE 3-8
SUMMARY OF DETECTED COMPOUNDS
SITE 2 SOIL BORINGS
161st AREFB, PHOENIX, ARIZONA

SAMPLE NUMBER	SB2-01-0-2-01	SB2-01-50-52-01	SB2-01-55-57-01	SB2-02-0-2-01
BORING	SB2-01	SB2-01	SB2-01	SB2-02
DEPTH (FT)	0-2	50-52	55-57	0-2
DETECTED COMPOUND	UNITS			
VOLATILE ORGANIC COMPOUNDS		NOT ANALYZED		
Acetone	ug/kg			
Chlorobenzene	ug/kg			1 J
Toluene	ug/kg			1 J
SEMIVOLATILE COMPOUNDS		NOT ANALYZED		
Benzo(a) pyrene	ug/kg			
Benzo(k) fluoranthene	ug/kg			
Benzoic Acid	ug/kg	100 J		
Dicthyl pthalate	ug/kg			
Bis(2-ethylhexyl) pthalate	ug/kg			
INORGANIC COMPOUNDS				
Aluminum	mg/kg	1200	6200	5550
Antimony	mg/kg			12400
Arsenic	mg/kg	7 J	3.9 J	3 J
Barium	mg/kg	130	35.9 J	53.1
Beryllium	mg/kg	0.6 J	0.51 J	
Cadmium	mg/kg			
Calcium	mg/kg	27400	2790	2310
Chromium	mg/kg	20.5 J	11.9 J	37.2 J
Cobalt	mg/kg	10.6	6.8 J	4.2 J
Copper	mg/kg	44.9 J	35.2 J	51.2 J
Iron	mg/kg	17200	9320	6860
Lead	mg/kg	33.5 J	2.4 J	2.1 J
Magnesium	mg/kg	9360	2710	2570
Manganese	mg/kg	361	274	272
Nickel	mg/kg	25.2	10.8	11.1
Potassium	mg/kg	3420 J	693 J	569 J
Silver	mg/kg	1.4 J	1.2 J	
Sodium	mg/kg	713 J	189 J	174 J
Vanadium	mg/kg	36.4 J	19.8 J	14.6 J
Zinc	mg/kg	79 J	75 J	64.7 J
TPH	mg/kg	310		

J = Concentration is estimated below reporting limit
E = Concentration is estimated above calibration range

TABLE 3-8
(cont.)
SUMMARY OF DETECTED COMPOUNDS
SITE 2 SOIL SPRINGS
161st AREPO, PHOENIX, ARIZONA

SAMPLE NUMBER	SR2-02-19-12-91	SR2-02-79-72-91	SR2-04-0-2-01	SR2-04-15-17-01
HORIZON	SR2-02	SR2-02	SR2-04	SR2-04
DEPTH (FT)	18-12	73-71	0-2	15-17
DETECTED COMPOUND	UNITS			
VOLATILE ORGANIC COMPOUNDS				
Acetone	ug/kg			
Chlorobenzene	ug/kg			
Toluene	ug/kg			
SEMIVOLATILE COMPOUNDS				
Benzo(a)pyrene	ug/kg			
Benzo(k)fluoranthene	ug/kg			
Benzoic Acid	ug/kg			
Diethyl phthalate	ug/kg	52 J		
Bis(2-ethylhexyl) phthalate	ug/kg			
INORGANIC COMPOUNDS				
Aluminum	mg/kg	5400	7310	13000
Antimony	ug/kg			NOT ANALYZED
Arsenic	ug/kg	4.2 J	8.7 J	10 J
Barium	ug/kg	68.5 J	102 J	143 J
Beryllium	ug/kg			
Cadmium	ug/kg			
Calcium	ug/kg	14700 J	3780	31700 J
Carbonium	ug/kg	17.3	22.6	25.8
Cobalt	ug/kg	8.1 J	11.5	12.3
Copper	ug/kg	25.5 J	67.8 J	35.4
Iron	ug/kg	14700	15290	20700
Lead	ug/kg	3.2 J	3.2 J	6.5 J
Magnesium	ug/kg	4900 J	3850 J	10700 J
Manganese	ug/kg	179 J	414 J	587 J
Nickel	ug/kg	14.9	15.6	28.2
Potassium	ug/kg	914 J	893 J	3580 J
Silver	ug/kg	1.4 J		3.7 J
Selenium	ug/kg	577 J	729 J	1110 J
Vanadium	ug/kg	41.2 J	41.2 J	44.7 J
Zinc	ug/kg	27.8 J	47.5 J	51.2 J
TTH	ug/kg			

J = Concentration is estimated below reporting limit

E = Concentration is estimated above calibration range

TABLE 3-4
(cont.)
SUMMARY OF DETECTED COMPOUNDS
SITE 2 SOIL BORINGS
1614 ARBFO, PHOENIX, ARIZONA

SAMPLE NUMBER	SE2-04-33-17-01	SE2-04-70-72-01	ME2-71-0-2-01	ME2-02-30-32-01	ME2-02-70-72-01
BORING	SE2-04	SE2-04	ME2-02	ME2-02	ME2-02
DEPTH (FT)	33-37	70-72	0-2	30-32	70-72
DETECTED COMPOUND					
UNITS					
VOLATILE ORGANIC COMPOUNDS					
Acetone	ug/kg	17	14		
Chlorobenzene	ug/kg				
Toluene	ug/kg				
SEMIVOLATILE COMPOUNDS					
Benz(a)pyrene	ug/kg			45 J	
Benzo(k)fluoranthene	ug/kg			47 J	
Benzoic Acid	ug/kg				
Octyl phosphate	ug/kg				
Bis(2-ethylhexyl) phosphate	ug/kg				84 J
INORGANIC COMPOUNDS					
Aluminum	mg/kg	13660	4570	8910	2000
Antimony	mg/kg				4.5 J
Arsenic	mg/kg	6.8 J	4 J	6.4 J	3.1 J
Barium	mg/kg	152 J	26.1 J	115	27.1 J
Beryllium	mg/kg	0.72 J	0.45 J	0.30 J	0.21 J
Cadmium	mg/kg			1.3	
Calcium	mg/kg	2030 J	2430	22500 J	1470 J
Chromium	mg/kg	35.9	8 J	39.8	5
Cobalt	mg/kg	11.4	4.5 J	9.4 J	3.3 J
Copper	mg/kg	71.9 J	24.4 J	39.2 J	19 J
Iron	mg/kg	19100	7570	15900	4230 J
Lead	mg/kg	5.2 J	2.6 J	154	3.3 J
Magnesium	mg/kg	5430	2400	8230 J	2930 J
Manganese	mg/kg	720	120	334	94.7
Nickel	mg/kg	35.9	7.5 J	23.8	6.4 J
Potassium	mg/kg	1130 J	694 J	2190 J	543 J
Silver	ug/kg	1.3 J	0.93 J	1.3 J	
Sodium	mg/kg	130 J	185 J	299 J	22.5 J
Vanadium	mg/kg	34.1 J	15.3 J	33.9	12.4
Zinc	mg/kg	130 J	43.9 J	127 J	30.6 J
TPM	mg/kg			50	

J = Concentration is indicated below reporting limit
E = Concentration is indicated above calibration range

Inorganic Analysis. Table 3-8 also presents results of inorganic analytes in samples from Site 2. Aluminum was detected above the maximum background concentration of 10,400 mg/kg in three soil samples with concentrations of 12,400, 13,000, and 13,600 mg/kg. Arsenic was detected above the background of 8.2 mg/kg in two samples, ranging from 8.3 to 10 mg/kg. Beryllium was detected above the 0.55 mg/kg background value in one sample from SB2 at an estimated concentration of 0.6 mg/kg. Calcium was detected above the 32,800 mg/kg background level in one sample at a concentration of 33,100 mg/kg. Lead was detected in two samples above the 18.4 mg/kg background concentration at 33.5 and 154 mg/kg in surface samples from SB2-01 and MB2-02, respectively. Magnesium was detected above the 10,200 mg/kg background value with concentrations of 11,200 and 10,700 mg/kg. Manganese and nickel were each detected above their 463 and 31.1 mg/kg background concentrations in SB2-04 at concentrations of 720 and 35.9 mg/kg, respectively. Potassium was detected above the 1,700 mg/kg background level in three samples ranging from 2,970 to 3,580 mg/kg. Silver was detected with 3.7 mg/kg in SB2-04 compared to the background maximum of 2.6 mg/kg. Sodium was detected above the 726 mg/kg background concentration in two samples at concentrations of 1,110 and 1,180 mg/kg. Finally, zinc was detected above the 79.6 mg/kg background concentration in two samples that ranged from approximately 127 to 130 mg/kg.

3.4.2.2 Groundwater Sampling

One monitoring well (MW2-02) was installed and sampled downgradient of Site 2 (Figure 2-2). The sample was analyzed for VOA, SVOA, TPH, and TAL metals. A summary of detected compounds is presented in Table 3-9. The sample contained 7 µg/L of 1,2-DCE, 5 µg/L of TCE, and an estimated 1 µg/L of 1,1-dichloroethane (1,1-DCA). The confirmation sampling identified only estimated concentrations of 1,2-DCE (2 µg/L) and TCE (1 µg/L). Sodium and vanadium were the only inorganic constituents identified in concentrations above background at concentrations of 146,000 and 11.1 µg/L, respectively.

3.4.3 Geologic and Hydrologic Investigation Results

Geologic investigations at Site 2 are comparable to the Base background and Site 1. The site is underlain by heterogeneous mixtures of sand and gravel likely associated with the Salt River. Groundwater occurs at the site at a depth of approximately 76 feet below the surface.

TABLE 3-9

SUMMARY OF DETECTED COMPOUNDS
 SITE 2 MONITORING WELLS
 161st AREFG, PHOENIX, ARIZONA

LOCATION:	MW2-02	MW2-02
DATE:	APR-91	JUN-91
DETECTED COMPOUND	UNITS	
VOCs		
1,1-Dichloroethane	ug/l	1 J
1,2-Dichloroethylene	ug/l	7 2 J
Trichloroethene	ug/l	5 1 J
SVOCs		
INORGANIC COMPOUNDS		
Aluminum	ug/l	59.8 J
Arsenic	ug/l	6.7 J 5.5 J
Barium	ug/l	47.4 J 46.5 J
Calcium	ug/l	51400 50600
Copper	ug/l	13.2 J 21.2 J
Iron	ug/l	18.4 J 15.8 J
Magnesium	ug/l	19900 20000
Potassium	ug/l	4370 J 5200
Silver	ug/l	6.6 J
Sodium	ug/l	146000 146000 J
Vanadium	ug/l	11.1 J
Zinc	ug/l	36.8 21.6 J
Nitrate/	mg/l	NOT ANALYZED NOT ANALYZED
Nitrite	mg/l	
TPH	mg/l	1

cd:slj - C:\acopy

U = Compound not detected

J = Estimated value

E = Estimated value

3.4.4 Data Gaps

No data gaps are identified for Site 2. SOV and soil boring data are vertically and horizontally distributed to provide adequate site coverage. Groundwater data are complete as planned.

3.4.5 Conclusions

SOV analysis at Site 2 indicated the presence of low $\mu\text{g/L}$ concentrations of DCE and PCE in the soil. Field screening of soils indicates low ppb concentrations of benzene and xylenes in the surface to 2-foot bgl interval of MB2-02. Level C analyses did not confirm these results. Soil samples submitted for Level C analyses resulted in detection of two SVOCs and TPH at the surface to 2-foot bgl interval of MB2-02. These compounds were not identified at depth within the boring. SB2-01 contained an estimated 1 ppb of two VOCs at the 55- to 57-foot bgl interval. Finally, SB2-04 contained acetone at the 55- to 57- and 70- to 72-foot bgl intervals.

SI data are not representative of a widespread release of site-related contaminants. The data may be indicative of past small surface spillage in localized areas. The following compounds and analytes were identified in at least one sample in concentrations above background:

- Acetone
- Chlorobenzene
- Toluene
- TPH
- Benzo(a)pyrene
- Benzo(k)fluoranthene
- Benzoic acid
- Diethylphthalate
- Bis(2-ethylhexyl)phthalate
- Aluminum
- Arsenic
- Beryllium
- Calcium
- Cadmium
- Lead
- Magnesium
- Manganese
- Nickel
- Potassium
- Silver
- Zinc.

These metals are only slightly above background concentrations as discussed in Section 3.4.2.1.

Groundwater analyses detected and confirmed low $\mu\text{g/L}$ concentrations of 1,2-DCE and TCE; one detection of 1,1-DCA was not confirmed. Similar concentrations of these compounds were detected at Site 1 and in initial sampling of the background wells and are not thought to be associated with Site 2. Additionally, none of the organic compounds identified in soil samples was determined to be present in groundwater at Site 2. Given the previous discussion, the following compounds and analytes were detected above background concentrations in at least one sample from Site 2 groundwater samples:

- 1,1-DCA
- 1,2-DCE
- Sodium
- Zinc.

3.5 Site 3 - Fuel Bladder Area

3.5.1 Screening Activity Results

3.5.1.1 Geophysical Survey

Geophysical survey activities related to Site 3 were limited to delineation of subsurface structures for clearance of intrusive sampling locations. In general, sampling locations were cleared using a line locator and GPR. A discussion of methods and results is presented in the geophysical survey report contained in Appendix C.

3.5.1.2 SOV Survey

Geologic conditions at Site 3 prevented conducting the SOV survey. Large cobbles are present at the ground surface to at least a depth of 3 to 4 feet. Penetration of the cobble layer was attempted three times, resulting in destruction of the sampling equipment each time.

3.5.1.3 Soil Sampling

Three soil borings and two monitoring well borings were drilled at Site 3 to provide soil samples for chemical analyses. Figure 2-3 depicts sampling locations. Results of screening analysis of soil samples from Site 3 are presented in Appendix K. Aromatic and halogenated compounds were detected in selected samples from each boring. SB5-01 contained DCE in

the 35-foot depth interval sample and xylenes estimated below detection limits in the 45-foot depth sample. Toluene was detected in the 65-foot depth sample and TCE, PCE, ethylbenzene, and xylenes were estimated below detection limits. PCE and toluene were detected in the 70-foot depth interval sample.

Samples from SB3-03 contained TCE below detection limits in samples from 20- and 35-foot depth intervals, and xylenes were detected at the 35-foot depth interval.

Samples from SB3-04 contained benzene and TCE at the surface and estimated concentrations, below detection limits, of ethylbenzene and xylenes at the 70-foot depth interval. MB3-01 contained DCE in the 60-foot depth interval and MB3-02 did not contain detectable concentrations of target compounds.

Samples selected for Level C analyses are summarized in Table 2-8. Due to limited sample recovery, samples from intervals containing the highest screening results were not always available for laboratory analysis.

3.5.1.4 Groundwater Sampling

Two monitoring wells were installed in conjunction with the Site 3 investigation: MW3-01 upgradient from the site, and MW3-02 downgradient from the site. Results of field screening of water samples are displayed in Figure K-1 in Appendix K. The upgradient well, MW3-01 contained benzene and toluene; TCE and ethylbenzene were also estimated below detection limits. The downgradient well, MW3-02, contained concentrations of DCE and TCE estimated below detection limits.

Based on field screening information, it appears that an upgradient source may be contributing to the presence of target compounds in groundwater at Site 3. All wells at the site were sampled for Level C analyses.

3.5.2 Confirmation and Delineation Activity Results

3.5.2.1 Soil Sampling

Soil sampling from Site 3 is provided in Table 2-8 and results are presented in Table 3-10. In addition to acetone and methylene chloride, discussed earlier, three VOCs were identified in soil samples from Site 3. Ethylbenzene, toluene, or xylenes were detected in at least one sample from soil borings. The compounds were not detected in samples from MB3-02.

TABLE 3-10

SUMMARY OF DETECTED COMPOUNDS
SITE 3 SOIL BORINGS
16th ARIFO, PHOENIX, ARIZONA

SAMPLE NUMBER	SB3-01-0-1.5-01	SB3-01-50-51.5-01	SB3-01-70-71.5-01	SB3-03-0-1.5-01	SB3-03-10-11.5-01
BORING	SB3-01	SB3-01	SB3-01	SB3-03	SB3-03
DEPTH (FT)	0-1.5	50-51.5	70-71.5	0-1.5	10-11.5
DETECTED COMPOUND	UNITS				
VOLATILE ORGANIC COMPOUNDS					
Ethylbenzene			16		
Toluene	2 J		21		
Total Xylenes			150		
SEMI-VOLATILE COMPOUNDS					
Benzoic Acid					
Chrysene					38 J
Dibenzophthalene					56 J
Fluoranthene					97 J
Pyrene					71 J
TPH	30			46	50
Organic Lead					

J = Concentration is estimated below reporting limit
E = Concentration is estimated above calibration range

TABLE 3-10
(cont.)
SUMMARY OF DETECTED COMPOUNDS
SITE 3 SOIL BORINGS
1614 ARESO, PHOENIX, ARIZONA

SAMPLE NUMBER	DEPTH (FT)	SEB-03 20-715	SEB-04-0-13-01 SEB-04 0-15	SEB-04-5-8.5-01 SEB-04 5-8.5	SEB-04-15-16.5-01 SEB-04 15-16.5	SEB-01-0-13-01 SEB-01 0-13	UNITS
VOLATILE ORGANIC COMPOUNDS							
Dichloromethane							ug/g
Trichloroethene							ug/g
Total Xylenes							ug/g
SEMI-VOLATILE COMPOUNDS							
Benzoic Acid							ug/g
Chloroform							ug/g
Dihydroxyacetone							ug/g
Formaldehyde							ug/g
Phenanthrene							ug/g
Toluene							ug/g
TPH							mg/g
Dyeing Lead							mg/g

J = Concentration is estimated below reporting limit
E = Concentration is estimated above calibration range

LAB-104949-9

TABLE 3-10
(cont.)

SUMMARY OF DETECTED COMPOUNDS
SITE 3 SOIL BORINGS
16th ARBFO, PHOENIX, ARIZONA

SAMPLE NUMBER	MB3-01-50-51.5-01	MB3-01-60-61.5-01	MB3-02-0-1.5-01	MB3-02-5-6.5-01
BORING	MB3-01	MB3-01	MB3-02	MB3-02
DEPTH (FT)	50-51.5	60-61.5	0-1.5	5-6.5

DETECTED COMPOUND	UNITS
VOLATILE ORGANIC COMPOUNDS	
Ethylbenzene	ug/kg
Toluene	ug/kg
Total Xylenes	ug/kg
SEMI-VOLATILE COMPOUNDS	
Benzoic Acid	ug/kg
Chrysene	ug/kg
Diethylmaleate	ug/kg
Fluoranthene	ug/kg
Phenanthrene	ug/kg
Pyrene	ug/kg
TPH	mg/kg
Organic Lead	ug/kg

J = Concentration is estimated below reporting limit
E = Concentration is estimated above calibration range

SB3-01 contained ethylbenzene, toluene and xylene in the 70- to 71.5-foot bgl sample at concentrations of 16, 21, and 150 $\mu\text{g}/\text{kg}$, respectively, and an estimated concentration of 2 $\mu\text{g}/\text{kg}$ in the surface sample.

Toluene and xylenes were identified in SB3-03 at estimated concentrations of 2 $\mu\text{g}/\text{kg}$ each in the 10- to 11.5-foot bgl sample. No VOCs, other than acetone and methylene chloride, were detected in the 20- to 21.5-foot bgl sample. Samples from SB3-03 below a depth of 25 feet did not contain sufficient volume for Level C analyses.

Toluene was the only target compound identified in samples from SB3-04. An estimated concentration of 3 $\mu\text{g}/\text{kg}$ was identified in the surface sample. Similar to SB3-03, the sample volume from below 20 feet was not sufficient for laboratory analysis. One $\mu\text{g}/\text{kg}$ of toluene was also detected in the surface sample from MB3-01.

SVOC were detected only in two samples from SB3-03, at the 10- to 11.5- and 20- to 21.5-foot bgl intervals. Benzoic acid, chrysene, fluoranthene, phenanthrene, and pyrene were detected at concentrations below Arizona health-based guidance levels (HBGLs) in the 10- to 11.5- foot bgl sample. Diethylphthalate was detected at 3,800 $\mu\text{g}/\text{kg}$ in the 20- to 21.5-foot bgl sample.

TPH was detected in surface samples at the following concentrations: SB3-01, 30 mg/kg; SB3-03, 46 mg/kg; SB3-04, 140 mg/kg; and MB3-01, 10 mg/kg. TPH was also detected in the 10- to 11.5-foot bgl sample from SB3-03 at 50 mg/kg.

3.5.2.2 Groundwater Sampling

Two monitoring wells were installed at Site 3 (Figure 2-3) during the SI. Results from the third site-related well, MWS-04, are presented in Section 3.2. MW3-01 was installed upgradient from the site and MW3-02 was installed downgradient from the site. Samples were collected and analyzed for VOA, SVOA, TPH, TAL metals, and organic lead. Detected compounds from Site 3 are listed in Table 3-11. The upgradient well, MW3-01, contained an estimated 1,200 $\mu\text{g}/\text{L}$ of benzene and an estimated 18 $\mu\text{g}/\text{L}$ of ethylbenzene in the initial sampling. The following compounds and concentrations were identified in the confirmation sampling: 1,2-DCE (4 $\mu\text{g}/\text{L}$); benzene (2,600 $\mu\text{g}/\text{L}$); ethylbenzene (240 $\mu\text{g}/\text{L}$); xylenes (8 $\mu\text{g}/\text{L}$); and TCE (1 $\mu\text{g}/\text{L}$).

TABLE 3-11

SUMMARY OF DETECTED COMPOUNDS
 SITE 3 MONITORING WELLS
 161st AREFCO, PHOENIX, ARIZONA

DETECTED COMPOUND	UNITS	LOCATION: MW3-01 DATE: APR-91	MW3-02 APR-91	MW3-02 JUN-91
VOLATILE ORGANIC COMPOUNDS				
1,2-Dichloroethylene	ug/l		4 J	2 J
Benzene	ug/l	1200 D	2600 D	
Ethylbenzene	ug/l	18 J	240 D	
Total xylenes	ug/l		8	
Trichloroethene	ug/l		1 J	3 J
SEMIVOLATILE ORGANIC COMPOUNDS				
INORGANIC COMPOUNDS				
TPH	ug/l	NOT ANALYZED	NOT ANALYZED	NOT ANALYZED
Organic Lead	mg/l	4	3.8	2
	ug/L			

TABLE 3-11 (cont.)

