United States
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Agency

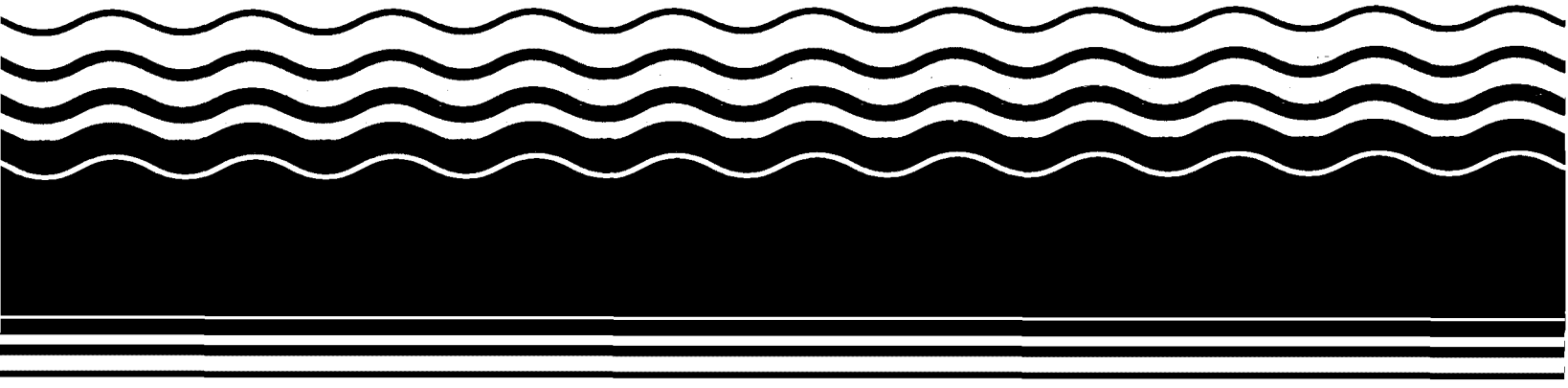
Office of
Emergency and
Remedial Response

EPA/ROD/R10-93/068
July 1993

EPA

Superfund Record of Decision:

Fairchild Air Force Base 4 Areas (Operable Unit 2), WA



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15. Supplementary Notes

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16. Abstract (Limit: 200 words)

The Fairchild Air Force Base 4 Areas (Operable Unit 2) site is part of the 4,300-acre Fairchild Air Force Base (AFB) located approximately 12 miles west of Spokane, Washington. Land use in the area is predominantly agricultural. In addition, a portion of the site may be within a floodplain, since it could be flooded during intense precipitation. Initially, in 1942, the Base was established as a U.S. Army repair depot. In 1947, it was transferred to the Strategic Air Command and renamed Fairchild AFB, in 1950. Since 1942, varying quantities of hazardous wastes from fuel management, industrial and aircraft operations, and fire training activities have been generated and disposed of onsite. The site consists of five separate Priority 1 (P1) OUs: SW-1 (Old Base Landfill northeast of Taxiway No. 7); IS-1 (Building 1034 French Drain System); OU1 (Flightline Sites PS-2, PS-6, PS-8); FT-1 (Fire Training Area); and WW-1 (Wastewater Lagoons). From about 1949 to 1958, the SW-1 landfill was the main disposal area for the base and received industrial wastes including plating sludge, solvents, and lubricating oils. The Building 1034 French drain system was constructed to dispose of wastewater from an inside sink and the roof runoff at Building 1034; however, it is believed that hazardous materials, including waste solvents, mineral

(See Attached Page)

17. Document Analysis a. Descriptors

Record of Decision - Fairchild Air Force Base 4 Areas (Operable Unit 2), WA
Second Remedial Action
Contaminated Media: soil, gw
Key Contaminants: VOCs (benzene, TCE, toluene, xylenes), other organics (PAHs), metals (chromium, lead)

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

18. Availability Statement	19. Security Class (This Report) None	21. No. of Pages 198
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(See ANSI-Z39.18) *See Instructions on Reverse*

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Abstract (Continued)

spirits (PD-680), cleaning compounds, and acid solutions were washed into the drain system. In 1992, the Air Combat Command division of the Air Force assumed command of Fairchild AFB. Also, in 1992, the Air Force completed a non-time-critical removal action to remove and treat offsite the contaminated sediment and water from the manholes of the French drain system, in addition to, rerouting drainage from the sink and roof and sealing the manholes with water-tight gaskets. The flightline OU is comprised of three sites: PS-2, where approximately 5,120 gallons of JP-4 fuel leaked/spilled between 1984 and 1985; PS-6, where approximately 3,550 gallons of JP-4 fuel leaked in 1986; and PS-8, where petroleum vapors were attributed to leaks in the underground fuel lines. Until 1991, fire training exercises, which included burning approximately 300 gallons of JP-4 fuel and extinguishing the blaze with approximately 125 gallons of aqueous film-forming foam, were held two or three times a month at the Fire Training Area. The Wastewater Lagoons currently are used for disposal of industrial wastewater and storm water, but wastes such as JP-4 fuel, oil, industrial solvents, acids, and cleaning compounds are known to have been discharged previously into the lagoons. Until 1989, the lagoons periodically were dredged, and approximately 18 inches of the dredged material was spread over the lagoon banks. As part of the Department of Defense's Installation Restoration Program (IRP), onsite environmental investigations of past disposal practices were initiated that revealed onsite soil and ground water contamination. A 1993 ROD addressed the source contamination at the Craig Road Landfill and onsite and offsite ground water, as OU1. This ROD addresses soil and ground water contamination at the five P1 areas, as OU2. A future ROD will address the P2 OUs. The primary contaminants of concern affecting the soil and ground water are VOCs, including benzene, TCE, toluene, and xylenes; other organics, including PAHs; and metals, including chromium and lead.

The selected remedial action for this site includes combining onsite in-situ bioventing of the contaminated soil in the FT-1 area with an in-situ ground water air sparging treatment system to prevent continued movement of contaminated water from the FT-1 area; treating contaminated air vapors from both systems to comply with State air standards; collecting and treating floating product at the PS-2 area by either a passive or active removal system; transporting the collected product offsite to a recycling facility for reuse as a fuel source; extracting and treating contaminated ground water at the WW-1 area using an air stripping unit and/or a carbon adsorption unit; reinjecting the treated water into the aquifer or discharging it onsite either directly or indirectly to No Name Ditch; recycling spent carbon offsite; allowing contaminated ground water to naturally attenuate at SW-1, PS-2, and PS-8; conducting onsite ground water monitoring at SW-1, PS-2, PS-8, and FT-1 sites, and offsite ground water monitoring at SW-1, FT-1 and WW-1 areas; and implementing institutional controls, including deed restrictions, and site access restrictions at the SW-1 and the WW-1 areas, and ground water use restrictions at the SW-1, PS-2, PS-8, FT-1, and WW-1 areas. The estimated present worth cost for this remedial action is $5,816,000, which includes an estimated annual O&M cost of $340,000 for 30 years.

PERFORMANCE STANDARDS OR GOALS:

Chemical-specific soil cleanup goals are based on the State Model Toxics Control Act (MTCA), which establishes maximum acceptable overall site risk for carcinogens of $1x10^{-5}$, and for non-carcinogens as levels which the human population may be exposed during a 30-year period without adverse health effects, and include benzene 0.5 mg/kg and cadmium 2 mg/kg. Chemical-specific ground water cleanup goals are based on SDWA MCLs and the State (MTCA), and include benzene 5 ug/l; TCE 5 ug/l; and TPH 1 mg/l.

United States Air Force

Environmental Restoration Program

Final
Record of Decision

On-Base Priority One Operable Units

Fairchild Air Force Base (O.U.2)

June 1993

7/14/93

(O.U.2)

DECLARATION OF THE RECORD OF DECISION

SITE NAMES AND LOCATIONS

On-Base Priority 1 Operable Units: Old Base Landfill LF-01 (SW-1); Building 1034 French Drain System SD-05 (IS-1); Flightline Operable Unit Site (OU-1) PS-2; Flightline Operable Unit Site (OU-1) SS-18 (PS-6); Flightline Operable Unit Site (OU-1) SS-27 (PS-8); Wastewater Lagoons WP-03 (WW-1); Fire Training Area FT-04 (FT-1)

Fairchild Air Force Base

Spokane County, Washington

STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedial actions for the Priority 1 (P1) Operable Units, Fairchild Air Force Base (AFB), Spokane County, Washington, which were chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended by the Superfund Amendments and Reauthorization Act of 1986, and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan. This decision is based on the Administrative Record for this site.

The lead agency for this decision is the U.S. Air Force. The U.S. Environmental Protection Agency (EPA) approves of this decision and, along with the State of Washington, Department of Ecology (Ecology), has participated in the scoping of the site investigations and in the evaluation of the remedial investigation data and the development of remedial alternatives. The State of Washington concurs with the selected remedies.

ASSESSMENT OF THE SITES

Actual or threatened releases of hazardous substances from the on-Base P1 sites, if not addressed by implementing the response actions selected in this Record of Decision (ROD), may present an imminent and substantial endangerment to public health, welfare, or the environment.

DESCRIPTION OF THE SELECTED REMEDIES

This ROD addresses soil and groundwater contamination at five P1 operable units. This is the second of three RODs planned for Fairchild Air Force Base. The first ROD, signed in February 1993, addressed contamination at the Craig Road Landfill operable unit. The third ROD will address the Priority Two (P2) operable units.

The major components of the selected remedies for the five P1 operable units are highlighted below. Further explanations regarding the remedial alternatives and selected alternatives are located in sections VIII and X, respectively, of the ROD Decision Summary.

Old Base Landfill (SW-1)

The goals of the remedial action at SW-1 are to restore the groundwater to drinking water quality within a reasonable timeframe, and to prevent exposure to landfill materials. The selected remedy combines the soil alternative of Institutional controls (Alternative 2) with the groundwater alternative of Institutional controls and Point-of-Use Treatment/Alternate water supply (Alternative 2). This remedy consists of the following elements:

- Maintaining institutional controls restricting access to the site.
- Maintaining institutional controls, in the form of restrictions against on-base usage of TCE-contaminated groundwater associated with the site, until cleanup levels are achieved.
- Monitoring groundwater at the site to identify a trend in contaminant concentrations, estimating a timeframe for restoration by natural dispersion, dilution, and degradation, evaluating the acceptability of the estimated timeframe, and implementing a compliance monitoring program to estimate attainment of cleanup levels.
- Monitoring off-site water supply wells in the vicinity of the site and providing point-of-use treatment and/or alternate water supply, if necessary.

The estimated costs associated with this remedy are:

Capital Cost:	$0
O&M Costs:	$40,000
Present Net Worth:	$615,000

Building 1034 French Drain System (IS-1)

The USAF has determined that no further remedial action is necessary at the IS-1 site to ensure protection of human health and the environment. This decision is based on the results of the human health risk assessment, which determined that conditions at the site pose no unacceptable risks to human health or the environment. With the completion of the removal action at IS-1 in December 1992, all conduits, including surface water drainage into the manholes, and potential sources of groundwater contamination have been eliminated at the IS-1 site. The TCE groundwater contamination detected upgradient of this site is believed to be associated with site PS-10, a P2 operable unit, and will be addressed under the RI/FS for the P2 sites.

Flightline Site (OU-1) PS-2

The goal of the remedial action at PS-2 is to restore the groundwater to drinking water quality within a reasonable timeframe. The selected remedy combines the soil alternative of No Action (Alternative 1) with the groundwater alternative of Free Product Removal with Institutional Controls (Alternative 5). This remedy consists of the following elements:

- Remediation of the floating product through passive collection and treatment, and recycling of recovered product at an offsite facility.

- Maintaining institutional controls, in the form of restrictions against on-base usage of benzene- and TPH-contaminated groundwater associated with the site, until cleanup levels are achieved.

- Monitoring groundwater at the site to identify a trend in contaminant concentrations, estimate a timeframe for restoration by natural dispersion, dilution, and degradation, evaluating the acceptability of the estimated timeframe, and implementing a compliance monitoring program to estimate attainment of cleanup levels.

The estimated costs associated with this remedy are:

Capital Cost:	$195,000
O&M Costs:	$85,000
Present Net Worth:	$447,000

Flightline site (OU-1) PS-6

The USAF has determined that no further remedial action is necessary at the PS-6 site to ensure protection of human health and the environment. This decision is based on the results of the human health risk assessment, which determined that conditions at the site pose no unacceptable risks to human health or the environment. The TCE groundwater contamination detected upgradient of this site is not believed to be associated with this site and will be addressed under the RI/FS for the P2 sites.

Flightline site (OU-1) PS-8

The goal of the remedial action at PS-8 is to restore the groundwater to drinking water quality within a reasonable timeframe. The selected remedy combines the soil alternative of No Action (Alternative 1) with the groundwater alternative of Institutional Controls (Alternative 2). This remedy consists of the following elements:

- Maintaining institutional controls, in the form of restrictions against on-base usage of benzene-contaminated groundwater associated with the site, until cleanup levels are achieved.

- Monitoring groundwater at the site to identify a trend in contaminant concentrations, estimating a timeframe for restoration by natural dispersion, dilution, and degradation, evaluating the acceptability of the estimated timeframe, and implementing a compliance monitoring program to estimate attainment of cleanup levels.

The estimated costs associated with this remedy are:

Capital Cost:	$0
O&M Costs:	$31,000
Present Net Worth:	$477,000

Fire Training Area (FT-1)

The goals of the remedial action at FT-1 are to remediate soils to levels that are protective of groundwater, and to restore groundwater to drinking water quality. The selected remedy combines the soil alternative of In-situ Bioventing (Alternative 4) with the groundwater alternative of In-situ Air Sparging with Institutional Controls (Alternative 4). This remedy consists of the following elements:

- Maintaining institutional controls, in the form of restrictions against on-base usage of benzene-contaminated groundwater associated with the site, until cleanup levels are achieved.
- Implementing an in-situ bioventing treatment system for benzene-contaminated soil.
- Implementing a pilot-scale in-situ air sparging system to evaluate the effectiveness of this technology for remediating benzene-contaminated groundwater, to be followed by implementation of a full-scale system if the pilot scale system is successful.
- Monitoring off-site water supply wells in the vicinity of the site and providing point-of-use treatment and/or alternate water supply, if necessary.

The estimated costs associated with this remedy are:

Capital Costs:	$542,000
O&M Costs:	$49,000
Present Net Worth:	$785,000

Wastewater Lagoons (WW-1)

The goals of this remedial action are to restrict the site from future residential or agricultural uses, and to restore groundwater to drinking water quality. The selected remedy combines the soil alternative of Institutional Controls (Alternative 2) with the groundwater alternative of Groundwater Extraction and Treatment with Institutional Controls and Point-of-Use Treatment/Alternate water supply (Alternative 3). This remedy consists of the following elements:

- Implementing additional source investigation activities to identify the source of groundwater TCE contamination. If a source of TCE contamination is detected in soils, soil remedial alternatives will be evaluated at that time.
- Maintaining institutional controls restricting access to the site.
- Maintaining institutional controls, in the form of restriction against on-base usage of TCE-contaminated groundwater associated with the site, until cleanup levels are achieved.
- Implementing a groundwater extraction and treatment system, using air stripping and/or carbon adsorption.
- Monitoring off-site water supply wells in the vicinity of the site and providing point-of-use treatment and/or alternate water supply, if necessary.

The estimated costs associated with this remedy are:

Capital Cost:	$1,442,000
O&M Costs:	$135,000
Present Net Worth:	$3,522,000

STATUTORY DETERMINATIONS

The selected remedies are protective of human health and the environment, comply with Federal and State requirements that are legally applicable, or relevant and appropriate to the remedial action, and are cost effective. Where practicable, the remedies utilize permanent solutions and alternative treatment technologies to the maximum extent practicable and satisfy the statutory preference for remedies that employ treatment which reduce contaminant toxicity, mobility, or volume as a principal element.

Because the remedial actions at sites SW-1, PS-2, PS-8, FT-1, and WW-1 may require five or more years to attain cleanup levels, a review of the selected remedies will be conducted for each of these sites within five years. The purpose of the five year review is to assure that the remedies remain protective of human health and the environment. A five year review is required at WW-1 because the selected remedy does not allow for unlimited use.

INSTALLATION RESTORATION PROGRAM (IRP)

RECORD OF DECISION
ON-BASE PRIORITY ONE OPERABLE UNITS
(SITES SW-1, IS-1, OU-1 (PS-2, PS-6, AND PS-8), FT-1, AND WW-1)

FINAL

FOR

FAIRCHILD AIR FORCE BASE
WASHINGTON

JUNE 1993

PREPARED BY

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USAF CONTRACT NO. F33615-90-D-4011
DELIVERY ORDER NO. 0006

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Signature for the foregoing On-Base Priority 1 Operable Units Record of Decision between the U.S. Air Force and the U.S. Environmental Protection Agency, with concurrence by the Washington State Department of Ecology.

Gerald A. Emison
Acting Regional Administrator, Region X
U.S. Environmental Protection Agency

7-14-93
Date

Signature for the foregoing On-Base Priority 1 Operable Units Record of Decision between the U.S. Air Force and the U.S. Environmental Protection Agency, with concurrence by the Washington State Department of Ecology.

Alan P. Babbitt
Deputy for Hazardous Materials and Waste
Deputy Assistant Secretary of the Air Force
(Environment, Safety and Occupational Health)

7/13/93
Date

Signature for the foregoing On-Base Priority 1 Operable Units Record of Decision between the U.S. Air Force and the U.S. Environmental Protection Agency, with concurrence by the Washington State Department of Ecology.

Carol L. Fleskes, Program Manager
Toxics Cleanup Program
Washington State Department of Ecology

July 12, 1993
Date

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INTRODUCTION

In March 1989, Fairchild Air Force Base (AFB) was listed on the U.S. Environmental Protection Agency's (EPA) National Priorities List (NPL) of hazardous waste sites to be addressed under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA). In March 1990, the U.S. Air Force (USAF), EPA, and Washington State Department of Ecology (Ecology) signed a Federal Facilities Agreement (FFA) establishing a cleanup schedule for the Base.

In accordance with Executive Order 12580 (Superfund Implementation) and the National Contingency Plan (NCP), the USAF recently completed a Remedial Investigation/Feasibility Study (RI/FS) for the five on-Base Priority 1 (P1) Operable Units at Fairchild AFB. The purpose of the RI/FS was to determine the nature and extent of contamination associated with these sites, to evaluate the current and potential risks to human health and the environment posed by the sites, and to evaluate various cleanup alternatives for sites posing unacceptable potential risks to human health or the environment. The RI/FS addressed contamination associated with surface water, groundwater, soil, and sediment.

I. SITE NAMES AND LOCATIONS

Fairchild AFB is located approximately 12 miles west of Spokane, Washington and occupies approximately 4,300 acres. The Base was established in 1942 as a U.S. Army repair depot. It was transferred to the Strategic Air Command in 1947 and renamed Fairchild AFB in 1950. On June 1, 1992, the Air Combat Command division of the USAF was established which assumed command of Fairchild AFB. Since 1942, varying quantities of hazardous wastes have been generated and disposed at Fairchild AFB. The sources of wastes include fuel management, industrial and aircraft operations, and fire training activities.

The on-Base P1 Operable Units at Fairchild AFB consist of the following five sites:

- SW-1 (Old Base Landfill northeast of Taxiway No. 7)
- IS-1 (Building 1034 French Drain System)
- OU-1 (Flightline Sites PS-2, PS-6, and PS-8)
- FT-1 (Fire Training Area)
- WW-1 (Wastewater Lagoons)

The locations of the five P1 sites are shown in Figure 1.

II. SITE HISTORIES AND ENFORCEMENT

A. Installation Restoration Program Activities

Environmental problems associated with the P1 operable Units were discovered under the USAF Installation Restoration Program (IRP). The program was initiated through the 1981 Executive Order 12316 that directed the military branches to design their own program of compliance with the NCP established by CERCLA. In order to respond to the changes in the NCP brought about by SARA, the IRP was modified in November 1986 to provide for a RI/FS Program to improve continuity in the site investigation and remedial planning process for USAF installations.

WW – Industrial Waste Lagoon Site
SW – Solid Waste Sites
FT – Fire TRaining Site
OU – Operable Unit

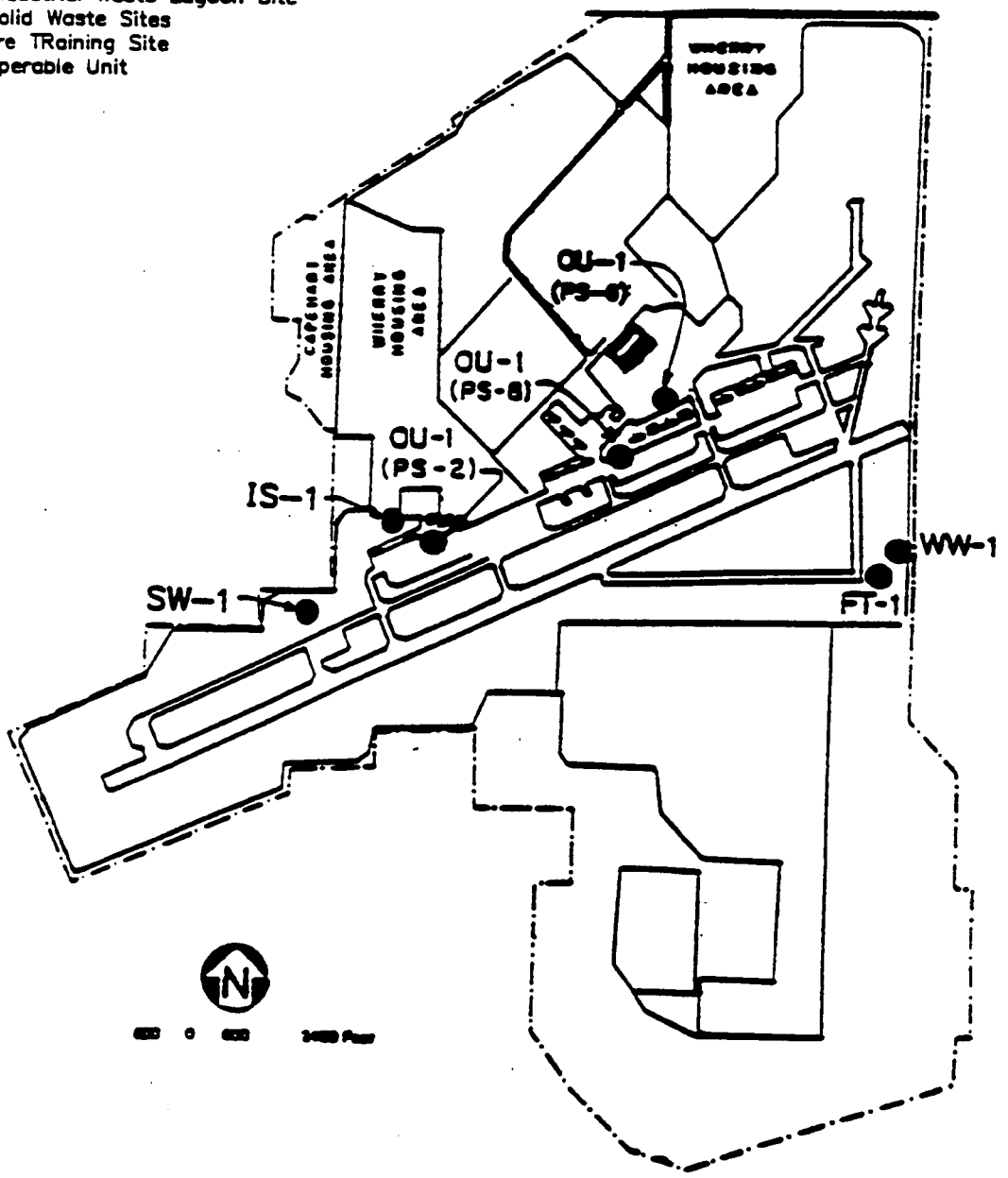


FIGURE 1
ON-BASE PRIORITY ONE OPERABLE UNITS
FAIRCHILD AFB, WASHINGTON

Environmental investigations of past hazardous waste disposal practices and sites were initiated at Fairchild AFB in 1984 as part of the USAF IRP. In 1985, the first report summarizing IRP investigations at Fairchild AFB was published. Preliminary findings in this report identified the P1 Sites for additional investigations, which will continue through the remediation of the site.

In 1987, EPA scored the Fairchild AFB (based on four sites) using the Hazard Ranking System (HRS). As a result of the HRS scoring, Fairchild AFB, including the P1 Sites, was added to the NPL in March 1989. In response to the NPL designation, the USAF, EPA, and Ecology entered into a FFA in March 1990. The FFA established a procedural framework and schedule for developing, implementing, and monitoring appropriate response actions conducted at Fairchild AFB. Under the terms of the FFA, EPA and Ecology provided oversight of subsequent RI activities and agreement on the final remedies selected in this Record of Decision (ROD).

In order to facilitate the CERCLA process, potential source areas at the Base have been grouped into operable units. The remedial investigation for each operable unit has a separate schedule. The ROD for the Craig Road Landfill P1 operable unit was signed in February 1993. This ROD addresses the remaining five P1 operable units.

The USAF recently completed the RI for the on-Base P1 Operable Units. A large part of the investigation consisted of a field data collection effort conducted between February 1991 and January 1992. In addition, several other IRP investigations have been conducted at the P1 sites since 1984 as follows:

- IRP Phase I Record Search: 1984-1985
- IRP Phase II Confirmation/Quantification, Stage 1: 1986-1988
- IRP Phase II Confirmation/Quantification, Stage 2: 1988-1990

Since 1986, environmental samples (i.e., soil, sediment, surface water, and groundwater samples) have been collected at the P1 sites during 11 separate sampling events, or rounds. Sampling rounds 1 through 7 were conducted from 1986 to 1990. The results from these sampling rounds are referred to in the RI Report and in this ROD as historical data. Sampling rounds 8 through 11 were performed from February 1991 to January 1992. The results from these sampling rounds are referred to in the RI Report and in this ROD as current data. A summary of the field investigation activities for the on-Base P1 Operable Units is presented in Table 1.

B. Site Histories

SW-1, Old Base Landfill Northeast of Taxiway No. 7

The SW-1 landfill is located northeast of Taxiway No. 7, adjacent to the west end of Taxiway No. 1, and occupies approximately 16 acres. Mounded fill material extends to an estimated depth of ten to 20 feet. This site was the main disposal area for the Base from about 1949 to 1957 or 1958. The landfill was used for disposal of all Base wastes, which may have included industrial wastes, plating sludges, solvents, lubricating oils, cutting oils and shavings, dry-cleaning filters and spent filtrates, paint wastes, coal fly ash, and miscellaneous sanitary wastes.

TABLE 1

SITE-BY-SITE SUMMARY OF RI FIELD INVESTIGATION ACTIVITIES
SEPTEMBER 1986 TO JANUARY 1992
FAIRCHILD AFB, WASHINGTON

SW-1

- Installed 24 monitoring wells
- Collected 37 groundwater samples
- Performed quantitative soil gas survey
- Excavated 8 test pits and collected 18 subsurface soil samples
- Collected 13 surface soil samples
- Performed 1 pumping test
- Performed 2 geophysical investigations
- Advanced 3 subsurface soil borings and collected 4 subsurface soil samples

IS-1

- Installed 4 monitoring wells
- Collected 11 groundwater samples
- Collected 13 sediment samples
- Collected 2 surface water samples
- Advanced 4 soil borings and collected 4 soil samples

OU-1 (PS-2)

- Installed 11 monitoring wells
- Collected 15 soil samples from 6 of the 11 monitoring well borings
- Collected 25 groundwater samples
- Performed quantitative soil gas survey
- Collected 2 surface soil samples
- Advanced 22 subsurface borings and collected 37 subsurface soil samples
- Performed 1 pumping test

OU-1 (PS-6)

- Installed 6 monitoring wells
- Collected 4 groundwater samples
- Collected 8 surface soil samples
- Performed qualitative soil gas survey
- Advanced 8 subsurface soil borings and collected 12 subsurface soil samples

OU-1 (PS-8)

- Installed 18 monitoring wells
- Collected 21 subsurface soil samples from 8 of the 18 monitoring well borings
- Collected 45 groundwater
- Performed quantitative soil gas survey
- Collected 7 surface soil samples
- Advanced 12 subsurface soil borings and collected 19 subsurface soil samples
- Performed 1 pumping test

WW-1

- Installed 23 monitoring wells
- Collected 4 subsurface soil samples from 2 monitoring well borings
- Collected 97 groundwater samples
- Performed qualitative and quantitative soil gas surveys
- Performed geophysical survey
- Collected 18 surface soil samples
- Excavated 24 test pits and collected 21 soil samples
- Advanced 23 subsurface soil borings and collected 38 subsurface soil samples
- Collected 24 surface water samples
- Collected 35 sediment samples
- Performed 2 pumping tests

FT-1

- Installed 36 monitoring wells
- Collected 12 subsurface soil samples from 5 monitoring well borings
- Collected 74 groundwater samples
- Advanced 28 subsurface soil borings and collected 44 subsurface soil samples
- Collected 5 surface soil samples
- Performed 3 pumping tests
- Performed 2 qualitative soil gas surveys

MISCELLANEOUS

- Collected 11 rounds of groundwater level measurements
- Collected 22 groundwater samples from residential wells

IS-1, Building 1034 French Drain System

The Building 1034 french drain system is located adjacent to the flightline, north of Taxiway No. 6. The site consists of five underground dry wells or french drains. The drains are constructed of perforated concrete manholes, each four feet in diameter and approximately ten feet deep. The drain system was constructed in 1978 to dispose of wastewater from an inside sink and the roof runoff at Building 1034. Wastewater from Building 1034 first flows into Manhole 3, which is closest to the building.Effluent from Manhole 3 flows into two parallel systems, each consisting of two manholes piped in series.

Building 1034 houses a portion of the Consolidated Aircraft Maintenance Squadron of the Washington Air National Guard (WANG). Several WANG maintenance shops are located within this building including: the Electrical/Battery, Environmental, Pneudralics, Wheel and Tire, Machine, Metal Processing, Welding, and Avionics Maintenance shops. Hazardous materials, including waste solvents, PD-680 (mineral spirits), cleaning compounds, and acid solutions are believed to have been washed into the french drain system.

An Engineering Evaluation/Cost Analysis (EE/CA) for a non-time-critical removal action was performed in 1992 to develop and evaluate removal action alternatives for removal and disposal of the contaminated sediment in the five manholes. The selected alternative included the following actions:

- Removal and offsite treatment of the sediment and water from the manholes.
- Rerouting of the drainage from the sink in Building 1034 to the sanitary sewer system.
- Rerouting of the drainage from the roof of Building 1034 to the storm water sewer system.
- Sealing the manholes with solid lids and water-tight gaskets.

Rerouting of the sink and storm water drainage was completed in August 1992, and removal and disposal of the sediment and sealing of the manholes was completed in December 1992. With the completion of these actions, all conduits, including surface water drainage into the manholes, and potential sources of groundwater contamination have been eliminated at the IS-1 site.

OU-1, Flightline Operable Unit - PS-2, PS-6, and PS-8

The flightline operable unit (OU-1) is comprised of three separate sites referred to as PS-2, PS-8, and PS-6. Each of these sites are described in further detail in the following paragraphs.

Site PS-2 includes the tank at refueling/defueling Pit 18, which is known to have leaked up to 120 gallons of JP-4 fuel in the spring of 1984. A large surface fuel spill occurred during the summer of 1985 in which some 5,000 gallons of JP-4 spilled when a fuel-line flange cracked near refueling/defueling Pit 21 located in front of Hangar 1037. It is believed some 4,000 gallons were recovered during a four-day effort. Approximately 1,000 gallons were believed to have entered the storm sewer and soil. Evidence of a petroleum product in the groundwater was detected during flightline foundation drilling at PS-2 and later confirmed in the IRP Phase II, Confirmation/ Quantification, Stage 1 study in 1989, and during the RI field activities.

Site PS-6 is located adjacent to the north side of Buildings 1011 and 1013, and west of Taxiway No. 3. A JP-4 fuel spill of approximately 3,550 gallons occurred in February, 1986 as the result of a shut-off valve malfunction in an underground defueling tank. Most of the fuel is reported to have been recovered and used in fire training exercises.

Site PS-8 is located along Taxiway Nos. 1 and 4, adjacent to Building 1019. Petroleum odors were noted near Building 1019 during runway soil compaction testing in July 1982. The petroleum vapors were attributed to leaks in the underground fuel lines underlying the area.

FT-1, Fire Training Area

This operable unit is located south of the main runway and WW-1, between Taxiway No. 10 and the perimeter road. A raised gravel pad, approximately two feet thick and 300 feet in diameter has been constructed around a concrete block building used in fire training exercises. A lined, circular burn pit containing a mock aircraft has been constructed out of bermed gravel. An unlined burn pit was in use on the current site until a more recent pit was built in 1970. During fire training exercises, the burn pit was filled with two to three inches of water. Fuel was pumped to the burn pit through underground fuel lines from an underground storage tank located approximately 200 feet west of the training area. Approximately 300 gallons of JP-4 was then sprayed onto the water and ignited. Approximately 125 gallons of aqueous film-forming foam (AFFF) was then used to extinguish the fire. Fire training exercises were conducted two to three times a month until July 1991.

An oil/water separator was used to separate the waste fuel and AFFF mix from the water following each training exercise. Water from the separator was discharged into a small ditch that flows eastward and disperses onto a low-lying area. The oil/water separator is believed to have malfunctioned and prematurely discharged an oil/water mix at some point in the past. Fuel stains and dead vegetation have been observed within the drainage area adjacent to the discharge port. Only clean JP-4 or fuel contaminated with water were used during the most recent fire training exercises. However, other types of wastes are reported to have been burned in the past during fire training exercises including JP-4 fuel, waste oil, and solvents.

WW-1, Wastewater Lagoons

Operable unit WW-1 is located south of the eastern end of the runway, between the perimeter road and the north-south portion of Taxiway No. 10. The site consists of two interconnected unlined lagoons with a combined capacity of approximately five million gallons. The large, upper skimming lagoon is approximately 900 feet long, and ranges from 30 to 200 feet wide, and is between three and five feet deep. Water from the skimming lagoon can be directed via a concrete sluice to the smaller, lower holding lagoon which is approximately 450 feet long, 150 feet wide, and four feet deep.

Industrial wastewater and storm water are currently discharged into the large skimming lagoon. Wastewater discharged from the holding lagoon has been permitted under the National Pollutant Discharge Elimination System (NPDES) since May 1979. Typical dry weather flow from the holding lagoon ranges from 360,000 to 580,000 gallons per day. The lagoons drain into No Name Ditch. No Name Ditch flows perennially to the southeast. Within one mile of crossing Craig Road, flow from No Name Ditch spreads over a large flat area and the surface water percolates into the ground. The RI report concluded that No Name Ditch conveys an average flow of 0.75 cubic feet per second.

Waste types known to have been discharged into the lagoons in the past are JP-4 fuel, oil, industrial solvents, acids, and cleaning compounds. Approximately 50 oil/water separators and grit chambers located throughout the base, which until recently had not been properly serviced, were believed to be the primary source of contamination to the lagoons. Servicing of all of the separators and grit chambers was completed in May 1992. Since this time, a significant reduction in the input of petroleum hydrocarbons (TPH) into the lagoons has been observed. TPH which enter the large skimming lagoon are removed by a skimming boom located at the lagoon discharge point.

Until 1989, the lagoons were periodically dredged. The dredged material was spread over the lagoon banks. At least 18 inches of sludge are known to have been spread on the lagoon banks.

III. HIGHLIGHTS OF COMMUNITY PARTICIPATION

The USAF developed a Community Relations Plan (CRP) in March 1990 as part of the overall management plan for environmental restoration activities at the Base. The CRP was designed to promote public awareness of the investigations and public involvement in the decision-making process. The CRP summarizes concerns that Fairchild AFB, in coordination with EPA and Ecology, are aware of based on community interviews and comments obtained at a public workshop. Since this initial workshop, Fairchild AFB has sent out numerous fact sheets and has held annual workshops in an effort to keep the public informed and to hear concerns on the Craig Road Landfill (CRL) issues. The CRP was updated in September 1992.

On February 9, 1992, Fairchild AFB made available for public review and comment the draft EE/CA that recommended a removal action for contaminated sediment at the Building 1034 french drain system (IS-1). The public was notified of this document's availability through a fact sheet mailed to local, interested persons and in a public announcement published in *The Spokesman-Review.* The public comment period began on February 9, 1993, ended March 9, 1993.

The RI Report for the on-Base P1 Operable Units was released to the public on February 9, 1993; the FS and Proposed Plan were released on March 1, 1993. The Proposed Plan was mailed to each address contained on the mailing list. These documents, as well as previous reports from the RI/FS investigation, were made available to the public in both the Administrative Record and the Information Repository maintained at the locations listed below:

ADMINISTRATIVE RECORD (contains all project deliverables):

Fairchild AFB Library
Building 716
Fairchild AFB, WA 99011

Spokane Falls Community College Library
W. 3410 Fort George Wright Drive
Spokane, WA 99204

INFORMATION REPOSITORY (contains limited documentation):

Airways Heights City Hall
S. 1208 Lundstrom
Airway Heights, WA 99101

The notice of the availability of these documents was published in *The Spokesman-Review* on February 28, 1993. The public comment period was held from March 1, 1993, through March 31, 1993. In addition, a public meeting was held on March 15, 1993. Prior to this meeting, copies of the Proposed Plan were sent to over 200 local residents and other interested parties. At this meeting, representatives from the USAF, EPA, and Ecology answered questions about problems at the P1 sites and the remedial alternatives under consideration. A response to the comments received during the public comment period is included in the Responsiveness Summary, which is part of this ROD (Appendix B).

IV. SCOPE AND ROLE OF OPERABLE UNITS

Potential source areas at Fairchild AFB have been grouped into separate operable units. A different schedule has been established for each of the operable units. The CRL site comprises the first P1 Operable Unit at Fairchild AFB for which a final cleanup action has been selected. A ROD was signed in February of 1993 for the CRL Site. Selection of cleanup actions for the remaining five P1 Operable Units is being made in this ROD. The remaining Priority 2 (P2) Operable Units are scheduled for remedy selection during the spring of 1995.

The cleanup actions for the on-Base P1 Operable Units described in this ROD address both onsite and offsite groundwater contamination, and source areas associated with subsurface contamination at the sites. The cleanup actions described in this ROD address all known current and potential risks to human health and the environment associated with the on-Base P1 Sites.

V. SUMMARY OF SITE CHARACTERISTICS

A. Geology, Hydrogeology, and Land Classifications

The geology at Fairchild AFB is comprised of two basalt bedrock formations overlain by alluvial soil. The two basalt layers, referred to as Basalt A flow and Basalt B flow, are separated by a layer of low-permeability clay about eight feet to ten feet in thickness. The clay layer separating Basalt A and Basalt B acts as a confining layer and restricts groundwater flow between these two formations.

The thickness of the alluvial soil overlying the basalt ranges from one foot to 46 feet. The soil is comprised of clays and silts interfingered with sandy silts, sandy clays, and sandy gravels. Basalt A varies across the Base from approximately 166 feet thick in the west near SW-1 to approximately 193 feet thick in the east near FT-1. The top of the basalt is fractured and highly weathered in places, whereas the center portion of Basalt A is a zone of massive, fine grained basalt with infrequent fractures and low permeability. Bedrock investigations during the RI have generally been limited to the upper portions of the basalt flows.

Groundwater in the alluvial and Basalt A aquifers generally flows from west to east across the Base as shown by the potentiometric surface map in Figure 2. Groundwater is typically encountered eight to 20 feet below the ground surface. There is a high degree of hydraulic connection between the alluvial and shallow bedrock aquifers, except near the WW-1 site, where the alluvium and shallow bedrock are separated by a low-permeability clay layer. Groundwater flow within Basalt A is predominantly within the upper and lower portions of the formation where the degree of interconnected fractures is highest. These upper and lower regions of Basalt A are referred to in the RI report as the shallow and deep bedrock flow systems, respectively. Vertical groundwater movement through Basalt A is typically slow due to the tightness of fractures within the center of the basalt formation.

Sites SW-1, IS-1, PS-2, PS-6, PS-8, and FT-1 are not located within floodplains or wetlands. WW-1 may be located within a floodplain since it could be flooded during intense precipitation. Also, none of the P-1 sites are believed to contain artifacts of substantial archeological significance.

B. Nature and Extent of Contamination

Contaminant occurrence and distribution tables summarizing the sampling results for soil, sediment, surface water, and groundwater at the on-Base P1 Operable Units during sampling round 11 are included in Appendix A.1. Contaminant occurrence and distribution figures depicting the sampling results for soil, sediment, surface water, and groundwater at the on-Base P1 Operable Units are included in Appendix A.2.

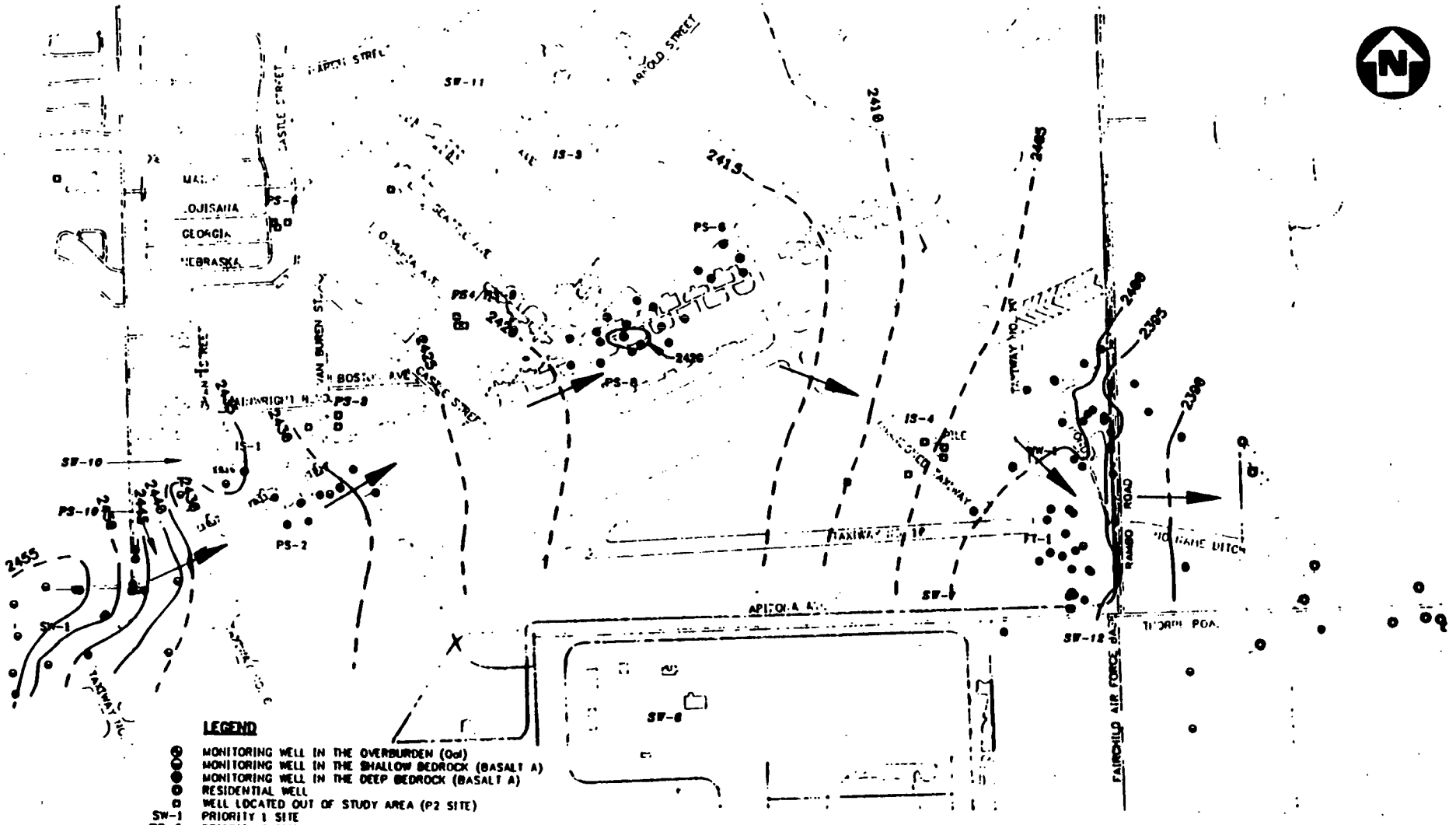


FIGURE 2
SCHEMATIC BASEWIDE POTENTIOMETRIC SURFACE MAP - SURFICIAL AQUIFER
FAIRCHILD AFB, WASHINGTON

SW-1, Old Base Landfill Northeast of Taxiway No. 7

Soils

Two soil borings were collected during 1989. Trichloroethene (TCE), the primary contaminant of concern at SW-1, was not detected in either sample.

Based on the results of test pit excavations conducted during 1991, the SW-1 landfill is a sanitary-type landfill which also contains construction debris. Minimal contamination was detected in the surface and subsurface soil samples collected from the landfill. Although the soil gas results suggested the presence of elevated areas of TCE and perchloroethylene, these compounds were not detected in the surface or subsurface soil samples analyzed by a fixed base laboratory. Low concentrations of other organic chemicals (e.g., di-n-butylphthalate) were detected in soil samples submitted to the laboratory. Metals were generally found in the soils at concentrations similar to reported background concentrations.

Groundwater

TCE was determined in the RI to be the primary organic contaminant detected in the groundwater at SW-1. Groundwater at SW-1 was sampled during sampling rounds 1 (1986), 3 (1989), 7 (1990), 8 (1991), 9 (1991), 10 (1991), and 11 (1991). TCE was not detected during sampling rounds 1 and 3.

TCE was detected in shallow bedrock monitoring well MW-90 (north of SW-1) during sampling rounds 7, 8, and 9 at 10 µg/L, 4 µg/L, and 11 µg/L. During sampling round 10, TCE was detected in shallow bedrock monitoring wells MW-131 (north of SW-1), and MW-132 (southeast of SW-1) at 18 µg/L, and ~5 µg/L and 6 µg/L (duplicate samples), respectively. During sampling round 11, TCE was detected in shallow bedrock monitoring wells MW-90 (north of SW-1), MW-128 (north of SW-1), MW-131 (within the eastern portion of SW-1), MW-132 (north of SW-1), MW-133 (northeast of SW-1), MW-164 (northeast of SW-1), and MW-165 (east of SW-1) at concentrations of 8 µg/L, 0.5 µg/L, 11 µg/L and 9 µg/L (duplicate sample), 12 µg/L, 89 µg/L, 7 µg/L, 9 µg/L, respectively. The 89 µg/L TCE detection was believed to have been associated with a nearby P2 site. TCE was not detected in any of the monitoring wells located west, southwest, and south of the landfill. The estimated levels of TCE in the shallow bedrock aquifer are shown in Figure 3. The vertical migration of the TCE appears to be limited to the upper portion of the Basalt A since TCE was not detected in any of the deep bedrock or alluvial monitoring wells. Groundwater appears to be migrating generally to the east, through Fairchild AFB.

Concentrations of most metals in groundwater were similar to natural background levels. In contrast to the TCE contamination, no pattern of elevated metals concentrations was observed in the groundwater at the site. Metals with elevated concentrations in some of the wells are believed to be the result of high turbidity in the wells and are not believed to be site-related since they were not detected at elevated levels in the soils at the site.

IS-1, Building 1034 French Drain System

Soils

The soil surrounding the french drain system has not been shown to be contaminated, based on the results of soil samples collected from four soil borings during sampling round 1 in 1986.

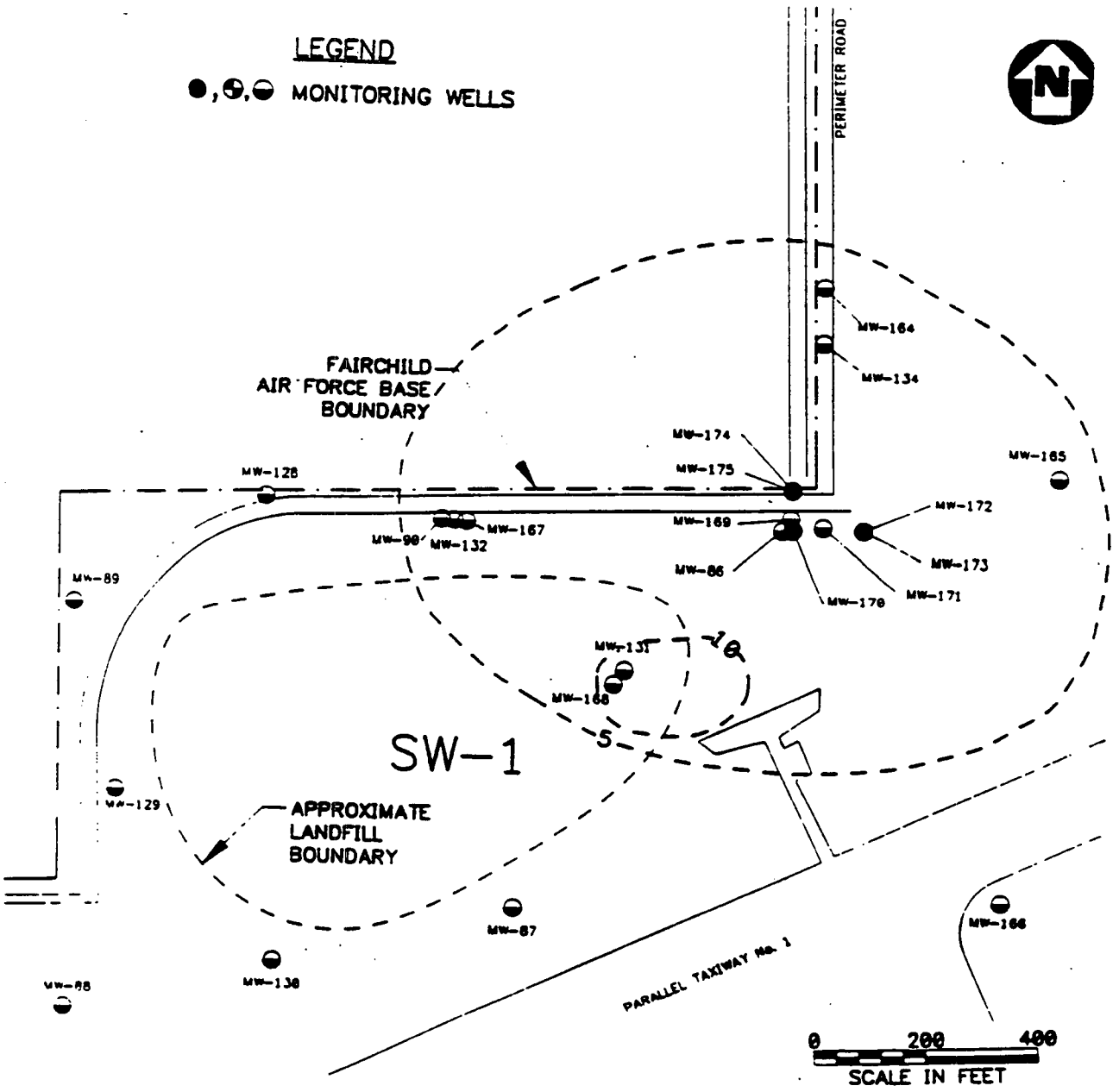


FIGURE 3
ESTIMATED LEVELS OF TCE IN GROUNDWATER AT SW-1 SITE (µg/L)
FAIRCHILD AFB, WASHINGTON

Sediments

Sediments were sampled during sampling rounds 6 (1990), 10 (1991), and 11 (1991). Analytical results collected during sampling rounds 6, 10, and 11 indicated that the sediment in Manhole 3, which is closest to Building 1034 and received the bulk of the wastewater flow, was the most contaminated. Manhole 3 contained TCE at maximum concentration of 280 mg/kg during sampling round 6, and 120 mg/kg during sampling round 11 as well as lead and cadmium at levels significantly above background concentrations. TCE was not detected in the other four drains (Manholes 1, 2, 4, and 5). Elevated levels of lead and cadmium were also detected in these manholes, however, their concentrations were only slightly above background values. Elevated concentrations of TPH were detected in four of the drains, which may have been associated with asphalt materials washed into the manholes. As previously mentioned, the USAF completed a removal action for the IS-1 site in 1992 in which all sediment was removed from the manholes and transported off-Base for treatment and/or disposal.

Surface Water

During sampling round 11 (1991), surface water samples were collected in Manhole No. 3. TPH was detected at 1.5 mg/L and 4.6 mg/L. Cadmium, chromium, and nickel were detected at 23 mg/L and 19 mg/L, 80 mg/L and 72 mg/L, and 138 mg/L and 30 mg/L, respectively.

Groundwater

Groundwater samples were collected from the shallow Basalt A (mid-top) aquifer at IS-1 during sampling rounds 7 (1990), 8 (1991), 9 (1991), 10 (1991), and 11 (1991).

The RI investigation did not identify a groundwater TCE plume associated with the french drain system since TCE was not detected in monitoring wells located downgradient of the site. TCE was detected in monitoring well MW-93, located upgradient of the site, at concentrations ranging from 2 µg/L to 7 µg/L. This contamination is not believed to be associated with site IS-1, but could be associated with site PS-10, a P2 operable unit. The TCE groundwater contamination at this site will be addressed under the RI/FS for the P2 sites.

OU-1, Flightline Site PS-2

Soils

Soils were sampled at PS-2 during sampling rounds 1 (1986), 3 (1988), 7 (1990), and 11 (1991).

During sampling rounds 1 and 3, TPH was detected in 20 of 47 soil samples at concentrations ranging from 13 mg/kg to 1278 mg/kg. Benzene was detected in 1 of 21 samples at a concentration of 2.4 mg/kg. Ethylbenzene was detected in nine of 36 soil samples at concentrations from 1.0 mg/kg to 10.6 mg/kg. Toluene was detected in five of 21 soil samples at concentrations from 1.8 mg/kg to 9.4 mg/kg. Xylenes (m-xylene, o-xylene, and p-xylene) were detected in 12 of 37 soil samples at concentrations ranging from 2.0 mg/kg to 92.1 mg/kg.

During sampling round 7 (taken 1990), TPH was detected in one of 11 soil samples (taken during the construction of monitoring wells) at a concentration of 34 mg/kg.

During sampling round 11, TPH contamination was detected in two out of ten soil borings at a maximum concentration of 1,200 mg/kg. These two borings were located in the vicinity of refueling/defueling Pits 18 and 19, respectively, and near historical soil borings containing TPH.

Benzene, toluene, ethylbenzene, and xylene (BTEX) are the major volatile organic contaminants typically associated with fuel contamination. Results of previous sampling rounds indicate that TPH and BTEX were detected in soil to 10.5 feet deep. Of these BTEX contaminants, xylenes and ethylbenzene were the only compounds that were detected in the subsurface soil samples collected during sampling round 11. These contaminants were detected in two out of ten soil borings at low concentrations (maximum concentrations of 4.7 mg/kg and 1.7 mg/kg, respectively). In general, the data collected during previous sampling events contained higher concentrations of BTEX compounds. Of the TPH contamination that was detected in the soil, the presence of few BTEX compounds indicates that the volatile, and more soluble, fraction of the fuel contamination has disappeared from the soil, and only the semi-volatile (less soluble/less mobile) fraction of the TPH remains.

Metals concentrations detected in the soils at PS-2 were generally similar to those reported for the background soil samples.

Groundwater

Downgradient alluvial monitoring wells and upgradient monitoring well MW-56 were sampled at PS-2 for TPH and BTEX during sampling rounds 3 (1989), 4 (1989), 6 (1990), 7 (1990), 8 (1991), and 9 (1991). Downgradient alluvial and Basalt A monitoring wells, and upgradient well MW-56 were also sampled during sampling round 11 (1991).

TPH, benzene, ethylbenzene, and xylenes were detected in monitoring well MW-55 during sampling round 3 at concentrations of 6.6 mg/L, 15 µg/L, 21 µg/L, and 72 µg/L, respectively. TPH, benzene, ethylbenzene, and xylenes were detected in monitoring well MW-55 during sampling round 4 at concentrations of 0.6 µg/L, 29 µg/L, 35 µg/L, and 150 µg/L, respectively. During sampling round 6, TPH, benzene, and ethylbenzene were detected in monitoring well MW-55 at 2.0 µg/L, 12 µg/L, and 12 µg/L, respectively. Benzene, ethylbenzene, and xylenes were detected in monitoring well MW-55 during sampling round 7 at concentrations of 53 µg/L, 180 µg/L, and 270 µg/L, respectively. During sampling round 8, TPH, benzene, ethylbenzene, and xylenes were detected in monitoring well MW-109 at concentrations of 16 mg/L, 150 µg/L, 530 µg/L, and 1,200 µg/L, respectively. TPH, benzene, and xylenes were detected in monitoring well MW-109 during sampling round 9 at concentrations of 6.8 mg/L, 34 µg/L, and 290 µg/L, respectively.

Floating fuel product was detected in monitoring wells MW-176 and MW-177 at PS-2 during sampling round 11. The thickness of the product in MW-176, which was black in color, was approximately seven inches, whereas the thickness of the fuel in MW-177, which was amber in color, was approximately two inches. The product in MW-177 is believed to be JP-4 and may have originated from the fuel spill which occurred in 1985. The source of the product in MW-176 is currently unknown. Additional field investigation activities are planned for 1993 to determine the extents of these product areas, which are currently not-well defined.

