INSTALLATION RESTORATION PROGRAM

AD-A277 739

②

FINAL

Site Investigation Report

Volume 2

Appendices A Through G

November 1992

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

AIR NATIONAL GUARD

94-09980

94 4 1 062

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-AC05-840R21400

Report Documentation Page

OMB No. 0704-0188

(computer generated)

1. Agency Use Only (Leave Blank)

2. Report Date
Nov. 1997

3. Report Type and Dates Covered Vol. [illegible]
Site Investigation Report

4. Title and Subtitle
Sky Harbor ANG Base, Phoenix, AZ Vol. 2

5. Funding Numbers

6. Author(s)

7. Performing Organization Name(s) and Address(es)
IT Corporation
312 Directors Drive
Knoxville, TN 37923

8. Performing Organization Report number

9. Sponsoring/Monitoring Agency Name(s) and Address(es)
Hazardous Waste Remedial Action Program
Oak Ridge TN

Air National Guard Readiness Center
Andrews Air Force Base, Maryland 20331

10. Sponsoring/Monitoring Agency Report Number

11. Supplemental Notes

12. Distribution/Availability Statement

Approved for public release: distribution is unlimited

12b. Distribution Code

13. Abstract (maximum 200 words)

Site Investigation of five (5) IRP sites at Sky Harbor Air National Guard Base and one (1) site at Papago Military Reservation. Three volumes containing

14. Subject Terms
Installation Restoration Program, Air National Guard Readiness Center, Site Investigation Report, Arizona Air National Guard, Sky Harbor International Airport, Phoenix, AZ

15. Number of Pages
620

16. Price Code

17. Security Classification of Report	**18. Security Classification of this Page**	**19. Security Classification of Abstract**	**20. Limitation od Abstract**
Unclassified	Unclassified	Unclassified	None

NSN 7540-01-280-5500 Standard Form 298 (Rev. 2-89) Prescribed by ANSI Std Z39-18 298-02

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

VOLUME 2
APPENDICES
A THROUGH G

Submitted To:

AIR NATIONAL GUARD READINESS CENTER
ANDREWS AIR FORCE BASE, MARYLAND

Submitted By:

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

Prepared By:

IT CORPORATION
312 DIRECTORS DRIVE
KNOXVILLE, TENNESSEE 37923

NOVEMBER 1992

List of Appendices

Appendix	Title
	VOLUME 2
A	Variance and Nonconformance Reports
B	Preliminary Review of Hydrogeologic Data for Facilities Adjacent to Sky Harbor Air National Guard Base
C	Geophysical Survey Report
D	SOV Survey Report
E	Soil Boring Logs
F	Piezometer and Monitoring Well Completion Diagrams
G	Piezometer and Monitoring Well Development Records
	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

APPENDIX A

VARIANCE AND NONCONFORMANCE REPORTS

IT INTERNATIONAL TECHNOLOGY CORPORATION

VARIANCE LOG
CHRONOLOGIC LIST OF PROJECT VARIANCES

PROJECT NUMBER 409721 **PAGE** 1 **OF** 1

PROJECT NAME SKY HARBOR

DATE [illegible] APPROVED ✓	VARIANCE GRANTED AND APPLICABLE DOCUMENT	RESPONSIBLE INDIVIDUAL
11/29/90	VAR.#1 USE OF DIFFERENT GC INSTRUMENT; FIELD SAMPLING PLAN (FSP)	S. SARES
11/29/90	VAR.#2 USE OF EVACUATED GLASS VIALS FOR SOV; FSP	S. SARES
12/11/90	VAR.#3 MODIFICATION OF SITE #3 SAMPLING POINTS	S. SARES/S. WILSON
12/12/90	VAR.#4 CHANGE IN ANALYTICAL PROCEDURES & EQUIPMENT FOR ON-SITE FIELD SCREENING OF SOIL BORINGS/SAMPLES	DOUG PEERY
1/11/91	VAR.#5 CHANGE IN PIEZO./WELL SAND PACK	S. SARES
1/11/91	VAR.#6 CHANGE IN SOIL CLASSIFICATION AND SAMPLING FORMS	S. SARES
1/16/91	VAR.#7 SAMPLE COLLECTION/SHIPMENT	S. SARES
1/17/91	VAR.#8 CHANGE IN ANALYTE TESTS	CHERYL FERGUSON
1/24/91	VAR.#9 SITE 4, DELETION OF SOIL BORING SAMPLES	S. SARES
2/13/91	VAR.#10 GROUNDWATER SAMPLING PURGE PROCEDURE	S. SARES
4/9/91	VAR #11 GROUNDWATER SAMPLING OF 2IN. PIEZOMETER	S. SARES

INTERNATIONAL TECHNOLOGY CORPORATION

VARIANCE FORM

VARIANCE NO. 1

PROJECT NO. 409721.02 **PAGE** 1 **OF** 1

PROJECT NAME SKY HARBOR ANG BASE SI **DATE** 29 NOV 90

VARIANCE (INCLUDE JUSTIFICATION)

THE SKY HARBOR WORK PLANS WERE PREPARED SPECIFYING A PHOTOVAC 10550 GC/PID FOR ANALYSIS OF SOV SAMPLES FOR AROMATIC AND HALOGENATED VOLATILE ORGANIC COMPOUNDS. DETECTION LIMITS FOR THIS EQUIPMENT ARE TYPICALLY 20-100 PPb (ug/l) FOR SOV AROMATIC SAMPLES AND 50 PPb FOR HALOGENATED. THE SUBCONTRACTOR SELECTED FOR SOV ANALYSIS PROPOSES TO UTILIZE A "SHIMADZU 14A" GAS CHROMATOGRAPH WITH FID AND ECD RATHER THAN THE PHOTOVAC. THE SHIMADZU EQUIPMENT IS "LABORATORY QUALITY" AS OPPOSED TO A "FIELD" SCREENING INSTRUMENT LIKE THE PHOTOVAC 10550. USE OF THE SHIMADZU SHOULD PROVIDE MORE EFFICIENT LABORATORY OPERATION AND LOWER DETECTION LIMITS. DETECTION LIMITS FOR THE SHIMADZU ~~WILL~~ SOS 11-29-90 ARE EXPECTED TO BE APPROXIMATELY 0.1 TO 1 PPb FOR HALOGENATED COMPOUNDS AND 1 PPb FOR AROMATIC COMPOUNDS.

APPLICABLE DOCUMENT: SECTION 5.2

FINAL SITE INVESTIGATION FIELD SAMPLING PLAN, 161ST AIR REFUELING GROUP, AZ. AIR NATIONAL GUARD, SKY HARBOR INTERNATIONAL AIRPORT, PHOENIX, ARIZONA, SEPTEMBER 1990.

CC: B. Stanley (MMES)

REQUESTED BY **DATE** 11-29-90

APPROVED BY **DATE** 11/29/90

Project Manager

R. A. Mack **DATE** 30 NOV 90

Quality Assurance Officer

DATE 1/21/91

HAZWRAP PROJECT MGR.

IT INTERNATIONAL TECHNOLOGY CORPORATION

VARIANCE FORM

VARIANCE NO. 2

PROJECT NO. 409721.02 **PAGE** 1 **OF** 1

PROJECT NAME SKY HARBOR ANG BASE SI **DATE** 29 NOV 90

VARIANCE (INCLUDE JUSTIFICATION)

SOV SAMPLE CONTAINER CHANGE FROM TEDLAR BAG TO EVACUATED GLASS VIAL.

CONTAINER FILL METHOD CHANGE FROM DESSICATOR DEFLATION TO ACTIVE PLACEMENT.

SKY HARBOR WORK PLANS WERE PREPARED USING IT'S NORMAL PROCEDURE FOR SAMPLE COLLECTION. RFPS WERE LET TO TWO QUALIFIED FIRMS FOR EXECUTION OF SOV SURVEY. EACH FIRM RESPONDED WITH MINOR CHANGES TO SAMPLE COLLECTION AND HANDLING PROCEDURES. THE VENDOR WITH PROCEDURES MOST CLOSELY FOLLOWING IT'S WAS SELECTED. THE METHOD OF COLLECTION IS DESCRIBED BELOW.

SAMPLE CONTAINERS ARE EVACUATED GLASS VIALS RATHER THAN TEDLAR BAGS. THE VIALS WILL BE FILLED BY ACTIVE SYSTEM RATHER THAN DESSICATOR DEFLATION. Vials meet EPA CLEANING CRITERIA FOR ORGANIC COMPOUNDS. SAMPLES ARE PUMPED INTO VIALS AT [illegible] PSIG.

THE USE OF "EPA CLEAN" GLASS VIALS INSTEAD OF TEDLAR BAGS ~~WILL NOT CAUSE~~ SWD 11-29-90 AND THE ACTIVE PLACEMENT METHOD WILL NOT ~~CAUSE~~ CHANGE DATA QUALITY; RATHER, PLACEMENT OF SAMPLES INTO CONTAINERS AT HIGHER THAN ATMOSPHERIC PRESSURE SHOULD DECREASE POTENTIAL FOR SAMPLE CONTAMINATION DUE TO CONTAINER LEAKS AS ANY LEAKS WOULD BE FROM THE CONTAINER TO THE ATMOSPHERE. THE PROPOSED SAMPLE COLLECTION METHOD WILL BE CONSISTANT WITH DQO LEVEL B.

APPLICABLE DOCUMENT: FINAL SITE INVESTIGATION FIELD SAMPLING PLAN, SECTION 5.2 161ST AIR REFUELING GROUP, AZ, AIR NATIONAL GUARD, SKY HARBOR INTERNATIONAL AIRPORT, PHOENIX AZ, SEPTEMBER 1990.

CC: J. Stanley (MMES)

REQUESTED BY **DATE** 11-29-90

APPROVED BY **DATE** 11/29/90

Project Manager

DATE 30 NOV 90

Quality Assurance Officer

DATE 1/21/91

HAZWRAP PROJECT MGR.

INTERNATIONAL TECHNOLOGY CORPORATION

VARIANCE FORM

VARIANCE NO. 3

PROJECT NO. 409721 PAGE 1 OF 1

PROJECT NAME SKY HARBOR ANG BASE SI DATE 12/11/90

VARIANCE (INCLUDE JUSTIFICATION)

THE FIELD SAMPLING PLAN WAS PREPARED UTILIZING "EXISTING" BLUE LINE DRAWINGS FROM THE BASE. IN PARTICULAR, SITE 3 WAS A FUEL STORAGE AREA BELIEVED TO HAVE BEEN WITHIN A CYCLONE FENCED AREA (ATTACHMENT 1). RECENT UTILITY CLEARANCE ACTIVITIES DISCLOSED A 1972 MAP SHOWING THE FUEL STORAGE AREA ABOUT 150 F. WEST OF LEASE LINE. THE PURPOSE OF THIS VARIANCE IS TO REQUEST MODIFICATION OF SAMPLING AREAS TO THAT SHOWN ON ATTACHMENT 2. NO SCOPE CHANGE IS ENVISIONED. THE SAME SAMPLING POINTS OCCUR BUT IN SLIGHTLY DIFFERENT LOCATION TO ADEQUATELY CHARACTERIZE THE SITE.

APPLICABLE DOCUMENT:

FINAL FIELD SAMPLING PLAN, ~~APP~~ SECTION 4.6, SITE 3, FUEL BLADDER STORAGE AREA; AZ AIR NATIONAL GUARD, SKY HARBOR INTERNATIONAL

CC: David Bunn

HAZWRAP Files-0449

REQUESTED BY DATE 12/11/90

APPROVED BY DATE 12/11/90

Project Manager DATE 11DEC90

Quality Assurance Officer DATE 4/15/91

ATTACHMENT

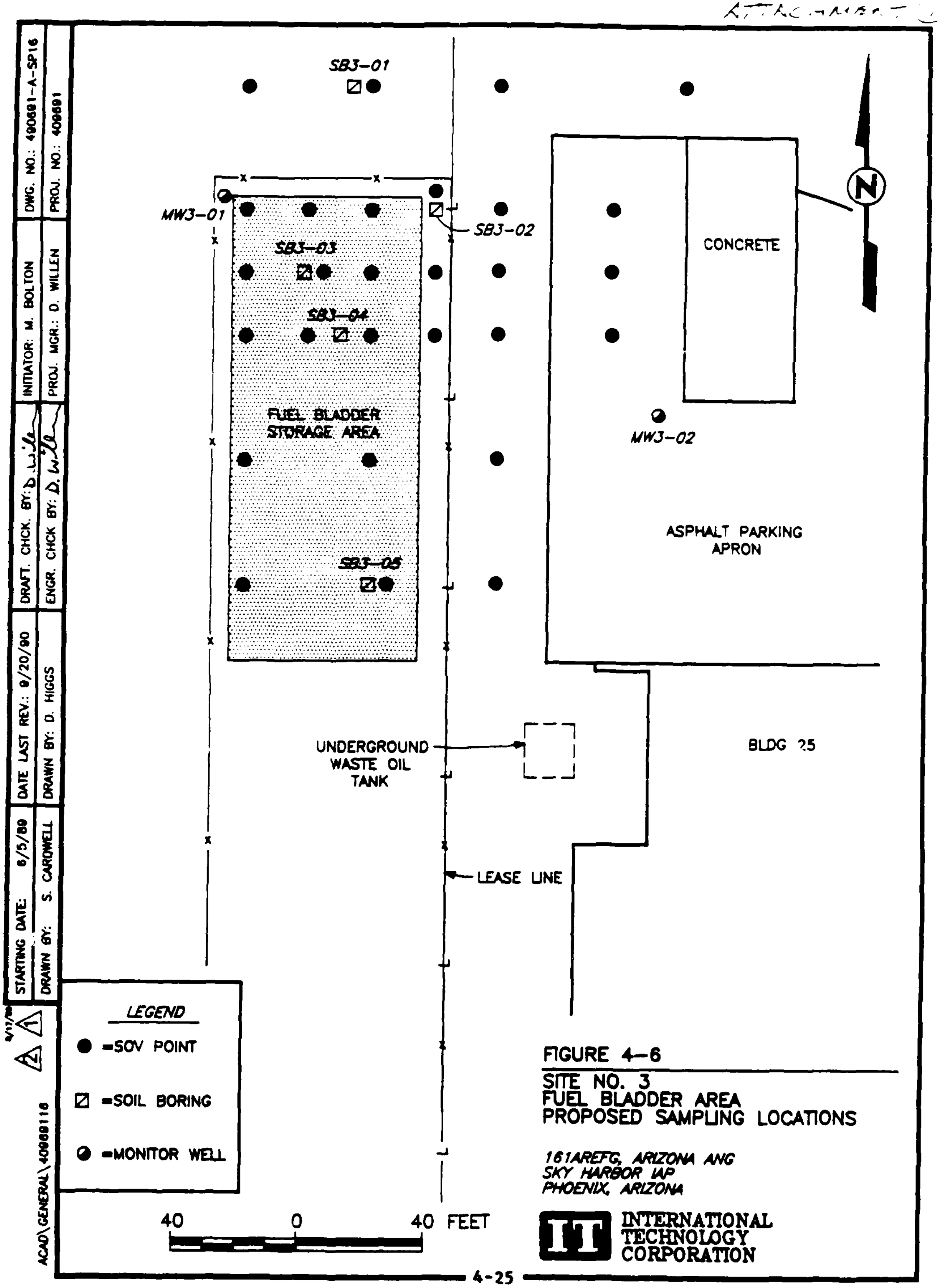


FIGURE 4-6

SITE NO. 3
FUEL BLADDER AREA
PROPOSED SAMPLING LOCATIONS

161AREFG, ARIZONA ANG
SKY HARBOR IAP
PHOENIX, ARIZONA

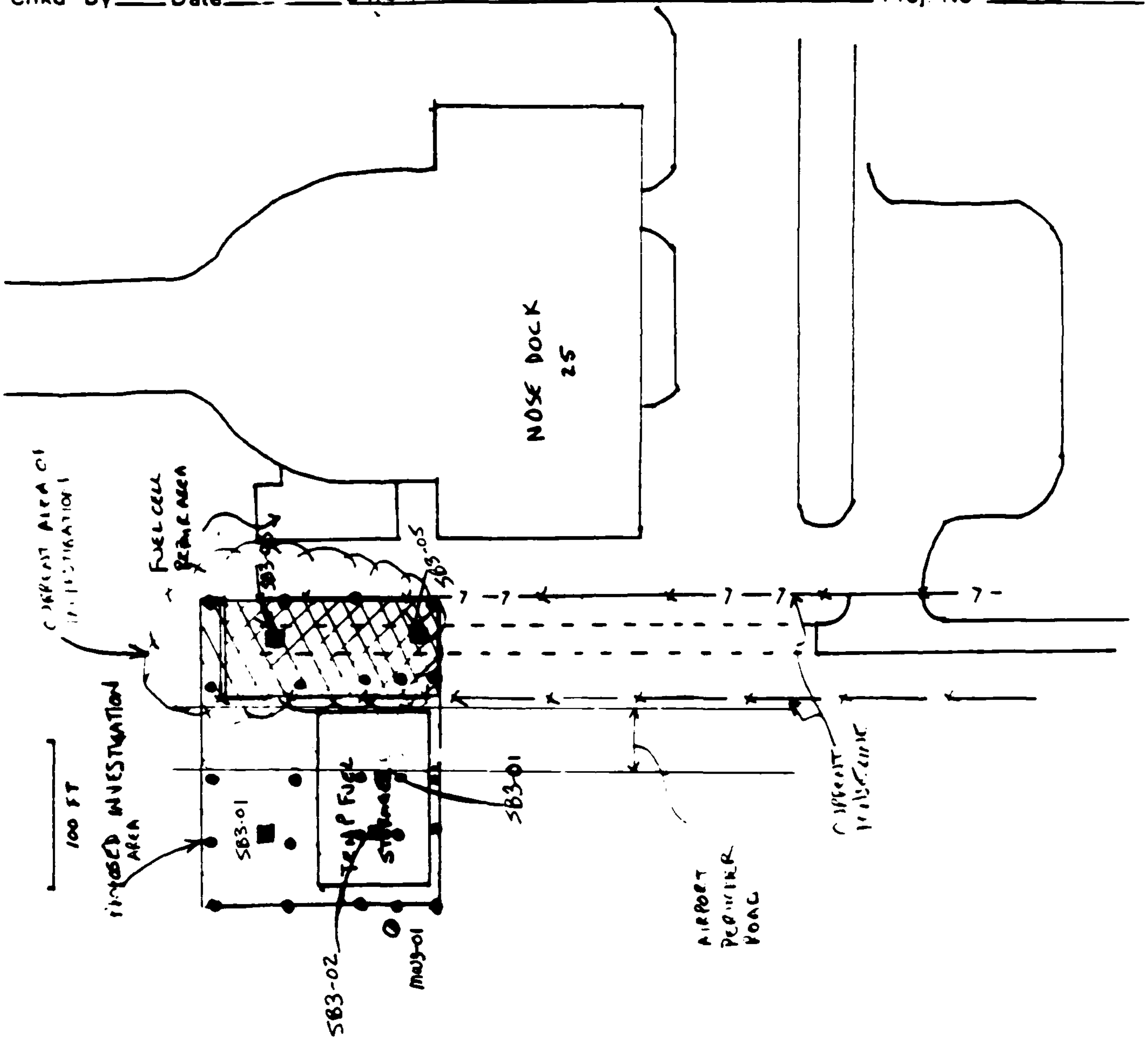
IT INTERNATIONAL TECHNOLOGY CORPORATION

INTERNATIONAL TECHNOLOGY CORPORATION

ATTACHMENT ②

By SWS Date 11 DEC 90 Subject SKETCH MAP OF AREA AROUND Sheet No 1 of

Chkd By Date SITE NO 3 ADAPTED FROM BASE ENG. DRAWING Proj. No 409721



INTERNATIONAL TECHNOLOGY CORPORATION

VARIANCE NO. 4 ~~1~~

VARIANCE LOG

PROJECT NO. 409721 PAGE 1 OF 3

PROJECT NAME AIR NATIONAL GUARD SKY HARBOR DATE: 12/11/90

VARIANCE (INCLUDE JUSTIFICATION)

PURPOSE:

The purpose of this variance is to document a change in the analytical procedure and equipment for on-site field screening analysis of soil boring samples at Sky Harbor National Guard. This change does not affect the target compounds or the intended use of the resulting data, but allows a more accurate qualification and quantification of the target compounds.

CHANGE:

Originally as stated in the SAP, a Photovac 10S50 portable gas chromatograph (GC) using headspace technique was to be used to determine relative concentrations of the target compounds.

The change will be to replace the 10S50 GC with a SRI model 8610 GC equipped with an PID and FID detector in series, purge and trap, and Peaksimple data system. The onboard integrator of the 10S50 will be replaced with a laptop computer and printer.

APPLICABLE DOCUMENT:

FIELD SAMPLING PLAN, SECTION 5.2, SOV SURVEY / FIELD SCREENING

CC: B. Stanley (MMES)

REQUESTED BY: DATE: 12/12/90

APPROVED ~~BY:~~ DATE: 12/12/90

Project Manager

DATE: 12 DEC. 90

Quality Assurance Officer

DATE: 1/21/91

HAZWRAP Project Mgr.

[illegible]

INTERNATIONAL TECHNOLOGY CORPORATION

VARIANCE NO. 42

VARIANCE LOG

PROJECT NO. 409721

PAGE 2 OF 3

PROJECT NAME AIR NATIONAL GUARD SKY HARBOR

DATE: 12/11/90

VARIANCE (INCLUDE JUSTIFICATION)

JUSTIFICATION:

1. The headspace procedure is an indirect method for determining the concentration of compounds. The use of the SRI with the purge and trap allows direct measurement of the compounds. Because of the direct measurement:
   - lower detection limits are obtainable
   - there will be less variability of measurement therefore the data will be more accurate
   - less sample prep equipment is required causing a reduction in cost, time, and potential biasing and errors
   - more accurate simulation of standard laboratory procedures
2. Because the SRI utilizes the FID and PID in series it is easier to more accurately identify and quantify the target compounds in a complex chromatograph by comparing the results of the two detectors. The 10S50 only utilizes the PID thus relying more on the operators interpretation.

APPLICABLE DOCUMENT:

CC:

REQUESTED BY: DATE: 12/12/90

APPROVED BY: DATE:

Project Manager

DATE:

Quality Assurance Officer

DATE:

408819-7

INTERNATIONAL TECHNOLOGY CORPORATION

VARIANCE NO. 4x

VARIANCE LOG

PROJECT NO. 409721 PAGE 3 OF 3

PROJECT NAME AIR NATIONAL GUARD SKY HARBOR DATE: 12/11/90

VARIANCE (INCLUDE JUSTIFICATION)

JUSTIFICATION (continued):

3. The interfacing and utilization of a laptop computer by the SRI allows chromatographic data to be stored on floppy disk in a format that permits the data to be easily stored an recalled at any future time for reexamination, integration and manipulation. The 10S50 does not allow this without the addition of extra peripheral support.

4. The higher level of technology in the SRI allows the operator to easily and more accurately control the GC operational parameters thus allowing for more accurate qualification and quantification of the target compounds

APPLICABLE DOCUMENT:

CC:

REQUESTED BY: DATE: 12/11/90

APPROVED BY: DATE:

Project Manager

DATE:

Quality Assurance Officer

DATE:

INTERNATIONAL TECHNOLOGY CORPORATION

VARIANCE FORM

VARIANCE NO. 5

PROJECT NO. 409721.02.06 **PAGE** 1 **OF** 3

PROJECT NAME SKY HARBOR ANG - SI **DATE** 11 JAN 91

VARIANCE (INCLUDE JUSTIFICATION) CHANGE IN PIEZO./WELL SAND PACK.

Drillers requested substitution of silica sand specification for piezometers and monitoring well sand pack from 30-or-40 mesh (current work plan) to 20/40 mix. 30-40 mesh sand is not a readily available product and obtaining special mix will cause delay and added expense. 20/40 mesh is similar gradation and is commonly used with screen-size to be used (0.010 in slot).

The 20/40 Sand is suitable for use with 0.010 slot screen and should not cause data quality to be effected. The 20/40 sand with the 0.010 screen size is recommended in HAZWRAP position paper #4, pg. 12.

APPLICABLE DOCUMENT:

Final Site Investigation Field Sampling Plan, 161st Air Refueling Group, AZ Air National Guard, Sky Harbor International Airport, Phoenix Arizona, Sept. 1990, Section 5.5.3.1, Pg 5-20

CC: WILLEN
TYBURSKI
D. MACK
B. Standley (MMES)

REQUESTED BY **DATE** 11 JAN 91

APPROVED BY **DATE** 1/11/91

Project Manager

D. W. Mack **DATE** 11 JAN 91

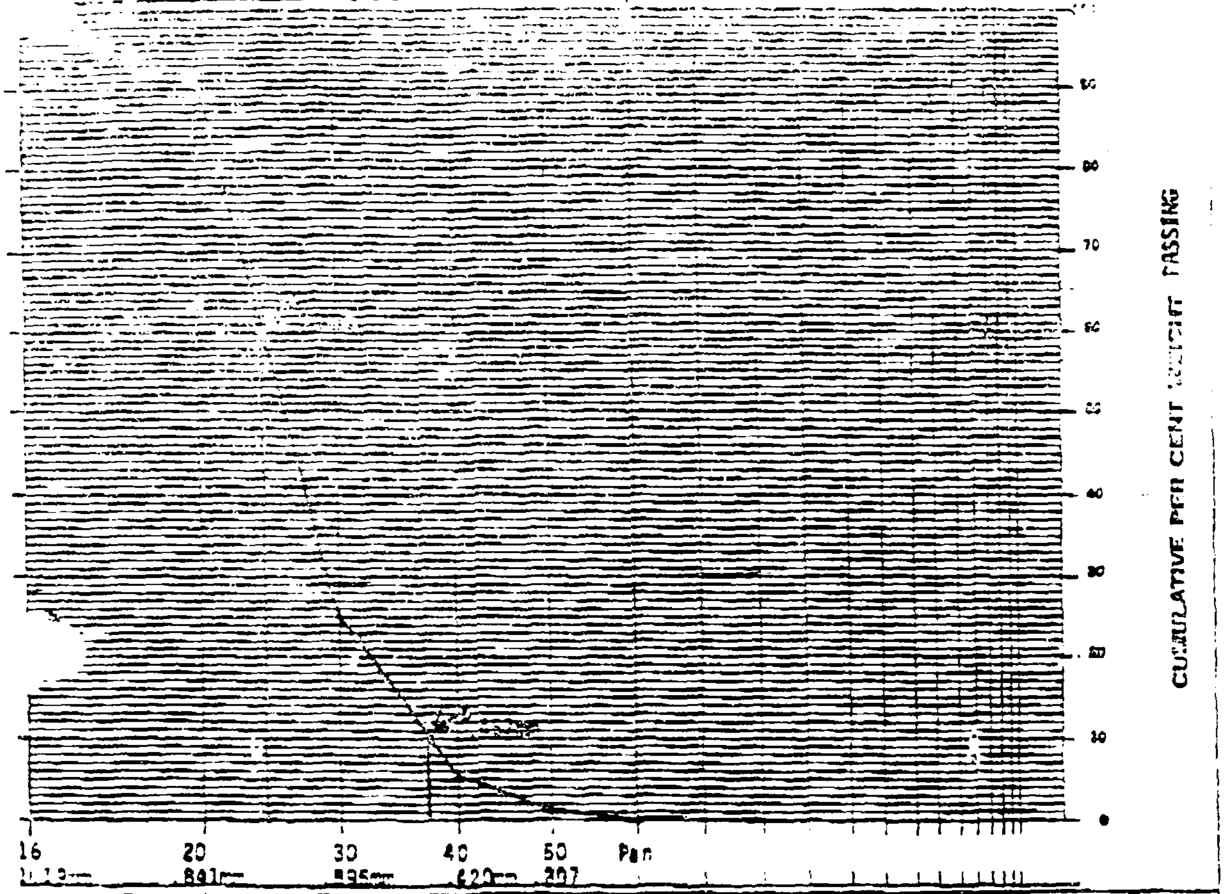
Quality Assurance Officer

DATE 1/18/91

Fourth Root of Two Series for Close Sizing

Cumulative Direct Diagram of Screen Analysis on Sample of ______ Production

Effective Size .457mm U.C. 1.57 Date ______



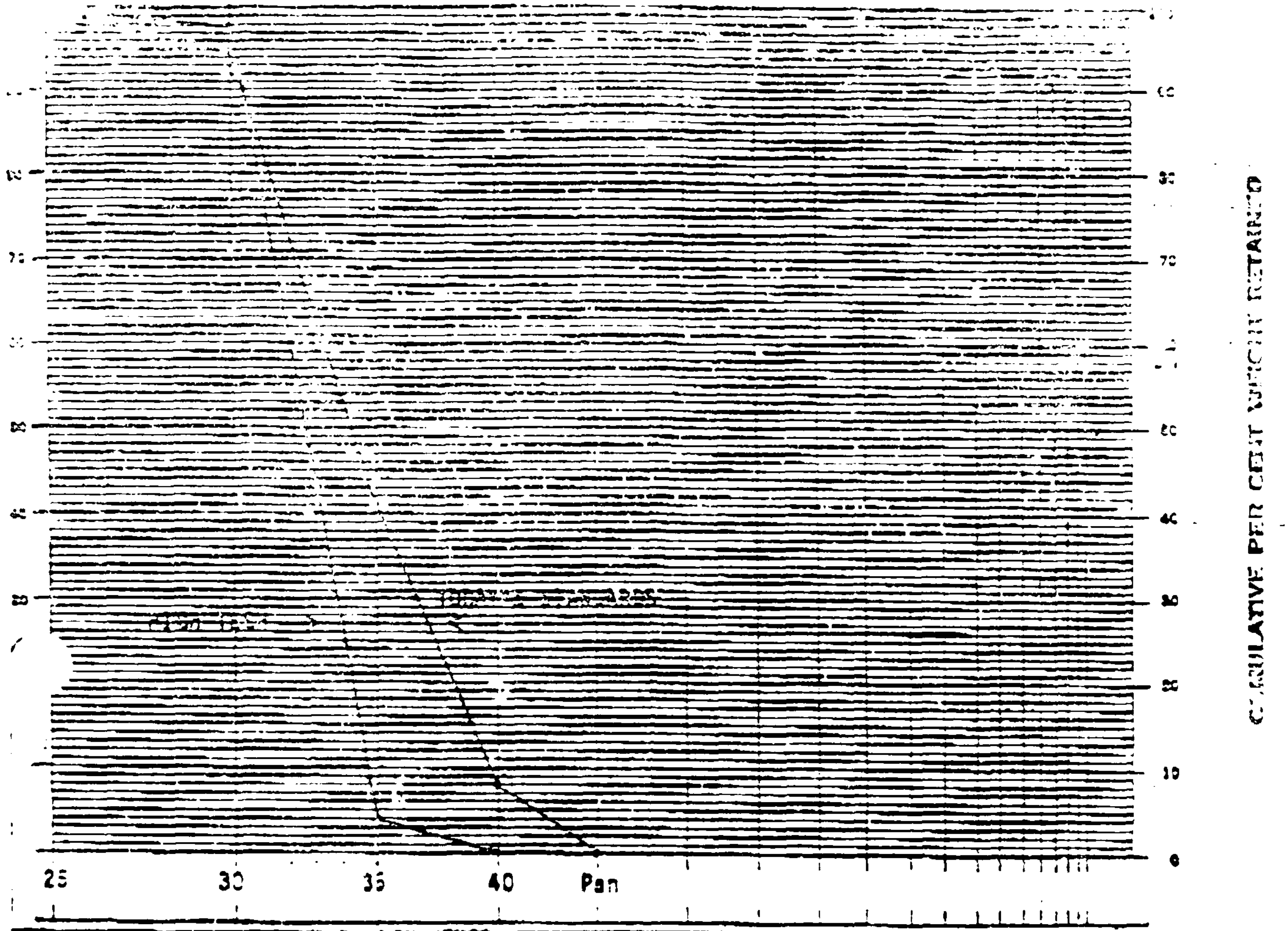
SCREEN SCALE RATIO 1.189												
Openings		Tyler Mesh	U. S. No.	Sample Weights	Per Cent	Per Cent Cumulative Weights	Sample Weights	Per Cent	Per Cent Cumulative Weights	Sample Weights	Per Cent	Per Cent Cumulative Weights
Inches	Millimeters											
			16			100						
			20			99.2						
			30			25.2						
			40			5.2						
			50			1.0						
			Pan			-						

[illegible]

Fourth Root of Two Series for Closer Sizing

Cumulative Direct Diagram of Screen Analysis on Sample of ______ Gravel Pack Sand

HIGH TECH 30-40 ______ Date______



SCREEN SCALE RATIO 1.189												
Openings		Tyler Mesh	U. S. No.	Sample Weights	Per Cent	Per Cent Cumulative Weights	Sample Weights	Per Cent	Per Cent Cumulative Weights	Sample Weights	Per Cent	Per Cent Cumulative Weights
Inches	Milli-meters											

INTERNATIONAL TECHNOLOGY CORPORATION

VARIANCE FORM

VARIANCE NO. 6

PROJECT NO. 409721.02.06 **PAGE** 1 **OF** 7

PROJECT NAME SKY HARBOR ANG BASE SI **DATE** 11 JAN 91

VARIANCE (INCLUDE JUSTIFICATION) CHANGE IN SOIL CLASS. & SAMPLING FORMS

Substitute the following field description forms for forms described in work plans. the "new" forms are specified in HAZWRAP Guidance documents as preferred to maintain program consistancy. the replacement forms contain the same or more information as the work plan forms

Current WP Form	Replacement
① Visual Classification of Soils Fig 5-3	Boring Log - Rev Date May 1990 (Figure 5-3a)
② No Form	Monitoring Well Construction Log - Rev Date May 1990 - Standard and flush mount Fig. 5-4a & 5-4b
③ No Form	Monitoring Well Development Log - Rev Date May 1990, Including Post Development Water Level Recovery Graph (FIGURES 5-4c & 5-4d)
④ Sampling Information Form Fig 5-6	Monitoring Well Purging Log - Rev Date May 1990 (Fig. 5-6a) Monitoring Well Sampling Log - Rev Date May 1990 (Fig. 5-6b)

THE FSP IS MODIFIED AS FOLLOWS: PG. 5-17, SECT. 5.5.2, 2ND SENTENCE, IS MODIFIED TO READ, "THE INFORMATION RECORDED ON THE BORING LOG FORM (FIGURE 5-3a) WILL ALSO INCLUDE ----."; PG. 5-24, SECT. 5.5.3.2, LAST SENTENCE, REPLACE REFERENCE TO "FIGURE 5-4" WITH "FIGURES 5-4a AND 5-4b)"; PG. 5-25, SECT. 5.5.4, LAST PARA., 2ND SENTENCE, IS MODIFIED AS FOLLOWS: "FIELD TURBIDITY AND OTHER DEVELOPMENT RESULTS WILL BE REPORTED ON FIGURES 5-4c AND 5-4d FOR EACH WELL."; PG 5-30, SECT. 5.7.4.2, LAST SENTENCE, IS MODIFIED BY REPLACING "FIGURE 5-6" WITH "FIGURES 5-6a AND 5-6b."

APPLICABLE DOCUMENT:

Final Site Investigation Field Sampling Plan, 161st Air Refueling Group, Az Air National Guard, Sky Harbor International Airport, Phoenix Az., Sept 1990, Section ~~5.5~~ 5.5.3.2, 5.7.4.2, 5.5.2

CC: WILLEN
TYBURSKI
D. MACK
B. Stanley (MMES)

REQUESTED BY **DATE** 11 JAN 91

APPROVED BY **DATE** 1/11/91
Project Manager

D. N. Mack **DATE** 14 JAN 91
Quality Assurance Officer

DATE 1/18/91

FIGURE 5-3a

REV. DATE [illegible]

BORING LOG | BORING/WELL NO. | Page ____ of ____

Installation **Sky Harbor** **Coordinates:** | Site

Project No. | Client/Project:

HAZWRAP Contractor | Drlg Contractor | Driller

Drlg Started ___ m/ | Drlg Ended ___ m/ | Borehole dia.(s)

Drlg Method/Rig Type

Logged by | E-Log (Y / N) From _____ to _____ | Protection Level

Depth (ft)	Sample	Sample No.	Sample Type	Anal. (Y/N)	Recovery ( )	Headspace ( )	Lithologic Description	USCS	Blows/6 inch	Graphic Log	Well data	Water depth &	Remarks	Elev.

T = Thin wall Tube | R = Rock Coring ____________ | Field GC (Make/Model) ____________

S = Split spoon tube | O = Other ____________ | GC Oper. ____________

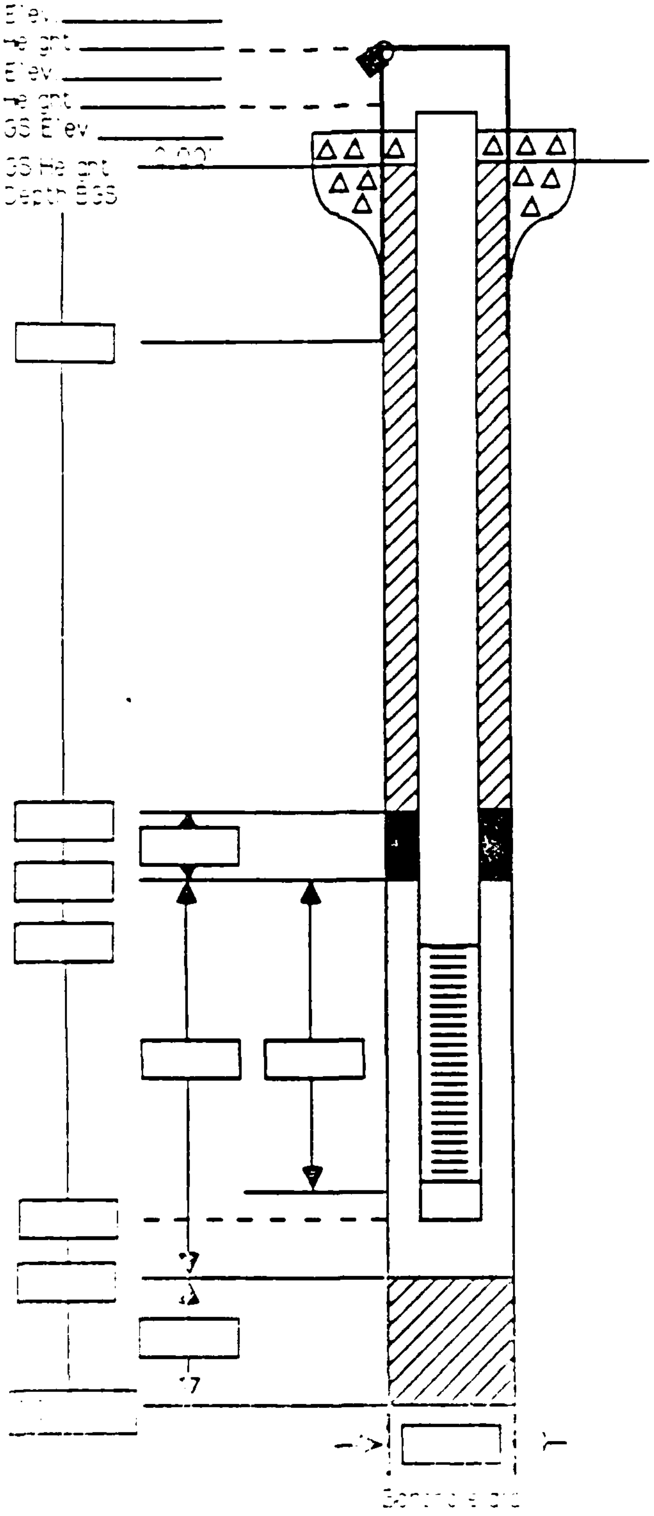
C = Cuttings | Notes ____________

FIGURE 5-4a

REV. DATE [illegible]

MONITORING WELL CONSTRUCTION LOG -- Standard

WELL NO.: | Installation: **Sky Harbor** **Coordinates:** | Site
Project No.: | Client/Project:
HAZWRAP Contractor: | Drlg Contractor:
Comp. Start: (____m) | Comp. End: ____m
Built By: | Well Coord.: ____________



PROTECTIVE CSG
Material / Type ____________
Diameter ____________
Depth BGS ____________ Weep Hole (Y / N)

GUARD POSTS (Y / N)
No. ________ Type ________

SURFACE PAD
Composition & Size ____________

RISER PIPE
Type ____________
Diameter ____________
Total Length (TOC to TOS) ____________
Ventilated Cap (Y / N)

GROUT
Composition & Proportions ____________
____
Tremied (Y / N)
Interval BGS ____________

CENTRALIZERS (Y / N)
Depth(s) ____________

SEAL
Type ____________
Source ____________
Setup/Hydration time ________ Vol. Fluid Added ________
Tremied (Y / N)

FILTER PACK
Type ____________
Amt. Used ____________
Tremied (Y / N)
Source ____________
Gr. Size Dist. ____________

SCREEN
Type ____________
Diameter ____________
Slot Size & Type ____________
Interval BGS ____________

SUMP (Y / N)
Interval BSG ____________ Length ________
Bottom Cap (Y / N)

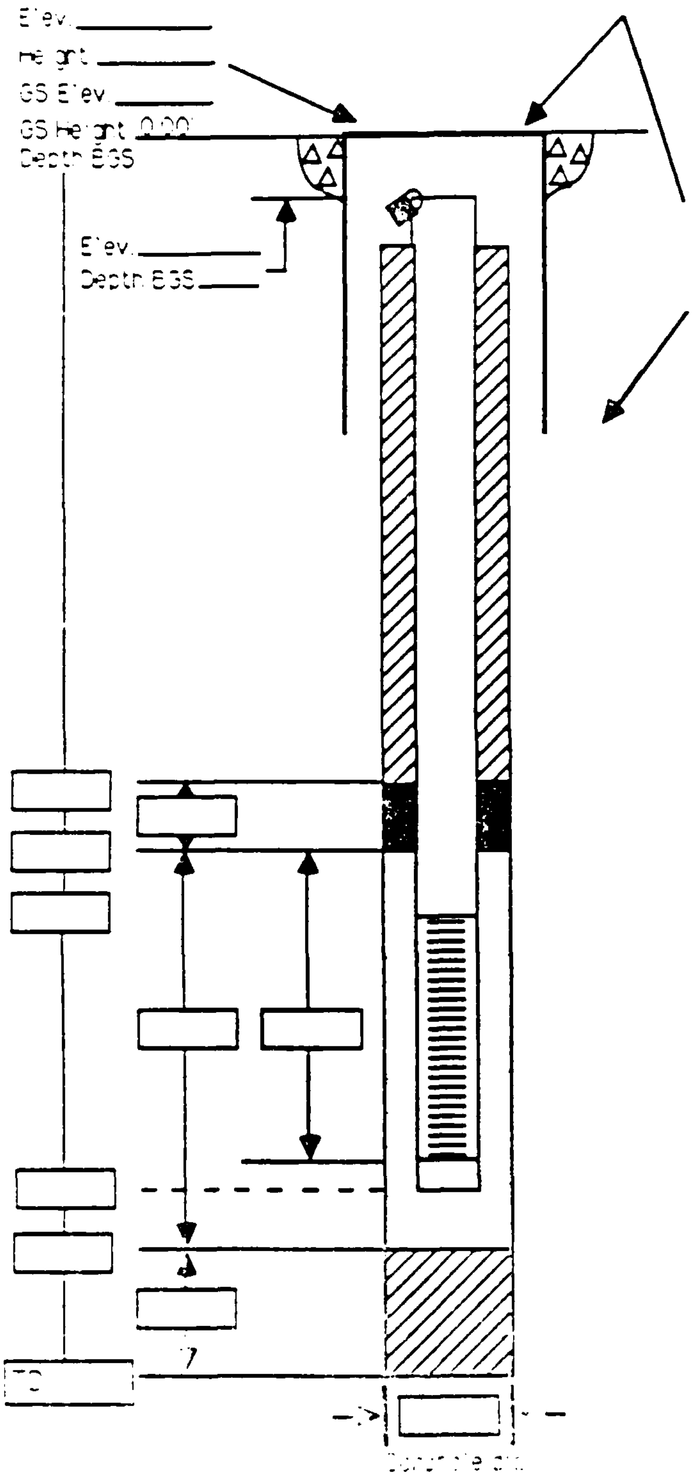
BACKFILL PLUG
Material ____________
Setup/Hydration time ____________
Tremied (Y / N)

FIGURE 5-4b

REV DATE MAY 1990

MONITORING WELL CONSTRUCTION LOG -- Standard Flush Mount

WELL NO.:	Installation **Sky Harbor** **Coordinates:**	Site:
Project No.:	Client/Project:	
HAZWRAP Contractor:	Drlg Contractor:	
Comp. Start. (____m)	Comp. End: (____m)	
Built By:	Well Coord.: ____	



PROTECTIVE CSG
Material / Type ____
Diameter ____
Depth BGS ____
Watertight O-Ring (Y / N)

SURFACE PAD
Composition & Size ____
Breathes With Vadose Zone (Y / N)

RISER PIPE
Type ____
Diameter ____
Total Length (TOC to TOS) ____
Ventilated Cap (Y / N)

GROUT
Composition & Proportions ____

Tremied (Y / N)
Interval BGS ____

CENTRALIZERS (Y / N)
Depth(s) ____

SEAL
Type ____
Source ____
Setup/Hydration time ____ Vol. Fluid Added ____
Tremied (Y / N)

FILTER PACK
Type ____
Amt. Used ____
Tremied (Y / N)
Source ____
Gr. Size Dist. ____

SCREEN
Type ____
Diameter ____
Slot Size & Type ____
Interval BGS ____

SUMP (Y / N)
Interval BSG ____ Length ____
Bottom Cap (Y / N)

BACKFILL PLUG
Material ____
Setup/Hydration time ____
Tremied (Y / N)

FIGURE 5-4c

REV. DATE MA[illegible]

WELL DEVELOPMENT LOG	Well No.	Page ____ of ____
Installation **Sky Harbor** **Coordinates**	Site	
Project No.	Client/Project	
HAZWRAP Contractor	Dev. Contractor	
Dev. Start (____m)	Dev. End ____m)	Csg Dia
Developed by		Dev. Rig (Y/N)

Dev. Method ______________________________

____

____

Equipment ______________________________

____

Pre-Dev. SWL ____________ Maximum drawdown during pumping ____________ ft. at ____________ gpm

Range and Average Discharge rate ______________________________ gpm

Total quantity of material bailed ______________________________

Total quantity of water discharged by pumping ______________________________

Disposition of discharge water ______________________________

Time	Volume Removed (gals)	Water Level ft. BTOC	Turbidity	Clarity/ Color	Temp °C	pH	Conductivity	Remarks

FIGURE 5-42

POST DEVELOPMENT WATER LEVEL RECOVERY GRAPH

REV DATE MAY 1990

Well Recording Instrument ____________________

Start Recovery ______ (______ m) End Recovery ______ (______ m) Total Recovery Time ____________

Beginning WL ______________ Final SWL ______________ **Project Name** ______________ **No.** ____

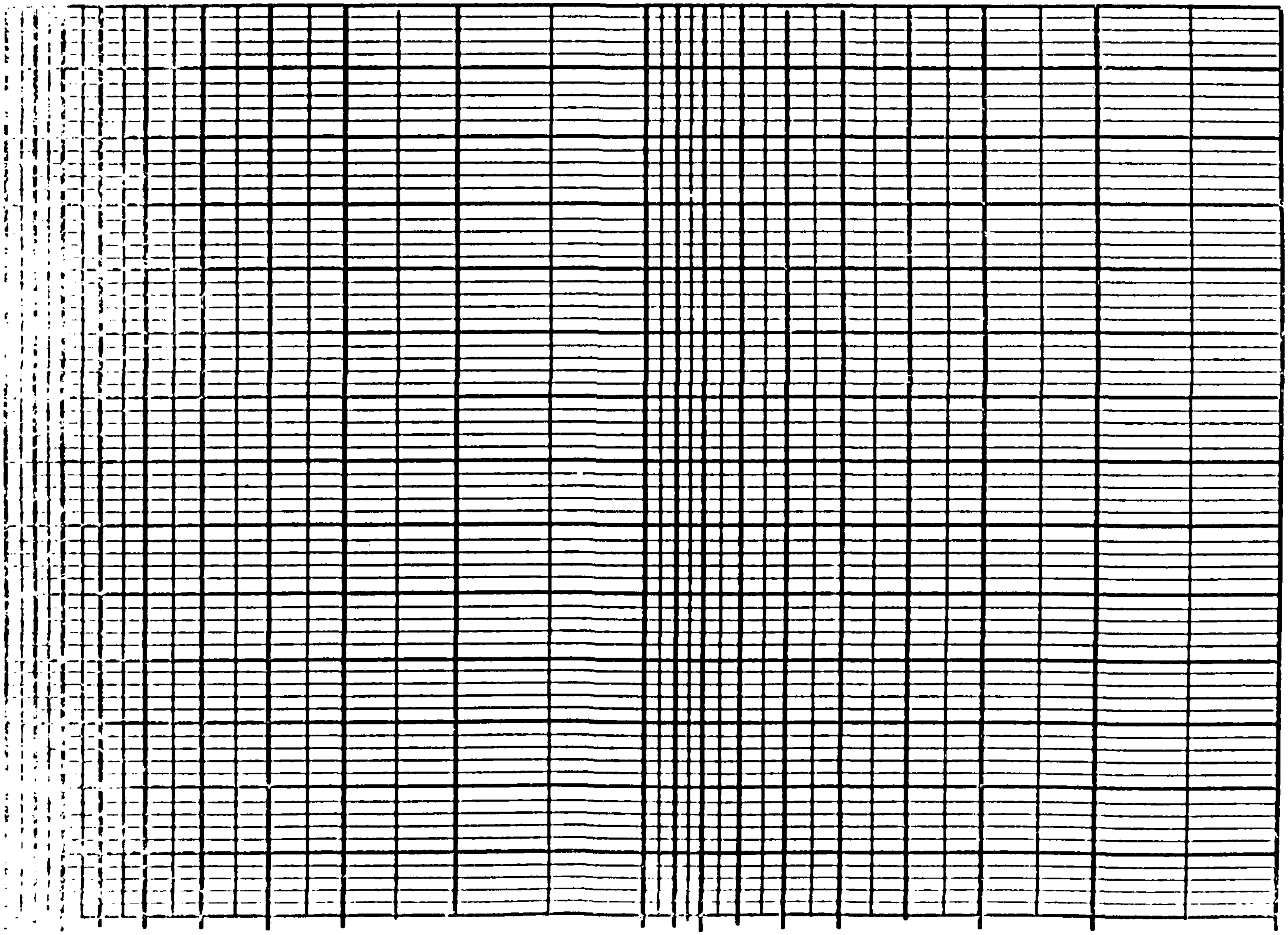


FIGURE 5-6a

REV. DATE MAY 1990

Sample ID No

MONITORING WELL PURGING LOG

WELL NO

Installation **Sky Harbor** **Coordinates**

Site

HAZWRAP Contractor

Project No

Purge Start (Date) (Time) Purge End (Date) (Time)

Purged by

Depth Measurement Ref. Point* ____________ Well Csg ID 2" 4" 6" Other ______

Well Headspace/Odor ________ LNAPL Check (Y / N) DNAPL Check (Y / N)

Equipment Used To Measure Thickness and Sample Free Product (Make, Model, etc.)

____

Depth to Top and Bottom of Screen Interval ________

Depth to LNAPL ________ Depth to DNPL ________ Orig DTW ________ Final DTW ________

LNAPL/DNAPL Thickness ________ LNAPL/DNAPL Sample and Volume ________

Measured Well TD ________

(-) Orig DTW ________

(=) Wtr Col Thick. ______ (x) 2" - 0.16 / 4" - 0.65 / 6" - 1.47 / __-____ Gals/ft (=) ______ Gals/Csg Vol. (x) 2 / 3 / 4 / 5 Csg Vol (=) ______ Total Purge Gals

Purge Method

Submersible Pump ☐ Dedicated Bladder Pump ☐ Bladder Pump ☐ Bailer ☐ SS ☐ Tef ☐ PVC ☐ Centrifugal Pump ☐

Peristaltic Pump ☐ Hand Pump ☐ Gas Lift/ Displacement Pump ☐ Other ________

Purging Equipment (Make, Model, etc.) ________ Purge Equipment Decon'd? Y / N

____

Purge Wtr Containerized? (Y / N) Avge Purge Rate ________ gpm

Weather ________________________ (°F)

Actual Time	Elapsed Time	Vols Purged (Gals)	Depth To Wtr (ft)	Depth Of Pump Intake(ft)	Temp (°C)	pH (s.u)	Cond. (umhos/cm)	Turbidity (NTU)	Other	Comment

* [illegible] Top of Casing TOC
[illegible] Free Product [illegible]

REV. DATE MAY 1990

FIGURE 5-6 b

Sample ID No

MONITORING WELL SAMPLING LOG

WELL NO

Installation: **Sky Harbor** **Coordinates**

Site

HAZWRAP Contractor:

Project No

Sample Start (Date) (Time) Sample End (Date) (Time)

Sampled by

Orig SWL ________ ft BTOC* Final SWL ________ ft BTOC

Screen Interval: ________ - ________ ft BTOC

Temp	pH	Cond	Turbidity

Are parameters 20% of purge values? Y / N

Repurge Y / N

No repurge volumes ________

Sampling Method

Submersible Pump ☐ Dedicated Bladder Pump ☐ Bladder Pump ☐ Bailer ☐ SS ☐ Tef ☐ PVC ☐ Centrifugal Pump ☐

Peristaltic Pump ☐ Hand Pump ☐ Gas Lift/Displacement Pump ☐ Other ________

Sampling Equipment (Make, Model, etc.) ________

Sample Equipment Decon'd? Y / N

If pump or discrete bailer, Depth(s) where pump set ________ ft BTOC

weather ________ (°F)

Lab Analyses (Circle)

VOA SVOA METALS PEST/PCBS TPH CATIONS ANIONS TDS

Others: ________

Metals (Circle) Filtered Unfiltered Both

Field Dups Y / N Referee Dups Y / N

Comments

*BTOC = Below Top of Casing (or other measurement reference point)
SWL = Static Water Level

Figure 6-1

IT INTERNATIONAL TECHNOLOGY CORPORATION

VARIANCE FORM

VARIANCE NO. 7

PROJECT NO. 409721 **PAGE** 1 **OF**

PROJECT NAME SKY HARBOR ANG BASE SI **DATE** 16 JAN 91

VARIANCE (INCLUDE JUSTIFICATION) SAMPLE COLLECTION/SHIPMENT

Section 6.2 of the Field Sampling Plan specifies that samples will be packaged and shipped.... within 24 hours of collection, and coolers containing samples will be shipped by next-day delivery service. Field work for the SI is on a 4 day off-10 day on schedule for cost efficiency. ~~S~~ SS Because of the schedule, soil samples will be collected on saturday and sunday, periodically. ~~Ground~~ SS Samples collected on Sunday cannot be shipped overnight Because delivery services typically do not work on sunday. This variance allows for samples collected on sunday to be shipped on monday for Tuesday delivery at the laboratory.

Samples collected on saturday could be shipped for monday delivery; however This would require them to sit in a warehouse on Sunday. This variance allows for soil samples collected on saturday to be shipped ~~f~~ SS Monday for Tuesday delivery. Using this schedule a sample collected Saturday would be 3 days old upon arrival at the laboratory. The shortest soil-holding time for analytes to be tested is 14 days. This variance allows the lab 11 days to meet holding time.

Water samples will not be collected on weekends, with the exception of rinsate blanks. Rinsate blanks which must be collected on weekends will be specially scheduled with the laboratory to meet holding times.

APPLICABLE DOCUMENT:

Final Field Sampling Plan, 161st Air Refueling Group, Arizona Air National Guard, Sky Harbor International Airport, Phoenix, AZ. SECTION 6.2 (PG 6-1)

CC: D. MACK
J. TYBURSKI
P. Bunn (HAZWRAP)
HAZWRAP Files-U449

REQUESTED BY **DATE** 1-16-91
APPROVED BY **DATE** 1/16/91
Project Manager
Mack **DATE** 17 JAN 91
Quality Assurance Officer
DATE 4/11/91

Figure 6-1

IT INTERNATIONAL TECHNOLOGY CORPORATION

VARIANCE FORM

VARIANCE NO. 0

PROJECT NO. 409721 PAGE 1 OF 1

PROJECT NAME Sky Harbor ANG DATE 1/16/91

VARIANCE (INCLUDE JUSTIFICATION) CHANGE IN ANALYTE TESTS

The current CLP Statement of Work covers the Target Compound List (TCL) which replaces the Hazardous Substance List (HSL) ~~as~~ in older statements of work. Four (4) organic compounds which were on the HSL are not on the TCL (Volatiles: 2-chloroethyl vinyl ether; Semivolatiles: N-nitrosodimethylamine, aniline, benzidine)

ITAS/Cerritos requests a variance to the Sky Harbor QAPP to omit these compounds from the analytical testing program (Table 9-3 : Analyte # 26, # 36, # 38, # 90)

APPLICABLE DOCUMENT: Field Sampling Plan - Appendix A (QAPP) TABLE 9-3

CC: C. FERGUSON
~~[illegible]~~
J. DYBURSKI
B. MACK
D. Bunn HAZWRAP
HAZWRAP Files -0449

REQUESTED BY Cheryl Ferguson/ITAS DATE 1/16/91
APPROVED BY DATE 1/17/91
Project Manager
A.W. Mack DATE 17JAN91
Quality Assurance Officer
DATE 4/18/91

INTERNATIONAL TECHNOLOGY CORPORATION

VARIANCE FORM

VARIANCE NO. 9

PROJECT NO. 402721 **PAGE** 1 **OF** 1

PROJECT NAME SKY HARBOR ANG BASE SI **DATE** 22 JAN 91

VARIANCE (INCLUDE JUSTIFICATION) SITE 4, DELETION OF ~~SOIL~~ BORING SAMPLES

The Field Sampling Plan (FSP) Section 4.7.2 specifies that a minimum of 2 soil borings are to be completed at Site 4. Section 4.7.6 specifies that the borings will be 20-45 feet deep, depending on the depth to water. Soil samples are to be collected at 5-foot-depth intervals and three from each boring are to be submitted for laboratory analysis.

During the initial hydrogeologic characterization, the hammer rig penetration rate was approximately 1 ft per hour. The soil materials are ~~+~~ SWS sand, gravel, weathered breccia to approximately 10' below this is caliche and volcanic bedrock the conditions will not allow collection of split spoon samples due to penetration difficulties.

In lieu of installing soil borings this variance will allow collection of surficial soil samples to assess soil contamination from site 4. Six samples will be collected, 3 at the current drum storage area, 2 at the PA - drum storage area, and one background sample located east of PP-01. Samples will be collected from the ground surface, below any gravel cover, using a slide hammer with brass sample rings. If no sample recovery is obtained after three attempts, samples may be collected with a stainless-steel trowel and placed in a 250 ml glass jar <u>and</u> 2-40 ml VOA vials.

Samples are also to be collected from monitoring well boreholes, as specified in section 4.7.7. Due to adverse subsurface conditions ~~Soil~~ SWS (e.g. bedrock) soil samples will not be able to be ~~installed a~~ SWS collected from monitoring wells at Papago.

APPLICABLE DOCUMENT:

Final Site Investigation Field Sampling Plan, 161st Air Refueling Group, Sky Harbor Air National Guard, Sky Harbor International Airport, Phoenix Arizona, Sept. 1990. Sections 4.7.2, 4.7.6, 4.7.7.

CC: David Bunn
HAZWRAP Files - 0449

REQUESTED BY **DATE** 24 JAN 91

APPROVED BY **DATE** 1/24/91
Project Manager

D.W. Mack **DATE** 24 JAN 91
Quality Assurance Officer

DATE 4/15/91

CWS

IR-07326-0449
Sky Harbor

RECEIVED
FEB 1

Section No.: 6.0
Revision No.: 1
Date: 2/09/90
Page 4 of 6

Figure 6-1

IT INTERNATIONAL TECHNOLOGY CORPORATION

VARIANCE FORM

VARIANCE NO. 10

PROJECT NO. 409721 **PAGE** 1 **OF** 2

PROJECT NAME SKY HARBOR ANGB SI **DATE** 13 Feb 91

VARIANCE (INCLUDE JUSTIFICATION)

GROUNDWATER SAMPLING PURGE PROCEDURE (FSP SEC 5.7.4.1)

The calculated purge volume for monitoring wells at the SKY Harbor site is approximately 145 gallons (3 well volumes) assuming 40% porosity in the casing - borehole annulus. The sampling plan specifies the wells will be purged using bailers or bladder pumps. Using a 3 inch diameter - 3 foot long bailer will require ~130 trips to purge a well. Using a bladder pump against 100' head requires a 2-stage pump to achieve flow rates greater than 1 gallon per minute (GPM). Such pumping systems are over $2200 cost. This variance is to allow use of a piston-pump (IT-owned) to purge wells at SKY Harbor sites. The piston pump will produce flow rates of ~1.5 GPM and allow wells to be purged in 1½-2 hrs. This is viewed as preferable to bailer purge which is likely to aggitate water or the more costly bladder-2 stage pump.

After completion of purging, wells will be sampled using teflon bailers in accordance to the sampling plan and HAZWRAP SOP #57 (SEE ATTACHED). All down-hole wetted equipment will be decontaminated before and after introduction to a well in accordance with the sampling plan.

Wells at the Papago Military Reservation are likely to be "low yielding wells."

APPLICABLE DOCUMENT:

Final SI Field Sampling Plan, 161st Air Refueling Group, Arizona ANG, Sky Harbor International Airport, Phoenix, Arizona - September 1990.

CC: D. Bunn (HAZWRAP)
HAZWRAP Files-0449

REQUESTED BY **DATE** 13 Feb 91

APPROVED BY **DATE** 2/13/91
Project Manager

DATE 14 FEB 91
Quality Assurance Officer

DATE 4/30/91
HAZWRAP PROJECT MGR.

Figure 6-1

INTERNATIONAL TECHNOLOGY CORPORATION

VARIANCE FORM

VARIANCE NO. 10

PROJECT NO. 409721 **PAGE** 2 **OF** 2

PROJECT NAME SKY HARBOR ANGB SI **DATE** 13 FEB 91

VARIANCE (INCLUDE JUSTIFICATION)

Such wells will be purged and sampled in accordance with the HAZWRAP Position Paper No. 3, "Development and Sampling of Low Recharge Wells" (SEE ATTACHED). ~~The purging process and steps will be fully documented in the Site log~~ [illegible] ~~purging will be accomplished using~~ [illegible] ~~3 gpm or less. After one borehole volume has been purged, samples will be collected as soon as sufficient water returns to the well to collect a sample.~~ A bailer will be used to collect samples.

14 FEB 91

APPLICABLE DOCUMENT:

CC:

REQUESTED BY ______________ **DATE** ______

APPROVED BY ______________ **DATE** ______
Project Manager

______________ **DATE** ______
Quality Assurance Officer

______________ **DATE** ______

HAZARDOUS WASTE REMEDIAL ACTIONS PROGRAM
STANDARD OPERATING PROCEDURE 5
GROUNDWATER SAMPLING WITH BAILERS

1. OBJECTIVE

The purpose of this procedure is to define requirements for the collection of groundwater samples.

2. BACKGROUND

Methods used for the collection of groundwater samples include bailing and a variety of pumping techniques. Bailers are hollow cylinders with unidirectional (open up) check valves at the bottom end. Some bailers may also be closed or valved at the upper end. Bailers used in environmental applications are typically constructed of stainless steel, disposable nylon string, disposable monofilament polypropylene, Teflon-coated stainless steel wire, or Teflon, with stainless steel or Teflon being preferred. The bailer is lowered into the well on an acceptable line or coated wire line until submerged. The bailer is then retrieved to the surface for sample collection. This procedure describes groundwater sampling with bailers. For the best results, the sequence of sampling is from least to most contaminated wells. It is preferable for most sampling events using bailers to have dedicated bailers or enough bailers to last for 1 day's worth of sampling (normally 6 to 8/d).

3. RESPONSIBILITIES

Site Manager: The Site Manager is responsible for ensuring that field personnel are trained in the use of this procedure and for verifying that groundwater samples are collected in accordance with this procedure.

Project Field Geologist: The Project Field Geologist is responsible for complying with this procedure, including sample collection, packaging, and documentation.

4. REQUIRED EQUIPMENT

- For surface sample - bailer types.
- For specific depths - bailer types.
- Bottom-filling, bottom-emptying bailer (with bottom release, if needed) of the appropriate material.
- Clean rope or wire line of sufficient length for conditions.
- Appropriate sample containers with labels and preservatives, as required.
- Hard plastic or steel cooler with cold packs (or ice).
- Water-level meter and/or other water-level measuring device.
- Temperature, conductivity, pH, dissolved oxygen, and organic vapor meters, if required.
- Plastic sheeting.
- Decontamination supplies, as required
- Personnel protective clothing and equipment, if required by the site-specific health and safety plan.
- Latex or polyvinyl chloride (PVC) gloves.

5. PROCEDURE

The following steps must be followed when sampling groundwater with boilers:

1. Put on protective clothing and equipment as specified in the site-specific health and safety plan.
2. Prepare the site for sample acquisition by covering the ground surface around the wellhead with plastic sheeting. Arrange the required sampling equipment for convenient use. If on-site decontamination is required, arrange the necessary supplies in a nearby but separate location, away from the wellhead.
3. Open the well and note the condition of the casing and cap. Check for vapors using vapor analyzing equipment. Using a water-level meter, determine the static water level and depth to well bottom. Record this information in the field logbook or on the water sampling form.
4. Purge the well according to Hazardous Waste Remedial Actions Program (HAZWRAP) Standard Operating Procedure (SOP) 4, if not already accomplished. Allow the water level to recover to a depth at least sufficient for the complete submergence of the bailer without contacting the well bottom.
5. While the well is recovering from purging, decontaminate the bailer. If the bailer was decontaminated before arrival at the site, remove the protective wrappings. Securely attach the bailer to the line. The end of the line should also be secured.

6. Arrange the sample containers in the order of use. Volatile organic analyte (VOA) samples, if required, will be obtained first, followed in order by semivolatiles (SVOA) and other samples.
7. Lower the bailer into the well. Do not allow the bailer to touch the casing. The bailer should enter the water slowly to prevent aeration, particularly when VOA and SVOA samples are being collected. Do not permit the bailer to contact the well bottom.
8. Retrieve the filled bailer to the surface. Do not allow the line to contact the ground. Hang the bailer from a bailer stand or other support, if available, or have an assistant hold it off the ground. The first bailer of water should be used as a rinse and then discarded. Immediately obtain any required VOA and SVOA samples by using the release valve to gently transfer water to the sample bottle. The sample bottle should be tilted when filling to prevent aeration. Check the filled vial for bubbles. The first volume of sample should be used as a rinse and then discarded, unless the sample bottles contain preservative. If sample filtration is required, it should be done as soon as possible, or after sample retrieval. If, after collecting VOA and SVOA samples, the total required sample volume is greater than the water remaining in the bailer, decant the water into a clean compositing container. The compositing container must have adequate volume to contain the entire volume necessary for collection. Again lower the bailer to collect water for additional sample volume, if needed.
9. When the composited sample volume is sufficient, decant water into the remaining sample containers. Add preservative (if needed), cap, seal, and properly label all containers. Place the filled containers in the cooler(s) immediately.
10. Record sample types and amounts collected, and time and date of collection in the field logbook and on the groundwater sampling form per HAZWRAP SOP 1, Parts A and B, respectively. Prepare chain-of-custody and analytic request documents as required by the project quality assurance plan.
11. Decontaminate sampling equipment according to HAZWRAP SOP 14.
12. Clean up the area and place disposable materials (plastic sheeting, gloves, Tyvek) in the designated receptacle. Close and lock the well cover.

6. RESTRICTIONS/LIMITATIONS

Obtain on-site data such as temperature conductivity, pH, or dissolved oxygen measurements after samples have been collected. This may require additional time for well recovery.

7. REFERENCES

Driscoll, F. G., *Groundwater and Wells*, Second Edition, St. Paul, Minnesota, Johnson Division, 1986.

U.S. Environmental Protection Agency, *A Compendium of Superfund Field Operations Methods*, EPA/540/P-87/001, 1987.

U.S. Environmental Protection Agency, *Manual of Water Well Construction Practices*, EPA/570/9-75-001, 1975.

RECEIVED
NOV 30 1990

POSITION PAPER NO. 2

DEVELOPMENT AND SAMPLING OF LOW RECHARGE WELLS

Hydrogeology Support Group
Hazardous Waste Remedial Actions Program*
Martin Marietta Energy Systems. Inc.
Oak Ridge, Tennessee 37831-7106

1. INTRODUCTION

A low recharge well can be defined as a well that does not recover to 90% of its static water level within 6 to 8 h after being purged. There are many other definitions for low recharge formations; however, this is the one that the Hazardous Waste Remedial Actions Program (HAZWRAP) will use in its discussion of this issue. Low recharge formations can be found in most of the following environmental scenarios: fine-grained, unconsolidated material such as clay, silt, shale, or clay in the interstices of larger-grained material; or igneous and metamorphic rocks. Under the above conditions, four problem areas surface when it is the task of the hydrogeologist to obtain a representative sample of the groundwater from these types of aquifers. They are: how do you reduce siltation within the well, how do you develop a low recharge well, how do you purge a low recharge well, and when do you sample for volatile organics after purging a low recharge well?

In the following document, we will discuss these issues and present the most recent discussions with regard to these issues. It is the intent of this position paper to make the hydrogeologist aware of the problems associated with low recharge wells and to provide some guidance on the above issues. For the purpose of this position paper, only low recharge aquifers composed of fine-grained, unconsolidated materials will be discussed.

2. SILTATION AND DEVELOPMENT

2.1 STATEMENT OF THE PROBLEM

Siltation and development problems are usually relegated to unconsolidated sediment aquifers. These are generally not problems associated with slow recharge in consolidated sedimentary, igneous, or metamorphic environments. Both of these issues (i.e., siltation and development) will be

---

*Operated by Martin Marietta Energy Systems, Inc., for the U.S. Department of Energy under contract DE-AC05-84OR21400.

discussed concurrently since, in general, they are related issues (i.e., siltation is largely a problem of ineffective development procedures and/or well construction techniques).

Siltation is the process whereby, during well construction and/or development, small-sized aquifer material (generally smaller than that retained on a #50 US standard sieve) can be found within the well casing, making the water sample turbid. It is of note that this same grain size range (i.e., less than #50 standard sieve size) makes up over 30% of the aquifer material, which is the principal reason why the formation is a slow recharger. This material ends up in the well casing usually by two methods. In the first, the fine-grained materials are introduced into the well casing directly during well installation. This usually occurs at the same time as the well screen, filter pack, and riser pipe are placed at the bottom of the borehole. From the time the borehole drilling is complete and the well is placed, groundwater will move up into the auger flights, carrying with it an associated amount of aquifer material due to hydrostatic pressure. The screen, casing, and filter pack are introduced directly into this "soup", thereby introducing the fine-grained material directly into the casing. Also during placement, the aquifer material may become integrated with the filter pack material during placement of the filter pack.

The second siltation problem area occurs during development. In monitoring well construction, the purpose of the design of the filter pack is to retain 95 to 100% of the aquifer material. In general, this is not always accomplished because all too often the well screen size and filter pack size are selected before the field investigation (i.e., during the work plan development stage). During this stage, when they suspect slow recharge aquifers, 10-slot screens with Ottowa #1, Morie #1, or equivalent filter pack material are selected in advance of actual field information. The development procedure, therefore, must clean out the residual materials in the well casing and must also pull the fine material out of the filter pack since it was placed and commingled with aquifer material during placement. Therefore, due to poor construction design, new aquifer fine-grained material is pulled into the casing during development because the filter pack material cannot retain 95 to 100% of the aquifer material.

This represents a synopsis of the siltation and development problems associated with monitoring well construction techniques. The following section will discuss some of the more recent published articles relevant to these issues.

2.2 PUBLISHED APPROACHES TO SILTATION AND DEVELOPMENT

2.2.1 Well Construction Methods

The key question to be answered in assessing well construction methods in low-yield aquifers is, "Can well-designed construction techniques improve the quality and quantity of groundwater samples from a low recharge aquifer?". In review of the literature, the following information is submitted for evaluation:

- o In a study conducted by Paul, Palmer, and Cherkauer (1988), a series of ten wells were placed in glacial tills. Of these wells some had been installed wet (the well was not cleaned out of excess loose material before well placement) because of delays in setting the screens, and some had been installed dry (the loose materials had been removed from the borehole). Of the wells installed wet, the wet wells exhibited 50 to 200 times greater turbidity than wells installed dry.

- o In an article in Groundwater Age (Wehrmann, 1983), a method that can be used in clayey environments, where an open borehole can be sustained, is to pump water down the inside of the monitoring well casing, out the screen, and up the annulus of the borehole. This should be done both before and after the gravel pack is emplaced to free fine-grained material from the surface of the borehole and the gravel pack materials. Circulation should be continued until the water coming up the annulus looks clear (Wehrmann, 1983).

- o According to Nielson (1988), the continuous-slot, wire- wound screen is more effective in preventing formation materials from becoming clogged in the openings. It allows particles slightly smaller than the openings to pass freely into the well without wedging in the opening, making these intakes nonclogging.

- o In an article by Gass (1989), drilling methods and well construction techniques must be adapted to minimize borehole damage before the installation of a well screen (commonly referred to as "skin effect") and a filter pack, or at least to correct borehole damage before installation of the well screen and filter pack. In addition, it must be understood that the effectiveness of well development is going to be extremely limited in alleviating this effect. To reduce this effect, he suggests several techniques: (1) boring the zone representing the screened interval with a 3- to 5-in. Shelby tube, (2) scratching the sides of the borehole with an oversized brush or wire to eliminate the smear effect, and/or (3) developing the low-recharge well with a bailer or small-diameter surge block to achieve gentle agitation of the filter pack so that any residual fine material that may have been incorporated into the filter pack during its emplacement can be removed.

2.2.2 Well Construction Materials

In assessing well construction materials, the following information is submitted for evaluation:

- o In an article by Gass (1988), Gass states that the filter pack should be graded, fine to medium sand. Because of the gradation, the effective size of the filter pack will be quite small and yet will still be orders of magnitude more permeable than the formation and will not restrict well yield. In almost all cases, a 10-slot screen will retain 80% to 90% of the filter pack.

- In an article by Nielson (1988), the use of an artificial filter pack in a fine-grained material allows the screen slot size to be considerably larger than if the screen were placed in without the filter pack. This is particularly true where fine slot sizes, which are designed to hold out formation materials, are either impractical or not commercially available. The larger screen slot size afforded by the filter pack allows for the collection of adequate volume of sediment-free samples (Nielson, 1988).

- Paul, et al. (1988), states that the function of the filter pack is to stabilize the borehole and to prevent formation materials from entering the well. They recommend that the proper size of filter pack and screen can be chosen from the grain size distribution curve of the formation by applying the method outlined by Driscoll (1986). In addition, he states that commonly available well screens and sand packs were not capable of filtering out clay-sized particles found in fine-grained glacial tills. The optimal well design would require a silt-sized sand pack and a very fine-meshed screen (<0.05 mm). In addition, the wells within his study were constructed of different types of screens (slotted and continuous). From this condition he observed in his glacial till study that surging of the wells that had standard factory slot screens pulled more formation material through the sand pack and into the screen than wells that had continuous-slot screens. There were no substantial differences in the turbidity measurements between the three types of well screens that had been bailed.

From the information collected, several issues were not discussed. One of these issues is the use of sumps in well construction in low-yield unconsolidated aquifers. It has been a standing practice during the past 5 years that sumps be used in well construction in low-yield aquifers. A sump is a piece of blank casing placed below the screen and is designed to retain and separate the siltation materials (accumulated fine-grained material settling out of suspension) from the screened interval. This device is used primarily to keep the entire surface area of the screened interval open to receive groundwater.

Another issue that has become a standard practice is to ensure an appropriate filter pack thickness. All too often, particularly in shallow groundwater wells (i.e., those less than 50 ft), a 2-in. well is placed in a nominal 4-in. borehole. It is generally agreed that the filter pack thickness should equal the well diameter and that it should be tremied into place. The reasoning behind this position is that an insufficiently large filter pack thickness will not retain the large volume of fine- grained material trying to enter the well screen and that a sufficient volume is needed to effectively retain or retard this condition.

In addition to the above, Johnson Screens has developed a new screen specifically designed for low-yield aquifers. This new well screen is called Channel Pack and is basically two continuously wrapped screens separated by a glass bead filter pack. This screen has not been extensively field tested, so its advantages and disadvantages have not been well established.

2.2.3 Recommendations

Based on the above information, the following construction methods and material specifications are recommended:

- o Filter pack thickness around the well screen should be at least the same thickness as the diameter of the casing/riser.
- o Sumps should be placed below the well screens to act as a sediment trap for all low-yield aquifer wells.
- o Well screens should be of the continuous slot variety.
- o Well screens, casing, and filter pack material should be placed in dry wells (i.e., the loose "soupy" material within the drill casing should be cleaned out or removed before materials placement).
- o For optimum design, the filter pack should be graded according to the aquifer particle size distribution to ensure that the largest percentage of the aquifer material will be retained by the filter pack.
- o Well screen slot size should be sized to the filter pack. In most instances, the filter pack should be sized to retain 95 to 100% of the aquifer material.

3. DEVELOPMENT

The main purpose for the development of a well, any well, is to produce a turbid-free sample (i.e., to rid the filter pack, screen, and well casing of the small particles that remain that are the direct result of the installation procedure or design). Beyond this, the goal for wells in the water well industry differs significantly from the hazardous waste industry. In the water well industry, the purpose of well development is to obtain maximum yield with the least turbidity for the purpose of water consumption. In the hazardous waste industry, the purpose of development is to obtain a turbid-free sample for the purposes of chemical analysis in the parts per billion range. Wells designed for pump testing are the exception since increasing well efficiency may improve the quality of the pump test data. There is a significant difference between these two goals. In the hazardous waste industry, constructing wells for the purpose of high yields tends to be a secondary requirement.

Common methods of well development in fine-grained materials are pumping, surging, bailing, and the use of compressed air to "blow out" the well. All of these, or combinations thereof, are acceptable methods within the water well industry; however, all do not carry the same level of confidence within the hazardous waste industry. The following is a presentation of recent information from literature addressing this issue.

3.1 PUBLISHED INFORMATION ON DEVELOPMENT

- In the development of wells in glacial tills (Harman, 1988), a stainless steel submersible pump was used. The pump was lowered by hand to decrease the turbidity of the water. The pumping rate was slow and continuous, with a low volume of water being pumped. This pulled the fine-grained material from the sand pack. The silt settled to the bottom, and water samples could be taken from the top of the water column. Bailing could be used instead of pumping to develop the well.

- In tight formations, well development must be sufficiently vigorous to remove fine-grained particles without damaging the well (Marbury and Brazie, 1988). The turbidity of the water needs to be reduced.

- According to Giddings (1985), the steep hydraulic gradient caused by dewatering the well during pumping causes turbulent flow in the aquifer and in the gravel and sand pack, and this results in a very turbid sample. A surge and block bailer has been successfully used in developing low recharge wells.

- According to Gass (1988), when an attempt is made to develop a silt or clay formation, the formation will not bridge, and greater amounts of the formation will be pulled into the well. The same type of surge energy reaches the formation when a well is purged and sampled with a bailer that fits snugly within the well or when a pump that just fits in a well is rapidly inserted or removed from the well. The key to achieving clean samples then is to reduce or eliminate surge energy from reaching the formation.

- The following study was performed by Paul, Palmer, and Cherkauer (1988). In this case, some wells installed in fine-grained glacial tills were surged for 10 min and then bailed along with wells that were bailed only. Water was collected from the screened intervals for turbidity analysis. The hydraulic conductivity of the formation was sufficiently low that no significant well recovery occurred between the time the well was bailed and the sample was taken. Many of the samples contained a considerable amount of sediment. Bailings of two wells indicated a large amount of clay sediment at the bottom, which was easily agitated, especially when the bailer touched bottom. The wells were then pumped dry to reduce the amount of sediment and were allowed to recover. When samples were taken 4 months later, the turbidity had been reduced in all but one well.

