INSTALLATION RESTORATION PROGRAM

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IDAHO AIR NATIONAL GUARD
GOWEN FIELD, BOISE, IDAHO

SITE INSPECTION REPORT

VOLUME I

FINAL

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Site Inspection Report on sites believed to be contaminated with hazardous material. The report describes the potential contamination and the data collected to determine the accuracy of the assessment. Conclusions are drawn from the data collected as to the hazard to human health and reccommendations made for future work. This study was conducted under the Air National Guard's Installation Restoration Program.

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SITE INSPECTION REPORT

VOLUME I

Prepared by:

Science Applications International Corporation

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EXECUTIVE SUMMARY

This site inspection report describes field activities and presents and evaluates the resulting data for four sites at Idaho Air National Guard, Gowen Field, Boise, Idaho. These four sites were identified in Phase I (Preliminary Assessment) of the U.S. National Guard Bureau (NGB) Installation Restoration Program (IRP) for further IRP Phase II (Site Inspection/Remedial Investigation) characterization. This report presents the results of the Site Inspection (SI).

The purpose of this SI is to confirm or deny the presence of significant contamination at sites identified in the Phase I study. If contamination were confirmed, then further Remedial Investigation (RI) activities would be undertaken.

Site 1 - Current Fire Training Area has been in operation since 1974, and it is estimated that approximately 400,000 gallons of fire-fighting training fuels have been used since 1974. The liquids used for fire-fighting activities are nonspecification JP-4 fuel products, which are not suitable for use in fighter aircraft. The fire-fighting training fuels are stored in two underground storage tanks and pumped to the pit, where they are burned during training exercises. Site 2 - Former Fire Training Area reportedly was used for fire training activities from 1953 to 1974. In 1974, the site was abandoned, filled, regraded, and partially paved over. Site 5 - Former Wood Preserving Operation is the area where three opened 55-gallon drums were discovered that contained residual material resulting from treatment of wood fenceposts with creosote and/or pentachlorophenol (PCP) solutions. The drums since have been removed and disposed of. A patch of discolored soil still remains, however, due to the spill of the contents of the drums onto the adjacent area. The wood treating operations at Site 5 along with the handling of any wastes were conducted by a private company. Site 6 - Tar Pit was used by an asphalt distribution company to dispose of waste asphalt products until 1977. The waste product is viscous during warm weather and solidifies during cold weather.

The field program at Gowen Field consisted of a variety of data collection methods to enable confirmation of the presence or absence of contamination at the sites. These methods are as follows:

- Conduct soil gas survey for Sites 1 and 2
- Install and sample a total of four monitoring wells at Sites 1, 5, and 6
- Drill a total of 10 shallow soil borings at Sites 1, 2, and 5
- Screen environmental samples using on-site, laboratory-quality gas chromatography (GC) at all four sites
- Sample stream sediment at Site 1, tar at Site 6, and surface soils at Site 1
- Conduct aquifer testing and collect water level measurements for all installed monitoring wells.

Established U.S. Environmental Protection Agency (EPA) protocols for sampling, chain-of-custody, and quality assurance/quality control (QA/QC) were followed throughout the field program.

The field program showed limited contamination (concentrations of contaminants generally within one order of magnitude of background concentrations, if detected at all) of soils at Sites 1 and 5, and minimal contamination (concentrations of contaminants generally only slightly above background, if detected at all) of soils at Sites 2 and 6. The vertical extent of soil contamination at Sites 1 and 5 did not exceed depths of 55 feet. Therefore, groundwater contamination was not expected because the shallow aquifer is located 150 feet below land surface (BLS). Groundwater contamination was not confirmed at any of the four sites under investigation. A summary of the risk-based evaluation of data from these sites is provided in Table ES-1. Ingestion of the groundwater by on-base personnel was used for this worst-case evaluation of risk, even though this shallow aquifer is not used as a source of drinking water on-base. The risk-based evaluation showed that risk to human health would not be significantly increased from the ingestion of soil

TABLE ES-1. SUMMARY OF RISK-BASED EVALUATION OF DATA FOR IDAHO AIR NATIONAL GUARD, GOWEN FIELD, BOISE, IDAHO

Media	Comparison with ARARS	Potential for Noncarcinogenic Effects	Carcinogenic Risk Estimate**
Groundwater	Selenium > MCL Nickel > AWQC*	No adverse noncarinogenic effects found	10^{-7}***
Soil/Sediment	No ARARs Available	No adverse noncarcinogenic effects found	$\leq 10^{-6}$

Notes:

1. ARARs are Applicable or Relevant and Appropriate Requirements.
2. Selenium was not present in soils, and therefore may not be related to site activities.
3. This shallow aquifer is not used as a source of drinking water on-base, which would have been the worst-case scenario.

* AWQC (EPA Ambient Water Quality Criteria) is used for evaluation of surface water quality. EPA has not made a final decision as to using this criteria to evaluate public health risks.

** EPA guidelines are that acceptable additional lifetime cancer risk is 10^{-6}. See Section 4 for a detailed explanation.

***This risk was calculated for hypothetical exposure to a compound (bis (2-ethylhexyl) phthalate), which is considered to be a laboratory contaminant and not present in groundwater.

or groundwater at any of the sites based on guidance provided by EPA in the Superfund Public Health Evaluation Manual (U.S. EPA 1986c).

The data generated from this study were not intended to characterize fully the areal extent of any constituents found, the hydrogeology, or the contaminant transport mechanisms at these sites, but to determine if any pollution problem exists. The study sufficiently characterized the sites to allow this determination. As a result, based on collected data that show the absence of chemical contaminants at levels that exceed guidelines for risk to public health established by EPA, no further data collection or remedial action planning activities are necessary under the IRP.

The Air National Guard Support Center (ANGSC) will develop a focused Feasibility Study (FS) for Site 1 - Current Fire Training Area to determine if a cost-effective cleanup alternative exists to virtually eliminate risk of migration of off-specification fuels from near-surface soils to groundwater. If the recommendation is made for cleanup, then ANGSC will proceed to carry out the recommended cleanup alternative.

Gowen Field will further investigate ways to either clean up or provide more permanent physical barriers for Site 6 - Tar Pit for safety reasons. Once a cost-effective approach is developed, then Gowen Field will proceed with this approach.

1. INTRODUCTION

1.1 BACKGROUND

The purpose of this study was to further investigate four sites at Gowen Field that were identified in the Installation Restoration Program (IRP) Phase I as requiring further characterization.

The Idaho Air National Guard, Gowen Field, is located within the boundaries of Boise Air Terminal and the southern limits of the city of Boise in Ada County in southwestern Idaho. The Greater Boise area extends to just north of Gowen Field and has expanded to the west and northwest of the base. The land area of Gowen Field encompasses 570 acres. An additional 1,425 acres, including the runways, are in joint use with Boise Air Terminal (HMTC 1985).

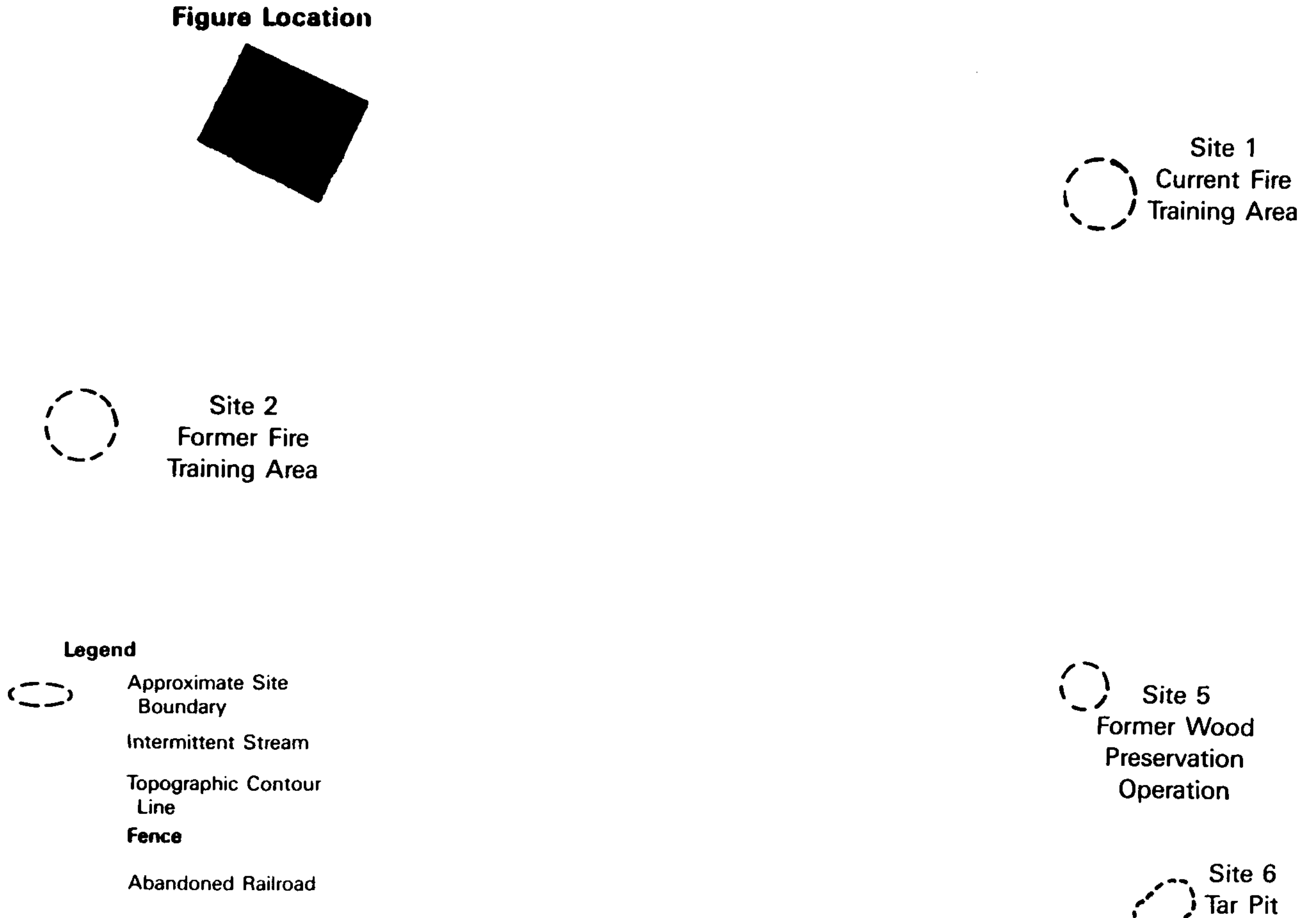
In 1984, a search of waste management records and interviews with current and former employees were conducted during the IRP Phase I (Preliminary Assessment). The results of these Phase I activities were used to *evaluate six sites using the U.S. Air Force (USAF) Hazard Assessment Rating* Methodology (HARM). The rating for each site provided a means for the priority listing in Table 1-1.

Sites 3 and 4 (Central Drainage Ditch and Oil Patch in Drainage Field, respectively) show a high priority in Table 1-1, but were not included in this Site Inspection (SI) program because Site 3 was investigated by Gowen Field personnel and contamination was not confirmed, and because contaminated soils at Site 4 were removed and placed at Site 1. Therefore, Site 1 - Current Fire Training Area, Site 2 - Former Fire Training Area, Site 5 - Former Wood Preserving Operation, and Site 6 - Tar Pit were the four sites for which SI field data collection and evaluation activities were recommended. These sites are shown in Figure 1-1.

TABLE 1-1. PRIORITY LISTING OF SITES AT IDAHO AIR NATIONAL GUARD, GOWEN FIELD, BOISE, IDAHO FROM THE IRP PHASE I

Site No. and Priority	Site Description	Subscores				Overall Score
		Receptors	Waste Characteristics	Pathway	Waste Mgmt. Practices	
1	Current Fire Training Area	52	100	67	0.95	69
2	Former Fire Training Area	52	100	52	0.95	56
3	Central Drainage Ditch	52	48	67	1.00	56
4	Oil Patch in Drainage Field	50	40	67	1.00	52
5	Former Wood Preserving Operation	50	40	49	1.00	46
6	Tar Pit	50	30	49	1.00	43

Source: HMTC 1985



Source: HMTC (1986) and
Base Topographic Map

Figure 1-1. Site Location Map, Idaho Air National Guard, Gowen Field, Boise, Idaho.

1.2 SITE INVESTIGATION

Field data collection and analysis activities were planned and accomplished according to the following guidance:

- Air Force Installation Restoration Program Management Guidance. USAF 1985.
- Guidance on Remedial Investigations Under CERCLA. EPA 1985.
- Superfund Public Health Assessment Manual. EPA 1986.

The USAF IRP guidance manual identifies Phases I through IVA, which are similar to the U.S. Environmental Protection Agency (EPA) Remedial Investigation/Feasibility Study (RI/FS) process for identifying (I), investigating (II), and planning cleanup activities (IVA) for waste sites. Further, the Air National Guard Support Center (ANGSC) program for Air National Guard facilities focuses on IRP SI/RI for remedial action planning. Therefore, the field investigation activities at Gowen Field were planned under the ANGSC SI/RI program. If contamination were present in significant quantities at Gowen Field, the next step would be remedial action planning.

This report documents the data collection activities conducted at Gowen Field (Section 2), the data collected and quality assurance/quality control (QA/QC) evaluation of the data (Section 3), the significance of the data for risk to public health (Section 4), and resulting conclusions and recommendations (Section 5).

2. FIELD PROGRAM

2.1 FIELD PROGRAM SUMMARY

This section provides the objectives, methods, and rationale for the Site Inspection (SI) field program that was implemented by Science Applications International Corporation (SAIC) at the Idaho Air National Guard, Gowen Field. In addition, a description of the activities that were conducted at Gowen Field is presented.

The SI focused on four sites, which were outlined in the Preliminary Assessment (Phase I Records Search) (HMTC 1985). These sites, listed in order of priority ranking, are:

- Site 1 - Current Fire Training Area
- Site 2 - Former Fire Training Area
- Site 5 - Former Wood Preserving Operation
- Site 6 - Tar Pit.

The objectives of the Site Characterization activities are to:

- Confirm the presence or absence of contamination
- Identify the source(s) and nature of contamination
- Provide a preliminary assessment of the extent, magnitude, and movement of any contamination at the site
- Identify possible receptors of this contamination.

A summary of the field program, outlined in Table 2-1, is presented below, along with modifications to the field program as initially planned in SAIC's work plan and reasons for these modifications. Figures 2-1, 2-2, and 2-3 illustrate the sampling points for Sites 1, 2, and 5 and 6, respectively.

TABLE 2-1

SUMMARY OF PROPOSED AND IMPLEMENTED FIELD ACTIVITIES AT IDAHO AIR NATIONAL GUARD, GOWEN FIELD, BOISE, IDAHO.

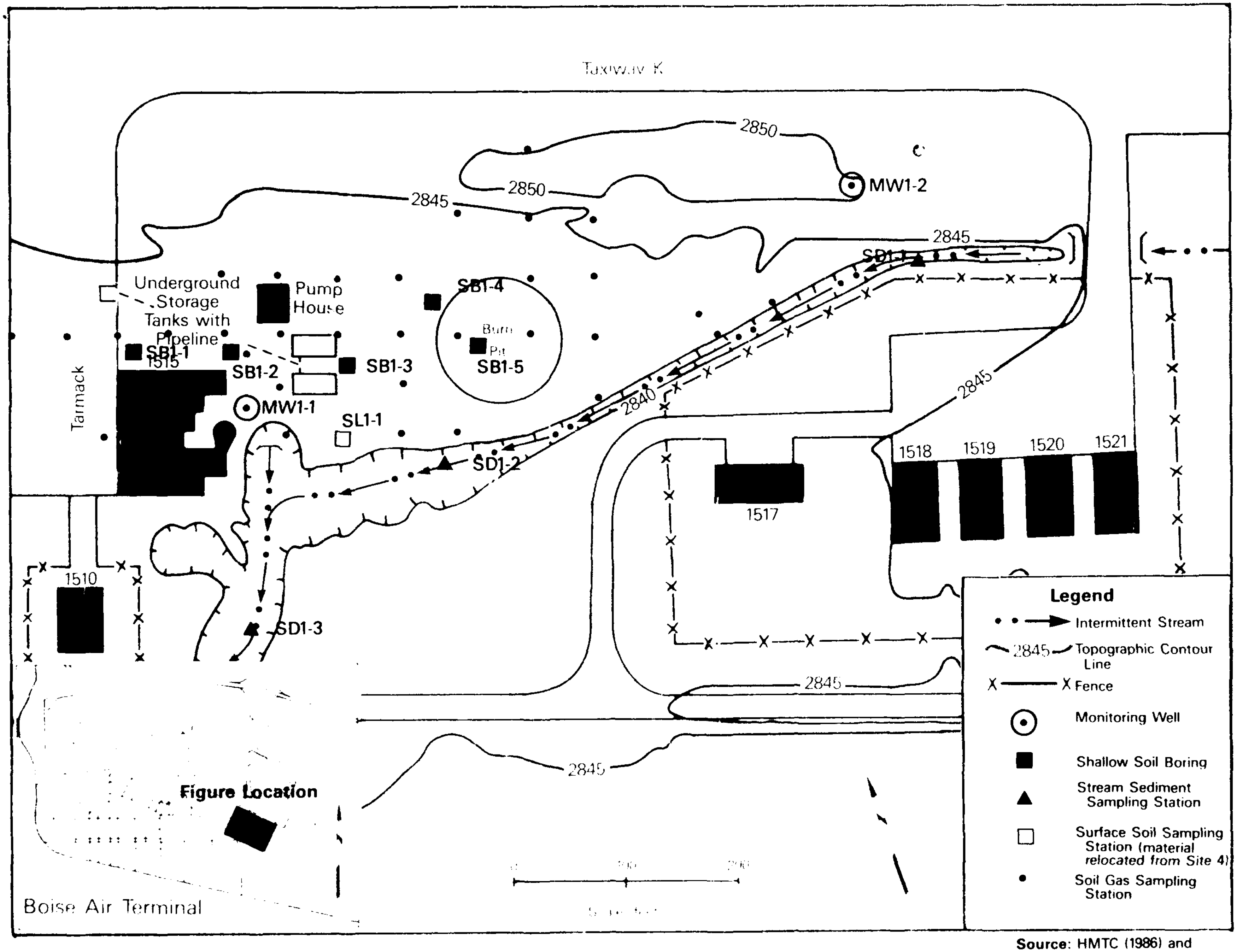
Site	Work Plan Proposed Activities	Implemented Activities	Reason for Modification
Site 1: Current Fire Training Area	• Soil Gas Survey.	• Implemented as proposed.	
	• Drill and sample 4 soil borings.	• Drilled and sampled 5 soil borings.	• Soil Gas Survey indicated that significant levels of soil contamination at the site were more areally extensive then first thought, requiring an additional soil boring.
	• Drill, install, and sample 2 groundwater monitoring wells.	• Implemented as proposed.	
	• Established and sample 3 surface water/ sediment sampling points	• Established and sampled 3 sediment sampling points. Surface water samples were not collected.	• Lack of surface water in the intermittent stream adjacent to the site prohibited surface water sampling.
	• Collect a composite sample of 6 surface soil samples of the material excavated from Site 4 Oil Patch in Drainage Field.	• Implemented as proposed.	
Site 2: Former Fire Training Area	• Soil Gas Survey.	• Implemented as proposed.	
	• Drill and sample 5 soil borings.	• Drilled and sampled 4 soil borings.	• Soil Gas Survey indicated that levels of soil contamination were not significant at the site; therefore, a soil boring was deleted.

(Continued)

TABLE 2-1 (Continued)

SUMMARY OF PROPOSED AND IMPLEMENTED FIELD ACTIVITIES AT IDAHO AIR NATIONAL GUARD, GOWEN FIELD, BOISE, IDAHO.

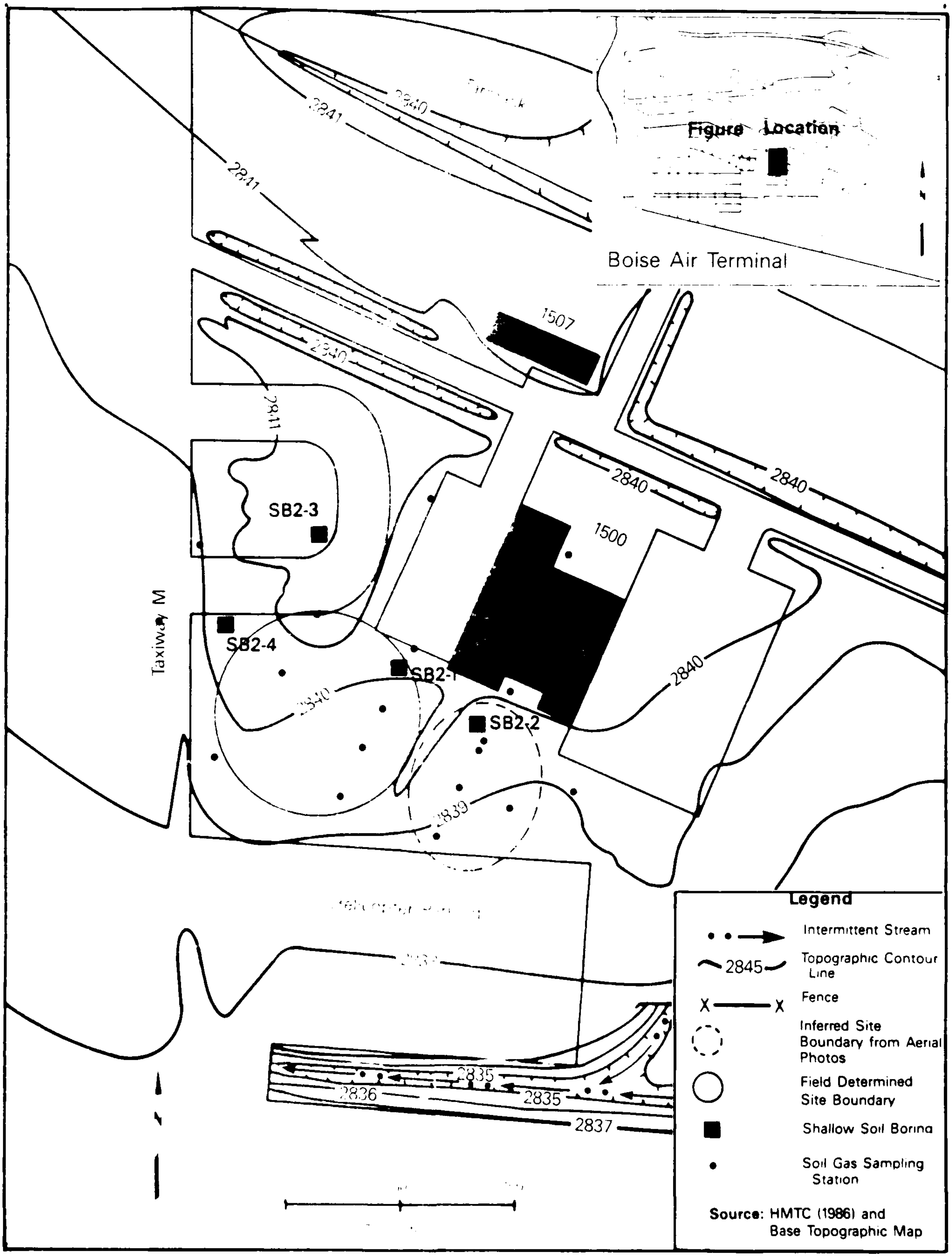
Site	Work Plan Proposed Activities	Implemented Activities	Reason for Modification
Site 5: Former Wood Preserving Operation	● Drill and sample 1 soil boring.	● Implemented as proposed.	
	● Drill, install, and sample 1 groundwater monitoring well.	● Implemented as proposed.	
Site 6: Tar Pit	● Drill, install, and sample 1 groundwater well while treating the upper 50 feet as a soil boring.	● Implemented as proposed.	
	● Establish and sample 2 tar pit sampling points.	● Implemented as proposed.	
All Sites	● Screen soil and groundwater samples with on-site gas chromatography (GC).	● Implemented as proposed.	
	● Establish and sample 2 background soil sampling points.	● Implemented as proposed.	
	● Collect 2 rounds of static water levels from the groundwater monitoring wells.	● Third round taken over 1 year after first 2.	● Determine if there are long-term or seasonal changes. None were found.
	● Perform aquifer tests in all groundwater monitoring wells.	● Implemented as proposed.	



Source: HMTC (1986) and Base Topographic Map

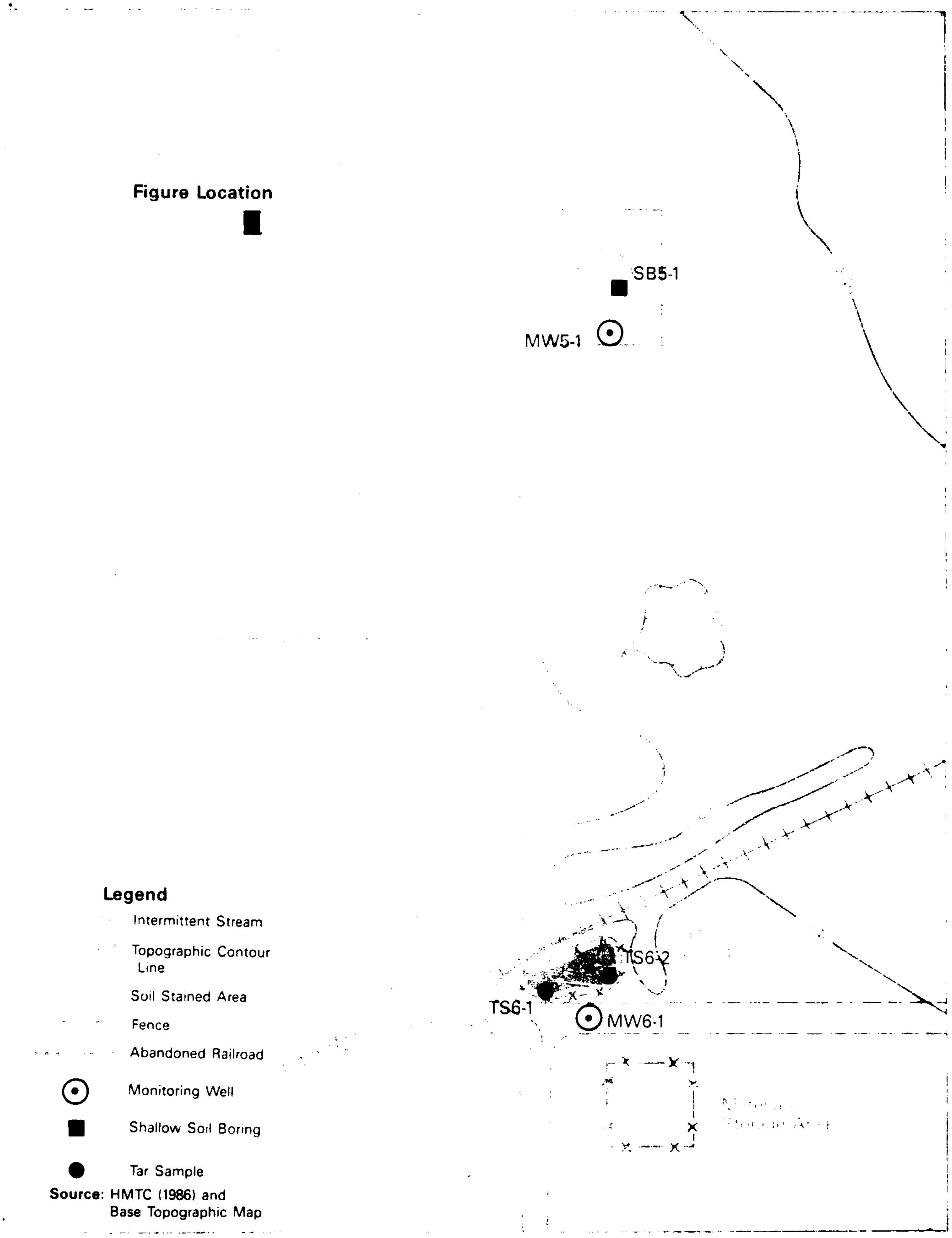
Figure 2-1. Sampling Locations at Site 1 — Current Fire Training Area, Idaho Air National Guard, Gowen Field, Boise, Idaho.

SAIC.



