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CORPORATION

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INSTALLATION RESTORATION PROGRAM
STAGE 5

INFORMAL TECHNICAL INFORMATION REPORT
ANALYTICAL DATA SUMMARY

PRELIMINARY PATHWAYS ASSESSMENT -
SURFACE WATER AND STREAM SEDIMENT SAMPLES
FINAL

FOR

McCLELLAN AFB/EM
McCLELLAN AFB, CALIFORNIA 95652-5990

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Analytical Data Summary: Preliminary Pathways Assessment - Surface Water
and Stream Sediment Samples - Final Copy

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1. The above mentioned document is enclosed for your information. The data in this document will be utilized to develop an Operable Unit Remedial Investigation (OURI) Sampling and Analysis Plan and will be evaluated in detail and presented for your review in the OURI report.

2. This document has been prepared for the United States Air Force for the purpose of aiding in the implementation of a final remedial action plan; and the ongoing nature of the Remedial Investigation/Feasibility Study, along with the evolving knowledge of site conditions and chemical effects on the environment and health, must be considered when evaluating this document, since subsequent facts may become known which may make this document premature or inaccurate. Acceptance of this document in performance of the contract under which it was prepared does not mean that the U.S. Air Force or the Department of Defense adopts the conclusions, recommendations, or other views expressed herein which are those of the contractor only and do not necessarily reflect the official position of either department. [The attached Radian document has been reviewed as a matter involved in litigation and has been approved for release to the general public.]

3. If you have any questions, contact Mr Bud Hoda, SM-ALC/EMR,
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1 Atch
Analytical Data Summary

cc: SM-ALC/JA
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NOTICE

This Analytical Data Summary has been prepared for the United States Air Force for the purpose of aiding in the implementation of a final remedial action plan under the Air Force Installation Restoration Program (IRP). As the letter report relates to actual or possible releases of potentially hazardous substances, its release prior to an Air Force final decision on remedial action is in the public interest. The limited objectives of this letter report, the ongoing nature of the IRP, and the evolving knowledge of site conditions and chemical effects on the environment and health all must be considered when evaluating this letter report, since subsequent facts may become known which may make this letter report premature or inaccurate. Acceptance of this letter report in performance of the contract under which it was prepared does not mean that the U.S. Air Force or the Department of Defense adopts the conclusions, recommendations, or other views expressed herein, which are those of the contractor only and do not necessarily reflect the official position of either department.

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PREFACE

Radian Corporation is the contractor for the Installation Restoration Program (IRP), Stage 5 Remedial Investigation/Feasibility Study (RI/FS) at McClellan Air Force Base (AFB), California. The work is being performed for the Air Force Human Systems Division (HSD/YAQI) under USAF Contract No. F33615-87-D-4023.

This Analytical Data Summary Report summarizes and presents the results of surface water and stream sediment sampling and analysis, and results from a geophysical survey to locate underground tanks. The work was performed January 1989 through March 1990. The data presented include analytical results for surface water and stream sediment samples collected from creeks and drainages on McClellan Air Force Base. Results from a geophysical survey to locate possible underground storage tanks at five locations on McClellan Air Force Base are also provided. These data are used to evaluate current conditions within the different Operable Units and to identify potential remedial measures that may be applied to clean up sites at McClellan AFB.

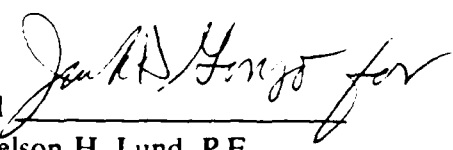
Key Radian project personnel were:

Nelson Lund, P.E. - Contract Program Manager
Jack D. Gouge' - Delivery Order Manager
William C. Knight - Project Manager
Thomas F. Cudzilo - Project Director

Radian acknowledges the cooperation of the McClellan Air Force Base Office of Environmental Management. In particular, Radian acknowledges the assistance of Mr. Mario Ierardi, Mr. Bud Hoda, and Mr. Gerald Robbins.

The work presented herein was accomplished between 01 January 1989 and 31 March 1990. Mr. Gary L. Woodrum of the Air Force Human Systems Division (HSD/YAQI), was the Technical Program Manager.

Approved


Nelson H. Lund, P.E.
Contract Program Manager



This report has been prepared by the staff of Radian Corporation under my supervision as Project Director. The presentation of information contained herein has been approved after thorough technical review. The recommendations in this report are based upon the data collected in the field and laboratory by Radian Corporation personnel. I believe the data presented are high quality. The presentation of these data and the recommendations made were governed by my experience and professional judgement.

A handwritten signature in dark ink, reading "Thomas F. Cudzilo". The signature is fluid and cursive, with the first and last names being more prominent.

Thomas F. Cudzilo, Ph.D.
Registered Geologist 4473

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1.0 INTRODUCTION

This Data Summary presents the results of surface water and stream sediment sampling and analysis performed by Radian Corporation to determine the presence of organic compounds and metals at selected locations along drainages that cross McClellan Air Force Base (AFB). Surface water samples were collected 6 through 12 January 1989; and stream sediment samples were collected 13 through 18 January 1989.

The surface water and stream sediment sampling and analysis was the initial effort in the Preliminary Pathways Assessment (Air, Soil, and Surface Water) for McClellan AFB. The Preliminary Pathways Assessment (PPA) was intended to be an extensive program of data collection and interpretation for the Potential Release Locations across McClellan AFB. The program was terminated after the surface water and stream sediment sampling efforts. In lieu of the PPA, an intensive remedial investigation of groundwater in Operable Unit B was undertaken. Therefore, the air and soil data were not collected. The surface water and stream sediment data are presented in this summary without interpretation of potential sources of the compounds detected. Additional evaluation and interpretation of these data will be performed during the development of sampling and analysis plan and included in results of more extensive remedial investigations to be conducted in each Operable Unit.

This investigation is part of the McClellan AFB Installation Restoration Program, Remedial Investigation/Feasibility Study (IRP/RI/FS). The investigation included: field activities, laboratory activities, and a preliminary data evaluation. These activities are summarized in the following sections. Only data for those compounds or metals detected in surface water and stream sediments by various analytical methods are presented in this report. All laboratory analytical results and data summary sheets were presented in the Informal Technical Information Report/Preliminary Pathways Assessment.

In addition to the surface water and stream sediment sampling, a geophysical survey was performed as part of the Preliminary Pathways Assessment. NORCAL Geophysical Consultants, Inc., were contracted by Radian to perform vertical magnetic gradiometer and ground penetrating radar surveys to locate possible



underground storage tanks at five locations on McClellan AFB. These locations are Potential Release Locations T-6, T-10, T-12, T-36 and one new location, T-66, identified during this investigation. The results of the geophysical investigation are presented in NORCAL's report in Appendix E.

2.0 FIELD ACTIVITIES

This section describes specific procedures associated with the collection of surface water and stream sediment samples. All field activities were performed in accordance with the McClellan Air Force Base (AFB) Draft Quality Assurance Project Plan (Radian, 1989). Sample locations, collection procedures, equipment, decontamination, and shipping and handling are described below.

2.1 Surface Water Sampling

Surface water drainages sampled include holding ponds and lagoons, on-base storm drainage systems, Magpie Creek, Don Julio Creek, and Robla Creek. Emphasis was placed on drainages that cross base boundaries and potentially receive contaminants. Specific sample locations are presented on Plate 1. Sample identification numbers are cross-referenced to the sample locations in Table 2-1. Locations shown on Plate 1 and referred to in Table 2-1 are identified as water/sediment (WS) sampling stations.

Surface water samples were collected on 6 through 12 January 1989 following a rainy period. Samples were collected from all designated locations with the exception of location WS22, where there was insufficient water flow to obtain a sample. Grab samples were collected by hand from the midpoint of each surface water drainage sampled. Water samples were collected by submerging the sample container beneath the water surface. Prior to sample collection, Radian field personnel replaced their gloves with new, clean latex surgical-type gloves to avoid cross-contamination of the sample container.

For all surface water bodies sampled, the depth of water, approximate flow rate, temperature, pH, and specific conductance were measured prior to collecting samples for laboratory analyses. The depth measuring rod, thermometer, and pH/conductance meter were thoroughly rinsed with distilled water prior to sampling each surface water drainage. The depth of water, flow rate, pH, specific conductance, and temperature data for each location sampled are provided in Appendix A.

After collection of each sample, all equipment, including boots and waders, were decontaminated according to the following three-step process: 1) the equipment

TABLE 2-1. SURFACE WATER SAMPLES IDENTIFICATION AND CROSS-REFERENCE

Sample Location ^a	Sample Identification ^b
WS1	NSWS1SW01 FDWS1SW01
WS3	NSWS3SW01
WS5	NSWS5SW01
WS6	NSWS6SW01
WS7	NSWS7SW01 FDWS7SW01
WS8	NSWS8SW01
WS9	NSWS9SW01 FDWS9SW01
WS10	NSWS10SW01
WS11	NSWS11SW01 FDWS11SW01
WS12	NSWS12SW01
WS13	NSWS13SW01 FDWS13SW01
WS14	NSWS14SW01
WS15	NSWS15SW01
WS16	NSWS16SW01
WS17	NSWS17SW01
WS18	NSWS18SW01
WS19	NSWS19SW01
WS20	ABWS20SW01 NSWS20SW01
WS21	NSWS21SW01
WS23	NSWS23SW01
WS24	NSWS24SW01
WS25	NSWS25SW01
WS26	NSWS26SW01
WS27	NSWS27SW01

^a Refer to Plate 1 for sample locations.

^b The first two letters in the sample identification denote the type of sample collected (e.g., NS = normal sample, FD = field duplicate, AB = ambient blank). The sample location is identified by the next three or four characters. The last four characters denote the matrix type and the number of sampling points at the given location (e.g., SW01 = surface water sample/one sampling point).

was washed in detergent and potable water solution using a brush; 2) the equipment was rinsed with potable water; and 3) the equipment was rinsed with deionized water.

Field quality assurance samples included trip blanks, ambient blanks, and field duplicates. Trip blanks were used to ensure that sample contamination did not occur during sample shipment. Trip blanks were collected by filling the sample containers with ASTM Type I Reagent Water prior to each day's field activities. These samples were then carried in sample coolers by the field crew during sampling and were then submitted blind to the laboratory along with the field samples. Trip blanks were collected at the rate of one blank per sample set (i.e., one per day) for volatile organic analyses only.

Ambient blanks were collected by pouring ASTM Type I Reagent Water (prepared in the Radian Analytical Laboratory) into sample containers at one field sampling location (WS20). These samples were used to determine if sample contamination occurred due to ambient conditions. Two ambient samples were collected during the surface water sampling program, one for volatile organics and one for semivolatile organics.

Field duplicates were collected by filling twice the required number of sample containers at a sampling point. These samples were submitted blind to the laboratory along with the field samples. Field duplicate samples were collected at a rate of 10 percent of all surface water samples, or one per sample set (i.e., one per day), whichever was greater.

The required sample volumes, containers, preservation requirements, and holding times for all samples collected during the surface water sampling program are given in the McClellan AFB QAPP. All sample containers were immediately sealed or capped and placed in plastic coolers with ice for storage at approximately 4°C. The glass bottles were protected inside the coolers by wraparound plastic mesh. Samples were transported to Radian Analytical Services Laboratory in Sacramento each day following completion of the sampling activities. Chain-of-custody records were completed subsequent to collection of each sample. The chain-of-custody records accompanied sealed samples to the laboratory and were kept with the samples at all times.

2.2 Stream Sediment Sampling

Stream sediment samples were collected from on-base storm drainages, Magpie Creek, Don Julio Creek, and Robla Creek. Samples were collected at points where each stream enters (initial datum point) and leaves the base (exit point). Additional sampling locations across the base were selected along the streams and drainage channels to determine if contaminants in sediment increase in concentration as a result of on-base activities. Specific sample locations are presented on Plate 1. Sample identification numbers are cross-referenced to the sample locations in Table 2-2.

Stream sediment samples were collected 13 through 18 January 1989 immediately following surface-water sampling. Samples were collected from all designated locations with the exception of location WS19, where there was an insufficient accumulation of sediment to obtain a sample.

Sediment samples were collected by hand augering or surface scraping at each sampling location. A hand auger (hand-operated coring device) was used to collect samples from the 0- to 1-foot, 1- to 2-foot, and 2- to 3-foot depths. These depths were selected to provide information on both present and past conditions within the channels. Surface sediment scrapes were taken at points where drainages are lined with concrete and where hand-auger boring in the stream bed was not possible. Sediment scrapes were collected using a stainless steel trowel and/or spoon.

Prior to sample collection, Radian field personnel replaced their gloves with new, clean latex surgical-type gloves to avoid cross-contamination of the sample or sample container. The depth of water, flow rate, and a brief sediment description were recorded for each sediment sampling location. These data are provided in Appendix B. After collection of each sample, all equipment, including boots and waders, were decontaminated according to the same procedure previously described for surface-water sampling.

Field quality assurance samples included trip blanks and field replicates. Trip blanks were collected by filling the sample containers with ASTM Type I reagent water prior to each day's field activities. These samples were carried in sample coolers by the field crew during sampling and were then submitted blind to the laboratory along

TABLE 2-2. STREAM SEDIMENT SAMPLES IDENTIFICATION AND CROSS-REFERENCE

Sample Location ^a	Sample Identification ^b
WS1	NSWS1SS01
WS2	NSWS2SS0101
	NSWS2SS0102
	NSWS2SS0103
WS3	NSWS3SS0101
	NSWS3SS0102
	NSWS3SS0103
WS4	NSWS4SS0101
	NSWS4SS0102
	NSWS4SS0103
WS5	NSWS5SS0101
	NSWS5SS0102
	NSWS5SS0103
WS6	NSWS6SS0101
	NSWS6SS0102
	NSWS6SS0103
	FDWS6SS0101
WS7	NSWS7SS0101
	NSWS7SS0102
	NSWS7SS0103
WS8	NSWS8SS01
	FDWS8SS01
WS9	NSWS9SS01
WS10	NSWS10SS01
WS11	NSWS11SS01
	FDWS11SS01
WS12	NSWS12SS01
WS13	NSWS13SS0101
	NSWS13SS0102
	NSWS13SS0103
WS14	NSWS14SS0101
	NSWS14SS0102
	NSWS14SS0103
	FDWS14SS0101
WS15	NSWS15SS01
	FDWS15SS01

(continued)

TABLE 2-2. (Continued)

Sample Location ^a	Sample Identification ^b
WS21	NSWS21SS0101 NSWS21SS0102 NSWS21SS0103
WS22	NSWS22SS0101 NSWS22SS0102 NSWS22SS0103
WS23	NSWS23SS01
WS28	NSWS28SS01
WS29	NSWS29SS01

^a Refer to Plate 1 for sample locations.

^b The first two letters in the sample identification denote the type of sample collected (e.g., NS = normal sample, FD = field replicate). The sample location is identified by the next three or four characters. The remaining characters denote the matrix type, the number of sampling points, and the respective sampling depth at a given point (e.g., SS0102 - stream sediment sample/one sampling point/2-foot sample depth). For paved ditches, surface scrapes were collected and no sample depth is listed.

with the field samples. Reagent grade water was used for sediment trip blanks instead of reagent grade soil. Reagent water ensures that sample contamination does not occur during sample shipping and handling and is as effective as reagent grade soil for determining cross-contamination. Trip blanks were collected at the rate of one blank per sample set (i.e., one per day) and analyzed for volatile organic compounds.

Field replicate samples were collected at a rate of 10 percent of total sediment samples or one per day, whichever was greater. Field replicates were obtained by collecting a sufficient quantity of sediment at designated sample points to fill twice the required number of sample containers. These additional samples were submitted blind to the laboratory along with the field samples.

The required sample volumes, containers, and holding times for all samples collected during the stream sediment sampling program are given in the McClellan AFB QAPP. After sampling all sample containers were immediately capped and placed in plastic ice chests for storage at approximately 4°C. Samples were transported to Radian Analytical Services Laboratory in Sacramento each day following completion of the sampling activities. Strict chain-of-custody procedures were followed during sample shipping and handling.

3.0 ANALYTICAL METHODS AND QUALITY ASSURANCE

Surface water and stream sediment samples were collected for analysis. Each sample was analyzed by several methods for the detection of a variety of potential contaminant analytes. Surface water samples were analyzed by the following methods: volatile and semivolatile organic compounds (U.S. Environmental Protection Agency [EPA] Methods 8240 and 8270), ICP screening for 22 metals (U.S. EPA Method 6010), arsenic (U.S. EPA Method 7060), lead (U.S. EPA Method 7421), mercury (U.S. EPA Method 7470), selenium (U.S. EPA Method 7740), cyanide (U.S. EPA Method 9010), oil and grease (U.S. EPA Method 413.2), petroleum hydrocarbons (U.S. EPA Method 418.1), and radioactivity (U.S. EPA Methods 901.1 and 9310). The metals included in the ICP screen are: silver, aluminum, boron, barium, beryllium, calcium, cadmium, cobalt, chromium, copper, iron, potassium, magnesium, manganese, molybdenum, sodium, nickel, antimony, silicon, thallium, vanadium, and zinc. In addition, water samples were filtered at collection and submitted for analysis of the following dissolved analytes: 22 metals previously listed plus arsenic, lead, mercury, and selenium. Stream sediments were also analyzed for: volatile and semivolatile organic compounds, soil moisture content (ASTM Method D2216), cyanide, mercury, petroleum hydrocarbons, oil and grease, radioactivity, pH and 22 metals. Samples collected and types of analysis performed, as well as number of times each analysis was performed, are summarized in Tables 3-1 and 3-2.

All samples collected at each site were assigned unique sample identifiers which were attached to each sample container and recorded in a sample Master Log and on the Chain-of-Custody form. These records provided specifications for analysis and ensured accurate sample tracking. Most samples were transported by Radian Corporation personnel to Radian Analytical Services laboratory in Sacramento for analysis. Stream sediment and surface- water samples from one location were sent by Federal Express to Radian Analytical Services in Austin, Texas to be analyzed for radioactivity.

Each analysis was performed according to appropriate U.S. EPA procedures. Quality assurance procedures as specified in the McClellan AFB Quality Assurance Project Plan (QAPP) (Radian, 1989) and in the applicable U.S. EPA Method were followed. Data were evaluated in terms of the Quality Assurance/Quality Control (QA/QC) objectives described in the QAPP. These

TABLE 3-1. ANALYTICAL METHODS AND TOTAL NUMBER OF WATER ANALYSES

Parameter	Analytical Method (U.S. EPA)	Reporting Units	Number of Analyses	Trip Blanks	Ambient Blanks	Equip. Blanks	Dup/Rep	QA Samples	Total Analysis
Volatile organics	8240	mg/L	23	4	1		3	3	34
Radioactivity	901.1	pCi/L	1				1		2
Radioactivity	9310	pCi/L	1				1		2
Oil and grease	413.2	mg/L	6				1		7
Petroleum hydrocarbons	418.1	mg/L	6				1		7
ICP screen (22 metals) ^a	3005/ 6010	mg/L					1		7
Total recoverable dissolved			23						
Arsenic	7060	mg/L	23				3		26
Total recoverable dissolved			23				3		26
Lead	3005HN03/ 7421	mg/L	23				3		26
Total recoverable dissolved			23				3		26

(Continued)

TABLE 3-1. (Continued)

Parameter	Analytical Method (U.S. EPA)	Reporting Units	Number of Analyses	Trip Blanks	Ambient Blanks	Equip. Blanks	Dup/Rep	QA Samples	Total Analysis
Mercury	7470	mg/L							
Total recoverable dissolved			23				3		26
			23				3		26
Selenium	7740	mg/L							
Total recoverable dissolved			23				3		26
			23				3		26
Semivolatile organic compounds	3520/ 8270	ug/L	23	4	1		3	3	34
Cyanide, Total	9010	mg/L	23				3		26

mg/L = milligram per liter

ug/L = microgram per liter

pCi/L = picocurie per liter

The metals are aluminum, antimony, barium, boron, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, magnesium, manganese, molybdenum, nickel, potassium, silicon, silver, sodium, thallium, vanadium, zinc.

TABLE 3-2. ANALYTICAL METHODS AND TOTAL NUMBER OF SEDIMENT ANALYSES

Parameter	Analytical Method	Reporting Units	Number of Analyses	Trip Blanks	Field Blanks	Dup/Rep	QA Samples	Total Analysis
Volatile organics	8240	mg/kg	39	7		4		50
Semivolatile organics	3550 8270	mg/kg	39	7		4		50
Soil moisture content	ASTM D2216	mg/kg	39			4		43
ICP screen (23 metals)	3050 6010	mg/kg	39			4		43
Mercury	7471	mg/kg	29			4		43
Cyanide Total	9010	mg/kg	39			4		43
Petroleum hydrocarbon	3550 418.1	mg/kg	13			2		15
Oil and grease	3550 413.1	mg/kg	13			2		15
Radioactivity	9310 901.1	pCi/L	1			1		2
pH	9040 or 9045		39			4		43

¹ All Methods U.S. EPA unless otherwise noted.
 mg/L = milligram per liter
 pCi/L = picocurie per liter

objectives specify performance targets for each method in terms of accuracy, precision, completeness, representativeness, and comparability. The attainment of Quality Assurance/Quality Control objectives is discussed in Appendix C in the following order: blanks of all types, duplicates, matrix spike recoveries, analytical spike recoveries, surrogate spike recoveries, and performance evaluation samples.

Some of the data presented in this report are qualified because they did not meet the QA/QC objectives. Qualified data are presented for completeness although their quality cannot be completely assured. All qualified data are identified in the data evaluation.

4.0 SAMPLING ANALYTICAL RESULTS AND DATA EVALUATION

This section presents the analytical results for the surface water and stream sediment sampling. Results of sample analyses for Robla Creek, Don Julio Creek, Magpie Creek, and two major drainages (north and south) are evaluated separately for this investigation. Additional sample locations, which are not part of the major creeks and/or drainages, are also discussed separately. All detectable analytes are tabulated and a preliminary evaluation of the data is provided.

Applicable or relevant and appropriate requirements (ARARs) have not been established for surface water and stream sediment at McClellan Air Force Base (AFB). Because there are no standards and/or cleanup goals established, the data are evaluated solely on the basis of analyte concentrations increasing or decreasing within the creek/drainage as it flows across McClellan AFB. Surface water in the major creeks and drainages generally flows from east to west across McClellan AFB. Stream sediment is also carried downstream from east to west.

The easternmost sample location on each creek/drainage is considered to be the initial datum point. The datum points for Robla Creek, Storm Drainage North (SDN), and Magpie Creek are located near the eastern perimeter of the base and may be considered representative of water or sediment entering the base from the east. The datum points for Don Julio Creek and Storm Drainage South (SDS) are located in the west central and south central portions of the base, respectively. Analyte concentrations from all sample locations downstream from the datum points are compared to analyte concentrations from the initial datum point. The westernmost sample location on each creek/drainage is the exit point from base boundaries. Except for SDN, all exit points are located on the western perimeter of the base. The final sample location for SDN is located south of Operable Unit (OU) D, well within base boundaries. Relative changes in analyte concentrations between the initial datum points and the exit points for each creek/drainage are discussed in the following subsections.

Surface water sample results are presented in Subsection 4.1 and results from stream sediment sampling are presented in Subsection 4.2.

4.1 Surface Water Results

As discussed in Section 3.0, surface water samples were analyzed by

several methods to detect different target analytes. The analytical methods and total number of water analyses performed are listed in Table 3-1 located on page 3-2. All analytes detected in surface water samples at or above laboratory detection limits are listed in Table 4-1 located on page 4-56, except radioactivity analysis. Analytes are listed according to the analytical method. Under each analytical method, the sample locations are listed numerically along with the sample identification. Concentrations are given in parts per million (ppm) or milligrams per liter (mg/L) for all analyses except volatile and semivolatile organics compounds. Concentrations for volatile and semivolatile organics compounds are given in parts per billion (ppb) or micrograms per liter (ug/L).

Samples for radioactivity analyses were collected from one location on Magpie Creek. The results are not included in Table 4-1, but are presented in the Magpie Creek discussion for both surface water and stream sediment.

The majority of analytes detected at or above laboratory detection limits are inorganic or metal cations. Analytical screening for both total and dissolved metals was performed on 23 surface water samples. In addition, arsenic, lead, mercury, and selenium were analyzed by ion-specific methods with lower detection limits. Metals were detected in all surface water samples analyzed. Arsenic was detected at one sample location, and lead was detected at all 23 locations. Samples from 6 locations were analyzed for oil and grease and total petroleum hydrocarbons. Three out of the six samples had detectable concentrations of both oil and grease and total petroleum hydrocarbons. Volatile and semivolatile organics were analyzed for at 23 sample locations. Two volatile organic compounds and four semivolatile organic compounds were detected. Samples collected from Magpie Creek for radioactivity analysis were analyzed for gross alpha, gross beta, and gamma radioactivity. Gross beta and gamma radiation were detected but the isotopes identified as sources of the radiation result from decay of radioactive elements occurring naturally in rocks and soils.

All of the metals detected are naturally occurring trace elements, and most surface water bodies have some natural concentrations of metals present, whereas the presence of any detectable amount of priority pollutant organic compound indicates contamination from a manufactured source. Many of the metals detected are relatively nontoxic and are of little concern at the concentrations detected in the surface waters. Of primary importance are metals that are Persistent and Bioaccumulative Toxic Substances, as listed in the California Code of Regulations, Title 22, Section 66699. The

listed metals of concern are: antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium, and zinc. Asbestos and fluoride are also listed in Title 22; however, they were not analyzed for during this investigation. The following evaluation of inorganic analytical results focuses on the listed metals only because of their potential impact on human health or the environment.

Each creek/drainage is discussed separately beginning with Robla Creek. Metals are discussed alphabetically beginning with antimony. Separate analyses were performed for total metal concentration and dissolved metal concentration in each surface water sample. Each of the analytical results for a specific metal are shown with different symbols on the graphs for each location where metals were detected. Field duplicate sample data are not plotted. If an analyte was not detected at a particular sample location, then the concentration at the sample point on the graph is shown at the detection limit, and the location is described briefly in the metals discussion. Displaying a metal's concentration at the limit of detection for sample locations where it was not detected is a graphical procedure used in this report to conservatively show variations in concentration. The true concentration below the detection limit cannot be accurately shown, and it is unlikely that the metal has a concentration of zero. If an analyte was not detected at any sample locations within a creek/drainage, then no graph was prepared for the analyte. The graphs are oriented with the initial datum point to the east on the left side of the graph, and the exit or final sampling point to the west, on the right side of the graph.

