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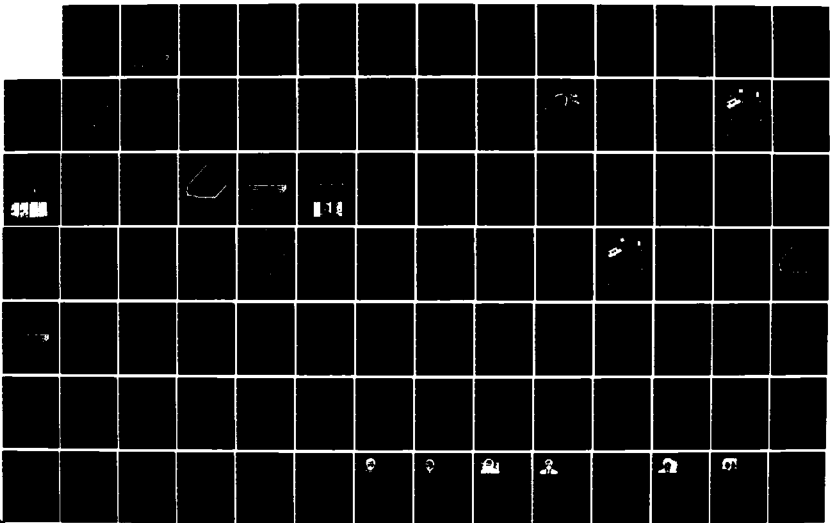

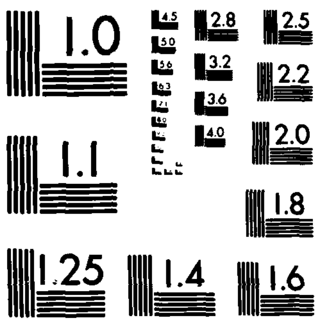
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Installation Restoration Program

AD-A151 808

Final Report
Phase II, Stage 1
Problem Confirmation Study
Luke Air Force Base
Glendale, Arizona

Prepared For:

United States Air Force
Occupational and Environmental Health Laboratory (OEHL)
Brooks Air Force Base, Texas

November 1984

WESTON
DESIGNERS CONSULTANTS

INSTALLATION RESTORATION PROGRAM
PHASE II - CONFIRMATION/QUANTIFICATION
STAGE 1

FINAL REPORT

FOR

LUKE AIR FORCE BASE
GLENDALE, ARIZONA

TACTICAL AIR COMMAND
LANGLEY AFB, VIRGINIA

PREPARED FOR

UNITED STATES AIR FORCE
OCCUPATIONAL AND ENVIRONMENTAL HEALTH LABORATORY (OEHL)
BROOKS AIR FORCE BASE, TEXAS 78235

NOVEMBER 1984

INSTALLATION RESTORATION PROGRAM
PHASE II - CONFIRMATION/QUANTIFICATION
STAGE 1

FINAL REPORT

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PREPARED BY

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WEST CHESTER, PA.

CONTRACT NO. F33615-80-D-4006

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BROOKS AIR FORCE BASE, TEXAS 78235

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PREFACE

The purpose of the Report is to document the accomplishment of the Phase II Stage 1, Problem Confirmation Study of the United States Air Force Installation Restoration Program (IRP) at Luke Air Force Base, Glendale, Arizona. This work was conducted by Roy F. Weston, Inc. under Contract Number F33615-80-D-4006, Task Order 0024.

Mr. Peter J. Marks is Program Manager for this Contract. Mr. Frederick Bopp III, Ph.D., P.G., managed this Task Order. Field work was supervised by Mr. John A. Williams. Laboratory analyses were accomplished at WESTON's Laboratory in West Chester, Pennsylvania, under the supervision of Dr. James S. Smith and Dr. Theodore F. Them. Roy F. Weston, Inc. wishes to acknowledge 1 Lt. Henry J. Thompson, Jr., USAF, BSC, Luke AFB Bioenvironmental Engineer, and Mr. John Forrest of the Luke AFB Civil Engineering staff for their kind assistance in conducting this project.

This work was accomplished during the period September, 1983 and August, 1984. Major Dennis D. Brownley, USAF, BSC, Technical Services Division, USAF Occupational and Environmental Health Laboratory (USAF OEHL/TS) was the Technical Monitor.

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EXECUTIVE SUMMARY

ES 1.0 INTRODUCTION

Roy F. Weston, Inc. (WESTON) was retained by the U.S. Air Force Occupational and Environmental Health Laboratory (OEHL) under Contract No. F33615-80-D-4006 to provide general engineering, hydrogeological and analytical services. These services were applied to the Installation Restoration Program (IRP) Phase II effort at Luke Air Force Base under Task Order 0024 of this contract.

In 1976 the Department of Defense (DoD) devised a comprehensive IRP. The purpose of the IRP is to assess and control the migration and potential migration of hazardous environmental contamination that may have resulted from past operation and disposal practices on DoD facilities. In response to the Resource Conservation and Recovery Act of 1976 (RCRA) and in anticipation of the Comprehensive Environmental Response Compensation and Liability Act of 1980 (CERCLA or "Superfund"), the DoD issued a Defense Environmental Quality Program Policy Memorandum (DEQPPM) dated June, 1980 (DEQPPM 80-6), requiring identification of past hazardous waste disposal sites on DoD agency installations. The U.S. Air Force implemented DEQPPM 80-6 by message in December, 1980. The program was revised by DEQPPM 81-5 (11 December 1981) which reissued and amplified all previous directives and memoranda on the IRP. The Air Force implemented DEQPPM 81-5 by message on 21 January 1982. The Installation Restoration Program has been developed as a four-phase program as follows:

- Phase I - Problem Identification/Records Search
- Phase II - Problem Confirmation and Quantification
- Phase III - Technology Base Development
- Phase IV - Corrective Action

Only the Phase II Problem Confirmation Stage (Stage 1) portion of the IRP effort at Luke Air Force Base was included in this Task Order.

ES 2.0 Scope of Work

Luke Air Force Base (LAFB) assigned to the Tactical Air Command (TAC), occupies 4,198 acres of land in Maricopa County, Arizona, 13 miles west of downtown Phoenix. Since the start of operations in 1941 as a World War II fighter pilot training facility, activities at LAFB in support of operational missions have resulted in the occurrence on the installation of several waste disposal sites of potential environmental concern.

The field investigation conducted under Task Order 0024 included four sites, as listed below:

- Site No. 6, South Fire Department Training Area
- Site No. 5, Waste POL Disposal Trenches
- Site No. 4, Perimeter Road Waste POL Application Area
- Site No. 7, North Fire Department Training Area

Locations of each of these sites on LAFB are shown in Figure S-1.

The scope of the investigation included: four soil samples at Site No. 6 (South Fire Department Training Area); ten soil borings, with continuous soil sampling to 20 feet, at Site No. 5 (Waste POL Disposal Trenches); eight soil borings to 2 feet at Site No. 4 (Waste POL Application Area), four soil borings, with continuous soil sampling to 20 feet, at Site No. 7 (North Fire Department Training Area); and water quality samples at all active Base production wells. All soil and water samples selected for analysis were analyzed at WESTON's laboratory facilities located in West Chester, Pennsylvania, and Stockton, California, and were analyzed in accordance with Standard USEPA Analytical Protocols.

ES 3.0 Major Findings

The major findings of this Phase II Confirmation Stage (Stage 1) Study may be summarized as follows:

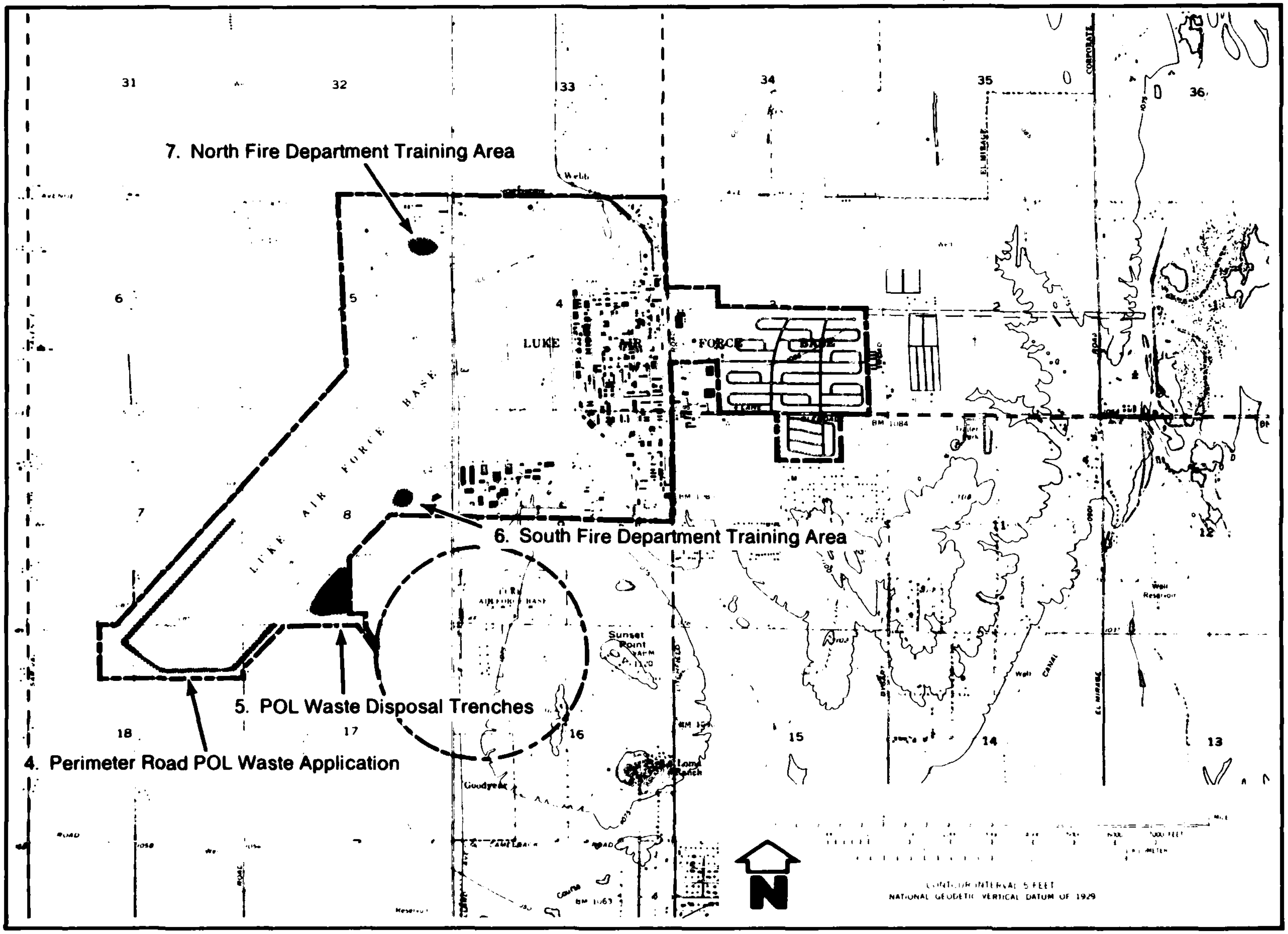

FIGURE S-1 LOCATIONS OF ALL POTENTIAL SOURCES OF CONTAMINATION RECEIVING PHASE I HARM SCORE RANKINGS

- At Site No. 6 (South Fire Department Training Area), levels of oil and grease (as defined by extraction in Freon 113) were high in two of the samples analyzed. All four samples showed visual evidence of oil staining, but even the two high oil and grease concentrations detected represent only between 1.5 and 3.7 percent of the soil by weight. These data, combined with the very low VOA concentrations detected, indicated that any solvent and fuel residues remaining from previous fire-training exercises have weathered extensively in the desert environment at LAFB. This weathering, coupled with the Major Construction Program (MCP) plan to cap the entire site with concrete construction slabs and macadam parking lots, indicates that the low levels of fuel and solvent residues remaining at the site probably will not be subject to any forces, such as infiltration of precipitation, which would induce vertical migration of contaminants deeper into the subsurface.

- At Site No. 5 (Waste POL Disposal Site), Freon 113 extractable oil and grease was uniformly in the low part per million range in all samples analyzed. Lead concentrations were fairly uniform in all samples ranging from 0.053 to 0.304 parts per million. Only five VOA compounds were detected in only half of the samples, with the maximum concentration found of 0.200 parts per million for chloroform. The most common VOA compound found was chloroform, present in five of the samples. The very low levels of oil and grease and VOA compounds indicate that the weathering process employed by the Air Force at this site was effective in devolatilizing the emplaced fuels prior to burial. The net impact of disposal of POL wastes at this site appears to be minimal.

- At Site No. 4 (Perimeter Road Waste POL Application Area), Freon 113 extractable oil and grease was uniformly in the low part per million range in all samples analyzed. Only six VOA compounds were detected in 7 of the 11 samples, with a maximum concentration found of 0.040 parts per million of 1,1-dichloroethylene. The most common VOA compound found was 1,1-dichloroethylene, found in all 7 of the samples containing VOA compounds. The very low level of oil and grease and VOA compounds indicates that weathering of sprayed fuels and solvents by the prevailing desert conditions at LAFB was effective in devolatizing the contaminants. The net impact of dust palliative spraying of waste fuels and solvents at this site appears to be minimal.

- At Site No. 7, (North Fire Department Training Area) Freon 113 extractable oil and grease occurred over a wide range of concentrations which covaried markedly with elevated HNu readings. Oil and grease levels are lower than the highest levels attained at the South Fire Department Training Area. Some oil stained samples were available, but not selected for analysis since the purpose of sample analysis was to detect vertical migration of contaminants away from the obvious oil-staining. Elevated oil and grease levels were detected to depths as much as 19 feet below the surface. This fact, combined with the failure to detect a caliche layer in any of the borings, indicates that the potential exists for downward migration of contaminants to occur. Eleven VOA compounds were detected, and all 12 soil samples contained at least one VOA compound. The most common VOA compound found was 1,1-dichloroethylene, found in all but 2 of the samples. The highest VOA concentrations detected were for chloroform, with concentrations ranging from 0.320 to 0.800 parts per million. VOA compounds were found at various depths in the four borings, but the detection of elevated chloroform levels in 3 samples below 9 foot depths confirms that fuels and solvents emplaced at the Site are migrating vertically to depths greater than those sampled.

- For Base production wells, the pesticide dibromochloropropane(DBCP) was detected at the limit of detection in only one well, Well No. 10. This well is located near the northeast boundary of LAFB, and it might be expected to be impacted by pesticide usage on adjacent farm fields. Analysis for lead was required only on Well No. 121, adjacent the POL Waste Disposal Trenches site - lead was not detected at a detection limit equivalent to the Federal and State Safe Drinking Water Standard of 0.05 parts per million. Neither oil and grease nor phenol were detected in the three wells required to be analyzed. Four radiological parameters were analyzed on Well No. 4, located in the Waste Treatment Annex - only gross beta and gross gamma activities were detected at levels of 34±4 and 38 ±4 picocuries per liter, respectively. No data has yet been located which would indicate whether or not such activities are typical of background water quality in the area. VOA analyses were performed on three wells, and only in Well No. 10 were significant levels of any VOA compounds detected. Well No. 10 is located adjacent to both Site No. 7, the North Fire Department Training Area, and the current Fire Department Training Area. The 1,2-dichloroethane detected at 0.0108 ppm in Well No. 10 was also found at low levels in five of the soil samples from the North Fire Department Training Area, but the (Trans)-1,2-dichloroethylene detected at 0.100 ppm in Well No. 10 was not found in any of the North Fire Department Training Area samples. The source of the two VOA contaminants in Well No. 10 remains unidentified, but the two nearby Fire Training Areas must be considered as potential sources.

ES 4.0 CONCLUSIONS

Based upon the Confirmation Study being conducted, the following conclusions were drawn:

- Shallow soil conditions determined at LAFB indicate that levels of potential contaminants are low at most sites. The exception to this conclusion is Site No. 7, the North Fire Department Training Area, where VOA contaminants were detected at higher levels and deeper depths than at the other sites. No caliche layer was detected at Site No. 7.

- Water quality testing was done only on Base production wells, and water quality data for the species tested are generally good. The exceptions to this conclusion are Wells No. 4 and 10, where the concentrations of 1,2-dichloroethane were 0.0014 and 0.0108 parts per million, respectively.

- Well No. 10 is located adjacent to Site No. 7, the North Fire Department Training Area, and the potential exists that solvents detected in Well No. 10 are from either the North Fire Department Training Area or from the Current Fire Department Training Area.

- Site No. 7, the North Fire Department Training Area, as well as the Current Fire Department Training Area (located about 200 yards east of Site No. 7) should be subjected to additional evaluation in order to ascertain the source or sources of VOA compounds in Production Well No. 10.

ES 5.0 RECOMMENDATIONS

Based upon the Stage 1 Study conducted at LAFB, the following Recommendations are made.

ES 5.1 Base Production Wells - Recommendations

1. All Base Production Wells should be resampled and subjected to verification analyses for VOA compounds, pesticides (DBCP) and radionuclides (gross alpha, beta and gamma activities), at a minimum. Oil and grease analyses should also be run.

2. Based upon the results of the verification analyses, the Base should consider implementing a routine, quarterly water quality monitoring program for all Base Production Wells for these analytes.

ES 5.2 Current and North Fire Department Training Area - Recommendations

1. Based upon the results of the verification analyses, additional soil borings in the vicinity

of both Fire Department Training Areas are recommended. Four soil exploratory borings are recommended to be drilled to depths of 100 feet each, two at each of the two Areas. Soils should be sampled at 5-foot intervals, and should be analyzed for oil and grease and VOA compounds, in order to define the vertical extent of soil contamination.

2. If soil contaminants are found at the 100-foot level in any of the borings, then two downgradient monitor wells are recommended to be drilled - one between the North and Current Fire Department Training Areas, and one between the North Fire Department Training Area and the cluster of Base Production Wells at the northwestern corner of the Base. These wells should be sampled and analyzed for oil and grease and VOA compounds, at a minimum.

3. A Concept Engineering Evaluation of the two sites should be conducted in order to a) identify the broadest possible spectrum of potentially appropriate remedial actions, and b) make recommendations as to proper reconstruction and operation of the Current Fire Department Training Area, in order that continued use of the Site will not provide a continuing source of potential groundwater contaminants.

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SECTION 1

INTRODUCTION

1.1 INSTALLATION RESTORATION PROGRAM

In 1976 the Department of Defense (DoD) devised a comprehensive Installation Restoration Program (IRP). The purpose of the IRP is to assess and control the migration and potential migration of hazardous environmental contamination that may have resulted from past operations and disposal practices on DoD facilities. In response to the Resource Conservation and Recovery Act of 1976 (RCRA) and in anticipation of the Comprehensive Environmental Response Compensation and Liability Act of 1980 (CERCLA or "Superfund"), the DoD issued a Defense Environmental Quality Program Policy Memorandum (DEQPPM) dated June, 1980 (DEQPPM 80-6), requiring identification of past hazardous waste disposal sites on DoD agency installations. The U.S. Air Force implemented DEQPPM 80-6 by message in December, 1980. The program was revised by DEQPPM 81-5 (11 December 1981) which reissued and amplified all previous directives and memoranda on the IRP. The Air Force implemented DEQPPM 81-5 by message on 21 January 1982. The Installation Restoration Program has been developed as a four-phase program as follows:

Phase I - Problem Identification/Records Search
Phase II - Problem Confirmation and Quantification
Phase III - Technology Base Development
Phase IV - Corrective Action

1.2 PROGRAM HISTORY AT LUKE AIR FORCE BASE

Roy F. Weston, Inc. (WESTON) has been retained by the United States Air Force Occupational and Environmental Health Laboratory (OEHL) under Contract Number F33615-80-D-4006, to provide general engineering, hydrogeological and analytical services. The Phase I, Problem Identification/Records Search for Luke Air Force Base (LAFB) was accomplished by CH2M Hill in late 1981 and early 1982, and their Final Report was dated February 1982. In response to the findings contained in the CH2M Hill Phase I Final Report, the OEHL issued Task Order 0012 to WESTON, directing that a pre-survey site inspection be conducted at LAFB. The purpose of this pre-survey was to obtain sufficient information to develop a work scope and cost estimate for the conduct of a Phase II, Problem Confirmation Stage (Stage 1) Study at LAFB. The Pre-Survey Report was submitted in December 1982.

Task Order 0024 was issued on 12 September 1983, ordering a Phase II Problem Confirmation Stage (Stage 1) Study for the four sites at LAFB. A copy of the formal Task Order and technical scope of work are included here as Appendix B.

On 7 November 1983, WESTON personnel met with representatives of LAFB to review the goals of the investigation, contact LAFB security and staff responsible for site access and safety, and discuss drilling procedures, locations and schedules. Exploratory drilling was initiated on 9 November and was completed by 17 November 1983. Sampling of all active LAFB production wells was conducted on 17 November 1983. This report documents the procedures and findings of the Phase II Problem Confirmation Stage (Stage 1) investigation.

1.3 BASE PROFILE

Luke Air Force Base (LAFB), assigned to the Tactical Air Command (TAC), occupies 4,198 acres of land in Maricopa County, Arizona, 13 miles west of downtown Phoenix. The cities of Sun City, Sun City West, and Litchfield Park are located northeast, north, and south respectively, of the Base. The White Tank Mountains are located west of the Base. Figure 1-1 is an index map showing the location of LAFB. Luke Air Force Base also supports the following off-site facilities:

1. Gila Bend Air Force Auxiliary Field
2. Luke Air Force Range
3. Auxiliary Field No. 1 (now closed)
4. Holbrook Radar Bomb Scoring Range
5. Fort Tuthill Recreation Annex
6. Sanitary Landfill Annex
7. Waste Treatment Annex
8. Humbolt Mountain Radar Site.

Construction at LAFB began in March of 1941 after the land had been acquired from the City of Phoenix. Occupation of the base took place in June of 1941 with the primary purpose of providing advanced flight training to fighter pilots. In November of 1946, the base was deactivated after having trained 17,000 pilots over a 5-year period. The Gila Bend Gunnery Range, a major part of the training operation, remained open, but was operated by Williams AFB near Chandler,

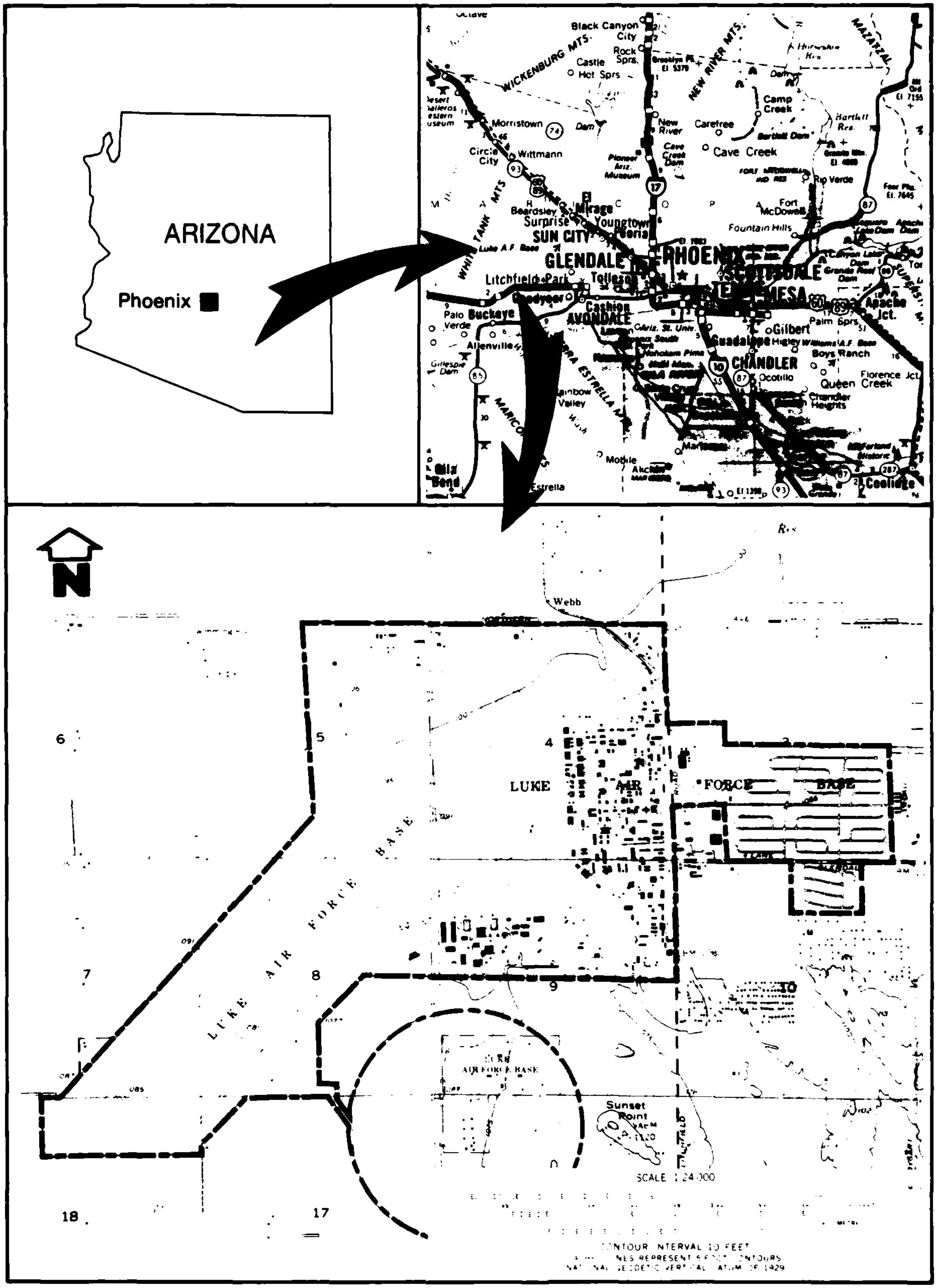

FIGURE 1-1 INDEX MAP SHOWING THE LOCATION OF LUKE AFB

Arizona. With the onset of the Korean War, LAFB was re-opened in February of 1951, again to provide advanced flight training. The Base was transferred from Air Training Command (ATC) to Tactical Air Command (TAC) in July of 1958. In December of 1980, the 832nd Air Division replaced Tactical Training Luke (TTL) to become the current host of LAFB. The primary mission of the unit today is to provide command supervision of the F-16 training program of the 58th Tactical Training Wing and of the F-15 and F-5 programs of the 405th Tactical Training Wing.

Past Air Force activities at LAFB in support of operational missions have resulted in the occurrence at the base of several waste disposal sites of potential concern. Each of these sites was rated by CH2M Hill during the Phase I activities in accordance with the IRP Hazard Assessment Rating Methodology (HARM). The results of these ratings are summarized in Table 1-1 (modified from the CH2M Hill report). Based upon these ratings and all other pertinent data, CH2M Hill recommended that Phase II activities concentrate only on Site No. 5, the Waste POL Disposal Trenches. Task Order 0024 required evaluation of the four sites shown in Table 1-1. The locations of the sites are shown on Figure ES-1. Following is a discussion of each of those sites.

1.3.1 Site No. 6 South Fire Department Training Area

The South Fire Department Training Area is located in the south central portion of the Base between Facility 999 and "N" Street. This site was the original fire department training area and was used from 1941 until deactivation of the Base in 1946, and again from the time of Base reactivation in 1951 until approximately 1963. Training exercise fires were fueled by a mixture of flammable liquids including waste POL products generated by the Base. The waste was poured onto an old aircraft or simulated aircraft in a cleared circular area approximately 100 feet in diameter and then ignited. Surface drainage from the site is southerly through erosional gullies into man-made drainageways.

Figure 1-2 is a general site map for Site No. 6, and shows the actual location of Site No. 6 as discovered from historical aerial photographs. It should be noted that this area

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Table 1-1

PRIORITY RANKING OF POTENTIAL CONTAMINATION SOURCES

Priority Ranking	Site No.	Site Description	HARM Score
1	6	South Fire Department Training Area	69
2	5	Waste POL Disposal Trenches	68
3	4	Perimeter Road Waste POL Application Site	64
4	7	North Fire Department Training Area	62

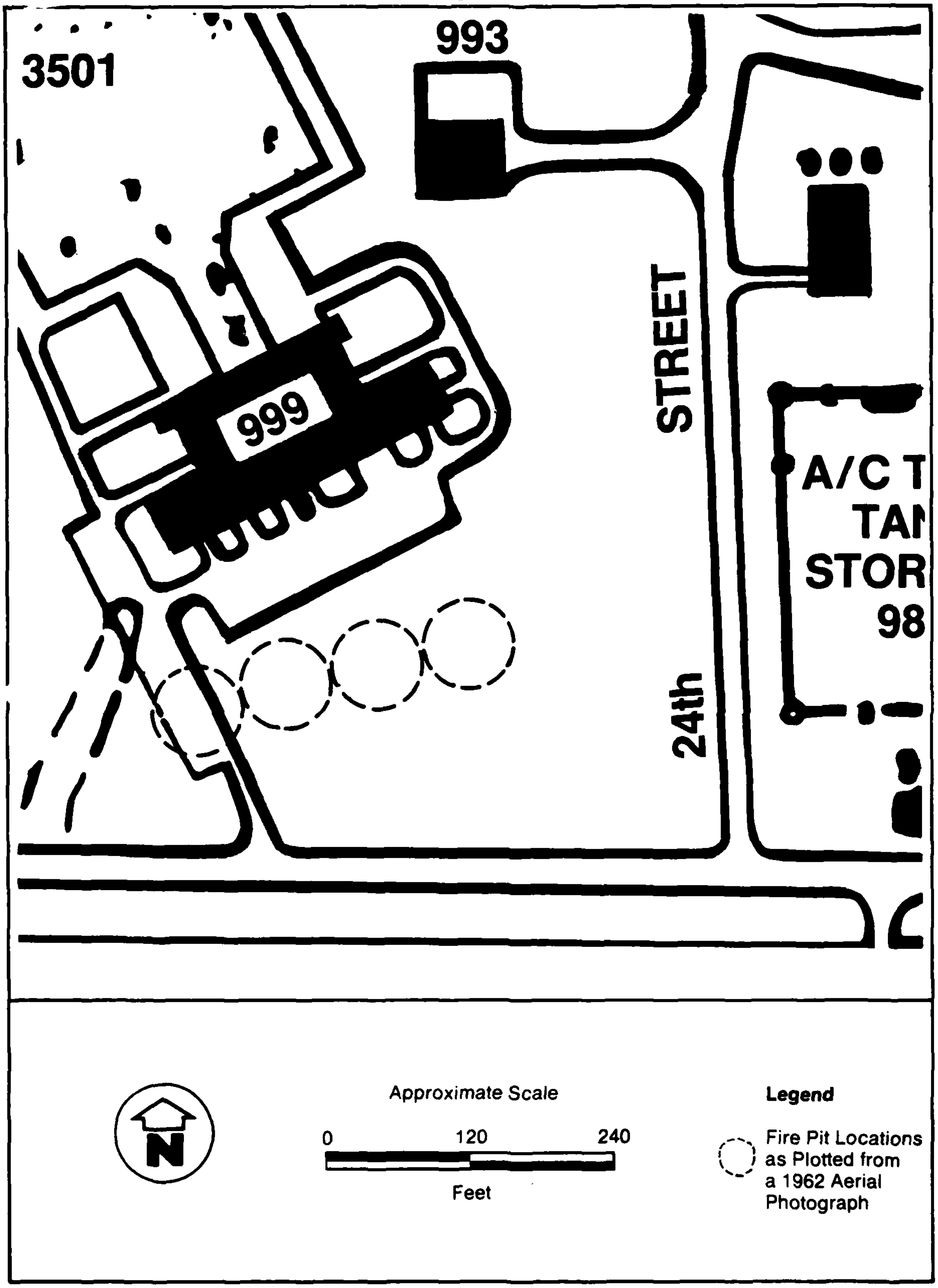


FIGURE 1-2 GENERAL SITE MAP FOR SITE NO. 6
(SOUTH FIRE DEPARTMENT TRAINING AREA)

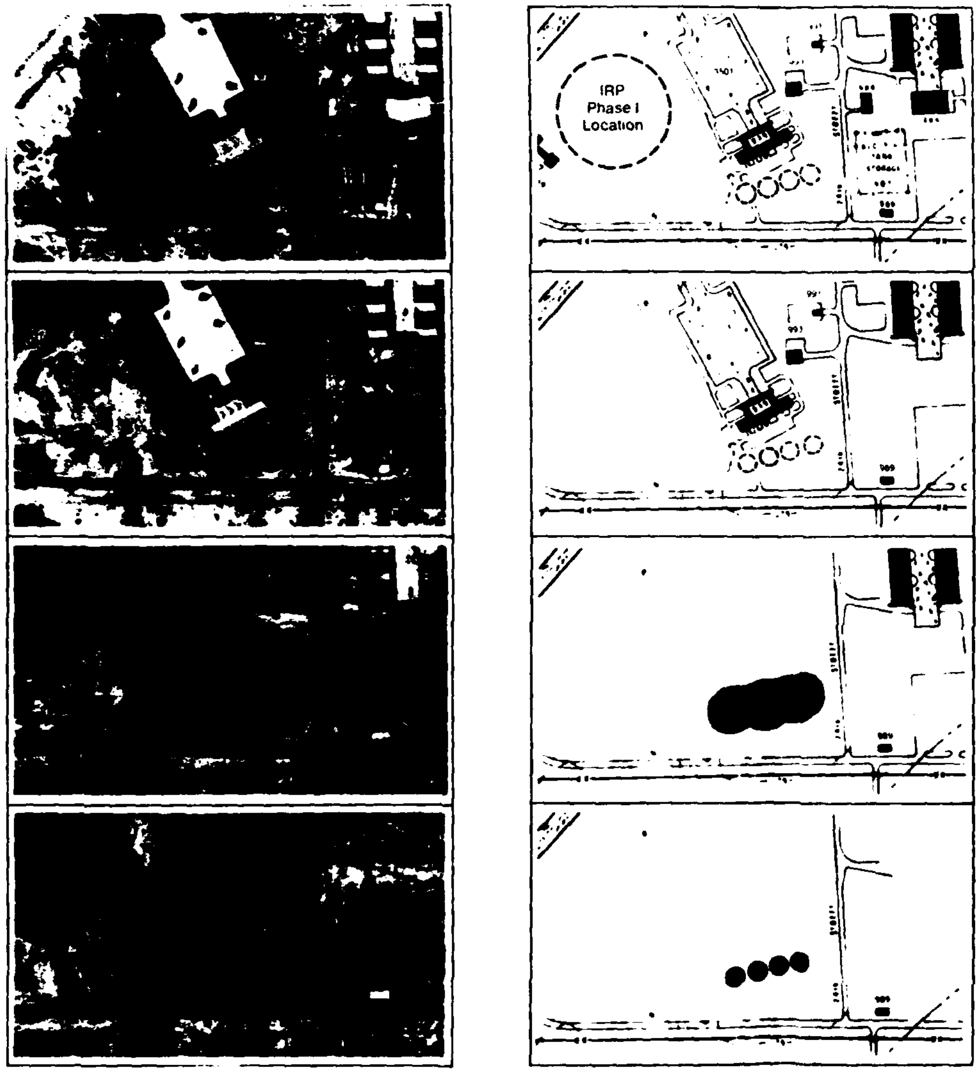
is located approximately two hundred yards east of the location shown in the IRP Phase I Report. A sequence of four aerial photographs taken at seven year intervals between 1962 and 1983 are shown in Figure 1-3. Four distinct circular fire pits are evident in the 1962 aerial photograph. As seen in the 1983 aerial photograph, it is apparent that earth moving and weathering processes have eliminated all previously existing surficial evidence of the now defunct fire pits. Construction of a new Air Force Reserve facility is currently underway, and excavations had re-exposed the residues of past fire training exercises. The site was not, however, accessible to drilling equipment, due to the construction in-progress and construction contractor concerns for schedules and liabilities.