Source: HMTC (1986) and Base Topographic Map

Figure 2-2. Sampling Locations at Site 2 — Former Fire Training Area, Idaho Air National Guard, Gowen Field, Boise, Idaho.



Source: HMTC (1986) and Base Topographic Map

Figure 2-3. Sampling Locations at Site 5 – Former Wood Preserving Operation and Site 6 – Tar Pit, Idaho Air National Guard, Gowen Field, Boise, Idaho.

2.2 FIELD PROGRAM ACTIVITIES AND PROCEDURES

The field program at Gowen Field consisted of the following data collection activities:

- Conduct soil gas survey
- Drill, install, and sample monitoring wells
- Drill shallow soil borings
- Screen environmental samples using on-site gas chromatography (GC)
- Sample stream sediment, tar, and surface soil
- Conduct aquifer testing and collect water level measurements.

The following subsections describe the procedures and underlying purpose for the performance of these data collection activities, along with the quality assurance/quality control (QA/QC) measures used to maintain the validity of the work conducted at Gowen Field.

2.2.1 Soil Gas Survey and Procedures

Field activities began on April 30, 1987 with a soil gas survey. By identifying and quantifying volatile organic compounds (VOCs), the purpose of this survey is to indicate that soil contamination has occurred or is occurring. This survey was used to confirm the suspected presence of contaminants, define the horizontal (areal) magnitude and extent of contamination, and locate the probable source(s) of any soil contamination found at the sites. The survey also was used to locate shallow soil borings for maximum utility.

The soil gas survey was conducted at both Site 1 - Current Fire Training Area and Site 2 - Former Fire Training Area by Tracer Research Corporation (TRC) of Tucson, Arizona under the direction of SAIC field personnel. Because the analytical equipment used for the soil gas surveys only detects VOCs and the possible contaminants at Site 5 - Former Wood Preserving Operation and

Site 6 - Tar Pit were nonvolatile compounds, soil gas surveys were not performed at Sites 5 and 6.

The strategy employed for the soil gas survey was to begin sampling soil gas on a regular pattern or uniform probe spacing. The sampling began at a point of known or suspected contamination. As results were obtained from each soil gas point, subsequent sampling points were selected so as to direct the soil gas probe survey in the general direction of higher contamination. This strategy was employed so that the sampling and mapping of contaminant concentrations eventually could be used to locate the source of contamination. Once the probable sources were located, the survey progressed to delineate the extent of any contamination by progressing toward points of lower contaminant concentrations.

SAIC selected a 50-foot grid for probe spacing at Site 1 - Current Fire Training Area as the basis for locating sampling points. A 100-foot grid for probe spacing was used at Site 2 - Former Fire Training Area. This open spacing was appropriate for Site 2 because points of known or suspected contamination were not evident from available information or site conditions. Sample spacing was adjusted by 2 to 10 feet at Site 1 and by (up to) 25 feet at Site 2 to delineate accurately the areal extent of any detected contamination in a timely manner.

Because Site 2 - Former Fire Training Area was abandoned in 1974, filled, regraded, and partially paved over, the location of the original site was initially determined by studying aerial photographs taken during the time period the area was in use. The boundaries of the site then were approximated using landmarks from the aerial photographs and the soil gas sampling grid was established based on the assumed site boundaries. Soil gas samples were collected, analyzed, and mapped. Sample spacing was adjusted, as mentioned above, until the site boundaries were located. The soil gas survey successfully located the site and delineated the boundaries of the Former Fire Training Area.

Based on the materials that are or were stored or used at the sites, samples were analyzed specifically in the field using a laboratory-quality GC, which was portable but fully equipped, checked, and calibrated prior to use in the field. The samples were collected and immediately analyzed in the field with the GC for the following compounds, which were suspected of being present at Sites 1 and 2:

- Total petroleum hydrocarbons
- Total xylenes
- Benzene
- Toluene
- Tetrachloroethylene (PCE)
- Trichloroethylene (TCE)
- Carbon tetrachloride
- Bromochloromethanes
- Trichloroethane (1,1,1-TCA).

Samples were collected by hydraulically pushing a hollow steel probe 3 to 4 feet into the ground and evacuating soil gas with a vacuum pump. During the evacuation, samples were collected by inserting a syringe needle through a silicone evacuation line down into the steel probe. Approximately 10 milliliters of sample were collected for immediate analysis by GC. Following the collection of the sample, the probe was extracted from the ground. The sample then was subsampled (duplicate injections) in volumes ranging from 1 ul to 2 ml, depending on the VOC concentration.

Samples were analyzed using a Varian 3300 GC and a Spectra-Physics SP4270 computing integrator. The detection limits for the analysis were a function of the injected volume as well as the detector sensitivity for individual compounds; thus, the detection limits varied with the sample size. Generally, the larger the injected sample, the lower the detection limit. However, chromatographic peaks for compounds of interest needed to be kept within the linear range of the integrator. When a compound had a high concentration, it was necessary to use small injections to keep it within linear range. In some cases, this may have caused higher detection limits for other compounds in the analyses. An electron capture detector was used for the analysis of halogenated compounds and a flame ionization detector was used for the analysis of hydrocarbons.

Cross-contamination of samples was prevented by purging syringes with ultrapure (deionized, double distilled, HPLC grade) water prior to sampling and checking for contamination by injection into the GC. System blanks were run periodically to confirm that no contamination existed in the probes, adapters, or 10-ml syringes. Analytical instruments were checked continually for calibration by the use of chemical standards prepared in water from commercially available pure chemicals. Probes were used only once during the course of a working day and then were thoroughly cleaned by steam cleaning before use on the subsequent day. Additional QA/QC information for the groundwater probe survey is included in Volume II, Appendix F (Soil Gas Results).

2.2.2 On-Site Gas Chromatography (GC)

Following the soil gas survey, an on-site, laboratory-quality GC was set up by TRC to enable the screening of samples for VOCs. The purposes of this activity were to: (1) analyze environmental samples that would help to confirm the presence, determine the magnitude and extent, and locate probable sources of any contamination at the site; (2) aid in the selection of environmental samples that were to be sent to the laboratory for complete analyses; and (3) aid in project QA/QC by identifying any sources of contamination that could be introduced during the field program (i.e., decontamination water, ultrapure field blank, and bailer wash water).

Soil samples were prepared for on-site GC analysis by placing approximately 20 grams of soil into a 40-ml VOC vial containing 10 ml of ultrapure water and sealing with a Teflon cap. This mixture then was shaken for 1 minute and a volume of headspace gas was extracted using decontaminated syringes. This headspace gas was injected into the GC using the methods discussed in the previous section. Water samples were prepared and analyzed using the same methods except that the actual water sample was injected into the GC. The same compounds analyzed for during the soil gas surveys were analyzed for during monitoring well and shallow soil boring sampling using the on-site GC. QA/QC procedures used for the on-site GC are the same as those used for the soil gas survey and are described in Volume II, Appendix F (Soil Gas Results), while the results of the analyses are presented in Volume II, Appendix G (On-Site GC Results).

2.2.3 Monitoring Well Drilling, Installation, and Sampling Procedures

The monitoring well installation program was initiated on May 5, 1987, immediately following the completion of the soil gas survey. Borehole drilling and installation were performed by Layne Environmental Services, Inc. of Phoenix, Arizona under the direction of SAIC personnel.

These borings and monitoring wells were drilled and installed primarily to provide analytical data that would confirm the presence of any soil or groundwater contamination at Gowen Field. Secondarily, these data are used to help define the vertical magnitude and extent and define the chemical nature of any contamination found. Information on the geologic and hydrologic nature of the shallow aquifer also was collected during the drilling and sampling procedures.

Four monitoring wells were installed at three of the sites investigated at Gowen Field. Two wells were installed at Site 1 - Current Fire Training Area (MW1-1 and MW1-2) and one well was installed at both Site 5 - Former Wood Preserving Operation (MW5-1) and Site 6 - Tar Pit (MW6-1). A two-staged approach was used to locate these wells. First, three wells (MW1-1, MW5-1, and MW6-1) were selected to be located as close to each site as possible and downgradient based upon an assumed southerly groundwater flow direction. This assumption was based upon an earlier study performed on the shallow aquifer by Dion (1972). Second, after the installation of the three downgradient wells, static water levels were measured within the downgradient wells and referenced to a surveyed datum, allowing the groundwater flow direction to be determined. The final well (MW1-2) then was located in an assumed upgradient direction of the sites.

2.2.3.1 Monitoring Well Borehole Drilling

Dual-walled reverse air circulation drilling methods were used to drill the monitoring well boreholes. Ten 2.5-inch split-spoon samples were collected from each borehole. Samples were collected when distinct changes in the drilling characteristics, geology, or wetness of the drill cuttings were observed. All split-spoon samples were examined for the following characteristics:

- Organic vapor monitoring results (HNU)
- Recovery
- Lithology (special emphasis on contaminated horizons)
- Grain size (visual)
- Color (Munsell)
- Consistency and texture
- Relative density (based on blow counts, noncohesive materials)
- Moisture (visual)
- Fabric/bedding
- Standard penetration test values (blow count)
- Other distinctive features.

A minimum of three soil samples were sent to an off-site laboratory from each monitoring well borehole based on the results of the on-site GC screening and proximity to the water table. The most contaminated soil samples were sent to the laboratory for chemical characterization. However, when on-site GC screening showed that all samples showed similar or no contamination, the first soil sample collected below the water table and two other random samples were sent to the laboratory for chemical characterization. The laboratory analyses were conducted to confirm, quantify, and characterize any contamination detected during the organic vapor monitoring. In addition, other potential contaminants (e.g., metals and extractable organic compounds) that could not be detected using the on-site GC were analyzed for by the off-site laboratory. Laboratory analytical parameters were selected for each site on the basis of potential or suspected contaminants or chemicals used or stored at those sites. These chemical parameters are listed in Table 2-2. Analytical methods, sample preservation guidelines, and holding times for these parameters are described in Table 2-3. Results of these analyses appear in Volume II, Appendix H (Laboratory Analytical Data).

2.2.3.2 Monitoring Well Installation

Monitoring well boreholes were drilled to a depth of at least 20 feet below the water table. The water table was located by measuring the water level inside the dual-walled temporary drilling casing immediately following the first sign of wet drill cuttings. After the total borehole depth was reached and the dual-walled casing was "blown" with air pressure to remove any remaining cuttings, well installation commenced. A typical as-built diagram that illustrates the monitoring wells installed at Gowen Field is presented in Figure 2-4. Monitoring well completion forms and logs are presented in Volume II, Appendix C (Monitoring Well Completion Forms and Logs).

Procedures for monitoring well installation are described as follows:

- A 20-foot length (30 feet at MW1-2) of 4-inch inside diameter (I.D.), PVC Schedule 40, 0.020-inch slot well screen and appropriate length of riser were installed. All screen and riser were threaded flush joint. The well screen and casing were steam cleaned prior to installation in the borehole. The screened interval (20 feet) extended from the water table to 20 feet below the water table. Monitoring wells were installed in May 1987 (springtime) during assumed high water table conditions. Therefore, placement of the top of the screen accounted for groundwater fluctuations that may occur throughout the year. The top of the PVC casing was completed flush to the ground so as not to interfere with normal activities around the base.

- The temporary dual-walled drill casing was raised in 2-foot increments and No. 3 silica sand pack was added. The incremental lifting of the casing and emplacement of sand pack was continued until the sand pack extended at least 5 feet above the top of the

TABLE 2-2

SAMPLE ANALYSIS FOR FIELD ACTIVITIES AT IDAHO AIR NATIONAL GUARD, GOWEN FIELD, BOISE, IDAHO

Site/Sample	Analytes				
	Petroleum Hydrocarbons	Volatile Organic Compounds	Metals (1)	BN/A Extractables (2)	EP Toxicity and Ignitability
Site 1: Current Fire Training Area					
GW1-1 and GW1-2	X	X	X		
MW1-1-1 to MW1-1-10	X	X	X		
SB1-1-1 to SB1-5-9	X	X	X		
SD1-1 to SD1-3	X	X	X		
SL1-1 (Composite Sample)					X
Site 2: Former Fire Training Area					
SB2-1-1 to SB2-4-4	X	X	X		
Site 5: Former Wood Preserving Operation					
GW5-1	X	X	X	X	
MW5-1-1 to MW5-1-10	X	X	X	X	
SB5-1-1 to SB5-1-11	X	X	X	X	
Site 6: Tar Pit					
GW6-1	X	X	X	X	
TS6-1 and TS6-2					X
MW6-1-1 to MW6-1-14	X	X	X	X	

(1) = Sb, As, Be, Cd, Cr, Cu, Pb, Hg, Ni, Se, Ag, Tl, and Zn
(2) = Base Neutral/Acid Extractables
GW = Groundwater Sample
MW = Monitoring Well Borehole Soil Sample
SB = Shallow Soil Boring Soil Sample
SD = Stream Sediment Sample
SL = Composite of 6 Near-Surface Soil Samples
TS = Tar Pit Sample

TABLE 2-3

SUMMARY OF SAMPLE PRESERVATION, ANALYTICAL METHODS, AND STORAGE PROCEDURES FOR IDAHO AIR NATIONAL GUARD, GOWEN FIELD, BOISE, IDAHO

Media	Parameter	Method(1)	Containers	Preservative	Holding Time
Water	Petroleum Hydrocarbons	E418.1	1000 ml glass	5 ml HCl and Cool to 4°C	28 days
	Volatile Organic Compounds	E624	40 ml glass vial with Teflon septa	Cool to 4°C	14 days
	Base Neutrals/Acid Extractables	E625	1000 ml amber glass with Teflon lined screw caps	Cool to 4°C 1 ml thiosulfate	7 days (extraction) 40 days (analysis)
	Metal Scan:			Cool to 4°C	
	Antimony	E204.2	1000 ml plastic	1 ml HNO3	6 mos.
	Arsenic	E206.2	1000 ml plastic	1 ml HNO3	6 mos.
	Beryllium	E200.7	1000 ml plastic	1 ml HNO3	6 mos.
	Cadmium	E200.7	1000 ml plastic	1 ml HNO3	6 mos.
	Chromium	E200.7	1000 ml plastic	1 ml HNO3	6 mos.
	Copper	E200.7	1000 ml plastic	1 ml HNO3	6 mos.
	Lead	E200.7	1000 ml plastic	1 ml HNO3	6 mos.
	Mercury	E245.1	1000 ml plastic	1 ml HNO3	28 days
	Nickel	E200.7	1000 ml plastic	1 ml HNO3	6 mos.
	Selenium	E270.2	1000 ml plastic	1 ml HNO3	6 mos.
	Silver	E200.7	1000 ml plastic	1 ml HNO3	6 mos.
	Thallium	E200.7	1000 ml plastic	1 ml HNO3	6 mos.
	Zinc	E200.7	1000 ml plastic	1 ml HNO3	6 mos.
Soils/Tar	Petroleum Hydrocarbons	SW3550/ E418.1	32 oz. widemouth glass jar	Cool to 4°C	28 days
	Volatile Organic Compounds	SW8240	40 ml glass vial with Teflon septa	Cool to 4°C	14 days

(Continued)

TABLE 2-3 (Continued)

SUMMARY OF SAMPLE PRESERVATION, ANALYTICAL METHODS, AND STORAGE PROCEDURES FOR IDAHO AIR NATIONAL GUARD, GOWEN FIELD, BOISE, IDAHO

Media	Parameter	Method(1)	Conteiners	Preservative	Holding Time
Soils/Tar (Cont'd)	Base Neutrals/Acid Extractables	SW3550/SW8270	32 oz. widemouth glass jar with Teflon lined screw caps	Cool to 4°C	7 days (extraction) 40 days (analysis)
	Metals Scan:				
	Antimony	SW3050M/6010	32 oz. widemouth plastic jar	Cool to 4°C	6 mos.
	Arsenic	SW303EM/7061	32 oz. widemouth plastic jar	Cool to 4°C	6 mos.
	Beryllium	SW3050M/6010	32 oz. widemouth plastic jar	Cool to 4°C	6 mos.
	Cadmium	SW3050M/6010	32 oz. widemouth plastic jar	Cool to 4°C	6 mos.
	Chromium	SW3050M/6010	32 oz. widemouth plastic jar	Cool to 4°C	6 mos.
	Copper	SW3050M/6010	32 oz. widemouth plastic jar	Cool to 4°C	6 mos.
	Lead	SW3050M/6010	32 oz. widemouth plastic jar	Cool to 4°C	6 mos.
	Mercury	SW7471M	32 oz. widemouth plastic jar	Cool to 4°C	28 days
	Nickel	SW3050M/6010	32 oz. widemouth plastic jar	Cool to 4°C	6 mos.

(Continued)

TABLE 2-3 (Continued)

SUMMARY OF SAMPLE PRESERVATION, ANALYTICAL METHODS, AND STORAGE PROCEDURES FOR IDAHO AIR NATIONAL GUARD, GOWEN FIELD, BOISE, IDAHO

Media	Parameter	Method(1)	Containers	Preservative	Holding Time
Soils/Tar (Cont'd)	Selenium	SW303EM/7741	32 oz. widemouth plastic jar	Cool to 4°C	6 mos.
	Silver	SW3050M/6010	32 oz. widemouth glass jar with	Cool to 4°C	6 mos.
	Thallium	SW3050M/6010	32 oz. widemouth glass jar with	Cool to 4°C	6 mos.
	Zinc	SW3050M/6010	32 oz. widemouth glass jar with	Cool to 4°C	6 mos.
	Ignitability	40 CFR 261.21	32 oz. widemouth glass jar with	Cool to 4°C	6 mos.
	EP Toxicity	40 CFR 261.24	32 oz. widemouth glass jar with	Cool to 4°C	6 mos.

(1) E600-series methods referenced from Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater, EPA-600/4-82-057, July 1982.

Additional E-series methods referenced from Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020, March 1979.

SW-series methods referenced from Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW 846, Second Edition, July 1982.

The letter M at the end of the method number indicates that a modified preparation was used.

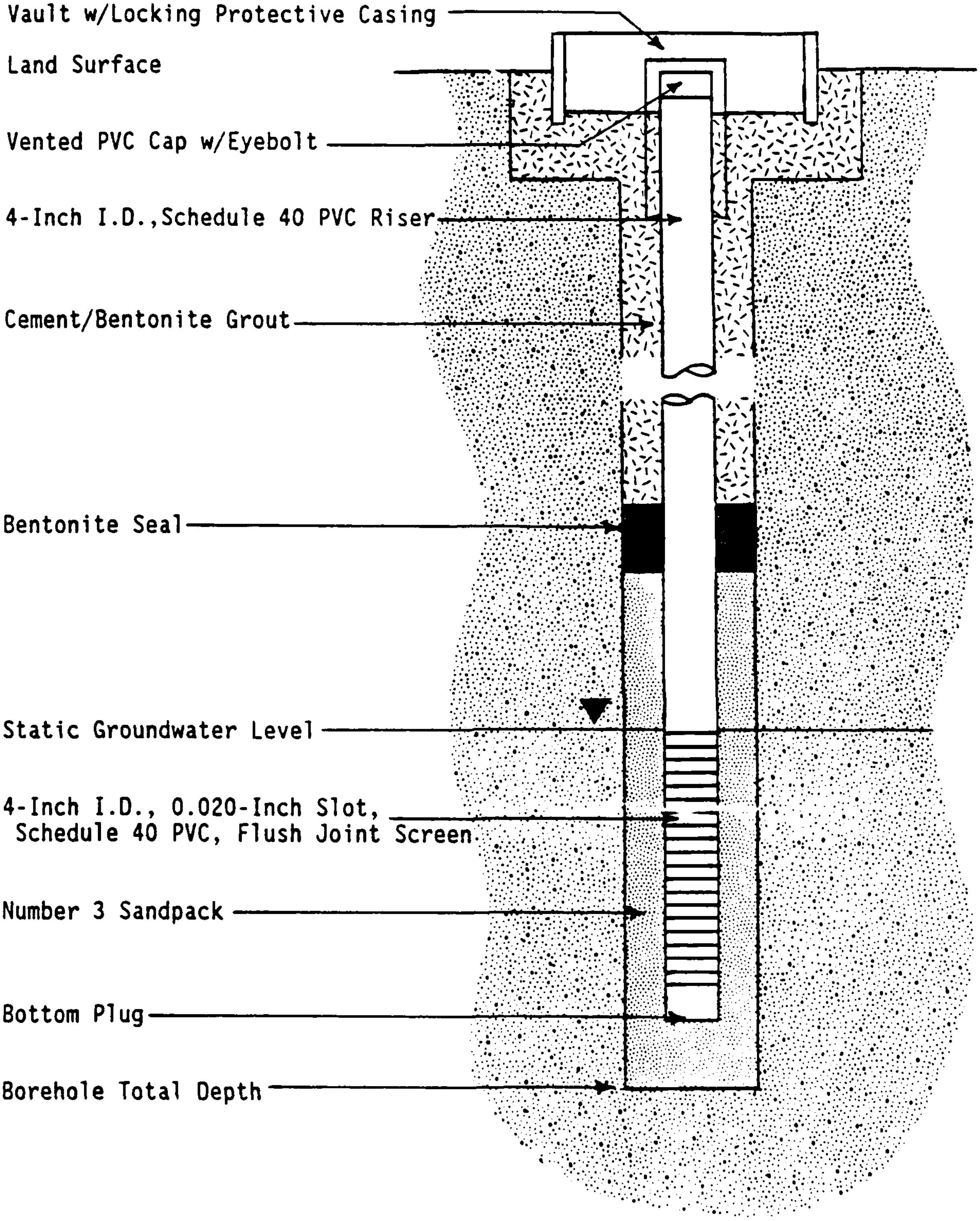


Figure 2-4. Typical Monitoring Well As-Built, Idaho Air National Guard, Gowen Field, Boise, Idaho.

screen. Periodic sounding was conducted during this process to ensure a continuous sand pack.

- After the sand pack was in place and measurements were taken to ensure its proper location, at least 5 feet of bentonite pellet seal were placed on top of the sand pack.

- After the bentonite seal was in place, it was allowed to hydrate for a period of 30 minutes, and measurements were taken to ensure its proper location, a cement/bentonite grout was tremied in place from the top of the seal to the land surface. This was accomplished in such a manner so that a tight, continuous grout seal was ensured through the entire interval. Cement/bentonite grout mixtures consisted of potable water, bentonite, and Type I or II Portland cement with 94 pounds of cement and 5 pounds of bentonite per 6.5 gallons of water.

- A protective man-hole cover capable of being locked to prevent unauthorized entry was installed within 12 hours of well installation. A concrete pad was built around the cover and sloped to drain away from the well and extended below the frost line. The cover was equipped with a rubber gasket to prevent surface water seepage. All wells were fitted with keyed-alike locks.

- Each well was developed by surging and pumping until well water was acceptable to the SAIC Supervisory Geologist (i.e., where clarity and specific conductivity stabilized and showed no further improvement or reduction with continued development). Minimal development was needed as no drilling fluids were used. The total volume of removed water was estimated and recorded.

- A blank pump, with an outside diameter (O.D.) of 3 7/8 inches, was lowered into the well, and passed unobstructed throughout the entire well depth, prior to well acceptance.

- The monitoring well identification number was painted on the top of the protective man-hole cover.

- After the wells were completed at each site, they were surveyed to define the groundwater flow direction and hydrogeologic relationships. The initial survey was performed by Roylance and Associates, a local land surveyor licensed in the State of Idaho. A discrepancy identified, and since resolved, on the elevation of MW1-1 prompted a second survey. The second survey was conducted by Smith and Kangas Engineers, a local land surveyor licensed in Idaho. The second survey verified the results of the first survey, as shown in Table 2-4. The surveys were completed to a vertical accuracy of 0.01 feet and a horizontal accuracy of 1 foot. All surveys were referenced to U.S. Geodetic Survey elevation datum and the Idaho

TABLE 2-4

HORIZONTAL COORDINATES AND ELEVATIONS OF GROUNDWATER MONITORING WELLS FOR IDAHO AIR NATIONAL GUARD, GOWEN FIELD, BOISE, IDAHO (Results of second survey in parentheses)

Site/Well Number	Elevation (MSL)		Idaho State Plane Coordinates	
	Top of Casing	Land Surface	Northings	Eastings
Site 1: Current Fire Training Area				
MW1-1	2,841.40(2,841.43)	2,841.7(2,841.6)	689,917.03(689,918.33)	376,463.43(376,464.14)
MW1-2	2,850.06(2,850.05)	2,850.2(2,850.3)	689,826.90(689,828.23)	377,009.86(377,010.72)
Site 5: Former Wood Preserving Operation				
MW5-1	2,843.36(2,843.36)	2,843.8(2843.9)	689,040.71(689,041.95)	376,220.42(376,221.46)
Site 6: Tar Pit				
MW6-1	2,836.32(2,836.30)	2,836.8(2,836.8)	688,521.17(688,522.41)	376,205.61(376,206.33)

All measurements in feet
MSL = Mean Sea Level Datum

State Coordinate System. Table 2-4 presents the horizontal coordinates and elevation data of the monitoring wells installed at Gowen Field.

2.2.3.3 Monitoring Well Sampling

Prior to purging and sample collection, static water level measurements were taken in each well using an electric water level indicator. Depths to groundwater were used to calculate the volume of standing water in each well and therefore to determine the volume of water to be purged from each well prior to sampling.

Prior to collection of samples from monitoring wells, three to five casing volumes of water were purged from each well using a 3 7/8-inch submersible pump, a centrifugal pump, or a bailer. Field measurements for temperature, pH, and specific conductance were monitored during purging to ensure that these parameters had stabilized. Purging ensures that a representative sample of the aquifer (i.e., not stagnant water) has been collected. Prior to commencement of well purging operations, between wells, and after purging was completed, the pump and/or hose was washed with a laboratory-grade detergent (e.g., Liqui-Nox/Alconox) and rinsed with potable water.

Groundwater samples were collected within 2 hours of purging each well. Samples were retrieved with a point-source Teflon bailer and dispensed directly into an appropriate relabeled sample bottle containing the required preservative (if any was required) for the analyte to be tested. Field measurements for temperature, pH, and specific conductance were taken at each well. Field calibration was performed at the start of each day. Sample containers were wrapped in packing material and placed in coolers containing "blue ice" to maintain a temperature of 4°C or below. Sample coolers were shipped to laboratories via overnight carrier within a maximum of 4 days of sample collection. The chemical parameters tested in samples collected at each site are listed in Table 2-2. Analytical methods, sample preservation guidelines, and holding times for these parameters are described in Table 2-3.

2.2.4 Shallow Soil Borings

Concurrent with drilling and installation of the groundwater monitoring wells, 10 soil borings were completed at Gowen Field. Five of the borings were completed at Site 1 - Current Fire Training Area, four at Site 2 - Former Fire Training Area, and one at Site 5 - Former Wood Preserving Operation. Because of the relative lack of soil gas contamination detected at Site 2, one of the borings originally planned for this site was moved to Site 1, where areally extensive, elevated soil gas contaminant levels were found. In addition to these soil borings, the upper 45 feet of the monitoring well borehole at Site 6 - Tar Pit was sampled as a shallow soil boring. The actual locations of the borings at Sites 1 and 2 were determined by evaluating the results of the soil gas survey. By locating the borings in the areas of highest soil gas contamination, the utility of the borings was maximized. The shallow boring at Site 5 was located in the middle of the site, which was delineated by the presence of stained soil. The data obtained from the soil borings, in combination with on-site GC analysis, were intended to confirm the presence, define the vertical magnitude and extent, define the chemical nature, and locate the probable source(s) of any soil contamination present at the sites. The data also were used to correlate with the data obtained during the soil gas survey.

Soil samples were collected at 5-foot intervals in these shallow soil borings as opposed to the 10 samples per monitoring well borehole. It originally was proposed to drill and sample the shallow soil borings using hollow-stem auger drilling techniques with split-spoon samplers. However, approximately 45 feet of the upper soils on the base were composed of a predominance of cobbles (2.3 to 10 inches in diameter), which made hollow-stem auger drilling extremely difficult and rendered the 2.5-inch I.D. split-spoon samplers useless. As a result, only 1 (SB1-1) of the 10 shallow soil borings was completed using this drilling method and split-spoon samplers could not be used above the 45-foot depth below land surface (BLS).