Following the metals evaluation, total petroleum hydrocarbons, oil and grease, volatile organic compounds, and semivolatile organic compounds are discussed for each creek/drainage. Results from the additional sample locations including aeration lagoons and holding ponds are presented last.

4.1.1 Robla Creek

Robla Creek is the northernmost creek that crosses McClellan AFB boundaries and enters the base as two separate branches. The branches converge north of Patrol Road. From this point, the creek flows southwest and exits the base at approximately 26th Street. Surface water samples were collected from locations WS01 and WS03 shown on Plate 1.

4.1.1.1 Metals

Arsenic, barium, copper, lead, and zinc were detected in Robla Creek samples. Arsenic was only detected in the field duplicate sample from the datum point. The concentration of arsenic was 0.005 mg/L with a detection limit of 0.004 mg/L. Concentration graphs for barium, copper, lead, and zinc are presented in Figure 4-1.

The datum point concentrations for total and dissolved barium are 0.061 mg/L and 0.043 mg/L, respectively. Total and dissolved barium concentrations increase slightly along Robla Creek from the datum point to the exit point.

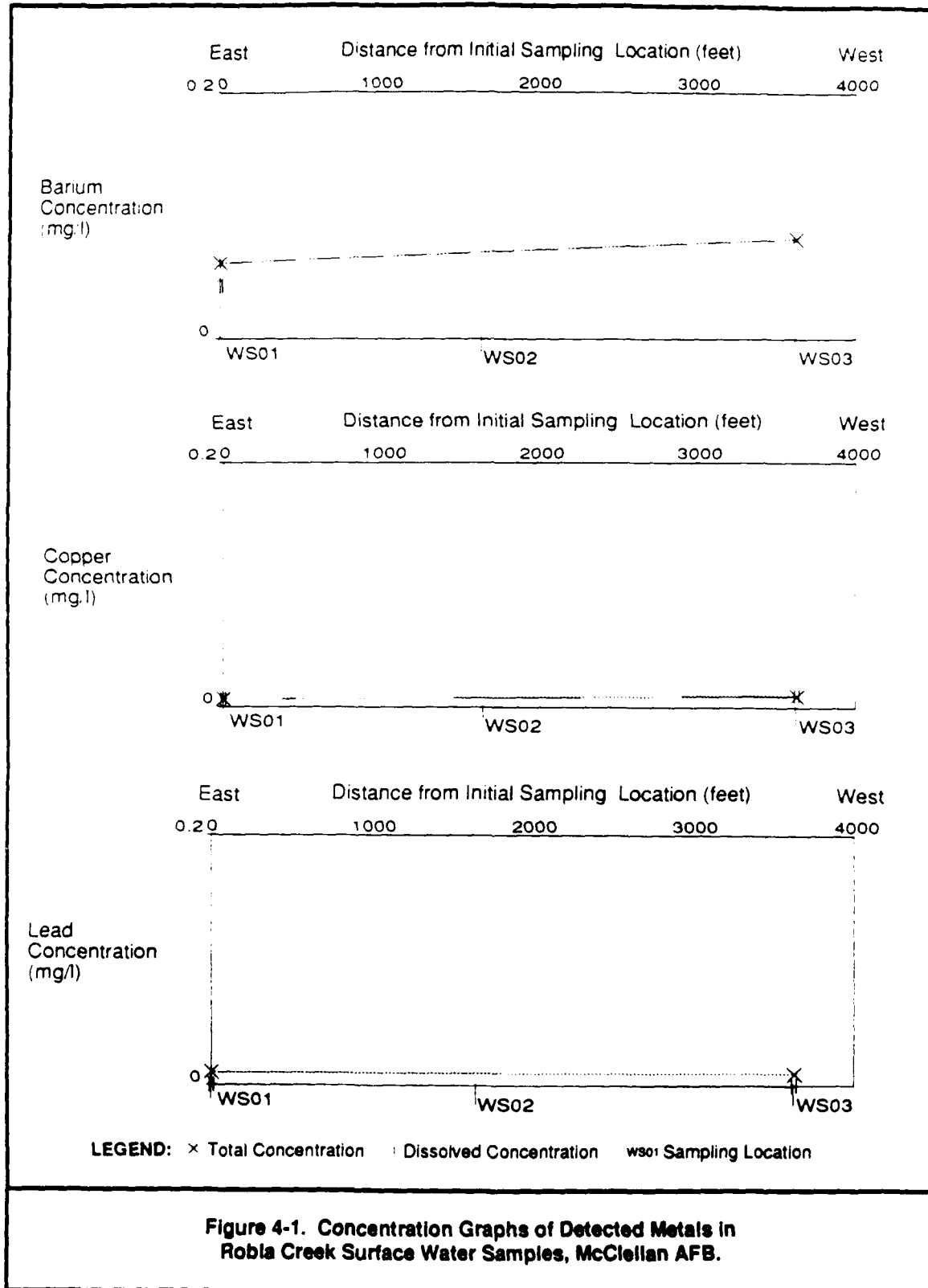
Copper in Robla Creek samples increases slightly from below the detection limit at the datum point to 0.009 and 0.010 mg/L for total and dissolved copper, respectively, at the exit point. The dissolved copper concentration at the exit point is slightly greater than the total concentration. The dissolved concentration is normally less than the total concentration. However, in this case, both the total and dissolved concentrations are very close to the detection limit of 0.006 mg/L. The variability in laboratory precision is much higher when results are less than five times the detection limit. The concentrations detected occur within the range of error for this analytical method.

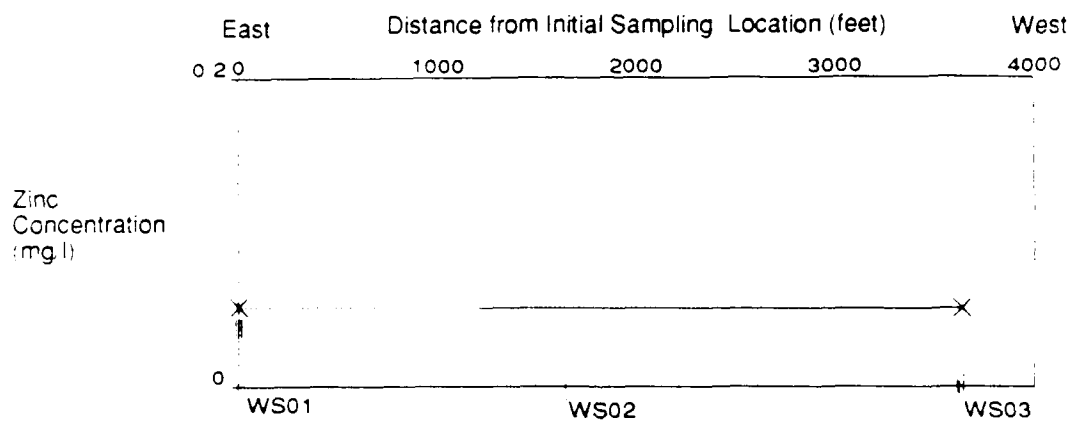
The total lead concentration decreases along Robla Creek from the initial datum point concentration of 0.010 mg/L to the exit point concentration of 0.009 mg/L. Dissolved lead was not detected.

The datum point concentration for total and dissolved zinc are 0.051 mg/L and 0.038 mg/L, respectively. Total zinc decreased slightly to 0.050 mg/L at the exit point. Dissolved zinc was not detected at the exit point.

4.1.1.2 Volatile Organic Compounds

Dichlorodifluoromethane was detected at a concentration of 9.2 ug/L at the datum point. This was an estimated result less than five times the detection limit. Acetone was detected at both the datum point and the exit point; however, all acetone results are qualified due to laboratory contamination. The results for volatile organic compounds are not shown graphically.





LEGEND: x Total Concentration — Dissolved Concentration ws01 Sampling Location

Figure 4-1(Continued). Concentration Graphs of Detected Metals in Robla Creek Surface Water Samples, McClellan AFB.

4.1.1.3 Semivolatile Organic Compounds

Pentachlorophenol was detected at a concentration of 7.8 ug/L at the datum point. This was an estimated result less than five times the detection limit. Bis(2-ethylhexyl)phthalate was detected at the exit point; however, this was a qualified result due to laboratory contamination. The results for semivolatile compounds are not shown graphically.

4.1.2 Storm Drainage North

Storm Drainage North (SDN) is a large drainage ditch extending across the northern portion of the base. The location of this ditch and sampling points along it are shown in Plate 1. Storm Drainage North is routed underground beneath a portion of the north-south runway. The ditch returns to the surface at the western base boundary near Gate 1002, runs westward off base as an open ditch, and reenters the base north of Building 1080. Surface water samples were collected from locations WS15 through WS19. Sample station WS17 is located at the point where SDN exits the base near Gate 1002, and WS18 is where the ditch reenters the base north of Building 1080.

4.1.2.1 Metals

Barium, chromium, copper, lead, nickel, and zinc were detected in SDN samples. Concentration graphs for these metals are presented in Figure 4-2.

The datum point concentration for both total and dissolved barium is 0.050 mg/L. Barium concentrations increase slightly along SDN, except WS16, which had a concentration of 0.025 mg/L for both total and dissolved barium.

Total chromium was only detected at WS18 at a concentration of 0.008 mg/L, which is slightly above the detection limit of 0.007 mg/L. Dissolved chromium was not detected in any SDN surface water samples.

Copper in SDN samples increases from below the detection limit for both total and dissolved copper at the datum point and location WS16, to a peak concentration of 0.14 mg/L for total copper at location WS18. The concentrations of total and dissolved copper at the final sample location (WS19) are 0.008 and 0.015

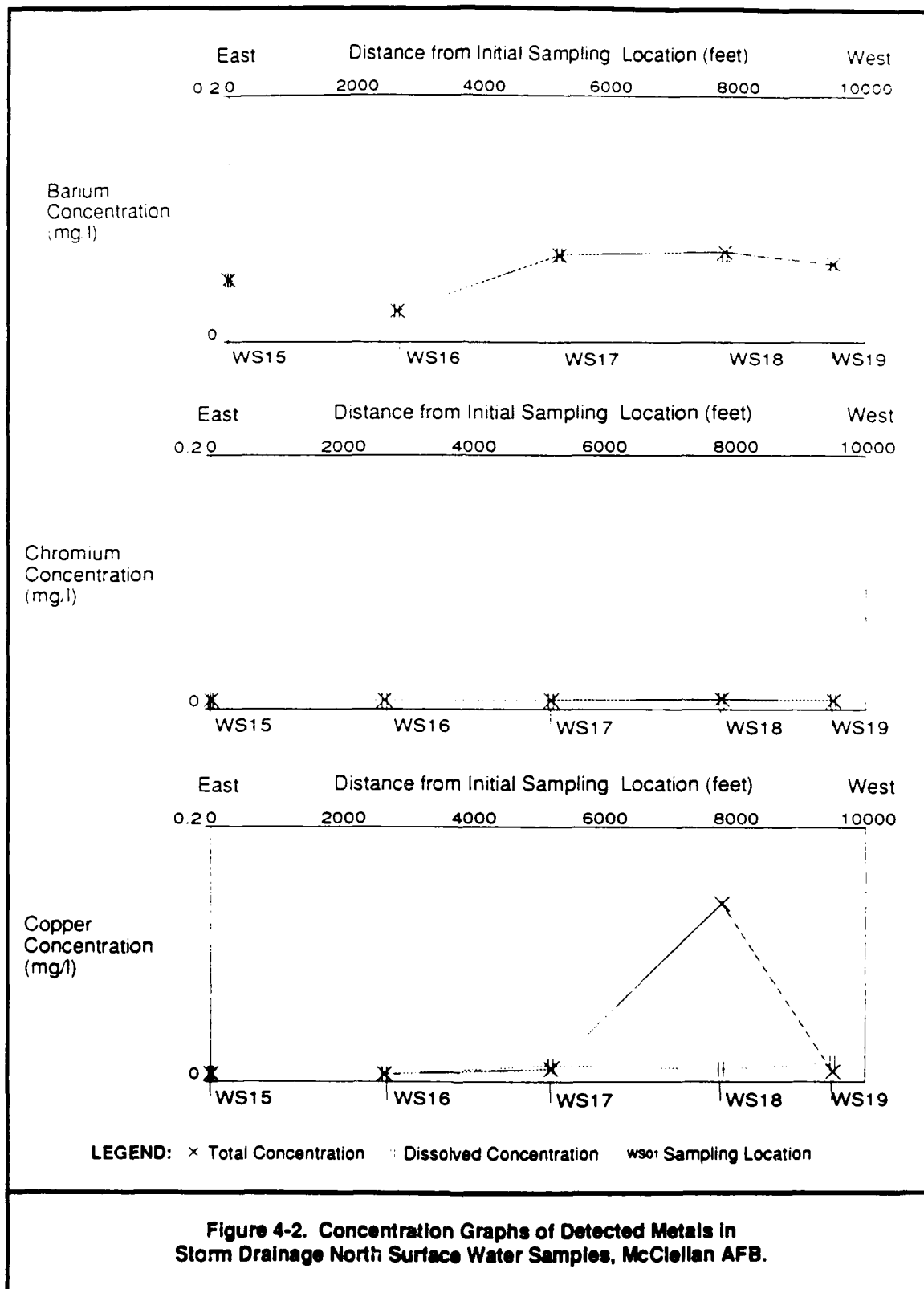


Figure 4-2. Concentration Graphs of Detected Metals in Storm Drainage North Surface Water Samples, McClellan AFB.

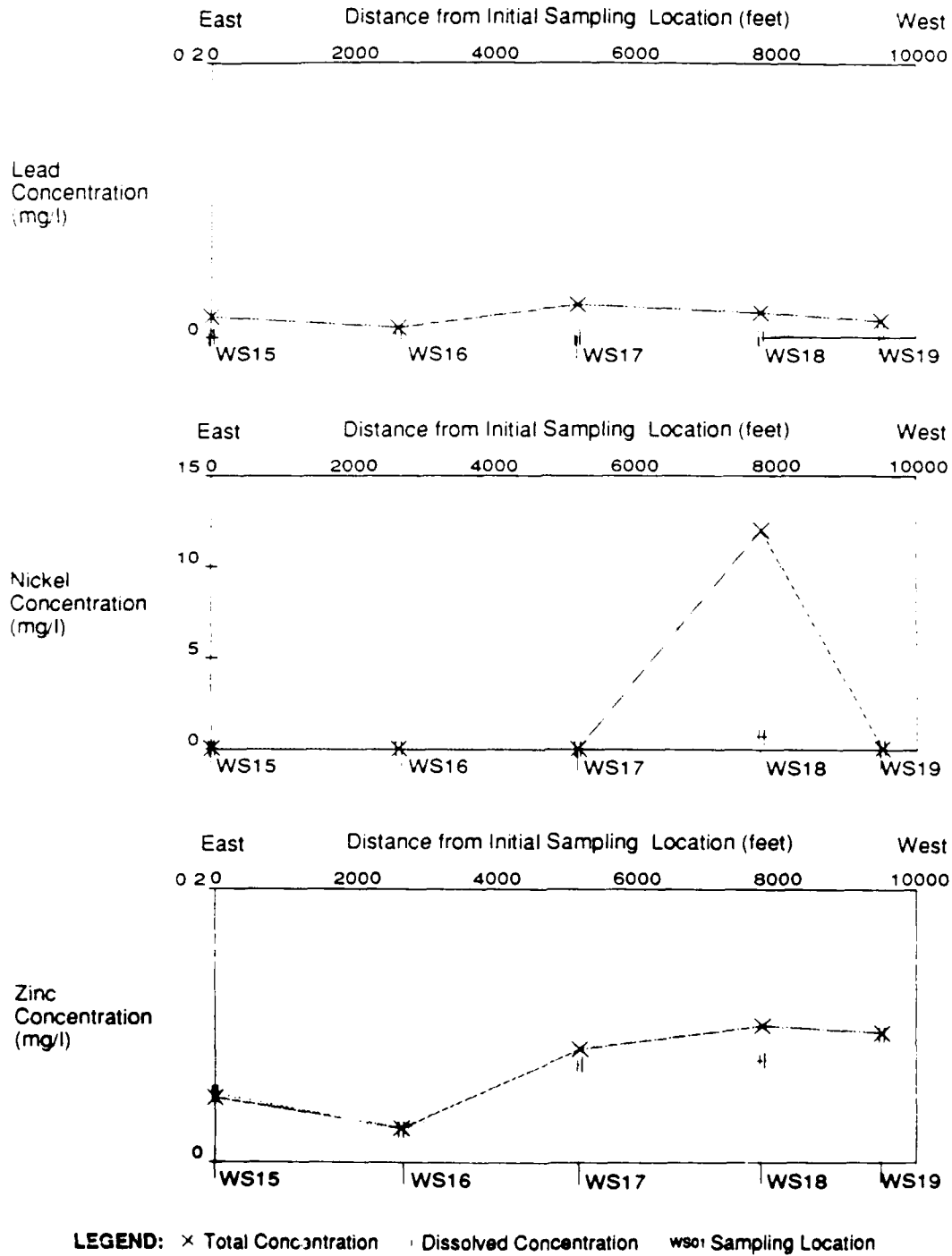


Figure 4-2(Continued) Concentration Graphs of Detected Metals in Storm Drainage North Surface Water Samples, McClellan AFB.

mg/L, respectively. The dissolved copper concentration at WS19 is approximately two times greater than the total concentration. As previously discussed, a dissolved metal concentration is normally less than the total concentration. However, both the total and dissolved concentrations are very close to the detection limit of 0.006 mg/L, and the detected concentrations are within the range of error for this analytical method.

Total lead was detected at all five sample locations and dissolved lead was detected only at WS19. Total lead concentrations at WS17 and WS18 are slightly elevated above the datum point concentration of 0.015 mg/L. At WS19 total and dissolved lead concentrations are 0.012 and 0.004 mg/L, respectively.

Nickel was not detected at the datum point or at WS16 or WS17. The total nickel concentration at WS18 is 12.0 mg/L, which is well above the detection limit of 0.015 mg/L. At the final sample location, total and dissolved nickel concentrations are 0.049 and 0.089 mg/L, respectively. The dissolved nickel concentration is almost two times greater than the total concentration. These results are also within the range of error for this analytical method.

Total and dissolved zinc were detected at all sample locations. However, all zinc results for WS17-WS19 are qualified due to laboratory contamination. Zinc results were not qualified for the datum point and WS16. Total and dissolved zinc concentrations decreased from the datum point to WS16.

4.1.2.2 Volatile Organic Compounds

Acetone was detected at WS15, WS17, WS18, and WS19. All results are qualified due to laboratory contamination. Results for volatile organic compounds are not presented graphically.

4.1.2.3 Semivolatile Organic Compounds

Phenol and 4-nitrophenol were detected at location WS17. Phenol was detected at 1.8 ug/L, and 4-nitrophenol was detected at 7.9 ug/L. Both were estimated results less than five times the detection limit. Results for semivolatile organic compounds are not presented graphically.

4.1.3 Don Julio Creek

Don Julio Creek, located on the west side of the base, begins as two unpaved branches west of Buildings 772 and 779. The branches converge north of Shelter Road and from this point the creek flows generally to the west towards Patrol Road. The creek is routed around two holding ponds (Potential Release Location [PRL] 51). North of the holding ponds, Don Julio Creek flows to the west and exits the west-central portion of McClellan AFB east of Raley Boulevard. Surface water samples were collected from locations WS5, WS6, and WS7. The course of the creek and sampling locations are shown in Plate 1.

4.1.3.1 Metals

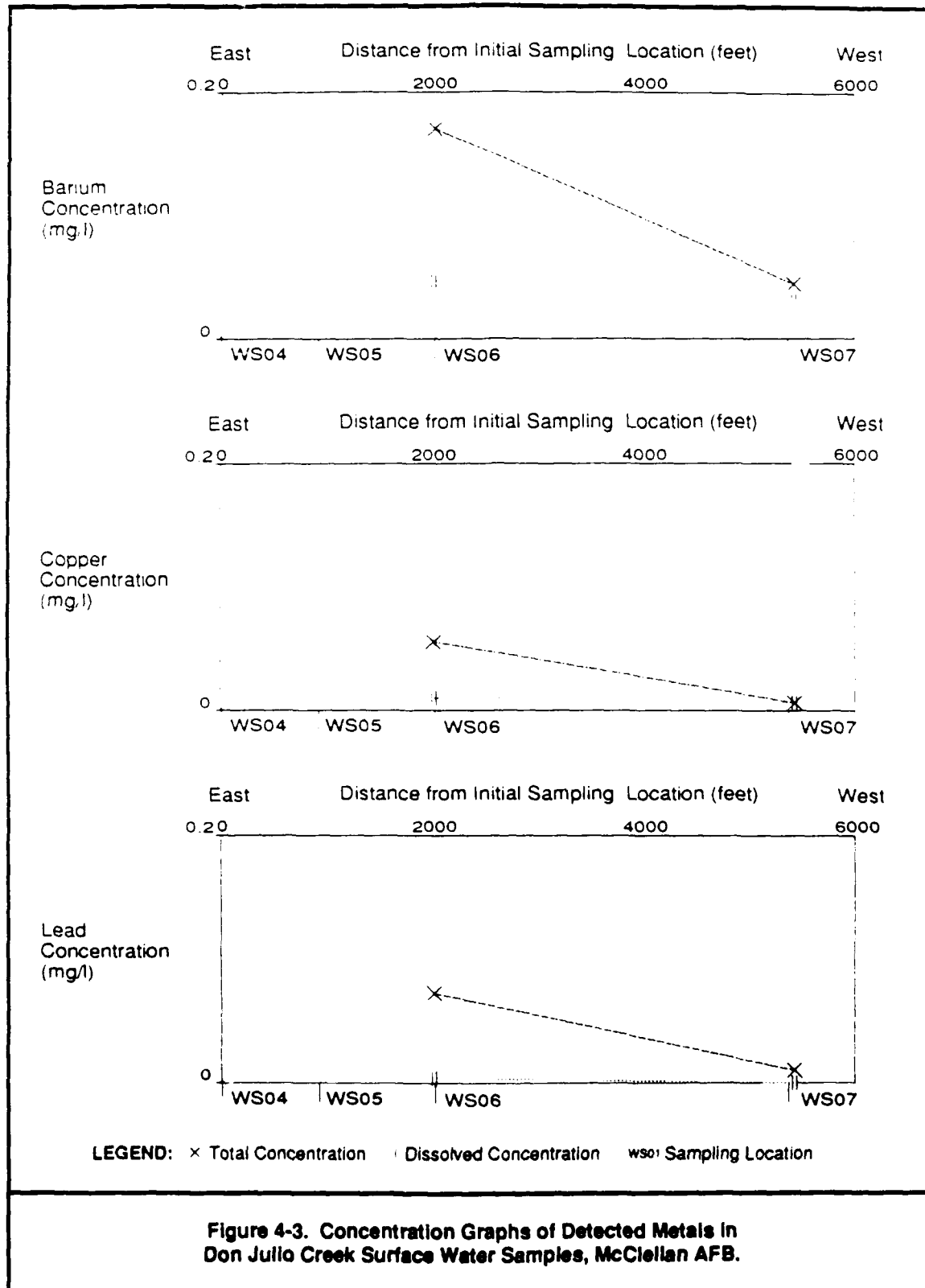
The portion of Don Julio Creek studied for this investigation originates well within base boundaries. Unlike Robla and Magpie Creeks, it does not have a datum point where the creek enters the base from the east. Location WS6 is the initial sample point and will not be referred to as a datum point for the metals evaluation. Metals analyses were performed on samples from locations WS6 and WS7. Barium, copper, lead, nickel, vanadium, and zinc were detected in Don Julio Creek samples; graphs of concentration changes for these metals are presented in Figure 4-3.

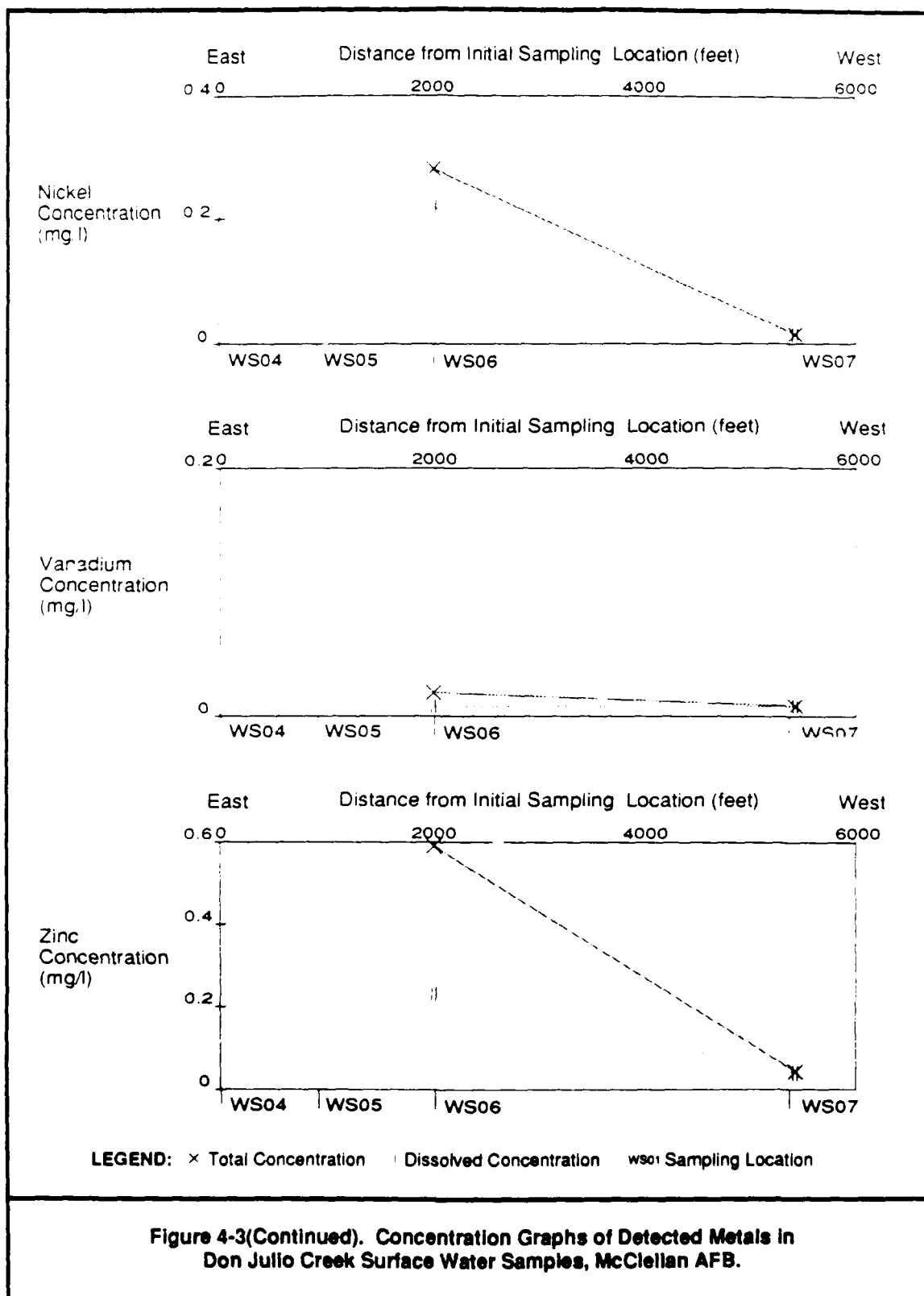
The total and dissolved barium concentrations at the initial sample point are 0.17 and 0.047 mg/L, respectively. Total and dissolved barium concentrations decrease along Don Julio Creek from the initial sample point to the exit point.