Benzene, ethylbenzene, xylenes, and TPH were the predominant organic contaminants detected in the groundwater at site PS-2. The contamination generally appears to be limited to the upper alluvial aquifer. TPH was detected in three alluvial monitoring wells at concentrations ranging from 4.4 mg/L to 110 mg/L. Benzene was detected in four alluvial monitoring wells at concentration ranging from 10 µg/L to 2,600 µg/L. Benzene was detected in one Basalt A monitoring well at 7.0 µg/L. Ethylbenzene was detected in five monitoring wells at concentrations ranging from 5.0 µg/L to 1,200 µg/L. Ethylbenzene was detected in one Basalt A monitoring well at 11 µg/L. Xylenes were detected in five monitoring wells at concentrations ranging from 12 µg/L to 5,000 µg/L. Xylenes were detected in one Basalt A monitoring well 40 µg/L.

The estimated levels of benzene in the alluvial aquifer are shown in Figure 4. The estimated extent of benzene contamination also encompasses the extent of the other contaminants. The highest concentrations of the contaminants were associated with the floating fuel product detected in MW-176 and MW-177. It is believed that the benzene detected in the groundwater is a constituent of the floating product.

Concentrations of most metals in groundwater were similar to natural background levels. Metals with elevated concentrations in some of the wells are believed to be the result of high turbidity in the wells and are not believed to be site-related since they are not components of fuel and were not detected at high levels in the soils at the site.

Groundwater at PS-2 appears to be flowing to the northeast, on-Base, beneath Taxiway No. 1.

OU-1, Flightline Site PS-6

Soils

The surface samples collected from site PS-6 contained minimal organic chemical contamination. Di-n-butyl phthalate, naphthalene, fluorene, phenanthrene, fluoranthrene, pyrene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, benzo(g,h,i)perylene, and benzo(a)anthracene were detected infrequently and at concentrations similar to those reported for typical urban soils (i.e., 95% upper confidence limits of detections were 0.23 mg/kg, 0.43 mg/kg, 3.2 mg/kg, 0.28 mg/kg, 4.7 mg/kg, 2.5 mg/kg, 2.0 mg/kg, 1.7 mg/kg, 1.1 mg/kg, 1.4 mg/kg, 0.87 mg/kg, 0.93 mg/kg, and 1.7 mg/kg, respectively). These compounds are believed to be associated with asphalt material since asphalt fragments were observed throughout the surface soils at PS-6.

TPH were detected in seven soil samples at concentrations ranging from 48 mg/kg to 4,400 mg/kg The TPH may be associated with asphalt material since no fuel stains were apparent in the soils during the sampling round 11 field investigation.

Subsurface soil samples were also relatively free of contamination. The only BTEX chemical detected in the subsurface soil was xylenes, which was found in a single sample at a concentration of 0.048 mg/kg. TPH was detected in two out of eight soil borings at a maximum concentration of 130 mg/kg. The infrequent and sporadic detections of TPH and BTEX compounds in the surface and subsurface soils at PS-6 demonstrated no evidence of the JP-4 fuel spill that occurred at the site in 1986.

Metals were generally found at concentrations similar to background concentrations in both surface and subsurface soil samples.

Groundwater

No fuel-related contaminants were observed in the PS-6 groundwater samples, indicating that the reported fuel spill has not adversely affected the groundwater in this area. TCE was the only organic chemical found in the groundwater near the PS-6 area. The TCE was detected in one upgradient shallow bedrock well at a concentration of 10 μg/L. The source of this contamination is currently unknown but is not believed to be site-related since TCE is not a fuel-related contaminant and was not detected in the soils at the site. TCE groundwater contamination at this site will be addressed under the RI/FS for the P2 sites.

Concentrations of most metals detected in the groundwater were similar to natural background concentrations. Metals with elevated concentrations in some of the wells are believed to be the result of high turbidity in the wells and are not believed to be site-related since they are not components of fuel and were not detected at elevated levels in the soils.

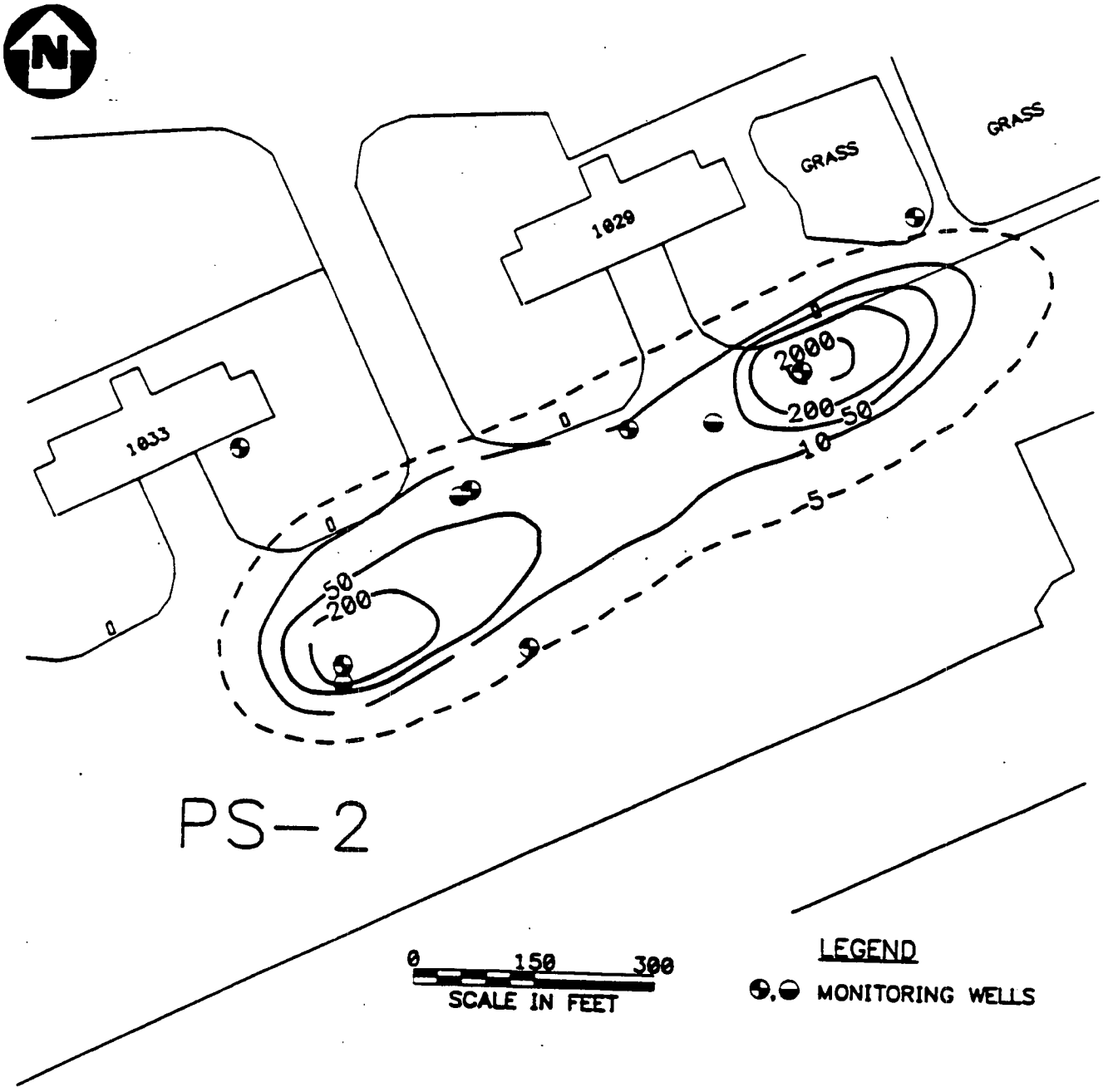


FIGURE 4
ESTIMATED LEVELS OF BENZENE IN GROUNDWATER AT PS-2 SITE (µg/L)
FAIRCHILD AFB, WASHINGTON

OU-1, Flightline Site PS-8

Soils

Soil sampling results indicate that the surface soil at Site PS-8 is relatively free of contamination. Surface soil samples contained relatively low levels of TPH. TPH was detected in four surface soil samples at concentrations from 24 mg/kg to 330 mg/kg (95% upper confidence limit for detections was 205 mg/kg).

TPH were measured in four out of ten soil borings at the site located close to the suspected fuel line break in concentrations ranging from 38 mg/kg to 22,000 mg/kg.

Xylene, a fuel-related contaminant, was detected in one soil boring sample at a concentration of 0.039 mg/kg. As with site PS-2, the presence of few BTEX compounds in the subsurface soil indicates that the volatile fraction of the fuel contamination has disappeared from the soil, and only the residual semi-volatile fraction of the TPH, which is less soluble, remains.

Groundwater

The fuel-line rupture at site PS-8 appears to have affected groundwater in the immediate vicinity of the release. Benzene, ethylbenzene, xylenes, and TPH were the predominant organic contaminants detected in monitoring wells located immediately downgradient of the source area. The contamination generally appears to be limited to the upper alluvial aquifer. Similar to PS-2, groundwater near PS-8 appears to be flowing to the northeast, on-Base, beneath Taxiway No. 1.

Groundwater near PS-8 was sampled during sampling rounds 1 (1986), 2 (1987), 3 (1989), 4 (1989), 7 (1990), 8 (1991), 9 (1991), and 11 (1991). Source area and downgradient alluvial monitoring wells were sampled during sampling rounds 1, 2, 3, 4, 7, 8, and 9. Source area and downgradient alluvial monitoring wells, and Basalt A monitoring wells were sampled during sampling round 11.

During sampling round 1, TPH, benzene, toluene, ethylbenzene, and xylene were detected in monitoring wells MW-30 and MW-31 at concentrations of 2.7 mg/L and 5.9 mg/L, 4.8 µg/L and 198 µg/L, 1.5 µg/L and 46.1 µg/L, 28.7 µg/L and 348 µg/L, and 165 µg/L and 4,330 µg/L.

During sampling round 2, benzene and xylenes were detected in monitoring wells MW-30 and MW-31 at 8.5 µg/L and 65 µg/L, and 260 µg/L and 2,300 µg/L. Toluene was detected in MW-30 at 1.6 µg/L during sampling round 2.

Benzene was detected in MW-30 during sampling round 3 at 41 µg/L. TPH was detected in monitoring wells MW-67 and MW-68 at 0.5 mg/L and 6.3 mg/L, respectively. Ethylbenzene and xylenes were detected in monitoring wells MW-30, MW-31, MW-67, and MW-68 at concentrations ranging from 320 µg/L to 1,300 µg/L, and 960 µg/L and 4,400 µg/L, respectively.

During sampling round 4, TPH was detected in monitoring wells MW-31, MW-67, and MW-68 at 5.4 mg/L 3.7 mg/L, and 1.8 mg/L. Benzene was detected in MW-30 at 26 µg/L. Toluene was detected at 820 µg/L. Ethylbenzene was detected in monitoring wells MW-30, MW-31, MW-67, and MW-68 at 300 µg/L, 590 µg/L, 410 µg/L, and 150 µg/L. Xylenes were detected in MW-31, MW-67, and MW-68 at 3,400 µg/L, 1,600 µg/L, and 470 µg/L.

TPH, ethylbenzene, and xylenes were detected in monitoring wells MW-67 and MW-68 during sampling round 6, at 4.0 mg/L and 4.0 mg/L, 410 µg/L and 150 µg/L , and 1,600 µg/L and 470 µg/L, respectively.

TPH, ethylbenzene, and xylenes were detected in monitoring wells MW-67 and MW-68 during sampling round 7, at 2.0 mg/L and 2.0 mg/L, 380 µg/L and 160 µg/L , and 1,100 µg/L and 430 µg/L, respectively.

TPH, ethylbenzene, and xylenes were detected in monitoring well MW-112 during sampling round 8 at 1.7 mg/L, 55 µg/L, and 110 µg/L, respectively.

During sampling round 9, TPH was detected in five monitoring wells at concentrations ranging from 0.2 mg/L to 4 mg/L. Ethylbenzene was detected in monitoring wells MW-31 and MW-107 at 590 µg/L and 130 µg/L, respectively. Xylenes were detected in monitoring wells MW-31, MW-107, and MW-112 at 3,100 µg/L, 160 µg/L, 380 µg/L, respectively.

The estimated levels of TPH detected in the alluvial aquifer in sampling round 11 are shown in Figure 5. The estimated extent of TPH contamination encompasses the extent of the other BTEX contaminants. Concentrations of these fuel-related contaminants appear to be on a decreasing trend. The maximum concentrations of benzene and TPH detected during historical sampling rounds were 198 µg/L and 6.3 mg/L, respectively, whereas maximum values found during sampling round 11 were 5 µg/L and 1.9 mg/L, respectively.

TCE was also detected during the sampling round 11 in the three shallow bedrock wells at concentrations ranging from 10 µg/L to 26 µg/L. The source of this contamination is currently unknown but is not believed to be site-related since TCE is not a fuel-related contaminant and was not detected in the soils at the site. TCE groundwater contamination at this site will be addressed under the RI/FS for the P2 sites.

Concentrations of most metals in groundwater were similar to natural background levels. Metals with elevated concentrations in some of the wells are believed to be the result of high turbidity in the wells and are not believed to be site-related since they are not components of fuel and were not detected at high levels in the soils.

FT-1, Fire Training Area

Soils

Soils at FT-1 were sampled for TPH and BTEX during sampling rounds 1 (1986), 3 (1988), and 11 (1991).

TPH was detected during sampling rounds 1 and 3, in eight of 25 samples at concentrations from 21 mg/kg to 8,350 mg/kg. Benzene was detected in two of 25 soil samples at 1 mg/kg and 35.7 mg/kg. Toluene was detected in three of 25 soil samples at a range from 2.8 mg/kg to 109.7 mg/kg. Ethylbenzene was detected in three of 25 at a range from 3.2 mg/kg to 52.3 mg/kg. Xylenes were detected in one sample at 90 mg/kg.

TPH and BTEX compounds were the primary contaminants detected in subsurface soil samples collected during sampling round 11. Metals are not considered to be a problem in the soil since concentrations were similar to background values. The soil samples collected from areas closest to the fire training pit contained the highest concentrations of TPH and BTEX. Maximum concentrations detected were 14 mg/kg, 170 mg/kg, 61 mg/kg, and 140 mg/kg for benzene, toluene, ethylbenzene, and xylene, respectively. The estimated levels of benzene in the soil are shown in Figure 6.

TPH were detected over a larger area than that covered by the BTEX compounds with a maximum concentration of 7,500 mg/kg. Although TPH was more prevalent in the soil than the BTEX compounds at FT-1, TPH does not appear to be causing groundwater contamination since there have been no positive detections of TPH in the groundwater at FT-1 since sampling round 3 in 1989.

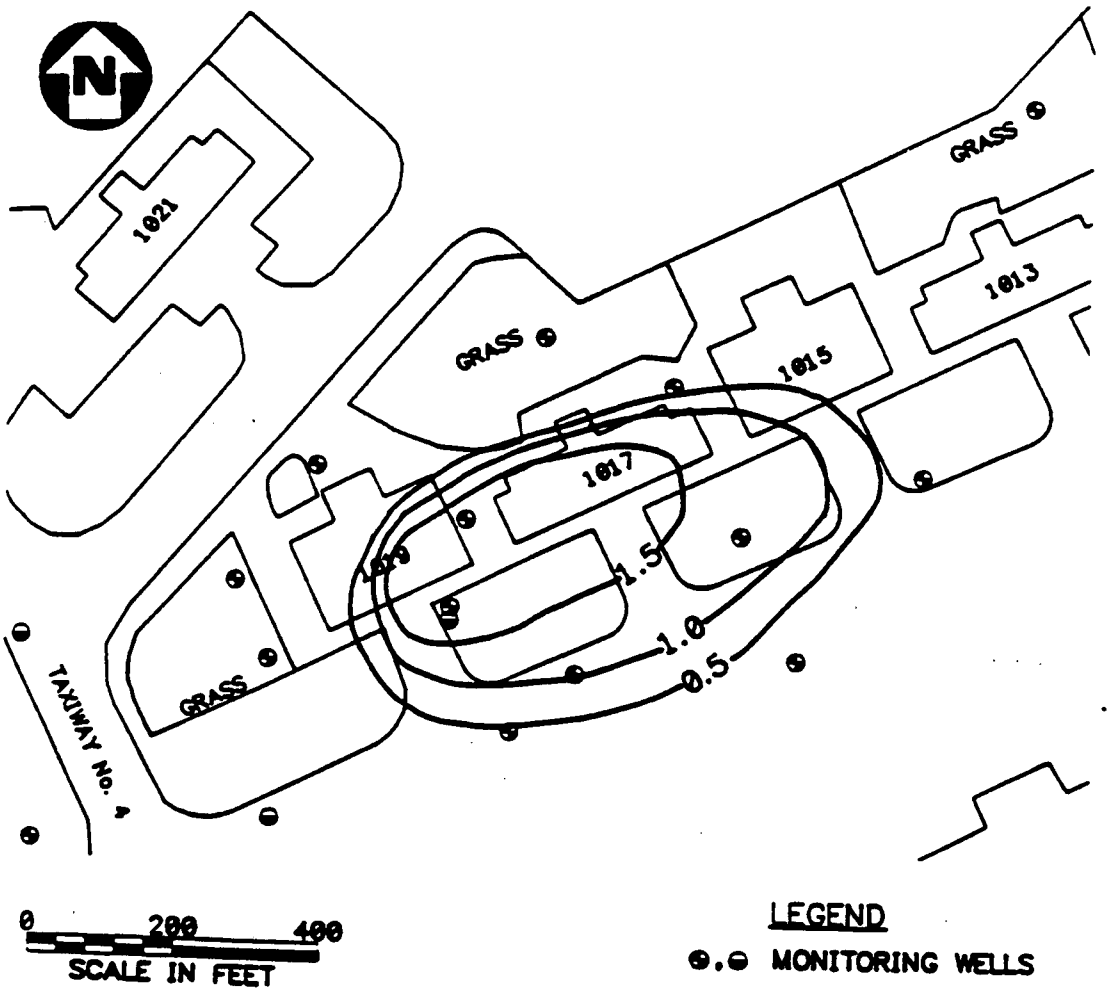


FIGURE 5
ESTIMATED LEVELS OF TPH IN GROUNDWATER AT PS-8 SITE (mg/L)
FAIRCHILD AFB, WASHINGTON

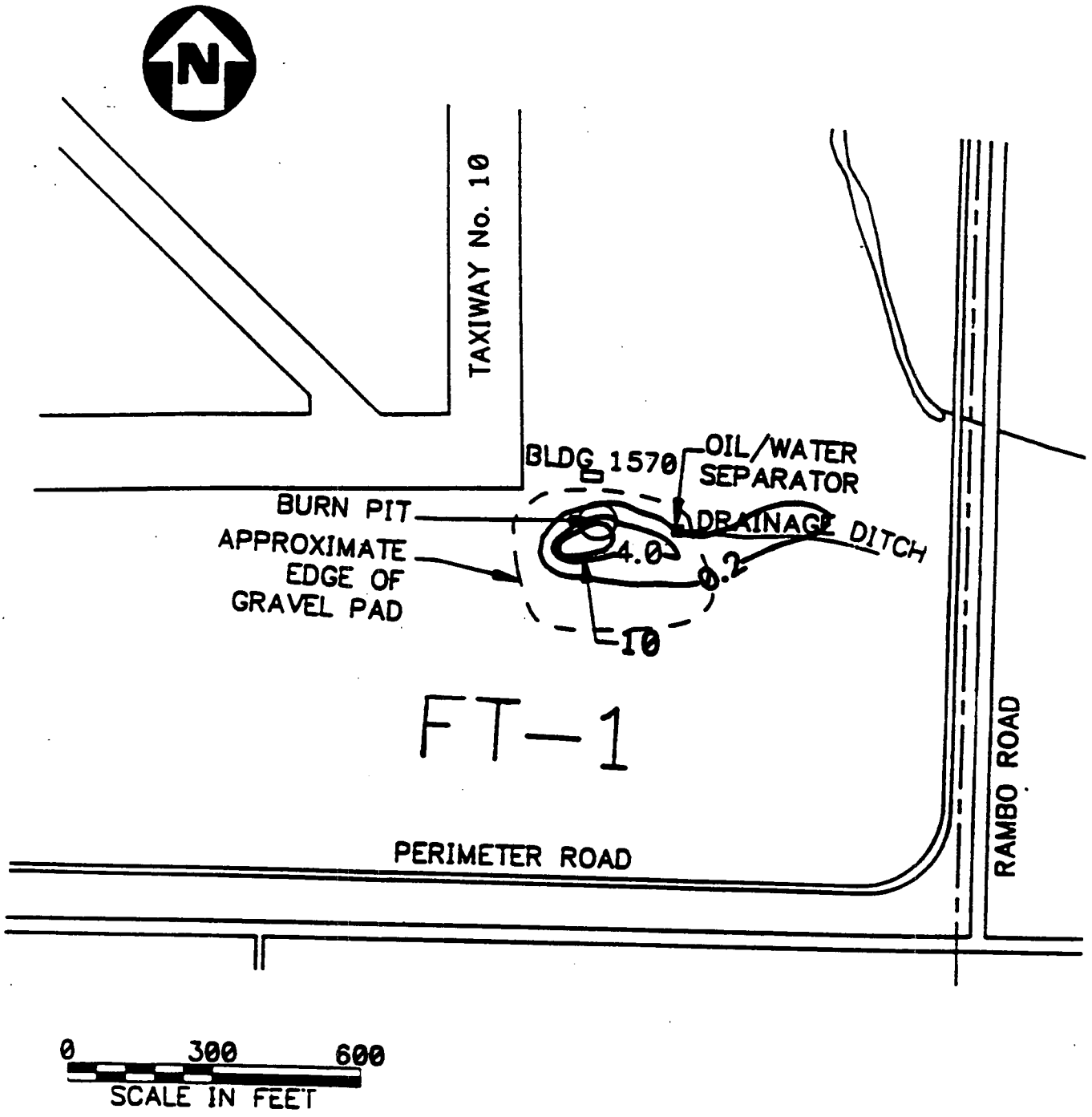


FIGURE 6
ESTIMATED LEVELS OF BENZENE IN SOIL AT FT-1 SITE (mg/kg)
FAIRCHILD AFB, WASHINGTON

Groundwater

Groundwater at FT-1 was sampled for TPH, BTEX, and TCE during sampling rounds 1 (1986), 2 (1987), 3 (1989), 4 (1989), 6 (1990), 7 (1990), 8 (1991), 9 (1991), and 11 (1991). Sampling rounds 1, 2, 3, 4, 6, and 7 were used to sample source area and downgradient (on-Base) alluvial monitoring wells. Sampling round 8 sampled source area and downgradient (on-Base) alluvial monitoring wells, off-Base alluvial monitoring wells, on-Base Basalt A (top-mid) monitoring wells, and on-Base Basalt A (deep) monitoring wells.

During sampling round 1, benzene, toluene, and ethylbenzene were detected in monitoring well MW-3 at 1.5 µg/L, 0.4 µg/L, and 1.4 µg/L, respectively. Xylenes were detected in monitoring wells MW-1 and MW-3 at 0.6 µg/L and 8.1 µg/L, respectively. TCE was detected in monitoring well MW-4 at 0.54 µg/L.

Toluene and xylenes were detected in monitoring well MW-3, during sampling round 2 at 3.0 µg/L and 27 µg/L, respectively. TCE was detected in monitoring wells MW-1 and MW-2 at 2.3 µg/L and 16 µg/L, respectively.

TPH was detected during sampling round 3 in monitoring well MW-1 at 0.3 mg/L. Benzene, ethylbenzene, and xylenes were detected in monitoring wells MW-1 and MW-3 at concentrations of 43 µg/L and 79 µg/L, 75 µg/L and 68 µg/L, and 87 µg/L and 180 µg/L, respectively. TCE was detected in four monitoring wells at concentrations ranging from 2.1 µg/L to 29 µg/L.

Benzene, ethylbenzene, and xylenes were detected in monitoring well MW-3, during sampling round 4, at concentrations of 170 µg/L, 100 µg/L, and 250 µg/L, respectively. TCE was detected in four monitoring wells at concentrations ranging from 1.0 µg/L to 12 µg/L.

TPH, TCE, ad BTEX were not detected in groundwater during sampling round 6.

TCE was detected in monitoring wells MW-50 and MW-51, during sampling round 7 at concentrations of 2.0 µg/L and 5.0 µg/L, respectively.

TCE was detected in monitoring well MW-100 (on-Base Basalt A (top-mid) monitoring well) at 2.0 µg/L during sampling round 8.

TPH, TCE, and BTEX were not detected in groundwater during sampling round 9.

BTEX and TCE were the primary organic contaminants detected in the groundwater at FT-1. BTEX compounds are most prevalent in the immediate vicinity of the fire training pit. Analytical results indicate that the BTEX contamination is only present in the alluvial aquifer. Of the BTEX contaminants benzene was detected with a maximum sampling round 11 concentration of 320 µg/L. The estimated levels of benzene detected in the alluvial aquifer in sampling round 11 are shown in Figure 7. It is currently believed that the benzene-contaminated soils are the source of benzene contamination in the nearby groundwater.

Low levels of TCE were detected in several wells at this site. The source of the TCE contamination is currently unknown but is not believed to be site-related since TCE is not a fuel-related contaminant and was not detected in the soils at the site. The maximum on-Base concentration of TCE detected in this area in both the alluvial and bedrock wells during historical sampling rounds was 29 µg/L, whereas the maximum level found during sampling round 11 was 5 µg/L. These results suggest that the overall level of TCE contamination at the site may be decreasing. The maximum off-Base TCE concentration in this area was 0.6 µg/L in sampling round 11. TCE groundwater contamination at this site will be addressed under the RI/FS for the P2 sites.

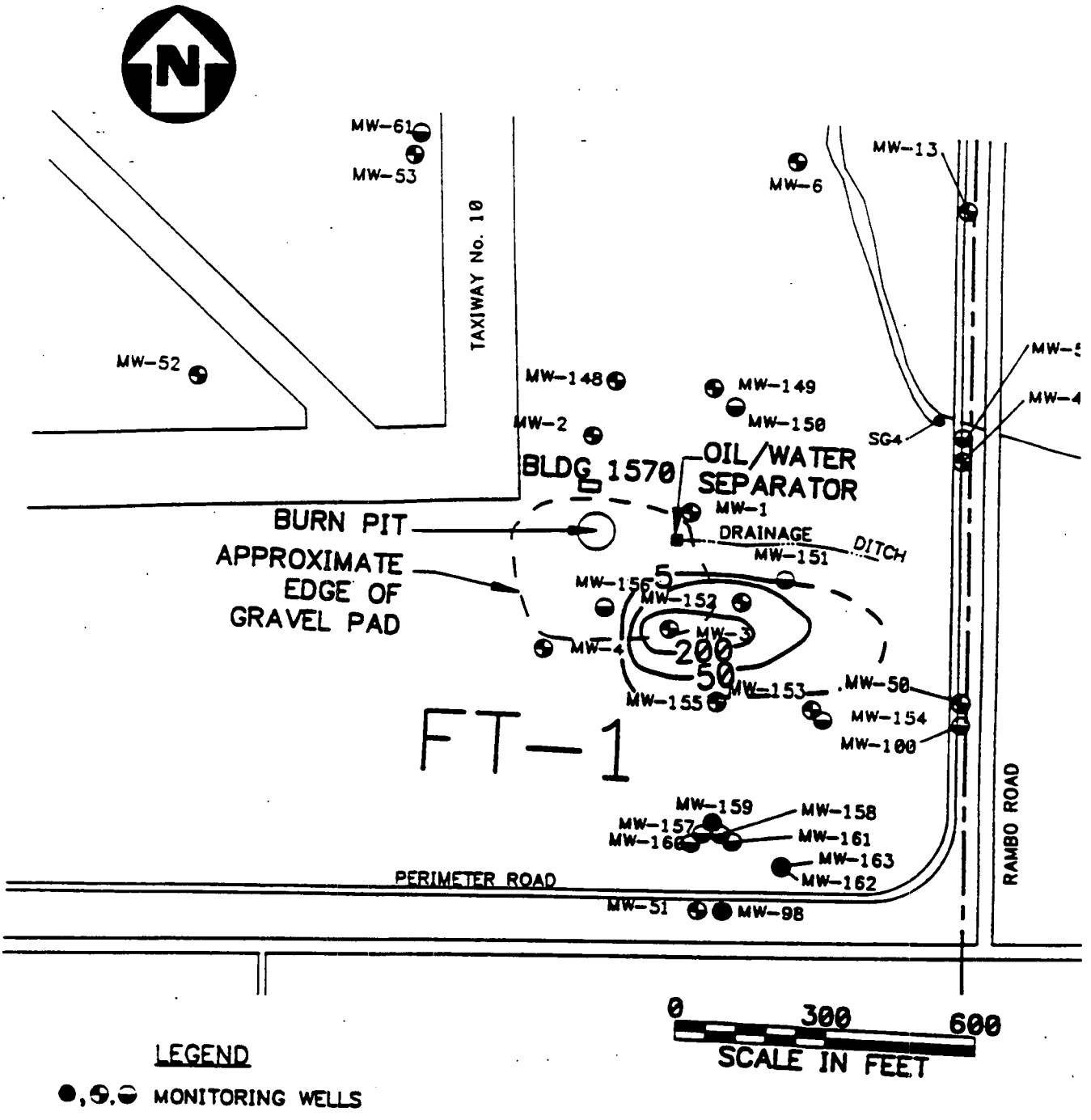


FIGURE 7
ESTIMATED LEVELS OF BENZENE IN GROUNDWATER AT FT-1 SITE (µg/L)
FAIRCHILD AFB, WASHINGTON

Groundwater near FT-1 appears to migrating toward the east. It is currently believed that the benzene-contaminated groundwater may migrate off-Base in the near future.

WW-1, Wastewater Lagoons

Surface Water

TPH was detected in the WW-1 skimming basin at 2.0 mg/L during sampling round 3 (1989). TCE was detected in the skimming basin, outlet to No Name Ditch, and No Name Ditch off-Base, at concentrations of 1.9 µg/L, 0.5 µg/L, and 1.9 µg/L, respectively.

TPH was detected in the skimming basin and No Name Ditch at 2.0 mg/L and 22 mg/L, respectively, during sampling round 7 (1990). TCE was detected in the skimming basin at approximately 4.0 µg/L.

TPH was the primary contaminant of concern detected in surface waters in No Name Ditch. TPH was detected in the surface water in the on-Base portion of No Name Ditch at levels slightly exceeding 1.0 mg/L during sampling round 11 (1991), but was not detected above this concentration in surface water samples collected from off-Base portions of No Name Ditch. The concentrations observed in 1991 were generally lower than those found in earlier sampling rounds.

Sediments

TPH was detected in skimming basin, skimmed waste pond, No Name Ditch (on-Base) and No Name Ditch (off-Base) sediments during sampling rounds 1 (1986) and 3 (1989), at concentrations ranging from 2,914 mg/kg to 33,089 mg/kg, from 1,976 mg/kg to 6,115 mg/kg, from 1,210 mg/kg to 5,000 mg/kg, and 119 mg/kg, respectively.

TPH was detected in the skimming basin, skimmed waste pond, outlet to No Name Ditch, and No Name Ditch (off-Base), during sampling round 7 (1990), at concentrations of from 2,800 mg/kg to 3,500 mg/kg, 110 mg/kg, 81 mg/kg, and from 38 mg/kg to 86 mg/kg.

TPH was the most significant contaminant detected in the sediment samples from the lagoons and No Name Ditch. TPH detected in the lagoons during sampling round 11 ranged from 150 mg/kg to 8,300 mg/kg, whereas TPH levels detected at off-Base No Name Ditch locations ranged from less than 20 mg/kg to 120 mg/kg. The TPH concentrations observed in No Name Ditch in 1991 were significantly lower than those found in earlier sampling rounds.

The concentrations of lead, chromium, and cadmium detected in No Name Ditch sediments were slightly elevated above background soil concentrations.

Soils

TPH was detected during sampling rounds 1 (1986) and 2 (1987) at a range of concentrations from 480 mg/kg to 518 mg/kg.

TPH was not detected during sampling round 7 (1990).

TPH was the most significant contaminant detected in the surface and subsurface soil samples collected from soil borings and test pits installed in the immediate vicinity of the lagoons with sampling round 11 concentrations ranging from less than 20 mg/kg to 4,500 mg/kg.

Polyaromatic hydrocarbons (PAHs) were detected in the subsurface soil. The semi-volatile organic compounds detected in the wastewater lagoon dikes during the round 11 (1991) were di-n-butyl phthalate (0.27 mg/kg to 0.66 mg/kg in surface soil samples, and a maximum concentration of 0.98 mg/kg in subsurface soils), a,a-dimethylphenylamine (0.04 mg/kg), benzo(b)fluoranthene (0.36 mg/kg), benzo(a)pyrene (0.25 mg/kg), and indeno(1,2,3-cd)pyrene (0.24 mg/kg). Test pits were also excavated around the lagoons. The semi-volatile organic compounds detected in the soil samples were di-n-butyl phthalate (0.22 mg/kg to 0.45 mg/kg), benzoic acid (1.4 mg/kg), chrysene (0.51 mg/kg), fluoranthene (0.71 mg/kg), and pyrene (0.7 mg/kg).

TCE, the groundwater contaminant of concern at WW-1, was detected in only a few of the soil samples (three out of 52 samples) and at relatively low concentrations (maximum concentration of 0.035 mg/kg).

Elevated levels of lead, cadmium, and chromium were detected in a few of the soil samples collected in the vicinity of the wastewater lagoons. Overall, the concentrations of lead, chromium, and cadmium detected in the soils were only slightly greater than background soil concentrations. Cadmium was detected in the lagoon dike soil samples during round 11 at 6.4 mg/kg (95% upper confidence limit) in surface soils, 27.4 mg/kg (95% upper confidence limit) from 0 feet to four feet deep, and at 1.8 mg/kg from four feet to eight feet deep. Cadmium was also detected during the test pit activities at 22.1 mg/kg, 95% upper confidence limit.

Groundwater

Groundwater samples were collected during sampling rounds 1 (1986), 2 (1987), 3 (1989), 4 (1989), 6 (1990), 7 (1990), 8 (1991), 9 (1991), and 11 (1992). TCE was not detected during sampling round 1. During sampling rounds 2, 3, and 4, TCE was detected in monitoring well MW-12 (downgradient of lagoons in an on-Base alluvial monitoring well) at 20 µg/L, 33 µg/L, and 180 µg/L, respectively. TCE was not detected during sampling round 6.

TCE was detected during sampling round 8 in monitoring well MW-102 (downgradient of lagoons in an on-Base alluvial monitoring well) at 280 µg/L. TCE was detected in monitoring wells MW-12 (downgradient of lagoons in an on-Base alluvial monitoring well), MW-102 (downgradient of lagoons in an on-Base alluvial monitoring well), and MW-120 (off-Base alluvial monitoring well) at concentrations of 72 µg/L, 190 µg/L, and 18 µg/L, respectively. TCE was detected in monitoring wells MW-12 (downgradient of lagoons in an on-Base alluvial monitoring well), MW-102 (downgradient of lagoons in an on-Base alluvial monitoring well), MW-120 (off-Base alluvial monitoring well), MW-147 (off-Base alluvial monitoring well), and MW-122 (off-Base Basalt A (mid-top) monitoring well) at concentrations of 14 µg/L, 57 µg/L, 38 µg/L, and 0.4 µg/L, respectively.

TCE is the primary groundwater contaminant at this site. Groundwater sampling results, shown in Figure 8 for sampling round 11, indicate that a narrow plume of TCE contamination has migrated off-Base from the area near monitoring wells MW-12 and MW-102 to wells MW-147 and MW-120. The WW-1 area is underlaid by a silty clay layer restricting vertical migration of contaminants into the bedrock. The source of the TCE contamination at Site WW-1 is unknown. The TCE may have originated from one or more small source areas in the WW-1 area created from past disposal of solvent-containing wastes or potentially from (a) localized spill(s) in the WW-1 area. Since TCE was infrequently detected in the surface or subsurface soil samples, the source of the TCE has either disappeared through volatilization and leaching or is very small in size and was not detected by the test pit sampling. Additional soil investigation activities are planned for 1993 to identify potential TCE source areas in the vicinity of the wastewater lagoons.

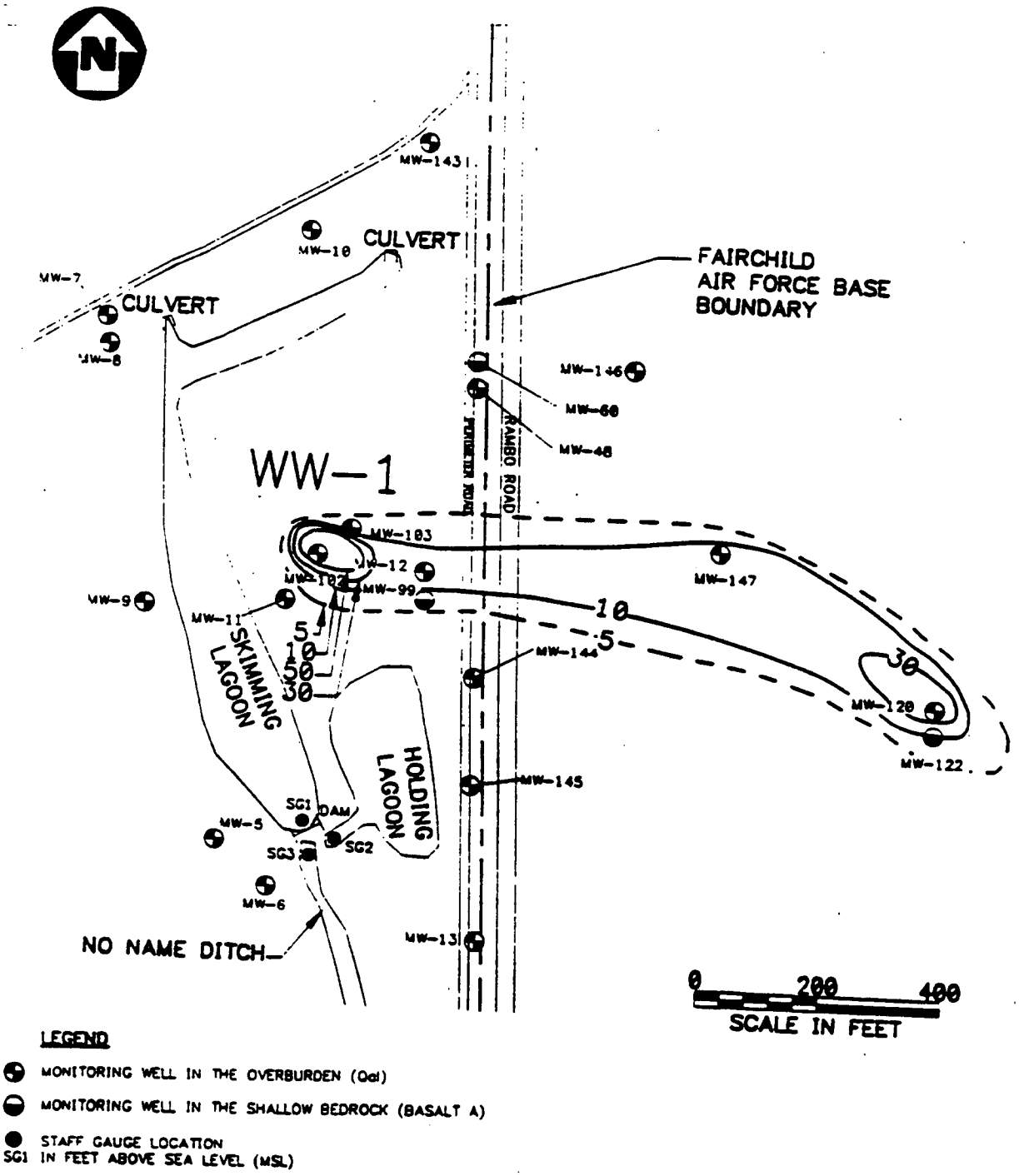


FIGURE 8
ESTIMATED LEVELS OF TCE IN GROUNDWATER AT WW-1 SITE (µg/L)
FAIRCHILD AFB, WASHINGTON

Concentrations of most metals in groundwater were similar to natural background levels. In contrast to the TCE contamination, no distinct pattern of elevated metals concentrations was observed in the groundwater at the site. Metals with elevated concentrations in some of the wells are believed to be the result of high turbidity in the wells and are not believed to be site-related since they were not detected at high levels in the soils and sediments.

The TCE-contaminated groundwater plume is currently migrating off-Base to the east.

Residential Well Monitoring Results

Several residential wells are located in the vicinity of sites SW-1, FT-1, and WW-1. These wells have been periodically sampled for volatile organic contamination since 1986. TCE and chlorobenzene were the only contaminants detected in samples collected during sampling rounds 8, 9, 10, and 11. The maximum concentrations detected for both contaminants did not exceed 1 µg/L.

VI. SUMMARY OF SITE RISKS

CERCLA response actions at the P1 Operable Units as described in the ROD are intended to protect human health and the environment from risks related to current and potential exposures to hazardous substances at the sites.

To assess the risk posed by site contamination, a Baseline Risk Assessment was completed as part of the RI. The human health risk assessment for the on-Base P1 Sites considered potential effects of the site-related contaminants on human health, and the ecological risk assessment evaluated potential risks to the environment. The risk assessments were conducted in accordance with EPA's Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (RAG HHEM) and Volume II: Environmental Assessment Manual, other EPA national guidance, and EPA Region 10 Supplemental Risk Assessment Guidance for Superfund. This section of the ROD summarizes the results of the Baseline Risk Assessment for the on-Base P1 Sites.

A. Human Health Risks

The human health risk assessment considered potential risks associated with exposure to site contaminants. The assessment involved a four-step process that included the identification of contaminants of concern, an assessment of contaminant toxicity, an exposure assessment of the population at risk, and a characterization of the magnitude of risk. The risk assessment uses reasonably conservative assumptions to determine risk, such as daily exposure to contamination for 30 years. The risk assessment also considers changes in uses of land or groundwater that may occur in the future.

A.1 Major Contaminants of Concern

Chemicals of concern were selected for each Fairchild AFB P1 site evaluated based on contaminant occurrence and distribution in the environmental media (summarized in Section V) and a risk-based screening approach suggested in the EPA Region X Supplemental Risk Assessment Guidance for Superfund (EPA, August 1991). The following list presents the major contaminants of concern for each site:

- SW-1 - Trichloroethene
- PS-2 - Total petroleum hydrocarbons, benzene, ethylbenzene, and xylenes

- PS-6 - Trichloroethene
- PS-8 - Total petroleum hydrocarbons, trichloroethene, benzene, ethylbenzene, and xylenes
- FT-1 - Benzene, toluene, ethylbenzene, xylene, and trichloroethene
- WW-1 - Trichloroethene, polyaromatic hydrocarbons, cadmium, lead, and chromium
- IS-1 - Trichloroethene

In overview, the major contaminants of concern for the Fairchild AFB P1 sites were fuel related contaminants and/or the chlorinated hydrocarbons. Metals (cadmium, lead, chromium) and the polyaromatic hydrocarbons are also considered major contaminants of concern for site WW-1.

A.2 Toxicity Assessment

A toxicity assessment was performed for all chemicals selected as indicator chemicals for public health risk assessment. A toxicity profile developed for each chemical provides a qualitative weight-of-evidence that site contaminants pose actual or potential hazards to human health. Toxicity criteria (cancer slope factors, reference doses) and regulatory standard or guidelines were summarized for each contaminant of concern.

A.3 Exposure Assessment

The exposure assessment conducted for the Fairchild AFB P1 sites identified the potentially exposed populations given the current and expected future land use scenarios, characterized the exposure based on the most relevant exposure pathways, and developed exposure doses which were evaluated during the risk characterization.

Current and Future Land/Groundwater Use at Fairchild Air Force Base

Fairchild AFB is currently an active air force base and will remain an active base for the foreseeable future. Land use classifications and access restrictions at Fairchild AFB prohibit Base residents and off-Base residents from coming into direct contact with contaminated environmental media at any of the operable units under investigation. The current and expected future land use for areas adjoining the base is residential, light commercial/industrial, or agricultural. It should be noted that site SW-1, FT-1, and WW-1 are located at the Base boundary. If land use near Fairchild AFB significantly changes, or if Fairchild AFB ceases operations, the remedies presented in this decision document will be reevaluated.

Groundwater (on-Base) in the immediate vicinity and downgradient of the Priority 1 sites is not currently used as a domestic water supply source. There are no plans to develop this groundwater as a resource in the future. However, more than 20 residential water supply wells are located downgradient of sites FT-1 and WW-1 (off-Base). At least two residential wells are located in the vicinity of site SW-1. Residents in these areas do not currently have the option of tapping into a public water supply system.

Receptors of Concern/Exposure Assessment Methodology

Based on the contamination summary presented in Section V and the current/future land use scenarios described in the preceding paragraphs, the following primary receptors of concern are identified:

- Base personnel who come into contact with potentially contaminated surface soils during the performance of assigned duties (relevant for all P1 sites)

- Off-Base residents who use domestic water supply wells downgradient of the Priority 1 operable units, this is particularly relevant for FT-1 and WW-1).

- Base personnel/residents who contact (accidental ingestion, dermal contact, inhalation of dusts) No-Name ditch sediments (relevant for site WW-1).

Exposures incurred by the aforementioned receptors under the current land use scenarios were evaluated quantitatively in the baseline public health risk assessment. Additionally, the baseline risk assessment also evaluated, quantitatively, exposures incurred by a theoretical receptor assuming residences are built on Base property in the vicinity of the P1 sites at some time in the future (i.e., A future residential land use scenario assumed that a resident would use the groundwater as a domestic water supply and be exposed to surface soil contaminants. As stated previously, a future residential land use scenario is very unlikely for Fairchild AFB.

The exposure assessment of contaminant concentrations detected at the P1 sites used standard exposure factors (Federal EPA or Region X) to develop exposure doses for relevant exposure routes. Assuming the domestic use of groundwater resource, the ingestion, dermal contact, and inhalation of volatile compounds exposure routes were evaluated. Assuming contact with contaminated surface soils, the accidental ingestion, dermal contact and inhalation of airborne soil particulates exposure routes were evaluated. Average and the upper 95% confidence limit on the average define the exposure point concentrations evaluated. Contaminant concentrations detected in overburden and basalt monitoring wells were evaluated separately. On-Base contaminant concentrations were evaluated separately from off-Base contaminant concentrations.

A.4 Risk Characterization

The Risk Characterization integrates the information developed in the toxicity assessment and exposure assessment to characterize the carcinogenic and non-carcinogenic risks associated with contaminant concentrations detected at the five P-1 sites. The acceptable risk range for carcinogens is one additional chance in ten thousand (1×10^{-4}) to one chance in one million (1×10^{-6}) according to CERCLA. Under the Washington State Model Toxics Control Act (MTCA), the maximum acceptable overall site risk from carcinogens is one chance in one hundred thousand (1×10^{-5}).

For non-carcinogens, acceptable levels are generally those to which the human population may be exposed during a 30 year period without adverse health effects. Non-carcinogenic risks are estimated by calculating a Hazard Index (HI). According to both federal and state hazardous waste laws, an acceptable risk level for non-carcinogens is a HI value less than one.

The results of the human health risk assessment are shown in Tables 2 and 3 for the soils/sediments and groundwater, respectively. As shown in Table 2, for exposures to soil or sediment, risk estimates were calculated for both residential and industrial land use scenarios. The combined soil/sediment and groundwater risk-results, assuming that a receptor was exposed to site-related contaminants via both groundwater and soil/sediment pathways, are shown in Table 4.

TABLE 2

SUMMARY RISK TABLE FOR SOIL/SEDIMENT EXPOSURE SCENARIOS
FAIRCHILD AFB, WASHINGTON

Site	Risk Results							
	Cancer Risk Results				Hazard Indices			
	Residential		Industrial		Residential		Industrial	
	RME[1]	AVG[2]	RME[1]	AVG[2]	RME[1]	AVG[2]	RME[1]	AVG[2]
SW-1								
Surface Soils	3×10^{-6}	3×10^{-7}	4×10^{-7}	3×10^{-7}	4×10^{-4}	1×10^{-4}	5×10^{-5}	5×10^{-5}
Test Pit Soil Samples (0- to 4-foot depth)	3×10^{-6}	2×10^{-7}	3×10^{-7}	2×10^{-7}	4×10^{-4}	8×10^{-5}	5×10^{-5}	4×10^{-5}
PS-2								
Surface Soils	—	—	—	—	4×10^{-3}	8×10^{-4}	8×10^{-4}	6×10^{-4}
Subsurface Soils	—	—	—	—	7×10^{-2}	4×10^{-3}	1×10^{-2}	4×10^{-3}
PS-6								
Surface Soils	—	—	—	—	2×10^{-1}	2×10^{-2}	4×10^{-2}	1×10^{-2}
Subsurface Soils	—	—	—	—	5×10^{-3}	5×10^{-4}	8×10^{-4}	4×10^{-4}
PS-8								
Surface Soils	—	—	—	—	2×10^{-2}	2×10^{-3}	4×10^{-3}	1×10^{-3}
Subsurface Soils	—	—	—	—	4×10^{-1}	4×10^{-2}	8×10^{-2}	3×10^{-2}
FT-1								
Soils	2×10^{-7}	7×10^{-9}	2×10^{-8}	8×10^{-9}	4×10^{-1}	4×10^{-2}	7×10^{-2}	4×10^{-2}
WW-1								
Surface Soils	3×10^{-5}	1×10^{-6}	5×10^{-6}	3×10^{-6}	7×10^{-2}	1×10^{-2}	1×10^{-2}	7×10^{-3}
Test Pits East	1×10^{-5}	4×10^{-7}	2×10^{-6}	9×10^{-7}	3×10^{-1}	3×10^{-2}	6×10^{-2}	2×10^{-2}
Test Pits North	—	—	—	—	6×10^{-3}	6×10^{-4}	1×10^{-3}	5×10^{-4}
Dike Surface Soils	3×10^{-7}	3×10^{-8}	2×10^{-7}	9×10^{-8}	2×10^{-1}	2×10^{-2}	3×10^{-2}	1×10^{-2}
Dike Borings	1×10^{-6}	1×10^{-7}	8×10^{-7}	3×10^{-7}	3×10^{-1}	3.0×10^{-2}	4×10^{-2}	2×10^{-2}
No Name Ditch	4×10^{-7}	3×10^{-8}	2×10^{-7}	8×10^{-8}	4×10^{-1}	4×10^{-2}	5×10^{-2}	2×10^{-2}

(1) RME - Reasonable Maximum Exposure case
(2) AVG - Average case

TABLE 3

SUMMARY RISK TABLE - GROUNDWATER[1]
FUTURE RESIDENTIAL LAND USE SCENARIO
FAIRCHILD AFB, WASHINGTON

Site	Risk Result			
	Residential Cancer Risk		Residential Hazard Indices	
	RME	AVG	RME	AVG
SW-1				
Basalt A - SW of landfill	–	–	2.0×10^{-2}	1.0×10^{-2}
Basalt A - NE of landfill	4.0×10^{-6}	5.0×10^{-7}	9.0×10^{-3}	2.0×10^{-3}
Basalt A - Base	–	–	–	–
IS-1				
Basalt A Top Mid	2.0×10^{-6}	2.0×10^{-7}	–	–
Basalt A (Base)	5.0×10^{-6}	4.0×10^{-7}	4.0×10^{-2}	1.0×10^{-2}
PS-2				
Alluvial	1.0×10^{-3}	8.0×10^{-5}	1.0×10^{1}	3.0×10^{0}
Basalt A	1.0×10^{-5}	2.0×10^{-6}	7.0×10^{-2}	3.0×10^{-2}
PS-6				
Alluvial	4.0×10^{-6}	3.0×10^{-7}	–	–
Basalt A	–	–	–	–
PS-8				
Alluvial	8.0×10^{-6}	2.0×10^{-6}	2.0×10^{0}	8.0×10^{-1}
Basalt A	1.0×10^{-5}	2.0×10^{-6}	–	–
WW-1				
Alluvial Wells - Upgradient	4.0×10^{-6}	3.0×10^{-7}	2.0×10^{-3}	4.0×10^{-4}
Alluvial Wells - Downgradient	3.0×10^{-5}	3.0×10^{-6}	–	–
Alluvial Wells - Off Base	2.0×10^{-6}	2.0×10^{-6}	–	–
Basalt A (Top Mid) On Base	–	–	–	–
Basalt A (Top Mid) Off Base	2.0×10^{-7}	3.0×10^{-6}	–	–
FT-1				
On-Base Alluvial	1.0×10^{-4}	1.0×10^{-5}	3.0×10^{-1}	9.0×10^{-2}
Off-Base Alluvial	2.0×10^{-7}	5.0×10^{-8}	–	–
Basalt A Top-Mid-On Base	1.0×10^{-4}	9.0×10^{-6}	3.0×10^{-3}	2.0×10^{-3}
Basalt A Top-Mid-Off Base	–	–	–	–
Basalt A (Base) On Base	–	–	9.0×10^{-2}	1.0×10^{-2}
Basalt A (Base) Off Base	–	–	–	–

(1) The risks presented are the sum of the risk contributions by the ingestion, inhalation and dermal contact exposure pathways in groundwater for the RME and AVG receptors.

TABLE 4

SUMMARY RISK TABLE FOR COMBINED GROUNDWATER AND SOIL EXPOSURE PATHWAYS[1]
FUTURE RESIDENTIAL LAND USE SCENARIO
FAIRCHILD AFB, WASHINGTON

Site	Risk Result			
	Residential Cancer Risk		Residential Hazard Indices	
	RME	AVG	RME	AVG
SW-1	[3]	[4]	[3]	[4]
Basalt A - SW of landfill	3.0×10^{-6}	3.0×10^{-7}	2.0×10^{-2}	2.0×10^{-2}
Basalt A - NE of landfill	7.0×10^{-6}	7.0×10^{-7}	1.0×10^{-2}	2.0×10^{-3}
Basalt A - Base	3.0×10^{-6}	3.0×10^{-7}	4.0×10^{-4}	1.0×10^{-4}
IS-1	[2]	[2]	[2]	[2]
Basalt A Top Mid	2.0×10^{-6}	2.0×10^{-7}	–	–
Basalt A (Base)	5.0×10^{-6}	4.0×10^{-7}	4.0×10^{-2}	1.0×10^{-2}
PS-2	[2]	[2]	[6]	[6]
Alluvial	1.0×10^{-3}	8.0×10^{-6}	1.0×10^{1}	3.0×10^{0}
Basalt A	1.0×10^{-5}	2.0×10^{-6}	1.0×10^{-1}	3.0×10^{-2}
PS-6	[2]	[2]	[7]	[7]
Alluvial	4.0×10^{-6}	3.0×10^{-7}	2.0×10^{-1}	2.0×10^{-2}
Basalt A	–	–	2.0×10^{-1}	2.0×10^{-2}
PS-8	[2]	[2]	[8]	[8]
Alluvial	8.0×10^{-6}	2.0×10^{-6}	3.0×10^{0}	8.0×10^{-1}
Basalt A	1.0×10^{-5}	2.0×10^{-6}	4.0×10^{-1}	4.0×10^{-2}
WW-1	[9]	[9]	[10]	[11]
Alluvial Wells - Upgradient	4.0×10^{-5}	2.0×10^{-6}	3.0×10^{-1}	3.0×10^{-2}
Alluvial Wells - Downgradient	6.0×10^{-5}	4.0×10^{-6}	3.0×10^{-1}	3.0×10^{-2}
Alluvial Wells - Off Base	5.0×10^{-5}	3.0×10^{-6}	3.0×10^{-1}	3.0×10^{-2}
Basalt A (Top Mid) On Base	3.0×10^{-5}	1.0×10^{-6}	3.0×10^{-1}	3.0×10^{-2}
Basalt A (Top Mid) Off Base	3.0×10^{-5}	1.0×10^{-6}	3.0×10^{-1}	3.0×10^{-2}

TABLE 4
SUMMARY RISK TABLE FOR COMBINED GROUNDWATER AND SOIL EXPOSURE PATHWAYS[1]
FUTURE RESIDENTIAL LAND USE SCENARIO
FAIRCHILD AFB, WASHINGTON
PAGE TWO

Site	Risk Result			
	Residential Cancer Risk		Residential Hazard Indices	
	RME	AVG	RME	AVG
FT-1	[5]	[5]	[5]	[5]
On-Base Alluvial	1.0×10^{-4}	1.0×10^{-5}	7.0×10^{0}	1.0×10^{-1}
Off-Base Alluvial	4.0×10^{-7}	6.0×10^{-8}	4.0×10^{-1}	4.0×10^{-2}
Basalt A Top-Mid-On Base	1.0×10^{-4}	9.0×10^{-6}	4.0×10^{-1}	5.0×10^{-2}
Basalt A Top-Mid-Off Base	2.0×10^{-7}	7.0×10^{-9}	4.0×10^{-1}	4.0×10^{-2}
Basalt A (Base) On Base	2.0×10^{-7}	7.0×10^{-9}	5.0×10^{-1}	6.0×10^{-2}
Basalt A (Base) Off Base	2.0×10^{-7}	7.0×10^{-9}	4.0×10^{-1}	4.0×10^{-2}

(1) The risks presented are the sum of the contributions by both soil and groundwater exposure pathways to determine the risk for the RME and AVG receptors. The risks presented above are the sum of the individual site risks due contaminants in groundwater (Table 3) and the site soil subset which would produce the most conservative risk value (Table 2). Site soil subsets containing hexavalent chromium were not considered in the evaluation of the soil contribution to risk under this scenario.