SAIC developed an alternative to this drilling technique to expedite sampling of the shallow soils. This alternative consisted of using the dual-walled reverse air circulation drilling method to complete all borings and to obtain shallow soil samples from the drill cuttings. This entailed collecting the air lifted cuttings from a discrete depth and depositing the cuttings directly into sample jars. A wire mesh was used to sieve off the pebbles and cobbles from the cuttings. Since air stripping of contaminants was a possibility, at least one split-spoon sample was obtained from each borehole to ensure the detection of any contaminants and to compare with the results from the drill cuttings sampling method. These results are discussed in detail in Section 3. Soil borings were continued to a depth until two consecutive uncontaminated samples were encountered based on the on-site GC results.

Based upon the results of the on-site GC, a minimum of four samples were selected from each borehole to be sent to the laboratory for the analyses outlined in Table 2-2. Analytical methods, sample preservation guidelines, and holding times for these parameters are outlined in Table 2-3. All shallow soil boring logs are included in Volume II, Appendix D (Soil Boring Logs).

Following the completion of the soil borings, each borehole was abandoned by backfilling with cement/bentonite grout to prevent the borehole from becoming an avenue for future contamination. This procedure was in compliance with the Idaho Hole Abandonment Regulations.

2.2.5 Stream Sediment, Tar, and Surface Soil Sampling Procedures

The following sections present the sampling procedures for collecting stream sediment, tar, and surface soil samples at Gowen Field.

2.2.5.1 Stream Sediment Sampling

Three surface water and stream sediment samples were proposed to be collected from Site 3 - Central Drainage Ditch, an intermittent stream that flows adjacent to Site 1 - Current Fire Training Area. These samples were collected to determine if potential contaminants from the site were impacting surface water quality and to determine if the stream is a contaminant transport pathway. Since water was not present during the field program activities, surface water samples could not be collected. Sampling points were located upstream of, adjacent to, and downstream of Site 1 to determine the effect on the stream when it flowed past the site. Using a hand trowel, the upper 4 to 6 inches of sediment were sampled from the stream bed. When VOCs were sampled, the sediment was placed directly into the sampling containers. Sediments for all other analyses were composited prior to placement into the sampling containers. Samples were sent to an off-site laboratory for analysis for the parameters listed in Table 2-2. Analytical methods, sample preservation guidelines, and holding times for these parameters are described in Table 2-3.

2.2.5.2 Tar Samples

Two tar samples were collected from Site 6 - Tar Pit. These samples were collected to determine if the tar in the pit could be considered hazardous according to Resource Conservation and Recovery Act (RCRA) characteristics.

To obtain the tar sample, the upper weathered surface of the tar was removed, and then a sample of the "fresh," extremely viscous tar was extracted using a hand trowel. The sample then was placed directly into the sampling container. Samples were sent to an off-site laboratory for analysis for the parameters listed in Table 2-2. Analytical methods, sample preservation guidelines, and holding times for these parameters are described in Table 2-3.

2.2.5.3 Surface Soil Samples

One surface soil sample was collected at Site 1 - Current Fire Training Area from soil relocated from Site 4 - Oil Patch in Drainage Field, which was described in the Installation Restoration Program (IRP) Phase I (Preliminary Assessment) report. Site 4 was not included in this SI study because this soil had been relocated. This sample was taken to determine if the relocated soil could be considered a RCRA hazardous waste, which could be a source of potential contamination at Site 1.

This soil sample was collected using a hand bucket auger. Six areas were sampled at 2- to 3-foot depths. These samples then were composited and placed into sampling containers. The samples were sent to an off-site laboratory for analysis for the parameters listed in Table 2-2. Analytical methods, sample preservation guidelines, and holding times for these parameters are described in Table 2-3.

Two additional soil samples were collected from remote desert areas surrounding Gowen Field. These samples were taken to characterize the natural background levels of the compounds that were being analyzed at the sites. Using these samples, it can be determined which, or at what level, compounds found at the sites are the result of actual site activities as opposed to natural background levels.

The upper 2 feet of soil were removed and the sample was then collected from the 2- to 3-foot depth (using a hand trowel). This removal of the upper 2 feet of soil was conducted to simulate borehole sampling at a 5-foot depth. Samples were placed directly in volatile analysis sampling containers. Samples for all other parameters were composited prior to placement into sample bottles. Samples were sent to an off-site laboratory for analysis for all parameters listed in Table 2-2, exclusive of EP toxicity and ignitability. Analytical methods, sample preservation guidelines, and holding times for these parameters are described in Table 2-3.

2.2.6 Hydrologic Data Collection

Aquifer (slug) testing and static groundwater measurements were taken as part of the field program. The following sections discuss the procedures employed.

2.2.6.1 Aquifer Testing

Aquifer (slug) testing was performed after the completion of groundwater sampling. Slug tests are short-duration, single-well tests conducted by "instantaneously" adding or removing a slug of known volume into or from the well and measuring drawdown versus time as groundwater levels return to the static level. These tests were performed at all wells installed during this program at Gowen Field.

The slug used during the tests consisted of a 10-foot section of 3-inch O.D. PVC pipe filled with potable water. This apparatus was lowered into the well by a rope until it was located immediately above the water table. At this time, all recording devices were set and the test began when the slug was dropped into the water. Measurement and recording of drawdown (water level) versus time during the tests were automated using an In-Situ, Inc. Hermit Data Logger. A transducer attached to this instrument measured head levels, and all readings were recorded by the instrument. The recording device was set to collect and record data on a logarithmic scale at intervals from 0.2 seconds up to 1.0 minute. All data for these tests were held within the Hermit Data Logger until they were transferred to an SAIC computer for storage and analysis. Hard copy printouts of the field data were obtained in the field after each test.

The data collected during the aquifer tests were analyzed using standard techniques to determine the hydraulic characteristics of the aquifer in the vicinity of the well. Data from the aquifer tests were analyzed using the Hvorslev (1951) method. This method provides values for the hydraulic conductivity of the aquifer in the localized area around the monitoring well. Aquifer testing data and analysis methods are presented in Volume II, Appendix E (Aquifer Test Data and Hydrogeologic Calculations).

2.2.6.2 Static Groundwater Measurements

Three rounds of static groundwater measurements were taken at the base. These levels were used to determine groundwater flow direction and to aid in the calculation of groundwater flow rates. In addition, three levels were taken to determine if there were significant seasonal changes in groundwater levels (indicating aquifer recharge or discharge), flow direction, and/or velocity. Since surface irrigation waters, a primary source of aquifer recharge, were believed to have a pronounced effect on the aquifer, the first round of levels was taken on June 2, 1987, early in the irrigation season.

The second round of static water levels was taken on August 15, 1987, when the effects of the irrigation waters would be most obvious. The third round was taken on February 6 and 7, 1989.

The levels were taken at each monitoring well with an electric water level indicator. The indicator was lowered into the well and a circuit was completed upon submersion in water, triggering a buzzer. The water level was then read off the indicator's graduated 0.01-foot tape at a surveyed notch on the top of the monitoring well casing. These data are presented on the well completion forms in Volume II, Appendix C (Monitoring Well Completion Forms and Logs).

2.2.7 Quality Assurance/Quality Control Procedures

The following sections discuss procedures used for collecting field QA/QC samples and for equipment decontamination.

2.2.7.1 Field QA/QC Samples

SAIC collected the following QA/QC samples during groundwater sampling:

- One field blank was collected prior to the start of groundwater sampling. Field blanks were prepared by pouring ultrapure (HPLC grade, deionized double distilled) water into sample containers and were maintained with other collected media samples in the field. Field blanks were used to evaluate the field sampling procedures.

- One bailer wash was collected for 10 percent of the environmental samples sent to the laboratory for analysis. Bailer washes consisted of pouring ultrapure water through the bailer and into sample containers immediately after the bailer had been decontaminated. Bailer washes were then handled as other field samples. They were used to verify the effectiveness of the field decontamination procedure.

- One field replicate was collected at a preselected monitoring point for 10 percent of the environmental samples sent to the laboratory for analysis for each site. Field replicates were collected at the same time and in the same manner as the normal laboratory samples. Field replicates are not the same as laboratory duplicates; rather, they are separate samples obtained from the same monitoring point. As such, results of the field replicate analyses are used to evaluate the reproducibility of the field replicate sampling methods, not the reproducibility of the analytical techniques.

SAIC collected the following QA/QC samples for each day of soil sampling (i.e., during monitoring well borings and shallow soil borings):

- One field blank (water) was collected per sampling rig prior to the start of each drilling day. Samples were prepared as discussed above.
- One field replicate (soil) was collected per sampling rig during drilling operations for every 10 environmental samples sent to the laboratory for analysis for each site.

2.2.7.2 Equipment Decontamination

Prior to the commencement of sampling activities, between samples, and after sampling activities were completed at a sampling location, all sampling equipment (i.e., split-spoon samplers, bailers) were decontaminated. Decontamination procedures consisted of scrubbing the equipment with laboratory-grade detergent (Alconox), rinsing with potable water, isopropyl alcohol, and rinsing with HPLC-grade ultrapure water. Lines used to lower bailers into the wells were replaced between wells. Water level monitoring devices and measuring tapes were scrubbed with laboratory-grade detergent and then rinsed with distilled water.

Drilling equipment (including rods, bits, tools, etc.) was decontaminated at the decontamination area with a steam cleaner, laboratory-grade detergent (Alconox), and a potable water rinse before and between drilling locations.

3. DISCUSSION OF RESULTS AND SIGNIFICANCE OF FINDINGS

This section presents the results obtained from the Site Inspection (SI) field activities and the significance of the findings. A detailed review and quality assurance/quality control (QA/QC) evaluation of all laboratory analytical data was conducted by Science Applications International Corporation (SAIC) to verify the quality of the data. A summary discussion of the QA/QC program is presented in Section 3.1 and details of the program are provided in Volume II, Appendix I (Laboratory QA/QC). Site-specific results of the soils investigation are discussed in Section 3.2 and include soil gas data, on-site gas chromatography (GC) results, shallow soil boring and monitoring well boring results, and a discussion of the site geology. Section 3.3 provides a discussion of the groundwater investigation, including site hydrology and groundwater chemical data.

3.1 QUALITY ASSURANCE/QUALITY CONTROL PROGRAM

A program of QA/QC procedures was instituted throughout the sampling effort at Gowen Field and the subsequent analysis of samples. The intent of this QA/QC program is to ensure that collected samples are representative of the sites under investigation, and that analytical data accurately describe the characteristics and concentrations of constituents in the samples. The QA/QC program consisted of the preparation and analysis of both laboratory and field QA/QC samples, and analysis of samples split between two laboratories. Laboratory QA/QC samples were composed of spiked samples, duplicate samples, and method blanks, which are intended to verify the accuracy and precision of laboratory procedures. All samples that were collected were sent to Laucks Testing Laboratory of Seattle, Washington, (referred to later in the text as the "primary" laboratory) for analysis. In addition, 10 percent of the samples collected were replicated and sent to Martin Marietta Energy Systems, Inc. of Oak Ridge, Tennessee (referred to later in the text as the "secondary" laboratory). The replicate samples were analyzed by both laboratories (primary laboratory and secondary laboratory) for the same constituents. These replicate samples are intended as an additional check on the precision and accuracy of the laboratory analyses. In addition to the evaluation of the data from laboratory QA/QC samples, analysis dates for all samples have been evaluated to ensure that appropriate holding times for samples were met. Field QA/QC samples were composed of field blanks, bailer washes, and field replicates, which are intended to confirm the adequacy of the field procedures used in collecting samples. Detailed discussions of all QA/QC results are included in Volume II, Appendix I (Laboratory QA/QC).

3.1.1 Laboratory QA/QC Results

The results of analyses of laboratory QA/QC samples are presented in Volume II, Appendix H (Laboratory Analytical Data). Detailed discussions of the QA/QC results are provided in Volume II, Appendix I (Laboratory QA/QC). These samples, consisting of spiked samples, duplicate analyses, and laboratory method blanks, serve as a check on the precision and accuracy of laboratory samples.

Two types of spiked samples are used in the laboratory to evaluate the accuracy of the analysis: surrogate spikes and matrix spikes. In both cases, the analytical results are used to calculate percent recoveries. Recoveries equal 100 percent in cases when all of the spike added was identified during analysis. Recoveries less than or greater than 100 percent indicate that a lesser or greater amount of spike was detected during analysis.

Surrogate spike samples are prepared by adding a known amount of one or more "surrogate" compounds to a sample, followed by analysis for those compounds. Surrogate compounds are compounds that are unlikely to be present in the unadulterated sample, yet are chemically similar to analytes of interest. Isotopically enriched compounds often are used as surrogates. After analysis, percent recovery is calculated by dividing the analytical result by the known amount of addition. Surrogate spike analyses yield information on the general accuracy of the analysis within a sample matrix.

Matrix spike samples are evaluated by analyzing a sample before and after the addition ("spike") of a known amount of a compound. Compounds used for matrix spike analyses are expected to be present in the unadulterated sample. Percent recovery is calculated by subtracting the first analytical result from the second and then dividing by the known amount of addition. Matrix spike analyses yield information on the effect of the sample matrix on the analysis of specific analytes of interest.

Complete results of the surrogate spike and matrix spike analyses are presented in Volume II, Appendix H (Laboratory Analytical Data) and discussed in Volume II, Appendix I (Laboratory QA/QC). In general, the review of the QA/QC data showed good accuracy for the laboratory analyses. Surrogate spike and matrix spike analyses, used to determine the accuracy of the analysis, showed recoveries within the control limits defined by the 95 percent confidence interval.

Duplicate samples are used in the laboratory to evaluate the precision of the analysis, by comparing the results of the two samples. This comparison often is expressed as the relative percent difference (RPD), calculated by dividing the difference in concentration between duplicates by the mean of the concentrations. By definition, RPD equals 0 percent when duplicate analyses are equivalent. Although a small RPD indicates good reproducibility, a large RPD does not necessarily indicate a large difference in actual concentration, since the RPD is a difference in concentration relative to the mean concentration. For example, the RPD between 0.0001 and 0.0002 ug/l is the same as that between 1,000 and 2,000 ug/l, and the RPD between 0 and 0.0001 ug/l is the same as that between 0 and 1,000 ug/l. Complete results of the duplicate analyses are presented in Volume II, Appendix H (Laboratory Analytical Data) and discussed in detail in Volume II, Appendix I (Laboratory QA/QC).

Duplicate analyses, performed by the laboratory to evaluate the precision of the analyses, most often were also within the control limits defined by the 95 percent confidence interval. Analyses that were out of the control limits included one (out of 22) duplicate analyses for semi-volatiles in soils, one (out of 8) duplicate analyses for pesticides and herbicides in soils, and five (out of 69) duplicate analyses for metals in soils. Analyses that were outside the U.S. Environmental Protection Agency (EPA) Contract Laboratory Program (CLP) control limits were attributed to analysis difficulties inherent in the analyte and in the matrix.

Method blanks (laboratory blanks) are generated by treating distilled, deionized water as if it were a sample, and carrying it through all of the sample preparation steps of a method. Method blanks are used to assess false positive analyses, either through contamination of samples in the laboratory or instrumental error. These method blanks are discussed in detail in Volume II, Appendix I (Laboratory QA/QC).

Concentrations of constituents such as methylene chloride, bis-(2 ethylhexyl) phthalate, di-n-octylphthalate, acetone, and metals (in particular selenium) are commonly found in laboratory method blanks because the laboratory is not totally free of organic and inorganic compounds. Plastic tubings, rinse solvents, and even laboratory-grade, certified reagents contain concentrations of organic and inorganic compounds. These compounds often are detected in environmental samples because chemical compounds are commonplace in the laboratory environment. Therefore, laboratory method blanks are analyzed to account for these concentrations that are present in the laboratory and also can be accounted for in environmental samples.

In general, method blanks were free of contamination. However, several compounds did appear in the method blanks, including acetone and bis-(2 ethylhexyl) phthalate in several soil and water method blanks, methylene chloride in one water method blank, and di-n-octylphthalate in one soil method blank. Occasional low concentrations of copper, zinc, and chromium appeared in several water method blanks, and copper, zinc, selenium, and antimony were detected in several soil method blanks. The presence of methylene chloride, bis-(2 ethylhexyl) phthalate, and di-n-octylphthalate were attributed to laboratory contamination. Therefore, concentrations of these compounds that were detected in environmental samples were evaluated in light of the concentrations present and were determined to be due to laboratory contamination and were not considered environmental contaminants due to site activities. The presence of acetone, detected in laboratory method blanks, also was considered a laboratory contaminant, and is discussed in more detail in Section 3.1.4.

3.1.2 Evaluation of Sample Holding Times

Each analysis method specifies a maximum length of time for which a sample may be held between collection and analysis, or between collection, preparation, and analysis. These holding times must be met to ensure the integrity of the sample for the specified analysis. The results of the holding time evaluations are discussed in Volume II, Appendix I (Laboratory QA/QC), by analysis type.

Analyses of sample holding times showed all holding times were met by the primary laboratory, with the exception of four samples for volatile analysis. The holding times of these four samples for volatile analysis (SB1-1-8, SB1-1-9, SB1-1-10, and SB1-2-1) were exceeded by 10 hours, which is not expected to compromise the integrity of the environmental data. Samples sent to the primary laboratory were analyzed for semi-volatiles, inorganics, and petroleum hydrocarbons within the specified holding times.

3.1.3 Field QA/QC Results

Field QA/QC procedures consisted of collecting and analyzing field blanks, bailer washes, and field replicates. These samples are intended as QA/QC checks on the integrity of sample collection, handling procedures, and bailer decontamination procedures. The following discussions summarize the collection procedures for field blanks and bailer wash samples. The results of the field blank, bailer wash, and field replicate analyses are presented in Volume II, Appendix H (Laboratory Analytical Data) and discussed in detail in Volume II, Appendix I (Laboratory QA/QC). A summary of field blank analyses for soil samples is provided in Table 3-1. Analytical results for the field blank and bailer wash samples associated with the groundwater samples are presented in Table 3-2.

TABLE 3-1

SUMMARY OF INORGANIC AND ORGANIC COMPOUNDS DETECTED IN FIELD QA/QC SAMPLES FOR SOIL SAMPLES COLLECTED AT IDAHO AIR NATIONAL GUARD, GOWEN FIELD, BOISE, IDAHO

Parameter	Unit	Lower Level of Detection	Test Results*											
			QA1-1-1	QA1-1-2	QA1-1-4	QA1-1-5	QA1-1-6	QA1-1-8	QA2-1-2	QA2-1-3	QA2-1-4	QA2-1-6	QA2-1-8	QA2-1-10
INORGANICS														
Antimony	ug/l	5	ND	18	200	6	ND	ND	ND	ND	ND	ND	ND	ND
Arsenic	ug/l	5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Beryllium	ug/l	1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chromium	ug/l	1	ND	ND	ND	ND	1(B)	ND	ND	ND	ND	ND	ND	ND
Copper	ug/l	1	8(B)	7(B)	9(B)	8(B)	8(B)	7	7(B)	4(B)	7	7	7	7
Lead	ug/l	10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mercury	ug/l	1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Nickel	ug/l	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Selenium	ug/l	5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Zinc	ug/l	1	2(B)	2(B)	3(B)	3(B)	2(B)	3(B)	4(B)	2(B)	2(B)	1(B)	3(B)	6(B)
PETROLEUM HYDROCARBONS	mg/l	0.1	1.4	0.8	0.7	NT	0.5	0.9	0.7	0.7	0.5	0.4	0.5	0.6
VOLATILE ORGANICS														
Acetone	ug/l	10	ND	ND	ND	19(B)	ND	ND	ND	NT	ND	ND	ND	ND
Acrolein	ug/l	10	ND	ND	ND	ND	ND	ND	ND	NT	ND	ND	ND	ND
Ethylbenzene	ug/l	5	ND	ND	ND	ND	ND	ND	ND	NT	ND	ND	ND	ND
Methylene Chloride	ug/l	5	ND	ND	ND	9(B)	6(B)	ND	ND	NT	ND	ND	ND	ND
Tetrachloroethylene	ug/l	5	ND	ND	ND	ND	ND	ND	ND	NT	ND	ND	ND	ND
Toluene	ug/l	5	ND	ND	ND	ND	ND	ND	ND	NT	ND	ND	ND	ND
Total Xylenes	ug/l	5	ND	ND	ND	ND	ND	ND	ND	NT	ND	ND	ND	ND
SEMI-VOLATILE ORGANICS														
Acenapthalene	ug/l	1	NT	NT	ND	ND	ND	NT	NT	NT	ND	NT	NT	ND
Benzoic Acid	ug/l	1	NT	NT	ND	ND	ND	NT	NT	NT	ND	NT	NT	ND
Bis-(2 ethylhexyl) phthalate	ug/l	1	NT	NT	ND	3	ND	NT	NT	NT	14(B)	NT	NT	ND
Dibutylpthalate	ug/l	1	NT	NT	ND	ND	ND	NT	NT	NT	3	NT	NT	ND
Pentachlorophenol	ug/l	1	NT	NT	ND	ND	ND	NT	NT	NT	ND	NT	NT	ND
2-methylnapthalene	ug/l	1	NT	NT	ND	ND	ND	NT	NT	NT	ND	NT	NT	ND

LEGEND

ND - Not Detected
NT - Not Tested
B - Indicates analyte of interest was detected in the method blank associated with this sample as well as in the sample itself.
* - These QA/QC samples are field blanks collected with soil samples.

TABLE 3-2

SUMMARY OF INORGANIC AND ORGANIC COMPOUNDS DETECTED IN FIELD QA/C SAMPLES FOR WATER SAMPLES AT IDAHO AIR NATIONAL GUARD, GOWEN FIELD, BOISE, IDAHO

Parameter	Unit	Lower Level of Detection	Test Results	
			Field Blank	Bailer Wash
INORGANICS				
Arsenic	ug/l	5	ND	ND
Beryllium	ug/l	1	ND	ND
Chromium	ug/l	1	ND	ND
Copper	ug/l	1	7(B)	7(B)
Lead	ug/l	10	ND	ND
Mercury	ug/l	1	ND	ND
Nickel	ug/l	2	ND	ND
Selenium	ug/l	5	ND	ND
Zinc	ug/l	1	3(B)	3(B)
PETROLEUM HYDROCARBONS	mg/l	0.1	0.4	0.6
VOLATILE ORGANICS				
Acetone	ug/l	10	ND	ND
Acrolein	ug/l	10	ND	ND
Ethylbenzene	ug/l	5	ND	ND
Methylene Chloride	ug/l	5	ND	ND
Tetrachloroethylene	ug/l	5	ND	ND
Toluene	ug/l	5	ND	ND
Total Xylenes	ug/l	5	ND	ND
SEMI-VOLATILE ORGANICS				
Acenapthalene	ug/l	1	ND	ND
Pentachlorophenol	ug/l	1	ND	ND
2-methylnapthalene	ug/l	1	ND	ND
Bis-(2 ethylhezyl) phthalate	ug/l	1	3	ND

LEGEND

ND - Not Detected.
B - Indicates analyte of interest was detected in method blank associated with this sample as well as in the sample itself.

Field blanks were prepared prior to the collection of environmental samples by pouring ultrapure (HPLC grade, deionized, double distilled) water into laboratory prepared sample bottles. These sample bottles were then handled in the same manner as environmental samples. Because field blanks accompany the environmental samples from the field to the laboratory, they are used to indicate the presence of external contaminants that may have been introduced into the samples during collection and shipment.

Bailer wash samples were collected during the sampling day by pouring ultrapure water into a clean bailer and then dispensing it into sample bottles. Analyses of bailer washes are used to evaluate the adequacy of bailer decontamination procedures in preventing cross-contamination of samples between wells.

In general, low levels of contaminants detected in field QA/QC samples were attributed to a known source and indicated that field sampling procedures and protocols were carefully followed. Compounds that were detected in field QA/QC samples and explanations of the potential sources of the contamination are discussed below. The impact of field and/or laboratory contamination is discussed in Sections 3.2 and 3.3 with evaluation of the data. Analysis of the QA/QC samples indicated that the presence of methylene chloride, bis-(2 ethylhexyl) phthalate, and di-n-butylphthalate could have been attributed to either the laboratory (as discussed above) or to field contamination. The presence of acetone detected in field blanks was attributed to either field contamination from the nearby steel finishing plant or to laboratory contamination.

Low levels of inorganics (i.e., copper, zinc, chromium) detected in field blanks and bailer wash samples (Tables 3-1 and 3-2) also were detected in corresponding method blanks, and therefore were not attributed to poor sampling procedures. Petroleum hydrocarbons detected at low levels in field QA/QC samples were attributed to ambient air concentrations from nearby air traffic.

Field replicates were obtained by collecting two separate samples from the same monitoring station, attempting to hold all variables constant. Field replicates differ from laboratory duplicates, which are the same sample split in two. Analytical results of field replicates are used to evaluate the precision of field sampling procedures as well as laboratory procedures. As such, these results are not expected to be identical because of the number of independent variables involved. However, results should not vary widely. The results of field replicate analyses are presented in Volume II, Appendix H (Laboratory Analytical Data) and discussed in Volume II, Appendix I (Laboratory QA/QC).

Analysis of field replicate results showed only minor disagreements between replicate analyses for soil samples. This occurrence is typical and often found in soil samples, due to the general inhomogeneity of soil samples and the general difficulty associated with obtaining two replicate soil samples.

3.1.4 <u>Analysis of Replicate Samples Between Two Laboratories</u>

Analyses of replicate samples that were sent to two different laboratories were evaluated by comparing all analytical results for each sample. This evaluation serves as an additional check on the precision and accuracy of the analyses. These comparisons also are discussed in Volume II, Appendix I (Laboratory QA/QC).

Analysis of samples sent to two laboratories generally showed good agreement, except for three volatile compounds (i.e., methylene chloride, acetone, and 2-butanone). Disagreements between methylene chloride and 2-butanone analyses were attributed to laboratory contamination. Acetone concentrations were not only attributed to laboratory contamination, but also to probable random contamination, at the sites during sample collection, by airborne acetone. For example, a nearby steel finishing plant was blasting and painting steel beams during the field program. Acetone is a highly volatile component of paint and could have been transported during the time of sample collection from the steel plant to the site (approximately 0.25

miles downwind). Therefore, doubt is cast on the presence of acetone in environmental samples and the relation to previous activities associated with the sites.

Samples sent to two laboratories showed good agreement for semi-volatiles, metals, and petroleum hydrocarbons. Minor differences were attributed to sample inhomogeneity, which is a frequent occurrence in collecting and analyzing soil samples.

Holding times also were evaluated for the replicate samples sent to the secondary laboratory. Each analysis specifies a maximum length of time for which a sample may be held between collection and analysis, or between collection, preparation, and analysis. These holding times must be met to ensure the integrity of the sample for the specific analysis.

Of the nine volatile samples that were sent to the secondary laboratory for duplicate analyses, all holding times were missed. This may compromise the integrity of the environmental data. Therefore, the data produced by the secondary laboratory were not used in evaluating the environmental problems at Gowen Field. Semi-volatile maximum holding times were exceeded for the two samples sent to the secondary laboratory. Therefore, the analyses received from this laboratory were not used in evaluating the environmental problems at Gowen Field. Of the nine replicate samples analyzed by the secondary laboratory for metals, all holding times were met.

3.1.5 QA/QC Conclusions

The following conclusions were made regarding the analytical data and were based on a thorough review of the QA/QC procedures conducted by both laboratory and field personnel:

- Evaluation and review of the laboratory and field QA/QC samples indicate that the data accurately represent the environmental samples collected. Concentrations of contaminants detected in laboratory and field QA/QC samples were low and can be attributed to a known source.

These concentrations do not affect the usefulness of the environmental data.

- Results of field replicate analyses showed good reproducibility and indicate good QA/QC procedures associated with field sampling techniques.

- Acetone concentrations detected in both soil and groundwater samples are considered to not be environmentally significant and are not attributed to past or present activities conducted at the base. Detection of acetone in environmental samples was attributed to laboratory contamination and/or nearby painting activities at the base. This was considered in the evaluation of the environmental data.

- Bis-(2 ethylhexyl) phthalate, di-n-octylphthalate, di-n-butylphthalate, methylene chloride, and 2-butanone also were attributed to laboratory or field contamination and are considered to not be environmentally significant. This was considered in the evaluation of the environmental data.

- Small amounts of petroleum hydrocarbons were attributed to nearby air traffic. Concentrations of these compounds, detected in field blanks or bailer washes, were considered in the evaluation of the environmental data.