The total and dissolved copper concentrations at the initial sample point are 0.055 and 0.01 mg/L, respectively. The total copper concentration decreases along Don Julio Creek from the initial sample point to the exit point. Dissolved copper was not detected at the exit point.

The total and dissolved lead concentrations at the initial sample point are 0.072 and 0.004 mg/L, respectively. The total lead concentration decreases along Don Julio Creek to the exit point. Dissolved lead was not detected at the exit point.

The total and dissolved nickel concentrations at the initial sample point are 0.28 and 0.22 mg/L, respectively. Nickel was not detected at the exit point.





Vanadium was only detected at the initial sample point. The initial sample point concentration was 0.019 mg/L (total). Dissolved vanadium was not detected at either sample location.

Total and dissolved zinc were detected at the initial sample location; however, these results are qualified due to laboratory contamination. The total and dissolved zinc concentrations at the exit point are 0.043 and 0.039 mg/L, respectively.

4.1.3.2 Total Petroleum Hydrocarbons and Oil/Grease

Don Julio Creek receives runoff from OU C. To determine if petroleum products are present in the surface runoff, surface water samples from locations WS5 and WS6 were analyzed for total petroleum hydrocarbons and total recoverable oil and grease.

Total petroleum hydrocarbons were detected at both locations WS5 and WS6 at concentrations of 5.4 and 6.0 mg/L, respectively. Total recoverable oil and grease was detected at WS5 at a concentration of 5.2 mg/L and at WS6 at 7.7 mg/L. The detection limits for both petroleum hydrocarbons and oil and grease are 2.0 mg/L. Results for total petroleum hydrocarbons and oil and grease are not shown graphically.

4.1.3.3 Volatile Organic Compounds

Acetone was detected in samples from both the initial sample point and the exit point. All acetone results are qualified due to laboratory contamination. Results for volatile organic compounds are not presented graphically.

4.1.3.4 Semivolatile Organic Compounds

Bis(2-ethylhexyl)phthalate was detected at the exit point; however, the result was qualified due to laboratory contamination. Results for semivolatile organic compounds are not presented graphically.

4.1.4 Magpie Creek

Magpie Creek enters the southeast side of McClellan AFB near OU A and flows generally to the west across McClellan AFB. Much of Magpie Creek has been channelized, and a portion of it has been routed through culverts beneath the southern

end of the runway. Magpie Creek is unpaved west of Patrol Road and exits McClellan AFB approximately 650 feet east of Raley Boulevard. The course of Magpie Creek and the seven sampling locations along it are shown in Plate 1.

4.1.4.1 Metals

Barium, chromium, copper, lead, vanadium, and zinc were detected in Magpie Creek samples. Concentration graphs for these metals are presented in Figure 4-4.

The datum point concentrations for total and dissolved barium are 0.068 and 0.059 mg/L, respectively. Barium concentrations decrease slightly from the datum point to WS11. From WS12 to the exit point, barium concentrations increase.

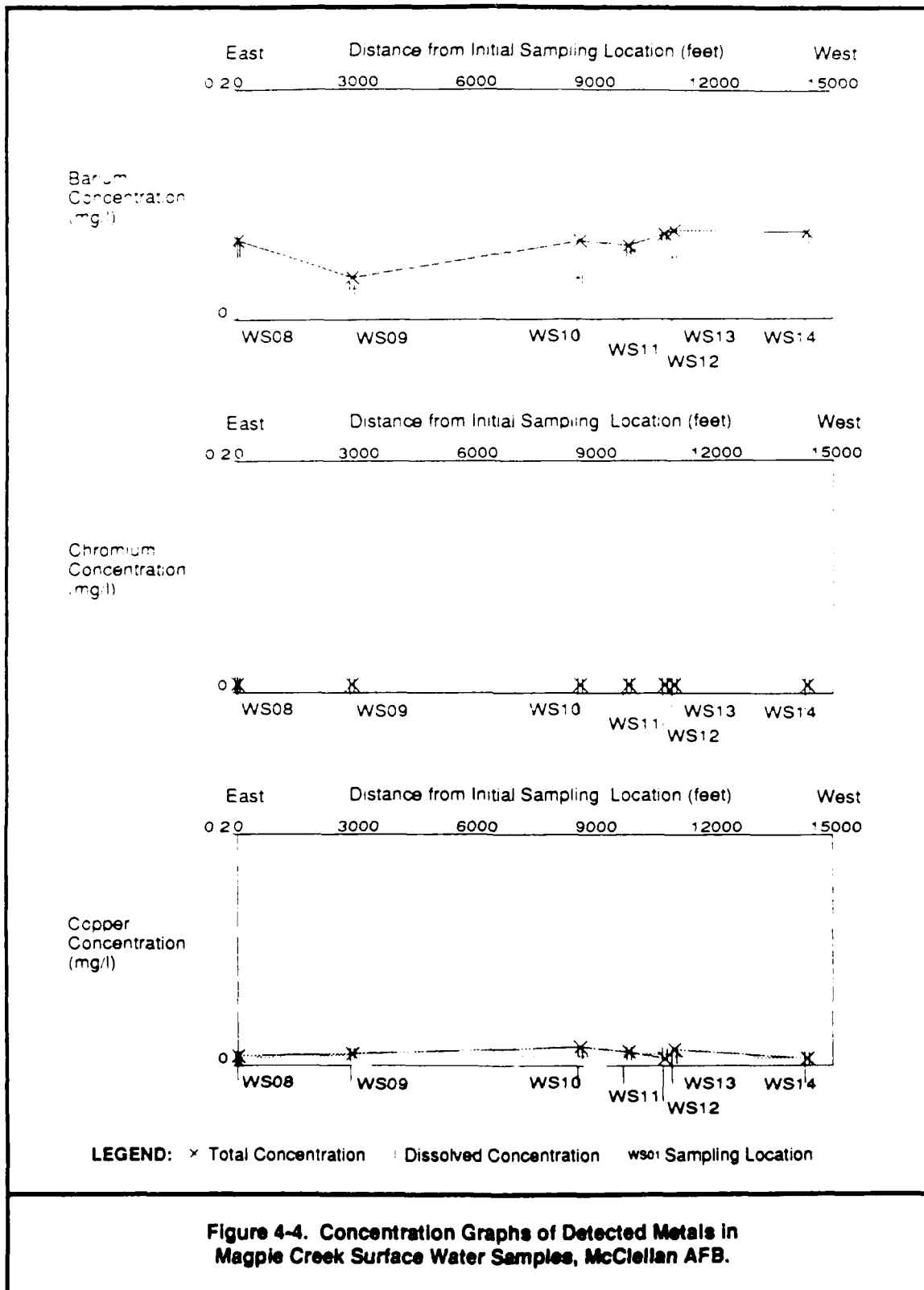
Total chromium was only detected at location WS13. The concentration detected at WS13 is equal to the detection limit of 0.007 mg/L. Dissolved chromium was not detected in any surface water samples collected from Magpie Creek.

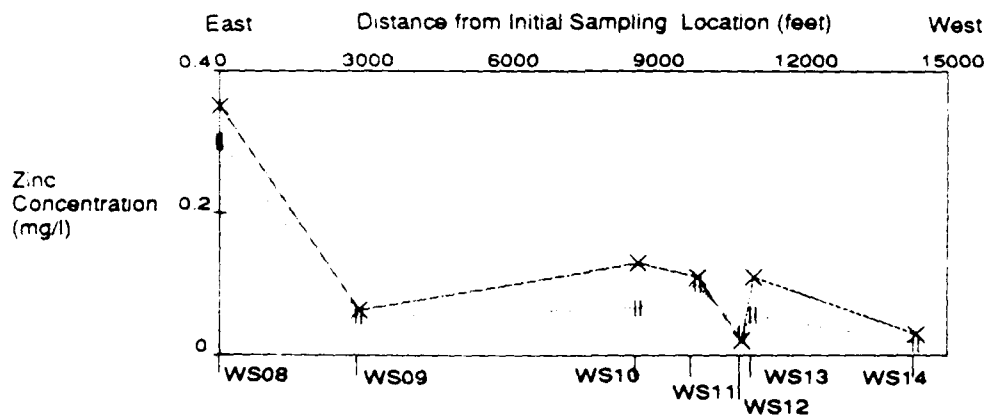
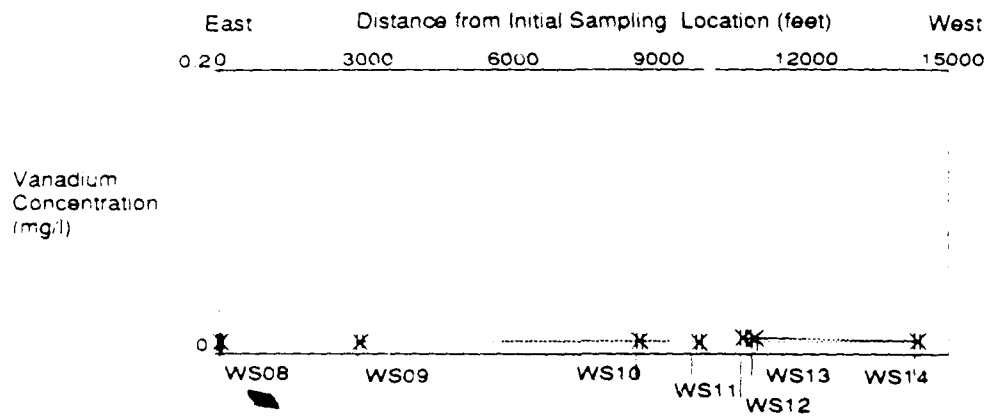
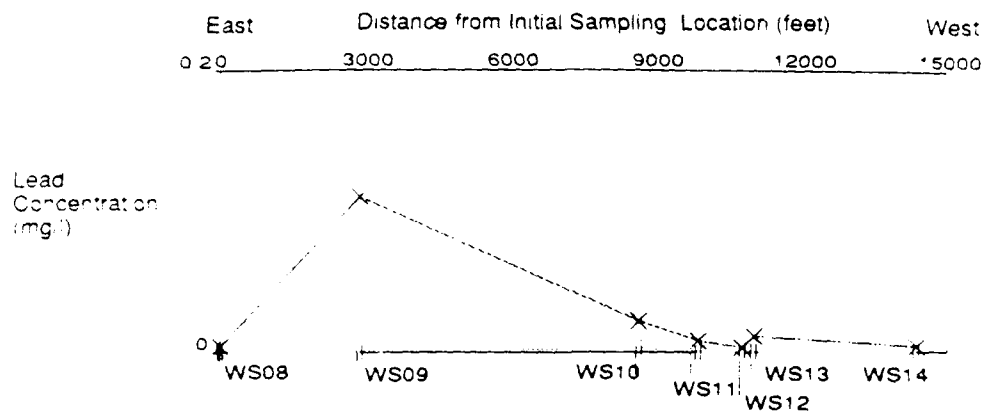
The total copper concentration at the datum point is 0.008 mg/L. Dissolved copper was not detected at the datum point. Copper concentrations increase slightly along Magpie Creek to location WS10. From WS10 to the exit point, copper concentrations decrease. Copper was not detected at the exit point.

Total lead was detected at all sample locations along Magpie Creek. Dissolved lead was detected only at location WS10. Lead results from sample locations WS09, WS10, WS12, and WS13 were qualified, and are not shown in the graph. Total lead concentrations at the datum point and the exit point are identical.

The total vanadium concentration at the datum point is 0.008 mg/L; dissolved vanadium was not detected. Total vanadium concentrations increase slightly along Magpie Creek from the datum point to the exit point, except for locations WS9 and WS11 where vanadium was not detected. Dissolved vanadium was detected only at WS12 and the exit point. The exit point concentration for both total and dissolved vanadium is 0.009 mg/L.

The datum point concentrations for total and dissolved zinc are 0.35 and 0.3 mg/L, respectively. Zinc concentrations decrease along Magpie Creek from the





LEGEND: x Total Concentration | Dissolved Concentration WS01 Sampling Location

Figure 4-4(Continued). Concentration Graphs of Detected Metals in Magpie Creek Surface Water Samples, McClellan AFB.

datum point concentration to the exit point. Zinc concentrations from the datum point were the highest concentrations detected in Magpie Creek samples. The results from location WS11 were qualified due to laboratory contamination.

4.1.4.2 Total Petroleum Hydrocarbons and Oil/Grease

Surface water samples from locations WS12, WS13, and WS14 were analyzed for total petroleum hydrocarbons and total recoverable oil and grease to determine if petroleum hydrocarbons are present along that portion of Magpie Creek.

Total petroleum hydrocarbons and oil and grease were detected at location WS13 at concentrations of 3.5 and 4.0 mg/L, respectively. The detection limits for both petroleum hydrocarbons and oil and grease are 2.0 mg/L. Total petroleum hydrocarbons and oil and grease concentrations for water samples from Magpie Creek are not shown graphically.

4.1.4.3 Volatile Organic Compounds

Acetone was detected in surface water samples from all Magpie Creek locations. However, all acetone results are qualified due to laboratory contamination. These results are not presented graphically.

4.1.4.4 Semivolatile Organic Compounds

Bis(2-ethylhexyl)phthalate and 4-nitrophenol were detected in field duplicate sample WS9. Bis(2-ethylhexyl)phthalate was also detected in surface water samples from locations WS8, WS11, and WS13; 4-nitrophenol was also detected in samples collected from locations WS9, WS10, and WS11. All bis(2-ethylhexyl)phthalate results were qualified due to laboratory contamination. All 4-nitrophenol results were estimated (less than five times the detection limit). Phenol was detected at location WS10. This was also an estimated result less than five times the detection limit. These results are not presented graphically.

4.1.4.5 Radioactivity

Sample location WS11 was selected for radioactivity analysis because it is located on Magpie Creek approximately 200 feet downstream from PRL 32. Potential

Release Location 32 (PRL 32) was reportedly a low-level radioactive and hazardous waste storage site. There is no evidence that any runoff from PRL 32 has the potential to carry radioactive materials to Magpie Creek. However, samples were taken to evaluate the potential.

Surface water samples collected from WS11 show detectable levels of beta and gamma radioactivity. The highest gross beta activity is 3.4 picocuries per liter (pCi/L). No standards are available for gross beta emissions. The beta activity would need to be speciated in order to make a comparison to any standards.

Gamma radioactivity detected was attributed to potassium-40 at 179.84 pCi/L and actinium-228 at 21.42 pCi/L. The State of California and the federal Nuclear Regulatory Commission have established standards of maximum radioactivity in effluents to unrestricted areas (10 Code of Federal Regulations [CFR] 20.105; and California Code of Regulations [CAC], Title 17, Section 30355). No standard is listed for potassium-40. The standard for soluble and insoluble actinium-228 is 90,000 pCi/L. Radiation levels for actinium 228 detected in samples are well below the radioactive effluent standards. Both potassium-40 and actinium-228 are naturally-occurring radioisotopes and may be present in surface water as a result of dissolution of natural minerals.

4.1.5 Storm Drainage South

Storm Drainage South (SDS) receives a majority of the runoff from the southern portion of the base. Storm Drainage South begins as an unpaved drainage west of Building 410. Surface water flows generally to the southwest towards a storm drainage line and culvert on "AK" Street. A major exit point for surface water from the southern portion of the base is at the intersection of "AK" Street and Kilzer Avenue. Surface water samples were to be collected from locations WS22 and WS23; however, there was an insufficient amount of water to collect a sample from location WS22. Samples were only collected from location WS23, shown in Plate 1, at the intersection of "AK" Street and Kilzer Avenue.

4.1.5.1 Metals

Barium, chromium, copper, vanadium, and zinc were detected in SDS samples. Total and dissolved barium were detected at 0.1 and 0.11 mg/L, respectively. Dissolved chromium was detected at 0.009 mg/L, which is only slightly above the

detection limit of 0.007 mg/L. Total chromium was not detected. Total copper and dissolved copper were detected at 0.012 and 0.008 mg/L, respectively. Both total and dissolved vanadium were detected at a concentration of 0.009 mg/L. Total and dissolved zinc were detected at 0.051 and 0.059 mg/L, respectively. The dissolved concentration is greater than the total; however, the results are within the range of error for the analytical method. Because samples were collected from only one location, the metals data are not presented graphically.

4.1.5.2 Volatile Organic Compounds

Acetone was detected in samples from WS23; however, all acetone results are qualified due to laboratory contamination.

4.1.6 Holding Ponds

Two holding ponds for treated industrial wastewater were sampled as part of the surface water investigation. The ponds are located in OU C and are identified as Potential Release Location (PRL) 51. Samples from location WS24 were taken in the larger earth-lined pond on the west, and samples from location WS25 were taken in the smaller cement-lined pond on the east. The ponds and sampling locations are shown in Plate 1.

4.1.6.1 Metals

Barium, chromium, copper, lead, nickel, vanadium, and zinc were detected in surface water samples from location WS24. Total and dissolved barium were detected at 0.053 and 0.044 mg/L, respectively. Total chromium and total copper were detected at 0.017 and 0.009 mg/L, respectively. Dissolved chromium and copper were not detected. Total and dissolved lead were detected; however, the results are qualified due to reagent blank contamination. Total nickel was detected at 0.032 mg/L and dissolved nickel was detected at 0.031 mg/L. Total and dissolved vanadium were detected at 0.014 and 0.013 mg/L, respectively. Total and dissolved zinc were both detected at 0.02 mg/L.

Barium, chromium, copper, lead, nickel, and zinc were detected in surface water samples from location WS25. The total and dissolved barium concentrations are 0.048 and 0.045 mg/L, respectively. Total chromium was detected at 0.039 mg/L and dissolved chromium was detected at 0.009 mg/L. The total and dissolved copper

concentrations are 0.01 and 0.04 mg/L, respectively. Total and dissolved lead were detected; however, the results are qualified due to reagent blank contamination. Total nickel was detected at 0.027 mg/L and dissolved nickel was detected at 0.026 mg/L. Total zinc was detected at 0.019 mg/L and dissolved zinc was detected at 0.029 mg/L. As previously discussed, dissolved concentrations are expected to be less than total concentrations. The zinc results for location WS25 are within the range of error for the analytical method.

4.1.6.2 Volatile Organic Compounds

Acetone was detected in samples from both locations, WS24 and WS25. All acetone results are qualified due to laboratory contamination.

4.1.6.3 Semivolatile Organic Compounds

Bis(2-ethylhexyl)phthalate was detected in samples from locations, WS24 and WS25. The results are qualified due to reagent blank contamination.

4.1.7 Aeration Lagoons

Two aeration lagoons located west of the industrial waste treatment plant were sampled as part of the surface water investigation. The lagoons are located in OU C and are identified as PRL 60. The lagoons are currently being used to divert and aerate Magpie Creek water before it exits from McClellan AFB. Surface water samples were collected from locations WS26 and WS27. Sampling locations are shown in Plate 1.

4.1.7.1 Metals

Barium, lead, vanadium, and zinc were detected at location WS26. Total and dissolved barium were detected at 0.079 and 0.072 mg/L, respectively. Total lead was detected; however, the result was qualified due to reagent blank contamination. Total and dissolved vanadium were detected at 0.009 and 0.008 mg/L, respectively. Total zinc was detected at 0.031 mg/L and dissolved zinc was detected at 0.02 mg/L.

Barium, copper, lead, and zinc were detected at location WS27. Total and dissolved barium were detected at 0.083 and 0.074 mg/L, respectively. Total copper was detected at 0.009 mg/L; dissolved copper was not detected. Total lead was detected,

however, the result was qualified due to laboratory contamination. Total and dissolved zinc were detected at 0.052 and 0.044 mg/L, respectively.

4.1.7.2 Volatile Organic Compounds

Acetone was detected at location WS27. All acetone results are qualified due to laboratory contamination.

4.1.7.3 Semivolatile Organic Compounds

Bis(2-ethylhexyl)phthalate was detected at both locations WS26 and WS27. The results were qualified due to reagent blank contamination.

4.1.8 Additional Sample Locations

Two additional locations were sampled as part of the surface water investigation (WS20 and WS21). Sampling station WS20 is located within Site P5. Site P5 is an unpaved ditch, located north of Building 475 in OU A. The ditch is approximately 4 feet deep and drains into Magpie Creek. Sampling Station WS21 is located in the unpaved portion of the drainage ditch that parallels Lang Avenue south of Water Tower #769. Runoff from this drainage also flows into Magpie Creek.

4.1.8.1 Metals

Barium, copper, lead, and zinc were detected in surface water samples collected from location WS20. Total and dissolved barium were detected at 0.040 and 0.033 mg/L, respectively. Total copper was detected at 0.013 mg/L and dissolved copper was detected at 0.012 mg/L. Total lead was detected at 0.006 mg/L; dissolved lead was not detected. Total and dissolved zinc were detected at 0.037 and 0.022 mg/L, respectively.

Barium, cadmium, chromium, copper, lead, and zinc were detected at location WS21. Total and dissolved barium were detected at 0.042 and 0.027 mg/L, respectively. Total cadmium and total chromium were detected at 0.006 and 0.008 mg/L, respectively; dissolved cadmium and dissolved chromium were not detected. Total copper was detected at 0.026 mg/L and dissolved copper was detected at 0.01 mg/L. Total and dissolved lead were detected at 0.057 and 0.004 mg/L, respectively. Total zinc was detected at 0.14 mg/L and dissolved zinc was detected at 0.07 mg/L.

4.1.8.2 Volatile Organic Compounds

Acetone was detected at locations WS20 and WS21. All acetone results are qualified due to suspected laboratory contamination.

4.2 Stream Sediment Results

Stream sediment samples were analyzed by several methods to detect different target analytes. The analytical methods and total number of sediment analyses performed are listed in Table 3-2 located on page 3-4. All analytes detected in stream sediment samples at or above laboratory detection limits are listed in Table 4-2 located on page 4-75 except for radioactive analysis. Analytes are listed according to the analytical method. Under each analytical method, the sample locations are listed numerically along with the sample identification. Concentrations are given in ppm or milligrams per kilogram (mg/kg) for all analyses except volatile and semivolatile organics. Concentrations for volatile and semivolatile organics are given in ppb or micrograms per kilogram (ug/kg).

Samples for radioactive analysis were collected from one location on Magpie Creek. The results are not listed in Table 4-2, but are presented in the Magpie Creek discussion.

The majority of analytes detected at or above laboratory detection limits are inorganic or metal cations. Analytical screening for metals was performed on stream sediment samples from 19 locations. In addition, mercury and total cyanide were analyzed for by ion-specific methods. Metals were detected in all sediment samples analyzed. Total cyanide was detected in samples from five locations. Samples from five locations were analyzed for oil and grease and total petroleum hydrocarbons. Samples from four locations had detectable concentrations of both oil and grease and total petroleum hydrocarbons. Volatile and semivolatile organics were analyzed for at 19 sample locations. Seven volatile organic compounds and eight semivolatile organic compounds were detected. Sediment samples collected from Magpie Creek for radioactive analysis were analyzed for gross alpha, gross beta, and gamma radioactivity. Gross alpha, gross beta, and gamma radioactivity were detected.

Each creek/drainage is discussed separately beginning with Robla Creek. Metals are discussed first. The metals of concern are the same as those listed in the surface water discussion under Section 4.1. Concentration graphs of detected metals are

presented for Robla, Don Julio, and Magpie creeks. Metal concentrations for surface scrapes are indicated by separate symbols on the graphs. At some locations, sediment samples were collected by hand auger at three depths in the stream bed. The depths of hand auger samples are also indicated by separate symbols on the graphs. In the metals discussion, the 0-1 foot, 1-2 foot, and 2-3 foot hand auger depths will be referred to as shallow, middle, and deep samples, respectively.

Field duplicate data are not plotted. If an analyte was not detected at a particular sample location, the concentration at the location is shown at the detection limit on the graph, and the location is discussed in the text. If an analyte was not detected at any sample locations or depths within a creek or drainage, it is not presented graphically. The graphs are oriented with the initial datum point to the east, on the left side of the graph, and the exit point to the west, on the right side of the graph.

Following the metals evaluation, total cyanide, total petroleum hydrocarbon, oil and grease, and volatile and semivolatile organic compound results are discussed for each creek/drainage. Results from additional sample locations that are not part of a major creek or drainage are presented last.