(2) Risk due to groundwater only; no soil contribution.

(3) SW-1 subsurface soil (4-8 feet).

(4) SW-1 surface soil.

(5) FT-1 subsurface soil (0-4 feet).

(6) PS-2 subsurface soil.

(7) PS-6 surface soil.

(8) PS-8 subsurface soil.

(9) WW-1 surface soil.

(10) WW-1 test pits east of lagoon.

(11) WW-1 subsurface soil (Dike).

Cancer risk values were not calculated for the soils at IS-1, PS-2, PS-6, and PS-8 because no site-related carcinogenic contaminants were detected at these sites. Risk estimates were also not calculated for the sediment contained in the french drain manholes at IS-1 because there is no direct exposure pathway to these sediments. These sediments were removed during the IS-1 removal action. The risk estimates shown in Table 2 indicate that there would be no unacceptable risks to human health posed by exposure to the soils or sediments at any of the P1 Operable Units under an industrial use scenario. With respect to a residential land use scenario, no unacceptable risks would be posed by exposure to the soils or sediments at the P1 sites with the exception of the soil at site WW-1. The cancer risk of 3×10^{-5} for the soil at WW-1 is within the acceptable 1×10^{-4} to 1×10^{-6} range established under federal law but slightly exceeds the 1×10^{-5} level established by the Washington State MTCA regulation. The principal indicator chemicals contributing to the risk are the carcinogenic PAHs and cadmium. However, it should be noted that the carcinogenic PAHs were detected infrequently in WW-1 soil samples (i.e., PAHs were detected in one of 11 soil samples only). Cadmium was detected in several surface and shallow subsurface soil (0-4 feet) collected (particularly from lagoon dikes and test pits to the east of the lagoons). However, few detections exceed the MTCA Method B action level of 40 mg/kg.

The groundwater risk assessment results shown in Table 3 indicate that cancer risks for all of the P1 sites are within the acceptable 1×10^{-4} to 1×10^{-6} range established under federal law, except for site PS-2, which significantly exceeds the 1×10^{-4} upper risk level. Cancer risks for sites PS-2, WW-1, and FT-1 (for benzene) exceed the 1×10^{-5} level established by the Washington State MTCA regulation. With respect to non-carcinogens, hazard indices calculated for sites PS-2 and PS-8 exceed one, indicating that potential adverse health effects could result from consumption of contaminated groundwater at these sites.

B. Uncertainty Analysis in Human Health Risk Assessment

Carcinogenic and non-carcinogenic health risks were estimated in the baseline public health risk assessment for the P1 sites using various assumptions; therefore, the risk assessment results presented in Tables 2, 3, and 4 contain an inherent amount of uncertainty. The extent to which health risks can be characterized is primarily dependent upon the accuracy with which a chemical's toxicity can be estimated and the accuracy of the exposure estimates.

Examples of uncertainty in the exposure and risk assessment methodology used in this risk assessment are as follows:

- The exposure scenarios assume chronic exposure to contaminant levels that do not change with time. In reality, contaminant levels often change with time in response to source loading or depletion and physical/chemical/biological forces such as chemical or biochemical degradation.

- The baseline public health risk assessment evaluated a hypothetical future residential land use scenario. Given that Fairchild AFB is currently an active USAF base and will remain an active base for the foreseeable future, this scenario is very conservative. It should be noted that cancer risk results for soils exceed 1×10^{-5} only when the residential scenario is evaluated for the WW-1 site.

- The baseline risk assessment evaluated the potential future use of the groundwater as a domestic water supply resource. However, groundwater is not used as a domestic water supply resource. Although the cancer risk estimates for contaminant concentrations detected in onsite monitoring wells for PS-2, FT-1, and WW-1 exceed 1×10^{-5}, with the exception of the off-Base WW-1 alluvial monitoring wells, risk estimates for the off-Base monitoring wells and residential wells do not exceed 1×10^{-5}.

- Although lead, a chemical of concern, has been classified as a B2 carcinogen, a Carcinogenic Slope Factor has not been published by EPA. This presents a data gap in the risk assessment. Additionally, the Reference Dose previously published for lead has been withdrawn. Because lead is a predominant contaminant at the Base, toxicity criteria for lead would allow for a more complete quantitative risk assessment.

- The toxicity criteria for and/or carcinogenic classifications of several of the chemicals of concern (e.g., carcinogenic PAHs other than benzo(a)pyrene) are currently under review by the EPA. Risk estimates based on current toxicity for those compounds should be viewed with less certainty than risks estimated for chemicals based on toxicity criteria completely reviewed and approved by EPA.

- The sampling locations selected for the Fairchild AFB RI were biased such that potential areas of elevated concentrations would not be overlooked. Thus, risk estimates are conservative.

- The EPA is currently reviewing draft guidance for assessment of the dermal route of exposure. As stated previously, dermal absorption of volatile organic compounds is predicted by some researchers to be significant.

- The Reference Dose used for TPH should be viewed as a tentative/interim value. It is not currently listed in IRIS. No Cancer Slope Factor is currently available for TPH.

In addition to these sources of uncertainty, the chemical analytical data base has limitations in such areas as sample locations and sample representiveness. These uncertainties are present in every baseline risk assessment.

Some of the uncertainties listed in the proceeding discussion potentially affect the results presented in the public health risk assessment. Because lead and TPH are predominant site contaminants, the lack of toxicity criteria for lead and the interim nature of the Reference Dose for TPH (and lack of a Cancer Slope Factor for TPH), in particular, may result in an underestimation of the risks presented in the quantitative risk assessment. Fortunately, public health benchmarks (MTCA goals and/or EPA Action Levels) exist for lead and TPH. Thus, although lead and TPH may not be evaluated to the fullest extent quantitatively, site contaminant levels are compared to the available benchmarks and public health/remediation conclusions can be drawn in the RI/FS prepared for the P1 sites. Thus, it is unlikely that these uncertainties would alter the overall conclusions of the risk assessment.

C. Ecological Risks

An ecological risk assessment was conducted to evaluate the potential adverse impacts to plants and animals resulting from exposure to contamination associated with the on-Base P1 sites. The assessment investigated potential impacts to burrowing and ground-dwelling animals exposed to surface and subsurface soil contamination at the sites as well as impacts to wildlife exposed to contaminated surface water and sediment present at the WW-1 site.

The results of the ecological assessment indicate that no adverse impacts to plants or animals are expected from their exposure to contaminated soil associated with the on-Base P1 sites. No federal or state threatened or endangered species or critical habitats are known to be associated with Fairchild AFB.

Much of the ecological assessment was focused on the wastewater lagoons and No Name Ditch at the WW-1 site. In addition to calculated risk estimates, a qualitative risk assessment was performed for the TPH detected in the lagoons based on a review of the available literature on the impact of TPH in aquatic ecosystems. The results of the revised ecological risk assessment show that current ecological impacts associated with the lagoons are minimal, and that conditions within the lagoons are expected to improve with time. Specific findings of the ecological assessment for WW-1 include:

- The primary threat to ducks and other waterfowl using the lagoons is the possibility of becoming fouled with oil. Servicing of the oil/water separators and grit chambers has significantly reduced the presence of floating product and oil sheens on the lagoons and the potential for ducks and other waterfowl using the lagoons to become fouled with oil.

- The toxicity associated with TPH is related to the concentrations of aromatic hydrocarbons. These compounds were infrequently detected in the surface water and sediments at WW-1, suggesting that there is minimal toxicity associated with the residual TPH present in the sediments.

- Biodegradation of TPH occurs naturally in the environment, and aerobic conditions serve to enhance the rate of biodegradation. The continuous supply of water, along with the stirring effects of wind action, are expected to enhance biodegradation of the TPH to some degree by promoting aerobic conditions in the lagoons. Thus, TPH levels in the existing lagoons are expected to gradually decline through biodegradation as well as through other weathering processes (e.g., photo- and chemical oxidation).

- The wastewater lagoons are a man-made structure in which an aquatic community, tolerant to the continuous input of TPH, has developed. With the decrease in TPH inputs and the continued degradation of the existing TPH in the sediments, it is anticipated that the aquatic community inhabiting the WW-1 lagoons will increase in diversity. Sensitive benthic species that may have previously been excluded from the lagoons due to the presence of TPH may colonize the lagoons as TPH levels gradually decline.

- Observations of the emergent vegetation growing in the WW-1 lagoons indicate that the current impacts of TPH, if any, are minimal. With the decrease in TPH inputs into the lagoons and the gradual degradation of resident TPH, the diversity of the lagoons' already abundant emergent vegetation is expected to improve.

D. Uncertainty in Ecological Risk Assessment

Because risk characterization is essentially the integration of the exposure assessment and hazard assessment, sources of uncertainty associated with either of these elements also contribute to uncertainty in risk characterization. In addition, the risk characterization procedure itself should contribute to overall uncertainty. Except for the food chain evaluation, the quotient method was selected as the risk characterization method of choice for this assessment. The advantages of this method, and one of the primary limitations associated with this method, were previously addressed.

Additional limitations of the quotient method, according to EPA's Risk Assessment Methods: A Review and Evaluation of Past Practices in the Superfund and RCRA Programs (EPA-230-03-89-044), include the following:

1. EPA-reviewed toxicity data are available for only a limited number of chemicals.

2. Chronic toxicity endpoint data can be inconsistent.

3. Toxicant interactions are not addressed.

4. Toxicity data are sparse for media other than surface waters.

5. Analytical detection limits commonly exceed toxicity benchmark values (i..e, criteria).

6. There is no means for estimating severity of impacts if benchmark toxicity values are exceeded.

Decreasing the level of uncertainty associated with each of the limitations described above was accomplished using a variety of processes. A brief response to each of these limitations follows:

1. The use of acceptable chemical quantitative structure activity relationships should provide reasonable estimates of toxicity data for untested chemicals.

2. Selecting chronic toxicity tests results based only on appropriate endpoints (e.g., effects on mortality, growth, and reproduction), test design, and test durations should decrease the uncertainty associated with chronic test results.

3. The method of Barthouse et al. (1986), which simply sums quotients and addresses cumulative toxicity, addresses toxicant interactions in a reasonable and consistent manner, based on the generally accepted principle of chemical additivity.

4. Sufficient toxicity data for media other than surface waters generally exist; when combined with extrapolations based on chemical structure activity relations or interspecies correlations, reasonable estimates of required data are possible.

5. A reasonable, conservative, and protective approach for dealing with relatively high detection limits and low "safe" chemical concentrations includes setting the environmental concentration of the chemical to one half the detection limit. This procedure probably results in overestimation of actual environmental concentrations of chemicals of concern, but is reasonable in view of analytical limitations.

6. The severity of ecological impacts expected from exceedences of toxicity benchmark values (e.g., chronic ambient water quality criteria) can be estimated using the cumulative method of assessing toxicant additivity.

Every effort was taken to ensure that risk characterization was performed in the most appropriate manner for this risk assessment. All of the above-mentioned items probably contribute to total uncertainty to some extent.

Data collection components that can be useful for some Ecological Risk Assessments, but were not performed for this assessment, include (1) detailed macroscopic and microscopic tissue analysis of aquatic and terrestrial biota, and (2) toxicity testing using study area surface waters, sediments, and surface soils. However, based on the extensive environmental sampling incorporated into this assessment, and on the limited exposure potential for most sites in the study area, it was determined that such additional procedures were unnecessary at this time.

In summary, several sources of uncertainty might contribute to overall uncertainty in the final risk estimates, including those sources discussed in the exposure and hazard sections of this assessment. Throughout this assessment, if levels of uncertainty were unknown, or if impacts associated with uncertainty could not be estimated accurately, a conservative approach was taken. The consistent use of conservative assumptions probably overestimated actual risk to biota in nearly all cases, but no appropriate or reasonable alternative to conservatism has been identified.

VII. REMEDIAL ACTION OBJECTIVES

The results of the RI and Risk Assessment were used to determine the need for cleanup action at these sites. The objectives of the cleanup actions for each site are summarized in the following sections. The following remedial action objectives have been established for the P1 sites:

- Prevent residential exposure to potential contaminants within the subsurface soil and debris (for Old Base Landfill and Wastewater Lagoons).
- Prevent exposure to potential contaminants in the subsurface soils and sediments at WW-1.
- Minimize movement of contaminants from soil/debris to groundwater.
- Prevent consumption of groundwater exceeding federal Safe Drinking Water Act (SDWA) Maximum Contaminant Levels (MCLs).
- Restore contaminated groundwater to its beneficial uses, which at these sites is drinking water.
- Prevent further migration of contaminated groundwater.

A. . Need For Feasibility Study Evaluation

Specific details concerning the need for soil or groundwater cleanup at each site are discussed in the following sections.

SW-1, Old Base Landfill Northeast of Taxiway No. 7

The results of the risk assessment indicate that there would be no unacceptable risks to human health posed by exposure to the soils at SW-1 under both residential and industrial use scenarios. However, since the site was a former sanitary landfill, there is a potential for buried contamination not identified during the RI to be present within the landfill. Therefore, exposure to potential contaminants within the landfill is still a human health concern.

The primary groundwater contaminant of concern at the SW-1 site is TCE. Although no sources of TCE were identified within the SW-1 landfill, buried waste not identified in the RI could serve as a source of groundwater contamination. Therefore, source control alternatives for the landfill were evaluated in the FS.

With respect to the TCE detected in the groundwater at SW-1, the estimated cancer risk is within the acceptable range established under federal law and is below the state level of 1×10^{-5}. However, TCE concentrations detected in several monitoring wells currently exceed the federal MCL standard of 5 μg/L. Therefore, groundwater cleanup alternatives were evaluated in the FS.

IS-1, Building 1034 French Drain System

The results of the risk assessment indicate that there would be no unacceptable risks to human health posed by exposure to the soils at IS-1 under both residential and industrial use scenarios. With the completion of the removal action at IS-1 in December 1992, contaminated sediment was removed, and all conduits, including surface water drainage into the manholes, and potential sources of groundwater contamination, have been eliminated at the IS-1 site. Thus, no further remedial actions are necessary for the soils or sediments at IS-1, and no remedial action objectives have been established.

The RI investigation did not identify a groundwater contaminant plume associated with the IS-1 site. Thus, no remedial action objectives have been established for the groundwater at IS-1.

OU-1, PS-2, Flightline Operable Unit

The results of the risk assessment indicate that there would be no unacceptable risks to human health posed by exposure to the soils at PS-2 under both residential and industrial use scenarios. Since soil contaminated with TPH could potentially serve as a source of groundwater contamination, source control alternatives for PS-2 were evaluated in the FS.

The floating fuel products detected in two of the monitoring wells at PS-2 serve as a source of groundwater contamination. It is believed that the floating product is the principal threat at PS-2. Therefore cleanup of floating product was evaluated.

With respect to groundwater, the estimated cancer risk currently exceeds acceptable levels established under both state and federal law. Furthermore, benzene concentrations detected in several monitoring wells currently exceed the federal MCL standard of 5 μg/L. For these reasons, groundwater cleanup alternatives were evaluated in the FS.

OU-1, PS-6, Flightline Operable Unit

The results of the risk assessment indicate that there would be no unacceptable risks to human health posed by exposure to the soils at PS-6 under both residential and industrial use scenarios. Also, results of the RI indicate that the soils are not a source of groundwater contamination. Thus, no remedial actions are necessary for the soils at PS-6, and no remedial action objectives have been established.

The RI investigation did not identify a groundwater contaminant plume associated with the PS-6 site. Thus, no remedial action objectives have been established for the groundwater at PS-6.

OU-1, PS-8, Flightline Operable Unit

The results of the risk assessment indicate that there would be no unacceptable risks to human health posed by exposure to the soils at PS-8 under both residential and industrial use scenarios. Since soil contaminated with TPH could potentially serve as a source of groundwater contamination, source control alternatives for PS-8 were evaluated in the FS.

With respect to the fuel-related contamination detected in the groundwater at PS-8, the estimated cancer risk is within the acceptable range established under federal law and does not exceed the state level of 1×10^{-5}. The maximum groundwater benzene concentration detected during sampling round 11 was equal to the federal MCL of 5 μg/L. However, benzene concentrations did exceed the MCL in earlier sampling rounds. In addition, TPH concentrations in several wells currently exceed the state MTCA groundwater cleanup level of 1.0 mg/L. For these reasons, groundwater cleanup alternatives were evaluated in the FS.

FT-1, Fire Training Area

The results of the risk assessment indicate that there would be no unacceptable risks to human health posed by exposure to the soils at FT-1 under both residential and industrial use scenarios. Results of the RI indicate that the soil contaminated with TPH are not a source of groundwater contamination, but that soil contaminated with benzene are a potential source of groundwater contamination. It is also believed that the benzene-contaminated soils are the principal threat at FT-1. Therefore, source control alternatives for the benzene-contaminated soil at FT-1 were evaluated in the FS.

With respect to the fuel-related contamination detected in the groundwater at FT-1, the estimated cancer risk is within the acceptable risk range established under federal law but exceeds the state level of 1×10^{-5}. The maximum groundwater benzene concentration significantly exceeds the federal MCL of 5 μg/L. For these reasons, groundwater cleanup alternatives were evaluated in the FS.

WW-1, Wastewater Lagoons

The results of the risk assessment indicate that there would be no unacceptable risks to human health posed by exposure to the sediments in No Name Ditch under both residential and industrial use scenarios. With respect to the soils, the industrial and residential use cancer risk estimates are within the acceptable range based on federal law, and the residential use cancer risk estimate is only slightly above the Washington State standard. Land use at this site is expected to remain industrial. Therefore, actions to clean up the soil for residential purposes were not considered in the FS. Institutional controls to limit the site to industrial usage were evaluated.

Results of the ecological risk assessment indicate that there are minimal risks to plants and animals associated with the wastewater lagoons, and that ecological conditions in the lagoons should continue to improve naturally. Therefore, cleanup actions for the purpose of ecological protection were not considered in the FS.

Results of the RI indicate that the soils and sediments at WW-1 are not a source of groundwater contamination. Therefore, source control alternatives were not evaluated in the FS at this time. However, additional field investigation activities are planned to determine if a TCE source is present at the site. If a TCE source is identified, cleanup alternatives will be evaluated at that time.

With respect to the TCE contamination detected in the groundwater at WW-1, the maximum TCE concentration significantly exceeds the federal MCL of 5 μg/L, the estimated cancer risk is within the acceptable range established under federal law but exceeds the state level of 1×10^{-5}. For these reasons, groundwater cleanup alternatives were evaluated in the FS.

B. Development of Cleanup Levels

Cleanup levels for the on-Base Priority One Sites have been developed with the intent to comply with applicable, or relevant and appropriate requirements (ARARs) of both federal and state laws, as required by CERCLA. In establishing the cleanup levels, MTCA Cleanup Regulation is a key law.

Soil Cleanup Levels

Results of the Risk Assessment for the P1 sites indicate that soils do not pose an unacceptable risk to human health through direct contact. Site specific cleanup levels for the soil were developed for several sites based on protection of groundwater.

Site-Specific Remedial Goals for Soils

In summary, site-specific remedial goals are presented below:

- SW-1 - the source of TCE groundwater contamination was not detected during the RI and therefore soil cleanup standards were not developed for this site.

- IS-1 - the french drain soils and sediments were remediated during the removal action. No further consideration of soil/sediment remedial goals is warranted.

- PS-2 - floating product is believed to be the source of groundwater contamination at this site. TPH contaminated soil is not believed to be a continuous source to groundwater at this site. If after the removal of floating product, groundwater contamination remains above 5 μg/L for benzene and 1 mg/L for TPH, soil cleanup standards may be developed under MTCA.

- PS-6 - the RI concluded that PS-6 soils were not a source of groundwater contamination. No remedial goals are required for PS-6 soils.

- PS-8 - based on the results of the RI, TPH-contaminated soil does not appear to be a continuous source of groundwater contamination, therefore TPH cleanup levels have not been developed for this site.

- FT-1 - results of the RI indicate that TPH-contaminated soil is not a continuous source of groundwater contamination. However, benzene-contaminated soils were identified as a source of groundwater contamination. A MTCA Method B soil cleanup level of 0.5 mg/kg was developed for benzene based on site-specific fate and transport modeling. This level, which is the same as the MTCA Method A level, is considered a preliminary cleanup level because groundwater protection must actually be demonstrated at the site through long-term monitoring. A higher soil cleanup level could be used if it can be demonstrated that it is protective of groundwater. A lower benzene level could be required if the 0.5 mg/kg level proves not to be protective of groundwater based on long-term monitoring.

- WW-1 - cadmium levels in soils at WW-1 exceed the MTCA Method A level of 2 mg/kg which is based on protection of certain agricultural plants.

Groundwater Cleanup Levels

MTCA establishes cleanup levels for groundwater which is a current or potential future source of drinking water. MTCA groundwater cleanup levels are set at levels which do not pose an unacceptable risk to human health and the environment. An acceptable risk is defined as a risk posed by all carcinogenic site contaminants that does not exceed one excess cancer in 100,000 chances, and a risk posed by individual carcinogenic site contaminants that does not exceed one excess cancer one in 1,000,000 chances. For non-carcinogenic contaminants, an acceptable risk is defined as a concentration of site contaminants that does not cause adverse health effects in humans. The MTCA Method B cleanup levels will establish groundwater cleanup levels for SW-1, OU-1 (PS-2 and PS-8), FT-1, and WW-1. These standards are at least as stringent as federal drinking water standards (MCLs).

For TCE and benzene, the MTCA Method B groundwater cleanup levels are 5 μg/L, which is equivalent to the federal MCL. A federal MCL and MTCA Method B groundwater cleanup level have not been established for TPH. A groundwater cleanup level of 1 mg/L has been established under MTCA Method A, which will be used for sites PS-2 and PS-8.

Site-Specific Remedial Goals for Groundwater

In summary, the following site-specific groundwater remedial goals have been established:

- SW-1 - the remedial goal for TCE-contaminated groundwater is 5 µg/L in accordance with MTCA Method B and the federal SDWA MCL.
- PS-2 - the remedial goal for benzene-contaminated groundwater is 5 µg/L in accordance with MTCA Method B and the federal SDWA MCL. The remedial goal for TPH-contaminated groundwater is 1 mg/L in accordance with MTCA Method A.
- PS-6 - groundwater contamination associated with PS-6 was not detected during the RI.
- PS-8 - the remedial goal for benzene-contaminated groundwater is 5 µg/L in accordance with MTCA Method B and the federal SDWA MCL.
- FT-1 - the remedial goal for benzene-contaminated groundwater is 5 µg/L in accordance with MTCA Method B and the federal SDWA MCL.
- WW-1 - the remedial goal for TCE-contaminated groundwater is 5 µg/L in accordance with MTCA Method B and the federal SDWA MCL.

VIII. DESCRIPTION OF ALTERNATIVES

A full range of cleanup alternatives was initially identified in the FS. These initial alternatives were evaluated in the FS based on effectiveness, implementability, and cost. Based on the alternative screening, the most promising alternatives were developed into site-specific alternatives that were then subjected to a detailed analysis in the FS. Alternatives evaluated in the detailed analysis are discussed below.

A. Soil Alternatives

The soil alternatives carried through the detailed analysis are described in the following sections and are shown in Table 5. For sites PS-2 and PS-8, soil treatment alternatives requiring excavation of contaminated soil were eliminated from the detailed analysis in the FS because of cost and implementability considerations. The estimated cost of each alternative is presented in Table 6.

ALTERNATIVE 1
No Action Alternatives: Sites SW-1, PS-2, PS-6, PS-8, FT-1, and WW-1

The no action alternatives are presented as a baseline comparison for the other alternatives. Under these alternatives, no action would be taken to control migration of potential contaminants from the source areas to groundwater. No institutional controls would be established to limit land development or prevent exposure to potential contaminants within the soils.

TABLE 5

SUMMARY OF SOIL ALTERNATIVES
FAIRCHILD AFB, WASHINGTON

Site	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
	No Action	Institutional Controls	Containment	Bio-Venting	Thermal Treatment
SW-1	●	●	●		
PS-2	●		●	●	
PS-8	●		●	●	
FT-1	●		●	●	●
WW-1	●	●			

TABLE 6

SOIL ALTERNATIVE COST ESTIMATES
FAIRCHILD AFB, WASHINGTON

Alternative	Cost	
SW-1		
1: No Action	Capital:	$0
	O&M:	$0
	PNW:	$0
2: Institutional Controls	Capital:	$0
	O&M:	$0
	PNW:	$0
3: Containment (30 Year O & M)	Capital:	$3,093,000
	O&M:	$5,000
	PNW:	$3,170,000
OU-1 (PS-2)		
1: No Action	Capital:	$0
	O&M:	$0
	PNW:	$0
3: Containment (30 Year O & M)	Capital:	$0
	O&M:	$1,500
	PNW:	$23,000
4: In-situ Bioventing (30 Year O & M)	Capital:	$519,000
	O&M:	$30,000
	PNW:	$649,000
OU-1 (PS-8)		
1: No Action	Capital:	$0
	O&M:	$0
	PNW:	$0
3: Containment (30 Year O & M)	Capital:	$0
	O&M:	$1,500
	PNW:	$23,000
4: In-situ Bioventing (30 Year O & M)	Capital:	$476,100
	O&M:	$23,000
	PNW:	$573,000

Alternative	Cost	
FT-1		
1: No Action (30 Year O & M)	Capital	$0
	O&M:	$40,000
	PNW:	$615,000
3: Containment (30 Year O & M)	Capital:	$0
	O&M:	$40,000
	PNW:	$615,000
4: In-situ Bioventing (5 Year O & M)	Capital:	$1,348,000
	O&M:	$126,000
	PNW:	$3,313,000
5: Thermal Treatment (5 Year O & M)	Capital:	$474,000
	O&M:	$46,000
	PNW:	$705,000
WW-1		
1: No Action	Capital:	$0
	O&M:	$0
	PNW:	$0
2: Institutional Controls	Capital:	$0
	O&M:	$0
	PNW:	$0

O&M: Operation and Maintenance
PNW: Present Net Worth (Annual Discount Rate = 5%)

All cost estimates are +50% / -30%

ALTERNATIVE 2
Institutional Control Alternatives: Sites SW-1 and WW-1

Institutional controls would include controls on access and use of the site, such as fencing and warning signs, to prevent exposure to potential contaminants within the soils. If the Base should close in the future, a restriction would be attached to the deed for the property to prevent the site from being used in the future for residential purposes.

For WW-1, an additional investigation would be conducted to attempt to locate the source of TCE groundwater contamination. This effort would involve excavating test pits, and collecting and analyzing soil samples.

ALTERNATIVE 3
Containment Alternatives: Sites SW-1, PS-2, PS-8, FT-1, and WW-1

For site SW-1, a cover or cap would be placed over the landfill to minimize the movement of potential contaminants to groundwater by reducing the amount of precipitation passing through the landfill. A passive gas collection system would be installed to prevent the buildup of landfill gases under the cap. The landfill cover and gas collection system would be constructed and maintained to meet the requirements of the Washington State's Minimum Functional Standards for Solid Waste Handling. Institutional controls would be implemented as described in Alternative 2.

For sites PS-2 and PS-8 located on the flightline, the existing asphalt and concrete taxiways would serve as a cap for these sites. The contaminated areas at PS-2 and PS-8 are currently covered by either asphalt or concrete. The asphalt covers would be maintained to minimize the movement of potential contaminants to groundwater by reducing the amount of precipitation passing through the soil. The covers would be maintained to meet the requirements of the Washington State's Minimum Functional Standards for Solid Waste Handling.

For sites FT-1 and WW-1, a cover or cap would be placed over the sites to minimize the movement of potential contaminants to groundwater by reducing the amount of precipitation percolating through the sites. The cover would be constructed and maintained to meet the requirements of the Washington State's Minimum Functional Standards for Solid Waste Handling. Institutional controls would be implemented as described in Alternative 2.

For WW-1, an additional investigation would be conducted to attempt to locate the source of TCE groundwater contamination. This effort would involve excavating test pits, and collecting and analyzing soil samples.

ALTERNATIVE 4
In-situ Bioventing Alternatives: Sites PS-2, PS-8, and FT-1

Under these alternatives, an in-situ bioventing system would be installed in the contaminated soil areas at each site. The system is called bioventing because it treats the soil through a combination of venting, or volatilization, and biological degradation using natural microorganisms in the soil. The system would consist of a network of vapor extraction wells and a vacuum pump to extract air containing volatile organic compounds such as benzene and to increase oxygen concentrations in the soil to enhance biodegradation of petroleum contamination. A system similar to the one shown in Figure 9 would be implemented (note: Figure 9 shows a combination bioventing/air sparging system). Contaminated vapors would be treated to

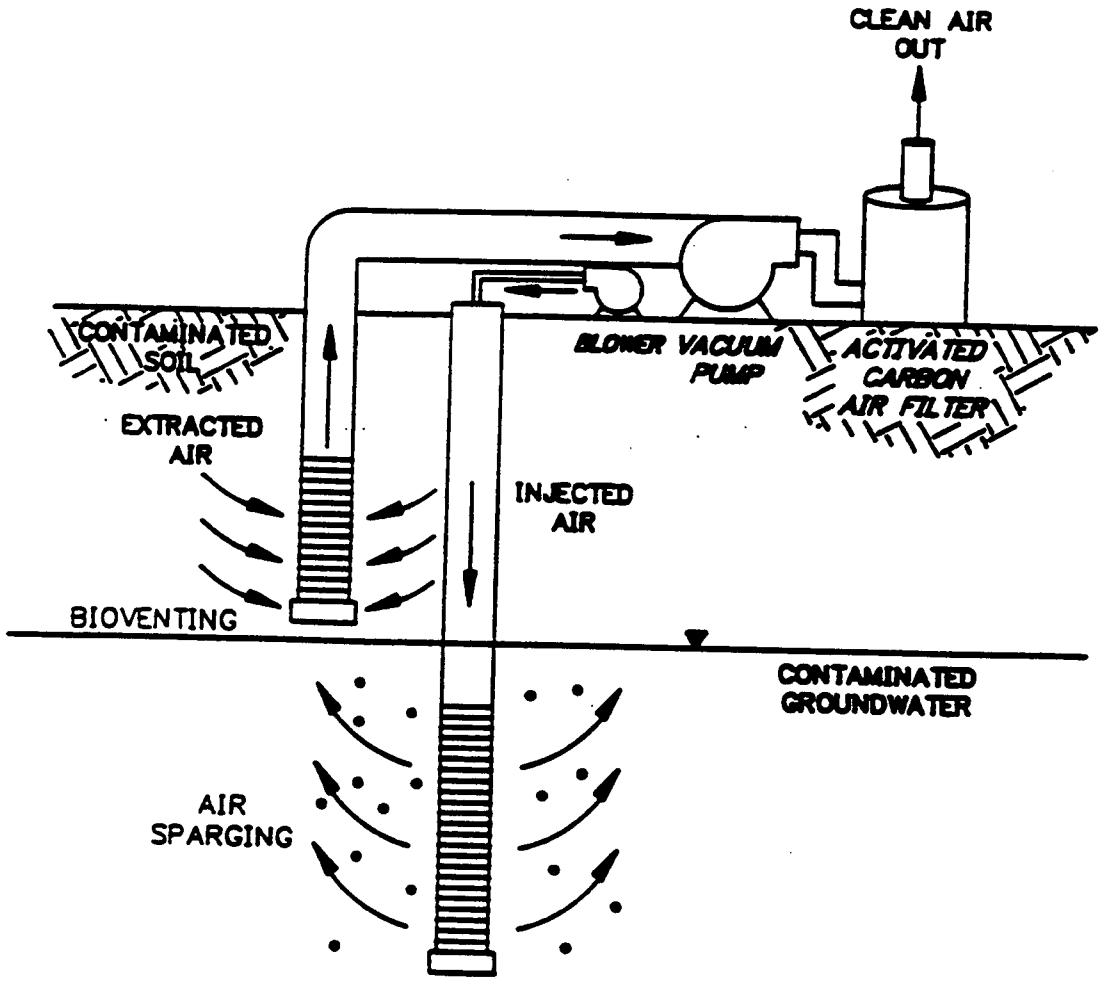


FIGURE 9
INSITU BIOVENTING/AIR SPARGING TREATMENT SYSTEM FOR SOILS/GROUNDWATER
FAIRCHILD AFB, WASHINGTON

comply with Washington State and Spokane County air standards. The system would be operated until soil cleanup levels are achieved, therefore protecting groundwater from further contamination. Soil cleanup levels are estimated to be achieved within a five-year timeframe. This time period was used for cost estimating purposes.

ALTERNATIVE 5
Thermal Treatment Alternative: Site FT-1

Under this alternative, the areas contaminated with benzene above the 0.5 mg/kg cleanup level at FT-1 would be excavated and treated in a low temperature thermal treatment unit. This technology consists of heating contaminated soil in a closed chamber to a temperature of about 400 °F to 800 °F to volatilize organic contaminants. An afterburner is typically used to destroy the volatilized contaminants at a temperature of about 1,400 °F. The soil would be treated onsite, off-Base, or using a combination of on- and off-Base treatment units, depending on the available capacity of off-Base treatment facilities.

Thermally treated soils would then be subject to Toxic Characteristic Leachate Procedure (TCLP) testing and analysis. The TCLP analysis would be used to determine if the treated soil is a characteristic waste under the Resource Conservation and Recovery Act, as amended (RCRA). If the treated soil is determined to be a characteristic waste, then it must be interned in a landfill regulated under RCRA Subtitle C. If the treated soil is determined not to be a characteristic waste, then it may be disposed under the provisions of RCRA Subtitle D.

The excavated area would be backfilled with clean soil. For onsite treatment, air emissions would be treated to comply with Washington State and Spokane County air standards. Off-Base treatment facilities would be permitted to accept petroleum-contaminated soil and would be in compliance with Washington State's Minimum Functional Standards for Solid Waste Handling and applicable state and county air standards.

B. Groundwater Alternatives

The groundwater alternatives carried through the detailed analysis are described in the following sections and are shown in Table 7. In-situ air sparging, which incorporates biological treatment, was only considered for the sites containing fuel-related contamination, such as benzene and TPH. This technology was not considered for the TCE contamination since TCE is not readily biodegradable. The estimated cost of each groundwater alternative is presented in Table 8.

ALTERNATIVE 1
No Action Alternatives: Sites SW-1, PS-2, PS-6, PS-8, FT-1, and WW-1

These alternatives are presented as a baseline comparison for other alternatives. Under these alternatives, no action would be taken to treat or contain contaminated groundwater, and no institutional controls would be imposed to prevent use of contaminated groundwater. Contaminants would continue to migrate, however, contaminant concentrations are expected to gradually decrease due to natural dispersion, dilution, and degradation. A groundwater monitoring program would be implemented to evaluate migration of contaminants. The specific sampling events should be implemented initially on a quarterly (seasonal) basis. This monitoring frequency should be used to establish seasonal groundwater and contaminant variations. After the seasonal variations are determined, the sampling frequency should not exceed the initial quarterly sampling events.

TABLE 7

SUMMARY OF GROUNDWATER ALTERNATIVES
FAIRCHILD AFB, WASHINGTON

Site	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
	No Action	Institutional Controls	Extraction & Treatment	In-Situ Air Sparging	Free Product Removal/ Recycling
SW-1	●	●	●		
PS-2	●	●	●	●	●
PS-8	●	●	●	●	
FT-1	●	●	●	●	
WW-1	●	●	●		

TABLE 8

GROUNDWATER ALTERNATIVE COST ESTIMATES
FAIRCHILD AFB, WASHINGTON

Alternative	Cost
SW-1	
1: No Action with Monitoring (30 Year O & M)	Capital: $0 O&M: $40,000 PNW: $615,000
2: Institutional Control with Monitoring and Point-of-Use Treatment/Alternate Water Supply (30 Year O & M)	Capital: $0 O&M: $40,000 PNW: $615,000
3: Onsite Groundwater Extraction and Treatment with Institutional Controls and Point-of-Use Treatment/Alternate Water Supply (30 Year O & M)	Capital: $996,000 O&M: $106,000 PNW: $2,626,000
OU-1 (PS-2)	
1: No Action with Monitoring (30 Year O & M)	Capital: $0 O&M: $31,000 PNW: $477,000
2: Institutional Controls with Monitoring (30 Year O & M)	Capital: $0 O&M: $31,000 PNW: $477,000
3: Onsite Groundwater Extraction and Treatment with Institutional Controls (30 Year O & M)	Capital: $1,612,000 O&M: $127,000 PNW: $3,571,000
4: In-situ Air Sparging with Institutional Controls (10 Year O & M)	Capital: $1,084,000 O&M: $68,000 PNW: $1,389,000
5: Floating Product Removal and Recycling with Monitoring and Institutional Controls (30 Year O&M)	Capital: $195,000 O&M: $85,000 PNW: $447,000
OU-1 (PS-8)	
1: No Action with Monitoring (30 Year O & M)	Capital: $0 O&M: $31,000 PNW: $477,000
2: Institutional Control with Monitoring (30 Year O & M)	Capital: $0 O&M: $31,000 PNW: $477,000
3: Onsite Groundwater Extraction and Treatment with Institutional Controls (30 Year O & M)	Capital: $1,528,100 O&M: $130,000 PNW: $3,532,000
4: In-situ Air Sparging with Institutional Controls (10 Year O & M)	Capital: $541,000 O&M: $60,000 PNW: $788,000

Alternative	Cost
FT-1	
1: No Action with Monitoring (30 Year O & M)	Capital: $0 O&M: $40,000 PNW: $615,000
2: Institutional Controls with Monitoring (30 Year O & M)	Capital: $0 O&M: $40,000 PNW: $615,000
3: Onsite Groundwater Extraction and Treatment with Institutional Controls (30 Year O & M)	Capital: $1,349,000 O&M: $128,000 PNW: $3,313,000
4: In-situ Air Sparging with Institutional Controls (10 Year O & M)	Capital: $474,000 O&M: $46,000 PNW: $705,000
WW-1	
1: No Action with Monitoring (30 Year O & M)	Capital: $0 O&M: $40,000 PNW: $615,000
2: Institutional Controls with Monitoring and Point-of-Use Treatment/Alternate Water Supply (30 Year O & M)	Capital: $0 O&M: $40,000 PNW: $615,000
3: Onsite Groundwater Extraction and Treatment with Institutional Controls and Point-of-Use Treatment/Alternate Water Supply (30 Year O & M)	Capital: $1,442,000 O&M: $135,000 PNW: $3,522,000

O&M: Operation and Maintenance
PNW: Present Net Worth (Annual Discount Rate = 5%)

All cost estimates are +50% / -30%.

The time it will take to achieve the groundwater cleanup levels at each site is very difficult to predict without a large amount of historical contaminant data with which to calibrate a groundwater model. A groundwater modeling study was conducted in the FS to estimate cleanup times. However, there is currently a high degree of uncertainty associated with the modeling results due to a lack of historical contaminant data to verify modeling results. Therefore, the results of the modeling effort are not presented here. After several years of actual site data, more accurate cleanup time estimates could be developed based on contaminant trends observed from groundwater monitoring results.

ALTERNATIVE 2
Institutional Control Alternatives: Sites SW-1, PS-2, PS-8, FT-1, and WW-1

Under these alternatives, no action would be taken to treat or contain contaminated groundwater. Existing institutional controls would be maintained to prevent use of contaminated groundwater on-Base. Contaminants would continue to migrate, however, contaminant concentrations would gradually decrease below cleanup levels due to natural dispersion, dilution, and degradation. A groundwater monitoring program and five-year review would be implemented to evaluate migration of contaminants, to verify that cleanup levels are attained within a reasonable time, satisfy CERCLA requirements for contaminants remaining onsite, and to determine if the remedy remains protective of human health and the environment. As discussed in Alternative 1, above, the time required to remediate the groundwater is difficult to predict. However, a five-year review and evaluation of the data produced during the monitoring program would be required. The specific sampling events should be implemented initially on a quarterly (seasonal) basis. This monitoring frequency should be used to establish seasonal groundwater and contaminant variations. After the seasonal variations are determined, the sampling frequency should not exceed the initial quarterly sampling events.

At sites SW-1, FT-1, and WW-1, point-of-use treatment or an alternate water supply would be provided if site-related contaminants are observed above the MCLs in any of the nearby off-Base residential wells. If necessary, the need for active groundwater cleanup would be evaluated as part of the five-year review.

ALTERNATIVE 3
Groundwater Extraction and Treatment Alternatives: Sites SW-1, PS-2, PS-8, FT-1, and WW-1

Under these alternatives, a groundwater extraction and treatment system would be installed to prevent continued movement of contaminated water from the site. Extraction wells would be placed near the edge of the groundwater plume defined by the groundwater cleanup levels. Groundwater would be pumped and treated using either an air stripper unit, carbon adsorption unit, or combination of these units similar to those shown in Figure 10. The optimum system configuration would be determined during a remedial design phase following evaluation of additional field data and treatability study results.

As water is pumped through the air stripper, volatile organic contaminants are transferred to the injected air stream, which is blown, or bubbled, upward through the water. The treated water would then be either re-infiltrated into the aquifer, discharged directly into No Name Ditch, or discharged indirectly to No Name Ditch through the storm water sewer system. Water re-infiltrated into the aquifer would be treated to meet the groundwater cleanup levels established in this ROD and water discharged to No Name Ditch would be treated to effluent standards established by EPA Region 10 under the Clean Water Act (CWA) NPDES program.

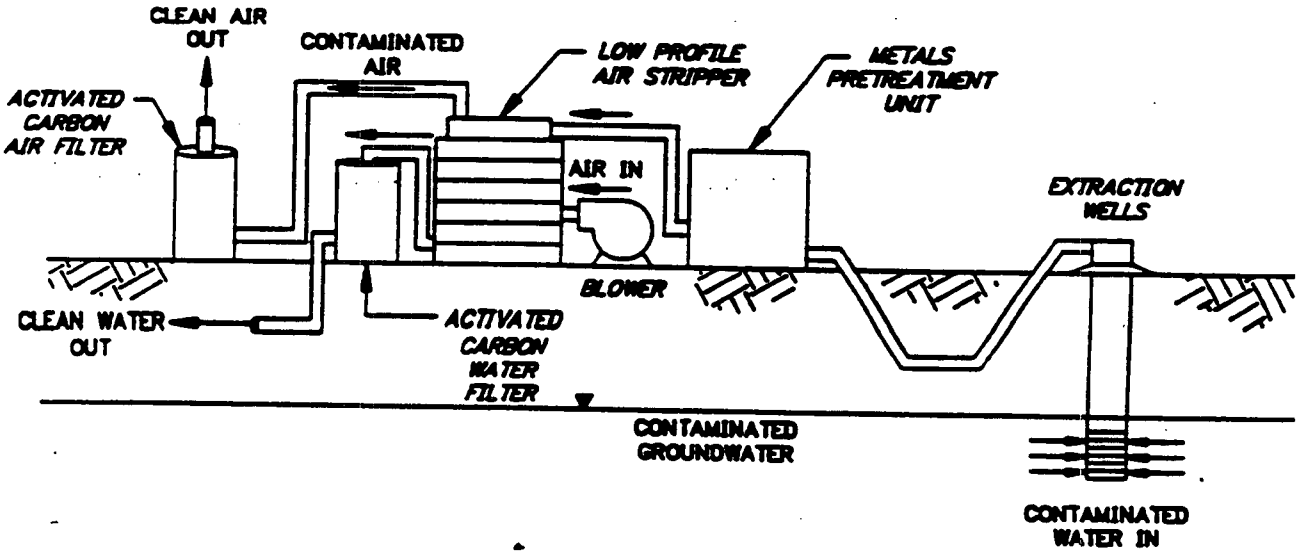


FIGURE 10
AIR STRIPPING/CARBON ADSORPTION GROUNDWATER TREATMENT SYSTEM
FAIRCHILD AFB, WASHINGTON

The contaminated air emissions from the stripper would be treated using activated carbon. The carbon selectively adsorbs organic contaminants such as TCE. Used carbon would be recycled offsite in accordance with EPA Office of Solid Waste and Emergency Response (OSWER) Directive 9834.11. Air emissions would be treated to comply with Washington State and Spokane County air quality standards.

Under this alternative, a groundwater monitoring program would be implemented to evaluate the effectiveness of the extraction and treatment systems. Institutional controls described in Alternative 2 would also be maintained until groundwater cleanup levels are achieved. Also, the monitoring program described in Alternative 2 should be used to determine if the remedial alternative is affecting contaminant concentrations (i.e., decreasing contaminant concentration or having no affect).

The groundwater extraction and treatment system would be operated at a site until the groundwater cleanup levels are achieved for that site. Cleanup times could range from less than five years to as many as 30 years. After several years of operation, more accurate time estimates would be developed based on contaminant trends observed from groundwater monitoring results.

With respect to the floating product detected at site PS-2, the product would either be removed as a separate action, as described under Alternative 5 or would be removed from the extracted groundwater using an oil/water separator prior to pumping the groundwater through the air stripping/carbon adsorption treatment system. The separated product would then be recycled off-Base as described under Alternative 5.

ALTERNATIVE 4
In-situ Air Sparging Groundwater Treatment Alternatives: Sites PS-2, PS-8, and FT-1

Under these alternatives, an in-situ groundwater air sparging treatment system would be installed to prevent continued movement of contaminated water from the site. The air sparging system is an innovative technology which is similar to bioventing because it treats organic contamination through a combination of volatilization and biological degradation using natural microorganisms in the groundwater. For the PS-2, PS-8, and FT-1 sites, air sparging would be used in combination with bioventing to simultaneously treat both soils and groundwater. The system would consist of a network of vapor extraction/injection well pairs arranged to inject air into the aquifer and extract air from the overlying soil. A compressor is used to inject clean air into the aquifer and a vacuum pump is used to extract air from the soils as shown in Figure 9. The well pairs would be placed within the interior of the groundwater plume defined by the groundwater cleanup levels. The well spacings and configuration would be determined during a remedial design phase.

Contaminated vapors would be treated to comply with Washington State and Spokane County air standards. The system would be operated until groundwater cleanup levels are achieved. Groundwater cleanup levels are estimated to be achieved within a five-year timeframe. This time period was used for cost estimating purposes.

Before full-scale implementation, the effectiveness of the air sparging technology would be tested using a smaller pilot-scale system. If the pilot- scale testing is not effective, then an air stripping/carbon adsorption groundwater extraction and treatment system would be installed at FT-1 as described in Alternative 3.

Under these alternatives, a groundwater monitoring program would be implemented to evaluate the effectiveness of the in-situ treatment system at each site. Institutional controls would also be maintained, as described in Alternative 2, until groundwater cleanup levels are achieved.

ALTERNATIVE 5
Floating Product Removal and Recycling Alternative: Site PS-2

Under this alternative, floating product at Site PS-2 would be removed using either a passive or active removal system. A passive system is designed to minimize the amount of groundwater collected by skimming the product layer off of the water table using special skimming pumps. An active system involves aggressively pumping groundwater and fuel together to induce a migration of the free product towards the collection well. Passive collection systems are typically more cost-effective than active systems and would most likely be implemented for the PS-2 site. Active pumping would only be used if a passive system proves ineffective. The number of collection wells and types of pumps would be selected during the remedial design phase. Most of the product is expected to be removed within a one-year period.

The collected product would be transported off-Base to a recycling facility. The product would be recycled as a fuel source for industrial purposes such as use in a cement kiln.

Under this alternative, a groundwater monitoring program would be implemented to evaluate the effectiveness of the product removal in reducing groundwater contaminant concentrations. Long-term groundwater monitoring would be performed to assure that groundwater cleanup levels can be achieved through natural dispersion, dilution, and degradation in a reasonable time period. If necessary, the need for active groundwater treatment would be reevaluated at the five-year review. Institutional controls would also be maintained, as previously described, until groundwater cleanup levels are achieved. The monitoring program and institutional controls described in this alternative are presented in Alternative 2.

IX. SUMMARY OF THE COMPARATIVE ANALYSIS OF ALTERNATIVES

In this section, each soil and groundwater alternative is compared against each other using the evaluation criteria presented in Table 9. This process allows for a full comparative analysis of each alternative. The nine criteria are categorized into three groups.

Threshold Criteria

1. Overall protection of human health and the environment
2. Compliance with applicable or relevant and appropriate requirements

Primary Balancing Criteria

3. Long-term effectiveness and permanence
4. Reduction of toxicity, mobility, or volume through treatment
5. Short-term effectiveness
6. Implementability
7. Cost

Modifying Criteria

8. State/support agency acceptance
9. Community acceptance

TABLE 9

GLOSSARY OF EVALUATION CRITERIA
FAIRCHILD AFB, WASHINGTON

Criteria	Definition
Overall Protection of Human Health and the Environment	Whether adequate protection of human health and the environment is provided during and after construction.
Compliance with ARARs	Whether all applicable or relevant and appropriate (ARARs) state and Federal laws and regulations are met.
Long-Term Effectiveness	The ability to protect human health and the environment after completion of the remediation.
Reduction of Toxicity, Mobility and Volume Through Treatment	How well the alternative effectively treats contamination to significantly reduce toxicity, mobility and volume of the hazardous substance.
Short-Term Effectiveness	How fast protection is achieved, and the potential to adversely affect human health and the environment during construction and implementation.
Implementability	The technical and administrative feasibility of the alternative.
Cost	Estimated capital, operation, and maintenance costs, and net present worth costs.
State Acceptance	Whether the state agrees with, opposes, or has not comment on the preferred alternative.
Community Acceptance	What are the community's comments or concerns about the alternative? Does the public generally support or oppose the preferred alternative?

A. Soil Alternatives

Threshold Criteria

The remedial alternatives were first evaluated in relation to the threshold criteria. The threshold criteria must be met by each alternative in order to be selected.

1. Overall Protection of Human Health and the Environment

Alternative 1 would provide no additional future protection from potential contaminants at SW-1 and WW-1. Alternative 2 would provide protection at these sites through institutional controls. Alternative 3 would provide a higher level of protection from direct contact with site contaminants at WW-1 through installation of a cap over contaminated areas. The source of contamination at SW-1 was not encountered during the RI.

Alternatives 1 and 2 would not prevent contaminant migration to groundwater. Alternative 3, capping, would reduce contaminant migration by preventing infiltration of precipitation through contaminated soil. Alternatives 4 and 5 would provide the maximum protection of groundwater by removing contaminants from the soil through treatment.

2. Compliance with Applicable or Relevant and Appropriate Requirements

Since contaminant concentrations in groundwater are at low levels and a continuing source of contamination was not identified during the RI at sites SW-1 and PS-8, Alternatives 1 and 2 may attain state and federal groundwater cleanup levels through natural dispersion, dilution, and degradation. Continued groundwater monitoring would be needed to determine if those standards can be achieved naturally within a reasonable timeframe.

Alternatives 1 and 2 are not expected to achieve groundwater cleanup levels for site PS-2 because floating product acts as a continuous source of groundwater contamination. Alternatives 1 and 2 are also not expected to achieve groundwater cleanup levels within a reasonable timeframe for sites FT-1 and WW-1. The leading edge of groundwater contamination at FT-1 is close to the base boundary and is expected to migrate off-Base in the vicinity of residential wells if remedial action is not taken. The groundwater contamination plume associated with WW-1 has already migrated off-Base and has been detected at low levels in nearby residential wells.

Primary Balancing Criteria

Once an alternative satisfies the threshold criteria, it is evaluated against five primary balancing criteria.

3. Long-term Effectiveness

Alternative 1 would provide no additional long-term protection to human health and the environment than that offered by existing site conditions. Alternative 2 would rely on enforcement of existing Base controls or enforcement of deed restrictions if the Base were to close in the future. Alternative 3 would require routine inspection and maintenance of the caps in order to be effective in the long-term. Alternatives 4 and 5 would provide the highest degree of long-term effectiveness by permanently removing contaminants from the sites through treatment and/or disposal.

4. Reduction of Toxicity, Mobility, and Volume Through Treatment

Only Alternatives 4 and 5 would permanently reduce the toxicity of contaminated soil through treatment.

5. Short-Term Effectiveness

Alternatives 1 and 2 do not contain provisions for aggressive remedial measures or construction activities. Therefore, Alternatives 1 and 2 should provide short-term effectiveness. Alternatives 3 and 5 would provide protection in a short period of time (several months). Alternative 4 may require several years to achieve cleanup levels. Alternative 5 would require engineering controls to protect workers and the environment from dust generated during excavation. Alternatives 4 and 5 would require air pollution controls to protect workers, nearby residents, and the environment from off-gas emissions during treatment.

6. Implementability

All alternatives could be implemented using existing technologies. Alternative 4 would require a pilot-scale treatability test to determine treatment effectiveness at each site.

7. Cost

Alternative 1 would involve no initial costs. Alternative 2 would require a minimal amount of legal and administrative expenses, which have not been estimated at this time. Of the treatment/disposal alternatives, Alternative 5 would be most expensive, whereas Alternative 4 would be the least expensive. The costs for Alternative 3 would be relatively low for the PS-2 and PS-8 sites (asphalt caps) and significantly higher for SW-1 and FT-1 (geosynthetic caps).

Modifying Criteria

Modifying criteria are used in the final evaluation of the remedial alternatives.

8. State Acceptance

The State concurred with the preferred alternatives described in the Proposed Plan.

9. Community Acceptance

This criterion refers to the public's support for the preferred soil (including sediment) remedial alternatives.

On March 15, 1993, Fairchild AFB held a public meeting to discuss the Proposed Plan for the on-Base P1 Operable Units. Prior to this meeting, copies of the Proposed Plan were sent to over 200 local residents and other interested parties. The results of the public meeting indicate that the residents of the surrounding communities accept the preferred soil remedial alternatives. Community response to the remedial alternatives is presented in the responsiveness summary, which addresses questions and comments received during the public comment period.

B. Groundwater Alternatives

Threshold Criteria

1. Overall Protection and Human Health and the Environment

Alternative 1 would provide no additional protection against consumption of contaminated groundwater. However, with respect to off-Base residential wells, groundwater monitoring, included with this alternative, would serve as a warning mechanism by identifying migration of contaminants towards existing wells. Alternative 2 would provide protection against consumption of contaminated groundwater through monitoring, maintenance of existing Base institutional controls, and provision of point-of-use treatment/alternate water supply, if necessary. Alternatives 3 and 4 would prevent consumption of contaminated groundwater through treatment to groundwater cleanup levels as well as through groundwater monitoring, institutional controls, and provision of point-of-use treatment/alternate water supply, if necessary.

Alternative 5 is unique to PS-2. It was specifically developed for the removal and treatment of floating product. The floating product was determined to be the principal threat to groundwater associated with PS-2.

Alternatives 1 and 2 would not actively restore contaminated groundwater to groundwater cleanup levels nor would they prevent further migration of contaminants. However, if the source of contamination is no longer present at the site, contaminant levels may decrease gradually through natural dispersion, dilution, and degradation. Alternatives 3 and 4 would actively restore contaminated groundwater to groundwater cleanup levels and would prevent further migration of contaminants through in-situ treatment or extraction and treatment.

2. Compliance with ARARs

At sites SW-1 and PS-8, Alternatives 1 and 2 may attain state and federal groundwater cleanup levels through natural dispersion, dilution, and degradation if contamination is no longer migrating from the soils to groundwater at these sites. Continued groundwater monitoring would be needed to determine if those standards can be achieved naturally within a reasonable period of time.

Alternatives 1 and 2 are not expected to achieve groundwater cleanup levels for sites PS-2, FT-1, and WW-1 within a reasonable period of time. Alternatives 3 and 4 would achieve these standards and required air quality standards for all sites. Alternative 5 for site PS-2 is expected to achieve groundwater cleanup levels following removal of the floating product. Following product removal, continued groundwater monitoring would be needed to determine if cleanup levels can be achieved naturally within a reasonable period of time at this site.

Primary Balancing Criteria

3. Long-term Effectiveness

Alternatives 3 and 4 would provide the highest degree of long-term effectiveness and protection through treatment of contaminated groundwater. Alternative 5 would remove the primary source of groundwater contamination at site PS-2, but would be less effective in restoring contaminated groundwater than Alternatives 3 and 4. Alternative 2 would rely on institutional controls and point-of-use treatment/alternate water supply and therefore is also less effective than Alternatives 3 and 4. Alternative 1 would provide the least degree of long-term effectiveness.

4. Reduction of Toxicity, Mobility, and Volume Through Treatment

Alternatives 1 and 2 would not actively reduce the toxicity, mobility, or volume of groundwater contamination at the sites. Alternatives 3 and 4 would reduce the toxicity, mobility, and volume of contamination through in-situ treatment or extraction and treatment. Alternative 5 would not treat the full extent of contaminated groundwater at site PS-2, but would reduce the toxicity and volume of floating product, which is the primary source of groundwater contamination at PS-2.

5. Short-term Effectiveness

Alternatives 3 and 4 would meet cleanup levels in a shorter timeframe than would Alternatives 1 and 2. At sites PS-2, PS-8, and FT-1, Alternative 4 could potentially achieve groundwater cleanup levels within a shorter period of time than could Alternative 3. At site PS-2, Alternative 5 would achieve groundwater cleanup levels in less time than would Alternatives 1 and 2 but in a longer timeframe than would Alternatives 3 and 4. Alternatives 3 and 4 would require air pollution controls to protect workers, nearby residents, and the environment from off-gas emissions during treatment.

6. Implementability

All alternatives could be implemented using existing technologies. Alternative 4 would require a pilot-scale treatability test to determine treatment effectiveness at each site.