U = Compound not detected
 J = Estimated value
 E = Estimated value
 D = Reported from dilution

MW3-02, located downgradient of Site 3 contained estimated concentrations of 1,2-DCE and TCE at 2 and 3 $\mu\text{g/L}$, respectively. Both compounds were confirmed at estimated concentrations of 3 $\mu\text{g/L}$. These values are typical of concentrations in background wells and the EWA. Benzene was not detected in MW3-02.

3.5.3 Geologic and Hydrologic Investigation Results

Geologic investigations at Site 3 are comparable to the Base background and other sites. The site is underlain by heterogeneous mixtures of sand and gravel likely associated with the Salt River. Groundwater occurs at the site at a depth of approximately 76 feet below the surface.

3.5.4 Data Gaps

Due to subsurface conditions, SOV data could not be collected at Site 3 during the SI. Because of the lack of SOV data, soil borings were placed to provide spatial coverage of the area. Soil samples for field screening were recovered from target depths in all borings except MB3-02; therefore, field screening data are reasonably complete. The sample volume recovered from SB3-03, SB3-04, and ME3-02 was insufficient to perform Level C analyses to facilitate the characterization of the vertical extent of contamination, however, field screening data for target compounds are available. Groundwater data are complete with no data gaps identified.

3.5.5 Conclusions

Appendix K and Table 3-10 summarize target VOCs identified in soil samples by field screening and Level C analyses. Low concentrations of target halogenated or aromatic VOCs were detected in 5 of 26 field screening analyses from samples above the water table zone of influence; one sample contained DCE. The vertical zone is estimated to be below 60 feet bgl. Similar target compounds were identified in Level C analyses. Four of thirteen samples identified only aromatic VOCs. Based on these results, there does not appear to be widespread soil contamination at Site 3. The source of the low concentrations of compounds detected in soil samples is uncertain. The following compounds were detected above background concentrations in soil at Site 3:

- Ethylbenzene
- Toluene
- Total xylenes
- Benzoic acid
- Chrysene

- Diethylphthalate
- Fluoranthene
- Phenanthrene
- Pyrene
- TPH.

Groundwater in the vicinity of Site 3 contains several target compounds upgradient of the site. The downgradient well contains only compounds widespread throughout the area. The source of target compounds in the upgradient well is not certain; however, the compounds and concentrations are similar to those observed in MBS-04 at Site 6. Compounds identified above background in the monitoring well downgradient of Site 3 include:

- 1,2-DCE
- TPH.

The upgradient well (MW3-01) contained several compounds in up to mg/L concentrations. The potential contamination of this well by the suspect well MWS-04 at Site 6 is discussed in Section 3.8.

3.6 Site 4 - 107TCS/111ATCF Hazardous Waste Collection Area

3.6.1 Screening Activity Results

3.6.1.1 Geophysical Survey

Geophysical survey activities related to Site 4 were limited to delineation of subsurface structures for clearance of intrusive sampling locations. In general, intrusive sampling locations were cleared using a line locator and GPR. A discussion of methods and results is presented in the geophysical survey report contained in Appendix C.

3.6.1.2 SOV Survey

The SOV survey was conducted at Site 4 using field-modified procedures to accommodate sampling in volcanic bedrock and caliche found at the site. Prior to sampling, sample holes were predrilled with an electric hammer drill prior to pushing in the sampling rod. Sampling depths of 2 to 4 feet were attained (Figure 2-4).

Results of the SOV survey at Site 4 are presented in Table 3-12. Spatial distribution of total SOV content is presented in Figure 3-13. Total SOV content for Site 4 ranged from not

TABLE 3-12
SOV SURVEY RESULTS
SITE 4
161a ARBFC, PHOENIX, ARIZONA

FIELD SAMPLE NUMBER:	OV4-1	OV4-2	OV4-3	OV4-4	OV4-5
SITE:	4	4	4	4	4
POINT:	FIELD	2	3	4	5
DEPTH (FT):	BLANK	2	2	4	3
MATRIX:	SOIL VAPOR	SOIL VAPOR	SOIL VAPOR	SOIL VAPOR	SOIL VAPOR
SAMPLE DATE:	17-JAN-91	17-JAN-91	17-JAN-91	17-JAN-91	17-JAN-91
BENZENE(UG/L)	1U	1U	1U	1U	1U
TOLUENE(UG/L)	1U	1U	1U	1U	1U
ETHYLBENZENE(UG/L)	1U	1U	1U	1U	1U
M- & P- XYLENES(UG/L)	1U	1U	1U	1U	1U
O-XYLENE(UG/L)	1U	1U	1U	1U	1U
TOTAL HD-DC(UG/L)	1U	1U	1U	12	1U
DCB(UG/L)	1U	1U	1U	1U	1U
TCA(UG/L)	0.1U	0.1U	0.1U	0.1U	0.1U
PCE(UG/L)	0.46	42	13	0.6	13
TCE(UG/L)	0.1U	0.1U	0.1U	0.1U	0.1U
TOTAL DETECTED(UG/L)	NA	42	13	18	13

41451- 10/1/91

NOTES

- U = NOT DETECTED AT CONCENTRATION GIVEN
- B = DETECTED IN FIELD BLANK, CONCENTRATION IS LESS THAN 5X THE BLANK CONCENTRATION
- * = LOWEST DAILY BLANK CONCENTRATION
- DCB = 1,1-DICHLOROETHENE
- TCA = 1,1,1-TRICHLOROETHANE
- PCE = TETRACHLOROETHENE
- TCE = TRICHLOROETHENE
- TOTAL HD VOC = SUM OF PEAK AREA FROM FID USING TOLUENE INSTRUMENT RESPONSE FACTOR

TABLE 3-12
SOV SURVEY RESULTS
SITE 4 (CONT.)
161st AREFO, PHOENIX, ARIZONA

FIELD SAMPLE NUMBER:	OV4-6	OV4-7	OV4-8	BCITP-1	BCITP-2
SITE:	4	4	4		
POINT:	6	7	4	LAB	LAB
DEPTH (FT):	2	2	FIELD	BLANK	BLANK
MATRIX:	SOIL VAPOR	SOIL VAPOR	SOIL VAPOR		
SAMPLE DATE:	17-JAN-91	17-JAN-91	17-JAN-91		
BENZENE (UG/L)	1 U	1 U	1 U	1 U	1 U
TOLUENE (UG/L)	1 U	1 U	1 U	1 U	1 U
ETHYLBENZENE (UG/L)	1 U	1 U	1 U	1 U	1 U
M- & P- XYLENES (UG/L)	1 U	1 U	1 U	1 U	1 U
O-XYLENE (UG/L)	1 U	1 U	1 U	1 U	1 U
TOTAL FID VOC (UG/L)	1 U	1 U	1 U	1 U	1 U
DCE (UG/L)	1 U	1 U	1 U	1 U	1 U
TCA (UG/L)	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
PCE (UG/L)	1.9	0.75 B	0.17 *	0.05 U	0.05 U
TCE (UG/L)	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
TOTAL DETECTED (UG/L)	1.9	U	NA	U	U

NOTES

- U = NOT DETECTED AT CONCENTRATION GIVEN
- B = DETECTED IN FIELD BLANK, CONCENTRATION IS LESS THAN 5X THE BLANK CONCENTRATION
- * = LOWEST DAILY BLANK CONCENTRATION
- DCE = 1,1-DICHLOROETHENE
- TCA = 1,1,1-TRICHLOROETHANE
- PCE = TETRACHLOROETHENE
- TCE = TRICHLOROETHENE
- TOTAL FID VOC = SUM OF PEAK AREA FROM FID USING TOLUENE INSTRUMENT RESPONSE FACTOR

1

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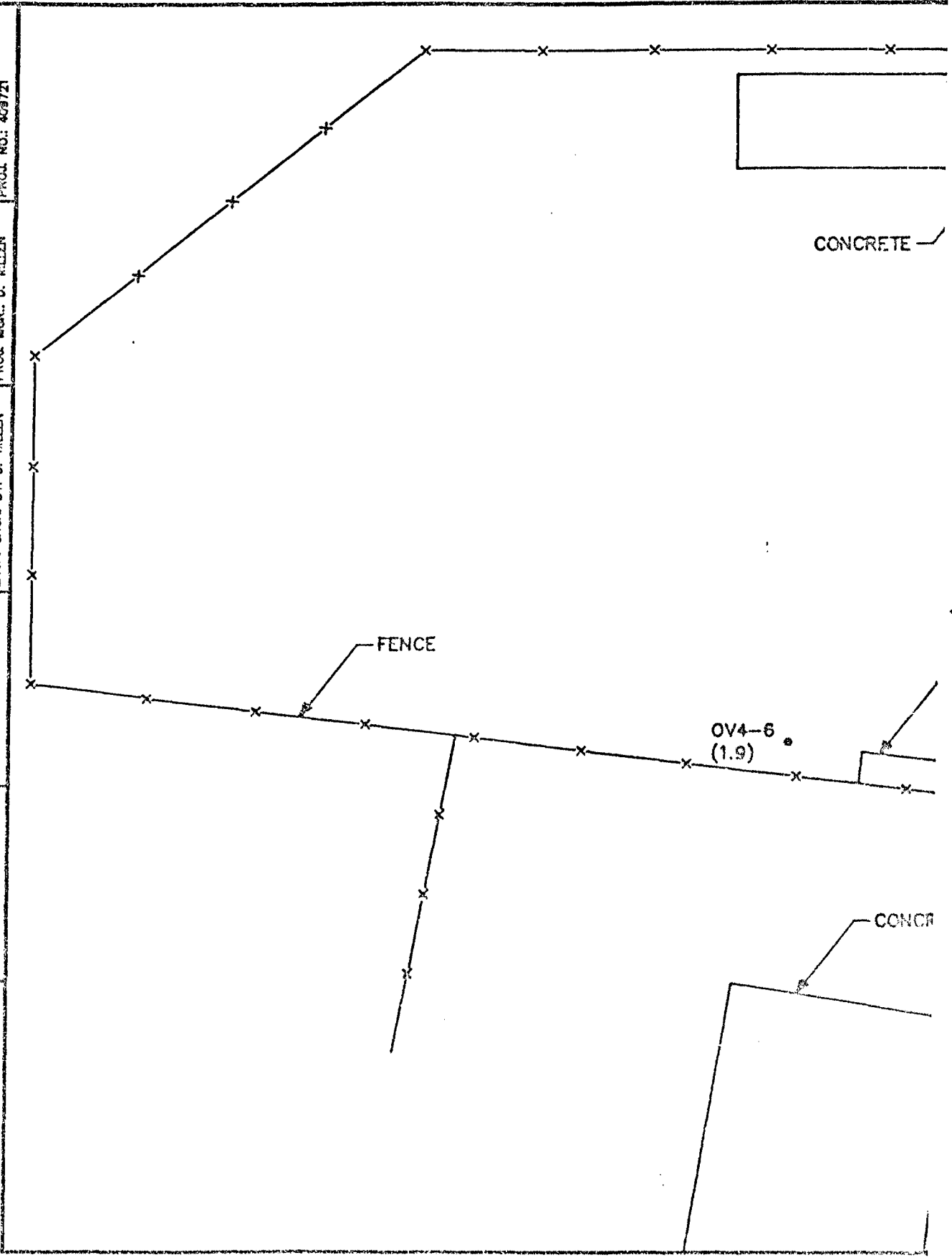
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DRAWN BY: S. CARDWELL

DATE LAST REV: 3/25/92
DRAWN BY: J. HUSSARD

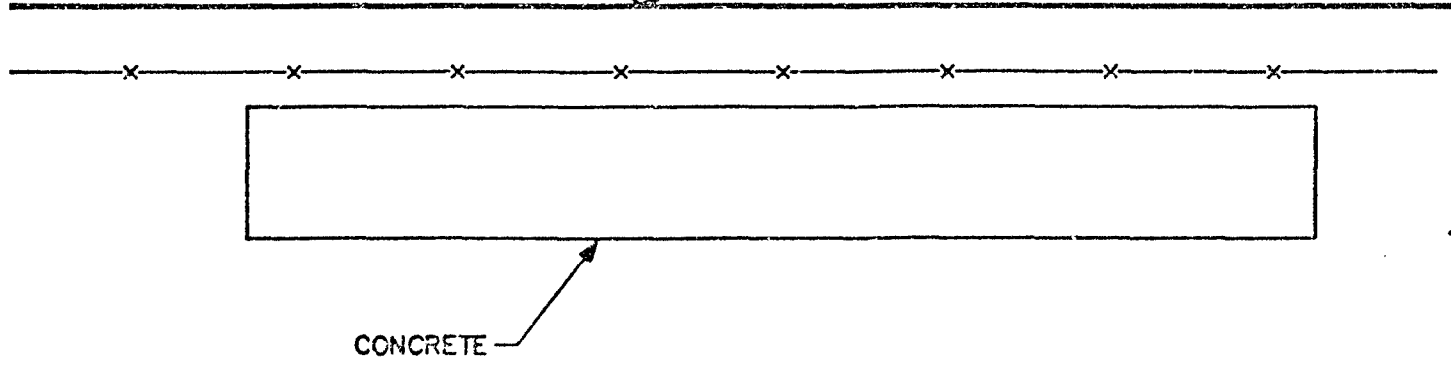
CRAFT. CHECK. BY: J. HUSSARD
ENGR. CHECK. BY: D. WELLEN

INITIATOR: D. WELLEN
PROJ. MGR.: D. WELLEN

DWG. NO.: 403721-B-C10
PROJ. NO.: 403721



2



LEGEND:
• TOTAL LOC.
(ND) NOT

• OV4-7
(ND)

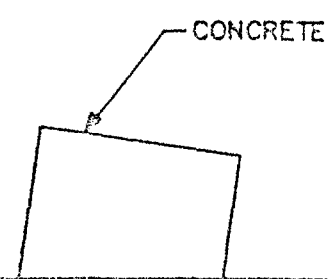
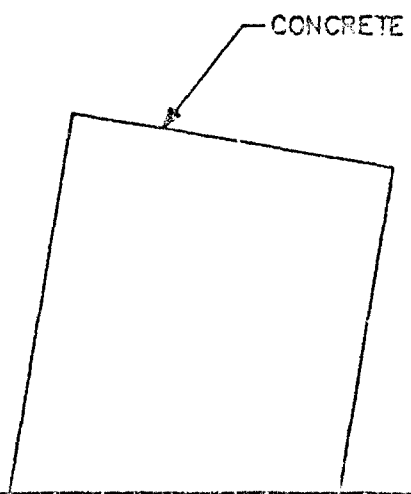
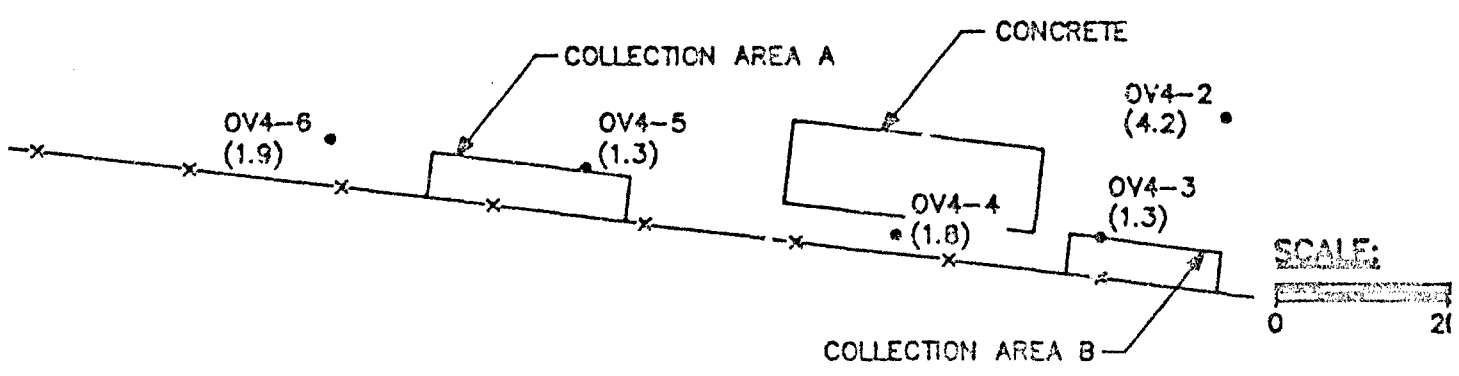
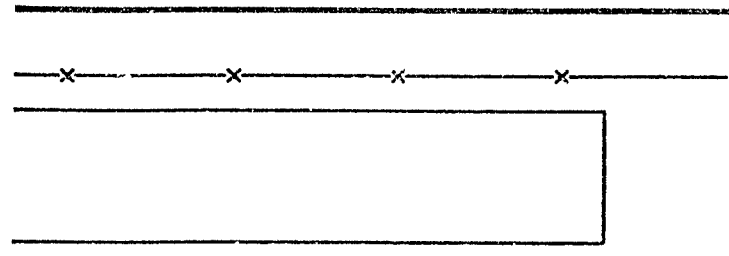


FIGURE 3-1
SOV DISTRI

107 TCS/111
PAPAGO MILITARY
PHOENIX, ARIZONA



3



LEGEND:

- TOTAL ORGANIC VAPOR SAMPLING LOC. (MICROGRAMS/LITER)
- (ND) NOT DETECTED

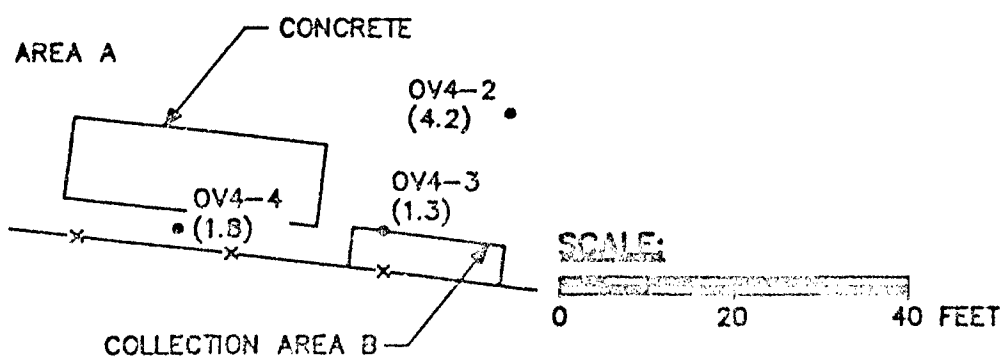
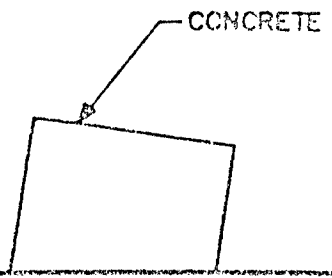


FIGURE 3-13
SOV DISTRIBUTION SITE NO. 4
 107 TCS/111 ATCF, ARIZONA ANG
 PAPAGO MILITARY RESERVATION
 PHOENIX, ARIZONA



INTERNATIONAL TECHNOLOGY CORPORATION

detected at location OV4-7 to a maximum of 4.2 $\mu\text{g/L}$ at location OV4-2. As with other sites, PCE was the primary compound detected at Site 4. PCE was detected in all environmental samples at low levels. Other than PCE, the only detected compound at Site 4 was total FID volatiles at 1.2 $\mu\text{g/L}$ in sample OV4-4.

3.6.1.3 Soil Sampling

Due to geologic conditions at Site 4, soil samples below 2 to 3 feet could not be collected with split-spoon samplers, thus soil borings were not advanced and soil samples from borings were not collected for field analysis. Surface soil samples were collected for Level C analyses.

One background soil sample (SS4-06) was collected from a location near PP-01 (Figure 2-4), east of Site 4. Due to a limited amount of available sample, field screening was not conducted and the entire sample was sent for Level C analyses (Table 2-9).

3.6.1.4 Groundwater Sampling

Two monitoring wells were installed at Site 4 as well as three piezometers. Water samples from each were screened in the field laboratory. A sample from MW4-01 contained xylenes. No other analytes were above detection limits in any of the Site 4 samples. A sample from piezometer PP-02 contained DCE below detection limits. Nontarget hydrocarbons, having short retention times, were detected in the MW4-01 sample; these compounds were not identified or quantified in the screening laboratory. All Site 4 monitoring wells were sampled for Level C analyses.

3.6.2 Confirmation and Delineation Activity Results

3.6.2.1 Soil Sampling

Organic Analysis. Six soil samples were collected from areas surrounding Site 4 at locations depicted in Figure 2-4. In addition to environmental samples, three samples of cuttings from monitoring wells and piezometers were collected to evaluate cuttings for waste disposal recommendations. Samples were analyzed for constituents listed in Table 2-4. Table 3-13 presents a summary of detected compounds. Toluene was detected in one sample from SS4-06, the background sample. No other volatile compounds were detected.

TABLE 3-13

SUMMARY OF DETECTED COMPOUNDS
 SITE 4 SOIL BORINGS
 15th AVE. PHOENIX, ARIZONA

SAMPLE NUMBER DEPTH (FT)	SS4-01 0-1	SS4-02 0-1	SS4-03 0-1	SS4-04 0-1	SS4-05 0-1	SS4-06 0-1
DETECTED COMPOUND	UNITS					
VOLATILE ORGANIC COMPOUNDS						
Toluene						
SEMI-VOLATILE COMPOUNDS						
Benz(a)pyrene			42 J		57 J	
Benzo(k)fluoranthene			140 J	170 J	530	
Benzo(a)Acid					270 J	
Ba(2-ethylhexyl)phthalate					72 J	
Ba(1-hexyl)phthalate					40 J	
Di-n-octylphthalate						
MINERALIC COMPOUNDS						
Aluminum	6310	6340	6150	5020	6470	4390
Antic	27 J	32 J	35 J	32	31 J	29 J
Barium	745	742	737	622	674	424 J
Beryllium	0.26 J	0.35 J	0.33 J	0.34 J		0.4 J
Calcium	69500 J	21400 J	21900 J	19000 J	33300 J	40000 J
Chromium	85	91	113	10	105	54
Cobalt	65 J	63 J	64 J	55 J	55 J	35 J
Copper	11 J	39.6 J	25.3 J	24.1 J	16 J	8.9 J
Iron	870	9520	9550	9520	10200	6900 J
Lead	10.2 J	8.4 J	66.9 J	12.5 J	9.4 J	7.3 J
Magnesium	430 J	4310 J	4560 J	3700 J	4310 J	4580 J
Manganese	189	205	189	180	189	133
Nickel	115	105 J	116	9.9 J	121	7 J
Potassium	1670 J	1570 J	1390 J	1460 J	1570 J	649 J
Silver	0.82 J		0.82 J		0.79 J	0.61 J
Sodium	144 J	163 J	191 J	146 J	219 J	194 J
Fluorine						
Vanadium	167	181	198	192	212	13.6
Zinc	414 J	29.8 J	44 J	27 J	273 J	22.6 J
TPH	63	68	480	28	78	970

Units - Micrograms

J = Concentration estimated below reporting limit
 E = Concentration is estimated above calibration range

Five semivolatile compounds were identified in Site 4 samples (Table 3-13), mostly below quantitation limits. Only bis(2-ethylhexyl)phthalate was detected above quantitation limits in sample SS4-05. Other compounds identified in SS4-05 are benzoic acid (57 $\mu\text{g}/\text{kg}$), bis(2-ethylhexyl)phthalate (530 $\mu\text{g}/\text{kg}$), butyl benzyl phthalate (270 $\mu\text{g}/\text{kg}$), di-n-butyl phthalate (72 $\mu\text{g}/\text{kg}$), and di-n-octyl phthalate (40 $\mu\text{g}/\text{kg}$). Samples from SS4-03 contained benzoic acid (42 $\mu\text{g}/\text{kg}$) and bis(2-ethylhexyl) phthalate (140 $\mu\text{g}/\text{kg}$). Only bis(2-ethylhexyl) phthalate was identified in SS4-04 at an estimated concentration of 170 $\mu\text{g}/\text{kg}$.