- Surging of the wells increased the turbidity. The turbidity was 50 to 100 times greater than that in wells that were bailed. Sand pack and screens had little effect on the amount of turbidity. In surged wells, the average turbidity stayed the same between the two sampling periods. In the bailed wells the turbidity decreased fourfold (Paul, Palmer, and Cherkauer, 1988).

- o In the restoration of clogged wells installed in glacial tills, jetting was used, and fine sand, silt, and clay are washed out of the water-bearing formation. The turbulence created by the jet brings these fine materials back into the well through screen openings above and below the point of operation (Gass, 1985).

3.2 DEVELOPMENT RECOMMENDATIONS

Based on the above information and in consideration of the procedures previously recommended for well design and installation, the following development procedures are recommended:

- o Remove any sediment that may exist within the well casing. This may be accomplished by using a sand bailer (which most drill rig operators are familiar with for larger diameter wells), by using pump and surge, or by using air lift techniques to remove the sediment in the sediment trap.
- o Ideally, the first attempt should be to develop a low yield well by pumping and/or removing water at a rate equal to or less than the recharge rate of the aquifer. This may be accomplished using peristaltic pumps, bailers, or bladder pumps for some aquifers. The object of this methodology is to induce water into the well at a very low but constant rate until the water is relatively clear. (NOTE: If bladder pumps are to be used, removing the silt from the well is critical because of the potential damage to the bladder.)
- o If the above techniques cannot be accomplished and the wells are pumped to near dryness even with slow rates of water removal, the next recommended option is to use a closed-bottom bailer in a pump-and-surge-type scenario. Under this scenario, as the bailer enters the well, the bailer itself acts as a surge block and forces water out through the screen, dislodging silt and clay size particles from the screen and the filter pack with the intention of the particles returning through the screen to be removed during the bailing operation. The surging activity, however, should not be so vigorous as to extend the surging action into the aquifer material itself. If during this process the well is pumped to dryness, the above procedure may have to be repeated one to two additional times to obtain a sample that is relatively sediment free. A specific application of this approach is to develop the well in stages (2 to 3 ft at a time, from the bottom up). In this the surge stroke should not exceed the surged interval.
- o At the completion of the development of a well, a well recovery test should be performed. This test is similar to a rising head slug test. These data will assist the field hydrogeologist in the development of other wells and in the scheduling and planning of

purge and sample activities. It is not implied, however, that well recovery tests should be conducted on every well. The discretion of the use of this test is held within the purview of the field hydrogeologist and the HAZWRAP project team.

4. PURGING AND SAMPLING

4.1 PURGING

Perhaps the most critical component of collecting a representative sample of the aquifer water occurs during the purging process. The main purpose of purging a well is to remove the stagnant water from the well casing and borehole and to replace it with groundwater that more accurately reflects chemical conditions within the aquifer. A lot of discussion has focused on this issue. The rationale for purging is to help remove fine-grained particles in the well and sand pack that may potentially enter the well screen and the sample (Paul, Palmer, and Cherkauer, 1988). (NOTE: All operations need to be performed with materials and equipment that have been thoroughly cleaned to avoid introducing contamination into the well. This is especially critical in low-yield wells because even a minute amount of contaminant may result in relatively high concentrations in samples.)

The following is a presentation of discussions on this issue that have occurred in technical publications over the past several years:

- According to the Wisconsin Department of Natural Resources Guidance (Lindorf, Feld, Connelly, 1987), the most straightforward method for removing all of the stagnant water from wells screened in low permeability formations is to pump or bail the well dry. This procedure may be the best way to ensure that all of the stagnant water in the well has been exchanged with water from the aquifer. After purging, the well should be allowed to fully recover and can be purged a second time if needed.

- The Environmental Protection Agency (EPA) Technical Enforcement Guidance Document (1986) is similar to this. It states that when low-yield wells are being developed, they should be pumped to dryness once. If the recharge rate of the well causes the formation water to vigorously cascade down the intake screen and accelerate the loss of volatiles, the well should not be pumped dry. If this is anticipated, three casing volumes should be purged from the well at a rate that does not cause the recharge water to be excessively agitated.

- If a monitoring well is drained completely during purging, the formation water will be exposed to the atmosphere as it enters the well. This may cause a 10% loss of volatiles within 5 min and a 70% loss within 1 h. Protocols should avoid draining the well and any unnecessary exposure of the sample to the atmosphere, especially when combined with turbulence (McAlary and Barker, 1987).

- If the sand pack around screens is drained during purging or flushing, the formation water will flow into the well by cascading through the headspace in the dewatered sand filter pack. Some volatilization can be expected to affect the groundwater even before a sample can be collected (McAlary and Barker, 1987).

- The amount of recharge may limit the amount of sample that can be collected. Frequent purging will likely dewater the saturated zone, causing the well to go dry for a period of time. In wells that require a very long period of time to recharge, the interval between sampling events may not be sufficient to allow full recovery to static water-level conditions. In such cases, an annual or semiannual sampling event may be more appropriate than quarterly events (Marbury and Brazie, 1988).

- The results of a laboratory standing-column volatilization test by McAlary and Barker (1987) showed that losses will reach 10% within 1 h and 99% in 1 month. The standing water should therefore be thoroughly purged before sampling. In the context of a sampling event, it may be acceptable in moderately low permeability materials to return for sampling of volatile organics several hours after purging, provided that the calm surface of the water in the casing was the only exposure of the sample to headspace.

4.2 SAMPLING

The problems of purging and sampling low recharge wells are mutually related events. The type of purging a field team performs may affect the sampling effort. In addition, within the literature, it is not clear as to the best time to sample for volatile organics. The following are submitted for evaluation and review:

- In low-yielding bedrock aquifers, wells may be pumped dry by removing only one bore volume of water. If the water- bearing fractures are located just below the static water table level, the well will refill by cascading water entering the bore and falling to the bottom. This alters the dissolved gases in the water and increases the dissolved oxygen content. Many monitoring parameters are sensitive to this alteration, and it can lead to misrepresentative sampling (Giddings, 1985).

- A water-level monitoring period of several hours or days may be required to determine whether the well bore is making water or to determine if the water level will return to static water-level conditions. In these instances, it may be possible to remove only one casing volume before sampling (Marbury and Brazie, 1988).

- Samples should be collected as soon as there is a sufficient amount of water in the well bore in order to get a sample that is representative of the formation water (Lindorf, Feld, Connelly, 1987).

- According to the EPA Guidance, as soon as the well recovers, the order of sampling should be pH, volatiles, oxidation-reduction, semivolatiles, pesticides/polychlorinated biphenyls (PCBs), metals, and inorganic compounds. For wells with a recovery time of greater than 3 h, samples should be taken in order of their volatility as soon as there is a sufficient volume of water available for a sample for each parameter. Parameters that are not pH sensitive or subject to volatilization should be taken last.

- In the sampling of naturally purged wells (Robin and Gillham, 1987), results indicated that a representative sample could be obtained from the screened interval through the use of dedicated sampling device, such as a syringe sampler. The intake would need to be located near the bottom of the screened interval. The volume of the sample would have to be significantly less than the volume of the screened interval. Some contamination could result from displacement of water by the sampling device. In this study, as screen lengths became shorter (screen lengths of 1, 2, and 5 ft), the first samples were progressively more contaminated.

- In a recent article by Herzon et al. (1988) eleven 2-in. OD stainless steel wells were developed using bailers and a diaphragm pump. Bailers were used to extract water and to act as surge blocks to draw in fine materials. This procedure was repeated four times for each well. The diaphragm pumps were used to pump the wells to dryness so that a rising-head test could be performed on each well. Samples were retrieved at several different times after purging. The final conclusions were that wells in low- yield aquifers should be purged before sampling and that concentrations of volatile organics in the sample collected 4 h after purging contained the highest volatile organic concentrations.

5. EQUIPMENT FOR DEVELOPMENT, PURGING, AND SAMPLING

To minimize the introduction of contamination into the well, positive gas displacement Teflon bladder pumps are recommended for purging wells. Teflon or stainless steel bailers are also recommended purging equipment. Where these devices can't be used, peristaltic pumps, gas-lift pumps, centrifugal pumps, and venturi pumps may be used. Where a sampling device requires an intake line, or discharge line, the composition of the line should be Teflon, polyethylene lined with Teflon, or polyethylene. Where a sampling device requires a support line to the surface (as in bailers), the support line should be single- strand, stainless steel wire, Teflon-coated stainless steel wire (single strand or braided), or a stainless steel leader attached to monofilament polyethylene line.

Pumping rates for peristaltic pumps are typically less than 1500 mL/min. Other types of pumps produce volatilization and high-pressure differentials, causing variability in the analysis of pH, specific conductance, metals, and volatile organic samples. They are, however, acceptable for purging wells (EPA Guidance, 1986).

The equipment required for jet development includes a jetting tool with two or more nozzles, a high-pressure pump, a high-pressure hose, and a supply of water. The nozzles should be evenly spaced on the jetting tool (Gass, 1985).

The valve-type plunger could be used in tight formations because it has a lighter surging action. A bailer can be used along with the plunger (Gass, 1985).

In Paul, Palmer, and Cherkauer, the surging process (in fine-grained glacial tills) was performed with a length of polyvinyl chloride (PVC) electrical conduit fitted with an oversized rubber stopper. The rubber stopper was small enough to allow passage through the well but large enough to force water before it. A peristaltic sampling pump was used to remove the bottom sediment from the monitoring wells.

In a study by Griffin et al. (1988) on the collection of volatile organics from fine-grained materials, samples were collected using a double-check valve, Teflon bailer with a bottom-draining device. For shallow, small-diameter wells with low yields, evacuation of the well by a bailer is feasible. Syringes can also be used to sample water from low hydrostatic head aquifers because they only remove a small volume of water from the well (Nielson, 1985).

6. RECOMMENDED PROCEDURES FOR PURGING AND SAMPLING

The following purge and sample procedures are based on a review of the information provided above, known characteristics of monitoring well recharge and well dynamics, and the best available technology. The succeeding information is provided to act as a starting point with regard to planning and execution of sampling activities within low recharge environments. It is understood that as field activities commence, minor revisions to the purge and sample activities may be required based on site- specific information; however, the following scenario should be used and planned for during the early stages of field activity development.

The following procedures are recommended for purging and sampling of low recharge aquifers:

- o As a general rule, under low recharge conditions, purge and sample activities should not occur for a minimum of 7 d after well development. This period may be extended, dependent upon very low recharge conditions and varying site conditions.

- Purging and sampling are considered by HAZWRAP to be mutually inclusive activities (i.e., they are not separate events). Therefore, the common field activity of purging all wells first then sampling is not considered to be the best available procedure. Purging and sampling should be considered, in terms of schedule, as one event.

- Purging begins with placing the pump or purge device at the top of the water column to remove the water from the well casing and borehole from the top down.

- Purge rates should be at a value less than that indicated from the well development recharge rate recorded at the conclusion of well development. Under low recharge conditions, this rate will rarely exceed 0.5 gal/min. This low purge rate will permit the water within the casing and borehole to exchange without pumping the well to dryness or appreciably depressing the static water level.

- If the above condition cannot be met, the entire volume of water within the well casing and borehole should be removed at the rate determined above. If it is already known that the well can be pumped down without appreciable recharge, the rate specified above should not be exceeded. Excessive pumping will only cause turbidity problems when eventual recharge and sampling begin. (**NOTE:** As a reminder, under the well construction recommendations, each well will exhibit a 2- to 5-ft sediment trap to be located below the screen. Therefore, the sediment trap should be removed of built-up sediment before actual purging and sampling).

- If the well does not recover to 90% of its static water level within 6 to 8 h, only one borehole volume need be removed. If the well recovers in less time, purge activities should be repeated at least one more time. At the conclusion of the initial purge activities, if significant fines have accumulated in the sediment trap, these fines should be removed before the second purge activity.

- Sampling from wells in which the static water level was not appreciably depressed is to occur immediately after purge activities are completed (within 3 h as a general rule). Sampling from wells, in which the water was completely removed from the well or the recovery time exceeds 3 h, will occur (for volatiles and pH and oxidation-reduction sensitive analytes) when the water level has reached a point above the bottom of the screen such that a sufficient sample can be retrieved. Sampling for other nonsensitive analytes may occur at some point later as the well has had time to more completely recover and provide sufficient sample. If sufficient sample has not become available within 24 h, the HAZWRAP Project Manager should be immediately informed so that a decision can be made as to the disposition of this condition.

REFERENCES

Driscoll, F. G., Groundwater and Wells, (second edition), Johnson Division, St. Paul, MN 55112, 1089 pp., 1986.

Gass, Tyler E., "Developing and Completing Observation Wells," Groundwater and Unsaturated Zone Monitoring and Sampling, National Water Well Association, pp. 94-117, October 22-24, 1985.

Gass, Tyler E., "Monitoring Well Filter Pack and Screen Slot Selection; A Reassessment of Design Parameters," Water Well Journal, pp. 30-32, June 1988.

Gass, Tyler E., "Monitoring Wells in Non-Aquifer Formations," Water Well Journal, pp. 27-28, February 1989.

Giddings, Todd, "Bore Volume Purging to Improve Monitoring Well Performance: An Often-Mandated Myth," pp. 253-256, Conference on Groundwater and Unsaturated Zone Monitoring and Sampling, National Water Well Association, October 1985.

Griffin, R. A., Herzog, B. L., Johnson, T. M., Morse, W. J., Hughes, R. E., Chou, S. F. J., and Follmer, L. R., "Mechanisms of Contaminant Migration Through a Clay Barrier - Case Study, Wilsonville, Illinois," ASTM Short Course, Vol. 2, Groundwater Sampling, pp. 12-110 to 12-121, 1988.

Harman, Dan, Personal Communication, September 19, 1988.

Herzog, B. L., Chou, S. J., Valkenburg, J. R., and Griffin, R. A., "Changes in Volatile Organic Chemical Concentrations After Purging Slowly Recovering Wells," Ground Water Monitoring Review, pp. 93-99, Fall 1988.

Lindorf, D., Feld, J., and Connelly, J., Groundwater Sampling Procedure Guidelines, Wisconsin Department of Natural Resources Publication PUBL-WR-153 87, February 1987.

Marbury, R. E., and Brazie, M. E., "Ground Water Monitoring in Tight Formations," Proceedings of the Second National Outdoor Action Conference on Aquifer Restoration, Groundwater Monitoring and Geophysical Methods, Vol. 1, pp. 483-492, Association of Groundwater Scientists and Engineers and U.S. EPA Environmental Monitoring and Support Laboratory-Las Vegas, May 23-26, 1988.

McAlary, T. A. and Barker, J. F., "Volatilization Losses of Organics During Groundwater Sampling from Low Permeability Materials," pp. 63-68, Groundwater Monitoring Review, Fall 1987.

Nielson, David M., "A Comparison of Sampling Mechanisms Available for Small-Diameter Ground-Water Monitoring Wells," Ground Water and Unsaturated Zone Monitoring and Sampling, National Water Well Association, October 1985.

Nielson, David M., "Design and Installation of Ground Water Monitoring Wells," ASTM Short Course, Vol. 1, Monitoring Wells: Location, Design and Installation, pp. 56-123, 1988.

Paul, D. G., Palmer, C. D. and Cherkauer, D. S., "The Effect of Construction, Installation, and Development on the Turbidity of Water in Monitoring Wells in Fine-Grained Glacial Till," pp. 73-82, Groundwater Monitoring Review, Winter 1988.

Robin, M. J. L. and Gillham, R. W., "Field Evaluation of Well Purging Procedures," pp. 85-93, Groundwater Monitoring Review, Fall 1987.

"Standard Guide for Sampling Groundwater Monitoring Wells," pp. 2-3, American Society for Testing and Materials, May 1986.

U.S. EPA, RCRA Ground Water Monitoring Technical Enforcement Guidance Document (TEGD), printed by National Water Well Association, Dublin, Ohio, p.208. 1986.

Wehrmann, H. A., "Monitoring Well Design and Construction," Groundwater Age, p. 37, April 1983.

IT INTERNATIONAL TECHNOLOGY CORPORATION

VARIANCE FORM

VARIANCE NO. 11

PROJECT NO. 409721.02.05 **PAGE** 1 **OF** ____

PROJECT NAME SKY HARBOR **DATE** 9 APR 91

VARIANCE (INCLUDE JUSTIFICATION)

The purge requirements for sampling groundwater in the Sky Harbor FSP require 3 wellvolumes be removed prior to sampling monitoring wells, FSP Section 5.7.4.1. Following HAZWRAP SOP #4 to calculate the well volume, this amounts to approximately 150 gallons per well. A piezometer (2-inch diameter) is being sampled for additional GW quality information. Because of the smaller diameter, the sampling pump will not fit into the piezometer screen. This variance requests the use of HAZWRAP SOP #4 - INDICATOR PARAMETER METHOD OF WELL PURGING (Section 5.3) (SEE ATTACHED) be used in place of the 3 volume requirement. The variance is requested because of the length of time that will be required to remove 150 gallons from a 2-inch piezometer using a 1-inch I.D. Bailer.

Monitoring wells sampled to date indicate parameter (PH, ec) stabilization is achieved within 1 well volume, thus, the need for purging beyond 1 well volume is not indicated. 1 well volume will be removed from the subject piezometer <u>and</u> parameter stabilization will be used prior to sampling. The indicator parameters to be measured are those discussed in Sec. 5.7.4.2. No adverse effects on data quantity or quality are expected to result from this variance.

This variance applies only to the sampling of 2-inch piezometers.

APPLICABLE DOCUMENT:

Final Site Investigation Field Sampling Plan 161st Air Refueling Group, Arizona Air National Guard, Sky Harbor International Airport, Phoenix, Arizona. Sept 1990 Section 5.7.4.1

CC: David Bunn DB
HAZWRAP Files - 0449

REQUESTED BY ____ **DATE** 4-9-91

APPROVED BY ____ **DATE** 4/9/91
Project Manager

Don Mack **DATE** 10 APR 91
Quality Assurance Officer

____ **DATE** 4/15/91
HAZWRAP Project Manager

HAZARDOUS WASTE REMEDIAL ACTIONS PROGRAM
STANDARD OPERATING PROCEDURE 4
WELL DEVELOPMENT AND PURGING

1. OBJECTIVE

The objective of this procedure is to define the procedural requirements for well development and purging.

2. BACKGROUND

Monitor wells are developed to remove skin (i.e., near-well-bore formation damage) and to settle and remove fines from the filter pack. Wells should not be developed for 24 h after completion when a cement bentonite grout is used to seal the annular space. However, wells may be developed before grouting if conditions warrant. Wells are purged immediately before groundwater sampling to remove stagnant water and a sample representative of groundwater conditions. Wells should be sampled within 3 h of purging (optimum) to 24 h after purging (maximum, for low recharge conditions).

3. RESPONSIBILITIES

Site Manager: The Site Manager is responsible for ensuring that field personnel are trained in the use of this procedure and for verifying that development and purging are carried out in accordance with this procedure.

Project Field Geologist: The Project Field Geologist is responsible for complying with this procedure.

4. REQUIRED EQUIPMENT

- Pump, pump tubing, or bailer and rope or wire line.
- Power source (e.g., generator), if required.
- Water-level meter or weighted surveyor's tape.
- Temperature, conductivity, pH, and/or dissolved oxygen meters (for Sect. 5.2 below).
- Personnel protective equipment as specified in the site-specific health and safety plan.

- Decontamination supplies, if required on-site.
- Disposal drums, if required.

5. PROCEDURES

5.1 WELL DEVELOPMENT

The following steps must be followed when developing wells:

1. Put on personnel protective clothing and equipment as specified in the site-specific health and safety plan.
2. Open and check the condition of the wellhead, including the condition of the surveyed reference mark, if any.
3. Determine the depth to static water level and depth to bottom of the casing.
4. Prepare the necessary equipment for developing the well. There are a number of techniques that can be used to develop a well. Some of the more common methods are bailing, overpumping, backwashing, mechanical surging, surge and pump, and high-velocity jetting. All of these procedures are acceptable; however, final approval of the development method rests with the appropriateness of a specific method to the site and the Hazardous Waste Remedial Actions Program (HAZWRAP) project manager.
5. For screened intervals longer than 10 ft, develop the well in 2- to 3-ft intervals from bottom to top. This will ensure proper packaging in the filter pack. Note: It is good practice to develop all screened and filter-packed wells in stages.
6. Continue well development until produced water is clear and free of suspended solids. Record pertinent data in the field logbook and on appropriate well development forms per HAZWRAP SOP 1, Parts A and B, respectively.
7. Remove the pump assembly or bailers from the well, decontaminate (if required), and clean up the site. Lock the well cover before leaving. Dispose of produced water as required by the project work plan.

5.2 VOLUMETRIC METHOD OF WELL PURGING

The following steps should be followed when purging a well by the volumetric method:

1. Put on personnel protective clothing and equipment as specified in the site-specific health and safety plan.
2. Open the well cover and check the condition of the wellhead, including the condition of the surveyed reference mark, if any.
3. Determine the depth to static water level and depth to bottom of well string. Calculate the well volume (volume of water within the well bore) using the following formula (or equivalent):

$$7.4805\ (\frac{D^2\pi}{4})dH = \text{volume (in gallons)},$$

where

D = casing diameter in feet. (NOTE: This equation is used for grouted wells with short screens. For wells with long screens and/or ungrouted wells, then D = borehole diameter in feet.)
dH = the distance from well bottom to static water level in feet.

Note these data and calculations in the field logbook.

4. Prepare the pump and tubing, or bailer, and lower it into the casing.
5. Remove the number of well volumes specified in the project plans. Generally, three to five well volumes will be required. In low-recharge aquifers, the well will commonly pump or bail to dryness before three well volumes of water are removed. If this is the case, there is no need to continue with purging operations (HAZWRAP Position Paper No. 2). Record pertinent data (e.g., water volume) in the field logbook.
6. Remove the pump assembly or bailer from the well, decontaminate it (if required), and clean up the site. Lock the well cover before leaving. Dispose of produced water as required by the project work plan.

5.3 INDICATOR PARAMETER METHOD OF WELL PURGING

1. Put on personnel protective clothing and equipment as specified in the site-specific health and safety plan.
2. Open the well cover and check the condition of the wellhead, including the condition of the surveyed reference mark, if any.
3. Determine the depth to static water level and depth to bottom. Lower the probe(s) of the indicator meters (e.g., temperature, conductivity) into the water to a point near (but not at) the well bottom or use the flow-through system for indicator parameter measurement. Alternatively, set up surface probe(s) (e.g., pH, dissolved oxygen) at the discharge orifice or dedicated probe port of the pump assembly or within the flow-through chamber. Allow subsurface probe(s) to equilibrate according to manufacturer's specifications. Record the equilibrated readings in the field logbook together with the time.
4. Assemble the pump and tubing, or bailer, and lower into the casing.
5. Begin pumping or bailing the well. Record indicator parameter readings at predetermined intervals. Maintain a record of the approximate volumes of water produced.
6. Continue pumping or bailing until indicator parameter readings remain stable within ±10% for three consecutive recording intervals. Purging should continue until the discharge stream is clear. In low-recharge aquifers the well may pump or bail to

dryness before indicator parameters stabilize. In this case, there is no need to continue purging. Record pertinent data (e.g., water volume) in the field logbook.

7. Remove the pump assembly or bailer from the well, decontaminate (if required), and clean up the site. Lock the well cover before leaving. Dispose of produced water as required by the project work plan.

6. RESTRICTIONS/LIMITATIONS

Where flammable free or emulsified product is expected or known to exist on or in groundwater, use only intrinsically safe electrical devices and place portable power sources (e.g., generators) 50 ft or more from the wellhead and disposal drums.

7. REFERENCES

Driscoll, F. G., *Groundwater and Wells*, Second Edition, St. Paul, Minnesota, Johnson Division, 1986.

U.S. Environmental Protection Agency, *A Compendium of Superfund Field Operations Methods*, EPA/540/P-87/001, 1987.

U.S. Environmental Protection Agency, *Manual of Water Well Construction Practices*, EPA/570/9-75-001, 1975.

IT INTERNATIONAL TECHNOLOGY CORPORATION

VARIANCE LOG

CHRONOLOGIC LIST OF PROJECT VARIANCES

PROJECT NUMBER 409721 **PAGE** 1 **OF** 1

PROJECT NAME SKY HARBOR

DATE	NONCONFORMANCES ~~VARIANCE~~ GRANTED AND APPLICABLE DOCUMENT	RESPONSIBLE INDIVIDUAL
1/18/91	#1 FIELD GC - POOR RECOVERY OF INSTRUMENT;	
	FIELD SAMPLING PLAN (FSP)	D. PEERY
1/30/91	#2 FIELD GC - SHIFTING OF RETENTION TIME	
	& LOSS OF RESOLUTION - FSP	D. PEERY
2/22/91	#3 SOIL SAMPLE ANALYSIS - FSP	S. SARES
3/4/91	#4 NO SENSITIVITY FOR TCA - FSP	D. PEERY

IT INTERNATIONAL TECHNOLOGY CORPORATION

NONCONFORMANCE REPORT

NR NO. /

PROJECT AZANG Sky Harbor

PAGE 1 **OF** 1

PROJECT NO. 409721

DATE: 01/18/91

1. NONCONFORMANCE DESCRIPTION

Problem: Poor recovery of some peaks or completed loss of peaks for start of day standard analysis.

Criteria: Per SOP, start of day calibration will be ran and acceptable recovery occur for all compounds.

Impact: Has no impact on previous analytical data, but will have significant impact on any future data if not corrected.

IDENTIFIED BY: **DATE:** 01/17/91

2. PROPOSED CORRECTIVE ACTION, INCLUDING INITIATION AND COMPLETION DATES

Cleaning of lamp and detector head 01/17, 01/18, 01/19 and recalibrate.

TO BE PERFORMED BY: D. PEERY

3. APPROVAL FOR PROPOSED CORRECTIVE ACTION

Project Manager — Date 1/17/91

Quality Assurance Manager — Date 8/24/91

4. CORRECTIVE ACTION TAKEN (IF DIFFERENT FROM THAT PROPOSED)

GC was replaced 01/19/91 with a new instrument from a different vendor.

5. CORRECTIVE ACTION COMPLETE

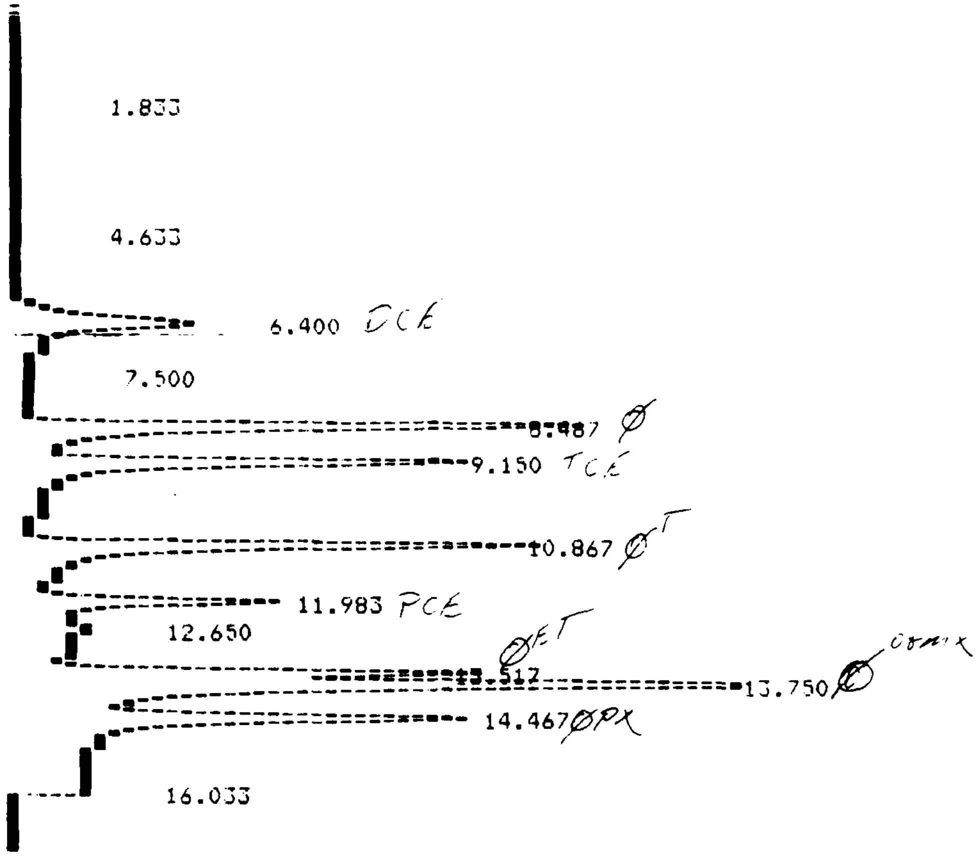
PERFORMED BY: **DATE:** 01/19/91

VERIFIED BY: **DATE:** 1/19/91

CC: PROGRAM MANAGER
PROJECT MANAGER
QUALITY ASSURANCE MANAGER
QUALITY ASSURANCE COORDINATOR
CENTRAL FILES
OTHER:

```
DATA FILE C:STSTD4.PRN
16:24:23  01-19-1991

FULLSCALE MILLIVOLTS  256
```



```
SKYHARBOR PHOENIX AZ, PROJECT £ 409721
DATA FILENAME     C:STSTD4.PRN
16:24:23   01-19-1991
START STANDARD DAY 4 @ 3uL S + 3uL BTEX

RET.TIME   PEAK AREA  HEIGHT    AREA%    NORM%     EXT.STD     INT.STD.  PEAKNAME   RRT
  6.400     1401.95    64.45    8.3007    9.61     1401.95     1401.9501             6.40
  8.467     2602.07   222.35   15.4064   17.84     2602.07     2602.0691             8.47
  9.150     2059.98   174.75   12.1968   14.12     2059.98     2059.9827             9.15
 10.867     2580.66   204.55   15.2796    1.89      275.12      275.1227  BENZENE   10.87
 11.983     1057.73    99.75    6.2626    7.25     1057.73     1057.7277            11.98
 12.650      280.54    26.10    1.6611    1.92      280.54      280.5441            12.65
 13.517     1550.76   177.85    9.1818   10.63     1550.76     1550.7592            13.52
 13.750     3431.59   323.75   20.3179   23.53     3431.59     3431.5930            13.75
 14.467     1667.60   172.85    9.8736   11.43     1667.60     1667.6001            14.47
 16.033      153.81    27.90    0.9107    1.05      153.81      153.8100            16.03

DILUTION FACTOR =  1
TOTAL NUMBER OF PEAKS DETECTED               14   AREA REJECT=  75
TOTAL NUMBER OF IDENTIFIED PEAKS             1        USING SKYHARB.CFT .CFT
TOTAL UN-CORRECTED PEAK AREA                 16889.5
TOTAL NORMALIZED PEAK AREA                   14583.97
INTERNAL STANDARD CORRECTION FACTOR          1
INTERNAL STANDARD PEAK NAME                   AT TIME  1

TOTAL HYDROCARBONS(total peak area using TPH cal.curve)  31979 NANOGRAMS
```

IT INTERNATIONAL TECHNOLOGY CORPORATION

NONCONFORMANCE REPORT

NR NO. 2

PROJECT AZANG Sky Harbor

PAGE 1 **OF** 1

PROJECT NO. 409721

DATE: 01/30/91

1. NONCONFORMANCE DESCRIPTION

Problem: Significant shifting of retention time and loss of resolution for ethylbenzene and xylenes.

Criteria: Per SOP, calibration should show consistent retention time and separation of peaks.

Impact: Samples ran during time GC was out of control, some tentative identification and quantification of compounds based upon information from retention time data obtained from extra standard runs daily. Samples will be rerun when back on line.

IDENTIFIED BY: Cora Huston **DATE:** 01/17/91

2. PROPOSED CORRECTIVE ACTION, INCLUDING INITIATION AND COMPLETION DATES

Check temperature program, carrier gas flow rate, carrier gas pressures, connectors for leaks, cycle through program shooting standards monitoring standards data 01/29 through 02/01/91.

TO BE PERFORMED BY: Cora Huston

3. APPROVAL FOR PROPOSED CORRECTIVE ACTION

Project Manager — Date 1/18/91

Quality Assurance Manager — Date 8/20/91

4. CORRECTIVE ACTION TAKEN (IF DIFFERENT FROM THAT PROPOSED)

Same as above.

5. CORRECTIVE ACTION COMPLETE

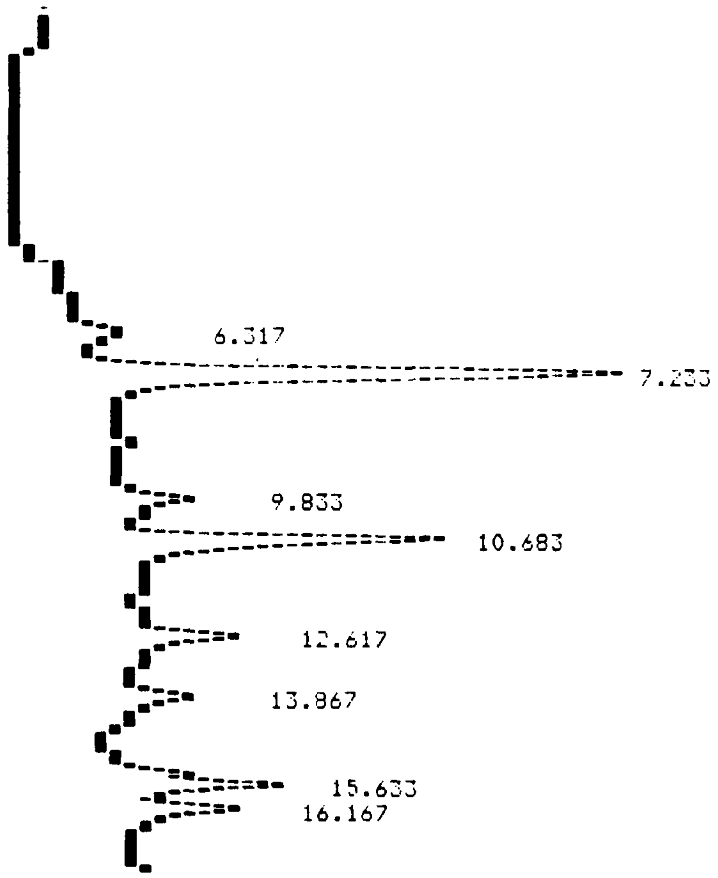
PERFORMED BY: Cora Huston **DATE:** 01/29/91-02/01/91

VERIFIED BY: **DATE:** 08/20/91

CC: PROGRAM MANAGER
PROJECT MANAGER
QUALITY ASSURANCE MANAGER
QUALITY ASSURANCE COORDINATOR
CENTRAL FILES ______
OTHER: ______

CHROMATOGRAM PLOT
DATA FILE C:STSD11.PRN
13:19:07 01-30-1991

FULLSCALE MILLIVOLTS 64



[illegible]
[illegible]
RT Shift
Peak Resolution

SKYHARBOR PHOENIX AZ, PROJECT £ 409721
DATA FILENAME C:STSD11.PRN
13:19:07 01-30-1991
START OF DAY 11 STANDARD 3µl Low

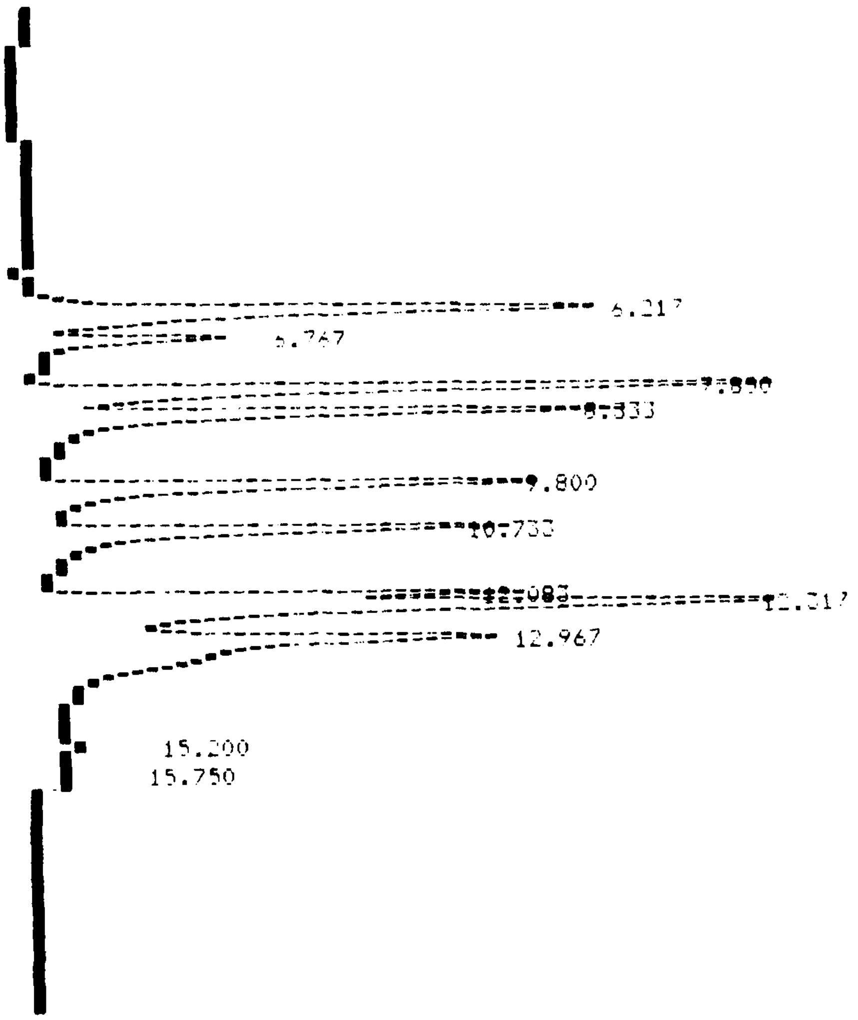
RET.TIME	PEAK AREA	HEIGHT	AREA%	NORM%	EXT.STD	INT.STD.	PEAKNAME	RR
7.233	316.85	53.46	39.8579	37.87	161.95	161.9519	TCA&DCE	[illegible]
9.833	81.76	13.61	3.9892	1.37	5.87	5.8719	BENZENE	[illegible]
10.683	462.07	38.52	22.5467	16.75	71.64	71.6403	TCE	[illegible]
12.617	142.23	17.93	6.9401	2.19	9.34	9.3440	TOLUENE	[illegible]
13.867	117.06	13.56	5.7119	14.71	62.90	62.8953	PCE	[illegible]
15.633	252.61	22.74	12.3261	5.84	24.98	24.9766	O&MXYL	[illegible]
16.167	96.20	18.04	4.6941	2.41	10.32	10.3249	PXYL	[illegible]

```
DILUTION FACTOR =  1
TOTAL NUMBER OF PEAKS DETECTED              8   AREA REJECT=  50
TOTAL NUMBER OF IDENTIFIED PEAKS            7               USING SKYHARB.CFT
ONLY IDENTIFIED PEAKS WERE REPORTED-OTHER PEAKS MAY HAVE BEEN DETECTED
TOTAL UN-CORRECTED PEAK AREA                2049.394
TOTAL NORMALIZED PEAK AREA                  427.6283
INTERNAL STANDARD CORRECTION FACTOR         1
INTERNAL STANDARD PEAK NAME                  AT TIME  1

TOTAL HYDROCARBONS(total peak area using TPH cal.curve)  2298.797 [illegible]
```

```
CHROMATOGRAM PLOT
DATA FILE C:EDSD13.PRN
21:54:33   02-01-1991

FULLSCALE MILLIVOLTS  128
```



IN
CONTROL
AT BACK-CALIB:
GOOD RESOLUTION

```
SKYHARBOR PHOENIX AZ, PROJECT £ 409721
DATA FILENAME     C:EDSD13.PRN
21:54:33   02-01-1991
END OF DAY STD.@ 2uL 100 + 2uL HI BX

RET.TIME  PEAK AREA HEIGHT   AREA%    NORM%    EXT.STD    INT.STD. PEAKNAME
  6.217    1800.21  108.30  15.5382  29.41     874.74    874.7409 TCA&DCE
  7.850    1706.73  144.70  14.7312   6.46     198.87    198.8682 BENZENE
  8.333    1381.09  111.70  11.9206   9.90     274.12    274.1245 TCE
  9.800    1192.63   94.80  10.2939   4.82     148.54    148.5386 TOLUENE
 10.733    1192.36   98.50  10.2916  12.70     390.90    390.8995 PCE
 12.083     857.19   94.10   7.3986   5.19     159.66    159.5612 ETHBEN
 12.317    1655.06  142.70  14.2854   8.30     255.57    255.5690 O&MXYL
 12.967    1262.56   88.50  10.8975   7.75     238.56    238.5634 PXYL

DILUTION FACTOR =  1
TOTAL NUMBER OF PEAKS DETECTED                   11   AREA REJECT=  50
TOTAL NUMBER OF IDENTIFIED PEAKS                 8              USING SKYHARB.
ONLY IDENTIFIED PEAKS WERE REPORTED-OTHER PEAKS MAY HAVE BEEN DETECTED
TOTAL UN-CORRECTED PEAK AREA                     11585.74
TOTAL NORMALIZED PEAK AREA                       3078.892
INTERNAL STANDARD CORRECTION FACTOR
```

IT INTERNATIONAL TECHNOLOGY CORPORATION

NONCONFORMANCE REPORT

NR NO. 3

PROJECT SKY HARBOR SI

PAGE 1 **OF** ~~54~~ 2 SWS 3/14/91

PROJECT NO. 409721

DATE: 22 FEB 91

1. NONCONFORMANCE DESCRIPTION

SAMPLES ARE SENT TO THE LABORATORY DAILY AND HELD PENDING PHONED-IN INSTRUCTIONS FOR WHICH SAMPLES TO ANALYZE BASED ON FIELD SCREENING. TWO CASES ARE IDENTIFIED IN WHICH MISCOMMUNICATION HAS RESULTED IN SAMPLES NOT BEING SCHEDULED FOR ANALYSIS. SAMPLES SB1-02-5-7 AND SB1-02-25-27 WERE NOT SCHEDULED FOR ANALYSIS; ONLY 1 SAMPLE FROM THIS BORING WAS ANALYZED. ALSO, SAMPLE SB2-01-50-52 WAS NOT ANALYZED; 2 SAMPLES FROM THIS BORING WERE ANALYZED. THE WORK PLANS CALL FOR THREE SAMPLES TO BE ANALYZED FROM EACH BORING.

SWS 3/14/91

LOSS OF THE VOA AND SVOA WILL NOT CAUSE SIGNIFICANT IMPACTS TO THE PROJECT RESULTS. EACH BORING HAS LABORATORY LEVEL C DATA FROM AT LEAST ONE DEPTH. FIELD-LEVEL B ANALYSES WERE CONDUCTED ON ALL SAMPLES AND CAN BE USED AS INDICATORS OF THE PRESENCE OR ABSENCE OF GROSS CONTAMINANTS. ALSO, TPH ANALYSES WILL PROVIDE SOME LEVEL C INDICATIONS OF CONTAMINATION FOR ALL SAMPLES. THE LOSS OF DATA WILL LOWER THE "COMPLETENESS" OBJECTIVE BUT WILL HAVE MINIMAL INTERPRETIVE SIGNIFICANCE

IDENTIFIED BY: S. Sares **DATE:** 22 FEB 91

2. PROPOSED CORRECTIVE ACTION, INCLUDING INITIATION AND COMPLETION DATES

1. SAMPLES FROM SB1-02 HAVE EXCEEDED HOLDING TIME FOR VOA AND SVOA AND DATA CANNOT BE RECOVERED
2. SAMPLES FROM SB1-02 CAN BE SCHEDULED FOR TPH WITHIN HOLDING TIME.
3. SAMPLE SB2-01-50-52 HAVE EXCEEDED HOLDING TIME FOR VOA AND SVOA AND DATA CANNOT BE RECOVERED
4. SAMPLE SB2-01-50-52 TO BE SCHEDULED FOR TPH AND TAL ANALYSIS
5. FUTURE INSTRUCTION FOR SAMPLES TO BE ANALYZED TO BE WRITTEN AND ~~FAXED~~ REQUEST FOR ANALYSIS TO LAB AND FOLLOWED BY PHONE VERIFICATION

TO BE PERFORMED BY: S. SARES/LAB #1-4; FIELD SUPER #5

3. APPROVAL FOR PROPOSED CORRECTIVE ACTION

Project Manager 2/25/91 Date

Alan Mach
Quality Assurance Manager 15 MAR 91 Date

4. CORRECTIVE ACTION TAKEN (IF DIFFERENT FROM THAT PROPOSED)

5. CORRECTIVE ACTION COMPLETE

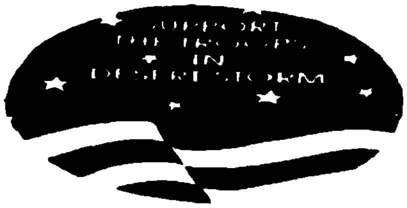
PERFORMED BY: K TYBURSKI **DATE:** 3-22-91

VERIFIED BY: D. Wilson **DATE:** 3-25-91

CC: PROGRAM MANAGER
PROJECT MANAGER
QUALITY ASSURANCE MANAGER
QUALITY ASSURANCE COORDINATOR
CENTRAL FILES ____________
OTHER: ____________

IT INTERNATIONAL TECHNOLOGY CORPORATION

e07



TELECOPY REQUEST

TELECOPY NUMBER: IT-~~Albuquerque~~-Cerritos

TO: Marla Miller

FROM: Steve Sones

DATE: 22 Feb 91

NUMBER OF PAGES 3 (INCLUDING COVER SHEET)

REMARKS:

IT CORPORATION
312 DIRECTORS DRIVE
KNOXVILLE, TN 37923
(615) 690-3211

DISCARD WHEN SENT ___

PLEASE RETURN ___

IF ALL PAGES ARE NOT RECEIVED, PLEASE ASK FOR EXTENSION 3223 AT THE ABOVE NUMBER. THANK YOU.

IT KNOXVILLE FAX NO. 615/690-3626 OR 615/690-4652

TRANSMISSION REPORT

```
THIS DOCUMENT WAS CONFIRMED
(REDUCED SAMPLE ABOVE - SEE DETAILS BELOW)

  ** COUNT **
TOTAL PAGES SCANNED    :  3
TOTAL PAGES CONFIRMED  :  3

RESULT OF LAST BATCH SENT
 *** SEND ***
-------------------------------------------------------------------------------------
No.   REMOTE STATION    START TIME        DURATION #PAGES   MODE        RESULTS
-------------------------------------------------------------------------------------
 1          CERRITOS  2-22-91 11:41AM       2'00"   3/ 3            COMPLETED
                                                                    9600
-------------------------------------------------------------------------------------
                              TOTAL      0:02'00"    3
NOTE:
No.  OPERATION NUMBER   48 : 4800BPS SELECTED   EC : ERROR CORRECT    G2 : G2 COMMUNICATION
PD : POLLED BY REMOTE   SF : STORE & FORWARD    RI : RELAY INITIATE   RS : RELAY STATION
MB   SEND TO MAILBOX    PG   POLLING A REMOTE   MP : MULTI-POLLING    RM : RECEIVE TO MEMORY
```

IT INTERNATIONAL TECHNOLOGY CORPORATION

RECORD OF ☒ TELECON ☐ MEETING

Project Name	Number	Phase	Task	Subtask
SKY HARBOR	409721			

Date 22 FEB 91

Time 11^{05} EST

CALL FROM ☒ NAME: Steve Sares
CALL TO ☐

Other Participants — Name/Location/Representing:
NONE

CALL FROM ☐ NAME: Marla Miller
CALL TO ☒

Telephone Number:

Company Name: ITAS-CERRITOS

Address:

City

State

Zip Code

Topic
SKY HARBOR ANALYSES.

Summary (Decisions & Specific Actions Required by Named Persons):

1. I've reviewed her fax from 21 FEB with respect to sample nos. and analyses - action items for lab are:

A. Sample no. recorded as SB1-01-0-2-01 - Lab # C1-01-317 01A received 1/30/91 on C of C # 163132 should be SB2-01-0-2-01/-02 SB1-01 was not drilled.

B. Sample SB1-02-5-7-01, Lab # C1-02-071 01A received 2/6/91 should be analyzed for TPH. - Note close holding time.

C. Sample SB1-02-25-27-01, Lab # C1-02-071 02A received 2/6/91 should be analyzed for TPH. - Note close holding time.

D. Sample SB2-01-50-52-01, Lab # C1-01-317 06A received 1/30/91, should be analyzed for TPH and TAL Metals. - Note close holding time on TPH.

Required Action: A. LAB to schedule analyses indicated above
B. Sares to fax phone record for confirmation
C. LAB to include RFA with sample log in letter
D. Marla to send copy of tracking spreadsheet regularly.

Prepared by (Signature)

Distribution:
Original to Project File
Copy to Project Manager
Copy to Preparer

☒ Other Distribution (By Preparer)
J. Tybuski, M. Miller

PAGE 1 OF 2

548A-8-87

IT INTERNATIONAL TECHNOLOGY CORPORATION

RECORD OF ☒ TELECON ☐ MEETING

Project Name	Number	Phase	Task	Subtask
SKY HARBOR	409721			

Date: 22 FEB 91

Time: 11^{05} EST

CALL FROM ☒ CALL TO ☐ NAME: Steve Sares

Other Participants — Name/Location/Representing: NONE

CALL FROM ☐ CALL TO ☒ NAME: Marla Miller

Telephone Number:

Company Name: ITAS - Cerritos

Address:

City

State

Zip Code

Topic: SKY HARBOR ANALYSES

Summary (Decisions & Specific Actions Required by Named Persons):

2. Ground Water Sampling will be delayed, Probably will do ~5-6 Soil Borings x 3 Samples each in 2 to 3 weeks. GW Sampling will be after soil borings. Schedule not certain yet. Tyburski will coordinate field schedule as soon as we know more.

3. Lab to send RFA with sample log in receipts

* Tyburski to fax revised RFAs to Lab to indicate changes in analytical program and follow up with ~~a~~ usual phone call.

Required Action:

E. Tyburski to fax revised RFA to Lab to indicate changes from original RFA.

Prepared by (Signature)

Distribution
Original to Project File
Copy to Project Manager
Copy to Preparer

☒ Other Distribution (By Preparer): J. Tyburski, M. Miller

PAGE 2 OF 2

548A-8-87

INTERNATIONAL
TECHNOLOGY
CORPORATION

REQUEST FOR ANALYSIS

R/A Control No. 203062
C/C Control No. 163151

PROJECT NAME Sky Harbor ANG
PROJECT NUMBER 409721.02.06
PROFIT CENTER NUMBER 3521
PROJECT MANAGER Don Willen
BILL TO IT-Knoxville
312 Directors Dr.
Knoxville, TN
PURCHASE ORDER NO. See Don Willen

DATE SAMPLES SHIPPED 3/21/91
LAB DESTINATION ITAS - Cerritos, CA
LABORATORY CONTACT Marla Miller
SEND LAB REPORT TO Don Willen
IT-Knoxville
|
DATE REPORT REQUIRED 3 weeks
PROJECT CONTACT Joe Tyburski
PROJECT CONTACT PHONE NO. 602/275-1325

Sample No	Sample Type	Sample Volume	Preservative	Requested Testing Program	Special Instructions
MBS-04-0-2-01	Soil	6-inch Brass Sleeve	Ice	TPH, TOPb, VOA, & SemiVOA	
MBS-04-15-16½-01&02	↓	2x6-inch Brass Sleeves	↓	TPH, TOPb, VOA, SemiVOA	
* MBS-04-99-01	Soil	400 mL	Ice	Hold for Instructions	←

TURNAROUND TIME REQUIRED: (Rush must be approved by the Laboratory Project Manager.)
Normal ✓ Rush ____ (Subject to rush surcharge.)

QC LEVEL: (Levels II and III subject to surcharge; project-specific requirements must be submitted to lab before beginning work.)
I ____ II ____ III ____ Project Specific ✓

POSSIBLE HAZARD IDENTIFICATION (Please indicate if sample(s) are hazardous materials and/or suspected to contain high levels of hazardous substances.)
Non-hazard ____ Flammable ____ Skin Irritant ✓ Highly Toxic ____ Other Possible Petroleum [illegible] Solvent Constituents (Please Specify)

SAMPLE DISPOSAL. (Please indicate disposition of sample following analysis. Lab will charge for packing, shipping, archive and disposal.)
Return to Client ____ Disposal by Lab ✓ Archive ____ (Indicate number of months.)

FOR LAB USE ONLY
Received by ____ (Marla Miller) Date/Time ____

WHITE - Original, to accompany samples
YELLOW - Field copy

* Lab instructed to analyze for TPH, TCPb, VOA, SVOA. JRT 3-22-91

126A 10 85

INTERNATIONAL TECHNOLOGY CORPORATION

REQUEST FOR ANALYSIS

R/A Control No. 208057

C/C Control No. 163146

PROJECT NAME Sky Harbor ANG

PROJECT NUMBER 409721.02.06

PROFIT CENTER NUMBER 3521

PROJECT MANAGER Don Willen

BILL TO IT-Knoxville
312 Directors Dr.
Knoxville, TN

PURCHASE ORDER NO. See Don Willen

DATE SAMPLES SHIPPED 7 February 91

LAB DESTINATION ITAS-Carritos, CA

LABORATORY CONTACT Maria Miller

SEND LAB REPORT TO Don Willen
IT-Knoxville

DATE REPORT REQUIRED 3 Weeks

PROJECT CONTACT Joe Tyburski

PROJECT CONTACT PHONE NO. 602/275-1325

Sample No.	Sample Type	Sample Volume	Preservative	Requested Testing Program	Special Instructions
MBS-01-0-2-01,02,03	Soil	3 x 6-inch Brass Sleeves	Ice to 4°C	TPH, VOA, SVOA, TAL, TOPb, Nitrate/Nitrite,	
* MBS-01-5-7-01,02	↓	2 x 6-inch Brass Sleeves	↓	Hold for Instructions	
MBS-01-70-72-01	Soil	1 x 6-inch Brass Sleeve	Ice to 4°C	TPH, VOA, SVOA, TAL, TOPb, Nitrate/Nitrite	If sample amount is insufficient, contact project contact for order of priority.
MBS-01-TB	Water	2 x 40 mL	HCl, Ice to 4°C	VOA	
←		Last	MG ~~Line~~ 2/14[illegible]1 1300		→
MPS-01-60-62-01	Soil	1 x 6-inch Brass Sleeve	Ice to 4°C	Hold for Instructions	
←		Last	Line		→
				[illegible]	

TURNAROUND TIME REQUIRED: (Rush must be approved by the Laboratory Project Manager)

Normal ✓ Rush ____ (Subject to rush surcharge)

QC LEVEL: (Levels II and III subject to surcharge; project-specific requirements must be submitted to lab before beginning work)

I ____ II ____ III ____ Project Specific ✓

POSSIBLE HAZARD IDENTIFICATION: (Please indicate if sample(s) are hazardous materials and/or suspected to contain high levels of hazardous substances)

Non-hazard ____ Flammable ____ Skin Irritant ✓ Highly Toxic ____ Other Possible Petroleum &/or Solvent Contamination (Please Specify)

SAMPLE DISPOSAL: (Please indicate disposition of sample following analysis. Lab will charge for packing, shipping, archive and disposal)

Return to Client ____ Disposal by Lab ✓ Archive ____ (Indicate number of months.)

FOR LAB USE ONLY

Received by ____ Date/Time ____

WHITE - Original, to accompany samples
YELLOW - Field copy

* Notified Lab to add sample to analysis group. SRT 2-8-91

126A 10 85

INTERNATIONAL TECHNOLOGY CORPORATION

REQUEST FOR ANALYSIS

R/A Control No. 208055
C/C Control No. 163141

PROJECT NAME Sky Harbor ANG
PROJECT NUMBER 409721
PROFIT CENTER NUMBER 3521
PROJECT MANAGER Don Willen
BILL TO IT - Knoxville,
312 Directors Dr.
Knoxville, TN
PURCHASE ORDER NO. See Don Willen

DATE SAMPLES SHIPPED 6 February 91
LAB DESTINATION ITAS - Cerritos, CA
LABORATORY CONTACT Marla Miller
SEND LAB REPORT TO Don Willen
IT - Knoxville
|
DATE REPORT REQUIRED 3 Weeks
PROJECT CONTACT Joe Tyburski
PROJECT CONTACT PHONE NO. 602/275-1325

Sample No.	Sample Type	Sample Volume	Preservative	Requested Testing Program	Special Instructions
MB2-02-0-2-01,02,03	Soil	3 X 6-inch Brass Sleeve w/ Teflon Lined Caps	Ice to 4°C	TPH, VOA, SVOA, TAL	
MB2-02-5-7-01,02	↓	2 X 6-inch Brass Sleeve	↓	Hold for Instructions	
* MB2-02-30-32-01	↓	1 X 6-inch Brass Sleeve	↓	Hold for Instructions	
MB2-02-70-72-01,02	Soil	2 x 6 inch Brass Sleeve	Ice to 4°C	TAL, VOA, SVOA, TAL	
MB2-02-TB	Water	2 x 40mL VOA	Ice to 4°C, HCl	VOA	

TURNAROUND TIME REQUIRED: (Rush must be approved by the Laboratory Project Manager.)
Normal ✓ Rush ____ (Subject to rush surcharge.)

QC LEVEL: (Levels II and III subject to surcharge; project-specific requirements must be submitted to lab before beginning work.)
I ____ II ____ III ____ Project Specific ✓

POSSIBLE HAZARD IDENTIFICATION: (Please indicate if sample(s) are hazardous materials and/or suspected to contain high levels of hazardous substances.)
Non-hazard ____ Flammable ____ Skin Irritant ✓ Highly Toxic ____ Other Possible, Petroleum H/R, Solvent Constituents, OR Metals (Please Specify)

SAMPLE DISPOSAL: (Please indicate disposition of sample following analysis. Lab will charge for packing, shipping, archive and disposal.)
Return to Client ____ Disposal by Lab ✓ Archive ____ (Indicate number of months.)

FOR LAB USE ONLY
Received by ____ Date/Time ____

WHITE - Original, to accompany samples
YELLOW - Field copy

* Lab directed to run analyses 2/7/91 JRT

126A 10/85

INTERNATIONAL TECHNOLOGY CORPORATION

REQUEST FOR ANALYSIS

R/A Control No. B 87028
C/C Control No. 163141

PROJECT NAME Sky Harbor ANG
PROJECT NUMBER 409721.02.06
PROJECT MANAGER Don Willen
BILL TO IT-Knoxville
312 Directors Dr.
Knoxville, TN
PURCHASE ORDER NO. See Don Willen

DATE SAMPLES SHIPPED 5 February 91
LAB DESTINATION ITAS-Cerritos
LABORATORY CONTACT Cheryl Ferguson
SEND LAB REPORT TO Don Willen
IT-Knoxville
|
DATE REPORT REQUIRED 3 weeks
PROJECT CONTACT Joe Tyburski
PROJECT CONTACT PHONE NO. 602/275-1325

Sample No.	Sample Type	Sample Volume	Preservative	Requested Testing Program	Special Instructions
* SB1-02-5-7-01	Soil	6-inch Brass Sleeve	Ice to 4°C	Hold for Instructions	
* SB1-02-25-27-01	Soil	6-inch Brass Sleeve	Ice to 4°C	Hold for Instructions	
SB1-02-TB2	Water/Trip Blank	2 x 40ml Glass	Ice to 4°C; HCl	VOA	

TURNAROUND TIME REQUIRED (Rush must be approved by the Project Manager)

Normal ✓ Rush ______ (Subject to rush surcharge)

POSSIBLE HAZARD IDENTIFICATION: (Please indicate if sample(s) are hazardous materials and/or suspected to contain high levels of hazardous substances)

Nonhazard ______ Flammable ______ Skin Irritant ✓ Highly Toxic ______ Other Possible Presence of Solvent Constituents (Please Specify)

SAMPLE DISPOSAL (Please indicate disposition of sample following analysis. Lab will charge for packing, shipping, and disposal.)

Return to Client ______ Disposal by Lab ✓

FOR LAB USE ONLY

Received By ______________ Date/Time ______________

WHITE - Original, to accompany samples
YELLOW - Field copy

* S. Sares instructed Lab to analyze for TPH 2/22/91 Telecon

INTERNATIONAL TECHNOLOGY CORPORATION

REQUEST FOR ANALYSIS

R/A Control No. B 87027
C/C Control No. 163141

PROJECT NAME SKY HARBOR ANG
PROJECT NUMBER 409721
PROJECT MANAGER DON WILLEN
BILL TO IT-KNOXVILLE
312 DIRECTORS DR.
KNOXVILLE, TN
PURCHASE ORDER NO. SEE DON WILLEN

DATE SAMPLES SHIPPED 4 FEBRUARY 91
LAB DESTINATION ITAS-CERRITOS
LABORATORY CONTACT CHERYL FERGUSON
SEND LAB REPORT TO ~~IT-T~~ DON WILLEN
IT-KNOXVILLE
DATE REPORT REQUIRED 3 WEEKS
PROJECT CONTACT JOE TYBURSKI
PROJECT CONTACT PHONE NO. 602/275-1325

Sample No.	Sample Type	Sample Volume	Preservative	Requested Testing Program	Special Instructions
QC-FBS	WATER	1-LITER GLASS	HCl; ICE to 4°C	TPH	
		1-LITER GLASS		SVOA	
		1-LITER GLASS		TOTAL ORGANIC Pb	
		2 x 40mL GLASS	HCl;	VOA	
		2 x 40mL GLASS	HCl;	VINYL CHLORIDE	
		1-LITER POLY	HNO_3;	METALS (EXCEPT MERCURY)	
		1-LITER POLY	HNO_3;	MERCURY	
		1-500mL POLY	H_2SO_4;	NITRATE/NITRATE	
QC-FBS-TB		2 40mL GLASS	HCl;	VOA	
QC-FBS-TB	WATER	2-40mL GLASS	HCl;	VINYL CHLORIDE	

TURNAROUND TIME REQUIRED: (Rush must be approved by the Project Manager.)
Normal ✓ Rush ____ (Subject to rush surcharge)

POSSIBLE HAZARD IDENTIFICATION: (Please indicate if sample(s) are hazardous materials and/or suspected to contain high levels of hazardous substances)
Nonhazard ✓ Flammable ____ Skin Irritant ____ Highly Toxic ____ Other ____ (Please Specify)

SAMPLE DISPOSAL: (Please indicate disposition of sample following analysis. Lab will charge for packing, shipping, and disposal.)
Return to Client ____ Disposal by Lab ✓

FOR LAB USE ONLY
Received By ____ Date/Time ____

WHITE - Original, to accompany samples
YELLOW - Field copy

IT INTERNATIONAL TECHNOLOGY CORPORATION

REQUEST FOR ANALYSIS

R/A Control No. B 87022
C/C Control No. 163136

PROJECT NAME Sky Harbor ANG
PROJECT NUMBER 409721.02.06
PROJECT MANAGER Don Willen
BILL TO IT - Knoxville
312 Directors Dr.
Knoxville, TN
PURCHASE ORDER NO. See Don Willen

DATE SAMPLES SHIPPED 30 January 91
LAB DESTINATION ITAS - Cerritos
LABORATORY CONTACT Cheryl Ferguson
SEND LAB REPORT TO Don Willen
IT - Knoxville
|
DATE REPORT REQUIRED 3 Weeks
PROJECT CONTACT Joe Tyburski
PROJECT CONTACT PHONE NO. 602/275-1325

Sample No.	Sample Type	Sample Volume	Preservative	Requested Testing Program	Special Instructions
M35-03-0-2-01 & 02	Soil	2x6-inch Brass Sleeves	Ice to 4°C	TPH, VOA, SVOA, TAL, TOPG Nitrate/Nitrite	
* M35-03-5-7-01	Soil	1x6 inch Brass Sleeves	Ice to 4°C	Hold for Instructions	
M35-03-TB	Water/Trip Blank	2x40 mL	Ice to 4°C, HCl	VOA	
←		Last Line			→

TURNAROUND TIME REQUIRED: (Rush must be approved by the Project Manager.)

Normal ✓ **Rush** ____ (Subject to rush surcharge)

POSSIBLE HAZARD IDENTIFICATION: (Please indicate if sample(s) are hazardous materials and/or suspected to contain high levels of hazardous substances)

Nonhazard ____ **Flammable** ____ **Skin Irritant** ✓ **Highly Toxic** ____ **Other** Possible Petroleum or Solvent Constituents **(Please Specify)**

SAMPLE DISPOSAL. **(Please indicate disposition of sample following analysis. Lab will charge for packing, shipping, and disposal.)**

Return to Client ____ **Disposal by Lab** ✓

FOR LAB USE ONLY

Received By ____________ **Date/Time** ____________

WHITE - Original, to accompany samples
YELLOW - Field copy

* Contacted Cheryl Ferguson 2-1-91 to add sample for analyses.
IRT

INTERNATIONAL TECHNOLOGY CORPORATION

REQUEST FOR ANALYSIS

R/A Control No B 27018
C/C Control No. 163132

PROJECT NAME Sky Harbor ANG
PROJECT NUMBER 409721
PROJECT MANAGER Bill Willen
BILL TO IT-Knoxville
312 Directors Dr
Knoxville, TN
PURCHASE ORDER NO. See Bill Willen

DATE SAMPLES SHIPPED 29 January 91
LAB DESTINATION ITAS-Cerritos
LABORATORY CONTACT Cheryl Ferguson
SEND LAB REPORT TO Bill Willen
IT Knoxville
DATE REPORT REQUIRED 3 weeks
PROJECT CONTACT Joe Tyburski
PROJECT CONTACT PHONE NO. 602/275-1325

Sample No.	Sample Type	Sample Volume	Preservative	Requested Testing Program	Special Instructions
SB2-01-0-2-01&02	Soil	2 x 6-inch Brass Sleeves	Ice to 4°C	TPH, VOA, SVOA, TAL	
SB2-01-5-7-01	↓	1 x 6-inch Brass Sleeve	↓	Hold for Instructions	
SB2-01-10-12-01	↓	↓	↓	Hold for Instructions	
SB2-01-15-17-01	↓	↓	↓	Hold for Instructions	
* SB2-01-50-52-01	↓	↓	↓	Hold for Instructions	
* SB2-01-55-57-01	↓	1 x 6-inch Brass Sleeve	↓	TPH, VOA, SVOA, TAL	See Project Contact if sample volume is insufficient
MBS-01-0-2-01,02&03	↓	3 x 6-inch Brass Sleeve	↓	TPH, VOA, SVOA, TAL, TOPb, Nitrate/Nitrite	
MBS-01-60-62-01	Soil	1 x 6-inch Brass Sleeve	Ice to 4°C	TPH, VOA, SVOA, TAL, TOPb, Nitrate/Nitrite	See Project Contact if sample volume is insufficient
MBS-01-TB	Water (Trip Blank)	2 x 40 mL	HCl; Ice to 4°C	VOA	

TURNAROUND TIME REQUIRED: (Rush must be approved by the Project Manager.)

Normal ✓ Rush ____ (Subject to rush surcharge)

POSSIBLE HAZARD IDENTIFICATION: (Please indicate if sample(s) are hazardous materials and/or suspected to contain high levels of hazardous substances)

Nonhazard ____ Flammable ____ Skin Irritant ✓ Highly Toxic ____ Other Possible Petroleum or Solvent constituents (Please Specify)

SAMPLE DISPOSAL: (Please indicate disposition of sample following analysis. Lab will charge for packing, shipping, and disposal.)

Return to Client ____ Disposal by Lab ✓

FOR LAB USE ONLY

Received By ____ Date/Time ____

WHITE - Original, to accompany samples
YELLOW - Field copy

* Cheryl Ferguson told to use sample for analysis
1/30 JST

INTERNATIONAL TECHNOLOGY CORPORATION

REQUEST FOR ANALYSIS

R/A Control No. B 87017
C/C Control No. 163131

PROJECT NAME Sky Harbor ANG
PROJECT NUMBER 409721
PROJECT MANAGER Bill Willen
BILL TO IT-Knoxville
312 Directors Dr.
Knoxville, ~~A~~ TN MB
PURCHASE ORDER NO. See Bill Willen

DATE SAMPLES SHIPPED 28 January 91
LAB DESTINATION ITAS-Cerritos
LABORATORY CONTACT Cheryl Ferguson
SEND LAB REPORT TO Bill Willen
IT-Knoxville
DATE REPORT REQUIRED Three Weeks
PROJECT CONTACT Joe Tyburski
PROJECT CONTACT PHONE NO. 602/275-1325

Sample No.	Sample Type	Sample Volume	Preservative	Requested Testing Program	Special Instructions
MB1-02-0-2-01	Soil	6" Brass Sleeve	Ice to 4°C	TPH, VOA, SVOA	
MB1-02-0-2-02	↓	↓		TPH, VOA, SVOA ~~Hold for Instructions~~ MB	
* MB1-02-35-37-01	↓	↓		Hold for Instructions	
MB1-02-60-62-01	↓	↓		Hold for Instructions	
MB1-02-75-77-01	Soil	6" Brass Sleeve		TPH, VOA, SVOA	See Project Contact if Sample Volume is [illegible]
MB1-02-TB	Water	2 x 40mL	HCl; Ice to 4°C	~~TPH~~ MB, VOA, ~~SVOA~~ MB	

TURNAROUND TIME REQUIRED (Rush must be approved by the Project Manager.)

Normal ✓ Rush ______ (Subject to rush surcharge)

POSSIBLE HAZARD IDENTIFICATION. (Please indicate if sample(s) are hazardous materials and/or suspected to contain high levels of hazardous substances)

Nonhazard ______ Flammable ______ Skin Irritant ✓ Highly Toxic ______ Other Possible [illegible] & Solvent [illegible] (Please Specify)

SAMPLE DISPOSAL (Please indicate disposition of sample following analysis. Lab will charge for packing, shipping, and disposal.)

Return to Client ______ Disposal by Lab ✓

FOR LAB USE ONLY

Received By ____________________ Date/Time ____________________

WHITE - Original, to accompany samples
YELLOW - Field copy

* Cheryl Ferguson notified to analyze sample
1/30 JRT

INTERNATIONAL TECHNOLOGY CORPORATION

REQUEST FOR ANALYSIS

R/A Control No. 179885
C/C Control No. ____

PROJECT NAME Sky Harbor ANG
PROJECT NUMBER 409721
PROJECT MANAGER Don Willen
BILL TO IT Corporation
312 ~~Knox~~ Directors Dr.
Knoxville, TN 90701
PURCHASE ORDER NO See Don Willen

DATE SAMPLES SHIPPED 1-22-91
LAB DESTINATION Carritos, CA
LABORATORY CONTACT Cheryl Ferguson
SEND LAB REPORT TO Don Willen
DATE REPORT REQUIRED 3 weeks
PROJECT CONTACT J. Tyburski
PROJECT CONTACT PHONE NO. 602/275-1325

Sample No	Sample Type	Sample Volume	Preservative	Requested Testing Program	Special Instructions
SB1-03-55-57-01	Soil	6" Brass Sleeve	Ice to 4°C	TPH, VOA, SVOA	
SB1-03-55-54-02				↓	
SB3-03-55-57-03				TPH, VOA, SVOA	Matrix Spike & Matrix Spike Duplicate
SB2-02-0-2-01				TPH, VOA, SVOA, TAL	
SB2-02-5-7-01				Hold for Instructions	←
* SB2-02-10-12-01				Hold for Instructions	←
SB2-02-40-42-01				Hold for Instructions	←
SB2-02-50-52-01				Hold for Instructions	←
SB2-02-55-57-01	↓	↓	↓	Hold for Instructions	←
SB2-02-70-72-01	Soil	6" Brass Sleeve	Ice to 4°C	TPH, VOA, SVOA, TAL	

TURNAROUND TIME REQUIRED (Rush must be approved by the Project Manager)
Normal ✓ Rush ____ (Subject to rush surcharge)

POSSIBLE HAZARD IDENTIFICATION (Please indicate if sample(s) are hazardous materials and/or suspected to contain high levels of hazardous substances)
Nonhazard ____ Flammable ____ Skin Irritant ✓ Highly Toxic ____ Other Possible [illegible] &/or [illegible] (Please Specify)

SAMPLE DISPOSAL (Please indicate disposition of sample following analysis. Lab will charge for packing, shipping, and disposal)
Return to Client ____ Disposal by Lab ✓

FOR LAB USE ONLY
Received By ____ Date/Time ____

WHITE - Original, to accompany samples
YELLOW - Field copy

* Directed lab (James Martin) to analyze 1-23-91

INTERNATIONAL TECHNOLOGY CORPORATION

REQUEST FOR ANALYSIS

R/A Control No. B 37010
C/C Control No. 143034

PROJECT NAME Sky Harbor ANG
PROJECT NUMBER 409721
PROJECT MANAGER Don Willen
BILL TO IT Corp
312 Directors Drive
Knoxville, TN
PURCHASE ORDER NO. See Don Willen

DATE SAMPLES SHIPPED 1-21-91
LAB DESTINATION Cerritos, CA
LABORATORY CONTACT Cheryl Ferguson
SEND LAB REPORT TO Don Willen

DATE REPORT REQUIRED 2-11-91
PROJECT CONTACT J. Tyburski
PROJECT CONTACT PHONE NO. 602-275-1325

Sample No.	Sample Type	Sample Volume	Preservative	Requested Testing Program	Special Instructions
SB1-03-15-17-01	SOIL	6" BRASS SLEEVE	ICE TO 4°C	TPH, ~~SOV~~ MB VOA, SVOA	HOLD FOR INSTRUCTIONS
* SB1-03-20-22-01	|	|	|	|	HOLD FOR INSTRUCTIONS
SB1-03-35-37-01	|	|	|	|	
SB1-03-35-37-01	SOIL	6" BRASS SLEEVE	ICE TO 4°C	TPH, VOA, SVOA	
SB1-04-TB	WATER	2 x 40 mL	HCl, ICE TO 4°C	VOA	

TURNAROUND TIME REQUIRED (Rush must be approved by the Project Manager)

Normal ✓ Rush ____ (Subject to rush surcharge)

POSSIBLE HAZARD IDENTIFICATION (Please indicate if sample(s) are hazardous materials and/or suspected to contain high levels of hazardous substances)

Nonhazard ____ Flammable ____ Skin Irritant ✓ Highly Toxic ____ Other Possible [illegible] [illegible]
(Please Specify)

SAMPLE DISPOSAL (Please indicate disposition of sample following analysis. Lab will charge for packing, shipping, and disposal.)

Return to Client ____ Disposal by Lab ✓

FOR LAB USE ONLY

Received By ____ Date/Time ____

WHITE - Original, to accompany samples
YELLOW - Field copy

* Directed lab (James Martin) to analyze 1-23-91.

INTERNATIONAL TECHNOLOGY CORPORATION

REQUEST FOR ANALYSIS

R/A Control No. 179883
C/C Control No. 105430

PROJECT NAME Sky Harbor ANG
PROJECT NUMBER 409721.02.06
PROJECT MANAGER Don Willen
BILL TO IT - Knoxville
312 Directors Dr.
Knoxville, TN 90701
PURCHASE ORDER NO. See Don Willen

DATE SAMPLES SHIPPED 1/18/91
LAB DESTINATION ITAS - Cerritos, CA
LABORATORY CONTACT Cheryl Ferguson
SEND LAB REPORT TO Don Willen
IT - Knoxville
DATE REPORT REQUIRED Standard
PROJECT CONTACT Joe Tyburski
PROJECT CONTACT PHONE NO. 602/275-1325

Sample No	Sample Type	Sample Volume	Preservative	Requested Testing Program	Special Instructions
SB1-05-0-1/01	Soil	6 inch Brass Sleeve	Ice to 4°C	TPH, VOA, SVOA	—
SB1-05-0-5/01					Hold for Instructions
SB1-05-5-10/01					Hold for Instructions
SB1-05-10-15/01					Hold for Instructions
SB1-05-25-30/01					Hold for Instructions
* SB1-05-30-35/01					Hold for Instructions
SB1-05-35-40/01					Hold for Instructions
SB1-05-40-45/01					Hold for Instructions
SB1-05-45-50/01					Hold for Instructions
SB1-05-65-70/01	Soil	6 inch Brass Sleeve	Ice to 4°C	TPH, VOA, SVOA	—

TURNAROUND TIME REQUIRED (Rush must be approved by the Project Manager)

Normal ✓ Rush ___ (Subject to rush surcharge)

POSSIBLE HAZARD IDENTIFICATION (Please indicate if sample(s) are hazardous materials and/or suspected to contain high levels of hazardous substances)

Nonhazard ___ Flammable ___ Skin Irritant ✓ Highly Toxic ___ Other [illegible] Contaminat[illegible] [illegible] (Please Specify)

SAMPLE DISPOSAL (Please indicate disposition of sample following analysis. Lab will charge for packing, shipping, and disposal.)

Return to Client ___ Disposal by Lab ✓

FOR LAB USE ONLY

Received By ___ Date/Time ___

WHITE - Original, to accompany samples
YELLOW - Field copy

* Analyze for indicated list, Lab notified 1-21-91 JRT

INTERNATIONAL TECHNOLOGY CORPORATION

REQUEST FOR ANALYSIS

R/A Control No. 179880
C/C Control No. 105428

PROJECT NAME Sky Harbor ANG
PROJECT NUMBER 409721
PROJECT MANAGER Don Willen
BILL TO IT Corp
312 Directors Drive
Knoxville, TN 90701
PURCHASE ORDER NO. Contact D. Willen

DATE SAMPLES SHIPPED 1/18/91
LAB DESTINATION Cerritos, CA
LABORATORY CONTACT Cheryl Ferguson
SEND LAB REPORT TO Don Willen
DATE REPORT REQUIRED
PROJECT CONTACT J. Tyburski
PROJECT CONTACT PHONE NO. 602-275-1325

	Sample No.	Sample Type	Sample Volume	Preservative	Requested Testing Program	Special Instructions
	QC-FB1	Water	1-Liter Amber	NA /4°C	Organic Lead	
	QC FB1	Water	2-40ml glass	HCL /4°C	VOA	
	QC-FB1		2-40ml glass	HCL /4°C	Vinyl chloride	
	QC-FB1		1-liter amber	4°C	Extractable Organics	
	QC FB1		1-liter poly	HNO_3 /4°C	Metals (except Merc)	
	QC-FB1		1-liter poly	HNO_3 /4°C	Mercury	
	QC-FB1		1 liter amber	HCL /4°C	TPH	
*	QC FB1		1 40ml glass	HCL /4°C	BTX, TCA, TCE, DCE	
	QC FB1		1 500ml poly	H_2SO_4 /4°C	Nitrate/Nitrite	
	QC FB1-TB		2-40ml glass	HCL 4°C	Trip Blanks VOA	

TURNAROUND TIME REQUIRED (Rush must be approved by the Project Manager.)

Normal ✓ **Rush** ____ (Subject to rush surcharge)

POSSIBLE HAZARD IDENTIFICATION: (Please indicate if sample(s) are hazardous materials and/or suspected to contain high levels of hazardous substances)

Nonhazard ✓ **Flammable** ____ **Skin Irritant** ____ **Highly Toxic** ____ **Other** ____ **(Please Specify)**

SAMPLE DISPOSAL (Please indicate disposition of sample following analysis. Lab will charge for packing, shipping, and disposal.)

Return to Client ____ **Disposal by Lab** ✓

FOR LAB USE ONLY

Received By ____ **Date/Time** ____

WHITE - Original, to accompany samples
YELLOW - Field copy

* Cancelled SRT 1-21-91, Lab notified.

Fr.
3-22-91

Weather: Clearing today 50°F calm in AM. Afternoon partly cloudy, 65°F, calm

IT Personnel: M. Gardiner, D. Schamp, B. Wilkins, J. Tyburski

Visitors: MMES - D. Bunn, F. Lebow

Layne - D Peterson, B. Shrum, W. Williams, M Phillips

- Arrive at Base at 0630. MMES visitors arrive at 0715. Tailgate Safety Mtg. held w/ IT & MMES.

- Contacted Marla Miller (Cerritos) to verify receipt of samples shipped 3-21-91. Directed Marla to analyze MBS-04-99-01 for TPH, TOB, VOA, & SVOA

- Drilled and sampled well MW3-01. Sampled well to 70ft, drilled to total depth of 100ft., set screen and well casing.

- Collected three samples of spoils, one each from well PS-1, PS-2, and PS-3. Samples shipped on Fed Ex waybill no. 0144320120.