7. Cost

Alternatives 1 and 2 would involve only operation and maintenance costs for performing groundwater monitoring. Alternative 2 would include the cost for providing point-of-use treatment/alternate water supply, if necessary, which has not been estimated at this time. At sites PS-2, PS-8, and FT-1, Alternative 4 could be implemented for a lower cost than Alternative 3. For site PS-2, the cost for Alternative 5 is substantially less than those for Alternatives 3 and 4.

Modifying Criteria

8. State Acceptance

The State concurred with the preferred alternatives described in the Proposed Plan.

9. Community Acceptance

This criterion refers to the public's support for the preferred groundwater remedial alternatives.

X. SELECTED REMEDIES

The cleanup alternatives selected by the USAF combine the soil alternatives and the groundwater alternatives developed in the FS. The rationale for the selection of these remedies considers several factors, including the concentrations of contaminants in relation to risk-based or regulatory levels, the location of the sites with respect to the base boundaries, the presence or absence of potential receptors, and the presence or absence of identifiable source areas.

At sites SW-1 and PS-8, concentrations of contaminants are relatively low in comparison to risk-based levels and MCLs, no sources of groundwater contamination were identified, and contaminant plumes are largely confined within the base boundaries. Consequently, remedies that emphasize ongoing monitoring and evaluation of the groundwater, and the use of on-Base institutional controls are appropriate for these sites. At SW-1, a portion of the plume is believed to be outside of the base boundaries. Although the only water supply wells in the vicinity of the site are located upgradient of the site and the plume, an element has been added to the selected remedy for this site to, in the future, provide point-of-use treatment and/or an alternate water supply to users of nearby wells if their water supplies should become contaminated above MCLs by site-related contaminants.

Concentrations of contaminants at site PS-2 are high in relation to risk-based and regulatory levels, a source of contamination has been identified in the form of a floating product layer in two monitoring wells, and the plume is located well within the base boundaries. Accordingly, a remedy consisting of removing the floating product, establishing on-Base institutional controls on groundwater use, and conducting confirmational monitoring of the groundwater is appropriate for this site.

Sites FT-1 and WW-1 both exhibit high concentrations of contaminants relative to risk-based and regulatory levels, and are adjacent to the down-gradient base boundary. A groundwater contaminant plume from WW-1 currently extends beyond the base boundary and has impacted nearby water supply wells at levels below MCLs. No source for this plume has been identified, although the plume is believed to originate in a fairly small area of the site. The edge of a contaminant plume associated with FT-1 is close to the base boundary, and there is an identified source of contaminants in the soils at FT-1. These factors support the selection of remedies that actively clean up the groundwater plumes at these sites, that will provide point-of-use treatment and/or alternate water supplies as necessary to protect users of nearby wells that may become contaminated, that remediate the soil source at FT-1, and that attempt to identify the suspected source area at WW-1. Soils at WW-1 also contain cadmium at concentrations that are harmful to agricultural plants, and PAHs at concentrations that exceed MTCA risk-based levels for residential exposures. Consequently, institutional controls restricting the site from future residential or agricultural uses are included in the selected remedy for WW-1.

The specific selected remedies for each site are described in detail below:

Old Base Landfill (SW-1)

The goals of the remedial action at SW-1 are to restore the groundwater to drinking water quality within a reasonable timeframe, and to prevent exposure to landfill materials. The selected remedy combines the soil alternative of Institutional controls (Alternative 2) with the groundwater alternative of Institutional controls and Point-of-Use Treatment/Alternate water supply (Alternative 2). This remedy consists of the following elements:

- Maintaining institutional controls restricting access to the site.
- Maintaining institutional controls, in the form of restrictions against on-base usage of TCE-contaminated groundwater associated with the site, until cleanup levels are achieved.
- Monitoring groundwater at the site to identify a trend in contaminant concentrations, estimating a timeframe for restoration by natural dispersion, dilution, and degradation, evaluating the acceptability of the estimated timeframe, and implementing a compliance monitoring program to estimate attainment of cleanup levels.

- Monitoring off-site water supply wells in the vicinity of the site and providing point-of-use treatment and/or alternate water supply, if necessary.

The estimated costs associated with this remedy are:

Capital Cost:	$0
O&M Costs:	$40,000
Present Net Worth:	$615,000

A. Maintaining institutional controls restricting access to the site.

Institutional controls established under the authority of the base commander currently restrict access to the landfill site. Restricted access to the site will be maintained under that authority as part of the selected remedy. If the Base should be closed in the future, a deed restriction precluding the site from residential or agricultural uses will be implemented prior to transfer of the site property to any other entities.

B. Maintaining institutional controls, in the form of restrictions against on-base usage of TCE-contaminated groundwater associated with the site, until cleanup levels are achieved.

Institutional controls established under the authority of the base commander currently restrict access to and use of groundwater throughout the Base. Such restrictions will be maintained under that authority as part of the selected remedy. If the Base should be closed in the future, the need for additional remedial actions to address site-related groundwater contamination will be reevaluated by the USAF, EPA and Ecology.

C. Monitoring groundwater at the site to identify a trend in contaminant concentrations, estimating a timeframe for restoration by natural dispersion, dilution, and degradation, evaluating the acceptability of the estimated timeframe, and implementing a compliance monitoring program to estimate attainment of the cleanup levels.

An analysis to identify a trend in contaminant concentrations will be based on groundwater sampling data collected from a maximum of five years of periodic monitoring. During the first year of monitoring, samples will be collected quarterly. An iterative approach will be used to establish the subsequent sampling frequency. Factors to be considered in this approach include the variability observed in water levels and contaminant concentrations during the first year. If at any time prior to five years, either the USAF, EPA, or Ecology believe that the data collected identifies a reliable trend in contaminant concentrations, then the parties will jointly evaluate the data. If the USAF, EPA, and Ecology agree that a reliable trend in contaminant concentrations has been identified, then the data collection period may be concluded. If agreement is not reached, then the dispute resolution provisions of the Fairchild AFB FFA may be invoked.

At the end of the data collection period, a definition of a reasonable timeframe for restoration by natural dispersion, dilution, and degradation will be developed by the USAF, EPA, and Ecology. Factors that should be considered in developing this definition include any changes in the use of land or groundwater on private property adjoining the site, any changes in the operation or mission of the Base that may affect the implementability of on-base institutional controls, and the site-specific fate and transport characteristics of the contaminants. In no case will the reasonable timeframe for restoration by natural dispersion, dilution, and degradation exceed thirty years.

The groundwater cleanup level for SW-1 is 5 μg/L for TCE, in accordance with the SDWA MCL and MTCA Method B. This cleanup level will be achieved throughout the plume. If the trend analysis indicates that contaminant concentrations are decreasing such that natural dispersion, dilution, and degradation will achieve the cleanup level within the reasonable timeframe, a compliance monitoring program will be implemented and remain in operation until the cleanup levels are achieved. The specific details of the compliance monitoring program will be developed by the USAF, EPA, and Ecology. If the trend analysis indicates that cleanup levels would not be attained by natural dispersion, dilution, and degradation within the reasonable timeframe, the need for remedial action will then be reevaluated by the USAF, EPA, and Ecology.

If the Base should be closed in the future, the need for additional remedial actions to address site-related groundwater contamination will be reevaluated by the USAF, EPA, and Ecology. In the event that the need for remedial action is reevaluated, remedial actions that will be considered include additional investigation to characterize contaminant sources and the extent of plume migration, and the implementation of groundwater extraction and treatment and/or capping, consistent with all regulatory requirements.

D. Monitoring off-site water supply wells in the vicinity of the site and providing point-of-use treatment and/or alternate water supply, if necessary.

Off-site water supply wells will be monitored for the presence of site-related contaminants. To prevent consumption by area residents of groundwater exceeding MCLs, point-of-use treatment and/or an alternate water supply will be provided as necessary by the Air Force to users of wells which are constructed in compliance with state and local regulations. In the event that site-related contaminants are detected in nearby residential wells, the need for remedial action will then be reevaluated by the USAF, EPA, and Ecology. Point-of-use treatment systems typically consist of a filtration system installed at the well head for wells serving multiple users, or near the point where piping from an individual user's well enters the user's building. Routine maintenance and periodic replacement of system components will be necessary. Provision of an alternate water supply will be considered based on factors such as the distance to an existing water system or the amount of water delivered. Based on recent groundwater sampling, no residential wells exhibit contaminants above MCLs and therefore no provision of point-of-use treatment/alternate water supply is required at this time.

Building 1034 French Drain System (IS-1)

The USAF has determined that no further remedial action is necessary at the IS-1 site to ensure protection of human health and the environment. This decision is based on the results of the human health risk assessment, which determined that conditions at the site pose no unacceptable risks to human health or the environment. With the completion of the removal action at IS-1 in December 1992, all conduits, including surface water drainage into the manholes, and potential sources of groundwater contamination have been eliminated at the IS-1 site. The TCE groundwater contamination detected upgradient of this site is believed to be associated with site PS-10, a P2 operable unit, and will be addressed under the RI/FS for the P2 sites.

Flightline Site (OU-1) PS-2

The goal of the remedial action at PS-2 is to restore the groundwater to drinking water quality within a reasonable timeframe. The selected remedy combines the soil alternative of No Action (Alternative 1) with the groundwater alternative of Free Product Removal with Institutional Controls (Alternative 5). This remedy consists of the following elements:

- Remediation of the floating product through passive collection and treatment, and recycling of recovered product at an offsite facility.
- Maintaining institutional controls, in the form of restrictions against on-base usage of benzene- and TPH-contaminated groundwater associated with the site, until cleanup levels are achieved.
- Monitoring groundwater at the site to identify a trend in contaminant concentrations, estimating a timeframe for restoration by natural dispersion, dilution, and degradation, evaluating the acceptability of the estimated timeframe, and implementing a compliance monitoring program to estimate attainment of cleanup levels.

The estimated costs associated with this remedy are:

Capital Cost:	$195,000
O&M Costs:	$85,000
Present Net Worth:	$447,000

A. Remediation of the floating product through passive collection and treatment, and recycling of recovered product at an offsite facility.

Under this alternative, floating product at Site PS-2 would be removed using either a passive or active removal system. Most of the product is expected to be removed within a 1-year period. The collected product would be transported off-Base to a recycling facility. The product would be recycled as a fuel source for industrial purposes such as use in cement kiln.

B. Maintaining institutional controls. in the form of restrictions against on-base usage of benzene- and TPH-contaminated groundwater associated with the site, until cleanup levels are achieved.

Institutional controls established under the authority of the base commander currently restrict access to and use of groundwater throughout the Base. Such restrictions will be maintained under that authority as part of the selected remedy. If the Base should be closed in the future, the need for additional remedial actions to address site-related groundwater contamination will be reevaluated by the USAF, EPA, and Ecology.

C. Monitoring groundwater at the site to identify a trend in contaminant concentrations and estimate a timeframe for restoration by natural dispersion, dilution, and degradation, evaluating the acceptability of the estimated timeframe, and implementing a compliance monitoring program to estimate attainment of cleanup levels.

An analysis to identify a trend in contaminant concentrations will be based on groundwater sampling data collected from a maximum of five years of periodic monitoring. During the first year of monitoring, samples will be collected quarterly. An iterative approach will be used to establish the subsequent sampling frequency. Factors to be considered in this approach include the variability observed in water levels and

contaminant concentrations during the first year. If at any time prior to five years, either the USAF, EPA, or Ecology believe that the data collected identifies a reliable trend in contaminant concentrations, then the parties will jointly evaluate the data. If the USAF, EPA, and Ecology agree that a reliable trend in contaminant concentrations has been identified, then the data collection period may be concluded. If agreement is not reached, then the dispute resolution provisions of the Fairchild AFB FFA may be invoked.

At the end of the data collection period, a definition of a reasonable timeframe for restoration by natural dispersion, dilution, and degradation will be developed by the USAF, EPA, and Ecology. Factors that should be considered in developing this definition include any changes in the use of land or groundwater on-Base near the site, any changes in the operation or mission of the Base that may affect the implementability of on-Base institutional controls, and the site-specific fate and transport characteristics of the contaminants. In no case will the reasonable timeframe for restoration by natural dispersion, dilution, and degradation exceed thirty years.

The groundwater cleanup levels for PS-2 are 5 μg/L for benzene in accordance with the SDWA MCL and MTCA Method B, and 1 mg/L for TPH in accordance with the MTCA Method A. These cleanup levels will be achieved throughout the plume. If the trend analysis indicates that contaminant concentrations are decreasing such that natural dispersion, dilution, and degradation will achieve the cleanup level within a reasonable timeframe, a compliance monitoring program will be implemented and remain in operation until the cleanup levels are achieved. The specific details of the compliance monitoring program will be developed by the USAF, EPA, and Ecology. If the trend analysis indicates that cleanup levels would not be attained by natural dispersion, dilution, and degradation within the reasonable timeframe, the need for remedial action will then be reevaluated by the USAF, EPA, and Ecology.

If the Base should be closed in the future, the need for additional remedial actions to address site-related groundwater contamination will be reevaluated by the USAF, EPA, and Ecology. In the event that the need for remedial action is reevaluated, remedial actions that will be considered include additional investigation to characterize contaminant sources and the extent of plume migration, and the implementation of groundwater extraction and treatment and/or bioventing, consistent with all regulatory requirements.

Flightline site (OU-1) PS-6

The USAF has determined that no further remedial action is necessary at the PS-6 site to ensure protection of human health and the environment. This decision is based on the results of the human health risk assessment, which determined that conditions at the site pose no unacceptable risks to human health or the environment. The TCE groundwater contamination detected upgradient of this site is not believed to be associated with this site and will be addressed under the RI/FS for the P2 sites.

Flightline site (OU-1) PS-8

The goal of the remedial action at PS-8 is to restore the groundwater to drinking water quality within a reasonable timeframe. The selected remedy combines the soil alternative of No Action (Alternative 1) with the groundwater alternative of Institutional Controls (Alternative 2). This remedy consists of the following elements:

- Maintaining institutional controls, in the form of restrictions against on-base usage of benzene-contaminated groundwater associated with the site, until cleanup levels are achieved.

- Monitoring groundwater at the site to identify a trend in contaminant concentrations, estimating a timeframe for restoration by natural dispersion, dilution, and degradation, evaluating the acceptability of the estimated timeframe, and implementing a compliance monitoring program to estimate attainment of cleanup levels.

The estimated costs associated with this remedy are:

Capital Cost:	$0
O&M Costs:	$31,000
Present Net Worth:	$477,000

A. **Maintaining institutional controls, in the form of restrictions against on-base usage of benzene-contaminated groundwater associated with the site, until cleanup levels are achieved.**

Institutional controls established under the authority of the base commander currently restrict access to and use of groundwater throughout the Base. Such restrictions will be maintained under that authority as part of the selected remedy. If the Base should be closed in the future, the need for additional remedial actions to address site-related groundwater contamination will be reevaluated by the USAF, EPA, and Ecology.

B. **Monitoring groundwater at the site to identify a trend in contaminant concentrations, estimating a timeframe for restoration by natural dispersion, dilution, and degradation, evaluating the acceptability of the estimated timeframe, and implementing a compliance monitoring program to estimate attainment of cleanup levels.**

An analysis to identify a trend in contaminant concentrations will be based on groundwater sampling data collected from a maximum of five years of periodic monitoring. During the first year of monitoring, samples will be collected quarterly. An iterative approach will be used to establish the subsequent sampling frequency. Factors to be considered in this approach include the variability observed in water levels and contaminant concentrations during the first year. If at any time prior to five years, either the USAF, EPA, or Ecology believe that the data collected identifies a reliable trend in contaminant concentrations, then the parties will jointly evaluate the data. If the USAF, EPA, and Ecology agree that a reliable trend in contaminant concentrations has been identified, then the data collection period may be concluded. If agreement is not reached, then the dispute resolution provisions of the Fairchild AFB FFA may be invoked.

At the end of the data collection period, a definition of a reasonable timeframe for restoration by natural dispersion, dilution, and degradation will be developed by the USAF, EPA, and Ecology. Factors that should be considered in developing this definition include any changes in the use of land or groundwater on-Base near the site, any changes in the operation or mission of the Base that may affect the implementability of on-base institutional controls, and the site-specific fate and transport characteristics of the contaminants. In no case will the reasonable timeframe for restoration by natural dispersion, dilution, and degradation exceed thirty years.

The groundwater cleanup level for PS-8 is 5 μg/L for benzene in accordance with the SDWA MCL and MTCA Method B. This cleanup level will be achieved throughout the plume. If the trend analysis indicates that contaminant concentrations are decreasing such that natural dispersion, dilution, and degradation will achieve the cleanup level within a reasonable timeframe, a compliance monitoring program will be implemented and remain in operation until the cleanup levels are achieved. The specific details of the compliance monitoring program will be developed by the USAF, EPA, and Ecology. If the trend analysis indicates that cleanup levels would not be attained by natural dispersion, dilution, and degradation within the reasonable timeframe, the need for remedial action will then be reevaluated by the USAF, EPA, and Ecology.

If the Base should be closed in the future, the need for additional remedial actions to address site-related groundwater contamination will be reevaluated by the USAF, EPA, and Ecology. In the event that the need for remedial action is reevaluated, remedial actions that will be considered include additional investigation to characterize contaminant sources and the extent of plume migration, and the implementation of groundwater extraction and treatment and/or bioventing, consistent with all regulatory requirements.

Fire Training Area (FT-1)

The goals of the remedial action at FT-1 are to remediate soils to levels that are protective of groundwater, and to restore groundwater to drinking water quality. The selected remedy combines the soil alternative of In-situ Bioventing (Alternative 4) with the groundwater alternative of In-situ Air Sparging with Institutional Controls (Alternative 4). This remedy consists of the following elements:

- Maintaining institutional controls, in the form of restrictions against on-base usage of benzene-contaminated groundwater associated with the site, until cleanup levels are achieved.
- Implementing an in-situ bioventing treatment system for benzene-contaminated soil.
- Implementing a pilot-scale in-situ air sparging system to evaluate the effectiveness of this technology for remediating benzene-contaminated groundwater, to be followed by implementation of a full-scale system if the pilot scale system is successful.
- Monitoring off-site water supply wells in the vicinity of the site and providing point-of-use treatment and/or alternate water supply, if necessary.

The estimated costs associated with this remedy are:

Capital Costs:	$542,000
O&M Costs:	$49,000
Present Net Worth:	$785,000

A. Maintaining institutional controls, in the form of restrictions against on-base usage of benzene-contaminated groundwater associated with the site, until cleanup levels are achieved.

Institutional controls established under the authority of the base commander currently restrict access to and use of groundwater throughout the Base. Such restrictions will be maintained under that authority as part of the selected remedy. If the Base should be closed in the future, the need for additional remedial actions to address site-related groundwater contamination will be reevaluated by the USAF, EPA, and Ecology.

B. Implementing an in-situ bioventing treatment system for benzene-contaminated soil.

An in-situ bioventing system will be installed in the contaminated soil area at the site. The system will consist of a network of vapor extraction wells and a vacuum pump to extract air containing volatile organic compounds such as benzene and to increase oxygen concentrations in the soil to enhance biodegradation of petroleum contamination. Contaminated vapors will be treated to comply with Washington State and Spokane County air standards. The system will be operated until the soil cleanup level of 0.5 mg/kg for benzene is achieved, thereby protecting groundwater from further contamination. It is estimated that soil cleanup levels can be achieved within a 5-year timeframe. The estimated volume of soil requiring treatment is 9,500 cubic yards.

C. **Implementing a pilot-scale in-situ air sparging system to evaluate the effectiveness of this technology for remediating benzene-contaminated groundwater, to be followed by implementation of a full-scale system if the pilot-scale system is successful.**

Air sparging will be used in combination with bioventing to simultaneously treat both soils and groundwater. The system will consist of a network of vapor extraction/injection well pairs arranged to inject air into the aquifer and extract air from the overlying soil. The well pairs will be placed within the interior of the groundwater plume defined by the groundwater cleanup level. The groundwater cleanup level for FT-1 is 5 μg/L for benzene in accordance with the SDWA MCL and MTCA Method B. The point of compliance will be throughout the plume. The well spacings and configuration will be determined during the remedial design phase. Contaminated vapors will be treated to comply with Washington State and Spokane County air standards. The system will be operated until groundwater cleanup levels are achieved. Groundwater cleanup levels are estimated to be achieved within a 5-year timeframe.

Groundwater monitoring to demonstrate compliance with the cleanup levels will be continued following the implementation of the groundwater treatment system. The specific details of the compliance monitoring program will be developed by the USAF, EPA, and Ecology during the remedial design phase.

D. **Monitoring off-site water supply wells in the vicinity of the site and providing point-of-use treatment and/or alternate water supply, if necessary.**

Off-site water supply wells will be monitored for the presence of site-related contaminants. To prevent consumption by area residents of groundwater exceeding MCLs, point-of-use treatment and/or an alternate water supply will be provided as necessary by the Air Force to users of wells which are constructed in compliance with state and local regulations. Point-of-use treatment systems typically consist of a filtration system installed at the well head for wells serving multiple users, or near the point where piping from an individual user's well enters the user's building. Routine maintenance and periodic replacement of system components will be necessary. Provision of an alternate water supply will be considered based on factors such as the distance to an existing water system or the amount of water delivered.

<u>Wastewater Lagoons (WW-1)</u>

The goals of this remedial action are to restrict the site from future residential or agricultural uses, and to restore groundwater to drinking water quality. The selected remedy combines the soil alternative of Institutional Controls (Alternative 2) with the groundwater alternative of Groundwater Extraction and Treatment with Institutional Controls and Point-of-Use Treatment/Alternate water supply (Alternative 3). This remedy consists of the following elements:

- Implementing additional source investigation activities to identify the source of groundwater TCE contamination. If a source of TCE contamination is detected in soils, soil remedial alternatives will be evaluated at that time.
- Maintaining institutional controls restricting access to the site.
- Maintaining institutional controls, in the form of restriction against on-base usage of TCE-contaminated groundwater associated with the site, until cleanup levels are achieved.
- Implementing a groundwater extraction and treatment system, using air stripping and/or carbon adsorption.

C. Implementing a pilot-scale in-situ air sparging system to evaluate the effectiveness of this technology for remediating benzene-contaminated groundwater, to be followed by implementation of a full-scale system if the pilot-scale system is successful.

Air sparging will be used in combination with bioventing to simultaneously treat both soils and groundwater. The system will consist of a network of vapor extraction/injection well pairs arranged to inject air into the aquifer and extract air from the overlying soil. The well pairs will be placed within the interior of the groundwater plume defined by the groundwater cleanup level. The groundwater cleanup level for FT-1 is 5 μg/L for benzene in accordance with the SDWA MCL and MTCA Method B. The point of compliance will be throughout the plume. The well spacings and configuration will be determined during the remedial design phase. Contaminated vapors will be treated to comply with Washington State and Spokane County air standards. The system will be operated until groundwater cleanup levels are achieved. Groundwater cleanup levels are estimated to be achieved within a 5-year timeframe.

Before fully implementing this technology, its effectiveness will be determined in a controlled treatability study consisting of a pilot-scale installation. Effectiveness will be measured by using fixed field sampling locations to evaluate the trend in contaminant concentrations over a two year period. If the trend does not show remediation of groundwater to concentrations below the cleanup level, an air stripping/carbon adsorption groundwater extraction and treatment system will be installed at FT-1.

Groundwater monitoring to demonstrate compliance with the cleanup levels will be continued following the implementation of the groundwater treatment system. The specific details of the compliance monitoring program will be developed by the USAF, EPA, and Ecology during the remedial design phase.

Note - this Section C (July 2, 1993) supercedes the Section C presented on page 63 in the Final Record of Decision for the On-Base Priority One Operable Units for Fairchild Air Force Base (issued June 29, 1993).

- Monitoring off-site water supply wells in the vicinity of the site and providing point-of-use treatment and/or alternate water supply, if necessary.

The estimated costs associated with this remedy are:

Capital Cost:	$1,442,000
O&M Costs:	$135,000
Present Net Worth:	$3,522,000

A. Implementing additional source investigation activities to identify the source of groundwater TCE contamination. If a source of TCE contamination is detected in soils, soil remedial alternatives will be evaluated at that time.

USAF is currently developing field activities which are believed to be capable of determining the source of TCE groundwater contamination. These activities include excavation of test pits and soil sampling within the presumed site source area (i.e., east of the WW-1 lagoons).

B. Monitoring institutional controls restricting access to the site.

Institutional controls established under the authority of the base commander currently restrict access to the site. Restricted access to the site will be maintained under that authority as part of the selected remedy. If the Base should be closed in the future, a deed restriction precluding the site from residential or agricultural uses would be implemented prior to transfer of the site property to any other entities.

C. Maintaining institutional controls, in the form of restrictions against on-base usage of TCE-contaminated groundwater associated with the site, until cleanup levels are achieved.

Institutional controls established under the authority of the base commander currently restrict access to and use of groundwater throughout the Base. Such restrictions will be maintained under that authority as part of the selected remedy. If the Base should be closed in the future, the need for additional remedial actions to address site-related groundwater contamination will be reevaluated by the USAF, EPA, and Ecology.

D. Implementing a groundwater extraction and treatment system, using air stripping and/or carbon adsorption.

A groundwater extraction and treatment system will be installed to remove contaminants from the groundwater plume associated with the site. Extraction wells will be placed within the on-site and off-site portions of the plume. Extracted groundwater will be treated using either an air stripper unit, a carbon adsorption unit, or a combination of these units. The specific system configuration will be determined during the remedial design phase.

The treated water will be either reintroduced into the aquifer or discharged directly into No Name Ditch. The acceptable effluent concentrations from the treatment plant will be determined based on the method of disposal. If the method of disposal is to surface water, the treated water must be discharged in accordance with the NPDES program. If the method of disposal is reintroduction to the aquifer, the treated water must meet the requirements of the Washington State Waste Discharge Permit Program. The specific standards will be developed during the remedial design.

The contaminated air emissions from the stripper will be treated using activated carbon to comply with Washington State and Spokane County air quality standards. Used carbon will be recycled off-site in accordance with OSWER Directive 9834.11.

The groundwater extraction and treatment system will be operated until the groundwater cleanup levels are achieved. The groundwater cleanup level for WW-1 is 5 µg/L for TCE in accordance with the SDWA MCL and MTCA Method B. This cleanup level will be achieved throughout the plume. The cleanup times could range from less than five years to as many as 30 years.

Groundwater monitoring to demonstrate compliance with the cleanup levels will be continued following the implementation of the groundwater treatment system. The specific details of the compliance monitoring program will be developed by the USAF, EPA, and Ecology during the remedial design phase.

E. Monitoring off-site water supply wells in the vicinity of the site and providing point-of-use treatment and/or alternate water supply, if necessary.

Off-site water supply wells will be monitored for the presence of site-related contaminants. To prevent consumption by area residents of groundwater exceeding MCLs, point-of-use treatment and/or an alternate water supply will be provided as necessary by the Air Force to users of wells which are constructed in compliance with state and local regulations. Point-of-use treatment and/or an alternate water supply will be provided as necessary by the Air Force to users of wells which are constructed in compliance with state and local regulations. Point-of-use treatment systems typically consist of a filtration system installed at eh well head for wells serving multiple users, or near the point where piping from an individual user's well enters the user's building. Routine maintenance and periodic replacement of system components will be considered based on factors such as the distance to an existing water system or the amount of water delivered. Based on recent groundwater sampling, no residential wells exhibit contaminants above MCLs and therefore no provision of point-of-use treatment/alternate water supply is required at this time.

XI. STATUTORY DETERMINATIONS

Under CERCLA Section 121, selected remedies must be protective of human health and the environment, comply with ARARs, be cost effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practical. In addition, CERCLA includes a preference for remedies that employ treatment that significantly and permanently reduces the volume, toxicity or mobility of hazardous wastes as their principal element. The following sections discuss how the selected remedy meets these statutory requirements.

A. Protection of Human Health and the Environment

There are no unacceptable risks to human health posed by exposure to the soils at the SW-1 site under either residential or industrial use scenarios. However, institutional controls would reduce the threat of direct contact with any potential contaminants within the subsurface soil that were not identified during the investigation. Currently, SW-1 is an inactive landfill. Development of the landfill for residential use is unlikely. Development of SW-1 for industrial use is, to a lesser degree, also unlikely.

TCE groundwater concentrations currently exceed the MCL. The TCE-contaminated plume is currently migrating through Fairchild AFB. Maintaining groundwater institutional controls will prevent on-base consumption of contaminated water at SW-1 until groundwater cleanup levels are achieved. Continued monitoring will allow establishment of a trend in contaminant levels to evaluate whether they are decreasing and whether the cleanup levels can be achieved through natural dispersion, dilution, and degradation within a reasonable period of time. Monitoring of nearby residential wells and providing additional remedial action, such as point-of-use treatment/alternate water supply, if necessary, will prevent consumption by area

residents of groundwater exceeding federal MCLs. The remedy for SW-1 groundwater will be reevaluated within five years to determine its effectiveness as a remedy. Furthermore, a groundwater monitoring program and five-year review would be implemented to evaluate migration of contaminants, to verify that cleanup levels are attained within a reasonable time, satisfy CERCLA requirements for contaminants remaining onsite, and to determine if the remedy remains protective of human health and the environment.

There are no unacceptable risks to human health posed by exposure to the soils at the PS-2 site under either residential or industrial use scenarios. Soils at PS-2 are located beneath Taxiway No. 1. The taxiway is believed to act as a cover which prevents precipitation from percolating through the TPH-contaminated soils.

The estimated cancer risk for consumption of contaminated groundwater at site PS-2 exceeds the acceptable federal level of 1×10^{-4}. With respect to non-carcinogens, the hazard index calculated for site PS-2 exceeds one. The groundwater at PS-2 is currently migrating beneath Taxiway No. 1, and through Fairchild AFB. Removal of the floating product will eliminate the primary source of groundwater contamination at the site. Following removal of the product, residual levels of fuel contamination in the soils and groundwater are expected to decrease through natural dispersion, dilution, and degradation. Continued monitoring will allow establishment of a trend in contaminant levels to evaluate whether they are decreasing and whether the cleanup levels can be achieved through natural dispersion, dilution, and degradation within a reasonable period of time. Maintaining groundwater institutional controls will prevent consumption of contaminated on-base water at PS-2 until groundwater cleanup levels are achieved and risks to human health decrease to acceptable levels. This remedy will be reevaluated within five years to determine its effectiveness. Furthermore, a groundwater monitoring program and five-year review would be implemented to evaluate migration of contaminants, to verify that cleanup levels are attained within a reasonable time, satisfy CERCLA requirements for contaminants remaining onsite, and to determine if the remedy remains protective of human health and the environment.

The results of the risk assessment indicate that there would be no unacceptable risks to human health posed by exposure to the soils at PS-6 under both residential and industrial use scenarios. Also, results of the RI indicate that the soils are not a source of groundwater contamination. Thus, the no action alternative is appropriate for PS-6 soils.

The RI investigation did not identify a groundwater contaminant plume associated with the PS-6 site. Thus, the no action alternative is appropriate for PS-6.

There are no unacceptable risks to human health posed by exposure to the soils at the PS-8 site under either residential or industrial use scenarios.
There are no unacceptable risks to human health posed by consumption of contaminated groundwater at the PS-8 site, however, current benzene concentrations in the groundwater slightly exceed the SDWA MCL and TPH concentrations in three wells currently exceed the MTCA cleanup level of 1 mg/L. The groundwater at PS-8 is currently migrating beneath Taxiway No. 1, and through Fairchild AFB. Maintaining groundwater institutional controls will prevent consumption of contaminated water at PS-8 until this groundwater cleanup level is achieved. Continued monitoring will allow establishment of a trend in contaminant levels to evaluate whether TPH levels are decreasing and whether the cleanup levels can be achieved through natural dispersion, dilution, and degradation within a reasonable period of time. This remedy will be reevaluated within five years to determine its effectiveness. Furthermore, a groundwater monitoring program and five-year review would be implemented to evaluate migration of contaminants, to verify that cleanup levels are attained within a reasonable time, satisfy CERCLA requirements for contaminants remaining onsite, and to determine if the remedy remains protective of human health and the environment.

There are no unacceptable risks to human health posed by exposure to the soils at the FT-1 site under either residential or industrial use scenarios. However, benzene-contaminated soils may act as a source of groundwater contamination. The in-situ bioventing system will remediate the soils to a level that is protective of groundwater. Implementing an in-situ bioventing soil treatment system poses minimal risk to human health and the environment because excavation of the soil is not required.

The estimated cancer risk for consumption of contaminated groundwater at site FT-1 exceeds the 1×10^{-5} level established by the Washington State MTCA regulation and the SDWA MCL of 5 μg/L for benzene. With respect to non-carcinogens, the hazard index calculated for site FT-1 groundwater and soils exceed one. If proven effective through pilot-scale testing, implementing an in-situ air sparging treatment system for benzene-contaminated groundwater at FT-1 will reduce the spread of contaminants and will restore the groundwater to groundwater cleanup levels. If air sparging is proven ineffective, a groundwater extraction and treatment system will be implemented to achieve these objectives. Maintaining groundwater institutional controls will prevent consumption of contaminated water at FT-1 until groundwater cleanup levels are achieved and risks to human health decrease to acceptable levels. Monitoring of nearby residential wells and providing additional remedial action, such as point-of-use treatment/alternate water supply, if necessary, will prevent consumption by area residents of groundwater exceeding federal MCLs.

The cancer risk of 3×10^{-5} for exposure to the soil at WW-1 under a residential use scenario is within the acceptable 1×10^{-4} to 1×10^{-6} range established under federal law but slightly exceeds the 1×10^{-5} level established by the Washington State MTCA regulation. Institutional controls will reduce the threat of direct contact with potential contaminants within the subsurface soil by restricting the site to industrial uses only.

TCE concentrations currently exceeds the SDWA MCL. The estimated cancer risk for consumption of contaminated groundwater at site WW-1 exceeds the acceptable 1×10^{-5} level established by the Washington State MTCA regulation. Implementing an air stripping/carbon adsorption treatment system for TCE-contaminated groundwater will reduce the spread of contaminants and will restore the groundwater to groundwater cleanup levels. Maintaining groundwater institutional controls will prevent consumption of contaminated water at WW-1 until groundwater cleanup levels are achieved and risks to human health decrease to an acceptable level. Monitoring of nearby residential wells and providing additional remedial action, such as point-of-use treatment/alternate water supply, if necessary, will prevent consumption by area residents of groundwater exceeding federal MCLs.

B. Compliance with ARARs

The selected remedies will comply with the following federal and state ARARs that have been identified. No waiver of any ARAR is being sought or invoked for any component of the selected remedies. The ARARs identified for the on-Base P1 sites include the following:

Chemical-Specific ARARs

- SDWA, 40 United States Code (USC) Section 300, and 40 CFR Part 141, MCLs for public drinking water supplies established for the SDWA are relevant and appropriate for setting groundwater cleanup levels and in establishing effluent standards if treated groundwater is recharged to the aquifer.

- Title V of Clean Air Act Amendments of 1990, Section 112(b) of the Act lists sources covered by the New Source Performance Standards and requires major emission sources to obtain permits from federally approved state permitting agencies. This section defines major sources as those with the potential to emit ten tons per year of a hazardous air pollutant. This Act would be applicable in determining bioventing/air sparging system as non major sources under Section 502(a) of the Act.

- RCRA, Subtitle C (Title 40 Code of Federal Regulations (CFR) 261), Applicable in identifying if the spent activated carbon filters from the air stripping system and bioventing/air sparging system are considered a hazardous waste for purposes of transporting them offsite for treatment.

- Emission Standards and Controls for Emitting Volatile Organic Compounds (VOCs), (Chapter 173-400 Washington Administrative Code (WAC)), Establishes standards in the state of Washington for specific VOC source emissions; applicable in establishing emission standards for the active bioventing/air sparging system at FT-1 and from the activated carbon unit at WW-1.

- Pursuant to CERCLA, all air emissions associated with the remedial actions will comply with the substantive requirements of Chapter 173-460 WAC as implemented by the Spokane County Air Pollution Control Authority. Controls for New Sources of Toxic Air Pollutants (Chapter 173-460 WAC) requires the use of Best Available Control Technology for new sources of toxic air pollutants. This regulation lists benzene and TCE as Class A toxic air pollutants with Acceptable Source Impact Levels (ASILs) of 0.12 $\mu g/m^3$ and 0.8 $\mu g/m^3$, respectively. The ambient impact of emissions of toxic air contaminants from the air stripping unit at WW-1 and the air sparging/bioventing system at FT-1 will be evaluated against ASILs.

- MTCA, (Chapter 173-340 WAC), Method B risk-based cleanup levels are applicable for establishing soil and groundwater cleanup levels. As well as relevant and appropriate requirements for effluent standards for discharge to groundwater.

Soil contamination was not detected at SW-1 and PS-6. At sites PS-2 and PS-8, TPH will remain in the soils above the MTCA cleanup level, which is based on groundwater protection. Continued groundwater monitoring is needed to determine if the TPH levels in the soils at these sites are protective of groundwater. It is currently believed that the TPH-contaminated soil is not contributing to the groundwater contamination. PS-2 and PS-8 soils are beneath Taxiway No. 1. The taxiway apparently acts as a cover which prevents precipitation percolation into the groundwater. The selected remedy for site FT-1 will comply with the MTCA Method B cleanup level for benzene. Soils at WW-1 do not pose unacceptable human health risks under the industrial land use scenario.

At sites SW-1, PS-6, and PS-8, no action may attain state and federal groundwater cleanup levels through natural dispersion, dilution, and degradation if contamination is no longer migrating from the soils to groundwater at these sites. Continued groundwater monitoring is needed at sites SW-1 and PS-8 to determine if those standards can be achieved naturally within a reasonable period of time. At PS-2, groundwater cleanup levels are expected to be achieved following removal of the floating product. Continued groundwater monitoring is needed at this site to determine if cleanup levels can be achieved naturally within a reasonable period of time at this site following product removal. The groundwater at sites SW-1, PS-2, PS-6, and PS-8 is currently flowing through Fairchild AFB. The selected remedies for sites FT-1 and WW-1 will achieve the groundwater cleanup levels through treatment.

Action-Specific ARARs

- RCRA Subtitle C (40 CFR 262), Establishes standards for generators of hazardous wastes for the treating, storage, and shipping of wastes. Applicable to the storage, packaging, labeling, and manifesting of the spent granulated activated carbon filters offsite for treatment.

- Hazardous Materials Transportation Act (49 USC 1801-1813 and 49 CFR Parts 171 and 172), Applicable for transportation of potentially hazardous materials, including samples and wastes.

- Noise Control Act (42 USC 4910 and 40 CFR Part 209), Applicable for the design of bioventing/air sparging and air stripper systems.

- Dangerous Waste Regulations (Chapter 173-303 WAC), Applicable for onsite treatment, storage, or disposal of dangerous waste of hazardous wastes generated during the remedial actions.

- Minimum Standards for Construction and Maintenance of Wells (Chapter 173-160 WAC), Applicable regulations for the location, design, construction, and abandonment of water supply and resource protection wells.

- State Waste Discharge Permit Program (Chapter 173-216 WAC), Applicable for establishing effluent quality standards for discharges to groundwater. Pursuant to CERCLA, only the substantive requirements of this regulation will be completed for onsite discharges.

- CWA, NPDES Section 402 (33 USC 1342 and 40 CFR Parts 122-125), applicable for establishing effluent quality standards for surface water discharge from groundwater extraction and treatment units.

Location-Specific ARARs

- No location-specific ARARs.

Other Criteria, Advisories, or Guidance to be Considered for this Remedial Action

- EPA OSWER Directive 9834.11, Revised Procedures for Planning and Implementing Offsite Response Actions, November 13, 1987. This directive provides procedures for offsite disposal of CERCLA wastes.

C. Cost Effectiveness

The selected remedies provide overall effectiveness proportionate to their costs.

For sites SW-1 and WW-1, institutional controls provide the most cost-effective means of preventing exposure to potential subsurface soil contaminants by restricting these sites from residential use.

For site SW-1, contaminant concentrations in groundwater are at low levels, and are expected to decrease since a continuing source of contamination was not identified during the RI. Therefore, institutional controls combined with natural dispersion, dilution, and degradation is the most cost effective remedy for this site.

For site PS-2, removal and recycling of the floating product eliminates the primary source of groundwater contamination at the site at a cost that is substantially less than implementation of a full-scale groundwater extraction and treatment system.

For site PS-8, results of the RI indicate that concentrations of fuel-related groundwater contaminants are below or near their cleanup levels, and that contaminant levels are on a decreasing trend. Therefore, no action is the most cost-effective remedy for this site since contaminant levels are decreasing through natural dispersion, dilution, and degradation processes.

For site FT-1, in-situ bioventing is significantly more cost-effective than the other soil treatment/disposal alternatives. Similarly, in-situ air sparging is significantly more cost-effective than the groundwater extraction and treatment alternative.

For site WW-1, the present worth cost of groundwater extraction and treatment is the highest among the groundwater alternatives. However, this alternative provides the highest degree of long-term effectiveness by preventing the spread of contamination and restoring the groundwater to drinking water quality.

D. Utilization of Permanent Solutions and Alternative Treatment Technologies to the Maximum Extent Possible

The selected remedies provide the best balance of long-term effectiveness and permanence; reduction in toxicity, mobility, and volume achieved through treatment; short-term effectiveness; implementability; and cost.

The source of groundwater TCE contamination may no longer be present within the SW-1 landfill since the RI did not identify any source areas and the landfill has been closed for 35 years. Groundwater TCE levels may be declining naturally since a source has not been identified within the landfill. Therefore, source control actions and groundwater extraction and treatment at the landfill are not warranted at this time but could be reevaluated within a five-year review period.

The results of the RI indicate that the groundwater contamination at site PS-2 may be local to the floating product areas, and that contamination has not migrated beyond the site. Removal of the floating product will eliminate the primary source of groundwater contamination at the site. Following removal of the product, residual levels of fuel contamination in the soils and groundwater are expected to decrease through natural dispersion, dilution, and degradation. Therefore, further source control measures and/or groundwater extraction and treatment are not warranted at this time but could be reevaluated within a five-year review period.

At site PS-8, the results of the RI indicate that: concentrations of fuel-related groundwater contaminants are below or near their cleanup levels; contaminant levels are on a decreasing trend; residual fuel contamination detected in the soils is not contributing to groundwater contamination; and contamination has not migrated beyond the PS-8 site. Current levels of fuel contamination in the soils and groundwater are expected to decrease through natural dispersion, dilution, and degradation. Therefore, source control measures and/or groundwater extraction and treatment are not warranted at this time but could be reevaluated within a five-year review period.

The selected remedy for site FT-1 utilizes permanent solutions and alternative treatment technologies to the maximum extent possible. The remedy uses treatment of the contaminant source and of the affected groundwater. In-situ bioventing/air sparging provides a permanent solution by removing contaminants from the soil and groundwater through biodegradation and volatilization. Volatilized contaminants are collected and treated through biodegradation or activated carbon. In-situ bioventing/air sparging are considered alternative treatment technologies.

At WW-1, the source of groundwater TCE contamination may no longer be present within the soil since the RI did not identify any source areas. Therefore, source control actions are not warranted at this time but would be evaluated if additional investigation activities identify a TCE source. The selected remedy for groundwater at site WW-1 utilizes permanent solutions and alternative treatment technologies to the maximum extent possible. The remedy uses extraction and treatment of the contaminated groundwater. Air stripping and/or activated carbon provides a permanent solution by removing contaminants from the groundwater through volatilization. Volatilized contaminants are collected and treated using an activated carbon filter.

E. Preference for Treatment as a Principal Element

The selected remedy for site PS-2 satisfies the statutory preference for treatment by utilizing offsite recycling of the floating product to permanently reduce the toxicity, mobility, and volume of the primary source of groundwater contamination at the site.

The selected remedy for site FT-1 satisfies the statutory preference for treatment by utilizing in-situ treatment as a primary method to permanently reduce the toxicity, mobility, and volume of soil and groundwater contaminants. In addition, the selected remedy includes treatment at individual user well locations in the event of offsite contamination of drinking water above MCLs.

The selected remedy for site WW-1 satisfies the statutory preference for treatment by using treatment to permanently reduce the toxicity, mobility, and volume of groundwater contaminants. In addition, the selected remedy includes treatment at individual user well locations in the event of offsite contamination of drinking water above MCLs.

XII. DOCUMENTATION OF SIGNIFICANT CHANGES

The Proposed Plan for the on-Base Priority 1 Operable Units was released for public comment on March 1, 1993. Public comments on the Proposed Plan were evaluated at the end of the 30-day comment period, and it was determined that no significant changes to the Proposed Plan were necessary.

TABLE A-1

CONTAMINANT OCCURRENCE AND DISTRIBUTION - SUBSURFACE SOILS (1989)(1)
SITE SW-1
FAIRCHILD AFB, WASHINGTON

Parameter(1)	BW1-BH5 (3.0-3.5 feet) (mg/kg)	BW1-BH6 (3.5-4.0 feet) (mg/kg)	Background Concentration(2) (mg/kg)
Aluminum	8,500	5,800	0.5->10%*
Arsenic	14	9 U	<30-39
Barium	80	120	66-160
Beryllium	0.44	0.3	<0.02-0.57
Calcium	3,000	6,900	0.06-32%*
Cadmium	1.7	2	<0.3-1.3
Cobalt	8	10	<3-50*
Chromium	10	2	6-54
Copper	20	27	2-300*
Iron	22,000	30,000	0.1->10%*
Potassium	1,300	600	0.19-6.3%*
Magnesium	5,200	3,100	0.03->10%*
Manganese	410	450	56-670*
Molybdenum	17	7	<3-7*
Sodium	90	210	0.05-10%*
Nickel	10	8	5-30
Thallium	6 U	9	2.5
Vanadium	31	30	13-62
Zinc	53	62	24-82

J Estimated value.
U Parameter is not detected above detection limits. Value presented is the detection limit.
(1) Selenium, mercury, lead, and antimony were not detected above detection limits.
(2) If site-specific data were available, the background value is the range of metals concentrations for background sample locations (data provided by SAIC). If site-specific data were not available (*), background metals concentrations reported in Shacklette and Boerngen (1984) are presented.

TABLE A-2

CONTAMINANT OCCURRENCE AND DISTRIBUTION - SURFACE SOIL SAMPLES
ROUND 11
SITE SW-1
FAIRCHILD AFB, WASHINGTON

Parameter	Range of Positive Detections (Arithmetic Mean)	Geometric Mean	95% UCL(1)	Frequency of Detection
VOLATILE ORGANICS (mg/kg)				
Xylenes	0.014 (0.003)	0.002	0.006	1/11
Methylene chloride	0.003 (0.001)	0.001	0.0011	1/11
SEMIVOLATILE ORGANICS (mg/kg)				
Di-n-butyl phthalate	0.19-0.49 (0.28)	0.25	0.38	8/11
METALS (mg/kg)				
Aluminum	6,880-15,300 (10,809)	10,630	12,300	11/11
Barium	56-135 (113)	110	131	11/11
Beryllium	0.2-0.63 (0.42)	0.41	0.50	11/11
Cadmium	0.62J-0.81 (0.47)	0.42	0.63	4/11
Calcium	3,900-12,000 (5,950)	5,650	7,500	11/11
Chromium	6.4-10.8 (8.8)	8.8	9.7	11/11
Cobalt	8.5-16.6 (12.1)	11.9	13.9	11/11
Copper	12.1-16.9 (15.5)	15.4	16.5	11/11
Iron	21,500-35,700 (24,300)	23,900	27,900	11/11
Lead	10.1J (5.2)	5.0	6.4	1/11

TABLE A-2
CONTAMINANT OCCURRENCE AND DISTRIBUTION - SURFACE SOIL SAMPLES
ROUND 11
SITE SW-1
FAIRCHILD AFB, WASHINGTON
PAGE TWO

Parameter	Range of Positive Detections (Arithmetic Mean)	Geometric Mean	95% UCL(1)	Frequency of Detection
METALS (mg/kg)				
Magnesium	3,720-6,840 (4,910)	4,830	5,580	11/11
Manganese	319-650 (426)	417	498	11/11
Nickel	7.7-13.1 (10.2)	10.1	11.4	11/11
Potassium	906-2,020 (1,635)	1,610	1,860	11/11
Vanadium	27.3-68.7 (46.6)	44.4	57.4	11/11
Zinc	37.7-57.2 (46.7)	46.4	50.9	11/11

(1) Upper 95% confidence limit on arithmetic mean.

TABLE A-3

CONTAMINANT OCCURRENCE AND DISTRIBUTION - TEST PIT SOIL SAMPLES
ROUND 11
SITE SW-1
FAIRCHILD AFB, WASHINGTON

Parameter	Range of Positive Detections (Arithmetic Mean)	Geometric Mean	95% UCL[1]	Frequency of Detection
METALS (mg/kg)				
Aluminum	8,190-11,600 (10,409)	10,343	11,414	9/9
Barium	81.5-471 (137)	126	196	9/9
Beryllium	0.34-0.52 (0.32)	0.26	0.44	4/9
Cadmium	0.52-1.6 (0.74)	0.62	1.1	4/9
Calcium	2,920-6,200 (4,991)	4,881	5,854	9/9
Chromium	5.8-20.6 (8.8)	8.4	11.5	9/9
Cobalt	10.1-15.8 (12.6)	12.4	14.1	9/9
Copper	13.7-37.2 (17.1)	16.5	21.9	9/9
Iron	19,600-32,600 (24,850)	24,562	28,268	9/9
Lead	13.2-18.0 (7.7)	6.5	12.1	3/9
Magnesium	4,340-5,820 (4,875)	4,855	5,281	9/9
Manganese	360-519 (414)	410	465	9/9
Nickel	8.3-12.7 (10.0)	10.0	11.2	9/9
Potassium	1,200-2,050 (1,771)	1,742	2,043	9/9
Silver	7.3 (2.2)	1.1	5	1/9
Sodium	124-317 (213)	202	273	9/9
Vanadium	27.4-64.0 (41.9)	40.7	51.3	9/9
Zinc	42-92.3 (54.0)	52.8	64.5	9/9

TABLE A-3
CONTAMINANT OCCURRENCE AND DISTRIBUTION - TEST PIT SOIL SAMPLES
ROUND 11
SITE SW-1
FAIRCHILD AFB, WASHINGTON
PAGE TWO

Parameter	Range of Positive Detections (Arithmetic Mean)	Geometric Mean	95% UCL[1]	Frequency of Detection
VOLATILE ORGANIC CHEMICALS (mg/kg)				
2-Butanone	0.05 (0.0071)	0.0024	0.02	1/9
Xylenes	0.006-0.018 (0.0042)	0.0025	0.009	2/9
Chlorobenzene	0.004 (0.0014)	0.0013	0.0023	1/9
METALS (mg/kg)				
Aluminum	6,490-15,000 (10,154)	9,714	12,871	9/9
Arsenic	7 (3.8)	3.6	4.9	1/9
Barium	90.2-174 (125)	121	153	8/9
Beryllium	0.31-0.59 (0.35)	0.27	0.52	6/9
Cadmium	0.52-1.5 (0.59)	0.48	0.96	5/9
Calcium	3,060-6,370 (4,393)	4,201	5,513	9/9
Chromium	6.0-46.5 (11.7)	7.8	23.7	7/9
Cobalt	10.9-15.7 (12.4)	12.3	13.7	9/9
Copper	11.8-40.4 (18.5)	17.1	26.3	9/9
Iron	20,300-31,400 (25,306)	25,052	28,519	9/9
Lead	40.3-101 (21.4)	9.3	50.2	2/9

TABLE A-3
CONTAMINANT OCCURRENCE AND DISTRIBUTION - TEST PIT SOIL SAMPLES
ROUND 11
SITE SW-1
FAIRCHILD AFB, WASHINGTON
PAGE THREE

Parameter	Range of Positive Detections (Arithmetic Mean)	Geometric Mean	95% UCL(1)	Frequency of Detection
METALS (mg/kg) (CONTINUED)				
Magnesium	3,670-5,310 (4,454)	4,425	4,896	9/9
Manganese	336-719 (446)	435	544	9/9
Nickel	7.7-12.3 (9.8)	9.7	11.3	9/9
Potassium	804-2,430 (1,696)	1,617	2,121	9/9
Silver	12.6 (3.8)	1.7	12.6	1/9
Sodium	117-420 (236)	211	332	9/9
Vanadium	30-68.5 (40.8)	39.7	50.6	9/9
Zinc	40.3-135 (62.5)	57.4	89.3	9/9

(1) Upper 95% confidence limit on arithmetic mean (the maximum concentration detected is presented when the UCL exceeds the maximum detected concentration.)

TABLE A-4

CONTAMINANT OCCURRENCE AND DISTRIBUTION - GROUNDWATER
ROUNDS 8 THROUGH 11
SITE SW-1
FAIRCHILD AFB, WASHINGTON

Parameter	Top Mid Basalt A Monitoring Wells (SW) (87, 130, 88, 129, 89)				Top-Mid Basalt A Monitoring Wells (NE) Downgradient (131, 168, 86, 90, 128, 132, 134, 167, 165)				Deep Basalt A Monitoring Well (170)	
	No of Positive Detections/ No of Samples	Range of Positive Detections (Arithmetic Mean)	Geometric Mean	95% UCL[1]	No of Positive Detections/ No of Samples	Range of Positive Detections (Arithmetic Mean)	Geometric Mean	95% UCL[1]	No of Positive Detections/ No of Samples	Range of Positive Detections (Arithmetic Mean)
ORGANICS (µg/L)										
trans 1,2-Dichloroethene	0/13	..	..		1/16	0 8 (0 69)	0 54	0 8	0/1	..
Trichloroethene	0/13	....	....	..	10/16	0 5-18 (5 5)	2 1	8 4	0/1	....
2 Butanone	0/13	....	....	..	1/9	40 (5 8)	2 2	15 6	0/1	....
Xylenes	0/13	....	....	....	1/16	0 7 (0 7)[2]	NC[3]	NC	0/1	....
Methylene chloride	0/13	....	....	..	1/16	0 7 (0 7)[2]	NC	NC	0/1	....
Chlorobenzene	1/13	1 (0 86)	0 70	1	0/16	....	....	....	0/1	....
1,4 Dichlorobenzene	0/13	....	....	....	1/9	1 (1)[2]	NC	NC	0/1	....
METALS (µg/L)										
Antimony (Total)	0/10	....	....	....	2/13	4 2-118 (56 5)	26 1	84 7	0/1	....
(Dissolved)	0/10	....	....	....	3/8	6 6-11 1 (8 4)[2]	NC	NC	0/1	....
Aluminum (Total)	10/10	1,500 140,000 (31,000)	9,360	64,300	13/13	300 49,800 (11,700)	5,770	20,000	1/1	183
Barium (Total)	10/10	49-1,200 (445)	221	786	13/13	45-770 (230)	164	354	1/1	28
(Dissolved)	2/2	22-625 (324)	117	NC	8/8	28-247 (79)	54 5	148	1/1	33
Arsenic (Total)	5/10	2 0-12 (3 2)	1 8	5 9	7/13	1 0-8 3 (2 7)	1 9	4 1	1/1	9 6
(Dissolved)	0/2	....	....	..	1/8	1 0 (0 6)	0 59	0 76	0/1	..
Beryllium (Total)	6/10	1-40 (7 9)	2 5	16 3	0/13	....	....	....	0/1	....
Cadmium (Total)	1/10	5 (2 8)	2 7	3 3	1/13	6 0 (2 8)	2 7	3 4	0/1	

TABLE A-4
CONTAMINANT OCCURRENCE AND DISTRIBUTION - GROUNDWATER
ROUNDS 8 THROUGH 11
SITE SW-1
FAIRCHILD AFB, WASHINGTON
PAGE TWO

Parameter	Top-Mid Basalt A Monitoring Wells (SW) (87, 130, 88, 129, 89)				Top-Mid Basalt A Monitoring Wells (NE) Downgradient (131, 168, 86, 90, 128, 132, 134, 167, 165)				Deep Basalt A Monitoring Well (170)	
	No. of Positive Detections/ No. of Samples	Range of Positive Detections (Arithmetic Mean)	Geometric Mean	95% UCL(1)	No. of Positive Detections/ No. of Samples	Range of Positive Detections (Arithmetic Mean)	Geometric Mean	95% UCL(1)	No. of Positive Detections/ No. of Samples	Range of Positive Detections (Arithmetic Mean)
METALS (µg/L) (CONTINUED)										
Calcium (Total)	10/10	17,000-135,000 (48,410)	36,400	80,500	13/13	24,000-242,000 (98,600)	65,600	157,000	1/1	19,200
(Dissolved)	2/2	17,000-121,000 (69,000)	45,400	NC	8/8	15,600-73,400 (62,500)	39,900	73,400	1/1	17,900
Chromium (Total)	7/10	5 0-47 (14 6)	9 924	24 6	8/13	5-109 (27 8)	14 1	49 4	0/1	....
Cobalt (Total)	4/10	10-50 (19 4)	12 6	32 0	3/13	9-27 (9 8)	8 7	13.2	0/1	....
Copper (Total)	6/10	5-92 (24 1)	14 0	43 9	6/13	10-37 (15 3)	10 2	23 9	0/1	....
Iron (Total)	10/10	1,600-60,000 (23,457)	13,600	38,700	3/13	380-60,700 (15,700)	7,360	26,600	1/1	474
(Dissolved)	2/2	66-1,650 (858)	330	NC	3/8	62-295 (82 1)	37 6	174	0/1	....
Lead (Total)	6/10	4-35 (10)	5 1	18 3	7/13	2 34 8 (9 4)	4 8	16 1	0/1	....
Magnesium (Total)	10/10	6,490-65,000 (21,879)	15,500	37,500	13/13	8,470-86,000 (32,800)	24,700	48,100	1/1	6,990
(Dissolved)	2/2	5,820-56,500 (31,200)	18,100	NC	8/8	7,150-72,300 (25,200)	17,600	44,800	1/1	6,970
Manganese (Total)	10/10	280-3,420 (1,030)	603	1,880	13/13	11 5-2,740 (747)	356	1,240	1/1	33
(Dissolved)	2/2	151-3,000 (1,580)	673	NC	5/8	29-2,510 (425)	49 7	1,140	0/1	....
Mercury (Total)	5/10	0 3-0 6 (0 21)	0 15	0 34	1/13	0 40 (0 092)	0 073	0 15	0/1	....
Molybdenum (Total)	1/10	5 0 (5 0)	3 0	5 0	2/13	13-15 (10 6)	10 5	11 6	0/1	....