TPH was detected in each sample except SS4-02. Concentrations ranged from 28 mg/kg in SS4-04 to 970 mg/kg in SS4-06.

Inorganic Analysis. Results of inorganic analyses are also presented in Table 3-13. Concentrations of each analyte in each sample exceeded the background sample, SS4-06, with few exceptions.

Aluminum was detected above the background concentration of 4390 mg/kg in all samples, ranging from 5820 to 6470 mg/kg. Arsenic with a background concentration of 2.9 mg/kg, was detected in samples that ranged from 3.1 to 3.5 mg/kg. Barium, with an estimated background of 42.4 mg/kg was exceeded by all samples from 62.2 to 74.5 mg/kg. Four samples were slightly below (0.26 to 0.35 mg/kg) the beryllium background of 0.4 mg/kg. Calcium background (40,600 mg/kg) was exceeded in one sample (69,500 mg/kg). Chromium background level (5.4 mg/kg) was exceeded by all samples ranging from 8.5 to 13.3 mg/kg. Background levels for cobalt (3.5 mg/kg) and copper (8.9 mg/kg) were exceeded slightly by all samples ranging from 5.5 to 6.5 mg/kg for cobalt and 11 to 39.6 mg/kg for copper. All samples exceeded the iron background level (6900 mg/kg) and ranged from 8,740 to 10,200 mg/kg. Lead background sample (7.3 mg/kg) was exceeded by all samples ranging from 8.4 to 66.9 mg/kg. The background for magnesium (4,390 mg/kg) was exceeded by two samples at 4,560 and 4,830 mg/kg. Manganese background (133 mg/kg) was exceeded by all samples ranging from 180 to 205 mg/kg. The background level for nickel (7 mg/kg) was exceeded by all samples (9.9 to 12.1 mg/kg). Potassium background level (649 mg/kg) was exceeded by all samples (1,390 to 1,670 mg/kg). Only three samples of silver were detected (0.79 to 0.82 mg/kg) that exceeded the background level of 0.61 mg/kg. Sodium background (194 mg/kg) was exceeded by only one sample at 219 mg/kg. All vanadium samples (18.1 to 21.2 mg/kg) exceeded the background of 13.6 mg/kg and zinc background of 22.6 mg/kg was exceeded by all samples ranging from 27 to 44 mg/kg.

3.6.2.2 Groundwater Sampling

Two episodes of groundwater monitoring were performed on the background well (MW4-02), as well as the downgradient monitoring well (MW4-01). The objective of the first episode of sampling was to detect chemicals of concern, while the second served to confirm results. Based on groundwater flow directions, well MW4-02 is upgradient of Site 4 and MW4-01 is a downgradient well. Samples from both wells were collected and analyzed for VOA, SVOA, TAL metals, and TPH. Detected compounds are presented in Table 3-14. The only detected organic compound is diethylphthalate in MW4-02 at a concentration of 21 $\mu\text{g/L}$ in the initial sampling. Diethylphthalate was not detected in the confirmation sampling.

Inorganic constituent analyses are also presented in Table 3-14. Barium, calcium, copper, manganese, potassium, silver, sodium, and zinc were detected in the downgradient well above upgradient concentrations.

3.6.3 Geologic and Hydrogeologic Investigation Results

Papago Military Reservation and Site 4 are located near the fringe of bedrock outcrops near Barnes Butte. The site is underlain by well indurated caliche to a depth of 14 to 21 feet bgl which, in turn, overlies volcanic bedrock. Groundwater occurrence is variable beneath the site, occurring at depths from 27 to 35 feet bgl and flowing west, away from bedrock outcrops.

3.6.4 Data Gaps

The data collection program for Site 4 was significantly altered during the SI due to the presence of caliche and bedrock at shallow depths. Rather than collecting samples of drill cuttings or rock cores for chemical analyses, surficial soil samples were substituted. Because the potential releases being investigated were also surficial in nature, the substitution was acceptable. The result of the substitution is an adequate horizontal distribution of sampling points with no vertical distribution. A practical method of collecting vertically-distributed soil samples, suitable for chemical analysis, was not identified during the SI. Groundwater data collection was complete with no gaps identified.

3.6.5 Conclusions

Petroleum hydrocarbons are the dominant target-compound group identified to be present at Site 4. Concentrations of TPH in the surface soil ranged from not detectable (10 mg/kg) to approximately 970 mg/kg. The source of TPH throughout the site is not known but is

TABLE 3-14

SUMMARY OF DETECTED COMPOUNDS
 SITE 4 MONITORING WELLS
 16TH AREFCO, PHOENIX, ARIZONA

LOCATION: DATE:	MW4-01 APR-91	MW4-01 JUN-91	MW4-02 APR-91	MW4-02 JUN-91
DETECTED COMPOUND				
UNITS				
VOLATILE ORGANIC COMPOUNDS				
SEMI-VOLATILE COMPOUNDS				
Diethylphthalate			21	
INORGANIC COMPOUNDS				
Aluminum		54.1 J		
Arsenic		32.4	59.6 J	14.2
Barium	217	195 J	121 J	118 J
Calcium	181000	206000	61200	62300
Copper		31.9 J	11.8 J	22.1 J
Iron	12 J	19.1 J	57.9 J	
Magnesium	61900	71600	24600	25500
Manganese	16.8	2.5 J		
Potassium	17700	13700	9100	7630
Silver		18.8 J	6.9 J	
Sodium	238000	223000	116000	104000 J
Zinc	38.3	22.4 J	10.8 J	12 J
Nitrate/Nitrite	NOT ANALYZED	NOT ANALYZED	NOT ANALYZED	NOT ANALYZED
TPH				

4433-106646

U = Compound not detected
 J = Estimated value
 E = Estimated value

suspected to be related to paving and sealing materials in areas of sample collection. Areas of sample collection at Site 4 were all within a graveled motor-vehicle parking area. Because target compounds were not identified in the shallow groundwater at the site, vertical migration is not thought to be significant.

Chemical constituents detected above background in soil samples include:

- Toluene
- Benzo(a) pyrene
- Benzo(k) fluoroanthene
- Benzoic Acid
- Bis(2-ethylhexyl) phthalate
- Butyl benzyl phthalate
- Di-n-butyl phthalate
- Di-n-octyl phthalate
- Aluminum
- Arsenic
- Barium
- Beryllium
- Calcium
- Chromium
- Cobalt
- Copper
- Iron
- Lead
- Magnesium
- Manganese
- Nickel
- Potassium
- Silver
- Sodium
- Thallium
- Vanadium
- Zinc
- TPH.

These metals are only slightly above background levels as discussed in Section 3.6.2.1.

Chemicals detected above upgradient concentrations in groundwater include:

- Diethyl phthalate
- Barium
- Calcium
- Copper
- Manganese

- Potassium
- Silver
- Sodium
- Vanadium
- Zinc.

3.7 Site 5 - Ammunition Dump

3.7.1 Screening Activity Results

3.7.1.1 Geophysical Survey

Investigation activities at Site 5 centered around a geophysical survey to identify the location of the ammunition dump. The geophysical survey report is presented in Appendix C. Figure 2-5 presents the site layout and area of suspected disposal activities identified in the PA. During the SI, specific areas of ammunition discovery were identified north of the PA site as depicted in Figure 2-5 (Johnson, 1990). As shown in Figure 2-5 the survey area was expanded to provide coverage of both the PA area and discovered locations.

Due to cultural interferences, only EM and GPR surveys were conducted over the areas shown in Figure 2-5. Results of the EM survey are presented in Appendix C. Discarding in-phase and conductivity anomalies due to known sources, significant remaining anomalies were observed to exhibit continuity between parallel survey lines. Because of their linear character, these anomalies are interpreted to be caused by underground utilities.

GPR surveys were conducted using 120 MHz and 300 MHz antennas. The effective depth of penetration for the 120 MHz antenna profile is approximately 12 feet bgl and 5 feet bgl for the 300 MHz antenna. Although the penetration depth of the 120 MHz model was greater, the resolution was correspondingly lower.

Two primary areas were investigated with the GPR, an area north of the fire station and a second area near Building 46 (Figure 2-5). Profiles in the area north of the fire station were capable of resolving underground utilities down to several inches in diameter. Assuming the ammunition was containerized or buried in some other bulk fashion, it is likely its presence would be indicated in the data to a depth of approximately 5 feet bgl. The lack of anomalies in this area is an indication that large concentrations are not present at this location.

GPR profiles in the vicinity of Building 46 were compared to known surface and subsurface features. Several anomalies were traceable across profile lines and are interpreted as utilities. No anomalies were found that strongly indicated the presence of trenches or buried ammunition near Building 46. Geologic layering below a depth of approximately 2 feet is indistinct to nonexistent. This leads to possibilities that layering does not exist, either through natural processes or through disruption; or, layering exists but was not resolved with GPR due to poor penetration or interference. The lack of layering in the vicinity of Building 46 does not provide direct evidence of buried ammunition; however, the apparent lack of layering of geologic materials may have been caused by excavation and disruption of the area. Although not conclusive evidence that ammunition is buried in the vicinity of Building 46, the lack of geologic layering prevents the conclusion that ammunition is not present.

Direct confirmation of the presence or absence of buried ammunition at Site 5 is not possible based solely on nonintrusive methods. Individual cartridges smaller than the minimum dimensions resolved by GPR may be present at the locations surveyed. Ammunition may also be present at depths greater than those penetrated by the radar. Finally, ammunition disposal occurring in discrete zones of dimensions smaller than the grid spacing may not have been crossed by a geophysical survey line and therefore may remain undetected.

3.7.1.2 Soil Sampling

Results of field screening of soil samples from the Site 5 monitoring well boring are presented in Appendix K. No target compounds were found above detection limits.

3.7.1.3 Groundwater Sampling

One groundwater sample was collected from monitoring well MW5-01 after development. Results of field screening of the sample are presented in Figure K-1 in Appendix K. Benzene and TCE were detected. DCE, toluene, and xylenes were identified below detection limits. These constituents and concentrations are similar to background field screening results and are not thought to originate from Site 5. The well was sampled for Level C analyses.

3.7.2 Confirmation and Delineation Activity Results

3.7.2.1 Soil Sampling

Soil samples submitted for analysis are present in Table 2-10. Results of three soil analyses from samples collected during installation of MW5-01 are presented in Table 3-15. Acetone

TABLE 3-15

SUMMARY OF DETECTED COMPOUNDS
SITE 5 SOIL BORINGS
161st AREFO, PHOENIX, ARIZONA

SAMPLE NUMBER	MBS-01-0-2-02	MBS-01-5-7-02	MBS-01-70-72-01	
BORING	MBS-01	MBS-01	MBS-01	
DEPTH (FT)	0-2	5-7	70-72	
DETECTED COMPOUND	UNITS			
VOLATILE ORGANIC COMPOUNDS				
Acetone	ug/kg	10 J	10 J	
SEMI-VOLATILE COMPOUNDS				
	NOT ANALYZED	NOT ANALYZED	NOT ANALYZED	
INORGANIC COMPOUNDS				
Aluminum	mg/kg	10500	3670	3710
Arsenic	mg/kg	7.8 J	3.2 J	6.5 J
Barium	mg/kg	115	49	152
Beryllium	mg/kg	0.41 J	0.2 J	0.53 J
Calcium	mg/kg	23100 J	10500 J	3620 J
Chromium	mg/kg	18.8	8.6	11
Cobalt	mg/kg	10.6 J	5.5 J	8.1 J
Copper	mg/kg	24.7 J	9.3 J	36.7 J
Iron	mg/kg	17200	9330	8480
Lead	mg/kg	10.8 J	3 J	2.6 J
Magnesium	mg/kg	8950 J	3620 J	2360 J
Manganese	mg/kg	358	132	736
Nickel	mg/kg	24.3	11.1	17.8
Potassium	mg/kg	2020 J	554 J	365 J
Silver	mg/kg	1 J		
Sodium	mg/kg	497 J	453 J	178 J
Thallium	mg/kg			
Vanadium	mg/kg	36	23	22.6
Zinc	mg/kg	53.7 J	20.5 J	57.5 J
Nitrate/Nitrite	mg/kg	28	7.5	0.2
TPH	ug/kg			
Organic Lead	mg/kg			

GLD/BLJ BLC/IV/AN

J = Concentration estimated below reporting limit
E = Concentration is estimated above calibration range

was detected, but was not associated with blank samples, in two samples from MB5-01. The surface to 2-foot bgl and 5- to 7-foot bgl samples each contained 10 µg/L of acetone.

Inorganic analysis laboratory results are also presented in Table 3-15. Aluminum and manganese are the only inorganic analytes exceeding background concentrations of 10,400 mg/kg and 468 mg/kg, respectively. Aluminum was detected at a concentration of 10,500 mg/kg in the surface sample of MB5-01, and manganese was detected at a concentration of 736 mg/kg in the 70- to 72-foot bgl sample from the same boring.

3.7.2.2 Groundwater Sampling

One monitoring well was installed downgradient of Site 5, MW5-01 (Figure 2-5). The well was sampled twice and analyzed for only TAL metals and nitrate/nitrite. Organic constituents are not of concern at Site 5. Results of the laboratory analyses are presented in Table 3-16. Copper, silver, zinc, and nitrate exceeded background groundwater concentrations.

3.7.3 Geologic and Hydrogeologic Investigation Results

Geologic investigations at Site 5 are comparable to the Base background and other sites. The site is underlain by heterogeneous mixture of sand and gravel likely associated with the Salt River. Groundwater occurs at the site at a depth of approximately 76 feet below the surface.

3.7.4 Data Gaps

Geophysical data were the primary data collection method at Site 5 due to hazards associated with intrusive sampling. Because of cultural interferences, data collection was highly limited to near-surface GPR. The area of GPR survey encompassed the IRP site; however, the depth of investigation was limited to approximately 5 to 6 feet bgl in most areas.

3.7.5 Conclusions

Conclusions regarding presence of ammunition at investigated areas of Site 5 have been discussed. No direct evidence of containerized or uncontainerized materials was identified along survey lines to depths of 5 to 6 feet bgl. The lack of geologic layering in the vicinity of Building 46 raises the possibility that excavation, trenching, or filling of the area has occurred. Due to the uncertainty inherent in geophysical investigations and the limited depth of investigation, conclusions regarding the presence or absence of ammunition below 5 to 6 feet bgl cannot be made with certainty.

TABLE 3-16

SUMMARY OF DETECTED COMPOUNDS
 SITE 5 MONITORING WELLS
 161st AREFG, PHOENIX, ARIZONA

	LOCATION:	MW5-01	MW5-01
	DATE:	APR-91	JUN-91
DETECTED COMPOUND	UNITS		
<i>VOLATILE ORGANIC COMPOUNDS</i>		NOT ANALYZED	NOT ANALYZED
<i>SEMIVOLATILE COMPOUNDS</i>		NOT ANALYZED	NOT ANALYZED
<i>INORGANIC COMPOUNDS</i>			
Aluminium	ug/l		48.4 J
Arsenic	ug/l	5.6 J	5.1 J
Barium	ug/l	55.6 J	52.5 J
Calcium	ug/l	65900	68200
Copper	ug/l	10.1 J	33.8 J
Iron	ug/l	24.2 J	18.2 J
Magnesium	ug/l	26700	27900
Mercury	ug/l	0.21	
Potassium	ug/l	4380 J	5850
Silver	ug/l		7.2 J
Sodium	ug/l	143000	118000
Zinc	ug/l	10.2 J	96.8 J
Nitrate/Nitrite	mg/l	2.4	6.3
TPH		NOT ANALYZED	NOT ANALYZED

add'l - 21 fol/wsp

U = Compound not detected
 J = Estimated value
 E = Estimated value

Soil samples indicate the presence of the following constituents above background concentrations:

- Acetone
- Manganese
- Aluminum.

The following constituents were identified above background concentration in groundwater:

- Copper
- Silver
- Zinc
- Nitrate.

3.8 Site 6 - POL Area

3.8.1 Screening Activity Results

3.8.1.1 Geophysical Survey

Geophysical survey activities related to Site 6 were limited to delineation of subsurface structures for clearance of intrusive sampling locations. In general, sampling locations were cleared using a line locator and GPR. Discussion of methods and results are presented in the geophysical survey report contained in Appendix C.

3.8.1.2 SOV Survey

An SOV Survey was not conducted at Site 6 as the site was included in the IRP after the SOV work was completed.

3.8.1.3 Soil Sampling

Detection of aromatic hydrocarbons in field screening of water samples from PS-02 raised concern of target compounds being released from a source not identified as an IRP site during the PA. The Base POL area, north of Building 18 was identified as a potential source for the compounds and was thus designated Site 6. Because the POL area is upgradient from Site 3, a soil boring and monitoring well were placed between the areas to assess contribution of target compounds from the direction of the POL area. The soil boring was labeled

MBS-04 as it was installed prior to designation of Site 6. Results of field screening of soil samples from MBS-04 are presented in Appendix K with the background samples. No target compounds were detected or estimated to be present at concentrations less than the detection limits in samples from above 40 feet bgl. Samples from 40 feet to 70 feet contained all target compounds except DCE, TCA, and PCE. Three samples from MBS-04 were selected for Level C analyses.

3.8.1.4 Groundwater Sampling

One monitoring well was installed in conjunction with the Site 6 investigation, MWS-04, which is located within Site 6 and is upgradient from Site 3. Results of field screening of water samples are displayed in Figure K-1 in Appendix K. The well contained benzene, toluene, and ethylbenzene. DCE and TCE were estimated below detection limits.

3.8.2 Confirmation and Delineation Activity Results

3.8.2.1 Soil Sampling

Results of soil samples from Site 6 are presented in Table 3-17. Due to low recovery, there was insufficient volume of material to be sent to the laboratory. Only three samples, from the surface, total depth (99 to 100 feet), and the 15- to 16.5-foot bgl interval, were submitted for analysis. The total depth sample contained benzene (5 µg/kg), ethylbenzene (80 µg/kg), toluene (26 µg/kg), and xylenes (190 µg/kg). TCE, detected in the screening laboratory, was not confirmed in the environmental sample. TPH was measured at 35 and 67 mg/kg in the surface and total depth sample but was not detected in the 15-foot depth sample. No other VOCs were detected in the validated results. SVOCs, phenanthrene and pyrene, were detected in the surface sample of MBS-04 at estimated concentrations of 43 and 53 µg/kg, respectively. 2-Methylnaphthalene and naphthalene were detected in the total depth sample at estimated concentrations of 490 and 110 µg/kg, respectively.

3.8.2.2 Groundwater Sampling

Boring MBS-04 was converted to monitoring well MWS-04 (Figure 2-9). Nine target compounds were detected in the initial round in April 1991 (Table 3-18). Similar results occurred for BTEX compounds in the confirmation sampling in June 1991 (Table 3-18). Although there was a decrease in ethylbenzene (310 vs. 230, µg/L), toluene (580 vs. 350 µg/L), and total xylenes (830 vs. 290 µg/L), there was a notable increase in benzene (1100 vs. 1900 µg/L) between sampling rounds.

TABLE 3-17

SUMMARY OF DETECTED COMPOUNDS
SITE 6 SML BORINGS
16th ARBFO, PHOENIX, ARIZONA

SAMPLE NUMBER: MBS-01-0-1-01 MBS-04-15-16.5-01 MBS-04-99-01
 BORING: MBS-04 MBS-04 MBS-04
 DEPTH (FT): 0-2 15-16.5 99-100

DETECTED COMPOUND	UNITS	RANGE	NOT ANALYZED	NOT ANALYZED	NOT ANALYZED
VOLATILE ORGANIC COMPOUNDS					
Aceone	ug/g	10U			5 J
Benzene	ug/g	5U			80
Ethylbenzene	ug/g	5U			28
Toluene	ug/g	5U-11			190
Total Aromatics	ug/g	5U			
SEMI-VOLATILE					
2-Methylphenol	ug/g	350U			450 J
Naphthalene	ug/g	350U			110 J
Phenanthrene	ug/g	350U	43 J		
Pyrene	ug/g	300U	53 J		
INORGANIC COP					
Aluminum	ug/g	3330-10400			
Antimony	ug/g	4-27			
Barium	ug/g	53.9-1851			
Beryllium	ug/g	0.2-0.551			
Calcium	ug/g	2170-328601			
Chromium	ug/g	11.2-51.1			
Cobalt	ug/g	4.6-14.3			
Copper	ug/g	17.5-97.81			
Iron	ug/g	8490-30300			
Lead	ug/g	3.4-18.41			
Magnesium	ug/g	2290-10200			
Manganese	ug/g	218-4221			
Nickel	ug/g	14.5-31.1			
Potassium	ug/g	561-17001			
Silver	ug/g	0.91-2.61			
Sodium	ug/g	127-7261			
Titanium	ug/g	0.21			
Vanadium	ug/g	19.3-1041			
Zinc	ug/g	33.8-79.6			
Kurats/Sirbe	ug/g	0.8-60	NOT ANALYZED	NOT ANALYZED	NOT ANALYZED
TPH	ug/g	1U-6000	35		67
Organic Lead	ug/g	10U			

TABLE 3-18

SUMMARY OF DETECTED COMPOUNDS
 SITE 6 MONITORING WELL
 161st AVEFG, PHOENIX, ARIZONA

LOCATION: MWS-04 MWS-04
 DATE: APR-91 JUN-91

DETECTED COMPOUND	UNITS		
VOCs			
1,1-Dichloroethane	ug/l		
1,1-Dichloroethene	ug/l	1 J	
1,2-Dichloroethylene	ug/l		2 J
Benzene	ug/l	1100 D	1900 D
Ethylbenzene	ug/l	310 D	230 J
Toluene	ug/l	580 D	350 D
Total Xylenes	ug/l	830 D	290 D
Trichloroethene	ug/l		4 J
SVOCs			
2-Methylnaphthalene	ug/l	7 J	
4-Methylphenol	ug/l	3 J	
Naphthalene	ug/l	7 J	3 J
Phenol	ug/l	2 J	
INORGANIC COMPOUNDS			
		NOT ANALYZED	NOT ANALYZED
TPH	mg/l	7	3.1
Organic Lead	ug/l		

OLDTBL-481013WPC

U = Compound Not Detected
 J = Estimated value
 E = Estimated value
 D = Reported from dilution

3.8.3 Geologic and Hydrologic Investigation Results

Geologic investigations at Site 6 are comparable to the Base background and other sites. The site is underlain by heterogeneous mixtures of sand and gravel likely associated with the Salt River. Groundwater occurs at the site at a depth of approximately 76 feet below the surface.