- Small amounts of metals (i.e., copper, zinc, chromium, and antimony) detected in soil and groundwater samples were attributed to laboratory contamination. Concentrations of these inorganic compounds that were detected in method blanks, field blanks, and/or bailer washes were considered in the evaluation of the environmental data.

- Replicate samples sent to the secondary laboratory exceeded analyses holding times. Therefore, these results were not included with the results of the environmental samples from the primary laboratory.

3.2 SOILS INVESTIGATION

The following sections discuss the geology of the four sites studied, background soil sampling results, and findings for each of the four sites.

3.2.1 Site Geology

During the study at Gowen Field, only one geologic formation was encountered (soil boring logs are included in Volume II, Appendices C and D). The sediments encountered during the field program indicated that this formation, the Older Terrace Gravel, was consistent throughout the study area. The formation consisted of an upper 45- to 50-foot layer of an unconsolidated, well-sorted mixture of medium to coarse sand and pebble to cobble sized gravels. The samples taken from this area were generally dry, loose, and pale brown and pale yellow. The sand within these samples showed wide variations in both angularity and sphericity, while the pebbles and cobbles were generally well-rounded, but varied in sphericity. The hardpan layer identified in earlier studies conducted at Gowen Field (CH2M HILL 1986), was not encountered during this program; however, a thin clay layer was found at the 5-foot depth in the soil boring within the Burn Pit at Site 1 - Current Fire Training Area.

Below the 45- to 50-foot depth, this layer graded into unconsolidated, well-sorted, interbedded, fine to coarse sands. The samples taken from this area were generally dry (above the water table), firm, and pale brown to brownish yellow. The samples show a wide variation in angularity and sphericity throughout the sampling depth. The sands were generally well-sorted, but several samples contained fine gravel or small amounts of silt and/or clay. Several minor (<0.5 ft) clay lenses also were found, along with several weakly cemented sand beds. These fine to coarse sands constitute at least the upper 30 feet of the shallow aquifer and extend below the depth investigated during the field program. The total thickness of these sands is unknown.

3.2.2 Background Soil Samples

Background contaminant levels are concentrations observed in environmental media in the absence of identified sources of contamination. Samples from upgradient monitoring stations frequently are shown to be free of contaminants of site-specific origin and are used to obtain background levels that can be compared to samples from other monitoring stations.

Two soil samples were collected from remote locations off-base, away from any base activities that potentially could contaminate the soils. The locations where the background soils were collected are shown in Figure 3-1.

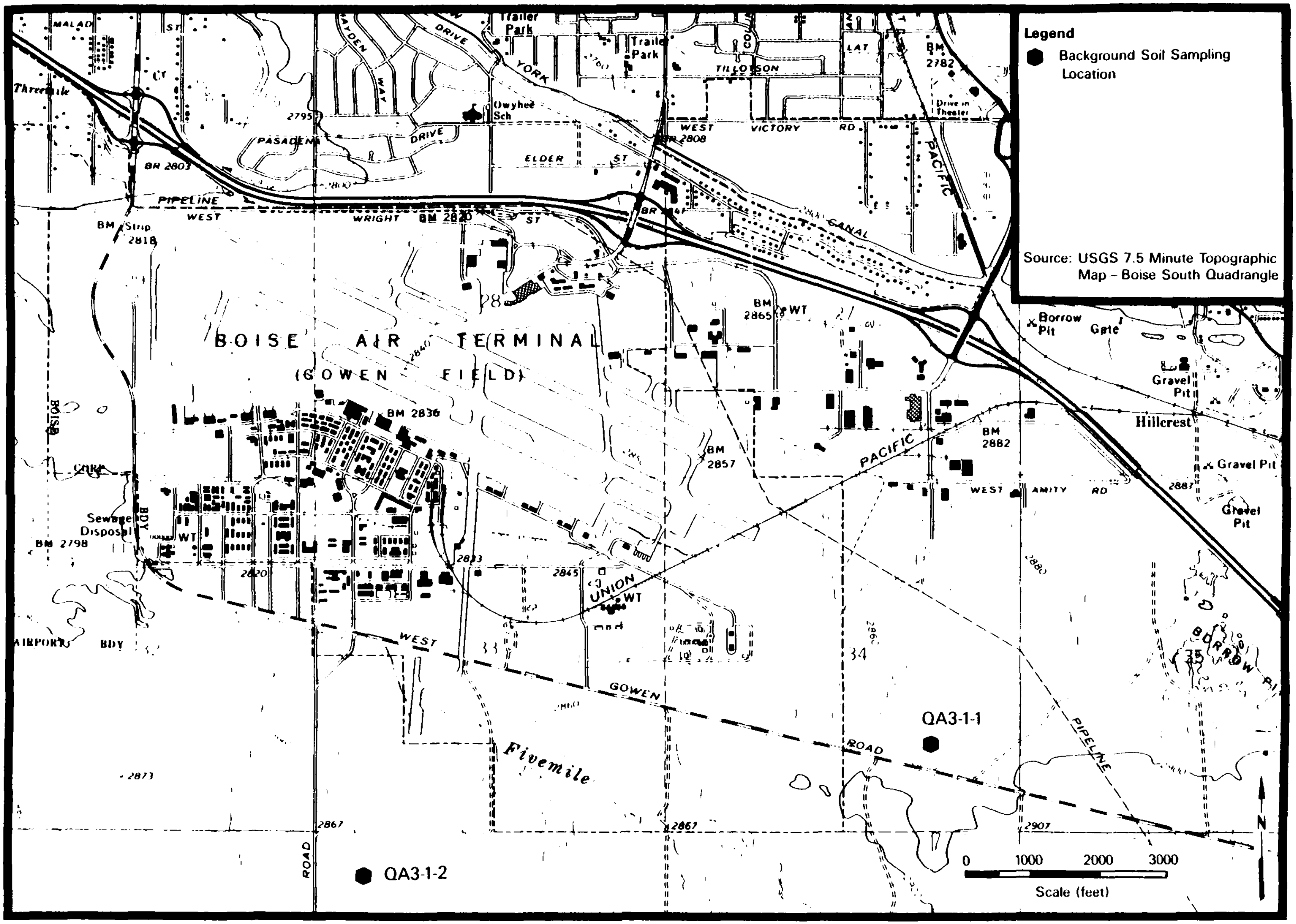


Figure 3-1. Background Soil Sample Location Map for Idaho Air National Guard, Gowen Field, Boise, Idaho.

These soil samples were sent to an off-site laboratory and analyzed for metals, petroleum hydrocarbons, volatile organics, and semi-volatiles. The results of these analyses are being considered as background levels because they were collected from an area unaffected by base activities. The results of the soil sample analyses are considered typical of the soils in the area and are used as a basis for comparison with analytical results of the soil samples collected at the sites of concern under investigation. A summary of the chemicals detected in the samples is presented in Table 3-3.

As Table 3-3 illustrates, metals such as arsenic (4.2 and 4.6 mg/kg), beryllium (0.6 and 0.6 mg/kg), chromium (17 and 16 mg/kg), copper (17 and 16 mg/kg), nickel (14 and 13 mg/kg), and zinc (52 and 52 mg/kg) were detected in similar concentrations in the two samples. These levels of metals are considered to be true background levels, typical of the soils in the Boise area. Similar concentrations were found in all soils sampled and analyzed by the off-site laboratory and at all depths to 180 feet below land surface (BLS), providing further evidence that these concentrations of metals are background levels. For comparison, Table 3-4 shows typical concentrations for metals in soils in the western United States. Concentrations of metals in soils at Gowen Field and in background samples are typical of concentrations found in this region.

A number of volatile organics and semi-volatile organic compounds also were detected in the two samples. Methylene chloride and acetone detected in the samples were determined to be field and/or laboratory contaminants, as previously discussed in Section 3.1. Other volatile organics, including tetrachloroethylene, toluene, ethylbenzene, and total xylenes, also were detected in similar concentrations in the two samples.

Among the semi-volatile organic compounds, bis-(2 ethylhexyl) phthalate and benzoic acid were found in the samples. The compounds were detected in only the surficial soils and were not found consistently throughout the soil column. Organic compounds commonly occur in surficial soil samples (as well as ambient air), although quantifiable levels in the Boise area are not

TABLE 3-3

COMPOUNDS ANALYZED IN BACKGROUND SOIL SAMPLES TAKEN OFF-SITE, IDAHO AIR NATIONAL GUARD, GOWEN FIELD, BOISE, IDAHO

Parameter	Unit	Lower Level of Detection	Test Results	
			Sample QA3-1-1	Sample QA3-1-2
INORGANICS				
Arsenic	mg/kg	0.5	4.2	4.6
Beryllium	mg/kg	0.1	0.6	0.6
Chromium	mg/kg	1	17	16
Copper	mg/kg	1	17	16
Nickel	mg/kg	2	14	13
Zinc	mg/kg	1	52	52
PETROLEUM HYDROCARBONS	mg/kg	20	ND	ND
VOLATILE ORGANICS				
Acetone	ug/kg	10	540(b)	46(B)
Ethylbenzene	ug/kg	5	7	6
Methylene Chloride	ug/kg	5	6	6
Tetrachloroethylene	ug/kg	5	32	55
Toluene	ug/kg	5	13	16
Total Xylenes	ug/kg	5	47	42
SEMI-VOLATILE ORGANICS				
Bis (2 ethylhexyl) phthalate	ug/kg	50	78	71
Benzoic Acid	ug/kg	50	470	ND

LEGEND

ND - Not Detected
B - Indicates that the analyte of interest was detected in the method blank associated with the sample as well as in the sample itself.

TABLE 3-4. BACKGROUND CONCENTRATIONS FOR SELECTED METALS IN SOILS FROM THE WESTERN UNITED STATES[a]

Metal	(Concentration (mg/kg)	
	Mean	Range
Aluminum	58,000	5,000 - >100,000
Arsenic	5.5	<0.1 - 97
Barium	580	70 - 5,000
Cadmium[b]	1	<1 - 10
Chromium	41	3 - 2,000
Copper	21	2 - 300
Iron	21,000	1,000 - >10,000
Lead	17	<10 - 700
Magnesium	10,000	<300 - 100,000
Manganese	380	30 - 5,000
Mercury	0.046	<0.01 - 4.6
Nickel	15	<5 - 700
Selenium	0.023	<0.01 - 4.3
Silver	0.5	<0.05 - 5
Zinc	55	<10 - 2,100

[a] Shacklette, H.T., and J.C. Boerngen, USGS Professional Paper 1270 (1984).
[b] Conner, J.J., and H.T. Shacklette, USGS Professional Paper 574-F (1975).

available. Concentrations of these organic compounds in background soils collected at 5 feet BLS near Gowen Field were not related to concentrations of organics in the deep soil samples because the deep soil samples are not exposed to the ambient air. The phthalate compound was determined to be a field and/or laboratory contaminant, as discussed in Section 3.1. Petroleum hydrocarbons were not detected in the two background soil samples collected.

In many cases, soil gas results, on-site GC results, and off-site laboratory analytical results show concentrations of contaminants in the parts per billion (ppb) to parts per trillion (ppt) range. These levels are near the detection levels of the analytical instruments and judgment needs to be used in determining the significance of these values.

3.2.3 Site 1 - Current Fire Training Area Soils Investigation Results

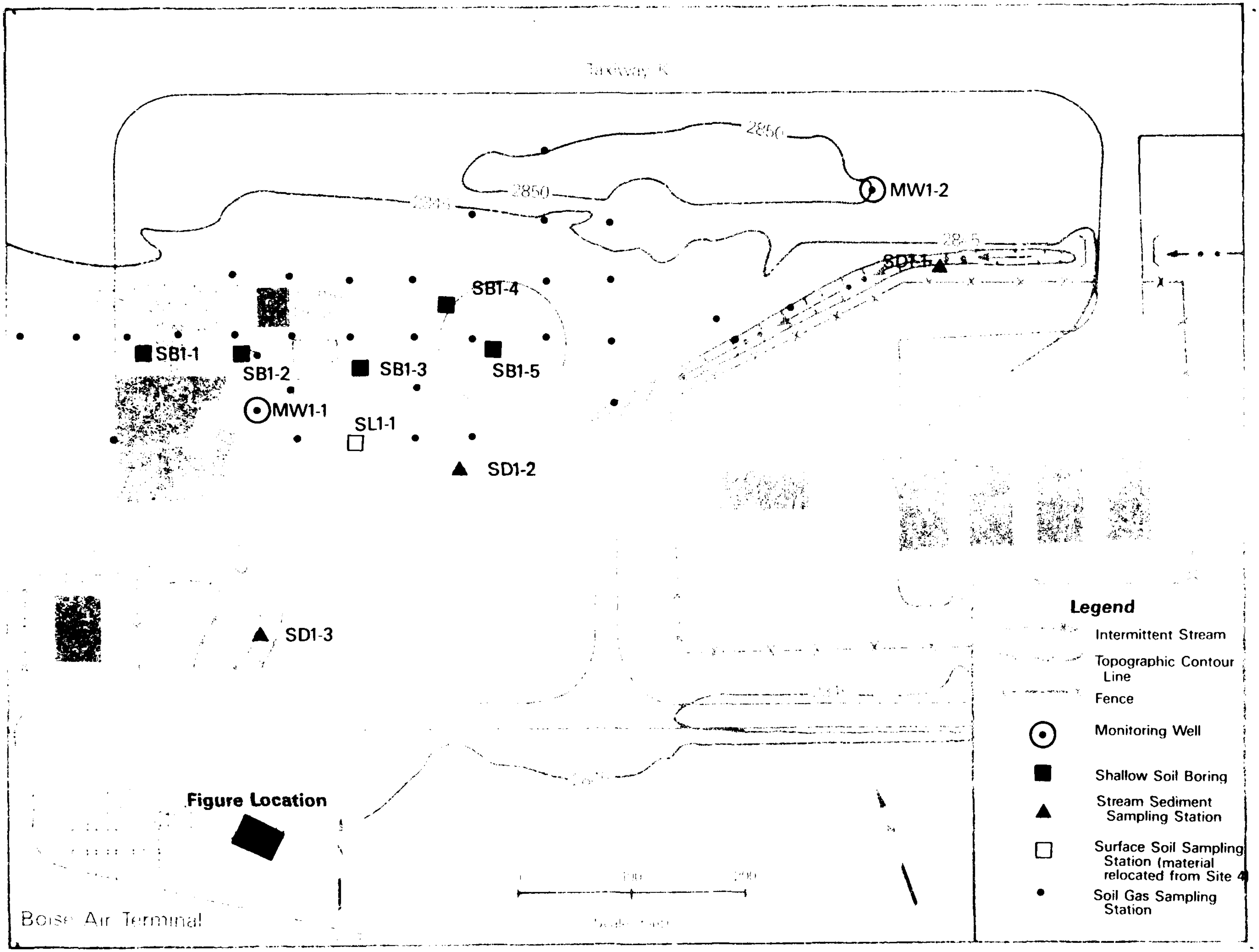
A soil gas survey was conducted at Site 1 - Current Fire Training Area. In addition, monitoring well soil boring samples and shallow soil boring samples were collected and analyzed. Figure 3-2 shows the sampling locations at Site 1.

3.2.3.1 Soil Gas Survey

Soil gas was collected and analyzed at 32 locations within Site 1 on a grid spacing of 50 to 100 feet. Details of the survey results are contained in a brief report included in Appendix F (Soil Gas Results). All samples were analyzed for halocarbon and hydrocarbon compounds.

Of the halocarbons analyzed for, TCE/$CHBrCl_2$ was the most frequently detected. The highest concentration of TCE/$CHBrCl_2$ (1,900 ug/L) was detected at a sampling location northeast of the Burn Pit. Among the other halocarbons analyzed for, concentrations (>0.01 ug/l) of PCE were detected at only three sampling locations.

Total hydrocarbon (inclusive of C_1 through C_{10} aliphatic and aromatic hydrocarbons) levels were determined at 20 of the 32 sampling locations. Based on the results, a soil gas hydrocarbon plume was plotted, measuring 470



Source: HMTC (1986) and Base Topographic Map

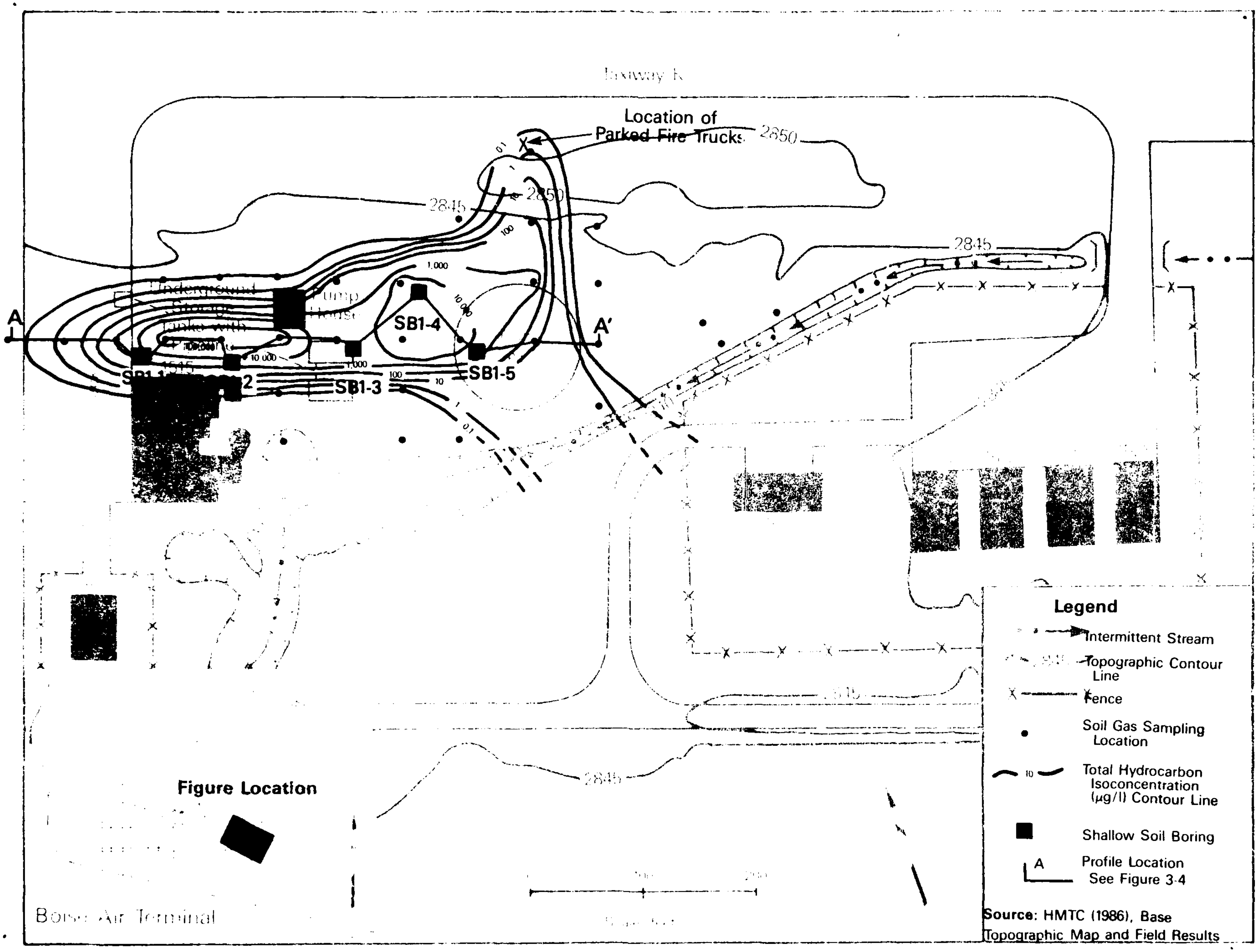
Figure 3-2. Sampling Locations at Site 1 — Current Fire Training Area, Idaho Air National Guard, Gowen Field, Boise, Idaho.

by 150 feet with the long axis of the plume oriented in a northwest-southeast direction. Figure 3-3 shows the orientation of the plume at Site 1 - Current Fire Training Area. Total hydrocarbon concentrations were found to be highest (400,000 ug/l) at a location northwest of the underground storage tanks. Two other samples taken from the Burn Pit showed concentrations of 98,000 and 46,000 ug/l total hydrocarbons. Distribution of toluene at Site 1 was similar to that of the total hydrocarbons.

The soil gas survey located three areas at Site 1 - Current Fire Training Area as primary sources of contamination. Northwest of the underground storage tanks is a source of hydrocarbon contamination where underground plumbing exists that transfers fire training fuels from a trough on the edge of the tarmac to the underground storage tanks. Second, an area northwest of the Burn Pit, where there formerly was underground plumbing that transferred fire-fighting fuels from the underground storage tanks to the Burn Pit, is a source of hydrocarbon and $CHBrCl_2$ contamination. The $CHBrCl_2$ exists because this location is also the area where the fire training trucks discharge their fire-fighting agents, which contain $CHBrCl_2$, during fire training exercises. Third, the Burn Pit itself is a source of hydrocarbon contamination.

3.2.3.2 Shallow Soil Boring Results

Soil samples were collected at 5-foot intervals from five boring locations at Site 1 - Current Fire Training Area. All samples collected underwent on-site GC analyses for volatile organic compounds (VOCs). Results from on-site GC analyses of the shallow borehole samples showed low levels of TCA (0.01-11 ug/kg), TCE (0.03-2 ug/kg), and PCE (0.007-0.07 ug/kg) at Site 1. Since these levels are at or near background concentrations found in air in the Boise area, the concentrations of these compounds, which did not vary significantly throughout the 50-foot depth of the soil columns, are considered to be unrelated to base activities. Other compounds were detected at higher levels near the surface at Site 1, but were not detected at significant levels deeper in the column. These compounds included (at maximum concentrations) benzene (47,000 ug/kg), toluene (29,000 ug/kg), xylene (18,000



Source: HMTC (1986), Base Topographic Map and Field Results

Figure 3-3. Soil Gas Isoconcentration Map for Total Hydrocarbons at Site 1 — Current Fire Training Area, Idaho Air National Guard, Gowen Field, Boise, Idaho.

ug/kg), and total hydrocarbons (370,000 ug/kg). Figure 3-4 presents the isoconcentration profile map, which shows the vertical extent of the most prevalent contaminant found at the site, total hydrocarbons. These maximum concentration locations correlated well with the maximum concentration locations found during the soil gas survey, confirming the source locations of contamination at the site. None of these compounds was found below the 45-foot depth.

A number of the samples were sent to the off-site laboratory and analyzed for VOCs and inorganic compounds. Results of the inorganic and organic compounds detected are presented in Table 3-5. For the inorganic compounds, the results indicate that arsenic, beryllium, chromium, copper, nickel, and zinc were detected in almost all of the soil samples, while lead was detected in only two of the samples (SB1-2 and SB1-3) and mercury in only one sample (SB1-2) at the 5-foot depth. Selenium was not detected in any of the soil samples from Site 1 - Current Fire Training Area. Concentrations of arsenic and zinc in the soil samples were similar to the background levels insoil. Beryllium concentrations were equal to or lower than background in all samples. Concentrations of copper, and nickel were lower than background levels at soil boring locations 2, 3, 4, and 5, but somewhat higher in some samples at location 1. Chromium concentrations were higher than background levels at locations 1 and 2, and lower than background at locations 3, 4, and 5. Lead and mercury were not detected in the background soil samples. Locations where the presence of these metals are above the background concentrations are believed to be related to site activities.

Petroleum hydrocarbons were detected in some samples at concentrations up to 8,000 mg/kg; however, the highest concentrations were found near the shallow surface area (5 feet BLS). Of the volatile organics, ethylbenzene, tetrachloroethylene, toluene, and total xylenes were detected, but again, primarily at shallow levels (0-5 feet BLS). Acetone was detected in soil samples, but as discussed earlier, is considered to be a laboratory or field contaminant.

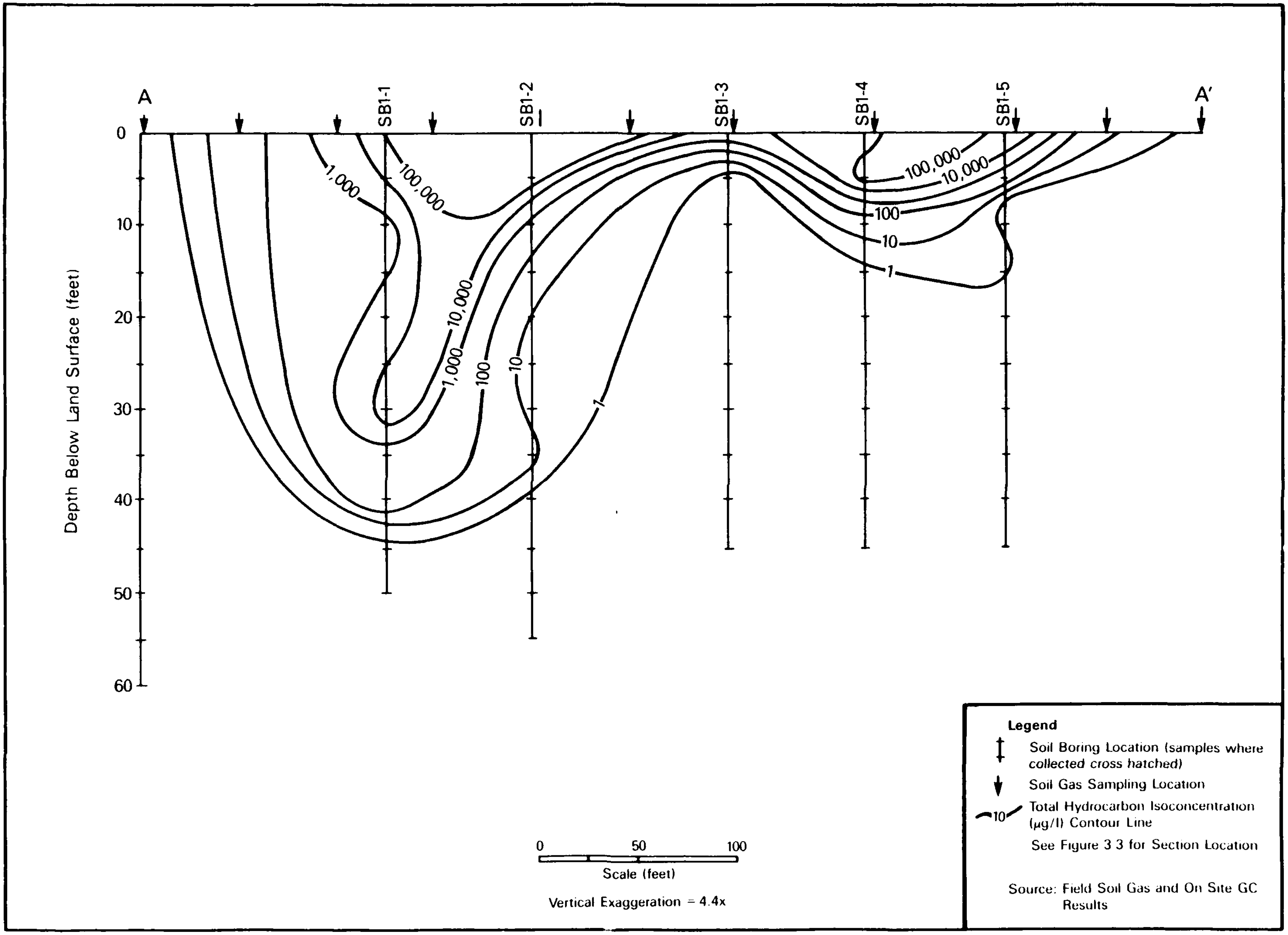


Figure 3-4. Isoconcentration Profile Map of Total Hydrocarbons from Soil Gas and On-Site GC Data at Site 1 Current Fire Training Area, Idaho Air National Guard, Gowen Field, Boise, Idaho.