1.3.2 Site No. 5, Waste POL Disposal Trenches

Site No. 5, referred to as the POL Waste Disposal Trench Site, is situated south of Building 1013 (Pump House, Well #11) and southeast of the power check pool (Facility 3640) as noted on the general site map shown in Figure 1-4. The site was used for the disposal of Base-generated waste POL products from 1970 through 1972. The liquid waste was distributed by tanker truck over the site in shallow trenches from 1 to 1.5 feet deep. The waste was left to weather for from four to six weeks, after which the trenches were backfilled and any residual product left from the weathering process covered. A reported shallow lagoon formerly located at the northeast corner of the site was also used. At present, this lagoon area is used to store asphalt rubble from an aircraft taxiway demolished in 1979. There is no surficial evidence of the location of the lagoon and the site is not accessible for subsurface evaluations. An estimated volume of 100,000 gallons per year, mostly waste JP-4 fuel, may have been dispersed at this site. Surficial expressions of two of the trenches were evident on the northeastern portion of the site, and analysis of the only available aerial photo of the site indicated the trench locations shown on Figure 1-4.

1.3.3 Site No. 4, Perimeter Road Waste POL Application Site

Site No. 4 encompasses the portion of a south perimeter road beginning approximately 200 feet north of Facility 1080 and running southwest to west around the southern portion of the runway, then turning northeast before terminating immediately



A 1982 aerial photograph showing the expected location of the Fire Training Area from the Phase I Report, and the location of the Major Construction Program (MCP) for the Air Force Reserve lying directly over top of the former Fire Training Pits

B 1976 aerial photograph showing that earthmoving for construction of facilities 999 and 3501 had obliterated all surficial evidence of the location of the former Fire Pits.

C. 1969 aerial photograph showing the four abandoned Fire Pits and the onset of weathering and revegetation

D 1962 aerial photograph showing four distinct circular Fire Pits

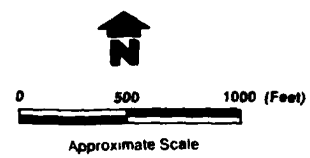


FIGURE 1-3 AERIAL PHOTOGRAPH ANALYSIS SHOWING HISTORICAL DEVELOPMENT OF SITE NO. 6, THE SOUTH FIRE DEPARTMENT TRAINING AREA

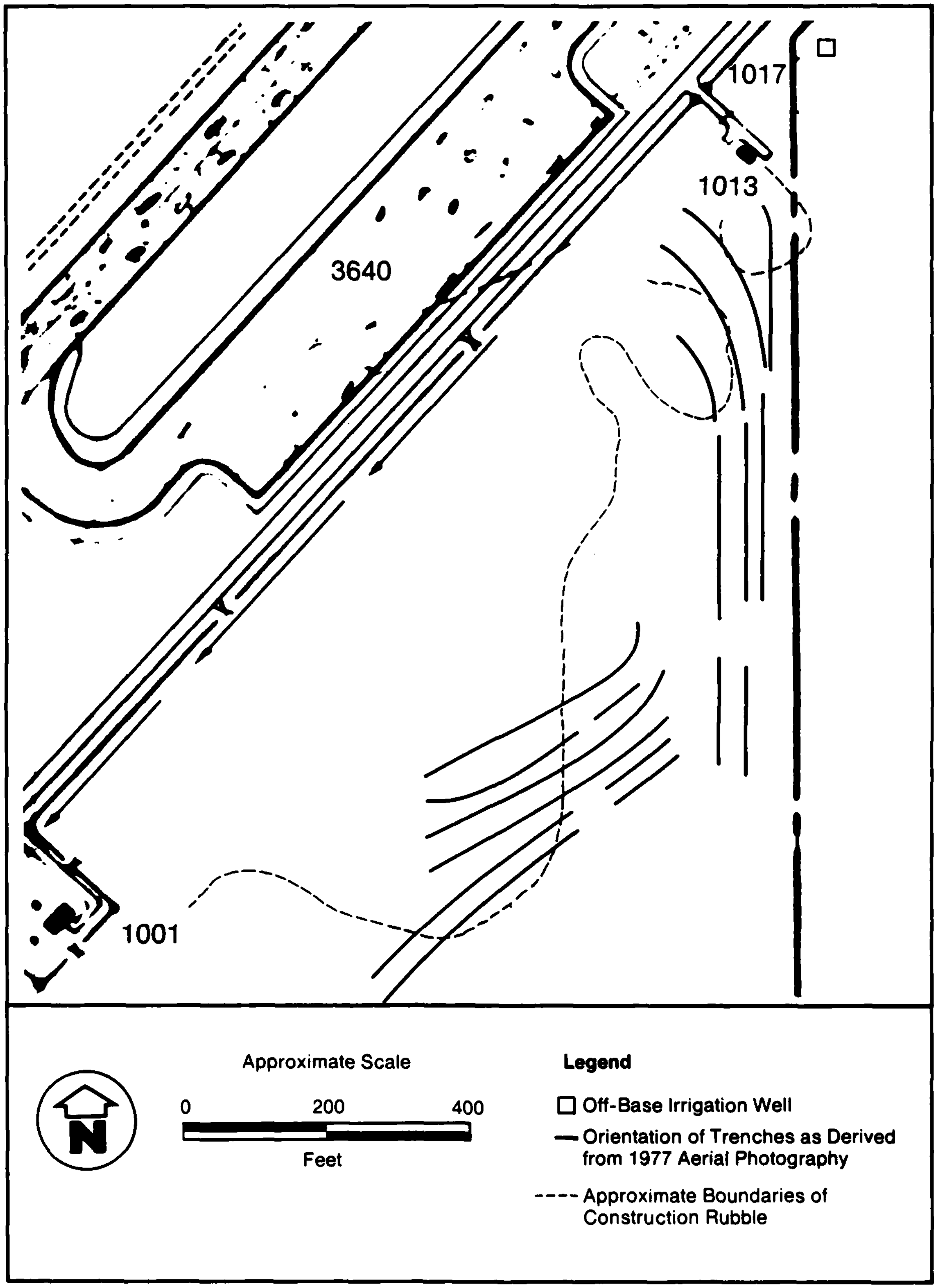


FIGURE 1-4 GENERAL SITE MAP FOR SITE NO. 5 POL WASTE DISPOSAL TRENCHES

adjacent to Facility 1082. A general site map of this unpaved road is shown in Figure 1-5.

This site was used for disposal of POL wastes from 1951 until approximately 1970. The POL waste generated from Base operations was collected on a weekly basis. A tanker truck collected the wastes from various holding tanks and drum storage areas located throughout the Base, and then spread the POL waste on the dirt perimeter road around the runway at the western portion of the Base. This "road oiling" procedure served a two-fold purpose: 1) to dispose of the POL waste and 2) as an effective palliative method to control excessive road dust which is hazardous to flight operations. Prior to 1954, the total volume of POL waste generated by the Base was small enough to be disposed of in fire department training exercises. After 1954, the total volume of POL waste increased significantly, due mainly to contaminated JP-4 from assigned F-104 and F-4 jet aircraft. Up to 50,000 gallons per year of POL waste may have been disposed of on the perimeter road. The majority of this POL waste consisted of contaminated JP-4, but some AVGAS, MOGAS, diesel fuel, waste engine oils, and waste solvents may also have been included.

1.3.4 Site No. 7, North Fire Department Training Area

This site, as shown on Figure 1-6 is located in the northern portion of the Base, west of the current Facility 1356 fire department training area. The site was used from approximately 1963 until 1973. Training exercises were conducted in this area in a fashion similar to that previously discussed in Section 1.3.1. Surficial site characteristics show evidence of past fires. Scorch marks within a gravel and dirt circle mark the locations of defunct fire training pits. The location of these areas as shown in historical aerial photographs are plotted on Figure 1-7. There is also surficial evidence of historical fuel spillage in the general area. The site is characteristically flat , exhibiting little or no topographic relief.

1.4 CONTAMINATION PROFILE

No large scale industrial operations generating large quantities of hazardous waste have been conducted at LAFB in the past. The generation of waste oils and solvents from cleaning and painting operations has been small in comparison to other Bases having significant industrial aircraft maintenance or overhaul missions. Interviewees from the Base indicated that up to 50,000 gallons per year of POL waste was disposed of at Site No. 4 on the south perimeter road from 1951 to approximately 1970, and volumes in excess of 100,000

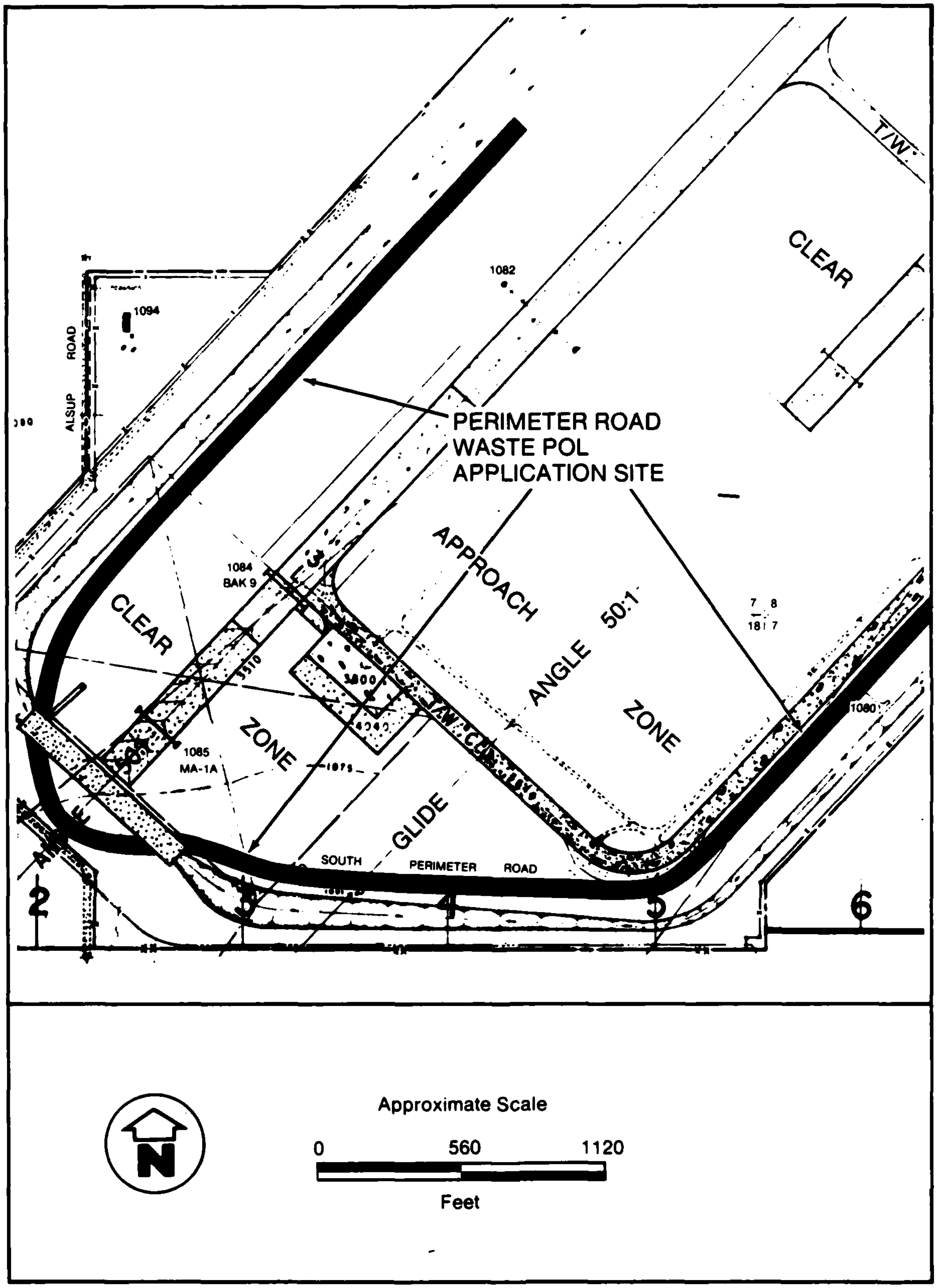


FIGURE 1-5 GENERAL SITE MAP FOR SITE NO. 4 PERIMETER ROAD WASTE POL APPLICATION SITE

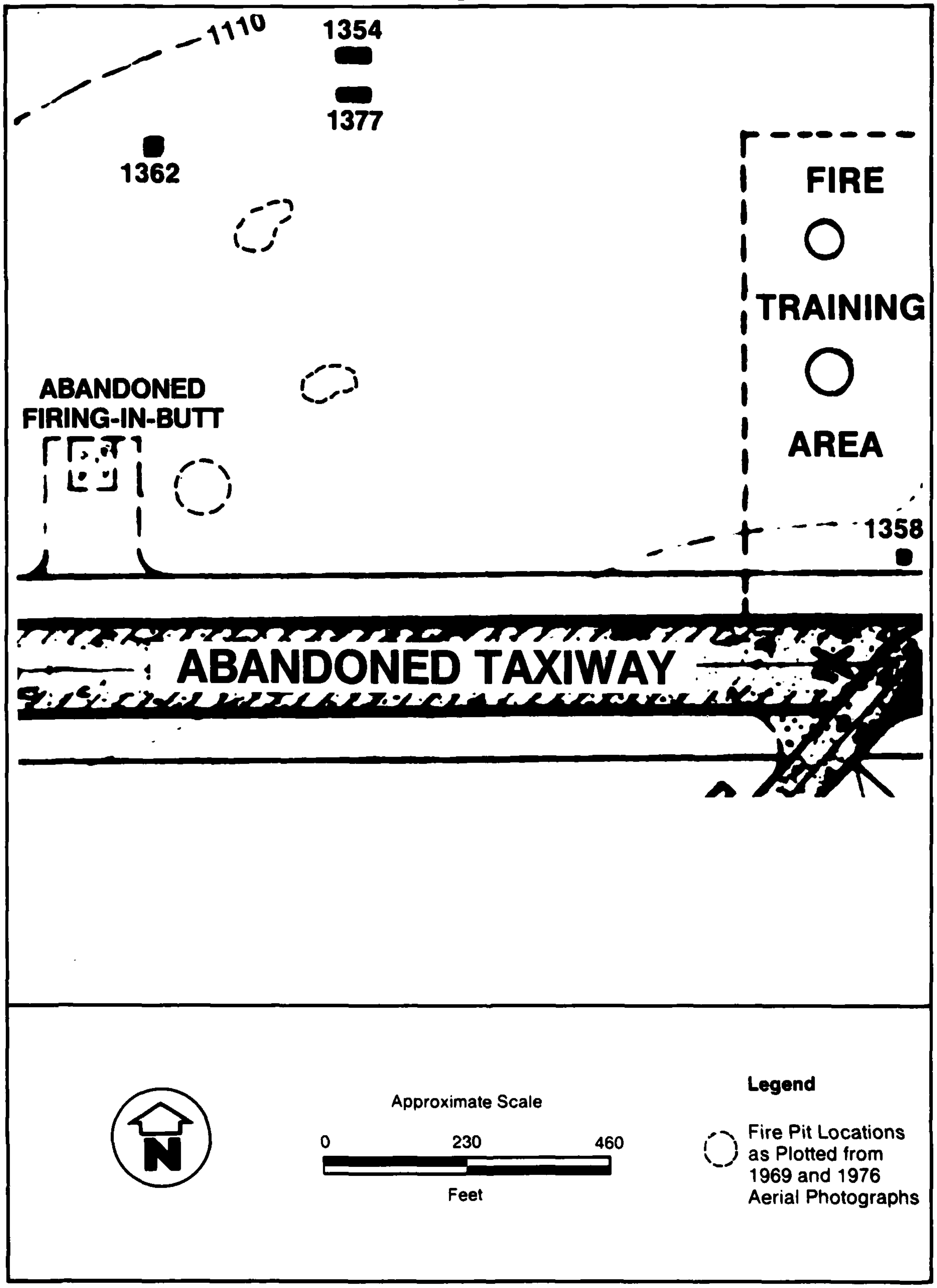
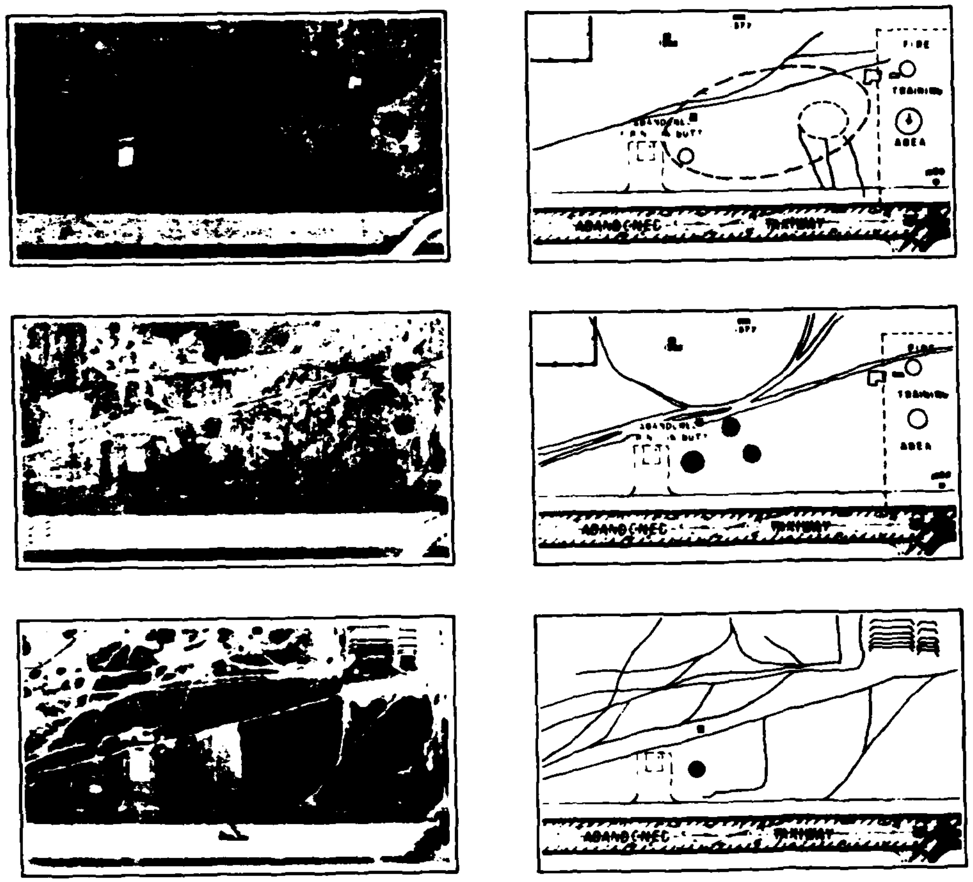


FIGURE 1-6 GENERAL SITE MAP FOR SITE NO. 7, NORTH FIRE DEPARTMENT TRAINING AREA



A: 1982 aerial photograph showing the current site configuration. The Phase I Report indicated the location of the site as being with the oval area outlined in long dashes. Surficial evidence of fairly intensive fuel spillage exists within the cicular area outlined in short dashes.

B: 1976 aerial photograph showing weathering effects and reestablishing vegetation at the old North Fire Department Training Area. Two additional potential Fire Training Pits can be seen east of the main pit.

C: 1969 aerial photograph showing the location of the North Fire Department Training Area

N

0 500 1000 (Feet)

Approximate Scale

FIGURE 1-7 AERIAL PHOTOGRAPH ANALYSIS SHOWING HISTORICAL DEVELOPMENT OF SITE NO. 7, THE NORTH FIRE DEPARTMENT TRAINING AREA

gallons per year of POL waste (mostly JP-4) were disposed of at the Site No. 5 POL Disposal Trenches between 1970 and 1972. Smaller quantities of combustible waste were burned in fire training exercises conducted at Fire Training Sites No. 6 and No. 7. It is suspected that pesticides have been introduced into the soils through extensive agricultural operations from farms adjacent to the north, west and south Base boundaries. Based on the Phase I Records Search Report, the key chemical parameters of most potential concerns at LAFB are oils and grease, phenol, pesticides and volatile organics.

To develop an initial determination of whether or not past operation and disposal practices have adversely impacted the environment, soils and groundwater in and around the four sites were sampled and analyzed for the parameters listed in Table 1-2. The details of the field investigation are reported in Section 3, and results of the sample analysis are reported in Section 4 of this report.

1.5 PROJECT TEAM

The Phase II Confirmation Stage (Stage 1) Study at LAFB was conducted by staff personnel of Roy F. Weston, Inc. and was managed through WESTON's home office in West Chester, Pennsylvania. The following personnel served lead functions in this project:

MR. PETER J. MARKS, PROGRAM MANAGER: Corporate Vice President and Manager of Laboratory Services, Master of Science in Environmental Scien~ (M.S.), 18 years of experience in laboratory analysis and applied environmental sciences.

MR. FREDERICK BOPP, III, PH.D., P.G., PROJECT MANAGER: Doctor of Philosophy (Ph.D.) in Geology and Geochemistry, Registered Professional Geologist (P.G.), over 8 years of experience in hydrogeology and applied geological science.

MR. WALTER M. LEIS, P.G., GEOTECHNICAL QUALITY ASSURANCE OFFICER: Corporate Vice President and Manager of the Geosciences Department, M.S. in Geological Sciences, Registered Professional Geologist, over 10 years of experience in hydrogeology and applied geological services.

MR. JAMES S. SMITH, PH.D., LABORATORY QUALITY ASSURANCE OFFICER: Ph.D. in Chemistry, over 16 years of experience in laboratory analysis.

Table 1-2

Analytical Protocol

Site	Potential Contaminant	Sample Medium	Analytes
Site No. 6 South Fire Department Training Area	Petroleum Products Spent Solvents	Soils	Oil & Grease VOA Compounds
Site No. 5, POL Waste Disposal Trenches	Petroleum Products Leaded Petroleum Sludges Spent Solvents	Soils	Oil & Grease VOA Compounds Lead
Site No. 4, Perimeter Road Waste POL Application Site	Petroleum Products Spent Solvents	Soils	Oil & Grease VOA Compounds
Site No. 7, North Fire Department Training Area	Petroleum Products Spent Solvents	Soils	Oil & Grease VOA Compounds
Wells Nos. 1, 7 & 12	Pesticides	Ground-water	DBCP Oil & Grease
Well No. 4	Pesticides Radio Isotopes Spent Solvents	Ground-water	DBCP Oil & Grease VOA Compounds Phenols Gross Alpha Gross Beta Radium 226
Well No. 8,9,10	Pesticides Spent Solvents	Ground-water	DBCP VOA Compounds Oil & Grease
Well No. 11	Pesticides Spent Solvents Leaded Petroleum Sludges	Ground-water	DBCP VOA Compounds Oil & Grease Lead

Professional profiles of these key personnel, as well as other project personnel, are contained in Appendix C.

1.5.1 Subcontracting

The drilling phase of the Confirmation Stage (Stage 1) Study at LAFB was performed by Western Technologies, Inc. of Phoenix, Arizona under contract to Roy F. Weston, Inc. All soil borings were drilled under direct supervision in the field by a WESTON geologist.

1.6 FACTORS OF CONCERN

Factors of concern should be highlighted at the outset of this Confirmation Study Report, which the reader should consider in the review of subsequent sections.

- LAFB overlies an extensively developed and over-pumped aquifer. Water levels in this aquifer have declined by over 300 feet at LAFB over the past years. Major water use in the area is for agricultural irrigation, but at this time groundwater is the sole source of potable water in LAFB. Surface water from the Central Arizona Project (CAP) is available to the Base, but at a significantly higher cost than that of groundwater. Any contamination introduced into the aquifer by either on-base or off-base activities could have far-reaching impacts upon the available supplies of potable water which currently support the Base mission at LAFB.

SECTION 2

ENVIRONMENTAL SETTING

2.1 REGIONAL GEOLOGY

Luke Air Force Base is located within the Sonoran Desert section of the Basin and Range physiographic province. The province, in general, is characterized by north to northwest-trending isolated mountain ranges separated by desert plains. The Sonoran Desert section consists of more desert plain than mountains, and the ranges are generally low and narrow comprising less than one-fourth of the area of this section. The Base rests on a broad alluvium-filled valley within the western portion of Phoenix Basin, and is surrounded on three sides, north, south and west, by highland bedrock mountain ranges. The White Tank Mountains lie approximately 8 miles west of Luke, while the Sierra Estrella lie 12 miles to the south, and the Hieroglyphic Mountains lie about 15 miles to the north. The rocks forming the mountains are predominantly granites, gneisses and schists of Precambrian age, overlain locally by volcanic and sedimentary rocks of Tertiary Age.

The history of mountain building and sedimentation in the area of Luke is long, quite complex and much of it well beyond the scope of IRP concerns. However, by the beginning of the Tertiary time, approximately 67 million years ago, the mountains were in a state of uplift, and the Phoenix Basin was subsiding. Fresh water runoff from the uplifting mountains carried eroded sediments into the subsiding Basin, resulting in the thick valley-fill sequence comprising the subsurface at Luke today. For the most part, the coarse-grained sediments were deposited in stream channels crossing the subsiding Basin. Along the margin of the White Tank Mountains, some coarse-grained materials were spread out from the mountains basinward by smaller streams. In areas outside of the channels where circulation was restricted, fine-grained sediments, including shallow-water lacustrine deposits, were laid down. Locally, evaporites are interbedded with these fine-grained sediments.

The thickness of the valley-fill sequence varies from a few feet at the periphery of the basin adjacent to the mountains to an estimated maximum of 10,000 feet at Litchfield Park, just south of Luke AFB. These unconsolidated sediments are deposited on top of basement rock which is probably of the same composition as the nearby mountain ranges.

No wells have penetrated the entire thickness of the alluvium to bedrock except at the periphery of the basin. The deepest well in the Luke AFB vicinity is 4,500 deep and is located at the salt processing operation approximately 1 mile east of the Base.

2.2 TOPOGRAPHY

Topographic relief in the western Phoenix Basin within a few miles of LAFB encompasses over 3,500 feet, ranging from about 1,000 feet msl on the desert plain to over 4,500 feet msl in the mountains, with the land surface varying from very steep to virtually flat. Elevations at Luke, located on the desert plain, range from 1,110 feet msl at the northwest corner to 1,075 feet msl at the southeast corner of the Base. The ground surface generally slopes uniformly from northwest to southeast at 25 feet per mile.

2.3 DRAINAGE

Average annual rainfall at Luke AFB is approximately seven inches, while the evapotranspiration rate is about 60 inches per year. Runoff from this extremely sparse and irregular rainfall at Luke is channeled into a network of surface ditches and storm drains. Due to the extreme aridity, and resulting excess evapotranspiration potential, much of this surface runoff never reaches discharge points to natural surface streams, but infiltrates or evaporates instead. Drainage from the northern portion of the Base discharges toward the nearest natural surface water feature, the Agua Fria River. Figure 2-1 summarizes surface drainage patterns at LAFB.

Rivers near the Base include the Agua Fria, the Salt and the Gila Rivers. The Aqua Fria, flowing north to south, lies approximately two miles east of the main portion of Luke. The Salt River, into which the Agua Fria discharges, flows from east to west and lies approximately 6.5 miles south of the Base. The Salt River discharges into the Gila River, which flows east to west, discharging to the Colorado River. The Gila River is located approximately 7 miles south of Luke. In years past these rivers, all fed by runoff from the mountains, experienced erratic natural flows which sometimes resulted in flooding - these natural flows represented virtually the only local recharge to groundwater resources in the Luke area. Dams and reservoirs were

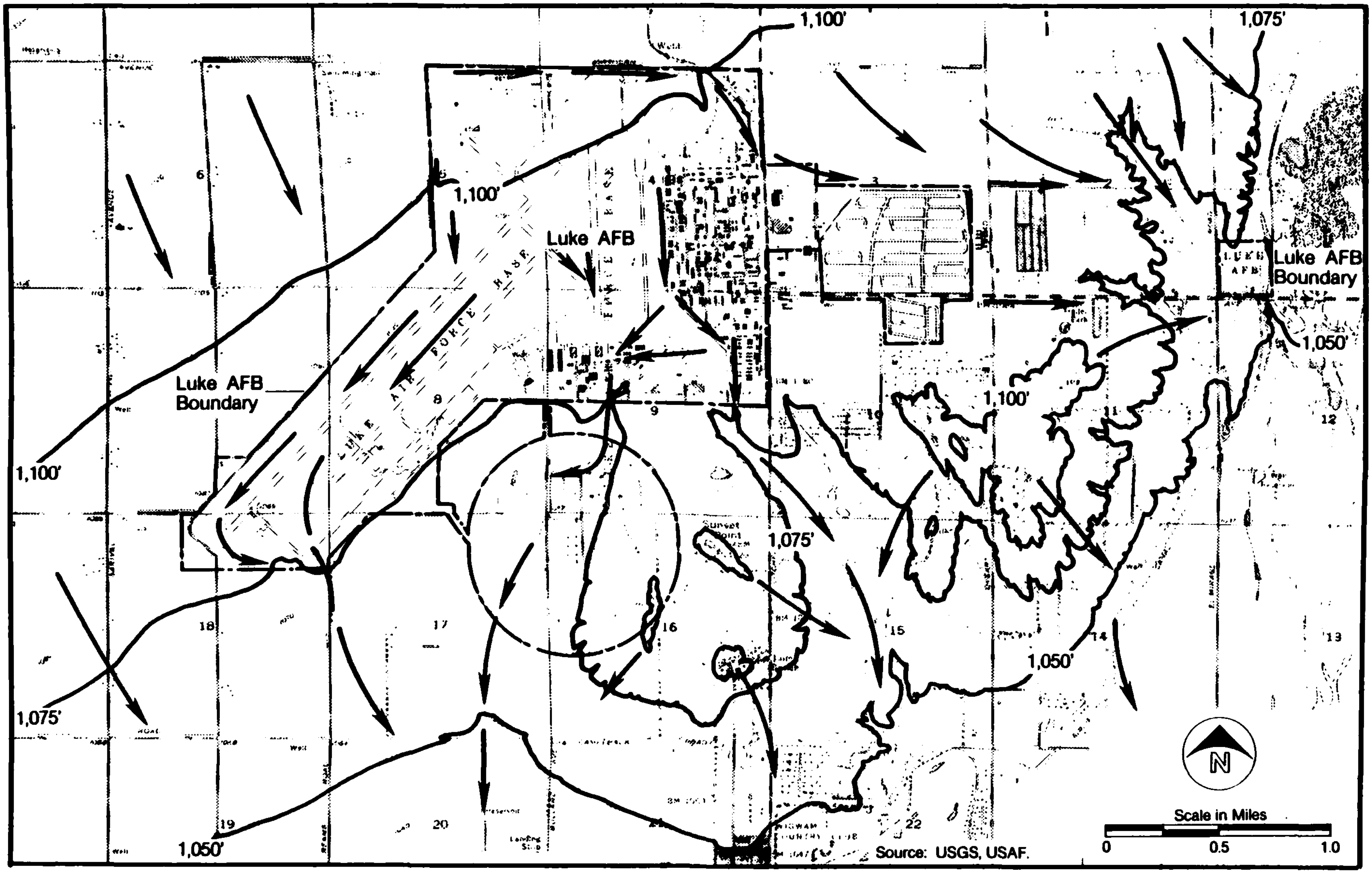


FIGURE 2-1 TOPOGRAPHY AND DRAINAGE MAP OF LUKE AFB (FROM THE CH2M HILL PHASE I REPORT)

in the mountains around Luke in order to 1) assist in water resource management, and 2) to prevent periodic damaging floods in these rivers. Now the rivers near Luke are dry most of the year and flow only during and immediately following storms.

2.4 HYDROGEOLOGY

Groundwater occurs within the unconsolidated alluvial valley-fill deposits of the Phoenix Basin. The saturated thickness of these sediments is extremely variable, from 200 to 10,000 feet. The sediments are thin toward the mountains and thicken toward the center of the basin. In the vicinity of Luke, near the center of the basin, the unconsolidated sediments are thought to be as much as 10,000 feet thick. In general, the unconsolidated alluvium can be divided into three hydrogeologic units, referred to as the upper alluvial unit, the middle fine-grained unit, and the lower conglomerate unit.

The upper alluvial unit is the major source of groundwater in the Luke vicinity, and is the unit into which the Base production wells are completed. The Base wells are completed at depths of from 800 to 1,000 feet. Locations of Base Production Wells and nearby off-Base irrigation wells are shown on Figure 2-2. The deposits within this hydrologic unit are generally unconsolidated, and groundwater occurs under unconfined or water table conditions. There are areas where the occurrence of locally extensive clay layers results in a perched or confined groundwater condition. However, under the influence of long-term groundwater withdrawals, aquifer response is more unconfined as a unit than confined. The upper alluvial unit ranges in thickness from a few feet at the periphery of the basin to over 1200 feet near the Base. Well yields within this unit are high, ranging from 500 to 3,000 gallons per minute (gpm), with variations resulting from differences in well construction, well depth, and local hydrogeologic conditions.