3.8.4 Data Gaps

Because Site 6 was identified after SOV sampling was completed, SOV data was not collected at Site 6 during the SI. Only one soil boring was placed to provide spatial coverage of the area. Soil samples for field screening were recovered from target depths and the field screening data are reasonably complete. The sample volume recovered from the boring was insufficient to perform Level C analyses to facilitate complete characterization of the vertical extent of contamination. Only the samples from the surface, 15-16.5 feet bgl, and the total depth sample (99-100 feet bgl) were analyzed. Groundwater data are complete with no data gaps.

3.8.5 Conclusions

Appendix K, and Tables 3-17 and 3-18 summarize target VOCs identified in soil samples by field screening and Level C analyses. All target compounds except DCE, TCA, and PCE were detected at the 40 to 70 foot bgl zone. The maximum concentration of constituents found in the screening results were benzene, toluene, ethylbenzene, total xylenes, and TCE.

Level C analyses confirmed the presence of the following compounds in soil at the 99-100 foot level, except as noted below:

- benzene
- ethylbenzene
- toluene
- xylene
- phenanthrene (surface sample)
- pyrene (surface sample)
- 2-methylnaphthalene
- naphthalene.

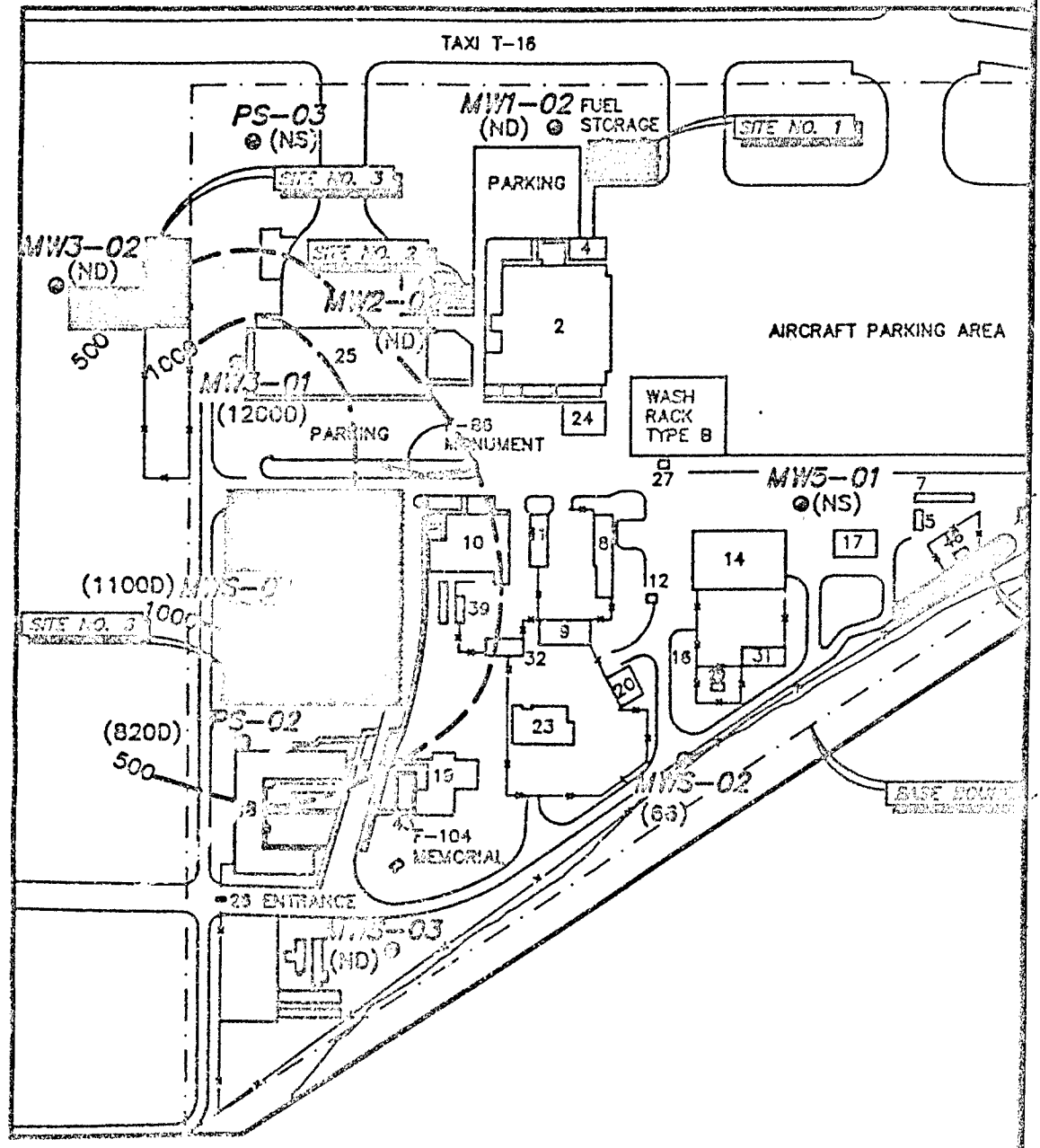
TPH was detected in the surface and at the 99-100 foot zone. Two rounds of groundwater sampling confirmed the presence of ethylbenzene, toluene, and total xylenes, although amounts decrease slightly from first round sampling. Benzene, however, increased significantly and exceeded the MCL by 1000 times in April and reached 1900 $\mu\text{g/L}$ in June 1991. The analyses imply that Site 6 is responsible for contamination of groundwater upgradient to Site 3. However, since only one well was drilled at Site 6, further confirmation of the

source and extent of contamination at Site 6 is needed. Groundwater concentration contour maps for benzene, BTEX, and TCE for April and June, 1991 are provided in Figures 3-14 through 3-19.

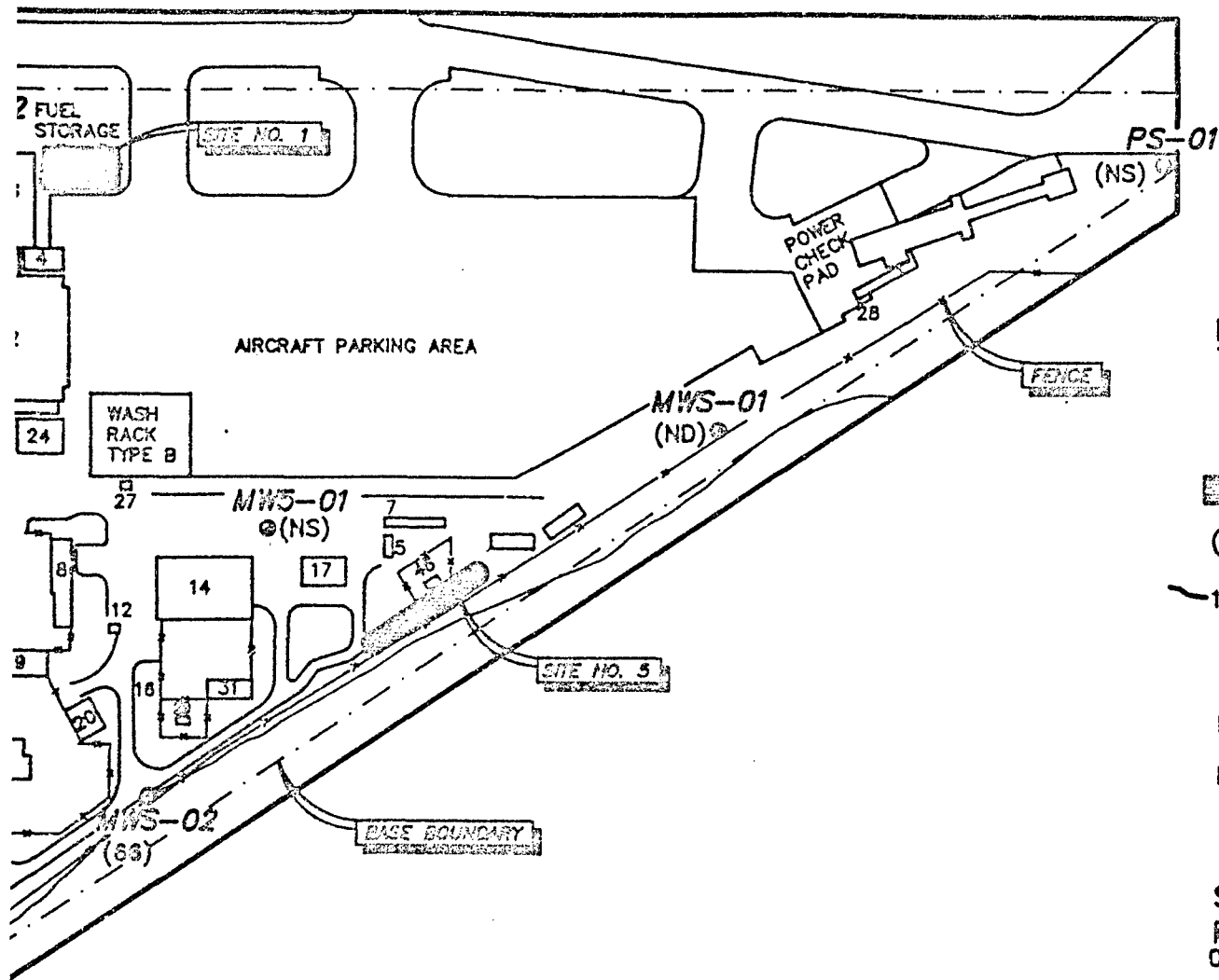
1

STARTING DATE: 04/21/82	DATE LAST REV:	DRAFT. CHK. BY: R. PITTS	ESTIMATOR: D. WILLEN	DWG. NO.: 409721-B-61
DRAWN BY: G. PACHICO	DRAWN BY:	ENGR. CHK. BY: D. WILLEN	PROJ. MGR.: D. WILLEN	PROJ. NO.: 409721

40972181 04/30/82 4:21pm 83



2



LEGEND:

- PI
- MC
- SI
- (66) CO
- 1000 — AF
- 1000 — CO
- D RE
- ND NO
- NS NO

SCALE:

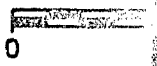
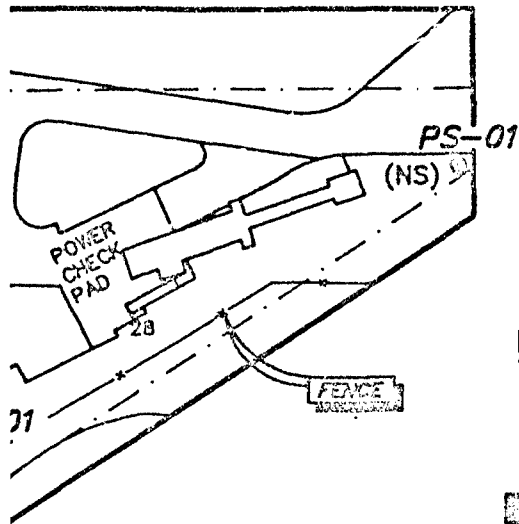


FIGURE 2
BENZENE
APRIL, 1963
161 AREA

161 AREFC
SKY HARD
PHOENIX, AZ



3



LEGEND:

- PIEZOMETER
- MONITORING WELL
- SITE AREA
- (66) CONCENTRATION (µg/L)
- 1000- APPROXIMATE CONCENTRATION CONTOUR (µg/L)
- D REPORTED FROM DILUTION
- ND NOT DETECTED
- NS NOT SAMPLED

SCALE:

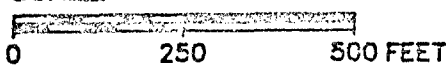


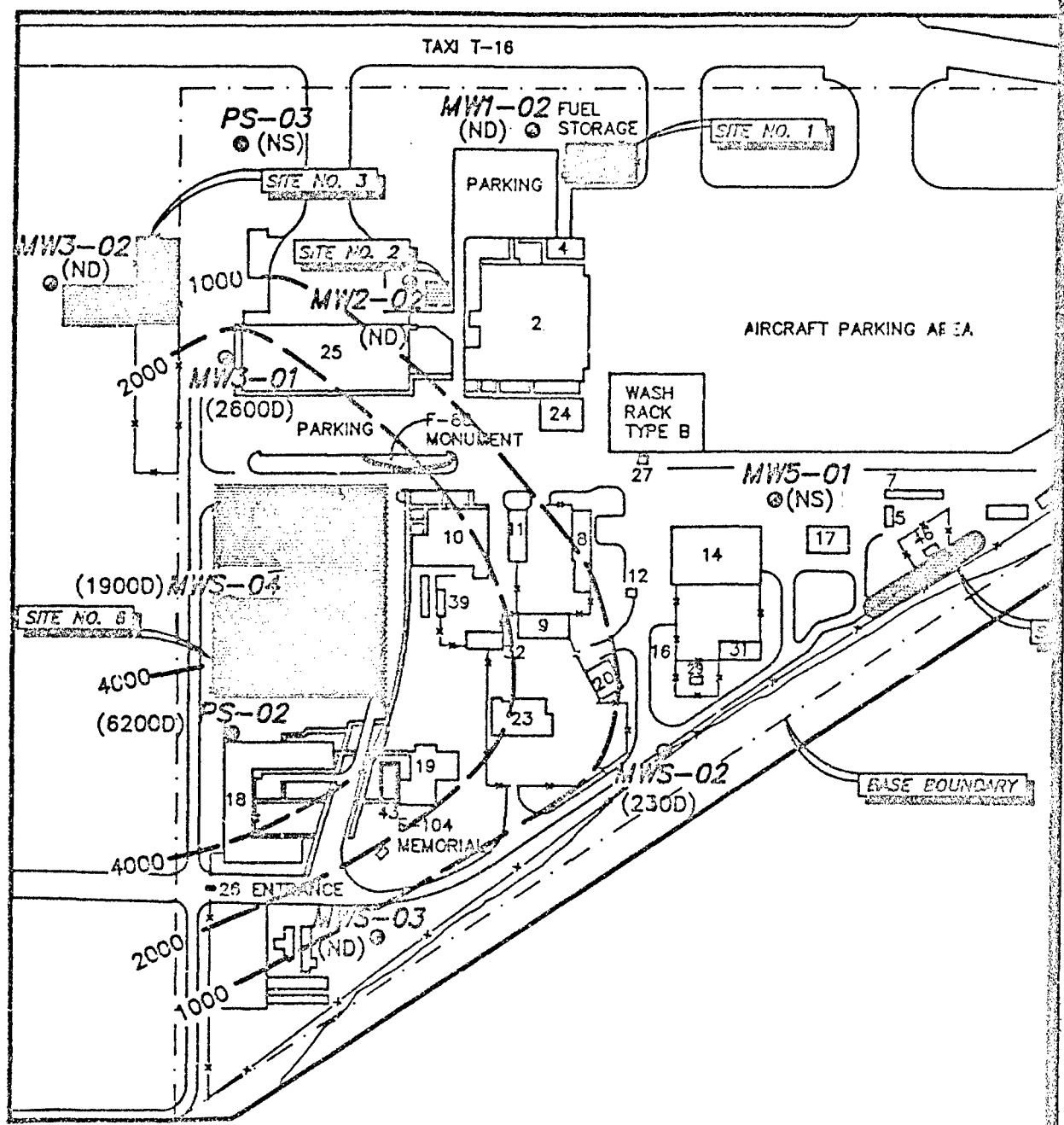
FIGURE 3-14
BENZENE IN GROUNDWATER
APRIL, 1991
161 AREFG
 161 AREFG, ARIZONA ANG
 SKY HARBOR IAP
 PHOENIX, ARIZONA

 INTERNATIONAL
 TECHNOLOGY
 CORPORATION

1

STARTING DATE: 04/22/92	DATE LAST REV.:	DRAFT. CHCK. BY: R. PITTS	INITIATOR: D. WILLEN	DWG. NO.: 409721-8-82
DRAWN BY: G. PACHECO	DRAWN BY:	ENGR. CHCK. BY: D. WILLEN	PROJ. MGR.: D. WILLEN	PROJ. NO.: 403721

40972192 04/30/92 4:23pm 03



TAXI T-16

PS-03 (NS)

MW1-02 FUEL STORAGE (ND)

SITE NO. 1

SITE NO. 3

PARKING

MW3-02 (ND)

SITE NO. 2

MW2-02 (ND)

AIRCRAFT PARKING AREA

1000

25

MW3-01 (2600D)

PARKING

F-85 MONUMENT

WASH RACK TYPE B

2000

MW5-01 (NS)

(1900D) MW5-04

SITE NO. 8

4000 (6200D)

PS-02

MW5-02 (230D)

4000

MEMORIAL

BASE BOUNDARY

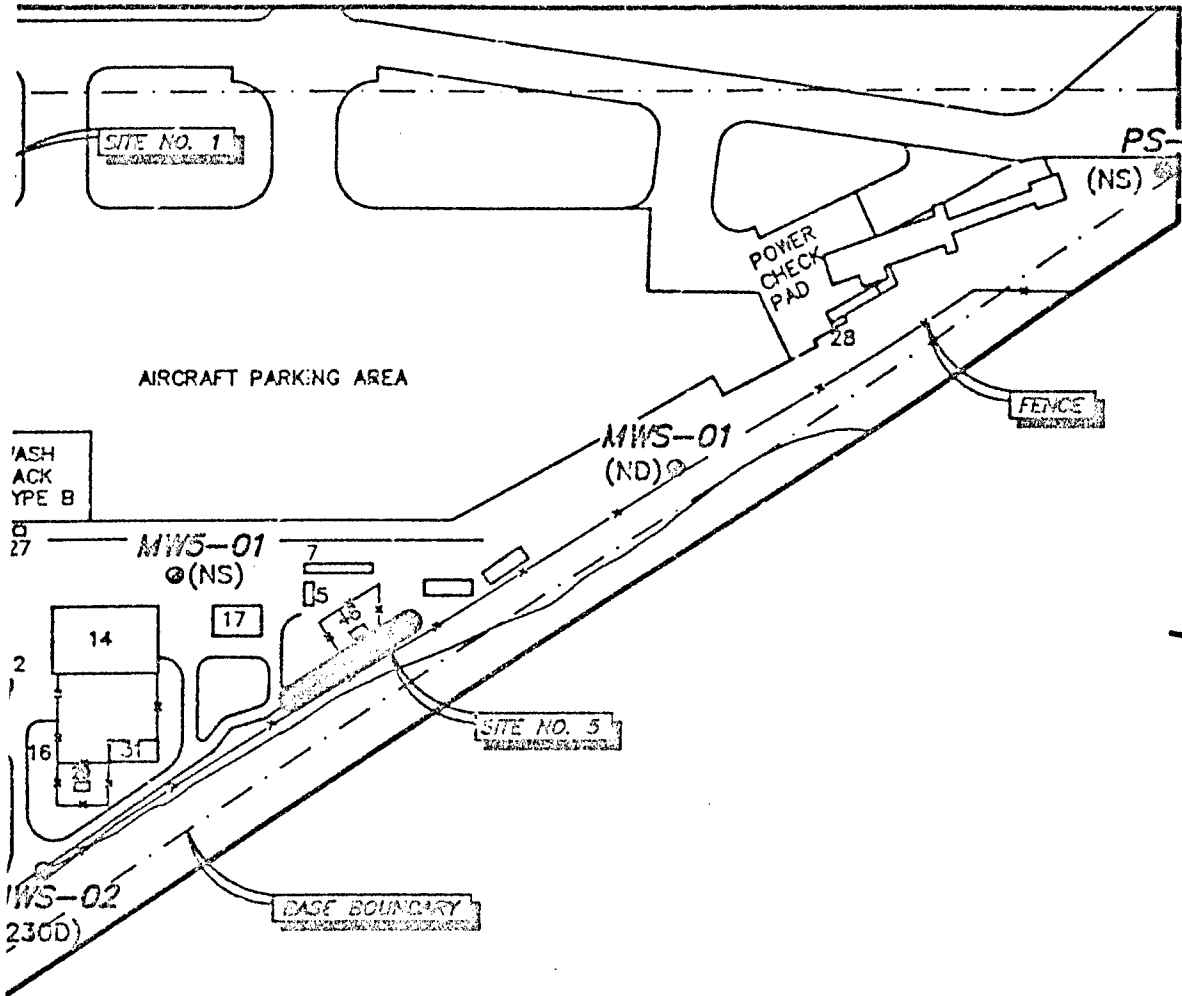
26 ENTRANCE

MW5-03 (ND)

2000

1000

2



LEGEND:

- PIEZOMETER
- ⊙ MONITOR
- SITE AREA
- (230D) CONCEALED
- ~1000~ APPROXIMATE CONTACT
- D REPORTED
- ND NOT DETECTED
- NS NOT SAMPLED

SCALE:

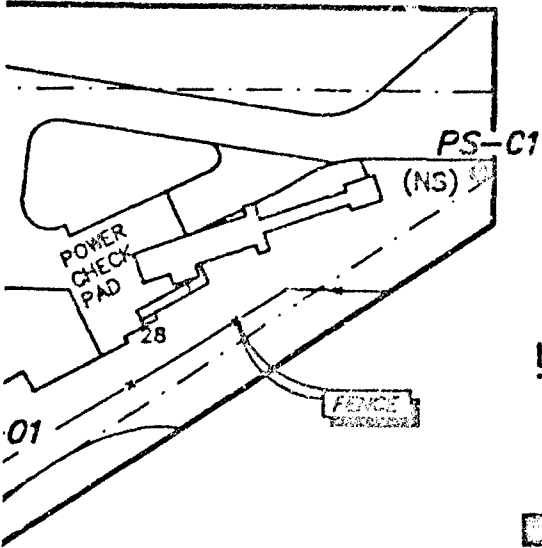


FIGURE 3-11
 BENZENE IN
 JUNE, 1991
 161 AREFG

161 AREFG, AIR
 SKY HARBOR IN
 PHOENIX, ARIZ



3



LEGEND:

- PIEZOMETER
- MONITORING WELL
- ▭ SITE AREA
- (2300) CONCENTRATION ($\mu\text{g/L}$)
- ~1000~ APPROXIMATE CONCENTRATION CONTOUR ($\mu\text{g/L}$)
- D REPORTED FROM DILUTION
- ND NOT DETECTED
- NS NOT SAMPLED

SCALE:

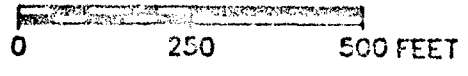
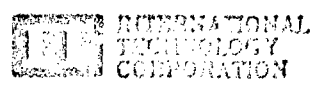
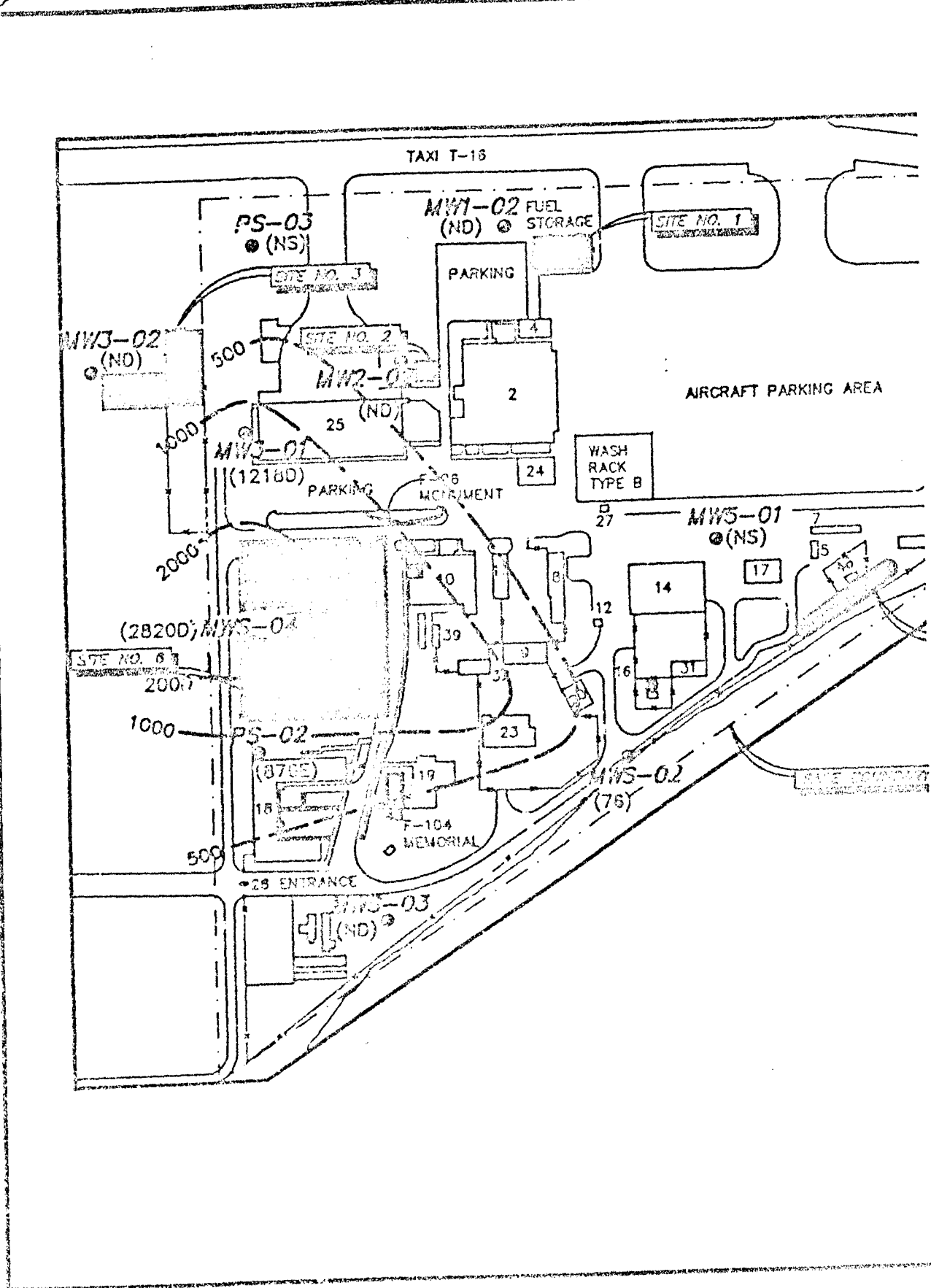


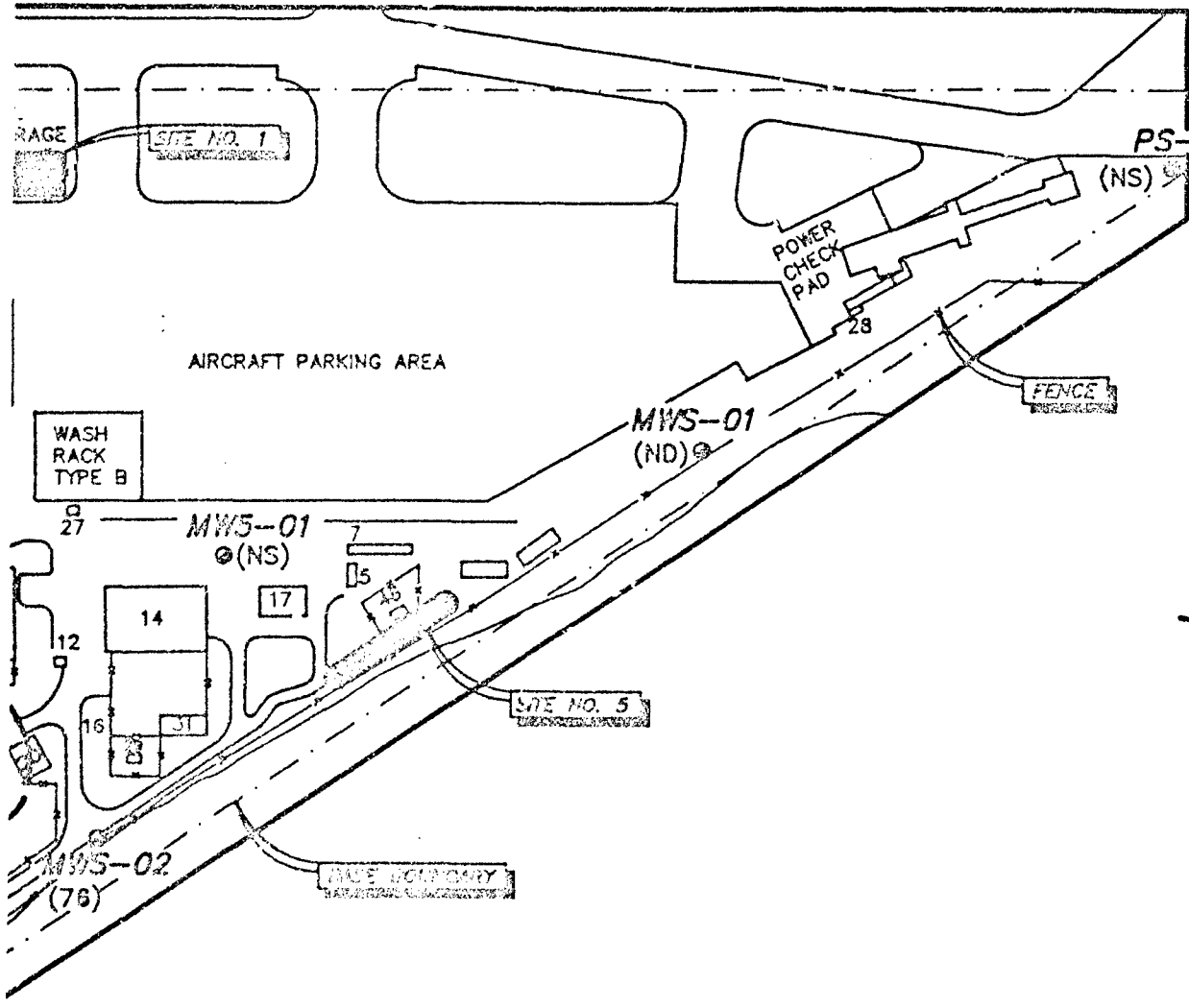
FIGURE 3-15
 BENZENE IN GROUNDWATER
 JUNE, 1991
 161 AREFG
 161 AREFG, ARIZONA AND
 SKY HARBOR IAP
 PHOENIX, ARIZONA



DWG. NO.: 409731-B-83
 PROJ. NO.: 499721
 DRAFT. CHK. BY: R. PITTS
 EXGR. CHK. BY: D. WILLEN
 DATE LAST REV: 04/22/92
 DRAWN BY: S. FALGOUTO
 409731B 04/20/92 3:35pm 85



2



- LEGEND:**
- PIEZI
 - MONI
 - SITE
 - (76) CONC
 - 1000— APPF
 - CONF
 - E ESTI
 - D REPC
 - ND NOT
 - NS NOT

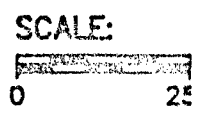
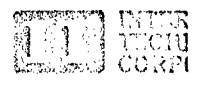
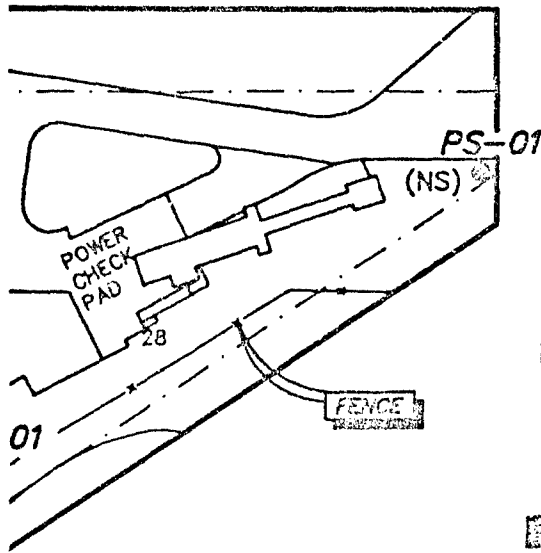


FIGURE 3-1
BTEX IN GR
APRIL, 1991
161 AREFG

161 AREFG, A
 SKY HARBOR
 PHOENIX, ARI





LEGEND:

- PIEZOMETER
- MONITORING WELL
- ▨ SITE AREA
- (76) CONCENTRATION (µg/L)
- 1000— APPROXIMATE CONCENTRATION CONTOUR (µg/L)
- E ESTIMATED VALUE
- D REPORTED FROM DILUTION
- ND NOT DETECTED
- NS NOT SAMPLED

SCALE:

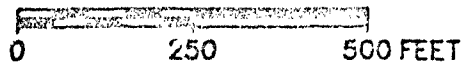


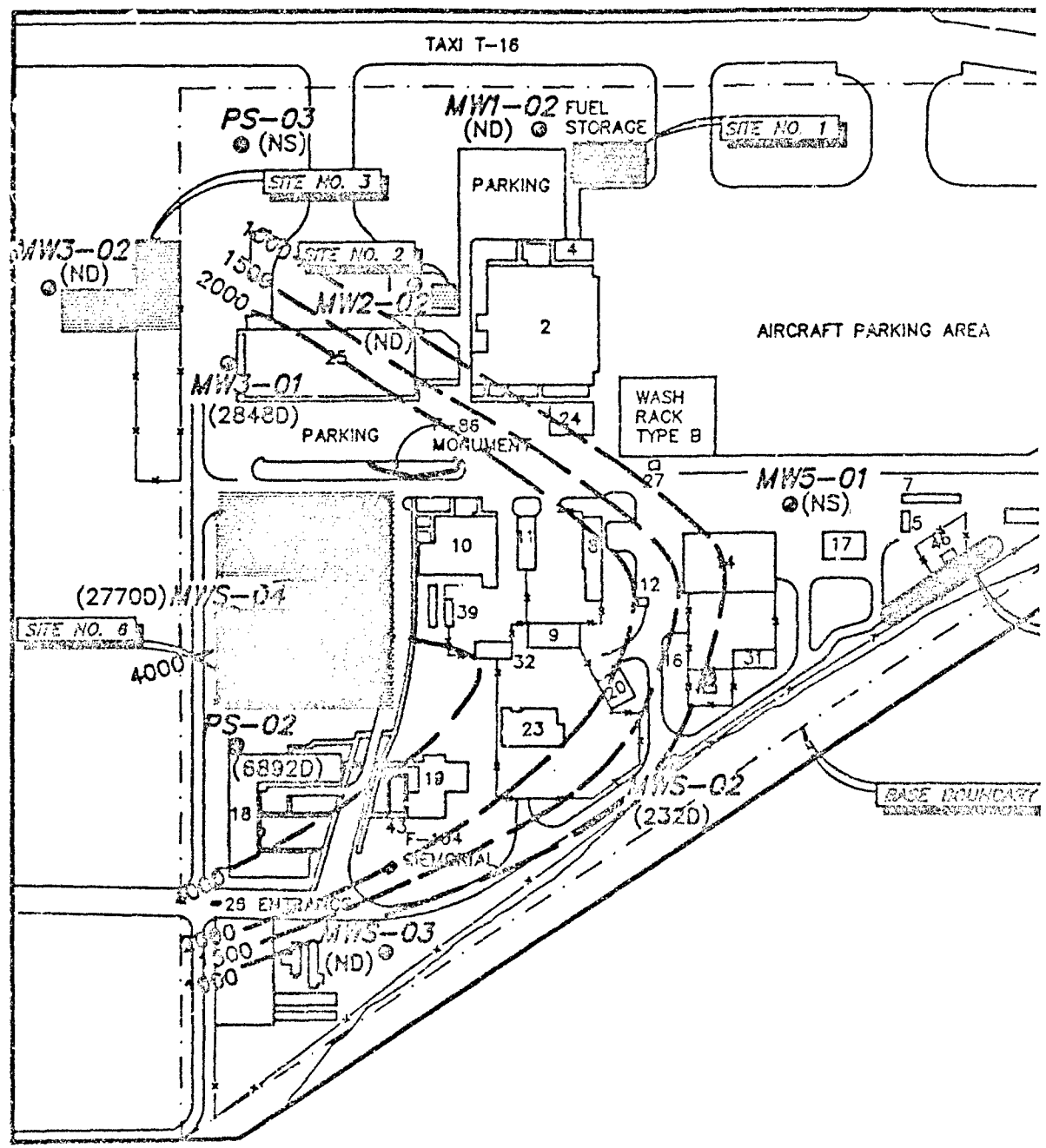
FIGURE 3-16
BTEX IN GROUNDWATER
APRIL, 1991
161 AREFG

161 AREFG, ARIZONA ANG
 SKY HARBOR IAP
 PHOENIX, ARIZONA

 INTERNATIONAL
 TECHNOLOGY
 CORPORATION

STARTING DATE: 04/22/92 DATE LAST REV.:
 DRAFT. CHK. BY: R. PITIS ENGR. CHK. BY: D. MILLEN
 DWO. NO.: 4972184-5-84 PROJ. NO.: 49721

4972184 04/30/92 3:43pm BS
 DRAWN BY: G. PACHECO



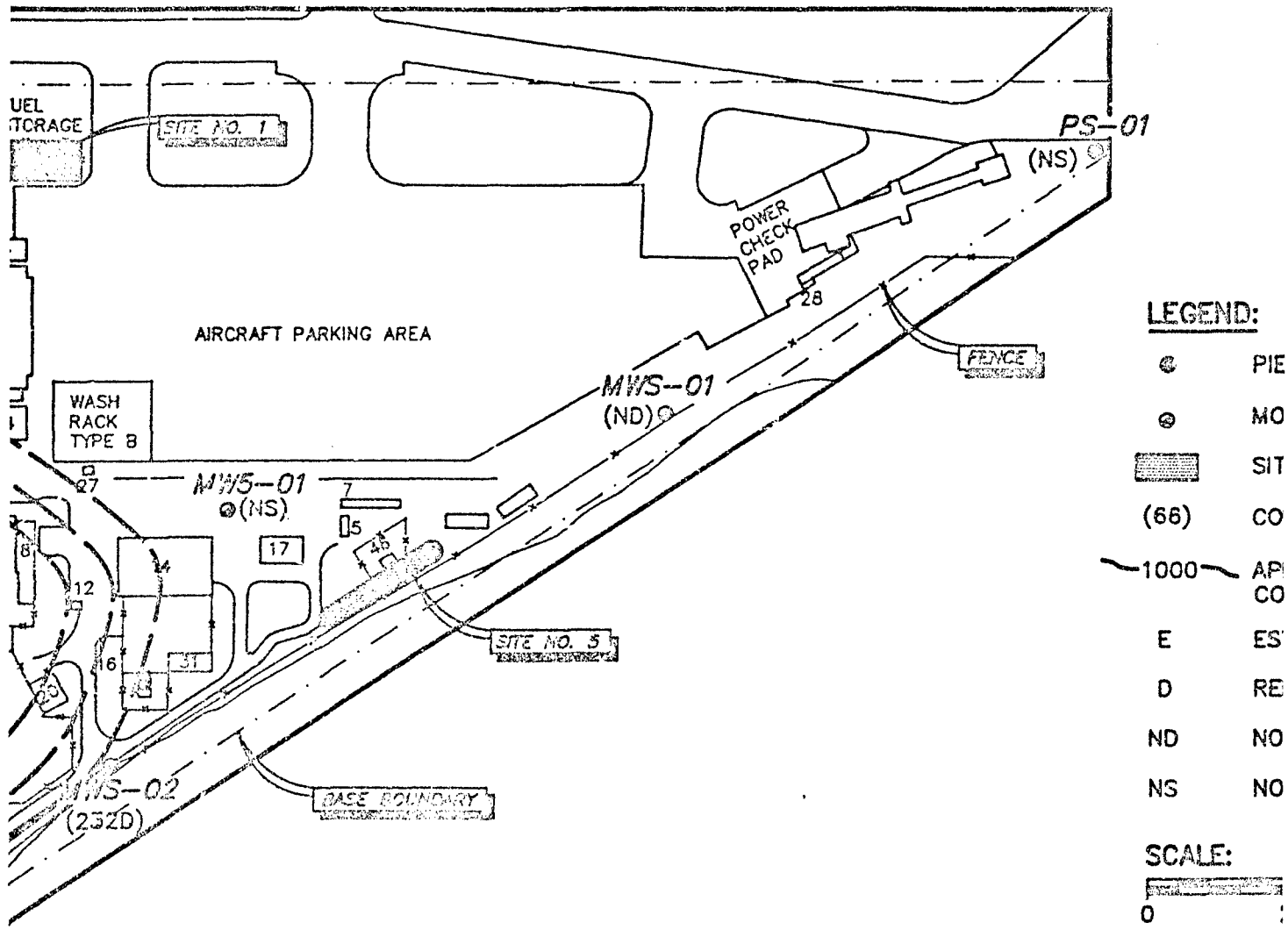
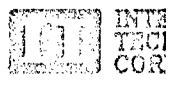
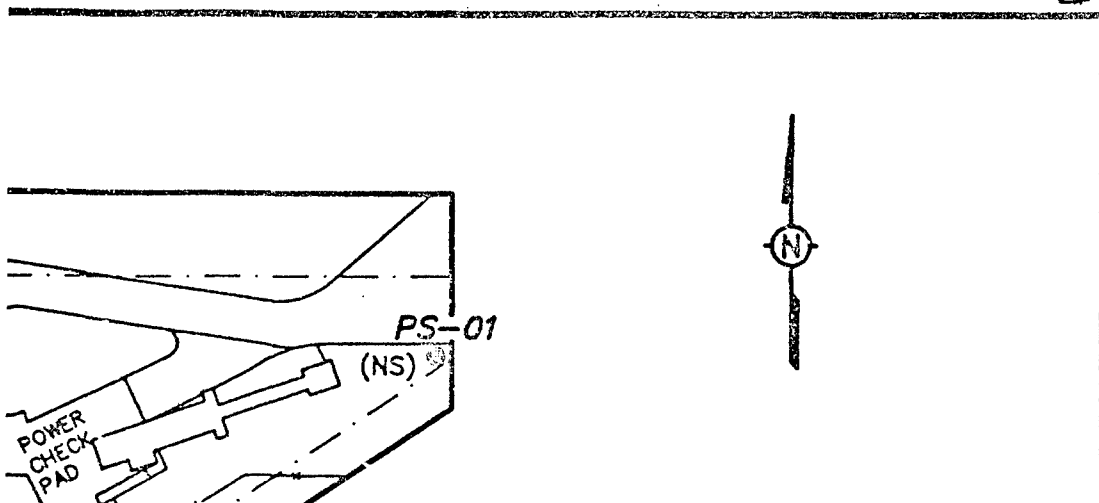


FIGURE 3-
 BTEX IN C
 JUNE, 199
 161 AREFG
 161 AREFG,
 SKY HARBO
 PHOENIX, AI



3



LEGEND:

- PIEZOMETER
- MONITORING WELL
- SITE AREA
- (66) CONCENTRATION ($\mu\text{g/L}$)
- 1000— APPROXIMATE CONCENTRATION CONTOUR ($\mu\text{g/L}$)
- E ESTIMATED VALUE
- D REPORTED FROM DILUTION
- ND NOT DETECTED
- NS NOT SAMPLED

SCALE:

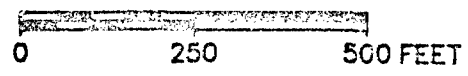


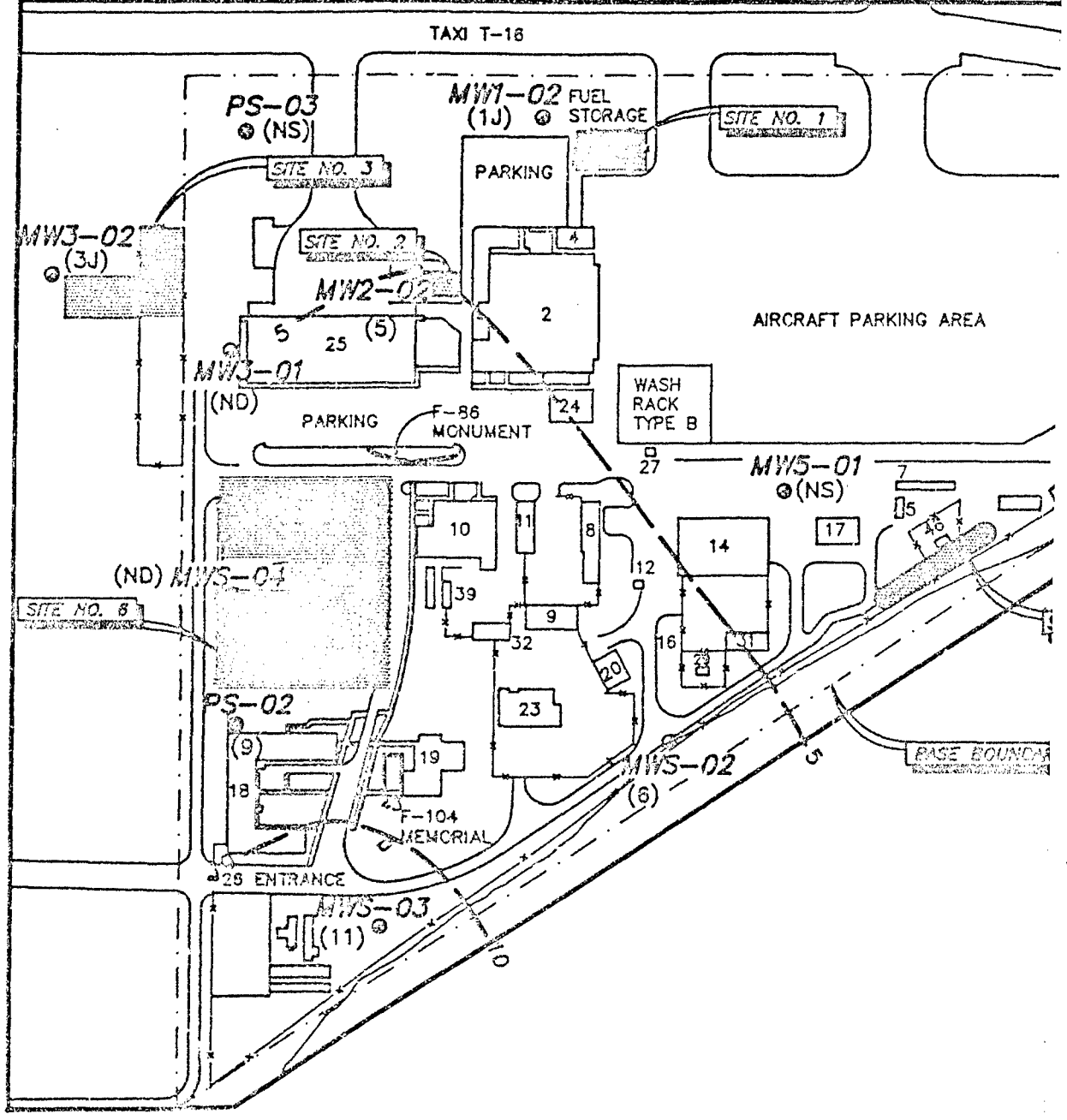
FIGURE 3-17
BTEX IN GROUNDWATER
JUNE, 1991
161 AREFG
 161 AREFG, ARIZONA ANG
 SKY HARBOR IAP
 PHOENIX, ARIZONA

 INTERNATIONAL
 TECHNOLOGY
 CORPORATION

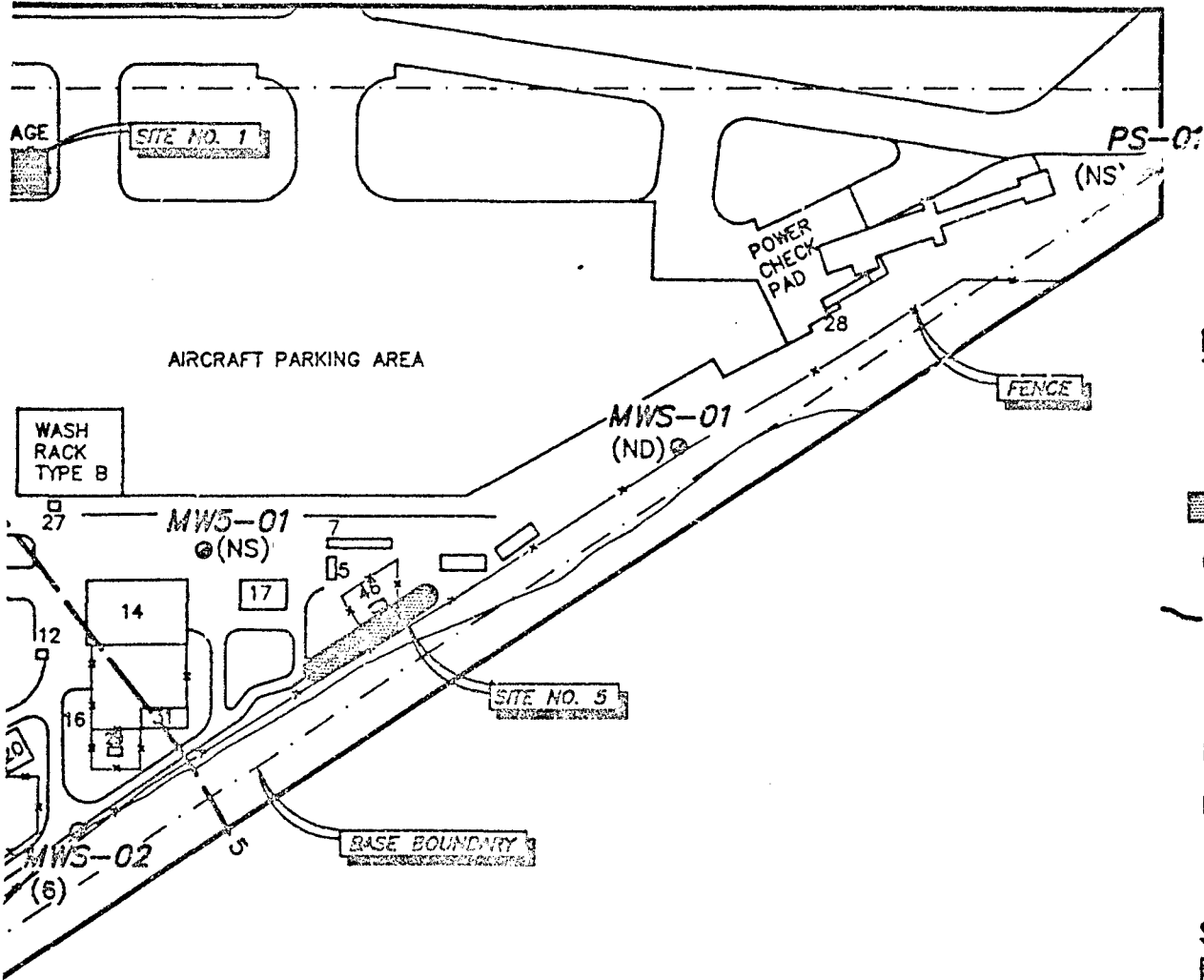
1

STARTING DATE: 03/22/92	DATE LAST REV:	DRAFT. CHK. BY: R. PITTS	INITIATOR: D. MILLEN	DWG. NO.: 409721-B-65
DRAWN BY: G. PACHECO	DRAWN BY:	ENGR. CHK. BY: D. MILLEN	PROJ. MGR.: D. MILLEN	PROJ. NO.: 409721

409721B5 04/30/92 3:40pm BS



2



- LEGEND:**
- ⊙ PIEZO
 - ⊙ MONIT
 - ▨ SITE
 - (5) CONC
 - 10- APPR CONT
 - J ESTIM
 - ND NOT
 - NS NOT

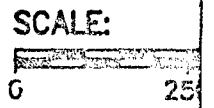
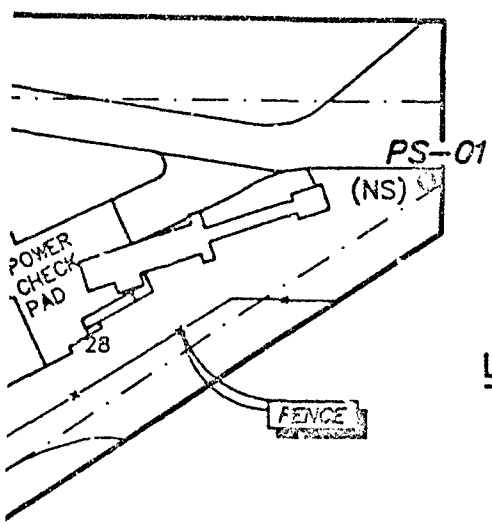


FIGURE 3-1
TCE IN GRC
APRIL, 1991
161 AREFG
 161 AREFG, A
 SKY HARBOR
 PHOENIX, ARIZ



3



LEGEND:

- ⊙ PIEZOMETER
- ⊙ MONITORING WELL
- ▨ SITE AREA
- (5) CONCENTRATION ($\mu\text{g/L}$)
- 10- APPROXIMATE CONCENTRATION CONTOUR ($\mu\text{g/L}$)
- J ESTIMATED VALUE
- ND NOT DETECTED
- NS NOT SAMPLED

SCALE:

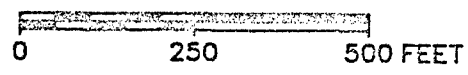


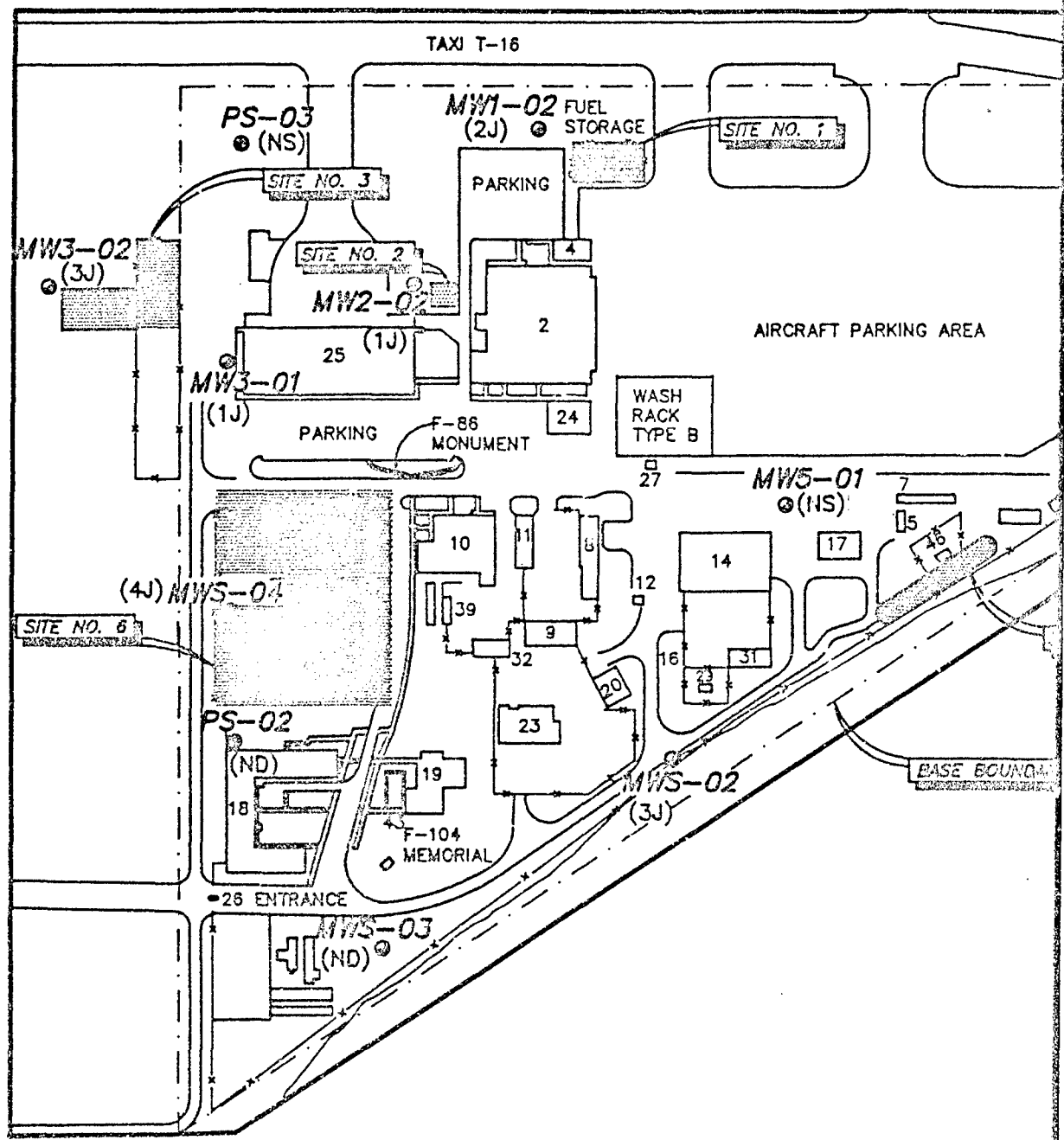
FIGURE 3-13
TCE IN GROUNDWATER
APRIL, 1991
161 AREFG

161 AREFG, ARIZONA ANG
 SKY HARBOR IAP
 PHOENIX, ARIZONA

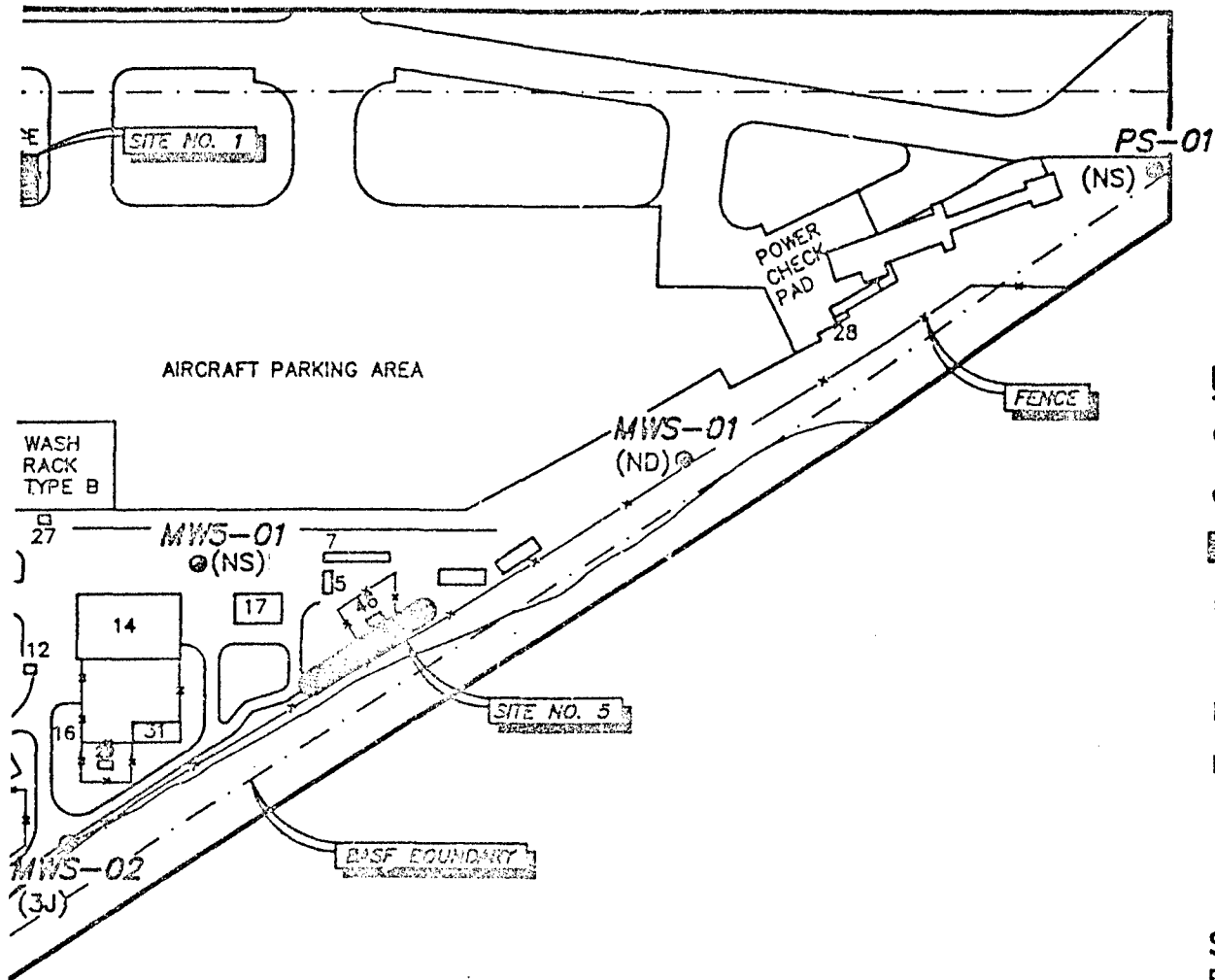


DIVG. NO.: 409721-8-68
 PROJ. NO.: 409721
 INITIATOR: D. WILLEN
 PROJ. MGR.: D. WILLEN
 DRAFT. CHCK. BY: R. PITTS
 ENGR. CHCK. BY: D. WILLEN
 DATE LAST REV.:
 DRAWN BY: G. PACHECO
 DRAWN BY:

STARTING DATE: 04/22/92
 40972169 C1/30/92 3:38pm B5



2



LEGEND:

- PIEZOMETER
- ⊙ MONITORING POINT
- ▭ SITE AREA
- (5) CONCEALED
- J ESTIMATED
- ND NOT DETERMINED
- NS NOT SPECIFIED

SCALE:

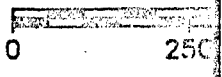
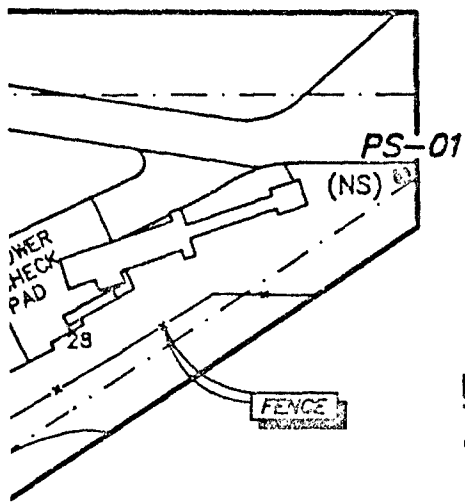


FIGURE 3-19
TCE IN GROUND
JUNE, 1991
161 AREFG

161 AREFG, AIR
 SKY HARBOR
 PHOENIX, ARIZONA



3



LEGEND:

- PIEZOMETER
- MONITORING WELL
- ▨ SITE AREA
- (5) CONCENTRATION ($\mu\text{g/L}$)
- J ESTIMATED VALUE
- ND NOT DETECTED
- NS NOT SAMPLED

SCALE:

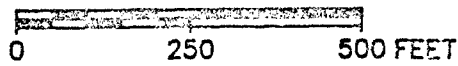


FIGURE 3-19

TCE IN GROUNDWATER
 JUNE, 1991
 161 AREFG

161 AREFG, ARIZONA ANG
 SKY HARBOR IAP
 PHOENIX, ARIZONA



4.0 Preliminary Risk Evaluation

4.1 Introduction and Approach

The purpose of this preliminary risk evaluation is to determine whether the presence of chemicals at 161AREFG facilities pose an immediate or substantial hazard to human health or the environment that may require interim remedial action. This evaluation also addresses the impacts, if any, resulting from potential exposure to these site-related chemicals. This preliminary risk evaluation, which is based on a qualitative review of available soil and groundwater data, characterizes the potential environmental hazards of the current soil and groundwater conditions to determine if further investigation is needed.

This preliminary risk evaluation consists of the following sections:

- Identification of chemicals of potential concern in soil
- Receptor survey
- Identification of potential migration pathways
- Identification of potential exposure pathways
- Hazard evaluation
- Preliminary environmental risk evaluation
- Conclusions and recommendations.

This preliminary risk evaluation examines analytical data and compares data to preliminary applicable or relevant and appropriate requirements (ARARs) and appropriate risk-based criteria to determine the need for immediate remedial action. It also identifies those areas that may require a more detailed quantitative baseline risk assessment.

4.2 Identification of Chemicals of Potential Concern

Identification of chemicals of potential concern follows the guidance given in the Risk Assessment Guidance for Superfund, Vol. I, Human Health Evaluation Manual (HHEM) (U.S. EPA, 1989).

4.2.1 Data Evaluation Methods

Prior to analysis of SI analytical data, all results were validated as discussed in Chapter 3.0 and chemicals that were present as a result of laboratory or field contamination were eliminated from consideration in the risk assessment. This was done following the U.S. EPA guidance (U.S. EPA, 1989).

Based on analytical results, a preliminary list of chemicals of potential concern was developed for each environmental medium tested at the 161AREFG. Each chemical found in soils with at least one positive result (i.e., quantitative value above the method detection limit) was included on the preliminary list of chemicals of potential concern. Chemicals found during the sampling effort were subsequently eliminated from the list of chemicals of potential concern based on the following factors:

- If a chemical was detected once and the concentration is not detected in a duplicate sample
- If a chemical was detected once and the concentration is an estimated value, which is below the detection limit
- If a chemical is an essential nutrient, such as iron, magnesium, sodium and potassium, as recommended by the U.S. EPA (U.S. EPA 1989).

The first two criteria are used to determine if a positive result is an artifact or perhaps a sampling contaminant. The third criterion eliminates chemicals that are not prevalent at the site and are found at very low levels.

4.2.2 Chemicals of Potential Concern

Chemicals of potential concern in soils and in groundwater are listed in Tables 4-1 and 4-2, respectively. A discussion on the selection of chemicals of potential concern is given in the following subsections.

Site 1 - JP-4 Hydrant Area. Site-related chemicals in soils include acetone, bis(2-ethylhexyl)phthalate and TPH (Section 3.3.5). Bis(2-ethylhexyl)phthalate was only detected in one sample; therefore, this chemical is not considered a prevalent chemical at the site and will not be considered further. Chemicals of potential concern in soils at this site are acetone and TPH. There are no site-related chemicals identified in groundwater at Site 1 (Section 3.3.5).