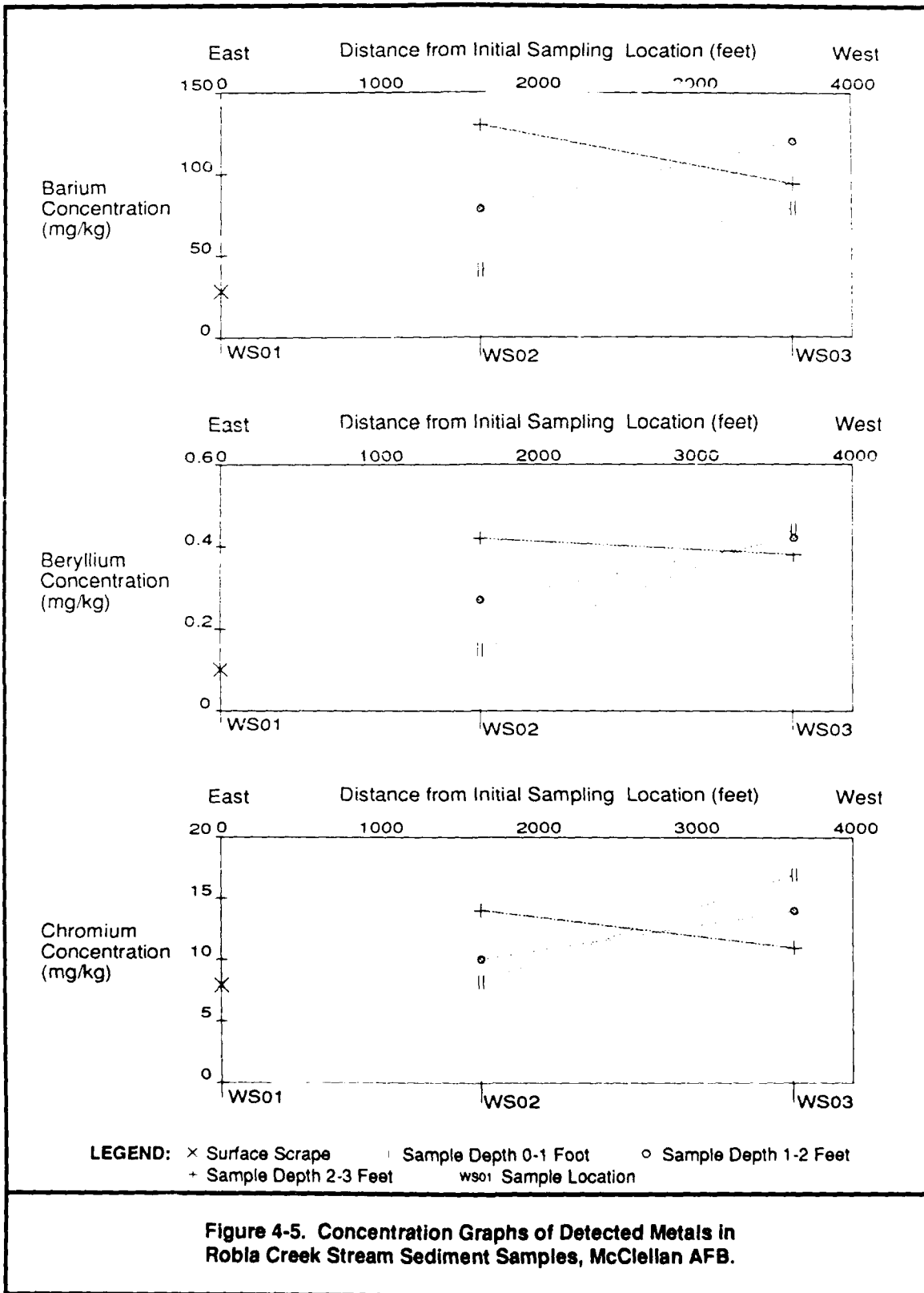
4.2.1 Robla Creek

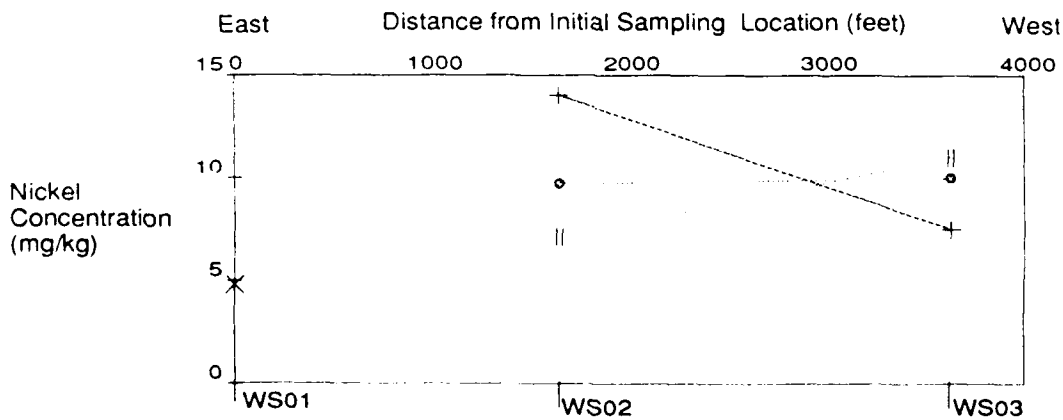
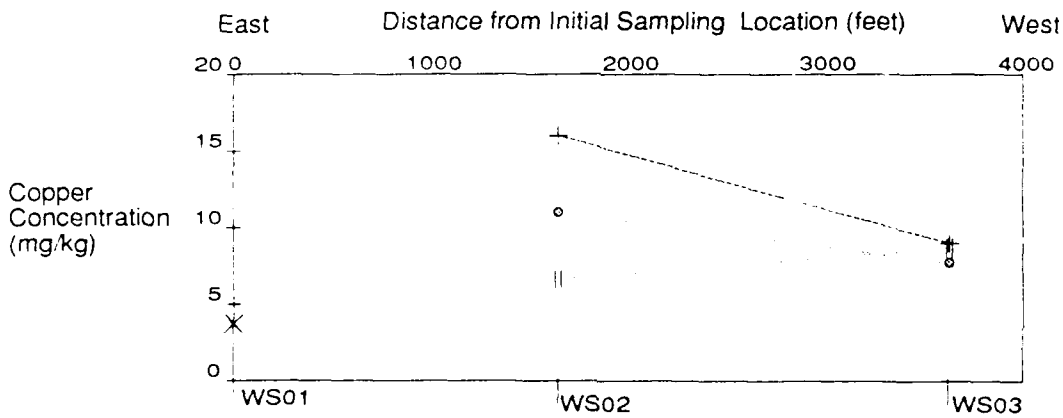
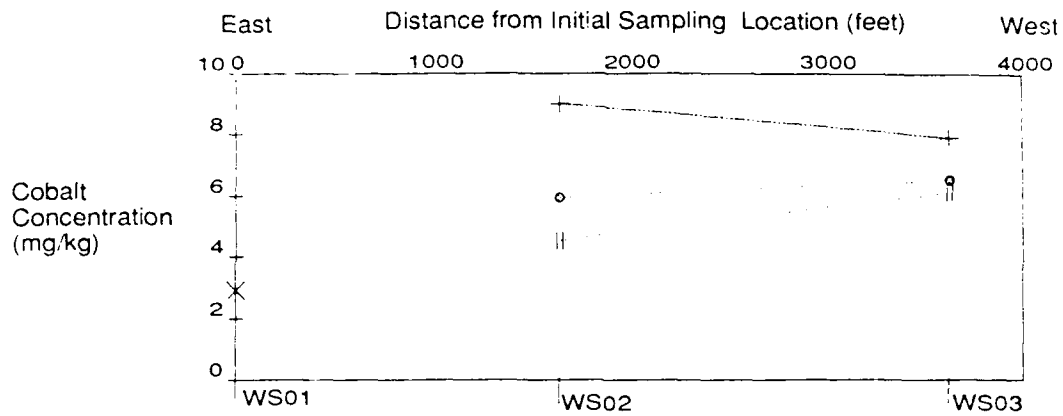
Stream sediment samples were collected at three locations along Robla Creek. A surface scrape sample was collected at location WS1 and is defined as the datum point. Samples were collected and analyzed from three depths at WS2 and WS3. The course of the creek and sampling locations are shown in Plate 1.

4.2.1.1 Metals

Barium, beryllium, chromium, cobalt, copper, nickel, vanadium, and zinc were detected in Robla Creek samples. Concentration changes for these metals in samples taken along the creek are presented graphically in Figure 4-5.

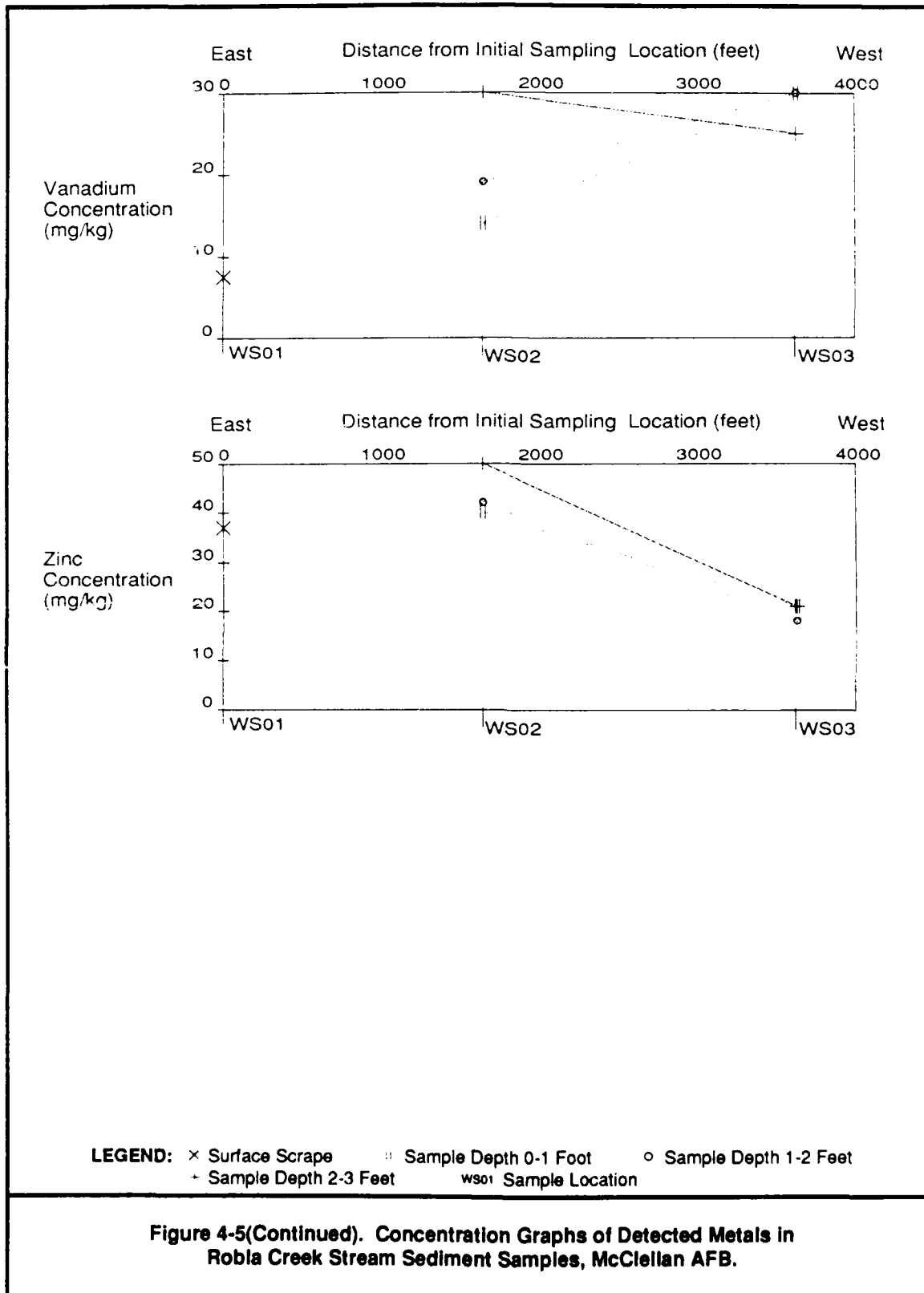
Barium was detected at 28.0 mg/kg at the datum point. Barium concentrations in the shallow and mid-level samples increase along Robla Creek from WS2 to the exit point. Barium concentrations in the deep samples decrease along Robla Creek from WS2 to the exit point.





LEGEND: × Surface Scrape + Sample Depth 0-1 Foot ○ Sample Depth 1-2 Feet
- Sample Depth 2-3 Feet WS01 Sample Location

Figure 4-5(Continued). Concentration Graphs of Detected Metals in Robla Creek Stream Sediment Samples, McClellan AFB.



Chromium was detected at the datum point at 7.9 mg/kg. Chromium concentrations increase in the shallow and mid-level samples toward the exit point, and decrease in the deep sample along Robla Creek.

Cobalt, copper, and nickel each had similar distribution patterns. At the datum point, cobalt was detected at 2.9 mg/kg, copper at 3.7 mg/kg, and nickel at 4.8 mg/kg. The shallow depth sample for cobalt, copper, and nickel increased toward the exit point. Mid-level sample results indicate cobalt and nickel increase slightly, while copper results decreased. The deep-sample concentrations decrease for all three metals from WS2 to the exit point.

Vanadium was detected at 7.5 mg/kg at the datum point. Shallow and mid-level samples indicate an increase in vanadium levels toward the exit point. Vanadium concentrations in the deep sample decrease, with increased distance from the datum point.

Zinc was detected at 37.0 mg/kg at the datum point. Zinc was detected at higher concentration for shallow, middle, and deep samples at WS2 than the datum point. Zinc concentrations decrease in all three depths at WS3, the exit point for Robla Creek.

4.2.1.2 Volatile Organic Compounds

Methylene chloride was detected in all sediment samples taken from Robla Creek. However, all results are qualified due to reagent blank contamination with methylene chloride. Volatile organic compounds are not presented graphically.

4.2.1.3 Semivolatile Organic Compounds

Bis(2-ethylhexyl)phthalate was the only U.S. EPA Method 8270 analyte identified in Robla Creek sediment samples. This compound is qualified due to probable laboratory contamination.

4.2.2 Storm Drainage North

Stream sediment was collected from one location along Storm Drainage North (SDN). Two locations, WS15 and WS19, had been selected for stream sediment

sampling; however, WS19 had an insufficient amount of sediment to sample. Therefore, only WS15 will be discussed in this section. A surface scrape sample was collected from location WS15. The SDN and its sampling locations are shown in Plate 1.

4.2.2.1 Metals

Barium was identified at 51.0 mg/kg at WS15. Beryllium was identified at 0.18 mg/kg. Cadmium was identified at 0.59 mg/kg. Chromium was detected at 15.0 mg/kg. Cobalt was detected at 4.9 mg/kg. Copper was detected at 14.0 mg/kg. Nickel was detected at 16.0 mg/kg. Lead was detected at 65.0 mg/kg, and zinc was detected at 150.0 mg/kg.

4.2.2.2 Total Cyanide

Total cyanide was only identified in the field duplicate of WS15 at a concentration of 5.0 mg/kg, which is equal to the detection limit. Cyanide was not detected in the normal sample. The presence of cyanide at the detection limit in the field duplicate suggests that the analyte is present in both samples but is just below detection in the normal sample.

4.2.2.3 Semivolatile Organic Compounds

Stream sediment samples from location WS15 and its field duplicate were analyzed for semivolatile organic compounds. The following compounds were estimated results identified at less than five times the detection limit: benzo(a)pyrene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, di-n-butylphthalate, and phenanthrene. Four additional compounds were detected at the indicated levels: bis(2-ethylhexyl)phthalate at 1300 ug/kg, butylbenzylphthalate at 1100 ug/kg, fluoranthene at 590 ug/kg, and pyrene at 930 ug/kg. These results are not presented graphically.

4.2.3 Don Julio Creek

Stream sediment samples were collected from four locations on Don Julio Creek: WS4, WS5, WS6, and WS7. Shallow, middle, and deep samples were taken at all sample sites. Sampling station WS4 is defined as the datum point for sediment sampling, and WS7 is the exit point. Sampling locations on Don Julio Creek are shown in Plate 1.

4.2.3.1 Metals

Arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, nickel, vanadium, and zinc were detected. Concentration graphs for these metals are presented in Figure 4-6.

Arsenic was not detected at the datum or at the exit point at any depth. At WS5, arsenic was detected in the middle and deep samples near the detection limit. At WS6, arsenic was detected near the detection limit in the deep sample only.

Barium was detected in all sediment samples collected from Don Julio Creek. Barium concentrations at all three sample depths increase from the datum point to the exit point. Barium concentrations at the exit point are 72.0 mg/kg, 101.0 mg/kg, and 120.0 mg/kg for shallow, middle, and deep samples, respectively.

Beryllium was detected at all three depths and at all sample locations along Don Julio Creek. Beryllium concentrations generally increase with depth. Beryllium levels in the shallow sample were 0.26 mg/kg for both the datum point and the exit point. Beryllium concentrations in mid-level handauger samples increase from the datum point to the exit point.

Cadmium concentrations in shallow samples increase from below the detection limit at the datum point to a peak concentration of 0.75 mg/kg at location WS5. Where Don Julio Creek exits the base, cadmium was detected at Figure 4-6 (page 1 of 4) 0.63 mg/kg in the shallow sample. Cadmium was not detected in any mid-level samples. Cadmium was detected in only one deep sample (WS6) at a concentration of 0.4 mg/kg.

Chromium was detected at all three depths and at all sample locations along Don Julio Creek. Chromium levels at all sample depths increase from the datum point to the exit point. Chromium was detected at the exit point in shallow sediment at 18.0 mg/kg, in mid-depth sediment at 22.0 mg/kg, and in deep sediment at 32.0 mg/kg.

Cobalt concentrations for all sample depths increase from the datum point to the exit point along Don Julio Creek. Concentrations are highest for the middle and deep samples. Cobalt concentrations at the exit point are 6.1 mg/kg in the shallow sample and 8.4 mg/kg for both the middle and deep samples.

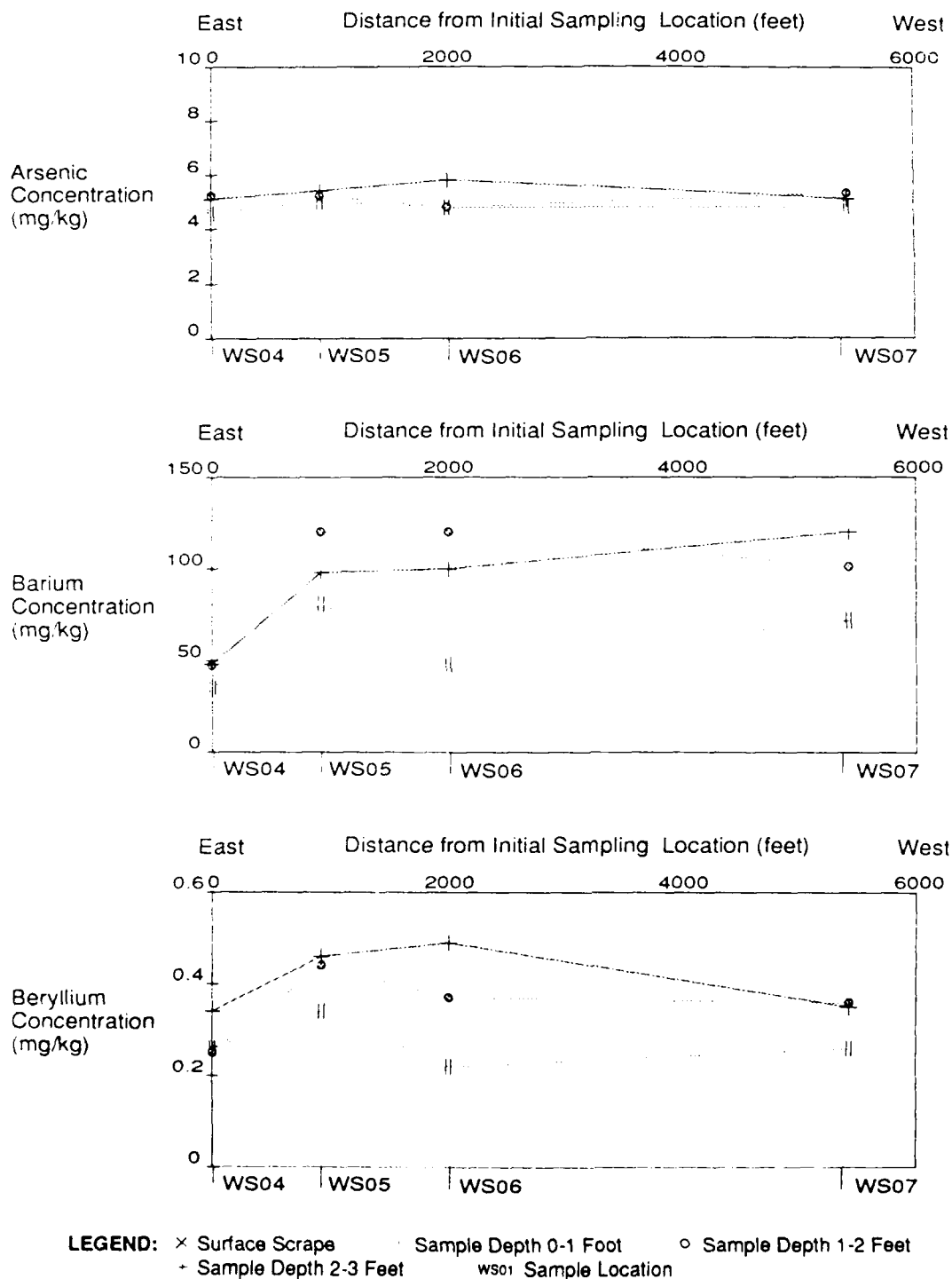
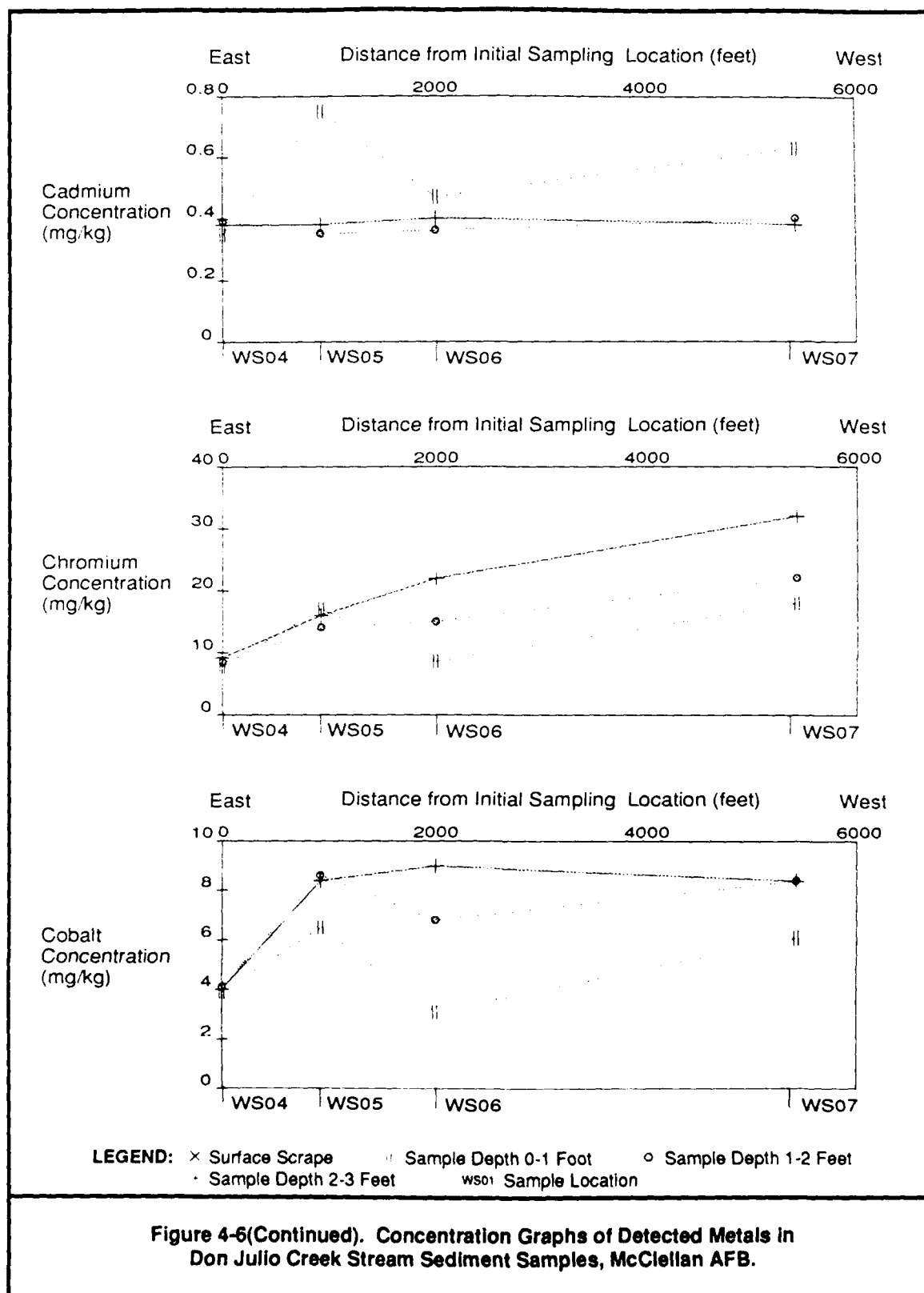


Figure 4-6. Concentration Graphs of Detected Metals in Don Julio Creek Stream Sediment Samples, McClellan AFB.