- Collected equipment rinsate sample no. QC-ER14 from sampler at well MW3-01. Sample shipped on above waybill.

Mon
3-25-91

Weather: Overcast 55°F in AM; PM clearing, 75°F

IT Personnel: M. Gardner, B. Wilkins, D. Schamp,
J. Tyburski

Visitors: Layne - D. Peterson, W. Williams, M. Phillips
MMES - D. Bunn

- Arrive at Base at ~~08~~ JT 0630.

- Contacted Marla Miller (Cerritos) to verify receipt of samples shipped Friday. Instructed Marla to run sample MB3-01-50-51½-01 for VOA, SVOA, TOPb, & TPH.

- Notified Lab to expect large number of samples collected Sat, Sun, & Mon for Tues delivery.

- Completed drilling and sampling soil boring SB3-04 to approx. 74 ft. Completed drilling and sampling SB3-03 to approx. 73 ft.

- Spoke with Steve Sares about various sampling issues at site:
  - Third soil boring at site 3 will be last one
  - Five poly tanks on site will be sampled for VOC & TPH for disposition of water.
  - Piezometer PS-2 will be sampled and analyzed for Site 3 parameters.

Tues
3-26-91

Weather: AM 5-10 mph, intermittent heavy rainy;
clearing PM interment drizzle 60°F

IT Personnel: M. Gardiner, B Wilkins, D. Schamp, J. Tybrak.

Visitors: W. Williams, D. Peterson, M. Phillips, Sugg,
O. Delaughter.

- Arrive at Base at 0630.

- Verified receipt of large sample shipment with Marla Miller (IT-Cerritos). Directed Marla to analyze sample SB3-03-10-11½-01,02 for VOA, SVOA, TOPb and TPH.

- Notified Marla Miller (IT-Cerritos) of error in samples shipped yesterday. Sample SB3-04-15-16½-01 was included in shipment but was not noted in RFA or Chain of Custody. Sample will be analyzed for VOA, SVOA, TOPb, & TPH. (Reference - Telecon JRT to Marla Miller 3/26/91).

- Developed monitor well MWS-04 by surging, bailing, and pumping. Purged approx 210 gallons from well. Well developed strong hydrocarbon odor, suspect approx 0.01 ft of PSH in well.

- Terminated well development do to weather conditions; will resume Wednesday.

- Depart Base at 1815 for Fed Ex. Boyd & Gardiner depart Base at 1900.

Thurs
4-4-91

Weather - AM - clear, high clouds 65°F, PM - slight breeze, 94°F.

IT Personnel - J. Boyd, M. Gardiner, J. Tyburski

- Arrive at Base at 0630. Prep materials and truck for sampling at Site 4 (Papago).

- Arrived at Site 4 at 0830 and set-up at well MW4-01. Well was bailed dry within approx. 1hr. Returned 5hrs later and were able to pull an additional ½ gallon. Total volume purged approx. 13 gallons, one well volume for current water level. Will discuss with IT Knoxville as to procedure for sampling this very slow producing well.

- Purged and sampled well MW4-02. This sample and samples identified 43-91 were shipped Fed Ex on waybill no. 0098749770.

- Collected bailer equipment rinsate no. QC-ER20 and shipped on above waybill no.

Notified Kim Luisy - IT - Middlebrook Lab of samples to expect Friday.

Replaced air compressor's located 'in-line' filter to help reduce clogging of pump piston

Notified by Middlebrook Lab that Friday samples received Saturday were at 10-17°C. Procedure will be changed to use an ice bath in coolers to help chill samples before refrigeration.

Depart site at 1700.

Tues
4-9-91

Weather: AM- Clear, calm 62°F PM- 92°F
IT Personnel: S. Boyd, M. Gardiner, J. Tyburski

Arrive at Base at 0630. Prep equipment for purging by bailer and sampling PS-2. One well volume will be removed from well based on discussion of S. Sares and B. Stanley (Hazwrap).

Telecon from S Sares - Notified that all previous samples (except for samples shipped Mon 4-8) were 6-8°C above specified 4°C. Hazwrap has directed all previous wells to be resampled. If samples cannot be chilled adequately they will be held overnight in refrigerator. Measured refrigerator with electronic temp probe, at 4.6°C which is fairly close. Turn refrigerator down slightly.

INTERNATIONAL TECHNOLOGY CORPORATION

NONCONFORMANCE REPORT

NR NO. 4

PROJECT AZANG Sky Harbor

PAGE ____ **OF** ____

PROJECT NO. 409721

DATE: 03/04/91

1. NONCONFORMANCE DESCRIPTION

Problem: No sensitivity of PID detector for TCA, after finding that TCA and DCE are not co-eluding as originally thought.

Criteria: Scope of work required analysis of samples and reporting contamination concentration for TCA.

Impact: Reported concentration for DCE will change along with detection limits; will not be able to report confident TCA values.

IDENTIFIED BY: **DATE:** 02/02/91

2. PROPOSED CORRECTIVE ACTION, INCLUDING INITIATION AND COMPLETION DATES

Continue program on present course, at end of project re-intergrate DCE values. review FID response for TCA and see if its possible to determine TCA concentration from FID.

TO BE PERFORMED BY: 02/21/91 - 03/04/91

3. APPROVAL FOR PROPOSED CORRECTIVE ACTION

Project Manager **Date** 2/21/91

Quality Assurance Manager **Date** 2/22/91

4. CORRECTIVE ACTION TAKEN (IF DIFFERENT FROM THAT PROPOSED)

Same as above. DCE values were reintergrated and corrected values reported, TCA detection limit for FID was high and resulting curve was poor and inconsistant. Results reported with unique qualifier.

5. CORRECTIVE ACTION COMPLETE

PERFORMED BY: **DATE:** 03/04/91

VERIFIED BY: **DATE:** 1/21/91

CC: **PROGRAM MANAGER**

PROJECT MANAGER

QUALITY ASSURANCE MANAGER

QUALITY ASSURANCE COORDINATOR

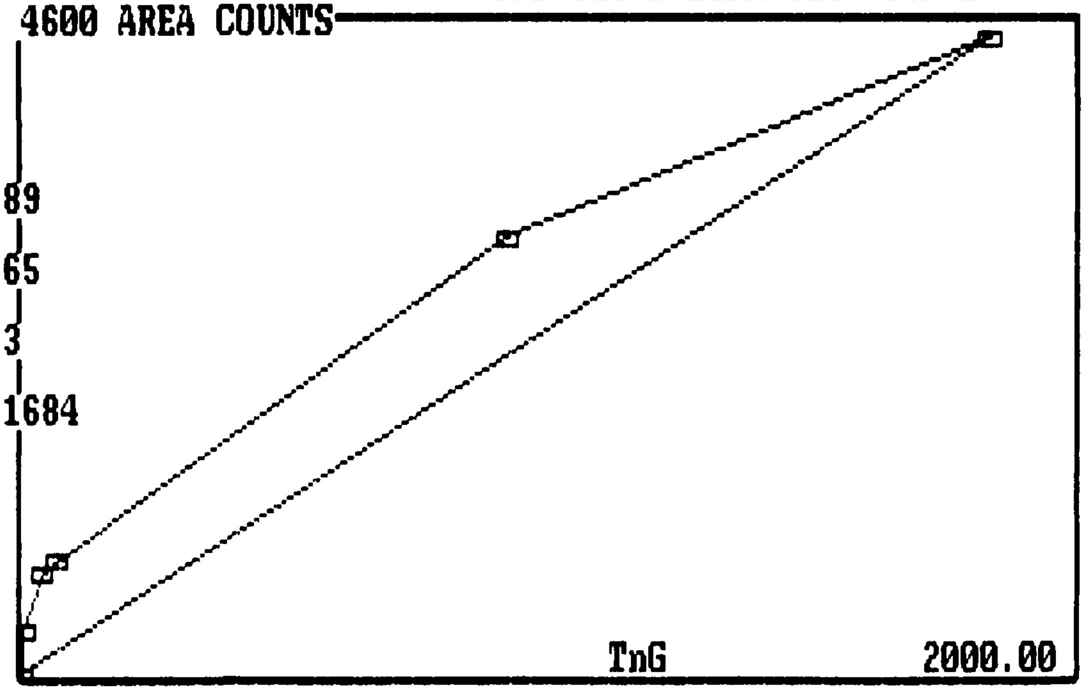
CENTRAL FILES ____________

OTHER: ____________

03/04/91
curve
DCE only

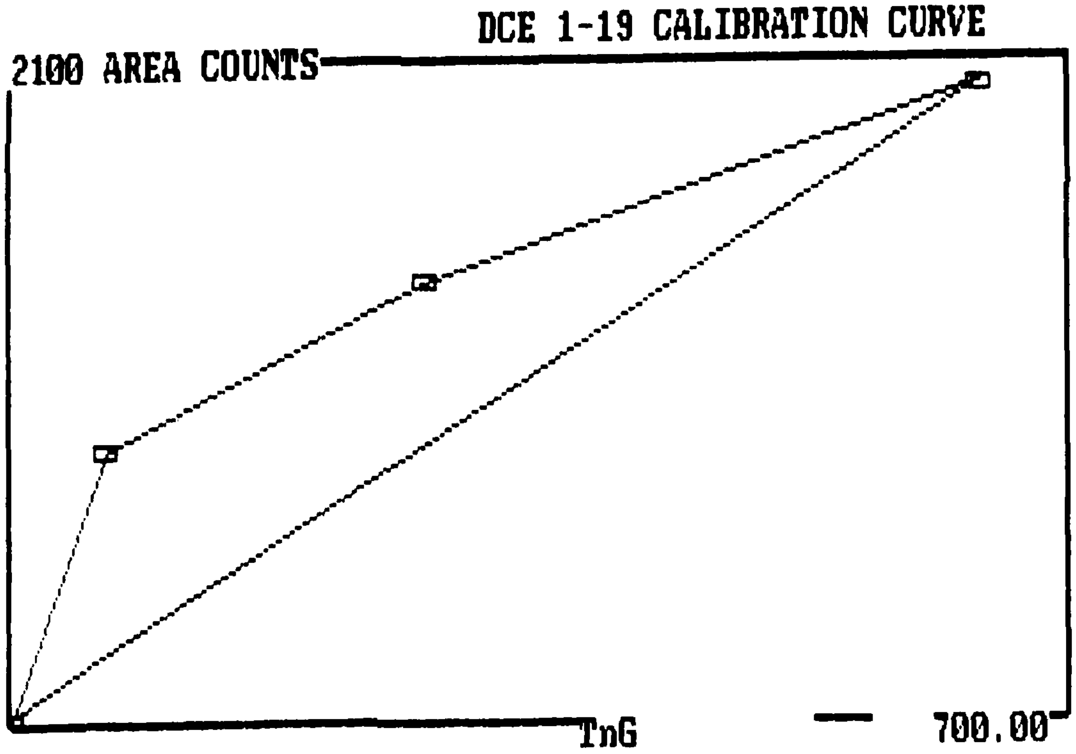
	AMOUNT	AREA	SLOPE	Y-INT
1)	1	300	%300.0	0
2)	36.8	691.47	10.9	289
3)	64.4	786.56	3.4	565
4)	920	3087.6	2.7	613
5)	1840	4491.47	1.5	1684
6)	0	0	2.4	0
7)	0	0	2.4	0
8)	0	0	2.4	0

DCE III CALIBRATION CURVE



01/19 curve
DCE + TCA

1)	64.4	862.79
2)	276	1401.95
3)	644	2037.09
4)	0	0
5)	0	0
6)	0	0
7)	0	0
8)	0	0



APPENDIX B

PRELIMINARY REVIEW OF HYDROGEOLOGIC DATA FOR FACILITIES ADJACENT TO SKY HARBOR AIR NATIONAL GUARD BASE

INTERNATIONAL
TECHNOLOGY
CORPORATION

Memorandum

To: Don Willen, Project Manager
Date: September 18, 1990

From: Steve Sares, Principal Hydrogeologist SWS

Subject: Preliminary Review of Hydrogeologic Data for Facilities Adjacent to Sky Harbor Air National Guard Base

I. INTRODUCTION

In accordance with your request, I have prepared a brief summary of data collection activities and analysis of hydrogeologic data for facilities adjacent to the Sky Harbor Air National Guard facilities at the Phoenix, Arizona Airport (the Base). These activities and preliminary conclusions regarding the hydrogeology of the vicinity are presented below.

The goal of this data collection and review effort is to aid in determining appropriate monitoring-well placement and design specifications for wells to be installed during the Base Site Investigation (SI). As you are aware, there has been much discussion of appropriate depth, screen interval, and location for the SI monitoring wells.

Data collection activities for this task were conducted between July 9 and 11, 1990 and consisted of locating and obtaining available potentiometric records for facilities generally within one and one-half miles of the Base. Field activities such as verification of well locations or measurement of water levels were not conducted during data collection activities. All findings presented below are based on the assumption that data collection, reduction, calculation, and presentation contained in the records are accurate and complete. Records were obtained from the following agencies:

City of Phoenix Environmental Services Department

Arizona Department of Environmental Quality (ADEQ)

Arizona Department of Water Resources (ADWR)

In addition, a Remedial Investigation report was located at a public library which contained hydrogeologic information relevant to the Air National Guard facilities at the Papago Military Reservation (Papago). The sources of information and relevant hydrogeologic information are further discussed below.

II. DATA SOURCE BIBLIOGRAPHY

Six primary sources of information were identified and evaluated in this effort. Selected pages of reports and files were extracted and copied from the sources listed below:

A. Summary of the Phase II Site Investigation for the City of Phoenix at the West Sky Harbor Fuel Storage Facility and Vicinity, Phoenix Sky Harbor International Airport, Phoenix, Arizona. (May 31, 1990), Groundwater Technology, Inc. Received from Mr. Donn Stoltzfus, City of Phoenix.

B. ADEQ files for Avis Sky Harbor, ADEQ File No. 4715.122. Received from Mr. Douglas Jamison, ADEQ.

C. ADEQ files for Garrett General Aviation Services Division, ADEQ File No. 4715.355. Received from Mr. Douglas Jamison, ADEQ.

D. Draft Remedial Action Plan for Del Rio Landfill, City of Phoenix, Arizona (February 23, 1990), Dames and Moore. Received from Mr. Donn Stoltzfus, City of Phoenix.

E. Estes Landfill Hydrogeology. Received from Mr. Donn Stoltzfus, City of Phoenix.

F. Remedial Investigation Report, 52nd Street RI/FS, Phoenix, Arizona for Motorola, Inc. (June 1987), Dames and Moore. Copy at Saguaro Library, Phoenix, Arizona.

In addition to the above referenced documents, several others were reviewed and received from the agencies listed above. Information in the additional documents either duplicated information presented below or are for facilities remote from the Base. Mr. David Annis of the ADWR also provided much valuable discussion regarding facilities and history of hydrogeologic investigations in the area adjacent to the Base.

II. FINDINGS

Results of the hydrogeologic investigation at the Sky Harbor fuel facilities (Reference A) are likely to be directly applicable to the SI as the fuel facilities are located approximately 4,300 feet (0.8 miles) from the center of the Base on a bearing of fifty degrees west of north (N 50 W). These findings are summarized below.

Five monitoring wells, 90 feet deep, were installed at the site in March and April 1990. The water level in each well is approximately 71 feet below grade or at an elevation of 1,038 to 1,036 feet above Mean Sea Level (feet MSL).

Detailed casing elevations and depth to water were not included in the information provided, however, a site gradient map indicates a due westerly groundwater flow direction at a gradient of approximately 0.002 or 10.9 ft per mile.

Lithologic logs indicate mixed, unindurated alluvium at the site consisting generally of sand to silt in the 0-5 foot depth interval, sand to pebbles in the 5-15 foot interval, and sand to cobbles below 15 feet.

Avis Car Rental facility at Sky Harbor is conducting an investigation for a fuel release (Reference B). The Avis facility is located approximately 7,600 feet (1.4 miles) from the center of the Base on a bearing of N 82 W. Findings from these files are summarized below.

The depth to water, measured on 24 Nov 87 ranges from 61.26 to 64.51 feet below the surface, this corresponds to an approximate elevation of 1,035 to 1,039 feet MSL.

The groundwater flow direction at the site is generally west with the flow direction diverging to northwest and southwest west of the Avis site. Reports suggest that the divergence may be caused by an Arizona Department of Transportation (ADOT) dewatering project located in line with 21st Street between Buckeye Road and the Salt River.

The ADOT project was in operation at the time the material in the files was prepared (1987). At that time the dewatering system consisted of 11 wells each pumping at approximately 1,500 gallons per minute.

The U.S. Geological Survey (USGS) conducted a pump test during the dewatering project and determined the aquifer transmissivity (T) to be 194,000 GPD/ft, and hydraulic conductivity (K) to be 1,200 GPD/ft, using a saturated thickness of 150 feet.

Garrett General Aviation Services Division operates a facility located approximately 6,300 feet (1.2 miles) southwest of the center of the Base on a bearing of S 73 W. This facility is conducting an investigation for fuel and solvent release (Reference C). Findings from the Garrett files are summarized below.

> The depth to groundwater was measured to be approximately 55.5 to 57.9 feet below grade or at an elevation of 1,044 to 1,042 feet MSL on 5 Dec 88.
>
> Garrett has presented the groundwater flow direction to be northwesterly (N 36 W). The ADEQ disagrees with this interpretation and states that the ground water flow direction at Garrett is North 80 East. This direction is inconsistent with the regional flow direction as indicated by all other references from the area. I have reviewed the available potentiometric data at Garrett and the flow direction, based on three-point solutions ranges from N 15 W to S 36 E depending on the combination of wells used. Thus the data from Garrett appears inconsistent and should not be relied upon for the Base SI.

The City of Phoenix owns a landfill located approximately 14,600 feet (2.8 miles) southwest of the Base on a bearing of S 74 W. This landfill is called the Del Rio or 16th Street landfill and it is located on the south edge of the Salt River (Reference D). Findings from the files are presented below.

> Depth to groundwater is typically 35 to 40 feet below ground level or at an elevation of 1,045 to 1,040 feet MSL.
>
> Water levels in wells have demonstrated fluctuation of up to 28.7 feet in a single well over a period of ten years. The peak water level (all wells) was 1,055.6 feet MSL (approximately 24 feet below ground level). The minimum water level over the same period was 1,020.51 feet MSL (approximately 59.5 feet below ground level).
>
> Hydrographs for monitoring wells over the period from 1979 to 1990 indicate that water elevations in wells in the period 1986 to 1990 are at the lower end of the range (1,025 to 1,045) while during the period 1983 to 1986 they were in peak ranges (1,055 to 1,045). In general, water levels in these wells have declined approximately 20 feet from the 1983 peaks to the 1990 lows or an average of 2.8 feet per year. Prior to the 1983 peak levels, water levels were in the 1,030 foot range as late

as 1982. Water levels in monitoring wells demonstrate a strong correlation to flows in the Salt River, thus a continued decline in water levels cannot be projected.

Reference D provided several potentiometric maps for the Del Rio Landfill. These maps were prepared by the authors of the report by unknown means. Based on the maps presented, the groundwater flow direction averages a bearing of N 60 W (300 degrees azimuth) for nine maps presented in the report under dry river conditions. One potentiometric map representing conditions of flow in the river was also presented, the groundwater flow direction in this case was S 57 W (213 degrees azimuth).

The City of Phoenix also owns another landfill southeast of the Base. The Estes Landfill is located approximately 6,500 feet (1.2 miles) from the Base on a bearing of S 82 E (Reference E).

Depth to water at the Estes Landfill is typically 40 to 60 feet below ground level or at an elevation of 1,080 to 1,060 feet MSL.

Water levels in monitoring wells also fluctuate in association with flow in the River at the Estes Landfill. The maximum fluctuation observed in a single well over a period of seven years is 43.77 feet. The peak groundwater elevation in all wells is 1,111.5 feet MSL (approximately 20 feet below ground level). The minimum water level in all wells was 1,038.63 feet MSL (84 feet below ground level.

Potentiometric data from shallow and deep wells suggest a downward vertical gradient at the Estes Landfill, however, lack of well specifications in the information presented prohibits and analysis of the vertical gradient conditions.

The groundwater flow direction from prepared maps reviewed averages S 83 W during dry conditions in the river. One map presented for streamflow conditions depicts a groundwater flow direction of S 51 W.

The Motorola facility is located approximately 3000 feet (0.6 miles) on a bearing of S 15 W from ANG facilities at the Papago Military Reservation. Findings from review of Reference F are presented below.

Depth to water at the Motorola facility is approximately 22 feet below the ground level or at an elevation of 1,198 feet MSL.

Hydrograph records for well DM101 (nearest to Papago) indicate a maximum fluctuation of five feet, primarily in response to precipitation, The peak water level in this well was 17.5 feet below the top of casing and the minimum measured was 23 feet below the top of casing.

Groundwater flow direction in the shallow portions of the aquifer is approximately S 70 W.

Alluvium overlies volcanic bedrock to a depth of approximately 26 feet. The alluvium thins to the north and west and may be thinner at ANG facilities at Papago.

III. DISCUSSION AND CONCLUSIONS

A. MONITORING WELL SCREEN INTERVAL

Sky Harbor

The Base is located in an area with ground elevation of approximately 1,110 feet MSL. The current monitoring well design calls for 50 feet of screen to be placed 30 feet below the ambient water table and 20 feet above the water table.

Data from the Sky Harbor fuel facility investigation and other sites in the area suggest that the water table will be encountered at a depth of approximately 70 feet below the surface or at an elevation or 1,040 feet MSL. This configuration will require soil borings to be extended to approximately 100 feet below the ground surface for well construction. The well bottom will be located at an elevation of approximately 1,010 feet MSL and the top of the screen interval will be approximately 50 feet below ground or 1,060 feet MSL.

Using data from the Del Rio Landfill (Reference D) during periods of prolonged flow in the Salt River, water levels may be expected to rise as much as 20 to 25 feet. Assuming a 20 foot rise in the water table due to flow in the river, the water table elevation at the Base would be approximately 1,060 feet MSL. This is at the level of the top of screen in proposed monitoring wells. Based on this scenario, it may be prudent to set the top of screen at an elevation of 1,065 or 25 feet above the expected water table.

A screen length of 50 feet would place the bottom of the well at 1,015 feet or 25 feet below the expected water table. Assuming five feet of saturated well are required for representative samples to be collected, the water table could go as low as 1,020 feet and the wells would remain useful. This is approximately the lowest level recorded at any of the surrounding areas, the 1,020 level also represents over seven years of useful life at an average water table decline rate of 2.8 feet per year. The 50-foot-long screen proposed should be adequate for the objectives of the SI and future use.

Papago

The current proposed monitoring well design for Papago wells is the same as the wells designed for the Base; thirty feet of screen to be placed within the water table. Given the information presented in Reference F, above, it is likely that upon completion of piezometers at Papago and measurement of water levels, it will be desirable to modify the screened interval to allow 15 feet below and five to ten feet above the water table. This interval should be sufficient to accommodate anticipated water-level fluctuations.

B. MONITORING WELL PLACEMENT

Sky Harbor

Proposed monitoring well locations for the Base SI were developed assuming a westerly (N 90 W) groundwater flow direction. The possibility of significant deviation from this direction motivated the collection of existing data to verify the assumption of westerly groundwater flow.

Because the potentiometric data obtained during this effort were not collected from a single point in time, they cannot be used in preparation of an area potentiometric map, therefore accurate prediction of groundwater flow direction for the base cannot be made.

Generally, published groundwater flow directions are in a westerly (S 83 W) to northwesterly (N 60 W) direction during no-flow conditions in the Salt River. The exceptions to this condition are during flow in the river and one combination of water levels at the Garrett Aviation facility. Groundwater flow direction during river flow is discussed below. The Garrett data are inconsistent, using the same four data points groundwater flow direction variation of

140 degrees can be obtained. It is advisable not to utilize this data in placement of SI wells unless separate conformation of easterly flow directions can be made.

The available data indicate that during periods of river flow, the groundwater gradient on the south side of the river is in a southwesterly direction (S 57 W to S 51 W). It follows, assuming flow in the river creates a mound in the water table coincident with the axis of the river, that the groundwater flow direction north of the river would be in a northwest (N 57 W to N 51 W) direction during periods of river flow.

Using the above discussion it is reasonable to assume that groundwater flow direction around the Base is primarily westerly, with a maximum northerly component of 30 degrees north of west during no-flow in the river and a maximum northerly component of 39 degrees during periods of flow in the river. Given this analysis it is recommended that the initial plan of piezometer installation and flow direction determination prior to well placement be adhered to for the SI. It may be prudent to periodically measure water levels in elevation-surveyed wells from surrounding facilities to develop an area potentiometric map during the SI. Any offsite monitoring should be limited to facilities within a one and one-half to two mile radius of the Base.

Papago

Proposed monitoring well locations for Papago were developed assuming a westerly groundwater flow direction. Should piezometric information agree with the data contained in Reference F, indicating a southwesterly flow direction, it may be desirable to relocate well MW4-03 to the west side of Building 112. However this determination should be postponed until site-specific potentiometric data are available.

APPENDIX C

GEOPHYSICAL SURVEY REPORT

GEOPHYSICAL INVESTIGATION

161 AREFG
SKY HARBOR IAP
PHOENIX, ARIZONA

PROJECT NO. 409721

PREPARED BY:

IT CORPORATION
17461 DERIAN AVENUE, SUITE 190
IRVINE, CALIFORNIA 92714

SEPTEMBER 1991

Table of Contents

List of Figures ii

1.0 Introduction 1

2.0 Field Procedures 1

- 2.1 Geophysical Clearance 2
- 2.2 Geophysical Survey: Site 5 - Ammunition Disposal Area 2

3.0 Data Processing and Interpretation 3

4.0 Discussion and Results 4

5.0 Conclusions 5

References R-1

Appendix A - Theoretical Background

Appendix B - Electromagnetic Induction Profiles

Appendix C - Sample Ground Penetrating Radar Records

List of Figures

Figures **Title**

1 Geophysical Survey Area

2 Geophysical Interpretation Map

GEOPHYSICAL SURVEY

1.0 Introduction

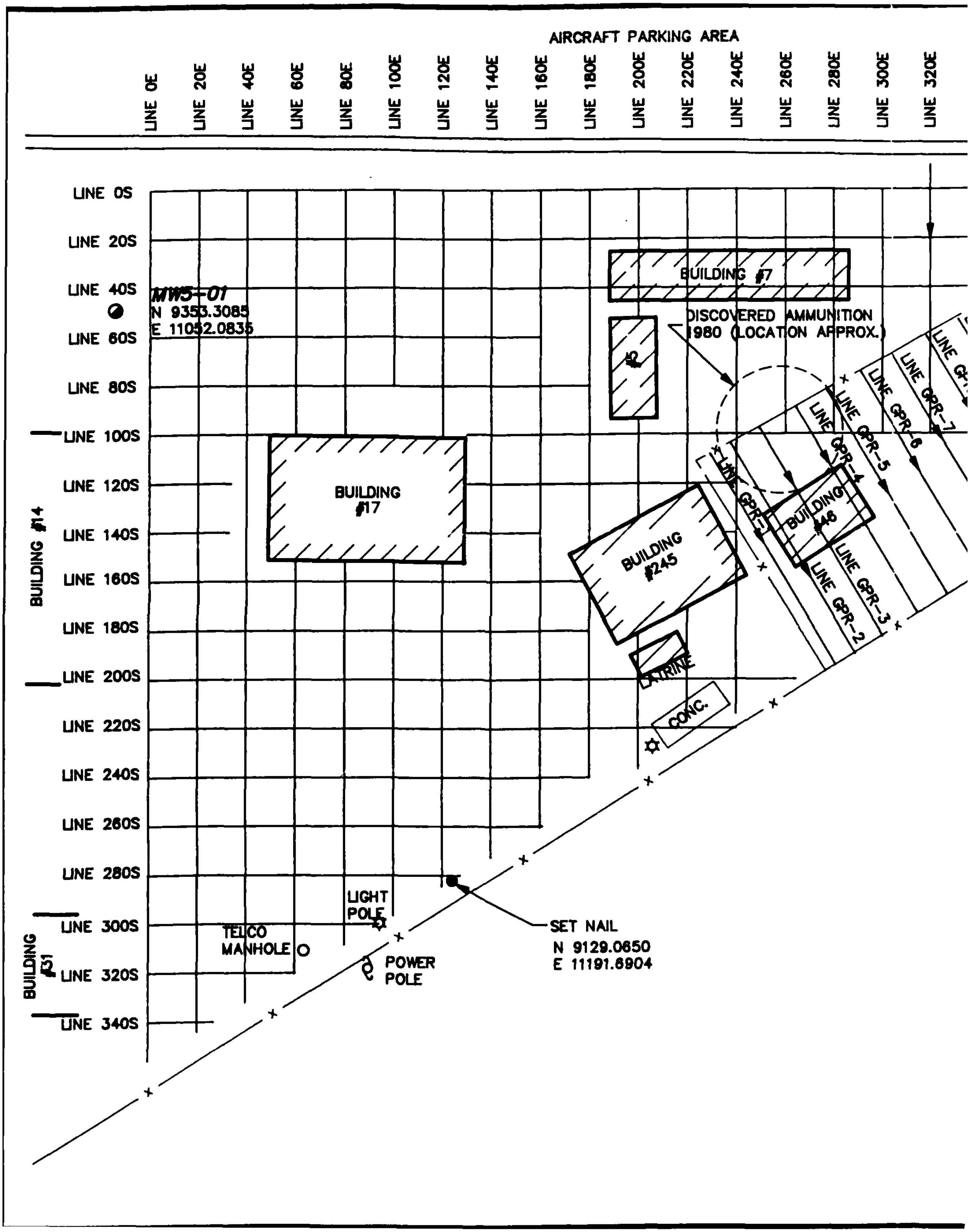
A geophysical survey was conducted from December 13 to 23, 1990 at Sky Harbor International Airport (IAP) in Phoenix, Arizona. The survey was conducted in two phases. The first phase involved the geophysical clearance of all proposed soil organic vapor (SOV) sampling points and soil boring and monitoring well locations of underground pipelines and utilities at Site 1 (JP-4 Hydrant Area), Site 2 (Hazardous Waste Storage Area), Site 3 (Fuel Bladder Area), Site 4 (107TCS Hazardous Waste Collection Area), and Site 5 (Ammunition Disposal Area). Electromagnetic (EM) utility locators and ground penetrating radar (GPR) methods were used during this phase of the investigation.

During the second phase of the geophysical investigation, EM and GPR surveys were conducted at Site 5 to locate buried ammunition. In 1980, live 50-caliber ammunition was discovered in excavations during installation of a closed circuit television (CCT) system (AZANG, 1990). Ammunition was found in two areas shown in Figure 1. The Preliminary Assessment (PA) reported that ammunition was found at depths ranging from 6 to 8 feet at a location approximately 50 feet south of the CCT trench locations (HMTC, 1988).

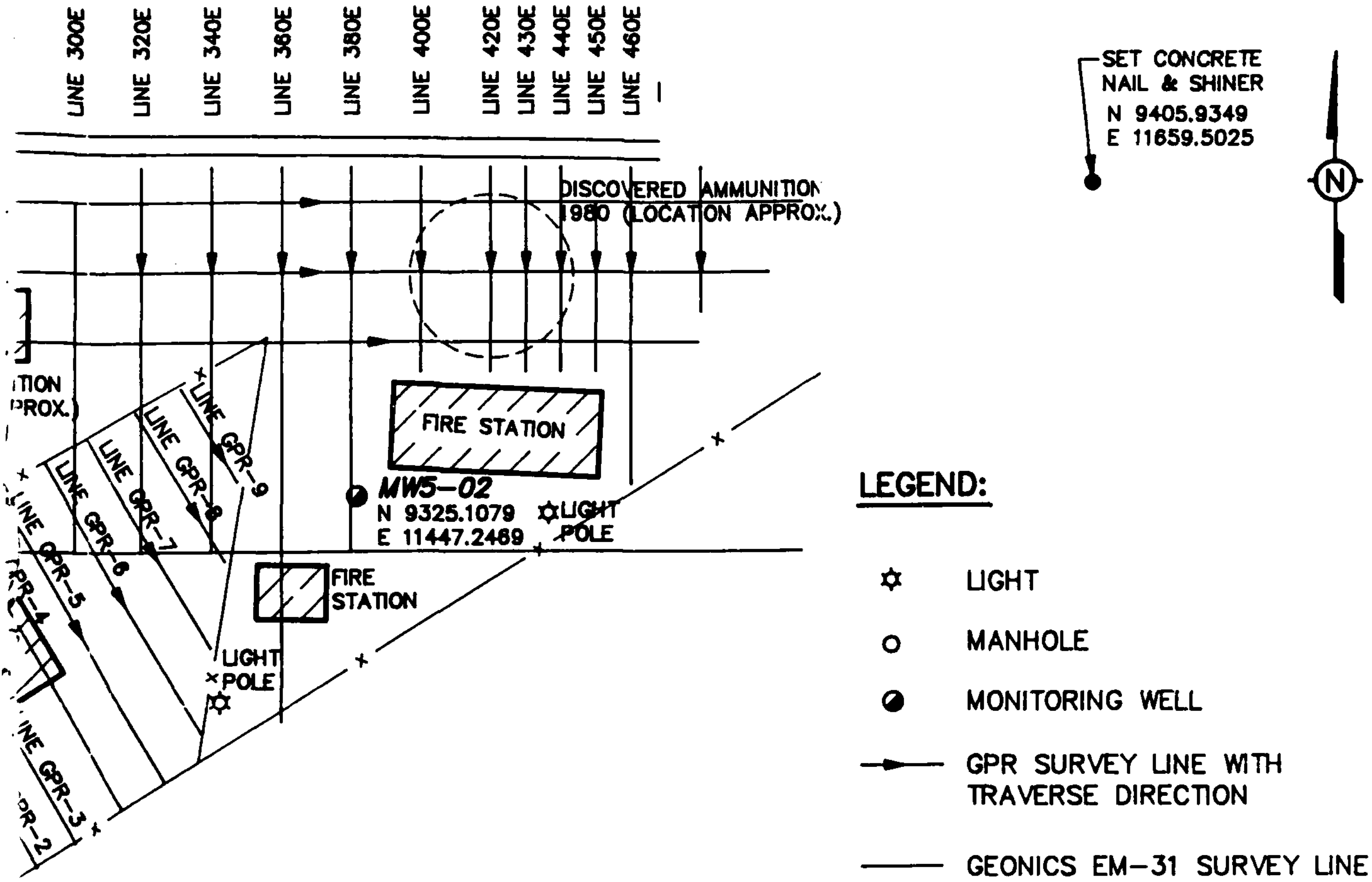
The locations of the Site 5 EM and GPR surveys are shown in Figure 1. Several modifications to the original survey design were necessary based on unanticipated field conditions. As originally planned, magnetic and EM surveys were to be the primary means of locating buried ammunition with the use of GPR restricted to problem areas or areas requiring additional data. However, due to the abundance of surface structures, vehicles, and underground utilities, EM surveying was conducted only in areas relatively uncongested with metallic material. The magnetic survey was not performed because of interference from unwanted sources over much of the area of the site. As a consequence, GPR was used as the primary exploration tool. In addition, the EM survey was extended 130 feet to the west to include a more open area approximating background soil conductivity conditions.

2.0 Field Procedures

This section describes the field procedures used for the geophysical clearance and the



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
LINE 320E
LINE 0S
LINE 20S
LINE 40S
LINE 60S
LINE 80S
LINE 100S
LINE 120S
LINE 140S
LINE 160S
LINE 180S
LINE 200S
LINE 220S
LINE 240S
LINE 260S
LINE 280S
LINE 300S
LINE 320S
LINE 340S
MW5-01
N 9353.3085
E 11052.0835
BUILDING #7
#2
DISCOVERED AMMUNITION
1980 (LOCATION APPROX.)
BUILDING #17
BUILDING #245
BUILDING #46
LATRINE
CONC.
BUILDING #14
BUILDING #31
LINE GPR-1
LINE GPR-2
LINE GPR-3
LINE GPR-4
LINE GPR-5
LINE GPR-6
LINE GPR-7
LINE GP
LIGHT POLE
TELCO MANHOLE
POWER POLE
SET NAIL
N 9129.0650
E 11191.6904



LEGEND:

✡	LIGHT
○	MANHOLE
●	MONITORING WELL
—►—	GPR SURVEY LINE WITH TRAVERSE DIRECTION
——	GEONICS EM-31 SURVEY LINE

SCALE:

0 50 100 FEET

FIGURE 1

SITE 5-AMMUNITION DISPOSAL AREA GEOPHYSICAL SURVEY AREA

161 AREFG, ARIZONA ANG
SKY HARBOR IAP
PHOENIX, ARIZONA

IT INTERNATIONAL TECHNOLOGY CORPORATION

SI REPORT

DRAWING NO.: H3971B-B-C22

PROJ. NO.: H3971B

INITIATOR: S. SARES

PROJ. MGR.: D. WILLEN

DRAFT. CHCK. BY: J. HUBBARD

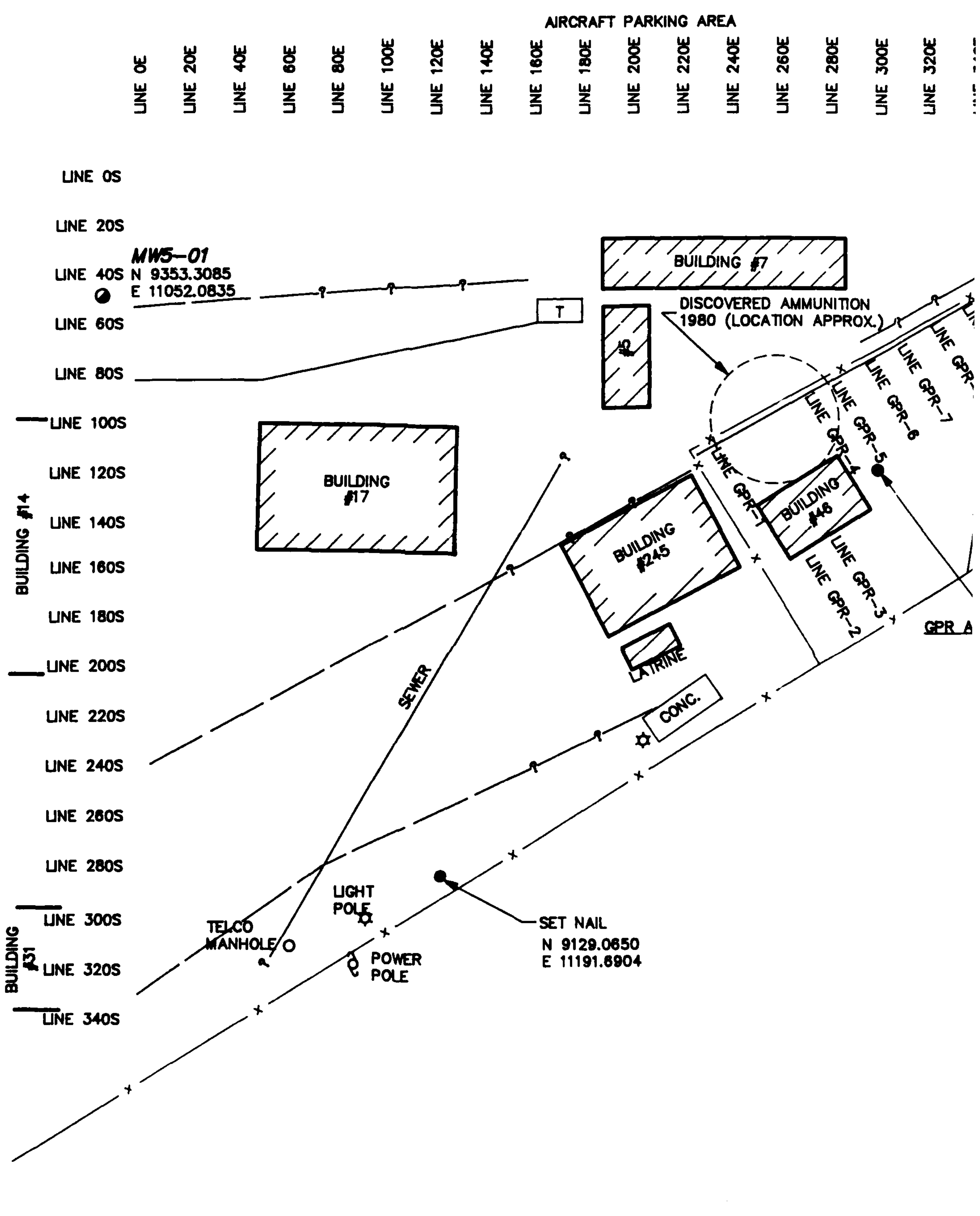
ENGR. CHCK BY: S. SARES

DATE LAST REV.:

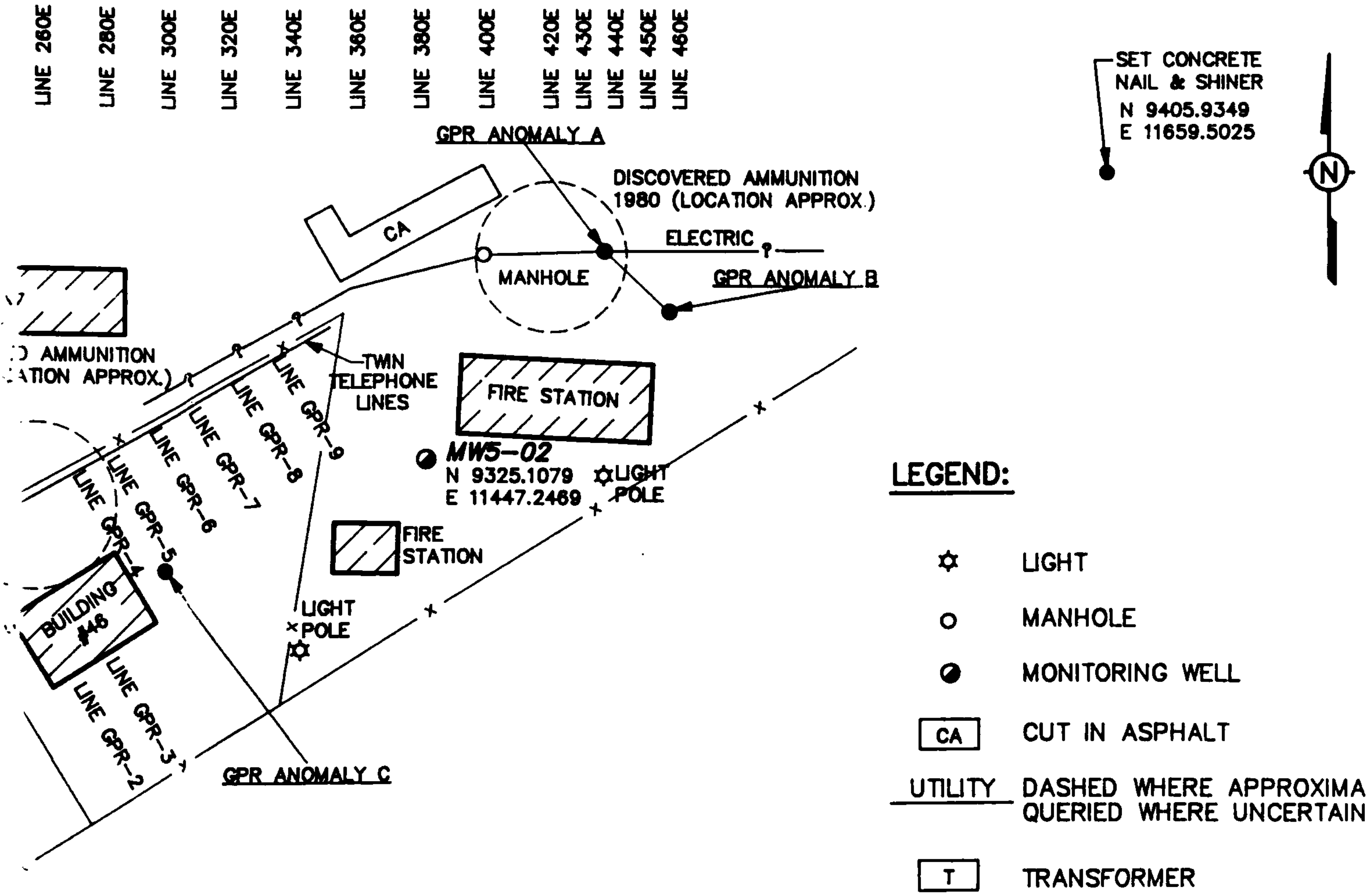
DRAWN BY:

STARTING DATE: 06/24/91

DRAWN BY: G. PACHECO



H3971B02 08/17/91 3:32pm SAT



LEGEND:

☼	LIGHT
○	MANHOLE
◐	MONITORING WELL
CA	CUT IN ASPHALT
UTILITY	DASHED WHERE APPROXIMATE, QUERIED WHERE UNCERTAIN
T	TRANSFORMER

SCALE:

0 50 100 FEET

FIGURE 2

SITE 5–AMMUNITION DISPOSAL AREA GEOPHYSICAL INTERPRETATION MAP

151 AREFG, ARIZONA ANG
SKY HARBOR IAP
PHOENIX, ARIZONA

INTERNATIONAL
TECHNOLOGY
CORPORATION

geophysical survey at Site 5 (Ammunitions Disposal Area). A Geophysical Survey Systems, Inc. (GSSI) Subsurface Interface Radar System 10, which was equipped with 120-, 300-, and 500-MHz monostotic antennae, a Radio Detection Model RD-400 electromagnetic cable locator, and a Metrotech Model 810 pipe and cable detector were used during the geophysical clearance phase. The GPR unit and a Geonics EM-31DL (EM-31) with a digital data logger were used during the geophysical surveys at Site 5. Detailed equipment descriptions and supporting theory are included in Appendix A.

2.1 Geophysical Clearance

Geophysical field procedures used to clear drilling locations of subsurface obstructions are described in this section. First, all utilities near the drilling point evident from utility maps and visual observation were traced by placing the Metrotech or RD-400 transmitter on the line, delineating the line using the receiver, and marking it on the ground surface using orange surveyor's paint. Individual drilling locations were then cleared by holding the transmitter on the line and circling with the receiver at a radius of approximately 40 feet. When a line was located using the receiver, the transmitter was relocated to that point and the line was traced and marked in the vicinity of the drill point. If a utility was found within approximately 3 feet of the drilling location, it was moved and the entire procedure repeated. Finally, in areas where nonmetallic pipes or large numbers of utilities were present, two perpendicular GPR profiles were conducted over the drilling point using the 120-, 300-, and/or 500-MHz antennae. If additional utilities were located within 3 feet of the drilling location, the boring was moved and the clearance procedures repeated.

2.2 Geophysical Survey: Site 5 - Ammunition Disposal Area

EM and GPR surveys were conducted at Site 5 to determine the possible location of buried ammunition disposed of during the 1950s.

To provide spatial control, a 20- by 20-foot grid was marked with surveyors paint in the area of interest. The location of the base grid relative to permanent site features is shown in Figure 1.

Readings of conductivity and in-phase component field strength, as measured by the EM-31, were collected at 5-foot intervals along both north-south and east-west lines spaced 20 feet apart. The locations of the EM survey lines are shown in Figure 1. Data were stored in a digital data logger and downloaded to a laptop computer at the completion of the survey. Many of the EM survey lines were conducted in segments due to buildings and other obstructions. For example, data were not collected in the Liquid Oxygen Storage Area (Building No. 46 and its perimeter) because of the adverse effects of the oxygen tanks and surrounding fences.

The GPR survey was concentrated in the vicinity of the Ammunition Dump and in the areas where ammunition was discovered during trench excavations in 1980. The locations of the GPR profiles are shown in Figure 1. All GPR profiles within the Liquid Oxygen Storage Area (Lines GPR-1 through GPR-9) were conducted with both the 300- and 120-MHz antennae. All other GPR profiles were conducted with only the 300-MHz antenna. All GPR data were stored on digital tape for later processing.

To allow an accurate interpretation of the geophysical data, the locations of all surface metallic objects were accurately plotted relative to the base grid as shown in Figure 2.

3.0 Data Processing and Interpretation

Computer-generated plots of the EM profiles are included in Appendix B. In-phase and conductivity anomalies were tracked from line to line when possible, or noted as single anomalies. Some portions of the data severely affected by buildings and vehicles were deleted before plotting.

Field mapping of surface metallic objects made it possible to distinguish anomalies caused by known sources from those caused by buried pipelines and other conductive objects. Contour maps of the EM data were not generated because a significant portion of the data was affected by buried objects and surface features.

Color plots of the GPR sections were made for interpretation, with a color scale proportional to the amplitude of the reflected signal. Two-way travel times were converted to depths using an assumed relative dielectric constant of five. Anomalies due to known sources, such as surface objects or buried pipes, are noted on the profiles. Examples of interpreted GPR sections are included in Appendix C.

4.0 Discussion and Results

The first phase of geophysical surveying involving geophysical clearance of subsurface obstructions to drilling resulted in the successful installation of all SOV probes, soil borings, and monitoring wells.

In the second phase of geophysical surveying, EM and GPR were used to assess the likelihood of additional buried ammunition at Site 5. The results of the EM survey are presented graphically in Appendix B and are summarized in Figure 2. After discarding in-phase and conductivity anomalies due to known sources, significant remaining anomalies were observed to exhibit continuity between parallel survey lines, and because of their linear character are interpreted to be caused by underground utilities.

GPR profiles are presented in Appendix C. Assuming a relative dielectric constant of five for geologic materials at Site 5, effective depth of penetration was approximately 5 feet for the 300 MHz antenna and approximately 12 feet for the 120 MHz antenna. Although the penetration depth of the 120 MHz antenna was significantly greater, its resolution was correspondingly lower then the 300 MHz model. In addition, the 120 MHz antenna was not shielded, and therefore was subject to signal interference from aboveground sources. An example of this can be seen in Figure C-4, in which a fence is responsible for a hyperbolic reflection between 75 and 90 feet. Because of these shortcomings, it is not likely that the 120 MHz antenna was capable of resolving containerized ammunition.

The anomalies observed on GPR profiles north of monitoring well MW5-02 were compared with known surface and subsurface features as shown in Figure 2. Two significant anomalies could not be related to known features. Anomaly A, shown in Figures 2 and C-2, is located at approximately 19 feet south on Line 440 east. This anomaly is traceable through several parallel survey lines, and its trace intersects a manhole located at the intersection of Lines 400 east and 20 south. Further, the depth of the anomaly is less than approximately 3 feet. There is little doubt that the source of the anomaly is an underground utility. Anomaly B (Figures 2 and C-2) is characteristic of a metal object very near the ground surface. A similar anomaly was caused by an iron manhole at the intersection of Lines 400 east and 20 south.

GPR surveys in the area north of monitoring well MW5-02 were apparently capable of resolving underground utilities down to several inches in diameter. Therefore, assuming that ammunition was containerized or buried in some other bulk fashion, it is likely its presence would be indicated in the GPR data to a depth of roughly 5 feet. The lack of unaccounted-for GPR anomalies is an indication that large concentrations of ammunition are not present in this location.

GPR profiles in the vicinity of Building 46, labelled GPR-1 through GPR-9 in Figure 1, were compared with known surface and subsurface features. Anomalies traceable across several records can be explained by the presence of features shown in Figure 2. For example, comparison of Figures 2 and C-4 demonstrates the hyperbolic signature of several underground utilities and the masking effect of the concrete-slab floor of Building 46.

No anomalies were found that strongly indicated the presence of buried ammunition near Building 46. However, as shown in Figure C-4, geologic layering below a depth of approximately 2 feet is apparently indistinct to nonexistent. This leads to two possibilities: (1) layering does not exist; this may be a natural condition or layering may be disturbed, (2) layering exists but was not resolved with GPR due to poor penetration or interference from known features. In considering the latter case, Figures C-1, C-2, and C-3 should be compared to Figure C-4. Figures C-1, C-2, and C-3 are radar profiles obtained along survey lines located approximately 150 feet northeast of Building 46 (Figure 1). Geologic layering in this area appears much more distinct than in the vicinity of Building 46; thereby lending support to the former possibility.

5.0 Conclusions

Two phases of geophysical surveying were conducted at Sky Harbor IAP using GPR and EM methods. The first phase of surveying involved geophysical clearance of drilling and SOV locations of subsurface obstructions. In the second phase of the survey, subsurface conditions were assessed for the presence of buried ammunition.

The geophysical clearance phase of work resulted in the successful installation of all borings, monitoring wells, and SOV sample points.

The results and conclusions of the second phase of the investigation are based primarily on GPR data. The EM data were of limited use because of the adverse effects of abundant surface and subsurface electrically conducting material not related to previous disposal operations.

Radar data in the vicinity of Building 46, the Liquid Oxygen Storage Area, did not provide direct evidence of buried ammunition. However, the apparent lack of layering in geologic materials within this area may be due to excavation and disruption during disposal operations.

Geologic layering appears more distinct in the survey area northwest of Building 46. This may be an indication that disposal has not occurred in this area. Further, no anomalous materials were apparent in the radar data to its approximately 5-foot depth limit, although underground utilities were clearly resolved in this same interval. This implies that buried ammunition, if present and of approximately the dimensions of a typical underground utility diameter, would be detected to a depth of approximately 5 feet.

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 any of the locations surveyed. Ammunition in any form may be present at depths greater than effectively sensed by radar. Finally, ammunition disposal occurring in discrete zones of dimensions smaller than the geophysical grid spacing of 20 feet may not have been crossed by a geophysical survey line and therefore could remain undetected.

References

Arizona Air National Guard, 11 July 1990, Memorandum to Martin Marietta Energy Systems (Map Attached).

Dobrin, M. B., 1976, ***Introduction to Geophysical Prospecting***, McGraw-Hill, New York.

Hazardous Materials Technical Center, July 1988, Preliminary Assessment, 161st Air Refueling Group, Arizona Air National Guard, Sky Harbor International Airport, Phoenix, Arizona.

Keller, G. V. and F. C. Frischknecht, 1966, ***Electrical Methods in Geophysical Prospecting. International Series in Electromagnetic Waves***, Vol. 10. Pergamon Press, Oxford, England.

Milson, J., 1989, ***Field Geophysics, Geological Society of London Handbook***, Open University Press, Milton Keynes.

Telford, W. M., L. P. Geldart, R. E. Sheriff, D. A. Keys, ***Applied Geophysics***, Cambridge University Press, Cambridge, England.

Ulriksen, C. P. F., 1982, "Application of Impulse Radar to Civil Engineering," Department of Engineering Geology, Lund University of Technology, Sweden.

APPENDIX A

THEORETICAL BACKGROUND

APPENDIX A
THEORETICAL BACKGROUND

A.1.0 Electromagnetic Induction

Electromagnetic (EM) induction equipment used during this investigation consisted of a Geonics EM-31DL terrain conductivity meter (EM-31) with an Omni digital data logger, a Metrotech Model 810 pipe and cable detector (Metrotech), and a Radio Detection Model RD-400 electromagnetic cable locator (RD-400).

The EM-31 has a transmitter and receiver coil mounted at each end of a 12-foot-long plastic boom. An audio-frequency alternating current is applied to the transmitter coil, causing the coil to radiate a primary EM field with a magnetic field vector parallel to the axis of the coils. This time varying magnetic field induces eddy currents in any conducting material in the subsurface as described by Faraday's Law on induction. These eddy currents have an associated (secondary) magnetic field with a strength and phase shift relative to the primary field that is dependent on the conductivity of the medium. The receiver coil measures the resultant effect of both primary and secondary fields. By comparing the signal at the receiver to that at the transmitter, the instrument is able to record the in-phase component (in-phase) and the component 90 degrees out of phase (quadrature) with the primary field.

Most geological materials are poor conductors, and the flow of current through the material takes place in the pore fluids (Keller and Frischknecht, 1966). Conductivity is predominantly a function of soil type, porosity, permeability, pore fluid ion content, and degree of saturation. The EM-31 is calibrated so that the out-of-phase component is converted to electrical conductivity in units of millisiemens per meter (mS/m) (McNeill, 1980). The in-phase component is read in parts per thousand (ppt) of the primary EM field and is generally adjusted in the field to read zero response over background materials.

The depth of penetration for EM induction instruments is dependent on the transmitter-receiver separation and coil orientation (McNeill, 1980). The EM-31 has an effective exploration depth of about 18 feet when operating in the vertical dipole mode (horizontal coils). In the absence of large metallic features such as tanks, drums, pipes, and reinforced concrete, the maximum instrument response results from materials at about 3 to 5 feet below ground surface. A single buried drum typically can be located to depths of about 5 feet whereas clusters of drums can be located to significantly greater depths depending on background noise. The EM-31 generally must pass over or very near to a buried metallic object to detect it. Both the out-of-phase (conductivity) and in-phase components exhibit a characteristic anomaly over near-surface metallic conductors. This anomaly consists of a narrow zone having strong negative amplitude centered over the target and a broader lobe of weaker, positive amplitude on either side of the target. For long, linear conductors such as pipelines, the characteristic anomaly is as described above when the axis of the coils (instrument boom) is at an angle to the conductor; however, when the instrument boom is oriented parallel to the conductor, a positive amplitude anomaly is obtained.

EM-31 applications include the delineation of soil contamination, oil brine pits, buried metallic and nonmetallic debris, landfill boundaries, buried pipes and cables, and buried drums and tanks.

The RD-400 and Metrotech are specifically designed to accurately locate and delineate underground pipes and utilities. A transmitter emits a radio-frequency signal that induces a secondary EM field in nearby utilities. A receiver unit measures the signal strength of this secondary field and emits an audible response to allow the precise location of the pipe, cable, or other conductor in which a signal is induced. If the utility is accessible anywhere, the source signal can be directly applied to it, making the secondary field much larger and readily measurable.

A.2.0 Ground Penetrating Radar

Ground penetrating radar (GPR) equipment used during this investigation consisted of a Geophysical Survey Systems, Inc. (GSSI) Subsurface Interface Radar System 10 equipped with 120-MHz, 300-MHz, and 500-MHz monostatic antennae.

In conducting a GPR survey, a transmitter antenna that emits a high frequency (center frequencies in the range of 80 to 900 MHz) EM wave into the subsurface is pulled along the survey line. This wave propagates at the speed of light in a vacuum scaled by the square root of the relative dielectric constant of the medium and reflects at boundaries where the relative dielectric constant (and therefore the propagation velocity) changes. The contrast in velocity between the two media can be quantified as a reflection coefficient at the boundary. The magnitude of the reflection coefficient increases as the contrast in velocities increases, and its sign is positive or negative depending on whether the velocity increases or decreases, respectively, at the boundary.

The reflected signal is detected at a receiver antenna, often as a characteristic triplet that is the result of the receiving antenna response and multiples generated along the propagation path. The signal is transmitted to a control unit, displayed on a color monitor, and saved on digital tape (if necessary).

As predicted by Maxwell's equations for a propagating EM wave, two kinds of charge flow are caused by the alternating electric (E) and magnetic (H) fields associated with it (Ulriksen, 1982). These are conduction currents and displacement currents. The conduction current term is predominant at lower frequencies and it is these that are used in the EM induction method. At the higher frequencies used in the GPR method, the displacement current term becomes predominant. The high frequencies will set bound charges in motion causing polarization.

The material physical properties that describe the movement of charges by conduction currents and displacement currents are the conductivity and the dielectric constant of the medium, respectively. The conductivity is a measure of the ease with which charges and charged particles move freely through the medium when subjected to an external electric field. The dielectric constant, or its value normalized by the dielectric constant of free space, called the relative dielectric constant, is a measure of how easily a medium polarizes to accommodate the EM fields of propagating wave (Keller and Frischknecht, 1966).

Although conductivity has a lesser effect on the transmission of EM waves emitted from a GPR unit, it does have an important effect on the attenuation of the waves (Ulriksen, 1982). Highly conductive media will attenuate the EM signal rapidly, restricting depth penetration of the first several feet. Highly resistive (poorly conductive) media will allow much deeper depth of penetration. The frequency of the transmitted waves also affects the depth of penetration. Lower frequencies penetrate deeper, but have low resolution, whereas the higher frequencies can resolve smaller objects and layers at the expense of decreased effective depth penetration.

In unconsolidated materials, conduction takes place mostly through the pore fluids (Keller and Frischknecht, 1966). Changes in pore fluid content, porosity, permeability, and degree of saturation will therefore affect reflected and refracted EM signals. This is how trenches, in which there may be different compaction relative to the surrounding area, can be identified. When the target of a GPR survey is a metallic conductor such as metal pipes and cables, drums, tanks, ammunition shells, etc., the mechanism is somewhat different. An EM wave will completely reflect when reaching a metallic conductor. This total reflection makes metallic targets well suited for the GPR method when they are within the depth of penetration range of the instrument. There will be no reflections from below the metallic conductor, although there generally will be multiples. The edges of the metallic reflector will have diffraction patterns that are a result of the fact that both the transmitting and the receiving antennae are not focused, but emit and receive from a 45 degree cone. This cone allows the radar to see objects that are ahead of it, placing them deeper in time. As the radar approaches the object, the reflection becomes shallower, with the shallowest reflection taking place when the radar is right above it. The same pattern will be seen as the antenna moves away from the object.

Applications of GPR include delineation of pits and trenches containing metallic and nonmetallic debris; location of buried pipes, drums, and tanks; mapping of landfill boundaries; and mapping of near-surface geology. Near-surface metallic objects such as pipes and tanks exhibit a characteristic high-amplitude hyperbolic anomaly and generally are relatively easy to recognize.

APPENDIX B

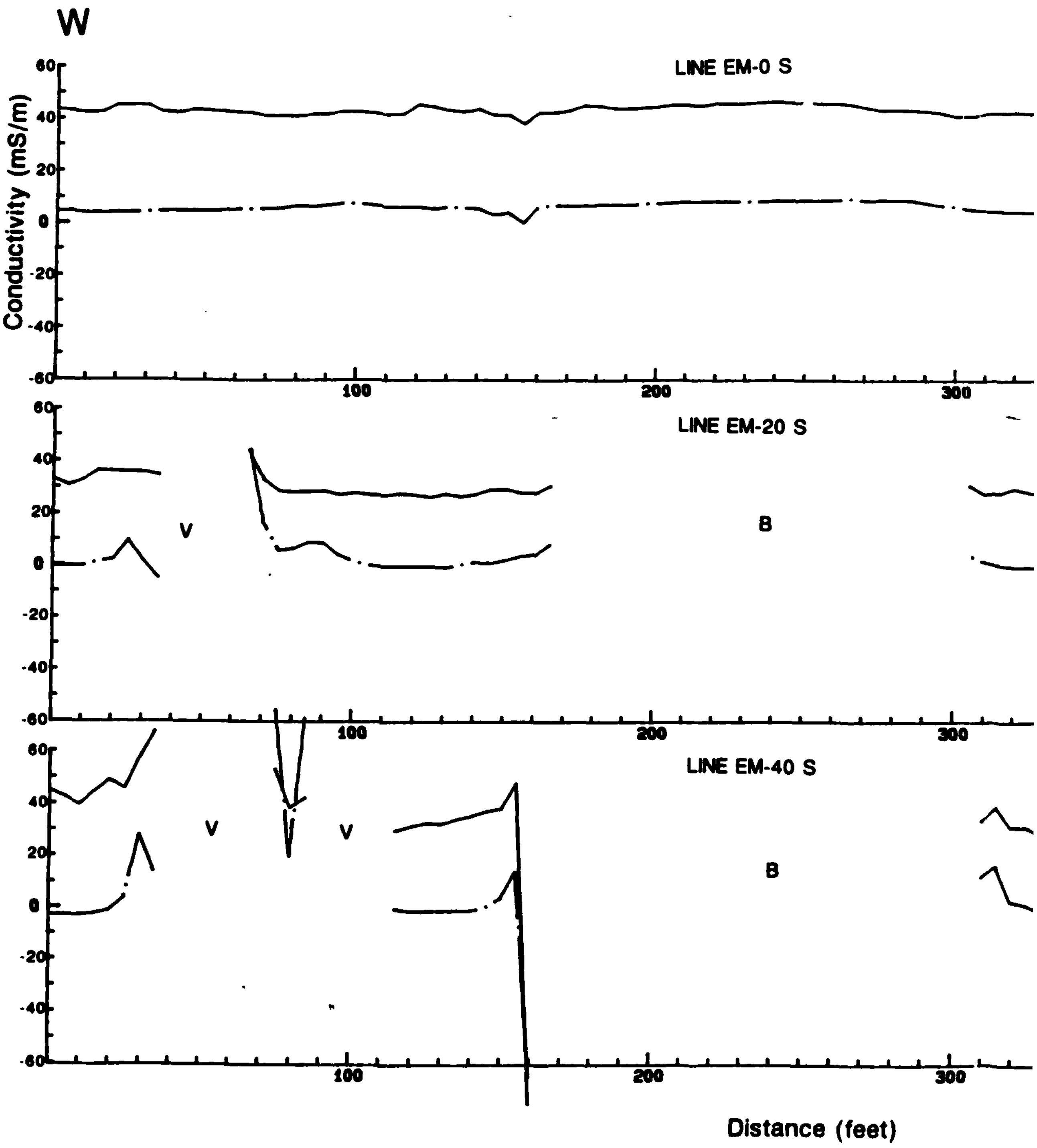
ELECTROMAGNETIC INDUCTION PROFILES

DRAWN BY J. WALL 4-24-91

CHECKED BY L.L. 4/30/91

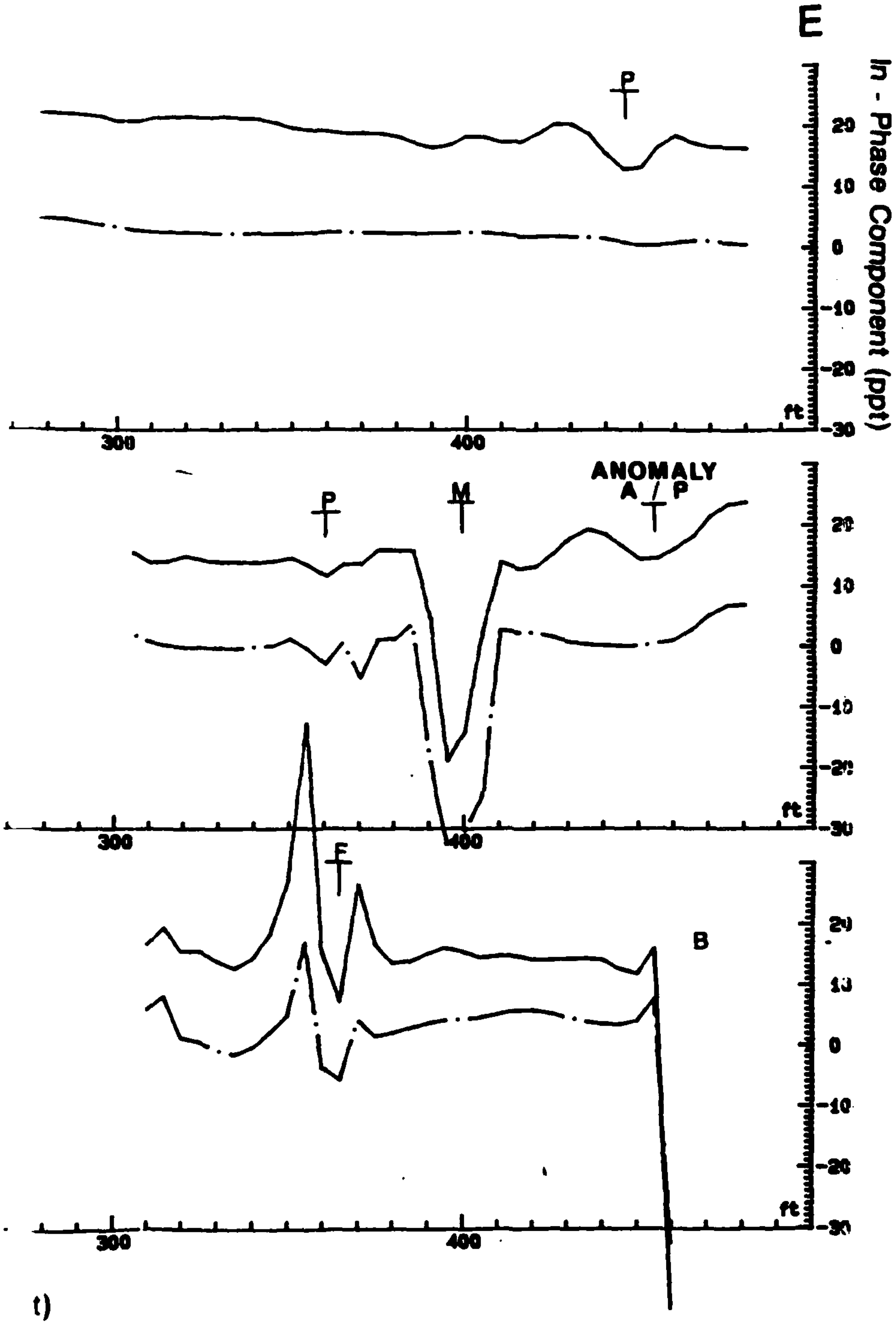
APPROVED BY 4/30/91

DRAWING NUMBER 409721-B13



067488

Do Not Scale This Drawing



LEGEND:

- B - BUILDING
- BF - BLAST FENCE
- F - FENCE
- FH - FIRE HYDRANT
- LP - LIGHT POLE
- M - MANHOLE
- P - UTILITY
- RC - REINFORCED CONCRETE
- S - SEWER
- V - VEHICLE

——— CONDUCTIVITY - MILLISIEMENS/METER (mS/m)

—·— IN-PHASE COMPONENT - PARTS PER THOUSAND OF PRIMARY ELECTROMAGNETIC FIELD (PPT)

NOTE:

REFER TO FIGURE 1 FOR LOCATION OF SURVEY LINES

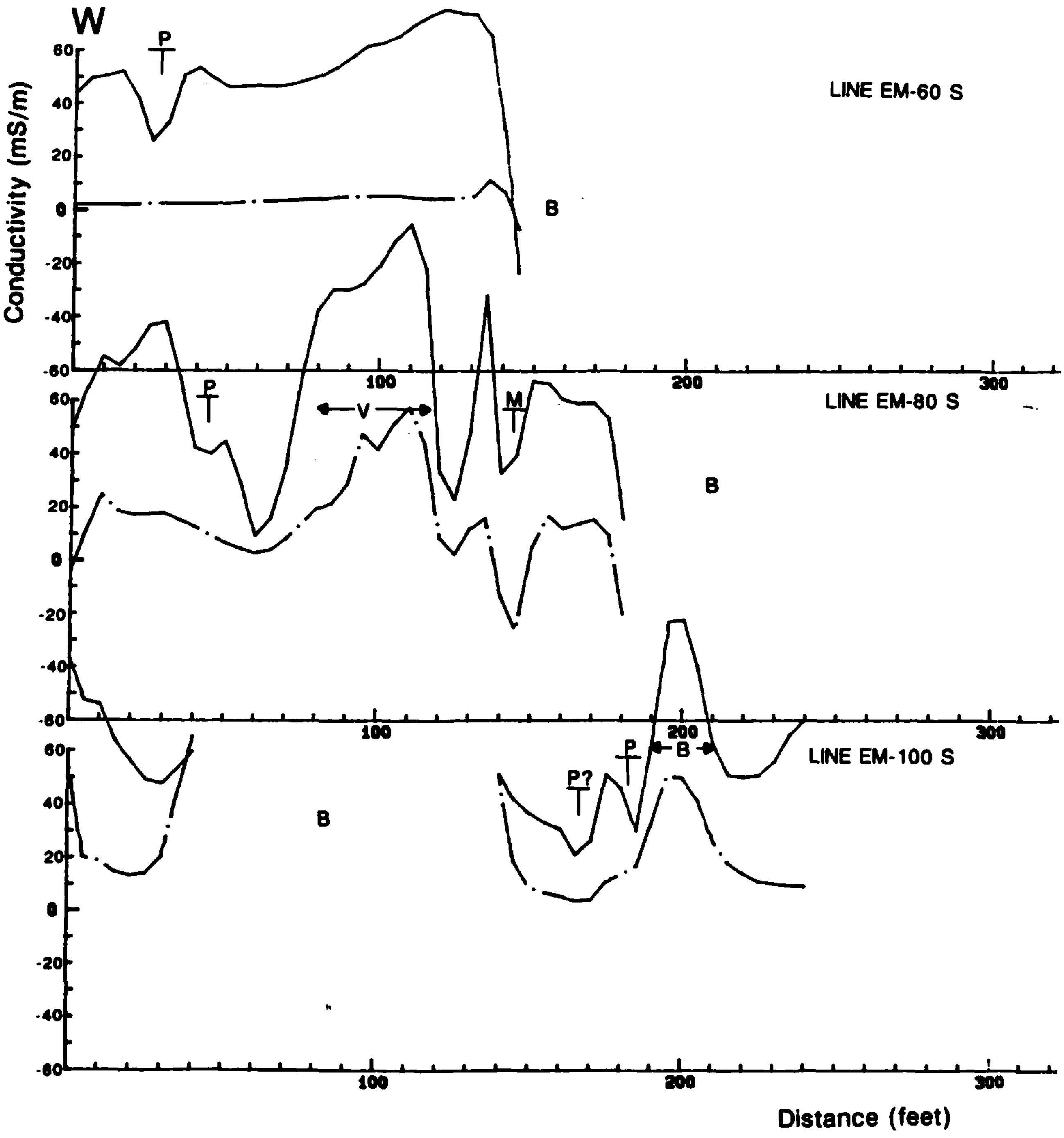
FIGURE B-1

ELECTROMAGNETIC INDUCTION PROFILES

SITE 5 - AMMUNITION DISPOSAL AREA
161 AREFG
SKY HARBOR IAP
PHOENIX, ARIZONA

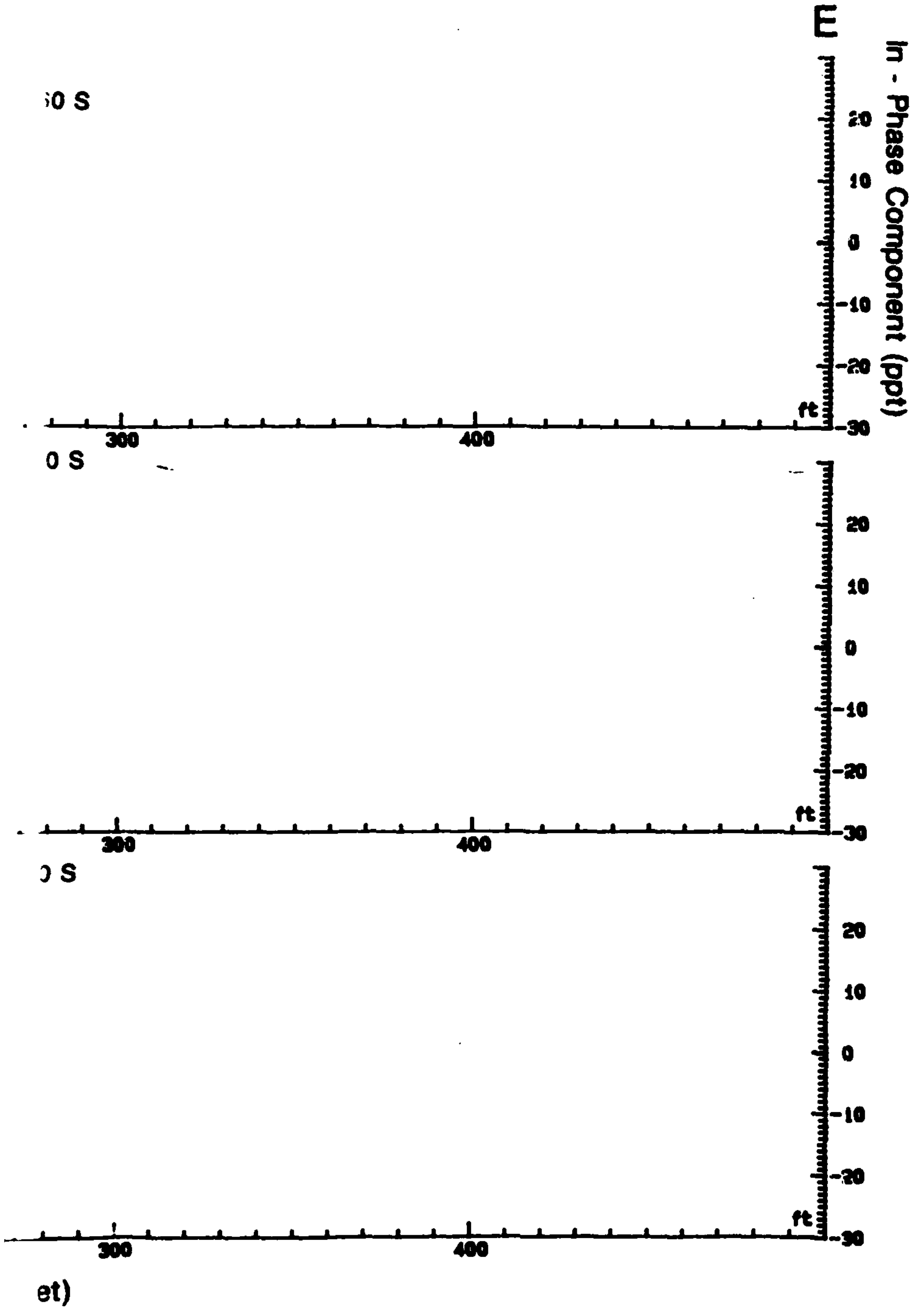
INTERNATIONAL TECHNOLOGY CORPORATION

DRAWN BY J. WALL 4-24-91
CHECKED BY L.C. 4/24/91
APPROVED BY [illegible] 4/22/91
DRAWING NUMBER 409721-B14



047988

Do Not Scale This Drawing



LEGEND:

B - BUILDING
BF - BLAST FENCE
F - FENCE
FH - FIRE HYDRANT
LP - LIGHT POLE
M - MANHOLE
P - UTILITY
RC - REINFORCED CONCRETE
S - SEWER
V - VEHICLE

——— CONDUCTIVITY - MILLISIEMENS/METER (mS/m)

—·— IN-PHASE COMPONENT - PARTS PER THOUSAND OF PRIMARY ELECTROMAGNETIC FIELD (PPT)

NOTE:

REFER TO FIGURE 1
FOR LOCATION OF SURVEY LINES

FIGURE B-2

ELECTROMAGNETIC INDUCTION PROFILES

SITE 5 - AMMUNITION DISPOSAL AREA
161 AREFG

SKY HARBOR IAP
PHOENIX, ARIZONA

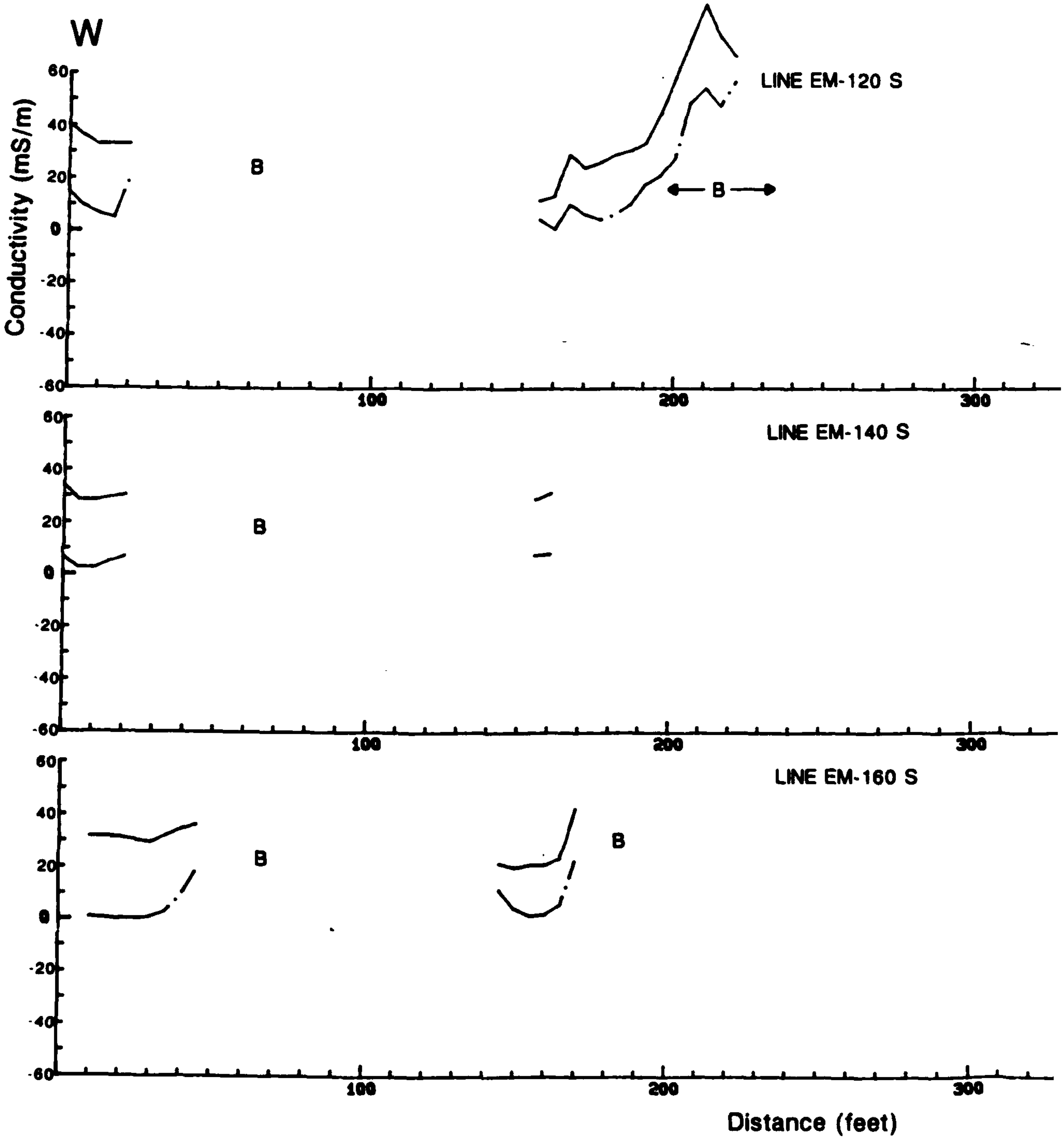
INTERNATIONAL
TECHNOLOGY
CORPORATION

DRAWN BY J. WALL 4-24-91

CHECKED BY L.C. 4/30/91

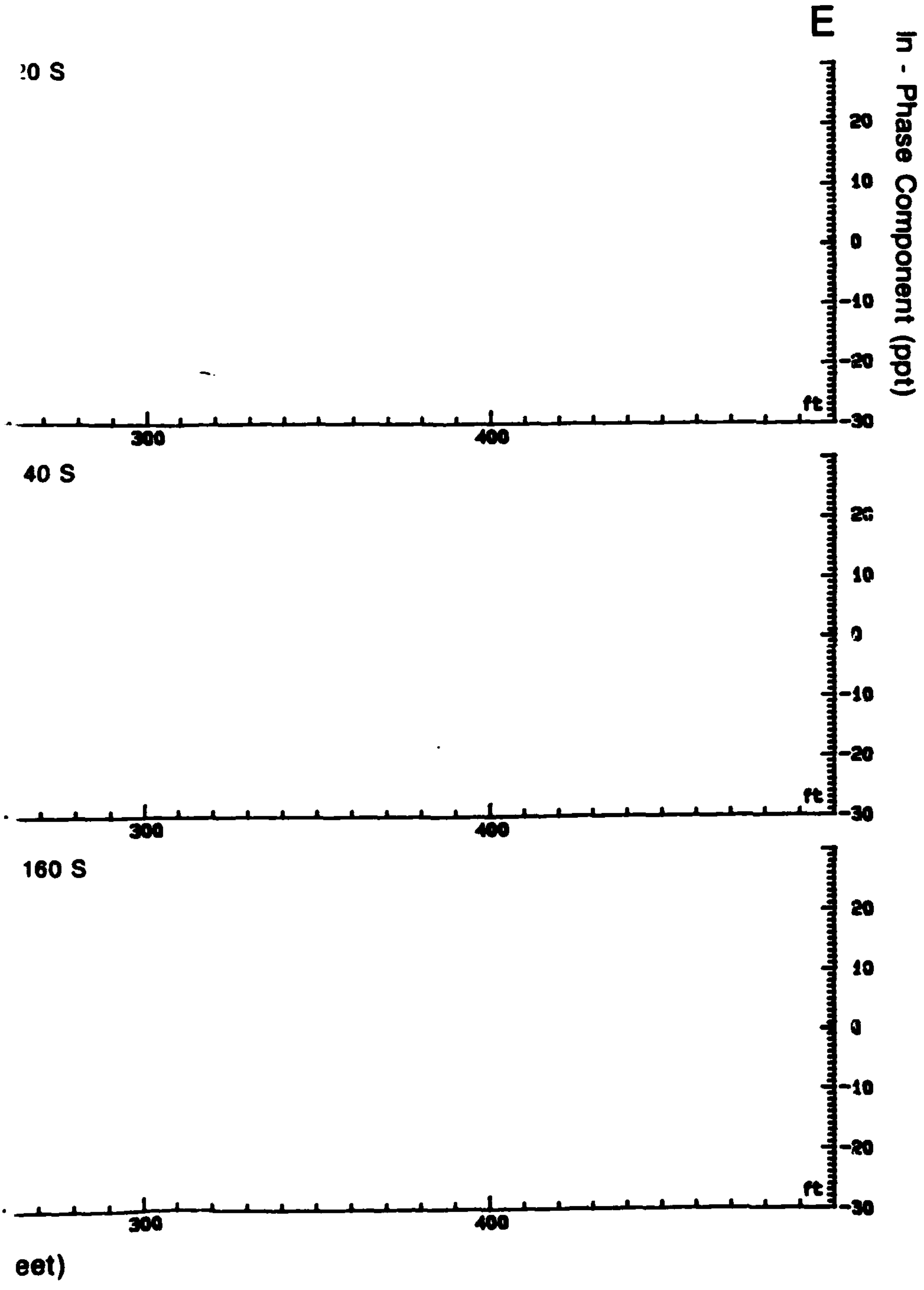
APPROVED BY 4/30/91

DRAWING NUMBER 409721-B17



© 1984 IT CORPORATION
ALL COPYRIGHTS RESERVED

Do Not Scale This Drawing



LEGEND:

B - BUILDING
BF - BLAST FENCE
F - FENCE
FH - FIRE HYDRANT
LP - LIGHT POLE
M - MANHOLE
P - UTILITY
RC - REINFORCED CONCRETE
S - SEWER
V - VEHICLE

——— CONDUCTIVITY - MILLISIEMENS/METER (mS/m)

—·— IN-PHASE COMPONENT - PARTS PER THOUSAND OF PRIMARY ELECTROMAGNETIC FIELD (PPT)

NOTE:

REFER TO FIGURE 1
FOR LOCATION OF SURVEY LINES

FIGURE B-3

ELECTROMAGNETIC INDUCTION PROFILES

SITE 5 - AMMUNITION DISPOSAL AREA
161 AREFG
SKY HARBOR IAP
PHOENIX, ARIZONA

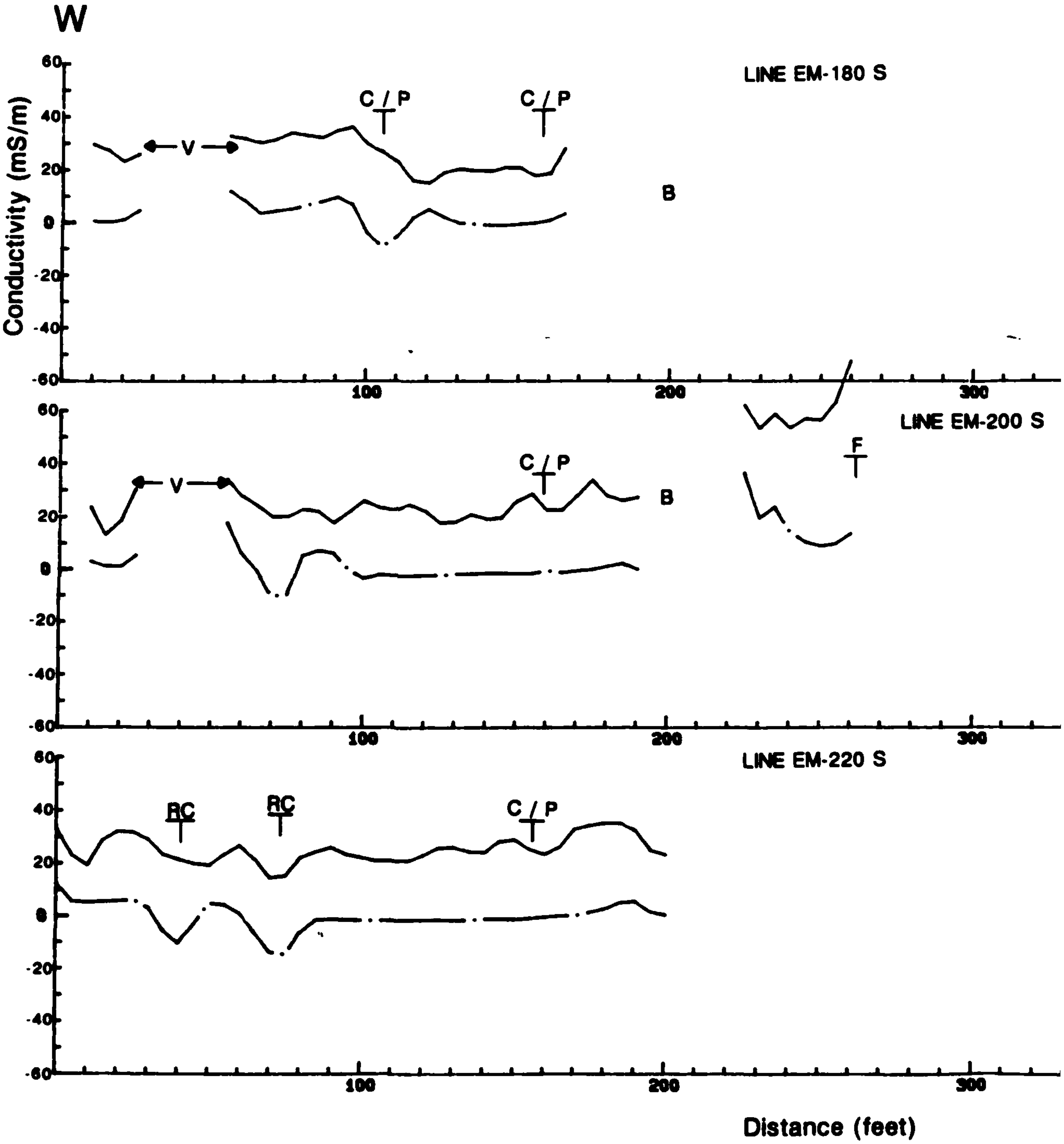
INTERNATIONAL
TECHNOLOGY
CORPORATION

DRAWN BY J. WALL 4-24-91

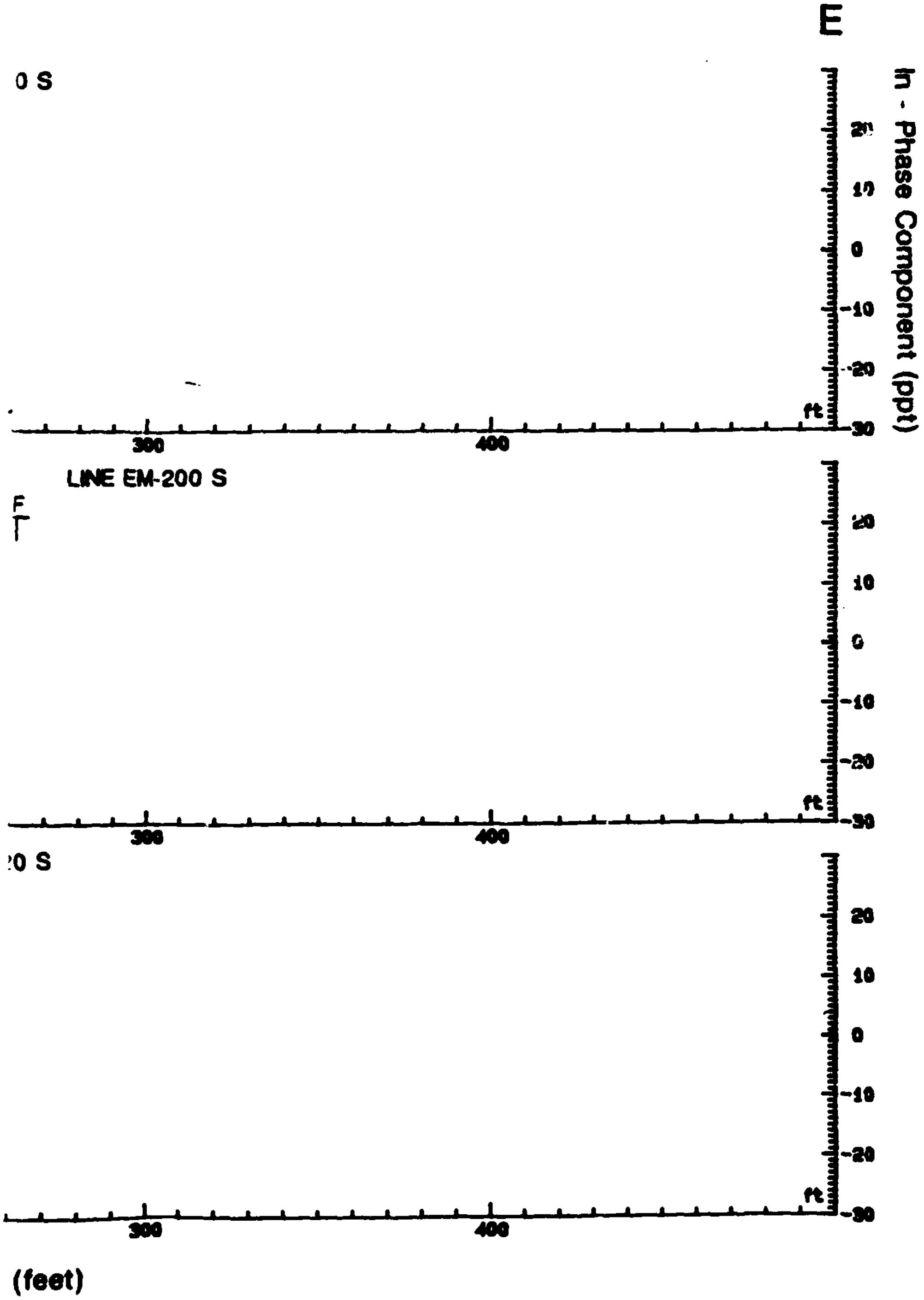
CHECKED BY L.C. 4/26/91

APPROVED BY 4/22/91

DRAWING NUMBER 409721-B15



"Do Not Scale This Drawing



LEGEND:

B - BUILDING
BF - BLAST FENCE
F - FENCE
FH - FIRE HYDRANT
LP - LIGHT POLE
M - MANHOLE
P - UTILITY
RC - REINFORCED CONCRETE
C - CURB
V - VEHICLE

——— CONDUCTIVITY - MILLISIEMENS/METER (mS/m)

—·— IN-PHASE COMPONENT - PARTS PER THOUSAND OF PRIMARY ELECTROMAGNETIC FIELD (PPT)

NOTE:

REFER TO FIGURE 1
FOR LOCATION OF SURVEY LINES

FIGURE B-4

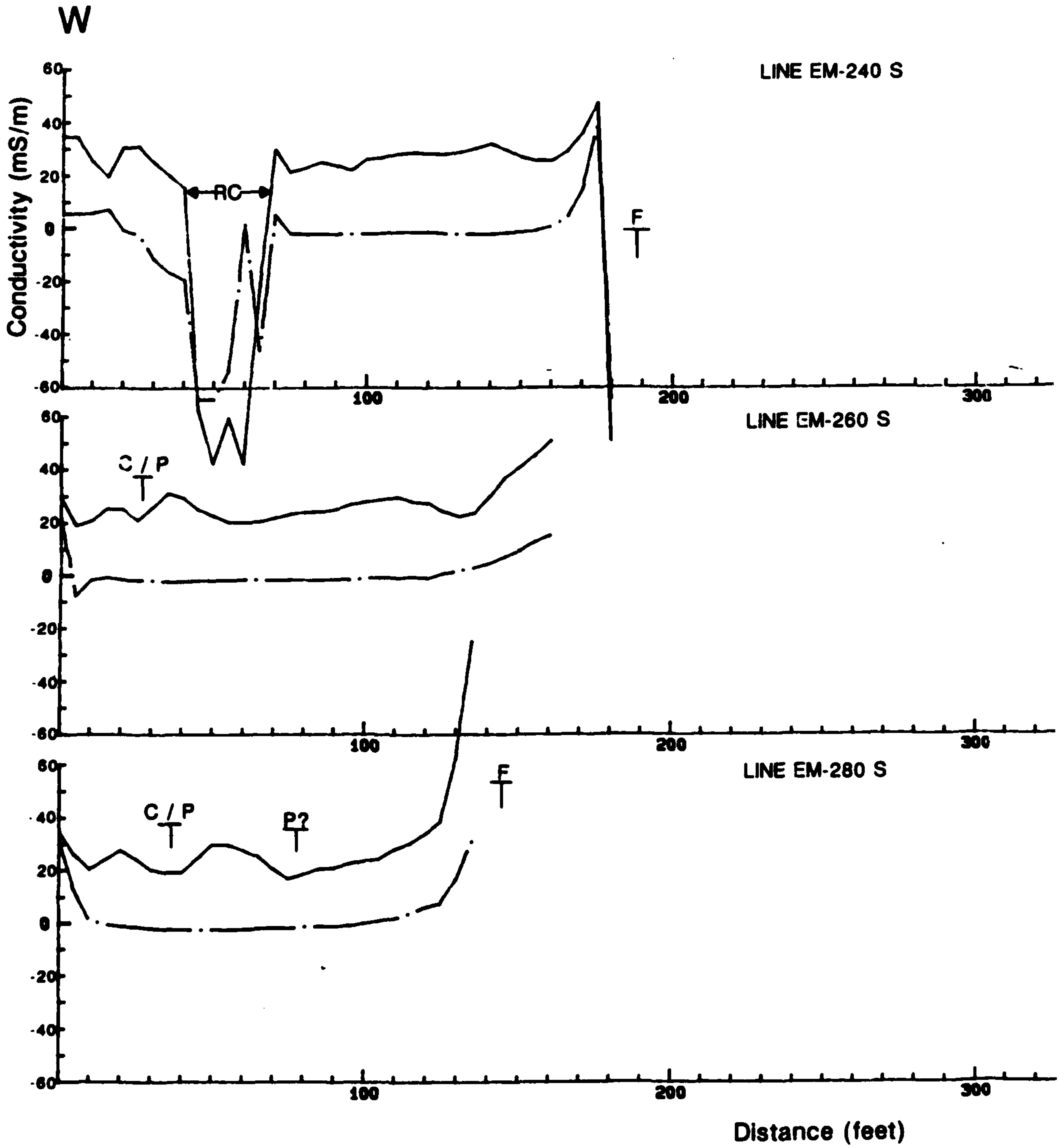
ELECTROMAGNETIC INDUCTION PROFILES

SITE 5 - AMMUNITION DISPOSAL AREA
161 AREFG
SKY HARBOR IAP
PHOENIX, ARIZONA

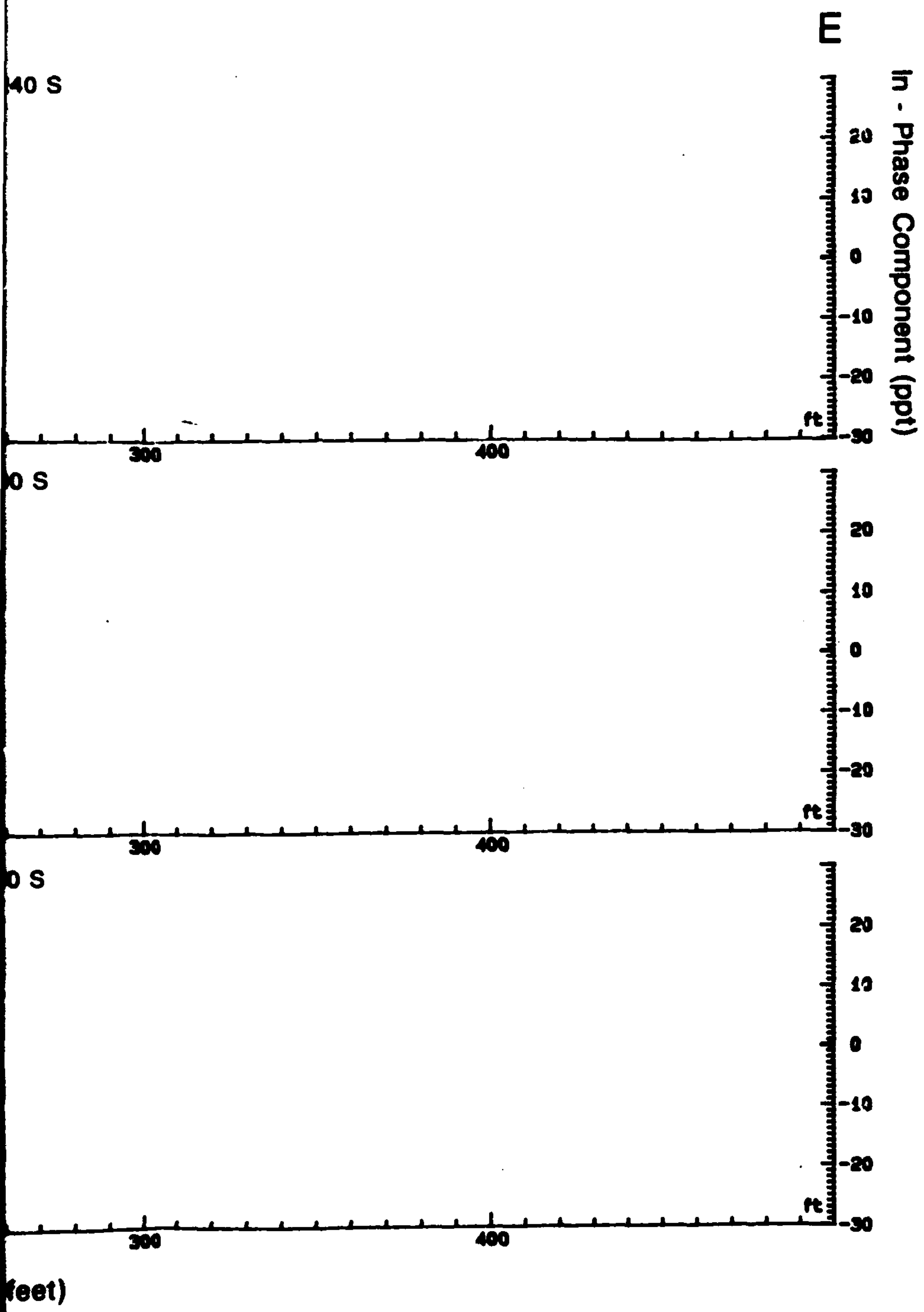
IT INTERNATIONAL
TECHNOLOGY
CORPORATION

DRAWN BY	J. WALL 4-24-91	CHECKED BY APPROVED BY	L.C. [illegible]	4/30/91 [illegible]

DRAWING NUMBER 409721-B16



Do Not Scale This Drawing



LEGEND:

B - BUILDING
BF - BLAST FENCE
F - FENCE
FH - FIRE HYDRANT
LP - LIGHT POLE
M - MANHOLE
P - UTILITY
RC - REINFORCED CONCRETE
C - CURB
V - VEHICLE

———	CONDUCTIVITY - MILLISIEMENS/METER (mS/m)
—·—	IN-PHASE COMPONENT - PARTS PER THOUSAND OF PRIMARY ELECTROMAGNETIC FIELD (PPT)

NOTE:

REFER TO FIGURE 1
FOR LOCATION OF SURVEY LINES

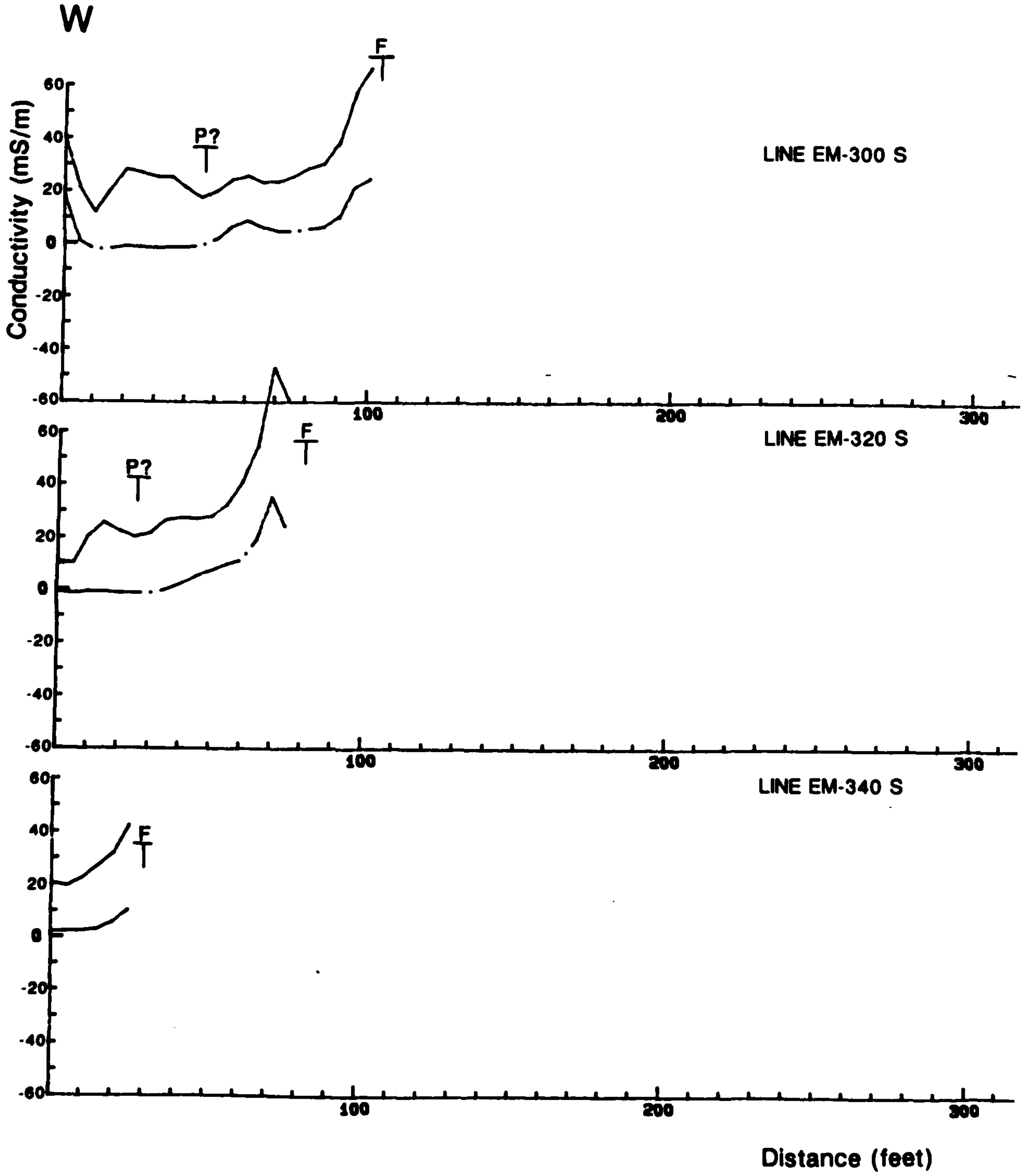
FIGURE B-5

ELECTROMAGNETIC INDUCTION PROFILES

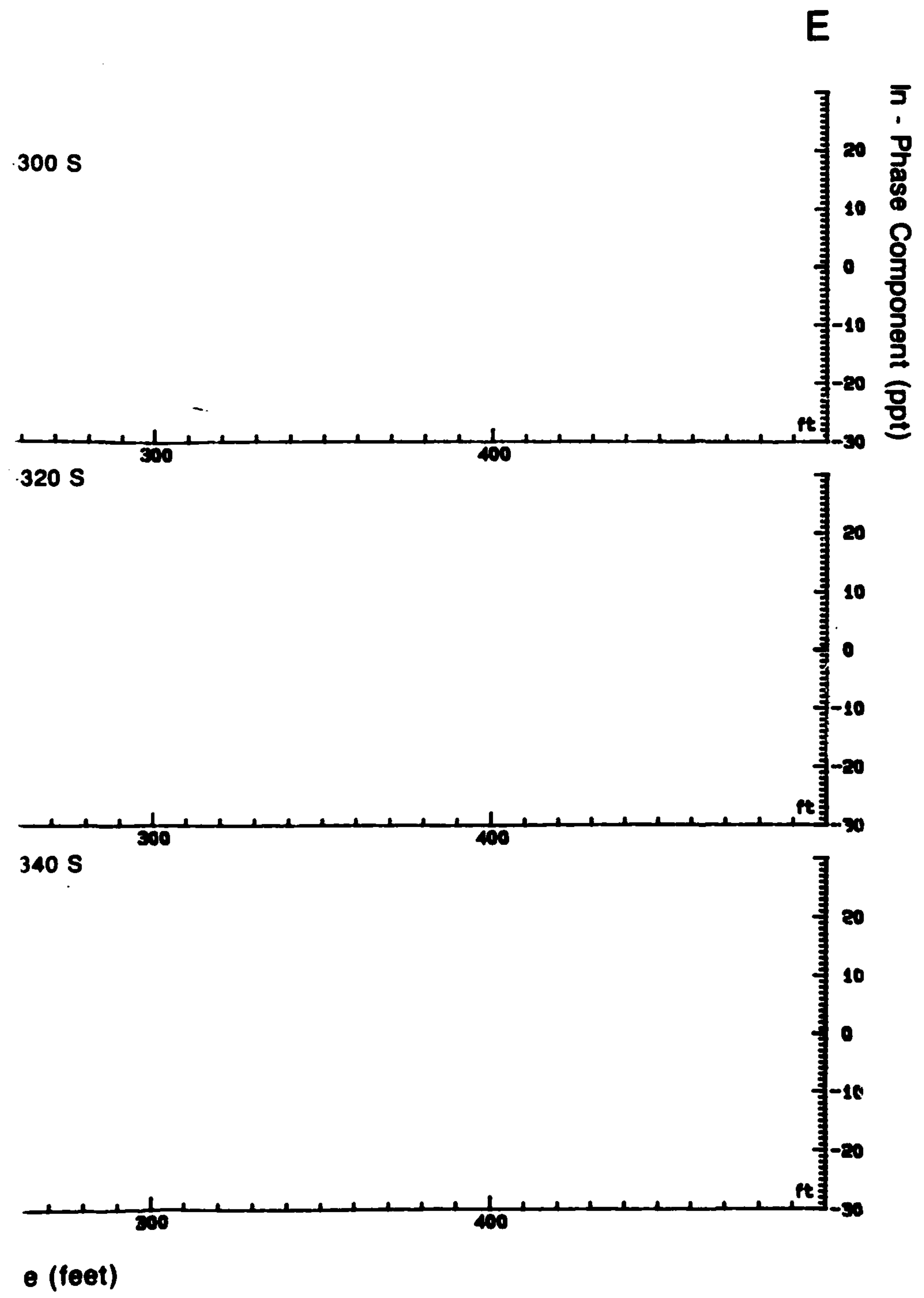
SITE 5 - AMMUNITION DISPOSAL AREA
161 AREFG
SKY HARBOR IAP
PHOENIX, ARIZONA

INTERNATIONAL
TECHNOLOGY
CORPORATION

DRAWN BY	J. WALL	4-24-91
CHECKED BY		4/30/91
APPROVED BY		4/30/91
DRAWING NUMBER	409721-B12	



Do Not Scale This Drawing



LEGEND:

B - BUILDING
BF - BLAST FENCE
F - FENCE
FH - FIRE HYDRANT
LP - LIGHT POLE
M - MANHOLE
P - UTILITY
RC - REINFORCED CONCRETE
S - SEWER
V - VEHICLE

——— CONDUCTIVITY - MILLISIEMENS/METER (mS/m)

—·— IN-PHASE COMPONENT - PARTS PER THOUSAND OF PRIMARY ELECTROMAGNETIC FIELD (PPT)

NOTE:

REFER TO FIGURE 1
FOR LOCATION OF SURVEY LINES

FIGURE B-6

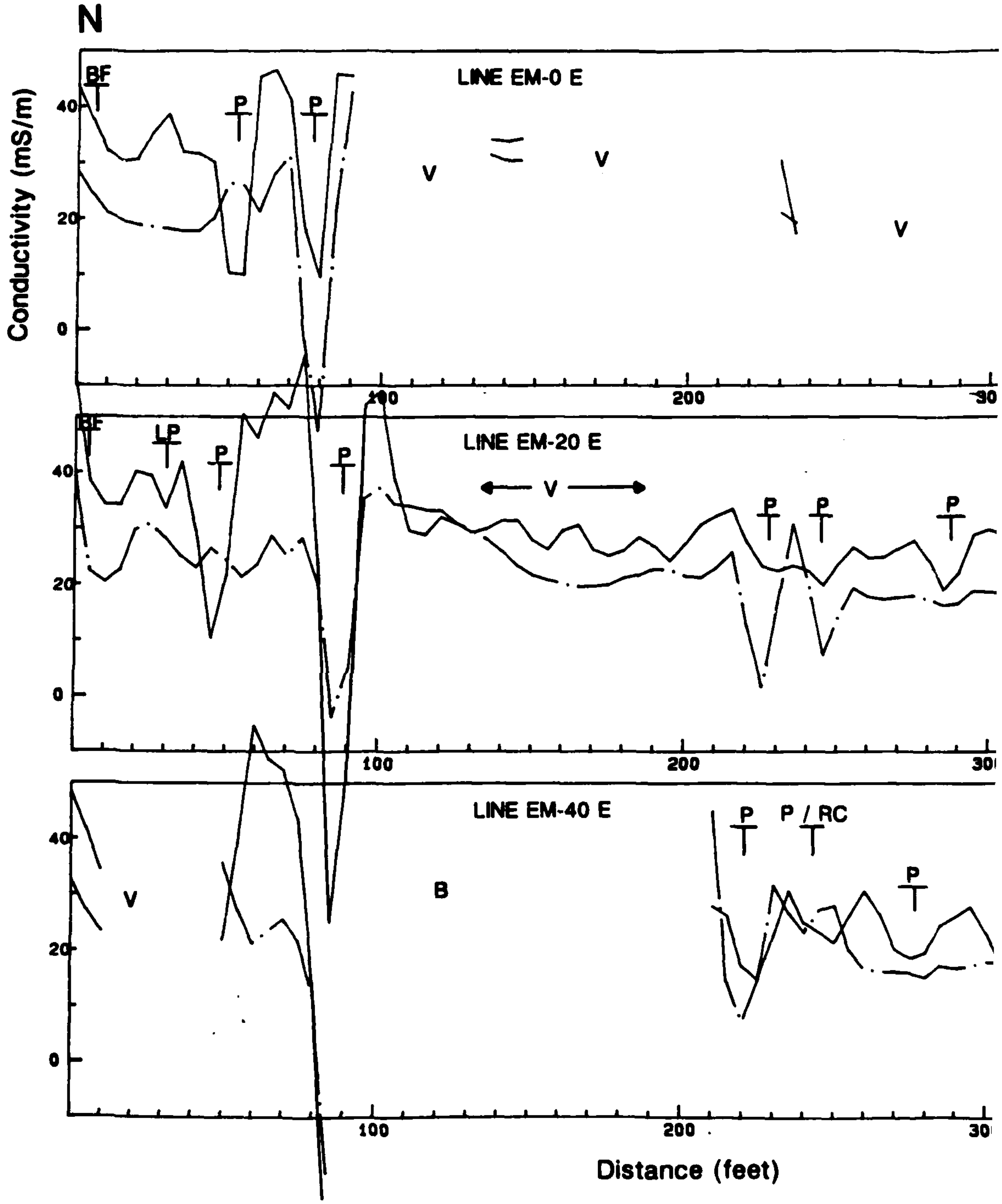
ELECTROMAGNETIC INDUCTION PROFILES

SITE 5 - AMMUNITION DISPOSAL AREA
161 AREFG

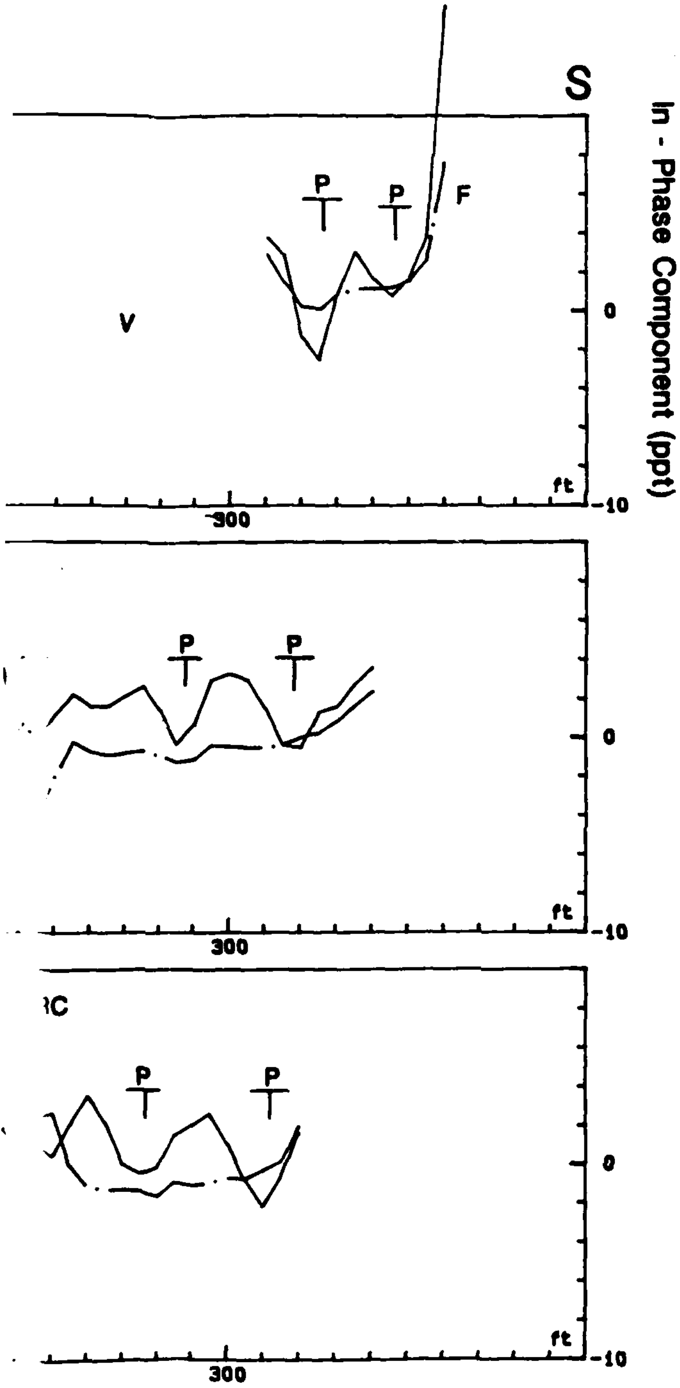
SKY HARBOR IAP
PHOENIX, ARIZONA

INTERNATIONAL
TECHNOLOGY
CORPORATION

DRAWN BY	J. WALL	CHECKED BY	L.C.	4/30/91	DRAWING NUMBER	409721-B5
	4-24-91	APPROVED BY		4/30/91		



Do Not Scale This Drawing



LEGEND:

- B - BUILDING
- BF - BLAST FENCE
- F - FENCE
- FH - *FIRE HYDRANT*
- LP - LIGHT POLE
- M - MANHOLE
- P - UTILITY
- RC - REINFORCED CONCRETE
- S - SEWER
- V - VEHICLE(S)

——— CONDUCTIVITY - MILLISIEMENS/METER (mS/m)

—·— IN-PHASE COMPONENT - PARTS PER THOUSAND OF PRIMARY ELECTROMAGNETIC FIELD (PPT)

NOTE:

REFER TO FIGURE 1
FOR LOCATION OF SURVEY LINES

FIGURE B-7

ELECTROMAGNETIC INDUCTION PROFILES

SITE 5 - AMMUNITION DISPOSAL AREA
161 AREFG
SKY HARBOR IAP
PHOENIX, ARIZONA

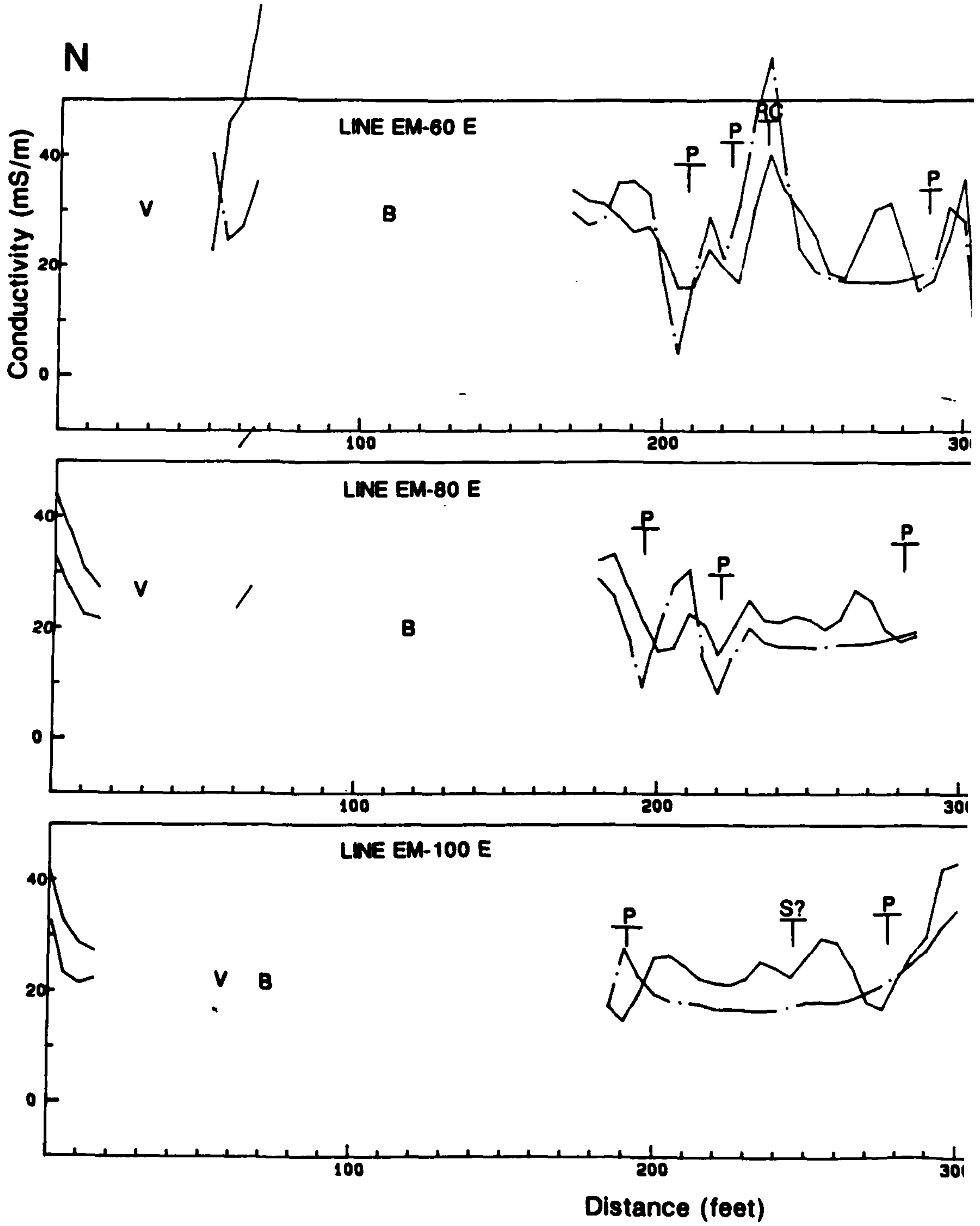
IT INTERNATIONAL
TECHNOLOGY
CORPORATION

DRAWN BY J. WALL 4-24-91

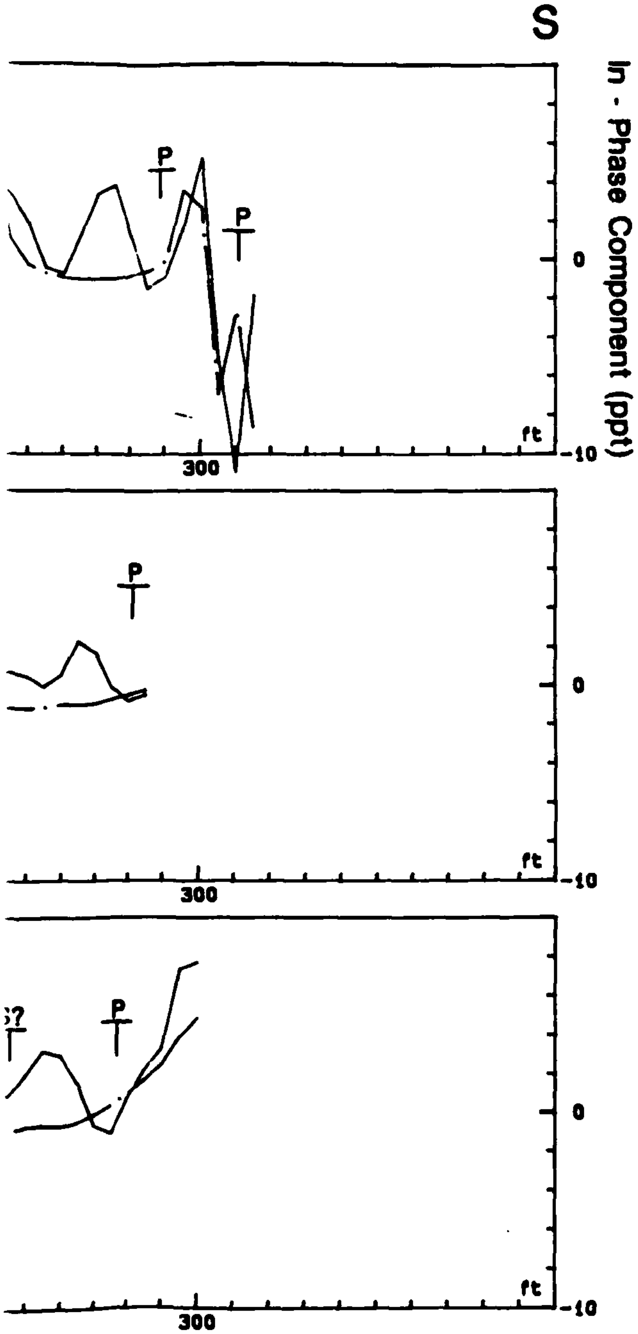
CHECKED BY L.C. 4/30/91

APPROVED BY 11/30/91

DRAWING NUMBER 409721-B7



Do Not Scale This Drawing



LEGEND:

B - BUILDING
BF - BLAST FENCE
F - FENCE
FH - FIRE HYDRANT
LP - LIGHT POLE
M - MANHOLE
P - UTILITY
RC - REINFORCED CONCRETE
S - SEWER
V - VEHICLE

——— CONDUCTIVITY - MILLISIEMENS/METER (mS/m)

—·— IN-PHASE COMPONENT - PARTS PER THOUSAND OF PRIMARY ELECTROMAGNETIC FIELD (PPT)

NOTE:

REFER TO FIGURE 1
FOR LOCATION OF SURVEY LINES

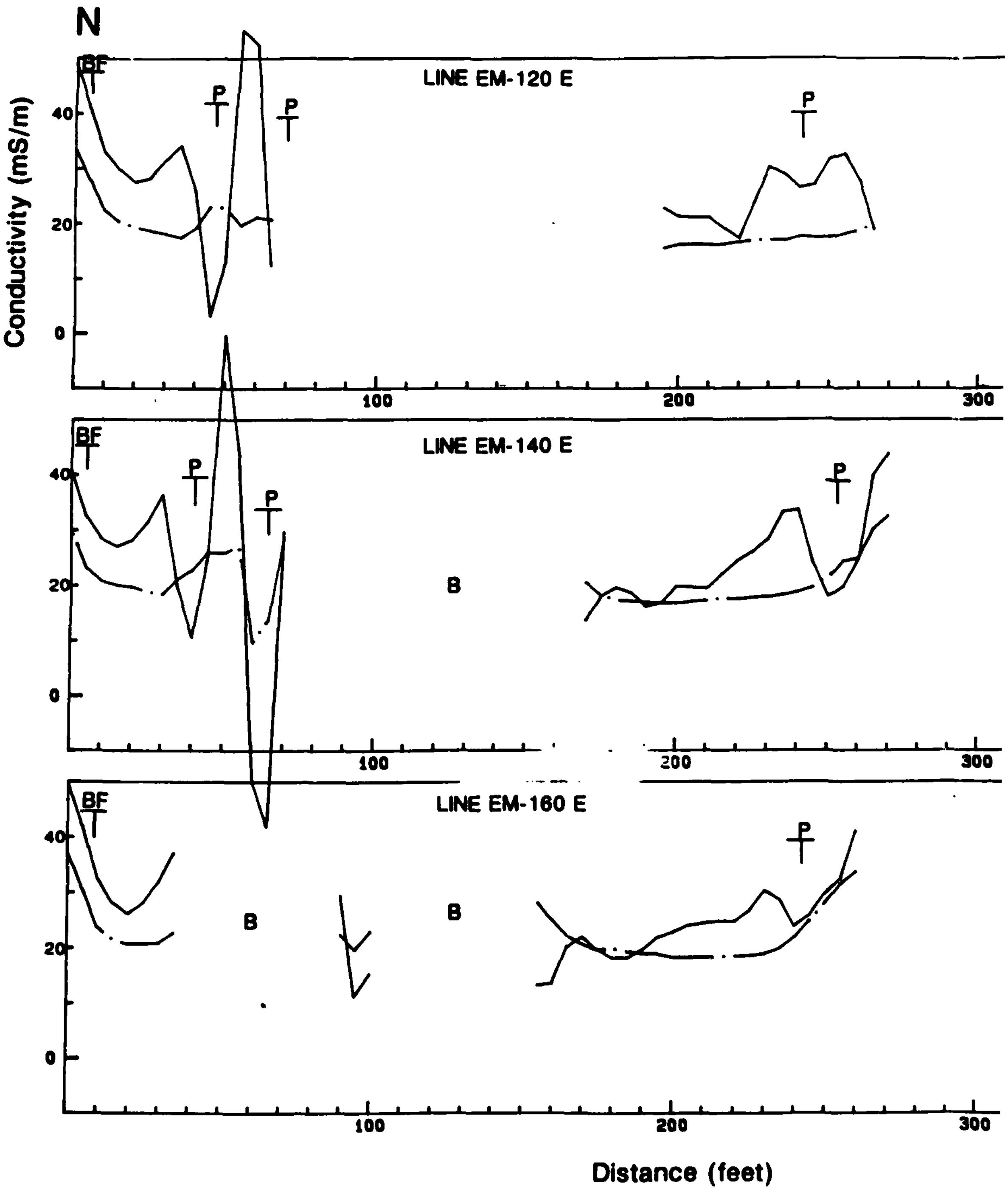
FIGURE B-8

ELECTROMAGNETIC INDUCTION PROFILES

SITE 5 - AMMUNITION DISPOSAL AREA
161 AREFG

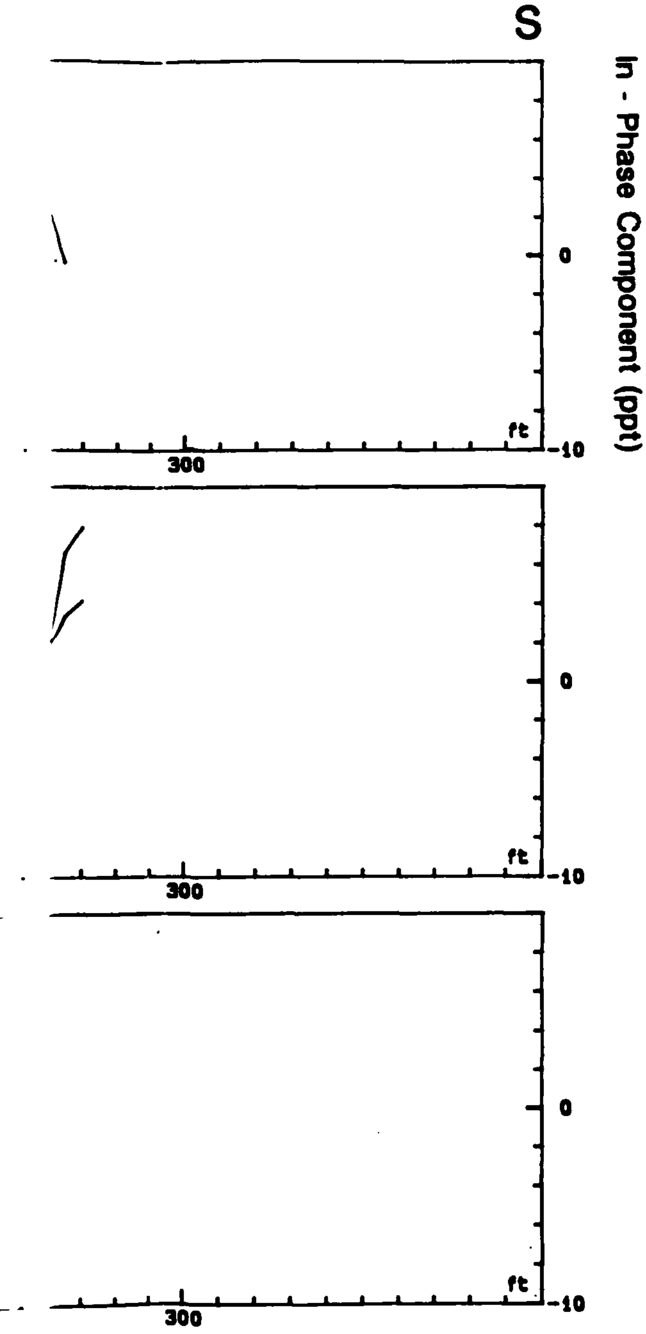
SKY HARBOR IAP
PHOENIX, ARIZONA

IT INTERNATIONAL TECHNOLOGY CORPORATION



DRAWN BY	J. WALL 4-24-91
CHECKED BY	[illegible] 5/30/91
APPROVED BY	[illegible] 4/29/91
DRAWING NUMBER	409721-B8

Do Not Scale This Drawing



LEGEND:

B - BUILDING
BF - BLAST FENCE
F - FENCE
FH - FIRE HYDRANT
LP - LIGHT POLE
M - MANHOLE
P - UTILITY
RC - REINFORCED CONCRETE
S - SEWER
V - VEHICLE

——— CONDUCTIVITY -
MILLISIEMENS/METER (mS/m)

—·— IN-PHASE COMPONENT -
PARTS PER THOUSAND OF PRIMARY
ELECTROMAGNETIC FIELD (PPT)

NOTE:

REFER TO FIGURE 1
FOR LOCATION OF SURVEY LINES

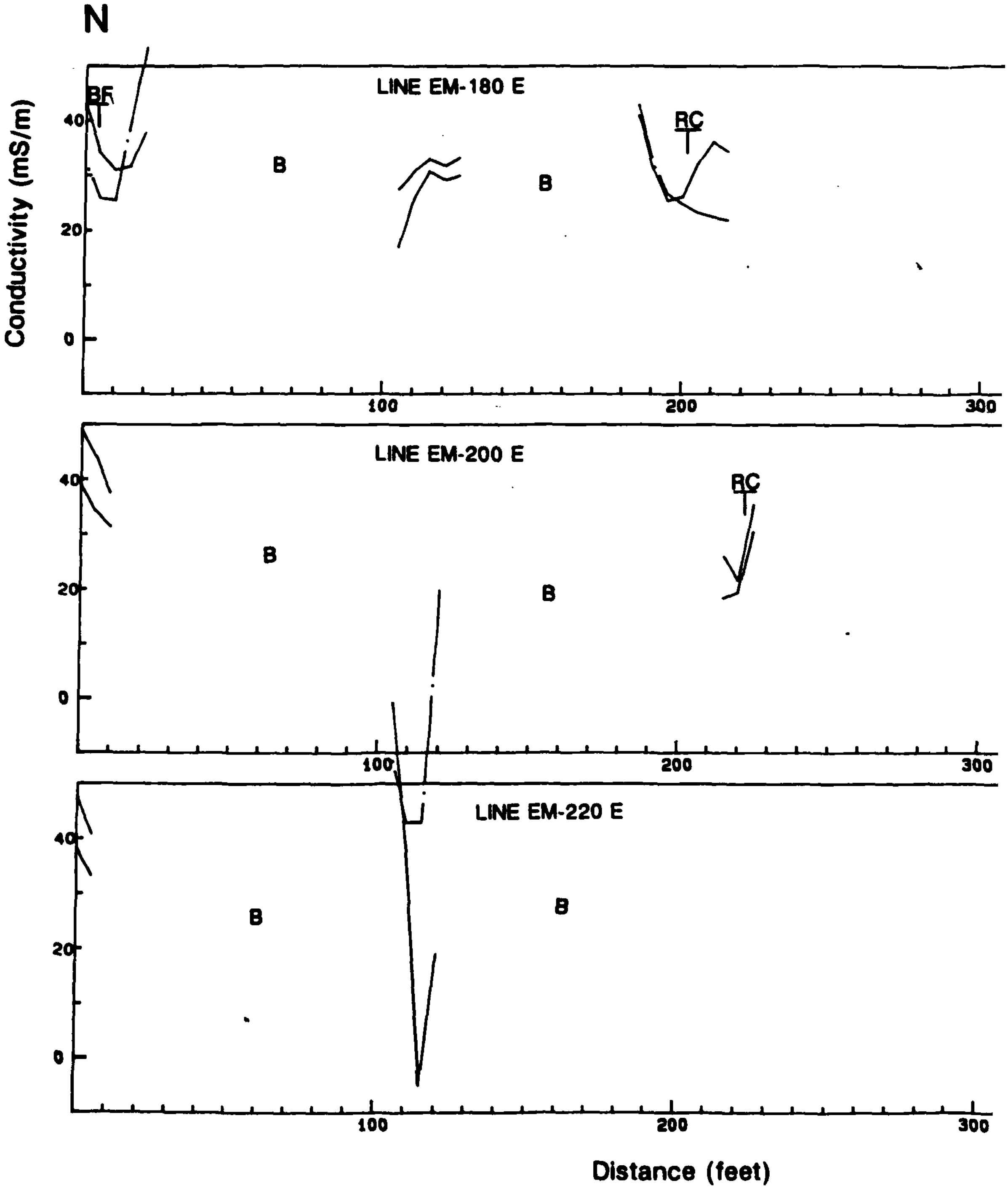
FIGURE B-9

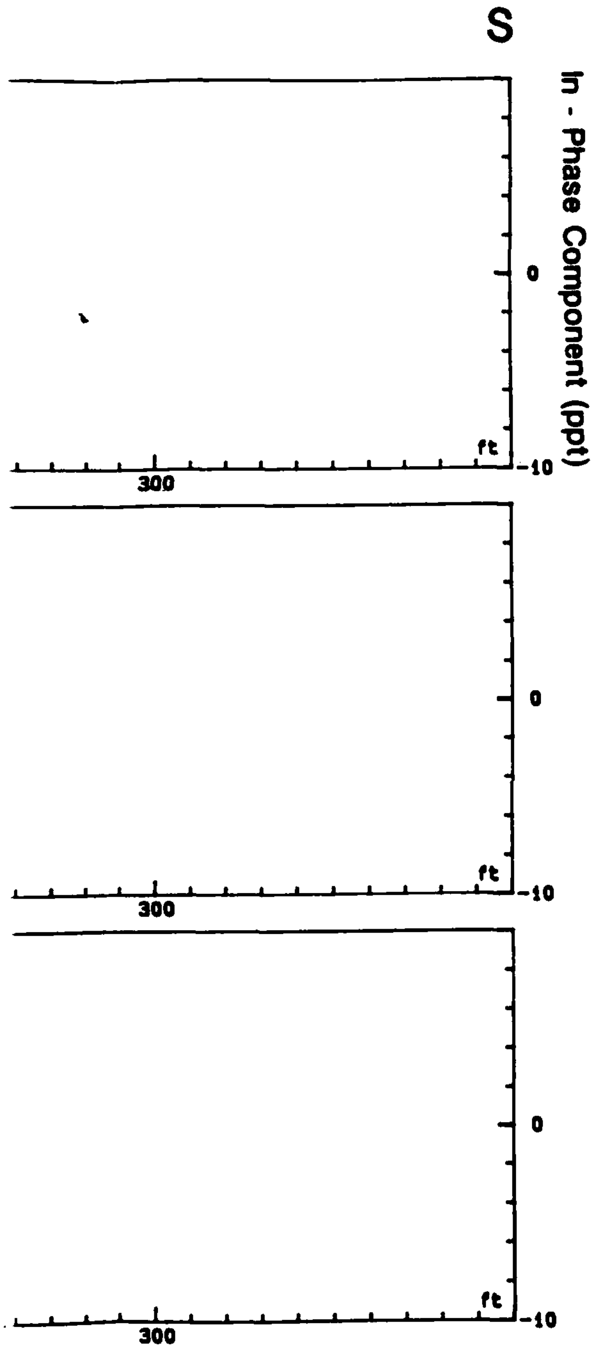
ELECTROMAGNETIC INDUCTION PROFILES

SITE 5 - AMMUNITION DISPOSAL AREA
161 AREFG
SKY HARBOR IAP
PHOENIX, ARIZONA

INTERNATIONAL
TECHNOLOGY
CORPORATION

DRAWN BY J. WALL 4-24-91
CHECKED BY 4/30/91
APPROVED BY 4/30/91
DRAWING NUMBER 409721-B9





LEGEND:

- B - BUILDING
- BF - BLAST FENCE
- F - FENCE
- FH - FIRE HYDRANT
- LP - LIGHT POLE
- M - MANHOLE
- P - UTILITY
- RC - REINFORCED CONCRETE
- S - SEWER
- V - VEHICLE

——— CONDUCTIVITY - MILLISIEMENS/METER (mS/m)

—·— IN-PHASE COMPONENT - PARTS PER THOUSAND OF PRIMARY ELECTROMAGNETIC FIELD (PPT)

NOTE:

REFER TO FIGURE 1
FOR LOCATION OF SURVEY LINES

FIGURE B-10

ELECTROMAGNETIC INDUCTION PROFILES

SITE 5 - AMMUNITION DISPOSAL AREA
161 AREFG

SKY HARBOR IAP
PHOENIX, ARIZONA

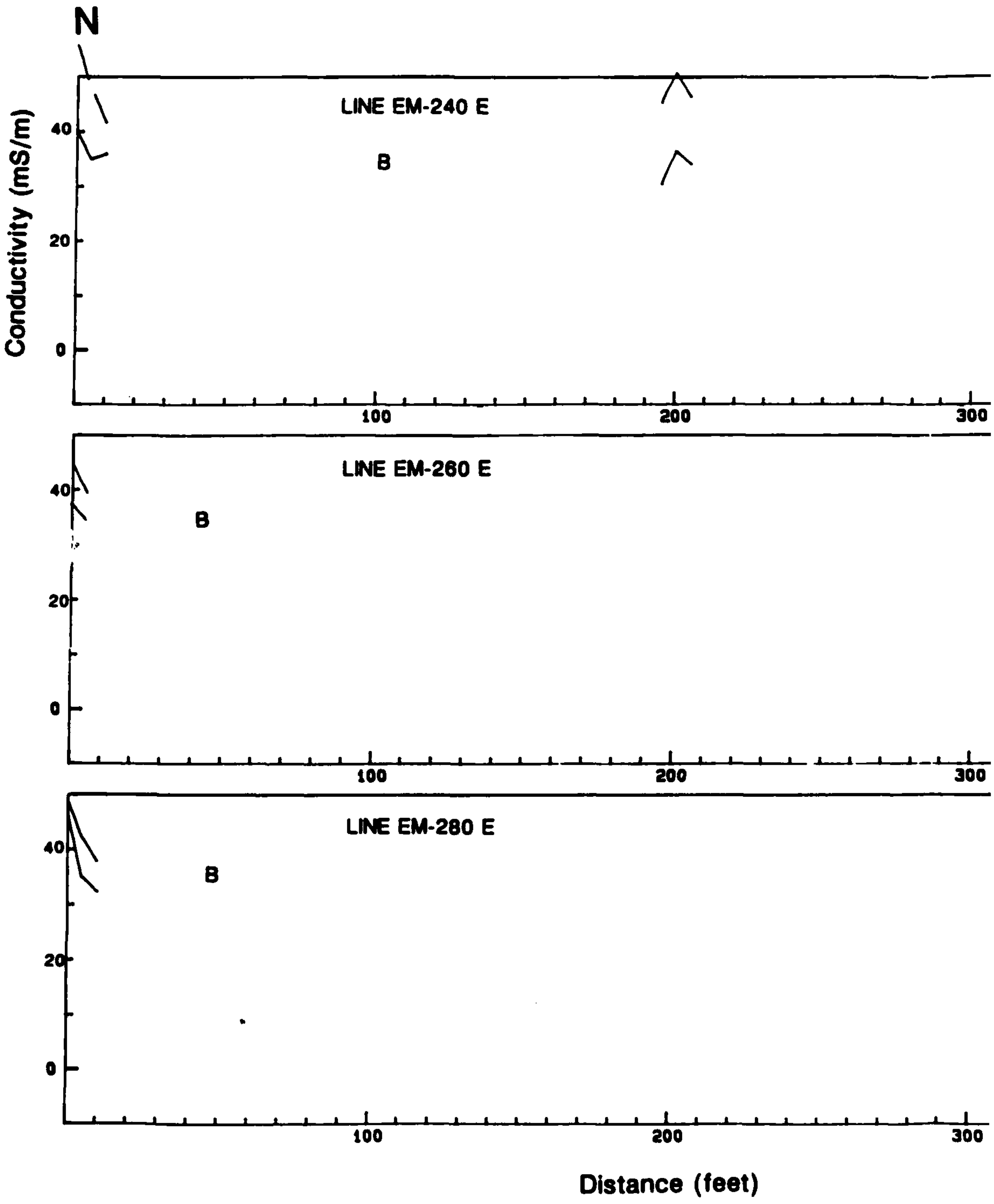
INTERNATIONAL
TECHNOLOGY
CORPORATION

DRAWING NUMBER 409721-B6

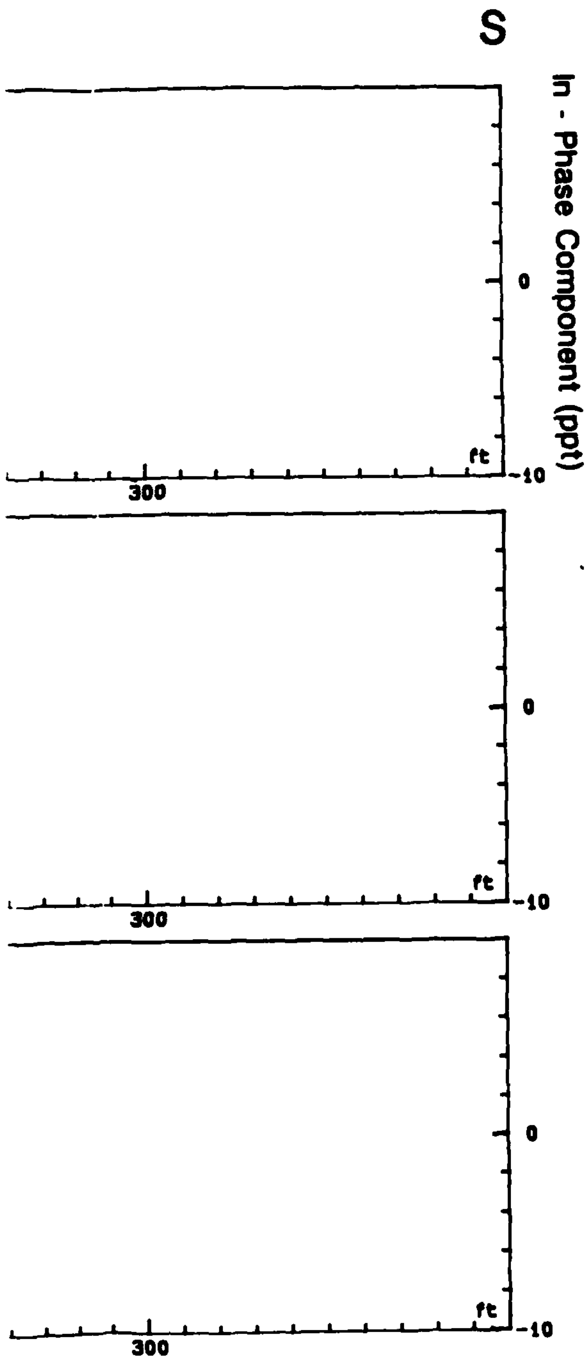
DRAWN BY J. WALL 4-24-91

CHECKED BY 4/30/91

APPROVED BY



Do Not Scale This Drawing



LEGEND:

B - BUILDING
BF - BLAST FENCE
F - FENCE
FH - FIRE HYDRANT
LP - LIGHT POLE
M - MANHOLE
P - UTILITY
RC - REINFORCED CONCRETE
S - SEWER
V - VEHICLE

——— CONDUCTIVITY - MILLISIEMENS/METER (mS/m)

——— IN-PHASE COMPONENT - PARTS PER THOUSAND OF PRIMARY ELECTROMAGNETIC FIELD (PPT)

NOTE:

REFER TO FIGURE 1
FOR LOCATION OF SURVEY LINES

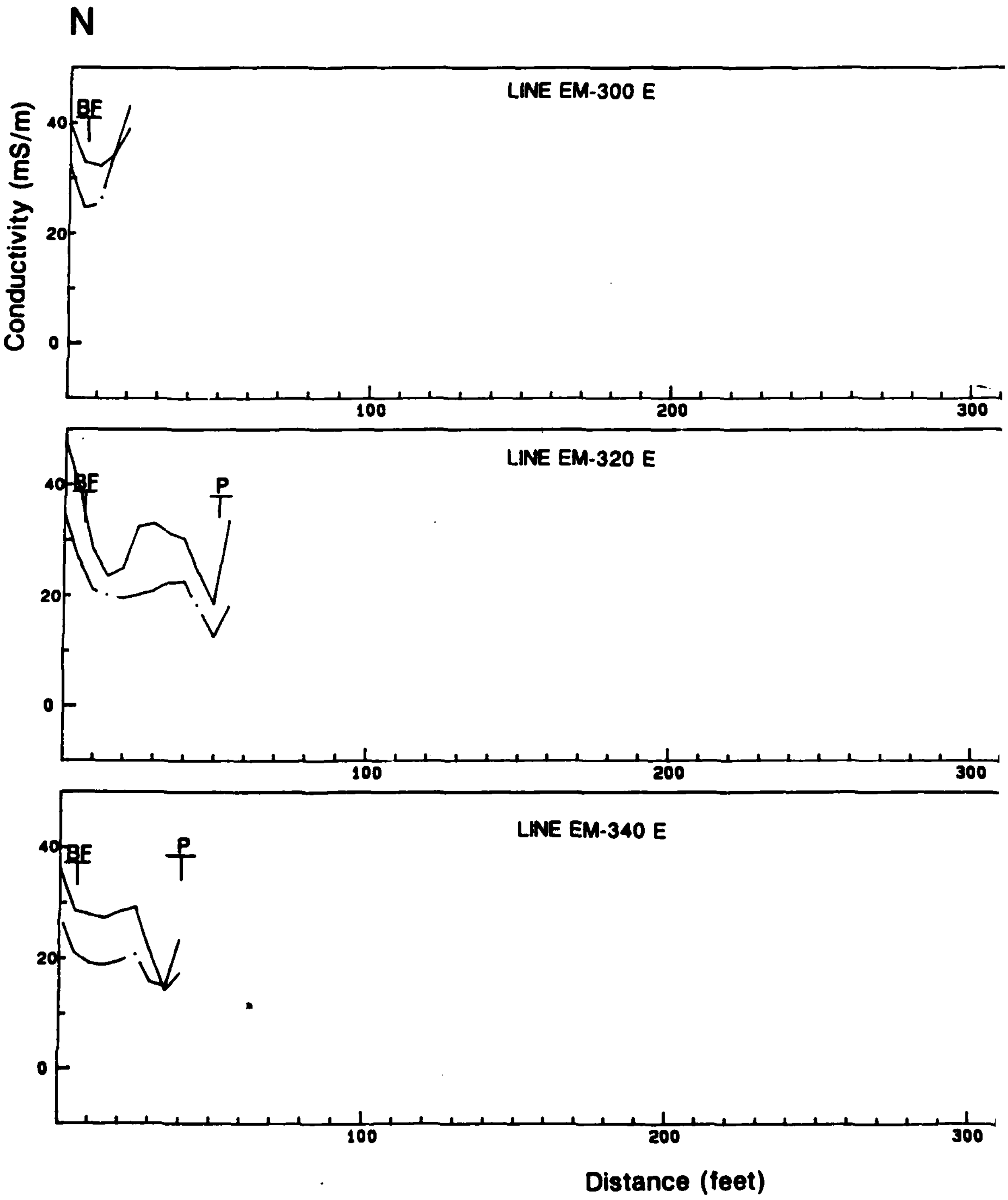
FIGURE B-11

ELECTROMAGNETIC INDUCTION PROFILES

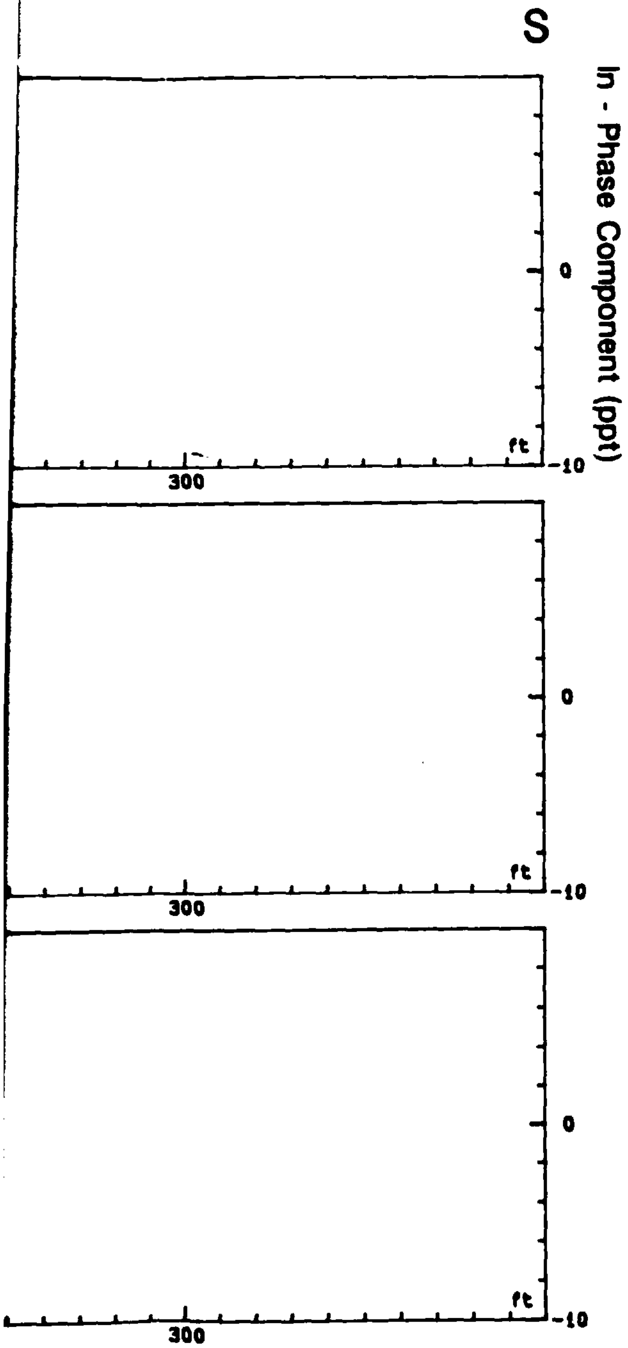
SITE 5 - AMMUNITION DISPOSAL AREA
161 AREFG
SKY HARBOR IAP
PHOENIX, ARIZONA

INTERNATIONAL
TECHNOLOGY
CORPORATION

DRAWN BY	J. WALL 4-24-91	CHECKED BY	L.C. 4/30/91
		APPROVED BY	4/30/91
DRAWING NUMBER	409721-B11		



Do Not Scale This Drawing



LEGEND:

B - BUILDING
BF - BLAST FENCE
F - FENCE
FH - FIRE HYDRANT
LP - LIGHT POLE
M - MANHOLE
P - UTILITY
RC - REINFORCED CONCRETE
S - SEWER
V - VEHICLE

——— CONDUCTIVITY - MILLISIEMENS/METER (mS/m)

—·— IN-PHASE COMPONENT - PARTS PER THOUSAND OF PRIMARY ELECTROMAGNETIC FIELD (PPT)

NOTE:

REFER TO FIGURE 1
FOR LOCATION OF SURVEY LINES

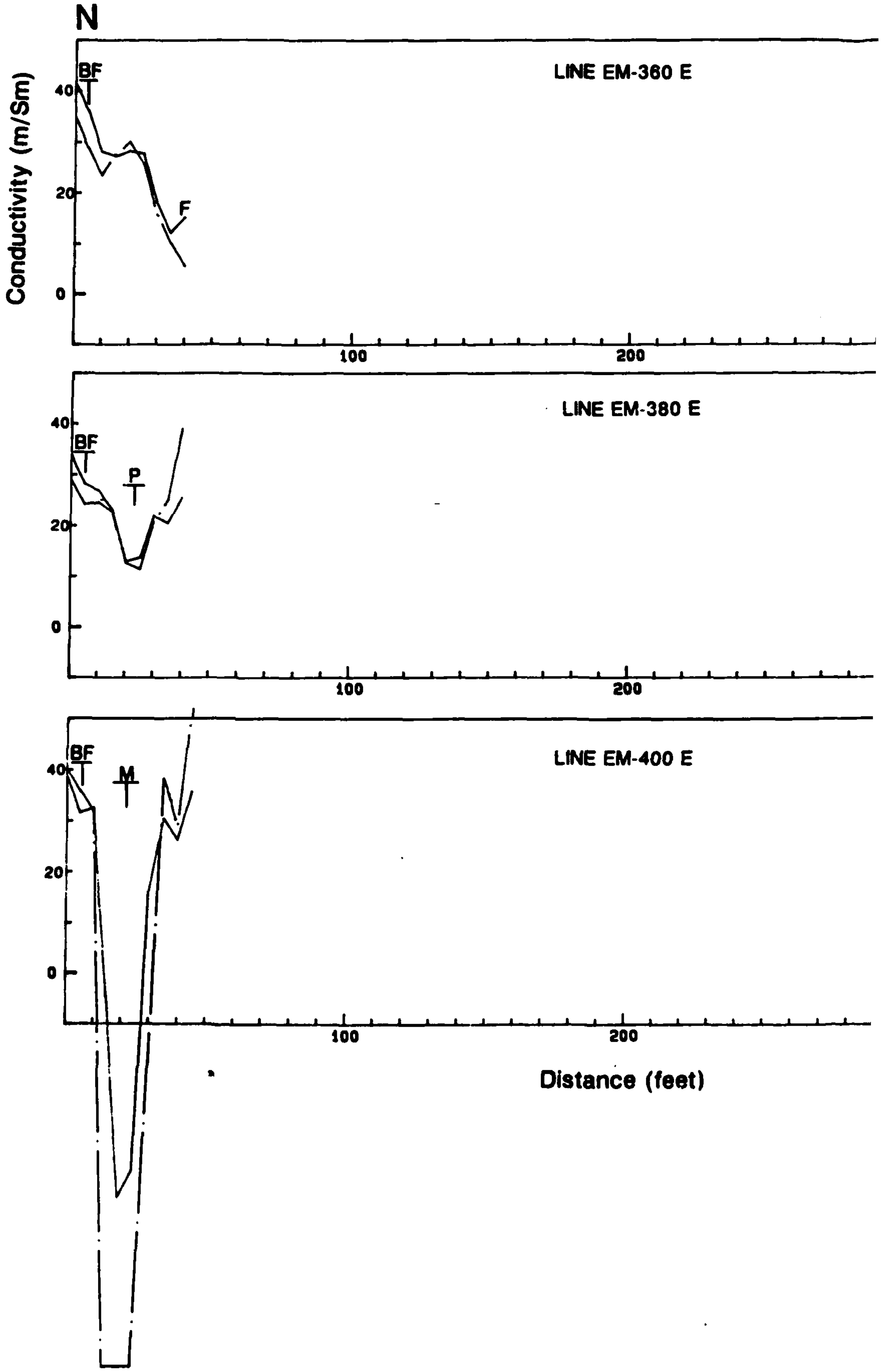
FIGURE B-12

ELECTROMAGNETIC INDUCTION PROFILES

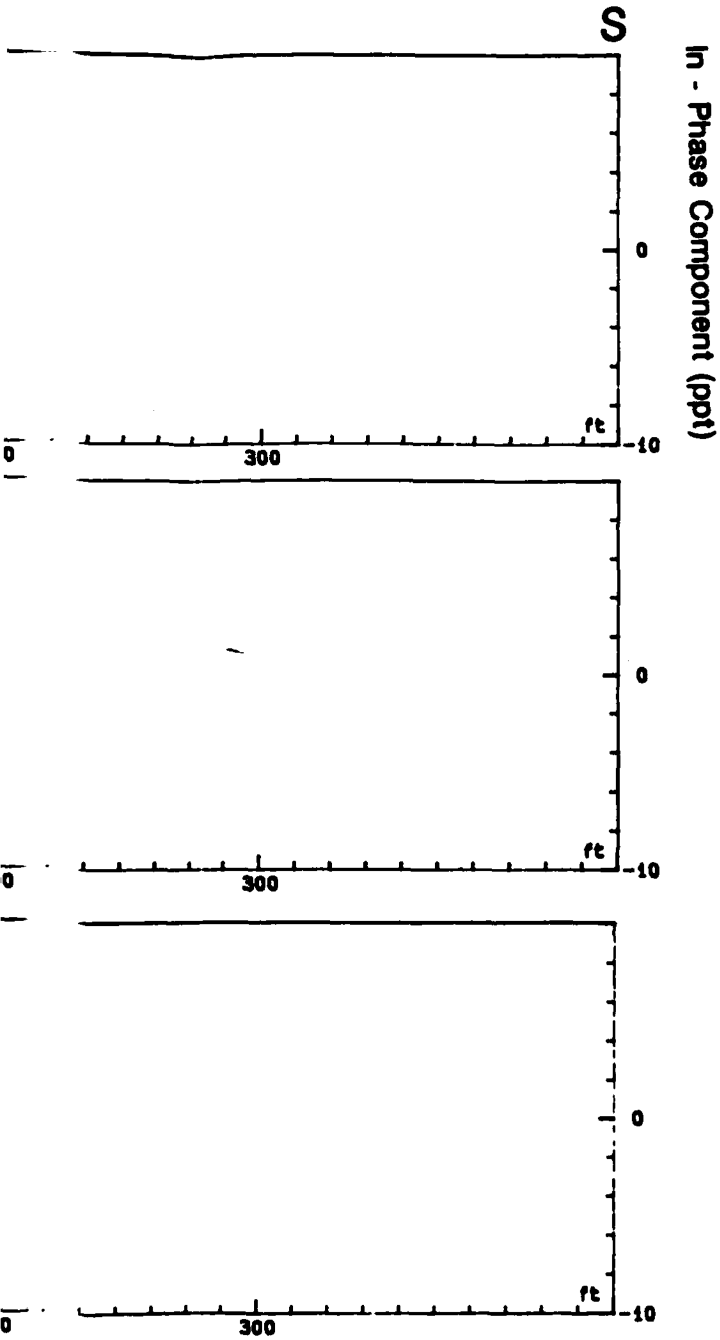
SITE 5 - AMMUNITION DISPOSAL AREA
161 AREFG
SKY HARBOR IAP
PHOENIX, ARIZONA

INTERNATIONAL
TECHNOLOGY
CORPORATION

DRAWN BY	J. WALL	CHECKED BY	C.C.	4/30/91	DRAWING NUMBER	409721-B18
	4-24-91	APPROVED BY		11/13/91		



Do Not Scale This Drawing



LEGEND:

B - BUILDING
BF - BLAST FENCE
F - FENCE
FH - FIRE HYDRANT
LP - LIGHT POLE
M - MANHOLE
P - UTILITY
RC - REINFORCED CONCRETE
S - SEWER
V - VEHICLE

——— CONDUCTIVITY - MILLISIEMENS/METER (mS/m)

—·— IN-PHASE COMPONENT - PARTS PER THOUSAND OF PRIMARY ELECTROMAGNETIC FIELD (PPT)

NOTE:

REFER TO FIGURE 1
FOR LOCATION OF SURVEY LINES

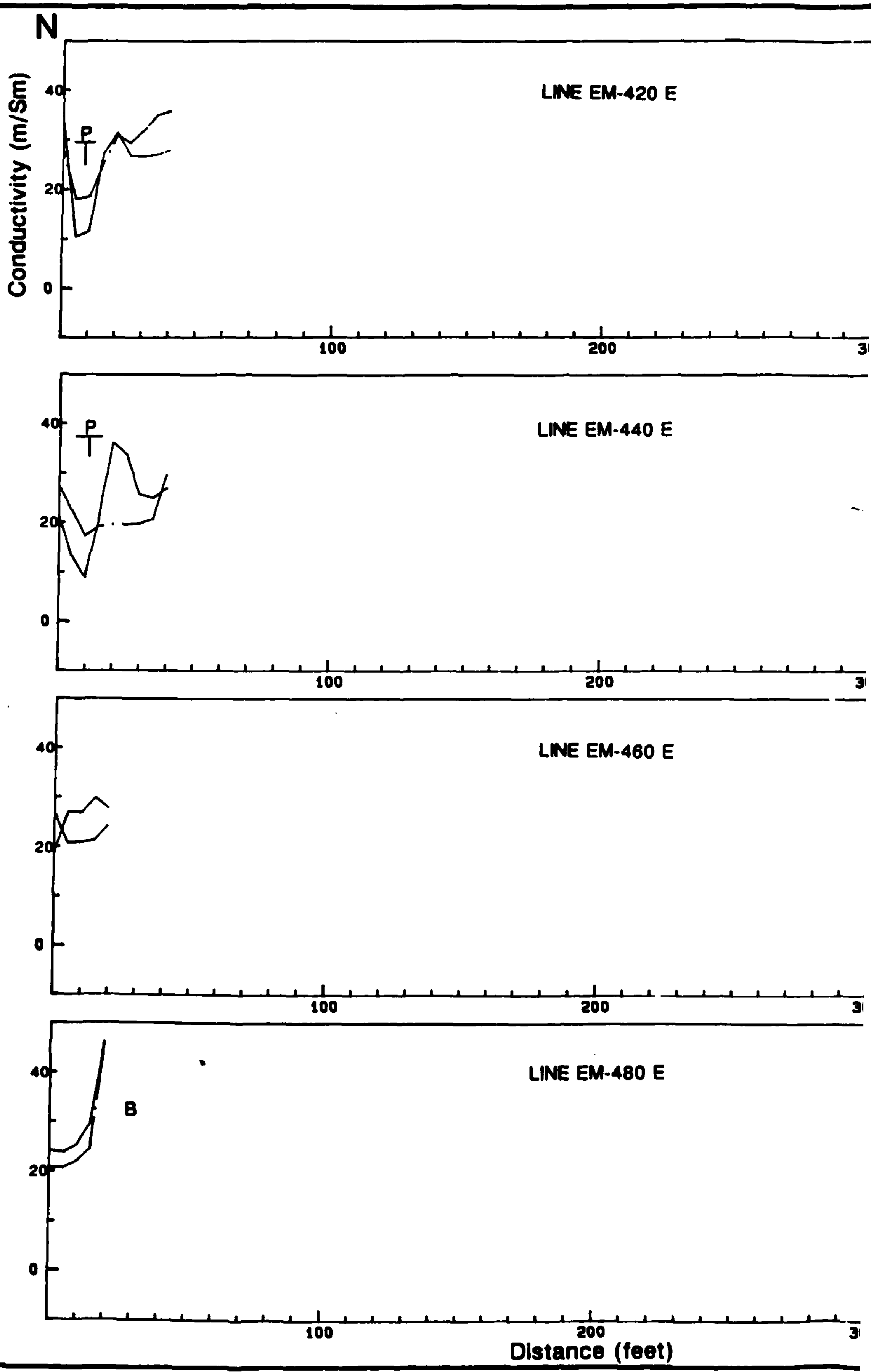
FIGURE B-13

ELECTROMAGNETIC INDUCTION PROFILES

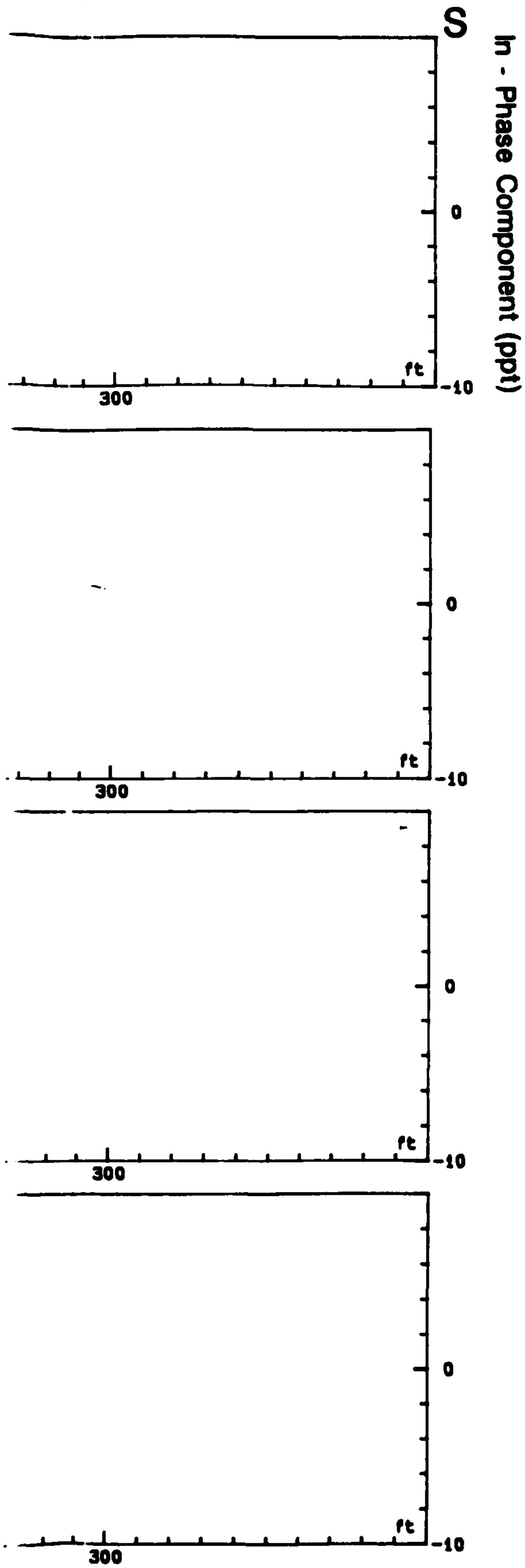
SITE 5 - AMMUNITION DISPOSAL AREA
161 AREFG
SKY HARBOR IAP
PHOENIX, ARIZONA

INTERNATIONAL
TECHNOLOGY
CORPORATION

DRAWN BY	J. WALL	CHECKED BY	L.C.	4/30/91	DRAWING NUMBER	409721-B10
	4-24-91	APPROVED BY	[illegible]	4/30/91		



Do Not Scale This Drawing



LEGEND:

B - BUILDING
BF - BLAST FENCE
F - FENCE
FH - FIRE HYDRANT
LP - LIGHT POLE
M - MANHOLE
P - UTILITY
RC - REINFORCED CONCRETE
S - SEWER
V - VEHICLE

——— CONDUCTIVITY - MILLISIEMENS/METER (mS/m)

—·— IN-PHASE COMPONENT - PARTS PER THOUSAND OF PRIMARY ELECTROMAGNETIC FIELD (PPT)

NOTE:

REFER TO FIGURE 1
FOR LOCATION OF SURVEY LINES

FIGURE B-14

ELECTROMAGNETIC INDUCTION PROFILES

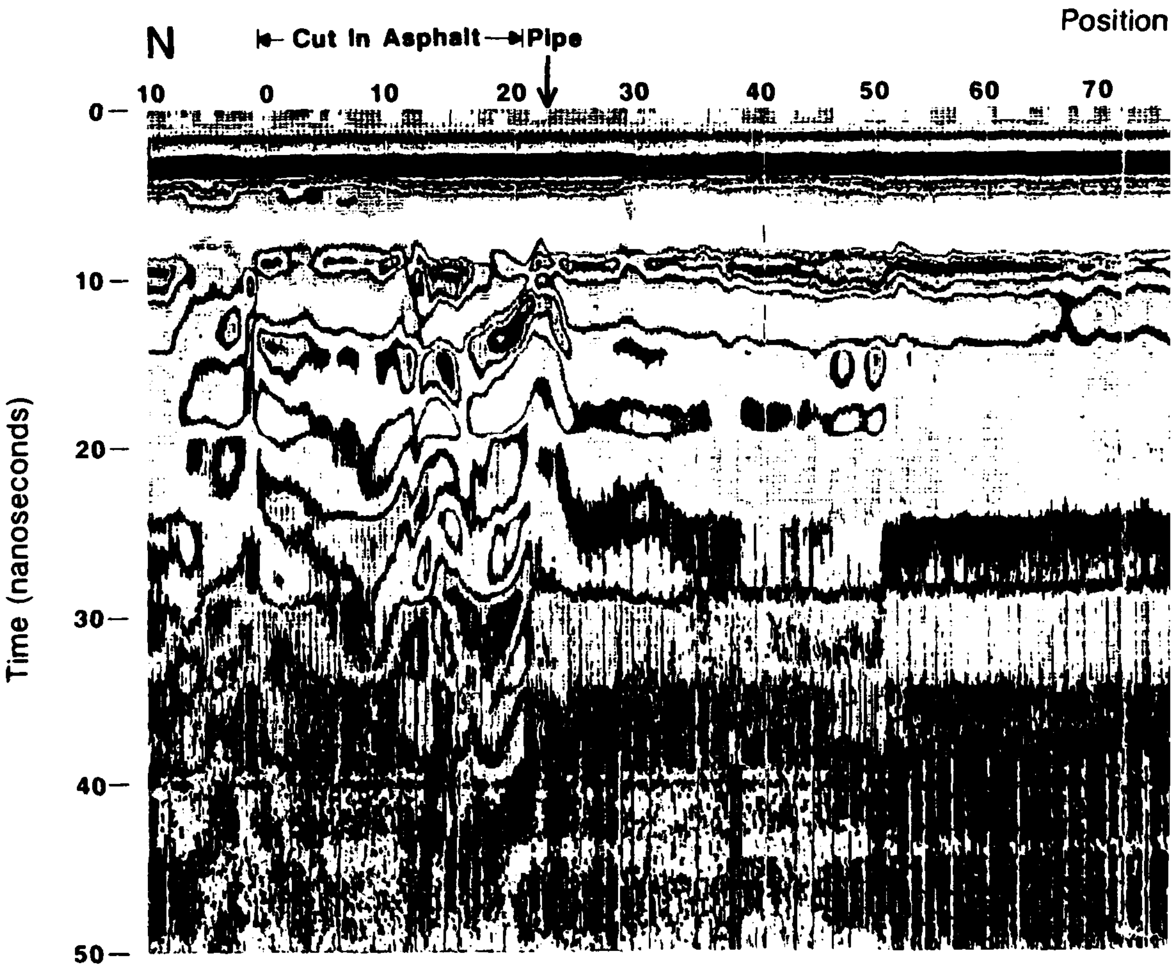
SITE 5 - AMMUNITION DISPOSAL AREA
161 AREFG
SKY HARBOR IAP
PHOENIX, ARIZONA

INTERNATIONAL
TECHNOLOGY
CORPORATION

APPENDIX C

SELECTED GROUND PENETRATING RADAR RECORDS

DRAWN BY	J. WALL 4-24-91	CHECKED BY APPROVED BY	4/30/91 4/30/91
DRAWING NUMBER	409721-B4		



Do Not Scale This Drawing

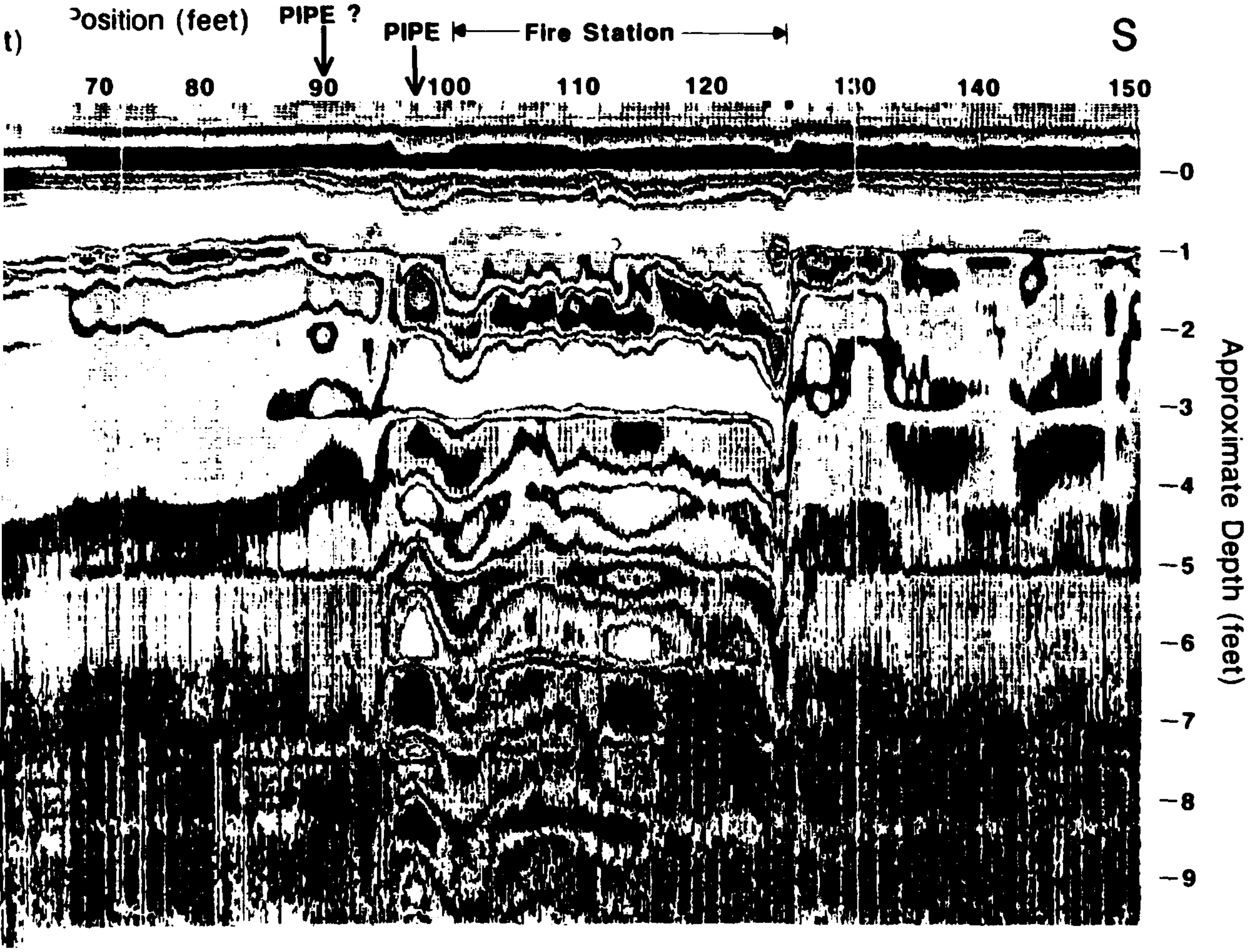


FIGURE C-1

GROUND PENETRATING RADAR

LINE 360 E, 300 MHz ANTENNA
SITE 5 - AMMUNITION DISPOSAL AREA
161 AREFG
SKY HARBOR IAP
PHOENIX, ARIZONA

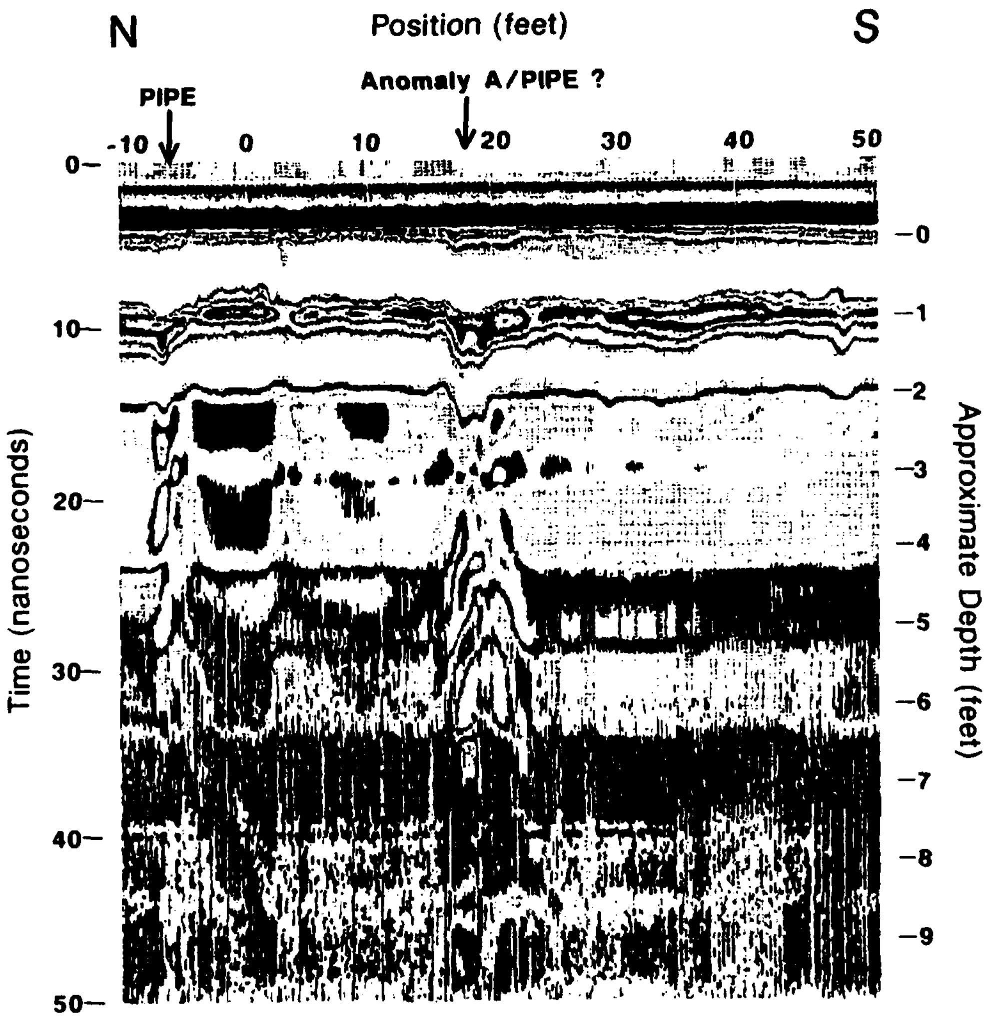
INTERNATIONAL
TECHNOLOGY
CORPORATION

DRAWN BY J. WALL 4-24-91

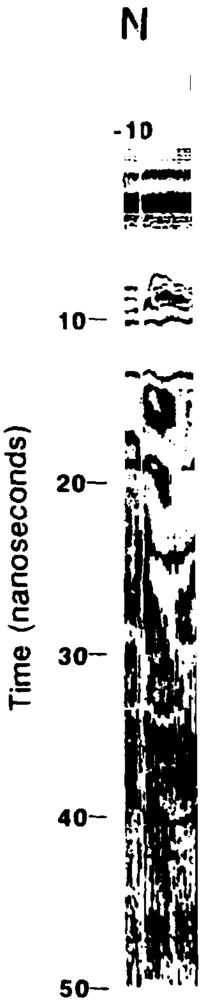
CHECKED BY 4/30/91

APPROVED BY 4/30/91

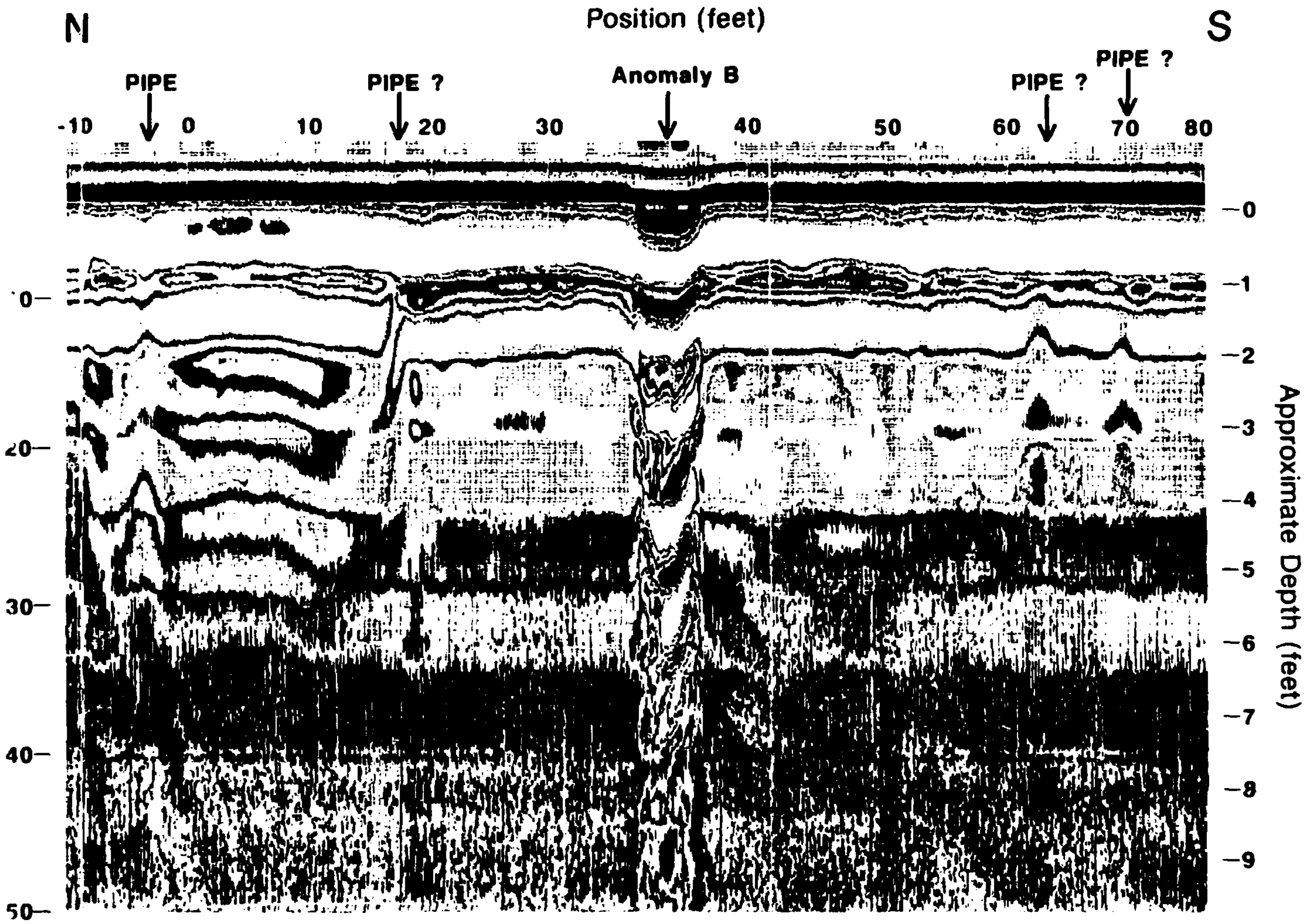
DRAWING NUMBER 409721-B3



LINE 440 E



Do Not Scale This Drawing



LINE 460 E

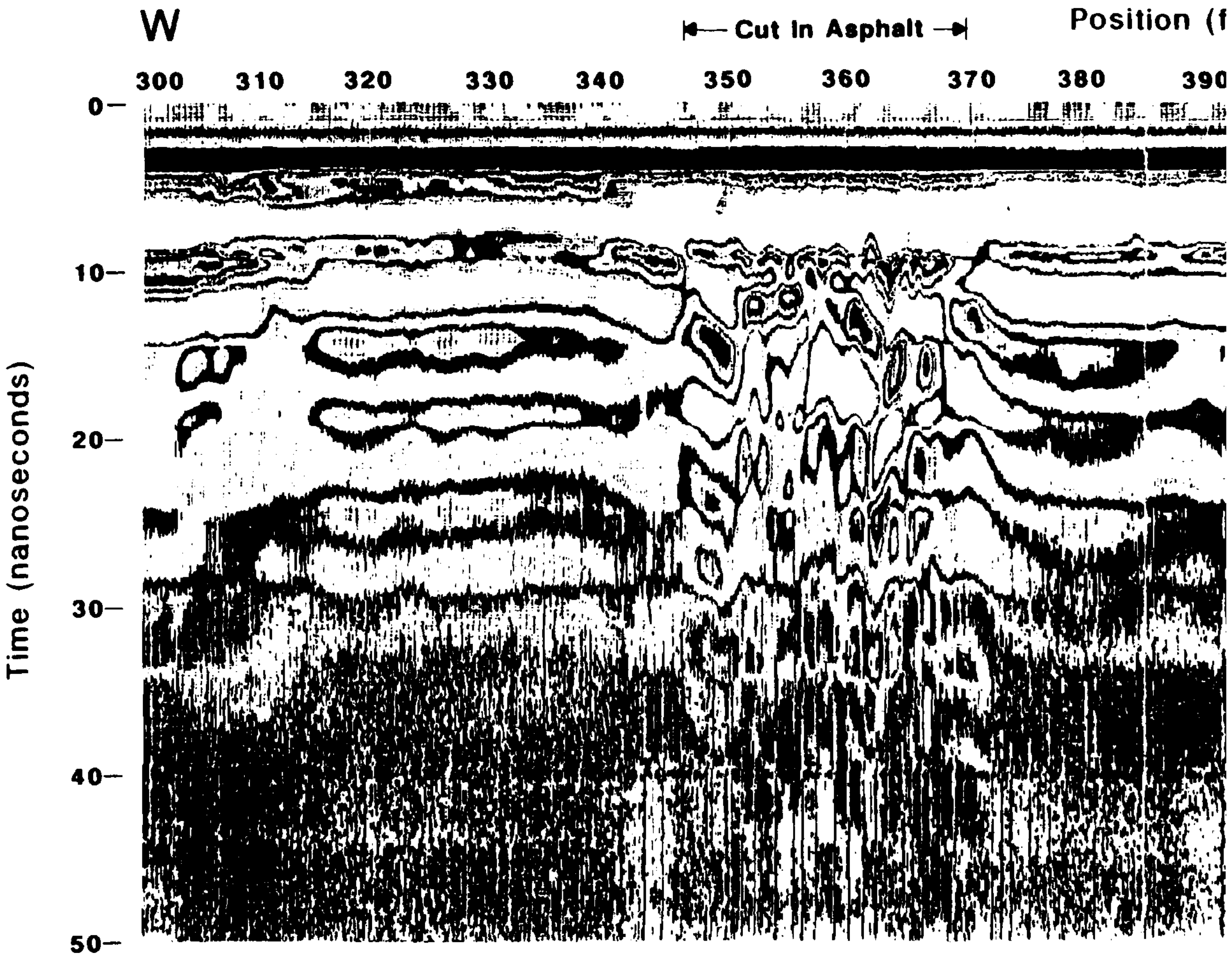
FIGURE C-2

GROUND PENETRATING RADAR
LINES 440 E & 460 E
300 MHz ANTENNA

SITE 5 AMMUNITION DISPOSAL AREA
161 AREFG
SKY HARBOR IAP
PHOENIX, ARIZONA

INTERNATIONAL
TECHNOLOGY
CORPORATION

DRAWN BY	J. WALL	CHECKED BY		4/30/91	DRAWING NUMBER	409721-B2
	4-24-91	APPROVED BY		4/30/91		



Do Not Scale This Drawing

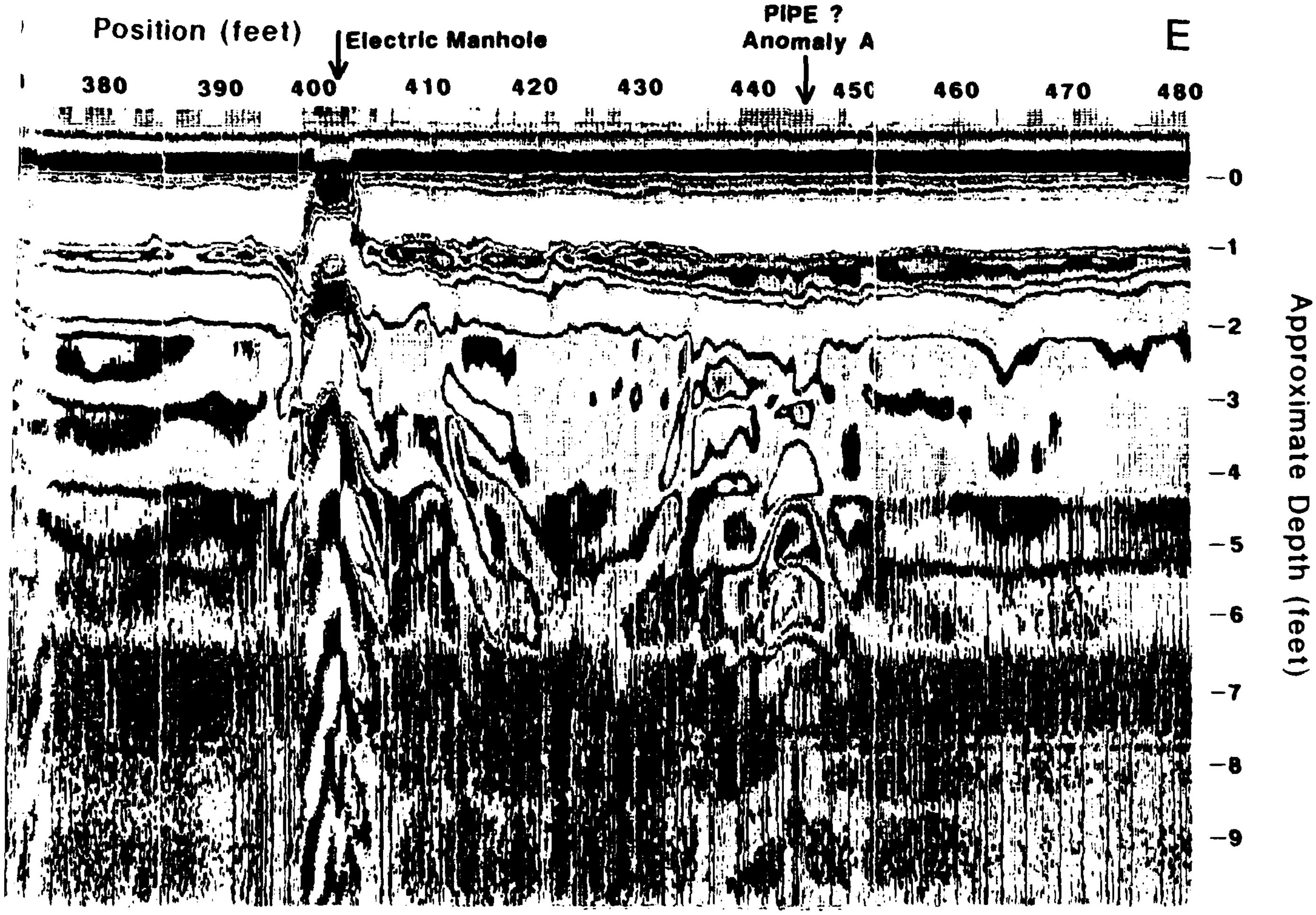


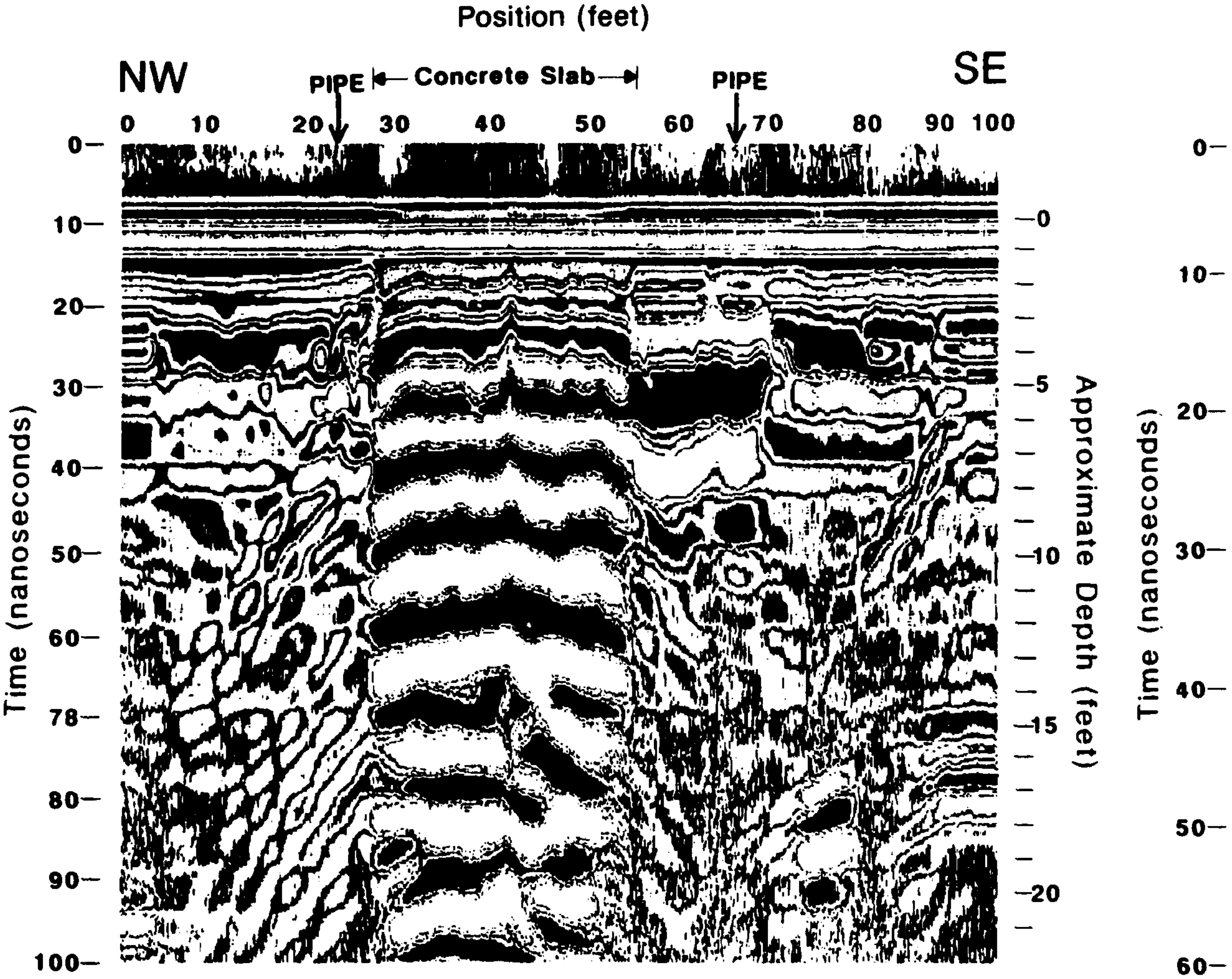
FIGURE C-3

GROUND PENETRATING RADAR

LINE 20 S, 300 MHz ANTENNA
SITE 5 · AMMUNITION DISPOSAL AREA
161 AREFG

SKY HARBOR IAP
PHOENIX, ARIZONA

INTERNATIONAL
TECHNOLOGY
CORPORATION



120 MHz

DRAWN BY J. WALL 4-24-91
CHECKED BY L.C. 4/30/91
APPROVED BY 4/30/91
DRAWING NUMBER 409721-B1

Do Not Scale This Drawing

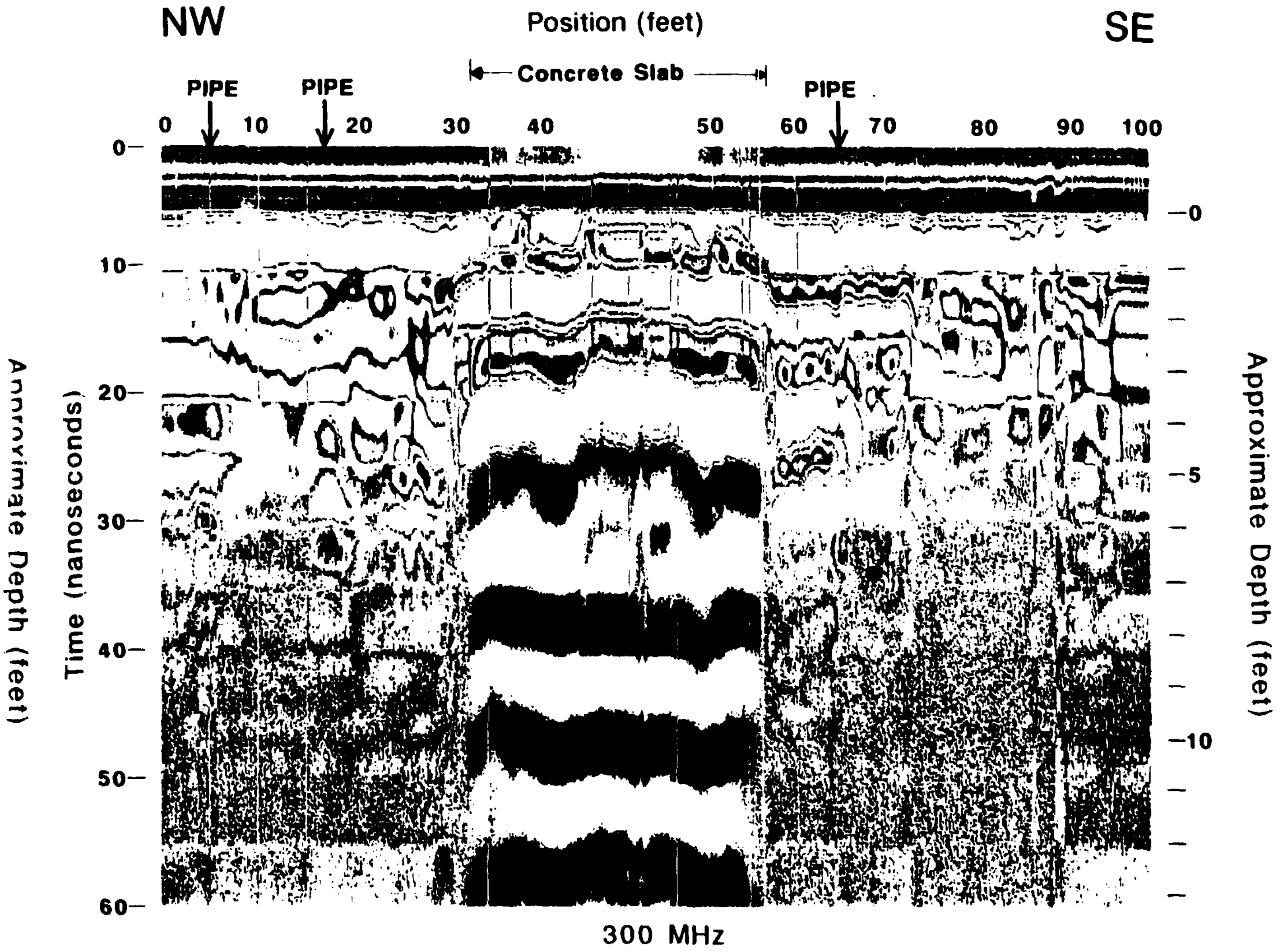


FIGURE C-4

GROUND PENETRATING RADAR

LINE GPR-4
120 AND 300 MHz ANTENNAE
SITE 5 - AMMUNITION DISPOSAL AREA
161 AREFG

SKY HARBOR IAP
PHOENIX, ARIZONA

INTERNATIONAL TECHNOLOGY CORPORATION

APPENDIX D

SOV SURVEY REPORT

SOIL GAS SURVEY

SKY HARBOR AIR NATIONAL BASE
& PAPAGO MILITARY RESERVATION
PHOENIX, ARIZONA

TARGET ENVIRONMENTAL SERVICES, INC.

SOIL GAS SURVEY
SKY HARBOR AIR NATIONAL BASE
& PAPAGO MILITARY RESERVATION
PHOENIX, ARIZONA

PREPARED FOR

IT CORPORATION
312 DIRECTORS DRIVE
KNOXVILLE, TENNESSEE

PREPARED BY

TARGET ENVIRONMENTAL SERVICES, INC.
9180 RUMSEY ROAD
COLUMBIA, MARYLAND 21045
(301) 992-6622

FEBRUARY 1991

EXECUTIVE SUMMARY

From January 15-17, 1991, **TARGET** Environmental Services, Inc. (**TARGET**) conducted a soil gas survey at the Sky Harbor Air National Guard Base and at the Papago Military Reservation, Phoenix, Arizona, as part of a site investigation. Samples were analyzed by GC/FID for petroleum hydrocarbons and by GC/ECD for chlorinated hydrocarbons.

Very low levels of FID Total Volatiles occurred in several locations in the JP-4 Hydrant Area and the Hazardous Waste Storage Area at the Sky Harbor Air National Guard Base and at the Papago Military Reservation. None of the standardized FID analytes were present above their 1 μg/l detection limit in any of the areas at either site.

GC/ECD analysis indicated that relatively low levels of 1,1-dichloroethene (1,1-DCE) were present in samples collected from the JP-4 Hydrant Area and the Hazardous Waste Storage Area at the Sky Harbor Air National Guard Base. Tetrachloroethene (PCE) was observed in all field samples. However, since comparable levels were also observed in all Field Control Samples (indicating persistent carryover in the sampling equipment), it is questionable whether the concentrations present in the field samples accurately reflect conditions in the soil gas at the sampling locations. None of the other standardized halogenated hydrocarbons were present above their respective detection limit in any soil gas samples from either site.

Introduction

IT Corporation contracted **Target** Environmental Services, Inc. (**TARGET**) to perform a soil gas survey at three locations on the Sky Harbor National Guard Base and at one location on the Papago Military Reservation, both in Phoenix, Arizona, as part of a site investigation. The field and analytical phases of the work were performed from January 15-17, 1991.

Field Procedures

Soil gas samples were collected at a total of 32 locations at the three sites. Fourteen (14) samples were collected at Site 1 (JP-4 Hydrant Area), 11 with the hydraulic probe and 3 with the drive rod. Twelve (12) samples were collected in Site 2 (Hazardous Waste Storage Area), all using the hydraulic probe. Sampling was attempted but was unsuccessful in three locations in Site 3 (Fuel Bladder Area). Six (6) samples were collected at the hazardous waste collection area on the Papago Military Reservation, all with the drive rod. Sampling order is included in Table 1 and sampling depths are shown in Table 2.

To collect samples with the van-mounted hydraulic probe, the probe was used to advance connected 3' sections of 1" diameter threaded steel casing down to the sampling depth. Although the proposed sampling depth was 10', some samples were collected at shallower depths due to probe refusal. The entire sampling system was purged with ambient air drawn through an organic vapor filter cartridge. A teflon line was inserted into the casing to the bottom of the hole, and the bottom-hole line perforations were isolated from the up-hole annulus by an inflatable packer.

To collect samples with the drive rod, a 1/2 inch hole was produced to the sampling depth. Where pavement was present, an electric hammer drill was employed for penetration prior to using the drive rod. The entire sampling system was purged with ambient air drawn through an organic vapor filter cartridge, and a stainless steel probe was inserted to the full depth of the hole and sealed off from the atmosphere.

Whether using the hydraulic probe or the drive rod, a sample of in-situ soil gas was then withdrawn through the probe and used to purge atmospheric air from the sampling system. A second sample of soil gas was withdrawn through the probe and encapsulated in a pre-evacuated glass vial at two atmospheres of pressure (15 psig). The self-sealing vial was detached from the sampling system, packaged, labeled, and transported to the laboratory for analysis.

Prior to the day's field activities all sampling equipment, drive rods, and probes were decontaminated by washing with soapy water and rinsing thoroughly. Internal surfaces were flushed dry using pre-purified nitrogen, and external surfaces were wiped clean using clean paper towels.

Field control samples were collected at the beginning and end of each day's field activities and after finishing a day's sampling in an area. These QA/QC samples were obtained by inserting the probe tip into a tube flushed by a 20 psi flow of pre-purified nitrogen and collecting in the same manner as described above.

Laboratory Procedures

All of the samples collected during the field phase of the survey were subjected to dual analyses in the field in **TARGET**'s climate-controlled mobile laboratory using a Shimadzu 14-A gas chromatograph.

The first analysis was conducted according to EPA Method 601 (modified) on a gas chromatograph equipped with an electron capture detector (ECD), but using direct injection instead of purge and trap. Specific analytes standardized for this analysis were:

1,1-dichloroethene (1,1-DCE)
1,1,1-trichloroethane (1,1,1-TCA)
tetrachloroethene (PCE)

Ten other halogenated hydrocarbons are also included in **TARGET**'s standard gas mixture and are standardized in every analytical batch. These compounds (and their respective detection limits, in µg/l) are trichlorofluoromethane (0.05), methylene chloride (1.0), trans-1,2-dichloroethene (1.0), 1,1-dichloroethane (1.0), cis-1,2-dichloroethene (1.0), chloroform (0.10), carbon tetrachloride (0.05), trichloroethene (0.10), 1,1,2-trichloroethane (0.10), and 1,1,2,2-tetrachloroethane (0.1).

The second analysis was conducted according to EPA Method 602 (modified) on a gas chromatograph equipped with a flame ionization detector (FID), but using direct injection instead of purge and trap. The analytes selected for standardization in this analysis were:

benzene
toluene
ethylbenzene
meta- and para- xylene
ortho-xylene

These compounds were chosen because of their utility in evaluating the presence of fuel products, or petroleum based solvents.

The FID Total Volatiles values were generated by summing the areas of all chromatogram peaks and calculated using the instrument response factor for toluene. Injection peaks, which also contain the light hydrocarbon methane, were excluded to avoid the skewing of the Total Volatiles (Totals) values due to injection disturbances and biogenic methane. For samples with low hydrocarbon concentrations, the calculated Total Volatiles concentration is occasionally lower than the sum of the individual analytes. This is because the response factor used for the Total Volatiles calculation is a constant, whereas the individual analyte response factors vary with concentration. It is important to understand that the Total Volatiles levels reported are relative, not absolute, values.

The analytical equipment was calibrated using an instrument-response curve and injection of known concentrations of the above standards. Retention times of the standards were used to identify the peaks in the chromatograms of the field samples and their response factors were used to calculate the analyte concentrations. The tabulated results of the laboratory analyses of the soil gas samples are reported in micrograms per liter (µg/l) in Tables 3 through 5. Although "micrograms per liter" is equivalent to "parts per billion (v/v)" in water analyses, they are not equivalent in gas analyses, due to the difference in the mass of equal volumes of water and gas matrices.

For QA/QC purposes, a duplicate analysis was performed on every tenth field sample. Laboratory blanks of nitrogen gas (99.999%) were also analyzed after every tenth field sample.

Quality Assurance Samples

All laboratory blanks were free of detectable levels of the standardized analytes.

All Field Control Samples contained tetrachloroethene (PCE) ranging from 0.08 to 4.0 µg/l, indicating persistent carryover in the sampling equipment. The PCE observed in the field samples (0.60 to 6.7 µg/l) may not accurately reflect conditions in the soil gas at the sampling locations. Unsuccessful attempts were made to remove the contamination from the sampling equipment. Instead of immediately outflushing the nitrogen drawn into the sampling system during the purging step, the nitrogen was allowed to set in the sampling box for 5 minutes prior to flushing. In addition, sampling boxes were evacuated for 1/2 hour at the end of each day.

Analyte concentrations in duplicate sample pairs were within acceptable limits.

TABLE 1

SAMPLING ORDER

JANUARY 15, 1991	JANUARY 16, 1991	JANUARY 17, 1991
SITE 2 SAMPLE	**SITE 1 SAMPLE**	**SITE 4 SAMPLE**
1*	6*	1*
2	7	2
3	8	3
4	9	4
5	10	5
6	11	6
7	12	7
8	13**	8**
9		
10		
11		
12		
13**		
SITE 1 SAMPLE	**SITE 2 SAMPLE**	**SITE 1 SAMPLE**
1	14	14
2	15***	15
3		16
4		17
5***		18***

* Beginning of Day, Field Control Sample
** Field Control Sample
***End of Day, Field Control Sample

TABLE 2

SAMPLING DEPTH SITE 1

SAMPLE	FEET
1	10
2	9
3	10
4	10
7	10
8	10
9	10
10	10
11	7
12	7
14	10
15	4
16	4
17	4

SAMPLING DEPTH SITE 2

SAMPLE	FEET
2	10
3	10
4	10
5	10
6	10
7	9
8	10
9	10
10	9
11	9
12	10
14	10

SAMPLING DEPTH SITE 4

SAMPLE	FEET
2	2
3	2
4	4
5	3
6	2
7	2

TABLE 3

*LABORATORY RESULTS FOR SITE 1
CONCENTRATIONS IN MICROGRAMS PER LITER

SAMPLE	BENZENE	TOLUENE	ETHYL-BENZENE	m- & p-XYLENE	o-XYLENE	FID TOTAL VOLATILES[1]	11DCE	111TCA	PCE
1	<1.0	<1.0	<1.0	<1.0	<1.0	1.5	<1.0	<0.10	6.0
2	1.3	<1.0	<1.0	<1.0	<1.0	12	<1.0	<0.10	5.2
3	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.4	<0.10	6.0
4	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	2.2	<0.10	4.2
7	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	0.62
8	<1.0	<1.0	<1.0	<1.0	<1.0	1.1	<1.0	<0.10	6.7
9	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	5.7
10	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	2.1
11	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	2.6
12	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	2.1
14	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	4.8
15	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	1.8
16	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	0.75
17	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	0.83

*** BTEX WERE ANALYZED VIA GC/FID AND HALOCARBONS WERE ANALYZED VIA GC/ECD.**

11DCE = 1,1-dichloroethene
111TCA = 1,1,1-trichloroethane
PCE = tetrachloroethene

[1] CALCULATED USING THE SUM OF THE AREAS OF ALL INTEGRATED CHROMATOGRAM PEAKS AND THE INSTRUMENT RESPONSE FACTOR FOR TOLUENE

TABLE 3 (cont)

*LABORATORY RESULTS FOR SITE 1
CONCENTRATIONS IN MICROGRAMS PER LITER

SAMPLE	BENZENE	TOLUENE	ETHYL-BENZENE	m- & p-XYLENE	o-XYLENE	FID TOTAL VOLATILES[1]	11DCE	111TCA	PCE
FIELD CONTROL SAMPLES									
5	<1.0	<1.0	<1.0	<1.0	<1.0	7.7	<1.0	<0.10	0.42
6	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	0.08
13	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	0.11
18	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	0.38
LABORATORY DUPLICATE ANALYSES									
15	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	1.8
15R	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	1.9
LABORATORY BLANKS									
BCITP-1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	<0.05

*** = BTEX WERE ANALYZED VIA GC/FID AND HALOCARBONS WERE ANALYZED VIA GC/ECD.**

11DCE = 1,1-dichloroethene
111TCA = 1,1,1-trichloroethane
PCE = tetrachloroethene

[1] CALCULATED USING THE SUM OF THE AREAS OF ALL INTEGRATED CHROMATOGRAM PEAKS AND THE INSTRUMENT RESPONSE FACTOR FOR TOLUENE

TABLE 4

*LABORATORY RESULTS FOR SITE 2
CONCENTRATIONS IN MICROGRAMS PER LITER

SAMPLE	BENZENE	TOLUENE	ETHYL-BENZENE	m- & p-XYLENE	o-XYLENE	FID TOTAL VOLATILES[1]	11DCE	111TCA	PCE
2	<1.0	<1.0	<1.0	<1.0	<1.0	1.0	1.3	<0.10	5.6
3	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.6	<0.10	4.5
4	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.7	<0.10	3.2
5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.6	<0.10	4.0
6	<1.0	<1.0	<1.0	<1.0	<1.0	1.1	1.2	<0.10	1.9
7	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.5	<0.10	2.1
8	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.2	<0.10	1.5
9	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	2.6
10	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	2.4
11	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	3.3
12	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.5	<0.10	2.6
14	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	2.7

* = BTEX WERE ANALYZED VIA GC/FID AND HALOCARBONS WERE ANALYZED VIA GC/ECD.

11DCE = 1,1-dichloroethene
111TCA = 1,1,1-trichloroethane
PCE = tetrachloroethene

[1] CALCULATED USING THE SUM OF THE AREAS OF ALL INTEGRATED CHROMATOGRAM PEAKS AND THE *INSTRUMENT RESPONSE* FACTOR FOR TOLUENE

TABLE 4 (cont)

*LABORATORY RESULTS FOR SITE 2
CONCENTRATIONS IN MICROGRAMS PER LITER

SAMPLE	BENZENE	TOLUENE	ETHYL-BENZENE	m- & p-XYLENE	o-XYLENE	FID TOTAL VOLATILES[1]	11DCE	111TCA	PCE
FIELD CONTROL SAMPLES									
1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	4.0
13	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	1.3
15	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	0.45
LABORATORY DUPLICATE ANALYSES									
10	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	2.4
10R	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	2.4
14	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	2.7
14R	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	2.5

*** = BTEX WERE ANALYZED VIA GC/FID AND HALOCARBONS WERE ANALYZED VIA GC/ECD.**

11DCE = 1,1-dichloroethene
111TCA = 1,1,1-trichloroethane
PCE = tetrachloroethene

[1] CALCULATED USING THE SUM OF THE AREAS OF ALL INTEGRATED CHROMATOGRAM PEAKS AND THE INSTRUMENT RESPONSE FACTOR FOR TOLUENE

TABLE 4 (cont)

*LABORATORY RESULTS FOR SITE 2
CONCENTRATIONS IN MICROGRAMS PER LITER

SAMPLE	BENZENE	TOLUENE	ETHYL-BENZENE	m- & p- XYLENE	o- XYLENE	FID TOTAL VOLATILES[1]	11DCE	111TCA	PCE
LABORATORY BLANKS									
BCITP-1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	<0.05
BCITP-2	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	<0.05

* = BTEX WERE ANALYZED VIA GC/FID AND HALOCARBONS WERE ANALYZED VIA GC/ECD.

11DCE = 1,1-dichloroethene
111TCA = 1,1,1-trichloroethane
PCE = tetrachloroethene

[1] CALCULATED USING THE SUM OF THE AREAS OF ALL INTEGRATED CHROMATOGRAM PEAKS AND THE INSTRUMENT RESPONSE FACTOR FOR TOLUENE

TABLE 5

*LABORATORY RESULTS FOR SITE 4
CONCENTRATIONS IN MICROGRAMS PER LITER

SAMPLE	BENZENE	TOLUENE	ETHYL-BENZENE	m- & p-XYLENE	o-XYLENE	FID TOTAL VOLATILES[1]	11DCE	111TCA	PCE
2	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	4.2
3	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	1.3
4	<1.0	<1.0	<1.0	<1.0	<1.0	1.2	<1.0	<0.10	0.60
5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	1.3
6	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	1.9
7	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	0.75
FIELD CONTROL SAMPLES									
1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	0.46
8	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	0.17
LABORATORY BLANKS									
BCITP-1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	<0.05

* = BTEX WERE ANALYZED VIA GC/FID AND HALOCARBONS WERE ANALYZED VIA GC/ECD.

11DCE = 1,1-dichloroethene
111TCA = 1,1,1-trichloroethane
PCE = tetrachloroethene

[1] CALCULATED USING THE SUM OF THE AREAS OF ALL INTEGRATED CHROMATOGRAM PEAKS AND THE INSTRUMENT RESPONSE FACTOR FOR TOLUENE

APPENDIX E

SOIL BORING LOGS

REV. DATE. MAY 1990

BORING LOG | BORING/WELL NO.: SH PIEZOMETER # 1 (PS-1) | Page 1 of 1

Installation: SKY HARBOR ANG | Site: JRT 1/19/91

Project No. 409721.02.06 | Client/Project: HAZWRAP / SKY HARBOR ANG

HAZWRAP Contractor: IT CORPORATION | Drlg Contractor: LAYNE ENVIRONMENTAL | Driller: DWIGHT PETERSON

Drlg Started: 1/15/91 (0750 am) | Drlg Ended: 1/15/91 (1335 pm) | Borehole dia(s): 9 3/4"

Drlg Method/Rig Type: AIR HAMMER CASING

Logged by: GARDINER | E-Log (Y / [✓ N]) From ____ to ____ | Protection Level: D (MODIFIED)

Depth (ft)	Sample	Sample No	Lab Anal. (Y / [✓ N])	Recovery ( )	Lithologic Description	Munsell Color	USCS	Blows/6 inch	Graphic Log	Well data	Water depth & Remarks	Elev (ft)
												1120.08
			N		0-9 ft. SAND: ~~Brown~~ RED, med grained at top; coarser to bottom. 1 ft. cobbles w/sand. 1 ft - gravel w/sand.	10R 3/3	SP GP					
			N		9-19 ft. SAND. Brown, med grained; Gravel w/ some sand at ~ 16 ft.	2.5YR 4/4	GP					
			N		19-29 ft. ~~20~~ SAND - Brown, poorly sorted, med. to coarse grained. Some gravel at 25 & 27 ft. Same as above, USC		GP					
			N		29-39 ft. Same. Note: At ~ 34 ft Dark Brown Drops appearing sand out of cyclone. HNu reading 5 ppm at coll. Drawn in cave no reading. Breathing zone: 0.		SP					
			N		39-49 ft. Same as above. Back to dry sand.		SP					
			N		49-59 ft. ~~Wet~~ MOIST at 50 ft. (No PID readings).							
			N		59-70 ft. Same as above. (Poorly sorted but coarse sand & gravel) Dry, No PID readings. Poorly sorted brown sand; coarse w/gravel. Color about same.		GP					
			N		70-80 ft. Wet. Hit water ca. 73-74 ft. Brown sand, poorly sorted, coarse grained occasional gravel; one cobble layer at ca. 76 ft	7.5 YR 5/4	SP GP				73-74 ft. WATER	
			N		80-90 ft. Same as above. Some free water		SP					
			N		90-100: Same as above		SP					

BOREHOLE DEPTH ≈ 100.5 ft.

NOTE: No sampler in use; observations are from cuttings as collected at the cyclone. Some specific depths are noted, where possible.

U = Thin Wall Tube | R = Rock Coring NA | Field G/C(Make/Mod.) NA

S = Split spoon(tube) | O = Other NA | G/C Oper.: NA

C = Cuttings | Notes: No Sampler in use

REV. DATE. MAY 1990

BORING LOG	BORING/WELL NO.: PS-2	Page 1 of 1
Installation: Sky Harbor ANG		Site:
Project No.: 407721.02.06	Client/Project: HAZWRAP / Sky Harbor ANG	
HAZWRAP Contractor: IT Corporation	Drlg Contractor: Layne Environmental	Driller: Doug Peterson
Drlg Started: ~~DOO~~ 1/15/91, 3:05 P m)	Drlg Ended: 1/16/91 (10:15 A m)	Borehole dia(s): 9 3/4 inches
Drlg Method/Rig Type: Air Hammer Casing /		
Logged by: Gardiner	E-Log (Y / [✓ N]) From ____ to ____	Protection Level: D (modified)

Depth (ft)	Sample	Sample No	Lab Anal (Y/N)	Recovery ( )	(ppm)	Lithologic Description	Munsell Color	USCS	Blows/6 inch	Graphic Log	Well data	Water depth & Remarks	Elev (ft)
0			N			0-10 ft: Sand. Damp, poorly sorted, medium to coarse grained. Cobbles at 6 ft. Lt. Brown	7.5 YR 6/4	SP GP					414.16
10			N			10-20 ft: (Cobbles at 15 ft, 18 ft.) Same	6/3	SP					
20			N			20-30 ft.: (Cobbles at 21): Sand, poorly sorted, coarse to very coarse. Some large occasional gravel.; Brown. Damp at 29 ft.	5/4	SP					
			N			30-40 ft.: Same as 20-30 ft. except some gravel w/ cobbles & is very angular. Damp		SP GP					
40			N			40-50 ft.: Sand; ~~Gra~~ very coarse grained. Dark Brown, angular, poorly sorted. Gravel, occasional cobbles. Damp.	4/4	SP					
60			N			50-60 ft. Sand: poorly sorted very coarse ~~gravel~~ sand to small gravel. Occasional small cobbles. Damp. Dark Brown	3/2	SP					
			N			60-70 ft.: Same as above, except no small angular gravel. Damp ~~[illegible]~~ (~~[illegible]~~)	to 3/3	SP					
80			N			70-80 ft: Same as 60-70 ft. Damp to wet (Water ca. 75?).		SP				Water at approx 75'	
			N			80-90 ft. Same to ca. 88 ft; 88-90 ft: Mostly gravel & cobbles w/ fine to medium grained silty sand stuck to them. Sticky, wet, Dark Brown	4/3	GP GM					
100			Y			90-100 ft: Blow water. Same as 80-~~[illegible]~~ section coarse cobbles & sand w/ silt.		GM					

Borehole Depth = ≅ 100'8"

Note: No sampler in use; observations are from cuttings as collected at the cyclone, some specific depths are noted, where possible.

U = Thin Wall Tube
S = Split spoon(tube)
C = Cuttings

R = Rock Coring NA
O = Other NA
Notes: No Sampler in Use

Field G/C(Make/Mod.) NA
G/C Oper.: NA

REV. DATE MAY 1990

BORING LOG
BORING/WELL NO.: PS-3
Page 1 of 1
Installation: SKY HARBOR ANG BASE
Site:
Project No.: 409721.02.06
Client/Project: HAZWRAP/SKY HARBOR ANG
HAZWRAP Contractor: IT CORPORATION
Drlg Contractor: LAYNE ENVIRONMENTAL
Driller: DWIGHT PETERSON
Drlg Started: 1/16/91 (12:55 P m)
Drlg Ended: 1/17/91 (9:10 A m)
Borehole dia(s): 9 3/4 inches
Drlg Method/Rig Type: AIR PERCUSSION HAMMER
Logged by: GARDINER
E-Log (Y / [✓ N]) From ____ to ____
Protection Level D (MODIFIED)

Depth (ft)	Sample	Sample No	Lab Anal. (Y/N)	Recovery ( )	ndsp ( )	Lithologic Description	USCS	Blows/6 inch	Graphic Log	Well data	Water depth & Remarks	Elev.
0			N			0-10ft: SAND; medium grained, MOSTLY WELL SORTED (5YR HUE 4/3), REDDISH BROWN. SUB ROUNDED TO SLIGHTLY ANGULAR.	SP					1114.13
20			N			10-20ft: SAME; GRAVEL AT ~18 ft. COLOR LESS RED, (H 7.5YR; 5/4) - Red Brown	SP					
			N			20-30ft.: SAND, MODERATELY SORTED, LIGHT BROWN (7.5YR 6/4), SMALL GRAVEL AT 29 ft & SMALL COBBLES AT 30ft., SUB ANGULAR	SP					
40			N			30-40 ft: SAND; medium grained (7.5YR 6/3), LARGE TO SMALL ANGULAR GRAVEL & SMALL ROUNDED COBBLES.	SP GP					
60			Y			40-50ft: SAND (DAMP FROM 46 ON DOWN) SAME AS 30-40 SAMPLE	SP GP					
80			N			50-60 ft.: SAND, MEDIUM TO COARSE GRAINED, POORLY SORTED, ANGULAR TO SUB ANGULAR; ANGULAR GRAVEL & ROUNDED COBBLES; DAMP. (7.5YR, 4/3)	SP					
			N			60-70ft. SAND, SAME AS BEFORE, DAMP (7.5YR 3/3) (DARK BROWN)	SP					
STET ~~100~~ JT 3-6-91			N			70-80ft.: SAND SAME AS 60-70ft. DAMP TO WET. ESTIMATE WATER AT 75 ft.						
JRT 3-6-91 ~~100~~			N			80-90ft.: SAND, WET. (5YR 3/2) (when wet) COARSE GRAINED, POORLY SORTED, ANGULAR TO SUB ANG.; ROUNDED GRAVEL & COBBLES MAKING WATER AT 93 ft.	SP GP					
			Y			90-100ft.: SAND, GRAVEL, WATER. LARGE COBBLES COARSE ~~[illegible]~~ medium SAND. ROUNDED GRAVEL & COBBLES, SUB ANGULAR SAND	GP					

U = Thin Wall Tube
S = Split spoon(tube)
C = Cuttings
R = Rock Coring NA
O = Other NA
Notes:
Field G/C(Make/Mod.) NA
G/C Oper.: NA

FIGURE 5-3a

REV DATE MAY 1990

BORING LOG | BORING/WELL NO.: MWS-01 | Page 1 of 3

Installation: **Sky Harbor** **Coordinates:** | Site: SKY HARBOR BACKGROUND WELL

Project No. 409726.02.06 | Client/Project: HAZWRAP / SKY HARBOR ANG

HAZWRAP Contractor: IT CORPORATION | Drlg Contractor: LAYNE ENVIRONMENTAL | Driller: DEARY LODDER

Drlg Started: 1/29/91 (12:40 P m) | Drlg Ended 1/30/91 (11:45 A m) | Borehole dia(s): 9 3/4"

Drlg Method/Rig Type: AIR HAMMER CASING

Logged by GARDINER | E-Log (Y / [✓ N]) From ____ to ____ | Protection Level D (MODIFIED)

Depth (ft)	Sample	Sample No.	Lab Anal. (Y/N)	Recovery ( )	RQD ( )	Lithologic Description	USCS	Blows/6 inch.	Graphic Log	Well data	Water depth & Remarks	Ele
0	☒		Y	0.2'	100	SAND MED TO FINE, ROUNDED, WELL SORTED, DARK BROWN (7.5YR 3/3). SLIGHTLY MOIST	S TO SW	4 10 12				1118.70
5	☒			0	10	SAND 90%, MED TO COARSE GRAINED, ANGULAR, MOD. WELL SORTED, BUT W/ GRAVEL, 10%, COARSE, ROUNDED. LIGHT BROWN (7.5YR 6/3)	SP	10 50				
10	☒			0	10	GRAVEL 80%, MED TO COARSE, ROUNDED, W/ SAND, 20%, LIGHT BROWN (7.5YR 6/2), MED, ROUNDED.	GP	8 10 50				
15	☒			0		NO RECOVRRY	—	50				
20	☒			0		NO RECOVERY; FROM CYCLONE AT 21 ft: SAND 60%, COARSE TO MED, ANGULAR, POORLY SORTED LIGHT BROWN (7.5YR 6/4), W/ GRAVEL, 40%, ROUNDED TO ANGULAR, MED TO COARSE W/ OCCASIONAL COBBLES	— SP	50 —				
25	☒			0		NO RECOVERY	—	50				
30	☒			0		NO RECOVERY; FROM CYCLONE AT ≅ 31 ft: SAND 50%, FINE TO COARSE, ROUNDED & ANGULAR, VERY POORLY SORTED W/ SILT (LIGHT BROWN 7.5YR 6/4) W/ GRAVEL, 50%, ROUNDED TO ANGULAR MED TO COARSE W/ COBBLES (ROUNDED).	— SP TO GP	50 —				

U = Thin wall Tube | R = Rock Coring NA | Field G/C(Make/Mod.) NA

S = Split spoon(tube) | O = Other CA S | G/C Oper. NA

C = Cuttings | Notes NA

FIGURE 5-3a

REV. DATE MAY 1990

BORING LOG | BORING/WELL NO.: MWS-01 | Page 2 of 3

Installation: **Sky Barbor** **Coordinates:** | Site: Sky Harbor Background Well

Project No.: 409721.02.06 | Client/Project: HAZWRAP/Sky Harbor ANG

HAZWRAP Contractor: IT Corporation | Drlg Contractor: Layne Environmental | Driller: Derry Lodder

Drlg Started: 1/29/91 (12:00 p m) | Drlg Ended: 1/30/91 (11:45 a m) | Borehole dia(s): 9 3/4"

Drlg Method/Rig Type: Air Hammer Casing

Logged by: Gardiner | E-Log (Y / [✓ N]) From ____ to ____ | Protection Level: D (Modified)

Depth (ft)	Sample	Sample No.	Lab Anal. (Y/N)	Recovery (ft)	Lithologic Description	USCS	Blows/6 inch	Graphic Log	Well data	Water depth	Remarks	Ele.
35	☒			0	No Recovery	—	50				NA	
40	☒			0	No Recovery; from cyclone at ≃ 41 ft.	—	50					
					Sand 70%, med to coarse, rounded to sub ang, med. brown (7.5YR 5/3), poorly sorted w/ gravel, 30%, mostly rounded to sub rounded, med. Very slightly moist	SA	—					
45	☒			0	No Recovery	—	50					
50	☒			0	No Recovery; from cyclone at ≃ 51 ft.	—	50					
					Sand 70%, med, rounded to sub rounded brown, (7.5YR 5/3), poorly sorted w/ gravel, med to coarse, rounded & angular w/ occasional cobbles (rounded)	Sp	—					
55	☒			0	No Recovery	—	50					
60	☒		Y	1.5	Sand 60% w/ some silt, med, rounded, dark brown (7.5YR 3/3), poorly sorted w/ gravel, 40% w/ some silt, med to coarse, rounded Very Moist	SP to SM	50 22 22 25					
65	☒			0	No Recovery	—	50					

U = Thin wall Tube R = Rock Coring NA Field G/C(Make/Mod.) NA

S = Split spoon(tube) O = Other CA S G/C Oper.: NA

C = Cuttings Notes: NA

FIGURE 5-3a

REV DATE MAY 1990

BORING LOG
BORING/WELL NO.: MWS-01
Page 3 of 3
Installation **Sky Harbor** **Coordinates:**
Site: Sky Harbor Background Well
Project No. 401221.02.06
Client/Project: HAZWRAP / Sky Harbor ANG
HAZWRAP Contractor: IT Corporation
Drlg Contractor: Layne Environmental
Driller: Danny Lodder
Drlg Started 1/28/91 (3:00 P m)
Drlg Ended 1/30/91 (11:45 A m)
Borehole dia(s): 9 3/4"
Drlg Method/Rig Type: Air Hammer Casing
Logged by: Gardiner
E-Log (Y / [✓ N]) From ____ to ____
Protection Level: D (Modified)

Depth (ft)	Sample	Sample No.	Lab Anal. (Y/N)	Recovery ( ) RQD ( )	Lithologic Description	USCS	Blows/6 inch	Graphic Log	Well data	Water depth & Remarks	Ele.
70	☒			0	No Recovery; From Cyclone at 71 ft:	—	50				NA
					SAND 75%, med to coarse, rounded to sub rnd, Brown (7.5YR 5/4), w/gravel 25%, rounded to subangular, med to coarse, occasional cobbles	SP	—				
75					From Cyclone from here down					Wet cuttings at 74 ft.	
80	☒				SAND 60%, med to coarse, rounded to sub angular, Dark Brown (7.5YR 4/3), w/gravel, 40%, med to coarse, rounded to angular, occasional cobbles (rounded).	SP	—				
85											
90	☒				SAND 70%, ~~is~~ med to coarse, rounded, Dark Brown (7.5YR 3/3) poorly sorted w/some silts, & w/gravel, 30%, mostly rounded, some angular, med to coarse, occasional to common rounded cobbles Very moist	SP	—				
95										Making free water at 95 ft.	
100	☒				SAND w/gravel & large cobbles, rounded to angular, flowing w/water some silts noted when caught in a bucket.	SP to GP	—				
					T.D. = ~ 101 ft.						

U = Thin wall Tube
S = Split spoon(tube)
C = Cuttings
R = Rock Coring NA
O = Other CA S
Notes: NA
Field G/C(Make/Mod.) NA
G/C Oper: NA

FIGURE 5-3a

REV DATE MAY 1990

BORING LOG	BORING/WELL NO.: MWS-02	Page 1 of 3
Installation **Sky Harbor** **Coordinates:**		Site: Sky Harbor Background Well
Project No. 401921.WL.06	Client/Project: HAZWRAP / ~~[illegible]~~ Sky Harbor ANG	
HAZWRAP Contractor: IT Corporation	Drlg Contractor: Layne Environmental	Driller: Derat Lodder
Drlg Started 1/31/91 (14:15 P m)	Drlg Ended: 2/6/91 10:00 Am)	Borehole dia(s) 9 3/4"
Drlg Method/Rig Type: Air Hammer Casing.		
Logged by: GARDINER	E-Log (Y / [✓ N]) From ____ to ____	Protection Level D (MODIFIED)

Depth (ft)	Sample	Sample No.	Lab Anal. (Y/N)	Recovery ( )	RQD ( )	Lithologic Description	USCS	Blows/6 inch.	Graphic Log	Well data	Water depth	Remarks
0	X		Y	0	10	SAND 75%, MED TO COARSE, ROUNDED TO SUB ROUNDED, POORLY SORTED w/ GRAVEL, 25%, ROUNDED, MED TO COARSE. SOME ASPHALT PEBBLES. ~~LIGHT~~ BRN (7.5YR 5/4)	SP	16 22 26				1115.91
5	X		Y	0	50	SAND 50%, MED TO COARSE, ROUNDED, MIXED w/ ASPHALT & CONCRETE FILL. MAY BE OLD FILL.	SP ?	10 15 20				
10	X		Y	0	70	SAND 90%, MED TO FINE, ROUNDED TO SUB ROUNDED, MOSTLY WELL SORTED, BUT w/ OCCASIONAL GRAVEL, 10%, ROUNDED, MED. (75YR 5/4)	SW SP	10 6 6				
15	X			0	10	SAND ~~[illegible]~~ 80%, MED TO COARSE, ANGULAR, POORLY SORTED w/ GRAVEL, 20%, MED TO FINE, ROUNDED (7.5YR 5/4)	SP	50				
20	X				0	NO RECOVERY	—	50				
25	X			0	10	(20% RECOVERY) SAND 55%, VERY COARSE, ANGULAR, ~~[illegible]~~ POORLY SORTED w/ GRAVEL 45%, ROUNDED TO SUB ROUNDED, MED. SLIGHTLY MOIST, BROWN (7.5YR 5/4).	SP	50				
30	X				0	~~SAND~~ NO RECOVERY	—	50				

U = Thin Wall Tube	R = Rock Coring NA	Field G/C(Make/Mod.) NA
S = Split spoon(tube)	O = Other CAS	G/C Oper.: NA
C = Cuttings	Notes: NA	

FIGURE 5-3a

REV DATE MAY 1990

BORING LOG | BORING/WELL NO.: MWS-02 | Page 2 of 3

Installation: **Sky Barbor** **Coordinates:**

Site: Sky Harbor Background Well

Project No. 409721.01.06

Client/Project: HAZWRAP / Sky Harbor ANG

HAZWRAP Contractor: IT Corporation

Drlg Contractor: Layne Environmental

Driller: Danny Lodder

Drlg Started 1/31/91 (14:25 P m)

Drlg Ended: 2/6/91 (10:00 A m)

Borehole dia(s) 9 3/4"

Drlg Method/Rig Type: Air Hammer Casing

Logged by: Gardiner

E-Log (Y / [✓ N]) From ____ to ____

Protection Level D (Modified)

Depth (ft)	Sample	Sample No.	Lab Anal. (Y/N)	Recovery ( )	ncsd ( )	Lithologic Description	USCS	Blows/6 inch	Graphic Log	Well data	Water depth	Remarks
35	☒				0	NO RECOVERY	–	50				NA
40	☒			0	10	SAND 70%, MOSTLY ROUNDED, MED TO COARSE, POORLY SORTED, BROWN (7.5YR 5/4) W/ GRAVEL, 30%, MED TO COARSE, MOSTLY ROUNDED TO SUBANGULAR W/ RARE ROUNDED COBBLES	SP	50				
45	☒			0	10	SAND [illegible]%, MOSTLY ROUNDED, MED. TO COARSE, BROWN (7.5YR 5/4), POORLY SORTED W/ SOME SILT OR SILTY CLAY, 5%, BROWN (7.5YR 5/4), MOIST, & W/ GRAVEL, 30%, ROUNDED, MED.	SP TO SM	50				
50	☒			0	10	SAND 70%, MED TO COARSE, ROUNDED TO SUB ANG., BROWN (7.5YR 5/4), MOIST, POORLY SORTED W/ SOME SILT/CLAY (BROWN & MOIST) & GRAVEL, MED, ROUNDED (30%).	SP TO SM	50				
55	☒				0	NO RECOVERY	–	50				
60	☒				0	NO RECOVERY; FROM CYCLONE AT ≈ 61 ft: SAND 60%, MED, ROUNDED TO SUB RND., BROWN (7.5YR 5/4), MOIST, W/ GRAVEL 40%, MED TO COARSE, ROUNDED W/ OCCASIONAL COBBLES.	– SP	50 –				
65	☒				0	NO RECOVERY	–	50				

U = Thin wall Tube
S = Split spoon(tube)
C = Cuttings

R = Rock Coring NA
O = Other CAS
Notes: NA

Field G/C(Make/Mod.) NA
G/C Oper.: NA

FIGURE 5-3a

REV DATE MAY 199?