Site 2 - Hazardous Waste Storage Area. Site-related chemicals in soils are given in Section 3.4.5. Of the organic chemicals listed, chlorobenzene, toluene, benzo(a)pyrene, benzo(k)fluoranthene, benzoic acid, diethyl phthalate, and bis(ethylhexyl)phthalate were detected in only one sample. These chemicals, therefore, were not considered prevalent site-related chemicals and will not be considered as chemicals of potential concern. Cadmium, manganese, and silver were detected above the maximum background concentrations in 1 of

Table 4-1
Comparison of Maximum Concentrations In Soil with ARARs
161AREFG, Phoenix, Arizona

(Page 1 of 2)

Chemicals	Units	Maximum Value	Arizona Health-Based Guidance Levels ^a	Estimated Health-Based Concentrations ^b	Reference Dose ^c (mg/kg-day)
Site 1					
Acetone	µg/kg	2.00 x 10 ¹	1.40 x 10 ⁷	NA ^d	NA
TPH	mg/kg	3.30 x 10 ²	ND ^e	NA	NA
Site 2					
Acetone	µg/kg	1.70 x 10 ¹	1.40 x 10 ⁷	NA	NA
Aluminum	mg/kg	1.36 x 10 ⁴	1.50 x 10 ³	NA	NA
Arsenic	mg/kg	1.00 x 10 ¹	1.00 x 10 ³	NA	NA
Beryllium	mg/kg	7.20 x 10 ⁻¹	1.40 x 10 ⁻¹	NA	NA
Lead	mg/kg	1.54 x 10 ²	4.00 x 10 ²	NA	NA
Zinc	mg/kg	1.30 x 10 ²	1.00 x 10 ⁶	NA	NA
Site 3					
Ethylbenzene	µg/kg	1.50 x 10 ¹	1.40 x 10 ⁷	NA	NA
Toluene	µg/kg	2.10 x 10 ¹	4.00 x 10 ⁷	NA	NA
Xylenes	µg/kg	1.50 x 10 ²	2.00 x 10 ⁸	NA	NA
Site 4					
Benzoic acid	µg/kg	5.70 x 10 ¹	ND	2.98 x 10 ⁸	4
Bis(2-ethylhexyl)phthalate	µg/kg	5.30 x 10 ²	6.00 x 10 ⁴	NA	NA
Aluminum	µg/kg	6.47 x 10 ³	1.50 x 10 ³	NA	NA
Arsenic	mg/kg	3.50 x 10 ⁰	1.00 x 10 ³	NA	NA
Barium	mg/kg	7.45 x 10 ¹	1.00 x 10 ⁵	NA	NA
Chromium	mg/kg	1.33 x 10 ¹	2.00 x 10 ³	NA	NA
Cobalt	mg/kg	6.50 x 10 ⁰	1.40 x 10 ¹	NA	NA
Copper	mg/kg	3.96 x 10 ¹	2.50 x 10 ⁴	NA	NA
Lead	mg/kg	6.69 x 10 ¹	4.00 x 10 ²	NA	NA
Manganese	mg/kg	2.05 x 10 ²	ND	7.19 x 10 ³	0.1

Table 4-1

(Page 2 of 2)

Chemicals	Units	Maximum Value	Arizona Health-Based Guidance Levels ^a	Estimated Health-Based Concentrations ^b	Reference Dose ^c (mg/kg-day)
<i>Site 4 (Continued)</i>					
Nickel	mg/kg	1.21 x 10 ¹	2.00 x 10 ³	NA	NA
Silver	mg/kg	8.20 x 10 ¹	1.00 x 10 ³	NA	NA
Vanadium	mg/kg	2.12 x 10 ¹	1.40 x 10 ²	NA	NA
Zinc	mg/kg	2.26 x 10 ¹	1.00 x 10 ⁵	NA	NA
<i>Site 5</i>					
Acetone	µg/kg	1.00 x 10 ¹	1.40 x 10 ⁷	NA	NA

^aADEQ, 1990.

^bSection 4.4.

^cU.S.EPA, 1991a.

*NA - Not Applicable.

*ND - No Data.

Table 4-2

**Comparison of Maximum Concentrations in Groundwater with ARARs
161AREFC, Phoenix, Arizona**

Chemical	Maximum Value ($\mu\text{g/L}$)	Arizona MCL ($\mu\text{g/L}$)	Human Health Guidance Level ^a in Drinking Water ^a ($\mu\text{g/L}$)	Reference Dose ^b (mg/kg-day)
Site 2				
1,2-Dichloroethylene	7.0×10^0	ND	70	NA
Site 4				
Barium	2.17×10^2	1.0×10^3	NA	NA
Manganese	1.68×10^1	ND	$3.5 \times 10^{2(a)}$	1.0×10^1
Zinc	3.83×10^1	ND	5.0×10^3	NA
Site 5				
Copper	3.38×10^1	ND	1.3×10^3	NA
Zinc	9.63×10^1	ND	5.0×10^3	NA
Nitrate	6.3×10^0	1.0×10^4	NA	NA
Site 6				
Benzene	1.9×10^3	5	NA	NA
Ethylbenzene	3.1×10^2	ND	7.0×10^2	NA
Toluene	5.8×10^2	ND	2.0×10^3	NA
Xylene	8.3×10^2	ND	1.0×10^4	NA

^aADEQ, 1990.

^bU.S.EPA, 1991a.

^cND - No data.

^dNA - Not Applicable.

^eValue calculated based on the reference dose (Section 4.5).

12 samples. These chemicals were also not considered to be prevalent site-related chemicals and were not included as chemicals of potential concern. The chemicals of potential concern in soils are: acetone, aluminum, arsenic, beryllium, lead, and zinc. The site-related chemical in groundwater is 1,2-dichloroethylene.

Site 3 - Fuel Bladder Area. Site-related chemicals in soils at this site are given in Section 3.5.5. Of the chemicals listed only toluene was detected in more than one sample; however, ethyl benzene and xylenes were detected along with toluene in one sample (SB03-01-70-71.5). This sample will be treated as a potential "hotspot." These chemicals, therefore, are considered to be chemicals of potential concern in soils at this site. There were no site-related chemicals identified for the groundwater at Site 3 (Section 3.5.5) because identified chemicals were detected in upgradient wells and other site locations.

Site 4 - 107TCS Hazardous Waste Collection Area. Site-related chemicals in soils are discussed in Section 3.6.5. Chemicals detected in more than one sample include benzoic acid and bis(2-ethylhexyl)phthalate. These chemicals will be evaluated as chemicals of potential concern. Inorganic chemicals of potential concern in soils for this site include all chemicals detected above background in more than one sample. These chemicals are: aluminum, arsenic, barium, beryllium, chromium, cobalt, copper, iron, lead, magnesium, manganese, nickel, potassium, silver, vanadium, and zinc.

Site-related chemicals measured in groundwater that are considered chemicals of potential concern at this site include: barium, manganese, and zinc (Section 3.6.5). Other chemicals were detected only once and were not confirmed or were estimated concentration values below the analytical detection limits.

Site 5 - Ammunition Dump. Chemicals of potential concern in groundwater include: copper, silver, zinc, and nitrate. Because only one monitoring well is located downgradient of this site, all chemicals measured above background will be considered.

The only site-related chemicals detected in soils were acetone, aluminum, and magnesium. Aluminum and manganese were detected above background in only one sample; therefore, these chemicals will not be considered as chemicals of potential concern for this site. Acetone is the sole chemical of potential concern for soils at Site 5.

Site 6 - POL Area. The groundwater monitoring well at this site is MWS-04 and is located on the downgradient (west) side of the site. Upgradient wells exhibit background conditions. Chemicals of potential concern in groundwater at this site include: benzene, ethylbenzene, toluene, and xylene. 1,2-Dichloroethylene and trichloroethane were detected at concentrations below the detection limit in only one round of sampling. Therefore, these chemicals are not considered to be site related.

All of the chemicals detected in soils were only found in one sample. Phenanthrene and pyrene were detected in only one sample and both were below the detection limit. Benzene, ethylbenzene, toluene, and total xylenes (BTEX) were detected in soils just above the water table. The source of BTEX is probably the groundwater, which transported the chemicals from the POL area. Therefore these chemicals are not considered chemicals of concern for soils at this time.

4.2.3 Uncertainties

There are three primary factors contributing to the uncertainty in determining chemicals of potential concern at 161AREFG. The almost ubiquitous presence of several common laboratory contaminants in samples, blanks, and background samples and the occasional occurrence of other compounds in various blanks causes uncertainty as to whether certain organics (i.e., acetone, methylene chloride, 2-hexanone, and phthalates) are actually present or if they were introduced into the samples during collection and analysis.

Procedures used for this risk assessment were designed by the U.S. EPA (1989) and are applied here to result in a health-protective list of all chemicals that may be present at the site while allowing for the elimination of chemicals that should not be considered of concern. Health-protective procedures include the inclusion of chemicals detected only once in soil samples taken from potential "hot spots."

4.3 Preliminary Exposure Evaluation

The preliminary exposure evaluation consists of a detailed receptor survey based on review of available demographic data and current and potential future land-use information. The assessment also identifies potential migration and exposure pathways for site-related chemicals. Exposure points are identified and site-specific exposure scenarios are developed.

4.3.1 Receptor Survey

The objective of the receptor survey is to identify potential human populations that may be exposed to site-related chemicals at either the Base or Papago. The survey includes a review of current and potential future land-use and considers the relationship between land use and the presence of potential receptor populations.

Land Use. The Base is located on approximately 51 acres of land leased from the City of Phoenix. The land is adjacent to the Sky Harbor International Airport. Airport property adjoins the Base on the north, east, and west sides. The area to the west also has municipal agencies and some light industrial operations. The areas to the south and east of the Base are undeveloped. Both of these areas are zoned for industrial use (City of Phoenix, 1990).

The Sky Harbor International Airport is planning on expanding and using the area currently held by the 161AREFG. A new base for the 161AREFG is being constructed on the undeveloped lands southwest of the present Base.

Papago is located within the Papago Military Reservation. The reservation is used by various national guard units and municipal and government agencies. The 111ATCF is located on the reservation.

Areas to the east and southeast are mixed military, government operations, and recreational use. Light industry is located to the west and southwest of the facility. Residential areas are located to the north and west.

At present there are no future plans for use of Papago other than to continue as a military reservation. Given the mountainous terrain at the Papago Military Reservation, it is unlikely that the area will be used for any purpose other than a military reservation or a park.

Identification of Potential Receptor Populations. This section identifies those populations that may be exposed to site-related chemicals. For an exposure to a human receptor to occur, site-related chemicals must migrate from a source to a point where a human receptor may contact the chemical. Exposure may occur through dermal contact, inhalation, or ingestion. The preliminary assessment is limited to the identification of potential receptor populations and the relationship between these potential receptor populations to identified migration and exposure pathways and points of exposure.

Generally, receptor populations are divided into two groups: on-site and off-site receptors. On-site receptors are "occupational" populations that include station personnel working full-time at the Base and those individuals who train at the Base. On-site populations fall into these potential receptor categories: individuals employed on a full-time basis and who are chronically exposed; and individuals not employed on a full-time basis and who have potential for subchronic exposure; and contractors who may be employed at the base to perform such duties as construction of new buildings or similar types of general contractor work. Individuals in the third category would be exposed for brief finite periods suggesting a subchronic exposure. This receptor population would have the shortest exposure period of the three on-site populations.

Potential off-site receptor populations could include people who work, live, or use the recreational facilities in the area surrounding the Base or Papago. The land adjacent to the Base is used for industrial purposes (City of Phoenix, 1990). The people who work in the surrounding area could include the employees of businesses located in the nearby industries and employees at the Sky Harbor International Airport. Potential off-site receptor populations at Papago include people living in the vicinity of Papago and employees working with other agencies within the reservation.

The future development of the Base area includes the expansion of the Sky Harbor Airport. The surrounding areas are targeted for development for industrial uses (City of Phoenix, 1990). It is unlikely that potential future exposure populations will be significantly different from the populations previously described.

4.3.2 Migration Pathway Analysis

This section describes the site-specific pathways related to chemical transport that may result in potential exposure points for human or environmental receptors. In general, the major routes of migration from a site such as the 161AREFG are via the air, surface water runoff, or leaching into and through groundwater. Each of these pathways is discussed in the following paragraphs.

Air Pathway. Site-related compounds in soils may be released via volatilization. This could result in potential exposures to human receptors via inhalation. This migration pathway is limited to VOCs found in the surface soils.

Particulate-bound chemicals may also be transported through soil erosion or generation of fugitive dust. This pathway is limited to compounds that have a high affinity for soils and a low vapor pressure, thus reducing the possibility of volatilization. This migration pathway is also limited to chemicals found in the surface soils.

Surface Water Runoff. The Base is built on a relatively flat terrain. There were no obvious drainage ditches or eroded channels noted during site characterization. It is unlikely that significant amounts of chemicals in surface soils at the Base are transported via surface water runoff.

Surface drainage in the area of Papago is toward the Salt River, 2.2 miles to the south. Surface water runoff enters surface drains that feed into the city storm water system.

Groundwater. Migration of soil contaminants to groundwater could occur from infiltration and percolation of rainwater through the soil. The extent of contaminant migration depends primarily on the amount of rainfall, evaporation, solubility of the chemical in water, the absorption coefficient, and distance to the groundwater. In general, VOCs travel more easily through soils than SVOCs, such as high-boiling fuel hydrocarbons. Solubility of metals is dependent on the metal species and is difficult to generalize. Groundwater occurs approximately 75 feet below the surface at the Base and approximately 20 to 25 feet at Papago.

4.3.3 Identification of Exposure Pathways

Potential human exposure may occur by primary pathways (e.g. dermal contact, inhalation, or direct consumption of soil or water), or through secondary pathways involving the transfer of site-related chemicals through the food chain.

Primary Pathways. Exposure to site-related chemicals in soils via primary pathways may result from dermal contact or inhalation of organic vapors or particle-bound chemicals. Chemicals transported in the groundwater may be transported to drinking water wells located in the area.

Site 1 - JP-4 Hydrant Area. Chemicals of potential concern detected in the surface soils include acetone and TPH. Therefore a human receptor may be exposed to these chemicals via airborne transport of the chemical-bearing particulate materials. Given the low vapor pressure of the TPH, it is unlikely that a human receptor would receive a significant exposure as a result of chemicals vaporizing into the air. A volatile compound such as

acetone, however, may volatilize from surface soils resulting in human exposure via inhalation; therefore, exposure to TPH and acetone via inhalation of airborne particulates and exposure to acetone via inhalation of vapors may occur at this site. Workers in the area may be exposed to chemicals in soil as the result of inadvertent ingestion of soils.

No site-related chemicals were detected in groundwater (Section 3.3.5); however, chemicals in the soils may leach into groundwater resulting in future exposure via ingestion of the groundwater.

Site 2 - Hazardous Waste Storage Area. The site-related chemicals at this site are found in subsurface soils. Exposure pathways associated with surface soils, i.e., wind erosion of chemical-bearing particulate material, would not be of concern at this site. However, subchronic exposure via inadvertent ingestion of soils to these chemicals may result from exposure during excavations associated with construction activities.

Chemicals present in soils may leach into groundwater. Human receptors may be exposed in the future to chemicals in groundwater via ingestion of drinking water.

Site 3 - Fuel Bladder Area. The only site-related chemical found in surface soil is toluene. Exposure to a potential receptor may result from the inhalation of chemical that had either volatilized from the soils or from inhalation of chemicals absorbed to windborne particulates.

Potential human receptors may be exposed to chemicals in soils as a result of the inadvertent ingestion of soils. Workers in the area may be exposed to chemicals in surface soils. Ingestion exposures to chemicals in the subsurface soils would be limited to construction workers or other individuals working within an excavation at this site.

Chemicals present in soils may leach into groundwater. Human receptors may be exposed to chemicals in groundwater via ingestion of drinking water.

Site 4 - 107TCS Hazardous Waste Collection Area. The hazardous waste collection area is covered with gravel. This prevents any site-related chemicals located in the surface soils from escaping into the atmosphere from wind erosion of particulate-bound chemicals. Potential human exposure to site-related chemicals in soils is unlikely given the current conditions at the site.

Humans could be exposed via inadvertent ingestion of soils if future activities at the site involve removal of the gravel at the site. Exposure may result from inadvertent ingestion of surface soils or inhalation of chemicals absorbed onto windborne particles.

Chemicals in the soils may leach into groundwater. Future exposure to chemicals in the groundwater may result if the groundwater is used as a source of drinking water.

Site 5 - Ammunition Dump. The site is currently paved or covered by structures; therefore, it is unlikely that chronic exposure to a receptor would occur given present conditions. However, human receptors may be exposed via inadvertent ingestion of soils as a result of future potential construction activities in the area.

Chemicals in the soils may leach into groundwater although it is unlikely because of asphalt paving and structures. Future exposure to chemicals in the groundwater may result if the groundwater is used as a source of drinking water.

Site 6 - POL Area. The site-related chemicals may be the result of leaking underground fuel tanks or ancillary equipment. Therefore, these chemicals are relatively isolated from human contact.

Chemicals present in these soils may leach into groundwater. Human receptors may be exposed in the future to chemicals in groundwater via ingestion of drinking water.

Secondary Pathways. Indirect exposure pathways would be limited to site-related chemicals that may migrate off site via groundwater. If groundwater is used to irrigate agricultural fields, nonvolatile site-related chemicals may bioaccumulate in crops. There are no agricultural wells located in the downgradient well field near the Base (Annis, 1990). The potential of exposure to these chemicals via a secondary pathway is minimal.

4.4 Identification of Potential ARARs

The investigation is being conducted pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and in conformance with the guidelines, criteria, and considerations set forth in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) and the Superfund Amendments and Reauthorization Act (SARA). Consistent with the CERCLA/SARA/NCP framework is the requirement that remedial action process must comply with all legally applicable or relevant and appropriate requirements

(ARARs). 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 Substances 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. In such cases, application of these requirements would be appropriate although not mandated by law. Relevant and appropriate requirements are intended to carry the same weight as legally applicable requirements.

The U.S. EPA has also identified certain guidance as to-be-considered (TBC) material. TBCs are nonpromulgated advisories or guidance issued by federal or state government that are not legally binding and do not have the status of potential ARARs. In some circumstances, TBCs will be used to estimate acceptable risk-based concentrations of chemicals in different media based on scenarios and formulas put forth in ARAR guidance documents.

The U.S. EPA has provided general guidance on the overall application of ARARs concepts into the RI/FS process (U.S. EPA, 1988c). More specific guidance on compliance with ARARs has also been provided by the U.S. EPA (U.S. EPA, 1987a; U.S. EPA, 1988d; U.S. EPA, 1989). In accordance with this guidance, ARARs are to be progressively identified and applied on a site-specific basis as the RI/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 potential ARARs considered for 161AREFG were categorized into the following U.S. EPA-recommended classifications:

- Chemical-specific ARARs are usually health- or risk-based numerical values or methodologies that, when applied to site-specific conditions, result in the establishment of numerical values for each chemical of concern. These values establish the acceptable amount or concentration of a chemical that may be found in or discharged to the ambient environment.
- Location-specific ARARs are restrictions placed on the concentration of a chemical or the conduct of activities solely because they occur in special locations.
- Action-specific ARARs are usually technology- or activity-based requirements or limitations on actions with respect to waste management and site cleanup.

The next step in the ARARs 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. Chemical-specific ARARs were selected based on the exposure pathway analysis (Section 4.3.3).

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 ARARs process even when prerequisites based on statutory or regulatory requirements exist (U.S. EPA, 1988d). As an example, for maximum contaminant levels (MCLs) promulgated under the SDWA to be considered as ARARs at a site, the surface water or groundwater media under consideration should be demonstrated to be potable and utilized as drinking water, either currently or at some planned future date. Flexibility is also provided in modifying a standard such as an MCL based on evidence that site-specific factors are different than those used in derivation of MCLs.

For chemicals for which ARARs are not available, the U.S. EPA has provided guidance on the use and application of TBCs, such as carcinogenic potency factors (CPFs) or reference doses (RfDs) (U.S. EPA, 1987a; U.S. EPA, 1988c; U.S. EPA, 1989). Although not actually ARARs, these data may be used to determine risk-based acceptable concentrations for chemicals in various environmental media.

Tables 4-3 through 4-5 present the potential federal and state ARARs reviewed and those ARARs that have been identified as potentially applicable for the Base and Papago.

Action- and location-specific ARARs are determined when any required remediation options are being considered. Action-specific or location-specific ARARs have not yet been identified. A brief statement of the rationale for the selection of each entry is also provided. Groundwater ARARs are considered to be pertinent because some of the chemicals of potential concern in soils may impact groundwater. A discussion of the chemical-specific ARARs is given in the following section.

4.4.1 Chemical-Specific ARARs for Soils

The Arizona Department of Environmental Quality has issued a draft report, Human Health-Based Guidance Levels for Contaminants in Drinking Water and Soil (ADEQ, 1990). These values represent a set of consistently-derived health-based levels that are based on toxicological values and set exposure scenarios. The exposure scenario assumes a residential

Table 4-3

**Standards, Requirements, Criteria, or Limitations Evaluated for
ARARs Determination, 161AREFG, Phoenix, Arizona**

Federal
Resource Conservation and Recovery Act
Safe Drinking Water Act
Clean Water Act
Solid Waste Disposal Act
Occupational Safety and Health Act
Hazardous Materials Transportation Act
National Historic Preservation Act
Archeological and Historical Preservation Act
Historic Sites, Buildings, and Antiquities Act
Fish and Wildlife Coordination Act
Endangered Species Act
Rivers and Harbors Act of 1899
Wilderness Act
Coastal Zone Management Act
Toxic Substances Control Act
Migratory Bird Protection Treaty Act
Federal Insecticide, Fungicide, and Rodenticide Act
Wild and Scenic Rivers Act
Clean Air Act
Marine Mammal Protection Act
Marine Protection, Research and Sanctuaries Act of 1972
National Environmental Policy Act
Comprehensive Environmental Response, Compensation, and Liability Act/Superfund Amendments and Reauthorization Act
National Contingency Plan
Executive Order 11990: Protection of Wetlands
Executive Order 11988: Floodplain Management
State
Human Health-Based Guidance Levels for Contaminants in Drinking Water and Soil
Arizona Drinking Water and Certification Regulation

Table 4-4

**Source Listing for Chemical-Specific ARARs for Soils
161AREFG, Phoenix, Arizona**

Arizona Human Health-Based Guidance Levels for Contaminants in Soil	Establishes guidance levels for screening chemical concentrations in soils.
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Table 4-5

**Source Listing for Chemical-Specific ARARs for Groundwater
161AREFG, Phoenix, Arizona**

Arizona Drinking Water and Certification Regulations	Establishes the maximum acceptable concentrations of a chemical in drinking water.
Arizona Human Health-Based Guidance Levels for Drinking Water	Establishes guidance levels for chemical concentrations in drinking water.

setting with an individual living on the site for 30 years. This type of exposure would not be applicable for these sites; therefore, if a chemical concentration exceeds the guidance level, it does not imply that a potential risk to human health exists. It does suggest that the situation should be more closely scrutinized. For the purposes of this report, these values will be used as screening levels to determine if chemicals in soils may present a potential threat to human health.