TABLE A-4
CONTAMINANT OCCURRENCE AND DISTRIBUTION - GROUNDWATER
ROUNDS 8 THROUGH 11
SITE SW-1
FAIRCHILD AFB, WASHINGTON
PAGE THREE

Parameter	Top-Mid Basalt A Monitoring Wells (SW) (87, 130, 88, 129, 89)				Top-Mid Basalt A Monitoring Wells (NE) Downgradient (131, 168, 86, 90, 128, 132, 134, 167, 165)				Deep Basalt A Monitoring Well (170)	
	No of Positive Detections/ No of Samples	Range of Positive Detections (Arithmetic Mean)	Geometric Mean	95% UCL[1]	No of Positive Detections/ No of Samples	Range of Positive Detections (Arithmetic Mean)	Geometric Mean	95% UCL[1]	No of Positive Detections/ No of Samples	Range of Positive Detections (Arithmetic Mean)
METALS (µg/L) (CONTINUED)										
Nickel (Total)	4/10	20-71 (26 4)	18 1	42 2	6/13	40-88 (35 3)	23 9	53 6	0/1	....
(Dissolved)	0/13	....	....	....	2/8	63-71 (28)	21 8	48 2	0/1	....
Potassium (Total)	10/10	2,000-9,900 (5,190)	4,380	7,390	13/13	93-11,000 (4,990)	3,300	6,960	1 1	4,070
(Dissolved)	2/2	2,460-5,890 (4,180)	3,800	NC	8/8	1,940-7,150 (3,440)	3,140	4,910	1/1	4,600
Selenium (Total)	0/2	....	....	....	3/13	1 0-11 (1 7)	0 83	3 5	0/1	....
Sodium (Total)	10/10	17,000-83,000 (35,900)	30,300	52,900	13/13	11,000-83,000 (33,800)	25,300	53,800	1/1	8,410
Sodium (Dissolved)	2/2	14,800-70,700 (42,800)	32,300	NC	8/8	11,400-33,100 (65,700)	32,100	14,600	1/1	8,860
Thallium (Total)	1/10	0 7 (0 7)[2]	NC	NC	0/13	....	....	....	0/1	....
Vanadium (Total)	8/10	12-590 (115)	31 7	252	6/13	4-115 (29 5)	13 0	51.0	0/1	....
Zinc (Total)	7/10	13-260 (80 1)	51 8	138	11/13	16-199 (59 3)	40 5	94 6	1/1	324
(Dissolved)	0/2	...	....	....	2/8	6 0-7 0 (3 4)	3 0	5 0	0/1	....

[1] Upper 95% confidence limit on arithmetic mean
[2] Average of positive detections only (due to use of different analytical methods)
[3] NC - Not calculated

TABLE A-5

SURFACE WATER QUALITY - FRENCH DRAIN SYSTEM, MANHOLE NO. 3
SITE IS-1
FAIRCHILD AFB, WASHINGTON

Parameter	Duplicate Sample Results Concentration (mg/L)		
Total Petroleum Hydrocarbons	4.6	/	1.5
Volatile organics	NPD(1)	/	NPD
Semivolatile organics	NPD	/	NPD
Aluminum	413 U(2)	/	407 U
Antimony	70 U	/	70 U
Arsenic	2.0 U	/	2.0 U
Barium	43	/	43
Beryllium	1.0 U	/	1.0 U
Cadmium	23	/	19
Calcium	12,200	/	12,300
Chromium	80	/	72
Cobalt	20 U	/	20 U
Copper	32	/	32
Iron	368	/	346
Lead	2.7 J(3)	/	3.5 J
Magnesium	7,260	/	7,350
Manganese	29	/	30.0
Mercury	0.1 U	/	0.1 U
Nickel	138 J	/	30 UJ
Potassium	145,000	/	147,000
Selenium	0.9 U	/	1.2 U
Silver	3.0 U	/	3.0
Sodium	8,160	/	8,280
Thallium	40.0 U	/	40.0 U
Vanadium	5.0 U	/	5.0 U
Zinc	63.0	/	65.0
Molybdenum	20.0 U	/	2.0 U
Cyanide	10 U	/	10 U

(1) NPD - No positives detected
(2) U - Chemical quantitation limit; nondetected value.
(3) J - Estimated value.

TABLE A-6

CONTAMINANT OCCURRENCE AND DISTRIBUTION - GROUNDWATER
SITE IS-1
FAIRCHILD AFB, WASHINGTON

Parameter	Top-Mid Basalt A Monitoring Wells (91, 93)			Base Basalt A Monitoring Well (92)		Upgradient Monitoring Well (133)	
	No. of Positive Detections/ No. of Samples	Range of Positive Detections (Arithmetic Mean)	Geometric Mean	No. of Positive Detections/ No. of Samples	Range of Positive Detections (Arithmetic Mean)	No. of Positive Detections/ No. of Samples	Range of Positive Detections
VOLATILE ORGANICS (µg/L)							
Trichloroethene	2/4	2.0-5.0 (2.1)	1.6 (UCL 95% 5.2)(1)	0/2	---	2/2	89 - 130
Tetrachloroethene	0/4	--- ---	---	0/2	---	2/2	5.0 - 8.0
SEMIVOLATILE ORGANICS (µg/L)							
Bis(2-ethylhexyl) phthalate	0/3	--- ---	---	1/2	30 (16.3)	0/1	---
METALS (µg/L)							
Aluminum (Total)	3/3	37-3,760 (1,850)	1,290	2/2	120-8,700 (4,410)	2/2	3,000 - 10,800
Arsenic (Total)	0/3	--- ---	---	2/2	1.0-4.0 (2.5)	0/1	---
Barium (Total)	3/3	69-79 (71)	70	2/2	28-96 (62)	2/2	85 - 201
(Dissolved)	1/1	48 (48)	NC(3)	NA(4)	---- ----	1/1	56
Cadmium (Total)	0/3	--- ---	---	1/2	6.0 (4.3)	0/2	---
Calcium (Total)	3/3	31,700-42,000 (38,400)	38,100	2/2	10,000-17,000 (13,500)	2/2	29,000-33,800
(Dissolved)	1/1	30,600 (30,600)	NC	NA	--- ----	1/1	27,000
Chromium (Total)	0/3	--- ---	---	2/2	6.0-17 (11.5)	1/2	26
Copper (Total)	0/3	--- ---	---	1/2	10 (7.3)	0/2	---
Iron (Total)	3/3	500-9,250 (3,990)	2,170	2/2	220-12,000 (6,110)	2/2	5,300-17,800
(Dissolved)	1/1	23 (23)	NC	NA	--- ---	0/1	---

TABLE A-6
CONTAMINANT OCCURRENCE AND DISTRIBUTION - GROUNDWATER
SITE IS-1
FAIRCHILD AFB, WASHINGTON
PAGE TWO

Parameter	Top-Mid Basalt A Monitoring Wells (91, 93)			Base Basalt A Monitoring Well (92)		Upgradient Monitoring Well (133)	
	No. of Positive Detections/ No. of Samples	Range of Positive Detections (Arithmetic Mean)	Geometric Mean	No. of Positive Detections/ No. of Samples	Range of Positive Detections (Arithmetic Mean)	No. of Positive Detections/ No. of Samples	Range of Positive Detections
METALS (Continued)							
Lead (Total)	1/3	1-4 (1.7)	1.0	2/2	1.0-15 (8.0)	0/2	---
Magnesium (Total)	3/3	9,250-12,000 10,800	10,700	2/2	5,600-7,800 (6,700)	2/2	6,800 - 7,820
(Dissolved)	1/1	8,310 (8,310)	NC	NA	--- ---	1/1	5,940
Manganese (Total)	3/3	10-218 (88)	42	2/2	9.0-180 (95)	2/2	170 - 382
Potassium (Total)	2/3	1,000-2,840 (1,450)	1,120	2/2	49,000-54,000 (51,500)	2/2	1,700 - 2,460
(Dissolved)	1/1	2260 (2,260)	NC	NA	--- ---	1/1	1,150
Sodium (Total)	3/3	11,700-24,000 (19,700)	18,800	2/2	28,000-33,000 (30,500)	2/2	11,000 - 11,800
(Dissolved)	1/1	11,000 (11,000)	NC	NA	--- ---	1/1	11,600
Vanadium (Total)	2/3	11-16 (11)	9.3	1/2	15 (825)	0/1	----
Zinc (Total)	1/3	42 (24)	21	1/2	240 (127)	2/2	23 - 42
Molybdenum (Total)	0/3	--- ---	---	2/2	7.0-9.0 (8.0)	0/1	---

(1) Upper 95% confidence limit on arithmetic mean for TCE.
(2) NAP - Not applicable.
(3) NC - Not calculated
(4) NA - Not analyzed.

TABLE A-7

CONTAMINANT OCCURRENCE AND DISTRIBUTION - SURFACE SOIL SAMPLES
ROUND 11
SITE PS-2
FAIRCHILD AFB, WASHINGTON

Parameter	Sample Number		Arithmetic Mean
	PS2-SL-001	PS2-SL-002	
TOTAL PETROLEUM HYDROCARBONS (mg/kg)			
TPH	44	24	34
SEMIVOLATILE ORGANICS (mg/kg)			
Di-n-butyl phthalate	0.460	0.360	0.41
METALS (mg/kg)			
Aluminum	10,900	10,600	10,750
Barium	195[J]	367[J]	281
Cadmium	1.0[J]	0.82[J]	0.91
Calcium	5,890[J]	5,710[J]	5,800
Chromium	29.3[J]	39.7[J]	34.5
Cobalt	11.6	9.9	10.8
Copper	18.5	20.0	19.3
Iron	23,000	19,400	21,200
Lead	114[J]	167[J]	141
Magnesium	4,710[J]	4,550[J]	4,630
Manganese	397	338	368

TABLE A-7
CONTAMINANT OCCURRENCE AND DISTRIBUTION - SURFACE SOIL SAMPLES
ROUND 11
SITE PS-2
FAIRCHILD AFB, WASHINGTON
PAGE TWO

Parameter	Sample Number		Arithmetic Mean
	PS2-SL-001	PS2-SL-002	
METALS (mg/kg) (CONTINUED)			
Nickel	9.7	8.4	9.1
Potassium	2,060J	1,920J	1,990
Sodium	205	183	194
Vanadium	41.7	34.0	37.9
Zinc	60.0J	65.8J	62.9

J - signifies an estimated positive result.

TABLE A-8

CONTAMINANT OCCURRENCE AND DISTRIBUTION - SOIL BORING SAMPLES
TPH AND BTEX RESULTS (mg/kg)
ROUND 11
SITE PS-2
FAIRCHILD AFB, WASHINGTON

Parameter	Soil Boring									
	1	2	3	4	5	6	7	8	9	10
0- TO 2-FOOT INTERVAL										
Benzene	0.003U(1)(3)		0.003U		0.003U				0.003U	
Toluene	0.003U		0.003U		0.003U				0.003U	
Xylene	0.003U		0.003U		0.003U				0.003U	
Ethylbenzene	0.003U		0.003U		0.003U				0.003U	
TPH	<20(2)				<20				<20	
2- TO 6-FOOT INTERVAL										
Benzene		0.003U	0.004U/ 0.004U		0.004U	**0.006**		0.004U	0.004U	0.003U
Toluene		0.003U	0.004U/ 0.004U		0.004U	0.004U		0.004U	0.004U	0.003U
Xylene		**0.007**	0.004U/ 0.004U		0.004U	0.004U		0.004U	0.004U	0.003U
Ethylbenzene		0.003U	0.004U/ 0.004U		0.004U	**0.005**		0.004U	0.004U	0.003U
TPH		<20	<20/<20		**180**	<20		<20	<20	<20
6- TO 10-FOOT INTERVAL										
Benzene		0.005U				0.460U				
Toluene		0.005U				0.460U				
Xylene		**0.014**				**4.7**				
Ethylbenzene		0.005U				**1.7**				
TPH		<20				<20				

TABLE A-8
CONTAMINANT OCCURRENCE AND DISTRIBUTION - SOIL BORING SAMPLES
TPH AND BTEX RESULTS (mg/kg)
ROUND 11
SITE PS-2
FAIRCHILD AFB, WASHINGTON
PAGE TWO

Parameter	Soil Boring									
	1	2	3	4	5	6	7	8	9	10
COMPOSITE										
Benzene				0.004U			0.420U			
Toluene				0.004U			0.420U			
Xylene				0.004U			0.420U			
Ethylbenzene				0.004U			0.420U			
TPH				<20			1,200			

(1) U signifies a nondetected result or a detection limit result.
(2) < signifies a nondetected result.
(3)
- 2-Hexanone was also detected in soil sample PS2-SS-001-001 at 0.007 mg/kg.
- Methylene chloride was detected in several subsurface soil samples (PS2-SS-002-002, PS2-SS-003-001,PS2-SS-003-002, PS2SS008-001, PS2SS009-001, and PS2SS009-002) at a concentration range of 0.011 to 0.110 mg/kg.
- Acetone was detected in PS2-SS-006-002 at 1.7 J mg/kg.
- Acetone was detected in PS2SS007-001 at 1.2 J mg/kg.

TABLE 4-9

CONTAMINANT OCCURRENCE AND DISTRIBUTION - COMPOSITE SOIL SAMPLES
ROUND 11
SITE PS-2
FAIRCHILD AFB, WASHINGTON

Parameter	Sample Number		Arithmetic Mean
	PS2-SS-004-001	PS2-SS-007-001	
METALS (mg/kg)			
Aluminum	9,920	11,500	10,710
Barium	137	110	124
Calcium	24,000J	4,140	14,070
Chromium	7.1J	9.4J	8.3
Cobalt	12.0	14.2	13.1
Copper	28.9	26.0	27.5
Iron	20,600	25,900	23,300
Magnesium	7,490J	5,130J	6,310
Manganese	359	505	432
Mercury	0.1U	0.1J	0.075
Nickel	7.5	8.2	7.9
Potassium	1,710	1,840	1,775
Sodium	299	210	255
Vanadium	37.0	50.7	43.9
Zinc	53.2J	52.5J	52.9
SEMIVOLATILE ORGANICS (mg/kg)			
Naphthalene	0.120U	0.570	0.32
2-Methylnaphthalene	0.120U	1.300	0.68

TABLE A-9
CONTAMINANT OCCURRENCE AND DISTRIBUTION - COMPOSITE SOIL SAMPLES
ROUND 11
SITE PS-2
FAIRCHILD AFB, WASHINGTON
PAGE TWO

Parameter	Sample Number		Arithmetic Mean
	PS2-SS-004-001	PS2-SS-007-001	
TCLP METALS (mg/L)			
Arsenic	<0.06	0.18	---
Barium	1.8	1.6	---
Lead	0.05	2.4 J	---
Cobalt	0.08	0.03	---
Copper	0.075	0.054	---
Iron	13	10	---
Manganese	5.9	6.3	---
Potassium	8.5	8.6	---
Zinc	0.38	0.45 U	---
Antimony	0.14	<0.07	---
Vanadium	0.16	<0.005	---
Magnesium	34	11	---
Calcium	700	60	---
Aluminum	2.5	0.2	---
MISCELLANEOUS PARAMETERS (mg/kg UNLESS NOTED)			
TOC	3,000	2,600	---
Kjeldahl Nitrogen	490	300 J	---
Ammoni Nitrogen	45	13	---
Total Phosphorus	370 J	460	---
Bulk Density (gm/cc)	1.1	1.2	---

TABLE A-9
CONTAMINANT OCCURRENCE AND DISTRIBUTION - COMPOSITE SOIL SAMPLES
ROUND 11
SITE PS-2
FAIRCHILD AFB, WASHINGTON
PAGE THREE

Parameter	Sample Number		Arithmetic Mean
	PS2-SS-004-001	PS2-SS-007-001	
GRAIN SIZE (% PASSED)			
1.0-Inch	100	100	—
3/4-Inch	97.7	95.9	—
1/2-Inch	92.4	93.6	—
3/8-Inch	90.9	91.4	—
Sieve No. 4	87.5	87.2	—
Sieve No. 10	80.3	79.7	—
Sieve No. 20	67.5	64.1	—
Sieve No. 40	57.0	53.2	—
Sieve No. 60	49.0	45.7	—
Sieve No. 140	39.7	33.8	—
Sieve No. 200	36.6	30.4	—
Particle Size 0.023 mm	23.5	16.9	—
Particle Size 0.007 mm	15.4	10.4	—
Particle Size 0.001 mm	10.5	5.7	—

J - signifies an estimated positive result.
U - signifies a nondetected result or a detection limit result.
The following fuel-related chemicals were detected in the TCLP extract of PS2-SS-007-001: ethylbenzene (210 µg/L); xylene (1,400 µg/L); 2-methylnaphthalene (32 µg/L); naphthalene (26 µg/L); lead (2,400 µg/L).

TABLE A-10

CONTAMINANT OCCURRENCE AND DISTRIBUTION - GROUNDWATER
ROUND 11
SITE PS-2
FAIRCHILD AFB, WASHINGTON

Parameter	Upgradient Alluvial Monitoring Well (56)		Alluvial Monitoring Well (177, 109, 110, 55, 176, 105, 106)				Basalt A Top-Mid Monitoring Wells (178, 180)	
	No. of Positive Detections/ No. of Samples	Range of Positive Detections (Arithmetic Mean)	No. of Positive Detections/ No. of Samples	Range of Positive Detections (Arithmetic Mean)	Geometric Mean	95%[1] UCL	No. of Positive Detections/ No. of Samples	Range of Positive Detections (Arithmetic Mean)
TOTAL PETROLEUM HYDROCARBONS								
TPH (mg/L)	0/1	----	6/14	4.0-110 (12.5)	0.67	29.4	0/2	----
VOLATILE ORGANIC COMPOUNDS (µg/L)								
Benzene	0/1	----	6/14	10-2,600 (220)	9.2	618	1/2	7.0[2] (4.3)
Ethylbenzene	0/1	----	6/14	5.0-1,200 (178)	12.6	380	1/2	10.0-11.0[2] (6.0)
Xylene	0/1	----	7/14	12-5,000 (648)	22.1	1,460	1/2	38-40[2] (20)
Chlorobenzene	0/1	----	3/14	2.0-18 (5.3)	2.7	8.9	0/2	----
SEMIVOLATILE ORGANIC COMPOUNDS (µg/L)								
Naphthalene	NA	----	2/11	8.5-32 (4.9)	2.3	11.1	0/1	----
2-Methylnaphthalene	NA	----	3/11	9.0-67 (9.3)	3.1	22	0/1	----
1,2,4-Trichlorobenzene	NA	----	1/11	3.0 (1.6)	1.6	1.7	0/1	----
Chrysene	NA	----	1/11	6.0 (3.3)	3.2	3.9	0/1	----
METALS (µg/L)								
Aluminum (Total)	NA	----	3/3	6,230-38,200 (26,000)	20,000	NC	1/1	299-323[2] (311)
Arsenic (Total)	NA	----	2/3	13.3-100 (39.7)	19.4	NC	1/1	6.4[2] (6.4)
(Dissolved)	NA	----	3/3	1.2-73.7 (26.3)	8.9	NC	1/1	2.0-2.2 (2.1)
Barium (Total)	NA	----	3/3	431-847 (609)	586	NC	1/1	202-203[2] (203)
(Dissolved)	NA	----	3/3	202-447 (345)	328	NC	1/1	181-188[2] (185)

TABLE A-10
CONTAMINANT OCCURRENCE AND DISTRIBUTION - GROUNDWATER
ROUND 11
SITE PS-2
FAIRCHILD AFB, WASHINGTON
PAGE TWO

Parameter	Upgradient Alluvial Monitoring Well (56)		Alluvial Monitoring Well (177, 109, 110, 55, 176, 105, 106)				Basalt A Top-Mid Monitoring Wells (178, 180)	
	No. of Positive Detections/ No. of Samples	Range of Positive Detections (Arithmetic Mean)	No. of Positive Detections/ No. of Samples	Range of Positive Detections (Arithmetic Mean)	Geometric Mean	95%(1) UCL	No. of Positive Detections/ No. of Samples	Range of Positive Detections (Arithmetic Mean)
METALS								
Calcium (Total)	NA	----	3/3	114,000-125,000 (114,000)	113,000	NC	1/1	55,000-55,200(2) (55,100)
(Dissolved)	NA	----	3/3	82,300-109,000 (95,900)	95,300	NC	1/1	55,800-56,100(2) (56,000)
Chromium (Total)	NA	----	2/3	16-32 (19.8)(3)	NC	NC	0/1	----
Cobalt (Total)	NA	----	2/3	42-51 (47)(3)	NC	NC	0/1	----
Copper (Total)	NA	----	2/3	52-69 (51)	49	NC	0/1	----
Iron (Total)	NA	----	3/3	24,600-119,000 (75,200)	624,000	NC	1/1	7,220-7,390(2) (7,300)
(Dissolved)	NA	----	3/3	41-12,400 (8,710)	1,910	NC	1/1	1,750-1,830(2) (1,790)
Lead (Total)	NA	----	10/11	8.0-130 (45.9)	30.6	76.3	0/1	----
Magnesium (Total)	NA	----	3/3	37,800-56,700 (45,200)	44,500	NC	1/1	38,000-38,400(2) (38,200)
(Dissolved)	NA	----	3/3	29,600-47,400 (39,000)	38,200	NC	1/1	39,900(2) (39,900)
Manganese (Total)	NA	----	3/3	2,340-13,400 (6,420)	4,830	NC	1/1	2,140-2,150(2) (2,150)
(Dissolved)	NA	----	3/3	2,170-10,700 (5,020)	3,730	NC	1/1	2,190-2,210(2) (2,200)
Nickel (Total)	NA	----	2/3	72-103 (88)(11)	NC	NC	1/1	45(2) (45)
(Dissolved)	NA	----	2/3	30-68 (35)	30	NC	1/1	33 (33)

TABLE A-10
CONTAMINANT OCCURRENCE AND DISTRIBUTION - GROUNDWATER
ROUND 11
SITE PS-2
FAIRCHILD AFB, WASHINGTON
PAGE THREE

Parameter	Upgradient Alluvial Monitoring Well (56)		Alluvial Monitoring Well (177, 109, 110, 55, 176, 105, 106)				Basalt A Top-Mid Monitoring Wells (178, 180)	
	No. of Positive Detections/ No. of Samples	Range of Positive Detections (Arithmetic Mean)	No. of Positive Detections/ No. of Samples	Range of Positive Detections (Arithmetic Mean)	Geometric Mean	95%(1) UCL	No. of Positive Detections/ No. of Samples	Range of Positive Detections (Arithmetic Mean)
METALS (CONTINUED)								
Potassium (Total)	NA	----	3/3	7,930-9,750 (9,150)	9,130	NC	1/1	4,700-4,740(2) (4,720)
(Dissolved)	NA	----	3/3	5,010-8,250 (6,470)	6,310	NC	1/1	5,140-5,270(2) (5,210)
Sodium (Total)	NA	----	3/3	14,800-84,000 (39,800)	29,400	NC	1/1	14,000-14,400(2) (14,200)
(Dissolved)	NA	----	3/3	10,800-79,300 (36,400)	25,400	NC	1/1	15,000-15,200 (2) (15,100)
Selenium (Total)	NA	----	0/3	----	----	NC	1/1	0.7(2) (0.7)
Vanadium (Total)	NA	----	2/3	145-178 (113)	84.8	NC	1/1	7.0(2) (7.0)
Zinc (Total)	NA	----	3/3	121-160 (140)	139	NC	1/1	9.0(2) (9.0)
(Dissolved)	NA	----	3/3	4.0-7.0 (5.2)	5.1	NC	1/1	6.0(2) (6.0)

(1) Upper 95% confidence level on arithmetic mean.
(2) Range shown is from a field duplicate pair.
(3) Arithmetic mean of Positive Detections only, due to analyses by different methods with different detection limits.
NA - Not Analyzed.
NC - Not Calculated.

TABLE A-11

CONTAMINANT OCCURRENCE AND DISTRIBUTION - SURFACE SOIL SAMPLES
ROUND 11
SITE PS-6
FAIRCHILD AFB, WASHINGTON

Parameter	Range of Positive Detections (Arithmetic Mean)	Geometric Mean	95% UCL(1)	Frequency of Detection
MISCELLANEOUS PARAMETERS (mg/kg)				
TPH(6)	48.4,400 (739)	140	2,240	6/8
SEMIVOLATILE ORGANIC CHEMICALS (mg/kg)				
Naphthalene	0.41 (0.10)	0.07	0.23	1/8
Fluorene	0.79 (0.18)	0.10	0.43	1/8
Phenanthrene	0.41-6.4 (1.0)	0.21	3.2	2/8
Di-n-butyl phthalate	0.25-0.28 (0.18)	0.15	0.28	2/8
Fluoranthene	0.32-9.0 (1.7)	0.42	4.7	4/8
Pyrene	0.6-4.8 (0.84)	0.21	2.5	2/8
Chrysene	0.29-3.8 (0.74)	0.26	2.0	3/8
Benzo(b)fluoranthene	0.21-3.1 (0.68)	0.27	1.7	4/8
Benzo(k)fluoranthene	2.1 (0.36)	0.12	1.1	1/8
Benzo(a)pyrene	0.53-2.6 (0.52)	0.21	1.4	2/8
Indeno(1,2,3-cd)pyrene	0.36-1.6 (0.36)	0.19	0.87	2/8
Benzo(g,h,i)perylene	0.33-1.7 (0.40)	0.23	0.93	2/8
Benzo(a)anthracene	3.3 (0.55)	0.15	1.7	1/8

TABLE A-11
CONTAMINANT OCCURRENCE AND DISTRIBUTION - SURFACE SOIL SAMPLES
ROUND 11
SITE PS-6
FAIRCHILD AFB, WASHINGTON
PAGE TWO

Parameter	Range of Positive Detections (Arithmetic Mean)	Geometric Mean	95% UCL(1)	Frequency of Detection
METALS (mg/kg)				
Aluminum	10,100-14,400 (11,400)	11,300	12,600	8/8
Antimony	12.5 (4.3)	4.1	5.9	1/8
Arsenic	7.3 (4.1)	3.9	5.6	1/8
Barium	119-692 (283)	231	477	8/8
Cadmium	0.20-3.1 (1.1)	0.78	2.0	6/8
Calcium	3,650-7,350 (4,890)	4,770	6,042	8/8
Chromium	8.3-43.1 (22.0)	18.7	34.7	8/8
Cobalt	6.8-14.9 (11.7)	11.5	14.1	8/8
Copper	13.3-22.5 (18.4)	18.2	21.1	8/8
Iron	15,500-25,700 (21,300)	21,100	24,200	8/8
Lead	11.5-248 (81.3)	51.0	160	8/8
Magnesium	4,160-6,150 (4,770)	4,740	5,330	8/8
Manganese	328-702 (435)	422	551	8/8
Nickel	7.0-12.6 (10.8)	10.6	12.7	8/8
Potassium	1,790-2,440 (2,170)	2,160	2,360	8/8
Sodium	141-239 (196)	192	233	8/8
Vanadium	23.2-40.4 (34.5)	34.0	39.9	8/8
Zinc	40.4-402 (126)	93.1	243	8/8

(1) Upper 95% confidence level on arithmetic mean.
TPH - Total Petroleum Hydrocarbons.

TABLE A-12

CONTAMINANT OCCURRENCE AND DISTRIBUTION - SUBSURFACE SOIL SAMPLES
TPH AND BTEX RESULTS (mg/kg)
ROUND 11
SITE PS-6
FAIRCHILD AFB, WASHINGTON

Parameter	Soil Boring							
	1	2	3	4	5	6	7	8
0- TO 2-FOOT SAMPLES								
Xylenes	0.003U(1)		0.003U					
TPH	<20(2)		<20					
2- TO 4-FOOT SAMPLES								
Xylenes	0.003U	0.003U		0.004U/(3) 0.003U				
TPH	<20	<20		<20/<20				
4- TO 6-FOOT SAMPLES								
Xylenes							0.003U	
TPH							<20	
6- TO 8-FOOT SAMPLES								
Xylenes		0.048		0.003U	0.003U			
TPH		<20		<20	<20			
COMPOSITE SAMPLES								
Xylenes						0.003U		0.003U
TPH						130		25

(1) U signifies a nondetected result or a detection limit result.
(2) < signifies a nondetected result.
(3) Field duplicate pair results are displayed.

TABLE A-13

CONTAMINANT OCCURRENCE AND DISTRIBUTION - COMPOSITE SOIL BORING SAMPLE RESULTS
ROUND 11
SITE PS-6
FAIRCHILD AFB, WASHINGTON

Parameter	Soil Boring Sample Identifier		Arithmetic Mean
	PS6-SS-008-001	PS6-SS-006-001	
METALS (mg/kg)			
Aluminum	7,680	8,700	8,190
Barium	71	79.8	75.4
Calcium	4,840J(5)	4,340J	4,590
Chromium	7.6J	11.8J	9.7
Cobalt	8.3	10.0	9.2
Copper	26.9	21.9	24.4
Iron	19,200	20,500	19,900
Lead	9.5UJ	11.9J	8.3
Magnesium	4,540J	5,470J	5,000
Manganese	335	348	342
Nickel	6.1	8.6	7.4
Potassium	1,410	1,650	1,530
Vanadium	25.5	30.5	28.0
Zinc	38.2J	65.4J	51.8
SEMIVOLATILE ORGANICS (mg/kg)			
Diethyl phthalate	0.26U(6)	2.00	1.1
Di-n-butyl phthalate	0.19	0.23	0.21

TABLE A-13
CONTAMINANT OCCURRENCE AND DISTRIBUTION - COMPOSITE SOIL BORING SAMPLE RESULTS
ROUND 11
SITE PS-6
FAIRCHILD AFB, WASHINGTON
PAGE TWO

Parameter	Soil Boring Sample Identifier		Arithmetic Mean
	PS6-SS-008-001	PS6-SS-006-001	
TCLP METALS (mg/L)			
Aluminum	0.12	0.15	---
Arsenic	0.14	0.18	---
Barium	0.77	1.0	---
Calcium	91	93	---
Copper	0.046	0.11	---
Lead	<0.02	0.04	---
Mangesium	8.4	11	---
Manganese	2.1	2.6	---
Iron	0.21	0.048	---
Potassium	8.4	8.9	---
Vanadium	0.006	<0.005	---
MISCELLANEOUS PARAMETERS (mg/kg UNLESS NOTED)			
TOC	1,000	650	---
Kjeldahl Nitrogen	920	160	---
Ammonia Nitrogen	<9.9	4.1	---
Total Phosphorus	310	380	---
Bulk Density (gm/cc)	1.2	1.4	---

TABLE A-13
CONTAMINANT OCCURRENCE AND DISTRIBUTION - COMPOSITE SOIL BORING SAMPLE RESULTS
ROUND 11
SITE PS-6
FAIRCHILD AFB, WASHINGTON
PAGE THREE

Parameter	Soil Boring Sample Identifier		Arithmetic Mean
	PS6-SS-008-001	PS6-SS-006-001	
GRAIN SIZE (PERCENT PASSED)			
3/4-Inch	100		---
1/2-Inch	98.1	100	---
3/8-Inch	95.3	97.7	---
Sieve No. 4	89.4	92.2	---
Sieve No. 10	78.3	77.6	---
Sieve No. 20	54.8	42.4	---
Sieve No. 40	36.3	19.2	---
Sieve No. 60	28.3	14.6	---
Sieve No. 140	18.0	10.7	---
Sieve No. 200	15.3	9.8	---
Particle Size 0.023 mm	8.6	6.9	---
Particle Size 0.007 mm	5.5	5.4	---
Particle Size 0.001 mm	3.9	2.3	---

TABLE A-14

CONTAMINANT OCCURRENCE AND DISTRIBUTION - GROUNDWATER
ROUND 11
SITE PS-6
FAIRCHILD AFB, WASHINGTON

Parameter	Alluvial Monitoring Wells (188, 189, 34)				Basalt A Monitoring Well (190)	
	No. of Positive Detections/ No. of Samples	Range of Positive Detections	Arithmetic Mean	Geometric Mean	No. of Positive Detections/ No. of Samples	Range of Positive Detections
VOLATILE ORGANICS (µg/L)						
Trichloroethene	1/3	10	4.0	2.2	0/1	----
METALS (µg/L)						
Aluminum (Total)	1/1	71,800-114,000[1]	92,900	NC[6]	1/1	1,330
Arsenic (Total)	1/1	49-64.6[1]	56.8	NC	1/1	1.7
(Dissolved)	1/1	9.0-9.4[1]	9.2	NC	1/1	1.3
Barium (Total)	1/1	743-1,020[1]	882	NC	1/1	27.0
(Dissolved)	1/1	189-193[1]	191	NC	1/1	16.0
Calcium (Total)	1/1	104,000-115,000[1]	110,000	NC	1/1	24,100
(Dissolved)	1/1	80,800-80,900[1]	80,900	NC	1/1	24,400
Chromium (Total)	1/1	74.0-91.0[1]	83.0	NC	0/1	----
Cobalt (Total)	1/1	58.0-95.0[1]	77.0	NC	0/1	----
Copper (Total)	1/1	113-165[1]	139	NC	0/1	----
Iron (Total)	1/1	115,000-169,000[1]	142,000	NC	1/1	2,030
(Dissolved)	1/1	171-187[1]	179	NC	0/1	----
Lead (Total)	1/1	47.8-78.0[1]	63.0	NC	0/1	----
Magnesium (Total)	1/1	41,000-52,400[1]	46,700	NC	1/1	6,350
(Dissolved)	1/1	17,600-17,800[1]	17,700	NC	1/1	6,410

TABLE A-14
CONTAMINANT OCCURRENCE AND DISTRIBUTION - GROUNDWATER
ROUND 11
SITE PS-6
FAIRCHILD AFB, WASHINGTON
PAGE TWO

Parameter	Alluvial Monitoring Wells (188, 189, 34)				Basalt A Monitoring Well (190)	
	No. of Positive Detections/ No. of Samples	Range of Positive Detections	Arithmetic Mean	Geometric Mean	No. of Positive Detections/ No. of Samples	Range of Positive Detections
METALS (Continued)						
Manganese (Total)	1/1	7,910-9,750[1]	8,830	NC	1/1	59
(Dissolved)	1/1	3,270-3,360[1]	3,320	NC	0/1	----
Nickel (Total)	1/1	129-166[1]	148	NC	0/1	----
(Dissolved)	1/1	30.0	30.0	NC	0/1	----
Potassium (Total)	1/1	11,800-16,800[1]	14,300	NC	1/1	770
(Dissolved)	1/1	4,010-4,240[1]	4,130	NC	1/1	732
Sodium (Total)	1/1	11,300-12,200[1]	11,800	NC	1/1	6,160
(Dissolved)	1/1	9,610-9,990[1]	9,800	NC	1/1	6,540
Vanadium (Total)	1/1	169-255[1]	212	NC	0/1	----
Zinc (Total)	1/1	267-387[1]	327	NC	1/1	16.0
(Dissolved)	1/1	7.0	7.0	NC	1/1	4.0

(1) Range of field duplicate pair results.
NC - Not calculated.

TABLE A-15

CONTAMINANT OCCURRENCE AND DISTRIBUTION - SURFACE SOIL SAMPLES
ROUND 11
SITE PS-8
FAIRCHILD AFB, WASHINGTON

Parameter	Range of Positive Detections (Arithmetic Mean)	Geometric Mean	95%(1) UCL	Frequency of Detections
TPH (mg/kg)	24-330 (72.7)	30.0	205	4/7
SEMIVOLATILE ORGANICS (mg/kg)				
Di-n-butyl phthalate	0.37-0.68 (0.47)	0.461	0.554	7/7
METALS (mg/kg)				
Aluminum	8,940-12,200 (10,900)	10,900	12,100	7/7
Antimony	7.8-19.8 (5.3)	4.5	9.7	2/7
Arsenic	12.2 (4.8)	4.1	8.7	1/7
Barium	121-826 (269)	203	559	7/7
Cadmium	0.51-1.0 (0.43)	0.37	0.75	3/7
Calcium	3,210-4,870 (3,700)	3,670	4,220	7/7
Chromium	11.1-24.2 (17.6)	17.2	22.2	7/7
Cobalt	9.8-12.7 (10.9)	10.8	12.3	7/7
Copper	15.2-18.0 (16.5)	16.5	17.5	7/7
Iron	17,000-22,200 (19,100)	19,000	21,300	7/7
Lead	24.4-84.1 (56.9)	53.2	78.0	7/7
Magnesium	4,200-4,940 (4,560)	4,550	4,860	7/7
Manganese	361-487 (399)	397	451	7/7
Nickel	8.5-13.1 (10.7)	10.7	12.2	7/7
Potassium	1,610-2,390 (2,150)	2,140	2,380	7/7
Sodium	156-244 (199)	197	232	7/7
Vanadium	22.9-38.5 (29.8)	29.3	36.2	7/7
Zinc	55.3-84.8 (63.9)	63.2	75.4	7/7

(1) Upper 95% confidence level on arithmetic mean.

TABLE A-16

CONTAMINANT OCCURRENCE AND DISTRIBUTION - SOIL BORING SAMPLES
TPH AND VOC RESULTS (mg/kg)
ROUND 11
SITE PS-8
FAIRCHILD AFB, WASHINGTON

Parameter	Soil Boring												Range of Positive Detections
	1	2	3	4	5	6	7	8	9	10	11	12	
0- TO 2-FOOT SAMPLES													
HNu Readings	1.6	30	----	1.5	1.25	25	----	----	3.5	1.5	----	----	1.25-30
VOC Results	NPD(1)	NPD	NS(2)	NS	NPD	NPD	NS	NS	NS	NS	NS	NS	NPD
TPH	<20	<20	NS	NS	<20	<20	NS	NS	NS	NS	NS	NS	NPD
2- TO 4-FOOT SAMPLES													
HNu Readings	1.0	20	----	1.5	1.0	10	15	0.5	5.0	5.0	6.5	1.0	0.5-20
VOC Results	NS	NS	NS	NPD	NS	NS	NS	NPD/NPD(3)	NS	NPD	NPD	NS	NPD
TPH	NS	NS	NS	(4)<20	NS	NS	NS	<20/<20	NS	<20	3,200	NS	3,200
4- TO 6-FOOT SAMPLES													
HNu Readings	----	22	2.0	1.0	0.5	12	15	1.5	1.5	1.0	22	2	0.5-22
Xylene	NS	0.039	NS	NS	NS	0.003U(5)	0.003U	NS	NS	NS	0.003U	NS	0.039
TPH	NS	<20	NS	NS	NS	<20	<20	NS	NS	NS	22,000	NS	22,000
6- TO 8-FOOT SAMPLES													
HNu Readings	0.2	4.0	1.0	1.0	0.5	6	22	15	0.5	1.0	4.0	0.5	0.2-22
VOC Results	NS	NS	NS	NS	NS	NS	----	NPD	NS	NS	NS	NS	NPD
TPH	NS	NS	NS	NS	NS	NS	NS	<20	NS	NS	NS	NS	NPD
8- TO 10-FOOT SAMPLES													
HNu Readings	2.0	24	1.0	1.0	NS	80	150	7.0	4.5	10	6.5	1.0	1-150
VOC Results	NS	NS	NPD	NS	NS	NS	NPD	NS	NS	NPD	NS	NS	NPD
TPH	NS	NS	<20	NS	NS	NS	38	NS	NS	53	NS	NS	38-53
COMPOSITE SAMPLES													
HNu Readings	NS	NS	NS	NS	NS	NS	NS	NS	----	NS	NS	----	NPD
VOC Results	NS	NS	NS	NS	NS	NS	NS	NS	NPD	NS	NS	NPD	58-3,200
TPH	NS	NS	NS	NS	NS	NS	NS	NS	3,200	NS	NS	58/63	58-3,200

(1) ---- No positive detections
(2) NS Not sampled
(4) < Represents a nondetected result
(5) U Chemical quantitation limit

TABLE A-17

CONTAMINANT OCCURRENCE AND DISTRIBUTION - GROUNDWATER
ROUNDS 8, 9, AND 11
SITE PS-8
FAIRCHILD AFB, WASHINGTON

Parameter	Alluvial Monitoring Wells (181, 107, 108, 111, 66, 30, 31, 68, 67, 184, 112, 113, 183)				Top-Mid Basalt A Monitoring Wells (185, 186, 187)		
	No of Positive Detections/ No of Samples	Range of Positive Detections (Arithmetic Mean)	Geometric Mean	95% UCL(1)	No of Positive Detections/ No of Samples	Range of Positive Detections (Arithmetic Mean)	Geometric Mean
TOTAL PETROLEUM HYDROCARBONS							
TPH (mg/L)	12/20	0.2-4 (1.3)	0.48	2.2	0/3	...	...
VOLATILES (µg/L)							
Trichloroethene	0/21	... ...	...	...	3/3	13-26 (17.7)	16.8
Benzene	1/21	5.0 (5.5)	3.2	5.0	0/3	...	...
Ethylbenzene	10/21	6.0-530 (101)	12.6	174	0/3	...	...
Xylene	10/21	9.0-3,100 (423)	23.9	794	0/3	...	...
SEMIVOLATILES (µg/L)							
Naphthalene	7/15	5.0-49 (10)	4.4	17.8	0/1	...	...
2-Methylnaphthalene	2/15	8.0-10 (7.8)	4.2	10.0	0/1	...	...
2,4-Dimethylphenol	7/9	7.0-27 (3.2)	2.2	5.7	0/1	...	...
METALS (µg/L)							
Aluminum (Total)	5/6	5,410-30,700 (19,500)	7,260	33,400	1/1	498	NC
Arsenic (Total)	6/6	12.1-23.7 (18)	17.6	23.0	1/1	1.1	NC
(Dissolved)	5/6	1.7-11.6 (5.8)	3.5	10.8	0/1	...	...
Barium (Total)	6/6	335-737 (487)	470	642	1/1	16	NC
(Dissolved)	6/6	109-524 (326)	276	506	0/1	...	...
Calcium (Total)	6/6	80,000-145,000 (107,000)	105,000	134,000	1/1	18,900	NC
(Dissolved)	6/6	74,000-145,000 (105,000)	102,000	133,000	1/1	19,000	NC
Chromium (Total)	3/6	17-33 (16.4)	13.8	27.0	0/1	...	...
Cobalt (Total)	2/6	32-36 (18)	15	31.1	0/1	...	...

TABLE A-17
CONTAMINANT OCCURRENCE AND DISTRIBUTION - GROUNDWATER
ROUNDS 8, 9, AND 11
SITE PS-8
FAIRCHILD AFB, WASHINGTON
PAGE TWO

Parameter		Alluvial Monitoring Wells (181, 107, 108, 111, 66, 30, 31, 68, 67, 184, 112, 113, 183)				Basalt A Top-Mid Monitoring Wells (185, 186, 187)		
		No of Positive Detections/ No of Samples	Range of Positive Detections (Arithmetic Mean)	Geometric Mean	95%(1) UCL	No of Positive Detections/ No of Samples	Range of Positive Detections (Arithmetic Mean)	Geometric Mean
METALS (CONTINUED)								
Copper	(Total)	4/6	38-47 (30 4)	19 7	51 9	0/1	---	---
	(Dissolved)	1/6	4 0 (1 9)	1 7	3 0	0/1	---	---
Iron	(Total)	6/6	26,000-69,500 (42,800)	40,800	58,800	1/1	686	NC
	(Dissolved)	5/6	65-27,100 (13,100)	2,030	25,800	0/1	---	---
Lead	(Total)	14/15	6 0-230 (40 8)	15 2	77.1	0/1	---	---
Magnesium	(Total)	6/6	25,900-59,800 (38,300)	36,700	51,500	1/1	5,410	NC
	(Dissolved)	6/6	18,000-55,700 (33,900)	31,200	49,400	1/1	5,480	---
Manganese	(Total)	6/6	933-9,800 (4,930)	3,690	8,480	0/1	---	---
	(Dissolved)	4/6	3,950-9,420 (4,390)	468	8,400	0/1	---	---
Nickel	(Total)	6/6	32-73 (56 2)	54 0	73	0/1	---	---
	(Dissolved)	3/6	32-63 (31.2)	26 2	52 4	0/1	---	---
Potassium	(Total)	6/6	6,200-13,200 (9,280)	9,030	11,800	1/1	2,600	NC
	(Dissolved)	6/6	3,610-11,800 (7,350)	6,520	11,300	1/1	2,820	NC
Sodium	(Total)	6/6	10,800-27,000 (17,000)	16,200	23,300	1/1	8,430	NC
	(Dissolved)	6/6	10,300-28,000 (17,300)	16,400	24,000	1/1	8,790	NC
Vanadium	(Total)	4/6	50-56 (33 3)	22 1	56	1/1	17	NC
Zinc	(Total)	6/6	11-112 (74 8)	56 0	112	1/1	17	NC
	(Dissolved)	2/6	6 0-7 0 (3 6)	3 1	6 0	1/1	4	NC

(1) Upper 95% confidence limit on the arithmetic mean
NC - Not calculated
TPH - Total Petroleum Hydrocarbons

TABLE A-18

CHEMICAL OCCURRENCE AND DISTRIBUTION - SURFACE WATER AND SEDIMENT SAMPLES
ROUND 9
SITE WW-1
FAIRCHILD AFB, WASHINGTON

Parameters	Background Concentration (1)	Sample Numbers				Federal SWDA Maximum Contaminant Level	Ambient Water Quality Criteria
							Aquatic Life
		WW1-SWND5-009	WW1-SWND5-010	WW1-SWND5-011	WW1-SWND5-012		Chronic Esposure
SURFACE WATER							
	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)
Arsenic	NA(2)	3	3	3	4	50	190
Cadmium	NA	5U(3)	5U	5U	5U	5	1.1
Lead	NA	2U	1U	2U	1U	15 (Action Level)	3.2
SEDIMENT							
	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Arsenic	8.3J(4)	6.9J	8.4J	7J	5.6J	NA	33(5)
Cadmium	2.7J	12.90J	17.3J	10.8J	2.6J	NA	31(5)
Lead	23.9U	89.60	75.8	58.7	35.0U	NA	132(5)

(1) Background data collected by SAIC during R9 sampling event.
(2) NA - Not applicable.
(3) U - Signifies a nondetected result or a detection limit result.
(4) J - Signifies an estimated positive result.
(5) Threshold Sediment Concentration (Batelle, 1985).

TABLE A-19

CONTAMINANT OCCURRENCE AND DISTRIBUTION - LAGOON SURFACE WATER SAMPLES(1)
ROUND 11
SITE WW-1
FAIRCHILD AFB, WASHINGTON

Parameter	Range of Positive Detections (Arithmetic Mean)	95% UCL(2)	Geometric Mean	Frequency of Detections
VOLATILE ORGANICS (mg/L)				
Methylene chloride	0.007 (0.002)	0.005	0.001	1/7
Acetone	0.006 (0.006)			2/7
MISCELLANEOUS PARAMETERS				
TPH (mg/L)	0.4-3.0 (0.76)	1.9	0.32	4/7
TDS (mg/L)	290-350 (325)	346	324	7/7
Alkalinity (mg/L)	180-200 (191)	202	191	7/7
Chloride (mg/L)	31-49 (39.5)	47.8	38.8	7/7
Fluoride (mg/L)	0.59-1.4 (0.84)	1.1	0.80	7/7
Sulfate (mg/L)	8.0-17 (13.9)	18.5	13.2	7/7
METALS (TOTAL AND [DISSOLVED]) (µg/L)				
Aluminum	96-186 (94.3) 94 (49.1)	138 59.6	85.4 48.4	5/7 1/7
Arsenic	2.4-10.8 (4.5) 2.1-4.6 (2.6)	8.2 3.9	3.6 2.4	6/7 6/7
Barium	84-109 (93.4) 73-95 (81.8)	103 90.4	93.1 81.4	7/7 7/7
Calcium	50,400-55,300 (52,500) 51,000-56,000 (52,400)	54,700 54,400	52,500 52,400	7/7 7/7
Iron	290-1,330 (560) 51-141 (65.3)	979 95.4	476 55.0	7/7 7/7
Magnesium	13,300-15,800 (14,400) 13,100-15,900 (14,300)	15,500 15,600	14,400 14,300	7/7 7/7
Manganese	138-444 (262) 116-517 (244)	368 390	247 219	7/7 7/7
Potassium	3,500-4,680 (4,040) 3,500-4,930 (4,120)	4,600 4,700	4,010 4,090	7/7 7/7
Sodium	29,000-37,500 (34,100) 32,400-36,300 (34,600)	37,000 35,800	34,000 34,500	7/7 7/7

(1) Units are µg/L unless otherwise indicated.
(2) Upper 95% confidence limit on the arithmetic mean.

TABLE A-20

CONTAMINANT OCCURRENCE AND DISTRIBUTION - NO NAME DITCH SURFACE WATERS(1)
NOVEMBER 1991
SITE WW-1
FAIRCHILD AFB, WASHINGTON

Parameter	Range of Positive Detections (Arithmetic Mean)	Geometric Mean	95% UCL(2)	Frequency of Detection
PESTICIDES/PCBs (µg/L)				
Endosulfan Sulfate	0.054-0.14 (0.035)	0.019	0.090	2/7
TOTAL PETROLEUM HYDROCARBONS (mg/L)				
TPH	0.4-1.5 (0.43)	0.25	1.0	3/7
MISCELLANEOUS PARAMETERS (mg/L)				
TDS(10)	310-340 (326)	326	340	7/7
TSS(11)	12 (6.2)	5.8	9.2	1/7
Alkalinity	170-220 (193)	193	213	7/7
METALS (µg/L)				
Aluminum	156-297 (118.6) NC	91.6	212	4/7 —
Barium	70-91 (83.6) 70-85 (77.1)	83.2 76.7	92.6 85.0	7/7 7/7
Cadmium	5-6 (3.5) 5-6 (3.5)	3.2 3.2	5.2 5.2	2/7 2/7
Calcium	52,300-53,800 (53,050) 51,600-52,700 (52,200)	53,000 52,200	53,600 52,600	7/7 7/7
Chromium	10-14 (7.33) 10 (5.83)	6.7 5.6	11.4 8.0	2/7 1/7
Iron	186-658 (357) 46-163 (97.4)	323 87.8	539 148	7/7 7/7
Lead	1.1-2.1 (1.7) 1-2.7 (1.2)	1.6 0.97	2.0 2.0	7/7 5/7
Magnesium	15,500-16,300 (15,900) 15,300-16,100 (15,600)	15,900 15,600	16,200 15,900	7/7 7/7

TABLE A-20
CONTAMINANT OCCURRENCE AND DISTRIBUTION - NO NAME DITCH SURFACE WATERS(1)
NOVEMBER 1991
SITE WW-1
FAIRCHILD AFB, WASHINGTON
PAGE TWO

Parameter	Range of Positive Detections (Arithmetic Mean)	Geometric Mean	95% UCL(2)	Frequency of Detection
METALS (µg/L)				
Manganese	106-166 (124) 36-87 (61.5)	123 57.9	148 84.6	7/7 7/7
Potassium	4,180-12,600 (8,170) 4,080-12,500 (8,100)	7,470 7,410	11,900 11,700	7/7 7/7
Sodium	32,400-35,200 (34,300) 31,900-35,100 (34,000)	34,252 34,000	35,396 35,100	7/7 7/7

(1) Units are µg/L unless otherwise indicated.
(2) Upper 95% confidence level on arithmetic mean.
TDS - Total Dissolved Solids.
TSS - Total Suspended Solids.
NC - Not Calculated

TABLE A-21

CONTAMINANT OCCURRENCE AND DISTRIBUTION - NO NAME DITCH SEDIMENTS
ROUND 11
SITE WW-1
FAIRCHILD AFB, WASHINGTON

Parameter	Range of Positive Detections (Arithmetic Mean)	Geometric Mean	95% UCL (1)	Frequency of Detections
VOLATILE ORGANICS (mg/kg)				
Chloromethane	0.003 (0.003)	0.003	0.003	1/7
Acetone	0.25 (0.049)	0.014	0.152	1/7
Toluene	0.28 (0.049)	0.005	0.168	1/7
SEMIVOLATILE ORGANICS (mg/kg)				
4-Methylphenol	1.5 (0.31)	0.12	0.92	1/7
Di-n-butyl phthalate	1.1 (0.29)	0.19	0.7	1/7
TOTAL PETROLEUM HYDORCARBONS				
TPH (mg/kg)	72 - 310 (107)	53.3	228	4/7
METALS (mg/kg)				
Aluminum	5,240-9,480 (7,370)	7,200	9,170	7/7
Antimony	47.4 (12.3)	7.5	30.4	1/7
Barium	50.7-626 (168)	105	404	7/7
Cadmium	11.2 (2.9)	1.4	7.2	1/7
Calcium	1,970-264,000 (48,400)	8,550	159,000	7/7
Chromium	9.9-60.3 (21.6)	17.5	41.7	7/7
Cobalt	5.7-9.1 (6.8)	6.6	8.7	6/7
Copper	7.3-30.8 (16.7)	15.3	25.2	7/7
Iron	15,000-23,300 (19,000)	18,800	22,200	7/7
Lead	12.7-35.5 (23.9)	16.6	47.4	4/7
Magnesium	3,750-9,090 (5,770)	5,530	7,800	7/7
Manganese	193-852 (419)	359	696	7/7

TABLE A-21
CONTAMINANT OCCURRENCE AND DISTRIBUTION - NO NAME DITCH SEDIMENTS
ROUND 11
SITE WW-1
FAIRCHILD AFB, WASHINGTON
PAGE TWO

Parameter	Range of Positive Detections (Arithmetic Mean)	Geometric Mean	95% UCL (1)	Frequency of Detection
METALS (mg/kg) (Continued)				
Nickel	4.5-7.1 (6.0)	5.9	6.9	6/7
Potassium	880-1,460 (1,200)	1,190	1,440	7/7
Vanadium	18.1-37.1 (26.0)	25.3	32.8	7/7
Zinc	41.3-97.9 (62.5)	60.0	84.2	7/7

(1) Upper 95% confidence limit on the arithmetic mean.

TABLE A-22

CONTAMINANT OCCURRENCE AND DISTRIBUTION - LAGOON
SEDIMENT SAMPLES
ROUND 11
SITE WW-1
FAIRCHILD AFB, WASHINGTON

Parameter	Range of Positive Detections (Arithmetic Mean)	95%(1) UCL	Frequency of Detections
TOTAL PETROLEUM HYDROCARBONS			
TPH (mg/kg)	150-8,300 (2,400)	4,800	8/9
VOLATILE ORGANICS (mg/kg)			
Toluene	0.008-0.032 (0.010)	0.019	3/9
Xylene	0.032-0.0058 (0.013)	0.03	3/9
SEMIVOLATILE ORGANICS (mg/kg)			
2-Methylnapthalene	0.22-0.51 (0.154)	0.28	2/9
Diethyl phthalate	0.35 (0.22)	0.29	1/9
Phenanthrene	0.11-0.91 (0.18)	0.34	3/9
Fluoranthene	0.33-1.1 - (0.15)	0.77	2/9
Pyrene	0.40-0.88 (0.19)	0.34	2/9
Benzo(a)anthracene	0.42 (0.15)	0.22	1/9
Chrysene	0.68 (0.19)	0.29	1/9
Bis(2-ethylhexyl) phthalate	0.32-4.0 (1.2)	2.3	7/9
Di-n-butyl phthalate	0.51-0.78 (0.52)	0.68	7/9

TABLE A-22
CONTAMINANT OCCURRENCE AND DISTRIBUTION - LAGOON SEDIMENT SAMPLES
ROUND 11
SITE WW-1
FAIRCHILD AFB, WASHINGTON
PAGE TWO

Parameter	Range of Positive Detections (Arithmetic Mean)	95%(1) UCL	Frequency of Detection
METALS (mg/kg)			
Aluminum	6,550-19,800 (11,500)	15,000	9/9
Antimony	13.1 (6.6)	9.3	1/9
Arsenic	16.1		1/9
Barium	56.9-607 (235)	366	9/9
Beryllium	0.74-0.89 (0.298)	0.57	2/9
Cadmium	3.6-11.1 (4.2)	8.0	5/9
Calcium	3.810-72,200 (24,796)	42,300	9/9
Chromium	9.1-93.4 (38.6)	60.6	9/9
Cobalt	7.3-38.1 (15.4)	24.0	9/9
Copper	13.7-107.0 (47.8)	75.2	9/9
Iron	13,700-37,300 (19,369)	27,600	9/9
Lead	15.3-451 (156)	283	8/9
Magnesium	3,390-8,040 (5,900)	7,060	9/9
Manganese	290-4,440 (1,099)	2,300	9/9
Mercury	0.6-0.9 (0.38)	0.68	5/9
Nickel	8.1-46.8 (17.6)	27.4	9/9
Potassium	996-2,150 (1,619)	1,980	9/9
Sodium	156-611 (299)	458	7/9
Vanadium	17.2-61.5 (36.9)	49.9	9/9
Zinc	32.5-439 (152)	270	9/9

(1) Upper 95% confidence level on arithmetic mean.
TPH - Total Petroleum Hydrocarbons.