BORING LOG | BORING/WELL NO.: MWS-02 | Page 3 of 3

Installation **Sky Harbor** **Coordinates:** | Site: Sky Harbor Background Well

Project No. 409721.02.04 | Client/Project: HAZWRAP / Sky Harbor ANG

HAZWRAP Contractor: IT Corporation | Drlg Contractor: Layne Environmental | Driller: Darry Lodder

Drlg Started 1/31/91 (14:15 p m) | Drlg Ended 2/6/91 (10:00 a m) | Borehole dia(s) 9 5/8"

Drlg Method/Rig Type: Air Hammer Casing.

Logged by: Gardiner | E-Log (Y / [✓ N]) From ____ to ____ | Protection Level D (Modified)

Depth (ft)	Sample	Sample No.	Lab Anal. (Y/N)	Recovery ( )	Lithologic Description	USCS	Blows/6 inch	Graphic Log	Well data	Water depth	Remarks
70	☒			0	NO RECOVERY	—	50				NA
75	☒				NO RECOVERY; FROM CLEANING AT ~78ft.:	—	50				
					SAND 65%, COARSE, ANGULAR TO SUB ANGULAR, MOIST, BROWN (7.5YR 5/4), POORLY SORTED w/ GRAVEL; 30%, med to coarse, ROUNDED & COBBLES, 5%, MED TO COARSE, ROUNDED	SP to GP	—			▲ Very moist at Ca. 78ft. Free water at 82 ft.	
80											
85											
90	☒				SAND WATER MIXTURE, APPROX 60% SAND, w/ 40% gravel & COBBLES, ROUNDED TO SUB ROUNDED & MINOR ANGULAR. SOME SMALL SILT FRACTION, DARK BROWN (7.5YR 4/4). FREE WATER.						
95											
100					SAND/WATER MIXTURE, w/ 20-40% GRAVEL & COBBLES, ROUNDED TO SUBROUNDED, DARK BROWN (7.5YR 4/4)	SP & GP	—				
					T.D. = ~101 ft.						

U = Thin wall Tube | R = Rock Coring NA | Field G/C(Make/Mod.) NA

S = Split spoon(tube) | O = Other CAS | G/C Oper.: NA

C = Cuttings | Notes: NA

FIGURE 5-3a

REV DATE MAY 1990

DRILLING LOG	BORING/WELL NO MWS-03	Page 1 of 3
Installation Sky Harbor	Coordinates:	Site Sky Harbor Background Well
Project No 401726.0006	Client/Project HAZWRAP / Sky Harbor ANG	
HAZWRAP Contractor IT Corporation	Drlg Contractor Layne Environmental	Driller Gary Ludden
Drlg Started 1/30/91 (13:30 p m)	Drlg Ended 1/31/91 (13 20 p m)	Borehole dia(s) 9 5/4"
Drlg Method/Rig Type: Air Hammer Casing		
Logged by Gardiner	E-Log (Y [✓ N]) From ____ to ____	Protection Level D (Modified)

Depth (ft)	Sample	Sample No	Sample Anal (Y/N)	Recovery ( )	RQD ( )	Lithologic Description	USCS	Blows/6 inch	Graphic Log	Well data	Water depth & Remarks
0	X		Y	0	6	SAND 95%, MED, ROUNDED TO SUBROUND, DARK BROWN (7.5YR 4/3), MOSTLY WELL SORTED BUT w/ OCCASIONAL GRAVEL, ~~10~~ 5%, ROUNDED, MED TO FINE	SW TO SP	20 50			1116.14
5	X		Y	0	30	SAND 75%, MED, ROUND TO ANGULAR, DARK BRN (7.5YR 4/3), POORLY SORTED w/ GRAVEL, 25%, ~~MED~~, ROUNDED. PIECE of CONCRETE IN TOP 4 INCHES	SP	6 9 13			
10	X				0	CONCRETE	—	4 10 40			
15	X				0	NO RECOVERY, CONCRETE RUBBLE	—	50			
20	X				0	NO RECOVERY, FROM CYCLONE AT ≅ 21 ft: SAND 60%, VERY COARSE, ANGULAR, LIGHT BROWN (7.5YR 5/4 TO 6/4), POORLY SORTED w/ SOME FINES & GRAVEL, 40%, PEA TO COARSE & OCCASIONAL COBBLES, ROUNDED	— SP TO GP	50 —			
25	X				0	NO RECOVERY	—	50			
30	X				0	NO RECOVERY; FROM CYCLONE AT ≅ 31 ft: SAND 55%, COARSE, ANGULAR, LIGHT BROWN (7.5YR 6/4), POORLY SORTED w/ GRAVEL, 40%, ROUNDED TO ANGULAR, FINE TO COARSE w/ COBBLES, 5%, ROUNDED.	— SP TO GP	50 —			

T = Thin-wall Tube
S = Split spoon (tube)
C = Cuttings
R = Rock Coring NA
O = Other CA S
Notes NA
Field GC (Make, Mod) NA
GC Oper NA

FIGURE 5-3a

REV DATE MAY 1990

BORING LOG	BORING/WELL NO MWS-03	Page 2 of 3
Installation **Sky Harbor** **Coordinates:**		Site Sky Harbor [illegible]
Project No 409826.02.06	Client/Project: HAZWRAP / Sky Harbor ANG	
HAZWRAP Contractor IT Corporation	Drlg Contractor Layne Environmental	Driller Dee [illegible]
Drlg Started 1/30/91 (13:20 p m)	Drlg Ended 1/31/91 (13:20 p m)	Borehole dia(s) 9 3/4"
Drlg Method/Rig Type: Air Hammer Casing		
Logged by Gardner	E-Log (Y/N) [✓ N] From ____ to ____	Protection Level D (Modified)

Depth (ft)	Sample	Sample No	Lab Anal (Y/N)	Recovery ( )	Lithologic Description	USCS	Blows/6 inch	Graphic Log	Well data	Water depth	Remarks
35	☒			0	No Recovery	—	50				NA
					No Recovery, from Cyclone at ≅ 41 ft.:	—	50				
40	☒			0	Sand 60%, angular, coarse to very coarse, red brown (2.5YR 4/4), poorly sorted w/ gravel, 40%, pea to coarse, rounded to angular w/ rare but large cobbles	SP to GP	—				
45	☒			0	No Recovery	—	50				
					Very Low Recovery (10%)						
50	☒			10	Sand 70%, very coarse, angular, brown (7.5YR 5/4), poorly sorted w/ some fines & gravel, 30%, rounded, med to coarse w/ rare large cobbles moist	SP	50				
55	☒			0	No Recovery	—	50				
					No Recovery, from Cyclone at ≅ 61 ft.	—	50				
60	☒			0	Sand 55%, coarse, angular, brown (7.5YR 5/4), poorly sorted w/ gravel, 40%, rounded to angular, med to coarse, w/ cobbles, 5%, coarse, rounded, moist	SP to GP	—				
65	☒			0	No Recovery	—	50				

U = Thin wall Tube R = Rock Coring NA Field GC (Make/Mod) NA

S = Split Spoon (tube) O = Other CA S GC Oper NA

C = Cuttings Notes NA

FIGURE 5-3a

REV DATE MAY 1990

BORING LOG | BORING/WELL NO.: MWS-03 | Page 3 of 3

Installation: **Sky Harbor** **Coordinates:** | Site: Sky Harbor Background Well

Project No.: [illegible] | Client/Project: HAZWRAP / Sky Harbor ANG

HAZWRAP Contractor: ITC [illegible] | Drlg Contractor: Layne Environmental | Driller: [illegible]

Drlg Started: 1/21/91 (13:30 p m) | Drlg Ended: 1/21/91 (13:20 p m) | Borehole dia(s): 9 7/8"

Drlg Method/Rig Type: Air Hammer Casing

Logged by: [illegible] | E-Log (Y / [✓ N]) From ____ to ____ | Protection Level D (Modified)

Depth (ft)	Sample	Sample No.	Lab Anal. (Y/N)	Recovery ( )	Lithologic Description	USCS	Blows/6 inch	Graphic Log	Well data	Water depth & Remarks	Elev.
70	X	/		0	NO RECOVERY	—	50				NA
75	X		Y	10	SAND 60%, MED TO COARSE, ANGULAR, BROWN (7.5YR 4/3) TO DARK BROWN, POORLY SORTED W/SOME SILT (5%) & GRAVEL, 35%, MED TO COARSE, ROUNDED & ANGULAR MOIST	SP	40/50			▼ Very MOIST CUTTINGS WATER AT ~75 ft.	
80					FROM CYCLONE FOR HERE TO T.D.:						
85											
90	X				SAND 55%, ANGULAR TO SUB ANG, COARSE, DARK BROWN (7.5YR 3/3), POORLY SORTED W/ GRAVEL, 40%, MED TO COARSE, ROUNDED TO SUB ANGULAR W/ COBBLES, 5%, MED TO COARSE, ROUNDED. <u>VERY MOIST</u>	SP TO GP	—				
95					WATER SAND MIXTURE:						
100	X				SAND 65%, ROUNDED TO SUB ANGULAR, DARK BROWN (7.5YR 3/3), POORLY SORTED W/ SOME SILT, 5%, & GRAVEL, 25%, ROUNDED TO ANGULAR, MED TO COARSE, & COBBLES, 5%, ROUNDED, COARSE.	SP TO GP	—				
					T.D. = ≃ 101 ft.						

U = Thin wall Tube | R = Rock Coring NA | Field G/C(Make/Mod.) NA
S = Split spoon(tube) | O = Other CA S | G/C Oper.: NA
C = Cuttings | Notes: NA

FIGURE 5-3a

REV DATE MAY 199

BORING LOG | BORING/WELL NO. ~~ABS-04~~ MWS-04 | Page 1 of 3

Installation: **Sky Barbor** **Coordinates:** | Site: SH BACKGROUND, WELL MWS-04

Project No.: 409721.02.02 | Client/Project: HAZWRAP / SKY HARBOR ANG BASE

HAZWRAP Contractor: IT CORPORATION | Drlg Contractor: LAYNE ENVIRONMENTAL | Driller: DWIGHT PETERSON

Drlg Started: 3/21/91 (9 45 A m) | Drlg Ended: 3/21/91 (4:30 P m) | Borehole dia(s): ~ 10¾"

Drlg Method/Rig Type: ~~AIR~~ DUAL TUBE PERCUSSION

Logged by: GARDINER | E-Log (Y / [✓ N]) From _____ to _____ | Protection Level: D (MODIFIED)

Depth (ft)	Sample	Sample No.	Lab Anal. (Y/N)	Recovery ( )	( )	Lithologic Description	USCS	Blows/6 inch.	Graphic Log	Well data	Water depth & Remarks
0	☒		y	0	10	SAND 70%, MED TO COARSE, ANGULAR, POORLY SORTED, BROWN (7.5YR 4/2) w/ SOME GRAVEL, 20%, RND, MED, & SOME SILT, 10%, FINE, BROWN, MOIST. ~~SP~~	SP	7 10 10			
5	☒				0	No Recovery	—	50			
					0	No Recovery: FROM CYCLONE AT ~ 10ft:	—	50			
10	☒					SAND 70%, MED TO COARSE, RND TO SUB ANG, DARK BROWN (7.5YR 3/2), POORLY SORTED w/ MINOR SILT & GRAVEL, 30%, RND TO SUB ANG, MED TO COARSE, RARE COBBLES. MOIST	SP				
15	☒		y	0	10	SAND 95%, MED TO COARSE, ANGULAR, ~~[illegible]~~ LT BRN (7.5YR 6/4), MOSTLY WELL SORTED BUT w/ OCCASIONAL GRAVEL, 5%, FINE, RND. MOIST	SW	25 10 18			
20	☒				10	SAND 75%, MED TO COARSE, ANGULAR, LT. BRN, (7.5YR 6/4), ~~MOSTLY WELL SOR~~ POORLY SORTED w/ GRAVEL, 25%, MED, RND. MOIST	SP	50			
25	☒				20	SAND 80%, MED TO COARSE, ANGULAR TO SUB ANG., BRN (7.5YR 5/4), MOSTLY WELL SORTED ON THE SAND, BUT w/ GRAVEL, 20%, MED, RND. MOIST	SP TO SW	50			
30	☒				10	No Recovery	—	50			

U = Thin wall Tube | R = Rock Coring ______________ | Field G/C(Make/Mod.) ______________

S = Split spoon(tube) | O = Other ______________ | G/C Oper. ______________

C = Cuttings | Notes ______________

FIGURE 5-3a

REV. DATE. MAY 199

BORING LOG | BORING/WELL NO. MWS-04 | Page 2 of 3

Installation: **Sky Harbor** **Coordinates:** | Site: SH Background Well MWS-04

Project No.: 409721.06 | Client/Project: HAZWRAP / Sky Harbor ANG Base

HAZWRAP Contractor: IT Corporation | Drlg Contractor: Layne Environmental | Driller:

Drlg Started: 3/21/91 (9:45 A m) | Drlg Ended: 3/21/91 (4:50 P m) | Borehole dia(s): ~ 10¾"

Drlg Method/Rig Type: Dual Tube Percussion

Logged by: Gardiner | E-Log (Y / [✓ N]) From ____ to ____ | Protection Level D (Modified)

Depth (ft)	Sample	Sample No.	Lab Anal. (Y/N)	nosp ( )	Recovery ( )	Lithologic Description	USCS	Blows/6 inch.	Graphic Log	Well data	Water depth & Remarks
35	X				0	No Recovery	—	50			
40	X			160	10	SAND 75%, med to coarse, ang to sub ang, Dark Brown (7.5YR 3/2), poorly sorted w/ Gravel, 25%, med to coarse, rnd to sub ang. Moist. Slight hydrocarbon odor.	SP	50			
45	X			190	10	SAND 90%, med to coarse, ang to sub ang, Dark Brown. (7.5YR 3/2), poorly sorted w/ gravel, 20%, med to coarse, rnd to sub ang. Moist. Hydrocarbon odor.	SP	50			
50	X			220	10	SAND 60%, med to coarse, ang, Dark Brown (7.5YR 3/2), poorly sorted w/ gravel, 40%, med to coarse, ang to sub rnd. Moist. Hydrocarbon odor Slight visible gray stain.	SP	50			
55	X				0	No Recovery	—	50			
60	X				0	No Recovery	—	50			
65	X			300	20	SAND 75%, med to coarse, ang to sub ang, Brown (7.5YR), poorly sorted w/ some silt & gravel, 25%, med to coarse, rnd to sub ang. Moist hydrocarbon odor.	SP	27 50			

U = Thin wall Tube R = Rock Coring ____ Field G/C(Make/Mod.) ____

S = Split spoon(tube) O = Other ____ G/C Oper. ____

C = Cuttings Notes ____

ARE NOTED, WHERE POSSIBLE.

U = Thin Wall Tube	R = Rock Coring NA	Field G/C(Make/Mod.) NA
S = Split spoon(tube)	O = Other NA	G/C Oper.: NA
C = Cuttings	Notes: NO SAMPLER IN USE	

FIGURE 5-3a

REV. DATE MAY 199

BORING LOG
BORING/WELL NO.: MWS-04
Page 3 of 5
Installation: **Sky Harbor** **Coordinates:**
Site: SH BACKGROUND WELL MWS-04
Project No.: 409321.02.06
Client/Project: HAZWRAP/ SKY HARBOR ANG BASE
HAZWRAP Contractor: IT CORPORATION
Drlg Contractor: LAYNE ENVIRONMENTAL
Driller:
Drlg Started: 3/21/91 (9:45 A m)
Drlg Ended: 3/21/91 (4:30 P m)
Borehole dia(s): ~10 3/4"
Drlg Method/Rig Type: DUAL TUBE PERCUSSION
Logged by: GARDINER
E-Log (Y / [✓ N]) From ____ to ____
Protection Level: D (MODIFIED)

Depth (ft)	Sample	Sample No.	Lab Anal. (Y/N)	Recovery	Lithologic Description	USCS	Blows/6 inch	Graphic Log	Well data	Water depth & Remarks
70	☒			38 10	SAND 70%, MOSTLY COARSE, BROWN (7.5YR) ANGULAR, POORLY SORTED w/ GRAVEL, 30%, MED TO COARSE, ANG TO SUB ANG., MOIST TO VERY MOIST, STRONG HYDROCARBON ODOR	SP	50			
75										
80					(FROM CYCLONE) SAND 60%, COARSE, ANG TO SUB ANG, BROWN (7.5YR), POORLY SORTED w/ GRAVEL, 40%, ANG TO SUB ANG, MED TO COARSE & COBBLES, ANG. MOIST, SLIGHT HYDROCARBON ODOR	SP TO ~~SW~~ GP	–			
85										
90					SAND 55%, MED TO COARSE, ANG TO SUB ANG, BROWN ~~&~~ POORLY SORTED w/ GRAVEL, 45%, MED TO COARSE, COBBLES MED TO COARSE, ANG TO SUB RND. WET. LITTLE ODOR	SP TO GP	–			FREE WATER AT ~92 ft
95										
100			Y		SAND, WATERY GRAVEL, COBBLE MIXTURES.	SP TO GP	–			

U = Thin wall Tube	R = Rock Coring	Field G/C(Make/Mod.)
S = Split spoon(tube)	O = Other	G/C Oper.:
C = Cuttings	Notes	

FIGURE 5-3a

REV DATE MAY 1990

BORING LOG	BORING/WELL NO. MW1-02	Page 1 of 3
Installation: **Sky Harbor** **Coordinates:**		Site: 1
Project No. 409721.02	Client/Project: HRBWCK / Sky Harbor ANG	
HAZWRAP Contractor: IT Corporation	Drlg Contractor: Layne Environmental	Driller: Derry Lodder
Drlg Started: 01/28/91 (08:45 a.m.)	Drlg Ended: 1/28/91 (15:00 p.m.)	Borehole dia(s): 9 3/4"
Drlg Method/Rig Type: Air Hammer Casing		
Logged by: Gardner	E-Log (Y / [✓ N]) From ____ to ____	Protection Level D (Level)

Depth (ft)	Sample	Sample No	Lab Anal (Y/N)	Recovery ( )	RQD ( )	Lithologic Description	USCS	Blows/6 inch	Graphic Log	Well data	Water depth	Remarks	E
0	☒	1		0	100	SAND MED TO FINE, BROWN (7.5YR 5/4), POORLY SORTED w/ OCCASIONAL GRAVEL (10%), MED TO FINE, ROUNDED, MOIST.	SP	12 17 20					1116.34
5	☒			0		NO RECOVERY	—	50					
10	☒			0		NO RECOVERY. FROM CYCLONE AT 11 ft	—	50					
						SAND 70%, POORLY SORTED, MED TO COARSE, BROWN (7.5YR 5/3), w/ GRAVEL (30%), MED TO COARSE, ROUNDED w/ OCCASIONAL COBBLES	SP	—					
15	☒			0	10	SAND 90% COARSE, ANGULAR, BROWN (7.5YR 5/3), WELL SORTED BUT w/ GRAVEL, 10%, ROUNDED, MED. MOIST.	SP	50					
20	☒			0		NO RECOVERY	—	50					
25	☒			0		NO RECOVERY; FROM CYCLONE AT ≅ 28 ft.:	—	50					
						SAND 60%, COARSE, ANGULAR, BROWN (7.5YR 5/3), POORLY SORTED w/ GRAVEL, 40%, ROUNDED TO ANGULAR, MED TO COARSE w/ RARE COBBLES	SP	—					
30	☒			0		NO RECOVERY	—	50					

U = Thin wall Tube R = Rock Coring NA Field G/C (Make/Model) NA

S = Split spoon tube O = Other CA S G/C Oper. NA

C = Cuttings Notes NA

FIGURE 5-3a

REV. DATE MAY 1990

BORING LOG | BORING/WELL NO.: MW1-02 | Page 2 of 3

Installation: **Sky Harbor** **Coordinates:** | Site: 1

Project No.: 409721.02.06 | Client/Project: HAZWRAP/Sky Harbor ANG

HAZWRAP Contractor: IT Corporation | Drlg Contractor: Layne Environmental | Driller: Dean Loddel

Drlg Started: 1/28/91 08:45 (A m) | Drlg Ended: 1/28/91 (5:00 P m) | Borehole dia(s): 9 3/4"

Drlg Method/Rig Type: Air Hammer Casing

Logged by: Gardner | E-Log (Y / [✓ N]) From ____ to ____ | Protection Level: D (Modified)

Depth (ft)	Sample	Sample No.	Lab Anal. (Y/N)	hnu ppm	Recovery (%)	Lithologic Description	USCS	Blows/6 inch	Graphic Log	Well data	Water depth & Remarks
35	X		Y	0	50%	SAND 75%, MED TO COARSE, ANGULAR, BROWN (7.5YR 5/3), POORLY SORTED w/ GRAVEL, 25%, MED, ROUNDED. MOIST.	SP	10 15 28			NA
40	X			0		NO RECOVERY	—	50			
45	X					NO RECOVER; FROM CYCLONE AT ≅ 44 ft:	—	50			
				0		SAND 60%, MED. TO COARSE, ANGULAR TO SUBANG., BROWN (7.5YR 5/3), POORLY SORTED w/ GRAVEL, 40% MED TO COARSE, ANGULAR & ROUNDED, w/ OCCASIONAL COBBLES	SP TO GP	-			
50	X			0	10	SAND ~~8~~ 75%, VERY COARSE, ANGULAR, BROWN (7.5YR 5/3), w/ GRAVEL, 25%, ROUNDED TO SUBANGULAR, MED TO FINE. MOIST. GRAVEL HAS MINOR, RED BROWN SILTY SAND STICKING TO IT.	SP	50			
55	X			0	35%	SAND 60%, COARSE TO MED, ANGULAR, BROWN (7.5YR 5/2), POORLY SORTED w/ VERY MINOR SILT, & GRAVEL, 40%, ROUNDED, MED MOIST.	SP	50			
60	X			0	40	SAND 55%, COARSE TO MED, ANGULAR, BROWN (7.5YR 5/2), POORLY SORTED w/ VERY MINOR SILT, & GRAVEL, 45%, MED, ROUNDED. MOIST.	SP TO GP	50			
65	X			0		No Recovery	—	50			

U = Thin wall Tube | R = Rock Coring: NA | Field G/C (Make/Mod.): NA

S = Split spoon (tube) | O = Other: CA S | G/C Oper.: NA

C = Cuttings | Notes: NA

C = Cuttings Notes: NA

FIGURE 5-3a

REV. DATE MAY 1990

BORING LOG | BORING/WELL NO.: MW-02 | Page 3 of 3

Installation: **Sky Harbor** **Coordinates:** | Site: SITE 1

Project No.: 409721.02.01 | Client/Project: HAZWRAP / SKY HARBOR ANG

HAZWRAP Contractor: IT CORPORATION | Drlg Contractor: LAYNE ENVIRONMENTAL | Driller: DERRY LOOPER

Drlg Started: 1/28/91 (08:45 A m) | Drlg Ended: 1/28/91 (1500 P m) | Borehole dia(s): 9 3/4"

Drlg Method/Rig Type: AIR HAMMER CASING

Logged by: GARDNER | E-Log (Y / [✓ N]) From ____ to ____ | Protection Level: D (MODIFIED)

Depth (ft)	Sample	Sample No.	Lab Anal. (Y/N)	Recovery ( )	RQSD ( )	Lithologic Description	USCS	Blows/6 inch	Graphic Log	Well data	Water depth	Remarks	Ele
70	☒				0	NO RECOVERY; FROM CYCLONE AT ≅ 69 FT.:	—	50				NA	
						SAND 60%, ~~MED~~ TO COARSE, SUBROUNDED TO SUBANG., BROWN (7.5YR 5/4), W/ GRAVEL, 40%, ROUNDED & ANGULAR, MED TO COARSE, OCCASIONAL COBBLES	SP TO GP	—					
75	☒		Y		0	SAND 70%, MED TO COARSE, SUBANGULAR TO ANG., BROWN (7.5YR 5/4), POORLY SORTED W/ GRAVEL, 30%, ANGULAR & FINE TO ROUNDED & MED. W/ RARE COBBLES. MOIST TO VERY MOIST	SP	50			MOIST TO WET ▲ WATER AT ≅ 75 FT.		
80													
85						ALL LITHOLOGIC SAMPLES FROM CYCLONE FROM HERE DOWN APPROX 89-90 FT. FROM CYCLONE:							
90	☒					SAND 80%, BROWN (7.5YR 5/2) TO DARK BROWN (7.5YR 4/3), ANGULAR, W/ SOME SILT MIXED IN & GRAVEL, 20%, ROUNDED TO ANGULAR, MED TO COARSE, RARE COBBLES. VERY WET.	SP TO SM	—					
95											WATER		
100	☒					SAND 55%, ANGULAR & COARSE TO ROUNDED & MED., BROWN, (7.5YR 4/3), POORLY SORTED W/ GRAVEL, 35%, ROUNDED, MED, OCCASIONAL COBBLES, & SILT, 10%. WET.	SP TO SM	—			WATER		
						T.D. = APPROX 101 FT.							

U = Thin wall Tube R = Rock Coring NA Field G/C(Make/Mod.) NA

S = Split spoon(tube) O = Other CA S G/C Oper.: NA

C = Cuttings Notes: NA

FIGURE 5-3a

REV DATE MAY 1990

BORING LOG | BORING/WELL NO SB1-02 | Page 1 of 2

Installation **Sky Barbor** **Coordinates:** | Site 1

Project No. 409721.03.06 | Client/Project: HAZWRAP / SKY HARBOR ANG

HAZWRAP Contractor IT CORPORATION | Drlg Contractor LAYNE ENVIRONMENTAL | Driller DARRY LOODER

Drlg Started 2/4/91 (1100 a m) | Drlg Ended 2/5/91 (1300 p m) | Borehole dia(s) 9⅝"

Drlg Method/Rig Type: AIR HAMMER CASING

Logged by GARDINER | E-Log Y [✓ N] From ____ to ____ | Protection Level D (MODIFIED)

Depth (ft)	Sample	Sample No	Lab Anal (Y/N)	HSD ( )	Recovery ( )	Lithologic Description	USCS	Blows/6 inch	Graphic Log	Well data	Water depth	Remarks	E
0	X		Y	0	10	SAND 45%, MED TO FINE GRAINED, DARK BROWN (7.5YR 4/4), SLIGHTLY MOIST, POORLY SORTED W/ OCCASIONAL GRAVEL, 5%, MED, ROUNDED	SP	5 11 16					1115.81
5	X		Y		30	SAND 90%, MED, ROUNDED TO SUB ROUNDED, SLIGHTLY MOIST, BROWN (7.5YR 4/3), POORLY SORTED W/ GRAVEL, 10%, MED TO FINE, ROUNDED.	SP	9 12 14					
10	X				0	NO RECOVERY	—	50					
15	X			3.5	5	SAND 70%, MED TO COARSE, ANGULAR, LIGHT BROWN (7.5YR 5/4 TO 6/4), POORLY SORTED W/ GRAVEL, MED TO COARSE, ROUNDED, 30%, W/ OCCASIONAL GRAVEL	SP	50					
20	X				0	NO RECOVERY	—	50					
25	X		Y	0	30	SAND 60%, COARSE, ANGULAR, MOIST, BROWN (7.5YR 5/4). W/ GRAVEL, 40%, MED COARSE, ROUNDED	SP	7 15 50					
30	X				0	~~NO RECOVERY~~ SAND 60%, COARSE, ANGULAR, MOIST, BROWN TO LIGHT BROWN (7.5YR 5/4 TO 6/4) W/ GRAVEL, 40%, MED TO COARSE, ROUNDED W/ RARE COBBLES.	SP	10 50					

U = Thin wall Tube | R = Rock Coring NA | Field G.C(Make/Mod) NA

S = Split spoon tube | O = Other CA S | G.C Oper NA

C = Cuttings | Notes NA

FIGURE 5-3a

REV DATE MAY 1990

BORING LOG	BORING/WELL NO SB1-02	Page 2 of 2
Installation **Sky Harbor** **Coordinates:**		Site 1
Project No 405221.02	Client/Project HAZWRAP / Sky Harbor ANG	
HAZWRAP Contractor IT Corporation	Drlg Contractor Layne Environmental	Driller Dean Lodder
Drlg Started 2/4/91 (0900 a m)	Drlg Ended 2/5/91 1300 p m	Borehole dia(s) 9 3/4"
Drlg Method/Rig Type: Air Hammer Casing		
Logged by Gardiner	E-Log Y [✓ N] From ____ to ____	Protection Level D (Modified)

Depth (ft)	Sample	Sample No	Lab Anal (Y/N)	Recovery (ft)	Lithologic Description	USCS	Blows/6 inch	Graphic Log	Well data	Water depth & Remarks
35	X			0	No Recovery	—	50			NA
40	X			0	No Recovery; From Cyclone at ~ 39 ft..	—	50			
					SAND 55%, Coarse, Angular, Light Brown, (7.5YR 6/4), Poorly Sorted w/ Gravel, 30%, Rounded to Angular, Med to Coarse & Cobbles, 15%, Rounded, Med to Coarse.	SP to GP	—			
45	X			0	No Recovery	—	50			
50	X		0	10	SAND 60%, Med to Coarse, ~~Light~~ Dark Brown, (7.5YR 3/2) w/Some Silt or Silty Clay, 10%, Black to Very Dark Gray, (7.5 YR N3/0), Moist, Sticky, w/ Gravel, 30%, Med to Coarse, Rounded.	SP to SM	50			
55	X			0	~~No R~~ No Recovery	—	50			
60	X			0	No Recovery ~~; From Cy~~	—	50			
					No Recovery, From Cyclone at ~ 66 ft.:	—	50			
65	X			0	SAND 60%, Coarse, Angular to Subangular, Brown (7.5YR 5/4), Moist, Poorly Sorted w/ Gravel, 30%, Med, Rounded & Cobbles, 10%, Med to Coarse, Rounded	SP to GP	—			
70	X			0	No Recovery	—	50			
72										

T = Thin wall Tube R = Rock Coring NA Field G.C (Make/Model) NA

S = Split spoon (tube) O = Other CA S G.C Oper NA

C = Cuttings Notes NA

FIGURE 5-3a

REV DATE MAY 1990

BORING LOG | BORING/WELL NO SB1-03 | Page 1 of 2
Installation **Sky Barbor** **Coordinates:** | Site 1
Project No 401724 | Client/Project HAZWRAP / SKY HARBOR ANG
HAZWRAP Contractor IT CORPORATION | Drilling Contractor LAYNE ENVIRONMENTAL | Driller DWIGHT PATTERSON
Drilling Started 1/21/91 (1300 p.m.) | Drilling Ended 1/22/91 (0730 a.m.) | Borehole dia(s) 9 3/4"
Drilling Method/Rig Type: AIR HAMMER CASING (PERCUSSION)
Logged by [illegible] | E-Log Y [✓ N] From ____ to ____ | Protection Level D (MODIFIED)

Depth (ft)	Sample	Sample No	Lab Anal (Y/N)	RQD ( )	Recovery ( )	Lithologic Description	USCS	Blows/6 inch	Graphic Log	Well data	Water depth & Remarks	El
0	X		Y	0	90	0-2ft. SURFACE SAMPLE SAND 90% MED, MOIST, ROUNDED, DARK BROWN (7.5YR 4/2) w/ MINOR GRAVEL (10%), ROUNDED, MED TO FINE, ~~MO~~	SW	15 12 13				1116.65
5	X				0	NO RECOVERY	—	13 12 18				
10	X			0	50	GRAVEL 60%, ROUND & ANGULAR, POORLY SORTED, MED TO COARSE w/ SAND, 40%, COARSE TO MED, ANGULAR, LIGHT BROWN (7.5YR 6/4), MOIST	GP	8 10 10				
15	X				10	NO RECOVERY (ONLY GRAVEL, BUT COULD ROUNDED & ANGULAR, ~~MO~~	—	50				
20	X		Y	0	50	SAND 80%, MED TO COARSE, ANGULAR, POORLY SORTED, BROWN (7.5YR 5/3), MOIST, w/ GRAVEL, 20%, ROUNDED, MED	SP	8 14 22				
25	X				0	NO RECOVERY	—	50				
30	X				0	NO RECOVERY, FROM CYCLONE AT 31ft: SAND MED TO COARSE, ANGULAR, POORLY SORTED w/ SOME GRAVEL 75% SAND w/ 25% GRAVEL BROWN TO LIGHT BROWN (7.5YR 5/4 to 6/4) GRAVEL IS MED TO COARSE w/ ROUNDED EDGES & OCCASIONAL GRAVEL	—	50				

U = Thin wall Tube | R = Rock Coring NA | Field GC (Make/Model) NA
S = Split spoon (tube) | O = Other CAS | GC Oper NA
C = Cuttings | Notes ~~CA~~ JTS 4-4-91 NA

FIGURE 5-3a

REV DATE MAY 990

BORING LOG | BORING/WELL NO 531-03 | Page 2 of 2

Installation **Sky Harbor** **Coordinates:** | Site 1

Project No [illegible] | Client/Project HAZWRAP / SKY HARBOR ANG

HAZWRAP Contractor IT CORPORATION | Drlg Contractor LAYNE ENVIRONMENTAL | Driller DWIGHT PETERSON

Drlg Started 1/21/91 (1300 P.m) | Drlg Ended 1/22/91 0920 A.m | Borehole dia(s) 9 7/8"

Drlg Method/Rig Type: AIR HAMMER CASING (PERCUSSION)

Logged by GARDNER | E-Log Y [✓ N] From ____ to ____ | Protection Level D (MODIFIED)

Depth (ft)	Sample	Sample No	Lab Anal (Y/N)	Recovery ( )	( )	Lithologic Description	USCS	Blows/6 inch	Graphic Log	Well data	Water depth	Remarks
35	☒		Y	0	1	SAND 80%, ~~COARSE~~, ANGULAR, LIGHT BROWN (7.5YR 6/4), MODERATELY SORTED BUT W/ GRAVEL, 80%, ANGULAR & ROUND, MED. MOIST.	SW	16 16 50				NA
40	☒				0	NO RECOVERY	–	50				
45	☒				0	NO RECOVERY. FROM CYCLONE AT 45 ft. GRAVEL 75%, ROUNDED TO ANGULAR, MED TO COARSE W/ SOME LARGE COBBLES, W/ SAND, 25%, ROUNDED TO ANGULAR, MED TO COARSE, LIGHT BROWN (7.5YR 6/4).	– GP	50				
50	☒				0	NO RECOVERY. FROM CYCLONE: GRAVEL 60%, ROUNDED TO ANGULAR, COARSE W/ SOME SMALL FRAGMENTS & OCCASIONAL LARGE GRAVEL, W/ SAND, 40%, ANGULAR, MED TO COARSE, LT. BROWN (7.5YR 6/4). MOIST.	GP	50				
55	☒		Y	0	1	SAND SILTY TO CLAYEY, 40%, DARK BROWN, POORLY SORTED (7.5YR 3/2), MOIST, W/ GRAVEL, 10%, ROUNDED, FINE TO MED.	SM TO SC	21 25 27				
60	☒				0	NO RECOVERY	–	50				
						NO RECOVERY. FROM CYCLONE AT ≈ 64 ft	–	50				
65	☒				0	SAND 50%, MED TO COARSE, ANGULAR, BROWN (7.5YR 5/4) W/ GRAVEL, 50%, MED TO COARSE, ROUNDED TO ANGULAR & OCCASIONAL COBBLES	SP TO GP	50				
					0	NO RECOVERY, FROM CYCLONE AT 69-70 ft: SAND 70%, MED TO COARSE, ANGULAR W/ SOME FINES, BROWN (7.5YR 5/4) W/ GRAVEL, 30%, MED TO COARSE, ROUNDED TO [illegible], [illegible] COBBLES	– SP					
70												
72												

T = Thin wall Tube | R = Rock Coring NA | Field G/C (Make/Mod) NA

S = Split spoon (tube) | O = Other CA S | G/C Oper NA

C = Cuttings | Notes NA

FIGURE 5-3a

REV DATE MAY 1990

BORING LOG	BORING/WELL NO S31-04 (MODIFIED)	Page 1 of 2
Installation **Sky Harbor** **Coordinates:**		Site 1
Project No 409721.02.01	Client/Project HAZWRAP / SKY HARBOR ANG	
HAZWRAP Contractor IT CORPORATION	Drlg Contractor LAYNE ENVIRONMENTAL	Driller DWIGHT PETERSON
Drlg Started 1/21/91 08 30 (a m)	Drlg Ended 1/21/91 1200 (p m)	Borehole dia(s) 9 3/4"
Drlg Method/Rig Type: AIR HAMMER CASING (PRECUSSION).		
Logged by GARDINER	E-Log Y [✓ N] From ____ to ____	Protection Level D (MODIFIED)

Depth (ft)	Sample	Sample No	Lab Anal (Y/N)	Recovery ( )	RQD ( )	Lithologic Description	USCS	Blows 6 inch	Graphic Log	Well data	Water depth & Remarks	E
0	X		Y	0.	5	0-2ft. SURFACE SAMPLE FROM UNDER ASPHALT SAND 80%, MEDIUM TO FINE, BROWN (7.5 YR 4/3), ~~DAMP~~ MOIST, ANGULAR w/ GRAVEL (20%), ROUNDED, MEDIUM	SP	12 20 24				1117.08
5	X			0	9	SAND MED TO FINE (85%) w/ SOME SILT DARK BROWN (7.5YR 4/4) W/GRAVEL (10-15%), ROUNDED, MEDIUM TO FINE	SP TO SM	10 16 35				
10	X		Y	0	9	SAND MED GRAINED (90%); Well sorted SAND, BUT w/ GRAVEL (~10%). BROWN (7.5 YR 5/3)	SP ~~18~~ ~~19~~ ~~20~~ TO SM	18 19 20				
15	X			0		~~SP~~ No Recovery	—	—				
20	X			0	10	SAND 60%, Med to COARSE POORLY SORTED, BROWN (7.5YR 5/3) MOIST w/ GRAVEL (40%), MEDIUM TO COARSE, ROUNDED	SP	50				
25	X			0		NO RECOVERY FROM CYCLONE — SAND (60%) Med to COARSE, POORLY SORTED, BROWN TO LIGHT BROWN (7.5YR 6/3) w/ GRAVEL & COBBLES (40%), Med to COARSE, ROUNDED. MOIST	— SP	50				
30	X			0	10	SAND 50% MED TO COARSE, BROWN, (7.5YR 5/3) w/ GRAVEL (50%), ROUNDED, COARSE, POORLY SORTED, MOIST	SP	6 10 90				

U = Thin wall Tube R = Rock Coring NA Field G/C (Make/Model) NA

S = Split spoon tube) O = Other CAS G/C Oper NA

C = Cuttings Notes NA

FIGURE 5-3a

REV DATE MAY 1990

BORING LOG | BORING/WELL NO SB1-04 (Modified) | Page 2 of 2

Installation **Sky Harbor** **Coordinates:** | Site

Project No. 409321.02.06 | Client/Project HAZWRAP / Sky Harbor ANG

HAZWRAP Contractor IT Corporation | Drlg Contractor Layne Engineering | Driller Dwight Peterson

Drlg Started 1/21/91 (08 30 a m) | Drlg Ended 1/21/91 (12 00 p m) | Borehole dia(s) 9 3/4"

Drlg Method/Rig Type: Air Hammer Casing (Percussion)

Logged by Gardiner | E-Log Y [✓ N] From ____ to ____ | Protection Level D (Modified)

Depth (ft)	Sample	Sample No	Lab Anal (Y/N)	Recovery (ft)	Lithologic Description	USCS	Blows/6 inch	Graphic Log	Well data	Water depth & Remarks
35				0	No Recovery	—	50			NA
40				0.5	Little Recovery (5%) Gravel, med to coarse, 100%. Rounded Moist. From Cyclone at ≈ 42 ft: Sand (50%), med to coarse, Light Brown (7.5YR 6/4), Angular. w/ Gravel, poorly sorted, 50%, Angular & Rounded.	G SP	50 -			
45				0	45-47 ft. No Recovery	—	50			
50				0	No Recovery	—	50			
55			Y	0.75	Sand 80%, med to coarse, Dark Brown (7.5YR 3/3), Moist w/ Gravel (20%), Rounded med to fine; Some Silt in Sand near top	SP to SM	13 23 21			Wet Cuttings at 55 ft
60				0	No Recovery: Cyclone has Moist Sand May be near water	-	50			
65				0	No Recovery	—	50			
					70ft. No Recovery. From Cyclone: Sand & Silty Sand w/some gravel. 75% Sand w/ 25% Gravel. Med to Coarse, Brown (7.5YR 5/3). Gravel is med to coarse, Rounded & Angular. Moist to Wet.	SP	50			Near water Wet Cuttings
70				0						

T = Thin wall Tube | R = Rock Coring NA | Field GC (Make/Model) NA

S = Split spoon (tube) | O = Other CA S | GC Oper NA

C = Cuttings | Notes NA

FIGURE 5-3a

REV DATE MAY 990

BORING LOG | BORING/WELL NO SB1-05 | Page 1 of 2

Installation **Sky Harbor** **Coordinates:** | Site 1

Project No. 409321.02.06 | Client/Project: HAZWRAP / SKY HARBOR ANG

HAZWRAP Contractor IT CORPORATION | Drlg Contractor LAYNE ENVIRONMENTAL | Driller ART RODRIGUEZ

Drlg Started 1/18/91 (10 20 a m) | Drlg Ended 1/18/91 (6.35 p m) | Borehole dia(s) 9 3/4"

Drlg Method/Rig Type: AIR PERCUSSION HAMMER

Logged by GARDINER | E-Log Y [✓ N] From _____ to _____ | Protection Level D (MODIFIED)

Depth (ft)	Sample	Sample No	Lab Anal (Y/N)	ndsp ( )	Recovery ( )	Lithologic Description	USCS	Blows/6 inch	Graphic Log	Well data	Water depth & Remarks
0	X	0	Y	0	100	SAND MEDIUM TO FINE GRAINED (80%) WITH GRAVEL, MEDIUM (20%). DARK BROWN (7.5YR 3/3), MOSTLY WELL SORTED FOR THE SAND. POORLY GRADED.	SW	13 13 10			1115.86
5	X			0.7	100	SAND MEDIUM GRAINED, DARK BROWN (80%) (7.5YR 4/3); W/ GRAVEL (20%), WELL ROUNDED, MEDIUM.	SP	14 18 22			
~~10~~											
10	X			1	100	SAND MEDIUM GRAINED, DARK BROWN (80%) (7.5YR 4/3), W/ GRAVEL (20%), WELL ROUNDED, MEDIUM.	SP	18 14 20			
15	X			1	0	SAND MEDIUM GRAINED (80%) DARK BROWN (7.5YR 4/3), POORLY SORTED W/ GRAVEL (20%), MEDIUM & WELL ROUNDED	SP	8 19 23			
20	X				0	No Recovery		50			
25	X				0	No Recovery		50			
30	X					FROM CYCLONE (NOT NECESSARILY FROM CORRECT INTERVAL) GRAVEL (90%) ROUNDED & LARGE UP TO COBBLES W/ SAND (10%), ROUNDED, MEDIUM TO COARSE LIGHT BROWN (7.5YR 6/4).	GP	NA			
			Y	1	50	SAND MED TO COARSE (60%), LIGHT BROWN (7.5YR 6/3) POORLY SORTED, ANGULAR TO SUBANGULAR W/ GRAVEL, MEDIUM, ROUNDED (40%)	SP	21 24 32			

T = Thin wall Tube | R = Rock Coring NA | Field G/C(Make/Mod) NA

S = Split spoon(tube) | O = Other CAS | G/C Oper NA

C = Cuttings | Notes NA

FIGURE 5-3a

REV DATE MAY 1990

BORING LOG | BORING/WELL NO SB1-05 | Page 2 of 2

Installation **Sky Harbor** **Coordinates:** | Site 1

Project No 409721.07.00 | Client/Project HAZWRAP / SKY HARBOR ANG

HAZWRAP Contractor IT CORPORATION | Drlg Contractor LAYNE ENVIRONMENTAL | Driller ART RODRIGUEZ

Drlg Started 1/18/91 (10 20 A m) | Drlg Ended 1/18/91 (4 26 A m) | Borehole dia(s) 9 3/4"

Drlg Method/Rig Type: AIR PERCUSSION HAMMER

Logged by GARDINER | E-Log (Y / [✓ N]) From ____ to ____ | Protection Level D (MODIFIED)

Depth (ft)	Sample	Sample No	Lab Anal (Y/N)	HNSP (%)	Recovery (%)	Lithologic Description	USCS	Blows/6 inch	Graphic Log	Well data	Water depth & Remarks	Ele
35	☒			0	50	SAND APPROX 80%, MEDIUM TO COARSE, ANGULAR, LIGHT BROWN (7.5YR 6/3), POORLY SORTED W/ GRAVEL (20%), MEDIUM TO COARSE.	GP TO SP	18 50				NA
40	☒			0	50	GRAVEL 70%, MEDIUM TO COARSE, ANGULAR TO SUBANGULAR & ROUNDED W/ SAND (30%), MEDIUM TO COARSE, ANGULAR, LIGHT BROWN (7.5YR 6/3)	GP	25 47 50				
45	☒			0	30	GRAVEL 90%, MEDIUM, POORLY SORTED W/ SAND (10%), MEDIUM TO COARSE, RED BROWN (5YR 4/4). MOIST	GP	50				
50	☒				0	SAND 90%, SILTY, POORLY SORTED FINE TO COARSE, RED BROWN (5YR 4/4), DARK ROUNDED TO ANGULAR W/ GRAVEL (1%) SMALL TO MEDIUM, ROUNDED. MOIST	SM	20 50				
55	☒				0	NO RECOVERY	—	50				
60	☒			0	0	NO RECOVERY: FROM CYCLONE (APPROX CORRECT INTERVAL)? GRAVEL 60% ANGULAR TO ROUNDED W/ SOME LARGER COBBLES (ROUNDED), MEDIUM, W/ SAND (40%), MEDIUM TO FINE & SOME SILT, RED BROWN (5YR 4/4)	GM	—				
65	☒		Y		0	NO RECOVERY	—	50				
					0	70-72ft SAND 80%, POORLY SORTED W/ SOME SILT, SUB-ROUNDED; (2.5YR 4/4), W/ GRAVEL (20%), ROUNDED, MEDIUM TO FINE	SM	60			NEAR WATER-CUTTINGS VERY MOIST.	
70						TD = 70ft.						

T = Thin wall Tube | R = Rock Coring NA | Field G/C(Make/Mod) NA

S = Split spoon tube) | O = Other CA S | G/C Oper NA

C = Cuttings | Notes NA

FIGURE 5-3a

REV DATE MAY 990

BORING LOG | BORING/WELL NO MW2-02 | Page 1 of 3

Installation **Sky Harbor** **Coordinates:** | Site 2

Project No. 409726.02.06 | Client/Project HAZWRAP / Sky Harbor ANG

HAZWRAP Contractor IT Corporation | Drlg Contractor Layne Environmental | Driller Denny Lodder

Drlg Started 2/6/91 10 55 a.m. | Drlg Ended 2/6/91 16 20 p.m. | Borehole dia(s) 9 3/4"

Drlg Method/Rig Type: Air Hammer Casing

Logged by Gardiner | E-Log Y [✓ N] From ____ to ____ | Protection Level D (modified)

Depth (ft)	Sample	Sample No	Lab Anal (Y/N)	Recovery ( )	RQD ( )	Lithologic Description	USCS	Blows/6 inch	Graphic Log	Well data	Water depth & Remarks	El
0	X		Y	0	90	SAND 90%, MED TO COARSE, ROUNDED, DARK BROWN (7.5YR 4/3), MOIST, w/ GRAVEL, 10%, FINE TO MED, ROUNDED	SP	NA				1114.50
5	X			0	50	SAND 90%, COARSE, ANGULAR, BROWN (7.5YR 5/4) POORLY SORTED w/ GRAVEL, 10%, med., ROUNDED., MOIST.	SP	6 13 14				
10	X			0	10	SAND 75%, COARSE, ANGULAR, ~~B~~ LIGHT BROWN (7.5YR 6/4), POORLY SORTED w/ GRAVEL, 25%, MED TO COARSE, ANGULAR TO ROUND, SLIGHTLY MOIST.	SP	6 26 50				
15	X				0	NO RECOVERY	—	50				
20	X				0	No Recovery	—	50				
25					0	No Recovery; From Cyclone at 25 ft:	—	50				
	X					SAND 60%, COARSE, ANGULAR TO SUBANG, LIGHT BROWN (7.5YR 6/4), POORLY SORTED w/ GRAVEL, 30%, ROUNDED TO ANGULAR, MED TO COARSE & COBBLES, 10%, ROUNDED	SP	—				
30	X		Y	0	40	SAND 80%, COARSE, ANGULAR, MOSTLY LIGHT BROWN (7.5YR 6/4), MOSTLY WELL SORTED BUT w/ GRAVEL, 20%, ROUND TO ANGULAR, MED & w/ RARE COBBLES. SLIGHTLY MOIST.	SP	30 25 50				

U = Thin wall Tube | R = Rock Coring NA | Field G/C (Make/Model) NA

S = Split spoon tube | O = Other CA S | G/C Oper NA

C = Cuttings | Notes NA

FIGURE 5-3a

REV DATE MAY 1990

BORING LOG	BORING/WELL NO MW2-02	Page 2 of 3
Installation **Sky Harbor**	**Coordinates:**	Site 2
Project No 409321.06.	Client/Project HAZWRAP / Sky Harbor ANG	
HAZWRAP Contractor IT Corporation	Drlg Contractor Layne Environmental	Driller Derry Lodder
Drlg Started 2/6/91 (10:55 A m)	Drlg Ended 2/6/91 (5:20 P m)	Borehole dia(s) 9 3/4"
Drlg Method/Rig Type: Air Hammer Casing		
Logged by Gardner	E-Log Y [✓ N] From ____ to ____	Protection Level D (Modified)

Depth (ft)	Sample	Sample No	Lab Anal (Y/N)	Recovery ( )	RQD ( )	Lithologic Description	USCS	Blows/6 inch	Graphic Log	Well data	Water depth & Remarks
35	☒				0	No Recovery	—	50			NA
40	☒				0	No Recovary; From Cyclone @ ≃ 41 ft:	—	50			
						Sand 60%, Coarse, Angular, Brown (7.5YR 5/4) Poorly Sorted w/ Gravel, 20%, Rounded to Angular, Med to Coarse, & Cobbles, 20%, Med to Coarse, Rounded. Moist	SP to GP	—			
45	☒			0	5	Sand 70%, Coarse, Angular, Dark Brown (7.5YR 3/3), Moist, Poorly Sorted w/ very minor silts, & Gravel, 30%, med., Rounded to Sub-Ang.	SP	50			
50	☒			0	5	Sand 51%, Coarse, Angular, Brown (7.5YR 5/4), moist w/ Gravel, 49%, Angular, Med to Coarse & Occasional Cobbles	SP to GP	50			
55	☒				0	No Recovary	—	50			
60	☒				0	No Recovary	—	50			
65	☒			0	5	Sand 70%, Coarse, Angular, Brown (7.5YR 5/4), Poorly Sorted w/ Gravel, 30%, med to coarse, Round to Ang., w/ Occasional Gravel	SP	50			

U = Thin wall Tube
S = Split spoon tube)
C = Cuttings

R = Rock Coring NA
O = Other CAS
Notes NA

Field GC (Make/Mod) NA
GC Oper NA

FIGURE 5-3a

REV DATE MAY 90

BORING LOG | BORING/WELL NO. MW2-02 | Page 3 of 3

Installation **Sky Harbor** **Coordinates:** | Site 2

Project No. 409721.02. | Client/Project HAZWRAP/SKY HARBOR ANG

HAZWRAP Contractor IT CORPORATION | Drlg Contractor LAYNE ENVIRONMENTAL | Driller DARRY LODDER

Drlg Started 2/6/91 10 55 Am | Drlg Ended 2/6/91 16 20 Pm | Borehole dia(s) 9 7/8"

Drlg Method/Rig Type: AIR HAMMER CASING

Logged by GARDNER | E-Log Y / [✓ N] From ____ to ____ | Protection Level D (MODIFIED)

Depth (ft)	Sample	Sample No.	Lab Anal (Y/N)	Recovery ( )	RQD ( )	Lithologic Description	USCS	Blows/6 inch	Graphic Log	Well data	Water depth & Remarks
70	X		Y	0	6	SAND 90%, COARSE, ANGULAR, BROWN (7.5YR 5/4), MOSTLY WELL SORTED BUT W/ GRAVEL, 10%, ROUNDED, MED TO FINE, VERY MOIST.	SW TO SP	17 30 50			NA
75	X	NA				FROM CYCLONE FROM HERE TO T.D.					▲ VERY MOIST CUTTINGS.
80	X					SAND 75%, COARSE, ANGULAR, BROWN TO DARK BROWN (7.5YR 4/4), POORLY SORTED W/ GRAVEL, 20%, MED TO COARSE, ROUNDED TO ANGULAR, & COBBLES, 5%, ROUNDED, MED TO COARSE	SP	—			
85											
90	X					SAND 65%, COARSE, ANGULAR TO SUB ANG, DARK BROWN (7.5YR 4/4), POORLY SORTED W/ GRAVEL, 35%, MED TO COARSE, ANG. TO SUB ROUNDED & OCCASIONAL VERY COARSE COBBLES (RND)	SP TO GP	—			
95											FREE WATER AT ~95 ft.
100	X					SAND/WATER/GRAVEL & COBBLE MIXTURE, FLOWING WATER, BROWN (7.5YR 5/4). ROUNDED TO ANGULAR MED TO COARSE GRAVEL & COBBLES. T.D. = ~ 101 ft.					

U = Thin wall Tube | R = Rock Coring NA | Field GC (Make/Model) NA

S = Split spoon tube | O = Other CAS | GC Oper. NA

C = Cuttings | Notes NA

FIGURE 5-3a

REV DATE MAY 1990

BORING LOG	BORING/WELL NO.: SB2-01	Page 1 of 2
Installation: **Sky Harbor** **Coordinates:**		Site: 2
Project No.: 409721.02.06	Client/Project: HAZWRAP / SKY HARBOR ANG	
HAZWRAP Contractor: IT CORPORATION	Drlg Contractor: LAYNE ENVIRONMENTAL	Driller: DEAN LODGER
Drlg Started: 1/29/91 (0805 A m)	Drlg Ended: 1/29/91 (11 40 A m)	Borehole dia(s): 9 3/4"
Drlg Method/Rig Type: AIR HAMMER CASING		
Logged by: GARDNER	E-Log (Y / [✓ N]) From ____ to ____	Protection Level: D (MODIFIED)

Depth (ft)	Sample	Sample No.	Lab Anal. (Y/N)	RQD ( )	Recovery ( )	Lithologic Description	USCS	Blows/6 inch.	Graphic Log	Well data	Water depth & Remarks	Ele
0	X		Y	0.7	10	SAND MED TO FINE, 90% W/SOME SILT, ROUNDED, DARK BROWN (7.5YR 3/2), POORLY SORTED W/ GRAVEL, 10%, ROUNDED, FINE. MOIST	SP	4 7 9				1115.38
5	X			0	1.5	SAND 70% VERY COARSE, ANGULAR, BROWN TO LIGHT BROWN (7.5YR 5/4 TO 6/4), POORLY SORTED W/GRAVEL, 30%, ROUNDED, MED. MOIST.	SP	4 7 8				
10	X			0	1.5	SAND 65% COARSE, ANGULAR, BROWN TO LIGHT BROWN, (7.5YR 3/4 TO 6/4), POORLY SORTED W/ GRAVEL, 35%, ROUNDED, MED TO COARSE, MOIST.	SP	10 14 13				
15	X			0	[illegible]	SAND 65%, COARSE, ANGULAR, BROWN TO LIGHT BROWN, (7.5YR, 5/4 TO 6/4), POORLY SORTED W/ GRAVEL, 35%, ROUNDED, MED.	SP	50				
20	X				0	NO RECOVERY	—	50				
25	X				0	NO RECOVERY, FROM CYCLONE AT 26 ft.: SAND 60%, MED TO COARSE, ANGULAR, BROWN (7.5YR 5/4), POORLY SORTED W/ GRAVEL, 40%, ROUNDED AND ANGULAR, MED TO COARSE W/ RARE COBBLES	— SP	50 -				
30	X				0	NO RECOVERY	—	50				

U = Thin Wall Tube
S = Split spoon (tube)
C = Cuttings

R = Rock Coring NA
O = Other CAS
Notes: NA

Field G/C (Make/Mod.) NA
G/C Oper.: NA

FIGURE 5-3a

REV DATE MAY 1990

BORING LOG | BORING/WELL NO.: SB2-01 | Page 2 of 2

Installation: **Sky Harbor** **Coordinates:** | Site: 2

Project No.: 409721.02.06 | Client/Project: HAZWRAP / Sky Harbor ANG

HAZWRAP Contractor: IT Corporation | Drlg Contractor: Layne Environmental | Driller: Danny Lodder

Drlg Started: 1/29/91 (08:05 A m) | Drlg Ended: 1/29/91 (11:40 A m) | Borehole dia(s): 9 3/4"

Drlg Method/Rig Type: Air Hammer Casing

Logged by: Gardiner | E-Log (Y / [✓ N]) From ____ to ____ | Protection Level: D (Modified)

Depth (ft)	Sample	Sample No.	Lab Anal. (Y/N)	Recovery (	ncsp (	Lithologic Description	USCS	Blows/6 inch	Graphic Log	Well data	Water depth & Remarks	Ele.
35	☒				0	NO RECOVERY; FROM CYCLONE AT ~ 36ft: SAND 70%, COARSE, ANGULAR, LIGHT BROWN (7.5YR 6/4), POORLY SORTED w/ GRAVEL, 30%, ROUNDED TO ANGULAR, MED TO FINE., MOIST.	— SP	50 -				NA
40	☒				0	NO RECOVERY	—	50				
45	☒				0	NO RECOVERY; FROM CYCLONE AT ~ 46ft: SAND 65%, ANGULAR, MED, LIGHT BROWN (7.5YR 6/4), POORLY SORTED w/ GRAVEL, 35%, ROUNDED TO SUBANGULAR, MED TO COARSE, RARE COBBLES.	— SP	50 —			←	
50	☒		Y	0	10	SAND 95%, COARSE, ANGULAR, ~~LIGHT &~~ BROWN (7.5YR 5/4), MOSTLY WELL SORTED BUT w/ 1-5% GRAVEL, MED, ROUNDED, MOIST	SW TO SP	50				
55	☒		Y	0	5	SAND 55%, COARSE, ANGULAR TO SUB ANG., BROWN (7.5YR 5/4), POORLY SORTED w/ GRAVEL, 45%, ROUNDED TO SUB ROUNDED, MED. MOIST	SP	50				
60	☒			0	5	SAND 50%, COARSE, ANGULAR, BROWN (7.5YR 5/4), POORLY SORTED w/ GRAVEL, 50%, ROUNDED TO SUBANGULAR, MED. MOIST. VERY POOR RECOVERY.	SP TO SP	50				
65	☒				0	NO RECOVERY	—	50				
					0	NO RECOVERY, FROM CYCLONE AT ≈ 70ft: SAND 50%, ANGULAR TO SUB ANG., MED TO COARSE, BROWN (7.5YR 5/4), POORLY SORTED w/ GRAVEL, 50%, ROUNDED TO ANGULAR, MED TO COARSE w/ OCCASIONAL COBBLES, MOIST	— SP TO SP	50 —			VERY MOIST, NEAR WATER	
70	☒											
72												

U = Thin wall Tube | R = Rock Coring: NA | Field G/C(Make/Mod.): NA

S = Split spoon(tube) | O = Other: CAS | G/C Oper.: NA

C = Cuttings | Notes: NA

T.D = ~70ft.

FIGURE 5-3a

REV DATE MAY 1990

BORING LOG | BORING/WELL NO. SB2-02 (02) | Page 1 of 2

Installation **Sky Harbor** **Coordinates:** | Site Site 2

Project No. 409721.02.26 | Client/Project HAZWRAP / Sky Harbor ANG

HAZWRAP Contractor IT Corporation | Drlg Contractor Layne Environmental | Driller Dwight Patterson

Drlg Started 1/22/91 (11:00 a m) | Drlg Ended 1/22/91 (30 p m) | Borehole dia(s) 9 3/4"

Drlg Method/Rig Type: Air Percussion Hammer Casing

Logged by [illegible] | E-Log Y / [✓ N] From ____ to ____ | Protection Level D (modified)

Depth (ft)	Sample	Sample No	Lab Anal (Y/N)	Recovery ( )	RQD ( )	Lithologic Description	USCS	Blows/6 inch	Graphic Log	Well data	Water depth & Remarks
0	☒		Y	0	95	SAND SILTY, FINE TO MEDIUM GRAINED, DARK BROWN, (7.5YR 4/2) MOIST.	SM	8 9 5			1115.59
5	☒			0	95	SAND SILTY, FINE TO MEDIUM, DARK BROWN (7.5YR 4/2), MOIST	SM	6 7 10			
10	☒		Y	0	60	SAND SLIGHTLY SILTY, FINE TO MEDIUM, BROWN (7.5YR 5/4), SLIGHTLY MOIST w/ MINOR SILT.	SM	8 10 16			
15	☒				0	NO RECOVERY	—	50			
20	☒			0	0	NO RECOVERY	—	50			
						FROM CYCLONE AT 26 ft.. SAND 60%, med to COARSE, ANGULAR, LIGHT ~~SAND~~ BROWN (7.5YR 6/4) w/ GRAVEL, 40%, med TO COARSE ~~#~~ SOME COBBLES, ROUNDED. DRY	SP				
25	☒				0	NO RECOVERY	—	50			
30	☒				0	NO RECOVERY FROM CYCLONE AT 29 ft.. SAND 75%, MED to COARSE, ANGULAR, LIGHT BROWN (7.5YR 6/4) w/ GRAVEL ~~30~~ 35%, COARSE, ROUNDED & ANGULAR, OCCASIONAL COBBLES	— SP	50			

U = Thin wall Tube | R = Rock Coring NA | Field G/C (Make/Mod) NA

S = Split spoon tube | O = Other CA S | G/C Oper NA

C = Cuttings | Notes: NA

FIGURE 5-3a

REV DATE MAY 1990

BORING LOG | BORING/WELL NO SB2-02 | Page 2 of 2

Installation **Sky Harbor** **Coordinates:** | Site 2

Project No 401221.02.06 | Client/Project: HAZWRAP / SKY HARBOR ANG

HAZWRAP Contractor IT CORPORATION | Drlg Contractor LAYNE ENVIRONMENTAL | Driller DWIGHT ROBERTSON

Drlg Started 1/22/91 (11:00 A m) | Drlg Ended 1/22/91 (4:30 P m) | Borehole dia(s) 9 7/8"

Drlg Method/Rig Type: AIR PERCUSSION HAMMER CASING

Logged by GARDNER | E-Log Y [✓ N] From ____ to ____ | Protection Level D (MODIFIED)

Depth (ft)	Sample	Sample No	Lab Anal (Y/N)	Recovery (%) / RQD (%)	Lithologic Description	USCS	Blows/6 inch	Graphic Log	Well data	Water depth & Remarks
35	☒			0	NO RECOVERY	—	50			NA
40	☒			0 75	SAND 90%, COARSE GRAINED, ANGULAR, POORLY SORTED, BROWN (7.5YR 5/3) w/ GRAVEL, 10%, ANGULAR, FRAGMENTED, FINE TO MED. MOIST	~~40~~ ~~56~~ SP	40 50			
45	☒			0	NO RECOVERY	—	50			
~~50~~										
50	☒			0 70	SAND 90%, MED TO COARSE, ANGULAR, BROWN (7.5YR 5/2), POORLY SORTED w/ SOME SILT & GRAVEL, 10%, ROUNDED TO ANGULAR, MED. MOIST	SP	13 50			
55	☒			0 90	SAND 60%, COARSE, ANGULAR, BROWN (7.5YR 5/3) POORLY SORTED w/ GRAVEL, 40%, ROUNDED, FINE TO MED. SOME DARK, SMOOTH, CLAY? SMEARED ON SAND. MOIST	SP	50			
60	☒			0	NO RECOVERY	—	50			
				0	NO RECOVERY	—	50			
65	☒		Y	0 80	70-72 ft. SAND 90%, COARSE, ANGULAR, BROWN (2.5YR 5/3), POORLY SORTED w/ GRAVEL (10%), ROUNDED, FINE TO MED. MOIST	SP	19 26			
70										
72										

☒ Thin wall Tube R = Rock Coring NA Field G/C (Make & Model) NA

☒ Split spoon (tube) O = Other CAS G/C Oper NA

☐ Cuttings Notes: NA

FIGURE 5-3a

REV DATE MAY 1990

BORING LOG | BORING/WELL NO 382-04 | Page 1 of 2

Installation **Sky Harbor** **Coordinates:** Site 2

Project No 409721-02.06 | Client/Project HAZWRAP / SKY HARBOR ANG

HAZWRAP Contractor IT CORPORATION | Drlg Contractor LAYNE ENVIRONMENTAL | Driller DWIGHT PATTERSON

Drlg Started 1/22/91 (1505 p m) | Drlg Ended 1/22/91 (1030 a m) | Borehole dia(s) 9 3/4"

Drlg Method/Rig Type: AIR PERCUSSION HAMMER CASING

Logged by GARDINER | E-Log Y [✓ N] From ____ to ____ | Protection Level D (MODIFIED)

Depth (ft)	Sample	Sample No	Lab Anal (Y/N)	[illegible] ( )	Recovery ( )	Lithologic Description	USCS	Blows/6 inch	Graphic Log	Well data	Water depth	Remarks	E
0	☒		Y	0	95	0-2 SAND 95%, MEDIUM, ANGULAR TO SUB-ANG, W/SOME SILT, DARK BROWN (7.5YR 4/3), MOIST, W/ GRAVEL, 5%, ROUNDED, FINE.	SP TO SM	5 4 4					1114.67
5	☒			0	40	SAND 95%, MED. TO COARSE, ANGULAR, BROWN (7.5YR 5/3), MOIST, W/ OCCASIONAL FINE ROUNDED GRAVEL	SP	5 8 16					
10	☒				0	NO RECOVERY	—	50					
15	☒		Y	0	75	SAND 75%, MED TO COARSE, ANGULAR, POORLY SORTED, BROWN (7.5YR 9/3), MOIST, W/ GRAVEL, 25%, ROUNDED, FINE TO MED. MOIST	SP	29 41 50					
20	☒				0	NO RECOVERY	—	50					
					0	NO RECOVERY FROM CYCLONE AT ≃ 26 ft	—	50					
25	☒					SAND 70%, COARSE, ANGULAR, LIGHT BROWN (7.5YR 6/4), W/ GRAVEL, 30%, MED TO COARSE, ROUNDED TO ANGULAR, RARE COBBLES	SP						
30	☒				0	NO RECOVERY	—	50					

U = Thin wall Tube | R = Rock Coring NA | Field G/C (Make/Mod) NA

S = Split spoon (tube) | O = Other CAS | G/C Oper NA

C = Cuttings | Notes NA

FIGURE 5-3a

REV DATE MAY 1990

BORING LOG | BORING/WELL NO SB2-04 | Page 2 of 2

Installation **Sky Harbor** **Coordinates:** | Site 2

Project No 409721.02.06 | Client/Project HAZWRAP / SKY HARBOR ANG

HAZWRAP Contractor IT CORPORATION | Drlg Contractor LAYNE ENVIRONMENTAL | Driller DWIGHT PETERSON

Drlg Strt 1/22/91 1505 p m | Drlg Ended 1/22/91 1030 A m | Borehole diam 9 3/4"

Drlg Method/Rig Type AIR PERCUSSION HAMMER CASING

Logged by GARDINER | E-Log Y [✓ N] From ____ to ____ | Protection Level D (MODIFIED)

Depth (ft)	Sample	Sample No	Lab Anal (Y/N)	[illegible] ( )	Recovery ( )	Lithologic Description	USCS	Blows 6 inch	Graphic Log	Well data	Water depth & Remarks
35	☒				0	NO RECOVERY	—	50			NA
					0	NO RECOVERY FROM CYCLONE AT APPROX 40 ft:	—	50			
40	☒					SAND 60%, COARSE, BROWN (7.5YR 5/3), SUBANGULAR, W/ GRAVEL, 40%, ROUNDED & SUBANGULAR, MED, BUT W/ RARE COBBLES	SP	50			MOIST CUTTINGS AT 43-44 ft
45	☒				0	NO RECOVERY	—	50			
50	☒			0	10	SAND 80%, MED TO COARSE, BROWN (7.5YR 5/3), ANGULAR W/ GRAVEL, 20%, ROUNDED, MED MOIST	SP	50			
55	☒		Y	0	90	SAND 90%, MED BUT W/ SOME SILT, POORLY SORTED, DARK BROWN (7.5YR 4/3) MOIST W/ RARE GRAVEL (5-10%), FINE TO MED, ROUNDED.	SP TO SM	50			
60	☒				0	NO RECOVERY DRY CUTTINGS.	—	50			
					0	NO RECOVERY. FROM CYCLONE AT ~ 66 ft:	—	50			
65	☒					SAND 70%, COARSE, ANGULAR TO SUBANGULAR, BROWN (7.5YR 5/3) MOIST, W/ GRAVEL 30%, MED TO COARSE W/ RARE COBBLES, ROUNDED	SP				
			Y	0.6	80	SAND 90%, MED TO COARSE, ROUNDED TO SUB-ANGULAR, BROWN (7.5YR 5/3) VERY MOIST, W/ MINIMUM GRAVEL, 10%, ROUNDED, FINE TO MED	S TO SW	7 16 22			VERY MOIST CUTTINGS - NEAR WATER
70	☒										
72											

T = Thin wall Tube | R = Rock Coring NA | Field GC/Make/Mod NA

S = Split spoon tube | O = Other CA S | GC Oper NA

C = Cuttings | Notes NA

FIGURE 5-3a

REV DATE MAY 19

BORING LOG	BORING/WELL NO. MW3-01	Page 1 of 2
Installation **Sky Harbor**	**Coordinates:**	Site 3
Project No. 409331.06	Client/Project HAZWRAP / SKY HARBOR ANG	
HAZWRAP Contractor IT CORPORATION	Drlg Contractor LAYNE ENVIRONMENTAL	Driller DWIGHT PETERSON
Drlg Started 3/22/91 (8 30 A m)	Drlg Ended 3/22/91 (3 30 P m)	Borehole dia(s) 10¾"
Drlg Method/Rig Type DUAL TUBE PERCUSSION		
Logged by GARDINER	E-Log (Y / [✓ N]) From ____ to ____	Protection Level D (MODIFIED)

Depth (ft)	Sample	Sample No	Lab Anal. (Y/N)	Recovery ( )	RQD ( )	Lithologic Description	USCS	Blows/6 inch.	Graphic Log	Well data	Water depth & Remarks
0	X		Y	0	70	SAND 90%, FINE, RND, DARK BROWN (7.5YR 3/3), ~~MOIST~~, MOSTLY WELL SORTED BUT W/ OCCASIONAL GRAVEL, 10%, FINE, RND. MOIST	SW	12 10 11			
5	X			0	100	SAND 100%, MED TO COARSE, ANG TO SUB ANG, BROWN (7.5YR 5/3), ~~MOIST~~, WELL SORTED W/ RARE GRAVEL, FINE, RND. MOIST	SW	5 6 8			
10	X			0	40	SAND 70%, MED TO COARSE, RND TO SUB ANG, BROWN (7.5YR, 5/3), POORLY SORTED W/GRAVEL, 30%, RND TO SUB ANG, MED TO COARSE. SLIGHTLY MOIST	SP	30 27 50			
15	X			0		NO RECOVERY	—	50			
20	X			0		NO RECOVERY	—	50			
						NO RECOVERY; FROM CYCLONE AT ~ 24 ft: - 25	—	50			
25	X			0		SAND 75%, MED TO FINE, RND TO SUB RND, LT. BRN (7.5YR 6/4), POORLY SORTED W/GRAVEL, 25%, MED TO COARSE, RND TO SUB ANG. NOTE: VERY HARD (BOULDER?) AT 24 ft, THEN SAND UNDERNEATH W/GRAVEL, THEN BACK TO HARD MATERIAL. DRY	SP	~~50~~			
30	X			0		NO RECOVERY	—	50			

U = Thin wall Tube
S = Split spoon(tube)
C = Cuttings

R = Rock Coring ________
O = Other ________
Notes ________

Field G/C(Make/Mod.) ________
G/C Oper ________

FIGURE 5-3a

REV DATE MAY 199

BORING LOG	BORING/WELL NO MW3-01		Page 2 of 3
Installation **Sky Barbor**	**Coordinates:**	Site: 3	
Project No.: 409341.02.06	Client/Project: HAZWRAP / SKY HARBOR ANG		
HAZWRAP Contractor IT CORPORATION	Drlg Contractor LAYNE ENVIRONMENTAL	Driller: DWIGHT PETERSON	
Drlg Started 3/22/91 (8:30 A m)	Drlg Ended: 3/22/91 (5:30 P m)	Borehole dia(s) 10¾"	
Drlg Method/Rig Type: DUAL TUBE PERCUSSION			
Logged by GARDNER	E-Log Y / [✓ N] From ___ to ___	Protection Level D (MODIFIED)	

Depth (ft)	Sample	Sample No	Lab Anal (Y/N)	ndsp ( )	Recovery ( )	Lithologic Description	USCS	Blows/6 inch	Graphic Log	Well data	Water depth	Remarks
35	X			0	15	80%, MED TO COARSE, ANG TO SUB RND SAND BROWN (7.5YR 5/3 TO 4/3), POORLY SORTED W/ MINOR SILT & GRAVEL, 20%, MED TO FINE, RND. VERY MOIST.	SP	50				
40	X			0	20	70%, MED TO COARSE, ANG, BROWN SAND (7.5YR 4/3), POORLY SORTED W/ SILT, 10%, FINE, BROWN, & GRAVEL, 20%, MED TO COARSE, RND TO SUB ANG. VERY MOIST.	SP	50				
45	X				0	55%, MED TO COARSE, ANG, BROWN SAND (7.5YR 4/3), POORLY SORTED W/ GRAVEL, 45%, MED TO COARSE, RND TO SUB ANG. MOIST. NOT ENOUGH SAMPLE TO ANALYZE.	SP TO GP	50				
50	X		Y	0	10	75%, MED TO COARSE, ANG TO SUB ANG, SAND BROWN (7.5YR 4/3), POORLY SORTED W/ SILT, 5%, FINE, BROWN, & GRAVEL. 20%, MED TO COARSE, RND TO SUB ANG, MOIST.	SP	50				
55	X			0	10	80%, MED TO COARSE, ANGULAR, BROWN SAND (7.5YR 4/3), POORLY SORTED W/ GRAVEL, 20%, MED TO COARSE, RND TO SUB ANG, MOIST	SP	36 50				
60	X		Y	0	30	40%, MED TO COARSE, ANGULAR, SAND BROWN (7.5YR 4/3), MOSTLY WELL SORTED BUT W/ OCCASIONAL GRAVEL, 10%, FINE, RND, & RARE SILT. MOIST	SW TO SP	32 50				
65	X				0	NO RECOVERY	—	50				

U = Thin wall Tube R = Rock Coring ___ Field G/C(Make/Mod) ___

S = Split spoon(tube) O = Other ___ G/C Oper. ___

C = Cuttings Notes ___

FIGURE 5-3a

REV DATE MAY 1990

BORING LOG	BORING/WELL NO. MW3-01	Page 3 of 3
Installation **Sky Harbor**	**Coordinates:**	Site 3
Project No. 401721.03.06	Client/Project: HAZWRAP / SKY HARBOR ANG	
HAZWRAP Contractor: IT CORPORATION	Drlg Contractor LAYNE ENVIRONMENTAL	Driller: DWIGHT PETERSON
Drlg Started 3/22/91 (8:30 a m)	Drlg Ended 3/22/91 (3:30 p m)	Borehole dia(s) 10 3/4"
Drlg Method/Rig Type: DUAL TUBE PERCUSSION		
Logged by GARDINER	E-Log (Y / [✓ N]) From ____ to ____	Protection Level D (MODIFIED)

Depth (ft)	Sample	Sample No	Lab Anal (Y/N)	Recovery ( )	Lithologic Description	USCS	Blows/6 inch	Graphic Log	Well data	Water depth & Remarks
70	X			0	NO RECOVERY	—	50			
75										VERY MOIST — AT WATER TABLE @ ~ 75 ft.
80	X				SAND 70%, MED TO COARSE, ANG, LT. BRN (7.5 YR 6/4), POORLY SORTED W/ GRAVEL, 30%, MED TO COARSE W/ COBBLES, RND TO SUB RND. VERY MOIST.	SP TO GP	—			
85										FREE WATER AT ~ 85 ft.
90	X				SAND 70%, MED TO COARSE, ANG TO SUB ANG, BROWN (7.5YR 4/3 TO 3/3), POORLY SORTED W/ GRAVEL, 30%, MED TO COARSE, RND TO SUB ANG, W/ COBBLES (RND). WET.	SP TO GP	—			
95										
100					SAND, GRAVEL, COBBLES, WATER MIXTURE					
					TD ~ 101 ft.					