TABLE 3-5

SUMMARY OF INORGANIC AND ORGANIC COMPOUNDS DETECTED IN SOIL BORING SAMPLES AT SITE 1- CURRENT FIRE TRAINING AREA, IDAHO AIR NATIONAL GUARD, GOWEN FIELD, BOISE, IDAHO

Parameter	Unit	Lower Level of Detection	Test Results							Average Background Levels
			Sample SB1-1 @ Depth (BLS), ft							
			10 (a)	20	30	35	40	45	50	
INORGANICS										
Arsenic	mg/kg	0.5	3.6	4	4.8	4.9	4.4	1.1	4.4	4.4
Beryllium	mg/kg	0.1	0.6	0.3	0.3	0.3	0.4	0.2	0.3	0.6
Chromium	mg/kg	1	37	24	140	83	100	14	7	17
Copper	mg/kg	1	37	19	11	15	11	4	3	17
Lead	mg/kg	10	ND	ND	ND	ND	ND	ND	ND	ND
Mercury	mg/kg	0.1	ND	ND	ND	ND	ND	ND	ND	ND
Nickel	mg/kg	2	28	21	9	18	10	ND	ND	14
Selenium	mg/kg	0.5	ND	ND	ND	ND	ND	ND	ND	ND
Zinc	mg/kg	1	66(B)	37(B)	34(B)	44(B)	41(B)	22(B)	26(B)	52
PETROLEUM HYDROCARBONS	mg/kg	20	110	110	180	55	110	ND	70	ND
VOLATILE ORGANICS										
Acetone	ug/kg	10	ND	33	76	35	ND	ND	ND	293(B)
Acrolein	ug/kg	10	ND	ND	ND	ND	58	ND	ND	ND
Ethylbenzene	ug/kg	5	ND	ND	80	ND	ND	ND	ND	7
Methylene Chloride	ug/kg	5	ND	ND	ND	ND	ND	ND	ND	6
Tetrachloroethylene	ug/kg	5	ND	10	15	5	36	ND	ND	44
Toluene	ug/kg	5	1,300	ND	23	ND	ND	ND	ND	15
Total Xylenes	ug/kg	5	10,000	7	340	6	16	ND	ND	45
Associated Field Blanks*			2-1-2	2-1-2	2-1-2	2-1-2	2-1-3	2-1-3	2-1-3	

(Continued)

LEGEND

SB - Soil Boring.
BLS - Below Land Surface.
ND - Not Detected.
B - Indicates analyte of interest was found in the method blank associated with the sample as well as in the sample itself.
a - Lower Level of Detection for these samples were: Toluene- 1,000 ug/kg and Total Xylenes - 10,000 ug/kg.
b - Lower Level of Detection for these samples were: Toluene, Ethylbenzene, and Total Xylenes - 2,000 ug/kg.
c - Lower Level of Detection for these samples were: Toluene, Ethylbenzene, and Total Xylenes - 1,000 ug/kg.
* - See Table 3-1 for Field QA/QC Analytical Results.

TABLE 3-5 (Continued)

SUMMARY OF INORGANIC AND ORGANIC COMPOUNDS DETECTED IN SOIL BORING
SAMPLES AT SITE 1- CURRENT FIRE TRAINING AREA, IDAHO AIR NATIONAL GUARD, GOWEN FIELD, BOISE, IDAHO

Parameter	Unit	Lower Level of Detection	Test Results										Average Background Levels
			Sample SB1-2 @ Depth (BLS), ft										
			5 (b)	5 (dup) (c)	10	10 (dup)	15	20	25	30	35	50	
INORGANICS													
Arsenic	mg/kg	0.5	4.9	3.5	1.6	2.1	3.4	4.6	4.7	3.7	4.7	ND	4.4
Beryllium	mg/kg	0.1	0.4	0.2	0.3	0.4	0.4	0.3	0.4	0.2	0.3	ND	0.6
Chromium	mg/kg	1	20	8	14	20	12	8	17	4	9	4	17
Copper	mg/kg	1	16	9	11	13	10	6	6	4	5	29	17
Lead	mg/kg	10	28	13	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mercury	mg/kg	0.1	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Nickel	mg/kg	2	9	8	10	13	7	3	8	2	4	ND	14
Selenium	mg/kg	0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Zinc	mg/kg	1	46(B)	94(B)	83(B)	85(B)	40(B)	36(B)	49(B)	25(B)	32(B)	26(B)	52
PETROLEUM HYDROCARBONS	mg/kg	20	3,800	8,000	ND	ND	ND	ND	ND	ND	ND	ND	ND
VOLATILE ORGANICS													
Acetone	ug/kg	10	ND	4,000(B)	100	ND	120	62	120	55	170	67	293(B)
Acrolein	ug/kg	10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	ug/kg	5	15,000	11,000	ND	ND	ND	ND	ND	ND	ND	ND	7
Methylene Chloride	ug/kg	5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	6
Tetrachloroethylene	ug/kg	5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	44
Toluene	ug/kg	5	34,000	15,000	ND	ND	ND	ND	ND	ND	ND	ND	15
Total Xylenes	ug/kg	5	240,000	130,000	ND	ND	ND	ND	ND	ND	ND	ND	45
Associated Field Blanks*			2-1-3	2-1-6	2-1-6	2-1-6	2-1-6	2-1-6	2-1-6	2-1-6	2-1-6	2-1-6	

(Continued)

LEGEND

SB - Soil Boring.
BLS - Below Land Surface.
ND - Not Detected.
B - Indicates analyte of interest was found in the method blank associated with the sample as well as in the sample itself.
a - Lower Level of Detection for these samples were: Toluene- 1,000 ug/kg and Total Xylenes - 10,000 ug/kg.
b - Lower Level of Detection for these samples were: Toluene, Ethylbenzene, and Total Xylenes - 2,000 ug/kg.
c - Lower Level of Detection for these samples were: Toluene, Ethylbenzene, and Total Xylenes - 1,000 ug/kg.

TABLE 3-5 (Continued)

SUMMARY OF INORGANIC AND ORGANIC COMPOUNDS DETECTED IN SOIL BORING
SAMPLES AT SITE 1- CURRENT FIRE TRAINING AREA, IDAHO AIR NATIONAL GUARD, GOWEN FIELD, BOISE, IDAHO

Parameter	Unit	Lower Level of Detection	Test Results Sample SB1-3 @ Depth (BLS), ft				Sample SB1-4 @ Depth (BLS), ft				Sample SB1-5 @ Depth (BLS), ft					Average Background Levels
			5	10	30	45	5 (c)	10	25	45	5	10	20	20 (dup)	45	
INORGANICS																
Arsenic	mg/kg	0.5	4.4	3	4.7	ND	3.8	3.5	3.4	0.6	4.1	5.4	3.5	4	0.6	4.4
Beryllium	mg/kg	0.1	0.3	0.2	0.3	ND	0.3	0.5	0.3	ND	0.3	0.6	0.3	0.3	ND	0.6
Chromium	mg/kg	1	15	5	7	3	14	15	15	7	11	16	9	8	3	17
Copper	mg/kg	1	10	5	5	5	11	12	7	10	10	12	6	6	8	17
Lead	mg/kg	10	28	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mercury	mg/kg	0.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Nickel	mg/kg	2	9	3	2	ND	10	12	11	ND	7	10	6	4	ND	14
Selenium	mg/kg	0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Zinc	mg/kg	1	62(B)	28(B)	30(B)	15(B)	35(B)	47(B)	39(B)	23(B)	32(B)	46(B)	37(B)	35(B)	17(B)	52
PETROLEUM HYDROCARBONS	mg/kg	20	4,800	ND	ND	ND	5,500	86	ND	ND	57	ND	ND	ND	ND	ND
VOLATILE ORGANICS																
Acetone	ug/kg	10	ND	140	56	11	ND	140	ND	89	ND	99	160	69	79	293(B)
Acrolein	ug/kg	10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	ug/kg	5	34	ND	ND	ND	10,000	ND	ND	ND	ND	ND	ND	ND	ND	7
Methylene Chloride	ug/kg	5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	6
Tetrachloroethylene	ug/kg	5	99	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	44
Toluene	ug/kg	5	21	ND	ND	ND	16,000	ND	ND	ND	ND	ND	ND	ND	ND	15
Total Xylenes	ug/kg	5	210	ND	ND	ND	96,000	ND	ND	ND	ND	ND	ND	ND	ND	45
Associated Field Blanks*			2-1-6	2-1-6	2-1-6	2-1-6	2-1-8	2-1-8	2-1-8	2-1-8	2-1-8	2-1-8	2-1-8	2-1-8	2-1-8	

LEGEND

SB - Soil Boring.
BLS - Below Land Surface.
ND - Not Detected.
B - Indicates analyte of interest was found in the method blank assiciated with the sample as well as in the sample itself.
a - Lower Level of Detection for these samples were: Toluene- 1,000 ug/kg and Total Xylenes - 10,000 ug/kg.
b - Lower Level of Detection for these samples were: Toluene, Ethylbenzene, and Total Xylenes - 2,000 ug/kg.
c - Lower Level of Detection for these samples were: Toluene, Ethylbenzene, and Total Xylenes - 1,000 ug/kg.
* - See Table 3-1 for Field QA/QC Analytical Results.

The shallow soil borings showed the vertical extent of contamination to be no deeper than 45 feet and concentrated principally within 5 to 10 feet of the surface. The borings also correlated well with the soil gas survey, confirming contaminant source locations. Full off-site laboratory analyses of several of the samples showed that the contamination is the result of fuels leakage, consisting primarily of organic fuel constituents. Also, $CHBrCl_2$, which was found in the soil gas survey, was not found at any depth below land surface in the soil borings.

3.2.3.3 Monitoring Well Soil Boring Results

On-site GC analyses were conducted to screen the monitoring well borehole samples for VOCs. On-site GC results are provided in Volume II, Appendix G (On-Site GC Results). All samples were analyzed for halocarbon and hydrocarbon compounds.

Of the compounds analyzed (using the on-site GC) in the monitoring well soil borings for well MW1-1, TCA and PCE were the compounds most frequently detected. TCA was detected in all nine samples collected from the borehole at very low levels, ranging from 0.01 to 0.5 ug/kg. PCE was detected at very low levels, ranging from 0.02 to 0.1 ug/kg. In addition, TCE was detected in the upper 50 feet of the soil column at 1 ug/kg.

Ten samples were collected and analyzed (using the on-site GC) from monitoring well borehole MW1-2. Of these samples, extremely low concentrations of TCA (0.01-0.3 ug/kg), TCE (0.2 ug/kg), and PCE (0.007-0.02 ug/kg) were detected. VOCs detected in the shallow soil samples are believed to be related to ambient air concentrations, as discussed in Section 3.2.2.

Three samples each were then collected from each of the two wells at Site 1 - Current Fire Training Area at varying depths BLS. All of the samples were analyzed in the off-site laboratory for volatile organics and inorganics. A list of the compounds detected is presented in Table 3-6. Of the inorganics tested for, arsenic, beryllium, chromium, copper, nickel, and zinc were detected in the samples. Arsenic concentrations ranged from 3.6 to 15 mg/kg,

TABLE 3-6

SUMMARY OF INORGANIC AND ORGANIC COMPOUNDS DETECTED IN MONITORING WELL SOIL BORING SAMPLES AT SITE 1- CURRENT FIRE TRAINING AREA, IDAHO AIR NATIONAL GUARD, GOWEN FIELD, BOISE, IDAHO

Parameter	Unit	Lower Level of Detection	Test Results							Average Background Levels
			MW1-1 @ Depth (BLS), ft				MW1-2 @ Depth (BLS), ft			
			58.5	138.5	138.5 (dup)	189	9	69	109	
INORGANICS										
Arsenic	mg/kg	0.5	3.9	11	9.7	8.2	4.9	15	3.6	4.4
Beryllium	mg/kg	0.1	0.4	0.2	0.2	0.3	0.7	0.7	0.6	0.6
Chromium	mg/kg	1	22	6	6	10	16	13	13	17
Copper	mg/kg	1	45	7	6	19	20	8	9	17
Lead	mg/kg	10	ND	ND	ND	ND	ND	ND	ND	ND
Mercury	mg/kg	0.1	ND	ND	ND	ND	ND	ND	ND	ND
Nickel	mg/kg	2	5	ND	ND	2	14	8	6	14
Selenium	mg/kg	0.5	ND	ND	ND	ND	ND	ND	ND	ND
Zinc	mg/kg	1	70(B)	28(B)	26(B)	43(B)	51	56	53	52
PETROLEUM HYDROCARBONS	mg/kg	20	**	ND	ND	ND	ND	ND	ND	ND
VOLATILE ORGANICS										
Acetone	ug/kg	10	31	48	40	44	100(B)	87(B)	190(B)	293(B)
Acrolein	ug/kg	10	ND	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	ug/kg	5	ND	ND	ND	ND	ND	ND	ND	7
Methylene Chloride	ug/kg	5	ND	ND	ND	ND	ND	ND	ND	6
Tetrachloroethylene	ug/kg	5	ND	ND	ND	ND	ND	ND	ND	44
Toluene	ug/kg	5	ND	ND	ND	ND	ND	ND	ND	15
Total Xylenes	ug/kg	5	ND	ND	ND	ND	ND	ND	ND	45
Associated Field Blanks*			1-1-1	1-1-2	1-1-2	1-1-2	1-1-8	1-1-8	1-1-8	

LEGEND

MW - Monitoring Well
ND - Not Detected
B - Indicates Analyte of interest was detected in the method blank associated with this sample as well as in the sample itself.
BLS - Below Land Surface
* - See Table 3-1 for Field QA/QC Analytical Results
** - This value is believed to be the result of a laboratory or sampling error.

while chromium levels were between 6 and 22 mg/kg. Other metals that were detected include beryllium (0.2-0.7 mg/kg), copper (up to 45 mg/kg), nickel (2-14 mg/kg) and zinc (up to 70 mg/kg). All of these levels are within one order of magnitude of background values, indicating that these levels are not a result of site activities.

Petroleum hydrocarbons were detected at 120 mg/kg in one soil sample collected from monitoring well MW1-1 at the 58.5-foot depth. Samples taken from two other depths from the same borehole (138.5 and 189 feet BLS) did not show the presence of petroleum hydrocarbons. Also, the on-site GC analyses of the split of this sample did not show any petroleum hydrocarbons, indicating that the concentration detected in the 58.5-foot sample is probably the result of laboratory or sampling error. The only volatile organic found in any of the samples was acetone, which was detected in each of the samples. As indicated in Section 3.1, acetone is thought to be a field and/or laboratory contaminant.

The monitoring well soil boring results show that virtually no site-related contamination exists at the monitoring well locations, even though one monitoring well location (MW1-1) was within 40 feet of the maximum contaminant concentrations found during the soil gas survey.

3.2.3.4 Stream Sediment Sampling Results

Three sediment samples were collected from Site 3 - Central Drainage Ditch, one upstream, one adjacent to, and one downstream of the site. All samples were analyzed for inorganics, petroleum hydrocarbons, and volatile organics. Results from on-site GC analyses showed PCE at a very low level of 0.07 ug/kg in all three samples and 0.01 ug/kg TCE in the downstream sample (SD1-1-3). The compounds detected in the samples, by off-site laboratory analyses, were similar to those compounds detected from the soil boring samples at Site 1 -Current Fire Training Area. These compounds are listed in Table 3-7. Inorganics detected include arsenic, beryllium, cadmium, chromium, copper, lead, nickel, and zinc. The concentrations of most of the inorganic

TABLE 3-7

SUMMARY OF ORGANIC AND INORGANIC COMPOUNDS DETECTED IN STREAM SEDIMENT SAMPLES AT SITE 1- CURRENT FIRE TRAINING AREA, IDAHO AIR NATIONAL GUARD, GOWEN FIELD, BOISE, IDAHO

Parameter	Unit	Lower Level of Detection	Test Results			
			SD1-1	SD1-2	SD1-3	SD-13 (dup)
INORGANICS						
Arsenic	mg/kg	0.5	3.8	3.9	3.6	4.3
Beryllium	mg/kg	0.1	0.5	0.5	0.5	0.5
Cadmium	mg/kg	0.5	0.5	1	0.8	1.1
Chromium	mg/kg	1	40	42	41	39
Copper	mg/kg	1	11	14	15	18
Lead	mg/kg	10	12	28	31	26
Mercury	mg/kg	0.1	ND	ND	ND	ND
Nickel	mg/kg	2	8	11	15	10
Selenium	mg/kg	0.5	ND	ND	ND	ND
Zinc	mg/kg	1	58	97	100	95
PETROLEUM HYDROCARBONS	mg/kg	20	37	52	74	78
VOLATILE ORGANICS						
Acetone	ug/kg	10	ND	440(B)	12(B)	ND
Acrolein	ug/kg	10	ND	ND	ND	ND
Ethylbenzene	ug/kg	5	ND	ND	ND	ND
Methylene Chloride	ug/kg	5	ND	ND	ND	ND
Tetrachloroethylene	ug/kg	5	6	ND	11	12
Toluene	ug/kg	5	ND	ND	ND	ND
Total Xylenes	ug/kg	5	11	6	ND	ND
Associated Field Blanks*			2-1-10	2-1-10	2-1-10	2-1-10

LEGEND

ND - Not Detected.
SD - Stream Sediment Sample.
B - *Indicates analyte was detected in the method blank associated with the sample as well as in the sample itself.*
* - See Table 3-1 for Field QA/QC Analytical Results.

stream sediment contaminant levels change little from upgradient to downgradient of the site and that precipitation runoff from the site is not introducing significant contamination to the drainage ditch. Petroleum hydrocarbons were detected at concentrations from 37 to 78 mg/kg in all of the stream sediment samples, including upstream and downstream samples. Very low levels of tetrachloroethylene (6-12 ug/kg) and xylenes (6-11 ug/kg) were detected in upstream and downstream sediment samples. Acetone was detected in two of the samples, but is not considered to be site-related because it is thought to be a field and/or laboratory contaminant.

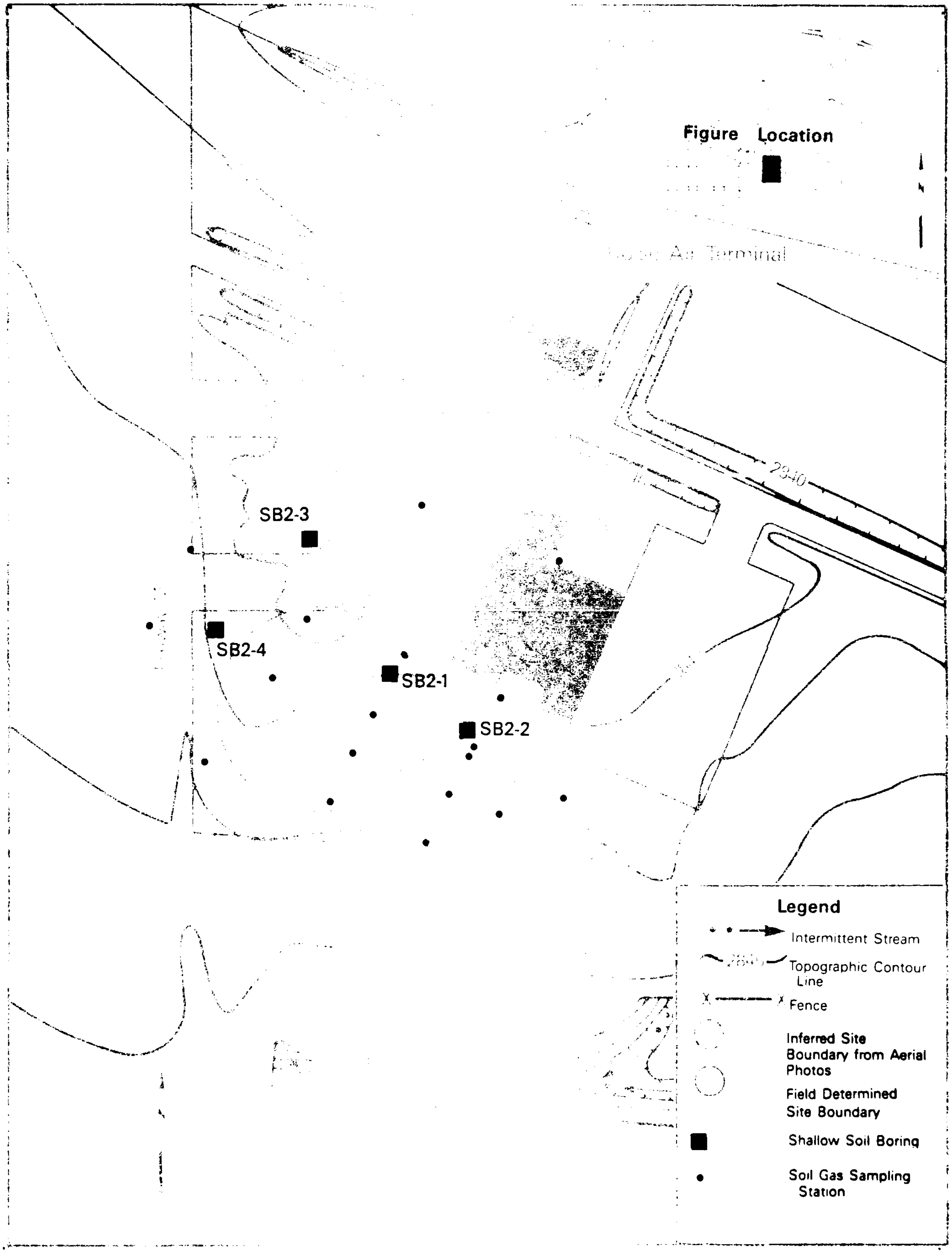
3.2.4 Site 2 - Former Fire Training Area Soil Investigation Results

A soil gas survey was conducted at Site 2 - Former Fire Training Area. Then, to characterize further the potential soil contamination at the site, shallow soil boring samples were collected and analyzed. Figure 3-5 shows the sampling locations for the soil gas survey and the soil borings at Site 2.

3.2.4.1 Soil Gas Survey

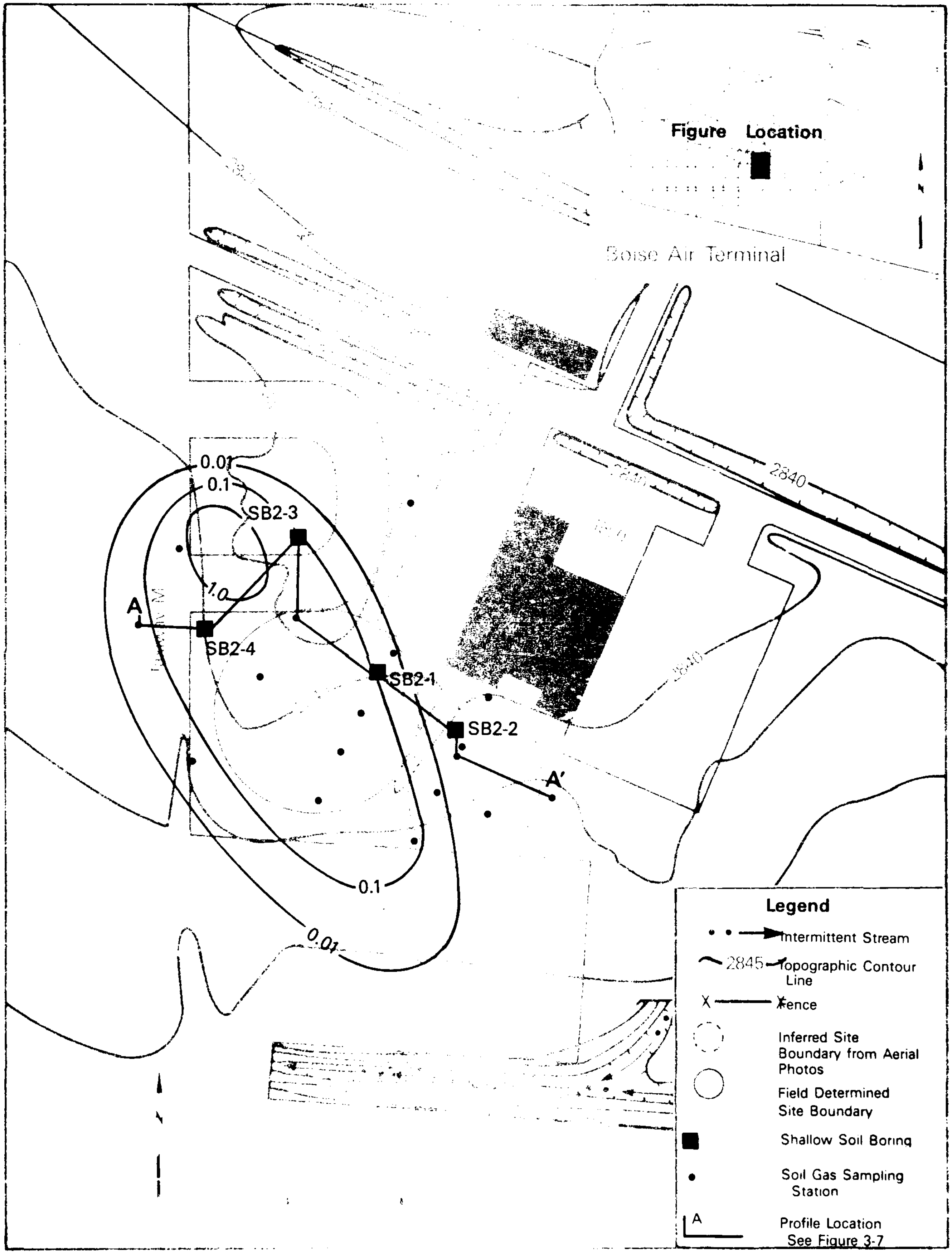
Soil gas was collected and analyzed at 18 locations at Site 2 - Former Fire Training Area. All of the samples were analyzed for halocarbon and hydrocarbon contamination. Details of the survey results are contained in Volume II, Appendix F (Soil Gas Results). TCE/$CHBrCl_2$ was the most widespread halocarbon contaminant found at Site 2. The most elevated concentration (2 ug/l) of TCE/$CHBrCl_2$ was detected at a sampling location northwest of Building 1500, and the compound was found to extend approximately 250 feet southeast of that location.

Figure 3-6 presents the soil isoconcentration map for TCE/$CHBrCl_2$ at Site 2 - Former Fire Training Area. As shown in the figure, the levels of TCE/$CHBrCl_2$ are on the order of 0.01 to 2 ppb, which are barely above detection limits. In general, the results of contaminant analyses, including total hydrocarbons, trichloroethylene, tetrachloroethylene, toluene, and xylene, showed either no contaminants detected or very low concentrations (ppb to ppt) of contaminants at Site 2. At one location south of Building 1500, total hydrocarbons and xylenes were detected. At a soil gas sampling location



Source: HMTC (1986), Base Topographic Map and Field Study Results

Figure 3-5. Sampling Locations at Site 2 — Former Fire Training Area, Idaho Air National Guard, Gowen Field, Boise, Idaho.



Source: HMTC (1986), Base Topographic Map and Field Study Results

Figure 3-6. Soil Isoconcentration Map for Trichloroethene/Bromodichloromethane at Site 2 — Former Fire Training Area, Idaho Air National Guard, Gowen Field, Boise, Idaho.

5 feet away, however, no contaminants were detected. Therefore, this appears to be a localized anomaly and not due to fire-fighting activities at the site.

In conclusion, results from the soil gas survey showed no contamination or very low concentrations (near detection limits) of contamination at Site 2 - Former Fire Training Area.

3.2.4.2 Shallow Soil Boring Results

Four soil samples each were collected from four boring locations at depths of 5, 10, 15, and 20 feet BLS. The four soil borings were labeled SB2-1, SB2-2, SB2-3, and SB2-4. On-site GC results, which are in Volume II, Appendix G (On-Site GC Results) indicated the presence of TCA (0.01-0.02 ug/kg), TCE (0.07 ug/kg), and PCE (0.02-0.07 ug/kg). Again, these concentrations are very low (ppb to ppt level) and near the detection limits. The compounds of fuel (i.e., xylene, benzene, and toluene) and total hydrocarbons were not detected in soils sampled from the shallow borings and analyzed with the on-site GC. An isoconcentration profile map, shown in Figure 3-7, was constructed for TCE at Site 2 - Former Fire Training Area from the soil gas and on-site GC data. As shown in this figure, the highest concentration was found in one area at less than 1 ppb (ug/l for soil gas, ug/kg for on-site GC). As stated above, all other concentrations of TCE, where detected in soil gas or soil samples, were in the ppb to ppt range.