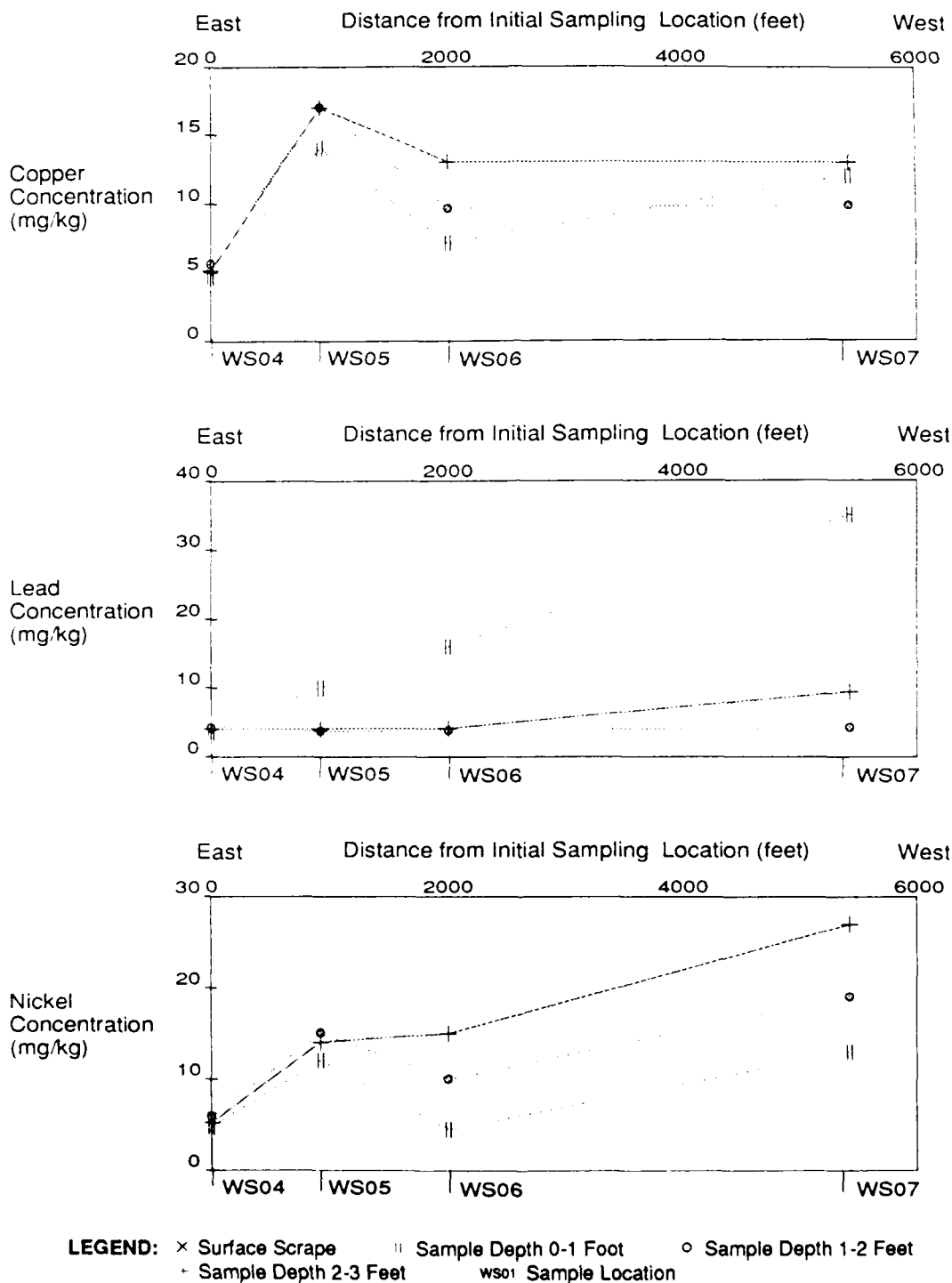


Figure 4-6(Continued). Concentration Graphs of Detected Metals in Don Julio Creek Stream Sediment Samples, McClellan AFB.

The distribution of copper in samples along Don Julio Creek was similar for all three sample depths. At the datum point, copper was detected in shallow sediment at 4.7 mg/kg, in mid-depth sediment at 5.6 mg/kg, and in deep sediment at 5.1 mg/kg. Copper concentrations increase at WS5 to approximately 15 mg/kg for all depths. From WS5 to WS6 copper levels decrease. From WS6 to the exit point copper levels remain approximately the same for middle and deep sediment, but increase by a factor of two in the shallow sediment sample.

Lead was not detected at the datum point at any depth. Lead in shallow sediment samples increase steadily along the creek to a maximum of 35.0 mg/kg at the exit point. Lead was not detected in middle and deep samples at any location except WS7, the exit point.

Nickel was detected in shallow, middle, and deep sediment samples from all locations along Don Julio Creek. Nickel levels increase from the datum point to the exit point for all sample depths. Concentrations generally increase with depth. The exit point concentrations are 13.0 mg/kg, 19.0 mg/kg, and 27.0 mg/kg for shallow, middle, and deep samples, respectively.

Vanadium was detected at all three depths at each sample location. Shallow and mid-depth vanadium levels are approximately constant from the datum point to the exit point. Vanadium concentrations in the deep samples increase from the datum point and reach a peak concentration of 70 mg/kg at WS6. From WS6 to the exit point at WS7, the vanadium concentration decreases by about 60 percent in the deep zone.

Zinc was detected at all three sample depths at each sample location. A peak concentration of 170.0 mg/kg was detected in the shallow sample from location WS5. Zinc concentrations show an overall increase from the datum point to the exit point, but concentrations in the shallow samples decrease from WS5 to WS6. Zinc concentrations at the exit point at 52.0 mg/kg, 24.0 mg/kg, and 36.0 mg/kg for the shallow, middle, and deep samples, respectively.

4.2.3.2 Total Cyanide

Total cyanide was detected at WS6 in shallow, middle, and deep sediment samples. The shallow and deep samples had cyanide levels of 6.0 mg/kg, and the mid-depth sample had cyanide detected at 8.0 mg/kg.

4.2.3.3 Total Petroleum Hydrocarbons and Oil/Grease

Stream sediment samples from locations WS5 and WS6 were analyzed for total petroleum hydrocarbons and total recoverable oil and grease. Hand auger samples were collected at three depths from both locations.

Total petroleum hydrocarbons were detected in the shallow sample at locations WS5 and WS6 at concentrations of 470 mg/kg and 400 mg/kg, respectively. Total petroleum hydrocarbons were not detected in the middle or deep samples.

Total recoverable oil and grease in the shallow sample at WS5 was 870 mg/kg. No method analytes were detected in the middle or deep samples. Oil and grease was detected at location WS6 in the shallow sample at 590 mg/kg. However, this result is qualified due to poor field duplicate precision. Oil and grease were detected in middle and deep samples at WS6. The mid-depth concentration is 200.0 mg/kg and the concentration in the deep sample is 300 mg/kg. Total petroleum hydrocarbons and recoverable oil and grease concentrations are not shown graphically.

4.2.3.4 Volatile Organic Compounds

Toluene was identified at the exit point (location WS7) in the shallow sediment sample. Dichlorodifluoromethane was identified at location WS4 in the mid-level and deep sediment samples at less than five times the detection limit but was not identified at any other location or depth. Acetone was detected in several samples, but its presence is due to laboratory contamination. Acetone results are qualified for all samples. Volatile organic compound results are not shown graphically.

4.2.3.5 Semivolatile Organic Compounds

Di-n-butylphthalate was detected in samples from all locations on Don Julio Creek. All di-n-butylphthalate results were qualified due to reagent blank contamination. Bis(2-ethylhexyl)phthalate was detected in samples from locations WS6 and WS7. The presence of bis(2-ethylhexyl)phthalate is most likely due to laboratory contamination because it is present in plastics used in the laboratory. Phenol was detected in the deep sediment sample at location WS4 and in the shallow and deep samples at WS5. Phenol was not detected at any amount greater than five times the detection limit. Semivolatile organic results are not shown graphically.

4.2.4 Magpie Creek

Stream sediment samples were collected from seven locations on Magpie Creek (WS8-WS14). Sample station WS8 is the initial datum point and WS14 is the exit point. Locations WS8-WS12 are surface scrape samples. Samples from WS11 were analyzed for radioactivity only. Samples from locations WS13 and WS14 shown in Plate 1 were collected with a hand auger at three depths.

4.2.4.1 Metals

Arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, nickel, silver, vanadium, and zinc were detected in sediment samples collected from Magpie Creek. Concentration graphs for these metals are presented in Figure 4-7.

Arsenic was detected in one deep hand auger sample from location WS13 at a concentration of 5.6 mg/kg. Arsenic was not detected in any other sediment samples from Magpie Creek.

Barium was detected in all sediment samples collected from Magpie Creek. Barium concentrations in surface scrape samples decrease from the datum point to location WS12. The datum point concentration is 100.0 mg/kg; however, this result is qualified due to a high relative percent difference between duplicate sample results. Barium concentrations in middle and deep hand auger samples increase from location WS13 to the exit point; concentrations in shallow samples decrease from WS13 to the exit point. Barium concentrations at the exit point are 91.0 mg/kg, 74.0 mg/kg and 94.0 mg/kg for shallow, middle, and deep samples, respectively.

Beryllium was detected in all sediment samples collected from Magpie Creek, except those from location WS10. The beryllium concentration in a surface scrape sample at the datum point is 0.2 mg/kg. Beryllium concentrations decrease in surface scrape samples along Magpie Creek from the datum point to location WS12. Beryllium levels in hand-auger samples decrease from location WS13 to the exit point. The exit point concentrations of beryllium are 0.21 mg/kg for shallow and 0.28 mg/kg for both middle and deep hand auger samples.

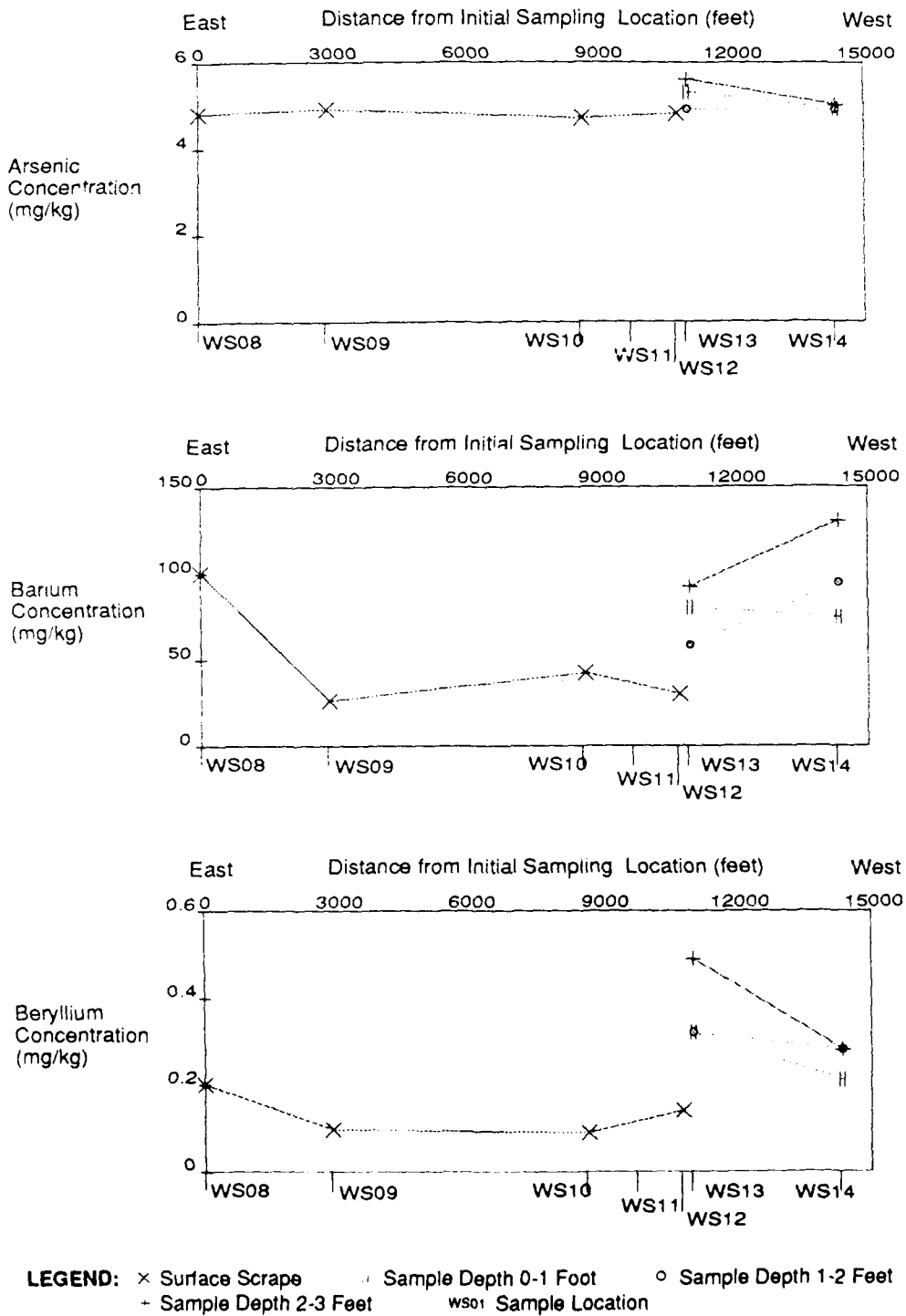


Figure 4-7. Concentration Graphs of Detected Metals in Magpie Creek Stream Sediment Samples, McClellan AFB.

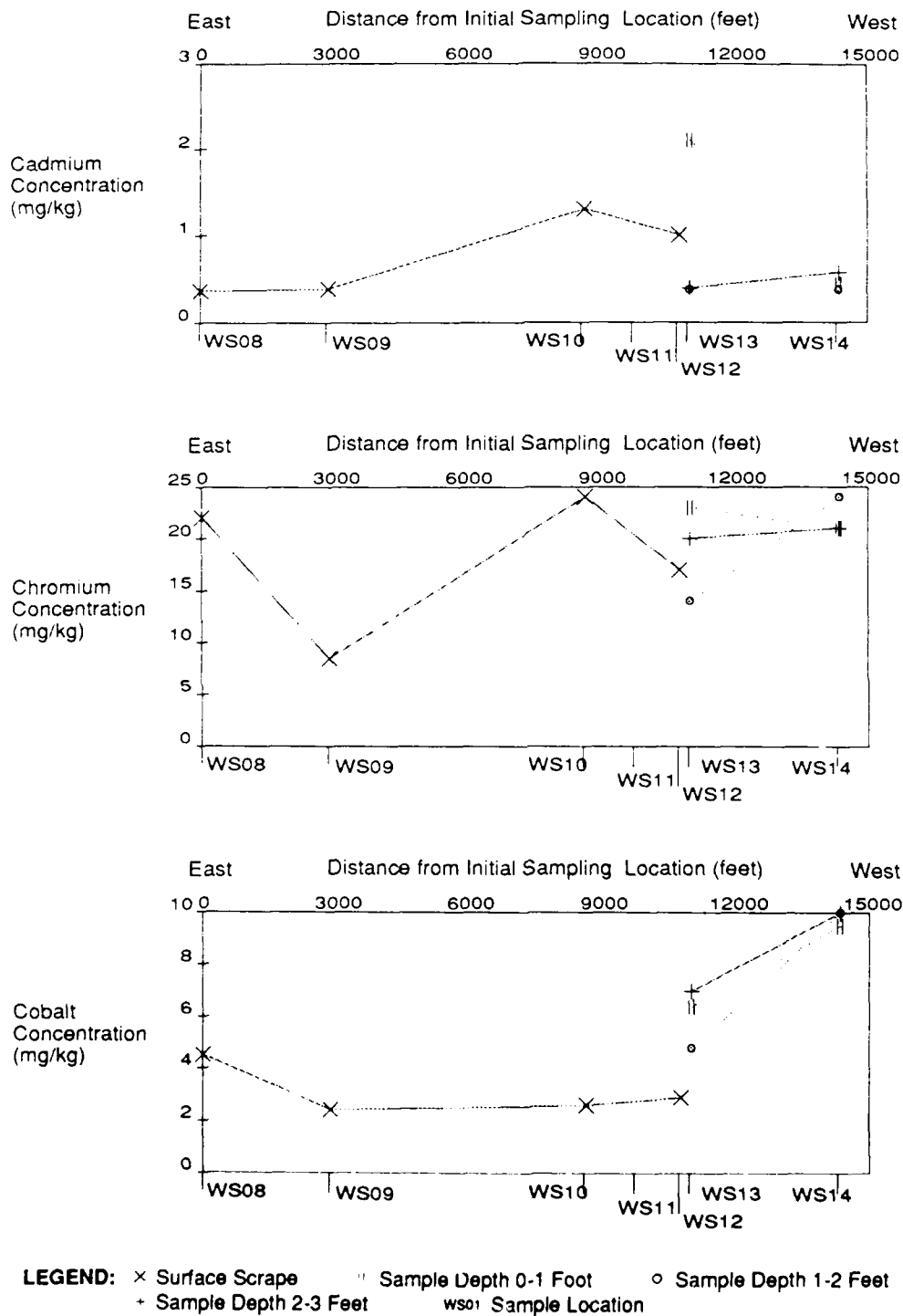


Figure 4-7(Continued). Concentration Graphs of Detected Metals in Magpie Creek Stream Sediment Samples, McClellan AFB.

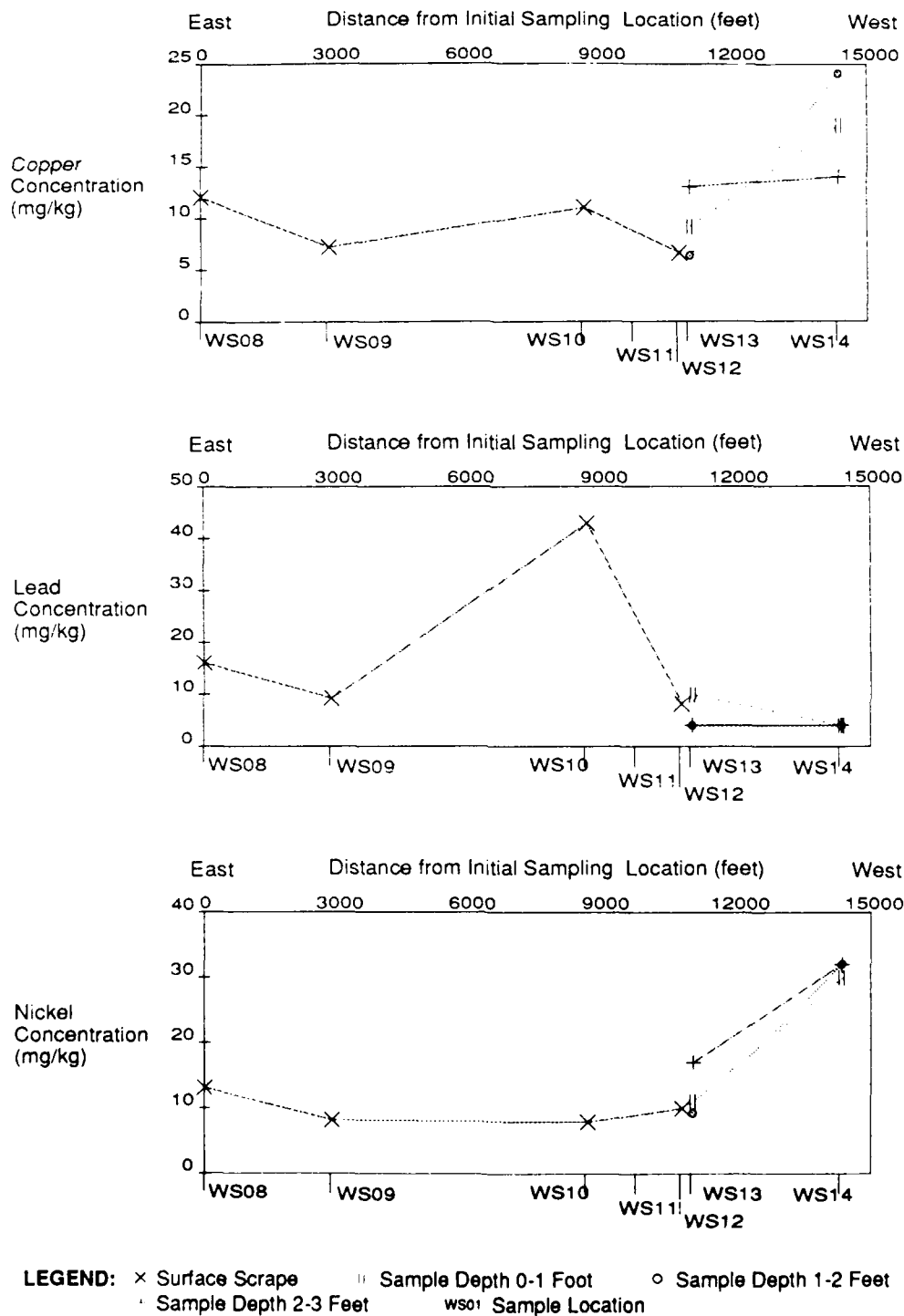


Figure 4-7(Continued). Concentration Graphs of Detected Metals in Maple Creek Stream Sediment Samples, McClellan AFB.

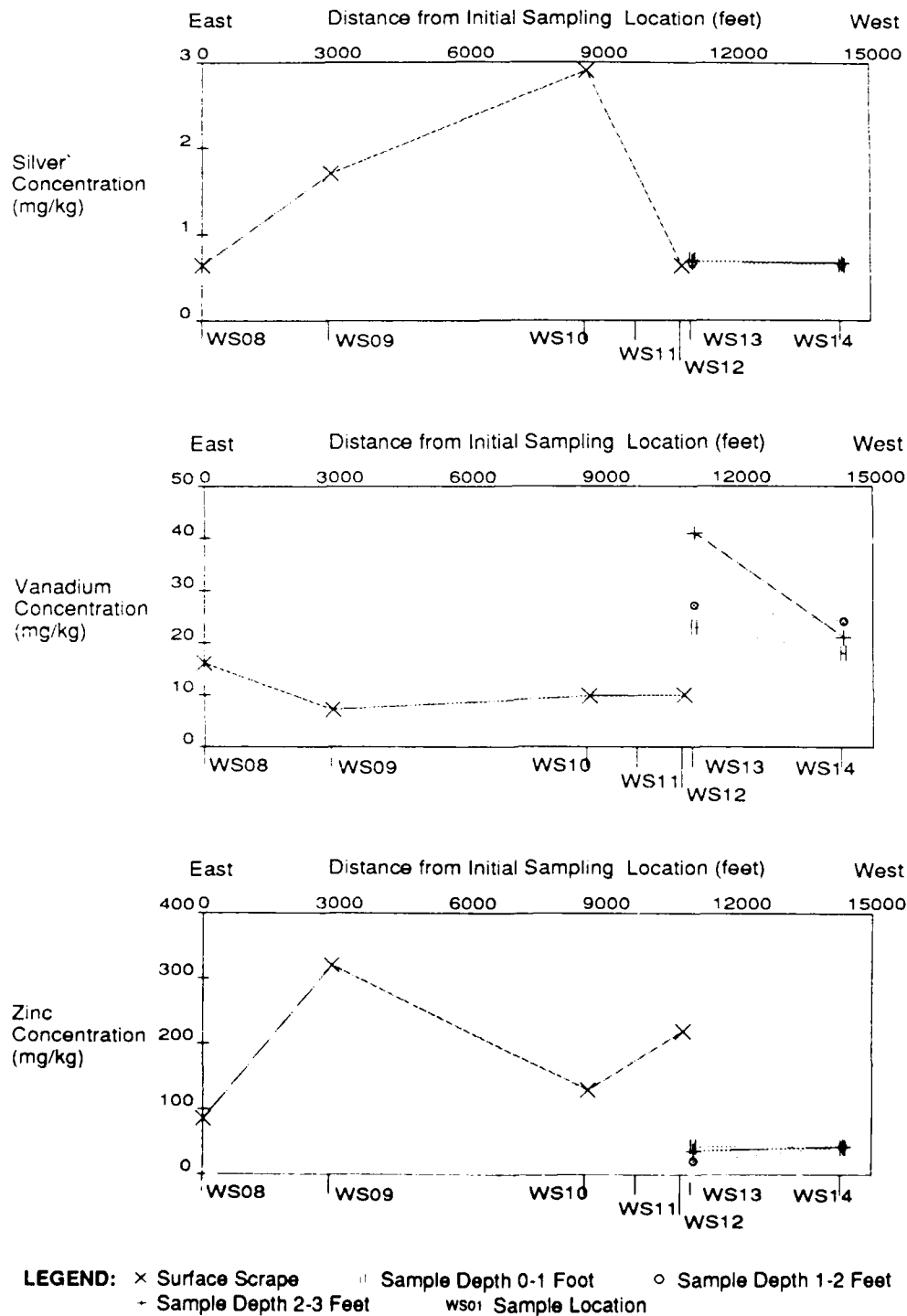


Figure 4-7(Continued). Concentration Graphs of Detected Metals in Maple Creek Stream Sediment Samples, McClellan AFB.

Cadmium concentrations increase from below the detection limit at the datum point to 1.0 mg/kg at location WS12. Cadmium concentrations in hand auger samples decrease from WS13 to the exit point in shallow samples, and increase from below the detection limit at WS13 to 0.57 mg/kg at the exitpoint in deep samples. The result for the shallow hand auger sample at location WS14 is qualified due to a high relative percent difference between duplicate sample pairs. Cadmium was not detected in mid-depth hand auger samples.

Chromium was detected in all sediment samples collected from Magpie Creek. Chromium concentrations fluctuated in surface scrape samples. A peak concentration of 24.0 mg/kg was detected at location WS10. The datum point concentration from the surface scrape at WS08 is qualified due to a high relative percent difference between a pair of duplicate samples. Chromium concentrations were 9.4 and 22 mg/kg in the pair. The greater value is plotted in Figure 4-7. Chromium levels in hand auger samples decrease in shallow samples, and increase in middle and deep samples, from location WS13 to the exit point. Chromium concentrations at the exit point are 21.0 mg/kg for shallow and deep, and 24.0 mg/kg for mid-depth hand auger samples. The chromium result for the shallow hand auger sample at location WS14 is also qualified due to a high relative percent difference between duplicate sample pairs.

Cobalt was detected in all sediment samples collected from Magpie Creek. Cobalt levels in surface scrape samples decrease from the datum point to location WS12. The datum point concentration is 4.5 mg/kg. Cobalt concentrations in hand auger samples increase from location WS13 to the exit point. The exit point concentrations are 9.5 mg/kg for shallow and 10.0 mg/kg for middle and deep samples.