TABLE A-23

CONTAMINANT OCCURRENCE AND DISTRIBUTION - DIKE SURFACE SOIL SAMPLES (mg/kg)(1)
ROUND 11
SITE WW-1
FAIRCHILD AFB, WASHINGTON

Parameter	Range of Positive Detections (Arithmetic Mean)	Geometric Mean	95% UCL(2)	Frequency of Detections
TPH	34 - 1,800 (364)	75.7	1,110	5/7
Aluminum	9,050 - 12,800 (11,500)	11,500	12,800	7/7
Barium	75.5 - 168 (112)	109	144	7/7
Cadmium	3.5 - 7.9 (3.3)	2.1	6.4	4/7
Calcium	3,780 - 11,600 (6,650)	6,112	9,810	7/7
Chromium	11.7 - 38.6 (21.2)	19.5	31.5	7/7
Cobalt	8.3 - 10.3 (9.2)	9.1	10.0	7/7
Copper	15.2 - 43.2 (22.1)	20.5	33.2	7/7
Iron	17,500 - 22,400 (20,400)	20,400	22,200	7/7
Lead	13.5 - 139 (43.5)	26.9	94.3	6/7
Magnesium	4,920 - 6,320 (5,550)	5,530	6,060	7/7
Manganese	228 - 532 (363)	354	453	7/7
Mercury	0.1 - 0.4 (0.15)	0.13	0.28	7/7
Sodium	221 - 247 (154)	129	247	3/7
Nickel	10.8-12.8 (11.7)	11.7	12.4	7/7

TABLE A-23
CONTAMINANT OCCURRENCE AND DISTRIBUTION - DIKE SURFACE SOIL SAMPLES (MG/KG)(1)
ROUND 11
SITE WW-1
FAIRCHILD AFB, WASHINGTON
PAGE TWO

Parameter	Range of Positive Detections (Arithmetic Mean)	Geometric Mean	95% UCL(2)	Frequency of Detections
Potassium	1,660-2,400 (2,037)	2,020	2,335	7/7
Vanadium	17.6 - 33.5 (29.6)	29.5	33.0	7/7
Zinc	45 - 127 (65.6)	61.2	98.0	7/7

(1) Di-n-butyl phthalate was detected in all 7 surface soil samples at concentrations ranging of 0.27 to 0.66 mg/kg.
Diethylphthalate was detected in sample WW1DSL-002 (skimmed waste pond) at 0.450 mg/kg.
(2) Upper 95% confidence level on arithmetic mean.
TPH - Total Petroleum Hydrocarbons.

TABLE A-24

CONTAMINANT OCCURRENCE AND DISTRIBUTION - DIKE SOIL BORING SAMPLES
ROUND 11
SITE WW-1
FAIRCHILD AFB, WASHINGTON

Parameter	Range of Positive Detections (Arithmetic Mean)	Geometric Mean	95% UCL[1]	Frequency of Detections
0- TO 4-FOOT DEPTH (mg/kg)				
TPH	27 - 180 (44.85)	29.1	74.3	8/12
Aluminum	8,970 - 14,200 (11,043)	10,951	12,130	12/12
Antimony	9.4 (4.1)	4.0	4.7	1/12
Arsenic	6.8 (3.8)	3.7	4.6	1/12
Cadmium	0.88 - 132 (12.0)	3.3	27.4	11/12
Chromium	6.7 - 116 (22.1)	17.3	35.1	12/12
Copper	21.6 - 108 (29.9)	21.6	50.4	5/12
Iron	17,600 - 39,200 (21,715)	21,369	24,859	12/12
Mercury	0.1 - 1.4 (.21)	.09	.51	3/12
Silver	3.1 (.37)	.25	.71	1/12
Vanadium	25 - 80.1 (32.8)	31.9	39.6	12/12

TABLE A-24
CONTAMINANT OCCURRENCE AND DISTRIBUTION - WW-1 DIKE SOIL BORING SAMPLES(1)
ENVIRONMENTAL SAMPLING ROUND 11
SITE WW-1
FAIRCHILD AFB, WASHINGTON
PAGE TWO

Parameter	Range of Positive Detections (Arithmetic Mean)	Geometric Mean	95% UCL(1)	Frequency of Detections
4- TO 8-FOOT DEPTH				
Aluminum	8,910 - 10,200 (9,770)	9,750	NC	3/3
Cadmium	0.8 - 1.8 (1.2)	1.1	NC	3/3
Chromium	10 - 10.9 (10.4)	10.4	NC	3/3
Copper	32.6 (16.6)	13.3	NC	1/3
Iron	17,800 - 19,500 (18,600)	18,587	NC	3/3
Vanadium	19.9 - 28.2 (23.3)	23.1	NC	3/3
COMPOSITE SAMPLES (mg/kg)				
TPH	120 (37.5)	NC	NC	1/3
Aluminum	13,300 - 18,000 (14,375)	NC	NC	3/3
Cadmium	1.7 - 2.0 (1.8)	NC	NC	3/3
Chromium	11.9 - 20.6 (16.6)	NC	NC	3/3
Copper	41.6 (20.8)	NC	NC	1/3
Iron	21,800 - 25,200 (24,100)	NC	NC	3/3
Vanadium	32.9 - 39.9 (36.9)	NC	NC	3/3

TABLE A-24
CONTAMINANT OCCURRENCE AND DISTRIBUTION - WW-1 DIKE SOIL BORING SAMPLES(1)
ENVIRONMENTAL SAMPLING ROUND 11
SITE WW-1
FAIRCHILD AFB, WASHINGTON
PAGE THREE

Parameter	Range of Positive Detections (Arithmetic Mean)	Geometric Mean	95% UCL(1)	Frequency of Detections
COMPOSITE SAMPLES (mg/kg) (Continued)				
TOC	NC	NC	NC	3/3
Ammonia Nitrogen	NC	NC	NC	3/3
Total Phosphorus	NC	NC	NC	3/3
Kjeldahl Nitrogen	NC	NC	NC	3/3
Bulk Density	NC	NC	NC	3/3

(1) Upper 95% confidence limit on arithmetic mean.
NC - Not Calculated.

TABLE A-25

CONTAMINANT OCCURRENCE AND DISTRIBUTION - SURFACE SOIL SAMPLES(11)
ROUND 11
SITE WW-1
FAIRCHILD AFB, WASHINGTON

Parameter	Range (Arithmetic Mean)	Geometric Mean	95% UCL(1)	Frequency of Detections
TPH AND METALS (mg/kg)				
TPH	6-600 (148)	36.0	308	5/11
Aluminum	9,560-14,600 (11,432)	11,327	12,612	11/11
Barium	90.8-169 (123)	121	139	11/11
Cadmium	3.1-6.1 (3.0)	1.8	4.6	6/11
Calcium	4,070-11,500 (7,087)	6,667	8,919	11/11
Chromium	8.7-38 (23.1)	21.0	30.0	11/11
Cobalt	9-12.6 (10.0)	9.9	10.6	11/11
Copper	14.9-41.3 (28.6)	26.3	37.3	11/11
Iron	18,400-24,800 (21,095)	21,008	22.563	11/11
Lead	12.3-131 (58.5)	35.7	90.5	8/11
Magnesium	4,480-6,000 (5,107)	5,088	5,437	11/11
Manganese	272-441 (360)	356	402	11/11
Mercury	0.1-1.0 (0.39)	0.27	0.62	11/11
Nickel	8.4-13.6 (10.9)	10.8	12.0	11/11
Potassium	1,540-2,240 (1,868)	1,858	2,011	11/11
Sodium	179-286 (140)	119	197	6/11
Vanadium	27.8-44.4 (34.6)	34.2	28.2	11/11
Zinc	44.1-119 (74.9)	70.8	93.6	11/11

(1) Upper 95% confidence limit on arithmetic mean.

TABLE A-26

CONTAMINANT OCCURRENCE AND DISTRIBUTION - EAST TEST PIT SAMPLES (0 - 4 FEET)
ROUND 11
SITE WW-1
FAIRCHILD AFB, WASHINGTON

Parameter	Range (Arithmetic Mean)	Geometric Mean	95% UCL[1]	Frequency of Detection
VOLATILE ORGANICS (mg/kg)				
Trichloroethene	0.005 (0.002)	0.0014	0.003	1/6
Toluene	0.007 (0.003)	0.002	0.005	1/6
Xylene	0.011-0.026 (0.009)	0.005	0.020	3/6
SEMIVOLATILE ORGANICS (mg/kg)				
Di-n-butyl phthalate	0.22-0.45 (0.283)	0.261	---	2/3
Benzoic Acid	1.4 (0.818)	---	---	1/3
Chrysene	0.51 (0.252)	0.196	---	1/3
Fluoranthene	0.71 (0.319)	0.219	---	1/3
Pyrene	0.700 (0.303)	0.196	NC	1/3
TOTAL PETROLEUM HYDROCARBONS				
TPH (mg/kg)	62-2,400 (543)	217	1,506	5/5
METALS (mg/kg)				
Aluminum	5,990-12,700 (9,372)	9,138	11,713	5/5
Arsenic	9 (4.1)	3.8	6.6	1/5
Barium	62.8-318 (128)	108	228	5/5
Beryllium	0.56 (0.23)	0.20	0.40	1/5
Cadmium	0.53-35.8 (7.2)	1.1	22.1	3/5
Calcium	5,000-17,600 (8,285)	7,534	13,165	5/5
Chromium	7.3-138 (35.1)	17.9	89.2	5/5
Cobalt	9.3-12.5 (10.6)			5/5
Copper	14.3-67.1 (25.1)	21.0	46.8	5/5

TABLE A-26
CONTAMINANT OCCURRENCE AND DISTRIBUTION - EAST TEST PIT SAMPLES (0 - 4 FEET)
ROUND 11
SITE WW-1
FAIRCHILD AFB, WASHINGTON
PAGE TWO

Parameter	Range (Arithmetic Mean)	Geometric Mean	95% UCL[1]	Frequency of Detections
METALS (mg/kg) (Continued)				
Iron	16,700-26,000 (21,950)	21,709	25,607	5/5
Lead	9.6-313 (64.2)	17.4	193	3/5
Magnesium	4,540-6,080 (5,370)	5,332	6,080	5/5
Manganese	208-486 (367)	356	462	5/5
Nickel	9.3-22.2 (13.0)	12.5	17.9	5/5
Potassium	873-1,890 (1,561)	1,512	1,890	5/5
Sodium	123-449 (209)	189	336	5/5
Vanadium	25.4-43.4 (36.2)	35.7	42.7	5/5
Zinc	44.8-168 (71.3)	62.9	121	5/5
MISCELLANEOUS PARAMETERS				
TOC (mg/kg)	2,400-3,200 (2,933)	2,907	NC	3/3
Kjeldahl Nitrogen	410-1,000 (610)	556	NC	3/3
Ammonia Nitrogen	48 (19.3)	10.5	NC	1/3
Total Phosphorous	300-660 (473)	450	NC	3/3

(1) Upper 95% confidence limit on arithmetic mean.
NC - Not calculated.

TABLE A-27

CONTAMINANT OCCURRENCE AND DISTRIBUTION - EAST TEST PIT SAMPLES (4 - 8 FEET)
ROUND 11
SITE WW-1
FAIRCHILD AFB, WASHINGTON

Parameter	Range of Positive Detections (Arithmetic Mean)	Geometric Mean	95% UCL[1]	Frequency of Detections
VOLATILE ORGANICS (mg/kg)				
Trichloroethene	0.018-0.035 (0.01)	0.003	0.025	2/7
Chloroform	0.003-0.006 (0.003)	0.002	0.004	3/7
TOTAL PETROLEUM HYDROCARBONS (mg/kg)				
TPH	150-4,500 (827)	75.8	2,719	3/7
METALS (mg/kg)				
Aluminum	6,530-15,800 (9,410)	9,020	12,705	7/7
Barium	68.9-175 (95.6)	90.4	135	7/7
Beryllium	0.26 (0.18)	0.17	0.25	1/7
Cadmium	0.75-6.2 (1.5)	0.72	3.9	3/7
Calcium	1,660-7,230 (5,250)	4,760	7,230	7/7
Chromium	8.2-21.5 (15.2)	14.3	20.9	7/7
Cobalt	8.3-25.7 (12.4)	11.7	17.1	7/7
Copper	12.8-23.1 (17.2)	16.8	21.3	7/7
Iron	17,100-35,300 (24,150)	23,300	31,900	7/7
Lead	15.5-23.5 (9.9)	8.0	18.2	2/7
Magnesium	4,070-6,100 (4,913)	4,870	5,710	7/7
Manganese	285-740 (390)	377	513	7/7
Nickel	7.6-15.1 (10.7)	10.5	13.2	7/7
Potassium	928-2,220 (1,418)	1,350	1,950	7/7
Sodium	71.8-282 (174)	154	265	7/7
Vanadium	22.7-57 (38.5)	35.7	55.3	7/7
Zinc	38.5-70.8 (48.0)	47.0	60.5	7/7

(1) Upper 95% confidence level on arithmetic mean.
TPH - Total petroleum hydrocarbons.

TABLE A-28

CONTAMINANT OCCURRENCE AND DISTRIBUTION - NORTH TEST PIT SAMPLES(1)
ROUND 11
SITE WW-1
FAIRCHILD AFB, WASHINGTON

Parameter	Range (Arithmetic Mean)	Geometric Mean	95% UCL(1)	Frequency of Detections
TPH (mg/kg)				
TPH	25-57 (25.5)	19.4	57	3/4
METALS (mg/kg)				
Aluminum	8,370-14,800 (11,868)	11,628	14,800	4/4
Barium	60.7-132 (106)	102	132	4/4
Calcium	2,450-5,460 (4,003)	3,758	5,460	4/4
Chromium	8.5-12.9 (10.8)	10.7	12.9	4/4
Cobalt	7.6-15.3 (11.6)	11.2	15.3	4/4
Copper	12.8-44.1 (21.7)	18.8	44.1	4/4
Iron	19,800-23,500 (21,225)	21,172	23,500	4/4
Lead	17.5 (3.2)	2.1	6.7	1/4
Magnesium	4,860-5,960 (5,438)	5,423	5,960	4/4
Manganese	336-459 (397)	394	459	4/4
Nickel	8-11.6 (10.3)	10.2	11.6	4/4
Potassium	1,610-2,380 (1,978)	1,959	2,380	4/4
Sodium	91.5-219 (175)	166	219	4/4
Vanadium	26.6-42.9 (34.0)	33.5	42.9	4/4
Zinc	42-52.7 (47.1)	46.9	52.7	4/4

(1) Upper 95% confidence limit on arithmetic mean.

TABLE A-29

CONTAMINANT OCCURRENCE AND DISTRIBUTION - NORTH TEST PIT SAMPLES (4 TO 8 FEET)
ROUND 11
SITE WW-1
FAIRCHILD AFB, WASHINGTON

Parameter	Range (Arithmetic Mean)	Geometric Mean	95% UCL[1]	Frequency of Detections
TPH (mg/kg)				
TPH	40-55 (28.8)	21.7	55	2/4
METALS (mg/kg)				
Aluminum	7,750-14,200 (9,883)	9,601	14,200	4/4
Arsenic	9.3-10.3 (6.6)	5.7	10.3	2/4
Barium	56.9-144 (94.3)	89.3	144	4/4
Cadmium	0.56 (0.35)	0.33	0.56	1/4
Calcium	2,000-6,320 (4,428)	4,052	6,320	4/4
Chromium	5-8.7 (6.9)	6.7	8.7	4/4
Cobalt	7.1-12.1 (8.8)	8.6	12.1	4/4
Copper	9.7-16.0 (13.2)	13.0	16	4/4
Iron	13,100-24,300 (19,075)	18,617	24,300	4/4
Magnesium	3,400-5,230 (4,598)	4,534	5,230	4/4
Manganese	239-350 (298)	295	350	4/4
Nickel	6.1-9.0 (8.1)	8.0	9	4/4
Potassium	1,360-1,950 (1,613)	1,599	1,950	4/4
Sodium	93.8-243 (172)	163	243	4/4
Vanadium	19.1-46.1 (29.3)	27.6	46.1	4/4
Zinc	28.5-48.7 (39.5)	38.7	48.7	4/4

(1) Upper 95% confidence limit on arithmetic mean.

TABLE A-30

CONTAMINANT OCCURRENCE AND DISTRIBUTION - ALLUVIAL MONITORING WELLS
ROUNDS 8 THROUGH 11
SITE WW-1
FAIRCHILD AFB, WASHINGTON

Parameter	Alluvial Monitoring Wells On Base (Upgradient) (54, 7, 8, 10, 142, 143)				Alluvial Monitoring Wells On Base (Downgradient) (9, 5, 6, 11, 12, 102, 103, 48, 13, 49, 144, 145)				Alluvial Monitoring Wells Off Base (146, 120, 147)	
	No of Positive Detections/ No of Samples	Range of Positive Detections (Arithmetic Mean)	Geometric Mean	95% UCL[1]	No of Positive Detections/ No of Samples	Range of Positive Detections (Arithmetic Mean)	Geometric Mean	95% UCL	No of Positive Detections/ No of Samples	Range of Positive Detections (Arithmetic Mean)
VOLATILE ORGANICS (µg/L)[2]										
Acetone	0/6	....	....	....	2/10	9.0-15 (4.8)	3.8	7.4	0/1	....
Trichloroethene	0/6	....	....	....	5/19	1.4-280 (32.8)	1.7	69.2	3/4	18-38 (21.3)
1,2-Dichloroethene	0/6	....	....	....	3/19	6.0-32 (2.9)	8.3	6.4	0/4	....
Styrene	1/6	8.0 (2.2)	1.4	5.2	0/12	....	....	....	0/1	....
Trichlorofluoro-methane	0/6	....	....	....	2/14	1.0-4.0 (1.5)	1.1	2.0	0/4	....
METALS (µg/L)										
Aluminum (Total)	5/5	2,560-19,900 (13,592)	11,190	19,900	16/17	2,280-340,000 (82,092)	30,075	138,852	0/1	3,400
Antimony (Total)	0/5	....	....	....	3/17	5.0-200 (70)	28.7	111	0/1	....
(Dissolved)	0/5	....	....	....	5/10	5.0-11.1* (21.7)	17.2	11.1	NA[3]	....
Arsenic (Total)	4/5	2.6-23.5 (8.2)	4.9	19.3	17/17	4.8-300 (102)	58.3	156	0/1	....
(Dissolved)	2/5	2.0-4.3 (1.9)	1.5	3.6	8/10	2.1-30.4 (13.0)	7.3	21.0	NA	....
Barium (Total)	5/5	110-869 (333)	258	711	17/17	190-2,900 (755)	509	1,166	1/1	46
(Dissolved)	5/5	107-153 (126)	125	149	10/10	75-200 (136)	129	167	NA	....
Beryllium (Total)	0/5	....	....	....	10/17	1.75 (20.6)	4.7	33.6	0/1	....
Cadmium (Total)	1/5	5.0 (3.9)	3.5	5	9/17	6.0-120 (16.7)	7.4	32.3	0/1	....
Chromium (Total)	3/5	11-110 (30.2)	14.3	86	14/17	16-550 (143)	51.9	256	1/1	4.0
Calcium (Total)	5/5	47,400-103,000 (72,160)	69,553	99,107	17/17	11,000-350,000 (98,388)	86,248	134,659	1/1	43,000
(Dissolved)	5/5	46,500-76,800 (53,400)	47,136	76,800	10/10	47,700-78,400 (65,190)	64,422	72,572	NA	....

TABLE A-30
CONTAMINANT OCCURRENCE AND DISTRIBUTION - ALLUVIAL MONITORING WELLS
ROUNDS 8 THROUGH 11
SITE WW-1
FAIRCHILD AFB, WASHINGTON
PAGE TWO

Parameter	Alluvial Monitoring Wells On Base (Upgradient) (54, 7, 8, 10, 142, 143)				Alluvial Monitoring Wells On Base (Downgradient) (9, 5, 6, 11, 12, 102, 103, 48, 13, 49, 144, 145)				Alluvial Monitoring Wells Off Base (146, 120, 147)	
	No of Positive Detections/ No of Samples	Range of Positive Detections (Arithmetic Mean)	Geometric Mean	95% UCL(1)	No of Positive Detections/ No of Samples	Range of Positive Detections (Arithmetic Mean)	Geometric Mean	95% UCL	No of Positive Detections/ No of Samples	Range of Positive Detections (Arithmetic Mean)
METALS (CONTINUED)										
Cobalt (Total)	1/5	114 (30 8)	16 3	88 5	11/17	200-232 (68 7)	34 3	115	0/1	....
Copper (Total)	5/5	6 0-135 (41 2)	23 6	107	14/17	12-796 (162)	49 3	291	0/1	....
(Dissolved)	3/5	3 0-13 (4 3)	2 8	10 4	3/10	3 0-7 0 (2 6)	2 0	4 0	NA	....
Iron (Total)	4/5	15,900-174,000 (54,308)	8,192	135,126	17/17	1,570-590,000 (136,281)	59,554	228,263	1/1	740
(Dissolved)	3/5	40-4,360 (896)	76 5	3,300	6/10	345-5,410 (1,613)	271	3,153	NA	....
Lead (Total)	4/5	4 8-52 6 (16 9)	8 2	42 8	15/17	4 7-1,300 (161)	44 1	323	0/1	....
(Dissolved)	0/5	.... (0 56)	0 41	1 3	1/10	11 6 (1 5)	0 51	4 0	NA	....
Magnesium (Total)	5/5	11,100-53,000 (27,560)	24 345	46,902	17/17	13,600-140,000 (46,079)	35,397	66,742	1/1	8,700
(Dissolved)	5/5	11,800-22,500 (18,340)	17,922	22,500	10/10	12,800-23,300 (17,875)	17,621	20,143	NA	....
Manganese (Total)	5/5	268-3,360 (951)	542	2,625	17/17	676-15,200 (4,405)	3,198	6,458	0/1	....
(Dissolved)	5/5	3 0 864 (195)	38 4	660	9/10	6 0-4,790 (2,014)	512	3,457	NA	....
Mercury (Total)	0/5	....	....	....	4/17	0 1-1 0 (0 18)	0 10	0 31	0/1	....
Molybdenum (Total)	0/5	....	....	....	3/17	2 0-8 0 (9 3)	5 4	8 0	0/1	
(Dissolved)	0/5	....	....	....	NPD				NA	....
Nickel (Total)	2/5	17-113 (35)	23	89	10/17	38-380 (99 4)	56 4	156	0/1	....
(Dissolved)	0/5	....	....	....	1/10	37 (18 6)	17 5	24 1	NA	....

TABLE A-30
CONTAMINANT OCCURRENCE AND DISTRIBUTION - ALLUVIAL MONITORING WELL
ROUNDS 8 THROUGH 11
SITE WW-1
FAIRCHILD AFB, WASHINGTON
PAGE THREE

Parameter	Alluvial Monitoring Wells On Base (Upgradient) (54, 7, 8, 10, 142, 143)				Alluvial Monitoring Wells On Base (Downgradient) (9, 5, 6, 11, 12, 102, 103, 48, 13, 49, 144, 145)				Alluvial Monitoring Wells Off Base (146, 120, 147)	
	No of Positive Detections/ No of Samples	Range of Positive Detections (Arithmetic Mean)	Geometric Mean	95% UCL(1)	No of Positive Detections/ No of Samples	Range of Positive Detections (Arithmetic Mean)	Geometric Mean	95% UCL	No of Positive Detections/ No of Samples	Range of Positive Detections (Arithmetic Mean)
METALS (CONTINUED)										
Potassium (Total)	5/5	4,330-15,300 (7,900)	7,143	13,297	17/17	2,450-45,000 (13,596)	9,207	20,576	1/1	3,000
(Dissolved)	5/5	3,610 6,130 (4,580)	4,503	5,788	10/10	1,740-6,150 (3,657)	3,467	4,543	NA	....
Selenium (Total)	0/5	....	....	....	1/17	2 1 (0 49)	0.42	0 71	0/1	....
Silver (Total)	0/5	....	....		1/10	3 0 (4 9)	3 4T	3	0/1	....
(Dissolved)	0/5	....	....			(1 0)	1 7	1		....
Sodium (Total)	5/5	21,200-35,600 (26,940)	26,546	33,562	17/17	18,000-40,400 (26,847)	26,350	29,621	1/1	19,000
(Dissolved)	5/5	18,800-34,800 (26,300)	25,788	33,504	10/10	23,600-32,700 (29,595)	29,309	32,866	NA	....
Vanadium (Total)	4/5	24-289 (75 3)	27 6	224 3	14/17	26-830 (175)	65 5	298	1/1	7 0
Zinc (Total)	4/5	42-409 (130)	55 4	334	12/17	32-1,700 (338)	119	587	0/1	....
(Dissolved)	0/5	....	....	....	1/10	7 0 (3 9)	3 5	5 5	NA	....

(1) Upper 95% confidence limit on arithmetic average
(2) 2-Naphthalenamine (B-Naphthy) was detected in MW-12 (WW1-GW-MW12-002) at 5 µg/L
NA - Not Analyzed

TABLE A-31

CONTAMINANT OCCURRENCE AND DISTRIBUTION - BASALT MONITORING WELLS (µg/L)
ROUNDS 8 THROUGH 11
SITE WW-1
FAIRCHILD AFB, WASHINGTON

Parameter	Top-Mid Basalt A On-Base Monitoring Well (99, 59, 60)			Top-Mid Basalt A Off-Base Monitoring Well (122)	
	No. of Positive Detections/ No. of Samples	Range of Positive Detections (Arithmetic Mean)	Geometric Mean	No. of Positive Detections/ No. of Samples	Range of Positive Detections (Arithmetic Mean)
VOLATILE ORGANIC COMPOUNDS (VOCs)					
Trichloroethene	0/5	----	----	1/2	0.4
1,2-Dichloroethane	1/5	0.5	----	0/2	----
SEMI-VOLATILE ORGANIC COMPOUNDS (SEMI-VOCs)					
Phenol	0/2	----	----	1/1	8.0-9.0(1)
METALS					
Aluminum (Total)	0/3	----	----	1/1	510(1)
Barium (Total)	3/3	4.0-22 (11)	8.51	1/1	68-69(1)
(Dissolved)	1/1	22		NA(7)	
Cadmium (Dissolved)	1/1	5.0		0/1	----
Calcium (Total)	3/3	20,000-37,600 (26,200)	25,088	1/1	19,000-20,000(1)
(Dissolved)	1/1	38,500		NA	
Chromium (Total)	1/3	4.0 (3.7)	3.42	0/1	-
Iron (Total)	1/3	150 (62)	34	1/1	390-470(1)
Magnesium (Total)	3/3	6,200-11,600 (8,100)	7,761	1/1	2,000-3,000(1)
Manganese (Total)	1/3	7.0 (3.0)	1.9	1/1	5.0-7.0(1)
Molybdenum (Total)	0/3	----	----	1/1	5.0(1)
Potassium (Total)	3/3	1,000-1,400 (1,133)	1,120	1/1	42,000(1)
(Dissolved)	1/1	1,600		NA	
Sodium (Total)	3/3	8,100-14,100 (10,100)	9,700	1/1	49,000-50,000(1)
(Dissolved)	1/1	15,000		NA	
Vanadium (Total)	2/3	10-11 (9.2)	8.9	1/1	11-13(1)
Zinc (Total)	2/3	4.0-9.0 (6.5)(2)	6.0	1/1	9.0(1)
(Dissolved)	1/1	6.0		NA	

(1) Range or value shown is from a field duplicate pair.
(2) Arithmetic mean of positive detections only, due to different method analyses detection limits.
NA - Not Analyzed

TABLE A-32

CONTAMINANT OCCURRENCE AND DISTRIBUTION - SOIL BORING SAMPLES[1] FUEL-RELATED CONTAMINATION ROUND 11 SITE FT-1 FAIRCHILD AFB, WASHINGTON

Parameter	Range of Positive Detections	Arithmetic Mean	Geometric Mean	95% UCL[1]	Frequency of Detections
0- TO 2-FOOT SAMPLES (mg/kg)					
TPH	890-2,900	953	127	2,900	2/5
Toluene	0.008[2]	0.008[2]	0.008[2]	0.008[2]	1/5
Xylene	1.2-14.0	4.1	0.102	14.0	3/5
Ethylbenzene	23.0	5.8	0.063	23	1/5
2- TO 4-FOOT SAMPLES (mg/kg)					
TPH	25-7,500	2,073	192	3,900	8/12
Benzene	14	1.6	0.018	4.2	1/14
Toluene	20-170	14.6	0.022	45.7	2/14
Xylene	0.18-130	25.4	0.077	55.1	5/14
Ethylbenzene	0.027-61	7.4	0.039	18.6	5/14
4- TO 6-FOOT SAMPLES (mg/kg)					
TPH	37-5,500	1,285	106	3,318	4/8
Toluene	45	6.5	0.018	22.2	1/8
Xylene	69-140	29.9	0.041	80.7	2/8
Ethylbenzene	11-18	4.1	0.024	10.9	2/8
6- TO 8-FOOT SAMPLES (mg/kg)					
Xylene	2.8	0.935	0.020	---	1/3

TABLE A-32
CONTAMINANT OCCURRENCE AND DISTRIBUTION - SOIL BORING SAMPLES(1)
FUEL-RELATED CONTAMINATION
ROUND 11
SITE FT-1
FAIRCHILD AFB, WASHINGTON
PAGE TWO

Parameter	Range of Positive Detections	Arithmetic Mean	Geometric Mean	95% UCL	Frequency of Detections
COMPOSITE SAMPLES (mg/kg)					
TPH	48-3,500	892	64.0	3,500	2/4
Toluene	48.0	12.0	0.021	48	1/4
Xylene	200	50.0	30.8	200	1/4
Ethylbenzene	29	7.3	0.019	30.3	1/4

(1) Upper 95% confidence limit on arithmetic mean.

(2) Average of positive detections presented because one or more sample quantitation limits exceed maximum positive detection.

TABLE A-33

CONTAMINANT OCCURRENCE AND DISTRIBUTION - ALLUVIAL MONITORING WELLS
ROUNDS 8 THROUGH 11
SITE FT-1
FAIRCHILD AFB, WASHINGTON

Parameter	Upgradient Alluvial Monitoring Wells (52, 53)		Alluvial Monitoring Wells On Base (148, 149, 1, 4, 104, 3, 152, 155, 153, 51, 2, 50)				Alluvial Monitoring Wells Off Base (125)	
	No of Positive Detections/ No of Samples	Range of Positive Detections (Arithmetic Mean)	No of Positive Detections/ No of Samples	Range of Positive Detections (Arithmetic Mean)	Geometric Mean	95% UCL(1)	No of Positive Detections/ No of Samples	Range of Positive Detections (Arithmetic Mean)
VOLATILE ORGANICS (µg/L)								
Trichloroethene	0/2	....	5/18	2 0-12 (2 31)	1.596	3 68	1/2	0.6
1,2-Dichloroethene	0/2	....	2/18	9 0-97 (6 99)	1 43	18 2	0/2	....
Benzene	0/2	....	4/18	8 0-320 (23 7)	2 51	56 9	0/2	....
Toluene	0/2	....	1/18	10 (1 8)	1 3	2 9	0/2	....
Ethylbenzene	0/2	....	3/18	45-220 (17 1)	2 2	40 9	0/2	....
Xylenes	0/2	....	3/18	110-780 (52 4)	2 7	134	0/2	....
1,1,1 Trichloroethane	0/2	....	1/18	1 0 (1 0)	1.0	1 0	0/2	....
1,1-Dichloroethene	0/2	....	1/18	3 0 (1.65)	1 44	2 03	0/2	....
1,1-Dichloroethane	0/2	....	1/18	2 0 (1.09)	0 98	1 33	0/2	....
Chloroform	0/2	....	1/18	6 0 (1 11)	0 90	1 53	1/2	0.3
SEMIVOLATILE ORGANICS (µg/L)								
Napthalene	NA	....	2/15	7 0-16 (2 89)	1 51	5 08	0/1	....
2,4-Dimethylphenol				86-110				
METALS (µg/L)								
Aluminum (Total)	NA	....	15/15	341-210,000 (43,900)	13,500	80,860	1/1	3,400
(Dissolved)	NA	....	0/9	....			NA	....
Antimony (Dissolved)	NA	....	4/9	6 2-17 9 (8 1)	12 8	17 9	NA	....
Arsenic (Total)	NA	....	13/15	5 0 190 (44 2)	20 4	73 6	1/1	2
(Dissolved)	NA	....	3/9	2 0-66 (13 0)	2 47	31 6	NA	....

TABLE A-33
CONTAMINANT OCCURRENCE AND DISTRIBUTION - ALLUVIAL MONITORING WELLS
ROUNDS 8 THROUGH 11
SITE FT-1
FAIRCHILD AFB, WASHINGTON
PAGE TWO

Parameter	Upgradient Alluvial Monitoring Wells (52, 53)		Alluvial Monitoring Wells On Base (148, 149, 1, 4, 104, 3, 152, 155, 153, 51, 2, 50)				Alluvial Monitoring Wells Off Base (125)	
	No of Positive Detections/ No of Samples	Range of Positive Detections (Arithmetic Mean)	No of Positive Detections/ No of Samples	Range of Positive Detections (Arithmetic Mean)	Geometric Mean	95% UCL[1]	No of Positive Detections/ No of Samples	Range of Positive Detections (Arithmetic Mean)
METALS (µg/L) (Continued)								
Barium (Total)	NA	....	15/15	64-3,100 (669)	380	1,140	1/1	100
(Dissolved)	NA	....	9/9	61-258 (103)	88 3	155	NA	....
Beryllium (Total)	NA	....	7/15	1 0-200 (27 3)	3 11	60 5	1/1	6
(Dissolved)	NA	....	0/9	....			NA	....
Cadmium (Total)	NA	....	5/15	5 0-43 (7 37)	4 31	13 4	0/1	....
(Dissolved)	NA	....	1/9	5 (2 78)	2 7	3 42	0/1	....
Calcium (Total)	NA	....	15/15	52,000-180,000 (78,000)	72,000	98,500	1/1	6,400
(Dissolved)	NA	....	9/9	46,000-62,200 (53,900)	53,700	57,600	NA	....
Chromium (Total)	NA	....	12/15	4 0-280 (53 5)	21 4	99 2	0/1	....
Cobalt (Total)	NA	....	7/15	20-240 (21 1)	21 1	92 1	0/1	....
Copper (Total)	NA	....	11/15	22-450 (936)	32 7	170	0/1	....
(Dissolved)	NA	....	3/9	2 0-3 0 (2 14)	2 0	2 83	NA	....
Iron (Total)	NA	....	15/15	464-530,000 (94,800)	32,400	176,000	1/1	6,600
(Dissolved)	NA	....	2/9	8,670-21,000*(3,170)	66 6	7,990	NA	....
Lead (Total)	NA	....	13/15	3 0-290 (45 0)	13 0	88 0	0/1	....

TABLE A-33
CONTAMINANT OCCURRENCE AND DISTRIBUTION - ALLUVIAL MONITORING WELLS
ROUNDS 8 THROUGH 11
SITE FT-1
FAIRCHILD AFB, WASHINGTON
PAGE THREE

Parameter	Upgradient Alluvial Monitoring Wells (52, 53)		Alluvial Monitoring Wells On Base (148, 149, 1, 4, 104, 3, 152, 155, 153, 51, 2, 50)				Alluvial Monitoring Wells Off Base (125)	
	No of Positive Detections/ No of Samples	Range of Positive Detections (Arithmetic Mean)	No of Positive Detections/ No of Samples	Range of Positive Detections (Arithmetic Mean)	Geometric Mean	95% UCL(1)	No of Positive Detections/ No of Samples	Range of Positive Detections (Arithmetic Mean)
METALS (µg/L) (Continued)								
Magnesium (Total)	NA	....	15/15	12,200-140,000 (41,900)	32,500	62,600	1/1	22,000
(Dissolved)	NA	....	9/9	13,400-25,700 (17,180)	16,800	19,700	NA	....
Manganese (Total)	NA	....	14/15	503-19,000 (6,170)	2,580	9,530	1/1	180
(Dissolved)	NA	....	7/9	4 0-7,440 (1 780)	81 3	3,960	NA	....
Mercury (Total)	NA	....	3/15	0 1-0 5 (0 117)	0 0867	0 185	0/1	....
(Dissolved)	NA	....	2/9	0 1-0 2 (0 081)	0 0712	0 119	NA	....
Molybdenum (Total)	NA	....	2/15	3 0-4 0 (4)	4 0	4 0	0/1	....
Nickel (Total)	NA	....	7/15	41-334 (67 7)	34 3	118	0/1	....
Potassium (Total)	NA	....	15/15	2,430-43,600 (12,200)	8,590	19,100	1/1	4,000
(Dissolved)	NA	....	9/9	1,980-5,990 (3,700)	3,250	4,620	NA	....
Sodium (Total)	NA	....	15/15	12,500 36,500 (26,100)	25,100	30,200	1/1	31,000

(1) Upper 95% confidence limit on arithmetic mean
NA - Not analyzed

METALS (µg/L) (Continued)

	(Dissolved)	NA	....	9/9	12,500-33,700 (22,600)	21,300	28,500	NA	....
Thallium	(Total)	NA	....	1/15	3.3 (3 31)	3.3	3 3	0/1	....
Vanadium	(Total)	NA	....	12/15	8.0-820 (135)	45.5	257	1/1	13
Zinc	(Total)	NA	....	12/15	31-1,200 (224)	80 2	413	0/1	....

(1) Upper 95% confidence limit on arithmetic mean
NA - Not analyzed

TABLE A-34

CONTAMINANT OCCURRENCE AND DISTRIBUTION - BASALT A (TOP-MID) MONITORING WELLS
ROUNDS 8 THROUGH 11
SITE FT-1
FAIRCHILD AFB, WASHINGTON

Parameter	Basalt Top-Mid A Monitoring Well On Base (150, 151, 154, 156, 157, 158, 100)				Basalt Top-Mid A Monitoring Well Off Base (121, 123, WW1-124)				Basalt Top-Mid A Monitoring Well Upgradient (61)	
	No. of Positive Detections/ No. of Samples	Range of Positive Detections (Arithmetic Mean)	Geometric Mean	95% UCL(1)	No. of Positive Detections/ No. of Samples	Range of Positive Detections (Arithmetic Mean)	Geometric Mean	95% UCL(1)	No. of Positive Detections/ No. of Samples	Range of Positive Detections (Arithmetic Mean)
VOLATILE ORGANICS (µg/L)										
Trichloroethene	3/9	0.7-3 (1.3)	1.2	1.9	0/6	----	----	----	0/1	----
1,2-Dichloroethene	0/9	----	----	----	0/6	----	----	----	0/1	----
1,1-Dichloroethene	1/9	1.0 (1.0)(2)	1.0	1.0	0/6	----	----	----	0/1	----
1,1-Dichloroethane	1/9	1.0 (1.0)	1.0	1.0	1/6	0.3 (0.3)(2)	0.3	0.3	0/1	----
1,1,1-Trichloroethane	1/9	0.5 (0.5)(2)	0.5	0.5	0/6	----	----	----	0/1	----
Vinyl Chloride	1/9	9.0 (2.2)	1.5	4.3	0/6	----	----	----	0/1	----
Dichlorodifluoro-methane	1/9	76 (11.2)	3.6	31.0	0/6	----	----	----	0/1	----
METALS (µg/L)										
Aluminum (Total)	4/6	218-6,170 (1,473)	342	4,023	4/5	7,100-14,600 (8,300)	4,390	14,600	NA(7)	----
Arsenic (Total)	0/6	----	----	----	2/5	4.0 (2.8)	2.3	4.0	NA	----
(Dissolved)	0/4	----	----	----	1/2	2.2	NC	NC	NA	----
Barium (Total)	6/6	22-69 (48)	45	66	5/5	28-175 (109)	93	175	NA	----
(Dissolved)	3/4	24-50 (30.6)	20.4	50	2/2	55-65	NC	NC	NA	----

TABLE A-34
CONTAMINANT OCCURRENCE AND DISTRIBUTION - BASALT A (TOP-MID) MONITORING WELLS
ROUNDS 8 THROUGH 11
SITE FT-1
FAIRCHILD AFB, WASHINGTON
PAGE TWO

Parameter	Basalt Top-Mid A Monitoring Well On Base (150, 151, 154, 156, 157, 158, 100)				Basalt Top-Mid A Monitoring Well Off Base (121, 123, WW1-124)				Basalt Top-Mid A Monitoring Well Upgradient (61)	
	No. of Positive Detections/ No. of Samples	Range of Positive Detections (Arithmetic Mean)	Geometric Mean	95% UCL(1)	No. of Positive Detections/ No. of Samples	Range of Positive Detections (Arithmetic Mean)	Geometric Mean	95% UCL(1)	No. of Positive Detections/ No. of Samples	Range of Positive Detections (Arithmetic Mean)
METALS (µg/L) (Continued)										
Cadmium	0/6	----	----	----	1/5	5 (3)	2.9	4.4	NA	
Calcium (Total)	5/6	16,600-62,000 (37,900)	33,066	58,800	5/5	33,000-60,100 (43,640)	41,640	60,100	NA	----
(Dissolved)	4/4	14,300-53,300 (35,440)	30,268	53,000	2/2	33,700-55,000	NC	NC	NA	----
Chromium (Total)	2/6	7.0-13 (6.3)	5.4	10.1	3/5	4.0-11 (5.6)	4.8	10	NA	----
Cobalt (Total)	0/6	----	----	----	2/5	20-24 (17.8)	10.4	24	NA	----
Copper (Total)	0/6	----	----	----	3/5	11-26 (13.4)	10.4	26	NA	----
Iron (Total)	5/6	30-7,930 (2,145)	344	5,536	5/5	580-26,600 (16,400)	9,700	26,600	NA	----
Lead (Total)	3/6	1.0-11.3 (3.1)	1.2	7.7	3/5	2.0-4.0 (3.1)	3.0	4.0	NA	----
(Dissolved)	1/4	3.6 (1.1)	0.56	2.9	0/2	----	----	----	NA	----
Magnesium (Total)	6/6	7,810-22,400 (15,780)	14,700	22,200	5/5	11,000-20,700 (17,700)	17,300	20,700	NA	
(Dissolved)	4/4	7,060-22,600 (15,404)	13,820	22,600	2/2	16,200-16,300	NC	NC	NA	
Manganese (Total)	6/6	64-380 (177)	132	331	5/5	39-609 (369)	267	609	NA	
(Dissolved)	3/4	23-65 (49)	35 4	65	1/2	284	NC	NC	NA	

TABLE A-34
CONTAMINANT OCCURRENCE AND DISTRIBUTION - BASALT A (TOP-MID) MONITORING WELLS
ROUNDS 8 THROUGH 11
SITE FT-1
FAIRCHILD AFB, WASHINGTON
PAGE THREE

Parameter	Basalt Top-Mid A Monitoring Well On Base (150, 151, 154, 156, 157, 158, 100)				Basalt Top-Mid A Monitoring Well Off Base (121, 123, WW1-124)				Basalt Top-Mid A Monitoring Well Upgradient (61)	
	No. of Positive Detections/ No. of Samples	Range of Positive Detections (Arithmetic Mean)	Geometric Mean	95% UCL(1)	No. of Positive Detections/ No. of Samples	Range of Positive Detections (Arithmetic Mean)	Geometric Mean	95% UCL(1)	No. of Positive Detections/ No. of Samples	Range of Positive Detections (Arithmetic Mean)
METALS (µg/L) (Continued)										
Molybdenum (Total)	1/6	2.0 (2)(2)	2	2	2/5	3.0 (3)	3	3	NA	
Nickel (Total)	1/6	11 (11)(2)	11	11	2/5	17-45 (15.8)	10.8	36.7	NA	
Potassium (Total)	6/6	1,000-7,530 (2,900)	2,400	5,400	5/5	2,000-6,270 (4,500)	4,200	6,270	NA	
(Dissolved)	4/4	1,810-8,370 (13,356)	2,731	6,876	2/2	2,660-4,420	NC	NC	NA	
Sodium (Total)	6/6	21,000-28,000 (23,600)	23,400	26,800	5/5	11,000-47,000 (34,340)	30,630	47,000	NA	
(Dissolved)	4/4	21,400-24,200 (22,840)	22,817	24,200	2/2	28,000-46,000	NC	NC	NA	
Vanadium (Total)	0/4	----	----	----	4/5	22-71 (36.1)	20.8	71	NA	
Zinc (Total)	2/6	10-14 (11.4)	10.3	14	4/5	54-69 (48.3)	33.6	69	NA	

(1) Upper 95% confidence limit on arithmetic average.
(2) Average of positive detections only.
NA - Not analyzed.
NC - Not calculated

TABLE A-35

GROUNDWATER CONTAMINANT OCCURRENCE AND DISTRIBUTION - BASALT A (DEEP) MONITORING WELLS
ROUNDS 8 THROUGH 11
SITE FT-1
FAIRCHILD AFB, WASHINGTON

Parameter	Basalt A (Base) On-Base Monitoring Wells (98, 159)			Basalt A (Base) Off-Base Monitoring Well (WW1-119)	
	No. of Positive Detections/ No. of Samples	Range of Positive Detections (Arithmetic Mean)	Geometric Mean	No. of Positive Detections/ No. of Samples	Range of Positive Detections (Arithmetic Mean)
VOLATILE ORGANICS (µg/L)					
2-Butanone	1/4	160 (41.1)	4.8	0/1	----
METALS (µg/L)					
Aluminum (Total)	2/3	100-20,300 (6838)	616	0/1	----
(Dissolved)	1/1	303		NA(6)	----
Arsenic (Total)	1/3	10.9 (4.0)	1.4	0/1	----
(Dissolved)	1/1	6.3		NA	----
Barium (Total)	1/3	20-155 (60.7)	27.9	1/1	28
Calcium (Total)	3/3	9,600-21,700 (14,567)	13,758	1/1	19,000-20,000(1)
(Dissolved)	1/1	2,570		NA	----
Chromium (Total)	2/3	6.0-46 (18)	8.2	0/1	----
(Dissolved)	1/1	20		NA	----
Cobalt (Total)	1/3	22 (10.7)	8.2	0/1	----
Copper (Total)	1/3	36 (15)	9	0/1	----
Iron (Total)	3/3	110-34,300 (11,523)	845	1/1	160-180
(Dissolved)	1/1	200		NA	----
Lead (Total)	1/3	13.1 (5)	2.4	1/1	1

TABLE A-35
GROUNDWATER CONTAMINANT OCCURRENCE AND DISTRIBUTION - BASALT A (DEEP) MONITORING WELLS
ROUNDS 8 THROUGH 11
SITE FT-1
FAIRCHILD AFB, WASHINGTON
PAGE TWO

Parameter	Basalt A (Base) On-Base Monitoring Wells (98, 159)			Basalt A (Base) Off-Base Monitoring Well (WW1-119)	
	No. of Positive Detections/ No. of Samples	Range of Positive Detections (Arithmetic Mean)	Geometric Mean	No. of Positive Detections/ No. of Samples	Range of Positive Detections (Arithmetic Mean)
METALS (µg/L) (Continued)					
Magnesium (Total)	3/3	8,100-11,000 (9,513)	9,457	1/1	12,000
Manganese (Total)	3/3	17-470 (169)	55.3	1/1	35-37
Molybdenum (Total)	3/3	3.0-44 (18)	10	0/1	----
(Dissolved)	1/1	36		NA	----
Potassium (Total)	3/3	31,000-216,000 (93,700)	61,061	1/1	3,000
(Dissolved)	1/1	232,000		NA	----
Sodium (Total)	3/3	30,000-110,000 (60,333)	51,751	1/1	19,000
(Dissolved)	1/1	111,000		NA	----
Vanadium (Total)	1/3	77 (27)	5.6	0/1	----
(Dissolved)	1/1	6.0		NA	----
Zinc (Total)	1/3	100 (40.8)	18.8	0/1	----

(1) Range of field duplicate pair results.
NA - Not analyzed.

TABLE A-36

GROUNDWATER SAMPLING DATES AND RESULTS FOR RESIDENTIAL WELLS[1] (µg/L)
FAIRCHILD AFB, WASHINGTON

Well Number	Sampling Round										
	1[a]	2[b]	3[c]	4[d]	5[e]	6[f]	7[f]	8[g]	9[h]	10[i]	11[j]
RW-12	....	....	08/28/89 [5]	10/05/89 [2]	....	05/30/90	09/10/90	....	04/91		01/92 [0.7]
RW-13	....	....	08/28/89 [3]	10/05/89 [2]	....	05/30/90	09/10/90 [0.9½J] [MC = 120B]	....	04/91	....	....
RW-14	....	....	08/28/89 [1]	....	....	05/31/90	09/10/90 [MC = 200B]	....	04/91	....	....
RW-15	....	....	08/28/89 [1]	....	....	05/31/90	09/10/90 [MC = 130B]	....	04/91	....	01/92 [0.2]
RW-16	....	....	08/28/89 [1]	....	....	05/30/90	09/10/90	....	04/91	....	01/92 [0.3]
RW-17	....	....	08/28/89	....	....	05/30/90 [MC = 3J]	09/10/90 [MC = 3J]	....	04/91	....	01/92
RW-18	....	....	08/28/89	....	....	05/31/90	09/10/90 [MC = 200B]	....	04/91	....	01/92
RW-19	....	....	08/28/89	....	....	05/30/90	09/10/90 [MC = 4J]	....	....	....	01/92
RW-20	....	....	08/28/89 [1]	....	....	05/31/90	09/10/90 [MC = 18B]	....	04/91	....	01/92 [0.5]
RW-21	....	....	08/28/89	....	....	05/30/90	09/10/90 [MC = 170B]	....	....	....	01/92 [0.4] [CB = 0.2]
RW-22	....	....	08/28/89	....	....	05/30/90	09/10/90	....	....	....	01/92
RW-23	....	....	08/28/89 [3]	....	....	05/31/90	09/11/90 [MC = 170B] [0.7J]	....	04/91	....	01/92 [1]
RW-24	....	....	08/28/89 [1]	....	....	05/31/90	09/10/90 [MC = 25B]	....	04/91		01/92 [1]

TABLE A-36
GROUNDWATER SAMPLING DATES AND RESULTS FOR RESIDENTIAL WELLS[1] (µg/L)
FAIRCHILD AFB, WASHINGTON
PAGE TWO

Well Number	Sampling Round										
	1[a]	2[b]	3[c]	4[d]	5[e]	6[f]	7[f]	8[g]	9[h]	10[i]	11[i]
RW-33	----	07/21/89	----	----	----	----	----	----	----	----	01/92
RW-34	----	07/21/89	----	----	----	----	----	----	----	----	----
RW-35	----	07/21/89	----	----	----	05/31/90	09/11/90	----	04/91	----	01/92
RW-36	----	07/21/89	----	----	----	05/31/90	09/11/90	----	04/91	----	----
RW-37	----	07/21/89	----	----	----	05/31/90	09/10/90	----	----	----	01/92
RW-38	----	07/21/89	----	----	----	----	09/10/90 [MC = 5]	----	----	----	----
RW-39	----	07/21/89	----	----	----	----	09/11/90	----	----	----	01/92
RW-40	----	07/21/89	----	----	----	----	09/10/90 [MC = 2[J]]	----	04/91	----	01/92
RW-41	----	07/21/89	----	----	----	----	09/10/90 [MC = 130[B]]	----	----	----	----
RW-42	----	07/21/89	----	----	----	----	09/10/90	----	04/91	----	01/92
RW-43	----	07/21/89	----	----	----	----	09/10/90 [MC = 190[B]]	----	04/91	----	01/92
RW-44	----	07/21/89	----	----	----	----	09/10/90 [MC = 5[J]]	----	04/91	----	----
RW-45	----	07/21/89	----	----	----	----	09/10/90	----	04/91	----	01/92 [0 3]
RW-46	----	----	----	----	----	----	----	----	----	----	01/92

CD Carbon disulfide
PCE Tetrachloroethene
MC Methylene chloride
T = Toluene
CB = Chlorobenzene
J = Estimated value
B = Parameter also detected in blank samples
[1] Unless otherwise noted, results in brackets are TCE concentrations (µg/L) ONLY positive detections are presented

TABLE A-36
GROUNDWATER SAMPLING DATES AND RESULTS FOR RESIDENTIAL WELLS[1] (µg/L)
FAIRCHILD AFB, WASHINGTON
PAGE THREE

	Sample Collection by	Analyses Performed by	Analytical Method	TCE Detection Limit
(a)	Washington Department of Health Services	Public Health Laboratories	EPA 524	0 5 ppb
(b)	Environmental Engineering (Fairchild AFB)	Professional Service Ind (PSI) (07/12-13 samples)	EPA 624	10 ppb (reporting limit)
	Environmental Engineering (Fairchild AFB)	ABC Laboratories (07/21 samples)	EPA 8010 (partial parameters)	1 ppb
(c)	Environmental Engineering (Fairchild AFB)	Lauck's Testing Laboratories	EPA 601 (08/21 samples)	1 0 ppb
	Environmental Engineering (Fairchild AFB)	Lauck's Testing Laboratories	SW846/8240 (08/28 samples)	1 0 ppb
(d)	Environmental Engineering (Fairchild AFB)	Lauck's Testing Laboratories	SW846/8240	1 0 ppb
(e)	SAIC	ABC Laboratories	Volatile Organics Scan (VOS)	Unknown
(f)	SAIC	SAIC Laboratory	SW846/8240	2 ppb (PQL: 5 ppb)
(g)	No residential wells sampled during this sampling round			
(h)	HALLIBURTON NUS Environmental Corporation	HALLIBURTON NUS Laboratory	SW8240	≥ 2 ppb
(i)	HALLIBURTON NUS Environmental Corporation	HALLIBURTON NUS Laboratory	EPA 524 2	≥ 0 2 ppb
(j)	HALLIBURTON NUS Environmental Corporation	HALLIBURTON NUS Laboratory	EPA 524 2	≥ 0 2 ppb