The middle fine-grained unit occurs below the upper unit and consists of sedimentary deposits of low permeability, primarily clay and silt in the upper section, and gypsum and salt in the lower section. The gypsum and salt deposits impede the downward flow of groundwater. Some groundwater does occur in the lower section, within limited sand and gravel deposits. Where it does occur, it is under artesian or confined conditions. This unit ranges in thickness from

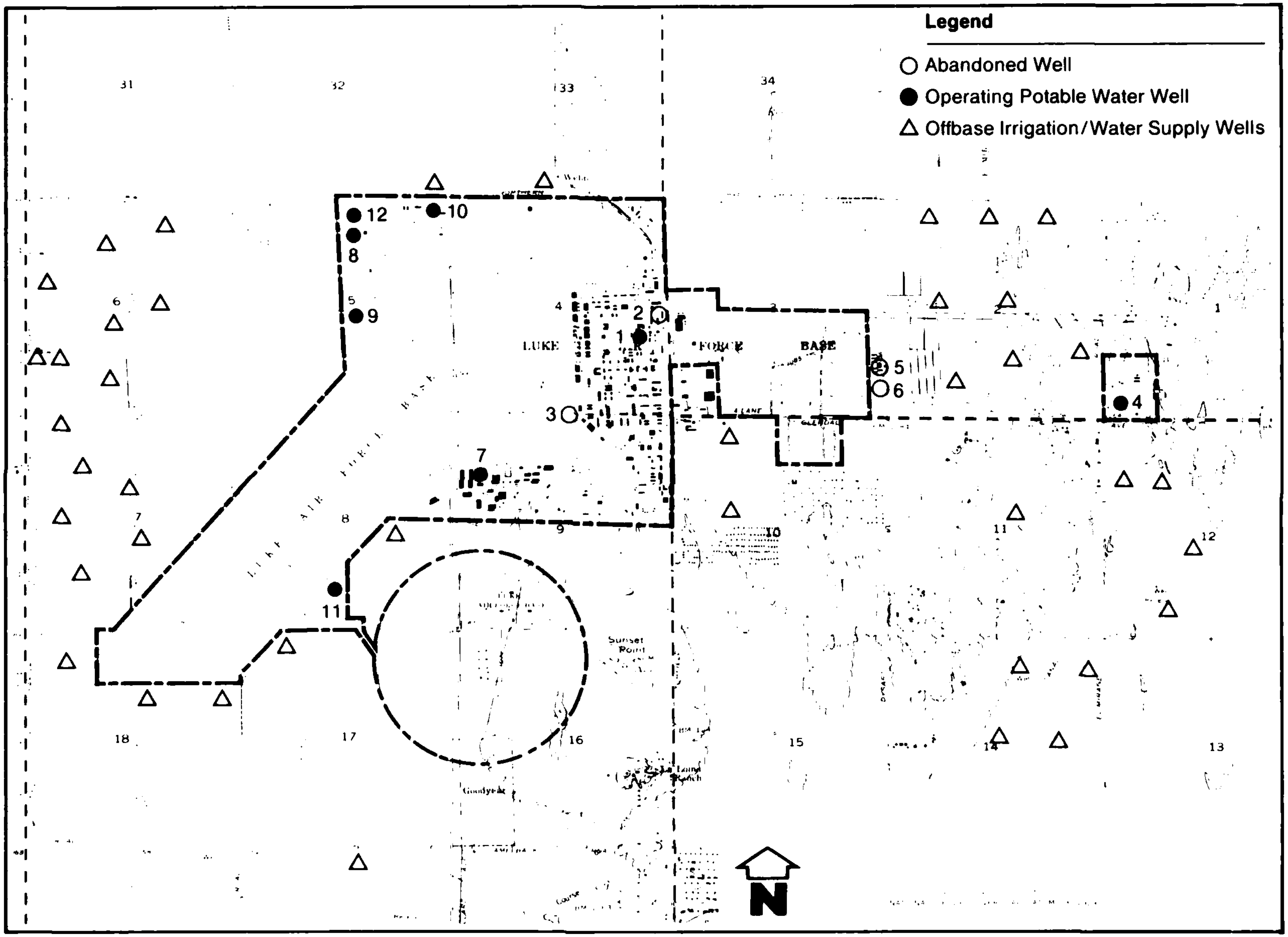


FIGURE 2-2 LOCATIONS OF BASE PRODUCTION WELLS AND NEARBY IRRIGATION/WATER SUPPLY WELLS

a few feet at the end of the basin to over 1500 in the vicinity of Luke. The occurrence of evaporite minerals, gypsum (calcium sulfate) and halite (sodium chloride) in this unit has a significant effect on local groundwater quality. The Luke Salt Body, located south and east of the Base occurs within this unit.

The lower conglomerate unit consists of a heterogeneous mixture of sand, gravel, and some clay. Groundwater generally occurs under artesian conditions confined by the middle fine-grain unit above. The exception is in those areas at the periphery of the basin where the middle unit is absent and the upper alluvial unit rests directly on top of the lower conglomerate unit. In those areas, the two units are hydrologically the same and the upper unit recharges the lower unit directly. The lower conglomerate unit ranges in thickness from a few feet near the edge of the basin to greater than 3,000 feet in the vicinity of Luke. Wells penetrating this unit are generally located along the basin edge and withdraw water from both the upper and lower units. Well yields are high and are generally greater than 1,000 gpm within this unit.

In the vicinity of Luke AFB, the upper alluvial unit is the primary source of water to over 500 western Phoenix Basin wells, and is the first unit which would potentially become contaminated by Air Force activities.

Groundwater withdrawals in the vicinity of Luke AFB have increased significantly during the past 20 years. More than 90 percent of the groundwater withdrawn is used for agricultural irrigation. The increased use of groundwater in the Luke AFB area has caused a number of significant changes in the hydrogeologic/geologic regime. For the past several years, groundwater levels have been declining by approximately 5 feet per year. During the period 1923 to 1977, the groundwater level has declined over 300 feet in the vicinity of Luke AFB.

The reason water levels are declining so rapidly is that groundwater withdrawals are significantly higher than recharge; thus, water is being "mined" from storage in the aquifer and not being replaced by recharge. Also, the effects of the groundwater pumpage are more pronounced in the area immediately around Luke AFB due to lower permeability production zones than in the surrounding area of the basin. Presently, the primary source of recharge is percolation from excess irrigation water and seepage losses from irrigation canals such as the Beardsley and Buckeye Canals instead of infiltration from river beds.

Historically, groundwater flowed southwesterly from recharge areas at the base of mountains following the channels of the Agua Fria and the Gila Rivers, both of which contributed recharge to the aquifer. Flow out of the groundwater basin occurred under the Gila River bed south of the White Tank Mountains. Today, as a result of large-scale off-Base agricultural withdrawals, a large cone of depression has formed around the Luke AFB area. This cone of depression is shown in Figure 2-3 (adapted from the Phase I Report). As a result, the groundwater no longer flows southwesterly but instead flows toward Luke AFB from all directions. Very little, if any, groundwater now leaves the basin as underflow. Recharge in the Luke AFB area now occurs almost entirely as excess irrigation water. This recharge, however, probably has yet to reach the water table. In the Luke AFB area, water levels are approximately 380-390 feet below land surface. Downward flow rates in unsaturated materials are estimated to be in the range of from 10 to 20 feet per year (Ch2M Hill 1982). Therefore, it would take from 20 to 40 years for irrigation water applied at the surface to reach the water table, which is declining at the rate of 5 feet per year. Vertical migration in unirrigated areas would take even longer. This is significant not only from the standpoint of recharge but also from the standpoint of contaminant migration. For example, Luke AFB has been in existence from 1941 to the present, a period of 43 years. A migrating contaminant on the surface during the first years of Base operation probably has not yet reached the water table.

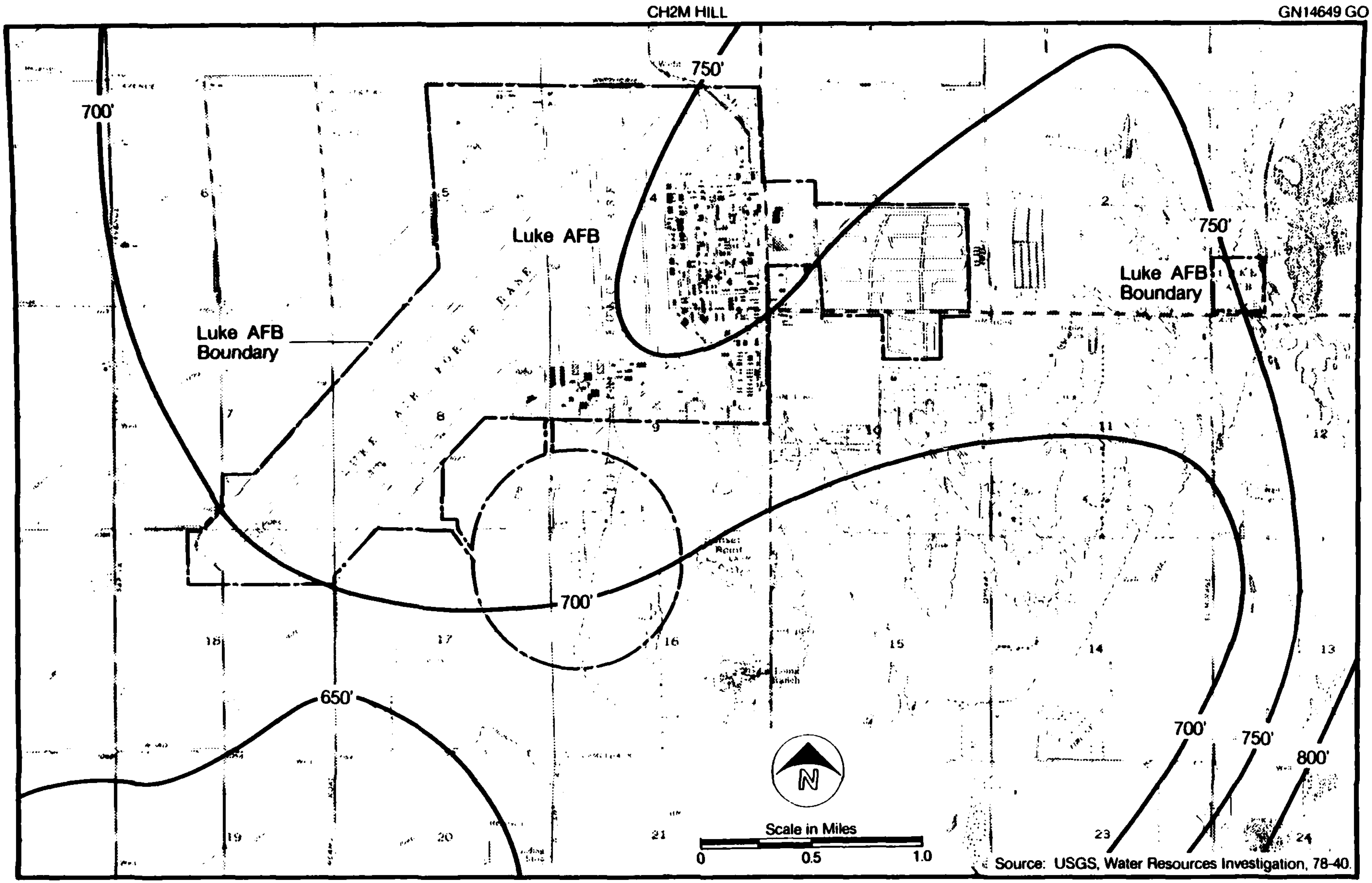


FIGURE 2-3 ELEVATION OF GROUND WATER (IN FEET ABOVE MEAN SEA LEVEL) IN 1977 AT LUKE AFB (FROM THE CH2M HILL PHASE I REPORT)

SECTION 3

FIELD PROGRAM

3.1 PROGRAM DEVELOPMENT

Based upon the conclusions of the Installation Restoration Program Phase I Records Search and the overall relative HARM Score ratings of Potential Contamination sources, the four sites prioritized in Table 1-1 were designated as areas showing the most significant potential for environmental impact. Subsequent to the Phase I Records Search Report, it was determined that the sites listed in Table 1-1 warranted a confirmatory Phase II field investigation.

The first work element of the Phase II confirmatory field investigation was a pre-survey site inspection at LAFB. On 3 November 1982, two WESTON personnel and a representative from OEHL conducted site inspections of LAFB and the four identified sites listed in the Phase I report. During that site inspection, all available maps, reports and aerial photographs were reviewed with Base Bioenvironmental and Civil Engineering personnel. At that time, representatives from OEHL requested that WESTON prepare a Technical Scope of Work and Cost Estimates for conducting a limited monitoring program at those four sites.

Following the 3 November 1982 pre-survey inspection, WESTON prepared a Pre-Survey Report (December 1982) addressing the four sites. The locations of the sites investigated are illustrated on Figure 3-1.

3.1.1 Analytical Protocol

An analytical protocol for each site under investigation was selected to provide specific and non-specific indicators of soil and groundwater contamination. The analytical parameters selected for each site are summarized in Table 1-2.

3.1.2 Formal Scope of Work

Task Order 0024, which formalized the proposed work is included in Appendix B. This Task Order provided the basis for the implementation of the field program described in the following sections.

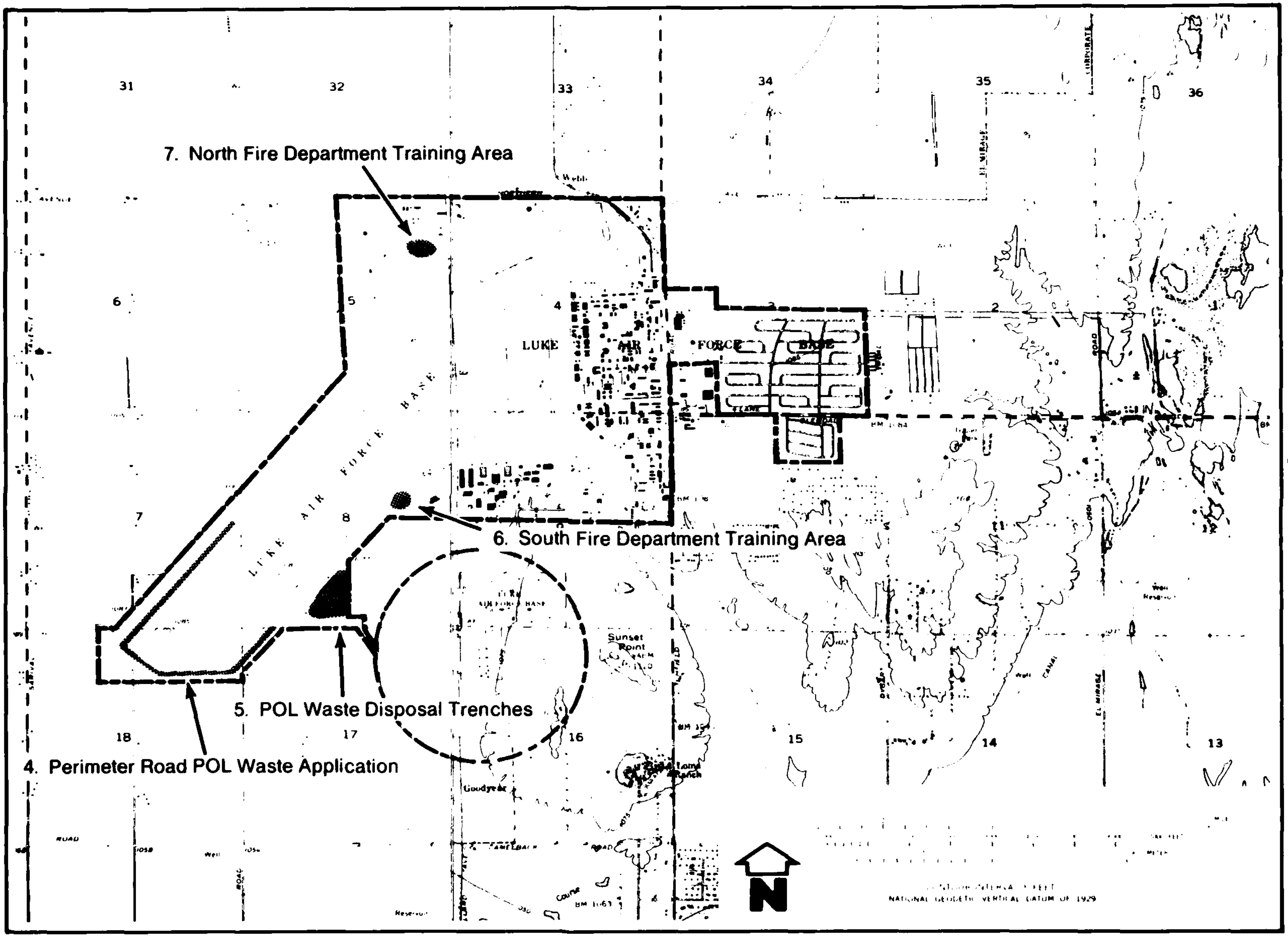


FIGURE 3-1 LOCATIONS OF PHASE II SITES

3.2 FIELD INVESTIGATION

Starting on 7 November 1983 and continuing through 19 November 1983, WESTON conducted a Phase II confirmation field investigation to define soil characteristics and assess the possible presence of hazardous environmental contaminants that may have resulted from past waste disposal activities at LAFB.

A shallow soil exploration and sampling program was conducted at the four sites listed in Table 1-1. Concurrent with this program, groundwater samples were collected at Well No. 4, immediately adjacent to the Waste Water Treatment Annex, and all remaining active Base production wells listed in Table 1-2. Data obtained from the two programs was used to evaluate the potential or real impacts resulting from past land filling and waste disposal operations. The field work conducted is summarized on a site-by-site basis in Table 3-1.

3.2.1 Schedule of Activity

The field investigation at LAFB was initiated on 7 November 1983 and completed on 18 November 1983. A chronology of WESTON's field activities at LAFB is summarized in Table 3-2.

3.2.2 Exploratory Soil Boring Program

The Soil Boring Program encompassing Sites Nos. 5, 4 and 7 was initiated 9 November 1983. A total of twenty-two soil borings were drilled between 9 November 1983 and 19 November 1983. All drilling work was accomplished under subcontract to WESTON by Western Technologies, Inc. of Phoenix, Arizona, under the direct supervision of an on-site WESTON geologist. Boring locations were pre-determined during a preliminary drilling site evaluation, after investigative interviews with Base personnel and careful inspection of historical reports, maps and aerial photographs. All borings were drilled in valley fill composed primarily of unconsolidated to semi-consolidated clay, silt, sand and gravel.

Each boring was advanced from the ground surface with a CME Model 75 drill rig, using conventional 4-inch inner-diameter hollow stem augers.

Soils in all borings were sampled continuously throughout the soil column and were recovered and retained in discrete one-foot increments. Samples were retrieved via two-inch diam-

Table 3-1

Summary of Technical Work Scope

Site	Action
Site No. 6	Four (4) discrete surface soil samples, obtained from sites rendered accessible by on-going construction activities.
Site No. 5	Ten (10) soil borings with continuous sampling at discrete one-foot intervals to a total depth of twenty (20) feet in each boring.
Site No. 4	Eight (8) soil borings with samples taken at discrete one-foot intervals to a total depth of two feet in each boring.
Site No. 7	Four (4) soil borings with continuous sampling at discrete one foot intervals to a total depth of twenty (20) feet in each boring.
Well No. 4 Base Production Wells	Water sample taken for locations and analytes referenced in Table 1-2

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Table 3-2

Field Activity Schedule

Date	Activity
7 November 1983	Site visit with drilling contractor and Base personnel to discuss terms of work scope, determine soil boring locations, and procure Work Clearance Requests (AF Form 103).
8 November 1983	Aerial photograph and final record search. Stake out soil boring locations. Surface soil samples taken at Site No. 6.
9 November 1983 thru 17 November 1983	Drilling Rig on site. Soil sampling performed at Sites Nos. 5, 4 and 7. Twenty-two borings completed.
17 November 1983	Completion of soil boring program. Acquisition of groundwater samples from Base production wells Nos. 1, 4, 7, 10, 11 and 12.

eter, eighteen-inch long split spoon samplers in compliance with Standard Penetration Test (SPT) Techniques (ASTM Standard Method No. D-1586). The split spoon sampler was driven ahead of the advancing auger into undisturbed soil. Each single split spoon sample penetrated 1.5 feet of soil. The resulting sample core recoveries were always less than 1.5 feet; only highly cohesive soils yielded full core recovery. In order to expedite sample recovery time and minimize open borehole exposure to the atmosphere (concerning VOA compounds) two split spoon samplers were utilized, enabling the field team to employ one sampler as the other was being decontaminated. Although the precise assignment of a depth interval of partially recovered samples is somewhat qualitative, the relative position of each soil sample in the soil column is accurate.

Upon retrieval, the soil cores were divided into two sections and transferred immediately from the split spoon sampler into EPA approved sample containers, and the containers labeled accordingly. Between samples, the split spoon samplers were washed thoroughly with water and detergent, then rinsed with deionized water. Between borings, the augers were washed clean of soil particles. All sample handling equipment was also washed and rinsed between samples. A representative subsample was taken from the samples to evaluate soil characteristics. Descriptions were made of each soil sample, using ASTM Standards for color, texture and moisture, and these descriptions were recorded on boring logs.

One log was produced for each boring. A compilation of all boring logs is presented in Appendix D. Throughout each sampling event, the borehole and sample were monitored for organic vapors and combustible gases using an H-Nu Model PI 101 photoionization detector and an MSA Combustible Gas Detector. Readings thus obtained from the H-Nu were incorporated into the boring logs; no positive readings above background levels were recorded at any drilling site using the explosimeter. Upon completion of each boring, the open borehole was pressure-grout backfilled with a bentonite-cement slurry. Drill cuttings were disposed of at a location designated by LAFB, and the general area cleaned. Location markers were permanently installed into the grout backfill.

The sample bottles were packed in bubble packs, placed in metal coolers, and shipped Air Express to WESTON's laboratory in Stockton, California pending their selection for chemical analysis.

3.2.2.1 Site No. 6 - South Fire Department Training Area

It was proposed that a total of ten soil borings, each drilled to a depth of twenty feet, be located throughout this site. Construction at the site by the U.S. Army Corp of Engineers prohibited the drilling of any soil borings. The Task Order was modified to delete the drilling and substitute four shallow soil samples to be taken from the construction site. WESTON personnel recovered four discrete subsurface soil samples exposed by construction activities. These four sampling points, labeled S-1 through S-4, are shown on Figure 3-2. Samples were taken at four separate locations within a 2-3 foot deep excavated area. These areas were intentionally chosen due to the discoloration of the exposed sub-soils and organic odor. Each sample was monitored for organic vapors using the H-Nu photoionizer.

3.2.2.2 Site No. 5 - POL Waste Disposal Trenches

Although most of the northwestern portion of this site is obstructed by asphalt rubble (from the demolition of an aircraft taxiway), surficial evidence of several of the trenches was noted on the northeastern portion of the site. Locations of additional trenches were estimated in the field based upon available aerial photos. These areas were drilled during the sampling programs. Ten soil borings, labeled SB-1 through SB-10, were drilled to a total depth of 20 feet each in the area of the POL trenches. The exact location selected for each boring was determined in the field using visual inspection of land subsidence associated with trenches, combined with analysis of available aerial photographs. The locations of the ten soil borings are plotted on Figure 3-3. Representative samples of each one foot increment of soils (a total of 20 samples) were collected from each boring. Duplicate samples were taken for 20% quality assurance, resulting in an additional 4 samples per 20 foot boring. Samples were monitored for organic vapors with the H-Nu and the values recorded on the boring log.

As the boring logs (Appendix D) indicate, the soil encountered beneath the site consisted dominantly of silts, clays, sands and gravels. A caliche layer of from three to five-foot thickness was encountered at between ten and fifteen feet deep in all borings on the site.

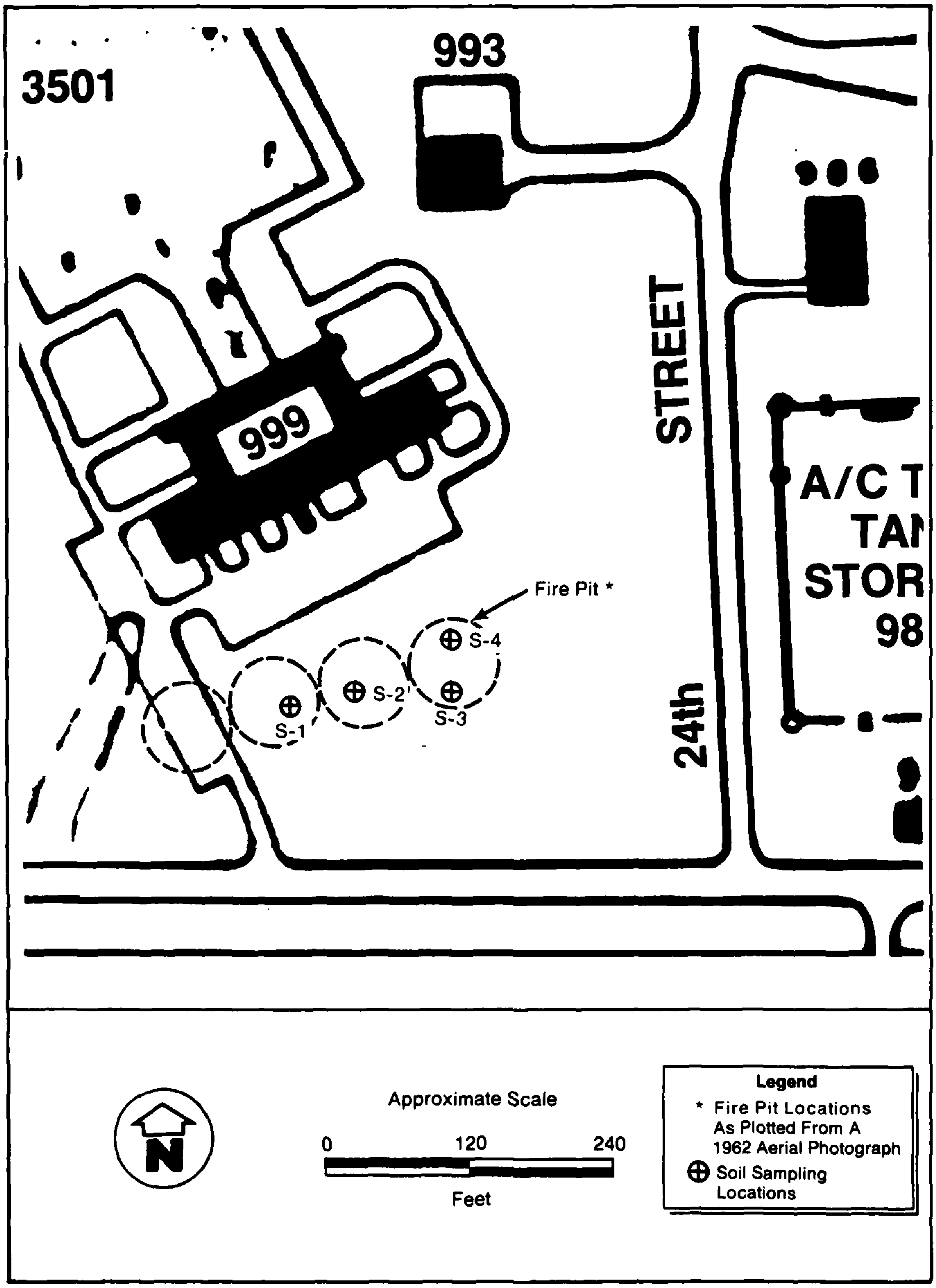

FIGURE 3-2 GENERAL SITE MAP FOR SITE NO. 6 (SOUTH FIRE DEPARTMENT TRAINING AREA) SHOWING SURFACE SEDIMENT SAMPLES

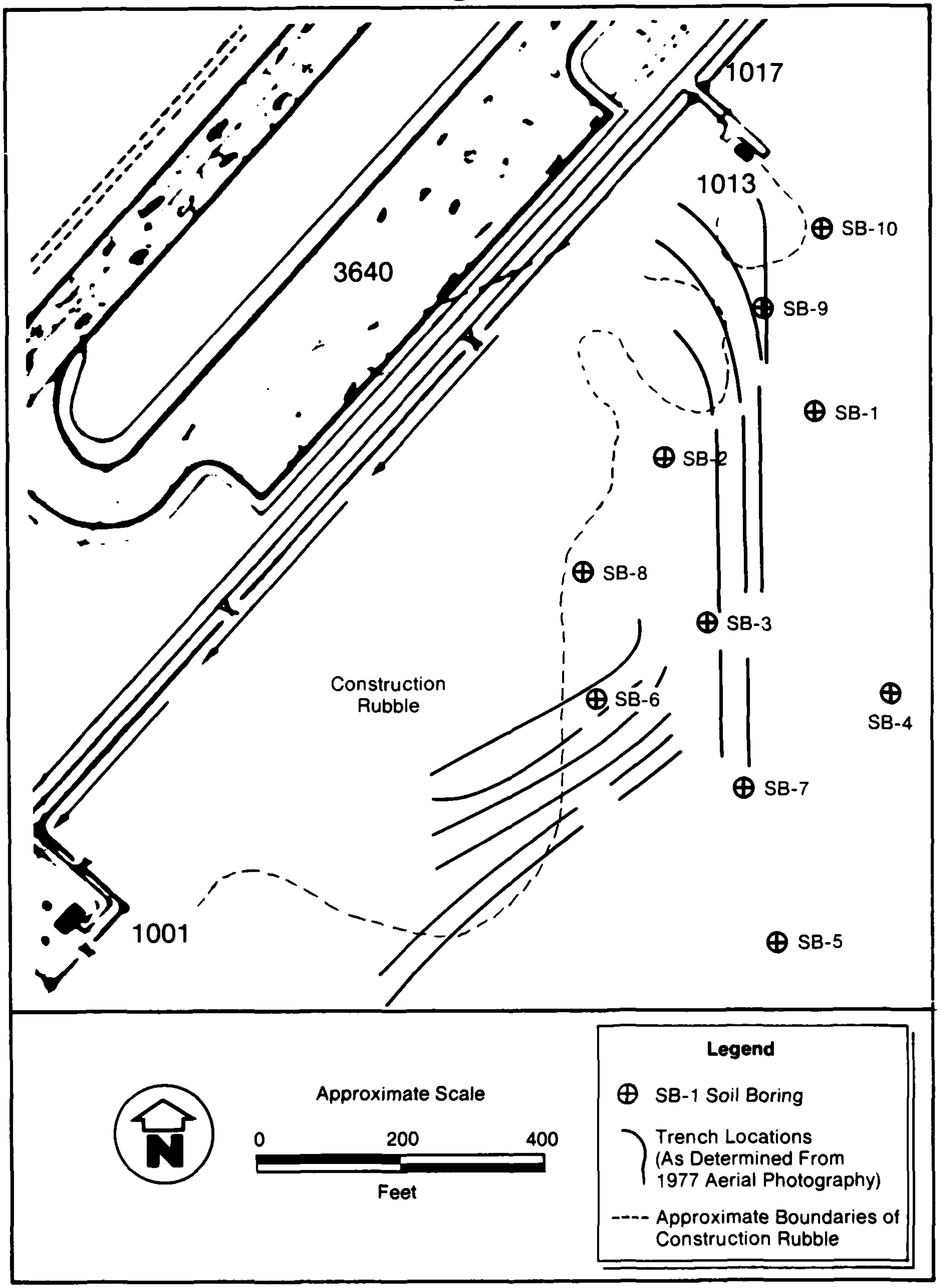

FIGURE 3-3 GENERAL SITE MAP FOR SITE NO. 5 (P.O.L. WASTE DISPOSAL TRENCH) SHOWING SOIL BORING LOCATIONS

3.2.2.3 Site No.4 - Perimeter Road Waste POL Application Site

Prior to establishing the boring location, the road bed was inspected during a reconnaissance survey for evidence of remaining waste POL products. Despite the staining properties of waste POL products, inspection of the road bed revealed no evidence of remaining oil stains or compacted tar-soil mixtures. Since no affected areas were observed, boring locations were distributed along the road bed. These locations, labeled SB-11 through SB-18 are shown on Figure 3-4. The limited soil boring program consisted of two-foot deep soil sampling borings at eight locations along the south perimeter road bed. Representative samples were taken from the surface to one foot and one-foot to two-foot intervals. An additional duplicate sample was taken for quality assurance, resulting in a total of three samples per boring. Sampling was performed in accordance to the procedures described in Section 3.2.2. Samples were monitored for organic vapors with an H-Nu photoionizer and the values recorded on the boring logs. No evidence of sub-surface oil-staining or soil-tar mixtures was encountered.