Copper concentrations in surface scrape samples decrease from the datum point to location WS12. The datum point concentration is 12.0 mg/kg. In hand auger samples, copper concentrations increase from location WS13 to the exit point. Copper concentrations at the exit point are 19.0 mg/kg, 24.0 mg/kg, and 14.0 mg/kg for shallow, middle, and deep samples, respectively.

Lead was detected in all surface scrape samples. A peak lead concentration of 43.0 mg/kg was detected at location WS10. Lead levels in all other surface scrape samples are below the datum point concentration of 16.0 mg/kg. The datum point result is qualified due to a high relative percent difference between duplicate sample pairs. Lead was detected only in the shallow hand auger sample at location WS13 and was not detected at the exit point.

Nickel was detected in all surface scrape samples collected from Magpie Creek. The datum point concentration is 13.0 mg/kg. However, this result is qualified due to a high relative percent difference between duplicate sample pairs. Nickel levels decrease in surface scrape samples from the datum point to location WS12. Nickel concentrations increase from location WS13 to the exit point. The exit point concentrations are 30.0 mg/kg for the shallow sample and 32.0 mg/kg for the middle and deep samples.

Silver was not detected in surface scrape samples at the datum point or at location WS12. A maximum concentration of 2.9 mg/kg was detected at location WS10. Silver was not detected in the hand auger samples.

Vanadium was detected in all sediment samples collected from Magpie Creek. Vanadium concentrations in surface scrape samples decrease from the datum point to location WS12. The datum point concentration is 16.0 mg/kg. Vanadium levels in hand auger samples decrease from location WS13 to the exit point. The exit point concentrations are 18.0 mg/kg, 24.0 mg/kg, and 21.0 mg/kg for shallow, middle, and deep hand auger samples.

Zinc was detected in all Magpie Creek sediment samples. Zinc levels increase from the datum point to location WS12 in surface scrape samples. A peak concentration of 320.0 mg/kg was detected at location WS9. Zinc levels in hand auger samples increase slightly from location WS13 to the exit point. The exit point concentrations are 41.0 mg/kg for shallow samples and 43.0 mg/kg for middle and deep hand auger samples. Zinc results from the surface scrape at location WS9 and the shallow hand auger sample at location WS14 are qualified due to low spike recovery and a high relative percent difference between duplicate sample pairs, respectively.

4.2.4.2 Total Cyanide

Total cyanide was detected in the surface scrape sample collected from location WS9. Total cyanide was detected at 5.0 mg/kg, which is equal to the detection limit. No other sediment samples from Magpie Creek contained detectable amounts of cyanide.

4.2.4.3 Total Petroleum Hydrocarbons and Oil/Grease

Stream sediment samples from locations WS12, WS13, and WS14 were analyzed for total petroleum hydrocarbons and total recoverable oil and grease. Location WS12 was a surface scrape sample. Hand auger samples were collected from three depths at both locations WS13 and WS14.

Total petroleum hydrocarbons were detected in the surface scrape sample at location WS12 at a concentration of 500.0 mg/kg. The shallow hand auger sample from location WS14 had a detectable concentration of 210.0 mg/kg; no method analytes were detected in the middle or deep samples. Petroleum hydrocarbons were not detected in sediment from location WS13.

Total recoverable oil and grease were detected in the surface scrape sample from location WS12 at a concentration of 870.0 mg/kg. The shallow hand auger sample from location WS14 had a detectable concentration of oil and grease at 340.0 mg/kg. No method analytes were detected in the middle or deep samples from location WS14. Total recoverable oil and grease were not detected in sediment from location WS13.

4.2.4.4 Volatile Organic Compounds

Toluene was detected at location WS8 and at location WS14 at 15.0 and 13.0 ug/kg, respectively. These are both estimated results less than five times the detection limit. Detected in the surface scrape sample from location WS12 were 1,1-dichloroethene and 1,2-dichloroethene; both results are estimated (less than five times the detection limit). Acetone was detected in the shallow and mid-level hand auger samples at location WS13; however, all acetone results are qualified. Dichlorodifluoromethane was detected at all sample depths in hand auger samples from location WS14. Concentrations of dichlorodifluoromethane increase with depth, and range from 36.0 to 110.0 ug/kg. Methylene chloride was detected in the shallow and deep hand auger samples collected from location WS14. Methylene chloride was qualified in the shallow sample because of a high relative percent difference between duplicate sample pairs.

4.2.4.5 Semivolatile Organic Compounds

Bis(2-ethylhexyl)phthalate and di-n-butylphthalate were detected at all sample locations along Magpie Creek, except for location WS13, where bis(2-ethylhexyl)phthalate was not detected. All bis(2-ethylhexyl)phthalate and di-n-butylphthalate results are qualified due to reagent blank contamination. Butylbenzylphthalate was detected at location WS10; this is an estimated result less than five times the detection limit.

Fluoranthene and pyrene were detected at surface scrape locations WS8, WS10, and WS12. Fluoranthene was detected at 290.0, 510.0, and 1100.0 ug/kg, at locations WS8, WS10, and WS12, respectively. The results from locations WS8 and WS10 are estimated (less than five times the detection limit). Naphthalene was detected at location WS8 at 300.0 ug/kg; this is also an estimated result. Anthracene, chrysene, and phenanthrene were all detected at location WS12; all results are less than five times the detection limit.

Benzo(a)pyrene, benzo(b)fluoranthene, and benzo(k)fluoranthene were detected at location WS12 at 680.0, 480.0, and 940.0 ug/kg, respectively. All results are less than five times the detection limit.

Phenol was detected in surface scrape samples at locations WS10, and WS12. The middle and deep hand-auger samples from location WS13 also contained detectable amounts of phenol. All are estimated results less than five times the detection limit.

4.2.4.6 Radioactivity

Because WS11 is located approximately 200 feet downstream from PRL 32, it was selected for radioactivity analysis. Potential Release Location (PRL) 32 was reportedly a low-level radioactive and hazardous waste storage site. There is no evidence that radioactive materials may have been carried to Magpie Creek from PRL 32. However, sediment samples were taken to evaluate potential radioactivity.

Stream sediment samples collected from location WS11 show detectable levels of alpha, beta, and gamma radioactivity. The highest gross alpha activity is 0.41 picocuries per gram (pCi/g) and the highest gross beta activity is 2.23 pCi/g. No standards are available for gross alpha and gross beta emissions. The alpha and beta

activity would need to be speciated in order to make comparisons to state or federal standards.

Gamma radioactivity detected in the sample results from the presence of the following isotopes: potassium-40 at 6.1 pCi/g, radium-226 at 2.6 pCi/g, thorium-234 at 3.5 pCi/g, lead-214 at 0.6 pCi/g, lead-212 at 0.6 pCi/g, and thallium-208 at 0.3 pCi/g. There are no state or federal regulations governing acceptable levels of radioactivity in sediments or soils at uncontrolled sites. However, the isotopes detected are members of three different decay series of natural radioactive isotopes, potassium-40, uranium-238, and thorium-232, that are known to occur naturally in rock and soil particles.

4.2.5 Storm Drainage South

Stream sediment samples were collected from two locations on SDS shown in Plate 1. Hand auger samples were collected from three depths at location WS22, and a surface scrape sample was collected from location WS23. Location WS23 is defined as the exit point.

4.2.5.1 Metals

Barium, beryllium, cadmium, chromium, cobalt, copper, lead, nickel, thallium, vanadium, and zinc were detected in SDS samples.

Barium concentrations in hand auger samples collected from location WS22 decrease with depth. The maximum concentration was detected in the shallow sample at 250.0 mg/kg. Barium was detected in the surface scrape sample from location WS23 at a concentration of 60.0 mg/kg.

Beryllium concentrations also decrease with depth at location WS22. The maximum concentration was detected in the shallow sample at 0.44 mg/kg. Beryllium was not detected in the surface scrape sample from the exit point.

Cadmium was only detected in the shallow sample from location WS22 at 0.47 mg/kg. Cadmium was detected at the exit point at 1.3 mg/kg.

Chromium was detected at 19.0, 16.0, and 12.0 mg/kg at location WS22 in shallow, middle, and deep hand auger samples, respectively. Chromium at 25.0 mg/kg was detected at the exit point.

Cobalt concentrations decrease with depth in hand auger samples from location WS22. The maximum concentration was detected in the shallow sample at 8.0 mg/kg. Cobalt was detected in the surface scrape sample at 4.0 mg/kg.

Copper was detected at all sample depths at location WS22. The concentrations are 16.0, 9.4, and 6.0 mg/kg for shallow, middle, and deep hand auger samples, respectively. Copper was detected in the surface scrape sample from location at location WS23 at 8.8 mg/kg.

Lead was not detected in hand auger samples from location WS22. Lead was detected in the surface scrape sample from location WS23 at 40.0 mg/kg; however, this result is qualified due to reagent blank contamination.

Nickel concentrations decrease with depth in hand auger samples from location WS22. The concentrations are 20.0, 14.0, and 9.2 mg/kg for shallow, middle, and deep samples, respectively. Nickel was detected in the surface scrape sample at 10.0 mg/kg.

Thallium was detected in the mid-level sample at location WS22 at a concentration of 4.7 mg/kg. Thallium was not detected in the shallow or deep samples. Thallium was also below the detection limit in the surface scrape sample collected from location WS23.

Vanadium concentrations decrease with depth in hand auger samples from location WS22. The maximum concentration was detected in the shallow sample at 40.0 mg/kg. Vanadium was detected in the surface scrape sample at 10.0 mg/kg.

Zinc was detected in hand auger samples from location WS22 at 40.0, 45.0, and 14.0 mg/kg for shallow, middle, and deep samples, respectively. Zinc was detected in the surface scrape sample from location WS23 at 86.0 mg/kg.

4.2.5.2 Volatile Organic Compounds

Methylene chloride was detected in hand auger samples from location WS22; however, these results are qualified due to reagent blank contamination. Trichloroethene was detected at 2.8 ug/kg in the surface scrape sample from location WS23. This is an estimated result, less than five times the detection limit.

4.2.5.3 Semivolatile Organic Compounds

Bis(2-ethylhexyl)phthalate and di-n-butylphthalate were detected in the surface scrape sample from location WS23. Both results are qualified due to reagent blank contamination. Phenol was also detected in the surface scrape sample from location WS23; however, this is an estimated result, less than five times the detection limit.

4.2.6 Additional Sample Locations

Two additional locations were sampled as part of the stream sediment investigation, WS28 and WS29, each shown in Plate 1. Sample station WS28 is located within Site P-6. Site P-6 consists of a concrete-lined drainage ditch and surrounding area located within OU A of McClellan AFB. Surface water from this ditch drains into Magpie Creek. One surface scrape sample was collected from location WS28.

Sample station WS29 is located within PRL S-13. The area designated as PRL S-13 is located in the western portion of OU B at McClellan AFB. The location is a hazardous storage lot operated by the Defense Reutilization and Marketing Office. One surface scrape sample was collected from location WS29.

4.2.6.1 Metals

Barium, beryllium, cadmium, chromium, cobalt, copper, nickel, lead, vanadium, and zinc were detected in sediment collected from location WS28. Barium and beryllium were detected at 33.0 and 0.11 mg/kg, respectively. Cadmium was detected at 1.0 mg/kg, and chromium was detected at 14.0 mg/kg. Cobalt was detected at 1.9 mg/kg, and copper was detected at 27.0 mg/kg. Lead, nickel, vanadium, and zinc were detected at 16.0, 3.6, 5.5, and 47.0 mg/kg, respectively.

Barium, beryllium, cadmium, cobalt, chromium, copper, nickel, lead, vanadium, and zinc were detected in the surface scrape samples taken from location WS29. Barium was detected at 66.0 mg/kg, and beryllium was detected at 0.19 mg/kg. Cadmium, chromium, cobalt, and copper were detected at 13.0 mg/kg, 15.0 mg/kg, 10.0 mg/kg, and 13.0 mg/kg, respectively. Lead, nickel, vanadium, and zinc were detected at 28.0, 19.0, 18.0, and 320.0 mg/kg, respectively. Lead and zinc results are both qualified due to high relative percent differences between duplicate sample pairs.

4.2.6.2 Total Cyanide

Total cyanide was detected at locations WS28 and WS29. Total cyanide was detected at 5.0 mg/kg at location WS28, and 14.0 mg/kg at location WS29.

4.2.6.3 Semivolatile Organic Compounds

Bis(2-ethylhexyl)phthalate and di-n-butylphthalate were detected at locations WS28 and WS29. These results are all qualified due reagent blank contamination. Pyrene was detected at location WS28; however, this is an estimated result less than five times the detection limit.

Table 4-1. SURFACE WATER SAMPLES CONTAINING ANALYTES DETECTED
 AT OR ABOVE LABORATORY DETECTION LIMITS.

Sample Location	Sample Identification	Analyte	Result	Detection Limit
<u>E205.2 - Arsenic (AA, Furnace), mg/L</u>				
WS1	FDWS1SW01	(T) Arsenic	0.005	0.004
<u>E239.2 - Lead (AA, Furnace), mg/L</u>				
WS1	FDWS1SW01	(T) Lead	0.009	0.002
	NSWS1SW01	(T) Lead	0.010	0.002
WS3	NSWS3SW01	(T) Lead	0.009	0.002
WS6	NSWS6SW01	(D) Lead (T) Lead	0.004 0.072	0.002 0.002
WS7	FDWS7SW01	(T) Lead	0.008	0.002
	NSWS7SW01	(T) Lead	0.010	0.002
WS8	NSWS8SW01	(T) Lead	0.004	0.002
WS9	FDWS9SW01	(T) Lead	0.010 B	0.002
	NSWS9SW01	(T) Lead	0.110 B	0.002
WS10	NSWS10SW01	(D) Lead (T) Lead	0.003 B 0.022 B	0.002 0.002
WS11	NSWS11SW01	(T) Lead	0.008	0.002
WS12	NSWS12SW01	(T) Lead	0.003 B	0.002
WS13	NSWS13SW01	(T) Lead	0.011 B	0.002

(D) = Dissolved

(T) = Total

B = Detected in Blank, result not corrected

Table 4-1. SURFACE WATER SAMPLES CONTAINING ANALYTES DETECTED
 AT OR ABOVE LABORATORY DETECTION LIMITS.

Sample Location	Sample Identification	Analyte	Result	Detection Limit
WS14	NSWS14SW01	(T) Lead	0.004	0.002
WS15	NSWS15SW01	(T) Lead	0.015	0.002
WS16	NSWS16SW01	(T) Lead	0.007	0.002
WS17	NSWS17SW01	(T) Lead	0.024	0.002
WS18	NSWS18SW01	(T) Lead	0.018	0.002
WS19	NSWS19SW01	(D) Lead	0.004	0.002
		(T) Lead	0.012	0.002
WS20	NSWS20SW01	(T) Lead	0.006	0.002
WS21	NSWS21SW01	(D) Lead	0.004	0.002
		(T) Lead	0.057	0.002
WS23	NSWS23SW01	(T) Lead	0.005 B	0.002
WS24	NSWS24SW01	(D) Lead	0.004 B	0.002
		(T) Lead	0.007 B	0.002
WS25	NSWS25SW01	(D) Lead	0.006 B	0.002
		(T) Lead	0.010 B	0.002
WS26	NSWS26SW01	(T) Lead	0.003 B	0.002
WS27	NSWS27SW01	(T) Lead	0.005 B	0.002

(D) = Dissolved

(T) = Total

B = Detected in Blank, result not corrected

Table 4-1. SURFACE WATER SAMPLES CONTAINING ANALYTES DETECTED
 AT OR ABOVE LABORATORY DETECTION LIMITS.

Sample Location	Sample Identification	Analyte	Result	Detection Limit
<u>E413.2 - Total Recoverable Oil and Grease, mg/L</u>				
WS5	NSWS5SW01	OIL/GREASE by IR EPA-413.2	5.200	2.000
WS6	NSWS6SW01	OIL/GREASE by IR EPA-413.2	7.700	2.000
WS13	FDWS13SW01	OIL/GREASE by IR EPA-413.2	4.200	2.000
	NSWS13SW01	OIL/GREASE by IR EPA-413.2	4.000	2.000
<u>E418.1 - Total Recoverable Petroleum Hydrocarbons, mg/L</u>				
WS5	NSWS5SW01	Total Petroleum Hydrocarbons	5.400	2.000
WS6	NSWS6SW01	Total Petroleum Hydrocarbons	6.000	2.000
WS13	FDWS13SW01	Total Petroleum Hydrocarbons	4.000	2.000
	NSWS13SW01	Total Petroleum Hydrocarbons	3.500	2.000
<u>SW6010 - Inductively Coupled Plasma (ICP) Metals Screen, mg/L</u>				
WS1	FDWS1SW01	(D) Barium	0.045	0.002
		(D) Boron	0.081	0.006
		(D) Calcium	13.000	0.010
		(D) Iron	0.077	0.007
		(D) Magnesium	4.000	0.030
		(D) Manganese	0.031	0.002
		(D) Silicon	6.600	0.058
		(D) Sodium	10.000	0.029
		(D) Zinc	0.060	0.002
		(T) Aluminum	0.460	0.045
		(T) Barium	0.058	0.002
		(T) Boron	0.079	0.006
		(T) Calcium	20.000	0.010
		(T) Iron	0.720	0.007
		(T) Magnesium	4.300	0.030
		(T) Manganese	0.050	0.002
		(T) Silicon	7.800	0.058
(D) = Dissolved (T) = Total				

Table 4-1. SURFACE WATER SAMPLES CONTAINING ANALYTES DETECTED
 AT OR ABOVE LABORATORY DETECTION LIMITS.

Sample Location	Sample Identification	Analyte	Result	Detection Limit
WS1	FDWS1SW01	(T) Sodium	11.000	0.029
		(T) Zinc	0.053	0.002
	NSWS1SW01	(D) Barium	0.043	0.002
		(D) Boron	0.075	0.006
		(D) Calcium	12.000	0.010
		(D) Iron	0.078	0.007
		(D) Magnesium	3.800	0.030
		(D) Manganese	0.034	0.002
		(D) Silicon	6.400	0.058
		(D) Sodium	10.000	0.029
		(D) Zinc	0.038	0.002
		(T) Aluminum	0.490	0.045
		(T) Barium	0.061	0.002
		(T) Boron	0.080	0.006
		(T) Calcium	14.000	0.010
		(T) Iron	0.760	0.007
		(T) Magnesium	4.300	0.030
		(T) Manganese	0.046	0.002
		(T) Silicon	7.700	0.058
		(T) Sodium	11.000	0.029
		(T) Zinc	0.051	0.002
WS3	NSWS3SW01	(D) Barium	0.068	0.002
		(D) Boron	0.120	0.006
		(D) Calcium	22.000 B	0.010
		(D) Copper	0.010	0.006
		(D) Iron	0.110 B	0.007
		(D) Magnesium	6.400 B	0.030
		(D) Manganese	0.037	0.002
		(D) Silicon	10.000	0.058
		(D) Sodium	19.000 B	0.029
		(T) Aluminum	0.290	0.045
		(T) Barium	0.081	0.002
		(T) Boron	0.120	0.006
		(T) Calcium	24.000 B	0.010
		(T) Copper	0.009	0.006
		(T) Iron	0.570 B	0.007
		(T) Magnesium	6.800 B	0.030
		(T) Manganese	0.035	0.002
		(T) Silicon	11.000	0.058
		(T) Sodium	19.000 B	0.029
		(T) Zinc	0.050 B	0.002

(D) = Dissolved

(T) = Total

B = Detected in Blank, result not corrected

Table 4-1. SURFACE WATER SAMPLES CONTAINING ANALYTES DETECTED
 AT OR ABOVE LABORATORY DETECTION LIMITS.

Sample Location	Sample Identification	Analyte	Result	Detection Limit
WS6	NSWS6SW01	(D) Barium	0.047	0.002
		(D) Boron	0.071	0.006
		(D) Calcium	14.000 B	0.010
		(D) Copper	0.010	0.006
		(D) Iron	0.110 B	0.007
		(D) Magnesium	3.600 B	0.030
		(D) Manganese	0.048	0.002
		(D) Nickel	0.220	0.015
		(D) Silicon	6.500	0.058
		(D) Sodium	9.400 B	0.029
		(D) Zinc	0.230 B	0.002
		(T) Aluminum	1.000	0.045
		(T) Barium	0.170	0.002
		(T) Boron	0.093	0.006
		(T) Calcium	29.000 B	0.010
		(T) Copper	0.055	0.006
		(T) Iron	2.100 B	0.007
		(T) Magnesium	4.700 B	0.030
		(T) Manganese	0.290	0.002
		(T) Nickel	0.280	0.015
		(T) Silicon	8.400	0.058
		(T) Sodium	9.200 B	0.029
		(T) Vanadium	0.019	0.008
		(T) Zinc	0.590 B	0.002
WS7	FDWS7SW01	(D) Barium	0.036	0.002
		(D) Boron	0.049	0.006
		(D) Calcium	11.000 B	0.010
		(D) Iron	0.085 B	0.007
		(D) Magnesium	2.800	0.030
		(D) Manganese	0.015	0.002
		(D) Silicon	4.800	0.058
		(D) Sodium	7.800 B	0.029
		(D) Zinc	0.035	0.002
		(T) Aluminum	0.280	0.045
		(T) Barium	0.044	0.002
		(T) Boron	0.051	0.006
		(T) Calcium	11.000 B	0.010
		(T) Copper	0.007	0.006
		(T) Iron	0.450 B	0.007
		(T) Magnesium	3.000	0.030
		(T) Manganese	0.024	0.002
		(T) Silicon	5.500	0.058

(D) = Dissolved

(T) = Total

B = Detected in Blank, result not corrected

Table 4-1. SURFACE WATER SAMPLES CONTAINING ANALYTES DETECTED
 AT OR ABOVE LABORATORY DETECTION LIMITS.

Sample Location	Sample Identification	Analyte	Result	Detection Limit
WS7	FDWS7SW01	(T) Sodium	8.000 B	0.029
		(T) Zinc	0.054	0.002
	NSWS7SW01	(D) Barium	0.034	0.002
		(D) Boron	0.047	0.006
		(D) Calcium	10.000 B	0.010
		(D) Iron	0.057 B	0.007
		(D) Magnesium	2.800	0.030
		(D) Manganese	0.015	0.002
		(D) Silicon	4.800	0.058
		(D) Sodium	7.800 B	0.029
		(D) Zinc	0.039	0.002
		(T) Aluminum	0.310	0.045
		(T) Barium	0.044	0.002
		(T) Boron	0.049	0.006
		(T) Calcium	11.000 B	0.010
		(T) Iron	0.520 B	0.007
		(T) Magnesium	3.000	0.030
		(T) Manganese	0.025	0.002
		(T) Silicon	5.500	0.058
		(T) Sodium	7.900 B	0.029
		(T) Zinc	0.043	0.002
WS8	NSWS8SW01	(D) Barium	0.059	0.002
		(D) Boron	0.075	0.006
		(D) Calcium	24.000 B	0.010
		(D) Iron	0.043 B	0.007
		(D) Magnesium	7.100	0.030
		(D) Manganese	0.026	0.002
		(D) Silicon	14.000	0.058
		(D) Sodium	15.000 B	0.029
		(D) Zinc	0.300	0.002
		(T) Aluminum	0.270	0.045
		(T) Barium	0.068	0.002
		(T) Boron	0.074	0.006
		(T) Calcium	24.000 B	0.010
		(T) Copper	0.008	0.006
		(T) Iron	0.480 B	0.007
		(T) Magnesium	7.400	0.030
		(T) Manganese	0.036	0.002
		(T) Silicon	15.000	0.058
		(T) Sodium	15.000 B	0.029
		(T) Vanadium	0.008	0.008
		(T) Zinc	0.350	0.002

(D) = Dissolved

(T) = Total

B = Detected in Blank, result not corrected

Table 4-1. SURFACE WATER SAMPLES CONTAINING ANALYTES DETECTED
 AT OR ABOVE LABORATORY DETECTION LIMITS.

Sample Location	Sample Identification	Analyte	Result	Detection Limit
WS9	FDWS9SW01	(D) Barium	0.026	0.002
		(D) Boron	0.045	0.006
		(D) Calcium	10.000 B	0.010
		(D) Copper	0.008	0.006
		(D) Iron	0.051 B	0.007
		(D) Magnesium	3.000	0.030
		(D) Manganese	0.016	0.002
		(D) Silicon	6.800	0.058
		(D) Sodium	7.600 B	0.029
		(D) Zinc	0.052	0.002
		(T) Aluminum	0.400	0.045
		(T) Barium	0.036	0.002
		(T) Boron	0.041	0.006
		(T) Calcium	10.000 B	0.010
		(T) Copper	0.010	0.006
		(T) Iron	0.610 B	0.007
		(T) Magnesium	3.100	0.030
		(T) Manganese	0.027	0.002
		(T) Silicon	7.400	0.058
		(T) Sodium	7.300 B	0.029
		(T) Zinc	0.063	0.002
	NSWS9SW01	(D) Barium	0.026	0.002
		(D) Boron	0.047	0.006
		(D) Calcium	10.000 B	0.010
		(D) Copper	0.009	0.006
		(D) Iron	0.051 B	0.007
		(D) Magnesium	2.900	0.030
		(D) Manganese	0.018	0.002
		(D) Silicon	6.800	0.058
		(D) Sodium	7.500 B	0.029
		(D) Zinc	0.054	0.002
		(T) Aluminum	0.390	0.045
		(T) Barium	0.036	0.002
		(T) Boron	0.046	0.006
		(T) Calcium	11.000 B	0.010
		(T) Copper	0.010	0.006
		(T) Iron	0.580 B	0.007
		(T) Magnesium	3.100	0.030
		(T) Manganese	0.028	0.002
		(T) Silicon	7.400	0.058
		(T) Sodium	7.300 B	0.029
		(T) Zinc	0.064	0.002

(D) = Dissolved

(T) = Total

B = Detected in Blank, result not corrected

Table 4-1. SURFACE WATER SAMPLES CONTAINING ANALYTES DETECTED
 AT OR ABOVE LABORATORY DETECTION LIMITS.