U = Thin wall Tube
S = Split spoon (tube)
C = Cuttings

R = Rock Coring ____________
O = Other ____________
Notes ____________

Field G/C (Make/Mod.) ____________
G/C Oper. ____________

FIGURE 5-3a

REV DATE MAY 1990

BORING LOG	BORING/WELL NO MW3-02	Page 1 of 3
Installation **Sky Harbor**	**Coordinates:**	Site 3
Project No 409721.02.06	Client/Project: HAZWRAP / SKY HARBOR ANG	
HAZWRAP Contractor IT CORPORATION	Drlg Contractor LAYNE ENVIRONMENTAL	Driller GABBY RODRIGUEZ
Drlg Started 3/23/91 (8 25 A m)	Drlg Ended 3/25/91 (4 30 P m)	Borehole dia(s) 10¾"
Drlg Method/Rig Type: DUAL TUBE PERCUSSION		
Logged by GARDNER	E-Log (Y / [✓ N]) From ____ to ____	Protection Level D (MODIFIED)

Depth (ft)	Sample	Sample No	Lab Anal (Y/N)	Recovery ( )	RQD ( )	Lithologic Description	USCS	Blows/6 inch	Graphic Log	Well data	Water depth & Remarks
0	☒		Y	0	90	SAND 95%, MED TO FINE, RND TO SUB RND, DARK BROWN (7.5YR 3/3), MOSTLY WELL SORTED BUT W/ OCCASIONAL GRAVEL, MED, RND. DRY.	SW	12 12 32			
5	☒		Y	0	90	SAND 99%, MED, RND TO SUB ANG, BROWN, (7.5YR 4/3), MOSTLY WELL SORTED W/ RARE GRAVEL, 1%, FINE, RND. DRY	SW	20 27 50			
10	☒				0	NO RECOVERY	—	32 50			
15	☒				0	No Recovery	—	50			
20	☒				0	Gravel 90%, MED TO COARSE, RND TO SUB ANG., POORLY SORTED W/ SAND, 10%, MED TO COARSE, BROWN (7.5YR 4/3) RND TO ANG. DRY	GP	50			
25	☒				0	No Recovery	—	50			
30	☒				0	No Recovery	—	50			

U = Thin wall Tube
S = Split spoon tube
C = Cuttings

R = Rock Coring ____
O = Other ____
Notes ____

Field G/C (Make/Mod) ____
G/C Oper ____

FIGURE 5-3a

REV DATE MAY 1990

BORING LOG | BORING/WELL NO MW3-02 | Page 2 of 3

Installation **Sky Harbor** **Coordinates:** Site 3

Project No. 409721.02.06 | Client/Project HAZWRAP / SKY HARBOR ANG

HAZWRAP Contractor IT CORPORATION | Drlg Contractor LAYNE ENVIRONMENTAL | Driller GABBY RODRIGUEZ

Drlg Started 3/23/91 (8 25 A m) | Drlg Ended 3/23/91 (4 30 P m) | Borehole dia(s) 10 3/4"

Drlg Method/Rig Type: DUAL TUBE PERCUSSION

Logged by GARDNER | E-Log Y / [✓ N] From ____ to ____ | Protection Level D (MODIFIED)

Depth (ft)	Sample	Sample No	Lab Anal (Y/N)	Recovery (	RQD (	Lithologic Description	USCS	Blows/6 inch	Graphic Log	Well data	Water depth &	Remarks
35	☒			0		NO RECOVERY; FROM CYCLONE AT ~ 34 ft.:	—	50				
						Gravel 90%, MED TO COARSE, RND TO ANG., POORLY SORTED w/ COBBLES, MED TO COARSE & SOME SAND, 10%, MED TO FINE, RND, LT BD (7.5YR 6/4) DRY.	GP	—				
40	☒			0		NO RECOVERY	—	50				
				0		NO RECOVERY; FROM CYCLONE AT ~ 44 ft:	—	50				
45	☒					Gravel 60%, MED TO COARSE, RND TO ANGULAR, POORLY SORTED w/ SILTY SAND, 30%, RND TO SUB ANG, MED TO COARSE, BROWN (7.5YR 5/4). MOIST, & COBBLES, COARSE, RND TO SUB ANG. 10%.	GP	—				
50	☒			0		NO RECOVERY	—	11 50				
55	☒			0		NO RECOVERY	—	50				
60	☒			0		NO RECOVERY; FROM CYCLONE AT ~ 59 ft.:	—	50				
						Gravel 60%, MED TO COARSE, RND TO ANGULAR, POORLY SORTED w/ SAND, 40%, MED TO COARSE, BROWN (7.5YR 5/4), RND TO SUB ANG. MOIST.	GP TO SP	—				
65	☒			0		NO RECOVERY	—	50				

U = Thin wall Tube R = Rock Coring ________ Field G/C(Make/Mod) ________

S = Split spoon(tube) O = Other ________ G/C Oper ________

C = Cuttings Notes ________

FIGURE 5-3a

REV DATE MAY 990

BORING LOG | BORING/WELL NO MW3-02 | Page 3 of 3

Installation **Sky Harbor** **Coordinates:** | Site 3

Project No 409721.01.06 | Client/Project HAZWRAP / SKY HARBOR ANG

HAZWRAP Contractor IT CORPORATION | Drlg Contractor LAYNE ENVIRONMENTAL | Driller GARY RODRIGUEZ

Drlg Started 3/23/91 (8 25 a m) | Drlg Ended 3/23/91 (4 30 p m) | Borehole dia(s) 10 3/4"

Drlg Method/Rig Type: DUAL TUBE PERCUSSION

Logged by GARDINER | E-Log (Y [✓ N]) From ____ to ____ | Protection Level D (MODIFIED)

Depth (ft)	Sample	Sample No	Lab Anal (Y/N)	Recovery ( )	RQD ( )	Lithologic Description	USCS	Blows/6 inch	Graphic Log	Well data	Water depth & Remarks
70	X				0	NO RECOVERY; FROM CYCLONE AT ≅ 69 ft:	—	50			
						SAND 50%, MED TO COARSE, RND TO SUB ANG, BROWN (7.5YR 5/4), POORLY SORTED W/ GRAVEL, 40%, MED TO COARSE, RND TO SUB ANG., & COBBLES, 10%, COARSE, RND TO SUB ANG. MOIST.	SP TO GP	—			
75											WATER EST AT ≈ 77 ft.
						EST. FROM CYCLONE ↓					
80											
85						SAND 60%, MED TO COARSE, DARK BROWN, (7.5YR 3/3), POORLY SORTED W/ GRAVEL, 40%, MED TO COARSE, RND TO ANG & COBBLES, COARSE, RND Very MOIST.	SP TO GP	—			
90											
95						SAND 60%, MED TO COARSE, DARK BROWN (7.5YR 3/3), POORLY SORTED W/ GRAVEL, 40%, MED, RND & SUB ANG, & COBBLES, RND, MED TO COARSE WET					FREE WATER AT ~ 96 ft.
100						SAND, SILT, GRAVEL, WATER MIXTURE	—	—			
						T.D. = ~101 ft.					

U = Thin wall Tube R = Rock Coring ____ Field GC(Make/Model) ____

S = Split spoon(tube) O = Other ____ GC Oper ____

C = Cuttings Notes ____

FIGURE 5-3a

REV. DATE MAY 19

BORING LOG | BORING/WELL NO.: SB3-01 | Page 1 of 2

Installation: **Sky Harbor** **Coordinates:** | Site: 3

Project No.: 409721.02.06 | Client/Project: HAZWRAP / SKY HARBOR ANG

HAZWRAP Contractor: IT CORPORATION | Drlg Contractor: LAYNE ENVIRONMENTAL | Driller: DWIGHT PETERSEN

Drlg Started: 3/24/91 (8:40 A m) | Drlg Ended: 3/24/91 (:00 P m) | Borehole dia(s): 10 3/4"

Drlg Method/Rig Type: DUAL TUBE PERCUSSION

Logged by: GARDINER | E-Log (Y / [✓ N]) From ____ to ____ | Protection Level: D (MODIFIE

Depth (ft)	Sample	Sample No.	Lab Anal. (Y/N)	ppm ( )	Recovery ( )	Lithologic Description	USCS	Blows/6 inch.	Graphic Log	Well data	Water depth @	Remarks
0	X		Y	0	90	SAND 99%, FINE, RND TO SUB ANG, BROWN (7.5YR 5/4 TO 4/4), MOSTLY WELL SORTED BUT W/ < 1% SILT & ~~FINE~~ FINE, AND GRAVEL.	SW	32 26 27				
5	X				0	NO RECOVERY	—	50				
10	X				0	NO RECOVREY	—	50				
					0	NO RECOVERY; FROM CYCLONE AT ~ 14-15 FT:	—	50				
15	X					SAND 55%, MED TO COARSE, SUB ANG TO ANG, LT BROWN (7.5YR 6/4), POORLY SORTED W/ GRAVEL, 30%, MED TO COARSE, RND TO ANGULAR, & COBBLES, COARSE, RND TO SUB ANGULAR. DRY	~~B~~ SP TO GP	—				
20	X				0	NO RECOVERY	—	50				
25	X				0	NO RECOVERY	—	50				
30	X				0	NO RECOVERY	—	50				

U = Thin wall Tube
S = Split spoon(tube)
C = Cuttings

R = Rock Coring ____
O = Other ____
Notes: ____

Field G/C(Make/Mod.) ____
G/C Oper.: ____

FIGURE 5-3a

REV. DATE MAY 19[illegible]

BORING LOG | BORING/WELL NO.: M SB3-01 | Page 2 of 2

Installation: **Sky Barbor** **Coordinates:** | Site: 3

Project No.: 409821-02-06 | Client/Project: HAZWRAP/SKY HARBOR ANG

HAZWRAP Contractor: IT CORPORATION | Drlg Contractor: LAYNE ENVIRONMENTAL | Driller: DOUG PETERSON

Drlg Started: 3/24/91 (8:40 A m) | Drlg Ended: 3/24/91 (1:00 P m) | Borehole dia(s): 10 3/4"

Drlg Method/Rig Type: DUAL TUBE PERCUSSION

Logged by: GARDNER | E-Log (Y / [✓ N]) From ____ to ____ | Protection Level D (MODIFIED)

Depth (ft)	Sample	Sample No.	Lab Anal. (Y/N)	Recovery ( )	[illegible] ( )	Lithologic Description	USCS	Blows/6 inch.	Graphic Log	Well data	Water depth	Remarks
35	X				0	NO RECOVERY; FROM CYCLONE AT ~ 34 ft: SAND 60%, MED TO COARSE, RND TO ANGULAR, LT. BROWN (7.5 YR 6/4), POORLY SORTED W/ GRAVEL, 30%, MED TO COARSE, RND TO SUB ANG, & COBBLES, 10%, RND TO SUB ANG. DRY.	–	50				
40	X			10	0	NO RECOVERY	–	50				
						NO RECOVERY; FROM CYCLONE AT ~ 44 ft:	–	50				
45	X				0	SAND 51%, COARSE, ANG TO SUB ANG, DARK BROWN (7.5YR 3/3), POORLY SORTED W/ SOME SILT, 5%, & GRAVEL, 30%, MED TO COARSE, RND TO SUB ANG, & COBBLES, 15%, RND, COARSE. MOIST. ODOR	SA TO GP	–				
50	X		Y	40		SAND 60%, MED TO COARSE, ANG TO SUB RND, DARK BROWN (7.5YR 3/3), POORLY SORTED W/ SILT, 5%, & GRAVEL, 30%, RND, MED TO COARSE, & COBBLES, 5%, RND, COARSE. MOIST. Very Sulfur odor	SP	27 50				
55	X				0	NO RECOVERY	–	29 50				
60	X			30	0	NO RECOVERY	–	50				
65	X			80	0	NO RECOVERY NO RECOVERY AT 70 ft = FROM CYCLONE AT 67-70:	–	50				
			Y	50	10	SAND 65%, MED TO COARSE, RND TO SUB ANG, DARK BROWN (7.5YR 3/3 TO 4/3), POORLY SORTED W/ GRAVEL, 30%, MED TO COARSE RND TO SUB ANG, & COBBLES, 5%, COARSE, RND	SP TO GP	–				VERY MOIST & MOD. STRONG ODOR
70	X											

U = Thin wall Tube | R = Rock Coring TD = 70 ft | Field G/C (Make/Mod.) SOLVENT.

S = Split spoon(tube) | O = Other ____ | G/C Oper. ____

C = Cuttings | Notes: ____

22 SX CEMENT

3 SX MUD

FIGURE 5-3a

REV. DATE MAY 199

BORING LOG	BORING/WELL NO.: SB3-03	Page 1 of 2
Installation: **Sky Harbor** **Coordinates:**		Site: 3
Project No.: 409721.02.06	Client/Project: HAZWRAP / SKY HARBOR ANG	
HAZWRAP Contractor: IT CORPORATION	Drlg Contractor: LAYNE ENVIRONMENTAL	Driller: DWIGHT PATTERSON
Drlg Started: 3/25/91 (11:45 A m)	Drlg Ended: 3/25/91 (4:30 P m)	Borehole dia(s): 10 3/4"
Drlg Method/Rig Type: DUAL TUBE PERCUSSION		
Logged by: GARDINER	E-Log (Y / [✓ N]) From ____ to ____	Protection Level: D (MODIFIED)

Depth (ft)	Sample	Sample No.	Lab Anal. (Y/N)	Recovery ( )	nosp ( )		Lithologic Description	USCS	Blows/6 inch.	Graphic Log	Well data	Water depth & Remarks
0	X		Y	0	50	SAND	80%, MED TO COARSE, RND TO SUB ANG, BROWN (7.5YR 5/4), POORLY SORTED W/ GRAVEL, 20%, MED TO FINE RND. SLIGHTLY MOIST.	SP	22 25 34			
5	X			0	50	SAND	70%, MED TO COARSE, RND TO SUB ANG, BROWN (7.5YR 5/4), POORLY SORTED W/ GRAVEL, 20%, MED TO COARSE, RND & COBBLES, 10%, MED TO COARSE, RND	SP	25 50			
10	X		Y	0	90	SAND	80%, MED TO COARSE, RND TO SUB ANG, DARK BROWN (7.5YR 3/3), POORLY SORTED W/ GRAVEL, 20%, MED TO COARSE, RND TO SUB RND. SLIGHTLY MOIST	SP	27 32 50			
15	X				0	NO RECOVERY		—	50			
20	X			0	50	SAND	70%, MED TO COARSE, RND TO SUB ANG, BROWN (7.5YR 4/3), POORLY SORTED W/ GRAVEL, 20%, MED TO COARSE, ANG TO SUB ANG, & COBBLES, 10%, RND, COARSE	SP	18 24 3[illegible]			
25	X				0	NO RECOVERY		—	50			
30	X				0	NO RECOVERY		—	50			

U = Thin wall Tube   R = Rock Coring ____   Field G/C(Make/Mod.) ____

S = Split spoon(tube)   O = Other ____   G/C Oper.: ____

C = Cuttings   Notes: ____

FIGURE 5-3a

REV DATE MAY 19C

BORING LOG | BORING/WELL NO.: SB3-03 | Page 2 of 2

Installation: **Sky Harbor** **Coordinates:** | Site: 3

Project No.: 404721.06.06 | Client/Project: HAZWRAP / SKY HARBOR ANG

HAZWRAP Contractor: IT CORPORATION | Drlg Contractor: LAYNE ENVIRONMENTAL | Driller: DWIGHT PETERSON

Drlg Started: 3/25/91 (11:45 a m) | Drlg Ended: 3/25/91 (4:30 p m) | Borehole dia(s): 10 3/4"

Drlg Method/Rig Type: DUAL TUBE PERCUSSION

Logged by: GARDINER | E-Log (Y / [✓ N]) From ____ to ____ | Protection Level: D (MODIFIED)

Depth (ft)	Sample	Sample No.	Lab Anal. (Y/N)	Recovery ( )	Lithologic Description	USCS	Blows/6 inch	Graphic Log	Well data	Water depth & Remarks
35				0	NO RECOVERY; FROM CYCLONE AT ≈ 34-35 ft:	—	50			
					SAND 55%, med to coarse, ANG, DARK BROWN (7.5YR 3/3), POORLY SORTED w/ GRAVEL, 35%, med to coarse, RND TO SUB ANG, & COBBLES, 10%, med, RND TO SUB RND. SLIGHTLY MOIST.	SP TO GP	-			
40			0	20	SAND 55%, med to coarse, ANG, BROWN (7.5YR 4/3), POORLY SORTED w/ SILT, 10%, MED., BROWN, & GRAVEL, 20%, MED TO COARSE, RND TO SUB ANG, & COBBLES, 15%, RND, COARSE. MOIST	SP TO GP	50			
45				0	NO SAMPLE AT 45 ft - LARGE COBBLES BLOCKING PIPE.					
50				0	NO RECOVERY	—	50			
				0	NO RECOVERY; FROM CYCLONE AT ~ 54 ft.	—	50			
55					SAND 60%, med, ANG TO SUB RND, DARK BROWN (7.5YR 3/3), POORLY SORTED w/ SILT (DARK BROWN, 20%, FINE, GRAVEL, 15%, med to COARSE, RND & COBBLES, 5%, med to coarse, RND. MOIST	SP	—			NO RECOV AT 60 ft
65 ~~60~~				0	NO RECOVERY	—	50			
68				0	NO RECOVERY; FROM CYCLONE AT ≃ 74 ft:	-	50			
70 ~~65~~				0	SAND 65%, med to coarse, RND TO SUB ANG, DARK BROWN (7.5YR 3/3), POORLY SORTED w/ GRAVEL, 20%, med to coarse, RND TO SUB ANG, & COBBLES, 15%, MED TO COARSE, RND TO SUB RND. WET.					WATER AT ~ 74 ft.
75 ~~70~~ 74				0	TD = 74 ft					

U = Thin wall Tube | R = Rock Coring | Field G/C(Make/Mod.)

S = Split spoon(tube) | O = Other | G/C Oper.:

C = Cuttings | Notes:

26 sx Cement

4 sx Bentonite Powder

FIGURE 5-3a

REV. DATE. MAY 19

BORING LOG BORING/WELL NO.: SB3-04 Page 1 of 2

Installation: **Sky Harbor** **Coordinates:** Site: 3

Project No.: 40321.02.06 Client/Project: HAZWRAP / SKY HARBOR ANG

HAZWRAP Contractor: (IT CORPORATION) Drlg Contractor: LAYNE ENVIRONMENTAL Driller: DUNCAN PETERSON

Drlg Started: 3/24/91 (2:00 P m) Drlg Ended: 3/25/91 (11:00 A m) Borehole dia(s): 6 3/4"

Drlg Method/Rig Type: DUAL TUBE PERCUSSION

Logged by: GARDINER E-Log (Y / [✓ N]) From ____ to ____ Protection Level: D (MODIFIED)

Depth (ft)	Sample	Sample No.	Lab Anal. (Y/N)	nosp ( )	Recovery ( )	Lithologic Description	USCS	Blows/6 inch.	Graphic Log	Well data	Water depth Remarks
0	☒		Y	0	80	SAND 99%, FINE, RND, DARK BROWN (7.5YR 3/3 to 4/3), MOSTLY WELL SORTED w/ MINOR SILT & RARE GRAVEL, FINE, RND. SLIGHTLY MOIST	SW	10 17 14			
5	☒		Y	0	80	SAND 100%, MED TO COARSE, RND TO SUB ANG, BROWN (7.5YR 5/3), WELL SORTED. SLIGHTLY MOIST.	SW	14 25 27			
10	☒			0	30	SAND 75%, MED TO COARSE, RND TO SUB ANG, BROWN (7.5YR 5/3), POORLY SORTED w/ GRAVEL, 20%, MED TO COARSE, RND TO SUB ANG & GRAVEL, 5%, MED TO COARSE, RND. DRY.	SP	50			
15	☒		Y	0	10	SAND 80%, MED, RND TO SUB ANG, BROWN TO DARK BROWN (7.5YR 4/3), POORLY SORTED w/ GRAVEL, 20%, MED TO COARSE RND. TO SUB ANG, & OCCASIONAL COBBLES, COARSE, RND DRY	SP	50			
20	☒			0	20	SAND 60%, MED TO COARSE, SUB RND TO ANG, BROWN (7.5YR 5/3), POORLY SORTED w/ GRAVEL, 30%, MED TO COARSE, RND TO SUB ANG & COBBLES, 10%, MED TO COARSE, RND TO SUB RND DRY	SP TO GP	50			
25	☒				0	NO RECOVERY	—	50			
30	☒				0	NO RECOVERY	—	50			

U = Thin wall Tube R = Rock Coring ____ Field G/C (Make/Mod.) ____

S = Split spoon (tube) O = Other ____ G/C Oper.: ____

C = Cuttings Notes: ____

FIGURE 5-3a

REV DATE MAY 199

BORING LOG	BORING/WELL NO.: SB3-04	Page 2 of 2
Installation: **Sky Harbor** **Coordinates:**		Site: 3
Project No.: 409721.02.06	Client/Project: HAZWRAP / Sky Harbor ANG	
HAZWRAP Contractor: IT Corporation	Drlg Contractor: Layne Environmental	Driller: Duncan Peterson
Drlg Started: 3/24/91 (2:00 P m)	Drlg Ended: 3/25/91 (11:00 A m)	Borehole dia(s) 10 3/4"
Drlg Method/Rig Type: Dual Tube Percussion		
Logged by Garoon	E-Log (Y [✓ N]) From ____ to ____	Protection Level: D (Modified)

Depth (ft)	Sample	Sample No.	Lab Anal. (Y/N)	Recovery ( )	Lithologic Description	USCS	Blows/6 inch.	Graphic Log	Well data	Water depth & Remarks
35	X		0	20	SAND 70%, med to coarse, rnd to sub ang, Brown to Dark Brown (7.5YR 4/3 to 3/3), poorly sorted w/ minor silt & gravel, 30%, med to coarse, & cobbles, med to coarse, rnd to sub rnd. Moist.	SP	50			
40	X		0	10	SAND 60%, med to coarse, rnd to sub rnd, Brown (7.5YR 5/2), poorly sorted w/ gravel, 30%, med to coarse rnd, & cobbles, 10%, med to coarse, rnd to sub rnd. Moist	SP to GP	30			
45	X			0	No Recovery	—	50			3/25/91
				0	No Recovery; From Cyclone at ≃ 49 ft.:	—	50			
50	X				SAND 70%, med to coarse, rnd to ang., Dark Brown (7.5YR 3/3 to 4/3), poorly sorted w/ gravel, 20%, med to coarse, rnd to sub ang, & cobbles, med to coarse, rnd. Moist.	SP	—			
65 ~~55~~										No Recovery at 55 ft.
										No Recovery at 60 ft.
68	X				Gravel 75%, med to coarse, rnd to angular, poorly sorted w/ sand, 25%, med to coarse, rnd to sub ang, Brown (7.5YR 4/3). Moist.	GP	50			
70 ~~60~~				10						
				0	No Recovery at 74 ft., From cyclone: SAND 60%, med to coarse, rnd to sub ang, Brown (7.5YR 4/3), poorly sorted w/ gravel, 30%, med to coarse, rnd to ang., & cobbles, 10%, coarse, rnd to sub rnd. Very Moist.					
75 ~~65~~	X									Wet at 74 ft.
					TD = 74 ft.					
~~70~~										

U = Thin wall Tube
S = Split spoon(tube)
C = Cuttings

R = Rock Coring ____
O = Other ____
Notes: ____

Field G/C(Make/Mod.) ____
G/C Oper.: ____

22 sx Cement
3 sx Mud

FIGURE 5-3a

REV DATE MAY 1990

BORING LOG | BORING/WELL NO MW5-01 | Page 1 of 3
Installation **Sky Harbor** **Coordinates:** | Site 5
Project No 409721.02.06 | Client/Project HAZWRAP/Sky Harbor ANG
HAZWRAP Contractor IT Corporation | Drlg Contractor Layne Environmental | Driller Derry Lodder
Drlg Started 2/7/91 (0850 A m) | Drlg Ended 2/7/91 14:00 P m) | Borehole dia(s) 9 3/4"
Drlg Method/Rig Type: Air Hammer Casing
Logged by Gardiner | E-Log Y [✓ N] From ____ to ____ | Protection Level D (Modified)

Depth (ft)	Sample	Sample No	Lab Anal (Y/N)	Recovery ( )	RQD ( )	Lithologic Description	USCS	Blows/6 inch	Graphic Log	Well Data	Water depth &	Remarks
0	X		Y	0	90	90%, DARK BROWN (7.5YR 3/3), MED SAND TO FINE, ROUNDED, POORLY SORTED w/ SOME SILT, 5%, & OCCASIONAL gravel, 5%, ROUNDED, MED. MOST	SM TO SP	6 9 8				1117.10
5	X		Y	0	80	SAND 95%, COARSE, MOSTLY WELL SORTED, LIGHT BROWN (7.5YR 6/4), ROUNDED TO ANGULAR, w/ OCCASIONAL GRAVEL, 5%, ROUNDED, FINE. SLIGHTLY MOIST.	SW	8 9 10				
10	X			0		SAND 50%, COARSE, ANGULAR, LIGHT BROWN (7.5YR 6/4), POORLY SORTED w/ GRAVEL, 45%, ROUND TO ANGULAR, MED TO COARSE & COBBLES, 5%, ROUNDED, COARSE	SP TO GP	15 50				
15	X			0		NO RECOVERY	—	50				
20	X			0	5	SAND 60%, COARSE, ANGULAR, RED LIGHT BROWN (7.5YR 6/4), POORLY SORTED w/ GRAVEL, 40%, MED TO COARSE, ROUNDED TO ANGULAR w/ OCCASIONAL COBBLES, RND, MED TO COARSE	SP	50				
25	X			0	5	SAND 60%, COARSE TO VERY COARSE, ANGULAR, LIGHT BROWN (7.5YR 6/4), POORLY SORTED w/ GRAVEL, 35%, MED TO COARSE, ROUND TO ANGULAR, & COBBLES, 5%, MED TO ~~COARSE~~, ROUNDED.	SP TO GP	50				
30	X			0		NO RECOVERY	—	50				

U = Thin wall Tube R = Rock Coring NA Field G/C (Make/Mod) NA
D = Split spoon (tube) C = Other CAS G/C Oper NA
C = Cuttings Notes NA

FIGURE 5-3a

REV DATE MAY 90

BORING LOG	BORING/WELL NO MW5-01	Page 2 of 3
Installation **Sky Harbor**	**Coordinates:**	Site 5
Project No. 409721.02.26	Client/Project HAZWRAP / SKY HARBOR ANG	
HAZWRAP Contractor IT CORPORATION	Drlg Contractor LAYNE ENVIRONMENTAL	Driller DERRY LUDDER
Drlg Started 2/7/91 (08:30 A m)	Drlg Ended 2/7/91 (14:00 P m)	Borehole dia(s) 9 3/4"
Drlg Method/Rig Type: AIR HAMMER CASING		
Logged by GARDINER	E-Log (Y [✓ N]) From ____ to ____	Protection Level D (MODIFIED)

Depth (ft)	Sample	Sample No	Lab Anal (Y/N)	Recovery ( )	Lithologic Description	USCS	Blows/6 inch	Graphic Log	Well data	Water depth & Remarks
35	X			0	NO RECOVERY	—	50			NA
				0	NO RECOVERY; FROM CYCLONE AT CA 39 ft.:	—	50			
40	X				SAND 65%, COARSE, ANGULAR TO SUB ROUNDED, ~~RED~~ BROWN (7.5YR 5/4), POORLY SORTED W/ GRAVEL, 30%, MED TO COARSE, ROUNDED TO ANGULAR & COBBLES, 5%, VERY COARSE, ROUNDED TO SUB ANGULAR. MOIST	SP TO GP	—			
45	X		0	5	SAND 65%, COARSE TO MED, ANGULAR TO SUB ROUNDED, POORLY SORTED W/ A MINOR SILT FRACTION & GRAVEL, 35%, MED TO COARSE, ROUNDED TO ANGULAR, & COBBLES, MED TO COARSE, ROUNDED. (7.5YR 5/4)	SP TO GP	50			
50	X			0	NO RECOVERY	—	50			
55	X		0	10	SAND 75%, COARSE, ANGULAR, ~~LIGHT~~ BROWN (7.5YR 5/4), POORLY SORTED W/ GRAVEL, 25%, MED TO COARSE, ROUNDED TO ANG, & COBBLES (RARE), COARSE, ROUNDED. VERY MOIST	SP	50			
60	X		0	39	SAND 70%, COARSE, ANGULAR, BROWN TO LIGHT BROWN (7.5YR 5/4 TO 6/4), POORLY SORTED W/ GRAVEL & COBBLES, 30%, MED TO COARSE, ROUNDED TO SUB ANG. VERY MOIST	SP	NA ~~50~~ 20 30 18			
65	X			0	NO RECOVERY	—	50			

U = Thin wall Tube	R = Rock Coring NA	Field GC/Make Mod NA
S = Split spoon tube	O = Other CAS	GC Oper NA
C = Cuttings	Notes NA	

FIGURE 5-3a

REV DATE MAY 1990

BORING LOG	BORING/WELL NO MW5-01	Page 3 of 3
Installation **Sky Harbor** **Coordinates:**		Site 5
Project No 409721.02.06	Client/Project HAZWRAP / SKY HARBOR ANG	
HAZWRAP Contractor IT CORPORATION	Drlg Contractor LAYNE ENVIRONMENTAL	Driller DARRY LODDER
Drlg Started 2/7/91 (0830 A m)	Drlg Ended 2/7/91 (14 00 P m)	Borehole dia(s) 9 3/4"
Drlg Method/Rig Type: AIR HAMMER CASING		
Logged by GARDINER	E-Log Y [✓ N] From ____ to ____	Protection Level D (MODIFIED)

Depth (ft)	Sample	Sample No	Lab Anal (Y/N)	Recovery ( )	RQD ( )	Lithologic Description	USCS	Blows/6 inch	Graphic Log	Well data	Water depth & Remarks	E
70	☒		Y	0	30	SAND 70%, COARSE, ANGULAR, BROWN (7.5YR 5/4), POORLY SORTED w/ MINOR SILT FRACTION (REDDISH BROWN) & GRAVEL, 30%, MED TO COARSE, ROUNDED TO ANGULAR, w/ MINOR COBBLES, ROUNDED, MED. SLIGHTLY MOIST	SP	50			NA	
75	☒			0	20	SAND 65%, COARSE TO MED, ANGULAR, BROWN (7.5YR 5/4), POORLY SORTED w/ SOME SILT, & GRAVEL, 30%, MED TO COARSE, ROUNDED TO SUB ANGULAR, & COBBLES MED TO COARSE, ROUNDED. VERY MOIST	SP	50			▲? WATER AT ≃ 78 ft?	
80						FROM CYCLONE TO T.D..						
85											FREE WATER AT ≃ 86 ft.	
	☒					SAND 70%, MED TO COARSE, ROUNDED TO ANGULAR, SOME SILT, w/ GRAVEL, 30%, MED TO COARSE, ROUNDED TO ANGULAR, & COBBLES, ROUNDED, COARSE. FREE WATER	SP TO GP	–				
90												
95												
100	☒					SAND/WATER MIXTURE w/ MED TO COARSE, ROUNDED TO ANGULAR GRAVEL, 35%, & MED TO COARSE, ROUND TO SUB ROUNDED COBBLES, 25%.	SP TO GP	–				
						T.D : ≃101 ft.						

U = Thin wall Tube	R = Rock Coring NA	Field GC(Make/Mod) NA
S = Split spoon tube	O = Other CAS	GC Oper NA
[illegible]	Notes NA	

REV DATE MAY '990

BORING LOG | BORING/WELL NO.: PP-01 | Page 1 of 2

Installation: PAPAGO MILITARY RESERVATION, PHOENIX AZ | Site: PAPAGO

Project No.: 40424.02.00 | Client/Project: HAZWRAP/SKY HARBOR ANG

HAZWRAP Contractor: IT CORPORATION | Drlg Contractor: LAYNE ENVIRONMENTAL | Driller: GARY LYONS

Drlg Started: 1/19/91 (___ m) | Drlg Ended: (___ m) | Borehole dia(s): 6" TO START 10" TO FINISH

Drlg Method/Rig Type: AIR ROTARY HAMMER

Logged by: GARDNER | E-Log (Y / [✓ N]) From _____ to _____ | Protection Level D (MODIFIED)

Depth (ft)	Sample	Sample No	Lab Anal. (Y/N)	Recovery ( )	RQD ( )	Lithologic Description	USCS	Blows/6 inch	Graphic Log	Well data	Water depth & Remarks	E.E.
0												1245.52
						5ft. SAND, RED BROWN (2.5YR 4/4), MEDIUM TO COARSE GRAINED W/ SMALL GRAVEL. POORLY SORTED & GRADED.	SP					
10						10ft CALICHE - WHITISH PINK, FINELY POWDERED FROM RIG. MIXED W/ REDDISH BROWN SAND & SMALL GRAVEL (5%)						
						15ft. SAND, WITH SOME CALICHE; SAND IS POORLY SORTED, MEDIUM TO COARSE, RED BROWN (2.5YR 4/4) W/ SMALL GRAVEL (ANGULAR).	SP					
20						20ft. GROUND VOLCANIC ROCK (2.5YR 4/4), RED BROWN W/ BRECCIA (2-5mm); MOSTLY QUARTZITE.						
30						25ft GROUND VOLCANIC ROCK (2.5YR 4/4), RED BROWN W/ QUARTZITE & OTHER BRECCIA FRAGMENTS of 2-5mm SIZE & ANGULAR. MAY BE MOIST?						
40						30ft. GROUND VOLCANIC ROCK (2.5YR 5/4); RED BROWN, BUT LIGHTER IN COLOR. SAME W/ ANGULAR BRECCIA FRAGMENTS.						
50						35ft GROUND VOLCANIC ROCK (2.5YR 5/4); RED BROWN. W/ 3-10mm BRECCIA FRAGMENTS (ANGULAR).						
						40ft. GROUND VOLCANIC ROCK (2.5YR 5/4); RED BROWN W/ 3-5mm ANGULAR BRECCIA FRAGMENTS						
~~60~~						45ft GROUND VOLCANIC ROCK (2.5YR 5/4); RED BROWN W/ 2-5mm ANGULAR BRECCIA FRAGMENTS.						
						49-50ft: GROUND VOLCANIC ROCK, LT GRAY (5YR 7/1) W/ ANGULAR 1-3mm BRECCIA FRAGMENTS.						
						~~50ft [illegible] 45ft~~						

U = Thin Wall Tube | R = Rock Coring NA | Field G/C(Make/Mod.) NA

S = Split spoon(tube) | O = Other CA S | G/C Oper.: NA

C = Cuttings | Notes: NA

FIGURE 5-3a

REV DATE MAY 1990

BORING LOG	BORING/WELL NO. PP-01	Page 2 of 2
Installation: **Sky Harbor** **Coordinates:**		Site: PAPAGO (SITE #5)
Project No. 409724.02.06	Client/Project: HAZWRAP / SKY HARBOR ANG	
HAZWRAP Contractor: IT CORPORATION	Drlg Contractor: LAYNE ENVIRONMENTAL	Driller: [illegible]
Drlg Started: 1/19/91 (10:05 A m)	Drlg Ended: 1/20/91 (13:30 P m)	Borehole dia(s): 10"
Drlg Method/Rig Type: AIR ROTARY HAMMER		
Logged by: GARDNER	E-Log (Y [✓ N]) From ____ to ____	Protection Level: D (MODIFIED)

Depth (ft)	Sample	Sample No.	Lab Anal. (Y/N)	Recovery ( )	ndsp ( )	Lithologic Description	USCS	Blows/6 inch.	Graphic Log	Well data	Water depth &	Remarks
50						50ft. RETURN TO GROUND RED BROWN VOLCANIC ROCK (2.5YR 5/4) w/ 2-5 mm ANGULAR BRECCIA FRAGMENTS (10%)						NA
60						55ft. GROUND VOLCANIC ROCK, VERY DARK RED (10YR 3/6) w/ 2-5 mm ANGULAR BRECCIA FRAGMENTS (10-15%)						
65						59 ft. GROUND VOLCANIC ROCK, RED BROWN (2.5YR 4/4) w/ 2-5 mm ANGULAR BRECCIA FRAGMENTS (10-15%) TD = 59'4". TO BE FURTHER ADVANCED — 1/20/91						
						65ft. RED BROWN VOLCANIC ROCK WITH 2-10 mm ANGULAR VOLCANIC BRECCIA FRAGMENTS (20-25%) TD = 65'0"						

U = Thin wall Tube
S = Split spoon (tube)
C = Cuttings

R = Rock Coring NA
O = Other CA S
Notes NA

Field G/C (Make/Mod.) NA
G/C Oper NA

FIGURE 5-3a

REV DATE MAY 1990

BORING LOG | BORING/WELL NO PP-02 | Page 1 of 1

Installation: **Sky Harbor** **Coordinates:** | Site: Papago (9)

Project No.: 40974.020 | Client/Project: HAZWRAP / Sky Harbor ANG

HAZWRAP Contractor: IT Corporation | Drlg Contractor: Layne | Driller: Gary Lyons

Drlg Started: 1/19/91 (0845 a m) | Drlg Ended: 1/19/91 (6:30 p m) | Borehole dia(s): 10"

Drlg Method/Rig Type: Air Rotary Hammer

Logged by: Gordon | E-Log (Y / [✓ N]) From ____ to ____ | Protection Level: D (modified)

Depth (ft) | Sample | Sample No | Lab Anal. (Y/N) | Recovery ( ) | RQD ( ) | Lithologic Description | USCS | Blows/6 inch | Graphic Log | Well data | Water depth & Remarks | E

1251.37

0

0-3 Gravel w/ some sand (~10%). Coarse, Angular, Light Reddish Brown (5YR 6/4). GP

3-5 Gravel, w/ 20% sand, Light Brown (7.5YR 6/4). GP

10

10ft Caliche; Yellow to Buff (2.5Y 7/4) w/ Some Quartzite & other Angular Pebbles. Fine powder when crushed.

20

20ft Buff to Gray, Caliche or other Powder: Rock w/ Small (1-3mm) Angular Fragments of Breccia. (2.5Y 7/4) Some gravel - well rounded.

30

30ft. Same Buff Ground Rock. Hard (Probably Not Caliche). Slightly Pink now, (7.5YR 7/4). Small Angular Fragments

31ft. Turning Red.

40

40ft Ground volcanic rock, (5YR 6/4) Light Reddish Brown, Softer at 39ft. Small Angular 2-5mm Breccia Fragments Making Water

WATER AT 38 TO 40ft

50

50ft. Ground Volcanic Rock, Reddish Brown (2.5YR 5/4), Small 2-5 mm Angular Breccia Fragments (ca. 10%).

60

55ft. Ground Volcanic Rock, Reddish Brown (2.5YR 5/4), w/ small 2-5 mm Angular Breccia Fragments (ca 10%).

TD: 55ft.

U = Thin wall Tube | R = Rock Coring: NA | Field G/C (Make/Mod): NA

S = Split spoon tube) | O = Other: NA | G/C Oper: NA

C = Cuttings | Notes: NA

REV. DATE. MAY 1990

BORING LOG | BORING/WELL NO.: PP-3 | Page 1 of 2

Installation: ~~SKY~~ PAPAGO MILITARY RESERVATION | Site: PAPAGO

Project No.: 409921.02.04 | Client/Project: MARTIN MARIETTA / SKY HARBOR ANG

HAZWRAP Contractor: IT CORPORATION | Drlg Contractor: LAYNE ENVIRONMENTAL | Driller: DWIGHT PETERSON

Drlg Started: 1/17/91 (12 55 pm) | Drlg Ended: 1/19/91 (09.30 am) | Borehole dia(s): ~~10~~ 6 INCH TO 55 FT

Drlg Method/Rig Type: AIR PERCUSSION / AIR ROTARY

Logged by: GARDNER | E-Log (Y [✓ N]) From ______ to ______ | Protection Level: D (MODIFIED)

Depth (ft) | Sample | Sample No | Lab Anal. (Y/N) | Recovery ( ) | RQD ( ) | Lithologic Description | USCS | Blows/6 inch. | Graphic Log | Well data | Water depth & Remarks | Elev.

1239.72

0-~~4~~6 ft: SAND. POORLY SORTED, POORLY GRADED W/ GRAVEL & FINES. HUE 7.5YR 6/3 LIGHT BROWN & DRY. AT NL ft IN VERY FINE POWDERED ROCK - PROBABLY CALICHE. - FROM SIX FEET ON. 5YR — SP

10

10 ft: CALICHE. (FINE POWDER & COARSE 7/2 FRAGMENTS - WHITE TO BUFF, NON CRYSTALLINE)

10-20 ft. (N 12-14 ft - INTO SAND & GRAVEL.; 16 ft: INTO FINE GRAINED SAND W/ SOME GRAVEL, DARK REDDISH BROWN, 2.5 YR 3/3

20

RUN IN W/ ROTARY RIG: 1/19/91/0845

VOLCANIC BRECCIA - RED BROWN (2.5YR 4/4); ~~GRAVEL FINE~~ SIMILAR GRAVEL COMPONENTS ARE MOSTLY QUARTZITE.

30

SLIGHTLY DARKER - VERY SLIGHTLY MOIST.

40

40 ft RED BROWN (2.5YR 4/4) VOLCANIC BRECCIA W/ 2-5 mm SIZED QUARTZITE & OTHER BRECCIA CLIPS.

50

55 ft. — Y

RED BROWN (2.5YR 4/4) VOLCANIC BRECCIA W/ 2-5 mm SIZED QUARTZITE & OTHER BRECCIA CHIPS SAMPLE AT ~~F~~ 54-55 ft

~~TD = 55 ft. [illegible]~~

U = Thin Wall Tube | R = Rock Coring NA | Field G/C(Make/Mod.) NA

S = Split spoon(tube) | O = Other ~~NK~~ CA S | G/C Oper.: NA

C = Cuttings | Notes: NA

FIGURE 5-3a

REV DATE MAY 1990

BORING LOG
BORING/WELL NO.: PP-03
Page 2 of 2
Installation: **Sky Harbor** **Coordinates:**
Site: Papago
Project No.: 409721
Client/Project: Martin Marietta / Sky Harbor ANG
HAZWRAP Contractor: IT Corp
Drlg Contractor: Layne Env.
Driller: Dwight Peterson
Drlg Started: See 1 of 2 (___ m)
Drlg Ended: See 1 of 2 (___ m)
Borehole dia(s):
Drlg Method/Rig Type: See 1 of 2
Logged by: Gardiner
E-Log (Y / [✓ N]) From ___ to ___
Protection Level: D (Modified)

Depth (ft)	Sample	Sample No.	Lab Anal. (Y/N)	Recovery ( )	nosp ( )	Lithologic Description	USCS	Blows/6 inch.	Graphic Log	Well data	Water depth & Remarks
50						CONTINUE FROM 55ft. CUTTINGS COMING DIRECTLY FROM BORE HOLE. NO CYCLONE w/ TRICONE BIT.					NA
60						RED BROWN GROUND VOLCANIC ROCK (2.5YR 4/4), W/ SMALL 2-5 MM ANGULAR BRECCIA FRAGMENTS. MOIST					
70						RED BROWN GROUND VOLCANIC ROCK (2.5YR 4/4) W/ SMALL 2-5 MM ANGULAR BRECCIA FRAGMENTS. DRY.					
						TD = ~~70 ft.~~ 71 ft. ~~8~~ 6 in.					

U = Thin wall Tube
S = Split spoon(tube)
C = Cuttings
R = Rock Coring: NA
O = Other: ~~NA~~ CAS
Notes: NA
Field G/C(Make/Mod.): NA
G/C Oper.: NA

FIGURE 5-32

REV DATE MAY 1990

BORING LOG | BORING/WELL NO. MW4-01 | Page 1 of 1

[illegible] 4 (Approx)

Project No 40992.02.06 | Client/Project HAZWRAP / SKY HARBOR ANG

HAZWRAP Contractor IT Corporation | Drlg Contractor Layne Environmental | Driller Gary Lyons

Drlg Started 2/1/91 (43:15 p m) | Drlg Ended 2/1/91 (15:30 p m) | Borehole dia(s) 10"

Drlg Method/Rig Type: Air Rotary Hammer Casing

Logged by: Gardin | E-Log (Y / [✓ N]) From ____ to ____ | Protection Level D (modified)

Depth (ft)	Sample	Sample No.	Lab Anal. (Y/N)	Recovery ( )	RQD ( )	Lithologic Description	USCS	Blows/6 inch	Graphic Log	Well data	Water depth & remarks
0							–				1238.17
	☒					CALICHE, BUFF COLORED w/ SMALL PEA GRAVEL, ROUNDED.					
10											
	☒					VOLCANIC BRECCIA, FINE GRAINED MATRIX w 2-10 mm ANGULAR BRECCIA FRAGMENTS (~ 10%). MOIST. DARK RED BROWN (2.5YR 3/3)	–				
20											
	☒					VOLCANIC BRECCIA. DRY, RED BROWN (2.5YR 4/4).	–				
30											
40	☒					VOLCANIC BRECCIA, FINE GRAINED MATRIX, w/ 2-5 mm ANGULAR BRECCIA FRAGMENTS, 10%, RED BROWN (2.5YR 4/4), FRAGMENTS MOSTLY QUARTZ & FELDSPAR.	–				
50	☒					VOLCANIC BRECCIA, FINE GRAINED MATRIX w/ 2-5 mm ANGULAR BRECCIA FRAGMENTS, 10%, MOSTLY QUARTZ & FELDSPAR. REDDISH BROWN (2.5YR 4/3).	–				
60						T.D. = ~ 51 ft.					

U = Thin Wall Tube | R = Rock Coring NA | Field G/C(Make/Mod.) NA

S = Split spoon(tube) | O = Other CAS | G/C Oper.: NA

C = Cuttings | Notes: NA

FIGURE 5-3 ~

REV DATE MAY

BORING LOG | BORING/WELL NO. MW4-02 | Page 1 of 1

Site Name | Coordinates: | PAPAGO (4)

Project No. 409721.02.06 | Client/Project HAZWRAP / SKY HARBOR ANG

HAZWRAP Contractor IT CORPORATION | Drlg Contractor LAYNE ENVIRONMENTAL | Driller GARY LYONS

Drlg Started 2/1/91 (09:00 Am) | Drlg Ended 2/1/91 (12:00 pm) | Borehole dia(s) 10"

Drlg Method/Rig Type: AIR ROTARY HAMMER CASING

Logged by: GARDNER | E-Log (Y / [✓ N]) From ___ to ___ | Protection Level D (MODIFIED)

Depth (ft)	Sample	Sample No.	Lab Anal. (Y/N)	Recovery ( )	PID ( )	Lithologic Description	USCS	Blows/6 inch.	Graphic Log	Well data	Water depth & Remarks
0											1241.99
	☒					CALICHE, APPROX 2-3 ft. THICK.	—				
10											
	☒					VOLCANIC BRECCIA, FINE GRAINED, RED BROWN (2.5 YR 4/4) w/ ANGULAR BRECCIA FRAGMENTS 2-10 mm.	—				
20											
30	☒					VOLCANIC BRECCIA, FINE GRAINED MATRIX, ~~DRY~~ RED BROWN (BUT MOIST FROM ADDED WATER), (2.5YR 3/3), w/ BRECCIA FRAGMENTS, 2-5mm, MOSTLY FELDSPAR & QUARTZ.	—				
40											
50	☒					VOLCANIC BRECCIA, FINE GRAINED MATRIX, DARK RED BROWN (MOIST, 2.5YR 3/3), w/ BRECCIA FRAGMENTS, 2-5mm, ANGULAR, MOSTLY FELDSPAR & QUARTZ.	—				
60						T.D. = ~51 ft.					

U = Thin Wall Tube | R = Rock Coring NA | Field G/C (Make/Mod.) NA

S = Split Spoon (Tube) | O = Other CAS | G/C Oper.: NA

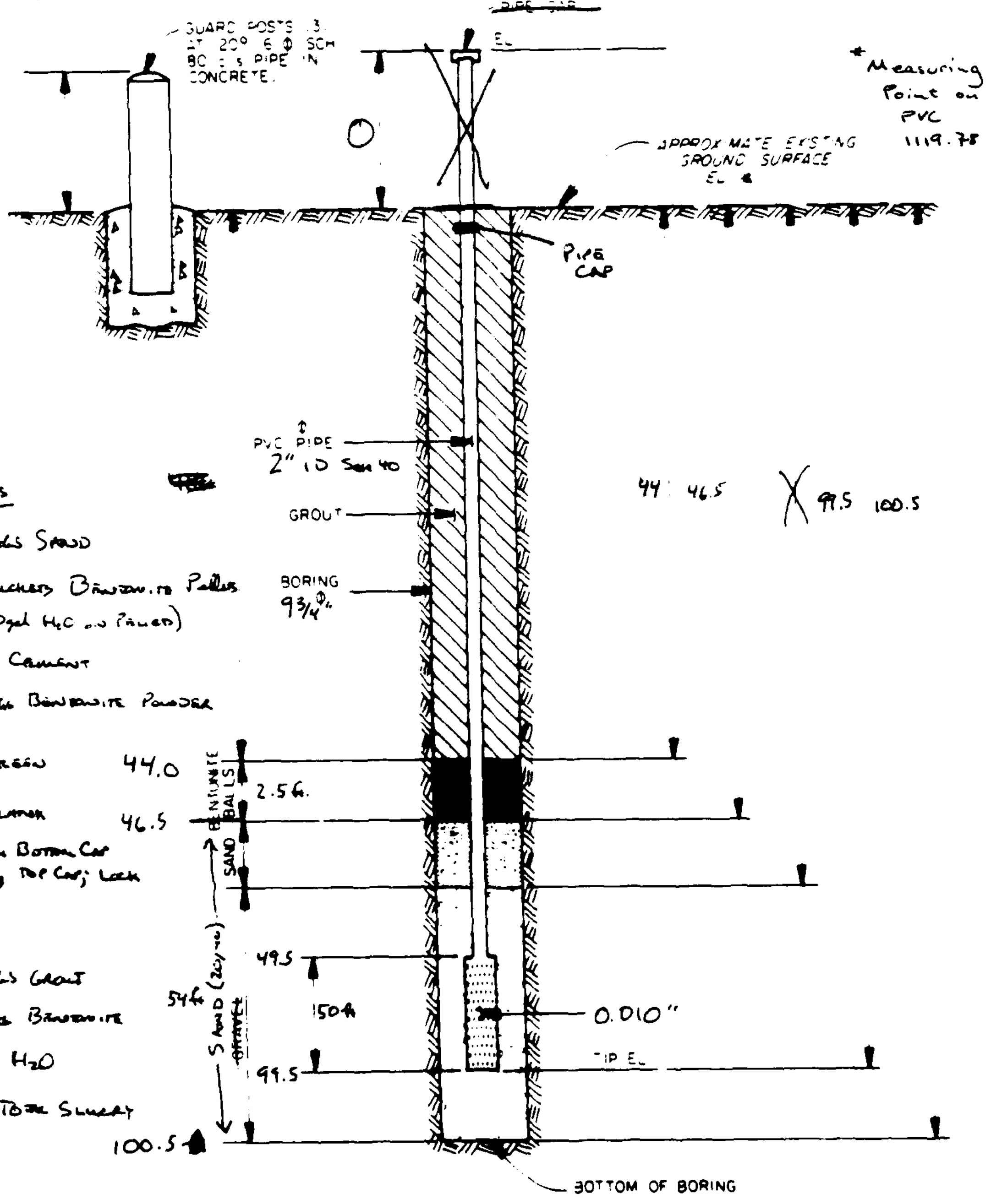
C = Cuttings | Notes: NA

APPENDIX F

PIEZOMETER AND MONITORING WELL COMPLETION DIAGRAMS

PIEZOMETER INSTALLATION SKETCH

PROJECT NAME Sky Harbor ANG INSTALLED BY Gardner DATE 1/15/91
PROJECT NO 409721.02.06 CHECKED BY NA DATE NA
BORING NO NA
PIEZOMETER NO SH #1 (PS-1)



Materials

24 ½ Bags Sand

1 ½ Buckets Bentonite Pellets
(10gal H₂O on Pellets)

15 Bags Cement

1 ½ Bag Bentonite Powder

50 ft Screen 44.0

50 ft. Blank 46.5

1 3-inch Bottom Cap
1 Locking Top Cap; Lock

Slurry

~ 4 Bags Grout

~ ⅓ Bag Bentonite

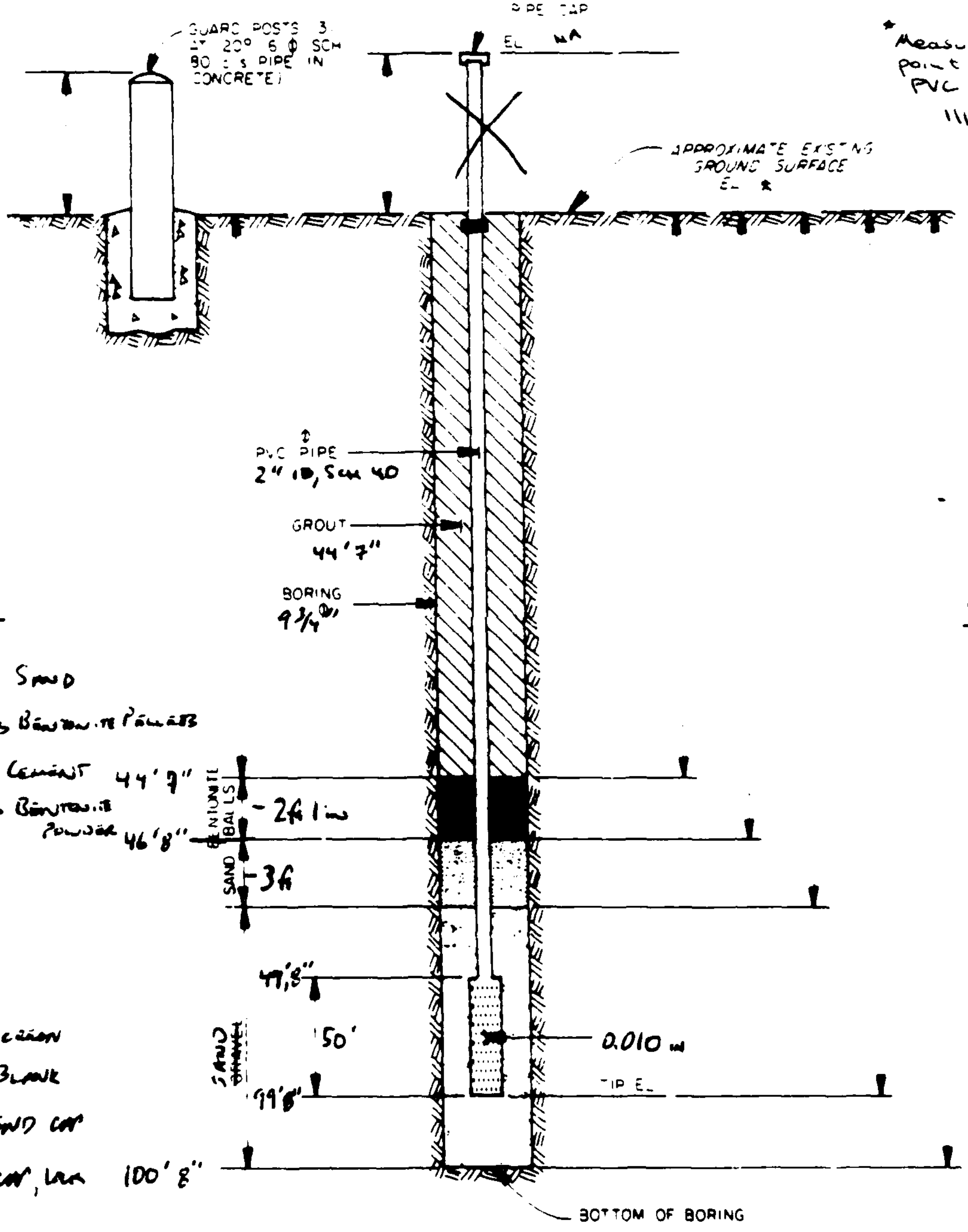
~ 40 gal H₂O

180gal Total Slurry

NOT TO SCALE

PIEZOMETER INSTALLATION SKETCH

PROJECT NAME SH ANG INSTALLED BY Gardner DATE 1/16/91
PROJECT NO 409721.U206 CHECKED BY NA DATE NA
BORING NO SHP-2
PIEZOMETER NO SH Piezometer #2 (PS-2)



* Measuring point on PVC
1113.86

Materials

21 ½ Bags Sand
1 ½ Buckets Bentonite Pellets
12 Bags Cement 44'7"
1 ½ Bags Bentonite Powder 46'8"

Casing

50ft Screen
50ft. Blank
1 - 4in End Cap
1 - Top Cap, Lock 100'8"

Grout gal

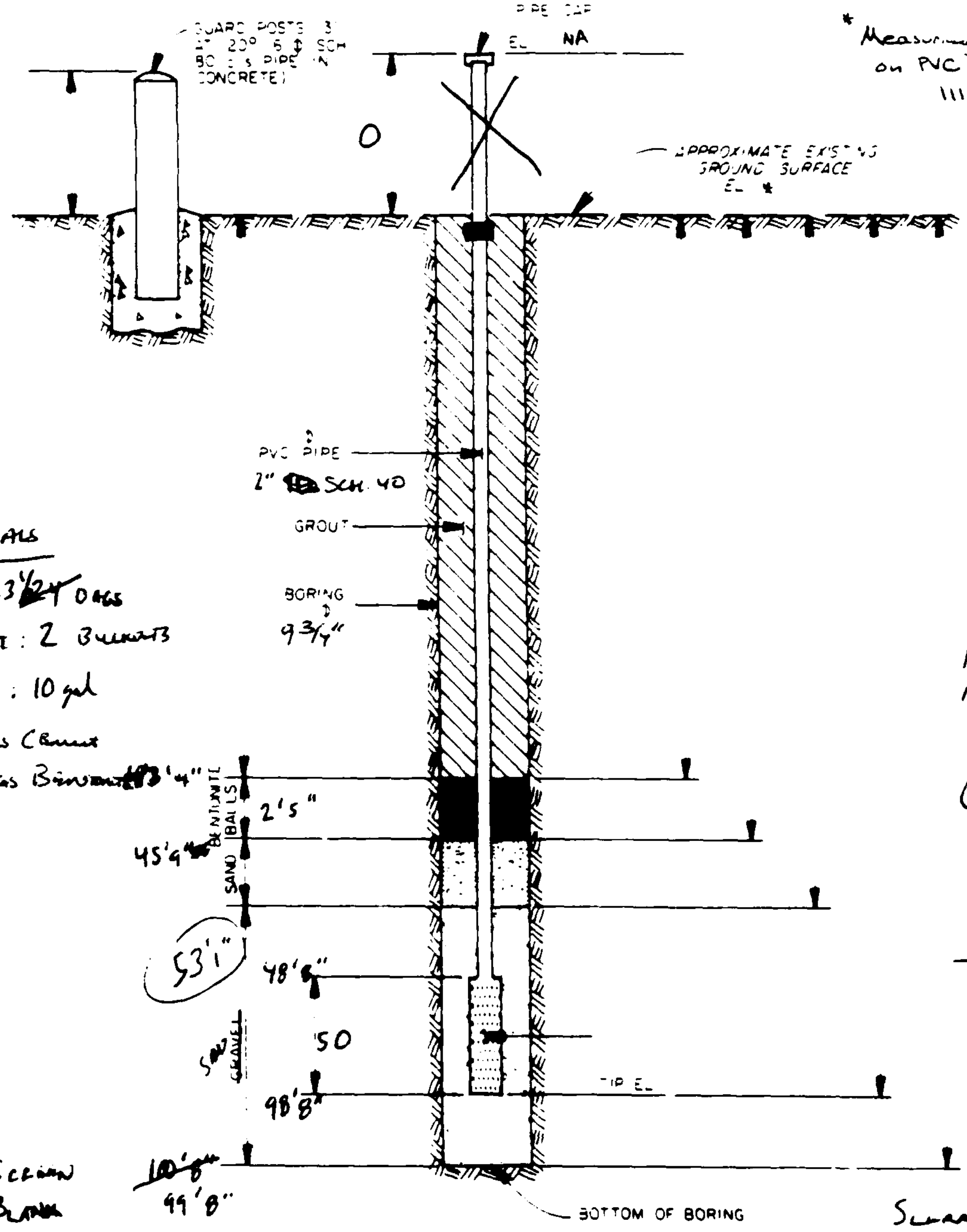
30
30
30
10
25
40
165 gal

Slurry M

~ 40 gal H
4 Bags C
½ Bag B

PIEZOMETER INSTALLATION SKETCH

PROJECT NAME Sky Harbor ANG INSTALLED BY Gardner DATE 1/16/91/1/17/91
PROJECT NO 409721.0202 CHECKED BY NA DATE NA
BORING NO PS-3
PIEZOMETER NO #3



* Measuring point on PVC
1113.83

Materials

Sand. 23 ~~24~~ bags
Bentonite: 2 Buckets
Water: 10 gal
NA
33 ~~31~~ Bags Cement
4 ~~2~~ Bags Bentonite

Top of Plug IN Morning.
42'2"
(Soil Swelling?

Slurry Vol
30
30
30
35
30
30
35
35
35
Slurry 290
w 40 gal H2O 30
320
4.3 AL. Cement TOC
1/3 " Bentonite

Casing

50 ft. Screen
50 ft. Blank
1- 4 in End cap
1- 1 Locking topcap, Lock

REV. DATE: MAY 1990

MONITORING WELL CONSTRUCTION LOG — Standard Flush Mount

WELL NO.: MWS-01

Installation: Sky Harbor Background Well

Site: Background Well #3

Project No.: 409324.00

Client/Project: HAZWRAP / Sky Harbor ANG

HAZWRAP Contractor: IT Corporation

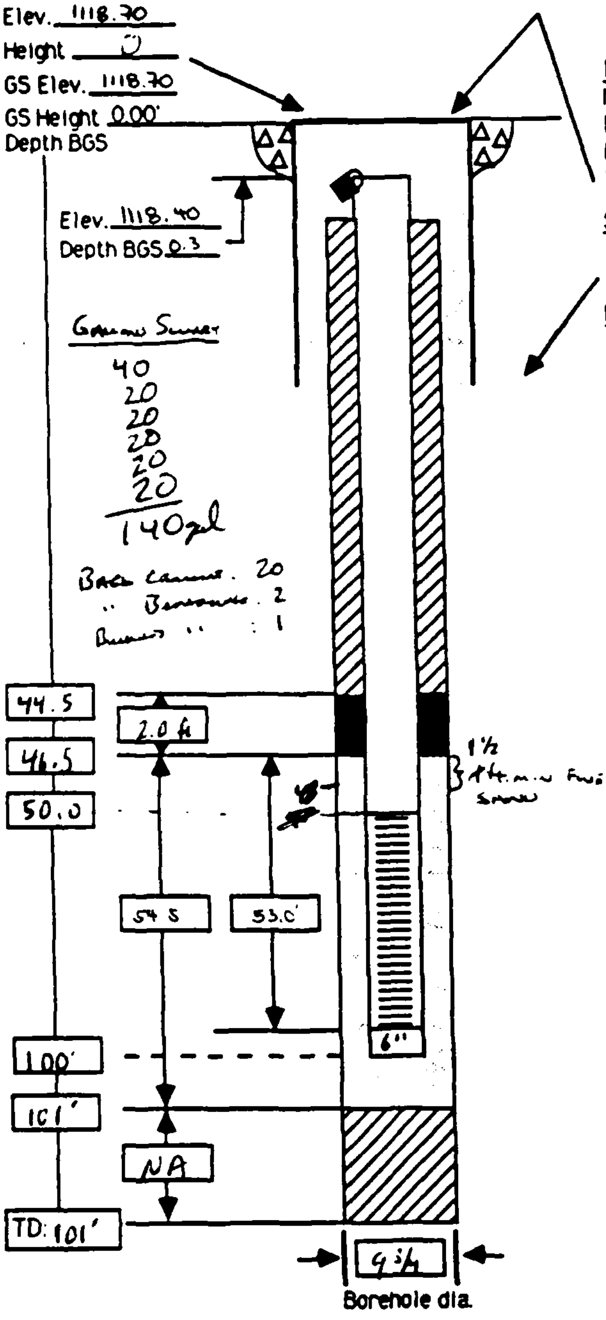
Drlg Contractor: Layne Environmental

Comp. Start: 1/20/91 (09 : 00 A m)

Comp. End: 1/30/91 (11 :50 A m)

Built By: Gardiner

Well Coord.: N 9484.29
E 11768.37



PROTECTIVE CSG

Material / Type Steel Tube w/Street Manhole Cover

Diameter

Depth BGS

Watertight O-Ring (Y / N)

SURFACE PAD

Composition & Size Concrete / 3ft x 3ft x 1ft.

Breathes With Vadose Zone (Y / [✓ N])

RISER PIPE

Type Schedule 40 PVC

Diameter 4-inch I.D.

Total Length (TOC to TOS)

Ventilated Cap (Y / [✓ N])

GROUT

Composition & Proportions 4 Bags Type I & II Cement + 1/3 Bag Bentonite Powder + ≈ 35-40 gal H2O

Tremied (Y / [✓ N])

Interval BGS

CENTRALIZERS (Y / [✓ N])

Depth(s)

SEAL

Type 1/4 inch Wyoming Bentonite Pellet

Source [illegible]

Setup/Hydration time 15 min. Vol. Fluid Added 10 gal H2O

Tremied (Y / [✓ N]) 20

FILTER PACK

Type 20/40 Colorado Silica Sand / 60 Silica Sand

Amt. Used 19 1/2 20/40 , 1/2 60

Tremied (Y / [✓ N])

Source

Gr. Size Dist. 20/40 for filter pack + 60 on top

SCREEN

Type Schedule 40 PVC

Diameter 4-inch I.D.

Slot Size & Type 0.010

Interval BGS

SUMP (Y / [✓ N])

Interval BSG Length

Bottom Cap ([✓ Y] / N)

BACKFILL PLUG

Material NA

Setup/Hydration time NA

Tremied (Y / [✓ N])

REV. DATE: MAY 1990

MONITORING WELL CONSTRUCTION LOG -- Standard Flush Mount

WELL NO.: MWS-02 | Installation: Sky Harbor | Site: Background Well

Project No.: 409921.02 | Client/Project: HAZWRAP/Sky Harbor ANG

HAZWRAP Contractor: IT Corporation | Drlg Contractor: Layne Environmental

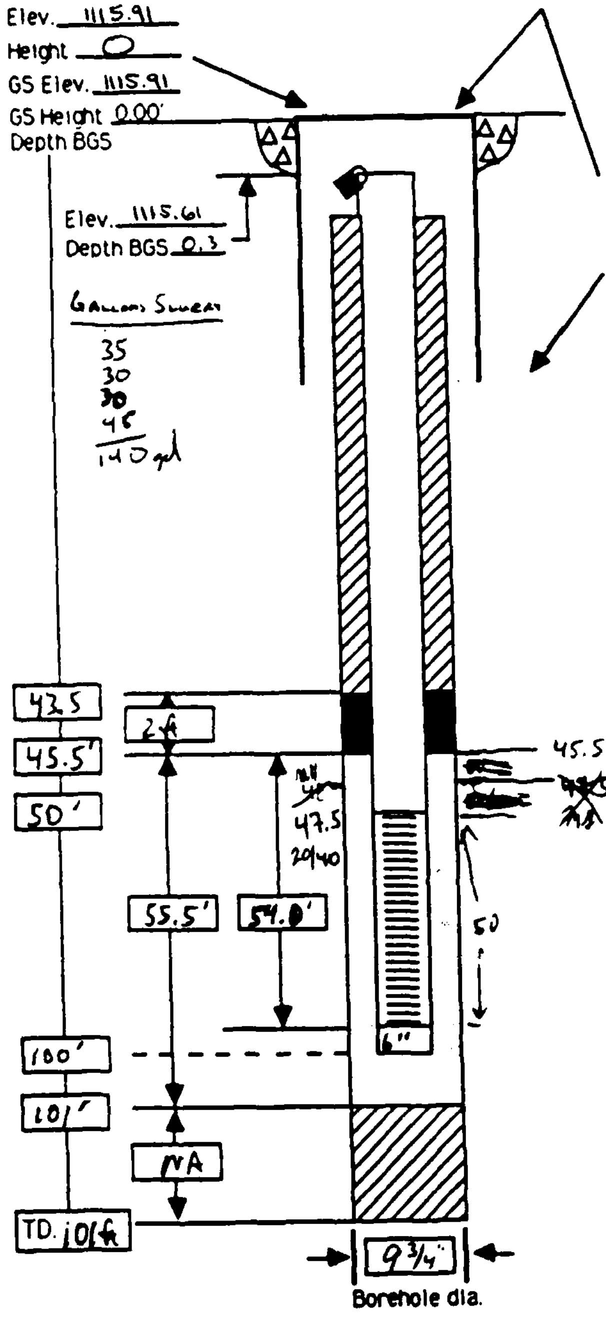
Comp. Start: 2/6/91 (08:05 A m) | Comp. End: 2/6/91 (10:00 A m)

Built By: Gardiner | Well Coord.: N 8941.36 E 10847.55

Elev. 1115.91
Height 0
GS Elev. 1115.91
GS Height 0.00'
Depth BGS

Elev. 1115.61
Depth BGS 0.3

Gallons Swept
35
30
30
45
140 gal



PROTECTIVE CSG
Material / Type: Steel Top/Sheet Metal Bottom
Diameter:
Depth BGS:
Watertight O-Ring [✓ Y]/~~N~~ JT ?-4-91

SURFACE PAD
Composition & Size: 3 ft. x 3 ft. x 1 ft. Concrete
Breathes With Vadose Zone (Y / N)

RISER PIPE
Type: Sch. 40 PVC
Diameter: 4 inch I.D.
Total Length (TOC to TOS): 50ft.
Ventilated Cap (Y / [✓ N])

GROUT
Composition & Proportions: 4 Bags Type I&II Cement to ½ bag Bentonite + ~ 35-40gal H_2O
Tremied (Y / [✓ N]) 15 sx Cement, 1 sx Bentonite
Interval BGS:

CENTRALIZERS (Y / [✓ N])
Depth(s): NA

SEAL
Type: ¼" Wyoming Bentonite Pellets 1 BKT
Source:
Setup/Hydration time: 20 min Vol. Fluid Added: 10 gal
Tremied (Y / [✓ N])

FILTER PACK
Type: 20/40 Colorado Silica Sand + 60 Granusil
Amt. Used: 18 sx 20/40; ½ sx 60
Tremied (Y / [✓ N])
Source:
Gr. Size Dist.: 20/40 Filter Pack; 60 on top.

SCREEN
Type: Sch. 40 PVC
Diameter: 4 inch I.D.
Slot Size & Type: 0.010 inch
Interval BGS: ~50-100 ft.

SUMP ([✓ Y] / N)
Interval BSG: Length: 2ft
Bottom Cap ([✓ Y] / N)

BACKFILL PLUG
Material: NA
Setup/Hydration time: NA
Tremied ~~(Y / N)~~

REV. DATE: MAY 1990

MONITORING WELL CONSTRUCTION LOG -- Standard Flush Mount

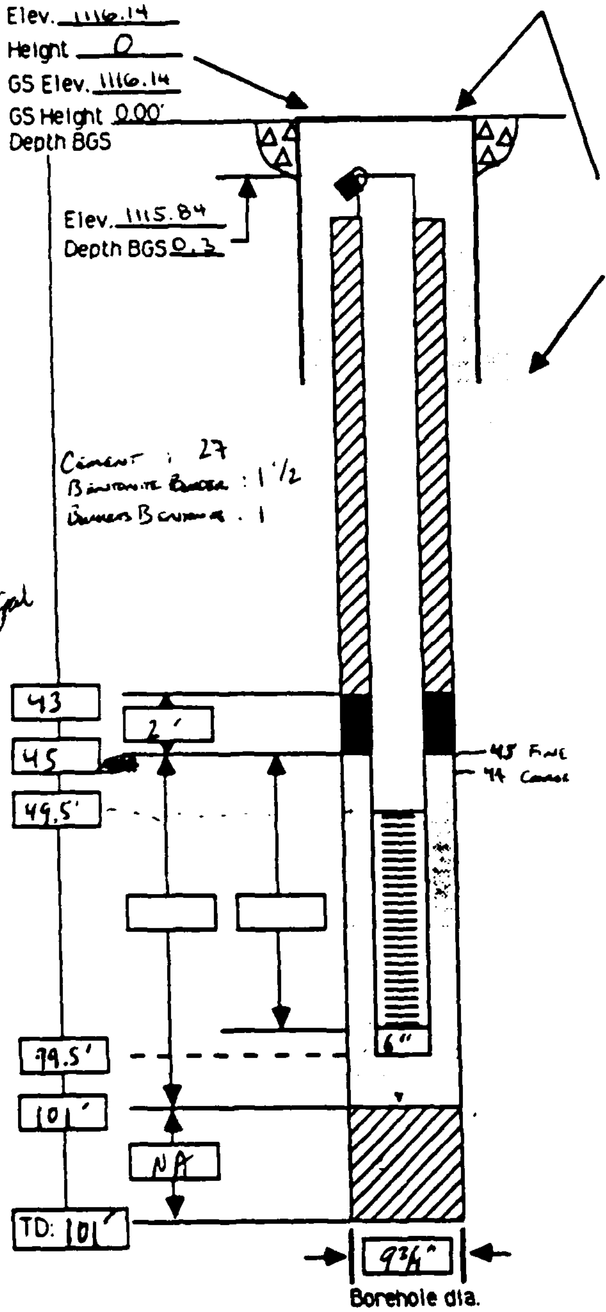
WELL NO.: MW15-03 | Installation: Sky Harbor | Site: Background Well

Project No.: 401221.02 | Client/Project: HAZWRAP / Sky Harbor ANG

HAZWRAP Contractor: IT Corporation | Drlg Contractor: Layne Environmental

Comp. Start: 1/31/91 (10 : 25 A m) | Comp. End: 1/31/91 (13 : 20 p m)

Built By: Gardiner | Well Coord.: N 8620.48 E 10430.88



Gallons Summary

40
35
35
35
30
30
20
10
235 gal

Cement : 27
Bentonite Bucket : 1 1/2
Benseal Bucket . 1

PROTECTIVE CSG
Material / Type Steel Top, Sheetmetal Cover
Diameter
Depth BGS
Watertight O-Ring ([✓ Y] / N)

SURFACE PAD
Composition & Size 3 ft x 3 ft x 1 ft Concrete
Breathes With Vadose Zone (Y / N)

RISER PIPE
Type Schedule 40 PVC
Diameter 4 inch I.D.
Total Length (TOC to TOS)
Ventilated Cap (Y / [✓ N])

GROUT
Composition & Proportions 4 Bags Type I & II Portland + 1/3 Bag Bentonite + ~ 35-40 gal H2O
Tremied (Y / [✓ N])
Interval BGS

CENTRALIZERS (Y / [✓ N])
Depth(s)

SEAL
Type 1/4" Wyoming Bentonite Pellets
Source
Setup/Hydration time 20 min Vol. Fluid Added 10 gal H2O
Tremied (Y / [✓ N]) 40

FILTER PACK
Type 20/40 Colorado Silica Sand; 60 Granusil Sand
Amt. Used 22 20/40, 1/2 60
Tremied (Y / [✓ N])
Source
Gr. Size Dist. 20/40 for filter pack, 60 on top.

SCREEN
Type Schedule 40 PVC
Diameter 4 inch I.D.
Slot Size & Type 0.010 inch
Interval BGS

SUMP (Y / [✓ N])
Interval BSG NA Length NA
Bottom Cap ([✓ Y] / N)

BACKFILL PLUG
Material NA
Setup/Hydration time NA
Tremied (Y / N)

REV. DATE: MAY 1990

MONITORING WELL CONSTRUCTION LOG — Standard Flush Mount

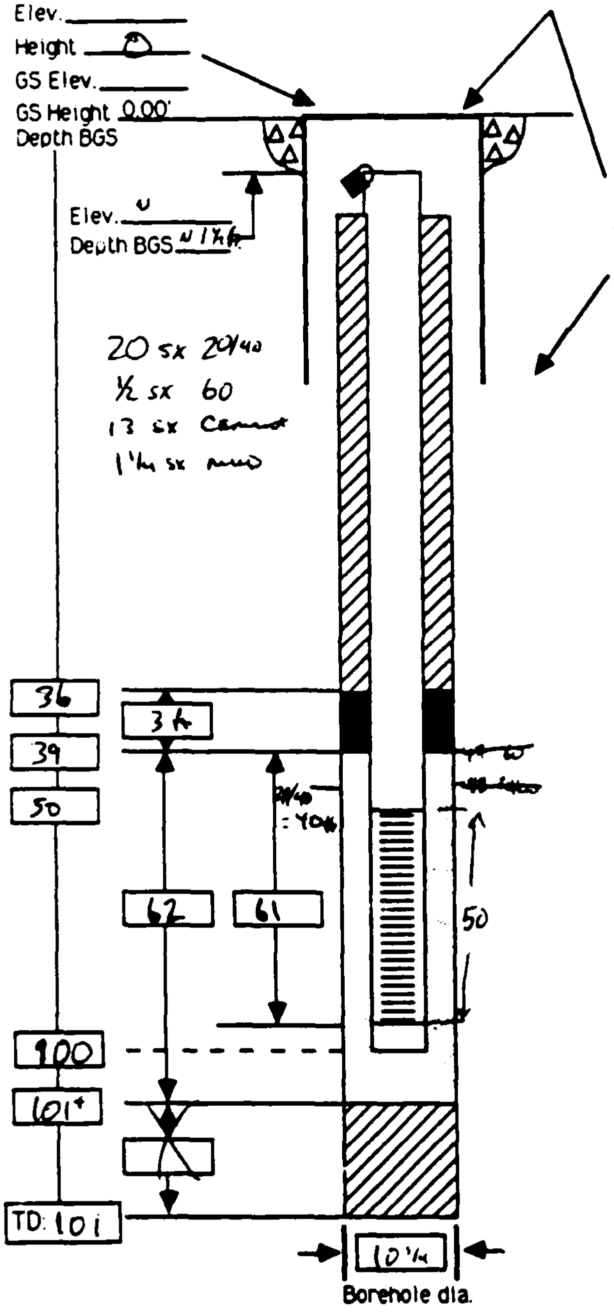
WELL NO.: MWS-04 | Installation: Sky Harbor ANG Base | Site: Background Well

Project No.: 409721.02.01 | Client/Project: HAZWRAP/Sky Harbor ANG

HAZWRAP Contractor: IT Corporation | Drlg Contractor: Layne Environmental

Comp. Start: 3/21/91 (2 : 25 p m) | Comp. End: 3/21/91 (4 : 30 p m)

Built By: Gardiner | Well Coord.:



Elev.
Height 0
GS Elev.
GS Height 0.00'
Depth BGS
Elev. 0
Depth BGS ~1 ft.

PROTECTIVE CSG
Material / Type Steel Top, Aluminum Bottom
Diameter 12"
Depth BGS Flush to -1 ft.
Watertight O-Ring [✓ Y] / N)

SURFACE PAD
Composition & Size ~~2 ft~~ Finished under Asphalt
Breathes With Vadose Zone (Y / N)

RISER PIPE
Type Schedule 40 PVC
Diameter 4 in I.D.
Total Length (TOC to TOS) 50'
Ventilated Cap (Y / [✓ N])

GROUT
Composition & Proportions 5% Bentonite/Type I & II Portland Cement Grout
Tremied ([✓ Y] / N)
Interval BGS 0 - 36 ft.

CENTRALIZERS (Y / [✓ N])
Depth(s)

SEAL
Type 1/4" Wyoming Bentonite Pellets
Source Enviroplug
Setup/Hydration time 10 min. Vol. Fluid Added 1 gal
Tremied (Y / [✓ N])

FILTER PACK
Type 20/40 Colorado Silica Sand / 60 Granusil
Amt. Used
Tremied (Y / [✓ N])
Source
Gr. Size Dist. 20/40 Pack, 60 on top

SCREEN
Type Schedule 40 PVC
Diameter 4 in. I.D.
Slot Size & Type 0.010 in
Interval BGS 50 - 100

SUMP ([✓ Y] / N)
Interval BSG 100 - 101 ft. Length 1 ft.
Bottom Cap ([✓ Y] / N)

BACKFILL PLUG
Material NA
Setup/Hydration time NA
Tremied ~~(Y / N)~~

REV. DATE: MAY 1990

MONITORING WELL CONSTRUCTION LOG — Standard Flush Mount

WELL NO.: MW1-02 | Installation: Sky Harbor | Site: 1

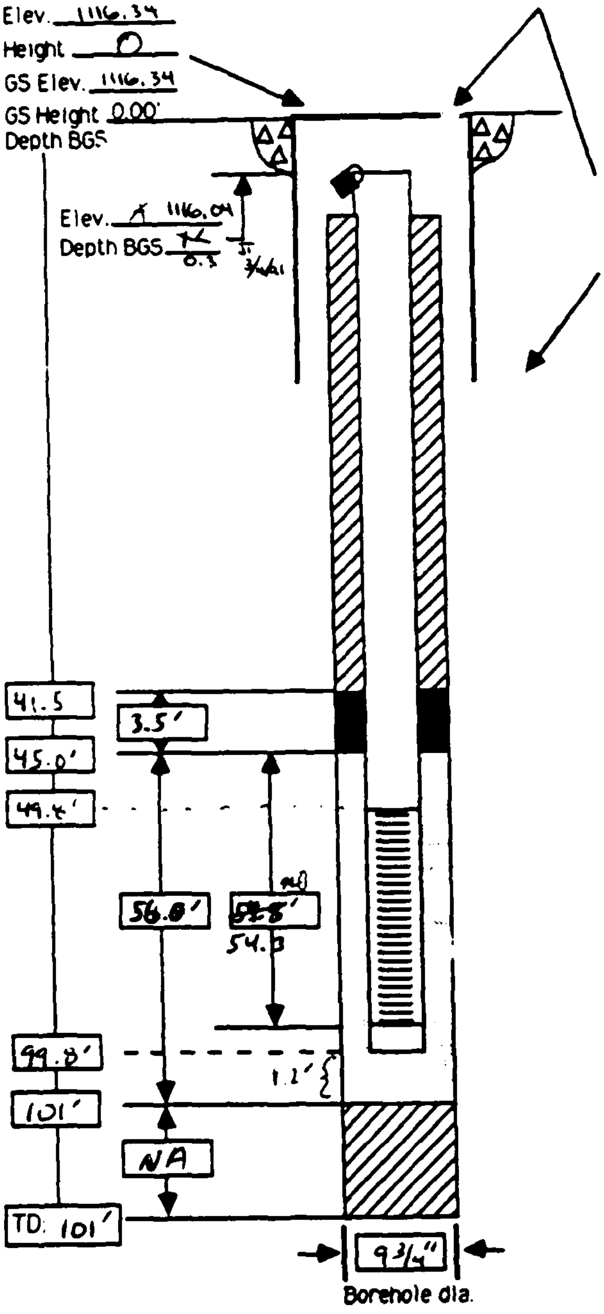
Project No.: [illegible] | Client/Project: HAZWRAP / Sky Harbor ANG

HAZWRAP Contractor: IT Corporation | Drlg Contractor: Layne Environmental

Comp. Start: 1/28/91 (12 : 45 p m) | Comp. End: 1/28/91 (15 :00 p m)

Built By: Gardiner

Well Coord.: N 9992.28
E 10606.30



PROTECTIVE CSG
Material / Type Steel Top, Sheet Metal Sides
Diameter
Depth BGS
Watertight O-Ring ([✓ Y]/ N)

SURFACE PAD
Composition & Size Concrete / 3ft. x 3ft.
Breathes With Vadose Zone (Y / N)

RISER PIPE
Type Schedule 40 PVC
Diameter 4 inch I.D.
Total Length (TOC to TOS) 49 ft.
Ventilated Cap (Y /[✓ N])

GROUT
Composition & Proportions Approx 4 bags Type I&II Cement + 1/3 Bag Bentonite Powder to 35-40 gal H₂O
Tremied (Y /[✓ N])
Interval BGS

CENTRALIZERS (Y /[✓ N])
Depth(s)

SEAL
Type 1/4" Wyoming Bentonite Pellets
Source
Setup/Hydration time 15 min Vol Fluid Added 10 gal
Tremied (Y /[✓ N])

FILTER PACK
Type 20/40 Colorado Silica Sand
Amt. Used 19 1/2 Bags 20/40 + 1/2 Bag 60
Tremied (Y /[✓ N])
Source
Gr. Size Dist. 20/40 for Sand Pack, 60 for Top of pack ([illegible]).