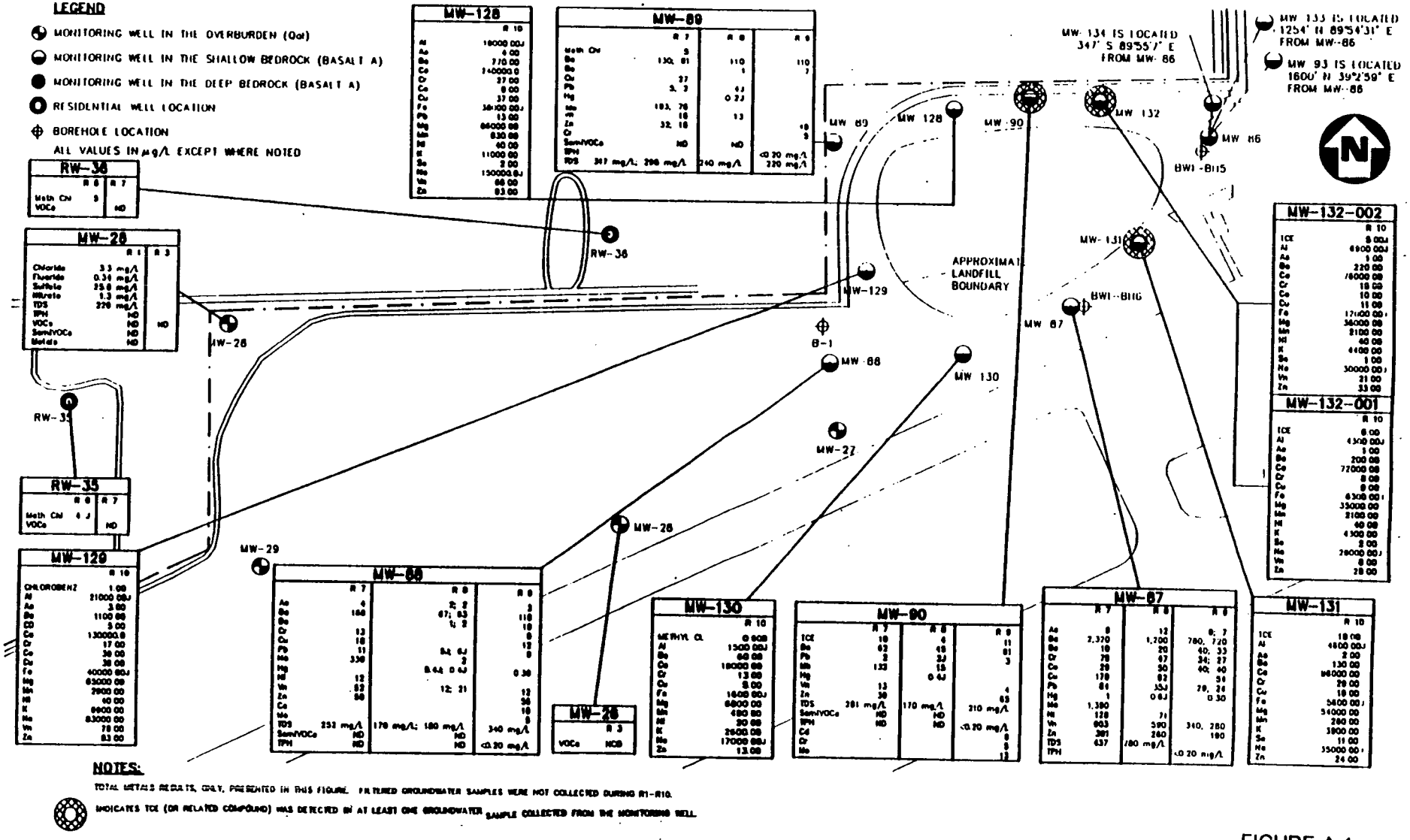


FIGURE A-1

SW-1
ANALYTICAL RESULTS FOR GROUNDWATER – R1-R10
FAIRCHILD AIR FORCE BASE, WASHINGTON

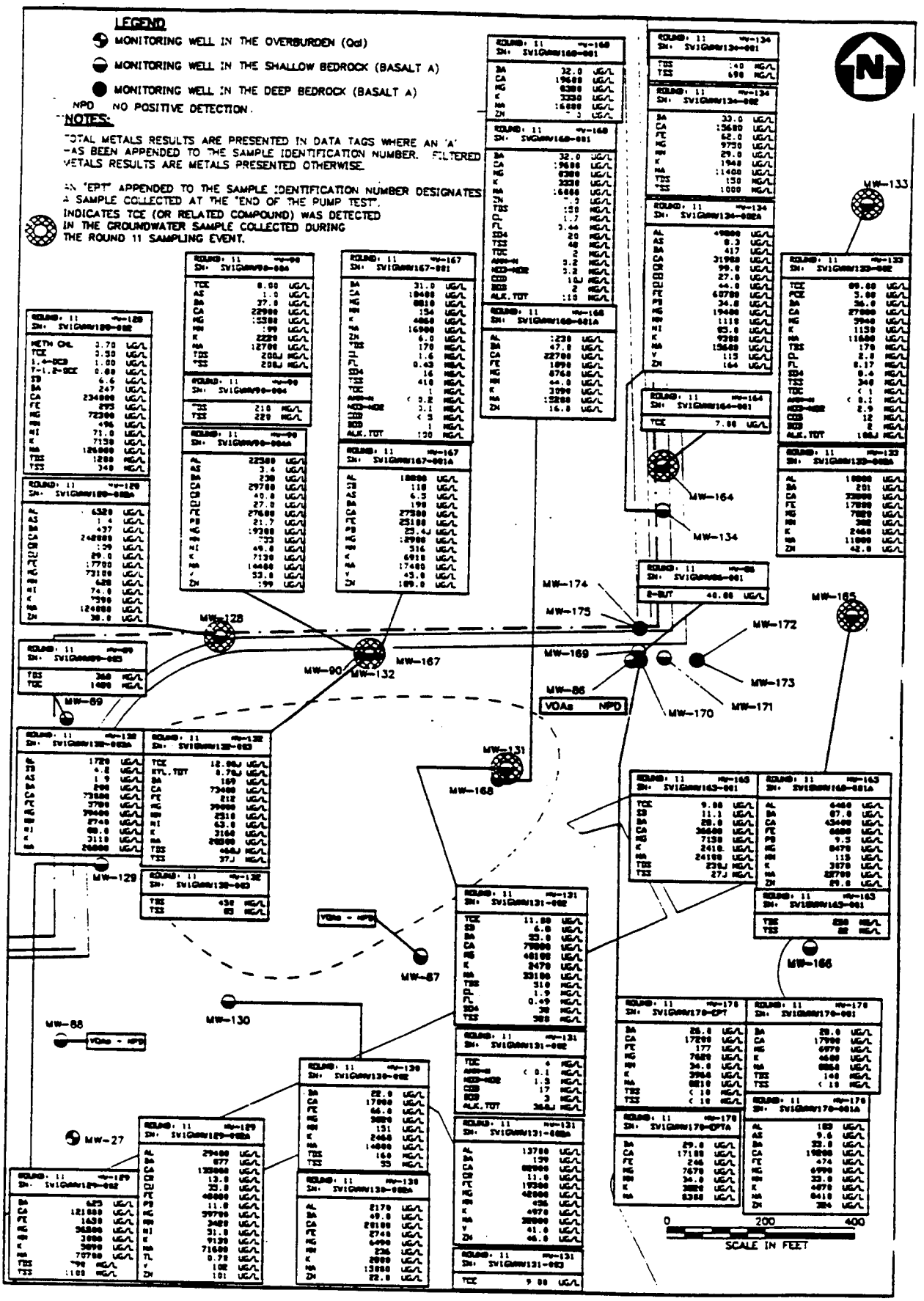


FIGURE A-2

ROUND 11 – GROUNDWATER MONITORING RESULTS
SW-1
FAIRCHILD AIR FORCE BASE, WASHINGTON

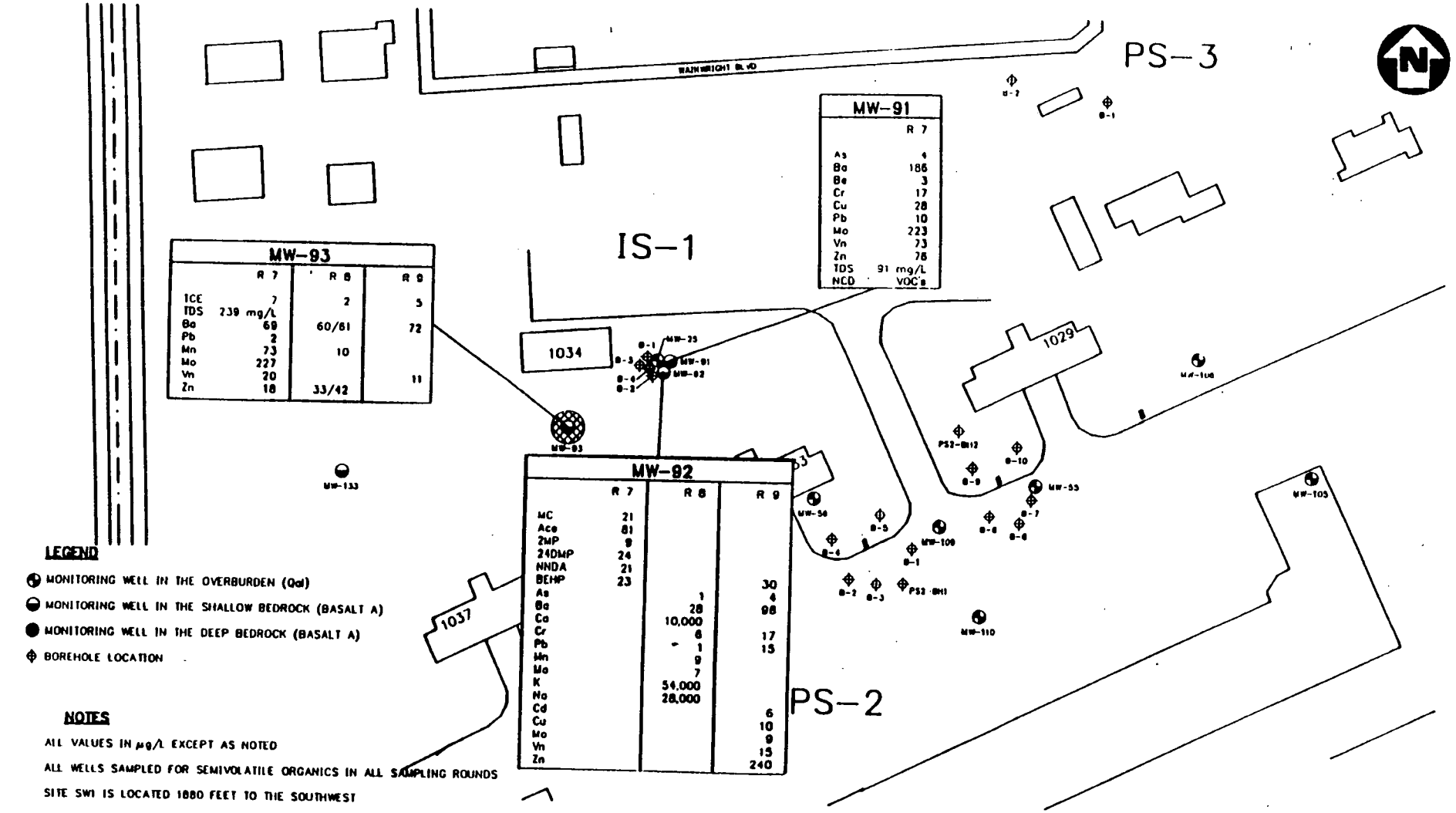


FIGURE A-3

IS-1 OPERABLE UNIT
ANALYTICAL RESULTS FOR GROUNDWATER - R7-R9
FAIRCHILD AIR FORCE BASE, WASHINGTON

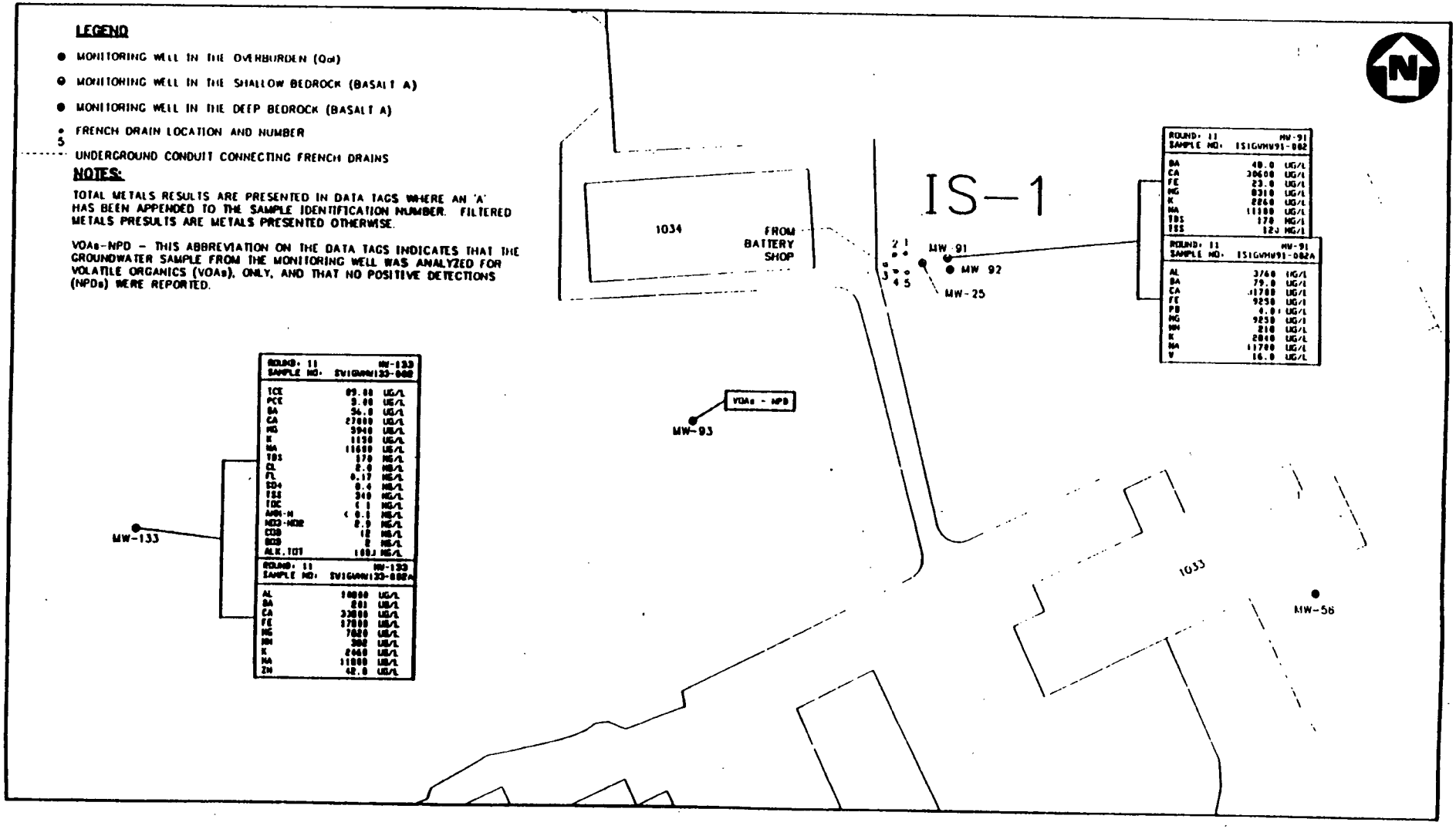
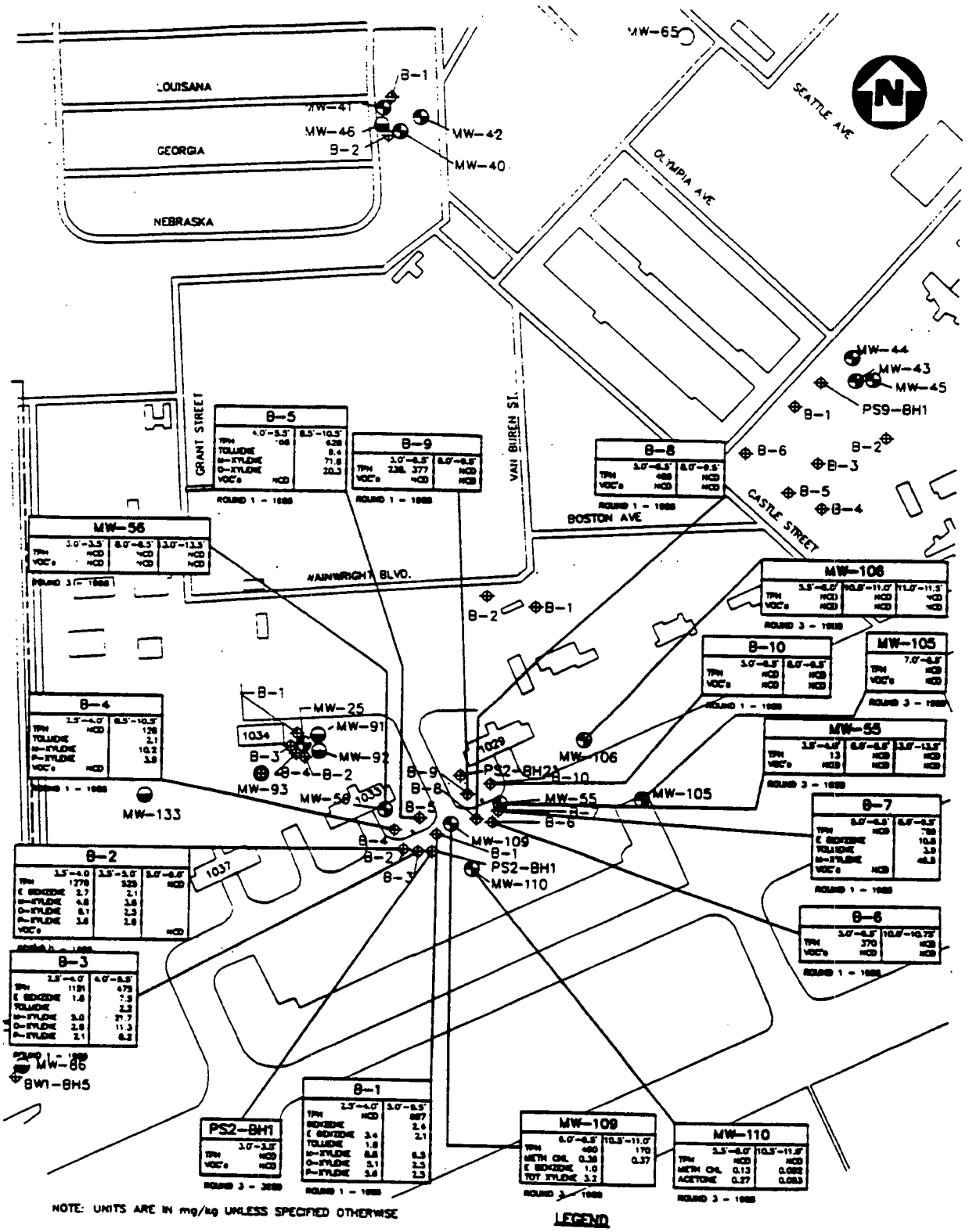


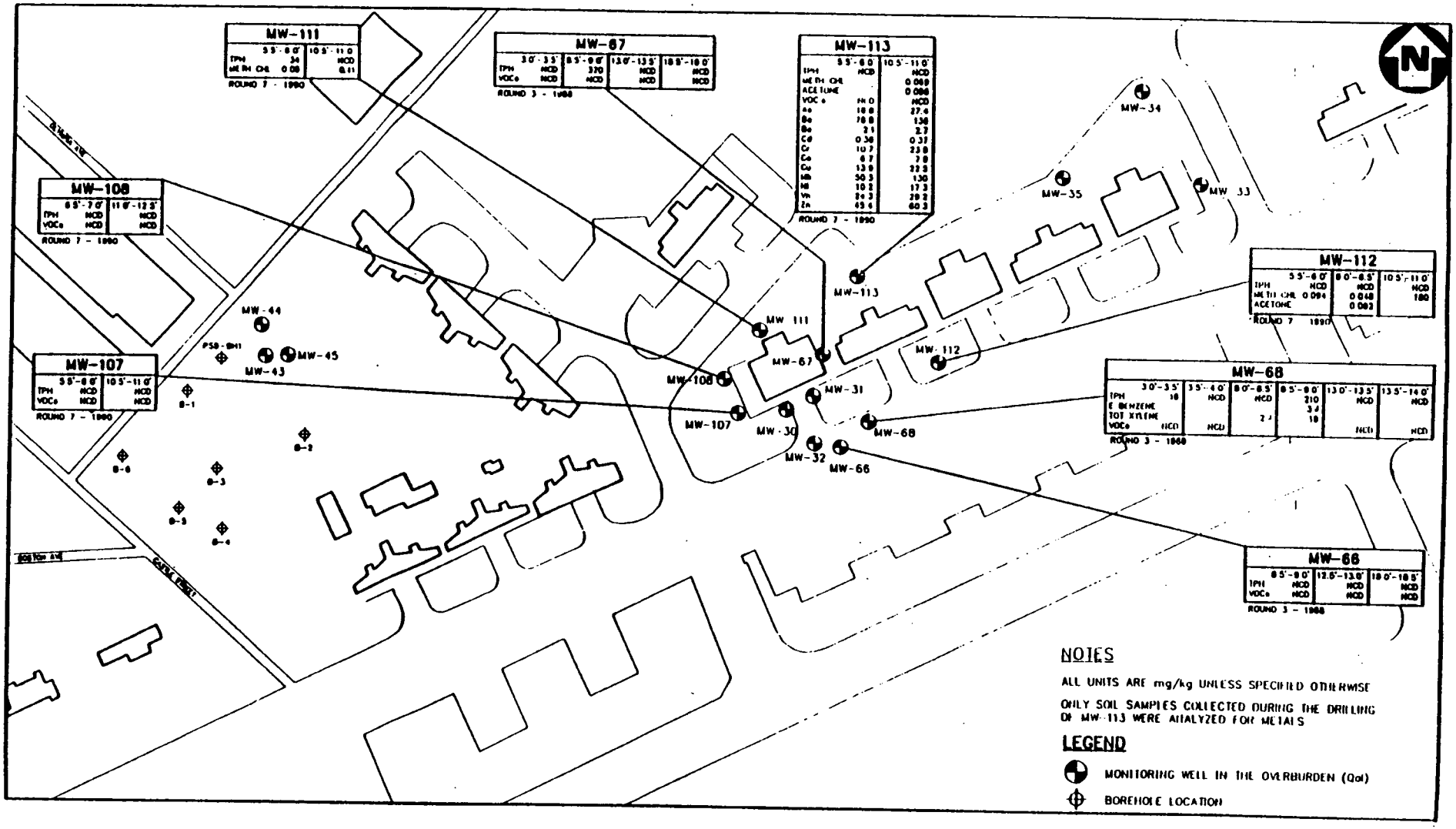
FIGURE A-4

ROUND 11 - GROUNDWATER MONITORING RESULTS
IS-1
FAIRCHILD AIR FORCE BASE, WASHINGTON



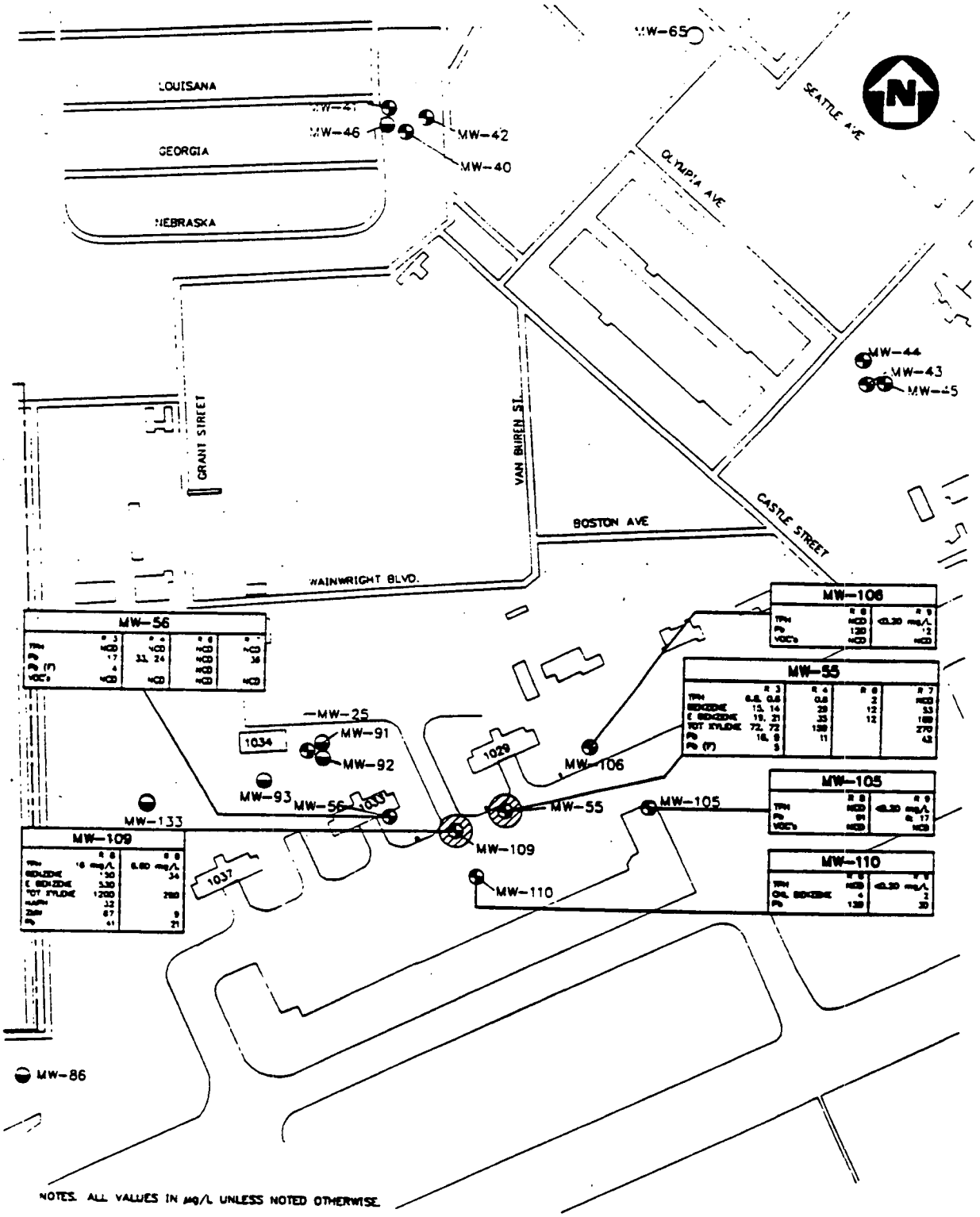
OU-1 (PS-2)
ANALYTICAL RESULTS FOR SOILS - R1, R3
VOLATILE ORGANIC CHEMICALS AND TOTAL PETROLEUM HYDROCARBONS
FAIRCHILD AIR FORCE BASE, WASHINGTON

FIGURE A-5



OU-1 (SITE PS-8)
ANALYTICAL RESULTS FOR SOILS - R3, R7
VOLATILE ORGANICS, TOTAL PETROLEUM HYDROCARBONS, SELECTED METALS
FAIRCHILD AIR FORCE BASE, WASHINGTON

FIGURE A-6



NOTES. ALL VALUES IN µg/L UNLESS NOTED OTHERWISE.

ALL WELLS SAMPLED FOR SEMIVOLATILE ORGANICS DURING ROUNDS 6, 7, 8, AND 9.

WELLS 55 AND 56 WERE SAMPLED FOR TOTAL/FILTERED LEAD IN ROUNDS 3 AND 4.

INDICATES TPH AND/OR BTEX WAS DETECTED IN AT LEAST ONE GROUNDWATER SAMPLE COLLECTED FROM THE MONITORING WELL

LEGEND

- MONITORING WELL IN THE OVERBURDEN (Qal)
- MONITORING WELL IN THE SHALLOW BEDROCK (BASALT A)

0 400 800

SCALE IN FEET

OU-1 (SITE PS-2)
ANALYTICAL RESULTS FOR
GROUNDWATER VOLATILE ORGANICS, LEAD, AND
TOTAL PETROLEUM HYDROCARBONS - R3-R9
FAIRCHILD AIR FORCE BASE, WASHINGTON

FIGURE A-7

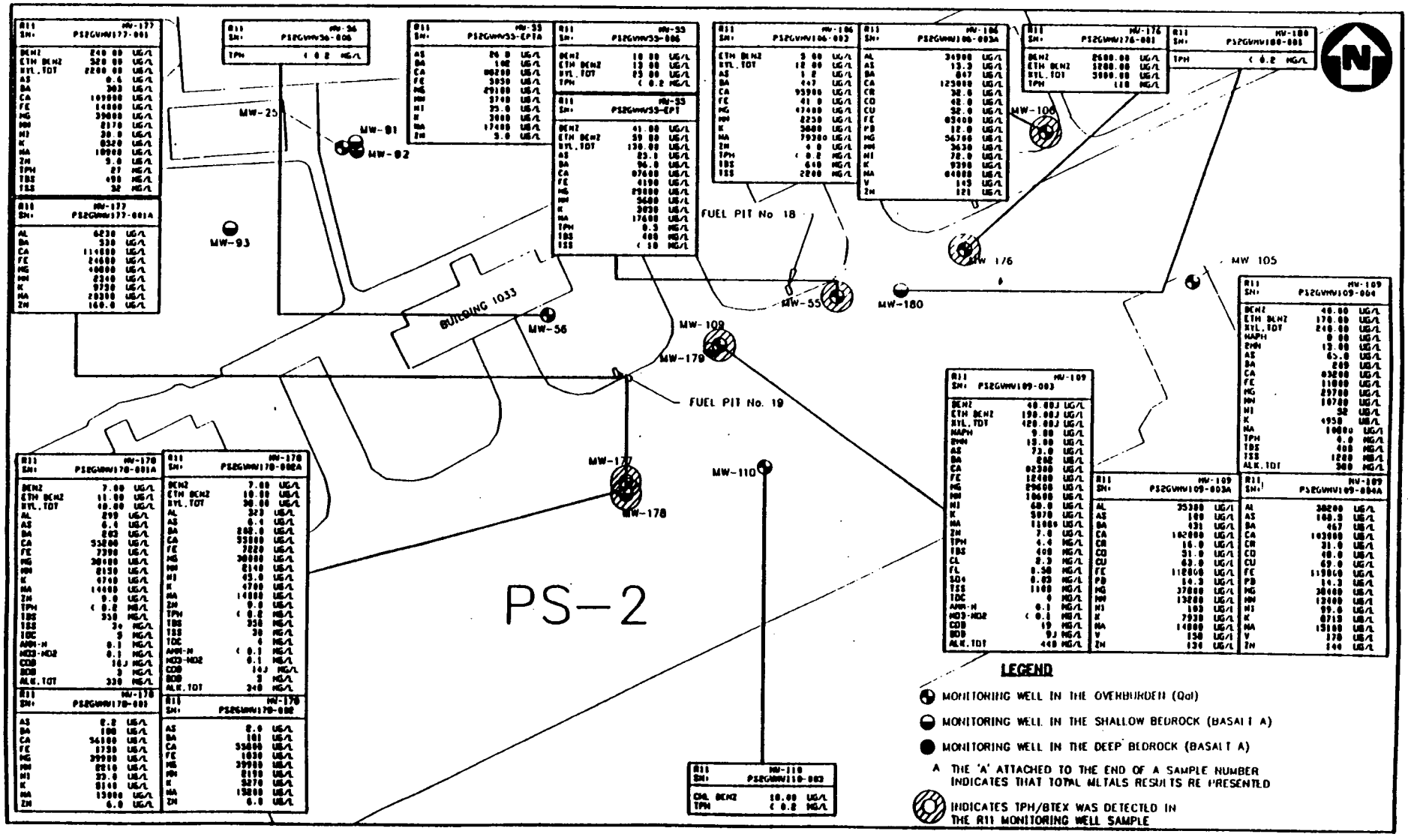
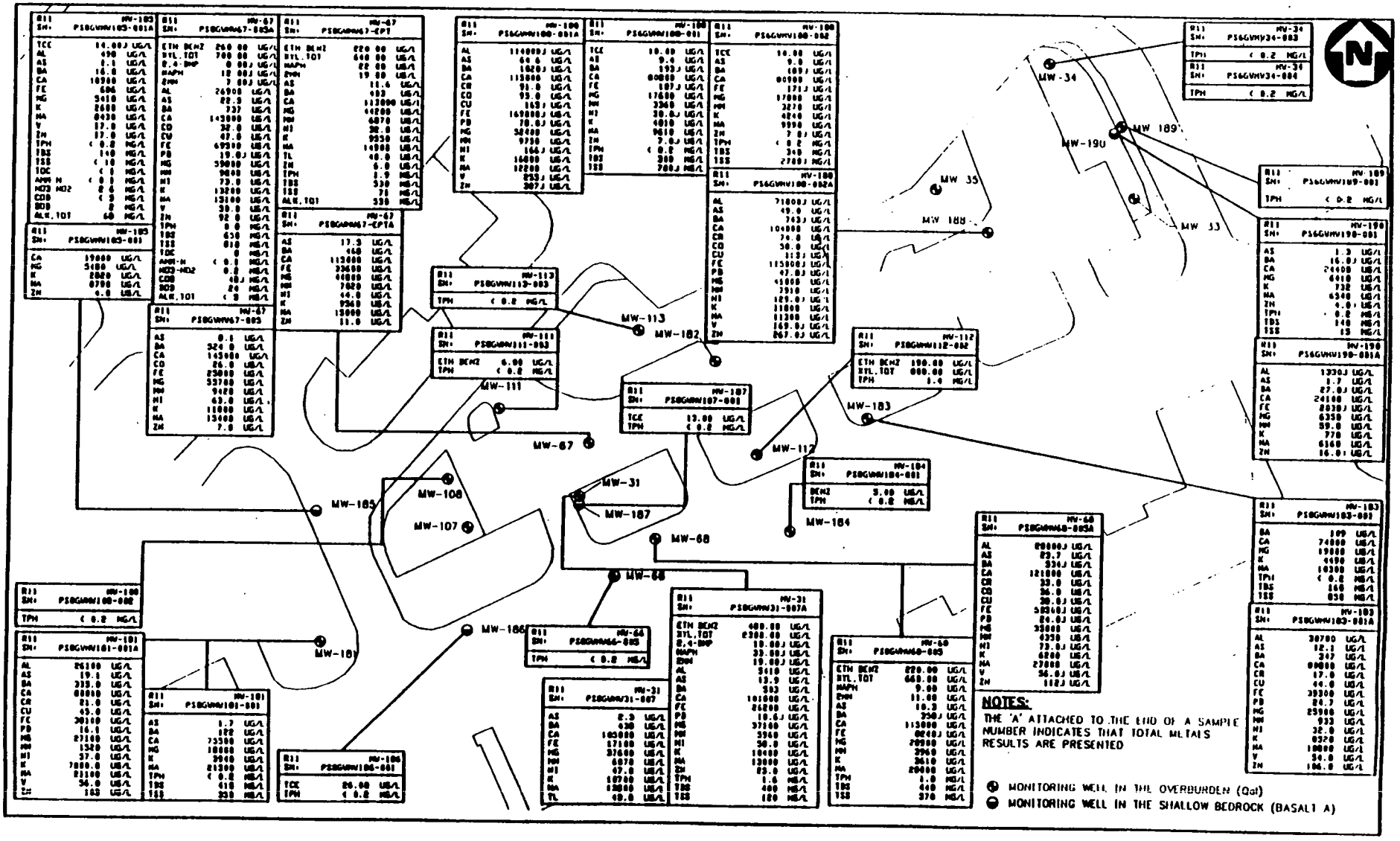


FIGURE A-8

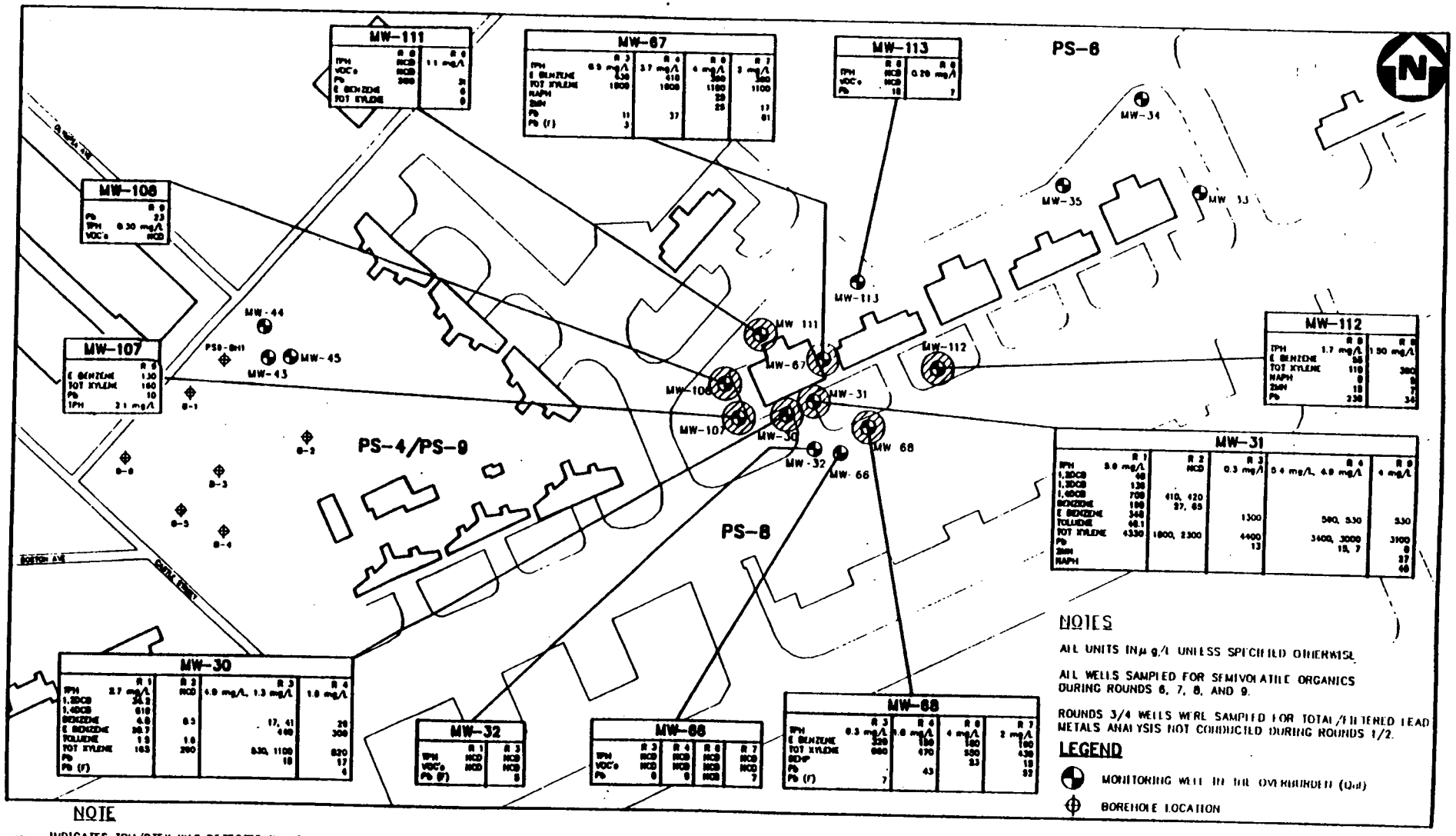
PS-2 – ROUND 11 – GROUNDWATER MONITORING RESULTS
IS-1/PS-2
FAIRCHILD AIR FORCE BASE, WASHINGTON



ROUND 11 – GROUNDWATER MONITORING RESULTS
PS-8 AND PS-6
FAIRCHILD AIR FORCE BASE, WASHINGTON

0 200 400
SCALE IN FEET

FIGURE A-9



NOTE

INDICATES TPH/BTEX WAS DETECTED IN AT LEAST ONE GROUNDWATER SAMPLE COLLECTED FROM THE MONITORING WELL

OU-1 (PS-8)

ANALYTICAL RESULTS FOR GROUNDWATER -- R1-R9

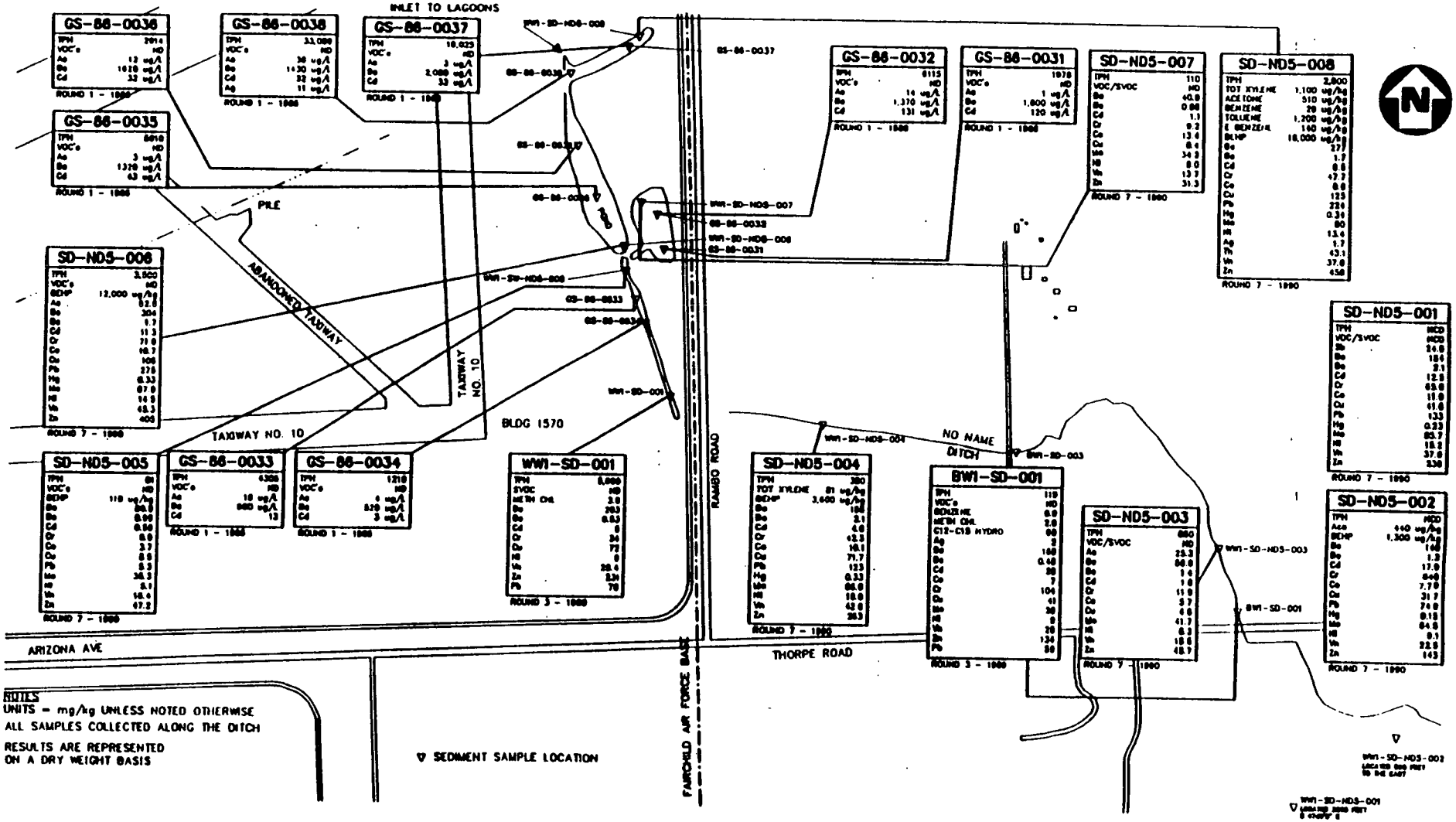
VOLATILE ORGANICS, LEAD, AND TOTAL PETROLEUM HYDROCARBONS

FAIRCHILD AIR FORCE BASE, WASHINGTON

0 300 600

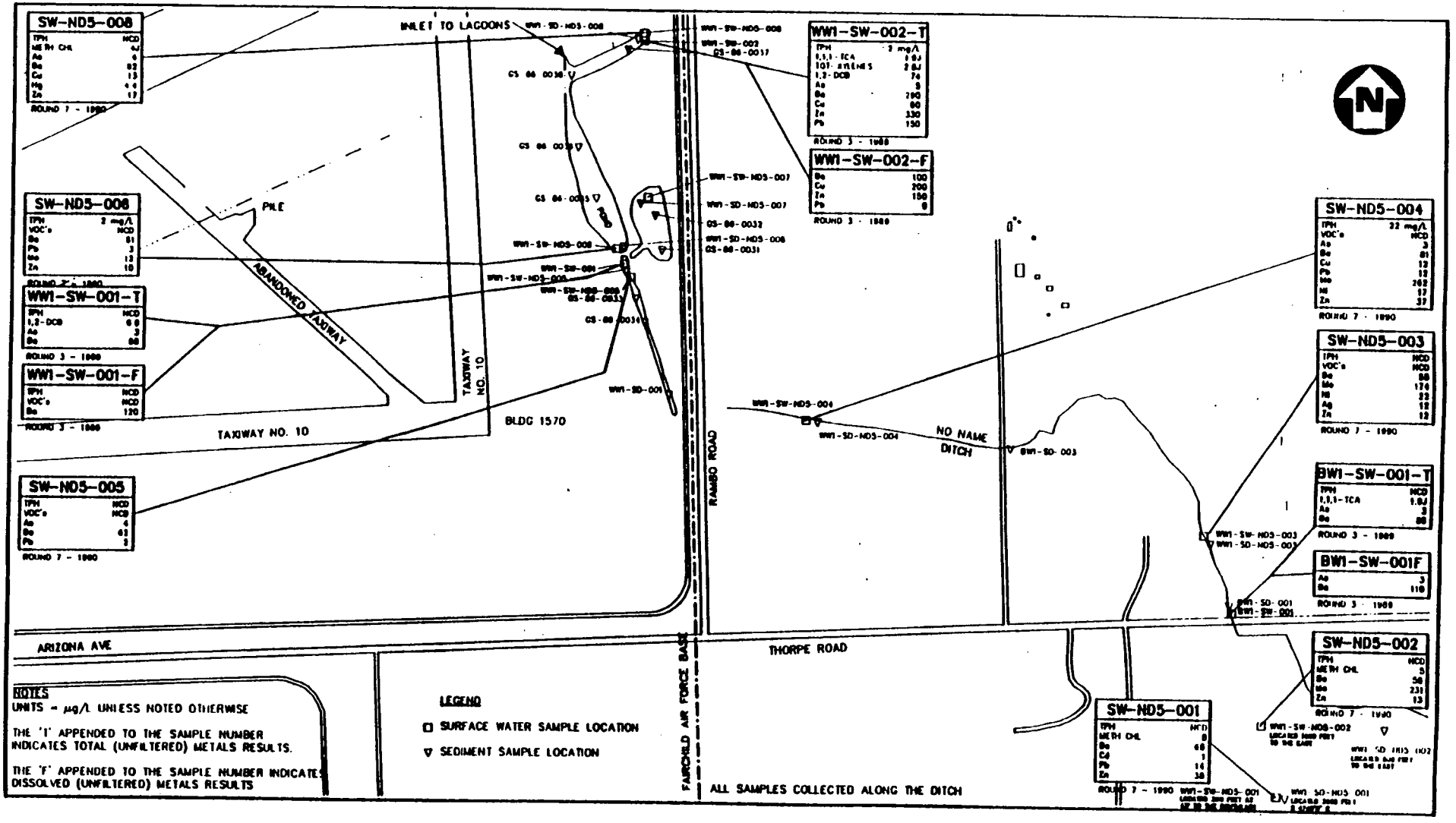
SCALE IN FEET

FIGURE A-10



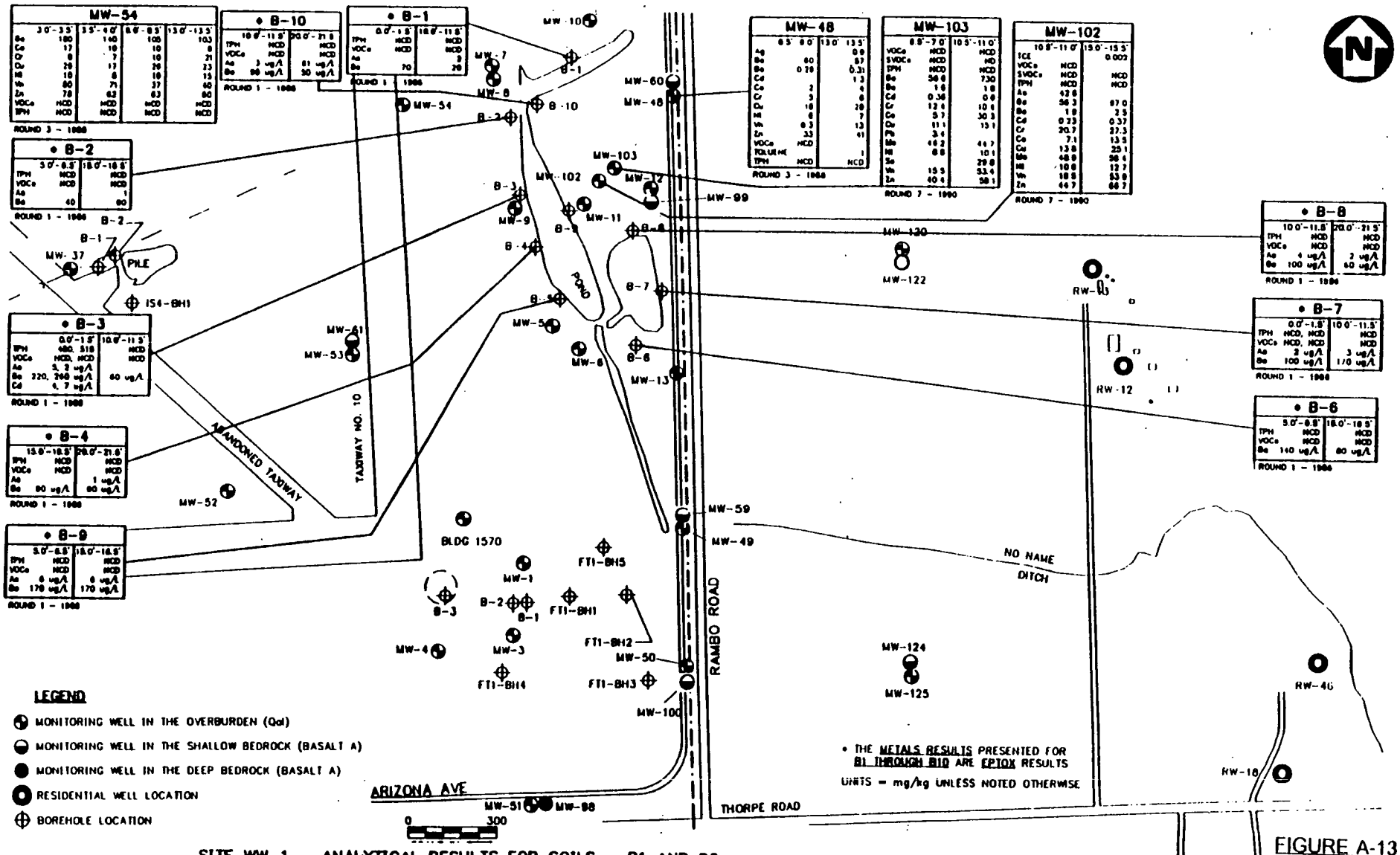
WW-1 – ANALYTICAL RESULTS FOR SEDIMENTS – R1, R3, AND R7
TOTAL METALS, ORGANICS, TOTAL PETROLEUM HYDROCARBONS
FAIRCHILD AIR FORCE BASE, WASHINGTON

FIGURE A-11



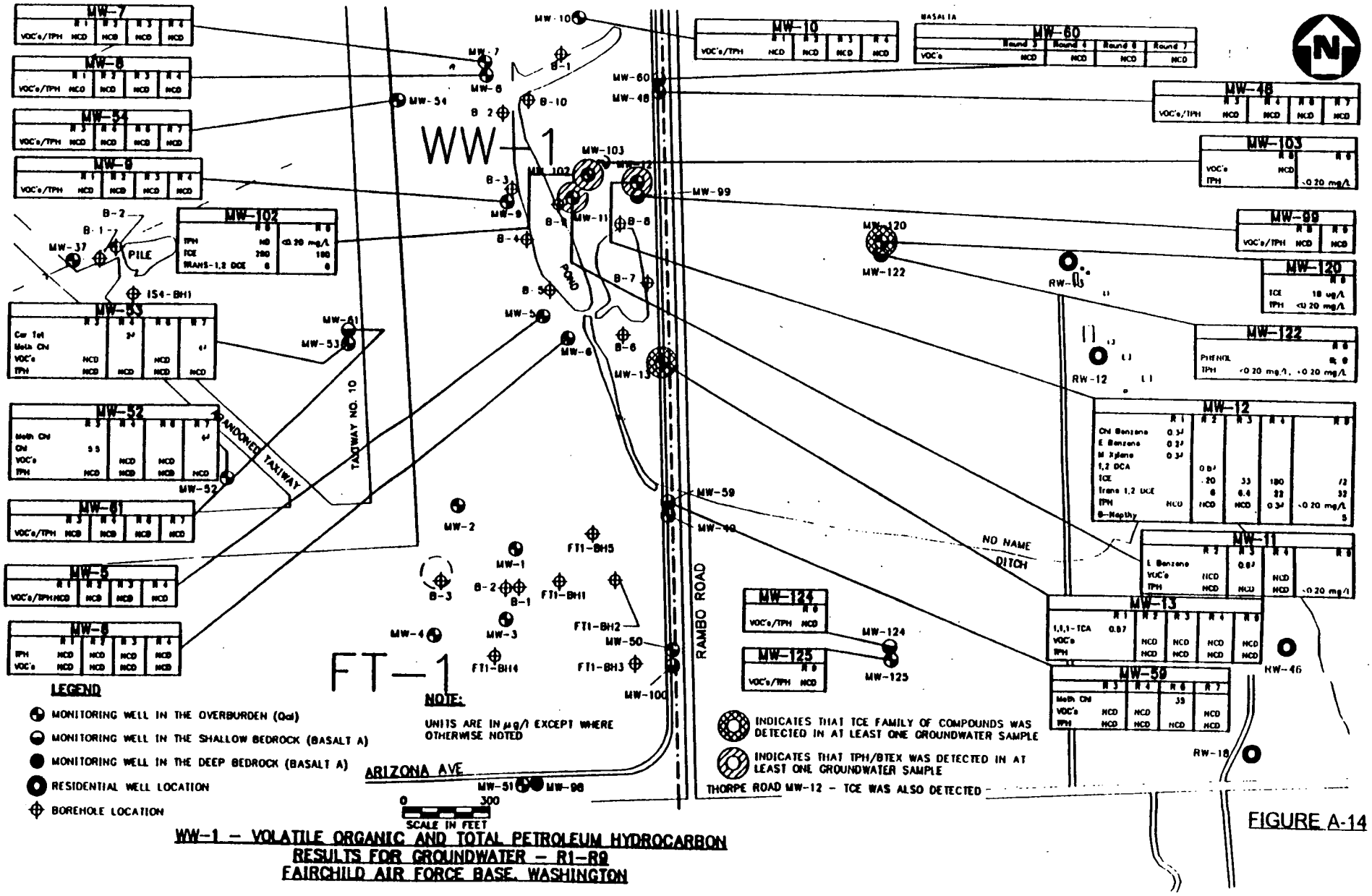
SITE WW-1 - ANALYTICAL RESULTS FOR SURFACE WATERS - R1, R3, AND R7
SELECTED TOTAL FILTERED METALS, ORGANICS, TOTAL PETROLEUM HYDROCARBONS
FAIRCHILD AIR FORCE BASE, WASHINGTON

FIGURE A-12



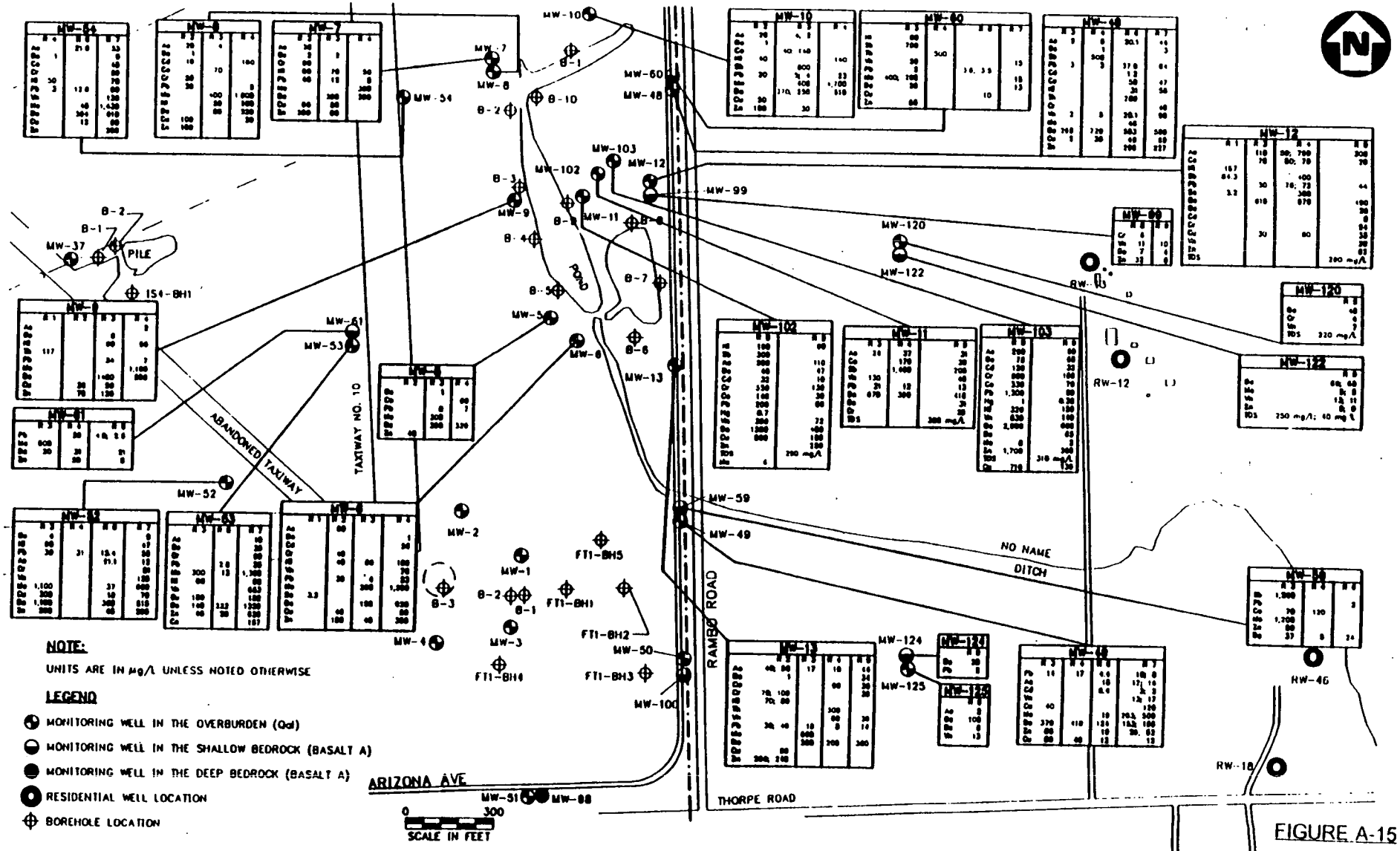
SITE WW-1 - ANALYTICAL RESULTS FOR SOILS - R1 AND R3
SELECTED METALS, EP-TOX METALS, ORGANICS, TOTAL PETROLEUM HYDROCARBONS
FAIRCHILD AIR FORCE BASE, WASHINGTON

FIGURE A-13



WW-1 - VOLATILE ORGANIC AND TOTAL PETROLEUM HYDROCARBON RESULTS FOR GROUNDWATER - R1-R9
FAIRCHILD AIR FORCE BASE, WASHINGTON

FIGURE A-14



NOTE:

UNITS ARE IN µg/l UNLESS NOTED OTHERWISE

LEGEND

- MONITORING WELL IN THE OVERBURDEN (Qal)
- MONITORING WELL IN THE SHALLOW BEDROCK (BASALT A)
- MONITORING WELL IN THE DEEP BEDROCK (BASALT A)
- RESIDENTIAL WELL LOCATION
- BOREHOLE LOCATION

FIGURE A-15

WW1- 1 SELECTED TOTAL METALS RESULTS FOR GROUNDWATER - R1-R9
FAIRCHILD AIR FORCE BASE, WASHINGTON

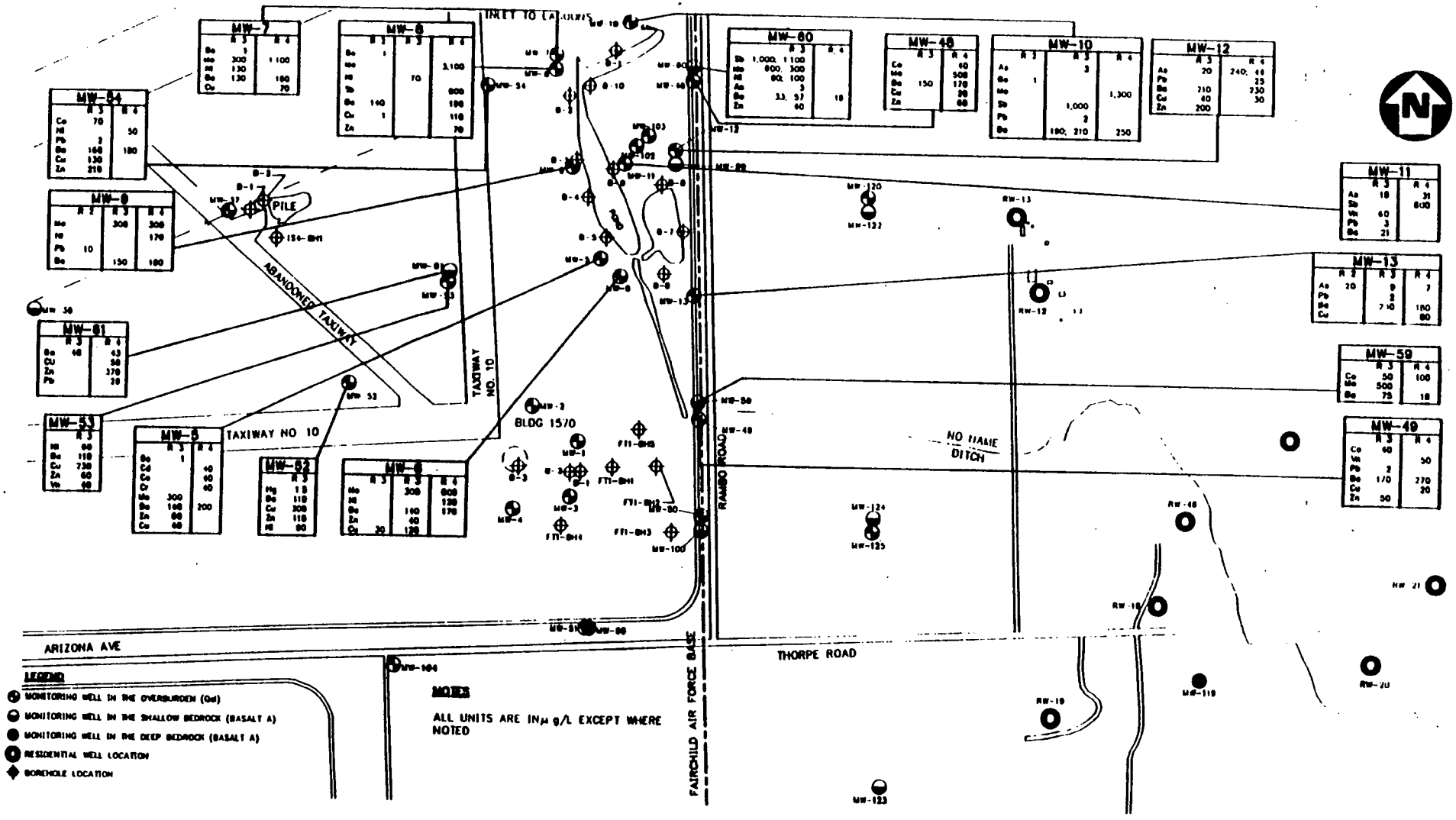
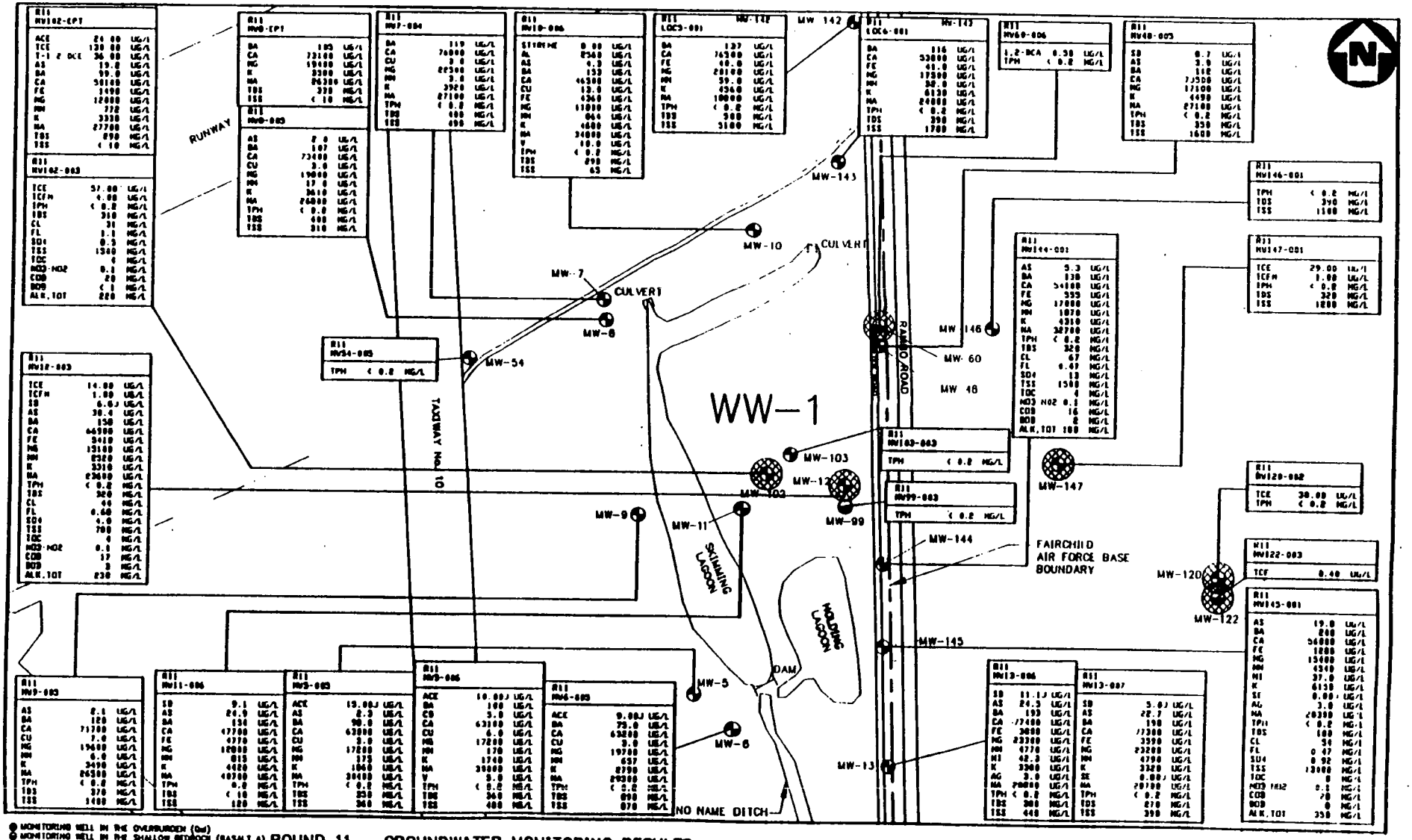


FIGURE A-16

WW-1 – SELECTED DISSOLVED METALS RESULTS FOR GROUNDWATER – R1-R9
FAIRCHILD AIR FORCE BASE, WASHINGTON



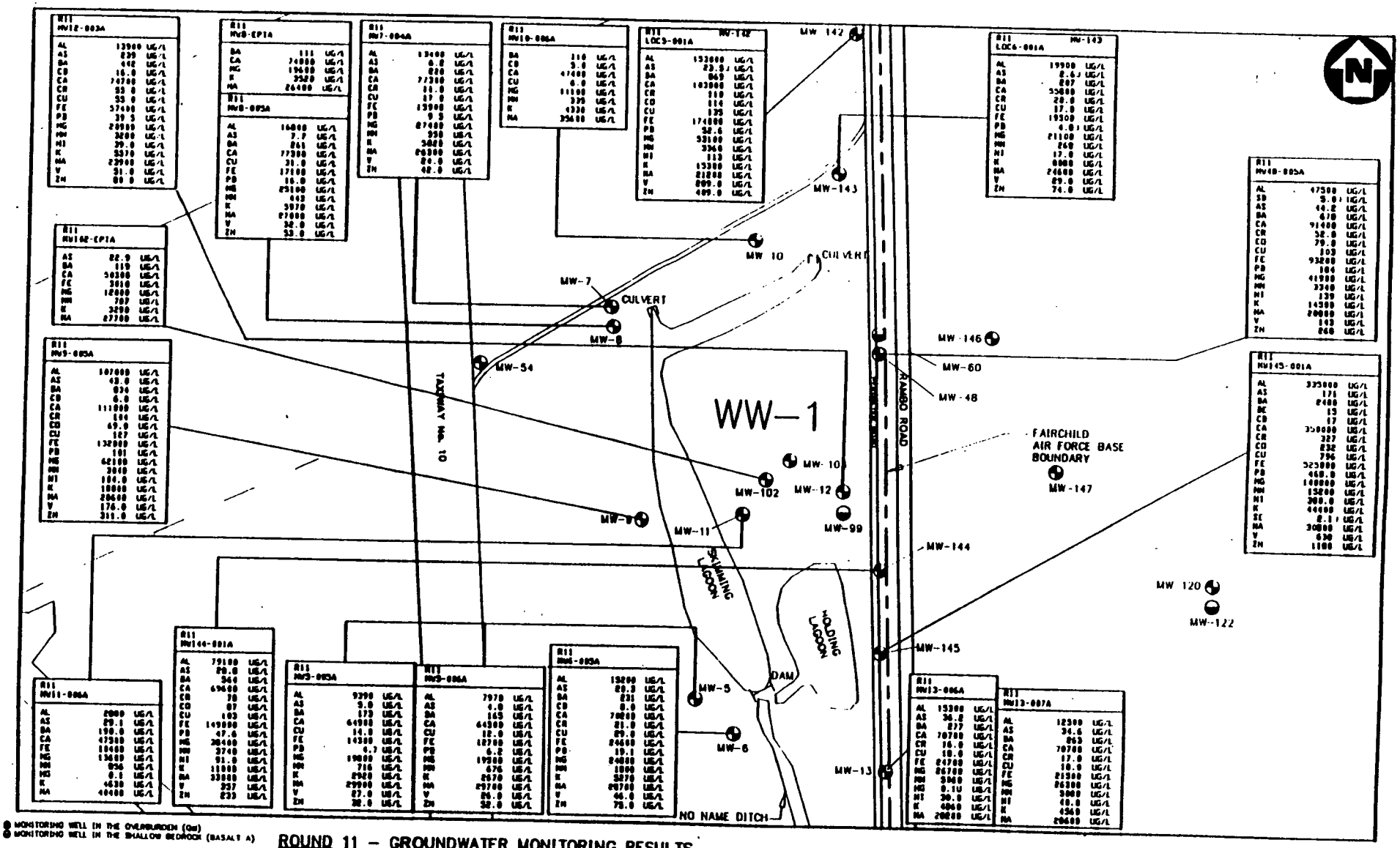
● MONITORING WELL IN THE OVERBURDEN (Qal)
● MONITORING WELL IN THE SHALLOW BEDROCK (BASALT A)

NOTE:
INDICATES TCE OR RELATED COMPOUND WAS DETECTED IN THE GROUNDWATER SAMPLE COLLECTED DURING THE ROUND 11 SAMPLING EVENT.

ROUND 11 – GROUNDWATER MONITORING RESULTS (ORGANICS AND DISSOLVED METALS RESULTS) WW-1 FAIRCHILD AIR FORCE BASE, WASHINGTON

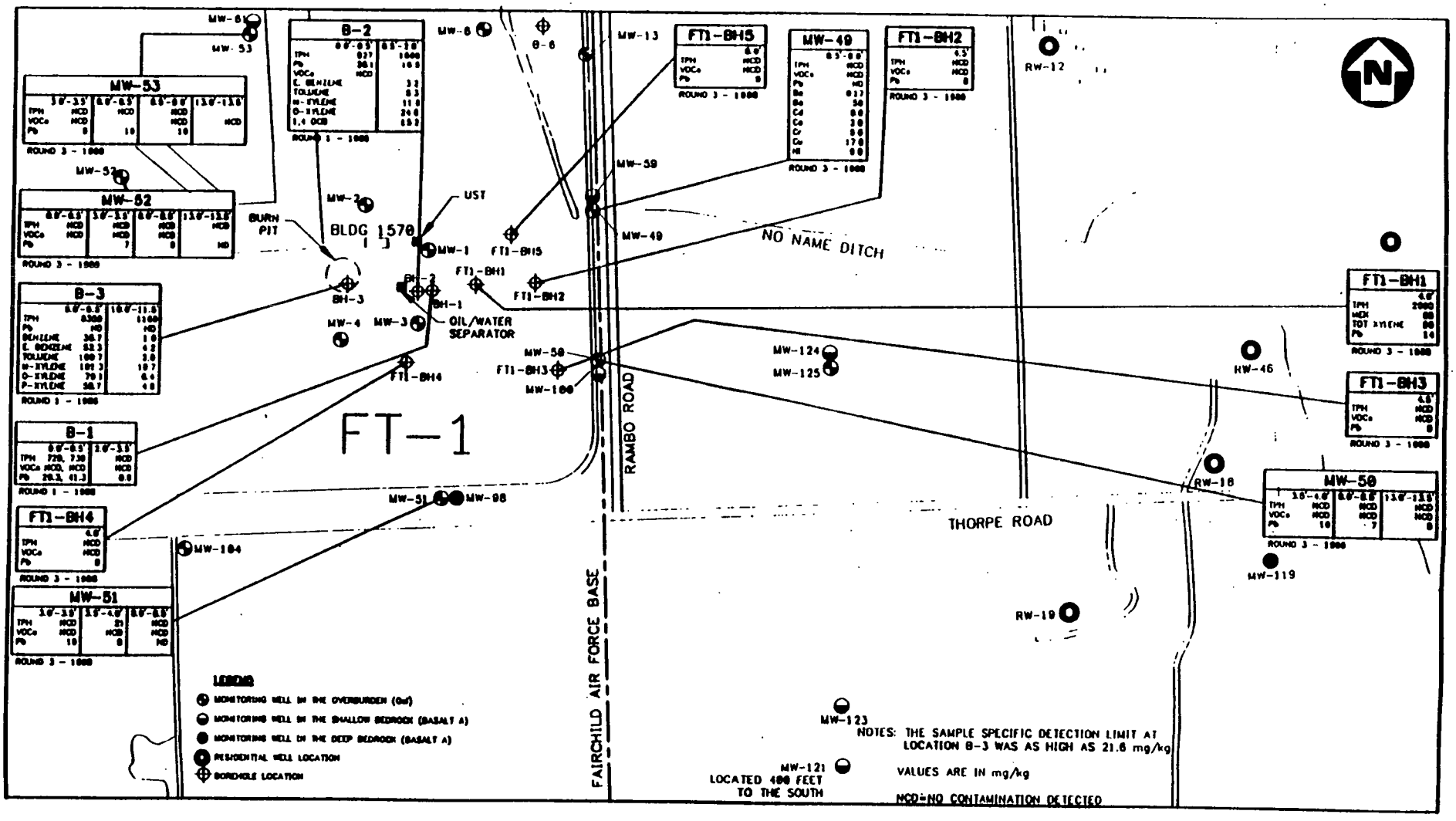
0 200 400
SCALE IN FEET

FIGURE A-17A



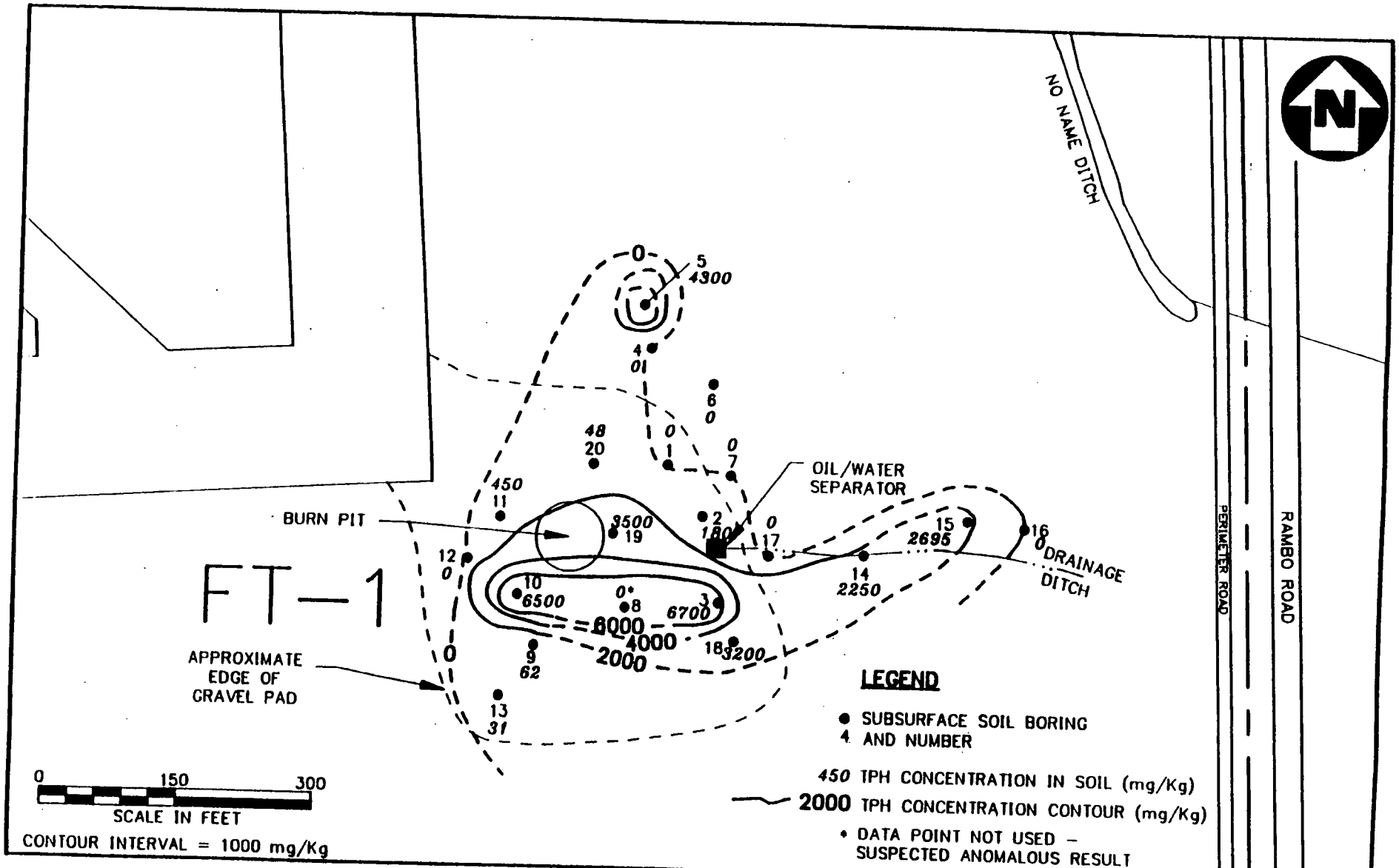
ROUND 11 – GROUNDWATER MONITORING RESULTS
(TOTAL METAL RESULTS)
WW-1
FAIRCHILD AIR FORCE BASE, WASHINGTON

FIGURE A-17B



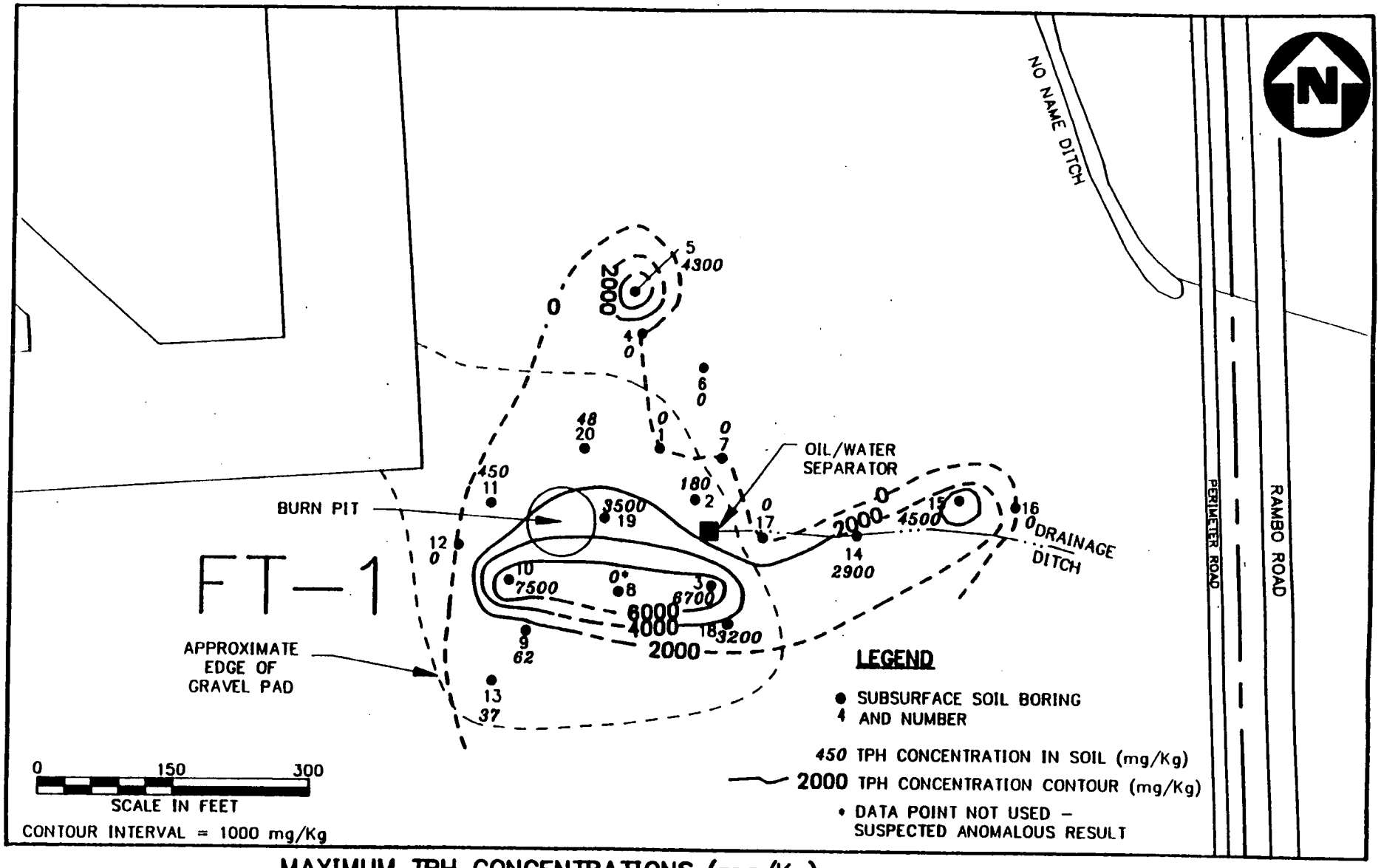
SITE FT-1 – ANALYTICAL RESULTS FOR SOILS – R1, R3
SELECTED METALS, ORGANICS, AND TOTAL PETROLEUM HYDROCARBONS
FAIRCHILD AIR FORCE BASE, WASHINGTON

FIGURE A-18



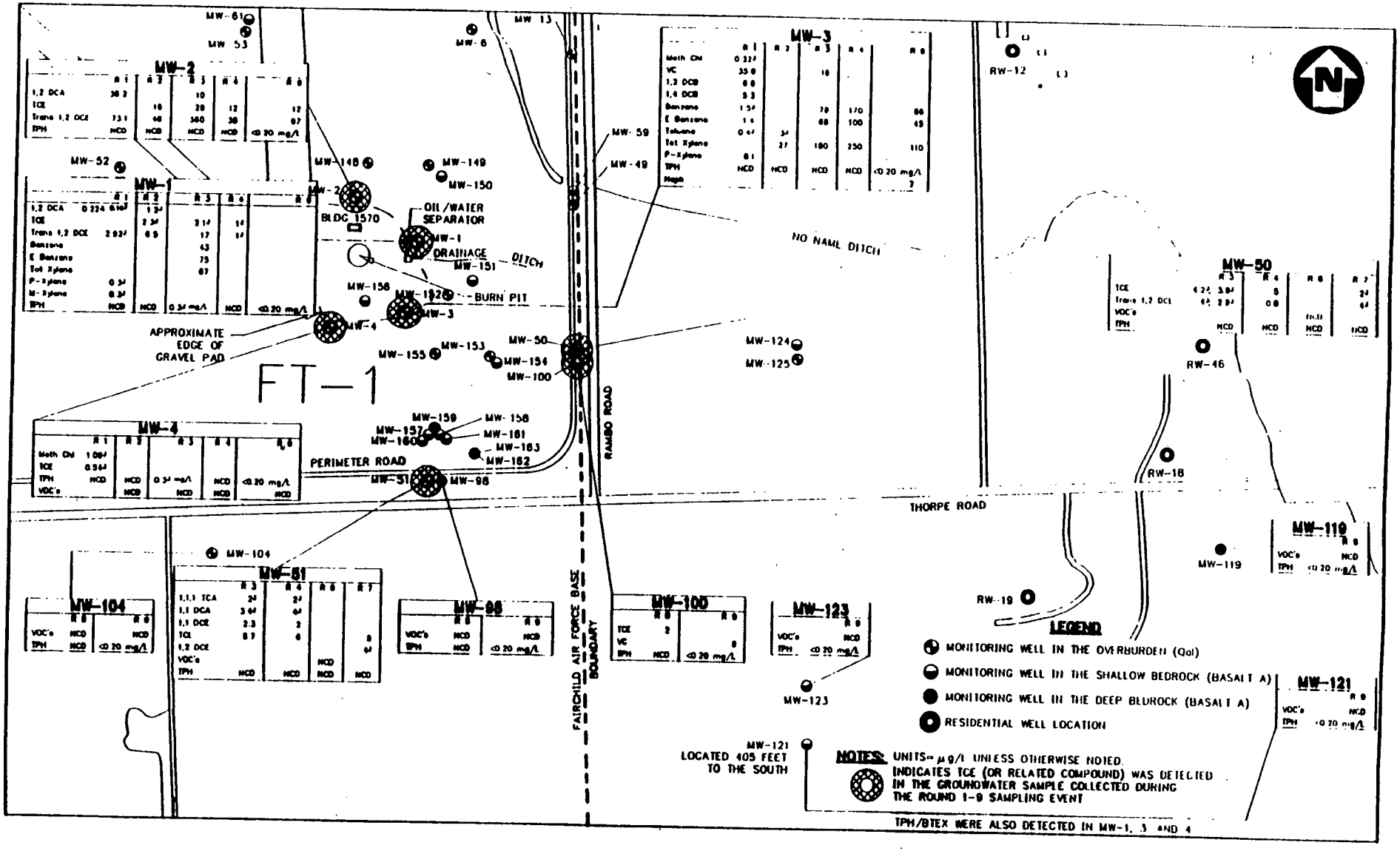
AVERAGE TPH CONCENTRATIONS (mg/Kg)
IN UNSATURATED SOILS
ROUND 11 SAMPLING
FAIRCHILD AIR FORCE BASE, WASHINGTON

FIGURE A-19



MAXIMUM TPH CONCENTRATIONS (mg/Kg)
IN UNSATURATED SOILS
ROUND 11 SAMPLING
FAIRCHILD AIR FORCE BASE, WASHINGTON

FIGURE A-20



FT-1 – VOLATILE ORGANIC AND TOTAL PETROLEUM HYDROCARBON RESULTS FOR GROUNDWATER – R1-R9
FAIRCHILD AIR FORCE BASE, WASHINGTON

FIGURE A-21

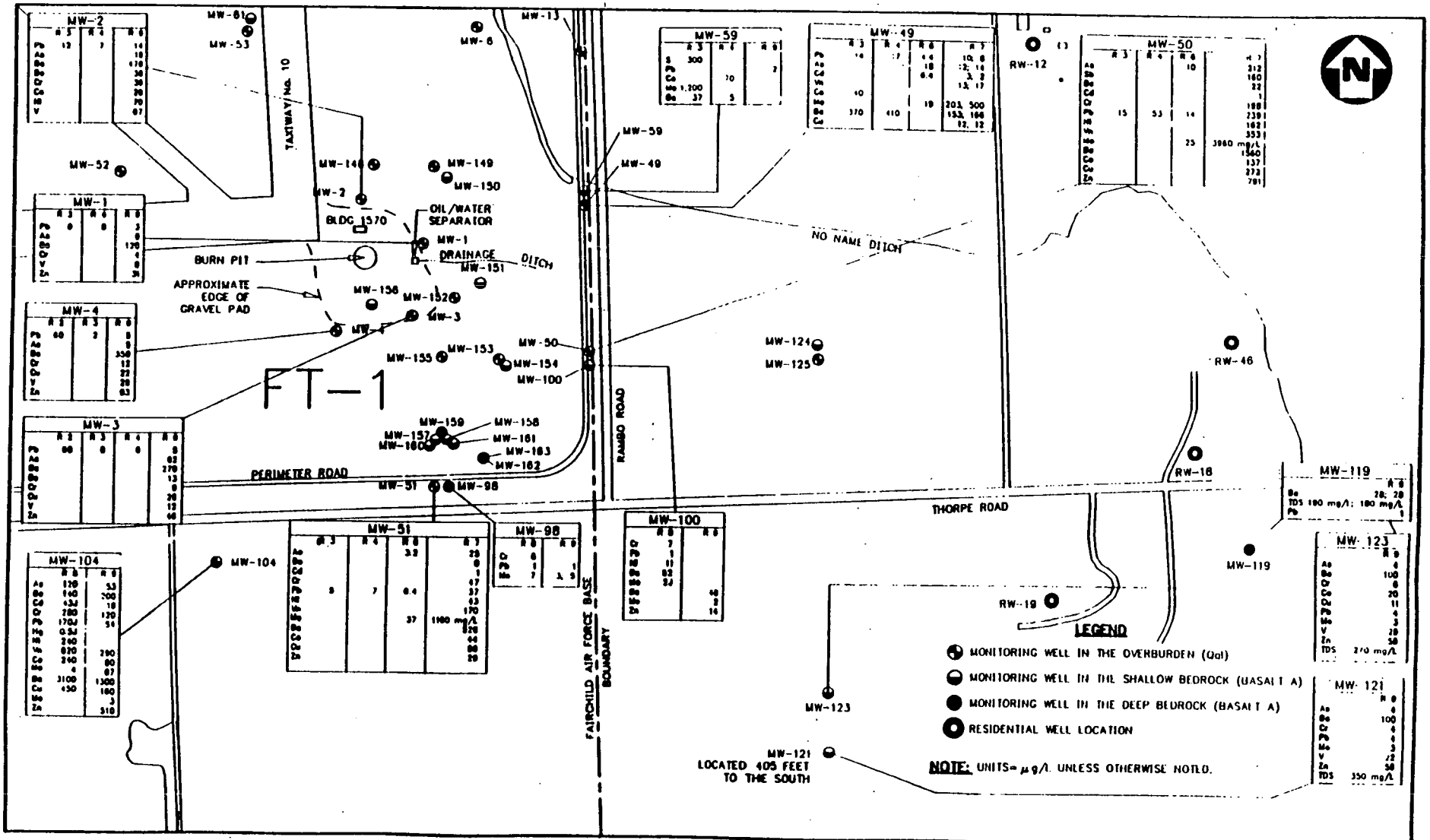


FIGURE A-22

FT-1 – SELECTED TOTAL METALS RESULTS FOR GROUNDWATER – R1-R9
FAIRCHILD AIR FORCE BASE, WASHINGTON

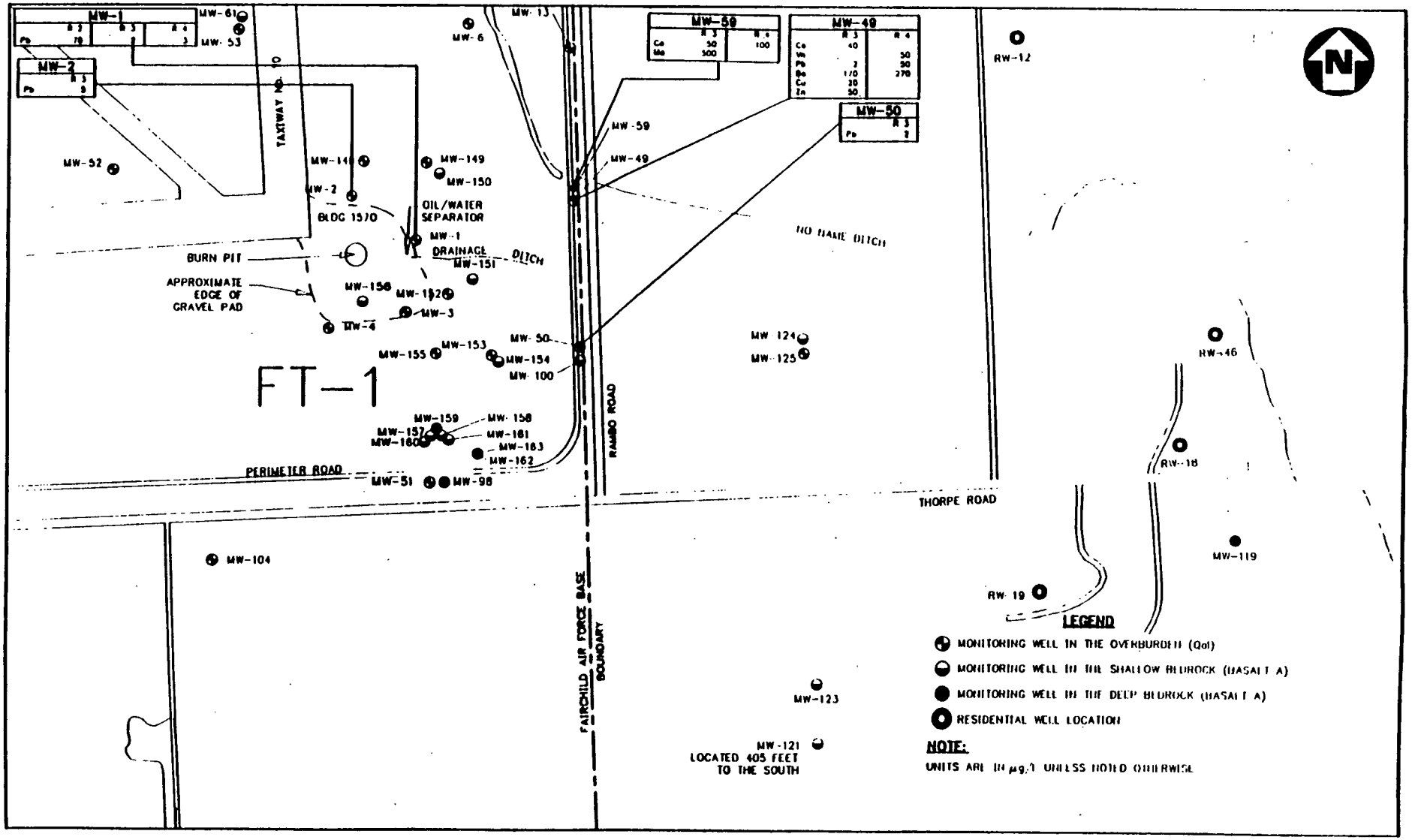
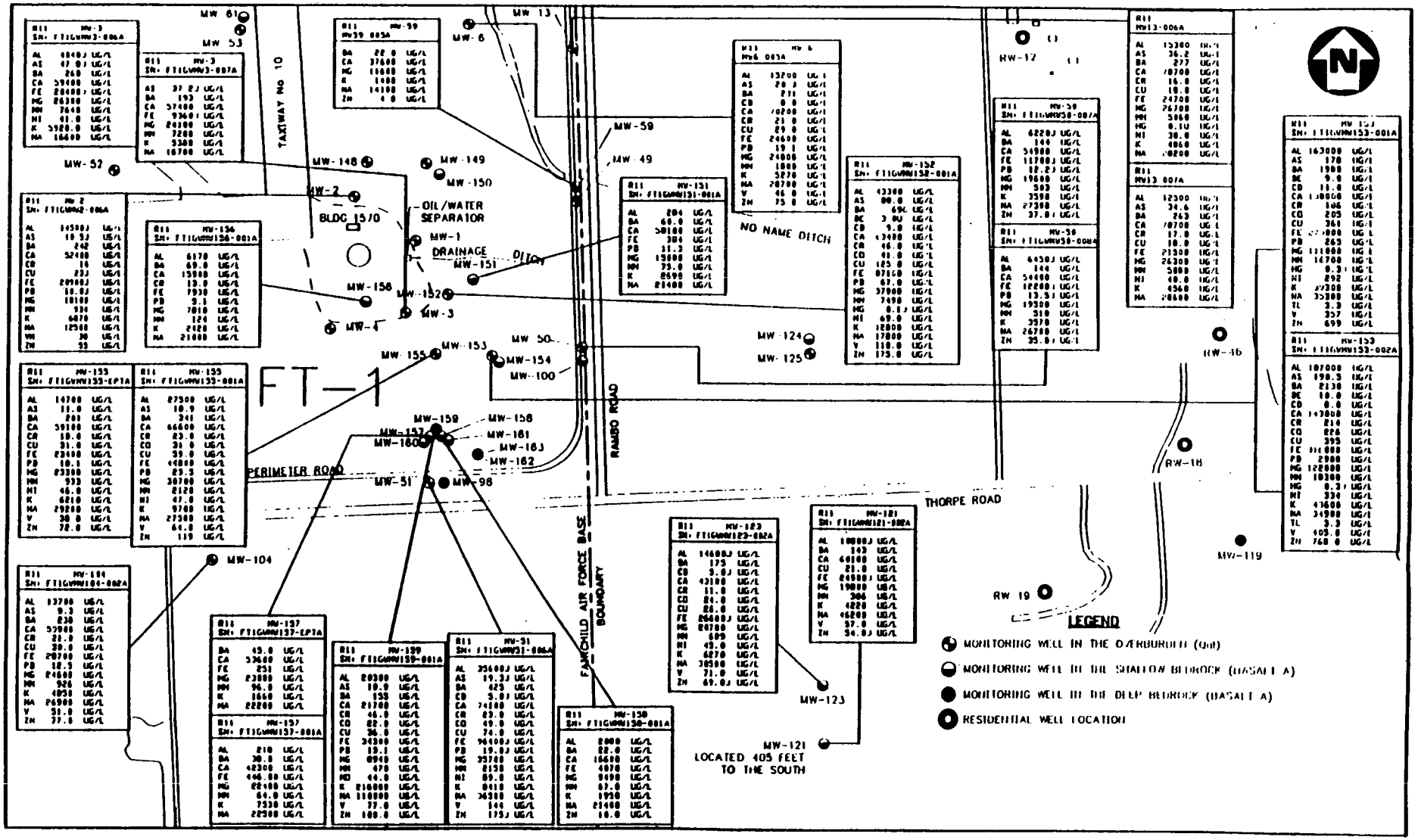


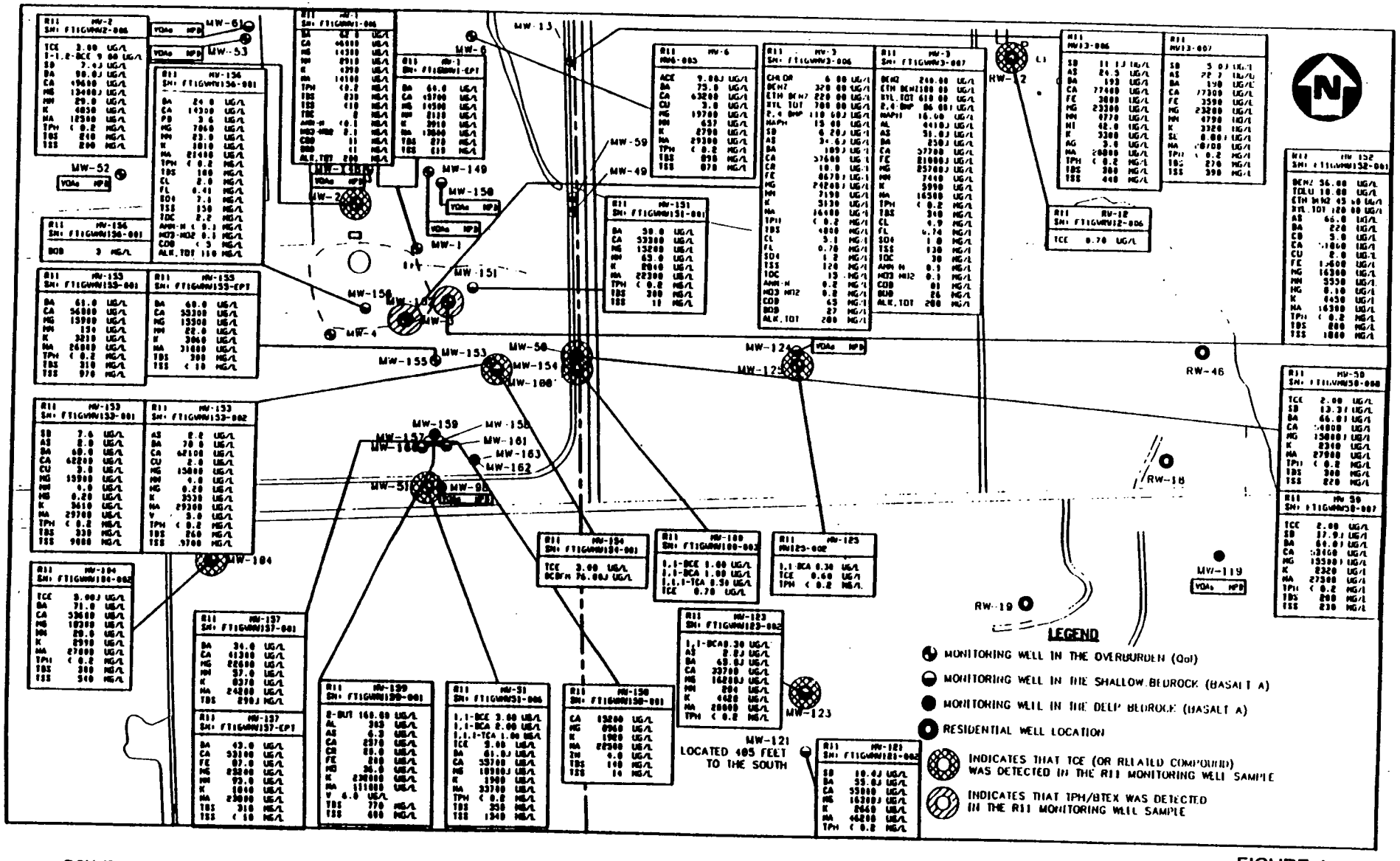
FIGURE A-23

FT-1 – SELECTED DISSOLVED METALS RESULTS FOR GROUNDWATER – R1-R9
FAIRCHILD AIR FORCE BASE, WASHINGTON



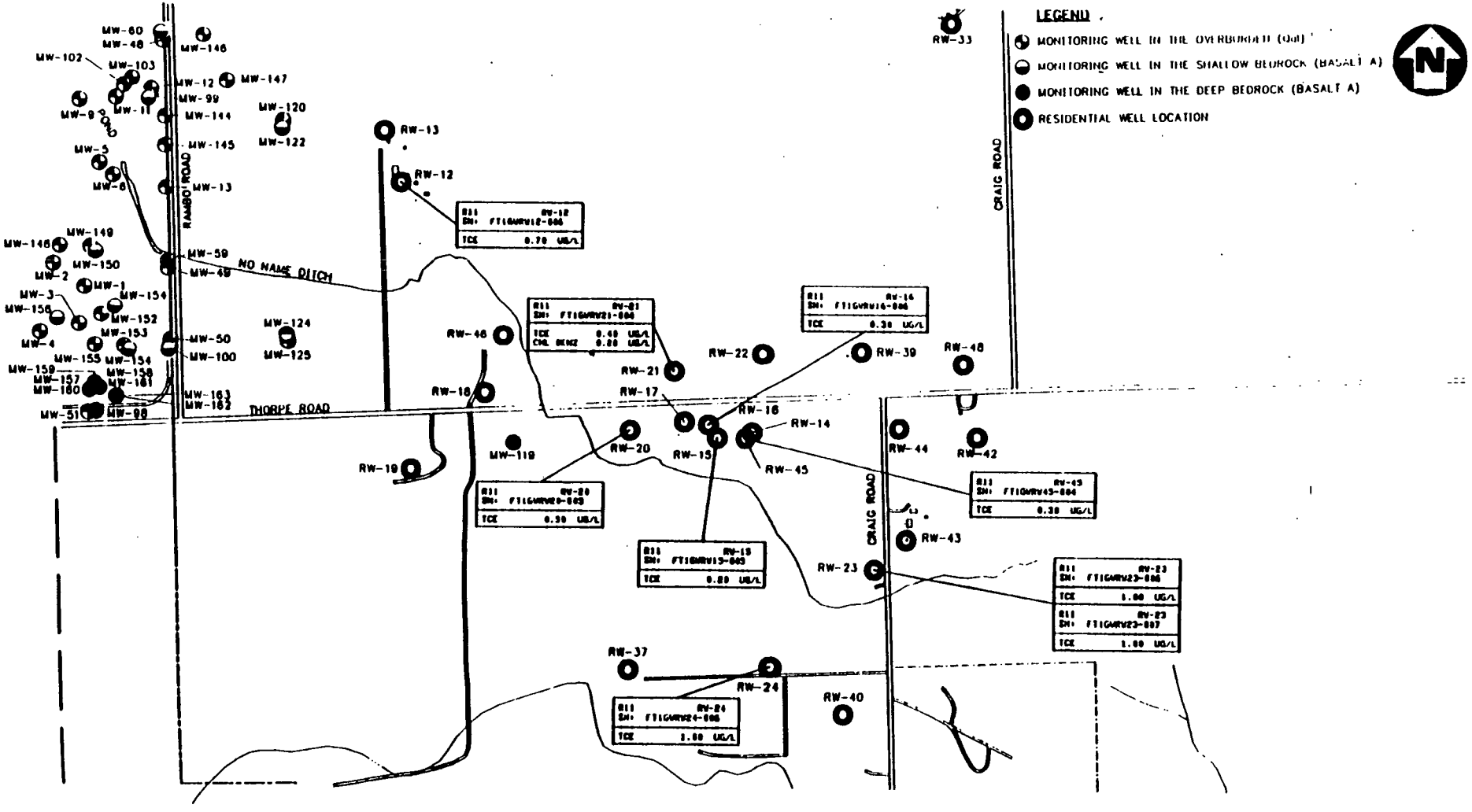
ROUND 11 – GROUNDWATER MONITORING RESULTS (TOTAL METALS RESULTS)
FT-1
FAIRCHILD AIR FORCE BASE, WASHINGTON

FIGURE A-24A



ROUND 11 – GROUNDWATER MONITORING RESULTS (ORGANICS & DISSOLVED METALS RESULTS)
FT-1
FAIRCHILD AIR FORCE BASE, WASHINGTON

FIGURE A-24B



ROUND 11 – GROUNDWATER MONITORING RESULTS

ET1

FAIRCHILD AIR FORCE BASE, WASHINGTON

FIGURE A-25

RE TECH
Remediation Technologies

March 31, 1993

Public Affairs
92 BW/PA
Fairchild AFB, WA 99011
Attn: Sgt. Geisler

RE: ON-BASE PRIORITY ONE OPERABLE UNITS
PROPOSED PLAN PUBLIC COMMENT

Thank you for the opportunity to comment on the above-referenced proposal for site remediation activities at Fairchild Air Force Base. As you may know, Remtech, Inc. has owned and operated a regional soil storage and treatment facility in Spokane, Washington for the past three years. Remtech has regularly provided off-site thermal treatment services to Fairchild since April of 1992.

During the public meeting held earlier this month on this proposal, Mr. Gordon Ruggaber of Halliburton NUS (NUS) stated that, due to its extremely high cost, thermal treatment was considered a possible cleanup alternative at only one of the five sites addressed in this proposal. In this one case, NUS estimated the cost for thermal treatment at approximately $2 million. According to Mr. Ruggaber, these costs were obtained from a local thermal remediation company. As Remtech is the only thermal remediation company within 300 miles, I must assume he was referring to Remtech. While it is true that I spoke with both Mr. Ruggaber and another NUS employee, Randy Elder, the information I provided bears little if any resemblance to that used by NUS in determining thermal treatment costs.

I strongly object to Mr. Ruggaber's statement attributing NUS's grossly overstated stated costs for thermal treatment to this company. If NUS had used the information that was provided to it by Remtech, the cost estimate for off-site thermal treatment should have been less than $600,000. NUS has done a great disservice to Fairchild and the surrounding community by misrepresenting the costs involved with this cleanup alternative, and by doing so, depriving them of the unique opportunity to take advantage of the valuable resource Remtech's facility represents.

Although I have not had sufficient time to review the entire proposal in depth, it is relatively easy to point out several major deficiencies in NUS's cost analysis for off-site thermal desorption. The cost spreadsheet for off-site thermal treatment developed by NUS contained many glaring errors. In particular, almost every assumption made for the Fire Training Area is inaccurate.

Project Time Frame: NUS estimated excavation and backfilling of 13,000 cubic yards and off-site transportation of 9,500 cubic yards of contaminated soil would take six months to complete. After reviewing the plan documents and speaking with Michele Poirier-McNeill of the EPA, I understand that the area to be excavated is already clearly defined from previous engineering studies; maximum depth of excavation is 7 1/2 feet, and; cleanup activities at this site would not disrupt any Base operations. Past experience from similar projects at Fairchild indicate that this project should be completed in two to three weeks rather than the six months predicted by NUS.

Labor & Equipment: NUS did not clearly show how labor and equipment costs for excavation, backfilling and compaction were generated. A conservative estimate of the time required to complete this project is one month. Equipment and labor costs for this time period are given below. Rental costs were obtained from a local Case dealer. Labor rates assume operators have 40 hour HazMat training and

receive prevailing wage.

EQUIPMENT	RENTAL COST
1258 Crawler Excavator	$6,000/mo
621 Front End Loader	$6,100/mo
1102 Self-Propelled Roller	$3,800/mo

OPERATOR	HOURLY WAGE + BENEFITS
Loader Operator (< 4 cy)	$17.22 + $4.50
Excavator Operator (< 3 cy)	$17.62 + $4.50
Roller Operator	$17.62 + $4.50

Assuming all the equipment and operators were required for one month, equipment costs would be $15,900 and labor costs would be $10,554 - a total of $26,454. This compares to NUS's estimate of $181,908. When adjustments are made for taxes, administrative costs, profit, health and safety monitoring, contingency and engineering, the figures are $61,564 and $379,901 respectively.

Decontamination Requirements: To my knowledge, in all other cases where petroleum contaminated soils were excavated and transported directly off-base, Fairchild has <u>never</u> required these types of decontamination facilities.

Backfill: Remtech has always provided suitable backfill material to Fairchild free of charge as part of off-site thermal treatment services. This material is loaded onto trucks delivering contaminated soils to Remtech's facility. Backhauling this material also eliminates additional trucking costs. This was made very clear during my previous discussions with Randy Elder and Gordon Ruggaber of NUS.

Contaminated Soil Transportation: Previous projects have demonstrated that truck round trip times from Fairchild to Remtech range from 30 to 45 minutes. The Washington State Department of Transportation requires an hourly rental cost for a truck and trailer of $72.10 per hour. NUS used a figure over twice that in their cost analysis.

Thermal Treatment: Remtech's estimate to NUS for turnkey off-site thermal treatment for projects this size was $35 to $40 per ton. NUS was told that $40 per ton should be used as a not-to-exceed price.

I have enclosed a comparative cost spreadsheet for the Fire Training Area reflecting the above information. Although I only had one day to review and obtain confirmation of the different costs, my estimate is still over 70% less than that given by NUS for the thermal treatment alternative in the proposed plan. Since I changed only those items I could readily confirm, I have no doubt that the actual cost for this alternative would be even less than this estimate.

In addition to cost considerations, there are many other advantages associated with off-site thermal treatment that are difficult to accurately value. When compared to the preferred alternative given for the Fire Training Area (in-situ bioventing), the evaluation criteria clearly favors thermal treatment if an accurate cost estimate is used. The following is a list of the

criteria and relevant excerpts from the text:

1) Overall Protection of Human Health/Environment: "Alternatives 4 and 5 [thermal treatment] would provide the maximum protection of groundwater"

2) Compliance with Regulations: "Treatment of contaminants under Alternatives 4 and 5 would comply with all required federal, state, and county regulations."

3) Long-Term Effectiveness: "Alternatives 4 and 5 would provide the highest degree of long-term effectiveness"

4) Reduction of Toxicity, Mobility, and Volume Through Treatment: "Only Alternatives 4 and 5 would permanently reduce the toxicity of contaminated soil through treatment."

5) Short-Term Effectiveness: "Alternatives 3 and 5 would provide protection in a short period of time"

6) Implementability: "Alternative 4 would require a pilot scale treatability test to determine treatment effectiveness at each site."

7) Cost

8) State Acceptance: NUS failed to mention that the State Department of Ecology strongly endorses the use of regional thermal treatment facilities. This endorsement is due in large part to these facilities' demonstrated effectiveness in treating petroleum contaminated soils while not causing a threat to human health or the environment.

9) Community Acceptance

As stated by NUS, the effectiveness of in-situ bioventing is suspect, and can only be determined after considerable time and expense. In at least the case of the Fire Training Area, off-site thermal treatment is clearly superior in every respect, including cost, when accurate information is considered.

Once again, thank you for allowing me this opportunity to comment on the proposed cleanup plan. If you have any questions about these comments, please do not hesitate to call me at (509) 624-0210.

Sincerely,

RENTECH INC.

Keith G. Carpenter
President

enclosures - as stated

cc: Tom Bailey, FAFB
Michele Poirier-McNeill, USEPA
Bill Harris, WDOE

FAIRCHILD AIR FORCE BASE
Offsite Thermal Treatment - Fire Training Area (FT-1)

Item	Qty	Unit	Unit Cost Sub.	Mat.	Labor	Equip.	Sub.	Mat.	Labor	Equip.	Total Direct Cost	Comments
MOBILIZATION/DEMOBILIZATION												
1) Office Trailer	1	MO	150.00				150				$150	UNI
2) Portable Communication Equipment	5	SETS				225.00					$1,125	Dan's Elec.
3) Equipment Mobilization/Demobilization		LS	680.00				680				$680	Cass
4) Site Utilities	1	MO	1000.00				1000				$1,000	
5) Security	1	MO	950.00				950				$950	Security fence & s
6) Decontamination Trailer	1	MO	1500.00				1500				$1,500	
SOIL REMOVAL												
1) Excavation (13,000 cy)	1	EA			10534.00	15900.00			10534	15900	$26,434	
OFFSITE THERMAL TREATMENT												
1) Hauling Contaminated Soil	456	HRS	72.10				32878				$32,878	
2) Thermal Treatment	11,400	TON	40.00				456000				$456,000	WOET Rate
RESTORATION												
1) Backfill Clean Overburden	3,500	CY										
a) Place, Spread & Compact	3,500	CY			*	*						
2) Backfill	9,500	CY			*	*						
a) Place, Spread & Compact	9,500	CY			*	*						
3) Revegetation	57	RSF			*	*						Free from Rentech
UST REMOVAL												
Remove & Dispose 4000 Gallon Tank		LS	2000.00	24.60	8.40	6.68	2000	1402	479	381	$2,262	
											$2,000	
							495158	1402	11013	16281	$524,999	
Burden @ 20% of Labor Cost									3600		$3,600	
Labor @ 15% of Labor Cost									1653		$1,653	
Material @ 5% of Material Cost								508			$508	
Subcontract @ 10% of Sub. Cost							3529				$3,529	
Total Direct Cost							500687	1910	16288	16281	$536,291	
Indirects @ 75% of Total Direct Labor Cost									12216		$12,216	
Profit @ 10% of Total Direct Cost (w/o treat.)											$48,029	
Health & Safety Monitoring @ 8% (w/o trans. & treat.)											$596,536	
Total Field Cost											$5,413	
Contingency @ 20% of Total Field Cost (w/o treat.)											$561,949	
Engineering @ 10% of Total Field Cost (w/o treat.)											$21,190	
TOTAL COST											$10,595	
											$595,733	

APR 01.'93 08:58 AM Roetzel, Inc. 508 824 8783 P.08