Sample Location	Sample Identification	Analyte	Result	Detection Limit
WS10	NSWS10SW01	(D) Aluminum	0.049	0.045
		(D) Barium	0.035	0.002
		(D) Boron	0.047	0.006
		(D) Calcium	13.000 B	0.010
		(D) Copper	0.008	0.006
		(D) Iron	0.087 B	0.007
		(D) Magnesium	3.000	0.030
		(D) Manganese	0.023	0.002
		(D) Silicon	5.600	0.058
		(D) Sodium	8.800 B	0.029
		(D) Zinc	0.067	0.002
		(T) Aluminum	0.980	0.045
		(T) Barium	0.067	0.002
		(T) Boron	0.050	0.006
		(T) Calcium	15.000 B	0.010
		(T) Copper	0.016	0.006
		(T) Iron	1.400 B	0.007
		(T) Magnesium	3.600	0.030
		(T) Manganese	0.073	0.002
		(T) Silicon	7.500	0.058
		(T) Sodium	9.100 B	0.029
		(T) Vanadium	0.009	0.008
		(T) Zinc	0.130	0.002
WS11	NSWS11SW01	(D) Barium	0.057	0.002
		(D) Boron	0.085	0.006
		(D) Calcium	21.000 B	0.010
		(D) Copper	0.010	0.006
		(D) Iron	0.031 B	0.007
		(D) Magnesium	7.100 B	0.030
		(D) Manganese	0.014	0.002
		(D) Silicon	16.000	0.058
		(D) Sodium	14.000 B	0.029
		(D) Zinc	0.099 B	0.002
		(T) Aluminum	0.200	0.045
		(T) Barium	0.063	0.002
		(T) Boron	0.088	0.006
		(T) Calcium	21.000 B	0.010
		(T) Copper	0.012	0.006
		(T) Iron	0.300 B	0.007
		(T) Magnesium	7.200 B	0.030
		(T) Manganese	0.021	0.002

(D) = Dissolved

(T) = Total

B = Detected in Blank, result not corrected

Table 4-1. SURFACE WATER SAMPLES CONTAINING ANALYTES DETECTED
 AT OR ABOVE LABORATORY DETECTION LIMITS.

Sample Location	Sample Identification	Analyte	Result	Detection Limit
WS11	NSWS11SW01	(T) Silicon	16.000	0.058
		(T) Sodium	14.000 B	0.029
		(T) Zinc	0.110 B	0.002
WS12	NSWS12SW01	(D) Barium	0.070	0.002
		(D) Boron	0.062	0.006
		(D) Calcium	25.000 B	0.010
		(D) Copper	0.010	0.006
		(D) Iron	0.031 B	0.007
		(D) Magnesium	14.000	0.030
		(D) Manganese	0.008	0.002
		(D) Silicon	28.000	0.058
		(D) Sodium	19.000 B	0.029
		(D) Vanadium	0.011	0.008
		(D) Zinc	0.032	0.002
		(T) Aluminum	0.180	0.045
		(T) Barium	0.073	0.002
		(T) Boron	0.059	0.006
		(T) Calcium	24.000 B	0.010
		(T) Iron	0.200 B	0.007
		(T) Magnesium	14.000	0.030
		(T) Manganese	0.034	0.002
		(T) Silicon	28.000	0.058
		(T) Sodium	18.000 B	0.029
		(T) Vanadium	0.011	0.008
		(T) Zinc	0.020	0.002
WS13	NSWS13SW01	(D) Barium	0.050	0.002
		(D) Boron	0.062	0.006
		(D) Calcium	18.000 B	0.010
		(D) Copper	0.008	0.006
		(D) Iron	0.030 B	0.007
		(D) Magnesium	8.400	0.030
		(D) Manganese	0.019	0.002
		(D) Silicon	21.000	0.058
		(D) Sodium	13.000 B	0.029
		(D) Zinc	0.057	0.002
		(T) Aluminum	0.710	0.045
		(T) Barium	0.076	0.002
		(T) Boron	0.062	0.006
		(T) Calcium	19.000 B	0.010
		(T) Chromium	0.007	0.007
		(T) Copper	0.014	0.006

(D) = Dissolved

(T) = Total

B = Detected in Blank, result not corrected

Table 4-1. SURFACE WATER SAMPLES CONTAINING ANALYTES DETECTED
 AT OR ABOVE LABORATORY DETECTION LIMITS.

Sample Location	Sample Identification	Analyte	Result	Detection Limit
WS13	NW1313W01	(T) Iron	1.000 B	0.007
		(T) Magnesium	9.100	0.030
		(T) Manganese	0.070	0.002
		(T) Silicon	23.000	0.058
		(T) Sodium	13.000 B	0.029
		(T) Vanadium	0.011	0.008
		(T) Zinc	0.110	0.002
WS14	NW1414W01	(D) Barium	0.066	0.002
		(D) Boron	0.059	0.006
		(D) Calcium	24.000 B	0.010
		(D) Iron	0.036 B	0.007
		(D) Magnesium	13.000	0.030
		(D) Manganese	0.311	0.002
		(D) Silicon	27.000	0.058
		(D) Sodium	18.000 B	0.029
		(D) Vanadium	0.009	0.008
		(D) Zinc	0.016	0.002
		(T) Aluminum	0.200	0.045
		(T) Barium	0.075	0.002
		(T) Boron	0.059	0.006
		(T) Calcium	24.000 B	0.010
		(T) Iron	0.330 B	0.007
		(T) Magnesium	14.000	0.030
		(T) Manganese	0.041	0.002
		(T) Silicon	27.000	0.058
		(T) Sodium	18.000 B	0.029
		(T) Vanadium	0.009	0.008
		(T) Zinc	0.030	0.002
WS15	NW1515W01	(D) Barium	0.050	0.002
		(D) Boron	0.120	0.006
		(D) Calcium	21.000	0.010
		(D) Iron	0.044	0.007
		(D) Magnesium	9.000	0.030
		(D) Manganese	0.010	0.002
		(D) Silicon	25.000	0.058
		(D) Sodium	20.000	0.029
		(D) Zinc	0.050	0.002
		(T) Aluminum	0.160	0.045
		(T) Barium	0.050	0.002
		(T) Boron	0.120	0.006
		(T) Calcium	22.000	0.010

(D) = Dissolved

(T) = Total

B = Detected in Blank, result not corrected

Table 4-1. SURFACE WATER SAMPLES CONTAINING ANALYTES DETECTED
 AT OR ABOVE LABORATORY DETECTION LIMITS.

Sample Location	Sample Identification	Analyte	Result	Detection Limit
WS15	NEWB15SW01	(T) Iron	0.340	0.007
		(T) Magnesium	9.200	0.030
		(T) Manganese	0.019	0.002
		(T) Silicon	26.000	0.058
		(T) Sodium	20.000	0.029
		(T) Zinc	0.047	0.002
WS16	NEWB16SW01	(D) Barium	0.025	0.002
		(D) Calcium	9.100	0.010
		(D) Iron	0.039	0.007
		(D) Magnesium	0.310	0.030
		(D) Manganese	0.013	0.002
		(D) Silicon	2.000	0.058
		(D) Sodium	2.000	0.029
		(D) Zinc	0.024	0.002
		(T) Aluminum	0.066	0.045
		(T) Barium	0.025	0.002
		(T) Calcium	9.400	0.010
		(T) Iron	0.099	0.007
		(T) Magnesium	0.940	0.030
		(T) Manganese	0.006	0.002
		(T) Silicon	2.200	0.058
		(T) Sodium	1.800	0.029
		(T) Zinc	0.025	0.002
WS17	NEWB17SW01	(D) Barium	0.071	0.002
		(D) Boron	0.170	0.006
		(D) Calcium	29.000 B	0.010
		(D) Copper	0.013	0.006
		(D) Iron	0.069 B	0.007
		(D) Magnesium	7.100 B	0.030
		(D) Manganese	0.018	0.002
		(T) Silicon	13.000	0.058
		(D) Sodium	25.000 B	0.029
		(D) Zinc	0.072 B	0.002
		(T) Aluminum	0.170	0.045
		(T) Barium	0.070	0.002
		(T) Boron	0.140	0.006
		(T) Calcium	28.000 B	0.010
		(T) Copper	0.010	0.006
		(T) Iron	0.330 B	0.007
		(T) Magnesium	6.000 B	0.030
		(T) Manganese	0.026	0.002

(D) = Dissolved

(T) = Total

B = Detected in Blank, result not corrected

Table 4-1. SURFACE WATER SAMPLES CONTAINING ANALYTES DETECTED
 AT OR ABOVE LABORATORY DETECTION LIMITS.

Sample Location	Sample Identification	Analyte	Result	Detection Limit
WS17	NSWS17SW01	(T) Silicon		
		(T) Sodium	12.000	0.058
		(T) Zinc	21.000 B	0.029
			0.083 B	0.002
WS18	NSWS18SW01	(D) Barium		
		(D) Boron	0.066	0.002
		(D) Calcium	0.160	0.006
		(D) Copper	18.000 B	0.010
		(D) Iron	0.010	0.006
		(D) Magnesium	0.130 B	0.007
		(D) Manganese	4.700 B	0.030
		(D) Nickel	0.021	0.002
		(D) Silicon	0.700	0.015
		(D) Sodium	9.300	0.058
		(D) Zinc	16.000 B	0.029
		(T) Aluminum	0.075 B	0.002
		(T) Barium	0.320	0.045
		(T) Boron	0.073	0.002
		(T) Calcium	0.760	0.006
		(T) Chromium	17.000 B	0.010
		(T) Copper	0.008	0.007
		(T) Iron	0.140	0.006
		(T) Magnesium	0.620 B	0.007
		(T) Manganese	4.700 B	0.030
		(T) Nickel	0.028	0.002
		(T) Potassium	12.000	0.015
		(T) Silicon	3.500	3.000
		(T) Sodium	9.500	0.058
		(T) Zinc	15.000 B	0.029
			0.100 B	0.002
WS19	NSWS19SW01	(D) Barium		
		(D) Boron	0.059	0.002
		(D) Calcium	0.096	0.006
		(D) Copper	18.000 B	0.010
		(D) Iron	0.015	0.006
		(D) Magnesium	0.100 B	0.007
		(D) Manganese	5.000 B	0.030
		(D) Nickel	0.012	0.002
		(D) Silicon	0.089	0.015
		(D) Sodium	11.000	0.058
		(D) Zinc	15.000 B	0.029
		(T) Aluminum	0.093 B	0.002
		(T) Barium	0.250	0.045
			0.063	0.002

(D) = Dissolved

(T) = Total

B = Detected in Blank, result not corrected

Table 4-1. SURFACE WATER SAMPLES CONTAINING ANALYTES DETECTED
 AT OR ABOVE LABORATORY DETECTION LIMITS.

Sample Location	Sample Identification	Analyte	Result	Detection Limit
WS19	NSWS19SW01	(T) Boron		
		(T) Calcium	0.097	0.006
		(T) Copper	18.000 B	0.010
		(T) Iron	0.008	0.006
		(T) Magnesium	0.460 B	0.007
		(T) Manganese	5.000 B	0.030
		(T) Nickel	0.017	0.002
		(T) Silicon	0.049	0.015
		(T) Sodium	12.000	0.058
		(T) Zinc	15.000 B	0.029
			0.095 B	0.002
WS20	NSWS20SW01	(D) Barium		
		(D) Boron	0.033	0.002
		(D) Calcium	0.055	0.006
		(D) Copper	12.000 B	0.010
		(D) Iron	0.012	0.006
		(D) Magnesium	0.029 B	0.007
		(D) Manganese	3.600	0.030
		(D) Silicon	0.004	0.002
		(D) Sodium	5.600	0.058
		(D) Zinc	7.200 B	0.029
		(T) Aluminum	0.022	0.002
		(T) Barium	0.250	0.045
		(T) Boron	0.040	0.002
		(T) Calcium	0.059	0.006
		(T) Copper	12.000 B	0.010
		(T) Iron	0.013	0.006
		(T) Magnesium	0.400 B	0.007
		(T) Manganese	3.700	0.030
		(T) Silicon	0.010	0.002
		(T) Sodium	6.200	0.058
		(T) Zinc	7.200 B	0.029
			0.037	0.002
WS21	NSWS21SW01	(D) Barium		
		(D) Boron	0.027	0.002
		(D) Calcium	0.044	0.006
		(D) Copper	9.400 B	0.010
		(D) Iron	0.010	0.006
		(D) Magnesium	0.038 B	0.007
		(D) Manganese	1.900	0.030
		(D) Silicon	0.010	0.002
		(D) Sodium	4.400	0.058
		(D) Zinc	5.000 B	0.029
			0.070	0.002

(D) = Dissolved

(T) = Total

B = Detected in Blank, result not corrected

Table 4-1. SURFACE WATER SAMPLES CONTAINING ANALYTES DETECTED
 AT OR ABOVE LABORATORY DETECTION LIMITS.

Sample Location	Sample Identification	Analyte	Result	Detection Limit
WS21	NSWS21SW01	(T) Aluminum	0.570	0.045
		(T) Barium	0.042	0.002
		(T) Boron	0.044	0.006
		(T) Cadmium	0.006	0.004
		(T) Calcium	10.000 B	0.010
		(T) Chromium	0.008	0.007
		(T) Cobalt	0.009	0.007
		(T) Copper	0.026	0.006
		(T) Iron	1.400 B	0.007
		(T) Magnesium	2.200	0.030
		(T) Manganese	0.029	0.002
		(T) Silicon	5.800	0.058
		(T) Sodium	5.200 B	0.029
		(T) Zinc	0.140	0.002
WS23	NSWS23SW01	(D) Aluminum	0.075	0.045
		(D) Barium	0.110	0.002
		(D) Boron	0.140	0.006
		(D) Calcium	22.000 B	0.010
		(D) Chromium	0.009	0.007
		(D) Copper	0.008	0.006
		(D) Iron	0.062	0.007
		(D) Magnesium	12.000	0.030
		(D) Manganese	0.002	0.002
		(D) Silicon	39.000	0.058
		(D) Sodium	25.000 B	0.029
		(D) Vanadium	0.009	0.008
		(D) Zinc	0.059	0.002
		(T) Aluminum	0.056	0.045
		(T) Barium	0.100	0.002
		(T) Boron	0.090	0.006
		(T) Calcium	22.000 B	0.010
		(T) Copper	0.012	0.006
		(T) Iron	0.100	0.007
		(T) Magnesium	13.000	0.030
		(T) Manganese	0.005	0.002
		(T) Silicon	41.000	0.058
		(T) Sodium	20.000 B	0.029
		(T) Vanadium	0.009	0.008
		(T) Zinc	0.051	0.002
WS24	NSWS24SW01	(D) Barium	0.044	0.002
		(D) Boron	0.200	0.006

(D) = Dissolved

(T) = Total

B = Detected in Blank, result not corrected

Table 4-1. SURFACE WATER SAMPLES CONTAINING ANALYTES DETECTED
 AT OR ABOVE LABORATORY DETECTION LIMITS.

Sample Location	Sample Identification	Analyte	Result	Detection Limit
WS24	NSWS24SW01	(D) Calcium	22.000 B	0.010
		(D) Iron	0.029	0.007
		(D) Magnesium	12.000	0.030
		(D) Manganese	0.014	0.002
		(D) Nickel	0.031	0.015
		(D) Silicon	29.000	0.058
		(D) Sodium	110.000 B	0.029
		(D) Vanadium	0.013	0.008
		(D) Zinc	0.020	0.002
		(T) Aluminum	0.150	0.045
		(T) Barium	0.053	0.002
		(T) Boron	0.210	0.006
		(T) Calcium	23.000 B	0.010
		(T) Chromium	0.017	0.007
		(T) Copper	0.009	0.006
		(T) Iron	0.150	0.007
		(T) Magnesium	12.000	0.030
		(T) Manganese	0.028	0.002
		(T) Nickel	0.032	0.015
		(T) Silicon	30.000	0.058
		(T) Sodium	110.000 B	0.029
		(T) Vanadium	0.014	0.008
		(T) Zinc	0.020	0.002
WS25	NSWS25SW01	(D) Barium	0.045	0.002
		(D) Boron	0.130	0.006
		(D) Calcium	18.000 B	0.010
		(D) Chromium	0.009	0.007
		(D) Copper	0.040	0.006
		(D) Iron	0.044	0.007
		(D) Magnesium	10.000	0.030
		(D) Manganese	0.097	0.002
		(D) Nickel	0.026	0.015
		(D) Silicon	31.000	0.058
		(D) Sodium	85.000 B	0.029
		(D) Zinc	0.029	0.002
		(T) Aluminum	0.140	0.045
		(T) Barium	0.048	0.002
		(T) Boron	0.130	0.006
		(T) Calcium	19.000 B	0.010
		(T) Chromium	0.039	0.007
		(T) Copper	0.010	0.006
		(T) Iron	0.140	0.007
		(T) Magnesium	10.000	0.030

(D) = Dissolved

(T) = Total

B = Detected in Blank, result not corrected

Table 4-1. SURFACE WATER SAMPLES CONTAINING ANALYTES DETECTED
 AT OR ABOVE LABORATORY DETECTION LIMITS.

Sample Location	Sample Identification	Analyte	Result	Detection Limit
WS25	NSWS25SW01	(T) Manganese	0.100	0.002
		(T) Nickel	0.027	0.015
		(T) Silicon	32.000	0.058
		(T) Sodium	86.000 B	0.029
		(T) Zinc	0.019	0.002
WS26	NSWS26SW01	(D) Barium	0.072	0.002
		(D) Boron	0.062	0.006
		(D) Calcium	24.000 B	0.010
		(D) Iron	0.028	0.007
		(D) Magnesium	14.000	0.030
		(D) Manganese	0.008	0.002
		(D) Silicon	28.000	0.058
		(D) Sodium	18.000 B	0.029
		(D) Vanadium	0.008	0.008
		(D) Zinc	0.020	0.002
		(T) Aluminum	0.150	0.045
		(T) Barium	0.079	0.002
		(T) Boron	0.063	0.006
		(T) Calcium	25.000 B	0.010
		(T) Iron	0.230	0.007
		(T) Magnesium	15.000	0.030
		(T) Manganese	0.036	0.002
		(T) Silicon	29.000	0.058
		(T) Sodium	18.000 B	0.029
		(T) Vanadium	0.009	0.008
		(T) Zinc	0.031	0.002
WS27	NSWS27SW01	(D) Barium	0.074	0.002
		(D) Boron	0.055	0.006
		(D) Calcium	23.000 B	0.010
		(D) Iron	0.053	0.007
		(D) Magnesium	14.000	0.030
		(D) Manganese	0.034	0.002
		(D) Silicon	28.000	0.058
		(D) Sodium	17.000 B	0.029
		(D) Zinc	0.044	0.002
		(T) Aluminum	0.270	0.045
		(T) Barium	0.083	0.002
		(T) Boron	0.056	0.006
		(T) Calcium	24.000 B	0.010
		(T) Copper	0.009	0.006
		(T) Iron	0.420	0.007

(D) = Dissolved

(T) = Total

B = Detected in Blank, result not corrected

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 Table 4-1. SURFACE WATER SAMPLES CONTAINING ANALYTES DETECTED
 AT OR ABOVE LABORATORY DETECTION LIMITS.

Sample Location	Sample Identification	Analyte	Result	Detection Limit
WS27	NSWS27SW01	(T) Magnesium	14.000	0.030
		(T) Manganese	0.056	0.002
		(T) Silicon	30.000	0.058
		(T) Sodium	17.000 B	0.029
		(T) Zinc	0.052	0.002
<u>SW8240 - 30 MS Method for Volatile Organics, ug/L</u>				
WS1	FDWS1SW01	Acetone	16.000 *,B	7.500
	NSWS1SW01	Acetone	18.000 *,B	7.500
		Dichlorodifluoromethane	9.200 *	5.900
WS3	NSWS3SW01	Acetone	12.000 *,B	7.500
WS6	NSWS6SW01	Acetone	11.000 *,B	7.500
WS7	FDWS7SW01	Acetone	13.000 *	7.500
	NSWS7SW01	Acetone	9.500 *	7.500
WS8	NSWS8SW01	Acetone	9.800 *	7.500
WS9	FDWS9SW01	Acetone	13.000 *	7.500
	NSWS9SW01	Acetone	10.000 *	7.500
WS10	NSWS10SW01	Acetone	49.000	7.500
WS11	NSWS11SW01	Acetone	11.000 *,B	7.500
WS12	NSWS12SW01	Acetone	9.500 *	7.500
WS13	NSWS13SW01	Acetone	8.300 *	7.500

(D) = Dissolved

(T) = Total

B = Detected in Blank, result not corrected

* = Estimated result less than 5 times the detection limit

Table 4-1. SURFACE WATER SAMPLES CONTAINING ANALYTES DETECTED
 AT OR ABOVE LABORATORY DETECTION LIMITS.

Sample Location	Sample Identification	Analyte	Result	Detection Limit
WS14	NSWS14SW01	Acetone	14.000 *	7.500
WS15	NSWS15SW01	Acetone	10.000 *,B	7.500
WS17	NSWS17SW01	Acetone	9.200 *,B	7.500
WS18	NSWS18SW01	Acetone	8.300 *,B	7.500
WS19	NSWS19SW01	Acetone	8.900 *,B	7.500
WS20	NSWS20SW01	Acetone	10.000 *	7.500
WS21	NSWS21SW01	Acetone	12.000 *	7.500
WS23	NSWS23SW01	Acetone	16.000 *	7.500
WS24	NSWS24SW01	Acetone	10.000 *	7.500
WS25	NSWS25SW01	Acetone	7.700 *	7.500
WS27	NSWS27SW01	Acetone	9.500 *,B	7.500
<u>SW8270 - Extractable Priority Pollutants (Base/Neutral and Acid), ug/L</u>				
WS1	NSWS1SW01	Pentachlorophenol	7.800 *	3.600
WS3	NSWS3SW01	bis(2-Ethylhexyl)Phthalate	2.600 *,B	2.500
WS7	NSWS7SW01	bis(2-Ethylhexyl)Phthalate	8.500 B	2.500

B = Detected in Blank, result not corrected

* = Estimated result less than 5 times the detection limit

Table 4-1. SURFACE WATER SAMPLES CONTAINING ANALYTES DETECTED
 AT OR ABOVE LABORATORY DETECTION LIMITS.

Sample Location	Sample Identification	Analyte	Result	Detection Limit
WS8	NSWS8SW01	bis(2-Ethylhexyl)Phthalate	3.100 *,B	2.500
WS9	FDWS9SW01	4-Nitrophenol	3.800 *	2.400
		bis(2-Ethylhexyl)Phthalate	2.800 *,B	2.500
	NSWS9SW01	bis(2-Ethylhexyl)Phthalate	2.500 *,B	2.500
WS10	NSWS10SW01	4-Nitrophenol	7.800 *	2.400
		Phenol	1.800 *	1.500
WS11	NSWS11SW01	4-Nitrophenol	4.200 *	2.400
		bis(2-Ethylhexyl)Phthalate	3.000 *,B	2.500
WS13	NSWS13SW01	bis(2-Ethylhexyl)Phthalate	3.100 *,B	2.500
WS17	NSWS17SW01	4-Nitrophenol	7.900 *	2.400
		Phenol	1.800 *	1.500
WS24	NSWS24SW01	bis(2-Ethylhexyl)Phthalate	2.800 *,B	2.500
WS25	NSWS25SW01	bis(2-Ethylhexyl)Phthalate	4.000 *,B	2.500
WS26	NSWS26SW01	bis(2-Ethylhexyl)Phthalate	3.100 *,B	2.500
WS27	NSWS27SW01	bis(2-Ethylhexyl)Phthalate	3.000 *,B	2.500

* = Estimated result less than 5 times the detection limit

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Table 4-2. STREAM SEDIMENT SAMPLES CONTAINING ANALYTES DETECTED
AT OR ABOVE LABORATORY DETECTION LIMITS.

Sample Location	Sample Identification	Analyte	Result	Detection Limit
<u>E335.2 - Total Cyanide, mg/Kg</u>				
WS6	FDWS6SS0101	Total Cyanide	6.000	5.000
	NSWS6SS0102	Total Cyanide	8.000	5.000
	NSWS6SS0103	Total Cyanide	6.000	5.000
WS9	NSWS9SS01	Total Cyanide	5.000	5.000
WS15	FDWS15SS01	Total Cyanide	5.000	5.000
WS28	NSWS28SS01	Total Cyanide	5.000	5.000
WS29	NSWS29SS01	Total Cyanide	14.000	5.000
<u>E413.2 - Total Recoverable Oil and Grease, mg/Kg</u>				
WS5	NSWS5SS0101	OIL/GREASE by IR EPA-413.2	870.000	100.000
WS6	FDWS6SS0101	OIL/GREASE by IR EPA-413.2	320.000	100.000
	NSWS6SS0101	OIL/GREASE by IR EPA-413.2	590.000	100.000
	NSWS6SS0102	OIL/GREASE by IR EPA-413.2	200.000	100.000
	NSWS6SS0103	OIL/GREASE by IR EPA-413.2	300.000	100.000
WS12	NSWS12SS01	OIL/GREASE by IR EPA-413.2	870.000	100.000
WS14	NSWS14SS0101	OIL/GREASE by IR EPA-413.2	340.000	100.000

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Table 4-2. STREAM SEDIMENT SAMPLES CONTAINING ANALYTES DETECTED
AT OR ABOVE LABORATORY DETECTION LIMITS.