SCREEN
Type Schedule 40 PVC
Diameter 4 inch I.D
Slot Size & Type 0.010.
Interval BGS 50ft. of Screen

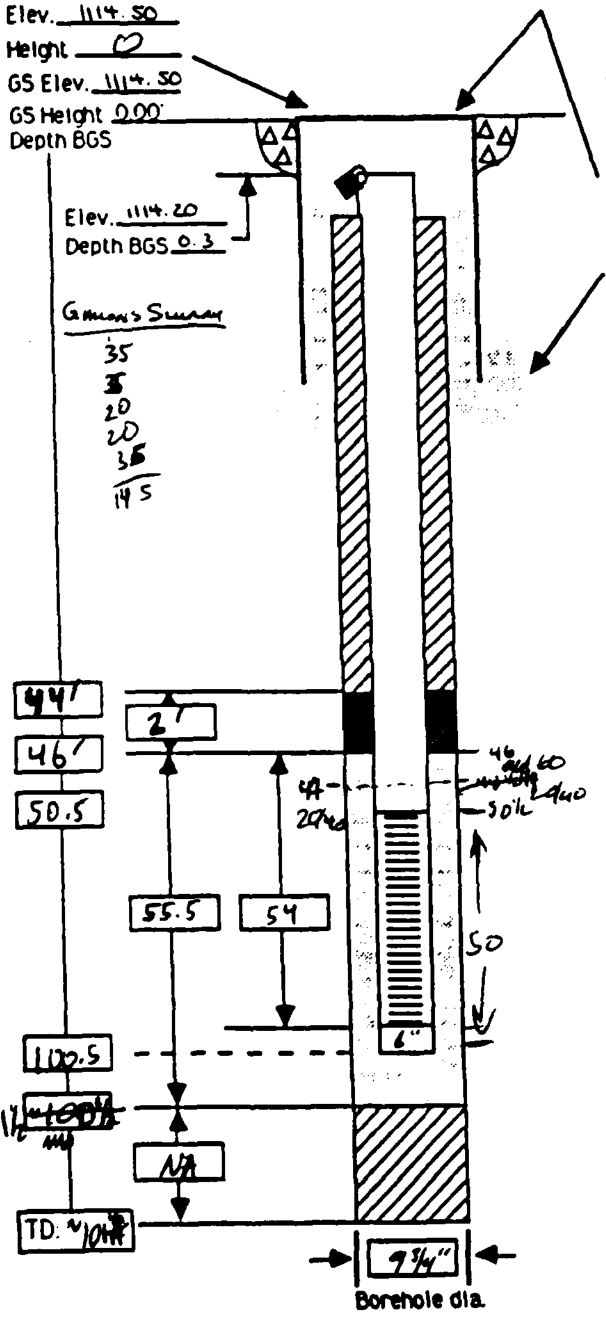
SUMP (Y / N)
Interval BSG Length
Bottom Cap ([✓ Y]/ N)

BACKFILL PLUG
Material NA
Setup/Hydration time NA
Tremied (Y / N)

REV. DATE: MAY 1990

MONITORING WELL CONSTRUCTION LOG -- Standard Flush Mount

WELL NO.: MW2-02	Installation: Sky Harbor	Site: 2
Project No.: [illegible]	Client/Project: HAZWRAP / Sky Harbor ANG	
HAZWRAP Contractor: IT Corporation	Drlg Contractor: Layne Environmental	
Comp. Start: 2/6/91 (14 : 50 P m)	Comp. End: 2/6/91 (16 : 20 P m)	
Built By: Gardiner	Well Coord.: N 9801.70 E 10386.43	



Elev. 1114.50

Height 0

GS Elev. 1114.50

GS Height 0.00'

Depth BGS

Elev. 1114.20

Depth BGS 0.3

Gallons Slurry

35

35

20

20

35

145

PROTECTIVE CSG

Material / Type Steel Top / Sheet Metal Bottom

Diameter

Depth BGS

Watertight O-Ring ([✓ Y] / ~~N~~) JT 3-4-91

SURFACE PAD

Composition & Size 3 ft. x 3 ft x 1 ft. Concrete

Breathes With Vadose Zone (Y / N)

RISER PIPE

Type Sch. 40 PVC

Diameter 4-inch I.D.

Total Length (TOC to TOS) 50 ft

Ventilated Cap (Y / [✓ N])

GROUT

Composition & Proportions 4 Bags Type I & II Cement, 1/2 Bag Bentonite Powder + ~35-40 gal H2O

Tremied (Y / [✓ N])

Interval BGS

CENTRALIZERS (Y / [✓ N])

Depth(s)

SEAL

Type 1/4" Bentonite Pellets

Source

Setup/Hydration time Vol. Fluid Added 10 gal H2O

Tremied (Y / [✓ N])

FILTER PACK

Type 20/40 Colorado Silica Sand + 60 [illegible]

Amt. Used 19 Sx 20/40, 1/2 Sx 60

Tremied (Y / [✓ N])

Source

Gr. Size Dist. 20/40 Filter Pack + 1 ft 60 on top

SCREEN

Type Sch 40 PVC

Diameter 4-inch I.D.

Slot Size & Type 0.010 in., 50 ft.

Interval BGS

SUMP ([✓ Y] / N)

Interval BSG 100½ to 101½ Length 1 ft

Bottom Cap ([✓ Y] / N)

BACKFILL PLUG

Material NA

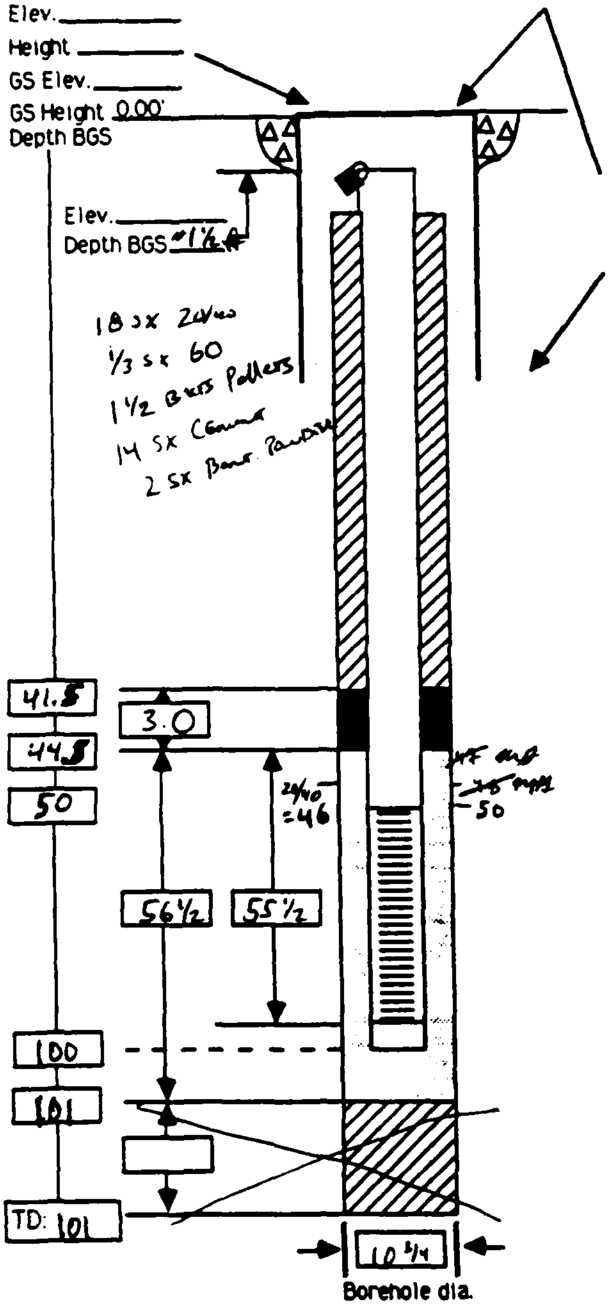
Setup/Hydration time NA

Tremied ~~(Y / N)~~

REV. DATE: MAY 1990

MONITORING WELL CONSTRUCTION LOG — Standard Flush Mount

WELL NO.: MW3-01
Installation: Sky Harbor ANG Base
Site: 3
Project No.: [illegible]
Client/Project: HAZWRAP / Sky Harbor ANG
HAZWRAP Contractor: IT Corporation
Drlg Contractor: Layne Environmental
Comp. Start: 3/22/91 (12 :45 p m)
Comp. End: 3/22/91 (15 :10 p m)
Built By: Gardner
Well Coord.:



PROTECTIVE CSG
Material / Type Steel Top, Aluminum Bottom
Diameter 12"
Depth BGS 0 - 1½ ft
Watertight O-Ring ([✓ Y] / N)

SURFACE PAD
Composition & Size Concrete under Asphalt
Breathes With Vadose Zone (Y / N)

RISER PIPE
Type Schedule 40 PVC
Diameter 4 inch ID
Total Length (TOC to TOS) 50 ft.
Ventilated Cap ([✓ Y] / N)

GROUT
Composition & Proportions 5% Bentonite / Type I & II Portland Cement Grout
Tremied (Y / [✓ N])
Interval BGS 0 - 41½ ft

CENTRALIZERS (Y / [✓ N])
Depth(s)

SEAL
Type ¼" Wyoming Bentonite Pellets
Source Enviroplug
Setup/Hydration time 20 min Vol. Fluid Added 10 gal H2O
Tremied (Y / [✓ N])

FILTER PACK
Type 20/40 Colorado Silica Sand, 60 Colorado Silica Sand
Amt. Used 18 SX
Tremied (Y / [✓ N])
Source Colorado Silica Sand
Gr. Size Dist. 20/40 Pack, 60 on top

SCREEN
Type Schedule 40 PVC
Diameter 4 inch ID
Slot Size & Type 0.010
Interval BGS 50 - 100 ft.

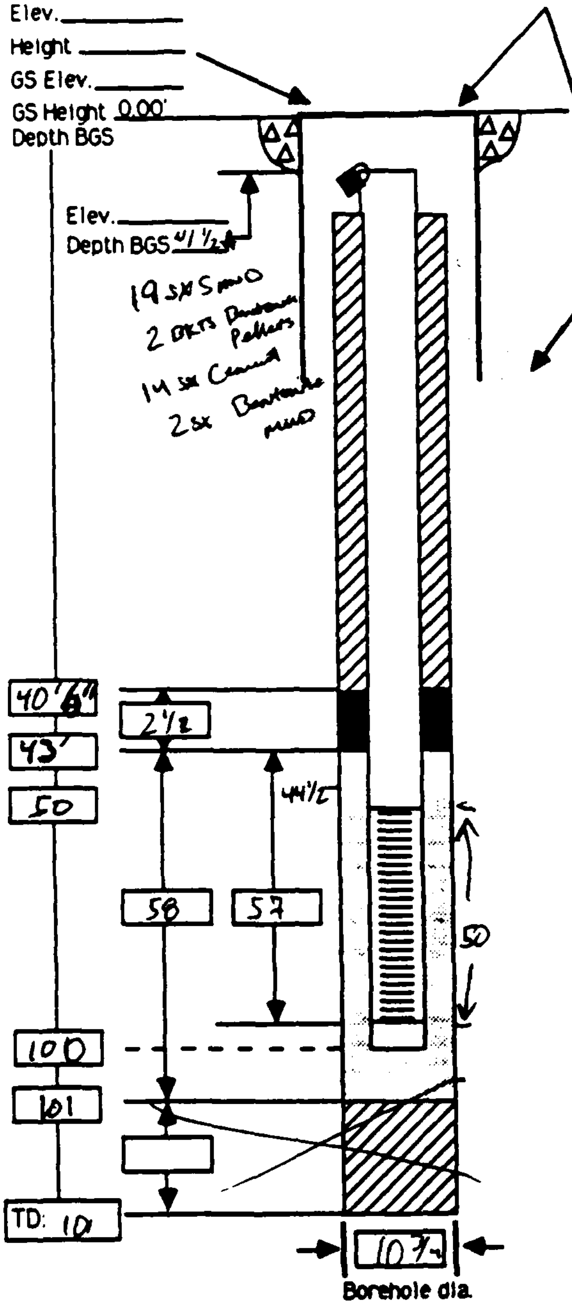
SUMP ([✓ Y] / N)
Interval BSG 100 - 101 Length 1
Bottom Cap ([✓ Y] / N)

BACKFILL PLUG
Material NA
Setup/Hydration time NA
Tremied ~~(Y /~~ [✓ N])

REV. DATE: MAY 1990

MONITORING WELL CONSTRUCTION LOG — Standard Flush Mount

WELL NO.: MW3-02
Installation: Sky Harbor ANG Base
Site: 3
Project No.: 409721.02.02
Client/Project: HAZWRAP / Sky Harbor ANG
HAZWRAP Contractor: IT Corporation
Drlg Contractor: Layne Environmental
Comp. Start: 3/22/91 (1 : 45 p m)
Comp. End: 3/23/91 (~~1~~4 : 30 p m)
Built By: Garzon
Well Coord.: ______



Elev. ______
Height ______
GS Elev. ______
GS Height 0.00'
Depth BGS
Elev. ______
Depth BGS 41½ ft

19 sk Sand
2 bkts Bentonite Pellets
14 sk Cement
2 sk Bentonite mud

PROTECTIVE CSG
Material / Type Steel Top / Aluminum Bottom
Diameter 12"
Depth BGS 0 - 1½
Watertight O-Ring ([✓ Y] N)

SURFACE PAD
Composition & Size 3x3x1 Concrete
Breathes With Vadose Zone (Y / N)

RISER PIPE
Type Schedule 40 PVC
Diameter 4 inch I.D.
Total Length (TOC to TOS) ~~0~~ 50 ft
Ventilated Cap ([✓ Y] N)

GROUT
Composition & Proportions 5% Bentonite / Type I & II Portland Cement Grout
Tremied (Y [✓ N])
Interval BGS 0 - 40½ ft

CENTRALIZERS (Y [✓ N])
Depth(s) ______

SEAL
Type ¼ inch Wyoming Bentonite Pellets
Source Enviroplug
Setup/Hydration time 15 min Vol. Fluid Added 10 gal
Tremied (Y [✓ N]) -20

FILTER PACK
Type 20/40 Colorado Silica Sand, 60 Colorado Silica
Amt. Used 19 sk
Tremied (Y [✓ N])
Source Colorado Silica
Gr. Size Dist. 20/40 Pack, 60 on top

SCREEN
Type Schedule 40 PVC
Diameter ~~0.~~ 4.0 in I.D.
Slot Size & Type 0.010 inch
Interval BGS 50 - 100 ft

SUMP ([✓ Y] N)
Interval BSG 100 - 101 ft Length 1 ft
Bottom Cap ([✓ Y] N)

BACKFILL PLUG
Material NA
Setup/Hydration time NA
Tremied ~~(Y / N)~~

REV. DATE: MAY 1990

MONITORING WELL CONSTRUCTION LOG -- Standard Flush Mount

WELL NO.: MW5-01 | Installation: Sky Harbor | Site: 5

Project No.: 409364.02.06 | Client/Project: HAZWRAP / Sky Harbor ANG

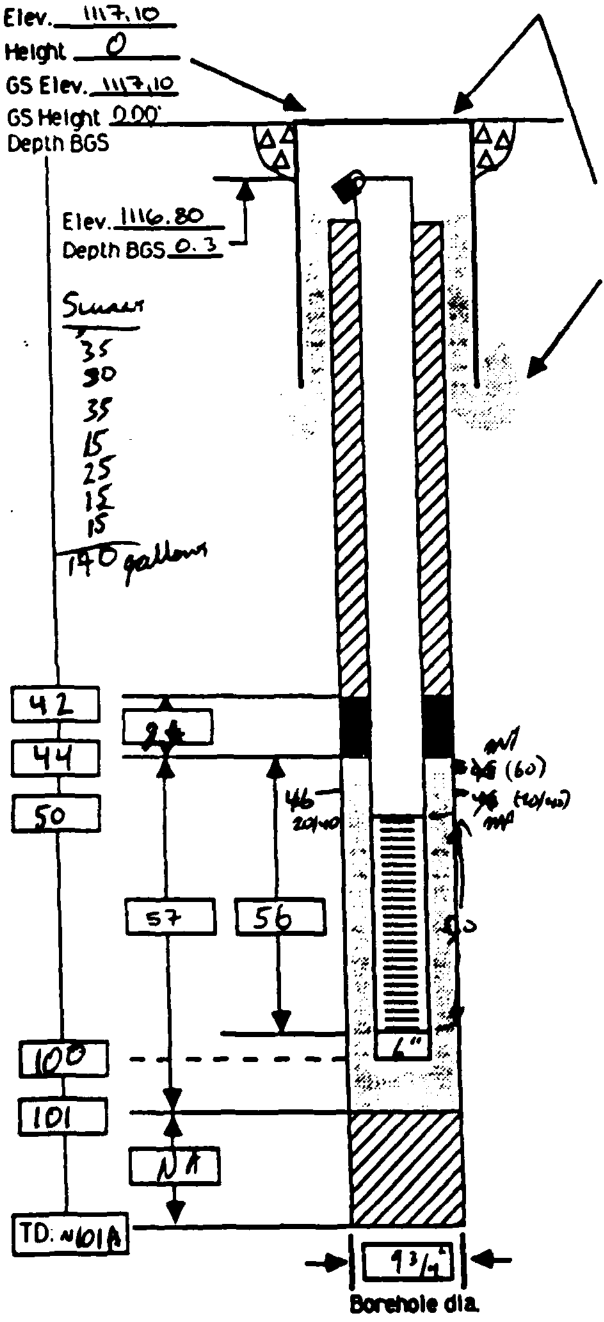
HAZWRAP Contractor: IT Corporation | Drlg Contractor:

Comp. Start: 2/7/91 (12 : 00 p m) | Comp. End: 2/7/91 (14 : 00 p m)

Built By: Gardner | Well Coord.: N 9345.98 E 11050.01

Elev. 1117.10
Height 0
GS Elev. 1117.10
GS Height 0.00'
Depth BGS

Elev. 1116.80
Depth BGS 0.3



PROTECTIVE CSG
Material / Type Steel Top/[illegible] Bottom
Diameter
Depth BGS
Watertight O-Ring ([✓ Y] / ~~N~~) IT 3-4-91

SURFACE PAD
Composition & Size 3 ft x 3 ft x 1 ft Concrete
Breathes With Vadose Zone (Y / N)

RISER PIPE
Type Sch 40 PVC
Diameter 4 in I.D.
Total Length (TOC to TOS) 50 ft.
Ventilated Cap (Y / [✓ N])

GROUT
Composition & Proportions 4 sx Type I & II cement + 1/2 sx Bentonite w/ ≈ 35-40 gal H2O; 1.5 Drums + 1 Drum
Tremied (Y / [✓ N])
Interval BGS 0-42 ft.

CENTRALIZERS (Y / [✓ N])
Depth(s) NA

SEAL
Type 1/4" Wyoming Bentonite Pellet
Source
Setup/Hydration time 15 min Vol. Fluid Added 10 gal
Tremied (Y / [✓ N])

FILTER PACK
Type Colorado Silica Sand & Gravel
Amt. Used 2 1/2 sx 20/40 1/2 sx 60
Tremied (Y / [✓ N])
Source
Gr. Size Dist. 20/40 Filter Pack + 60 on top

SCREEN
Type Sch 40 PVC
Diameter 4 inch I.D.
Slot Size & Type 0.010 in
Interval BGS (50 ft.) ≈ 100 ft – 50 ft

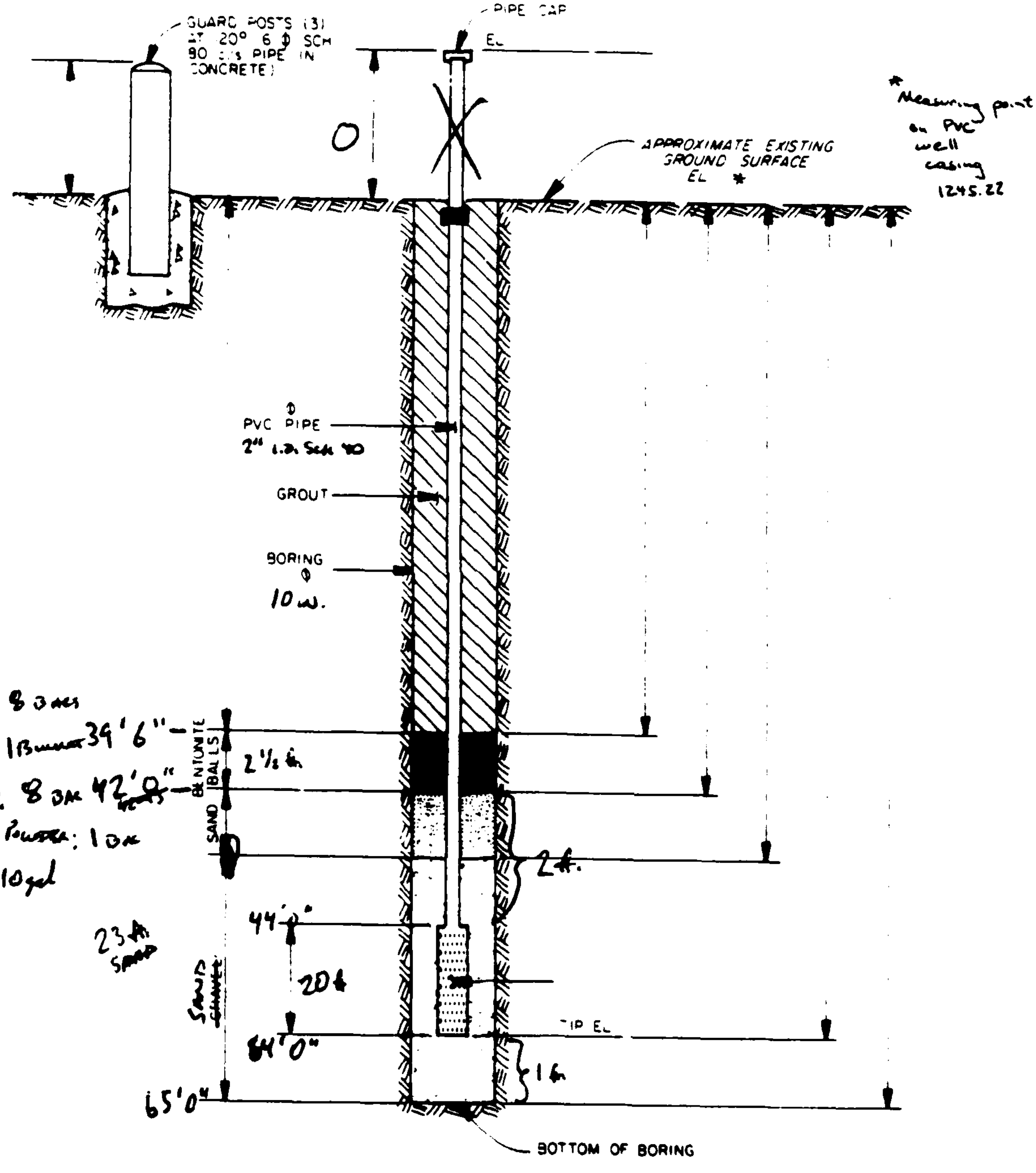
SUMP ([✓ Y] / N)
Interval BSG 101 to 100 Length 1 ft
Bottom Cap ([✓ Y] / N)

BACKFILL PLUG
Material NA
Setup/Hydration time NA
Tremied ~~(Y / N)~~

PIEZOMETER INSTALLATION SKETCH

PROJECT NAME Sky Harbor ANG
PROJECT NO 409721.02.06
BORING NO
PIEZOMETER NO PP-01

INSTALLED BY Gardner DATE 1/20/91
CHECKED BY NA DATE NA



* Measuring point on PVC well casing 1245.22

MATERIALS

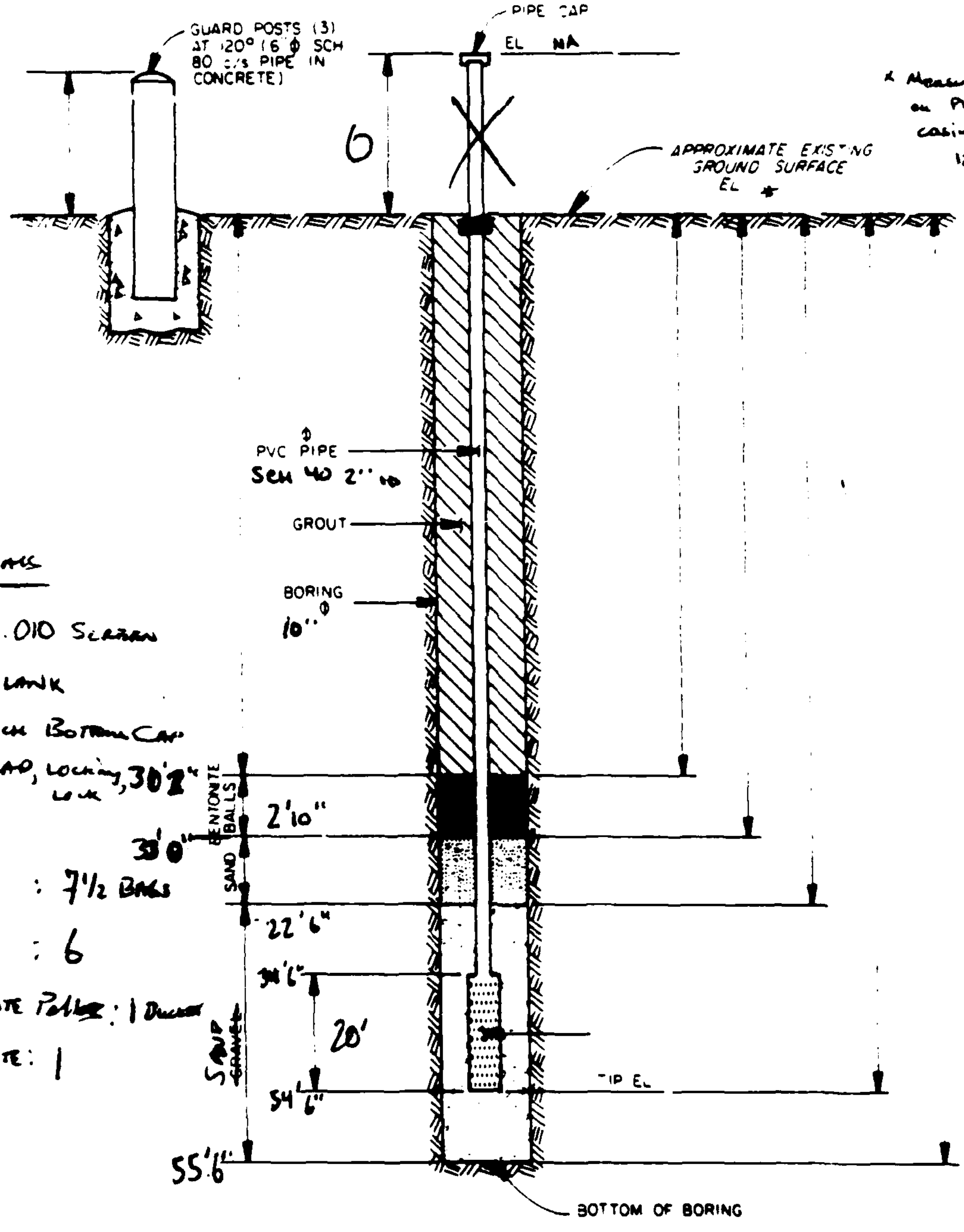
Sand : 8 bags
Pellets : 1 Bucket
Cement : 8 bags
Bentonite Powder : 1 bag
Water : 10 gal

Slurry

35
35
15
85 gal

PIEZOMETER INSTALLATION SKETCH

PROJECT NAME SH ANG
INSTALLED BY Gardner DATE 1/19/91
PROJECT NO 409721.02.06
CHECKED BY NA DATE NA
BORING NO
PIEZOMETER NO PP-02



* Measuring Point on PVC well casing
1251.07

MATERIALS

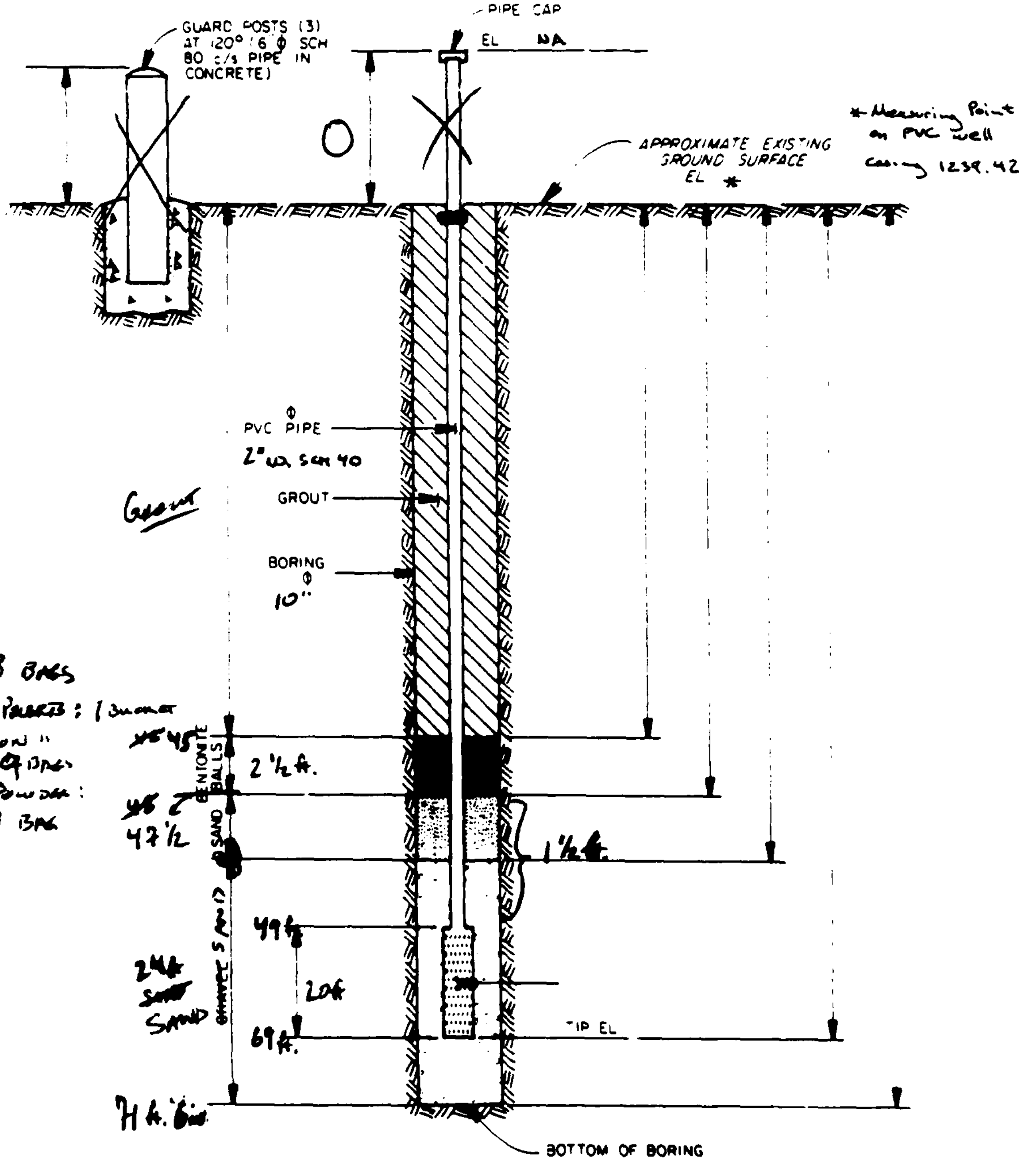
20 ft. 0.010 Screen
40 ft. Blank
1 - 4 inch Bottom Cap
1 - Top cap, locking lock, 30'2"

Sand : 7½ Bags
Cement : 6
Bentonite Pellets : 1 Bucket
Bentonite : 1

SLURRY
35
20
20
75 gal

PIEZOMETER INSTALLATION SKETCH

PROJECT NAME Sky Harbor ANG
INSTALLED BY Gardiner DATE 1/20/91
PROJECT NO 409721-02.06
CHECKED BY NA DATE NA
BORING NO NA
PIEZOMETER NO. PP-03



SAND : 8 BAGS
BENTONITE PELLETS : 1 Bucket
10 gal H2O on "
CEMENT : 9 BAGS
BENTONITE POWDER :
1 BAG

Slurry

35
30
36

100 gal

REV. DATE: MAY 1990

MONITORING WELL CONSTRUCTION LOG -- Standard Flush Mount

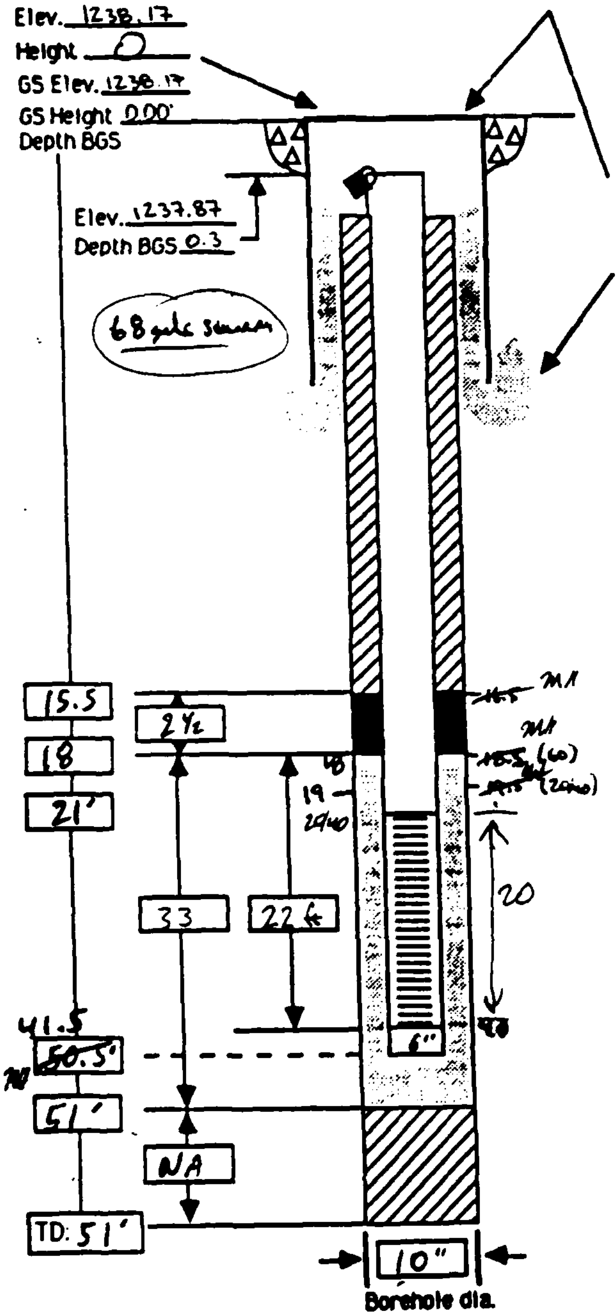
WELL NO.: MW4-01 | Installation: Papago Military Reservation | Site: 4

Project No.: 4097[illegible] | Client/Project: HAZWRAP / Sky Harbor ANG

HAZWRAP Contractor: IT Corporation | Drlg Contractor: Layne Environmental

Comp. Start: 2/1/91 (15 : 20 P m) | Comp. End: 2/8/91 (12 : 40 P m)

Built By: Gardiner | Well Coord.: N 13733.39 E 5749.44



PROTECTIVE CSG
Material / Type Steel Box/Sheet Metal Bottom
Diameter
Depth BGS
Watertight O-Ring [✓ Y] / ~~N~~ J 3-4-91

SURFACE PAD
Composition & Size 3 ft. x 3 ft. x 1 ft. Concrete
Breathes With Vadose Zone (Y / N)

RISER PIPE
Type Sch. 40 PVC
Diameter 4 in. I.D.
Total Length (TOC to TOS) 22 ft.
Ventilated Cap (Y / [✓ N])

GROUT
Composition & Proportions 4 Bag Type I & II Cement 1/2 Bag Bentonite Powder + ~ 35-40 gal H2O
Tremied (Y / [✓ N])
Interval BGS 0-15.5 7 sx Cement ½ sx Ben.

CENTRALIZERS ([✓ Y] / N)
Depth(s) 37 ft. ; 4 ft.

SEAL
Type 1/4" Wyoming Bentonite Pellets
Source
Setup/Hydration time 1/2 hr Vol. Fluid Added 10 gal H2O
Tremied (Y / [✓ N])

FILTER PACK
Type Colorado Silica Sand
Amt. Used 8 sx 20/40 ; 1/2 sx 60
Tremied (Y / [✓ N])
Source
Gr. Size Dist. 20/40 Filter Pack; 60 on top

SCREEN
Type Sch. 40 PVC
Diameter 4 in. I.D.
Slot Size & Type 0.010 in.
Interval BGS 21-41 ft.

SUMP ([✓ Y] / N)
Interval BSG 41.5-51 Length 9.5 ft.
Bottom Cap ([✓ Y] / N)

BACKFILL PLUG
Material NA
Setup/Hydration time NA
Tremied ~~(Y / N)~~

REV. DATE: MAY 1990

MONITORING WELL CONSTRUCTION LOG -- Standard Flush Mount

WELL NO.: MW4-02 | Installation: Papago Military Reservation | Site: 4

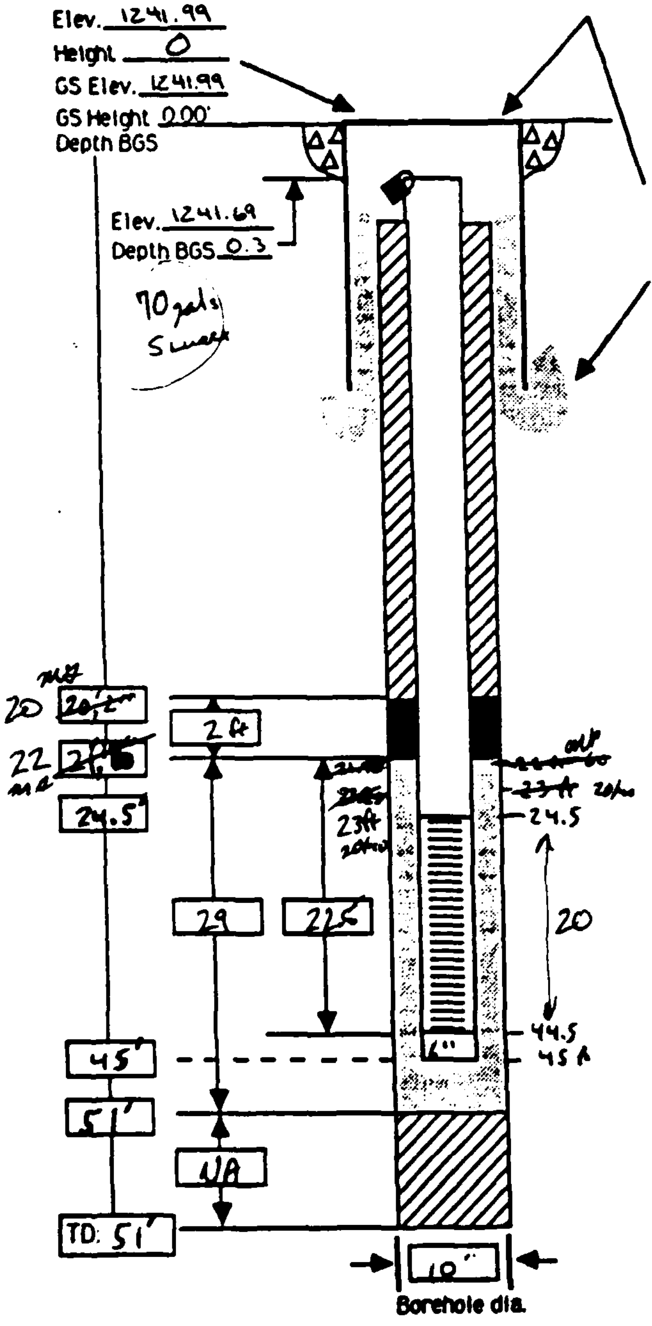
Project No.: 409721.02.06 | Client/Project: HAZWRAP / Sky Harbor ANG

HAZWRAP Contractor: IT Corporation | Drlg Contractor: Layne Environmental

Comp. Start: 2/8/91 (~~08:30~~ 12:00 ~~a~~ p m) | Comp. End: 2/8/91 (12:15 p m)

Built By: Gardiner

Well Coord.: N 13332.21
E 5959.36



Elev. 1241.99
Height 0
GS Elev. 1241.99
GS Height 0.00'
Depth BGS

Elev. 1241.69
Depth BGS 0.3

70 gals Slurry

PROTECTIVE CSG
Material / Type Steel Top / Sheet metal Bottom
Diameter
Depth BGS
Watertight O-Ring [✓ Y] / [✓ N] JT 3-4-91

SURFACE PAD
Composition & Size 3 ft x 3 ft x 1 ft Concrete
Breathes With Vadose Zone (Y / N)

RISER PIPE
Type Sch. 40 PVC
Diameter 4 in. I.D.
Total Length (TOC to TOS) 24.5 ft
Ventilated Cap (Y / [✓ N])

GROUT
Composition & Proportions 4 bags Type II cement +
1/2 bag Bentonite + 35-40 gal H2O
Tremied (Y / [✓ N])
Interval BGS 0-20 ft. (8 Type II cement 1/2 bag Bent)

CENTRALIZERS ([✓ Y] / N)
Depth(s) 24.5 ft ; ~~50~~ 44.5 ft

SEAL
Type 1/4" Wyoming Bentonite Pellets
Source
Setup/Hydration time 1 HR Vol. Fluid Added 10 gal H2O
Tremied (Y / [✓ N])

FILTER PACK
Type Colorado Silica Sand / Gravel
Amt. Used 9 Sx 20/40 ; 1/2 Sx 60
Tremied (Y / [✓ N])
Source
Gr. Size Dist. 20/40 Filter pack ; 60 on Top

SCREEN
Type Sch. 40 PVC
Diameter 4 in. I.D.
Slot Size & Type 0.010 in.
Interval BGS 24.5 - 44.5 (20 ft.)

SUMP ([✓ Y] / N)
Interval BGS 45 - ~~50~~ 51 Length 6 ft
Bottom Cap ([✓ Y] / N)

BACKFILL PLUG
Material NA
Setup/Hydration time NA
Tremied (~~Y / N~~)

APPENDIX G

PIEZOMETER AND MONITORING WELL DEVELOPMENT RECORDS

REV. DATE: MAY 1990

WELL DEVELOPMENT LOG PS-1	Well No.: PS-1	Page 1 of 1
Installation:	Site: General	
Project No.: 409721	Client/Project: MMES / Sky Harbor ANG	
HAZWRAP Contractor:	Dev. Contractor: Canonie Environmental	
Dev. Start (: __m)	Dev. End: (: __m)	Csg Dia.: 2 inch
Developed by: NA		Dev. Rig (Y / N)

Dev. Method Surge with bailer and extract 10-20 well volumes with Bailer

Equipment Smeal T-5

Pre-Dev. SWL ______ Maximum drawdown during pumping ______ ft at ~0.5 gpm

Range and Average Discharge rate 0.5 avg gpm

Total quantity of material bailed ______

Total quantity of water discharged by pumping N/A

Disposition of discharge water To be determined

Time	Volume Removed (gals)	Water Level ft. BTOC	Turbidity	Clarity/ Color	Temp °C	pH	Conductivity	Remarks
			N A ↓					Well could not be developed with 9ft bailer on hand. Blocked at 55ft Will attempt with shorter bailer at later date. JRT 1/22/91

INTERNATIONAL TECHNOLOGY CORPORATION

By JRT Date 1-20-91 Subject Calc. Well PS-1 Sheet No. 1 of 1
Chkd. By [redacted] Date [redacted] Casing Volume Proj. No. 409721

Total Depth : 98.42 ft
Water Depth : 76.12 ft
Water Column : 22.30 ft

$$\text{Vol} = \left(2\text{ in} \times \frac{1\text{ ft}}{12\text{ in}}\right)^2 \div 4 \times \pi \times 22.30 = 0.48\text{ ft}^3$$

or

3.6 gals

$\therefore$ Bail 36 to 72 gals

FIGURE 5-4c

REV DATE. MAY 1990

WELL DEVELOPMENT LOG

Well No.. PS1

Page 1 of 1

Installation: **Sky Harbor** **Coordinates**

Site: 1

Project No.: 40972.02.06

Client/Project Sky Harbor ANG Base

HAZWRAP Contractor: IT Corp

Dev Contractor

Dev Start (15:46 m)

Dev End (17:00 m)

Csg Dia. 4" ID

Developed by Layne Environmental 2/4/91

Dev. R'c [✓ Y] / N

Dev Method Bailer; surging in water

Equipment 1.5"x10' PVC Bottom loading Bailer

Pre-Dev. SWL 97.53ft Maximum drawdown during pumping NA ft at NA gp

Range and Average Discharge rate N/A gp

Total quantity of material bailed 27 gallons

Total quantity of water discharged by pumping N/A

Disposition of discharge water Held in poly tanks for analysis

Time	Volume Removed (gals)	Water Level ft. BTOC	Turbidity	Clarity/ Color	Temp °C	pH	Conductivity	Remarks
1546			Muddy	Muddy	24.8	7.27	1000µS	
1557	5		Muddy	Muddy	23.5	6.96	980µS	
1606	10		Muddy	Muddy	23.0	7.07	970µS	
1620	13				~~22~~ 23.0	7.09	960 ~~970~~µS	
1630	15				23.1	7.02	950µS	
1640	18 ~~18~~				22.3	6.93	950µS	
1655	24 ~~18~~ ~~17~~				22.5	6.96	970µS	
1700	27 ~~48~~				22.4	~~6.8~~ 6.93	940µS	

REV. DATE: MAY 1990

WELL DEVELOPMENT LOG PS-2 | Well No.: PS-2 | Page 1 of 1

Installation:

Site: General

Project No.: 409721

Client/Project: MMES / Sky Harbor ANG

HAZWRAP Contractor:

Dev. Contractor: Layne Environmental

Dev. Start (12:10 __m)

Dev. End: (13 :53 __m)

Csg Dia.: 2 inch

Developed by: ~~Layne Env~~ Southwest Well Services

Dev. Rig (Y / N)

ST Ysk. Developed 1-20-91

Dev. Method Surge with bailer and extract 10-20 well volumes with bailer

Equipment Smeal T-5

Pre-Dev. SWL 74.95 Maximum drawdown during pumping ~74.95 ft at ~0.5 gpm

Range and Average Discharge rate .05 over 1 hr 43 min gpm

Total quantity of material bailed 45 gals

Total quantity of water discharged by pumping NA

Disposition of discharge water To be determined

Time	Volume Removed (gals)	Water Level ft. BTOC	Turbidity	Clarity/ Color	Temp °C	pH	Conductivity	Remarks
1210	10		NA	cloudy & Brown	20.5	7.15	1170	Fine Sand silt
1229	15		↓	cloudy & Brown	20.3	7.49	1080	Fine sand silt
1243	16			cloudy/brown	21.0	7.40	1110	Silty (vy fine) settles to milky clarity.
1248	20			cloudy/brown	21.0	7.42	1120	silty/& settling
1307	23			cloudy/brown	20.8	7.34	1130	silty / settling to clear
1329	26			cloudy/brown	20.3	7.34	1150	Silty / settling to clear
1333	27			cloudy/brown	20.2	7.22	1110	Silty / and settling
1345	30			cloudy	20.4	7.43	1190	Silty and settling
1348	31			cloudy	20.9	7.30	1110	silty
1353	32			cloudy	21.1	7.37	1080	silty (Clear to sample for Pi70)

By JRT Date 1-20-91 Subject Calc Well PS-2 Sheet No. 1 of 1

Chkd. By ___ Date ___ Casing Volume Proj. No. 409721

Total Depth : 99.86

Water Depth : 81.82

Water Column : 18.04

$$Vol = \left(2\,in \times \frac{1\,ft}{12\,in}\right)^2 \div 4 \times \pi \times 18.04 = 0.39\ ft^3$$

or

~ 3 gals

∴ Bail 30 to 60 gals

FIGURE 5-4c PS-02 REV. DATE. MAY 1990

WELL DEVELOPMENT LOG | Well No.: ~~SHP-2~~ | Page 1 of 1

Installation: **Sky Harbor** **Coordinates** | Site: NA

Project No.: 409721.02.06 | Client/Project: Sky Harbor ANG

HAZWRAP Contractor: IT Corp | Dev. Contractor:

Dev Start (13:35 __m) | Dev. End (14:38 __m) | Csg Dia. 2" ID

Developed by: Layne Environmental | Dev Rig [✓ Y] / N

2nd Development 2-4-91

Dev. Method Bailing

Equipment 1.5" Bottom loading PVC bailer

Pre-Dev. SWL 76.41 Maximum drawdown during pumping NA ft at NA gpm

Range and Average Discharge rate NA gpm

Total quantity of material bailed ~32 gal

Total quantity of water discharged by pumping NA

Disposition of discharge water Held in 55 gal drums for analysis

Time	Volume Removed (gals)	Water Level ft. BTOC	Turbidity	Clarity/ Color	Temp °C	pH	Conductivity	Remarks
1335	2		—	muddy	21.9	7.19	1130	Slight Odor (petroleum)
1353	10		—	muddy	21.8	7.22	1160	↓
1406	16		—	muddy	21.7	7.28	1080	
1417	21		—	muddy	21.8	7.15	1140	
1438	32		—	muddy	21.8	7.17	1170	

REV. DATE: MAY 1990

WELL DEVELOPMENT LOG PS-3	Well No.: PS-3	Page 1 of 1
Installation:	Site: General	
Project No.: 409721	Client/Project: MMES / Sky Harbor ANG	
HAZWRAP Contractor:	Dev. Contractor: Layne Env.	
Dev. Start (09:45 __m)	Dev. End: (11:10 __m)	Csg Dia.: 2 inch
Developed by: Southwest Env. Well Services		Dev. Rig (Y / N)

Developed 1-20-91

Dev. Method Surge with bailer and extract 10-20 well volumes with bailer

Equipment ~~Sch~~ ST Smeal T-5

Pre-Dev. SWL 75.50 Maximum drawdown during pumping ~85 ft at ~0.5 gpm

Range and Average Discharge rate 0.5gpm over 1hr 20 mins gpm

Total quantity of material bailed 55gals

Total quantity of water discharged by pumping NA

Disposition of discharge water To be determined

Time	Volume Removed (gals)	Water Level ft. BTOC	Turbidity	Clarity/ Color	Temp °C	pH	Conductivity Mmhos	Remarks
0945			NA					
1008	15			Cloudy Brown	19.6	7.11	1080	Fine sand, silt
1026	18			Cloudy Brown	19.9	7.41	1060	Silty, sand
1037	24			Cloudy Brown	20.2	7.35	10 50	Silty, fine sand
1046	30			Cloudy	20.4	7.28	10 10	Silty
1050	35			Cloudy	20.5	7.31	10 60	Silty
1055	42			Cloudy gray	20.8	7.40	1070	Silty
1100	50			Cloudy brown	21.3	7.31	1050	Silty, vy fine
1108	55			Cloudy	20.5	7.32	1070	No visible fines
1110	55			Cloudy	20.9	7.36	1050	Clean enough for piezo

INTERNATIONAL TECHNOLOGY CORPORATION

By JRT Date 1-20-91 Subject Calc. Well PS-3 Sheet No. 1 of 1

Chkd. By ___ Date ___ Casing Volume Proj. No. 409721

Total Depth : 98.42 ft

Water Depth : ~~76.12 ft~~ 83.48 JT

Water Column : ~~22.30 ft~~ 16.42

$$Vol = \left(2 in \times \frac{1 ft}{12 in}\right)^2 \div 4 \times \pi \times \overset{16.42}{\cancel{22.30}} = 0.36 ft^3$$

or

~ 2 3/4 gals

∴ Bail 26 to 52 gals

FIGURE 5-4c S · REV. DATE: MAY 1990

WELL DEVELOPMENT LOG	Well No.: MW8-01	Page 1 of 1

Installation: **Sky Harbor** **Coordinates** Site: Background Well

Project No.: 409721.02.06 Client/Project: Sky Harbor ANG

HAZWRAP Contractor: IT Corp Dev. Contractor:

Dev Start (08:23 ___m) Dev. End: (09 28 ___m) Csg Dia.: 4" ID

Developed by: Layne Environmental Dev. Rig ([✓ Y] N)

Developed 2-5-91

Dev. Method Swab surge, bailer, submersible pump

Equipment 3 5/8" x 10' Bottom loading steel bailer, 1.5 HP Franklin submersible pump

Pre-Dev. SWL 77.14 ft Maximum drawdown during pumping NA ft at NA gp

Range and Average Discharge rate 5-20 gpm ~~6~~ 10 gpm nominal gp

Total quantity of material bailed ~18 gals

Total quantity of water discharged by pumping ~~200~~ ~180 gals

Disposition of discharge water Held in poly tanks for analysis

Time	Volume Removed (gals)	Water Level ft. BTOC	Turbidity	Clarity/ Color	Temp °C	pH	Conductivity	Remarks
0823	5		Muddy	Muddy	20.7	6.80	1090	
0904	60		|	|	22.1	6.83	1100	
0910	115		~~Cloudy~~ 159.1	Cloudy		6.75	1090	
0915	170		27.8	Slightly Cloudy	22.3	6.72	1110	
0920	185		17.6	Clear	22.4	6.78	1100	
0928	200		13.8	Clear	21.7	6.65	1070	

FIGURE 5-4c

REV. DATE. MAY 1990

WELL DEVELOPMENT LOG | Well No.: MWS-02 | Page 1 of 1

Installation: **Sky Harbor** **Coordinates** | Site: Background

Project No.: 409721 | Client/Project: MMES / Sky Harbor ANG

HAZWRAP Contractor: IT Corp | Dev. Contractor: Layne Env.

Dev Start (11:15 Am) | Dev. End: (12:40 Pm) | Csg Dia.: 4 inch

Developed by: Tyburski / Layne Env. | Dev. Rig ([✓ Y] N)

Developed MWS-02

Dev. Method Surge saturated screen interval; bail sediment as required; pump to visibly clean or 5 NTU's if possible

Equipment Smeal development rig

Pre-Dev. SWL 75.25 Maximum drawdown during pumping ______ ft at 5 gpm

Range and Average Discharge rate 3-6 gpm avg approx 5 gpm

Total quantity of material bailed 20 gals

Total quantity of water discharged by pumping 180 gals

Disposition of discharge water To be determined

Time	Volume Removed (gals)	Water Level ft. BTOC	Turbidity	Clarity/ Color	Temp °C	pH	Conductivity	Remarks
11:15	—	75.25	—	—	—	—	—	Start Surging
1145	-							start bailing
1210	20							Start pumping
1215	35			Brown	23.3	6.93	1130	
1223	60			Lt. Br	23.7	7.23	1110	
1227	100			Cloudy	23.3	7.40	1150	
1232	140			Cloudy	23.5	7.26	1120	
1235	170		44.1	Slightly Cloudy	23.4	7.40	1140	
1240	200		21.5	Clear	23.6	7.23	1140	Stop. Clarity good

FIGURE 5-4c

REV. DATE. MAY 1990

WELL DEVELOPMENT LOG

Well No.: MWS-03

Page 1 of 1

Installation: **Sky Harbor** **Coordinates**

Site: Background Well

Project No.: 409721.02.06

Client/Project: Sky Harbor ANG

HAZWRAP Contractor: IT Corp

Dev. Contractor:

Dev. Start (10:38__m)

Dev. End: (11:40__m)

Csg Dia.: 4" ID

Developed by: Layne Environmental

Dev. Rig [✓ Y]/ N)

Developed 2-5-91

Dev. Method Surge with swab, bail, submersible pump

Equipment 3 5/8"x10' Bottom loading steel bailer, 1.5 HP Franklin submersible pump

Pre-Dev. SWL 76.40ft Maximum drawdown during pumping NA ft at NA gp

Range and Average Discharge rate 5-20 gpm 12 gpm nominal gp

Total quantity of material bailed ~14 gals

Total quantity of water discharged by pumping ~205 gals

Disposition of discharge water Held in polly tank for analysis

Time	Volume Removed (gals)	Water Level ft. BTOC	Turbidity	Clarity/ Color	Temp °C	pH	Conductivity	Remarks
1038	10		Muddy	Muddy	21.8	7.15	1200	
1121	25		Cloudy	Cloudy	22.7	6.95	1240	
1125	70		~~Slightly Cloudy~~ 131.0	Slightly Cloud	22.6	6.85	1210	
1130	146		78.8	Clear	22.6	6.94	1170	
1133	165		30.2	Clear	22.8	7.04	1150	
1137	200		18.9	Clear	22.8	7.08	1140	
1140	220		19.5	Clear	21.7	7.15	1230	

FIGURE 5-4c

REV. DATE: MAY 1990

WELL DEVELOPMENT LOG	Well No.: MWS-04	Page 1 of 1

Installation: **Sky Harbor** **Coordinates**
Site: SKY HARBOR BACKGROUND WELL
Project No.: 409721.02.06
Client/Project: HAZWRAP / SKY HARBOR ANG
HAZWRAP Contractor: IT Corporation
Dev. Contractor: LAYNE ENVIRONMENTAL
Dev Start: (9:30 Am) 3/26/91
Dev End: (12:10 pm) 3/26/91
Csg Dia.: 4 in. I.D.
Developed by: GARDINO / WILLNOX
Dev Rig: [✓ Y] N

Dev Method: SURGE w/ 4 in. SWAB FOR 15-20 minutes, BAIL FOR APPROXIMATELY 30-40 gal, THEN PUMP UNTIL WATER CLARITY & TURBIDITY ARE ≤ 20NT

Equipment: DEVELOPMENT RIG, pH METER, CONDUCTIVITY METER, TEMP. PROBE

Pre-Dev. SWL 74.92 Maximum drawdown during pumping NA ft at NA gp

Range and Average Discharge rate 3-55 GPM / Average Rate Approx 5gpm gp

Total quantity of material bailed 55 gal

Total quantity of water discharged by pumping 165 gal

Disposition of discharge water CONTAINERIZED ON SITE PENDING WATER QUALITY ANALYSIS

Time	Volume Removed (gals)	Water Level ft. BTOC	Turbidity	Clarity/ Color	Temp °C	pH	Conductivity	Remarks
0935	20	74.92	NA	Cloudy	20.8	7.03	1170	VERY SMALL AMT (0.01 ft.?) of BH in well
1120	35		"	"	20.5	6.67	1140	
1123	50		"	"	22.5	6.74	1170	
1125	60		"	"	21.8	6.82	1170	
1129	70		"	"	22.1	6.85	1140	
1132	80		"	"	22.5	6.80	1150	
1137	90		77	"	23.2	6.82	1140	
1141			71	Slightly Cloudy	23.3	6.79	1180	
1145	150		100	"	22.9	6.81	1020	
1147	165		54.5	"	23.1	6.83	996	
1151	190		40.1	Very Slightly Cloudy	23.2	6.81	1120	
1154	200		31.8		22.8	6.83		
1159	220	75.06	25.2	"	23.1	6.78	1050	

NOTE: NA = NOT ANALYZED FOR.

REV. DATE: MAY 1990

WELL DEVELOPMENT LOG	Well No.: MW1-02	Page 1 of 1
Installation:	Site: 1	
Project No.: 409721.02.06	Client/Project: Sky Harbor ANG Base	
HAZWRAP Contractor: IT Corp	Dev. Contractor: Layne Environmental	
Dev. Start (10:50 __m)	Dev. End: (12:54 __m)	Csg Dia.: 4" ID
Developed by: Layne Environmental		Dev. Rig ([✓ Y] / N)

Developed 2-4-91

Dev. Method ~~3 5/8" OD x10' Steel Bailer~~ Bailer, followed by swab, finished with pump

Equipment 3 5/8" OD x10' Steel Bailer, 4" OD Swab, Franklin 1.5HP Submersible pump

Pre-Dev. SWL 77.32 ft Maximum drawdown during pumping ______ ft at ______ gpm

Range and Average Discharge rate 5-20 gpm 6 gpm nominal gpm

Total quantity of material bailed ~15 gallons

Total quantity of water discharged by pumping ~425 gallons

Disposition of discharge water Held in poly tanks for analysis

Time	Volume Removed (gals)	Water Level ft. BTOC	Turbidity	Clarity/ Color	Temp °C	pH	Conductivity	Remarks
~~0847~~ 1050	15		N/A	Cloudy Brown	22.4	7.36	1080 µS	
1200	60		>200	Slightly Cloudy	25.0	7.16	1100 µS	Clearing quickly
1213	80		155.2	Clear	Low Battery	7.01	1090 µS	Clearer
1222	~~165~~ 220		36.6	Clear	—	7.03	1070 µS	Fairly Clear
1235	240		63.2	Clear	—	6.84	1070 µS	pH & Conductivity Stable
1242	295		78.9	Clear	—	—	—	
1245	330		31.3	Clear	—	—	—	
1247	360		27.7	Clear	—	—	—	
1250	585		26.0	Clear	—	—	—	
1252	410		17.5	Clear				
1254	440		14.2	Clear	—	—	—	

Shut pump down →

REV. DATE: MAY 1990

WELL DEVELOPMENT LOG	Well No.: MW2-02	Page 1 of 1
Installation: 50ft of screen, Top at 50 bgs.	Site: Site 2	
Project No.: 409721	Client/Project: MMES / Sky Harbor ANG	
HAZWRAP Contractor: IT Corp	Dev. Contractor: Layne Env.	
Dev. Start (8:15 Am)	Dev. End: (10:15 Am)	Csg Dia.: 4 inch
Developed by: Bailing, Surging, Pumping (Tyborski) Developed 2-9-91		Dev. Rig [✓ Y] N

Dev. Method Surging saturated screen interval, bail, pump to visibly clear or 5NTU's.

Equipment Smeal development rig.

Pre-Dev. SWL 75.59 Maximum drawdown during pumping 99.74 ft at ~6gpm gpm

Range and Average Discharge rate approx 6gpm while pumping gpm

Total quantity of material bailed 20gals

Total quantity of water discharged by pumping 180gals

Disposition of discharge water To be determined

Time	Volume Removed (gals)	Water Level ft. BTOC	Turbidity	Clarity/ Color	Temp °C	pH	Conductivity	Remarks
0815	–	75.59	–	–	–	–	–	Start surging
0845	–	–	–	–	–	–	–	Run bailer in well
0855	20gals		–	Brown	20.1	6.84	1150	Begin to set pump
0935	60gals		–	Light Br.	21.7	6.35	1250	Began pumping 0930
0940	70gals			Light Br	21.8	6.28	1130	Stop pump temporarily
0945	80gals			Cloudy	22.1	6.40	1120	
0950	110gals			Cloudy	22.1	6.98	1130	
1000	130gals			Sl. cloudy	21.9	7.04	1170	
1001	135gals		58.2	Sl. Cloudy	22.3	7.15	1140	
1005	165 gals		47.5	Sl. Cloudy	22.5	7.11	1190	
1008	180gals		31.5	Clear	22.3	7.21	1150	
1015	200gals	99.74	25.8	Clear				Considered clear enough.

FIGURE 5-4c bldg REV. DATE. MAY 1990

WELL DEVELOPMENT LOG Well No.: MW3-01 Page 1 of 1

Installation: **Sky Harbor** **Coordinates** Site: 3

Project No.: 409721.02.06 Client/Project: HAZWRAP / Sky Harbor ANG

HAZWRAP Contractor: IT Corporation Dev. Contractor: Layne Environmental

Dev. Start (: __m) 3/26/91 Dev. End: (__m) Csg Dia.: 4.0 in. I.D.

Developed by: Gardner / Wilkins Dev. Rig ([✓ Y] N)

Dev Method ~~Swab~~ Surge w/ 4 in Swab for 15-20 minutes, Bail for Approx 30-40 gal, Then Pump until water clarity/turbidity is X ≤ 20 NTU

Equipment Development Rig, pH meter, Conductivity meter, Temp Probe

Pre-Dev. SWL 75.82 Maximum drawdown during pumping ______ ft at ______ gpm

Range and Average Discharge rate 3-5 GPM gpm

Total quantity of material bailed 55 Gallons

Total quantity of water discharged by pumping 155

Disposition of discharge water Containerized on site pending water quality analysis

Time	Volume Removed (gals)	Water Level ft. BTOC	Turbidity	Clarity/ Color	Temp °C	pH	Conductivity	Remarks
1120	0	75.28	-	-	-	-	-	Strong odor from well
1140	15	-	-	very cloudy	20.6	6.43	970	
1145	40			"	21.0	7.02	1070	
1148	55	-	-	"	21.4	7.01	1050	
1210	80	-		"	20.9	6.88	1110	
1213	95	-	-	cloudy	22.0	6.83	1020	
1216	105	-		"	23.1	6.79	1060	
1220	120	-		Slightly cloudy	23.3	6.78	1060	
1225	140			"	22.7	6.79	1050	
1230	160		137.6	"	22.4	6.75	1050	
1235	175		102.3	"	23.7	6.77	1050	
1239	190		92.1	"	23.6	6.76	1000	
1243	205		64.0	"	24.0	6.75	1010	
1245	215		41.1	"	23.7	6.77	1000	
		75.3			~~23~~			

58 FIGURE 5-4c airport [illegible] REV. DATE. MAY 1990

WELL DEVELOPMENT LOG | Well No. MW3-02 | Page 1 of 1

Installation: **Sky Harbor** **Coordinates** | Site: 3

Project No.: 409721.02.06 | Client/Project: HAZWRAP / Sky Harbor ANG

HAZWRAP Contractor: IT Corporation | Dev. Contractor: Layne Environmental

Dev. Start (: ___m) | Dev. End: (___m) | Csg Dia. 4 in. I.D.

Developed by: Gardin / Williams | Dev. Rig [✓ Y] N)

Dev. Method Surge w/ 4 in. Swab for 15-20 minutes, Bail for Approximately 30-40 gal, Then Pump until water clarity & turbidity is ≤ 20 NTU

Equipment Development Rig, pH Meter, Conductivity meter, Temp Probe

Pre-Dev. SWL 76.23 Maximum drawdown during pumping ______ ft at ______ gp

Range and Average Discharge rate 3-5 GPM ______ gp

Total quantity of material bailed ~~20~~ 55 gals.

Total quantity of water discharged by pumping 155 gals

Disposition of discharge water Containerized on site pending water quality analysis

Time	Volume Removed (gals)	Water Level ft. BTOC	Turbidity	Clarity/ Color	Temp °C	pH	Conductivity	Remarks
0830	15	76.23	NA	Cloudy	19	6.13	1150	
0833	45		NA	"	19.2	6.96	1140	
0900	60		NA	"	19.8	6.77	1130	
0904	75			"	21.5	6.83	1010	
0908	80		"		22.0	6.75	1030	
0912	95		"		22.7	6.73	1080	
0915	110			"	22.9	6.83	980	
0920	130			"	23.1	6.74	1010	
0923	145			Slightly cloudy	22.7	6.77	960	
0925	175		513 50.0	"	23.1	6.74	1010	
0930	180		45.6		23.0	6.78	980	
0935	200		24.6	clear	23.0	6.72	1010	
0940	210		18.1	clear	22.2	6.83	1110	
		*73.64						

*Finishing crew cut off several inches of well casing when finishing well.

FIGURE 5-4c REV. DATE. MAY 1990

WELL DEVELOPMENT LOG | Well No.. MW5-01 | Page 1 of 1

Installation: **Sky Harbor** **Coordinates** | Site: Site 5

Project No.: 409721 | Client/Project MMES / Sky Harbor ANG

HAZWRAP Contractor: ITCorp | Dev. Contractor Layne Env.

Dev Start (13:45 ___m) | Dev. End. (14 55 ___m) | Csg Dia.

Developed by Tyburski | Dev. Rig (Y / N)

Developed 2-9-91

Dev Method Surge saturated screen interval, bail coarse sediment, pump to clear or NTU of 5.

Equipment Smeal Development rig

Pre-Dev. SWL 76.50 Maximum drawdown during pumping 96.70 ft at 4-6gpm gp

Range and Average Discharge rate 3 - 8 gp

Total quantity of material bailed 20gals

Total quantity of water discharged by pumping 190

Disposition of discharge water To be determined. Held in poly tanks

Time	Volume Removed (gals)	Water Level ft. BTOC	Turbidity NTUs	Clarity/ Color	Temp °C	pH	Conductivity	Remarks
1345	-	76.50	-	-	-	-	-	Start Surging
1355	—	-	-	-	-	-	-	Stop surging, run bailer
1400	20gals	-	-	-	-	-	-	Start to run pump in well.
1415	20gals							Start pump
1420	25gals			Brown	24.6	6.76	1110	
1425	70			Lt. Brown	24.1	7.20	1060	
1430	90			Lt. Brown	24.5	7.22	1060	
1435	110			Lt. Grey	23.9	7.20	1070	
1440	130			Cloudy	24.	7.35	1080	
1443	150			Cloudy	23.7	7.22	1070	
1446	170			Sl. Cloudy	23.8	7.27	1080	
1448	180			Sl. Cloudy	23.6	7.25	1080	
1452	210		64.0	Sl. Cloudy	23.6	7.26	1080	Clear enough
1455								Stop

REV. DATE: MAY 1990

WELL DEVELOPMENT LOG	Well No.: PP-01	Page 1 of 1
Installation:	Site. PAPAGO ANG	
Project No.: 40934-02-06	Client/Project: MAES / AZ ANG	
HAZWRAP Contractor:	Dev. Contractor: SOUTHWEST ENVIRONMENTAL WELL SERVICE CO.	
Dev. Start (11:17 __m)	Dev. End: (12:22 __m)	Csg Dia.: 2"
Developed by: SOUTHWEST ENVIRONMENTAL WELL SERVICES CO. J.S. IT. CORP.		Dev. Rig (Y / N)

Developed 1-29-91

Dev. Method 1.25 O.D. x 9.90 PVC BOTTOM LOADING BAILER W/ DEDICATED ROPE

Equipment SMALL RIG USING HOIST + HAND PULLING.

Pre-Dev. SWL 30.84 Maximum drawdown during pumping N/A ft at N/A gpm

Range and Average Discharge rate N/A gpm

Total quantity of material bailed 17 GALLONS

Total quantity of water discharged by pumping N/A

Disposition of discharge water POURED INTO 55 gal DMS + LABELED BY PIEZOMETER NUMBER

Time	Volume Removed (gals)	Water Level ft. BTOC	Turbidity	Clarity/ Color	Temp °C	pH	Conductivity	Remarks
1118	1			BROWNISH	2.26	7.02	1740	MEASUREMENTS REPRESENT FIRST BAILER VOLUME REMOVED FROM WELL.
1134	3			BROWNISH	22.9	7.20	1610	WATER HAS A SLIGHT ODOR I CAN NOT DESCRIBE. SLIGHTLY CLOUDY.
1145	6			BROWNISH	23.0	7.20	1560	SLIGHT ODOR. MEASURED WATER LEVEL LEVEL DROPPED 16FT AFTER REMOVING 6 GALLONS
1200	9			BROWNISH	22.8	7.29	1510	SLIGHT ODOR. CLOUDY. SILTY.
1209	12			BROWNISH	22.9	7.24	1500	SLIGHT ODOR, CLOUDY SILTY.
1216	16			BROWNISH	22.8	7.20	1620	SLIGHT ODOR, CLOUDY, SILTY

REV. DATE: MAY 1990

WELL DEVELOPMENT LOG | Well No.: PP-02 | Page 1 of 1

Installation: | Site: PAPAGO ANG

Project No.: 409721-02-06 | Client/Project: MMES / AZ ANG

HAZWRAP Contractor: | Dev. Contractor: SOUTHWEST ENVIRONMENTAL WELL SERVICES CO.

Dev. Start (12:52 m) | Dev. End: (14:25 m) | Csg Dia.: 2"

Developed by: SOUTHWEST ENVIRONMENTAL WELL SERVICES CO. J.S. II. [illegible] | Dev. Rig ([✓ Y]/ N)

Developed 1-29-91

Dev. Method 1.25 OD x 9.96 PVC BOTTOM LOADING BAILER w/ DEDICATED ROPE.

Equipment SMEAL RIG w/ HOIST USING ROPE + HAND PULLING

Pre-Dev. SWL 37.45 Maximum drawdown during pumping N/A ft at N/A gpm

Range and Average Discharge rate ______ gpm

Total quantity of material bailed 42 GALLONS

Total quantity of water discharged by pumping N/A

Disposition of discharge water POURED INTO 55 gal DMS + LABELED BY PIEZOMETER NUMBER

Time	Volume Removed (gals)	Water Level ft. BTOC	Turbidity	Clarity/ Color	Temp °C	pH	Conductivity	Remarks
1303	~~4~~3			BROWN	24.0	7.22	1980	MUDDY, NO ODOR, HAD TO BAIL 4 GALS BEFORE WATER COMING OUT MUDDY.
1309	6			BROWN	22.7	7.37	1990	MUDDY, NO ODOR
1321	9			BROWN	23.8	7.37	1950	MUDDY, NO ODOR
1326	12			BROWN	24.4	7.40	1920	MUDDY, NO ODOR
1331	15			BROWN	24.7	7.30	1980	SLIGHTLY MUDDY, NO ODOR
1347	21			BROWN	24.8	7.29	1990	SLIGHTLY MUDDY, NO ODOR
1400	30			BROWN	24.4	7.29	2000	
1413	41			ALMOST CLEAR	24.5	7.34	2020	ALMOST CLEAR, NO ODOR

REV. DATE: MAY 1990

WELL DEVELOPMENT LOG	Well No.: PP-03	Page 1 of 1
Installation:	Site: PAPAGO ANG	
Project No.: 409721	Client/Project: MMES / AZ ANG	
HAZWRAP Contractor:	Dev. Contractor: SOUTHWEST ENVIRONMENTAL WELL SERVICES	
Dev. Start (0:9 31 m)	Dev. End: ~~10~~ (10:39___m)	Csg Dia.: 2"
Developed by: SOUTHWEST ENVIRONMENTAL WELL SERVICES CO.		Dev. Rig [✓ Y] / N

Developed 1-29-91

Dev. Method 1.25 O.D. x 9.90 PVC BOTTOM LOADING BAILER w/ DEDICATED POLY ROPE.

Equipment SMEAL RIG. w/ HOIST. PULLING BAILER BY HAND.

Pre-Dev. SWL 32.30 Maximum drawdown during pumping N/A ft at N/A gpm

Range and Average Discharge rate ______ gpm

Total quantity of material bailed 11 GALLONS

Total quantity of water discharged by pumping N/A

Disposition of discharge water PUMPED INTO 55 gal DRUM + LABELED BY PIEZOMETER NUMBER

Time	Volume Removed (gals)	Water Level ft. BTOC	Turbidity	Clarity/ Color	Temp °C	pH	Conductivity	Remarks
0935	~1			SLIGHTLY CLOUDY, NO ODOR	23.7	7.08	1330	MEASUREMENTS REPRESENT FIRST BAILER VOLUME.
0944	~2			BROWNISH	23.8	7.18	1360	SWL 37.83. SURGING WELL FOR ~10 MIN. IN-BETWEEN FIELD PARAMETERS
0954	~2.5			BROWNISH	24.5	7.26	1320	WATER SLIGHTLY/CLOUDY. NO ODOR
1006	3.5			BROWNISH	23.3	7.30	1320	WATER SLIGHTLY CLOUDY, NO ODOR
1018	4.5			BROWNISH	23.9	7.32	1310	SLIGHTLY CLOUDY, NO ODOR
1055	10			BROWNISH	23.6	7.32	1330	SLIGHTLY CLOUDY, NO ODOR REMOVED 5 gals IN [illegible] + WATER LEVEL DROPPED FROM 48.96 TO 57.45

FIGURE 5-4c

REV. DATE: MAY 1990

WELL DEVELOPMENT LOG

Well No.: AW4-02 Page 1 of ~~2~~ 1

Installation: **Sky Harbor** **Coordinates**

Site: 4 (Papago)

Project No.: 401221.02.06

Client/Project: HAZWRAP / Sky Harbor ANG

HAZWRAP Contractor: IT Corporation

Dev. Contractor: Layne Environ.

Dev. Start (10:45 a m) 2/1/91

Dev. End (16:00 p m) 2/1/91

Csg Dia.: 4-in I.D.

Developed by: Gardiner

Dev. Rig ([✓ Y] N)

Dev. Method SURGE w/ 4 WELL SWAB FOR 30 MINUTES; BAIL w/ 10 ft. (5 gal. BAILER) TO STABILIZED TURBIDITY, PH, TEMP, CONDUCTIVITY

Equipment Development Rig, PH/Conductivity Meter, Turbidity meter.

Pre-Dev. SWL 27.41 ft Maximum drawdown during pumping BAILED DRY ft at ___ gp

Range and Average Discharge rate ___ gp

Total quantity of material bailed ~ 500 ml to 1 liter of SAND/SILT; ~ 45 gal WATER

Total quantity of water discharged by pumping 0

Disposition of discharge water DRUMMED ON SITE NEAR DECON AREA AT PAPAGO

Time	Volume Removed (gals)	Water Level ft. BTOC	Turbidity	Clarity/ Color	Temp °C	pH	Conductivity	Remarks
1045	0	27.41						INITIAL.
1125	10		194	BROWN	26.2	7.02	930	—
1128	20		192	↓	26.2	7.33	940	
1130	27½		—		26.1	7.25	970	TURBIDITY METER
1132	31½		—	LT. BROWN	25.8	7.15	940	NOT FUNCTIONAL
1227	35		—	↓	26.7	7.36	980	↓
1305	37		—		26.5	7.31	990	
1340	39		—	VERY LT. BROWN	26.6	7.40	890	"
1435	42		—	"	26.4	7.38	910	"
1505	43½		—		26.5	7.43	960	"
1600	45		—	SLIGHTLY CLOUDY	26.3	7.43	950	"
1602	45½		—	"	26.2	7.45	940	"

BASED ON COLOR & AMOUNT of OPAQUENESS, TURBIDITY WAS PROBABLY REDUCED BY ABOUT ½ of STARTING VALUE.