The compounds detected (during the off-site laboratory analyses) of the samples are summarized in Table 3-8. Arsenic (2.3-18 mg/kg), beryllium (0.3-0.8 mg/kg), chromium (6-18 mg/kg), copper (4-34 mg/kg), nickel (3-13 mg/kg), and zinc (17-56 mg/kg) were among the inorganic compounds detected in the soil samples. Arsenic concentrations, although slightly higher than background levels, were within the same order of magnitude as the background concentrations. Arsenic concentrations decreased with depth BLS, with the highest concentrations of arsenic at 5 feet BLS. All other metals detected in the soil borings from Site 2, including beryllium, chromium, copper, nickel, and zinc, were found at levels similar to background concentrations.

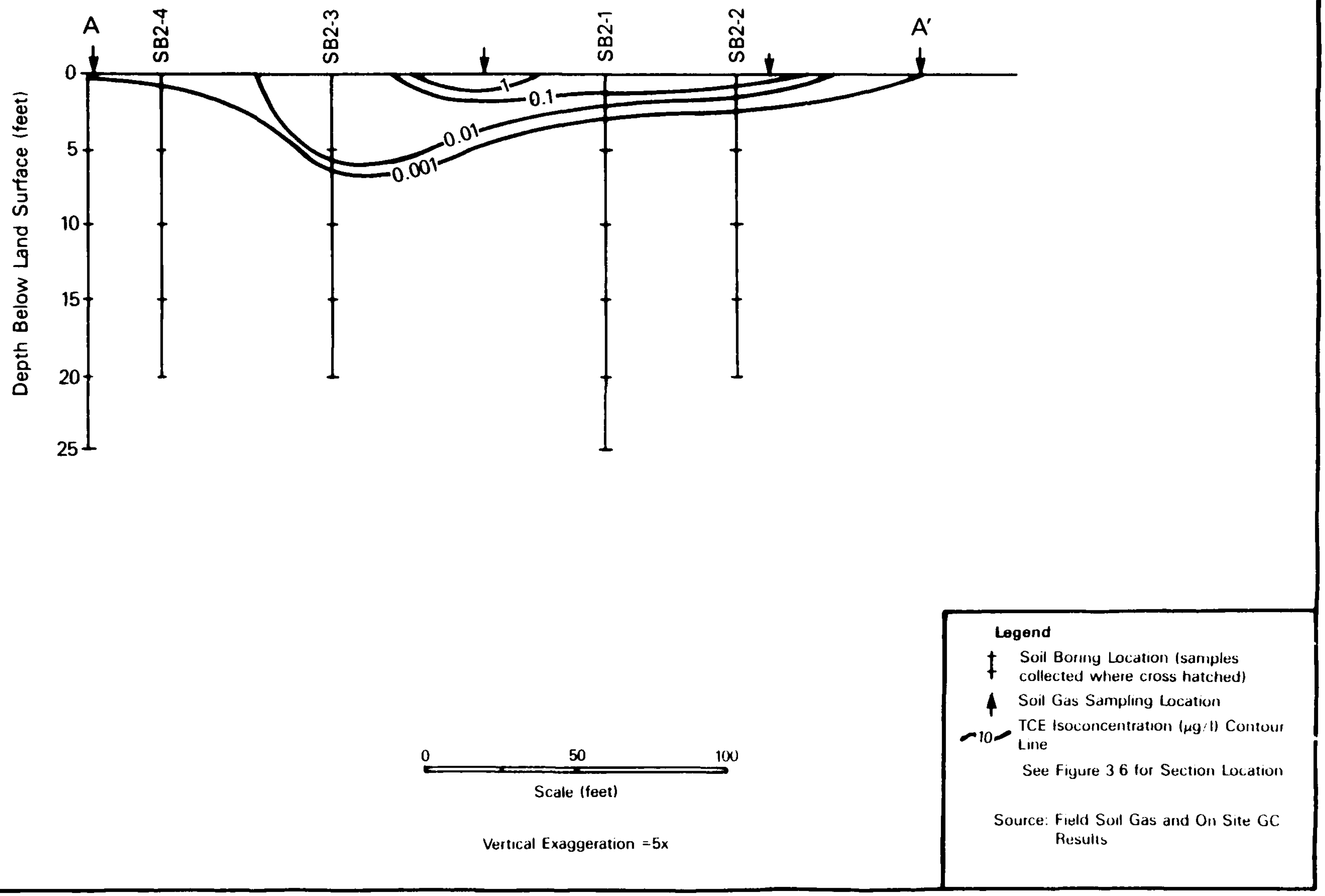


Figure 3-7. Isoconcentration Profile Map of Trichloethylene (TCE) from Soil Gas and On-Site GC Data at Site 2 - Former Fire Training Area, Idaho Air National Guard, Gowen Field, Boise, Idaho.

TABLE 3-8

SUMMARY OF INORGANIC AND ORGANIC COMPOUNDS DETECTED IN SOIL BORING
SAMPLES AT SITE 2- FORMER FIRE TRAINING AREA, IDAHO AIR NATIONAL GUARD, GOWEN FIELD, BOISE, IDAHO

Parameter	Unit	Lower Level of Detection	Test Results									Average Background Levels
			Sample SB2-1 @ Depth (BLS), ft				Sample SB2-2 @ Depth (BLS), ft					
			5	10	15	25	5	10	10 (dup)	15	20	
INORGANICS												
Arsenic	mg/kg	0.5	18	5.8	5.4	5.7	12	6.7	6.8	7.3	5.7	4.4
Beryllium	mg/kg	0.1	0.8	0.5	0.4	0.3	0.7	0.7	0.7	0.7	0.4	0.6
Chromium	mg/kg	1	18	13	6	10	14	10	10	11	7	17
Copper	mg/kg	1	14	9	6	6	18	8	8	10	5	17
Lead	mg/kg	10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mercury	mg/kg	0.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Nickel	mg/kg	0.5	13	9	3	3	11	6	7	8	3	14
Selenium	mg/kg	0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Zinc	mg/kg	1	48(B)	38(B)	27(B)	32(B)	54	41(B)	41(B)	43	26	52
PETROLEUM HYDROCARBONS	mg/kg	20	ND	23	ND	ND	ND	ND	ND	ND	ND	ND
VOLATILE ORGANICS												
Acetone	ug/kg	10	ND	69	79	ND	180(B)	290	120(B)	120(B)	41(B)	293(B)
Acrolein	ug/kg	10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	ug/kg	5	ND	ND	ND	ND	ND	ND	ND	ND	ND	7
Methylene Chloride	ug/kg	5	ND	ND	ND	ND	ND	ND	ND	ND	ND	6
Tetrachloroethylene	ug/kg	5	ND	ND	ND	ND	ND	ND	ND	ND	ND	44
Toluene	ug/kg	5	ND	ND	ND	ND	ND	ND	ND	ND	ND	15
Total Xylenes	ug/kg	5	ND	ND	ND	ND	ND	ND	ND	ND	ND	45
Associated Field Blanks*			2-1-8	2-1-8	2-1-8	2-1-8	2-1-10	2-1-10	2-1-10	2-1-10	2-1-10	

(Continued)

LEGEND

SB - Soil Boring.
BLS - Below Land Surface.
B - Indicates analyte of interest was found in the method blank associated with the sample as well as in the sample itself.
ND - Not Detected.
* - See Table 3-1 for Field QA/QC Analytical Results.

TABLE 3-8 (Continued)

SUMMARY OF INORGANIC AND ORGANIC COMPOUNDS DETECTED IN SOIL BORING
SAMPLES AT SITE 2- FORMER FIRE TRAINING AREA, IDAHO AIR NATIONAL GUARD, GOWEN FIELD, BOISE, IDAHO

Parameter	Unit	Lower Level of Detection	Test Results								Average Background Levels
			Sample SB2-3 @ Depth (BLS), ft				Sample SB2-4 @ Depth (BLS), ft				
			5	10	15	25	5	10	15	20	
INORGANICS											
Arsenic	mg/kg	0.5	15	12	9.4	6.5	9.4	2.3	3.9	2.6	4.4
Beryllium	mg/kg	0.1	0.8	0.8	0.7	0.4	0.5	0.4	0.6	0.3	0.6
Chromium	mg/kg	1	11	16	13	14	10	7	14	6	17
Copper	mg/kg	1	12	11	13	11	34	5	10	4	17
Lead	mg/kg	10	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mercury	mg/kg	0.1	ND	ND	ND	ND	ND	ND	ND	ND	ND
Nickel	mg/kg	0.5	10	7	10	8	9	5	8	3	14
Selenium	mg/kg	0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Zinc	mg/kg	1	30	47	56	45	43	33	51	17	52
PETROLEUM HYDROCARBONS	mg/kg	20	ND	ND	ND	ND	ND	ND	ND	ND	ND
VOLATILE ORGANICS											
Acetone	ug/kg	10	190(B)	16(B)	280(B)	ND	150	71	120	59(B)	293(B)
Acrolein	ug/kg	10	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	ug/kg	5	ND	ND	ND	ND	ND	ND	ND	ND	7
Methylene Chloride	ug/kg	5	ND	ND	ND	ND	ND	ND	ND	ND	6
Tetrachloroethylene	ug/kg	5	ND	ND	ND	ND	ND	ND	ND	ND	44
Toluene	ug/kg	5	ND	ND	ND	ND	ND	ND	ND	ND	15
Total Xylenes	ug/kg	5	ND	ND	ND	ND	ND	ND	ND	ND	45
Associated Field Blanks*			2-1-10	2-1-10	2-1-10	2-1-10	2-1-10	2-1-10	2-1-10	2-1-10	

LEGEND

SB - Soil Boring.
BLS - Below Land Surface.
B - Indicates analyte of interest was found in the method blank associated with the sample as well as in the sample itself.
ND - Not Detected.
* - See Table 3-1 for Field QA/QC Analytical Results.

These data are provided in Table 3-8. The presence of arsenic in the soilsis not considered to be attributable to site-related activities, since no other rganic and inorganic compounds were detected at concentration above background.

Petroleum hydrocarbons were detected in one (SB2-1) of the four soil borings from Site 2 - Former Fire Training Area, at a concentration of 23 mg/kg, at a depth of 10 feet BLS. Acetone was the only VOC detected in any of the soil borings from Site 2; however, as indicated in Section 3.1, it is thought to be a field or laboratory contaminant. Organic analyses are provided in Table 3-8.

In conclusion, analytical results from both on-site GC and off-site laboratory analyses of the samples collected from the four soil borings at Site 2 - Former Fire Training Area show virtually no site-related contamination.

3.2.5 Site 5 - Former Wood Preserving Operation Soil Investigation Results

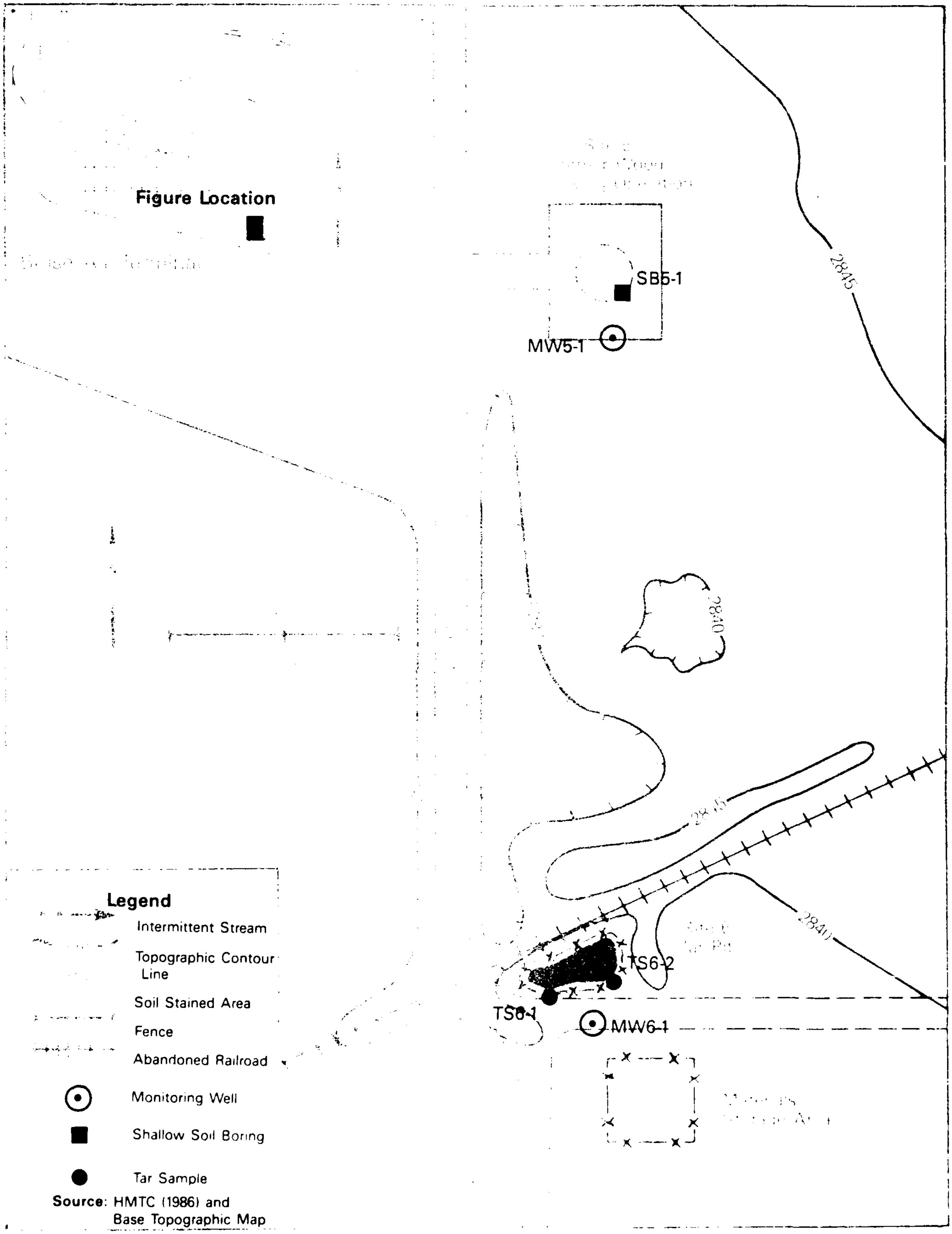
Shallow soil boring samples and monitoring well soil boring samples were collected and analyzed to characterize the contaminants at Site 5 - Former Wood Preserving Operation. Figure 3-8 presents the sampling locations at the site.

3.2.5.1 Soil Gas Survey

A soil gas survey was not planned for Site 5 - Former Wood Preserving Operation because chemicals typical to wood preserving operations (i.e., base/neutral and acid extractable organics) would not be detected using this analytical method, which detects volatile organics.

3.2.5.2 Shallow Soil Boring Results

Soil samples collected at 5-foot intervals at Site 5 - Former Wood Preserving Operation were screened with the on-site GC during drilling. Nine samples were collected during drilling to a total depth of 45 feet BLS. Results of the on-site GC analyses are provided in Volume II, Appendix G



Source: HMTC (1986) and Base Topographic Map

Figure 3-8. Sampling Locations at Site 5 – Former Wood Preserving Operation and Site 6 – Tar Pit, Idaho Air National Guard, Gowen Field, Boise, Idaho.

(On-Site GC Results). Low levels of TCA (0.01-0.02 ug/kg) and PCE (0.007-0.01 ug/kg) were detected in the majority of the soil samples. In addition, four of the nine soil samples were collected from one boring location (SB5-1) at depths of 5, 25, 35, and 55 feet BLS and were sent to the off-site laboratory for chemical analyses. The samples were analyzed for inorganics, petroleum hydrocarbons, volatile organics, and semi-volatile organic compounds. The results of the analyses are presented in Table 3-9. Arsenic, beryllium, chromium, copper, and nickel were among the inorganic compounds detected, all at concentrations near or below background soil concentrations. Zinc was detected in one soil sample at a depth of 35 feet BLS, at a concentration (230 mg/kg) higher than the background concentration. This is not considered to be a problem, because zinc was found in all laboratory method blanks and in the associated field blank and is considered to be a laboratory contaminant.

Petroleum hydrocarbons were detected in one soil boring at 5 feet BLS at 2,100 mg/kg. Soil borings collected at 25, 35, and 55 feet BLS showed no detection of petroleum hydrocarbons.

Volatile organic analyses were conducted on the four soil samples. Results are provided in Table 3-9. Tetrachloroethylene was detected in the near-surface (5 feet BLS) soil sample at a concentration (120 mg/kg) above background (44 mg/kg). Methylene chloride, toluene, and xylenes were detected only at 5 feet BLS and at concentrations below or equal to background concentrations. Acetone was detected at 5, 35, and 55 feet BLS at concentrations less than background concentrations. Acetone is considered to be a laboratory and/or field contaminant, and its presence is not due to site-related activities.

Semi-volatile analyses also were conducted on the soil samples and are presented in Table 3-9. Acenapthalene, 2-methylnapthalene, and pentachlorophenol (PCP) were detected at high levels (3,000; 20,000; and 150,000 mg/kg, respectively) at 5-feet BLS. PCP also was detected at

TABLE 3-9

SUMMARY OF INORGANIC AND ORGANIC COMPOUNDS DETECTED IN SOIL BORING SAMPLES AT SITE 5-FORMER WOOD PRESERVING OPERATION, IDAHO AIR NATIONAL GUARD, GOWEN FIELD, BOISE, IDAHO

Parameter	Unit	Lower Level of Detection	Test Results					Average Background Levels
			Sample SB5-1 @ Depth (BLS), ft					
			5 (a)	25	25 (dup)	35	55	
INORGANICS								
Arsenic	mg/kg	0.5	5.9	3	4	1.4	1.4	4.4
Beryllium	mg/kg	0.1	0.4	0.2	0.4	0.5	ND	0.6
Chromium	mg/kg	1	14	9	14	15	4	17
Copper	mg/kg	1	13	7	7	3	12	17
Lead	mg/kg	10	ND	ND	ND	ND	ND	ND
Mercury	mg/kg	0.1	ND	ND	ND	ND	ND	ND
Nickel	mg/kg	2	10	3	6	3	ND	14
Selenium	mg/kg	0.5	ND	ND	ND	ND	ND	ND
Zinc	mg/kg	1	53(B)	27(B)	48(B)	230(B)	23(B)	52
PETROLEUM HYDROCARBONS	mg/kg	20	2,100	ND	ND	ND	ND	ND
VOLATILE ORGANICS								
Acetone	ug/kg	10	270	ND	ND	90	100	293(B)
Acrolein	ug/kg	10	ND	ND	ND	ND	ND	ND
Ethylbenzene	ug/kg	5	ND	ND	ND	ND	ND	7
Methylene Chloride	ug/kg	5	6	ND	ND	ND	ND	6
Tetrachloroethylene	ug/kg	5	120	ND	ND	ND	ND	44
Toluene	ug/kg	5	15	ND	ND	ND	ND	15
Total Xylenes	ug/kg	5	38	ND	ND	ND	ND	45
SEMI-VOLATILE ORGANICS								
Acenapthalene	ug/kg	50	3,000	ND	ND	ND	ND	ND
Benzoic Acid	ug/kg	50	ND	ND	ND	ND	ND	235
Bis-(2 ethylhexyl) Pthalate	ug/kg	50	ND	67	120	92	51	75
Pentachlorophenol	ug/kg	50	150,000	560	490	140	ND	ND
2-Methylnapthalene	ug/kg	50	20,000	ND	ND	ND	ND	ND
Associated Field Blanks*			2-1-10	2-1-10	2-1-10	2-1-10	2-1-10	

LEGEND

SB - Soil Boring.
BLS - Below Land Surface.
B - Indicates analyte of interest was found in the method blank associated with the sample and in the sample itself.
(a) - Lower Level of Detection for these samples were 2,400 ug/kg for each of the analytes.
ND - Not Detected.
* - See Table 3-1 for Field QA/QC Analytical Results.

decreasing levels from 25 to 35 feet BLS. Bis-(2 ethylhexyl) phthalate was detected in the soil boring samples. This compound was determined to be a laboratory contaminant. The horizontal extent of this contamination should approximate the wood preservative-stained area on the surface, which is circular with a 40-foot diameter.

In conclusion, analytical results from the soil borings indicate that metal contamination at Site 5 - Former Wood Preserving Operation is not a problem. Organic contamination at Site 5 does exist, however, and consists of petroleum hydrocarbons, tetrachloroethylene, acenapthalene, 2-methylnapthalene, and PCP. These volatile organics and semi-volatile organic compounds are primarily confined to the shallow surface soil layer (5 feet BLS). However, PCP contamination extends to 35 to 55 feet BLS.

3.2.5.3 **Monitoring Well Soil Boring Results**

During drilling of the monitoring well (MW5-1), soil samples were collected and screened with the on-site GC. The results from the on-site GC analyses showed some low levels of TCA (0.01-0.03 ug/kg) and PCE (0.02-0.07 ug/kg) in the majority of the soil samples, as has been found in other soil samples. These results are provided in Volume II, Appendix G (On-Site GC Results).

Three soil samples were collected from the monitoring well (MW5-1) drilled at Site 5 - Former Wood Preserving Operation, at depths of 120, 175, and 193 feet BLS. These samples were tested by the off-site laboratory for inorganics, petroleum hydrocarbons, volatile organic compounds, and semi-volatile organic compounds. The compounds detected are listed in Table 3-10.

Beryllium, chromium, copper, nickel, and zinc were detected at levels below or near background soil levels. Arsenic, lead, and mercury were detected in soils at levels higher than background. Arsenic contamination is not considered to be related to site activities because its presence is widespread throughout the base and also in background soils.

TABLE 3-10

SUMMARY OF INORGANIC AND ORGANIC COMPOUNDS DETECTED IN MONITORING WELL SOIL BORING SAMPLES AT SITE 5- FORMER WOOD PRESERVING OPERATION, IDAHO AIR NATIONAL GUARD, GOWEN FIELD, BOISE, IDAHO

Parameter	Unit	Lower Level of Detection	Test Results				Average Background Levels
			Sample MW5-1 @ Depth (BLS), ft				
			120	120 (dup)	175	193	
INORGANICS							
Arsenic	mg/kg	0.5	3.6	2.9	7.1	6.4	4.4
Beryllium	mg/kg	0.1	0.5	0.5	0.5	0.2	0.6
Chromium	mg/kg	1	15	12	10	8	17
Copper	mg/kg	1	10	11	14	8	17
Lead	mg/kg	10	ND	ND	11	ND	ND
Mercury	mg/kg	0.1	0.5	ND	ND	ND	ND
Nickel	mg/kg	2	6	ND	5	ND	14
Selenium	mg/kg	0.5	ND	ND	ND	ND	ND
Zinc	mg/kg	1	55(B)	54(B)	57(B)	28(B)	52
PETROLEUM HYDROCARBONS	mg/kg	20	ND	2,500	ND	ND	ND
VOLATILE ORGANICS							
Acetone	ug/kg	10	ND	180(B)	ND	280(B)	293(B)
Acrolein	ug/kg	10	ND	ND	ND	ND	ND
Ethylbenzene	ug/kg	5	ND	ND	ND	ND	7
Methylene Chloride	ug/kg	5	ND	ND	5	ND	6
Tetrachloroethylene	ug/kg	5	ND	ND	ND	ND	44
Toluene	ug/kg	5	ND	ND	ND	ND	15
Total Xylenes	ug/kg	5	ND	ND	ND	ND	45
SEMI-VOLATILE ORGANICS							
Acenapthalene	ug/kg	50	ND	ND	ND	ND	ND
Benzoic Acid	ug/kg	50	ND	ND	ND	ND	235
Bis-(2 ethylhexyl) Pthalate	ug/kg	50	180	86	220	350	75
Pentachlorophenol	ug/kg	50	ND	ND	ND	ND	ND
2-methylnapthalene	ug/kg	50	ND	ND	ND	ND	ND
Associated Field Blanks*			1-1-6	1-1-6	1-1-6	1-1-6	

LEGEND

MW - Monitoring Well.
ND - Not Detected.
B - Indicates analyte of interest was detected in the method blank associated with this sample as well as in the sample itself.
BLS - Below Land Surface.
* - See Table 3-1 for Field QA/QC Analytical Results.

Petroleum hydrocarbons were detected in only one of the monitoring well boring samples at a concentration of 2,500 mg/kg at 120 feet BLS. The duplicate soil sample, however, did not show the presence of petroleum hydrocarbons, and therefore, lends doubt to the validity of the analysis.

Volatile organic and semi-volatile organic analyses showed the presence of acetone, methylene chloride, and bis-(2 ethylhexyl) phthalate. These compounds are not considered to site-related contaminants, but rather field and/or laboratory contaminants.

The results from the monitoring well soil borings support the shallow soil boring results in showing the vertical extent of contamination at Site 5 - Former Wood Preserving Operation to extend to approximately 35 to 55 feet BLS. Only scattered contaminants (e.g., lead, mercury, and petroleum hydrocarbons) were detected in the deeper monitoring well soil borings. Duplicate analyses of soils also did not verify the analytical results showing petroleum hydrocarbon contamination. In conclusion, site-related contamination at Site 5 - Former Wood Preserving Operation extends to approximately 35 to 55 feet BLS and does not appear to have migrated to depths beyond 55 feet.

3.2.6 Site 6 - Tar Pit Soils Investigation Results

Monitoring well soil boring samples were collected to define the soil contamination at Site 6 - Tar Pit. Tar samples were collected from the pit to determine if the material could be characterized as a hazardous waste. Figure 3-8 shows the sampling locations at Site 6.

3.2.6.1 Soil Gas Survey

A soil gas survey was not planned for Site 6 - Tar Pit because the contaminants that would be released from the asphalt would not be detected using this analytical method.

3.2.6.2 Shallow Soil Boring Results

Shallow soil borings were not completed at Site 6 - Tar Pit. However, the upper 50 feet of the monitoring well (MW6-1) borehole was sampled at 5-foot intervals and served as the soil boring for this site. Results are discussed in Section 3.2.6.3.

3.2.6.3 Monitoring Well Soil Boring Results

During drilling of the monitoring well at Site 6 - Tar Pit, soil samples were screened and analyzed with the on-site GC. TCA (0.01-0.7 ug/kg) and PCE (0.02-0.07 ug/kg) were detected at very low levels, as at all other sites. Three soil samples were collected at Site 6 at depths of 5, 165, and 170 feet BLS and sent to the off-site laboratory for analysis. All of the samples were tested for inorganics, petroleum hydrocarbons, volatile organic compounds, and semi-volatile organic compounds. The compounds detected are shown in Table 3-11. Arsenic, beryllium, chromium, copper, nickel, and zinc were among the inorganic compounds detected, all at concentrations either below or comparable to background concentrations. Petroleum hydrocarbons were detected at 5 feet BLS at a concentration of 26 mg/kg. However, no petroleum hydrocarbons were detected with the on-site GC analysis of this sample. Among the organics, levels of acetone and bis-(2 ethylhexyl) phthalate were found, but as discussed in Section 3.1, their presence is due to field and/or laboratory contamination. Therefore, no significant site-related contamination is indicated in the soils at this site.