3.2.2.4 Site No. 7 - North Fire Department Training Area

A series of continuous soil samples were recovered from four twenty-foot deep soil borings installed in the North Fire Department Training Area. A site plan showing the locations of the soil borings is shown in Figure 3-5. WESTON personnel established the four boring locations following an inspection of the site and its location in reference to historical aerial photographs. Two soil borings, SB-20 and SB-22, were drilled in a scorched gravel and dirt circle approximately 75 feet in diameter. The circle was evident in the 1969 aerial photograph, shown in Figure 1-8, and is most probably the remnant of the defunct fire pit. Soil borings SB-19 and SB-21 were located outside of the scorched area in two additional darkened areas found on the aerial photograph. Surficial evidence indicated that, at least, spillage had occurred in these locations. Sampling was accomplished following those procedures outlined in Section 3.2.2. During the drilling, fuel product odors were obvious in borings SB-20, SB-21 and SB-22. These odors were confirmed by elevated H-Nu readings taken over the open hole. Readings for organic vapors over borings GB-20, SB-21 and SB-22 ranged from 3-35 ppm for depths below 15 feet, to 100-300 ppm for depths shallower than 5 feet. This shows a decreasing presence of organics with depth. This finding tends to support earlier postulation that downward migration of

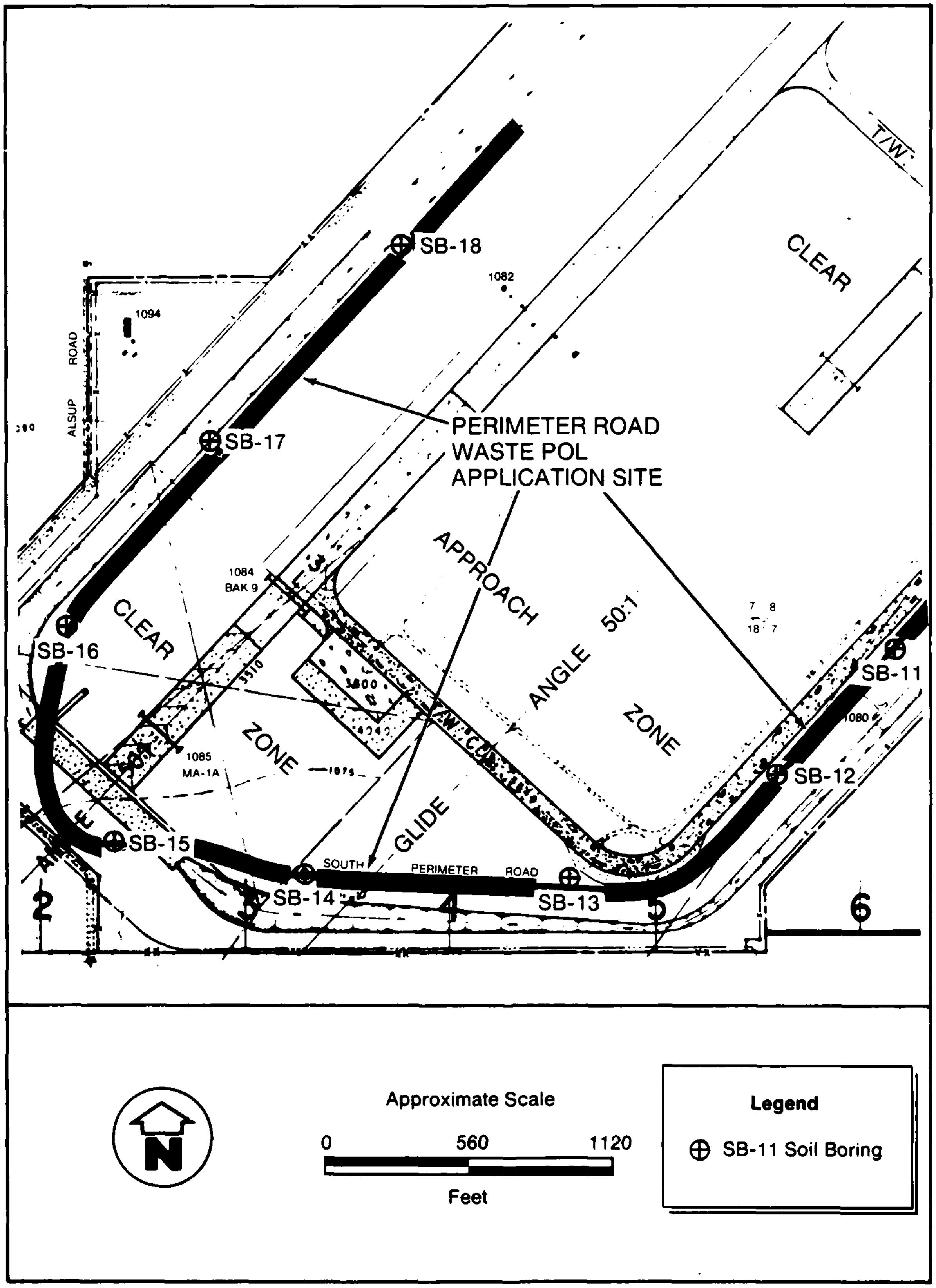

FIGURE 3-4 GENERAL SITE MAP FOR THE SITE NO. 4 (PERIMETER ROAD WASTE P.O.L. APPLICATION SITE) SHOWING SOIL BORING LOCATIONS

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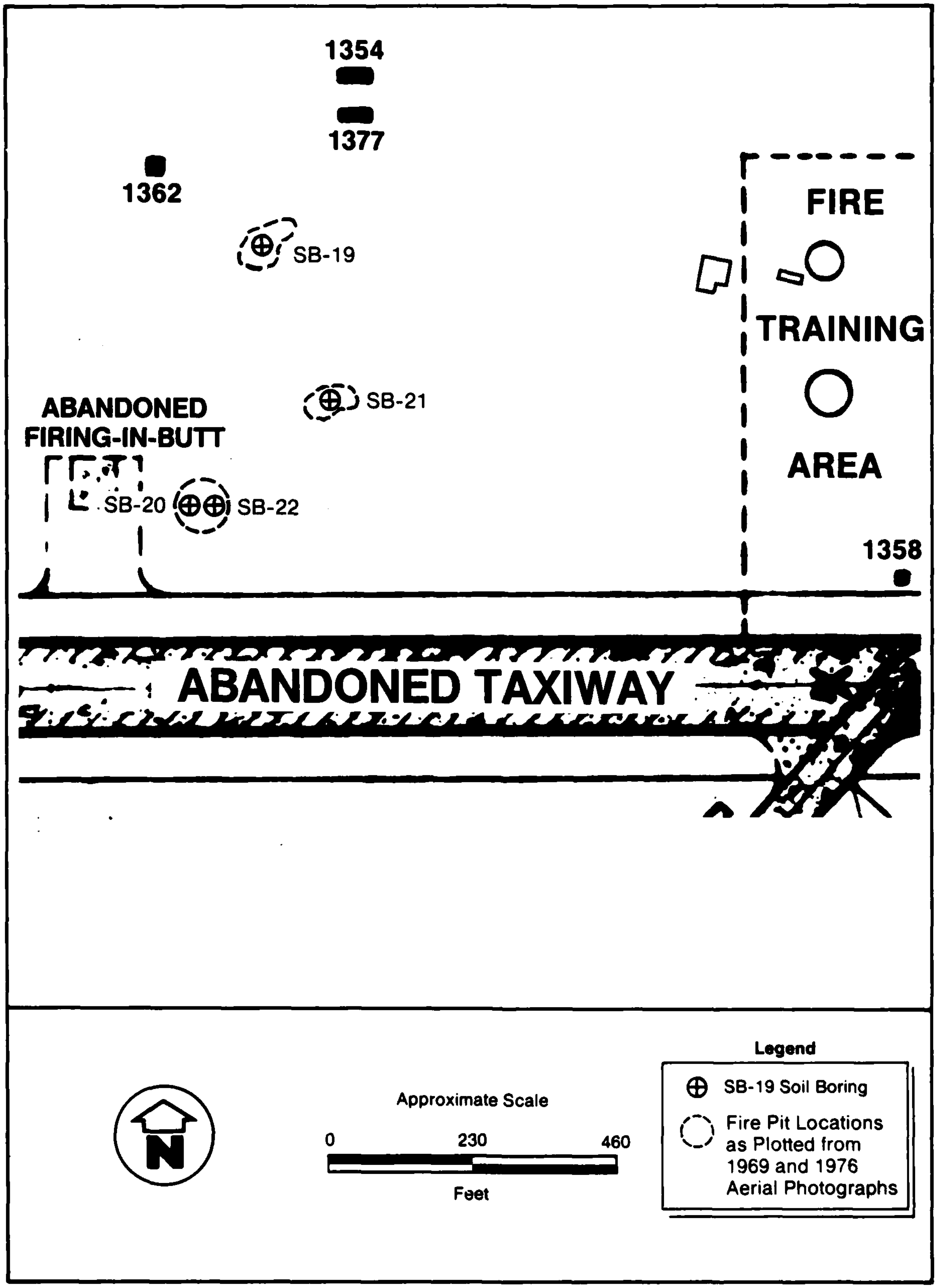


FIGURE 3-5 GENERAL SITE MAP FOR SITE NO. 7 (NORTH FIRE DEPARTMENT TRAINING AREA) SHOWING SOIL BORING LOCATIONS

environmental contaminants is inhibited by low permeability soil, although the boring logs indicate that the tightly cemented caliche layer characteristic of the POL Trench Area (Site No. 5) was not encountered at this site.

3.2.3 Water Quality Sampling Program

On 17 November 1983, WESTON conducted a Water Quality Sampling Program at LAFB. Samples were collected from all operating Base Production Wells, and at the Waste Water Treatment Annex influent and effluent. While the Task Order specified sampling to be done at nine Base Production Wells, only eight wells are currently in the production system at Luke AFB (See Figure 2-2). Two of these production wells were out of service (Wells 8 and 9) and could not be sampled. The sample analytes are given in Table 3-3.

The purpose of the water quality sampling program was to identify, insofar as possible at the level of a confirmation survey, the existence of contamination present in the hydrogeologic environment of the base pumping wells. To achieve these goals efficiently, specific field procedures were developed for purging the wells, collecting the samples, and ensuring field quality control. These procedures have been used to obtain a single complete set of representative samples for chemical analysis from the base production wells and the WWTP. The sampling and quality assurance plans used to accomplish these goals are contained in Appendix E. Since all wells sampled were in continuous operation, the wells were already in a purged condition. Representative samples were obtained directly from the pump discharge. Sample chain-of-custody documentation is contained in Appendix F. Standard laboratory analysis protocols used in the analysis of these samples are contained in Appendix G.

Table 3-3

Sample Analytes

Analytes	Well #1	Well #4	Well #7	Well #8[1]	Well #9[1]	Well #10	Well #11	Well #12
Pesticides:								
DBCP	*	*	*	*	*	*	*	*
Volatile Organics (VOA)		*		*	*	*	*	
Oil & Grease		*		*	*	*	*	
Phenol		*						
Lead							*	
Radiological Species:								
Gross A		*						
Gross B		*						
Gross Gamma		*						
Radium 226		*						

* Well Sampled for Specific Parameter

[1] Wells were out of service at the time sampling was conducted and could not be sampled.

SECTION 4

RESULTS

4.1 SITE INTERPRETIVE GEOLOGY

The subsurface exploration program conducted at LAFB penetrated the upper 20 feet of unconsolidated materials at the Base. Where natural, in-place soils at the Base were encountered during the soil sampling program, these soils were consistent with the Gilman, Laveen and Mohall soil series mapped for the base by the U.S. Soil Conservation Service (1977). These soils are characteristically deep, well-drained soils with moderate permeability. They are alkaline and mildly to strongly effervescent, indicating the presence of an elevated calcium carbonate component. The relatively high carbonate component of the soils leads to the formation of calcite deposits at depth below the soil zone in the desert environment typical at LAFB.

4.1.1 Site No. 6 - South Fire Department Training Area

No drilling was accomplished at this site. Soils observed and sampled in the MCP excavation appeared to be in-place, native soils, with a veneer of local oil-stained fill material above the soil horizon. The soils were developed over silty, gravelly sands typical of the alluvial valley fill materials in the area.

4.1.2 Site No. 5 - Waste POL Disposal Trenches

Ten soil borings were drilled at this site to depths of 20 feet each. Gilman soils were penetrated in several boreholes, although most boreholes encountered disturbed alluvial valley-fill materials at depths shallower than about six feet. Eight of the 10 borings at the site, and all within the area of trenching operations, penetrated a semi-consolidated, well-cemented caliche zone, which ranged in thickness from two to about six feet and was encountered at depths ranging between eight and 15 feet below grade. This caliche zone is tight enough, and well-enough cemented, that it would provide a physical barrier to the vertical migration of contaminants from the shallow subsurface to aquifer-scale depths.

4.1.3 Site No. 4 - Perimeter Road Waste POL Application Site

Borings at this site only penetrated two feet into the subsurface, so no data is available to document the presence or absence of a caliche zone. Soils encountered appear to be from the lower portion of the natural soil horizon, with the probability that the upper soil zone was removed or disturbed during construction of the runways.

4.1.4 Site No. 7 - North Fire Department Training Area

Soils drilled by the four borings at this site constituted the Gilman series soil horizon and underlying alluvial valley-fill deposits to depths of 20 feet in each boring. None of the four borings encountered a caliche zone which could retard the vertical migration of contaminants.

4.2 SOIL CHEMISTRY CONDITIONS

Soil samples were selected from each site and soil boring for chemical analyses of the analytes listed in Table 1-2. Samples selected for analysis at each site were selected on the basis of the detection of organic vapors during drilling, in order to obtain a "worst case" evaluation of potential soil contamination.

4.2.1 Site No. 6 - South Fire Department Training Area

All four of the available soil samples from this site were subjected to analysis. Table 4-1 contains a summary of the analytical findings. Table 4-2 contains a complete listing of the volatile organic compounds analyzed. From the data in Table 4-1 it can be seen that oil and grease (as defined by extraction in Freon 113) was high in two of the samples analyzed. All four samples showed visual evidence of oil staining, but even the two high oil and grease concentrations detected represent only between 1.5 and 3.7 percent of the soil by weight. These data combined with the very low VOA concentrations detected indicate that any solvent and fuel residues remaining from previous fire-training exercises have weathered extensively in the desert environment at LAFB. This weathering, coupled with the MCP plan to cap the entire site with concrete construction slabs and macadam

Table 4-1: SUMMARY OF SOIL CHEMISTRY DATA
SOUTH FIRE DEPARTMENT TRAINING AREA

Sample	Approximate Depth (feet)	Oil and Grease (ug/g)	1,1,1-Trichloroethane	Chloroform	Chloroethylene	Bromodichloromethane	Unidentified Peaks
S-1	1	14,600	0.004	0.162	0.022	0.003	0
S-2	2	36,500	<0.001	0.023	<0.001	<0.001	0
S-3	2	1,250	<0.001	<0.001	<0.001	<0.001	0
S-4	1	197	0.002	0.057	0.016	0.001	1

1 - For a complete list of compounds analyzed see Table 4-2. Compounds listed in Table 4-2, but not found at a detection limit of 0.001 ug/g are not reported here. Methylene Chloride was detected in all samples, QA duplicates and blanks - cross-contamination within laboratory is indicated, so no methylene chloride results are included here.

WESTON

Table 4-2

LISTING FOR USEPA PRIORITY POLLUTANTS
VOLATILE ORGANIC COMPOUNDS (VOA)

Acrolein	1,2 - Dichloropropane
Acrylonitrile	1,2 - Dichloropropylene
Benzene	Ethylbenzene
Bis-chloromethylether	Methyl Bromide
Bromoform	Methyl Chloride
Carbon Tetrachloride	Methylene Chloride
Chlorobenzene	1,1,2,2 - Tetrachloroethane
Chlorodibromomethane	Tetrachloroethylene
Chloroethane	Toluene
2-Chloroethylvinylether	(Trans) 1,2-Dichloroethylene
Chloroform	1,1,2 - Trichloroethane
Dichlorobromomethane	1,1,1 - Trichloroethane
Dichlorodifluoromethane	Trichloroethylene
1,1 - Dichloroethane	Trichlorofluoromethane
1,2 - Dichloroethane	Vinyl Chloride
1,1 - Dichloroethylene	

rking lots, indicates that low levels of fuel and solvent residues remaining at the site probably will not be subject to any forces, such as infiltration of precipitation, which would induce vertical migration of contaminants deeper into the subsurface.

4.2.2 Site No. 5 - Waste POL Disposal Trenches

HNu readings at all 10 borings and all soil samples were very low, remaining at only a few parts per million above background. These field observations made "worst-case" selection of 12 soil samples for analysis less definitive than at other sites. Of the 12 samples selected for analysis, four were chosen due to: (1) the position of the boring within the trench area; and (2) the depth of the sample being below the caliche layer present at the site. Table 4-3 summarizes the data obtained from chemical analysis of the 12 samples selected.

From the data in Table 4-3 it can be seen that Freon 113 extractable oil and grease was uniformly in the low part per million range in all samples analyzed. Lead concentrations, ostensibly linked to disposal of leaded fuel sludges, were fairly uniform in all samples ranging from 0.053 to 0.304 parts per million. Only 5 VOA compounds were detected in only half the samples, with the maximum concentration found of 0.20 parts per million for chloroform. The most common VOA compound found was chloroform, present in 5 of the samples. The very low levels of oil and grease and VOA compounds indicates that the weathering process employed by the Air Force at this site was effective in devolatizing the emplaced fuels prior to burial. While it does not appear that an actual waste POL trench was successfully penetrated and sampled, the net impact of disposal of POL wastes at the site appears to be minimal.

4.2.3 Site No. 4 - Perimeter Road Waste POL Application Site

A total of 16 soil samples were taken at 8 locations along the perimeter road. HNu readings at this site, as at the previous one, were uniformly within only a few parts per million of background, thereby making the selection of "worst case" samples less definitive than was desired.

TABLE 4-3: SUMMARY OF SOIL CHEMISTRY DATA, WASTE POL DISPOSAL TRENCHES

Boring No./ Sample No.	Sample Depth (ft.)	HNU Reading (PPM)	Oil & Grease (ug/g)	Lead (ug/kg)	VOA Compounds (ug/g)[1] 1,2-Dichloroethane	1,1-Dichloroethane	1,1-Dichloroethylene	(Trans) 1,2-Dichloroethylene	Chloroform	Unidentified Peaks
B1-4	4.5-6.0	6	209	161	<.001	<.001	<.001	<.001	<.001	0
B1-14	19.5-21.0	3	16	100	<.001	<.001	<.001	<.001	<.001	0
B2-4	4.5-6.0	5	26	103	<.001	<.001	<.001	<.001	<.001	0
B2-15	19.5-21.0	3	75	53	<.001	<.001	<.001	<.001	<.001	0
B3-6	7.5-9.0	5	10	304	.003	<.001	<.001	<.001	.008	0
B3-14	19.5-21.0	2	10	145	.012	.014	.010	.011	<.001	0
B4-9	8.0-9.0	6	10	151	<.001	<.001	<.001	<.001	<.001	0
B5-5	4.0-5.0	5	18	104	<.001	<.001	.001	<.001	.120	0
B6-15	14.0-15.0	5	38	101	<.001	<.001	<.001	<.001	.200	0
B7-20	19.0-20.0	BG	43	112	.001	<.001	<.001	<.001	.160	0
B8-6	5.0-6.0	5	63	114	<.001	<.001	.012	<.001	.035	0
B10-10	9.0-10.0	5	10	103	.001	<.001	<.001	.001	<.001	0

1 For a complete list of compounds analyzed see Table 4-2. Compounds listed in Table 4-2 but not found at a detection limit of .001 ug/g are not reported here. Methylene Chloride was detected in all samples, QA duplicates and blanks - cross-contamination within Laboratory is indicated, so no Methylene Chloride results are included here.

Twelve of the 16 samples taken were analyzed, and the results of these analyses are summarized in Table 4-4.

From the data in Table 4-4 it can be seen that Freon 113 extractable oil and grease was uniformly in the low part per million range in all samples analyzed. Only 6 VOA compounds were detected in 7 of the 11 samples, with a maximum concentration found of 0.040 parts per million of 1,1-dichloroethylene. The most common VOA compound found was 1,1-dichloroethylene, found in all 7 of the samples containing VOA compounds. The very low levels of oil and grease and VOA compounds indicate that weathering of sprayed fuels and solvents by the prevailing desert conditions at LAFB was effective in devolatizing the contaminants. The net impact of dust palliative spraying of waste fuels and solvents at this site appears to be minimal.

4.2.4 Site No. 7 - North Fire Department Training Area

A total of 80 soil samples were taken in four soil exploratory boreholes at the site. Twelve of these samples were selected for analysis, based upon the following criteria:

(1) Elevated HNu readings at the borehole; and

(2) Position of the sample within the borehole.

HNu readings in these boreholes ranged from background levels 1 up to a maximum of 300 parts per million. Table 4-5 summarizes the chemical analysis results obtained from this analytical program.

From the data in Table 4-5 it can be seen that Freon 113 extractable oil and grease occurred over a wide range of concentrations which covaried markedly with elevated HNu readings (i.e. HNu readings proved to be good indicators of fuel contamination as indicated by oil and grease data). Oil and grease levels are lower than the highest levels attained at the South Fire Department Training Area, but this is to be expected since no obviously oil-stained samples were selected for analysis. Several stained samples were recovered from the site at very shallow depths, but these were not analyzed since the purpose of these analyses was to detect vertical migration of contaminants away from the obvious oil-staining. Elevated oil and grease levels were detected to depths as much as 19 feet below the surface. This fact,

TABLE 4-4: SUMMARY OF SOIL CHEMISTRY DATA, PERIMETER ROAD WASTE POL APPLICATION

Boring No./ Sample No.	Sample Depth (ft)	HNU Reading (PPM)	Oil & Grease (mg/kg)	VOA Compounds (ug/g)[1] 1,2-Dichloroethane	1,1-Dichloroethane	1,1-Dichloroethylene	1,3-Dichloropropane	Tetrachloroethylene	Chloroform	Unidentified Peaks
SB 11-2	0-1	BG	38	<.001	<.001	<.001	<.001	<.001	<.001	0
SB 12-4	1-2	BG	33	<.001	<.001	.001	<.001	<.001	<.001	0
SB 13-6	1-2	BG	82	.008	.004	.024	<.001	<.001	.002	1
SB 14-8	1-2	1	19	<.001	<.001	.001	<.001	<.001	<.001	0
SB 15-9	0-1	1	28	<.001	<.001	.001	<.001	<.001	<.001	0
SB 15-10	1-2	2	15	.007	<.001	.007	<.001	<.001	<.001	0
SB 16-11	0-1	2	32	.008	.005	.007	<.001	<.001	<.001	3
SB 16-12	1-2	2	<10	.001	<.001	.001	<.001	<.001	.001	0
SB 17-13	0-1	2	40	.012	<.001	.002	<.001	<.001	.002	0
SB 17-14	1-2	3	38	.009	.009	.016	<.002	<.001	.001	2
SB 18-15	0-1	3	<10	.005	.011	.040	.002	<.001	.001	4
SB 19-16	1-2	3	<10	<.001	<.001	.002	<.001	<.001	.001	3

1 For a complete list of compounds analyzed see Table 4-2. Compounds listed in Table 4-2 but not found at a detection limit of 1 ug/kg are not reported here. Methylene Chloride was detected in all samples, QA duplicates and blanks - cross-contamination within laboratory is indicated, so no Methylene Chloride results are included here.

TABLE 4-5: SUMMARY OF SOIL CHEMISTRY DATA
NORTH FIRE DEPARTMENT TRAINING AREA

Soil Boring/ Sample No.	Sample Depth (ft)	HNU Reading (PPM)	Oil & Grease (ug/kg)	1,2-Dichlorethane	1,1-Dichlorethane	1,1-Dichloroethylene	Bromomethane	1,1,1-Trichloroethane	Chloroform	Bromodichloromethane	1,2-Dichloromethane	Trichloroethane	Vinyl Chloride	Unidentified Peaks
B 19-12	11-12	17	100	<.001	<.001	<.001	<.001	.002	.540	.010	<.001	<.001	<.001	2
B 19-17	16-17	16	300	.004	.002	.021	.013	<.001	<.001	<.001	<.001	<.001	<.001	1
B 20-3	2-3	190	24,700	.007	.009	.035	<.001	<.001	<.001	<.001	<.001	<.001	<.001	2
B 20-5	4-5	150	17,500	<.001	<.001	.015	<.001	.022	.390	.019	.190	.002	.090	2
B 20-13	12-13	15	350	.001	<.001	.003	<.001	<.001	<.001	<.001	<.001	<.001	<.001	2
B 20-19	18-19	20	1,400	.016	.005	.013	<.001	<.001	<.001	<.001	<.001	<.001	<.001	1
B 21-6	5-6	120	4,500	<.001	<.001	.002	<.001	<.001	<.001	<.001	<.001	<.001	<.001	0
B 21-20	19-20	4	350	.004	.004	.023	<.001	<.001	<.001	<.001	<.001	<.001	<.001	2
B 22-4	3-4	300	18,900	.031	.003	.006	<.001	<.001	<.001	<.001	<.001	<.001	<.001	2
B 22-6	5-6	200	11,250	<.001	<.001	.006	<.001	<.001	<.001	<.001	<.001	<.001	<.001	3
B-22-10	9-10	100	150	<.001	<.001	<.001	<.001	.011	.800	.016	<.001	<.001	<.001	0
B 22-20	19-20	32	300	<.001	<.001	<.001	<.001	.011	.013	.013	<.001	<.001	<.001	0

1. For a complete list of compounds analyzed see Table 4-2. Compounds listed in Table4-2 but not found at a detection limot of .001 ug/g are not reported here. Methylene chloride was detected in all samples, AQ duplicates and blanks--cross-contamination within laboratory is indicated, so no methylene chloride results are included here.

combined with the failure to detect a caliche layer in any of the borings, indicates that the potential exists for downward migration of contaminants to occur. Eleven VOA compounds were detected, and all 12 soil samples contained at least one VOA compound. The most common VOA compound found was 1,1-dichloroethylene, found in all but 2 of the samples. The highest VOA concentrations detected were for chloroform, with concentrations ranging from 0.320 to 0.800 parts per million. VOA compounds were found at various depths in the four borings, but the detection of elevated chloroform levels in three samples below 9 foot depths confirms that fuels and solvents emplaced at the site are migrating vertically to depths greater than those sampled.

4.3 WATER CHEMISTRY CONDITIONS

Water samples were taken for analysis from all base production wells and from the influent and effluent of the wastewater treatment plant. The principal purpose of this sampling and analysis protocol was to ascertain whether or not past hazardous waste disposal activities had resulted in environmental degradation of ground water resources at LAFB. Only base production wells were used in this initial program due to the extreme depth to the water table (expected to be on the order of from 350 to 400 feet below grade) and the high cost of constructing monitor wells to such a depth.

The analytical results obtained reflect only a single round of sampling and analysis, and conclusions drawn from these results should be evaluated with this understanding.

4.3.1 Groundwater Quality Results

Water quality data from the sampling and analysis of groundwater samples obtained from all available LAFB production wells are contained in Table 4-6. The pesticide dibromochloropropane was detected at the limit of detection in only one well, Well No. 10. As can be seen in Figure 2-1 this well is located near the northwest boundary of LAFB, and it might be expected to be impacted by pesticide usage on adjacent farm fields. Analysis for lead was required only on Well No. 11, adjacent to the Waste POL Disposal Trenches Site--lead was not detected at a detection limit equivalent to the Federal and State Safe Drinking Water Standard of 0.05 parts per million. Neither oil and grease nor phenol were detected in the well samples required to be analyzed. Four radiological parameters were analyzed on

Well No.4 located in the Waste Treatment Annex--only gross beta and gross gamma activities were detected at levels of 34 +/- 4 and 38 +/- 4 picocuries per liter (pCi/l) respectively. No data has yet been located which would indicate whether or not such activities are typical of background water quality in the area. VOA analyses were performed on three wells, and only in Well No. 10 were significant levels of any VOA compounds detected. Well No. 10 is located adjacent to both Site No. 7, the North Fire Department Training Area, and the current Fire Department Training Area. The 1,2-dichloroethane detected at 0.0108 ppm in Well No. 10 was also found at low levels in 5 of the soil samples from the North Fire Department Training Area, but the (trans)-1,2-dichloroethylene detected at 0.001 ppm in Well No. 10 was not found in any of the North Fire Department Training Area samples. The source of the two VOA contaminants in Well No. 10 remains unidentified, but the two nearby fire training areas must be considered as potential sources.

4.4 SIGNIFICANCE OF THE FINDINGS

4.4.1 Water Quality - General

The principal objective of the Phase II Confirmation Stage (Stage 1) Study was to determine whether past hazardous waste operations or disposal practices had resulted in environmental degradation. The analytical results of the Phase II study represent a single round of sampling at wells. The conclusions drawn from this information should be evaluated with this understanding.

Groundwater quality results are in Table 4-6. Appendix G includes all analytical results from monitoring the base production wells. The water quality analyses accomplished encountered none of any contaminants in excess of Federal or Arizona drinking water enforcement standards. Table 4-7 summarizes these analytes detected at Luke AFB and the Federal or State enforceable Standards which apply.

4.4.2 Water Quality at LAFB

From the data contained in Tables 4-6 and 4-8 it can be seen that groundwater quality at LAFB is generally excellent for

TABLE 4-6: SUMMARY OF WATER QUALITY DATA BASE PRODUCTION WELLS (ug/l)

Sample No.	DBCP	Lead	Oil & Grease	Phenols[2]	RA-226[3]	Gross Alpha[3]	Gross Beta[3]	Gross Gamma[3]	VOA Compounds[4] 1,2-Dichloroethane	(Trans) 1,2-Dichloroethylene
Well No. 1	<0.1	NR[1]	NR	NR	NR	NR	NR	NR	NR	NR
Well No. 4	<0.1	NR	<100	<1	<0.004	< 2	34±4	38±4	1.4	<0.1
Well No. 7	<0.1	NR	NR	NR	NR	NR	NR	NR	NR	NR
Well No. 8[5]										
Well No. 9[5]										
Well No. 10	0.1	NR	<100	NR	NR	NR	NR	NR	10.8	100.0
Well No. 11	<0.1	50	<100	NR	NR	NR	NR	NR	<0.07	< 0.10
Well No. 12	<0.1	NR	NR	NR	NR	NR	NR	NR	NR	NR

1. NR indicates not required by task order
2. As 2,4-Dimethylphenol
3. Picocuries per liter
4. For a complete list of compounds analyzed see Table 4-2. Compounds listed in Table 4-2, but not found at the Method 601 or 602 detection limits are not reported here.
5. These wells were out of service and could not be sampled.

TABLE 4-7: COMPARISON OF LAFB WATER QUALITY RESULTS WITH APPLICABLE STANDARDS GUIDELINES AND CRITERIA (mg/l unless otherwise noted)

Detected Parameters	Federal and State Drinking Water Standards	Monitor Points Exceeding Standards
Oil & Grease	-	-
Phenol	-	-
Lead	0.05	None of the Points Tested
DBCP	-	-
Trihalomethanes	0.100	None of the Points Tested
1,2-Dichloroethylene	-	-
(Trans)-1,2,-Dichloroethylene	-	-
Gross Alpha	15.0[1]	None of the Points Tested
Gross Beta	4.0[2]	None of the Points Tested
Gross Gamma	-	-
Radium - 226	5.0[1]	None of the Points Tested

[1] - Picocuries per liter

[2] - Millirem per year

TABLE 4-8: COMPARISON OF LAFB WATER QUALITY RESULTS WITH APPLICABLE STANDARDS GUIDELINES AND CRITERIA (mg/l unless otherwise noted)

Detected Parameters	Federal and State Drinking Water Standards	Monitor Points Exceeding Standards
Oil & Grease	-	-
Phenol	-	-
Lead	0.05	None of the Points Tested
DBCP	-	-
Trihalomethanes	0.100	None of the Points Tested
1,2-Dichloroethylene	-	-
(Trans)-1,2,-Dichloroethylene	-	-
Gross Alpha	15.0[1]	None of the Points Tested
Gross Beta	4.0[2]	None of the Points Tested
Gross Gamma	-	-
Radium - 226	5.0[1]	None of the Points Tested

[1] - Picocuries per liter

[2] - Millirem per year

the suite of potential contaminants tested. The detection of 0.1 ug/l of dibromochloropropane (DBCP) in production Well No. 10 should be verified, although it should be noted that the concentration reported is at precisely the limit of detection. The detection of 1,2-dichloroethane in two Base Production Wells should be verified. The detection of (trans)-1-2-dichloroethylene in Well No. 10 should also be verified.

4.4.3 Soil Quality General

Other than the USEPA Action Level of 50 mg/kg for PCB in soil, there are no current quality standards, guidelines or criteria for the majority of soil contaminants. Target concentrations for various compounds in soils are usually established on a case-by-case basis by the regulatory agency having jurisdiction, and these target concentrations are usually established for attainment purposes in cleanup of environmental contamination.

4.4.4 Soil Quality at LAFB

Soil contamination in the form of oil and grease was detected at Site No. 6, the South Fire Department Training Area, although planned construction of concrete pads and macadam parking lots on the site effectively remove this contamination from further concern. Very mild lead and chloroform contamination was detected at Site No. 5, the POL Waste Disposal Trenches, although the very low levels encountered, combined with the presence of a caliche zone, would effectively remove this site from further concern. It should be noted here, however, that only a portion of the site was accessible for evaluation. Virtually no soil contamination was detected at Site No. 4, the Perimeter Road Waste POL Application Site, effectively removing this site from further concern. At Site No. 7, the North Fire Department Training Area, contamination was detected in the form of oil and grease as well as several VOA compounds. While the levels of the contaminants detected are not high, the combination of:

(1) the soil concentrations found;
(2) the lack of caliche layer at the site; and
(3) the proximity to Base Production Wells;

indicates that the site, and the nearby Current Fire Training Area should be of further concern.

4.4.5 Conclusions

Based upon the results of the Phase II Confirmation Stage (Stage 1) Study at Luke AFB, the following key conclusions have been drawn:

1. Shallow soil conditions sampled and analyzed at LAFB indicate that levels of potential contaminants are low at most sites. The exception to this conclusion is Site No. 7, the North Fire Department Training Area, where VOA contaminants were detected at higher levels and deeper depths than at the other sites. No caliche layer was detected at Site No. 7.

2. Water quality testing was done only on Base Production Wells, and water quality data for the species tested are generally good. The exceptions to this conclusion are Wells Nos. 4 and 10, where low levels of 1,2-dichloroethylene was detected.

3. Well No. 10 is located adjacent to Site No. 7, the North Fire Department Training Area, and the potential exists that solvents detected in Well No. 10 are from either the North Fire Department Training Area of from the Current Fire Department Training Area.

4. Site No. 7, the North Fire Department Training Area, as well as the Current Fire Department Training Area (located about 200 yards east of Site No. 7) should be subjected to additional evaluation in order to ascertain the source or sources of VOA compounds in Production Well No. 10.

SECTION 5

ALTERNATIVE MEASURES

5.1 GENERAL

The principal goal of this Phase II Confirmation Study was to determine whether or not environmental degradation was occuring as a result of past waste disposal practices at LAFB. The work scope directed that an initial round of samples be collected. The basis for many of the above conclusions is, therefore, predicated on this set of analyses. That only two Base Production Wells contained detectable levels of halogenated organics is an important preliminary finding which requires verification. The detection of low levels of radionuclides in Production Well No. 4 also requires further evaluation.