In the absence of ARARs, a health-based acceptable concentration (HBC) will be estimated for soils. This standard is based on a conservative exposure model which is health protective and insures that a potential receptor will not be impacted by exposure to site-related chemicals. The exposure scenario used is not designed to be site-specific but is designed to health-protective, i.e., the health-based value will be much lower than what is required to protect actual receptors at the site.

For the purposes of this preliminary risk assessment, the health-based values will be based on the potential exposure of a child living on site. The default values from the U.S. EPA (U.S. EPA, 1991b) are used in the calculation of these values. The following equation is used to estimate the health-based concentrations.

$$HBC_i = \frac{RfD_i \times BW \times EFD}{IR \times AF_i \times CF \times AT} \quad (1)$$

where,

- HBC_i = Health-based acceptable concentration in soil for chemical i (mg/kg)
- RfD_i = Reference dose for chemical i (mg/kg-day)
- BW = Body weight, (15 kg)
- IR = Ingestion rate, (0.2 g/day)
- AF_i = Absorption factor for chemical i, (unitless)
- CF = Conversion factor, (0.001 kg/g)
- EFD = Exposure frequency and duration, 350 days/year for 6 years
- AT = Averaging time, 2,190 days.

For the purposes of this risk assessment, it was assumed that the absorption rates for laboratory animals and humans are equal; therefore, the absorption factor is 1.

The RfD is an estimate of a daily exposure level (with uncertainty spanning perhaps an order of magnitude or greater) for the human population, including sensitive subpopulations, which is likely to be without an appreciable risk of deleterious effects during a lifetime (U.S. EPA, 1989).

4.4.2 Chemical-Specific ARARs for Groundwater

The groundwater underlying the Base and Papago is not presently used for the drinking water purposes. The closest upgradient registered wells are two municipal monitoring wells approximately one-half mile southeast of the Base. The closest downgradient well is a private monitoring well approximately three-fourths of a mile northwest of the Base. There are no drinking water wells within 8 miles of the Base (White, 1991). Drinking water is primarily obtained from surface sources (Stoltzfus, 1991). For the purposes of this risk assessment and as a conservative health-protective assumption, it will be assumed that the chemicals present in the groundwater may migrate into drinking water wells. The state MCLs, therefore, will be used as ARARs for chemicals of potential concern in groundwater. In the absence of MCLs, the Arizona health-based guidance level for drinking water will be used. The state and federal MCLs for the selected chemicals of potential concern in groundwater and selected chemicals in soils are given in Table 4-2.

4.5 Hazard Assessment

This section characterizes the potential risks, if any, associated with the exposure to chemicals in soils and groundwater at the Base and Papago. For the purposes of this preliminary risk assessment, the maximum detected concentration of chemicals of potential concern were used compared to chemical-specific ARARs. This approach compensates for risk assessment uncertainties and provides a safety margin. Potential risks to human health associated with exposure to chemicals of potential concern at each of the sites is discussed in the following paragraphs.

Site 1 - JP-4 Hydrant Area. The maximum concentration of acetone in soils ($20 \mu\text{g}/\text{kg}$) is more than 5 orders of magnitude below the health-based guidance concentration of $1.4 \times 10^7 \mu\text{g}/\text{kg}$ (Table 4-1). A published inhalation reference concentration (RfC) for acetone was not found in the available literature; however, given that the maximum concentration of acetone in soils is more than 5 orders of magnitude below concentrations that may have a potential health impact upon a person living at the site for 30 years, it is unlikely that a receptor working at the Base will be exposed to significant amounts of acetone in air from either vaporization or from inhalation of windborne particulates.

There are no health-based ARARs or toxicological values for TPH. However, the most toxic components of petroleum hydrocarbons, i.e., benzene, toluene, xylene, ethyl benzene, naphthalenes, etc., were below the detection limit in soils. Therefore, it is unlikely the remaining compounds, such as alkanes and alkenes, present significant long-term health risks to workers (Sandmeyer, 1981).

Acetone present in soils may leach into groundwater. Acetone was measured in MB1-02 at depths extending to the upper reaches of the water table, 75 to 77 feet; however, acetone was not detected in the groundwater samples. This indicates that acetone leaching into groundwater is diluted to concentrations that are below detection limits; therefore, the concentrations of acetone in soils do not have a significant impact upon the groundwater.

Site 2 - Hazardous Waste Storage Area. The maximum concentrations of aluminum and beryllium in soils (13,600 and 0.72 mg/kg, respectively) exceed the respective health-based guidance levels of 1,500 and 0.14 mg/kg (Table 4-1). The maximum concentration of lead was less than one-half the respective health-based guidance level (Table 4-1). Concentrations of other potential chemicals of concern were at least two orders of magnitude less than their respective guidance levels (Table 4-1). The potential risks associated with exposure to aluminum and beryllium in soils will need to be evaluated further to determine if a potential risk to human health may exist. Based on the comparison with ARARs or HBCs, potential exposure of receptors to acetone, arsenic, lead, and zinc will not have a significant impact upon human health.

The maximum concentration of 1,2-dichloroethylene in groundwater was an order of magnitude below the health-based value for the most toxic isomer (cis-1,2-dichloroethylene) (Table 4-2). The concentrations of metals in groundwater did not exceed background concentrations; therefore, metals in the soils are not leaching into soils at concentrations that exceed background ranges.

Site 3 - Fuel Bladder Area. Chemicals of potential concern in soils include ethyl benzene, toluene, and xylenes. The maximum concentration of ethyl benzene, toluene, and xylenes are more than five orders of magnitude below the respective guidance concentrations (Table 4-1). Based on comparison with ARARs, potential inadvertent ingestion of these chemicals in soils by a human receptor will not have a significant health impact.

The only chemical detected in surface soils was toluene. This chemical was detected at concentrations ranging from 1 $\mu\text{g}/\text{kg}$ in MW3-01 to 3 $\mu\text{g}/\text{kg}$ SB3-04. All of these concentrations are below the reportable detection limit. The inhalation RfC for toluene is 2 mg/m^3 (U.S. EPA, 1991a). The RfC is an estimate of the concentration of a chemical in air to which an individual may be exposed to daily, that is likely to be without risk of deleterious effects during a lifetime. Therefore, to have a potential impact upon human health, it would require that everyday 1,000 kg of soil release all the toluene contained within the soil into a restricted air zone of 1 cubic meter. It is unlikely that this would happen, therefore, the concentrations of toluene in surface soils would not have a significant impact upon human health. Likewise it would require that a minimum of 1,000 kg of soil be suspended into 1 cubic meter of air for a person to receive a significant dose via inhalation of particulate-bound chemicals. Therefore, the potential risk from the inhalation of chemicals found in surface soils at the site is minimal and does not present a potential long-term risk to human health.

Chemicals in soils may leach into groundwater; however, the chemical spill occurred in this area more than 17 years ago. The absence of these chemicals in the groundwater at concentrations that exceed background indicates that the concentrations of chemicals entering groundwater from the site are below detectable concentrations. Therefore, these chemicals are not having a significant impact upon the groundwater.

Site 4 - 107TCS Hazardous Waste Collection Area. Benzoic acid and manganese did not have published health-based guidance levels. Therefore these chemicals were compared with the HBC. The maximum concentration of manganese was more than three orders of magnitude below its HBC (Table 4-1). Benzoic acid was more than five orders of magnitude below its HBC (Table 4-1); therefore, it is unlikely that these chemicals will have a significant impact upon human health.

Aluminum was the only compound that exceeded its guidance level, 6,470 $\mu\text{g}/\text{kg}$ as compared to 1,500 $\mu\text{g}/\text{kg}$ (ADEQ, 1990). Cobalt, lead, and vanadium were less than one-half their respective guidance concentrations (Table 4-1). The remaining compounds were greater than an order of magnitude less than the guidance concentrations (Table 4-1).

Elevated concentrations of barium, manganese, and zinc were measured in the groundwater at this site (Section 3.6.5). The maximum concentrations of barium and zinc were at least

one order of magnitude below their respective ARARs. The health-based guidance level was calculated for manganese using the following formula (ADEQ, 1990):

$$HBGL_w = \frac{RfD \times BW}{C_w} \times RSC$$

where:

- HBGL_w = Health-based guidance level for manganese in water
- RfD = Reference dose for manganese, 0.1 mg/kg-day (U.S. EPA, 1991a)
- BW = Body weight, 70 kgs, (ADEQ, 1990)
- C_w = Daily consumption rate of water, 2 L (ADEQ, 1990)
- RSC = Relative source contribution, 0.1 (ADEQ, 1990).

The RfD is an estimate of the daily exposure of the human populations to a potential hazard that is likely to be without risk of deleterious effects during a lifetime (U.S. EPA, 1989). The relative source contribution is used to adjust the acceptable value by taking into account potential intake of a chemical via other sources such as ingestion of soils or food consumption (ADEQ, 1990). The calculated health-based guidance level for manganese is 350 µg/L. The maximum concentration in groundwater at the site (16.8 µg/L) is an order of magnitude less than this value. Based on this analysis site-related chemicals in groundwater will not have an adverse effect upon human health as a result of consumption of groundwater.

Site 5 - Ammunition Dump. The maximum concentration of acetone in soils was more than six orders of magnitude less than the respective guidance level in soils. The concentrations of copper, zinc and nitrate are over an order of magnitude below their respective action levels (Table 4-1). Based on this evaluation, chemicals of potential concern in soils and groundwater at this site will not have a long-term adverse effect upon human health.

Site 6 - POL Area. The concentration of benzene in groundwater (1900 µg/L) is over two orders of magnitude above the Arizona MCL (5 µg/L). The remaining compounds, ethylbenzene, toluene and xylenes were below their respective ARARs (Table 4-2).

4.5 Environmental Assessment

The environment at 161AREFG represents a controlled ecosystem. Vegetation consist primarily of shrubs, trees, or grasses that have been planted for aesthetics or other landscap-

ing purposes. Much of the area at both the Base and Papago is barren soil or paved surfaces. Wildlife at both the Base and Papago consists of animals adapted to surviving in this type of environment and include squirrels, mice, rats and birds. There are no endangered or threatened species within a 1-mile radius of either location (Palmer, 1991).

Site 1 - JP-4 Hydrant Area. The area of this site consists of hardscape and barren ground. There is no vegetation growing at this site. There was no sign of animal life seen during reconnaissance and given the open terrain and lack of protective cover surrounding the site, it is unlikely that an animal would move across this site while traveling from one area to another. Given the lack of vegetation and the absence of signs of wildlife (burrows, droppings, tracks, etc.) in the area of the site, it is unlikely that an environmental receptor would come in contact with site-related chemicals. Therefore, this site does not present a significant risk to environmental receptors.

Site 2 - Hazardous Waste Storage Area. This site occupies approximately 80 square feet of open ground. The site is bordered by a paved area on two sides and the remaining sides are bordered by open ground with small patches of crab grass and various weeds. No signs of wildlife were seen during site reconnaissance. Given the apparent lack of wildlife habitat or the presence of wildlife, it is unlikely that environmental receptors would come in contact with chemicals at the site. Therefore, this site does not present a significant risk to environmental receptors.

Site 3 - Fuel Bladder Area. The site consists of open barren ground which is bordered by pavement on each side. Small patches of crab grass are growing at scattered points along the fence enclosing the site. No signs of wildlife were seen at the site. Given the open area which provides no cover for wildlife and the apparent absence of wildlife habitat surrounding the site, it is unlikely that environmental receptors will come in contact with chemicals at the site. The potential risk to environmental receptors is minimal.

Site 4 - 107TCS/111ATCF Hazardous Waste Collection Area. This site presently consists of barrels stored along a fence. The site is bordered by a parking lot and an open garage. Vegetation consists of weeds and some vines growing along the top of the fence. A small rodent may take up residence using the drums and fence for cover. The lack of appropriate habitat would limit wildlife to small animals which are adapted to living in close residence with humans, namely rats, mice, or other nuisance organisms. The potential for exposure of significant environmental receptors is considered to be minimal at this site.

Site 5 - Ammunition Dump. This site is either paved or covered with structures. It is unlikely that environmental receptors will come in contact with site-related chemicals. Chemicals at this site do not present a significant risk to environmental receptors.

Site 6 - PCL Area. The site related chemicals at this site are limited to subsurface soils. Therefore, the chemicals at this site are isolated from environmental receptors and does not present a significant risk to these receptors.

4.7 Conclusions and Recommendations

The chemicals present in the soils and groundwater at 161AREFG do not present an immediate or substantial hazard to human health or environmental receptors. Based on our knowledge of the Base, Sites 1, 3, and 5 do not present a significant threat to health either presently or under a future-use scenario. None of the sites will have a significant impact upon important environmental receptors.

The maximum concentrations of aluminum and beryllium present in surface soils at Site 2 exceeded the respective guidance levels. Given the concentrations of these compounds in background soils, the concentrations of these chemicals may be within the background range. Additional background surface soil samples should be taken to determine the range of background metal concentrations in soils.

The aluminum concentration in soils at Site 4 was above guidance levels. As was previously discussed, additional background samples will be required to determine if the chemical concentrations present are actually elevated above background levels.

Benzene concentrations in groundwater at Site 6 were over two orders of magnitude above drinking water standards. However, the groundwater at the site is not presently used as a drinking water source. This site should be evaluated further to determine if the benzene concentrations present in groundwater present a potential risk given future land use at the site.

Additional background sampling at the Base and Papago will be required to estimate the range of background concentrations of metals in these two areas. If the metals described are elevated above background, a quantitative risk assessment would be required to evaluate the potential health risks resulting from exposure to these site-related chemicals at Sites 2 and 4.

The quantitative risk assessment would require the development of appropriate exposure scenarios and the estimation of acceptable intake levels for the chemicals of potential concern identified for each of the sites.

5.0 Conclusions and Recommendations

5.1 Data Limitations

Data collected during the 161AREFG SI include screening and confirmation information. Screening data typically follow HAZWRAP Data Quality Objectives (DQOs) A and B and are suitable for initial site characterization and monitoring of remedial action activities. DQO Level B data are also useful for evaluation of remedial alternatives during feasibility studies. Confirmation activities were conducted according to HAZWRAP DQO Level C and are suitable for the uses described above, as well as risk assessment, engineering design of remedial actions, and responsible party determination.

Objectives of the SI were to determine the need for, and the next step, if necessary, in the IRP process for sites identified in the PA. This determination is based on confirmation of releases of environmental contaminants and assessment of risks posed by the releases. Although screening data are useful in determining the nature and extent of contaminants at each site, assessment of hazard to human health and the environment is based only on confirmation activities meeting DQO Level C.

5.2 Conclusions

The following conclusions can be drawn from the 161AREFG SI:

General

Groundwater occurs at a depth of approximately 75 feet bgl at the Base and flows toward the northwest. The Base is underlain by a vertically extensive aquifer system of locally high transmissivity. The aquifer is composed of alluvial material consisting of silt to boulder sized particles. Occurrence of flow in the Salt River influences the water table elevation and gradient but under conditions encountered during the SI, does not affect the direction of groundwater flow. The average minimum flow velocity is approximately 3.0×10^{-5} cm/s (31 ft/yr) and maximum flow velocity is 1.3×10^{-3} cm/s (1,304 ft/yr).

Wells MWS-01, -02, and -03 are located upgradient of all base facilities and serve as indicators of background water quality. Each of the wells contained in at least one sample, low (1 μ g/L) concentrations of halogenated VOCs commonly associated with the EWA State Superfund Site. Groundwater samples from MWS-02 contain concentrations of contaminants that may be related to higher concentrations found elsewhere on the Base or an off-site source.

The source of elevated TPH found in background soil samples may be related to past weed control practices or chemical quality of fill material. The occurrence

of the elevated TPH in near surface soil samples does not indicate movement of these contaminants through the soil column to the groundwater.

Because TPH detections were limited vertically and horizontally, no further action to address TPH detections is recommended.

Site No. 1 - JP-4 Hydrant Area

Soil organic vapor and Level C analyses of soil samples from Site 1 do not indicate environmentally significant releases of fuel products from the site. Groundwater analyses from a well located directly downgradient of the site do not indicate the presence of site-related contaminants; however, compounds and concentrations of halogenated VOCs are similar to that detected in background monitoring wells. Based on the analysis of the present data release of contaminants from Site 1 do not appear to pose a significant risk to human health or the environment.

Site No. 2 - HW Storage Area

Soil organic vapor and Level C analyses of soil samples from Site 2 are not indicative of environmentally significant releases of stored products from the site. Groundwater analyses from a well located directly downgradient of the site do not indicate the presence of site-related contaminants; however, compounds and concentrations of halogenated VOCs are similar to that detected in background monitoring wells. Based on current knowledge of the site, release of contaminants from Site 2 do not appear to pose a significant risk in concentrations to human health or the environment. Aluminum and beryllium were detected above background concentrations and guidance levels. It is not clear whether these concentrations are site related or if they reflect undetermined variability in background soil concentrations.

Site No. 3 - Fuel Bladder Area

Soil data collected from Site 3 indicate localized occurrence of VOCs in soil underlying the site. The source of the compounds is not certain but are believed to originate from Site 6. Soil samples collected from near the water table contain higher concentrations of halogenated and aromatic VOCs similar to and is presumed to be influenced by Site 6. Samples of groundwater from a monitoring well positioned upgradient of Site 3 contain mg/L concentrations of aromatic VOCs similar to and is presumed influenced by Site 6. Samples from the downgradient monitoring well contain only halogenated compounds similar to background sample concentrations. Chemicals spilled at the site are not entering the groundwater and no apparent threat to health exists at this site.

Site No. 4 - HW Collection Area

Papago Military Reservation is underlain by caliche and volcanic bedrock. Groundwater occurs at depths ranging from 27 to 37 feet bgl and flows generally westerly. Groundwater flow may trend northwesterly and southwesterly under high flow conditions. Based on water-yielding characteristics of monitoring wells and piezometers at Site 4, the aquifer likely consists predominantly of frac-

ured material with varying degrees of interconnectiveness. The hydraulic conductivity at Papago is extremely slow and slug tests required long recovery times. The minimum groundwater flow velocity is approximately 5.6×10^{-6} cm/s (0.1 ft/yr) to a maximum of 5.6×10^{-6} cm/s (6 ft/yr). Contaminants related to Site 4 were not identified in soil or groundwater samples, however, elevated levels of aluminum were detected in certain soil samples. It is not certain whether the aluminum is site related or if it reflects undetermined variability in background concentration. Elevated concentrations of TPH in soil samples at the site are likely related to surface activities associated with motor-vehicle parking areas. Releases of contaminants from Site 4 do not appear to pose a significant risk to human health or the environment.

Site No. 5 - Ammunition Dump

Evidence of buried ammunition was not discovered at Site 5 using geophysical methods. GPR was used to probe the subsurface in the area identified as disposal areas by the PA and by subsequent field discovery. GPR profiles penetrated to a depth of 5 to 6 feet bgl and did not provide evidence of disposal or trenching. Lack of geologic layering near Building 46 may indicate past disposal, trenching, or fill activities.

Site No. 6 - POL Area

During the course of investigating Site 3, aromatic hydrocarbons were detected in an upgradient well to Site 3. This confirmed that at Site 3, little or no migration of contaminants from the fuel bladders were reaching the groundwater, and that the POL area was the suspected source. Thus, a new site, Site No. 6, was designated for future investigation. Since only one boring and well were drilled, the horizontal extent of the VOCs is not known. Benzene was detected at over 1000 times the MCL at 1100 and 1900 $\mu\text{g/L}$ for April and June 1991, respectively. Concentrations greater than 1 mg/L of aromatic hydrocarbons are present in groundwater underlying the western boundary of the Base.

5.3 Recommendations

Site 1. JP-4 Hydrant Area

There are no significant releases of fuel products and levels are similar to background. No risk to human health or the environment is predicted.

Recommendation - Proceed to a decision document recommending no further action.

Site 2. Hazardous Waste Storage Area

Site 2 does not appear to contribute to groundwater quality concerns and no risk to human health or the environment is expected. However, the source of elevated aluminum and beryllium in soils has not been determined.

Recommendation - Collect additional background soil samples to provide a larger statistical sample population. Proceed to a decision document recommending no further action if additional sampling does not indicate potential contamination; otherwise, expand the SI.

Site 3. Fuel Bladder Area

No long-term risk to human health is expected from the soil and site-related chemicals are not impacting the groundwater.

Recommendation - Proceed to a decision document recommending no further action.

Site 4. 107th Tactical Control Squadron (107 TCS)/111 Air Traffic Control Flight (111 ATCF) Hazardous Waste Collection Area (Pupazo)

It is not known if aluminum is associated with Site 4 or if it represents undetermined variability in background concentrations; elevated TPH in the surface soil is probably related to surface storage and vehicle parking activities. No significant risk to human health or the environment is expected.

Recommendation - Collect additional background soil samples to provide a larger statistical sample population. Proceed to a decision document recommending no further action if additional sampling does not indicate potential contamination; otherwise, expand the SI.

Site 5. Ammunition Dump

Location of disposal areas is not conclusive at depths greater than 5-6 feet bgl.

Recommendation - Due to airport runway expansion in the near future that would require excavation, confirmation activities such as excavation of test pits and trenches near previous areas of munitions discovery are recommended.

Site 6. Petroleum, Oil, and Lubricant (POL) Area

Target compounds of benzene, toluene, ethylbenzene, and xylene, except DCE, TCA, and PCE, were detected in samples from 40 - 70 feet below ground surface. The actual source of contamination is not certain at this time.

Recommendation - Expand the SI, or initiate an RI and develop work plans for a more comprehensive investigation of this new site. Drill additional borings and install several monitoring wells west, north, and south of the site to ascertain vertical and horizontal extent and migration of organic compounds in the soil and groundwater.

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