3.2.6.4 Tar Sample Results

Two tar samples were collected from the pit containing the waste asphalt sludge and were tested for Extraction Procedure (EP) toxicity and ignitability in accordance with EPA procedures. The results of the tests were negative and indicate that the tar is nonhazardous. These results mean that special Resource Conservation and Recovery Act (RCRA) treatment, storage, or disposal procedures do not have to be followed for any remedial action that may be undertaken for this site. For ignitability, the test procedure shows that the sample would not flash (ignite) at a temperature of 200^{o}F. For EP toxicity for inorganics, arsenic, barium, cadmium, chromium, lead, mercury, selenium, and

3-11

SUMMARY OF INORGANIC AND ORGANIC COMPOUNDS D TORING WELL SOIL BORING SAMPLES AT SITE 6- TAR PIT, IDAHO AIR NATIONAL FIELD, BOISE, IDAHO

Parameter	Unit	Lower Level of Detection	Test Results Sample MW6-1 @ Depth (BLS), ft 5	 165	 170	Average Background Levels
INORGANICS						
Arsenic	mg/kg	0.5	5.5	2.4	0.6	4.4
Beryllium	mg/kg	0.1	0.8	0.2	0.1	0.6
Chromium	mg/kg	1	22	6	2	17
Copper	mg/kg	1	19	14	12	17
Lead	mg/kg	10	ND	ND	ND	ND
Mercury	mg/kg	0.1	ND	ND	ND	ND
Nickel	mg/kg	2	19	2	ND	14
Selenium	mg/kg	0.5	ND	ND	ND	ND
Zinc	mg/kg	1	58(B)	26(B)	18(B)	52
PETROLEUM HYDROCARBONS	mg/kg	20	26	ND	ND	ND
VOLATILE ORGANICS						
Acetone	ug/kg	10	ND	10	210	293(B)
Acrolein	ug/kg	10	ND	ND	ND	ND
Ethylbenzene	ug/kg	5	ND	ND	ND	7
Methylene Chloride	ug/kg	5	ND	ND	ND	6
Tetrachloroethylene	ug/kg	5	ND	ND	ND	44
Toluene	ug/kg	5	ND	ND	ND	15
Total Xylenes	ug/kg	5	ND	ND	ND	45
SEMI-VOLATILES						
Acenapthalene	ug/kg	50	ND	ND	ND	ND
Benzoic Acid	ug/kg	50	ND	ND	ND	235
Bis-(2 ethylhexyl) pthalate	ug/kg	50	290	340	240	75
Pentachlorophenol	ug/kg	50	ND	ND	ND	ND
2-methylnapthalene	ug/kg	50	ND	ND	ND	ND
Associated Field Blanks*			1-1-4	1-1-4	1-1-5	

LEGEND

MW - Monitoring Well.
ND - Not Detected.
B - Indicates analyte of interest was detected in the method blank associated with this sample as well as in the sample itself.
BLS - Below Land Surface.
* - See Table 3-1 for Field QA/QC Analytical Results.

silver were analyzed for using the EPA extraction procedure and none were detected. For EP toxicity for organics, endrin; methoxychlor; toxaphene; 2-4-D; 2,4,5-TP (silvex); and lindane were analyzed for using the EPA extraction procedure and only 2,4,5-TP was detected. The concentration of 2,4,5-TP was greater than the method detection limit, but less than the sample detection limit; therefore, an estimated value was given. These results are given in Volume II, Appendix H (Laboratory Analytical Data).

3.3 GROUNDWATER INVESTIGATION RESULTS

The following sections include discussions on the findings for the hydrology of the sites studied, background contaminant concentrations, and analytical chemistry results for each site.

3.3.1 Hydrology

This section focuses on the shallow aquifer system, since this is the system most likely affected by the waste handling, storage, and disposal practices at Gowen Field. Deeper aquifers would be protected from these activities by less permeable layers, which exist in the deeper geologic formations (HMTC 1985).

The hydrologic characterizations included in this section are based primarily on the following data developed during this study:

- Monitoring well logs, which are presented in Appendix C (Monitoring Well Completion Forms and Logs)
- Shallow soil boring logs, which are presented in Appendix D (Soil Boring Logs)
- Water level elevations, which are presented in Table 3-12
- Water table contour maps developed for the study area, which are presented in Figures 3-9 and 3-10.
- Aquifer test data and hydrologic calculations, which are presented in Appendix E (Aquifer Test Data and Hydrologic Calculations) and Table 3-13.

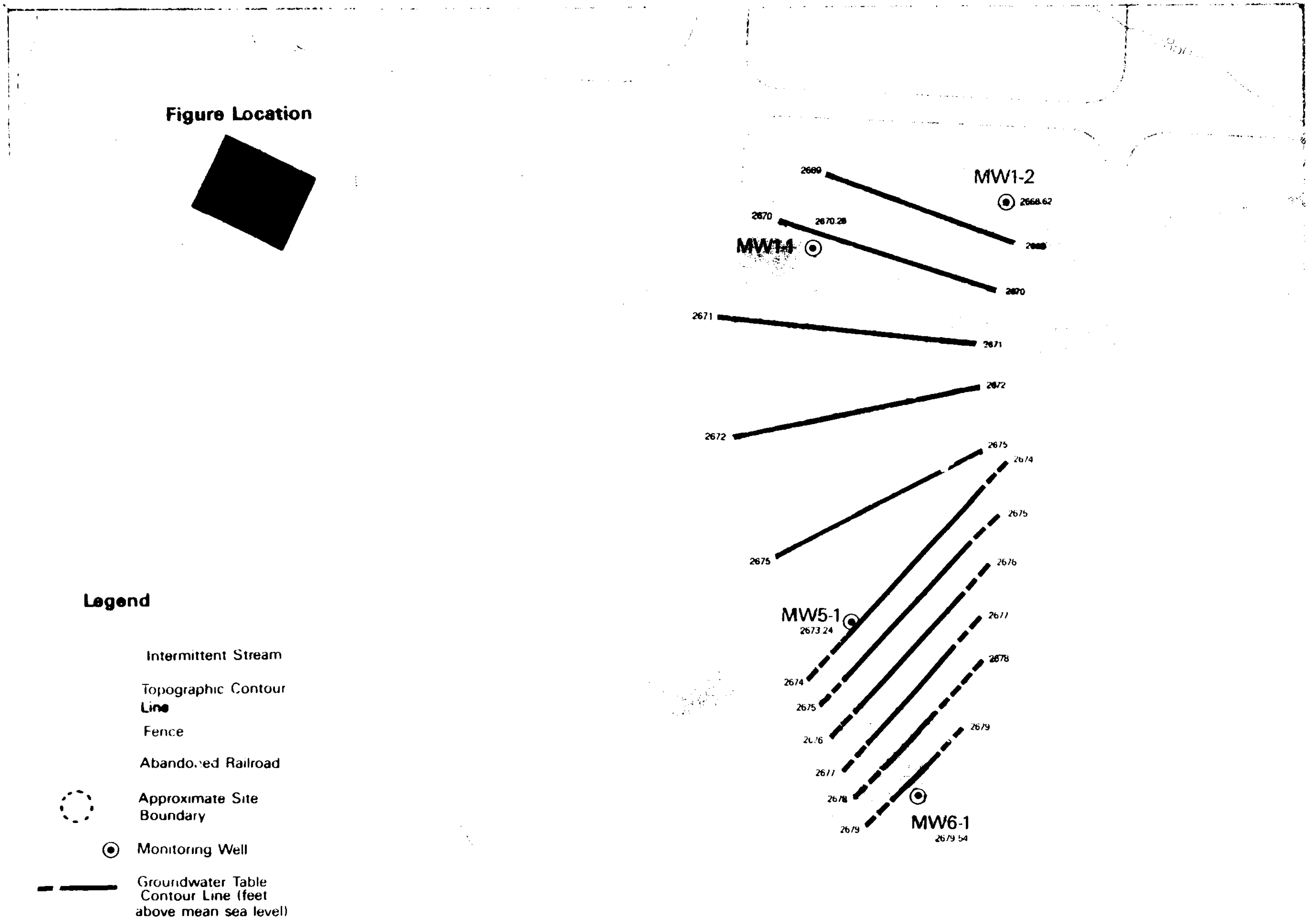
TABLE 3-12

STATIC GROUNDWATER ELEVATIONS FOR IDAHO AIR NATIONAL GUARD, GOWEN FIELD, BOISE, IDAHO

Site/Well Number	Static Water Level (6/02/87) Depth (ft BLS)	Static Water Level (6/02/87) Elevation (ft above MSL)	Static Water Level (8/15/87) Depth (ft BLS)	Static Water Level (8/15/87) Elevation (ft above MSL)	Static Water Level (8/15/87) and (2/7/89) Depth (ft BLS)	Static Water Level (8/15/87) and (2/7/89) Elevation (ft above MSL)
Site 1: Current Fire Training Area						
MW1-1	171.4	2,670.28	171.9	2,669.76	175.0	2,666.66
MW1-2	181.6	2,668.62	182.0	2,668.10	184.7	2,665.52
Site 5: Former Wood Preserving Operation						
MW5-1	170.5	2,673.24	171.0	2,672.69	not taken	________
Site 6: Tar Pit						
MW6-1	157.3	2,679.54	157.7	2,679.11	159.8	2,677.03

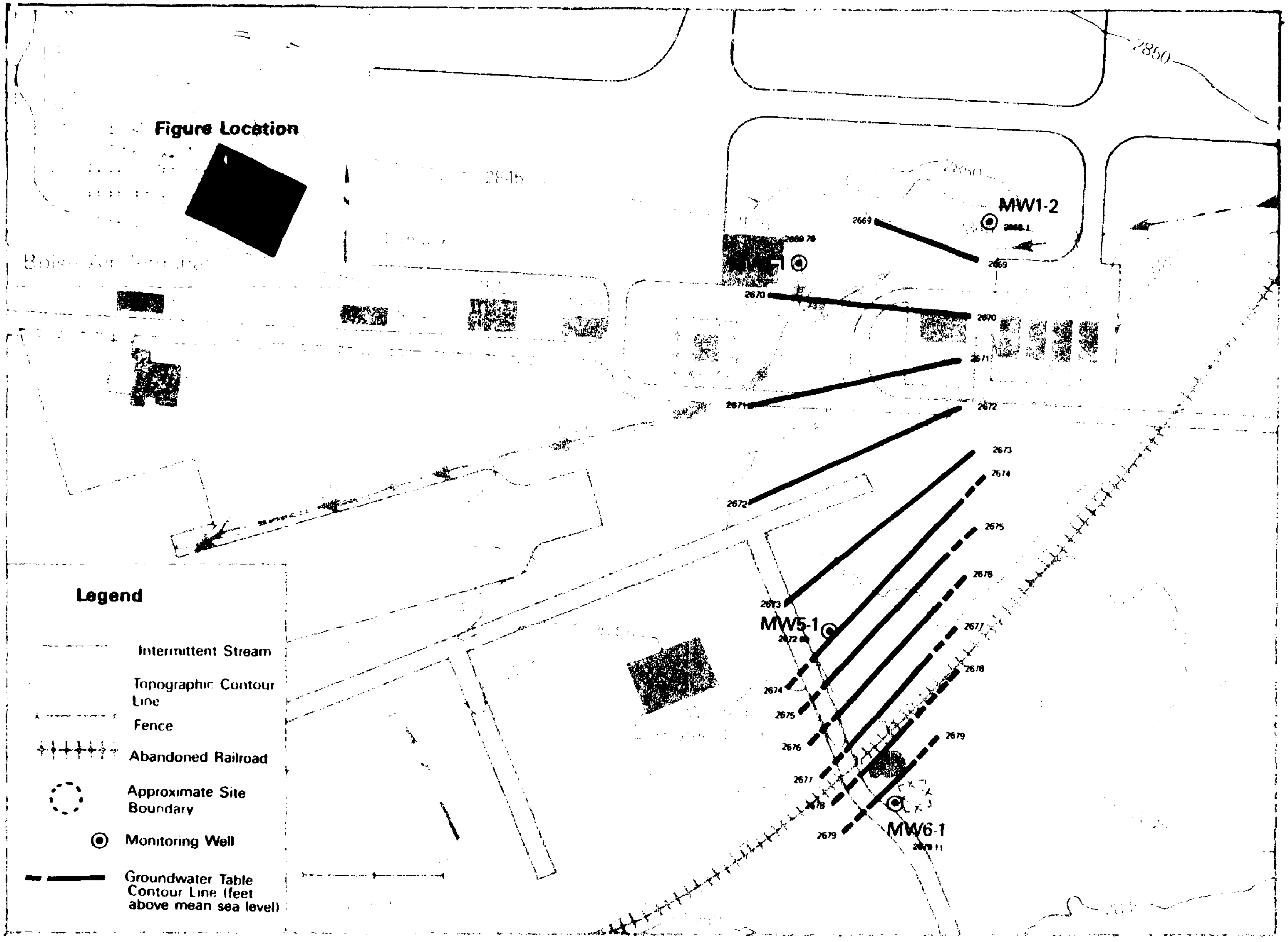
LEGEND

BLS - Below Land Surface.
MSL - Mean Sea Level Datum



Source: HMTC (1986), Base Topographic Map and Field Studies

Figure 3-9. Water Table Elevation Contour Map, June 2, 1987, Idaho Air National Guard, Gowen Field, Boise, Idaho.



Source: HMTC (1986), Base Topographic Map and Field Studies

Figure 3-10. Water Table Elevation Contour Map, August 15, 1987, Idaho Air National Guard, Gowen Field, Boise, Idaho.

TABLE 3-13

AQUIFER TEST RESULTS FOR IDAHO AIR NATIONAL GUARD, GOWEN FIELD, BOISE, IDAHO

Site/Well Number	Hydraulic Conductivity (K) ft/sec	cm/sec
Site 1: Current Fire Training Area		
MW1-1	3.93 x 10-5	1.20 x 10-3
MW1-2	3.13 x 10-5	9.54 x 10-4
Site 5: Former Wood Preserving Operation		
MW5-1	3.80 x 10-5	1.16 x 10-3
Site 6: Tar Pit		
MW6-1	3.88 x 10-5	1.18 x 10-3

The shallow aquifer in the study area is located within the Older Terrace Gravel formation. Based on the data collected at the study area, the groundwater in this formation occurs under water table conditions. The water table was found 60 to 80 feet deeper than estimates in earlier reports (HMTC 1985). Static groundwater levels measured on June 2, 1987 ranged from 2668.62 to 2679.54 feet above mean sea level (AMSL), from a depth of 157.3 to 181.6 feet BLS, as shown in Table 3-12. Static groundwater levels taken 2.5 months later on August 15, 1987 (Table 3-12) showed a consistent 0.5-foot decline in the water table. Static groundwater levels taken 20 months later on February 6-7, 1989 showed roughly a 2- to 3-foot decline in the water table. The decline in static water levels indicates that the shallow aquifer in this area is under natural recharge conditions, where recharge (and groundwater levels) are highest during the wet spring, lower at the end of the dry summer season, and lower still in winter.

The groundwater table maps shown in Figures 3-9 and 3-10 illustrate that groundwater flow is variable, but is generally in a northerly direction (flow direction is perpendicular to equipotential lines). Also, the consistent drop of levels in the wells between the two measurement dates indicates that the groundwater flow direction did not significantly change from spring to late summer of 1987 or to winter of 1989, as shown in Figures 3-9 and 3-10 and in Table 3-12. This northerly direction is significantly different from the southerly direction specified in earlier reports, indicating that the lining of the New York Canal northwest of Gowen Field in the late 1970's has reduced seepage of irrigation water into the aquifer. This seepage had been the cause of a groundwater mound, resulting in the previous southerly groundwater flow direction in the Gowen Field area, noted in earlier reports.

Based on the groundwater table maps provided in Figures 3-9 and 3-10, monitoring well MW1-2 is downgradient to cross-gradient of Site 1 - Current Fire Training Area, while the remaining monitoring wells (MW1-1, MW5-1, and MW6-1) are slightly upgradient to cross-gradient of their respective sites. This differs from the originally proposed well locations, where monitoring wells MW1-1, MW5-1, and MW6-1 were to be located downgradient and MW1-2 was to be located upgradient. Because the groundwater flow direction differed from the assumed southerly direction and flow directions change within this area, monitoring wells were not located in hydrologically ideal positions.

Because the monitoring well locations were not ideal, samples from these wells may not be representative of the water quality of the aquifer downgradient of the sites. However, because of the great depth of the water table, horizontal spreading (dispersion) of any contaminants should have occurred if they migrated to the water table. Also, based on earlier reports (Dion 1972), a southerly groundwater flow direction existed because of infiltration of irrigation water from the unlined New York Canal until it was lined in the late 1970's. If the sites, which all existed well before this time, were contaminating groundwater, the southerly flow would have carried contamination through the sediments where the present monitoring wells exist. Therefore, because all of the proposed downgradient wells are located immediately adjacent to the sources of contamination at the sites, any existing site-related groundwater contamination should be detected in these wells.

The hydraulic gradient (I) is the change in hydraulic head per unit horizontal distance measured along a groundwater flowline, or, in other words, the slope of the water table. Using the water table surface maps, shown in Figures 3-9 and 3-10, calculations yielded a value of hydraulic gradient of 0.008, or 42 feet per mile. This hydraulic gradient is steeper and more varied than expected for a deep, high hydraulic conductivity water table aquifer (values of I from Dion 1972 were from 16 to 19 feet per mile). Possible reasons for this hydrologic anomaly are:

- A high or low permeability zone within the study area. Possibilities are geologic structures such as an ancient stream channel deposit, clay lens, or a basalt intrusion, which are all known to exist in the study area.
- An artificial recharge point, such as a broken water main in the study area.

However, no evidence was found to support either of these hypotheses.

Hydraulic conductivity (K) is the capacity of a geologic material to transmit water, expressed as the volume of water that will move in a unit time under a unit hydraulic gradient through a unit area measured perpendicular to the flow direction. The hydraulic conductivity of the surficial aquifer at selected wells was determined through slug testing. The slug testing and analytical methods are described in Section 2 and Volume II, Appendix E (Aquifer Test Results and Hydrogeologic Calculations), respectively. Final results are presented in Table 3-13. These values of hydraulic conductivity are in agreement with the range of values for sand aquifers presented in Freeze and Cherry (1979).

Horizontal groundwater flow rate (V) is the macroscopic velocity of groundwater in the horizontal plane. Using the maximum value of hydraulic conductivity (K) and the calculated value of the hydraulic gradient (I), the maximum horizontal groundwater flow rate (V) at Gowen Field is 49.6 feet per year. Accounting for associated error in the field data, this value can range from 3.0 to 1,100 feet per year. This is a relatively high groundwater flow rate. It is the high value of hydraulic gradient that is driving this high figure and, as noted earlier, this gradient appears to be much higher and the flow directions more varied than would be expected for an aquifer of this type.

3.3.2 Background Groundwater Contaminant Concentrations

Because of the uncertainty of the hydrogeologic conditions at the sites, no groundwater monitoring well installed can be strictly regarded as truly upgradient. Therefore, contaminant concentrations found in any of the wells cannot be regarded as background levels, which would be used to judge what is or is not site-related contamination.

One exception of this is the presence of selenium, which is considered to be a background contaminant. If selenium levels were the result of site activities, selenium should have been found in the soils underlying the sites.

However, selenium was not found in any of the soil samples analyzed by the off-site laboratory. Therefore, selenium is considered to be naturally occurring in the groundwater in this area.

3.3.3 Site 1 - Current Fire Training Area Groundwater Results

Two monitoring wells were installed at Site 1 - Current Fire Training Area. MW1-1 was located adjacent to the site and well MW1-2 was located downgradient of the site. On-site GC results indicated only a very low (0.05 ug/l) TCA concentration in the groundwater sample from MW1-1. No volatile organics were found in the groundwater sample from MW1-2 using the on-site GC.

Samples from each of the wells were sent to the off-site laboratory for volatile organics, petroleum hydrocarbons, and metals analyses. The results of these tests are presented in Table 3-14. A variety of metals were detected in the samples, including chromium, copper, lead, nickel, selenium, and zinc. Because there is no true upgradient well, background water quality data are not available for comparison with the monitoring well data to determine if the levels present are site-related. Concentrations of these metals tended to be higher in sample GW1-1 than in GW1-2, but all results were within one order of magnitude of each other. Of these metals, concentrations of selenium are above the maximum contaminant level (MCL) of 10 ug/l and concentrations of nickel were above the EPA ambient water quality criteria (AWQC) adjusted for drinking water (15.4 ug/l). Trace amounts of petroleum hydrocarbons were found in the samples (0.7-0.9 mg/l), but comparable concentrations (0.4-0.6 mg/l) also were found in the field blanks. Therefore, these concentrations are considered to be a result of sampling and/or laboratory conditions. Of the organics, both samples were clean, with the exception of very low concentrations of acetone and toluene in sample GW1-1. As discussed in Section 3.1, acetone is a result of the sampling environment at Gowen Field. The actual existence of toluene in the groundwater in sample GW1-1 is questionable, because it was not found in either the duplicate sample of this well nor in the sample screened by on-site GC. Nevertheless, the concentration of toluene (20 ug/l) is well below the proposed maximum contaminant level goal (MCLG) for toluene (2,000 ug/l).

TABLE 3-14

SUMMARY OF INORGANIC AND ORGANIC COMPOUNDS DETECTED IN GROUNDWATER MONITORING WELLS AT SITE 1- CURRENT FIRE TRAINING AREA, Site 5- FORMER WOOD PRESERVING AREA, AND SITE 6- TAR PIT, IDAHO AIR NATIONAL GUARD, GOWEN FIELD, BOISE, IDAHO

Parameter	Unit	Lower Level of Detection	Test Results					Drinking Water MCL (e) (ug/l)	Drinking Water MCLG (f) (ug/l)	AWQC for Aquatic Organisms and Drinking Water (ug/l) (a)	AWQC Adjusted for Drinking Water Only (ug/l) (b)
			Site 1			Site 5	Site 6				
			GW1-1	GW1-1 (dup)	GW1-2	GW5-1	GW6-1				
INORGANICS											
Arsenic	ug/l	5	ND	ND	ND	ND	ND	50	50	0.0022	0.025
Beryllium	ug/l	1	ND	ND	ND	ND	ND			0.0037	0.0039
Chromium	ug/l	1	22	19	18	3	12		120		
Copper	ug/l	1	31(B)	40(B)	4(B)	2(B)	12(B)		1,300	1,000(d)	1,000(d)
Lead	ug/l	10	24	29	ND	ND	13	50		50	50
Mercury	ug/l	1	ND	ND	ND	ND	ND	2	3	0.144	10
Nickel	ug/l	2	63	79	21	3	24			13.4	15.4
Selenium	ug/l	5	50	47	18	9	ND	10	45	10	10
Zinc	ug/l	1	770(B)	980(B)	97(B)	40(B)	350(B)	5,000(c)		5,000(d)	5,000(d)
PETROLEUM HYDROCARBONS	mg/l	0.1	0.9	0.7	0.7	0.3	0.5				
VOLATILE ORGANICS											
Acetone	ug/l	10	ND	12	ND	10	260				
Acrolein	ug/l	5	ND	ND	ND	ND	ND			320	540
Ethylbenzene	ug/l	5	ND	ND	ND	ND	ND		680	1,400	2,400
Methylene Chloride	ug/l	5	ND	ND	ND	ND	ND				
Tetrachloroethylene	ug/l	5	ND	ND	ND	ND	ND		0	0.8	0.88
Toluene	ug/l	5	20	ND	ND	ND	74		2,000	14,300	15,000
Total Xylenes	ug/l	5	ND	ND	ND	ND	ND		440		
SEMI-VOLATILE ORGANICS											
Acenapthalene	ug/l	1	NT	NT	NT	ND	ND			20(d)	20(d)
Bis-(2 ethylhexyl) phthalate	ug/l	1	NT	NT	NT	2	14			15,000	21,000
Pentachlorophenol	ug/l	1	NT	NT	NT	ND	ND		220	1,010	1,010
2-methylnapthalene	ug/l	1	NT	NT	NT	ND	ND				
pH	units		7	7	7.4	6.8	7				
Specific Conductance	umhos/cm		790	790	520	780	580				
Temperature	C		17	17	16	16	19				

(Continued)

TABLE 3-14 (Continued)

SUMMARY OF INORGANIC AND ORGANIC COMPOUNDS DETECTED IN GROUNDWATER MONITORING WELLS AT SITE 1-CURRENT FIRE TRAINING AREA, SITE 5- FORMER WOOD PRESERVING AREA, AND SITE 6-TAR PIT, IDAHO AIR NATIONAL GUARD, GOWEN FIELD, BOISE, IDAHO

Parameter	Unit	Lower Level of Detection	Test Results	
			Field Blank	Bailer Wash
INORGANICS				
Arsenic	ug/l	5	ND	ND
Beryllium	ug/l	1	ND	ND
Chromium	ug/l	1	ND	ND
Copper	ug/l	1	7(B)	7(B)
Lead	ug/l	10	ND	ND
Mercury	ug/l	1	ND	ND
Nickel	ug/l	2	ND	ND
Selenium	ug/l	5	ND	ND
Zinc	ug/l	1	3(B)	3(B)
PETROLEUM HYDROCARBONS	mg/l	0.1	0.4	0.6
VOLATILE ORGANICS				
Acetone	ug/l	10	ND	ND
Acrolein	ug/l	10	ND	ND
Ethylbenzene	ug/l	5	ND	ND
Methylene Chloride	ug/l	5	ND	ND
Tetrachloroethylene	ug/l	5	ND	ND
Toluene	ug/l	5	ND	ND
Total Xylenes	ug/l	5	ND	ND
SEMI-VOLATILE ORGANICS				
Acenapthalene	ug/l	1	ND	ND
Bis-(2 ethylhexyl) phthalate	ug/l	1	3	ND
Pentachlorophenol	ug/l	1	ND	ND
2-methylnapthalene	ug/l	1	ND	ND

LEGEND

ND - Not Detected.
NT - Not Tested.
B - Indicates analyte of interest was detected in method blank associated with this sample as well as in the sample itself.
GW - Groundwater.
(a) USEPA Ambient Water Quality Criteria: guidelines developed for evaluating human exposure to combined levels.
(b) Ambient Water Quality Criteria for evaluating levels of toxicants in drinking water only.
(c) USEPA Secondary Drinking Water Regulation (not a health based standard).
(d) USEPA Ambient Water Quality Criterion not derived for protection against potential toxicity, but rather to control undesirable taste and odor quality.
(e) USEPA Primary Drinking Water Standard: Maximum Contaminant Levels.
(f) USEPA Maximum Contaminant Level Goals (all proposed values).
(e) USEPA Primary Drinking Water Standard: Maximum Contaminant Levels.
(f) USEPA Maximum Contaminant Level Goals (all proposed values).

Based on the analytical data for the groundwater samples collected at Site 1 - Current Fire Training Area, no significant organic contamination of the groundwater exists that can be related to site activities. The inorganic compound of concern at Site 1 is nickel, which exceeds the AWQC for drinking water. Selenium concentrations are considered not related to site activities, as discussed in Section 3.3.2. Of the remaining inorganic compounds detected at Site 1, none are above the applicable or relevant and appropriate requirements (ARARs) for those compounds.

3.3.4 Site 2 - Former Fire Training Area Groundwater Results

Because of the lack of contamination found at Site 2 - Former Fire Training Area during the soils investigation and the relatively small amounts of fuels used (26,000 gallons at Site 2 versus 400,000 gallons at Site 1 - Current Fire Training Area), the installation of monitoring wells and subsequent groundwater sampling were not warranted.

3.3.5 Site 5 - Former Wood Preservation Operation Groundwater Results

One monitoring well (MW5-1) was installed immediately adjacent to Site 5 - Former Wood Preserving Operation. *On-site GC results showed that no* volatile organics existed in the groundwater from this well. The groundwater sample (GW5-1) was sent to the off-site laboratory for organic, petroleum hydrocarbon, and metal analyses. The results of these tests are presented in Table 3-14. Again, as at the other sites, a variety of metals were detected, including chromium, copper, nickel, selenium, and zinc. Because there is no true upgradient well, background water quality data are not available for comparison with the monitoring well data to determine if the concentrations present are site-related. However, the concentrations of these metals tended to be significantly (5 to 30 times) less then those detected at Site 1 - Current Fire Training Area. None of the metals concentrations found at Site 5 were above the MCLs, MCLGs, or AWQCs. Trace amounts of petroleum hydrocarbons (0.3 mg/l) were found in the sample, but, as with the samples from the other sites, the concentrations are considered a result of sampling and/or laboratory conditions because similar concentrations (0.4 mg/l) were found in the field blank associated with groundwater sampling. The only organic compounds found in groundwater from Site 5 determined from the off-site laboratory analyses were acetone and bis-(2 ethylhexyl) phthalate, both of which are specified to be the result of field and/or laboratory conditions, as discussed in Section 3.1, and are not actually in the groundwater at the site. In addition, the phthalate was found in the field blank, further supporting this explanation.

Based on the results of the analyses of groundwater samples from Site 5 - Former Wood Preservation Operation, no significant groundwater contamination exists at the site.

3.3.6 <u>Site 6 - Tar Pit Groundwater Results</u>

One monitoring well (MW6-1) was installed immediately adjacent to Site 6 - Tar Pit. On-site GC results showed no volatile organics existed in the groundwater from this well. The groundwater sample (GW6-1) was sent to the off-site laboratory for organic, petroleum hydrocarbon, and metal analyses. The results of these analyses are presented in Table 3-14. A variety of metals were found, as with the other sites. These metals included chromium, copper, lead, nickel, and zinc. Because there is no true upgradient well, background water quality data are not available for comparison with the monitoring well data to determine if the concentrations present are site-related. Of the metals detected, only nickel (24 ug/l) exceeded the AWQC (15.4 ug/l). Trace amounts of petroleum hydrocarbons (0.5 mg/l) were found in the sample, but these concentrations are considered a result of sampling and/or laboratory conditions because a similar concentration was found in the field blank (0.4 mg/l). The other organic compounds found in the sample include acetone, toluene, and bis-(2 ethylhexyl) phthalate. Both the acetone and the phthalate are related to sampling and/or laboratory conditions, as discussed in Section 3.1. Also, phthalate was found in the field blank, giving further evidence of this origin. The actual presence of toluene, as with Site 1 - Current Fire Training Area, is questionable, since it was not found by on-site GC analysis. Nevertheless, the concentration of toluene (74 ug/l) is well below the proposed MCLG (2,000 ug/l).