The alternative measures discussed below focus mainly upon problem definition aspects of environmental contamination detected at LAFB. The alternative actions which could be undertaken at this point generally fall into the following categories:

	Action	Sites
1.	Quantification Stage (Stage 1) Monitoring at Base Production Wells	Base Wells
2.	Expanding Groundwater Monitoring Network	Current and North Fire Department Training Areas
3.	Interim Quarterly Monitoring	Base Wells
4.	Quantification Stage (Stage 1) Analysis	Current and North Fire Department Training Areas

These alternative measures are generally in the order of priority based on the findings to date.

5.1.1. Base Production Wells

All Base Production Wells should be resampled for at least the list of analytes run in the single Confirmation Stage (Stage 1) round of analyses. This new round of sampling and analyses should include those wells which were out of service and could not be sampled during Confirmation Stage (Stage 1) activities. In view of the detection of VOA compounds in two wells, and radionuclides and a pesticide in one well, the Base should consider establishing a routine, quarterly sampling program for this limited suite of analytes in order to establish a baseline of these water quality data.

5.1.2 Current and North Fire Department Training Areas

A verification round of water quality analyses should be run on all Base Production Wells, with particular attention paid to the cluster of wells west and downgradient of these sites. If this round of sampling verifies the presence of VOA compounds in one or more of the wells, then an expanded Quantification Stage (Stage 2) evaluation of the sites would be warranted.

5.2 SUMMARY

Supplementary actions concerning water resource analysis and monitoring are not believed to be necessary based on the data obtained to date.

SECTION 6

RECOMMENDATIONS

6.1 GENERAL

The findings of the Phase II Study at LAFB indicate the need for follow-on work. This work includes the following:

1. General verification of the initial round of water quality sampling and analysis.

2. An expanded monitoring program developed for the Current and North Fire Department Training Areas, with an emphasis on determining the nature and extent of contamination by priority pollutants.

The recommended actions are intended to establish the data base for evaluation of which, if any, remedial actions might be necessary for each given site. The recommendations are presented in prioritized order.

6.1.1 Base Production Wells

The following supplemental work is recommended for all Base Production Wells:

1. All Base Production Wells should be resampled and subjected to verification analyses for oil and grease, VOA compounds, pesticides and radionuclides, at a minimum. All positive VOA results should be subjected to second column confirmation.

2. Based upon the results of the verification analyses, the Base should consider implementing a routine, quarterly water quality monitoring program for all Base Production Wells for these analytes.

6.1.2 Current and North Fire Department Training Areas

The following supplemental work is recommended for the Current and North Fire Department Training Areas:

1. Based upon the results of the verification analyses, additional soil borings in the vicinity of both Fire Department Training Areas are recommended. Four soil exploratory borings are recommended to be drilled to depths of 100 feet each, two at each of the two Areas. Soils should be sampled at 5-foot intervals, and should be analyzed for oil and grease and VOA compounds, in order to define the vertical extent of soil contamination.

2. If soil contaminants are found at the 100-foot level in any of the borings, then two downgradient monitor wells are recommended to be drilled - one between the North and Current Fire Department Training Areas, and one between the North Fire Department Training Area and the cluster of Base Production Wells at the northwestern corner of the Base. These wells should be sampled and analyzed for oil and grease and VOA compounds, as a minimum.

3. A Concept Engineering Evaluation of the two sites should be considered in order to a) identify the broadest possible spectrum of potentially appropriate remedial actions, and b) make recommendations as to the proper reconstruction and operation of the Current Fire Department Training Area, in order that continued use of the site will not provide a continuing source of potential groundwater contaminants.

APPENDIX A

Acronyms, Definitions, Nomenclature
and Units of Measurement

ASTM	American Society for Testing and Materials
Alluvium	Sedimentary materials deposited in an environment of flowing surface waters.
Aquifer	Zone beneath the earth's surface capable of producing water for a well.
Artesian	Describes ground waters which are under pressure in an aquifer, with pressures causing ground water to rise in a well.
BEE	Bio-Environmental Engineering
Caliche	Gravel, sand or desert debris cemented by porous calcium carbonate.
CERCLA	Comprehensive Environmental Response Compensation and Liability Act of 1980.
cm/s	Centimeters per second
Conglomerate	A rock composed of rounded, water-worn fragments of gravel or pebbles, cemented together by another mineral substance.
BDCP	Pesticide compound syn: 1,2, Dibromo-3-Chloropropane.
DEQPPM	Defense Environmental Quality Program Policy Memorandum
DoD	Department of Defense
EDB	Pesticide compound syn: Ethylene Dibromide
Evaporites	Sedimentation deposits of minerals crystallized during evaporation of fresh or saline waters.
ground water divide	A line on the water table on each side of which the ground water table slopes away from the line.
ground water surface	The level below which the earth is saturated.
HARM	Hazard Assessment Rating Methodology.
HNu	Volatile organic vapor detection meter.

hydraulic gradient	Change in pressure or head in the ground water over a given distance of flow.
IRP	Installation Restoration Program.
Lacustrine Deposits	Sedimentary materials deposited on the bottom of a lake bed.
LAFB	Luke Air Force Base
MCP	Major Construction Program
ug/g	Micrograms per gram (equilavent to parts per billion in solids).
ug/l	Micrograms per liter (equivalent to parts per billion in water).
mg/l	milligrams per liter (equivalent to parts per million in water).
mgd	million gallons per day
M.S.	Master of Science degree
MSL	Mean Sea Level datum
N	North
O&G	Oil and grease
OEHL	Occupational and Environmental Health Laboratory
pCi/l	Picocuries per liter
P.G.	Registered Professional Geologist
Ph.D.	Doctor of Philosophy degree
POL	Petroleum, Oil and Lubricants
ppb	Parts per billion (equivalent to ug/l in water).
ppm	Parts per million (equivalent to mg/l in water).
RCRA	Resource Conservation and Recovery Act of 1976

TAC	Tactical Air Command
Unconsolidated Sediments	Sediments that are uncemented and thus contain interconnected void space (primary porosity) that allow for the storage and transmission of groundwater.
USAF	United States Air Force
USEPA	United States Environmental Protection Agency.
VOA	Volatile Organic and Aromatic Hydrocarbons
WTA	Waste Treatment Annex
WWTP	Waste Water Treatment Plant

APPENDIX B

TASK ORDER 0024

Revision No. 1 of Description of Task

INSTALLATION RESTORATION PROGRAM

Phase II Field Evaluation

Luke AFB AZ

I. Description of Work

The purpose of this task is to determine if environmental contamination has resulted from waste disposal practices at Luke AFB AZ; to provide estimates of the magnitude and extent of contamination, should contamination be found; to identify potential environmental consequences of migrating pollutants; to identify any additional investigations and their attendant costs necessary to identify the magnitude, extent and direction of movement of discovered contaminants.

The presurvey report (mailed under separate cover) and Phase I IRP report (mailed under separate cover) incorporated background and description of the sites for this task. To accomplish the survey effort, the contractor shall take the following steps:

A. General

1. Water sampling shall be accomplished only once at each location.

2. Sampling, maximum holding time and preservation of samples shall strictly comply with the following references: (a) Standard Methods for Examination of Water and Wastewater, 15th Ed. (1980), pp.35-42; (b) ASTM; Part 31, pp. 72-82, (1976), Method D-3370; and (c) Standard Methods for Chemical Analysis of Water and Wastes, EPA Manual 600/4-79-020, pp.xiii to xix (1979). Minimum detection limits for chemical analyses are shown in attachment 1.

3. Bore holes shall be monitored for organic vapors with photo-ionization detector and explosimeter throughout drilling, and the readings thus obtained shall become part of the boring logs.

B. In addition to items delineated above, conduct the following specific actions at sites identified on Luke AFB.

1. Site No. 6, South Fire Department Training Area

a. The contractor shall interview former employees familiar with the location of the South Fire Department Training Area to determine the exact location of this site. Names of personnel to be interviewed will be provided by the Luke AFB bioenvironmental engineer. Available aerial photos of the site shall also be reviewed. The contractor shall obtain the photos from Landis Aerial Surveys, Inc., in Phoenix AZ.

b. A maximum of four shallow soil samples shall be obtained for analysis. A maximum of 4 soil samples total shall be analyzed. Samples shall be analyzed for oil and grease by EPA method 413.2 and volatile aromatics and volatile halocarbons utilizing GC techniques.

2. Site No. 5, POL Waste Disposal Trench

a. The contractor shall install in this site 10 soil borings 20 feet deep. The exact location of each boring shall be determined in the field. Representative samples of each one foot increment (a total of 20) shall be collected from each boring. A maximum of two samples from each boring shall be selected for analysis. A maximum of 12 samples total shall be analyzed. Those samples not analyzed shall be frozen for possible future analyses. Samples shall be analyzed for lead, oil and grease by EPA method 413.2, and volatile aromatic and volatile halocarbons utilizing GC techniques.

b. Concurrently with the soil boring program, Luke AFB Production Well No. 11 shall be sampled and analyzed for lead, oil and grease by EPA method 413.2, and volatile aromatics and volatile halocarbons using GC techniques.

3. Site No. 4, Perimeter Road Waste POL Application Site

a. The contractor shall install eight soil borings two feet deep in the area the site is believed to be located. Representative samples of each one foot increment (a total of 2) shall be collected from each boring and shipped to the contractor laboratory. A maximum of two samples from each boring shall be selected for analysis. A maximum of 12 soil samples total shall be analyzed. Those samples not analyzed shall be frozen for possible future analyses. Samples shall be analyzed for oil and grease by EPA method 413.2 and volatile aromatics and volatile halocarbons using GC techniques.

4. Site No. 7, North Fire Department Training Area

a. The contractor shall install four soil borings 20 feet deep in the area where the site is believed to be located. Representative samples of each one foot increment (a total of 20) shall be collected from each boring and shipped to the contractor laboratory. A maximum of four samples from each boring shall be selected for analysis. A maximum of 12 soil samples total shall be analyzed. Those samples not analyzed shall be frozen for possible future analyses. Samples shall be analyzed for oil and grease by EPA method 413.2 and volatile aromatics and volatile halocarbons utilizing GC techniques.

b. Concurrent with the soil sampling program, Luke AFB Production Wells 8, 9 and 10 shall also be sampled and analyzed for oil and grease by EPA method 413.2 and volatile aromatics and volatile halocarbons using GC techniques.

5. Base Production Wells and Wastewater Treatment Plant

a. The contractor shall sample all 9 existing base production wells. All 9 samples shall be analyzed for dibromochloropropane (DBCP). The sample from Well No. 4 shall also be analyzed for Oils and Greases (IR Method 413.2), Phenols, Volatile, Aromatics, and Volatile Halocarbons by GC techniques, Gross-Alpha, Beta- and Gamma Activities, and Radium-226.

b. The contractor shall obtain one sample each from the influent and effluent to the Wastewater Treatment Plant. Each sample (2 total) shall be analyzed for Oils and Greases, Phenols, and Volatile Aromatics, and Volatile Halocarbons by GC techniques.

C. Boring Installation and Clean-up

Upon completion of each boring, the bore hole shall be pressure-grout backfilled with a bentonite-cement mixture. Boring area shall be cleaned following the completion of each boring. Drill cuttings shall be removed and the general area cleaned. A total of 22 borings shall be accomplished. The exact location of borings in each site shall be determined in the field.

D. Data Review

Results of sampling and analysis shall be tabulated and incorporated in the monthly R&D Status Report and forwarded to the USAF OEHL for review as soon as they become available as specified in Item VI below.

E. Reporting

1. A draft report deliniating all findings of this field investigation shall be prepared and forwarded to the USAF OEHL as specified in Item VI below for Air Force review and comment. This report shall include a discussion of the regional geohydrology, boring logs from all project borings, soil test results and conclusions, water quality analysis results, and laboratory quality assurance information. This report shall follow the USAF OEHL supplied format (mailed under separate cover).

2. Estimates shall be made of the magnitude and extent of movement of contaminants discovered. Potential environmental consequences of discovered contamination must be identified or estimated. Where survey data are insufficient to properly determine or estimate the magnitude and extent of movement of discovered contaminants specific recommendations, fully justified, shall be made for additional efforts required to properly evaluate contamination migration.

3. Specific requirements, if any, for additional soil borings or for future groundwater monitoring must be identified.

F. Quality Assurance

The quality assurance specified in Section H, para. xxi of the contract is applicable to this order.

G. Cost Estimates

The contractor shall provide cost estimates for all additional work recommended to permit proper determination of contaminants. The recommendations provided shall include all efforts required to determine the magnitude, extent and direction of movement of discovered contaminants along with an estimate of the time required to accomplish the proposed effort. This information shall be provided in a separately bound appendix to the draft final report.

II. Site Location and Dates

Luke AFB AZ
USAF Hospital Luke/SGPB
Dates to be established

III. Base Support: None

IV. Government Furnished Property: None

V. Government Points of Contact:

1. Dee Ann Sanders
USAF OEHL/CVT
Brooks AFB TX 78235
(512) 536-2158
AV 240-2158

2. 2Lt Henry J. Thompson, Jr
USAF Hospital Luke/SGPB
Luke AFB AZ 85309
(602) 856-7521
AV 853-7521

3. Col Jerry Dougherty
HQ TAC/SGPAE
Langley AFB VA 23665
(804) 764-2180
AV 432-2180

No modification or change to above task will be done, without being proposed and submitted in writing, in a timely manner to USAF OEHL/CVT.

VI. In addition to sequence numbers 1, 5, and 11 listed in Atch 1 to the contract, which are applicable to all orders, the reference numbers below are applicable to this order. Also shown are data applicable to this order.

Sequence Nr	Block 10	Block 11	Block 12	Block 13	Block 14
4*	ONE/R	84FEB13	84FEB27	84JUN15	*

*Contractor shall supply the USAF OEHL with 20 copies of the draft report and 50 copies plus the original camera ready copy of the final report.

Attachment 1

Required Sample Detection Limits

Parameter	Soil	Water
Oil and Grease (IR Method 413.2)	100 microgram/gram	0.1 milligram/liter
Phenol	- - -	1.0 microgram/litter
Dibromochloropropane (DBCP)	- - -	0.1 microgram/liter
Volatile Aromatics, Volatile Halocarbons	*	*
Gross Alpha, Beta, Gamma Activities	- - -	2 picocuries/liter
Radium 226	- - -	2 picocuries/liter

* Detection limits shall be as specified for compounds listed in EPA Methods 601 and 602.

APPENDIX C

Professional Profiles of Project Personnel

Peter J. Marks

Fields of Competence

Project management; environmental analytical laboratory analysis; hazardous waste, groundwater and soil contamination; source emissions/ambient air sampling; wastewater treatment; biological monitoring methods; and environmental engineering.

Experience Summary

Eighteen years in Environmental Laboratory and Environmental Engineering as Project Scientist, Project Engineer, Process Development Supervisor, and Manager of Environmental Laboratory with WESTON. Experience in analytical laboratory, wastewater surveys, hazardous waste, groundwater and soil contamination, DoD-specific wastes, stream surveys, process development studies, and source emission and ambient air testing. In-depth experience in pulp and paper, steel, organic chemicals, pharmaceutical, glass, petroleum, petrochemical, metal plating, food industries and DoD.

Applied research on a number of advanced wastewater treatment projects funded by Federal EPA.

Credentials

B.S., Biology—Franklin and Marshall College (1963)

M.S., Environmental Engineering and Science—Drexel University (1965)

American Society for Testing and Materials

Water Pollution Control Federation

Water Pollution Control Association of Pennsylvania

Employment History

1965-Present	WESTON
1963-1964	*Lancaster County General Hospital Research Laboratory for Analytical Methods Development*

Key Projects

USAF/OEHL Brooks AFB. Program Manager for this three-year BOA contract provides technical support in environmental engineering surveys, wastewater characterization programs, geological investigations, hydrogeological studies, landfill leachate monitoring and landfill siting investigations, bioassay studies, wastewater and hazardous waste treatability studies, and laboratory testing and/or field investigations of environmental instrumentation/equipment. Collection, analysis, and reporting of contaminants present in water and wastewater samples in support of Air Force Environmental Health Programs.

United States Army Toxic and Hazardous Materials Agency (USATHAMA), Aberdeen Proving Ground, Maryland. Program Manager for three-year basic ordering agreement contract to provide research and development for technology in support of the DOD Installation Restoration Program. The objective of the Program is to identify and develop treatment methods/technology for containment and/or remedial action. Technology development for remedial action is to include groundwater, soils, sediments, and sludges.

Confidential Client, Ohio. Project Manager of an on-going contract to conduct corporate environmental testing and special projects at client's U.S. and overseas plants. WESTON must be able to assign up to four professionals to a project within a two week notice.

Confidential Client (Inorganic and Organic Chemicals). Product Manager of a current contract to conduct wastewater sampling and analysis of plant effluent for priority pollutants. The project also includes a wastewater treatability study to evaluate a number of process alternatives for removal of priority pollutants from the present effluent.

Confidential Client, Utah. Technical Project Manager for in-depth wastewater survey, in-plant study, treatability study, and concept engineering study in support of the client's objectives to meet 1983 effluent limitations. WESTON had two project engineers, two chemists, five technicians and an operating laboratory in the field. Field effort is six months duration.

Professional Profile

Frederick Bopp III, Ph.D., P.G.

Registration

Registered Professional Geologist in the State of Indiana

Fields of Competence

Groundwater resources evaluation; hydrogeologic evaluation of sanitary landfills and other waste disposal sites; detection and abatement of groundwater pollution; digital modeling of groundwater flow and solute transport; statistical analysis of geological and geochemical data; geochemical prospecting; estuarine geology and geochemistry; trace metal and aqueous geochemistry.

Experience Summary

Seven years experience in hydrogeology and geochemistry, involving such activities as: assessment of subsurface water and soil contamination; development of contamination profiles; evaluation of remediation actions for groundwater quality restoration; quantitative chemical analysis of water and soil; ore assay and ore body evaluation; drilling supervisor; hydrogeologic assessment; pollution detection and abatement; estuarine pollution analysis; application of flow and solute transport computer models; computer programming; project management; teaching environmental geology and geochemistry.

Credentials

B.A., Geology—Brown University (1966)

M.S., Geology—University of Delaware (1973)

Ph.D., Geology—University of Delaware (1979)

Sigma Xi, The Scientific Research Society of North America

Geological Society of America, Hydrology Division

National Water Well Association, Technical Division

American Association for the Advancement of Science

Estuarine Research Federation: Atlantic Estuarine Research Society

Employment History

1979-Present	WESTON
1977-1979	U.S. Army Corps of Engineers Waterways Experiment Station
1976-1977	University of South Florida Department of Geology
1970-1976	University of Delaware Department of Geology
1974-1976	Earth Quest Associates President and Principal Partner
1974 (Summer)	WESTON
1966-1970	United States Navy Commissioned Officer

Key Projects

Project manager on seven task orders for environmental assessment services at United States Air Force facilities in nine states.

Task manager for a Superfund site evaluation in Ohio.

Site manager for drum recovery operations in Pennsylvania and New Jersey.

Project manager for site assessments of oil and fuel spills in four states.

Project manager for closure plan development at a hazardous waste landfill in New Jersey.

Definition and abatement of groundwater contamination from chemical manufacturing in Delaware.

Flow and solute transport digital model of a heavily-pumped regional aquifer in southern New Jersey.

Definition and abatement of groundwater contamination from chemical manufacturing in the Denver area.

Hydrogeologic impact assessment of on-land dredge spoil disposal in coastal North Carolina.

Geochemical prospecting and ore body analysis in Arizona.

Professional Profile

Walter M. Leis, P.G.

Registration

Registered Professional Geologist in the States of Georgia (No. 440) and Indiana.

Fields of Competence

Detection and abatement of groundwater contamination; design of artificial recharge wells; deep well disposal; simulation of groundwater systems; hydrogeologic evaluation of hazardous waste sites and landfills; practical applications of geophysical surveys to hydrologic systems, site investigations, and borehole geophysical surveys. Geochemical studies of acid mine drainage and hazardous wastes.

Experience Summary

Sixteen years experience as field hydrogeologist, field supervisor, project director, research director. Six years research involving two consecutive projects: 1) application of geophysical techniques in evaluating groundwater supplies in fractured rock terrain in Delaware and Pennsylvania; 2) project director for an artificial recharge and deep well disposal study. Provided consultation for waste disposal and aquifer quality problems for coastal communities.

Developed geochemical sampling techniques for deep mine sampling. Evaluated synthetic and field hydrologic data for deep formulational analysis in coal field projects.

Earlier research experience involved developing techniques for mapping subsurface regional structures having interstate hydrologic significance, and defining ore bodies by geochemical prospecting.

Credentials

B.S., *Biochemistry—Albright College (1966)*

M.S., Hydrogeology—University of Delaware (1975)

Cooperative Program Environmental Engineering—University of Pennsylvania

Additional special course work in Geology and Hydrology, Franklin and Marshall College and Pennsylvania State University

Remote Sensing Data Processing Training, Goddard Space Center (1978)

OWRR Research Fellow, 1973

National Water Well Association, Technical Division.

Geological Society of America, Engineering Geological Division.

Society of Economic Paleontologists and Mineralogists

Employment History

1974-Present	WESTON
1973-1974	University of Delaware Water Resources Center
1971-1973	University of Delaware
1967-1971	Pennsylvania Department of Environmental Resources

Key Projects

Definition of groundwater contamination from sanitary landfill leachate and recovery of contaminants to protect heavily used aquifer in Delaware.

Field design studies for artificial recharge and waste disposal wells.

Design and construction of hydrologic isolation systems for various class hazardous wastes.

Design and supervision of chemical and physical rehabilitation of groundwater collection systems in fractured rock and coastal plain areas.

Principal investigator for six projects involving subsurface migration of PCB's in New York, New Jersey, Pennsylvania, and Oklahoma.

Design and construction supervision of hydrocarbon recovery wells in Pennsylvania.

Professional Profile

James S. Smith, Ph.D.

Fields of Competence

Analytical laboratory management; organic chemistry; mass spectrometry, GC/MS/DS, high and low resolution, chemical ionization and special techniques; gas chromatography including capillary column techniques; high performance liquid chromatography (HPLC); the uses of NMR, IR, UV, visible, inorganic analyses, electrochemical, thermal techniques and surface methodologies (SEM, ESCA, SIMS) to solve industrial problems; the development of quality control measures in analytical protocols; the testing of laboratory safety methodologies; innovation of new analytical techniques and methods to solve industrial, product liability, production and environmental problems.

Experience Summary

Eleven years experience in the supervision of an analytical group involved in solving all types of industrial problems including environmental, product safety, production, research and development. The main emphasis was on the innovative development of analytical methods utilizing instrumental technologies. In-depth experience in the organic chemicals, inorganic chemicals polymer, fiber, tire, solvent, fluorine chemicals, coke and coal tar industries. Numerous scientific presentations. Contributor to three Chemical Manufacturers Association Task Groups: Environmental Monitoring, Groundwater, and Hazardous Waste Response Center.

Taught general chemistry, analytical chemistry, organic chemistry, and instrumental analysis for four years at Eastern Michigan University and the University of Illinois.

Credentials

B.A., Chemistry—Williams College (1960)

Ph.D., Organic Chemistry—Iowa State University (1964)

Postdoctoral Organic Chemistry—University of Illinois (1966)

Postdoctoral Mass Spectroscopy—Cornell University (1969)

American Chemical Society

American Society for Testing Materials

American Society of Mass Spectroscopists

Employment History

1981-Present	WESTON
1969-1981	Allied Chemical Corporation Corporate Research Center
1966-1968	Eastern Michigan University Assistant Professor of Chemistry
1965-1966	University of Illinois

Key Projects

Directed analytical group for five years of intensive sampling and analysis of a toxic insecticide. Analyses involved soil, air, water, sludge, blood, bile, feces, urine, animal feed, and plant samples to detect the compound at the low parts-per-billion level. The project involved rapid development of new and accurate analytical methods.

Developed an industrumental analytical laboratory consisting of trace environmental analyses, gas chromatography, high performance liquid chromatography, mass spectrometry, surface analyses, X-ray photoelectron spectroscopy and nuclear magnetic resonance spectroscopy including the design and manufacture of instrument modifications, purchasing instruments, and hiring of key personnel.

Isolated, identified, and developed a method of analysis for a colored impurity on a bulk chemical product. Synthesized the colorant for proof of identification and as a standard for future analysis. Proved the mechanism of the development of the color from the packaging materials. Designed new specifications eliminating the problem.

Conducted corporate plant environmental laboratory QA/QC audits including the development of a corporate QA/QC manual.

Professional Profile

Provided an inexpensive and accurate method of analysis of lead for a manufacturing plant effluent. A published methodology in kit form was modified for plant personnel use to measure soluble and total lead in a waste stream without use of excessive manpower or capital. QA/QC procedures were included as well as the use of performance samples.

Supervision of analytical technological advances that lead to either patents and new products in the fields of coal tar chemicals, food packaging and transformer manufacturing.

Publications

Smith, J., A. Weston, and C. Wezwick, "Tire Cord Emission Studies, Conclusion", The International Society of Industrial Yarn Manufacturers, Savannah, Georgia, 3-4 November 1977.

Hanrahan, J., E. McCarthy, D. Richton, J. Smith, and A. Weston, "Identification of an Interfering Compound is the Determination of Dimethylnitrosamine by Gas Chromatography-Mass Spectrometry", 26th Annual Conference on Mass Spectrometry and Allied Topics, St. Louis, Missouri, 28 May to 2 June 1978.

Brozowski, E., D. Jerolamon, D. Richton, D. Smith, J. Smith, and A. Weston, "Industrial Applications of Chemical Ionization with the Ammonium Ion", 26th Annual Conference on Mass Spectrometry and Allied Topics, St. Louis, Missouri, 28 May to 2 June 1978.

Mueller, B.W., L. Palmer, G. Rebyak, and J. Smith, "Analysis of Alpha and Beta Naphthalene Sulfonic Acids by High Performance Liquid Chromatography", North Jersey A.C.A. Chromatography Discussion Group, Nutley, New Jersey, 14 March 1979.

French, C., L. Palmer, and J. Smith, "Analysis of Polymer Oligomers by High Performance Liquid Chromatography", Middle Atlantic Regional A.C.S. Meeting, West Long Branch, New Jersey, 19-23 March 1979.

Burkitt, D. and J. Smith, "A Simple Chromatographic Modification Providing for Rapid Interchange of Capillary and Packed Columns", Middle Atlantic Regional A.C.S. Meeting, West Long Branch, New Jersey, 19-23 March 1979.

Brozowski, E., D. Jerolamon, D. Richton, D. Smith, and J. Smith, "A Convenient Method for the Evaporation of Solvent in the Priority Pollutant Program," Middle Atlantic Regional A.C.S. Meeting, West Long Branch, New Jersey, 19-23 March 1979.

Mady, N., D. Smith, J. Smith, and C. Wezwick, "The Analysis of Kepone in Biological Samples", Proceedings of the 9th Materials Research Symposium, Gaithersburg, Maryland, 10-12 April 1978.

Mueller, B., L. Palmer, and J. Smith, "A High Performance Liquid Chromatographic Method for the Analysis of Bis-phenol-A and Its Impurities", Middle Atlantic Regional A.C.S. Meeting, West Long Branch, New Jersey, 19-23 March 1979.

Gabriel, M., J. Hanrahan, and J. Smith, "A Sensitive Method for the Quantitative Analysis of Pyridine at the Low PPM Level", Middle Atlantic Regional A.C.S. Meeting, West Long Branch, New Jersey, 19-23 March 1979.

Burkitt, D., J. Hanrahan, and J. Smith, "Analysis of Hexachloroacetone and Hexafluoroacetone in Industrial Wastewater", Proceedings of the A.S.T.M. Committee D-19 Symposium, "The Measurement of Organic Pollutants in Water and Wastewater", Denver, Colorado, 19-20 June 1978.

Brozowski, E., D. Burkitt, M. Gabriel, E. McCarthy, J. Hanrahan, and J. Smith, "A Simple, Sensitive Method for the Quantitative Analysis of Carbon Tetrachloride and Chloroform in Water at the Parts Per Billion Level", Proceedings of the 9th Materials Research Symposium, Gaithersburg, Maryland, 10-12 April 1978.

John A. Williams, Jr.

Fields of Competence

Geologic and geophysical investigations; geological and groundwater sampling techniques and instrumentation technology; design, operation, and evaluation of geophysical survey, equipment, testing and analysis of aquifers, and groundwater pollution.

Experience Summary

Three years experience in geologic and geophysical investigtions including subsurface profiling using Ground Penetrating Radar (GPR), electrical resistivity and electromagnetic conductivity for numerous private and government facilities; groundwater sampling and aquifer pump tests, six years experience in bathymetric, hydrographic and biological studies.

Credentials

A. S., Marine Technology - Cape Fear Technical Institute (1975)

B. S., Earth Science (Geology) - West Chester State College (1983)

Certified Ground Penetrating Radar Operator

Certified NAUI/PADDI Scuba Diver

Geological Society of America

Employment History

1982 - Present	WESTON
1980-1982	Environmental Resources Management, Inc.
1977-1980	WESTON
1976-1977	Highway Service Marineland
1975-1976	Lawler, Matusky, Skelly Engineers

Key Projects

Coordinated and supervised geophysical investigations to locate buried drums and to delineate the boundaries of a buried waste lagoon for a scrap recovery plant in Rhode Island.

Geophysical field investigation to locate buried trenches and waste lagoons for a government facility in California.

Geophysical field investigation, well installation and sample collection to determine the distribution of leachate, and the extent of contamination in a heavily-used aquifer in New York.

Geophysical investigation to define the lateral and vertical effect of fill deposition for a facility in Massachusetts.

Soils investigation to determine the extent of contamination from old waste lagoons and fire training areas for a government facility in Arizona.

Hydrogeologic investigation for a scrap recovery facility in western Pennsylvania.

Responsible for deploying benthic and water quality sampling gear and an electronic navigation system for a dredge spoils disposal study in Lake Erie.

Geophysical investigation (ground penetrating radar and electrical resistivity) to locate buried drums and delineate trench boundaries for a government facility in Ohio.

Professional Profile

Vicki Bognar

Fields of Competence

Analytical laboratory analyses of water and soil utilizing wet chemistry and gas chromatography. Computer programing and operations. Data management.

Experience Summary

Two years of analytical laboratory experience in water analysis, process analysis of industrial plants, quality control checks of water treatment chemicals, preparation of lab quality assurance samples and subsequent performance reports using EPA standard methods of analysis. Methodology includes: wet methods of analysis, gas chromatography and auto analyzer.

Experience in field sampling, utilizing EPA techniques for water and soil. As data management coordinator: track sample status from logging through final reporting and sample disposal, complete operation of the laboratory data base computer system, and production of final tabular reports each month.

Credentials

Associates Degree—Milwaukee Area Technical College, Milwaukee, Wisconsin

Training Program by Varian Instrument Group on Gas Chromatography, Walnut Creek, CA

Basic Computer Programming and Operations—Tracy, CA

Employment History

1983-Present	WESTON
1982-1983	Occidental Chemical Company
1978-1982	Todd Shipyards, Inc.

Key Projects

Occidental Chemical Company—Data management, pesticide, herbicide and fumigant analysis.

Helped plan and start up new laboratory facility.

Professional Profile

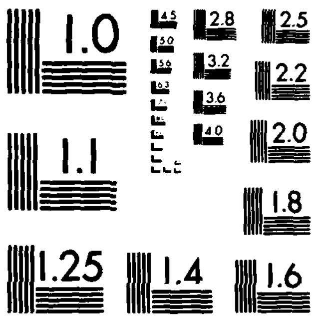
APPENDIX D

Soil Boring Logs

AD-A151 808 INSTALLATION RESTORATION PROGRAM PHASE II STAGE 1 2/2
PROBLEM CONFIRMATION ST..(U) WESTON (ROY F) INC WEST
CHESTER PA NOV 84 F33615-80-D-4006

UNCLASSIFIED F/G 13/2 NL

END



MICROCOPY RESOLUTION TEST CHART

NATIONAL BUREAU OF STANDARDS 1963-A

WESTON

BORING LOG

BORING NO.: SB-1
OWNER: USAF
LOCATION: Site #5 P.O.L. Waste Disposal Site
ADDRESS: Luke AFB Phoenix, Arizona
TOTAL DEPTH: 20.0'
SURFACE ELEVATION: —
WATER LEVEL: —
DRILLING COMPANY: Western Technologies
DRILLING METHOD: Hollow Stem Auger
DATE DRILLED: 9 Nov. 1983
DRILLER: J. Kualik
HELPER: E. Gonzales
LOG BY: J. Williams

SKETCH MAP

NOTES:

DEPTH (FEET)	H-NU	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
0-1.5	4.0	1063	SS 10.0	3,10 13	Fine Sandy Silt, Cemented, Dry, 7.5 YR 5/6
1.5-3.0	4.0	1064	SS 16.0	8,11 16	Fine Sandy Silt, Cemented, Dry, 7.5YR 5/6
3.0-4.5	6.0	1065 A	SS 18.0	15,21 26	Fine Sandy Silt, Cemented, Dry 10 YR 5/6
	6.0	1065 B			Duplicate
4.5-6.0	6.0	1066	SS 17.0	22,45 48	Fine Sandy Silt, Cemented, 10YR 5/6, Saturated layer at 4.5' to 4.8'
6.0-7.5	5.0	1067	SS 13.0	23,29 35	Fine Sandy Silt, Cemented, Dry, 7.5 YR 6/4
7.5-9.0	5.0	1068	SS 13.0	29,48 65	Fine Sandy Silt, Cemented, Dry, 7.5YR 7/4
9.0-10.5	6.0	1069	SS 10.0	50,93	Silt, Cemented, Very Hard, Dry, 5YR 7/3
10.5-12.0	5.0	1070	SS 4	100	Silt, Cemented, Very Hard, Dry, N8
12.0-13.5	5.0	1071	SS 10	37,37 45	Silt, Cemented, Striated, Dry, 10YR 5/4
13.5-15.0	5.0	1072 A	SS 15	28,42 53	Fine Sandy Silt, Low Moisture — Dry, 10YR 6/4
	5.0	1072 B			Duplicate
15.0-16.5	4.0	1073	SS 17	23,24 24	Fine – Medium Sands, some silt, Low Moisture — Dry, 10YR 7/4
16.5-18.0	5.0	1074	SS 17	23,29 48	Fine – Medium Silty Sands, 10YR 6/4, Hard Silt Layer at 17.0' to 17.02', Dry
18.0-19.5	4.0	1075 A	SS 16	25,21 17	Fine – Coarse Silty Sands, Dry, 10YR 5/6
	4.0	1075 B			Duplicate
19.5-21.0	3.0	1076	SS 15	23,21 15	Fine – Coarse Silty Sands, Small amount of gravel, Dry, 10YR 6/4

* ASTM D1586

SHEET 1 OF 1

WESTON

BORING LOG

BORING NO.: SB-2 OWNER: USAF

LOCATION: SITE #5 P.O.L. WASTE DISPOSAL TRENCH ADDRESS: LUKE AFB. Phoenix, Arizona

TOTAL DEPTH 21.0'

SURFACE ELEVATION: — WATER LEVEL: —

DRILLING COMPANY: WESTERN TECHNOLOGIES DRILLING METHOD: Hollow stem AUGER DATE DRILLED: 9 Nov. 1983

DRILLER: T. Kurlik HELPER: E. GONZALES

LOG BY: J. Williams

SKETCH MAP

NOTES:

DEPTH (FEET)	H-NU	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
-1.5	1.0	1077	SS 13.0	3, 13, 18	FINE SANDY SILT, DRY, HARD, 10YR 5/6
1.5-3.0	1.0	1078	SS 8.0	21, 18, 15	FINE SANDY SILT, DRY, CEMENTED, 10YR 5/4
3.0-4.5	3.0	1079	SS 10.0	15, 13, 16	FINE SANDY SILT, DRY, HARD, 7.5YR 5/4
4.5-6.0	5.0	1080	SS 14.0	12, 13, 21	FINE-MEDIUM SANDY SILT, DRY-LOW MOISTURE, 10YR 5/4
6.0-7.5	4.0	1081 A	SS 16.5	17, 21, 22	FINE-MEDIUM SAND, Small amounts Gravel & SILT, 7.5YR 5/6
	4.0	1081 B			
7.5-9.0	4.0	1082	SS 13.0	21, 25, 42	SILT, VERY HARD, CEMENTED, DRY, 7.5YR 7/2
9.0-10.5	5.0	1083	SS 17.0	38, 40, 38	SILT, VERY HARD, CEMENTED, DRY, 7.5YR 7/4
10.5-12.0	4.0	1084	SS 13.0	28, 91	SILT, VERY HARD, CEMENTED, DRY, 7.5YR 7/4
12.0-13.5	4.0	1085	SS 8.5	20, 100	FINE SANDY SILT, CEMENTED, DRY, 10YR 7/4
13.5-15.0	3.0	1086	SS 9.5	38, 80	FINE SANDY SILT, CEMENTED, DRY, 10YR 6/4
15.0-16.5	4.0	1087	SS 13.0	22, 24, 32	FINE to MEDIUM SANDS, DAMP, 10YR 7/4
16.5-18.0	3.0	1088	SS 15.0	16, 15, 20	FINE-MEDIUM SILTY SANDS, 1/4"-3/8" GRAVEL, DAMP
18.0-19.5	4.0	1089	SS 16.0	27, 25, 21	FINE-MEDIUM SILTY SAND, DRY
19.5-21.0	3.0	1090	SS 17.0	13, 14, 14	MEDIUM-COARSE SANDS, 1/4"-3/8" GRAVEL DRY

* A.S.T.M. D1586

SHEET 1 OF 1

WESTON

BORING LOG

BORING NO.: SB-3
OWNER: USAF
LOCATION: Site #5 POL WASTE Disposal Trench
ADDRESS: LUKE AFB Phoenix, ARIZONA
TOTAL DEPTH: 21.0'
SURFACE ELEVATION: —
WATER LEVEL: —
DRILLING COMPANY: Western Technologies
DRILLING METHOD: Hollow Stem Auger
DATE DRILLED: 9 Nov. 83
DRILLER: T. KURLIK
HELPER: E. GONZALES
LOG BY: J. Williams

SKETCH MAP

NOTES:

DEPTH (FEET)	H-NU	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR; TEXTURE, STRUCTURES)
-1.5'	3.0	1091	SS 12.0	6,12 15	MEDIUM TO FINE SAND, COMPACTED, DRY 10YR 5/6
1.5-3.0	3.0	1092	SS 11.0	15,16 21	MEDIUM TO FINE SAND, COMPACTED, DRY 10YR 5/6
-4.5	2.0	1093	SS 13.0	11,15 21	FINE SAND AND SILT, DRY 7.5YR 6/4
5-6.0	4.0	1094	SS 15.0	23,28 32	FINE SAND AND SILT, DRY 7.5YR 6/6
6.0-7.5	4.0	A 1095	SS 14.0	20,18 20	FINE SAND AND SILT, DRY 7.5YR 7/4
	4.0	B 1095			
7.5-9.0'	5.0	1096	SS 14.0	15,20 37	HARD, SILT, COMPACTED 7.5YR 6/4
.0-10.5	5.0	1097	SS 12.5	31,56 8	HARD, COMPACTED, SILT 7.5YR 6/4
5-12.0	3.0	1098	SS 10.0	80/3"	VERY HARD, CEMENTED, SILT 10YR 6/4
2.0-13.5	3.0	1099	SS 4.5	100/10"	VERY HARD, CEMENTED, SILT 10YR 6/4
5-15.0	3.0	1100	SS 6.0	100	VERY HARD, CEMENTED, LAMINATED, SILT 10YR 6/4
.50-16.5	3.0	1101	SS 10.0	48, 100	VERY HARD, CEMENTED, SILT 10YR 6/5
6.5-18.0	3.0	A 1102	SS 24.0	19,19 25	HARD, CEMENTED, SILT 10YR 5/6
	3.0	B 1102			
18.0-19.5	2.0	1103	SS 13.0	22,21 22	FINE SILTY SAND GRADING TO MEDIUM SAND and Gravel 10YR 6/6
5-21.0	2.0	1104	SS 16.0	20,21 23	

* ASTM D1586

SHEET 1 OF 1

WESTON

BORING LOG

BORING NO.: SB-4

LOCATION: Site # 5 P.O.L. Waste Disposal Trench

SURFACE ELEVATION: –

DRILLING COMPANY: Western Technologies

DRILLER: T. Kurlik

LOG BY: J. Williams

OWNER: USAF

ADDRESS: Luke AFB Phoenix, Arizona.

TOTAL DEPTH: 21.0'

WATER LEVEL: –

DRILLING METHOD: Hollow Stem Auger

DATE DRILLED: 10 Nov. 84

HELPER: C. Gonzales

SKETCH MAP

NOTES:

DEPTH (FEET)	H-NU	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
-1.5	3.0 1.0	1105 1106	SS 12"	3,4 7	FINE SANDY SILT 7.5 YR 5/6
1.5-3.0	2.0	1107	SS 14"	11,16 24	FINE SANDY SILT 7.5 YR 5/6
3.0-4.5	2.0 2.0	1108 1109	SS 18"	18,23 42	FINE SANDY SILT, SLIGHTLY Compacted 7.5YR 5/6
5-6.0	2.0	1110	SS 16"	6,10 22	FINE SANDY SILT, SLIGHTLY CEMENTED 7.5YR 5/4
6.0-7.5	4.0 4.0	1111 1112	SS 12"	32,51 63	FINE SANDY SILT, VERY HARD, CEMENTED 10YR 6/4
5-9.0	–		SS 14"	33,60 63	FINE SANDY SILT, VERY HARD, CEMENTED 10YR 6/4
9.0-10.5	6.0 5.0	1113 1114	SS 8"	41,62 54	FINE SANDY SILT, VERY HARD, CEMENTED 10YR 7/3
10.5-12.0	5.0	1115	SS 5"	49,83	FINE SANDY SILT, VERY HARD, CEMENTED 10YR 7/3
.0-13.5	5.0 5.0	1116 1117	SS 4"	40 100	FINE SANDY SILT, VERY HARD, CEMENTED 10YR 7/3
13.5-15.0	5.0	1118	SS 15"	11,23 30	SILTY FINE SAND 10YR 7/4
-16.5	5.0 5.0	1119 1120	SS 15"	19,19 27	SILTY FINE SAND with Trace of COARSE to Med Sand 10YR 6/4
.5-18.0	5.0	1121	SS 14"	15,19 22	SILTY FINE SAND, Little COARSE to MED SAND, and Trace of Gravel 10YR 5/4
18.0-19.5	4.0	1122	SS 15"	11,20 24	COARSE TO MEDIUM SAND AND GRAVEL 10YR 7/4
9.5-21.0	–		SS 18"	14,11 20	COARSE TO MEDIUM SAND AND GRAVEL

* ASTM D1586

WESTON

BORING LOG

BORING NO.: SB-5

OWNER: USAF

LOCATION: Site #5 P.O.L. WASTE DISPOSAL TRENCH

ADDRESS: LUKE AFB Phoenix, Arizona

TOTAL DEPTH: 21.0'

SURFACE ELEVATION: —

WATER LEVEL: —

DRILLING COMPANY: Western Technologies

DRILLING METHOD: Hollow Stem AUGER

DATE DRILLED: 10 Nov 1983

DRILLER: T. KURLIK

HELPER: C. GONZALES

LOG BY: J. Williams

SKETCH MAP

NOTES:

DEPTH (FEET)	H-NU	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
-1.5	4.0 4.0	1123 1124	SS 14"	3,5 9	FINE SANDY SILT 10YR 5/6
1.5-3.0	2.0	1125	SS 15"	15,15 15	FINE SANDY SILT 10YR 5/6
.0-4.5	3.0 5.0	1126 1127	SS 18"	9,13 21	FINE SANDY SILT 10YR 5/6
-6.0	5.0	1128	SS 15"	23,32 42	FINE SANDY SILT, LAMINATED 10YR 5/6
6.0-7.5	3.0	1129	SS 15"	23,34 41	FINE SANDY SILT 10YR 6/4
.5-9.0	2.0 4.0	1130 1131	SS 17"	18,18 22	FINE SANDY SILT, LAMINATED 10YR 7/4
9.0-10.5	4.0	1132	SS 4"	73	VERY HARD, CEMENTED, FINE SANDY SILT 10YR 7/4
10.5-12.0	3.0	1133 —	SS 3"	50	VERY HARD, CEMENTED, FINE SANDY SILT 10YR 7/3
.0-13.5	3.0	1134	SS 15"	20,21 31	FINE SANDY SILT 10YR 6/4
13.5-15.0	3.0 3.0	1135 1136	SS 15"	23,26 21	FINE SANDY SILT 10YR 6/4
.0-16.5	4.0	1137	SS 8"	12,13 14	SILTY FINE SAND 10YR 6/4
.5-18.0	4.0 4.0	1138 1139	SS 15"	10,15 17	COARSE AND MEDIUM SAND GRADING TO FINE SANDY SILT 10YR 6/4
18.0-19.5	3.0	1140	SS 17"	13,13 13	COARSE TO MEDIUM SAND AND GRAVEL
.5-21.0	2.0	1141 —	SS 18"	9,11 20	COARSE TO MEDIUM SAND AND GRAVEL

* ASTM D1586

SHEET 1 OF 1

WESTON

BORING LOG

BORING NO.: SB-6

LOCATION: SITE #5 POL. WASTE DISPOSAL TRENCH

SURFACE ELEVATION: –

DRILLING COMPANY: Western Technologies

DRILLER: T. KURLIK

LOG BY: J. Williams

OWNER: USAF

ADDRESS: LUKE AFB Phoenix, Arizona

TOTAL DEPTH: 21.0'

WATER LEVEL: –

DRILLING METHOD: Hollow Stem AUGER

DATE DRILLED: 10 NOV. 1988

HELPER: C. GONZALES

SKETCH MAP

NOTES:

DEPTH (FEET)	H-NU	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
0-1.5	5.0	1142	SS 12"	2,7 13	FINE SANDY SILT, DRY 10YR 6/4
1.5-3.0	3.0 3.0	1143 1144	SS 18"	17,21 25	FINE SANDY SILT, DRY 10YR 6/6
3.0-4.5	3.0	1145	SS 18"	13,19 35	FINE SANDY SILT, DRY 10YR 6/3
4.5-6.0	2.0 2.0	1146 1147	SS 17"	34,41 50	FINE SANDY SILT, LAMINATED, DRY 10YR 6/3
6.0-7.5	2.0	1148	SS 13"	24,34 32	FINE SANDY SILT, LAMINATED, DRY 10YR 6/4
7.5-9.0	3.0 3.0	1149 1160	SS 14"	17,27 47	FINE SANDY SILT, SLIGHTLY COMPACTED, DRY 10YR 6/4
9.0-10.5	3.0	1161	SS 9"	25,14	FINE SANDY SILT, COMPACTED, DRY 10YR 6/4
10.5-12.0	3.0 4.0	1152 1153	SS 13"	51,80	FINE SANDY SILT, HARD, CEMENTED, DRY 10YR 6/3
12.0-13.5	3.0	1154	SS 6"	100	VERY HARD, CEMENTED SILT, DRY 10YR 7/4
13.5-15.0	4.0 5.0	1155 1156	SS 16"	37,75 56	MEDIUM-COARSE SAND, MINOR SILT, DRY 10YR 6/4
15.0-16.5	4.0	1157	SS 17"	17,17 18	SILTY MEDIUM-COARSE SAND GRADING TO COARSE-VERY COARSE SAND 10YR 6/6
16.5-18.0	4.0 4.0	1158 1159	SS 15"	34,35 30	VERY COARSE SAND GRADING TO LAMINATED SANDY SILT 10YR 6/6
18.0-19.5	3.0	1160	SS 15"	22,34 40	FINE SANDY SILT, LAMINATED, DRY 10YR 5/6
19.5-21.0	3.0	1161	SS 9"	34,22 21	MEDIUM-FINE SANDY SILT, DRY 10YR 5/6

* ASTM D1586

SHEET 1 OF 1

WESTON

BORING LOG

BORING NO.: SB-7 OWNER: USAF

LOCATION: SITE #5 POL WASTE DISPOSAL TRENCH

ADDRESS: LUKE A.F.B. Phoenix, Arizona

TOTAL DEPTH 21.0'

SURFACE ELEVATION: — WATER LEVEL: —

DRILLING COMPANY: WESTERN TECHNOLOGIES DRILLING METHOD: HOLLOW STEM AUGER DATE DRILLED: 11 NOV. 1983

DRILLER: T. KURLIK HELPER: C. GONZALES

LOG BY: John Williams

SKETCH MAP

NOTES:

DEPTH (FEET)	H-NU	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
-1.5		1162 1163	SS 12"	3,6 9	FINE SANDY SILT 10YR 6/6
1.5-3.0		1164	SS 15"	11,11 12	FINE SANDY SILT 10YR 6/6
-.0-4.5		1165	SS 16"	10,15 18	FINE to MEDIUM SAND 7.5YR 5/6
.5-6.0		1166 1167	SS 18"	10,18 22	FINE to COARSE SAND GRADING to FINE SANDY SILT, Laminated 10YR 6/4
6.0-7.5		1168	SS 12"	17,19 19	FINE SANDY SILT, LAMINATED, COMPACTED 10YR 6/4
.5-9.0		1169 1170	SS 15"	18,26 34	FINE SANDY SILT, LAMINATED, COMPACTED 10YR 6/4
9.0-10.5		1171	SS 12"	27,39 50	FINE SANDY SILT, LAMINATED, COMPACTED 10YR 6/4
.0.5-12.0	Meter Inoperative	1172 1173	SS 9"	50,60	HARD FINE SANDY SILT, LAMINATED 10YR 6/4
.0-13.5		1174	SS 11"	44,100	FINE SANDY SILT, HARD, LAMINATED 10YR 6/4
13.5-15.0		1175 1176	SS SS	67	FINE SANDY SILT, LAMINATED, CEMENTED 10YR 6/6
.0-16.5		1177	SS 14	17,20 20	SILTY FINE SAND, SLIGHTLY COMPACTED 10YR 6/6
.5-18.0		1178 1179	SS 17"	14,14 18	SILTY FINE SAND, SLIGHTLY COMPACTED 10 YR 6/6
18.0-19.5		1180	SS 18"	12,13 14	SILTY FINE SAND GRADING TO MEDIUM-COARSE SAND
19.5-21.0		1181 —	SS 10"	15,14 17	SILTY FINE SAND GRADING TO FINE-COARSE SAND

* ASTM D1586

SHEET 1 OF 1

WESTON

BORING LOG

BORING NO.: SB-8
OWNER: USAF
LOCATION: SITE #5 POL WASTE DISPOSAL TRENCH
ADDRESS: LUKE AFB PHOENIX, ARIZONA
TOTAL DEPTH 21.0'
SURFACE ELEVATION: —
WATER LEVEL: —
DRILLING COMPANY: WESTERN TECHNOLOGIES
DRILLING METHOD: HOLLOW STEM AUGER
DATE DRILLED: 14 NOV 1983
DRILLER: T. KURLIK
HELPER: E. GONZALES
LOG BY: John Williams

SKETCH MAP

NOTES:

DEPTH (FEET)	H-NU	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
0-1.5	1.0 / 1.0	1182 / 1183	SS 12"	7,11 16	FINE SANDY SILT 10YR 4/6
1.5-3.0	2.0	1184	SS 16"	25,27 26	FINE SANDY SILT 10YR 6/6
3.0-4.5	2.0 / 1.0	1185	SS 18"	11,15 22	FINE SANDY SILT 10YR 5/6
4.5-6.0	5.0	1186 / 1187	SS 16"	15,20 18	FINE SANDY SILT, SLIGHTLY COMPACTED 10YR 5/4
6.0-7.5	3.0	1188	SS 14"	16,18 20	FINE SANDY SILT, SLIGHT MOTTLING 10YR 5/4
7.5-9.0	2.0 / 2.0	1189 / 1190	SS 17"	16,20 32	FINE SANDY SILT, SLIGHT MOTTLING 10YR 5/3
9.0-10.5	1.0	1191	SS 15"	23,42 61	FINE SANDY SILT, HARD, CEMENTED 10YR 7/4
10.5-12.0	1.0 / 1.0	1192 / 1193	SS 4"	100	FINE SANDY SILT, VERY HARD, CEMENTED, LAMINATED 10YR 7/4
12.0-13.5	1.0	1194	SS 14"	41,51 31	FINE SANDY SILT, HARD, CEMENTED 10YR 5/4
13.5-15.0	2.0 / 2.0	1195 / 1196	SS 16"	19,39 60	FINE SAND with minor SILT, COHESIVE 10YR 5/6
15.0-16.5	2.0	1197	SS 7"	60, 100	FINE SAND WITH MINOR SILT, COHESIVE 10YR 6/4
16.5-18.0	2.0 / 1.0	1198 / 1199	SS 15"	13,19 31	FINE SAND AND SILT 10YR 5/6
18.0-19.5	1.0	1200	SS 15"	19,22 17	FRAGMENTED ROCK, ANGULAR – SUBANGULAR
19.5-21.0	1.0	1201 —	SS 18"	6,13 17	SILTY MEDIUM SAND GRADING to MEDIUM-COARSE SAND and GRAVEL.

* A.S.T.M. D1586

SHEET 1 OF 1

WESTON

BORING LOG

BORING NO.: SB-9 — OWNER: USAF

LOCATION: SITE #5 POL WASTE DISPOSAL TRENCH — ADDRESS: LUKE AFB PHOENIX, ARIZONA

TOTAL DEPTH: 21.0'

SURFACE ELEVATION: – — WATER LEVEL: –

DRILLING COMPANY: WESTERN TECHNOLOGIES — DRILLING METHOD: HOLLOW STEM AUGER — DATE DRILLED: 14 NOV 1983

DRILLER: T. KURLIK — HELPER: E. GONZALES

LOG BY: J. Williams

SKETCH MAP

NOTES:

DEPTH (FEET)	H-NU	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
0-1.5	4.0	1202	SS 7"	6,10 15	FINE SANDY SILT 10YR 5/6
1.5-3.0	4.0 / 3.0	1203 / 1204	SS 12"	12,16 18	FINE SANDY SILT 10YR 5/6
3.0-4.5	4.0	1205	SS 16"	11,15 13	FINE SANDY SILT, MINOR GRAVEL 10YR 4/6
-.5-6.0	2.0 / 4.0	1206 / 1207	SS 15"	8,10 12	FINE SANDY SILT GRADING TO COARSE SAND AND GRAVEL 10YR 4/6
6.0-7.5	2.0	1208	SS 18"	12,17 24	FINE SANDY SILT, COHESIVE, MOIST 10YR 4/4
.5-9.0	3.0 / 4.0	1209 / 1210	SS 15"	13,14 20	CLAYEY SAND AND SILT, MOIST 10YR 5/4
.0-10.5	4.0	1211	SS 16"	25,15 25	FINE SANDY SILT 10YR 6/4
10.5-12.0	4.0 / 3.0	1212 / 1213	SS 15"	21,25 31	FINE SANDY SILT, COHESIVE, MOIST 10YR 5/4
0-13.5	3.0	1214	SS 16½	12,13 15	FINE SANDY SILT, COHESIVE, MOIST 10YR 5/4
13.5-15.0	2.0 / 4.0	1215 / 1216	SS 18	5,7 11	FINE TO COARSE SAND AND GRAVEL
.0-16.5	3.0	1217	SS 15"	8,10 12	FINE TO MEDIUM SANDY SILT GRADING TO MEDIUM TO COARSE SAND
5-18.0	4.0 / 4.0	1218 / 1219	SS 18"	8,28 32	MEDIUM TO COARSE SAND AND GRAVEL, MOIST
18.0-19.5	4.0	1220	SS 18"	17,16 13	FINE SANDY SILT AND CLAY, MOTTLED, DAMP
5-21.0	4.0	1221 –	SS 18"	21,29 38	FINE SANDY SILT, SLIGHTLY COMPACTED

* A.S.T.M. D1586

SHEET 1 OF 1

WESTON

BORING LOG

BORING NO.: SB-10

OWNER: USAF

LOCATION: SITE # 5 P.O.L. WASTE DISPOSAL TRENCH

ADDRESS: LUKE AFB PHOENIX, ARIZONA

TOTAL DEPTH 21.0'

SURFACE ELEVATION: —

WATER LEVEL: —

DRILLING COMPANY: WESTERN TECHNOLOGIES

DRILLING METHOD: Hollow Stem AUGER

DATE DRILLED: 14 NOV 1983

DRILLER: T. KURLIK

HELPER: E. GONZALES

LOG BY: J. Williams

SKETCH MAP

NOTES:

DEPTH (FEET)	H-NU	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
0-1.5	3.0	1222	SS 15	3,2 3	FINE SANDY SILT 10YR 6/6
1.5-3.0	3.0 1.0	1223 1224	SS 15	4,3 5	FINE SANDY SILT 10YR 6/6
3.0-4.5	2.0 4.0	1225 1226	SS 16	6,7 10	FINE SANDY SILT, SLIGHTLY COMPACTED 10YR 5/6
4.5-6.0	3.0	1227	SS 18	4,6 12	FINE SANDY SILT 10YR 5/4
6.0-7.5	3.0	1228	SS 16	10,13 15	FINE SANDY SILT 10YR 5/6
7.5-9.0	4.0 4.0	1229 1230	SS 18	11,10 24	FINE SANDY SILT 10YR 5/6
9.0-10.5	5.0	1231	SS 15 1/2	16,17 20	FINE SANDY SILT, CEMENTED 10YR 6/4
10.5-12.0	4.0 3.0	1232 1233	SS 14	14,13 12	FINE SANDY SILT, MOTTLED 10YR 5/6
12.0-13.5	5.0	1234	SS 14	10,10 11	FINE to COARSE SAND AND GRAVEL
13.5-15.0	4.0 4.0	1235 1236	SS 13	9,10 10	FINE to COARSE SAND AND GRAVEL
15.0-16.5	4.0	1237	SS 16	12,15 16	FINE to COARSE SAND AND GRAVEL
16.5-18.0	3.0 4.0	1238 1239	SS 13	13,45 60	FINE to COARSE SAND GRADING to HARD SANDY SILT
18.0-19.5	4.0	1240	SS 16	24,24 27	FINE to COARSE SAND AND GRAVEL
19.5-21.0	4.0	1241 —	SS 16	12,17 35	FINE to COARSE SAND AND GRAVE GRADING to HARD, CEMENTED SILT AND CLAY.

* A.S.T.M. D1586

SHEET 1 OF 1

WESTON

BORING LOG

BORING NO.: SB-11

OWNER: USAF

LOCATION: SITE #4 PERIMETER ROAD

ADDRESS: LUKE AFB PHOENIX, ARIZONA

TOTAL DEPTH: 2.0'

SURFACE ELEVATION: —

WATER LEVEL: —

DRILLING COMPANY: WESTERN TECHNOLOGIES

DRILLING METHOD: HOLLOW STEM AUGER

DATE DRILLED: 15 NOV. 1983

DRILLER: T. KURLIK

HELPER: E. GONZALES

LOG BY: J. Williams

SKETCH MAP

NOTES:

	DEPTH (FEET)	H-NU	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
		0.0	1242	SS	7, 19	
-1.5		0.0	1243	18"	24	Brown Sandy Silt

*ASTM D1586

SHEET 1 OF 1

WESTON

BORING LOG

BORING NO.: SB-12
OWNER: USAF
LOCATION: SITE #4 PERIMETER ROAD
ADDRESS: LUKE AFB Phoenix, Arizona.
TOTAL DEPTH 2.0'
SURFACE ELEVATION: –
WATER LEVEL: –
DRILLING COMPANY: WESTERN TECHNOLOGIES
DRILLING METHOD: Hollow Stem AUGER.
DATE DRILLED: 15 NOV. 1983
DRILLER: T. KURLIK
HELPER: E. GONZALES
LOG BY: J. Williams

SKETCH MAP

NOTES:

	DEPTH (FEET)	H-NU	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
0-1.0		0	1244	SS / 10"	6,15	LIGHT BROWN FINE SANDY SILT
1-2.0		0	1245	SS / 12"	13,13	LIGHT BROWN FINE SANDY SILT

* ASTM D1586

SHEET 1 OF 1

WESTON

BORING LOG

BORING NO.: SB-13

OWNER: USAF

LOCATION: SITE # 4 PERIMETER ROAD

ADDRESS: LUKE A.F.B. PHOENIX, ARIZONA

TOTAL DEPTH 2.0'

SURFACE ELEVATION: —

WATER LEVEL: —

DRILLING COMPANY: WESTERN TECHNOLOGIES

DRILLING METHOD: Hollow STEM AUGER

DATE DRILLED: 15 Nov. 1983

DRILLER: T. KURLIK

HELPER: E. GONZALES

LOG BY: J. Williams

SKETCH MAP

NOTES:

DEPTH (FEET)	H-NU	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
0-1.0	0	1246	SS 9"	7,13	FINE SANDY SILT 10 YR 5/6
1.0-2.0	0	1247	SS 9"	7,8	FINE SANDY SILT 10 YR 5/6

* A.S.T.M. D1586

SHEET 1 OF 1

WESTON

BORING LOG

BORING NO.: SB-14
OWNER: USAF
LOCATION: SITE #4 PERIMETER ROAD
ADDRESS: LUKE AFB PHOENIX, ARIZONA
TOTAL DEPTH: 2.0'
SURFACE ELEVATION: —
WATER LEVEL: —
DRILLING COMPANY: WESTERN TECHNOLOGIES
DRILLING METHOD: HOLLOW STEM AUGER
DATE DRILLED: 15 NOV 1983
DRILLER: T. KURLIK
HELPER: E. GONZALES
LOG BY: J. Williams

SKETCH MAP

NOTES:

DEPTH (FEET)	H-NU	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
--1.0	1.0	1248	SS / 8"	7,22	FINE SANDY SILT 10YR5/6
1'--2.0	1.0	1249	SS / 11"	24,20	FINE SANDY SILT

* ASTM D1586

SHEET 1 OF 1

WESTON

BORING LOG

BORING NO.: SB-15

OWNER: USAF

LOCATION: SITE #4 PERIMETER ROAD

ADDRESS: LUKE AFB Phoenix, Arizona

TOTAL DEPTH 2.0'

SURFACE ELEVATION: –

WATER LEVEL: –

DRILLING COMPANY: WESTERN TECHNOLOGIES

DRILLING METHOD: HOLLOW STEM AUGER

DATE DRILLED: 15 NOV 1983

DRILLER: T. KURLIK

HELPER: E. GONZALES

LOG BY: J. Williams

SKETCH MAP

NOTES:

	DEPTH (FEET)	H-NU	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
0-1.0		1.0	1250	SS / 5"	9, 27	FINE SANDY SILT
1.0-2.0		2.0	1251	SS / 10"	39, 26	FINE SANDY SILT

* ASTM D1586

SHEET ___ OF ___

WESTON

BORING LOG

BORING NO.: SB-16
LOCATION: SITE #4
PERIMETER ROAD

SURFACE ELEVATION: –

DRILLING COMPANY: WESTERN TECHNOLOGIES
DRILLER: T. KURLIK

LOG BY: J. Williams

OWNER: USAF
ADDRESS: LUKE AFB
PHOENIX, ARIZONA
TOTAL DEPTH 2.0'
WATER LEVEL: –
DRILLING METHOD: Hollow STEM AUGER
DATE DRILLED: 15 Nov. 1983
HELPER: E. GONZALES.

SKETCH MAP

NOTES:

DEPTH (FEET)	H-NU	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
-1.0	2.0	1252	SS 7½	3,8	FINE SANDY SILT
1.0-2.0	2.0	1253	SS 12	10,10	FINE SANDY SILT

* ASTM D1586

SHEET 1 OF 1

WESTON

BORING LOG

BORING NO.: SB-17

OWNER: USAF

LOCATION: SITE #4 PERIMETER ROAD

ADDRESS: LUKE AFB PHOENIX, ARIZONA

TOTAL DEPTH 2.0'

SURFACE ELEVATION: —

WATER LEVEL: —

DRILLING COMPANY: WESTERN TECHNOLOGIES

DRILLING METHOD: HOLLOW STEM AUGER

DATE DRILLED: 15 Nov. 1983

DRILLER: T. KURLIK

HELPER: E. GONZALES.

LOG BY: J. Williams

SKETCH MAP

NOTES:

	DEPTH (FEET)	H-NU	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
?-1.0		2.0	1254	SS 9"	10,30	FINE SANDY Silt, Compacted
?-2.0		3.0	1255	SS 12"	31,25	FINE SANY SILT, COMPACTED.