4. BASELINE PUBLIC HEALTH EVALUATION

As indicated in Guidance on Remedial Investigations/Feasibility Studies Under CERCLA (USEPA 1985a,b), the evaluation of risk to public health is a critical component of site characterization. A baseline public health evaluation is conducted to assess site conditions in the absence of remedial actions. The objective of a baseline public health evaluation is to provide as complete a picture as possible of the magnitude of potential health problems associated with release of chemical contaminants from the waste sites under investigation.

The public health evaluation of Gowen Field examines the release of chemicals from the four sites under investigation, the observed concentrations of the compounds in soil/sediment and groundwater, the potential routes of human exposure, and the likelihood of adverse health effects following contact with contaminated water and soil/sediment. An overview of the assessment methods used is presented in Volume II, Appendix J (Baseline Public Health Evaluation). This section presents a summary of the results of the analysis. The intention is not to characterize the absolute risks to human health, but rather to project potential risks associated with observed concentrations of contaminants and to determine the need for site remediation.

Data were not available on concentrations of site-related chemicals in off-site groundwater or surface water, and data are not adequate to predict these concentrations (i.e., through the use of transport modeling). Therefore, this assessment principally has focused on the projected risks to Gowen Field personnel, due to the isolated location of the sites and inaccessibility to the general public, given the observed concentrations of on-site contamination. Exposure to Gowen Field personnel represents a worst-case scenario, because access to the sites typically is limited to the personnel at Gowen Field. The surrounding public generally are not exposed to the sites. Therefore, any risk to the surrounding public would be less than the risk to Gowen Field personnel.

4.1 DEFINITION OF PROBLEMS AND EXPOSURE ASSESSMENT

At Site 1 - Current Fire Training Area, fire-fighting training fuels (nonspecification fuel not suitable for fighter aircraft) are stored in two underground storage tanks and pumped through underground pipes to the pit, where they are incinerated. Site 1 has been in operation since 1974 and an estimated 400,000 gallons of fire-fighting fuels (nonspecification fuel not suitable for fighter aircraft) have been incinerated at this site since 1974. Site 2 - Former Fire Training Area reportedly was used for fire training activities from 1953 to 1974. In 1974, it was abandoned, filled, regraded, and partially paved over. Site 5 - Former Wood Preserving Operation is an area where three, opened 55-gallon drums were discovered that contained sludge resulting from treatment of wood fenceposts with creosote and/or pentachlorophenol (PCP) solutions. The drums have since been removed and disposed of. A patch of discolored soil still remains, however, due to the spill of the contents of the drums onto the adjacent area. The wood treating operations at Site 5, along with the handling of any wastes, were conducted by a private company. Site 6 - Tar Pit was used by an asphalt distribution company to dispose of waste asphalt products until 1977. The sludge that is in the pit is viscous during the warm months and solidifies during colder months.

4.1.1 Routes of Exposure

Exposure to chemicals in the groundwater may potentially occur through the ingestion of contaminated water, dermal absorption through washing and bathing, and inhalation of volatile compounds. The shallow aquifer that was sampled and analyzed during field studies is not the source of drinking water for Gowen Field personnel. However, to evaluate the significance of observed levels of contamination from a public health perspective, consumption of groundwater has been established as the basis for risk characterization.

Exposure to contaminants in the soil may occur from the intentional or inadvertent ingestion of soil, through dermal absorption of contaminants, or from inhalation of volatile chemicals or contaminants on suspended soil particulates. In general, the largest dose to exposed humans would be associated with direct soil ingestion. Sufficient data are not available to evaluate meaningfully the significance of inhalation exposure or dermal contact with soil. Absorption factors for use in examining transport/absorption across biological membranes have not been established satisfactorily for all compounds under investigation. Also, air monitoring data are not available for concentrations of volatile organic compounds (VOCs) in the ambient air at Gowen Field or concentrations of contaminants on suspended particulates. These latter two exposure pathways (dermal absorption or inhalation of contaminants on suspended soil particulates) would be anticipated to contribute minimally to the overall level of exposure to soil contaminants.

4.1.2 Populations Exposed

As mentioned earlier, the shallow aquifer that was sampled and analyzed during field studies is not the source of drinking water for Gowen Field personnel. The two wells (located off-base) that provide water to the City of Boise and are much deeper (greater than 600 feet) than the monitoring wells sampled (150-180 feet) supply water to Gowen Field. The population at risk of exposure to groundwater is a hypothetically proposed group of Gowen Field personnel.

Populations considered to be at risk from chemicals in soil are those that are likely to come into direct contact with the soil. All four sites under investigation are isolated and located in a remote area. Only Gowen Field personnel are likely to be in the vicinity of the sites. No formally promulgated health criteria or standards currently exist for chemicals in soil. However, the U.S. Environmental Protection Agency (EPA) has suggested an approach for evaluating the significance of observed concentrations of contamination and quantifying the risks to human health due to exposure to the contaminated soil. Based on guidance provided in the Superfund Public Health Evaluation Manual (USEPA 1986c), Science Applications International Corporation (SAIC) has evaluated risks of exposure to contaminated soil, assuming ingestion exposure of a small amount of soil per day. A value of

0.1 grams per day is recommended by EPA as the basis for evaluating ingestion exposure in adults. Higher levels are observed in young children that regularly play in soil. However, the exposed population for the evaluation at Gowen Field was assumed to be adults and not children because it is highly unlikely that children would be in the vicinity of any of the sites. See Volume II, Appendix J (Baseline Public Health Evaluation) for details on the exposure methodology.

4.2 BASELINE PUBLIC HEALTH EVALUATION

This section presents a summary of the evaluation of the potential risks to human health of exposure to observed concentrations of chemicals in groundwater, soils, and sediment at the four sites under investigation at Gowen Field. Volume II, Appendix J (Baseline Public Health Evaluation) presents an overview of the general methods recommended by EPA and used in this assessment for conducting a public health evaluation of hazardous waste sites. In addition, detailed evaluations of each of the exposure pathways are presented in Volume II, Appendix J, along with the characterization/quantification of risks to human health. Section 4.2.1 presents the assumptions made in conducting the evaluations of each exposure pathway. Section 4.3 presents the summary of the overall findings.

4.2.1 Assumptions in Conducting the Public Health Evaluation

Uncertainty is inherent in the public health evaluation process. Therefore, in interpreting the results of the evaluation, it is essential to delineate fully and clearly all assumptions used in the analyses. Of particular importance are the assumptions used in estimating exposure concentrations and doses for contaminants in the various environmental media. These assumptions can greatly affect the overall estimates of risks to human health. The following subsections provide a listing of sources of data and key assumptions by exposure pathway used in the baseline public health evaluation. This is followed by general assumptions applicable to the assessment as a whole. The assumptions used in this analysis are conservative and result in an overestimate of the actual risks to human health.

4.2.1.1 Exposure to Contaminated Groundwater

- Exposure levels were quantified using the observed concentrations of contaminants in on-site monitoring wells.

- Dose estimates were derived assuming ingestion of 2 liters (0.53 gallon) of water per day for a 70 kg (154 lb) adult. Absorption of chemicals was assumed to be 100 percent.

- Concentrations of the contaminants are assumed to remain constant over the entire exposure period (i.e., transformation processes that may alter the environmental concentration, such as biodegradation or volatilization, are assumed to not occur).

4.2.1.2 Exposure to Contaminated Soil and Sediment

- The assessment focuses on the potential for chronic noncarcinogenic effects and the lifetime risks of cancer following exposure to inorganic and organic chemicals present at each of the sites.

- The major exposure pathway considered is the direct ingestion of soil/sediment. Inhalation and dermal exposure are not anticipated to contribute significantly to the overall exposure due to contact with contaminated soil (i.e., small in comparison with direct ingestion). The dermal exposure route also has not been considered because of the lack of meaningful absorption factors for compounds under investigation. In addition, ambient air monitoring data at the sites are not available for VOCs or chemicals on suspended particulates.

- Dose estimate for chronic (long-term) ingestion exposure to soil assumed ingestion of 0.1 grams soil/day, and a 70 kg (154 lb) body weight for exposed adult receptors.

The exposure period was projected to vary as the function of circumstances at the sites under investigation. Based on information obtained from Gowen Field personnel, the following soil exposure scenarios were constructed.

- Site 1 - Individuals 25 to 40 years old are at risk of exposure. Fire training drills are conducted an average of 6 hours per month, 9 months per year, and an individual is exposed over a 15-year period. Individuals working in the Fire Training Pit are equipped with respirators and protective clothing. Observers are not protected.

- Site 2 - Individuals 25 to 50 years old are at risk of exposure. At this site, Gowen Field personnel work inside the adjoining building with some occasional outside activity. The exposure period is estimated to be 1 hour per day, 260 days per year, and an individual is exposed over a 25-year period.

- Sites 5 and 6 - These sites are isolated and no exposure of Gowen Field personnel or to the public to contaminated soil is anticipated to occur. Although isolated, the public is not prevented from gaining access to these sites. Therefore, to incorporate consideration of the potential for some limited but unlikely contact of the public with soil at Sites 5 and 6, an exposure period of 8 hours per year has been projected over a 70-year period (lifetime).

4.2.1.3 General Assumptions

- All risk estimates were developed based on observed concentrations of chemicals in groundwater and soil/sediment at the sites under investigation. Background concentrations (see Section 3) were not subtracted out prior to interpreting the results of sampling and analysis.

- Carcinogenic risks for exposure to more than one carcinogen are considered additive in the absence of information on synergism or antagonism.

- Carcinogenic potency factors used in this assessment were obtained from the Superfund Public Health Evaluation Manual (USEPA 1986c). Considerable uncertainty is associated with the derivation of carcinogenic potency estimates, and as new data become available, these factors are subject to change.

4.3. SUMMARY OF RISKS TO HUMAN HEALTH

This section presents a summary of findings of the public health evaluation of exposure to the chemicals at the four sites under investigation at Gowen Field. Conclusions are provided for each pathway of concern. As discussed in the introduction to this section, the objective of the risk appraisal of the four sites has been to prepare a baseline evaluation of the potential for adverse toxicological effects to Gowen Field personnel in the vicinity of the sites and to examine the need for site remediation. Entry of the general public to the sites is restricted and strictly monitored. The opportunity for the public to be in the vicinity of Sites 1 and 2 (Current and

Former Fire Training Areas) is extremely limited. At Sites 5 and 6 (Former Wood Preserving Operation and Tar Pit), the public does have access by way of a dirt road off of a public highway. However, it is unlikely that non-base personnel would use this road to a great extent because of its remote location. Therefore, evaluation of exposure to Gowen Field personnel represents a worst-case scenario. The shallow aquifer is not currently being used at Gowen Field as a source of drinking water.

The potential for both noncarcinogenic and carcinogenic effects has been evaluated in this assessment. Noncarcinogenic effects were evaluated by comparing subchronic or chronic doses of chemicals under investigation (i.e., in water and soil/sediment) with acceptable intake values or reference doses established by the Federal Government for short- or long-term exposure. Exposure to potentially carcinogenic compounds is evaluated in terms of the additional (or extra) lifetime risk (probability) of cancer in the individual.

In interpreting the results for potentially carcinogenic compounds, it is important to recognize that there is no completely safe level of exposure, and that all levels carry a certain degree of risk. Furthermore, there is no formally established risk level for use in evaluating the results of the risk assessment. In the Remedial Investigation/Feasibility Study (RI/FS) process, recent EPA guidance suggests that remedial alternatives should be refined as necessary to ensure that options considered span a carcinogenic risk range from 10^{-4} to 10^{-7} (USEPA 1986c; Zamuda et al. 1986). The 10^{-6} risk level, however, often is chosen as the target risk within this range (Zamuda et al. 1986). This is based on EPA recommended procedures and guidance.

4.3.1 Exposure to Contaminated Groundwater

In comparing dose estimates for short- and long-term exposure to contaminants in on-site groundwater, no compounds were identified for which adverse noncarcinogenic effects would be anticipated. The additional lifetime risk of cancer was calculated based on levels of an observed potential carcinogen in the groundwater (bis (2-ethylhexyl) phthalate). Using the exposure assumptions outlined above and in Volume II, Appendix J (Baseline Public

Health Evaluation), the additional individual lifetime risk of cancer was on the order of 10^{-7}. Conservative assumptions were used in the exposure assessment. In addition, the shallow aquifer is not a source of drinking water and the compound is considered a laboratory contaminant (see Section 3) and considered to not be present in the groundwater at the sites. Based on these points, and the EPA guidelines, this risk is considered to be acceptable (i.e., within the range of 10^{-4} to 10^{-7} specified by EPA). However, selenium concentrations in two well samples exceeded the maximum contaminant level (MCL) for drinking water (10 ug/l), and nickel concentrations exceeded the ambient water quality criterion (AWQC) adjusted for drinking water (15.4 ug/l) in three well samples. MCLs and the adjusted AWQCs are considered applicable or relevant and appropriate requirements (ARARs) under the Comprehensive Environmental Response, Compensation, and Liability Act/Superfund Amendments and Reauthorization Act (CERCLA/SARA).

Because groundwater in the shallow aquifer is not used by Gowen Field personnel as a source of drinking water, the observed levels of selenium and nickel do not constitute a risk to human health. Selenium is a compound that may occur naturally in the groundwater. Selenium was not found in any of the soil collected from the sites nor in the background soil samples. Therefore, the presence of selenium in the groundwater may be natural and not due to activities that were conducted at the sites under investigation.

In conclusion, no compounds were identified in the groundwater for which adverse noncarcinogenic effects would be anticipated. The additional individual lifetime risk of cancer, due to the presence of bis (2-ethylhexyl) phthalate in the groundwater, was on the order of 10^{-7}, which is considered acceptable by EPA guidelines.

4.3.2 Exposure to Contaminated Soils and Sediments

The evaluation of contaminated soils was based on long-term ingestion exposure of 0.1 g soil/day. Exposure duration varied as a function of circumstances at the particular sites under investigation, as discussed in Volume II, Appendix J (Baseline Public Health Evaluation). Results of the evaluation indicate that no adverse noncarcinogenic health effects would be anticipated due to long-term ingestion of soils at the four sites. The combined additional lifetime risk of cancer was calculated based on levels of observed potential carcinogens in soil and sediment (arsenic and tetrachloroethylene). Using the exposure assumption outlined above and in Volume II, Appendix J, the additional individual lifetime risk of cancer was on the order of 10^{-6} or less for all sites under evaluation. Given the conservative assumptions used in the exposure assessment, and based upon EPA guidelines, these risks are considered to be acceptable (i.e., within the range of 10^{-4} to 10^{-7} specified by EPA).

The carcinogenic risk evaluation of soils and sediments also served to identify arsenic as the major contaminant of concern. Each of the cancer risk estimates were found to be primarily attributable to the presence of arsenic. Potential sources of arsenic include wood treating processes, paint pigments, insecticides, herbicides, and metal adhesives. However, arsenic also was detected at comparable concentrations (4.4 mg/kg) in the two background soil samples that were collected at remote locations where the above-mentioned activities have not occurred. Because arsenic was found in most of the soil samples collected from each location, at concentrations comparable to those concentrations detected in the background soil samples, the presence of arsenic is not considered to be due to base activities.

In summary, results of the evaluation indicate that no adverse noncarcinogenic health effects would be anticipated due to long-term ingestion or exposure to soils at the four sites under investigation at Gowen Field. The combined additional lifetime risk of cancer, due to the presence of arsenic and tetrachloroethylene, was on the order of 10^{-6} or less, for each of the sites. This is considered to be within acceptable range established by EPA guidelines.

5. CONCLUSIONS AND RECOMMENDATIONS

This section presents a summary of the conclusions that were drawn based on field investigations that were conducted at the four sites under investigation at Gowen Field and recommends steps that should be taken to prevent future problems.

The primary objective of this study was to determine if a contamination problem exists at any of the four sites under investigation at Gowen Field. In order to attain this objective, environmental data were collected to:

- Confirm the presence or absence of contamination
- Identify the sources(s) or nature of contamination
- Provide a preliminary assessment of the extent, magnitude, and movement of any contamination at the site
- Identify the potential threat any contamination poses to public health or the environment.

5.1 ANALYTICAL DATA QA/QC CONCLUSIONS

A program of quality assurance/quality control (QA/QC) procedures was instituted throughout the sampling effort at Gowen Field and the subsequent analyses of samples. In general, evaluation and review of the laboratory and field QA/QC samples indicate that the data accurately represent the environmental samples collected. Results of field replicate analyses showed good reproducibility and indicate good QA/QC procedures associated with field sampling techniques. Low concentrations of several contaminants were detected in field and laboratory QA/QC samples. These concentrations can be attributed to a known source and do not affect the usefulness of the environmental data. A summary of these findings follows.

Small concentrations of antimony, chromium, copper, and zinc were found in method blanks, field blanks, and/or bailer washes associated with soil and groundwater samples. The presence of these compounds in QA/QC samples was used to evaluate the significance of concentrations of the same compounds in environmental samples. Frequently, the concentrations of these compounds were sufficiently low in the environmental samples to discount any significance that may normally have been attached to their presence.

Concentrations of petroleum hydrocarbons often were detected in soil and groundwater samples and the associated field blanks and bailer wash samples. Small amounts of petroleum hydrocarbons were attributed to nearby air traffic because all field blanks and bailer wash samples contained concentrations of petroleum hydrocarbons.

Acetone was detected in the majority of soil samples and in three of the five groundwater samples collected. However, acetone also was detected in laboratory method blanks. The presence of acetone was determined from QA/QC of the data to not be environmentally significant and not attributed to past or present activities at the base. First, acetone is commonly used in laboratory procedures and can be considered a laboratory contaminant, verified by the presence of acetone in laboratory method blanks. Nearby painting activities at the base also could have resulted in acetone contamination of the environmental samples. Therefore, acetone is not considered a site-related contaminant.

Several other organic compounds were considered to be attributable to laboratory or field contamination and were not considered as site-related contamination. These compounds included bis(2-ethylhexyl) phthalate, di-n-octylphthalate, di-n-butyl phthalate, methylene chloride, and 2-butanone. These compounds were found in only a few soil and groundwater samples, generally at low concentrations. The compounds are considered field or laboratory contaminants because plastic materials and rinse solvents, used in the laboratory or field, contain these compounds and can contaminate environmental samples on contact.

These conclusions were used in evaluating the analytical data from environmental samples and to determine the significance of the contaminants detected.

5.2 DATA EVALUATION CONCLUSIONS

Only one geologic formation was encountered during the study. This formation, the Older Terrace Gravel, was found to be consistent throughout the study area. It was composed of an upper 45- to 50-foot layer of a well-sorted mixture of medium to coarse sand and pebble to cobble sized gravels. Below the 45- to 50-foot depth, this layer graded into unconsolidated, well-sorted, interbedded fine to coarse sand with some minor (approximately 0.5 ft) gravel or silt and clay beds. The total thickness of this sand layer is unknown.

5.2.1 Groundwater

The study focused on the shallow aquifer underlying Gowen Field, since it is the aquifer that would be principally affected by hazardous materials handling, storage, and disposal. The shallow aquifer is contained within the Older Terrace Gravel formation under water table conditions. Water levels were found from a depth of 157.4 to 181.2 feet BLS, much deeper than expected. This fact indicates that there is a large "buffer" area between the hazardous materials handling, storage, and disposal practices at the land surface and the shallow aquifer. Data suggest that the aquifer is under natural recharge conditions, where recharge is greatest following the spring thaw and lowest at the end of the dry summer. Flow directions and high hydraulic gradients change from site to site, but seasonal changes in these properties do not seem to exist. This variability differs from aquifer properties noted in previous reports and suggests that unique hydrogeologic properties may exist at the base. The groundwater monitoring wells installed during this study were not located directly downgradient of the sites because of assumptions based on earlier reports. However, because the wells are immediately adjacent and south of the sites, dispersion of contaminants occurs as they migrate through the unsaturated zone, and a southerly groundwater flow direction existed until the late 1970's, any site-related groundwater contamination should be detected in these wells. The hydraulic conductivity of the aquifer was consistent and is in the 10^{-5} feet/second (+/- one order of magnitude) range, which is common for aquifers of this type. The maximum horizontal groundwater flow rate is calculated to be 49.6 feet/year, ranging from 3.0 to 1,100 feet/year with associated error of measurements taken into account.

There is no truly upgradient monitoring well installed at the sites. Therefore, true background levels of compounds were not available for use in interpreting the groundwater data. One exception was the presence of selenium, which was found in groundwater samples collected at Sites 1 and 5. Selenium was not detected in any of the soil samples collected, which is evidence that selenium presence in the groundwater is not related to site activities.

5.2.2 Soils

Two soil samples were collected at remote locations off-base, away from any base activities that potentially could contaminate the soils. Results of the analyses of these soils show that arsenic, beryllium, chromium, copper, nickel, and zinc concentrations are considered to be true background levels, typical of the soils in the Boise area. The compounds also were found universally in the soil samples collected at Gowen Field at similar concentrations to background levels, to depths of 180 feet below land surface (BLS). These data also show that these compounds can be considered typical of the soils in the Boise area and the concentrations present in the background soils can be used to determine the significance of the environmental data.

Contaminated soils were found at Site 1 - Current Fire Training Area. The contamination consists primarily of the constituents of fuel (petroleum hydrocarbons, toluene) and to a lesser extent the fire-fighting agent $CHBrCl_2$. Copper, nickel, chromium, lead, and mercury were detected at several locations at concentrations higher than background levels. The fuel contamination is present in an area measuring 470 by 150 feet and exists primarily in the upper 5 to 10 feet of soil. No contamination was detected below the 45-foot depth. $CHBrCl_2$ contamination was limited to a small area (50 by 50 feet) northeast of the Burn Pit and was only present within 5 feet of the land surface. Three source locations were identified as follows: 1) a fuel transfer pipe northwest of the underground storage tanks, 2) an area northeast of the Burn Pit where an underground fuel pipe existed and fire truck discharge occurred, and 3) the Burn Pit itself. Stream sediment samples adjacent to the site showed that there is negligible, if any, contamination of the surface water due to the site. Groundwater samples collected at Site 1 did not indicate the presence of any site-related organic contamination. Selenium and nickel were found at levels above the maximum contaminant level (MCL) and ambient water quality criteria (AWQC). The lack of site-related contamination of the groundwater was expected because of the depth of the water table (> 170 feet BLS) and the shallow depth of the site soil contamination (< 45 feet BLS).

The soils investigation at Site 2 - Former Fire Training Area showed that minimal soil contamination exists at the site. A variety of metals were found, but are not attributed to Site 2 activities because concentrations were similar to those detected in background soil samples. Because of this minimal contamination, a groundwater investigation was unnecessary.

The soils investigation at Site 5 - Former Wood Preserving Operation indicated a limited amount of soil contamination exists at the site. The contamination primarily consists of wood preservation chemicals, including acenapthalene, 2-methylnapthalene, and pentachlorophenol (PCP). A number of metals were found, but, as with all the other sites, were found primarily at concentrations comparable to background levels. Lead and mercury were detected at concentrations higher than background. The contamination at Site 5 is concentrated in the upper 5 to 10 feet of soil. No contamination was detected below the 35- to 55-foot depth. The horizontal extent of contamination should approximate the 40-foot, circular, soil-stained area on the soil surface. Groundwater samples collected at Site 5 did not indicate the presence of any site-related contamination. Small concentrations of metals were found that were below the applicable or relevant and appropriate requirements (ARARs).

The soils investigation at Site 6 - Tar Pit showed that minimal soil contamination exists at the site. A variety of metals were found in the soils at concentrations comparable to background levels. Samples from the groundwater monitoring well installed at Site 6 did not indicate the presence of any site-related contamination. A variety of metals were present, but only nickel exceeded the AWQC.

5.3 BASELINE PUBLIC HEALTH EVALUATION CONCLUSIONS

A baseline public health evaluation was conducted to assess site conditions in the absence of remedial actions and to determine the magnitude of potential health problems associated with the release of chemical contaminants from the waste sites at Gowen Field. The assessment focused principally on the projected risks to Gowen Field personnel because of the isolated location of the sites and inaccessibility of the sites to the general public. Exposure to Gowen Field personnel represents a worst-case scenario for the evaluation.

Conservative assumptions also were made regarding routes of exposure and the populations exposed to both contaminated soils and groundwater. In particular, groundwater consumption at a rate of 2 liters/day, 100 percent absorption, for a 70 kg (154 lb adult) was assumed. The shallow aquifer is not used as a source of drinking water by Gowen Field personnel, making this exposure scenario quite conservative. In addition, the presence of bis(2-ethylhexyl) phthalate, a potential carcinogen, was assumed to be at the concentration shown by laboratory analyses. In reality, this compound is considered a laboratory contaminant and not present in the groundwater at the sites.

The results of the assessment of risks associated with exposure to contaminated groundwater showed that no compounds were identified for which noncarcinogenic efforts would be anticipated. One hypothetical carcinogen, bis(2-ethylhexyl) phthalate, was evaluated. The additional individual lifetime risk of cancer, due to the presence of this compound, was determined to be on the order of 10^{-7}, which is considered within the acceptable range established by U.S. Environmental Protection Agency (EPA) guidelines.

The evaluation of exposure to contaminated soils and sediments was determined based on long-term ingestion exposure of 0.1 g soil/day. Exposure scenarios regarding duration varied as a function of circumstances at the particular site.

Results of the evaluation of exposure to contaminated soils and sediments indicate no adverse noncarcinogenic health effects would be anticipated due to long-term ingestion of soils at the four sites under investigation. Two potential carcinogens, arsenic and tetrachloroethylene, were evaluated to determine the combined additional lifetime risk of cancer. The additional risk was calculated on the order of 10^{-6} or less for each of the sites. This is considered to be within the acceptable range established by EPA guidelines.

5.4 RECOMMENDATIONS

Based on the findings of this study, all four sites at Gowen Field have been adequately investigated and characterized to determine the magnitude of the contamination problem. As a result of this study, contamination at the sites was found to be limited, and the potential threat of the existing contamination to public health is minimal. Therefore, no further monitoring or remedial actions are deemed necessary at this time.

It is recognized that the hydrology of the study area has not been completely defined. The reasons for the variable groundwater flow directions, steep hydraulic gradients, and seasonal fluctuations in static groundwater levels found during this study have not been identified. However, based upon the fact that very little risk exists from ingestion of the groundwater and soils and that site-related soil contamination was not found within 100 feet above the water table, further hydrologic characterization of the study area is not necessary.

Also, the study located areas of soil contamination at both Site 1 - Current Fire Training Area and Site 5 - Former Wood Preserving Operation. This contamination was determined to present a minimal risk to human health;

however, the potential for future movement of this contamination to the water table was of concern and was investigated for this study. A number of factors indicate that movement of contamination to the groundwater will not be a problem at Gowen Field. First, it is a prerequisite of downward contaminant migration to have infiltration of precipitation. In the desert climate at Gowen Field, evapotranspiration exceeds the precipitation on a yearly basis, even when runoff of precipitation is not considered. Even during very wet years when there is some precipitation infiltration, the retarding effects of the insolubility of contaminants, biodegradation, attenuation, volatilization, and dispersion would tend, in general, to prevent significant contaminant movement through the soil column to the groundwater.

Although no further action is required for the four sites studied, the Air National Guard Support Center (ANGSC) will develop a focused Feasibility Study (FS) for Site 1 - Current Fire Training Area to determine if a cost-effective cleanup alternative exists to virtually eliminate the risk of migration of off-specification fuels from near-surface soils to groundwater. If the result of the focused FS is a recommendation for cleanup, then ANGSC will proceed to carry out the recommended cleanup alternative.

Gowen Field will further investigate ways to either clean up or provide more permanent physical barriers for Site 6 - Tar Pit for safety reasons. Once a cost-effective approach is developed, then Gowen Field will proceed with this approach.