* A.S.T.M. D1586

SHEET 1 OF 1

WESTON

BORING LOG

BORING NO.: SB-18
OWNER: USAF
LOCATION: SITE #4 PERIMETER ROAD
ADDRESS: LUKE AFB PHOENIX, ARIZONA
TOTAL DEPTH 2.0'
SURFACE ELEVATION: –
WATER LEVEL: –
DRILLING COMPANY: WESTERN TECHNOLOGIES
DRILLING METHOD: HOLLOW STEM AUGER
DATE DRILLED: 15 NOV. 1983
DRILLER: T. KUBLIK
HELPER: E. GONZALES
LOG BY: J. Williams

SKETCH MAP

NOTES:

DEPTH (FEET)	H-NU	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
0-1.0	3.0	1256	SS 8"	8,15	FINE SANDY SILT
1.0-2.0	3.0	1257	SS 11"	13,14	FINE SANDY SILT

* ASTM D1586

SHEET ___ OF ___

WESTON

BORING LOG

BORING NO.: SB-19
OWNER: USAF
LOCATION: SITE # 7 NORTH FIRE TRAINING AREA
ADDRESS: LUKE AFB PHOENIX, ARIZONA
TOTAL DEPTH 21.0'
SURFACE ELEVATION: –
WATER LEVEL: –
DRILLING COMPANY: WESTERN TECHNOLOGIES
DRILLING METHOD: HOLLOW STEM AUGER
DATE DRILLED: 16 NOV. 1983
DRILLER: T. KURLIK
HELPER: E. GONZALES
LOG BY: J. Williams

SKETCH MAP

NOTES:

DEPTH (FEET)	H-NU	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
0-1.5	4.0	1258	SS 12"	4,5 6	FINE SANDY SILT MIXED WITH MEDIUM SAND 10YR 4/6
1.5-3.0	2.0 1.0	1259 1260	SS 15"	8,12 12	FINE SANDY SILT MIXED WITH GRAVEL 10YR 4/6
3.0-4.5	1.0	1261	SS 18"	15,25 35	FINE SANDY SILT, SLIGHTLY COMPACTED 10YR 5/6
4.5-6.0	1.0 1.0	1262 1263	SS 12"	23,20 13	FINE SANDY SILT MIXED WITH GRAVEL 10YR 7/4
6.0-7.5	1.0	1264	SS 18"	13,14 20	FINE SANDY SILT WITH ROCK FRAGMENTS 10YR 5/4
7.5-9.0	4.0 14.0	1265 1266	SS 12"	18,24 25	FINE SANDY SILT MIXED WITH GRAVEL 10YR 5/4
9.0-10.5	13.0	1267	SS 17	16,19 20	FINE SANDY SILT, LAMINATED 10YR 6/4
10.5-12.0	15.0 17.0	1268 1269	SS 12½	17,19 20	FINE SANDY SILT 10YR 7/4
12.0-13.5	11.0	1270	SS 17"	13,12 11	FINE to COARSE SAND, MINOR SILT, WITH ROCK FRAGMENTS
13.5-15.0	13.0 3.0	1271 1272	SS 17"	10,11 13	FINE to COARSE SAND, WITH ROCK FRAGMENTS
15.0-16.5	8.0	1273	SS 16"	9,15 19	FINE to COARSE SAND WITH ROCK FRAGMENTS, DAMP
16.5-18.0	16.0 8.0	1274 1275	SS 16"	20,19 29	FINE to COARSE SAND WITH ROCK FRAGMENTS
18.0-19.5	12.0	1276	SS 17"	16,19 22	FINE to COARSE SAND WITH ROCK FRAGMENTS
19.5-21.0	14.0	1277 –	SS 17"	18,15 16	FINE SANDY SILT 10YR 5/6

* ASTM D1586

SHEET ___ OF ___

WESTON

BORING LOG

BORING NO.: SB-20
OWNER: USAF
LOCATION: SITE #7 NORTH FIRE TRAINING AREA
ADDRESS: LUKE AFB. PHOENIX, ARIZONA
TOTAL DEPTH: 21.0'
SURFACE ELEVATION: —
WATER LEVEL: —
DRILLING COMPANY: WESTERN TECHNOLOGIES
DRILLING METHOD: HOLLOW STEM AUGER
DATE DRILLED: 16 NOV. 1983
DRILLER: T. KURLIK
HELPER: E. GONZALES
LOG BY: J. Williams

SKETCH MAP

NOTES:

DEPTH (FEET)	H-NU	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
0-1.5	70	1278	SS 16"	3,4, 4	ASH and SLAG 0-6" 10YR 3/2 STRONG ORGANIC Fine SANDY SILT, 6"-18' 10YR 3/6, DAMP, ODOR
1.5-3.0	120 190	1279 1280	SS 13"	4,4 5	Fine SANDY SILT, TRACE of Med-Coarse Sands. 10YR 3/6 ODOR
3.0-4.5	180	1281	SS 13"	1,1, 5	Fine SANDY SILT, Some Med-Coarse Sands. 10YR 4/6 ODOR
4.5-6.0	150 40	1282 1283	SS 15½"	15,16 20	Fine SANDY SILT GRADING to Medium-Coarse Sand, Laminar Compaction. 10YR 4/6 ODOR
6.0-7.5	30	1284	SS 17½"	14,13 10	Fine SANDY SILT GRADING to Med.-Coarse Sands & FRAG. Rock, Rounded-Sub Rounded. Compacted Little GRAVEL 10YR 4/6
7.5-9.0	30 40	1285 1286	SS 17½"	7,10 13	Medium-Coarse SAND, SOME ROCK FRAG. SubAngular-SubRounded 10YR 4/6
9.0-10.5	11	1287	SS 17"	8,10 13	Medium-Coarse SAND, Some GRAVEL Rounded-SubRounded 10YR 5/6
10.5-12.0	14 12	1288 1289	SS 14"	10,16 19	Medium Coarse SAND, Some fine Sandy Silt 10YR 5/6
12.0-13.5	15	1290	SS 14"	15,13 15	fine SANDY SILT, Some Med.-Coarse Sands. 10YR 5/6
13.5-15.0	12 13	1291 1292	SS 14"	18,17 19	fine SANDY SILT, GRADING to Med.-Coarse Sands 10YR 5/6
15.0-16.5	7	1293	SS 15"	9,9 8	Silty fine SAND GRADING to fine-Coarse SAND 10YR 6/4
16.5-18.0	5 4	1294 1295	SS 17"	5,9 14	SILTY FINE SAND GRADING to Medium-Coarse SAND 10YR 6/4
18.0-19.5	20	1296	SS 4"	10,16 13	fine SAND GRADING to Med-Coarse SANDS, Little GRAVEL
19.5-21.0	6	1297 —	SS 18"	11,24 33	fine-Coarse SAND, Some GRAVEL

* ASTM D1586

SHEET 1 OF 1

WESTON

BORING LOG

BORING NO.: SB-21
OWNER: USAF
LOCATION: SITE #7 NORTH FIRE TRAINING AREA
ADDRESS: LUKE AFB. PHOENIX, ARIZONA
TOTAL DEPTH 21.0'
SURFACE ELEVATION: –
WATER LEVEL: –
DRILLING COMPANY: WESTERN TECHNOLOGIES
DRILLING METHOD: HOLLOW STEM AUGER
DATE DRILLED: 16 Nov. 1983
DRILLER: T. KURUK
HELPER: E. GONZALES
LOG BY: J. Williams

SKETCH MAP

NOTES:

DEPTH (FEET)	H-NU	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
ↄ-1.5	10	1298	SS 12"	2,3 4	TOP SOIL 10YR 3/6
5-3.0	14 7	1299 1300	SS 12"	4,5 6	FINE SANDY, SILTY, CLAY 5YR 4/6
3.0-4.5	40	1301	SS 17"	5,9 10	FINE SANDY, SILTY CLAY, MINOR COARSE SAND 5YR 4/6
.5-6.0	80 120	1302 1303	SS 15"	7,7 9	FINE SANDY, SILTY, CLAY, MINOR COARSE SAND 7.5YR 5/6
6.0-7.5	80	1304	SS 13"	9,9 10	MEDIUM to COARSE SAND AND GRAVEL 7.5YR 5/6
7.5-9.0	70 30	1305 1306	SS 17"	5,5 6	MEDIUM to COARSE SAND AND GRAVEL 7.5YR 5/6
9.0-10.5	30	1307	SS 15"	10,12 19	FINE SAND AND SILT 7.5YR 5/6
10.5-12.0	11 9	1308 1309	SS 14"	14,14 16	FINE SAND AND SILT 6 YR 5/6
2.0-13.5	10	1310	SS 16"	13,13 18	FINE SAND AND SILT 10YR 5/6
13.5-15.0	11 9	1311 1312	SS 14½"	9,10 15	FINE SAND AND SILT 10YR 5/6
15.0-16.5	7	1313	SS 8½"	8,9 11	SILTY MEDIUM to FINE SAND 10YR 5/4
6.5-18.0	5 3	1314 1315	SS 16"	8,8 10	SILTY SAND AND GRAVEL
18.0-19.5	5	1316	SS 3"	8,13 11	MEDIUM TO COARSE SAND AND GRAVEL
19.5-21.0	4	1317 –	SS 15"	12,12 33	MEDIUM TO FINE SAND, HARD

* A.S.T.M. D1586

SHEET 1 OF 1

WESTON

BORING LOG

BORING NO.: SB-22	OWNER: USAF
LOCATION: SITE #7 NORTH FIRE TRAINING AREA	ADDRESS: LUKE AFB. PHOENIX, ARIZONA
	TOTAL DEPTH 21.0'
SURFACE ELEVATION: –	WATER LEVEL: –
DRILLING COMPANY: WESTERN TECHNOLOGIES	DRILLING METHOD: HOLLOW STEM AUGER
DATE DRILLED: 17 NOV. 1983	
DRILLER: T. KURLIK	HELPER: E. GONZALES
LOG BY: J. Williams	

SKETCH MAP

NOTES:

DEPTH (FEET)	H-NU	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
0-1.5	130	1318	SS 13"	5,8 7	ASH & SLAG 0-6" 10 YR 2/2 Strong Organic ODOR; FINE SANDY SILT, 6"-18" 10YR 3/6 DAMP, COMPACTED
1.5-3.0	100 140	1319 1320	SS 14"	6,5 7	fine SILTY SAND GRADING to Medium-Coarse Sand, Some Gravel
3.0-4.5	300	1321	SS 15"	8,10 13	CLAYEY FINE SAND GRADING TO MEDIUM-COARSE SAND
4.5-6.0	300 200	1322 1323	SS 17"	9,31 35	MEDIUM - COARSE SAND, MINOR SILT
6.0-7.5	100	1324	SS 15"	20,16 13	MEDIUM - COARSE SAND AND GRAVEL
7.5-9.0	160 140	1325 1326	SS 16"	9,11 11	MEDIUM - COARSE SAND AND GRAVEL
9.0-10.5	100	1327	SS 15½"	11,18 25	MEDIUM SAND GRADING to HARD SANDY SILT
10.5-12.0	90 50	1328 1329	SS 13"	14,17 19	HARD, FINE SANDY SILT, MOIST
12.0-13.5	60	1330	SS 16"	5,7 9	HARD, FINE SANDY SILT
13.5-15.0	100 30	1331 1332	SS 15"	7,10 12	SILTY FINE SAND
15.0-16.5	35	1333	SS 18"	6,7 8	SILTY FINE SAND GRADING TO MEDIUM-COARSE SAND
16.5-18.0	10 35	1334 1335	SS 18"	11,18 13	MEDIUM TO COARSE SAND AND GRAVEL
18.0-19.5	35	1336	SS 13"	13,15 18	MEDIUM TO COARSE SAND AND GRAVEL
19.5-21.0	32	1337 –	SS 14"	11,16 18	MEDIUM TO COARSE SAND AND GRAVEL GRADING to FINE SANDY SILT.

* A.S.T.M. D1586

APPENDIX E

Sampling and Quality Assurance Procedures

WESTON

APPENDIX E

SAMPLING AND QA/QC PLANS

E-1.1 PRODUCTION WELL PURGING

All groundwater sampling at Luke AFB was accomplished on Base Production Wells using the permanent pumps installed. All wells on-line at the time of sampling were assumed to have been purged after the sampling petcock at the wellhead had been allowed to flow for about five minutes. Wells not on-line, but serviceable, at the time of sampling were restarted by the Civil Engineering escort and allowed to run for about 20 minutes prior to opening the sampling petcock. Two of the eight wells could not be started for sampling, and, therefore, were not sampled. All sampling was accomplished under escort of personnel from Civil Engineering.

3.1.2 GROUNDWATER SAMPLE COLLECTION

Groundwater sampling was directed toward the detection of:

- Oil and Grease
- Lead
- Volatile Organic Compounds
- Phenol
- Radiological Species

All required sample containers were prepared by WESTON laboratories in accordance with standard EPA procedures and protocols.

After the wells were purged, sampling consisted of the following steps:

1. Each sample container was gently filled from the pump line, taking care to avoid aeration and turbulence in the sample water.

2. Appropriate containers were filled according to analytical parameter. The containers used were:

   - VOA: 40 ml septum seal glass vial, no preservative, taken at least in duplicate.
   - Metals (Lead): 1 liter plastic bottle, preserved with nitric acid after filtration in the field.
   - Phenols: 250 ml amber glass jar preserved with phosphoric acid and copper sulfate.
   - Pesticides (DBC): 1 liter amber glass jar, no preservative.
   - Oil and Grease: 1 liter amber glass jar, preserved with sulfuric acid.
   - Radiological Species: 2 gallon plastic bottle, no preservative.

3. Grab samples were taken for immediate analyses in the field for pH, temperature and specific conductance.

4. The sample containers were wrapped in packaging material and placed in a thermal chest packed with enough ice to insure cooling to 4°C.

E-1.3 SOIL SAMPLING

All soil sampling accomplished using a drill rig employed the Standard Penetration Test (ASTM Method 1586) using a steel split-spoon sampler. Prior to taking each sample, the following procedures were followed:

1. The split-spoon sampler was washed thoroughly with an Alconox and water solution, and rinsed in tap water from the Base-approved source for drilling.

2. After assembly of the sampler, the sampler was lowered into the boring, and the sample taken by the Standard Penetration Test Method.

3. Upon recovery of the sampler, the spoon was split and the sample examined for soil characteristics.

4. The sample was then cleaned of any smeared sample around the outside of the sampler, and the cleaned, representative sample was put in a marked and labelled 1 liter clear glass sampling jar with a screw cap.

5. Samples for analysis of Oil and grease, Pesticides or PCB were stored for analysis in washed and baked sample jars of amber glass, equipped with a washed aluminum foil inner seal.

All soil sampling not accomplished using a drill rig was done using a Teflon scoop, or a PVC-lined coring device. Care was taken to ensure that the sample taken for analysis was as undisturbed as possible, in order that any contaminants present would not be winnowed out of the sample (in a subaqueous site). As above, only specially prepared sample jars were used for taking and storing samples for pending analyses.

Soil samples at Luke AFB were taken for analyses of:

1. Oil and Grease

2. Volatile Organic Compounds

E-2.0 QUALITY ASSURANCE PLAN

WESTON Analytical Services enforces a rigid QA/QC program toward maintenance of validity and reliability of all analytical data. The Laboratory QA/QC Manual (Table of Contents thereof is Attachment No. 1 to this appendix) outlines the specifics of the QA/QC plan. This plan is patterned after the EPA Handbook for Analytical Quality Control in Water and Wastewater Laboratories (EPA-600/4-79-019, March 1979), augmented by general applicable experience and interaction with the QA/QC plan of the U.S. Army Toxic and Hazardous Materials Agency (USATHAMA). All methods and procedures followed by WESTON are either USEPA or ASTM-approved. Any variations from such procedures, regardless of cause, are documented by the responsible analyst(s) and are documentable, and, literature-traceable. A general review of this QA/QC plan is in the following paragraphs.

Although specific QA/QC measures for each method are designated in WESTON's Laboratory Quality Assurance Manual, the general QA/QC program normally includes:

- EPA-acceptable sample preparation and analytical methods.
- Instrument calibration via use of Standard Analytical Reference Materials (SARMS).
- Regular equipment maintenance and servicing.
- Use of SARMS and QA/QC samples (spikes, laboratory blanks, replicates, and splits) to ascertain overall precision.
- Statistical evaluation of data to delineate acceptable limits.
- Documentation of system/operator performance.
- Suitable chain-of-custody procedures.
- Maintenance and archiving of all records, charts, and logs generated in the above.
- Proper reporting.

Acceptable analyses at WESTON's Analytical Laboratory Services include, but are not limited to, the above.

In general, WESTON's QA/QC sequence follows the following diagram (Figure E-1). Documentation (as available from instrument recordings and technicians' notebooks) is sufficient to validate each step in the sequence.

E.2.2 CONTAINER PREPARATION

Another consideration in this, or any, analytical project is that of sample container preparation. Accordingly, all appropriate sample bottles shall be cleaned in a manner mandated by the U.S. EPA to insure maximal cleanliness (and minimal contamination) before the containers go to the field. Sufficient bottles to accommodate both laboratory and field blank requirements will be preferred in a single batch mode for each monthly sampling requirement.

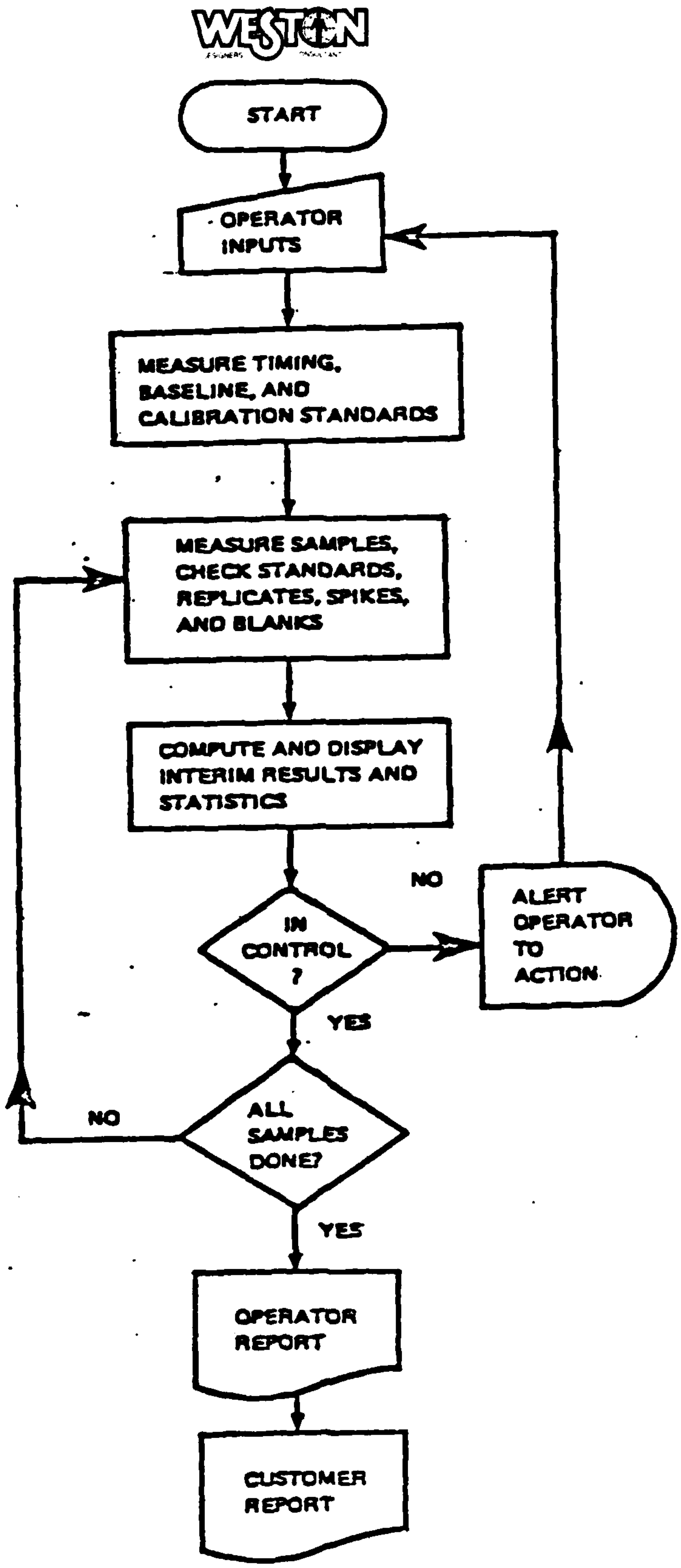


Figure E-1: Flow Chart of the Sequence of Events during a Controlled Series of Laboratory Measurements.

E.2.3 VERIFICATION/VALIDATION

In the laboratory, the analytical scheme begins with initial verification, which is comprised of:

- Lab Blanks - To insure that no background level of specific analytes is introduced by laboratory procedures.
- Standard Analytical Reference Materials (SARMS) - To determine the accuracy and precision of procedures.
- Spikes - To determine the percent recovery of analyte(s).

If the laboratory QA/QC program is extended to the field, it includes a fifth item:

- Field Blanks - To provide a check on contamination of containers and/or preservatives and to establish "practical" detection limits.

WESTON has used all of the above in this project. All data resulting from these verification media have been archived for future reference, retrieval, or processing. (QA/QC data from WESTON's above-described, internal QA/QC plan normally are not available to clientele without associated reimbursement to WESTON).

E.2.4 DATA HANDLING - LABORATORY

Use of any analytical data should be preceded by an assessment of its quality. The assessment should be based on accuracy, precision, completeness, representativeness, and comparability. These criteria are, in turn, assessed as follows:

- Accuracy - Is it acceptable for the planned use? QA/QC shall measure the accuracy of all data.

- Precision - Is it acceptable for the planned use? QA/QC shall reflect the reproducibility of the measurements.

- Completeness - Are the data sufficient for the planned use? QA/QC shall identify the quantity of data needed to match the goals.

- Representativeness -Do the data accurately reflect actual site conditions, sampling procedures, and analytical method? QA/QC shall ensure this.

- Comparability - Is the report self-consistent in format, units, and standardization of methods used to generate it? QA/QC shall ensure this.

Additionally, statistical methods outlined in the QA/QC program have been applicable to data evaluation.

The Laboratory Supervisor and the Laboratory QA/QC Officer have been responsible for the evaluation of the above criteria and for enforcement of analytical protocols that will necessarily lead to acceptable data quality. The signature of the Supervisor and QA/QC Officer accompany each laboratory analytical report and serve to ensure the overall validity of the reported data.

E.2.5 SAMPLE PLAN/LOG

Normal protocol demands client-and /or site-specific logging of all sample batches delivered to WESTON. Basic information -- such as client name, address, etc.; client phone number; reporting/invoicing instructions; site descriptions; and parameter-specifications and total requirements -- is initiated here. Additionally, sample storage/disposal instructions as well as turnaround requirements and sample collection requirements are addressed at this point.

The appropriate number of method blanks is also logged at this point, and in-house chain-of-custody documentation is initiated here.

E.2.6 SAMPLE RESULTS

WESTON's analytical protocols generally require five-point calibration curve plus a reagent blank as the basis for quantification analytes from a linear calibration curve. (A three-point plus blank curve vs. the original five point one is acceptable if it falls within the QA/QC requirements of ± 3 standard deviation of the original curve.) Linear regression analysis is then performed. Method- and detection limit-specific data are accessed for quantitation and report-writing from each such data set. For reporting accuracy, the algorithm

$$\frac{\text{Linear-Regressed Raw Concentration from Calibration Curve} \quad \text{Solid Sample Extract Volume If Solid} \quad \text{Concentration or Dilution Factor}}{\text{Solid Sample Mass If Solid} \quad \text{Fraction Solids If Solid}} = \text{Final Concentration}$$

is used for all quantitations. (All such algorithm input data are archived for long-term storage.) Detection limits for solids are generated on a per-sample basis and calculated by replacing "LINEAR-REGRESSED RAW CONCENTRATION FROM CALIBRATION CURVE" with "DETECTION LIMIT OF ANALYTE IN LIQUID MATRIX" in the above equation.

E.2.7 CHAIN-OF-CUSTODY

Since they document the history of samples, chain-of-custody procedures are a crucial part of a sampling/analysis program. Chain-of-custody documentation enables identification and tracking of a sample from collection to analysis to reporting.

WESTON's chain-of-custody program necessitates the use of EPA-approved sample labels, secure custody, and attendant recordkeeping. Depending on the client's requirements, WESTON also offers container sealing during unattended transportation of samples.

In essence, WESTON considers a sample in custody if it: is in a WESTON employee's physical possession; it is in view of that WESTON employee; is secured by that WESTON employee to prevent tampering; or is secured by that WESTON employee in an area that is restricted to authorized personnel.

Each time a sample is relinquished from one analyst to another or from one major location to another, WESTON's analytical personnel are required to make appropriate entries. Personnel-specific initials are used as identifiers of analysts, as are location codes for various locations (refrigerators, extraction areas, analytical areas, etc.)

within the laboratory. Each transaction for each sample is accompanied by a specific reason for transfer. Chain-of-custody documentation is given in Appendix F.

E.2.8 QA/QC OFFICER

Toward maintenance of a rigid, credible QA/QC regimen, WESTON Analytical Services maintains a full-time, in-house QA/QC officer who retains independent authority to declare out-of-control situations, thereby precluding reporting of unacceptable data. The QA/QC officer has been available, as needed, on the project.

APPENDIX F

Chain-of-Custody Documentation

CHAIN OF CUSTODY RECORD

4437

SAMPLERS: *(Signature)* M Nechols

Phone:

SHIP TO: Weston Sth.

ATTENTION:

Phone No.

SHIPPING INFORMATION

Shipper

Address

Date Shipped

Shipment Service

Airbill No.

Cooler No.

Relinquished by: *(Signature)*	Received by: *(Signature)*	Date/Time
M. Nechols		
Relinquished by: *(Signature)*	Received by: *(Signature)*	Date/Time
Relinquished by: *(Signature)*	Received by: *(Signature)*	Date/Time
Relinquished by: *(Signature)*	Receive for laboratory by*: *(Signature)* Dave Bregman	Date/Time 11/15 1130

*Analysis laboratory should complete, "sample condition upon receipt", section below, sign and return top copy to Occidental Chemical Co., 16777 Howland Ave., P. O. Box 198, Lathrop, California 95330. Attn: Environmental Dept.

Sample Number	Site Identification	Date Sampled	Analysis Requested	Sample Condition Upon Receipt
1059-ATQ	SFT-1	11-8-83		ok
1060-ATQ	-2			
1061-ATQ	-3			
1062-ATQ	-4			
1063-ATQ	POL-B1-1	11-9-83		
1064-ATQ	POL-B1-2			
1065-ATQ	POL-B1-3			
1065-BTQ	POL-B1-3			
1066-ATQ	POL-B1-4			
1067-ATQ	POL-B1-5			
1068-ATQ	POL-B1-6			
1069-ATQ	POL-B1-7			
1070-ATQ	POL-B1-8			
1071-ATQ	POL-B1-9			
1072-ATQ	POL-B1-10			
1072-BTQ	POL-B1-10			
1073-ATQ	POL-B1-11			
1074-ATQ	POL-B1-12			
1075-ATQ	POL-B1-13			
1075-BTQ	POL-B1-13			

Form A-382 (Rev. 7/82)

CHAIN OF CUSTODY RECORD

4438

SAMPLERS: *(Signature)* M. Nickels

Phone:

SHIP TO:

ATTENTION:

Phone No.

SHIPPING INFORMATION

Shipper

Address

Date Shipped

Shipment Service

Airbill No.

Cooler No.

Relinquished by: *(Signature)*	Received by: *(Signature)*	Date/Time
M. Nickels		
Relinquished by: *(Signature)*	Received by: *(Signature)*	Date/Time
Relinquished by: *(Signature)*	Received by: *(Signature)*	Date/Time
Relinquished by: *(Signature)*	Receive for laboratory by* *(Signature)* Dave Bogun	11/15 1:00

*Analysis laboratory should complete, "sample condition upon receipt", section below, sign and return top copy to Occidental Chemical Co., 16777 Howland Ave., P. O. Box 198, Lathrop, California 95330. Attn: Environmental Dept.

Sample Number	Site Identification	Date Sampled	Analysis Requested	Sample Condition Upon Receipt
1076-ATQ	POL-B1-14	11-9-83		ok
1077-ATQ	POL-B2-1	〃		〃
1078-ATQ	POL-B2-2	〃		〃
1079-ATQ	POL-B2-3			〃
1080-ATQ	POL-B2-4			〃
1081-ATQ	POL-B2-5			〃
1081-BTQ	POL-B2-5			〃
1082-ATQ	POL-B2-6			〃
1083-ATQ	POL-B2-7			〃
1084-ATQ	POL-B2-8			〃
1083-ATQ	POL-B2-7			
1085-ATQ	POL-B2-89			
1086-ATQ	POL-B2-10			
1087-ATQ	POL-B2-110			
1087-BTQ	POL-B2-117			
1088-ATQ	POL-B2-12	〃		
1089-ATQ	POL-B2-13	〃		
1090-ATQ	POL-B2-14	〃		〃
1091-ATQ	POL-B3-1			
1092-ATQ	POL-B3-2	〃		〃

Form A-382 (Rev. 7/82)

Pink - Lab Courtesy Copy

CHAIN OF COUSTODY RECORD

4439

SAMPLERS: *(Signature)* M. Meekels

Phone:

SHIP TO:

ATTENTION:

Phone No.

SHIPPING INFORMATION

Shipper

Address

Date Shipped

Shipment Service

Airbill No.

Cooler No.

Relinquished by: *(Signature)*	Received by: *(Signature)*	Date/Time
M. Meekels		
Relinquished by: *(Signature)*	Received by: *(Signature)*	Date/Time
Relinquished by: *(Signature)*	Received by: *(Signature)*	Date/Time
Relinquished by: *(Signature)*	Receive for laboratory by:* *(Signature)* [illegible]	11/15 1100

*Analysis laboratory should complete, "sample condition upon receipt", section below, sign and return top copy to Occidental Chemical Co., 16777 Howland Ave., P. O. Box 198, Lathrop, California 95330. Attn: Environmental Dept.

Sample Number	Site Identification	Date Sampled	Analysis Requested	Sample Condition Upon Receipt
1093-ATQ	POL-B3-3	11-9-83		
1094-ATQ	POL-B3-4			
1095-ATQ	POL-B3-5			
1095-BTQ	POL-B3-5			
1096-ATQ	POL-B3-6			
1097-ATQ	POL-B3-7			
1098-ATQ	POL-B3-8	11-10-83		
1099-ATQ	POL-B3-9			
1100-ATQ	POL-B3 10			
1101-ATQ	POL-B3-10			
1102-ATQ	POL-B3-11			
1102-ATQ	POL-B3-12			
1103-ATQ	POL-B3-13			
1104 ATQ	POL-B3-14			
1105 ATQ	POL-B4-1			
1106-ATQ	POL-B4-2			
1107-ATQ	POL-B4-3			
1108 ATQ	POL-B4-4			
1109-ATQ	POL-B4-5			
1110 ATQ	POL-B4-6			

Form A-382 (Rev 7/82)

Pink: Lab Courtesy Copy

CHAIN OF CUSTODY RECORD

4440

SAMPLERS: *(Signature)* M. Nickels

Phone:

SHIP TO:

ATTENTION:

Phone No.

SHIPPING INFORMATION

Shipper

Address

Date Shipped

Shipment Service

Airbill No.

Cooler No.

Relinquished by: *(Signature)*	Received by: *(Signature)*	Date/Time
M. Nickels		
Relinquished by: *(Signature)*	**Received by:** *(Signature)*	**Date/Time**
Relinquished by: *(Signature)*	**Received by:** *(Signature)*	**Date/Time**
Relinquished by: *(Signature)*	**Receive for laboratory by*:** *(Signature)*	**Date/Time**
	Dave Bognar	11/5 / 1130

*Analysis laboratory should complete, "sample condition upon receipt", section below, sign and return top copy to Occidental Chemical Co., 16777 Howland Ave., P. O. Box 198, Lathrop, California 95330. Attn: Environmental Dept.

Sample Number	Site Identification	Date Sampled	Analysis Requested	Sample Condition Upon Receipt
1111-AJQ	POL-B4-7	11-10-83		ok
1112-AJQ	B4-8			
1113-AJQ	B4-9			
1114-AJQ	B4-10			
1115-AJQ	B4-11			
1116-AJQ	B4-12			
1117-AJQ	B4-13			
1117-BJQ	B4-13			
1118-AJQ	B4-14			
1119-AJQ	B4-15			
1120-AJQ	B4-16			
1121-AJQ	B4-17			
1122-AJQ	B4-18			
1122-BJQ	B4-18			
1123-AJQ	B5-1			
1124-AJQ	B5-2			
1125-AJQ	B5-3			
1126-AJQ	B5-4			
1127-AJQ	B5-5			
1128-AJQ	B5-6			

Form A-382 (Rev. 7/82)

Pink: Lab Courtesy Copy

CHAIN OF CUSTODY RECORD

4441

SAMPLERS: *(Signature)* M. Nickels

Phone:

SHIP TO:

ATTENTION:

Phone No.

SHIPPING INFORMATION

Shipper

Address

Date Shipped

Shipment Service

Airbill No.

Cooler No.

Relinquished by: *(Signature)*	Received by: *(Signature)*	Date/Time
M. Nickels		
Relinquished by: *(Signature)*	Received by: *(Signature)*	Date/Time
Relinquished by: *(Signature)*	Received by: *(Signature)*	Date/Time
Relinquished by: *(Signature)*	Receive for laboratory by*: *(Signature)* Dave Bogan	[illegible] 1:00

*Analysis laboratory should complete, "sample condition upon receipt" section below, sign and return top copy to Occidental Chemical Co., 16777 Howland Ave., P. O. Box 198, Lathrop, California 95330. Attn: Environmental Dept.

Sample Number	Site Identification	Date Sampled	Analysis Requested	Sample Condition Upon Receipt
1129-ATQ	POL-B5-7	11-10-83		ok
1130-ATQ	-8			
1131-ATQ	-9			
1131-BTQ	-9			
1132-ATQ	-10			
1133-ATQ	-11			
1134-ATQ	-13			
1135-ATQ	-13-14			
1136-ATQ	-14-15			
1137-ATQ	-15-16			
1138-ATQ	-16-17			
1139-ATQ	-17-18			
1139-BTQ	-17-18			
1140-ATQ	POL-B5-19			
1141-ATQ	20			
1142-ATQ	POL-B6-1			
1143-ATQ	POL-B6-2			
1144-ATQ	POL-B6 -3			
1144-BTQ	POL-B6 -3			
1145-ATQ	POL-B6 -4			

Form A-382 (Rev. 7/82)

CHAIN OF CUSTODY RECORD

4442

SAMPLERS: *(Signature)* [signature]

Phone:

SHIP TO:

ATTENTION:

Phone No.

SHIPPING INFORMATION

Shipper

Address

Date Shipped

Shipment Service

Airbill No.

Cooler No.

Relinquished by: *(Signature)*	Received by: *(Signature)*	Date/Time	
[signature]			
Relinquished by: *(Signature)*	Received by: *(Signature)*	Date/Time	
Relinquished by: *(Signature)*	Received by: *(Signature)*	Date/Time	
Relinquished by: *(Signature)*	Receive for laboratory by*: *(Signature)* [signature]	11/15	1100

*Analysis laboratory should complete, "sample condition upon receipt", section below, sign and return top copy to Occidental Chemical Co., 16777 Howland Ave., P. O. Box 198, Lathrop, California 95330. Attn: Environmental Dept.

Sample Number	Site Identification	Date Sampled	Analysis Requested	Sample Condition Upon Receipt
1146-ATQ	POL-B6-5	11-10-83		ok
1147-ATQ	-6			
1148-ATQ	-7			
1149-ATQ	-8			
1150-ATQ	-9			
1150-BTQ	-9			
1151-ATQ	-10			
1152-ATQ	-11			
1153-ATQ	-12			
1154-ATQ	-13			
1155-ATQ	-14			
1156-ATQ	-15			
1157-ATQ	-16			
1157-BTQ	-16			

Form A-382 (Rev 7/82)
White Samples

CHAIN OF CUSTODY RECORD

4443

SAMPLERS: *(Signature)* V Bogner + J. WILLIAMS

Phone:

SHIP TO:

ATTENTION:

Phone No.

SHIPPING INFORMATION

Shipper

Address

Date Shipped

Shipment Service

Airbill No.

Cooler No.

Relinquished by: *(Signature)*	Received by: *(Signature)*	Date/Time
Relinquished by: *(Signature)*	Received by: *(Signature)*	Date/Time
Relinquished by: *(Signature)*	Received by: *(Signature)*	Date/Time
Relinquished by: *(Signature)*	Receive for laboratory by*: *(Signature)*	Date/Time
V Bogner	Dave Bogner	11/16 [illegible]

*Analysis laboratory should complete, "sample condition upon receipt" section below, sign and return top copy to Occidental Chemical Co., 16777 Howland Ave., P. O. Box 198, Lathrop, California 95330. Attn: Environmental Dept.

Sample Number	Site Identification	Date Sampled	Analysis Requested	Sample Condition Upon Receipt
1158-ATQ	POL-B6-17	11-10-83		ok
1159-ATQ	-18			
1160-ATQ	-19			
1160-BTQ	-20			
1161-ATQ	-20			
[illegible]-ASQ	[illegible]-B7-1	11-11-83		
[illegible]-ASQ	-2			
[illegible]-ASQ	-3			
[illegible]-BSQ	-3			
[illegible]-ASQ	-4			
[illegible]-ASQ	-5			
[illegible]-ASQ	[illegible]			
[illegible]-BSQ	-6			
[illegible]-ASQ	-7			
[illegible]-ASQ	8			
[illegible]-ASQ	9			
[illegible]-ASQ	10			
1171-BSQ	10			
[illegible]-ASQ	11			
[illegible]-ASQ	-12			

Form A-382 (Rev 7 82)

Pink - Lab Courtesy Copy

CHAIN OF CUSTODY RECORD

4444

SAMPLERS: (Signature) V. Rogan + J. Williams

Phone:

SHIP TO:

ATTENTION:

Phone No.

SHIPPING INFORMATION

Shipper

Address

Date Shipped

Shipment Service

Airbill No.

Cooler No.

Relinquished by: (Signature)	Received by: (Signature)	Date/Time
Relinquished by: (Signature)	Received by: (Signature)	Date/Time
Relinquished by: (Signature)	Received by: (Signature)	Date/Time
Relinquished by: (Signature) V Rogan	Receive for laboratory by*: (Signature) Dave Bogan	Date/Time 11/16 11:30

*Analysis laboratory should complete, "sample condition upon receipt" section below, sign and return top copy to Occidental Chemical Co., 16777 Howland Ave., P. O. Box 198, Lathrop, California 95330. Attn: Environmental Dept.

Sample Number	Site Identification	Date Sampled	Analysis Requested	Sample Condition Upon Receipt
1174-AJQ	PCL-B1-13	11-11-83		ok
1175-AJQ	14			
1176-AJQ	15			
1177-AJQ	16			
~~1178-AJQ~~	~~17~~	VB		
~~1179-AJQ~~	~~18~~	VB		
~~1180-AJQ~~	~~19~~	VB		VB
~~1180-AJQ~~	~~19~~	VB		
~~1181-AJQ~~	~~20~~	VB		

Form A-382 (Rev. 7/82)
White-Sampler Canary-Occidental Chem[illegible] F-8 [illegible]vironmental Dept. Pink-Lab Courtesy Copy

CHAIN OF CUSTODY RECORD

4445

SAMPLERS: *(Signature)* V. Bognar J. Williams

Phone:

SHIP TO:

ATTENTION:

Phone No.

SHIPPING INFORMATION

Shipper

Address

Date Shipped

Shipment Service

Airbill No.

Cooler No.

Relinquished by: *(Signature)*	Received by: *(Signature)*	Date/Time
Relinquished by: *(Signature)*	Received by: *(Signature)*	Date/Time
Relinquished by: *(Signature)*	Received by: *(Signature)*	Date/Time
Relinquished by: *(Signature)* Vicki Bognar	Receive for laboratory by*: *(Signature)* Dave Bognar	Date/Time 11/12 1400

*Analysis laboratory should complete, "sample condition upon receipt", section below, sign and return top copy to Occidental Chemical Co., 16777 Howland Ave., P. O. Box 198, Lathrop, California 95330. Attn: Environmental Dept.

Sample Number	Site Identification	Date Sampled	Analysis Requested	Sample Condition Upon Receipt
1178 AJQ	Pa-B7-17	11-11-83		ok
1179 AJQ	18			
1179 BJQ	18			
1180 AJQ	19			
1181 AJQ	20			
1182 AJQ	POL-B3-1	11-14-83		
1183 AJQ	2			
1184 AJQ	3			
1185 AJQ	4			
1185 BJQ	4			
1186 AJQ	5			
1187 AJQ	6			
1188 AJQ	7			
1189 AJQ	8			
1190 AJQ	9			
1190 BJQ	9			
1191 AJQ	10			
1192 AJQ	11			
1193 AJQ	12			
1194 AJQ	13			

Form A-382 (Rev 7/82)

Pink Lab Courtesy Copy

CHAIN OF CUSTODY RECORD

4446

SAMPLERS: *(Signature)* V Bognar X J Williams

Phone:

SHIP TO:

ATTENTION:

Phone No.

SHIPPING INFORMATION

Shipper

Address

Date Shipped

Shipment Service

Airbill No.

Cooler No.

Relinquished by: (Signature)	Received by: (Signature)	Date/Time
Relinquished by: (Signature)	Received by: (Signature)	Date/Time
Relinquished by: (Signature)	Received by: (Signature)	Date/Time
Relinquished by: (Signature) Vicki Bognar	Receive for laboratory by*: (Signature) Dave Bognar	Date/Time 11/17 1400

*Analysis laboratory should complete, "sample condition upon receipt", section below, sign and return top copy to Occidental Chemical Co.,16777 Howland Ave.,P. O. Box 198, Lathrop, California 95330. Attn: Environmental Dept.

Sample Number	Site Identification	Date Sampled	Analysis Requested	Sample Condition Upon Receipt
1195 AJQ	POL-B8-14	11/14/83		ok
1196 AJQ	15			
1196 BJQ	15			
1197 AJQ	16			
1198 AJQ	17			
1199 AJQ	18			
1200 AJQ	19			
1201 AJQ	20			
1201 BJQ	20			
1202 AJQ	POL-B9-1			
1203 AJQ	2			
1204 AJQ	3			
1205 AJQ	4			
1205 BJQ	4			
1206 AJQ	5			
1207 AJQ	6			
1208 AJP	7			
1209 AJP	8			
1210 AJP	9			
1210 BJP	9			

Form A-382 (Rev. 7/82)

Pink-Lab Courtesy Copy

CHAIN OF COUSTODY RECORD

4447

SAMPLERS: *(Signature)* V BOENAR + J. WILLIAMS

Phone:

SHIP TO:

ATTENTION:

Phone No.

SHIPPING INFORMATION

Shipper

Address

Date Shipped

Shipment Service

Airbill No.

Cooler No.

Relinquished by: *(Signature)*	Received by: *(Signature)*	Date/Time
Relinquished by: *(Signature)*	Received by: *(Signature)*	Date/Time
Relinquished by: *(Signature)*	Received by: *(Signature)*	Date/Time
Relinquished by: *(Signature)*	Receive for laboratory by*: *(Signature)*	Date/Time
VICKI BOENAR	Dave Boynar	11/17 1400

*Analysis laboratory should complete, "sample condition upon receipt", section below, sign and return top copy to Occidental Chemical Co., 16777 Howland Ave., P. O. Box 198, Lathrop, California 95330. Attn: Environmental Dept.

Sample Number	Site Identification	Date Sampled	Analysis Requested	Sample Condition Upon Receipt
1211 AJP	10			OK
1212 AJP	11			
1213 AJP	12			
1214 AJP	13			
1215 AJP	14			
1216 AJP	15			
1217 AJP	16			
1217 BJP	16			
1218 AJP	17			
1219 AJP	18			
1219 BJP	18			
1220 AJP	19			
1221 AJP	20			
1222 AJP	POL BIO- 1			
1223 AJP	POL BIO- 2			
1224 AJP	3			
1225 AJP	4			
1226 AJP	5			
1226 BJP	5			
1227 AJP	6			

Form A-382 (Rev. 7/82)

CHAIN OF CUSTODY RECORD

4448

SAMPLERS: *(Signature)* V. Bognar + J. Williams

Phone:

SHIP TO:

ATTENTION:

Phone No.

SHIPPING INFORMATION

Shipper

Address

Date Shipped

Shipment Service

Airbill No.

Cooler No.

Relinquished by: (Signature)	Received by: (Signature)	Date/Time
Relinquished by: (Signature)	Received by: (Signature)	Date/Time
Relinquished by: (Signature)	Received by: (Signature)	Date/Time
Relinquished by: (Signature)	Receive for laboratory by*: (Signature)	Date/Time
V. Bognar	Dave Bognar	11/17 1400

*Analysis laboratory should complete, "sample condition upon receipt", section below, sign and return top copy to Occidental Chemical Co., 16777 Howland Ave., P. O. Box 198, Lathrop, California 95330. Attn: Environmental Dept.

Sample Number	Site Identification	Date Sampled	Analysis Requested	Sample Condition Upon Receipt
1228 AJP	PxB-10-7			ok
1229 AJP	8			↓
1230 AJP	9			
1230 BJP	9			
1231 AJP	10			
1232 AJP	11			
1233 AJP	12			
1234 AJP	13			
1235 AJP	14			
1236 AJP	15			
1236 BJP	15			
1237 AJP	16			
1238 AJP	17			
1239 AJP	18			
1240 AJP	19			
1241 AJP	20			
1241 BJP	20			

Form A-382 (Rev 7/82)

Pink-Lab Courtesy Copy

CHAIN OF CUSTODY RECORD

4449

SAMPLERS: *(Signature)* V. Bognar + J. Williams

Phone:

SHIP TO:

ATTENTION:

Phone No.

SHIPPING INFORMATION

Shipper

Address

Date Shipped

Shipment Service

Airbill No.

Cooler No.

Relinquished by: *(Signature)*	Received by: *(Signature)*	Date/Time
Relinquished by: *(Signature)*	Received by: *(Signature)*	Date/Time
Relinquished by: *(Signature)*	Received by: *(Signature)*	Date/Time
Relinquished by: *(Signature)* V Bognar	Receive for laboratory by*: *(Signature)* V. Bognar	Date/Time 11/28

*Analysis laboratory should complete, "sample condition upon receipt", section below, sign and return top copy to Occidental Chemical Co., 16777 Howland Ave., P. O. Box 198, Lathrop, California 95330. Attn: Environmental Dept.

Sample Number	Site Identification	Date Sampled	Analysis Requested	Sample Condition Upon Receipt
1242AJP	B11-1	11-15-83		OK
1243AJP	B11-2			
1244AJP	B12-3			
1244BJP	B12-3			
1245AJP	B12-4			
1246AJP	B13-5			
1247AJP	B13-6			
1248AJP	B14-7			
1249AJP	B14-8			
1249BJP	B14-8			
1250AJP	B15-9			
1251AJP	B15-10			
1252AJP	B16-11			
1252BJP	B16-11			
1253AJP	B16-12			
1254AJP	B17-13			
1255AJP	B17-14			
1256AJP	B18-15			
1256BJP	B18-15			
1257AJP	B18-16			

Form A-382 (Rev. 7/82)

CHAIN OF CUSTODY RECORD

4451

SAMPLERS: *(Signature)* V. Bognar + J. Williams

Phone:

SHIP TO:

ATTENTION:

Phone No.

SHIPPING INFORMATION

Shipper

Address

Date Shipped

Shipment Service

Airbill No.

Cooler No.

Relinquished by: *(Signature)*	Received by: *(Signature)*	Date/Time
Relinquished by: *(Signature)*	Received by: *(Signature)*	Date/Time
Relinquished by: *(Signature)*	Received by: *(Signature)*	Date/Time
Relinquished by: *(Signature)* V. Bognar	Receive for laboratory by* *(Signature)* V. Bognar	Date/Time 11/17

*Analysis laboratory should complete, "sample condition upon receipt", section below, sign and return top copy to Occidental Chemical Co., 16777 Howland Ave., P. O. Box 198, Lathrop, California 95330. Attn: Environmental Dept.

Sample Number	Site Identification	Date Sampled	Analysis Requested	Sample Condition Upon Receipt
1258 AJP	B19-1	11-16-83		OK
1259 AJP	B19-2			
1260 AJP	B19-3			
1261 AJP	B19-4			
1261 BJP	B19-4			
1262 AJP	B19-5			
1263 AJP	B19-6			
1264 AJP	B19-7			
1265 AJP	B19-8			
1266 AJP	B19-9			
1266 BJP	B19-9			
1267 AJP	B19-10			
1268 AJP	B19-11			
1269 AJP	B19-12			
1270 AJP	B19-13			
1271 AJP	B19-14			
1271 BJP	B19-14			
1272 AJP	B19-15			
1273 AJP	B19-16			
1274 AJP	B19-17			

Form A-382 (Rev. 7/82)

CHAIN OF CUSTODY RECORD

4452

SAMPLERS: *(Signature)* V. Bognar + J. Williams

Phone:

SHIP TO:

ATTENTION:

Phone No.

SHIPPING INFORMATION

Shipper

Address

Date Shipped

Shipment Service

Airbill No.

Cooler No.

Relinquished by: *(Signature)*	Received by: *(Signature)*	Date/Time
Relinquished by: *(Signature)*	Received by: *(Signature)*	Date/Time
Relinquished by: *(Signature)*	Received by: *(Signature)*	Date/Time
Relinquished by: *(Signature)* V. Bognar	Receive for laboratory by*: *(Signature)* V. Bognar	Date/Time

*Analysis laboratory should complete, "sample condition upon receipt" section below, sign and return top copy to Occidental Chemical Co., 16777 Howland Ave., P. O. Box 198, Lathrop, California 95330. Attn: Environmental Dept.

Sample Number	Site Identification	Date Sampled	Analysis Requested	Sample Condition Upon Receipt
1275 AJP	B19-18	11-16-83		
1276 AJP	B19-19			
1277 AJP	B19-20			
1277 AJP	B19-20			
1278 AJP	B20-1			
1279 AJP	B20-2			
1280 AJP	B20-3			
1280 BJP	B20-3			
1281 AJP	B20-4			
1282 AJP	B20-5			
1283 AJP	B20-6			
1284 AJP	B20-7			
1285 AJP	B20-8			
1286 AJP	B20-9			
1286 BJP	B20-9			
1287 AJP	B20-10			
1288 AJP	B20-11			
1289 AJP	B20-12			
1290 AJP	B20-13			
1291 AJP	B20-14			

Form A-382 (Rev. 7/82)

CHAIN OF CUSTODY RECORD

4453

SAMPLERS: *(Signature)* V. Bognar + J. Williams

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ATTENTION:

Phone No.

SHIPPING INFORMATION

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Date Shipped

Shipment Service

Airbill No.

Cooler No.

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Relinquished by: *(Signature)*	Received by: *(Signature)*	Date/Time
Relinquished by: *(Signature)*	Received by: *(Signature)*	Date/Time
Relinquished by: *(Signature)* V. Bognar	Receive for laboratory by*: *(Signature)* V. Bognar	Date/Time 1/20

*Analysis laboratory should complete, "sample condition upon receipt", section below, sign and return top copy to Occidental Chemical Co., 16777 Howland Ave., P. O. Box 198, Lathrop, California 95330. Attn: Environmental Dept.

Sample Number	Site Identification	Date Sampled	Analysis Requested	Sample Condition Upon Receipt
1291 BJP	B20-14	11-16-83		M
1292 AJP	B20-15			
1293 AJP	B20-16			
1294 AJP	B20-17			
1295 AJP	B20-18			
1296 AJP	B20-19			
1296 BJP	B20-19			
1297 AJP	B20-20			
1298 AJP	B21-1			
1299 AJP	B21-2			
1300 AJP	B21-3			
1300 BJP	B21-3			
1301 AJP	B21-4			
1302 AJP	B21-5			
1303 AJP	B21-6			
1304 AJP	B21-7			
1305 AJP	B21-8			
1306 AJP	B21-9			
1306 BJP	B21-9			
1307 AJP	B21-10			

Form A-382 (Rev 7/82)

Pink Lab Courtesy Copy

CHAIN OF CUSTODY RECORD

4454

SAMPLERS: *(Signature)* T. Bognar + J. Williams

Phone:

SHIP TO:

ATTENTION:

Phone No.

SHIPPING INFORMATION

Shipper

Address

Date Shipped

Shipment Service

Airbill No.

Cooler No.

Relinquished by: *(Signature)*	Received by: *(Signature)*	Date/Time
Relinquished by: *(Signature)*	Received by: *(Signature)*	Date/Time
Relinquished by: *(Signature)*	Received by: *(Signature)*	Date/Time
Relinquished by: *(Signature)* V. Bognar	Receive for laboratory by*: *(Signature)* V. Bognar ✓	Date/Time 11/30

*Analysis laboratory should complete, "sample condition upon receipt", section below, sign and return top copy to Occidental Chemical Co., 16777 Howland Ave., P. O. Box 198, Lathrop, California 95330. Attn: Environmental Dept.

Sample Number	Site Identification	Date Sampled	Analysis Requested	Sample Condition Upon Receipt
1308 AJP	B21-11	11-16-83		OK
1309 AJP	B21-12	↓		↓
1310 AJP	B21-13			
1310 BJP	B21-13			
1311 AJP	B21-14			
1312 AJP	B21-15			
1313 AJP	B21-16			
1314 AJP	B21-17			
1315 AJP	B21-18			
1316 AJP	B21-19			
1317 AJP	B21-20			
1317 BJP	B21-20	↓		↓

Form A-382 (Rev. 7/82)

Pink: Lab Courtesy Copy

CHAIN OF CUSTODY RECORD

4456

SAMPLERS: *(Signature)* V. Bognar + J. Williams

Phone:

SHIP TO:

ATTENTION:

Phone No.

SHIPPING INFORMATION

Shipper

Address

Date Shipped

Shipment Service

Airbill No.

Cooler No.

Relinquished by: *(Signature)*	Received by: *(Signature)*	Date/Time
Relinquished by: *(Signature)*	Received by: *(Signature)*	Date/Time
Relinquished by: *(Signature)*	Received by: *(Signature)*	Date/Time
Relinquished by: *(Signature)* V. Bognar	Receive for laboratory by*: *(Signature)* V. Bognar	Date/Time 1:30

*Analysis laboratory should complete, "sample condition upon receipt", section below, sign and return top copy to Occidental Chemical Co.,16777 Howland Ave., P. O. Box 198, Lathrop, California 95330. Attn: Environmental Dept.

Sample Number	Site Identification	Date Sampled	Analysis Requested	Sample Condition Upon Receipt
1318 AJP	B22-1	11-17-83		OK
1319 AJP	B22-2			
1320 AJP	B22-3			
1320 [illegible]JP	B22-3			
1321 AJP	B22-4			
1322 AJP	B22-5			
1323 AJP	B22-6			
1324 AJP	B22-7			
1325 AJP	B22-8			
1326 AJP	B22-9			
1326 BJP	B22-9			
1327 AJP	B22-10			
1328 AJP	B22-11			
1329 AJP	B22-12			
1330 AJP	B22-13			
1331 AJP	B22-14			
1332 AJP	B22-15			
1332 BJP	B22-15			
1333 AJP	B22-16			
1334 AJP	B22-17			

Form A-382 (Rev. 7/82)

Pink: Lab Courtesy Copy

CHAIN OF CUSTODY RECORD

4457

SAMPLERS: *(Signature)* V. Bognar + J. Williams

Phone:

SHIP TO:

ATTENTION:

Phone No.

SHIPPING INFORMATION

Shipper

Address

Date Shipped

Shipment Service

Airbill No.

Cooler No.

Relinquished by: *(Signature)*	Received by: *(Signature)*	Date/Time
Relinquished by: *(Signature)*	Received by: *(Signature)*	Date/Time
Relinquished by: *(Signature)*	Received by: *(Signature)*	Date/Time
Relinquished by: *(Signature)* V. Bognar	Receive for laboratory by*: *(Signature)* V. Bognar	Date/Time 1/5/88

*Analysis laboratory should complete, "sample condition upon receipt", section below, sign and return top copy to Occidental Chemical Co., 16777 Howland Ave., P. O. Box 198, Lathrop, California 95330. Attn: Environmental Dept.

Sample Number	Site Identification	Date Sampled	Analysis Requested	Sample Condition Upon Receipt
1335 AJP	B22-18			
1336 AJP	B22-19			
1337 AJP	B22-20			
1337 AJP	B22-20			
1338 AJP	B22-1			
1339 AJP	B22-2			
1340 AJP	B22-3			

Form A-382 (Rev. 7.82)

White-Sampler

Canary-Occidental Chem F-19 Environmental Dept

Pink-Lab Courtesy Copy

CHAIN OF CUSTODY RECORD

4458

SAMPLERS: (Signature) V. Bognar & V. Williams

Phone:

SHIP TO:

ATTENTION:

Phone No.

SHIPPING INFORMATION

Shipper

Address

Date Shipped

Shipment Service

Airbill No.

Cooler No.

Relinquished by: (Signature)	Received by: (Signature)	Date/Time
Relinquished by: (Signature)	Received by: (Signature)	Date/Time
Relinquished by: (Signature)	Received by: (Signature)	Date/Time
Relinquished by: (Signature) V. Bognar	Receive for laboratory by:* (Signature) V. Bognar	Date/Time

*Analysis laboratory should complete, "sample condition upon receipt", section below, sign and return top copy to Occidental Chemical Co., 16777 Howland Ave., P. O. Box 198, Lathrop, California 95330. Attn: Environmental Dept.

Sample Number	Site Identification	Date Sampled	Analysis Requested	Sample Condition Upon Receipt
1341	WTF	11-17-83		[illegible]
1341	WTF			
1342	WTF	Lost		
1342	WTF	Broke in transit		
1343	Well #10			
1343	Well #10			
1343	Well #10			
1343	Well #10			
1344	Well #13			
1344	Well #13			
1345	Well #11			
1345	Well #11			
1345	Well #11			
1345	Well #11			
1345	Well #11			
1346	Well #7			
1346	Well #7			
1347	Well #1			
1347	Well #1			
1348	Well #4			

Form A-382 (Rev 7/82)

White ... Occidental Ch... Environmental Dept ... Pink Lab Courtesy Copy

CHAIN OF CUSTODY RECORD

4459

SAMPLERS: *(Signature)* V. Bognar + J. Williams

Phone:

SHIP TO:

ATTENTION:

Phone No.

SHIPPING INFORMATION

Shipper

Address

Date Shipped

Shipment Service

Airbill No.

Cooler No.

Relinquished by: *(Signature)*	Received by: *(Signature)*	Date/Time
Relinquished by: *(Signature)*	Received by: *(Signature)*	Date/Time
Relinquished by: *(Signature)*	Received by: *(Signature)*	Date/Time
Relinquished by: *(Signature)* V. Bognar	Receive for laboratory by*: *(Signature)* V. Bognar	Date/Time

*Analysis laboratory should complete, "sample condition upon receipt", section below, sign and return top copy to Occidental Chemical Co., 16777 Howland Ave., P. O. Box 198, Lathrop, California 95330 Attn: Environmental Dept.

Sample Number	Site Identification	Date Sampled	Analysis Requested	Sample Condition Upon Receipt
1348	Well #4	11-17-83		
1348	Well #4			
1348	Well #4			
1348	Well #4			
1348	Well #4			

Form A-382 (Rev. 7-82)

APPENDIX G

Raw Water and Soil Quality Data

LUKE AFB

SOILS

LAB NO.	FIELD LABLE	PARAMETER	RESULTS ug/kg (ppb)
1772	B21-20 1317	1,2-Dichlorethane	4
		1,1-Dichloroethane	4
		1,1-Dichloroethylene	23
		Methylene Chloride	26
		Unidentified Peaks	2
1780	B22-6 1323	1,1-Dichloroethylene	6
		Methylene Chloride	18
		Unidentified Peaks	3
1728	B20-3 1280	1,2-Dichloroethane	7
		1,1-Dichloroethane	9
		1,1-Dichloroethylene	35
		Methylene Chloride	56
		Unidentified Peaks	2
1721	B19-17 1274	1,2-Dichloroethane	4
		1,1-Dichloroethane	2
		1,1-Dichloroethylene	21
		Methylene Chloride	16
		Bromomethane	13
		Unidentified Peaks	1
1747	B20-19 1296	1,2-Dichloroethane	16
		1,1-Dichloroethane	5
		1,1-Dichloroethylene	13
		Methylene Chloride	38
		Unidentified Peaks	1
Blank for 5 above		Methylene Chloride	32
1261	1059	1,1,1-Trichloroethane	4
		Chloroform	162
		Methylene Chloride	600
		Bromodichloromethane	3
		Trichloroethylene	22
1264	1062	1,1,1-Trichloroethane	2
		Chloroform	57
		Methylene Chloride	330
		Trichloroethylene	16
		Unidentified Peaks	1
1785	B22-10 1327	1,1,1-Trichloroethane	11
		Chloroform	320
		Methylene Chloride	790
		Bromodichloromethane	13

LUKE AFB (CONT.)

SOILS

LAB NO.	FIELD LABLE	PARAMETER	RESULTS ug/kg (ppb)
1796	B22-20 1337	1,1,1-Trichloroethane	11
		Chloroform	800
		Methylene Chloride	950
		Bromodichloromethane	16
1262	1060	Chloroform	23
		Methylene Chloride	130
Blank for above 5 samples		Methylene Chloride	410
1715	B19-12 1269	1,1,1-Trichloroethane	2
		Chloroform	540
		Methylene Chloride	1300
		Bromodichloromethane	10
		Unidentified Peaks	2
1731	B20-5 1282	1,2 Dichloromethane	190
		1,1,1-Trichloroethane	22
		Chloroform	390
		1,1 Dichloroethylene	15
		1,2 Dichloropropane	1
		Methylene Chloride	1300
		Bromodichloromethane	19
		Trichloroethylene	2
		Vinyl Chloride	90
		Unidentified Peaks	2
Blank for above 2 samples		Methylene Chloride	1300
1583	B20-16 1293	1,1-Dichloroethane	5
		1,1-Dichloroethylene	22
		Methylene Chloride	27
		Unidentified Peaks	4
1699	SB18-15 1256	1,2-Dichloroethane	5
		1,1-Dichloroethane	11
		1,1-Dichloroethylene	40
		Trans & Cis-1,3 Dichloropropane	2
		Tetrachloroethylene	1
		Unidentified Peaks	4
1693	SB-15-10 1251	1,2-Dichloroethane	7
		1,2-Dichloroethylene	7
		Methylene Chloride	8

LUKE AFB (CONT.)

SOILS

LAB NO.	FIELD LABLE	PARAMETER	RESULTS ug/kg (ppb)
1756	B-21-6 1303	1,1 Dichloroethylene	2
		Methylene Chloride	19
1692	SB 15-9 1250	Methylene Chloride	1
1701	SB 18-16 1257	1,1-Dichloroethylene	2
		Methylene Chloride	24
		Unidentified Peaks	3
1778	B22-4 1321	1,2-Dichloroethane	31
		1,1-Dichloroethane	3
		1,1-Dichloroethylene	6
		Methylene Chloride	65
		Unidentified Peaks	2
1255	SB17-14 1255	1,2-Dichloroethane	9
		1,1-Dichloroethane	9
		1,1-Dichloroethylene	16
		Methylene Chloride	59
		Unidentified Peaks	2
1694	SB-16-11 1252	1,2-Dichloroethane	8
		1,1-Dichloroethane	5
		1,1-Dichloroethylene	7
		Methylene Chloride	40
		Unidentified Peaks	3
1740	B20-13 1290	1,1-Dichloroethane	1
		1,1-Dichloroethylene	3
		Methylene Chloride	17
		Unidentified Peaks	2
1697	SB17-13 1254	1,2-Dichloroethane	12
		1,1-Dichloroethane	1
		Chloroform	2
		1,1-Dichloroethylene	2
		Methylene Chloride	62
1696	SB16-12-1253	Methylene Chloride	2
1590	SB14-8 1249	Methylene Chloride	2
1588	SB-13-6 1247	1,2 Dichloroethane	8
		1,1 Dichloroethane	4
		Chloroform	8
		1,1 Dichloroethylene	24
		Unidentified Peaks	1

LUKE AFB (CONT.)

SOILS

LAB NO.	FIELD LABLE	PARAMETER	RESULTS ug/kg (ppb)
1586	SB 12-4 1245	No peaks Found	
1492	B1-14 1076	Methylene Chloride	8
1579	B10-10 1231	No peaks found	
Blank for above 17 samples		Methylene Chloride	35
1518	B5-5 1127	Chloroform	120
		Methylene Chloride	950
1596	B7-20 1181	Chloroform	160
		Methylene Chloride	1200
1325	B6-15 1156	Chloroform	200
		Methylene Chloride	1400
1499	B3-6 1096	1,2 Dichloroethane	3
		Chloroform	8
		Methylene Chloride	320
1292	B2-14 1090	No peaks found	
1309	B4-9 1113	No peaks found	
1299	B3-14 1104	1,2 Dichloroethane	12
		1,1 Dichloroethane	14
		1,1 Dichloroethylene	10
		Trans-1,2 Dichloroethylene	11
		Methylene Chloride	970
1269	B1-4 1066	No peaks found	
1280	B2-4 1080	Methylene Chloride	430
Blanks for the above 9 samples			750
1601	B8-6 1187	Chloroform	35
		1,1 Dichloroethylene	12
		Methylene Chloride	13,000
Blank		Methylene Chloride	13,000
2210	SB 11-2 1243	No peaks found	

LUKE AFB (CONT.)

PHENOLS

LAB NO.	FIELD LABLE	PARAMETER	RESULTS ug/kg (ppb)
83-1868	WIF Influent	2,4 Dimethylphenol	53
83-1666	1341-HQ Effluent	2,4 Dimethylphenol	5
83-1677	1348-DQ #4	No detectable phenol	
83-1672	1345-HQ #11	No detectable phenol	
83-1669	1343-JQ #10	No detectable phenol	

RADIOLOGY

83-1676	Radium 226	ND 0.004
	Gross Alpha	ND 2
	Gross Beta	34 + 4
	CS 137	26 ± 4
	CS 139	12 ± 4

LUKE AFB

WATER

SITE LOCATION	PARAMETER	RESULTS
Well 10	1,2 Dichloroethane	10.8
	Trans-1,2-Dichloroethylene	100
	Methylene Chloride	24
	EDB	1.0
	DBCP	0.1
Effluent	1,2 Dichloroethane	2.9
	Chloroform	2.0
	Bromodichloromethane	0.15
	Trichloroethylene	0.63
Well 11	Methylene Chloride	0.28
	EDB	ND 1.0
	DBCP	ND 0.1
WIF Inffluent	1,2 Dichloroethane	1.0
	1,1,1-Trichloroethane	4.8
	1,1 Dichloroethane	2.5
	Chloroform	0.17
	1,2 Dichlorobenzene	3.8
	1,3 Dichlorobenzene	15
	Trans 1,2 Dichloroethylene	1.5
	Trans & Cis 1,3 Dichloropropene	0.30
	Methylene Chloride	6.2
	Tetrachloroethylene	2.3
	Trichloroethylene	2.2
	Unidentified Peaks	5
Well 4	1,2-Dichloroethane	1.4
	Methylene Chloride	43.7
	EDB	ND 1.0
	DBCP	ND 0.1
Well 1	DBCP	ND 0.1
	EDB	ND 1.0
Well 7	DBCP	ND 0.1
	EDB	ND 1.0
Well 12	DBCP	ND 0.1
	EDB	ND 1.0

TO: ______________________

____

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DATA SUMMARY SHEET

W.O/P.O. No. C 28-05-2/

Date(s) Samples Collected 1/1/81

Client Luke AFB

RFW No.	B.S. RFW #	Sample Description	Pb						
	81-73-0010	1066	161						
	0020	1076	99						
	0030	1080	103						
	0040	1090	52.5						
	0050	1096	304						
	0060	1104	145						
	0070	1113	151						
	0080	1127	104						
	0090	1136	101						
	0100	1131	112						
	0110	1157	114						
	0120	1231	103						
	0130	1345	ND						

Signed ______________________ Date ______________

Q. A. Officer

TO: ______________________________

DATA SUMMARY SHEET

Date(s) Samples Collected 1/1/81

W.O/P.O. No. C 28-05-01 Client Luke AFB

RFW No.	B.S. RFW #	Sample Description	ppb Pb						
	WI-83-0010	1000	161						
	0020	1071	99						
	0030	1080	103						
	0040	1090	52.5						
	0050	1096	304						
	0060	1104	145						
	0070	1113	151						
	0080	1137	104						
	0090	1156	101						
	0100	1181	112						
	0110	1187	114						
	0120	1231	105						
	0130	1345	NR						

Signed ______________________ Date ______________

Q. A. Officer

DATA SUMMARY SHEET

TO: ______________________

W.O/P.O. No. ____________

Date(s) Samples Collected 11/21

Client Norton & Luke AFB

RFW No.	B.S. RFW #	Sample Description	O/G mg/l					
	8401-694-0010	QA	21.3					
	0020	1066	41.8					
	0030	1062	39.4					
	0040	1061	250					
	0050	1060	7300					
	0060	1059	2930					
	0070	Blank	3.4					
	0080	1096	<2					
	0090	1076	3.2					
	0100	1104	<2					
	0110	1090	14.9					
	0120	1080	5.2					
	0130	1187	12.6					
	0140	1181	8.6					
	0150	1127	3.6					
	0160	1127 Dup	9.4					

Signed ____________ Date ____________

Q. A. Officer

TO: ______________________

____

______________________ W.O/P.O. No. ______________

DATA SUMMARY SHEET

Date(s) Samples Collected 1/81

Client Norton & Luke AFB

RFW No.	B.S. RFW #	Sample Description	O/G						
	8401-694-0170	1156	7.6						
	0180	1113	<2						
	0190	QA	11.0						
	0200	1231	<2						
	0210	1243	38.0						
	0220	1245	6.5						
	0230	1247	16.4						
	0240	1249	3.8						
	0250	Blank	3.2						
	0260	1354	8.0						
	0270	1353	<2						
	0280	1352	6.3						
	0290	1351	2.9						
	0300	1350	5.6						
	0310	1355	7.6						
	0320	1356	<2						

Signed ______________________ Date ______________

Q. A. Officer

TO: ______________________

DATA SUMMARY SHEET

Date(s) Samples Collected 12/21

W.O/P.O. No. ______ Client Lake ATB

RFW No.	B.S. RFW #	Sample Description	O/G						
	8401-694-0330	1257	<2						
	0340	1257 Dup	4.0						
	0350	1269	<2						
	0360	1274	6.3						
	0370	QA	35.5						
	0380	1303	90.4						
	0390	1296	28.0						
	0400	1290	6.8						
	0410	1252	350						
	0420	1250	494						
	0430	Blank	13.5						
	0440	1337	5.63						
	0450	1327	2.8						
	0460	1323	225						
	0470	1321	378						
	0480	1317	6.1						

Signed ______________ Date ________

Q. A. Officer

TO: ______________________

____

______________________ W.O/P.O. No. ______________

DATA SUMMARY SHEET

Date(s) Samples Collected 12/21

Client Lake AFB

RFW No.	B.S. RFW #	Sample Description	O/G						
	8401-694-0490	1250 Dup	343						
	0500	1282 "	36[illegible]						
	0510	1290 "	5.[illegible]						
	0520	1296 "	5.[illegible]						
	0530	~~1297~~ 1274 "	5.[illegible]						
	0540	1317 "	12.[illegible]						
	0550	QA	25.[illegible]						
	0560	1321 "	52[illegible]						
	0570	1323 "	21[illegible]						

Signed ______________________ Date ______________

Q. A. Officer

END

FILMED

4-85

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