Sample Location	Sample Identification	Analyte	Result	Detection Limit
<u>E418.1 - Total Recoverable Petroleum Hydrocarbons, mg/Kg</u>				
WS5	NSWS5SS0101	Total petroleum hydrocarbons	470.000	100.000
WS6	FDWS6SS0101	Total petroleum hydrocarbons	260.000	100.000
	NSWS6SS0101	Total petroleum hydrocarbons	400.000	100.000
	NSWS6SS0102	Total petroleum hydrocarbons	170.000	100.000
	NSWS6SS0103	Total petroleum hydrocarbons	260.000	100.000
WS12	NSWS12SS01	Total petroleum hydrocarbons	500.000	100.000
WS14	NSWS14SS0101	Total petroleum hydrocarbons	210.000	100.000
<u>SW6010 - Inductively Coupled Plasma (ICP) Metals Screen, mg/Kg</u>				
WS1	NSWS1SS01	Al Aluminum	1400.000	4.100
		Ba Barium	28.000	0.180
		Be Beryllium	0.100	0.091
		Ca Calcium	850.000 B	0.910
		Co Cobalt	2.900	0.640
		Cr Chromium	7.900	0.640
		Cu Copper	3.700	0.550
		Fe Iron	2900.000	0.640
		Mg Magnesium	790.000	2.700
		Mn Manganese	42.000	0.180
		Na Sodium	66.000 B	2.600
		Ni Nickel	4.800	1.400
		V Vanadium	7.500	0.730
		Zn Zinc	37.000	0.180
WS2	NSWS2SS0101	Al Aluminum	2800.000	4.100
		Ba Barium	41.000	0.180
		Be Beryllium	0.150	0.092
		Ca Calcium	1300.000 B	0.920
		Co Cobalt	4.500	0.640
		Cr Chromium	8.200	0.640
		Cu Copper	6.600	0.550
		Fe Iron	5300.000	0.640

B = Detected in Blank, result not corrected

Table 4-2. STREAM SEDIMENT SAMPLES CONTAINING ANALYTES DETECTED
 AT OR ABOVE LABORATORY DETECTION LIMITS.

Sample Location	Sample Identification	Analyte	Result	Detection Limit
WS2	NSWS2SS0101	Mg Magnesium	1300.000	2.800
		Mn Manganese	70.000 S	0.180
		Na Sodium	100.000 B	2.700
		Ni Nickel	7.100	1.400
		V Vanadium	14.000	0.730
		Zn Zinc	40.000	0.180
	NSWS2SS0102	Al Aluminum	5200.000	4.000
		Ba Barium	78.000	0.180
		Be Beryllium	0.270	0.089
		Ca Calcium	2400.000 B	0.890
		Co Cobalt	5.900	0.620
		Cr Chromium	10.000	0.620
		Cu Copper	11.000	0.530
		Fe Iron	8000.000	0.620
		K Potassium	670.000	270.000
		Mg Magnesium	2200.000	2.700
		Mn Manganese	150.000 S	0.180
		Na Sodium	190.000 B	2.600
		Ni Nickel	9.700	1.300
		V Vanadium	19.000	0.710
		Zn Zinc	42.000	0.180
	NSWS2SS0103	Al Aluminum	8600.000	4.000
		Ba Barium	130.000	0.180
		Be Beryllium	0.420	0.090
		Ca Calcium	3300.000 B	0.900
		Co Cobalt	9.000	0.630
		Cr Chromium	14.000	0.630
		Cu Copper	16.000	0.540
		Fe Iron	13000.000	0.630
		K Potassium	1100.000	270.000
		Mg Magnesium	3200.000	2.700
		Mn Manganese	150.000	0.180
		Na Sodium	300.000 B	2.600
		Ni Nickel	14.000	1.300
		V Vanadium	30.000	0.720
		Zn Zinc	50.000	0.180
WS3	NSWS3SS0101	Al Aluminum	7200.000	4.500
		Ba Barium	79.000	0.200
		Be Beryllium	0.440	0.099
		Ca Calcium	2100.000 B	0.990

B = Detected in Blank, result not corrected

S = Result determined by Method of Standard Addition

Table 4-2. STREAM SEDIMENT SAMPLES CONTAINING ANALYTES DETECTED
 AT OR ABOVE LABORATORY DETECTION LIMITS.

Sample Location	Sample Identification	Analyte	Result	Detection Limit
WS3	NSWS3SS0101	Co Cobalt	6.100	0.700
		Cr Chromium	17.000	0.700
		Cu Copper	8.700	0.600
		Fe Iron	11000.000	0.700
		Mg Magnesium	1800.000	3.000
		Mn Manganese	150.000	0.200
		Na Sodium	140.000 B	2.900
		Ni Nickel	11.000	1.500
		V Vanadium	30.000	0.700
		Zn Zinc	21.000	0.200
	NSWS3SS0102	Al Aluminum	5900.000	4.200
		Ba Barium	120.000	0.190
		Be Beryllium	0.420	0.093
		Ca Calcium	2000.000 B	0.730
		Co Cobalt	6.500	0.650
		Cr Chromium	14.000	0.650
		Cu Copper	7.700	0.560
		Fe Iron	9400.000	0.650
		Mg Magnesium	1800.000	2.800
		Mn Manganese	110.000	0.190
		Na Sodium	140.000 B	2.700
		Ni Nickel	10.000	1.400
		V Vanadium	30.000	0.700
		Zn Zinc	18.000	0.190
	NSWS3SS0103	Al Aluminum	5300.000	4.200
		Ba Barium	94.000	0.190
		Be Beryllium	0.380	0.094
		Ca Calcium	2200.000 B	0.940
		Co Cobalt	7.900	0.660
		Cr Chromium	11.000	0.660
		Cu Copper	9.000	0.570
		Fe Iron	8800.000	0.660
		Mg Magnesium	2200.000	2.800
		Mn Manganese	170.000	0.190
		Na Sodium	160.000 B	2.700
		Ni Nickel	7.500	1.400
		V Vanadium	25.000	0.750
		Zn Zinc	21.000	0.190
WS4	NSWS4SS0101	Al Aluminum	2900.000	3.900
		Ba Barium	35.000	0.170

B = Detected in Blank, result not corrected

Table 4-2. STREAM SEDIMENT SAMPLES CONTAINING ANALYTES DETECTED
 AT OR ABOVE LABORATORY DETECTION LIMITS.

Sample Location	Sample Identification	Analyte	Result	Detection Limit
WS4	NSWS4SS0101	Be Beryllium	0.260	0.087
		Ca Calcium	800.000 B	0.870
		Co Cobalt	3.900	0.610
		Cr Chromium	7.800	0.610
		Cu Copper	4.700	0.520
		Fe Iron	5400.000 B	0.610
		Mg Magnesium	790.000	2.600
		Mn Manganese	88.000	0.170
		Na Sodium	100.000 B	2.500
		Ni Nickel	4.800	1.300
		Si Silicon	77.000 B	5.000
		V Vanadium	20.000	0.690
		Zn Zinc	13.000 B	0.170
	NSWS4SS0102	Al Aluminum	3600.000	4.400
		Ba Barium	47.000	0.200
		Be Beryllium	0.250	0.098
		Ca Calcium	990.000 B	0.980
		Co Cobalt	4.100	0.680
		Cr Chromium	8.400	0.680
		Cu Copper	5.600	0.590
		Fe Iron	6100.000 B	0.680
		Mg Magnesium	1100.000	2.900
		Mn Manganese	110.000	0.200
		Na Sodium	95.000 B	2.800
		Ni Nickel	5.900	1.500
		Si Silicon	48.000 B	5.700
		V Vanadium	20.000	0.780
		Zn Zinc	12.000 B	0.200
	NSWS4SS0103	Al Aluminum	3900.000	4.300
		Ba Barium	48.000	0.190
		Be Beryllium	0.340	0.096
		Ca Calcium	1100.000 B	0.960
		Co Cobalt	4.000	0.670
		Cr Chromium	9.200	0.670
		Cu Copper	5.100	0.570
		Fe Iron	6500.000 B	0.670
		Mg Magnesium	1200.000	2.900
		Mn Manganese	110.000	0.190
		Na Sodium	120.000 B	2.800
		Ni Nickel	5.200	1.400
		Si Silicon	120.000 B	5.500
		V Vanadium	22.000	0.760

B = Detected in Blank, result not corrected

Table 4-2. STREAM SEDIMENT SAMPLES CONTAINING ANALYTES DETECTED
 AT OR ABOVE LABORATORY DETECTION LIMITS.

Sample Location	Sample Identification	Analyte		Result	Detection Limit
WS4	NSWS4SS0103	Zn	Zinc	12.000 B	0.190
WS5	NSWS5SS0101	Al	Aluminum	8300.000	4.200
		Ba	Barium	81.000	0.190
		Be	Beryllium	0.340	0.094
		Ca	Calcium	2000.000 B	0.940
		Cd	Cadmium	0.750	0.380
		Co	Cobalt	6.500	0.660
		Cr	Chromium	17.000	0.660
		Cu	Copper	14.000	0.560
		Fe	Iron	10000.000 B	0.660
		K	Potassium	620.000	280.000
		Mg	Magnesium	2400.000	2.800
		Mn	Manganese	150.000	0.190
		Na	Sodium	170.000 B	2.700
		Ni	Nickel	12.000	1.400
		Pb	Lead	10.000	3.900
		V	Vanadium	24.000	0.750
		Zn	Zinc	170.000 S B	0.190
	NSWS5SS0102	Al	Aluminum	11000.000	3.900
		As	Arsenic	5.200	4.600
		Ba	Barium	120.000	0.180
		Be	Beryllium	0.440	0.088
		Ca	Calcium	3100.000 B	0.880
		Co	Cobalt	8.600	0.610
		Cr	Chromium	14.000	0.610
		Cu	Copper	17.000	0.530
		Fe	Iron	15000.000 B	0.610
		K	Potassium	690.000	260.000
		Mg	Magnesium	3600.000	2.600
		Mn	Manganese	220.000	0.180
		Na	Sodium	380.000 B	2.500
		Ni	Nickel	15.000	1.300
		V	Vanadium	31.000	0.700
		Zn	Zinc	41.000 B	0.180
	NSWS5SS0103	Al	Aluminum	12000.000	4.200
		As	Arsenic	5.400	5.000
		Ba	Barium	98.000	0.190
		Be	Beryllium	0.460	0.094
		Ca	Calcium	3000.000 B	0.940
		Co	Cobalt	8.400	0.660

B = Detected in Blank, result not corrected

S = Result determined by Method of Standard Addition

Table 4-2. STREAM SEDIMENT SAMPLES CONTAINING ANALYTES DETECTED
 AT OR ABOVE LABORATORY DETECTION LIMITS.

Sample Location	Sample Identification	Analyte	Result	Detection Limit
WS5	NSWS5SS0103	Cr Chromium	16.000	0.660
		Cu Copper	17.000	0.560
		Fe Iron	15000.000 B	0.660
		K Potassium	810.000	280.000
		Mg Magnesium	3600.000	2.300
		Mn Manganese	200.000	0.190
		Na Sodium	360.000 B	2.700
		Ni Nickel	14.000	1.400
		V Vanadium	40.000	0.750
WS6	FDWS6SS0101	Zn Zinc	40.000 B	0.190
		Al Aluminum	2900.000	4.500
		Ba Barium	47.000	0.200
		Be Beryllium	0.210	0.100
		Ca Calcium	980.000 B	1.000
		Cd Cadmium	0.510	0.400
		Co Cobalt	4.100	0.700
		Cr Chromium	10.000	0.700
		Cu Copper	6.400	0.600
		Fe Iron	4500.000 B	0.700
		Mg Magnesium	910.000	3.000
		Mn Manganese	54.000	0.200
	NSWS6SS0101	Na Sodium	77.000 B	2.900
		Ni Nickel	0.700	1.500
		Pb Lead	13.000	4.200
		V Vanadium	17.000	0.800
		Zn Zinc	26.000 B	0.200
		Al Aluminum	2500.000	4.100
		Ba Barium	48.000	0.180
		Be Beryllium	0.220	0.091
		Ca Calcium	2300.000 B	0.910
		Cd Cadmium	0.470	0.370
		Co Cobalt	3.100	0.640
		Cr Chromium	8.600	0.640
		Cu Copper	7.100	0.550
		Fe Iron	4100.000 B	0.640
		Mg Magnesium	900.000	2.700
		Mn Manganese	62.000	0.180
		Na Sodium	78.000 B	2.600
		Ni Nickel	4.500	1.400
		Pb Lead	16.000	3.800
		V Vanadium	15.000	0.730

B = Detected in Blank, result not corrected

Table 4-2. STREAM SEDIMENT SAMPLES CONTAINING ANALYTES DETECTED
 AT OR ABOVE LABORATORY DETECTION LIMITS.

Sample Location	Sample Identification	Analyte		Result	Detection Limit
WS6	NSWS6SS0101	Zn	Zinc	35.000 B	0.180
	NSWS6SS0102	Al	Aluminum	5900.000	4.100
		Ba	Barium	120.000	0.180
		Be	Beryllium	0.370	0.090
		Ca	Calcium	1800.000 B	0.900
		Co	Cobalt	6.800	0.630
		Cr	Chromium	15.000	0.630
		Cu	Copper	9.600	0.540
		Fe	Iron	10000.000 B	0.630
		Mg	Magnesium	1800.000	2.700
		Mn	Manganese	300.000	0.180
		Na	Sodium	110.000 B	2.600
		Ni	Nickel	10.000	1.400
		V	Vanadium	29.000	0.720
		Zn	Zinc	26.000 B	0.180
	NSWS6SS0103	Al	Aluminum	9500.000	4.400
		As	Arsenic	5.800	5.100
		Ba	Barium	100.000	0.190
		Be	Beryllium	0.490	0.097
		Ca	Calcium	2200.000 B	0.970
		Cd	Cadmium	0.400	0.390
		Co	Cobalt	9.000	0.680
		Cr	Chromium	22.000	0.680
		Cu	Copper	13.000	0.580
		Fe	Iron	20000.000 B	0.680
		Mg	Magnesium	2200.000	2.900
		Mn	Manganese	550.000 S	0.190
		Na	Sodium	150.000 B	2.800
		Ni	Nickel	15.000	1.500
		V	Vanadium	70.000	0.770
		Zn	Zinc	40.000 B	0.190
WS7	NSWS7SS0101	Al	Aluminum	6500.000	4.100
		Ba	Barium	72.000	0.180
		Be	Beryllium	0.260	0.091
		Ca	Calcium	1700.000 B	0.910
		Cd	Cadmium	0.630	0.360
		Co	Cobalt	6.100	0.640
		Cr	Chromium	18.000	0.640
		Cu	Copper	12.000	0.540
		Fe	Iron	9200.000 B	0.640

B = Detected in Blank, result not corrected

S = Result determined by Method of Standard Addition

Table 4-2. SEDIMENT SAMPLES CONTAINING ANALYTES DETECTED
 AT OR ABOVE LABORATORY DETECTION LIMITS.

Sample Location	Sample Identification	Analyte	Result	Detection Limit
WS7	NSWS7SS0101	Mg Magnesium	1800.000	2.720
		Mn Manganese	160.000	0.180
		Na Sodium	110.000 B	2.600
		Ni Nickel	13.000	1.400
		Pb Lead	35.000	3.800
		V Vanadium	21.000	0.730
		Zn Zinc	52.000 B	0.180
	NSWS7SS0102	Al Aluminum	7800.000	4.500
		Ba Barium	101.000	0.200
		Be Beryllium	0.360	0.100
		Ca Calcium	1900.000 B	1.000
		Co Cobalt	8.400	0.700
		Cr Chromium	22.000	0.700
		Cu Copper	9.800	0.600
		Fe Iron	11000.000 B	0.700
		Mg Magnesium	2000.000	3.000
		Mn Manganese	200.000 S	0.200
		Na Sodium	150.000 B	2.900
		Ni Nickel	19.000	1.500
		V Vanadium	28.000	0.800
		Zn Zinc	24.000 B	0.200
	NSWS7SS0103	Al Aluminum	9300.000	4.300
		Ba Barium	120.000	0.190
		Be Beryllium	0.350	0.096
		Ca Calcium	2300.000 B	0.960
		Co Cobalt	8.400	0.670
		Cr Chromium	32.000	0.670
		Cu Copper	13.000	0.580
		Fe Iron	12000.000 B	0.670
		Mg Magnesium	3400.000	2.900
		Mn Manganese	220.000 S	0.190
		Na Sodium	230.000 B	2.800
		Ni Nickel	27.000	1.400
		Pb Lead	9.400	4.000
		V Vanadium	24.000	0.770
		Zn Zinc	36.000 B	0.190
WS8	FDWS8SS01	Al Aluminum	3000.000	4.300
		Ba Barium	170.000	0.190
		Be Beryllium	0.160	0.096
		Ca Calcium	2900.000	0.960

B = Detected in Blank, result not corrected

S = Result determined by Method of Standard Addition

Table 4-2. STREAM SEDIMENT SAMPLES CONTAINING ANALYTES DETECTED
 AT OR ABOVE LABORATORY DETECTION LIMITS.

Sample Location	Sample Identification	Analyte	Result	Detection Limit
WS8	FWWS8SS01	Co Cobalt	3.700	0.670
		Cr Chromium	9.400	0.670
		Cu Copper	9.400	0.580
		Fe Iron	4900.000 B	0.670
		Mg Magnesium	1200.000	2.900
		Mn Manganese	75.000	0.190
		Na Sodium	120.000	2.800
		Ni Nickel	6.800	1.400
		Pb Lead	5.200	4.000
		V Vanadium	12.000	0.770
		Zn Zinc	92.000	0.190
	MSWS8SS01	Al Aluminum	3500.000	4.100
		Ba Barium	100.000	0.180
		Be Beryllium	0.200	0.091
		Ca Calcium	2700.000	0.910
		Co Cobalt	4.500	0.640
		Cr Chromium	22.000	0.640
		Cu Copper	12.000	0.550
		Fe Iron	9400.000 B	0.640
		Mg Magnesium	2100.000	2.700
		Mn Manganese	100.000	0.180
WS9	MSWS9SS01	Na Sodium	120.000	2.600
		Ni Nickel	13.000	1.400
		Pb Lead	16.000	3.800
		V Vanadium	16.000	0.730
		Zn Zinc	85.000	0.180
		Ag Silver	1.700	0.650
		Al Aluminum	1600.000	4.200
		Ba Barium	26.000	0.190
		Be Beryllium	0.097	0.093
		Ca Calcium	1500.000	0.930
		Cd Cadmium	0.380	0.370
		Co Cobalt	2.400	0.650
		Cr Chromium	8.400	0.650
		Cu Copper	7.200	0.560
		Fe Iron	3900.000 B	0.650
		Mg Magnesium	1200.000	2.800
		Mn Manganese	56.000	0.190
		Na Sodium	78.000	2.700
		Ni Nickel	8.100	1.400
		Pb Lead	9.100	3.900

B = Detected in Blank, result not corrected

Table 4-2. STREAM SEDIMENT SAMPLES CONTAINING ANALYTES DETECTED
 AT OR ABOVE LABORATORY DETECTION LIMITS.

Sample Location	Sample Identification	Analyte	Result	Detection Limit
WS9	NSWS9SS01	V Vanadium	7.200	0.750
		Zn Zinc	320.000 S	0.190
WS10	NSWS10SS01	Ag Silver	2.900	0.620
		Al Aluminum	2100.000	4.000
		Ba Barium	42.000	0.180
		Ca Calcium	970.000 B	0.890
		Cd Cadmium	1.300	0.360
		Co Cobalt	2.600	0.620
		Cr Chromium	24.000	0.620
		Cu Copper	11.000	0.540
		Fe Iron	4000.000 B	0.620
		Mg Magnesium	1200.000	2.700
		Mn Manganese	52.000	0.180
		Na Sodium	77.000 B	2.600
		Ni Nickel	7.900	1.300
		Pb Lead	43.000	3.700
		V Vanadium	9.800	0.710
		Zn Zinc	130.000 B	0.180
WS12	NSWS12SS01	Al Aluminum	3200.000	4.100
		Ba Barium	30.000	0.180
		Be Beryllium	0.140	0.090
		Ca Calcium	1200.000 B	0.900
		Cd Cadmium	1.000	0.360
		Co Cobalt	2.900	0.630
		Cr Chromium	17.000	0.630
		Cu Copper	6.600	0.540
		Fe Iron	4800.000 B	0.630
		Mg Magnesium	1500.000	2.700
		Mn Manganese	60.000	0.180
		Na Sodium	85.000 B	2.600
		Ni Nickel	10.000	1.400
		Pb Lead	8.100	3.800
		V Vanadium	10.000	0.720
		Zn Zinc	220.000 B	0.180
WS13	NSWS13SS0101	Al Aluminum	7900.000	4.500
		Ba Barium	80.000	0.200
		Be Beryllium	0.320	0.099
		Ca Calcium	1700.000 B	0.990

B = Detected in Blank, result not corrected

S = Result determined by Method of Standard Addition

Table 4-2. STREAM SEDIMENT SAMPLES CONTAINING ANALYTES DETECTED
 AT OR ABOVE LABORATORY DETECTION LIMITS.

Sample Location	Sample Identification	Analyte		Result	Detection Limit
WS13	NSWS13SS0101	Cd	Cadmium	2.100	0.400
		Co	Cobalt	6.400	0.700
		Cr	Chromium	23.000	0.700
		Cu	Copper	9.100	0.600
		Fe	Iron	9600.000 B	0.700
		K	Potassium	470.000	300.000
		Mg	Magnesium	1900.000	3.000
		Mn	Manganese	160.000	0.200
		Na	Sodium	220.000 B	2.900
		Ni	Nickel	11.000	1.500
		Pb	Lead	9.900	4.200
		V	Vanadium	23.000	0.790
		Zn	Zinc	44.000 B	0.200
	NSWS13SS0102	Al	Aluminum	6100.000	4.200
		Ba	Barium	58.000	0.190
		Be	Beryllium	0.320	0.093
		Ca	Calcium	1200.000 B	0.930
		Co	Cobalt	4.800	0.650
		Cr	Chromium	14.000	0.650
		Cu	Copper	6.300	0.560
		Fe	Iron	9600.000 B	0.650
		Mg	Magnesium	1500.000	2.800
		Mn	Manganese	110.000	0.190
		Na	Sodium	310.000 B	2.700
		Ni	Nickel	9.200	1.400
		V	Vanadium	27.000	0.750
		Zn	Zinc	20.000 B	0.190
	NSWS13SS0103	Al	Aluminum	14000.000	4.400
		As	Arsenic	5.600	5.100
		Ba	Barium	92.000	0.190
		Be	Beryllium	0.490	0.097
		Ca	Calcium	2700.000 B	0.970
		Co	Cobalt	7.000	0.680
		Cr	Chromium	20.000	0.680
		Cu	Copper	13.000	0.580
		Fe	Iron	15000.000 B	0.680
		Mg	Magnesium	2700.000	2.900
		Mn	Manganese	180.000	0.190
		Na	Sodium	560.000 B	2.800
		Ni	Nickel	17.000	1.500
		V	Vanadium	41.000	0.770
		Zn	Zinc	36.000 B	0.190

B = Detected in Blank, result not corrected

Table 4-2. STREAM SEDIMENT SAMPLES CONTAINING ANALYTES DETECTED
 AT OR ABOVE LABORATORY DETECTION LIMITS.

Sample Location	Sample Identification	Analyte	Result	Detection Limit
WS14	FDWS14SS0101	Ag Silver	5.900	0.700
		Al Aluminum	6900.000	4.500
		Ba Barium	91.000	0.200
		Be Beryllium	0.260	0.100
		Ca Calcium	3800.000 B	1.000
		Cd Cadmium	3.300	0.400
		Co Cobalt	8.000	0.700
		Cr Chromium	64.000	0.700
		Cu Copper	20.000	0.600
		Fe Iron	10000.000 B	0.700
		Mg Magnesium	2400.000	3.000
		Mn Manganese	220.000	0.200
		Na Sodium	150.000 B	2.900
		Ni Nickel	27.000	1.500
		Pb Lead	19.000	4.200
		V Vanadium	25.000	0.800
		Zn Zinc	71.000 B	0.200
	NSWS14SS0101	Al Aluminum	4900.000	4.100
		Ba Barium	74.000	0.180
		Be Beryllium	0.210	0.092
		Ca Calcium	3200.000	0.920
		Cd Cadmium	0.430	0.370
		Co Cobalt	9.500	0.640
		Cr Chromium	21.000	0.640
		Cu Copper	19.000	0.550
		Fe Iron	8200.000 B	0.640
		Mg Magnesium	2800.000	2.800
		Mn Manganese	160.000	0.180
		Na Sodium	110.000	2.700
		Ni Nickel	30.000	1.400
		V Vanadium	18.000	0.740
		Zn Zinc	41.000	0.180
	NSWS14SS0102	Al Aluminum	6600.000	4.100
		Ba Barium	94.000	0.180
		Be Beryllium	0.280	0.092
		Ca Calcium	2700.000	0.920
		Co Cobalt	10.000	0.640
		Cr Chromium	24.000	0.640
		Cu Copper	24.000	0.550
		Fe Iron	11000.000 B	0.640

B = Detected in Blank, result not corrected

Table 4-2. STREAM SEDIMENT SAMPLES CONTAINING ANALYTES DETECTED
 AT OR ABOVE LABORATORY DETECTION LIMITS.

Sample Location	Sample Identification	Analyte	Result	Detection Limit
WS14	NSWS14SS0102	Mg Magnesium	4000.000	2.800
		Mn Manganese	290.000	0.180
		Na Sodium	160.000	2.700
		Ni Nickel	32.000	1.400
		V Vanadium	24.000	0.730
		Zn Zinc	43.000	0.180
	NSWS14SS0103	Al Aluminum	5700.000	4.300
		Ba Barium	130.000	0.180
		Be Beryllium	0.280	0.095
		Ca Calcium	2800.000	0.950
		Cd Cadmium	0.570	0.380
		Co Cobalt	10.000	0.660
		Cr Chromium	21.000	0.660
		Cu Copper	14.000	0.570
		Fe Iron	10000.000 B	0.660
		Mg Magnesium	3500.000	2.800
		Mn Manganese	303.000 S	0.190
		Na Sodium	140.000	2.700
		Ni Nickel	32.000	1.400
		V Vanadium	21.000	0.760
		Zn Zinc	43.000	0.190
WS15	FDWS15SS01	Al Aluminum	30.000	4.000
		Ba Barium	56.000	0.180
		Be Beryllium	0.200	0.090
		Ca Calcium	4200.000	0.900
		Cd Cadmium	0.600	0.360
		Co Cobalt	4.800	0.630
		Cr Chromium	18.000	0.630
		Cu Copper	16.000	0.540
		Fe Iron	7700.000 B	0.630
		Mg Magnesium	2200.000	2.700
		Mn Manganese	100.000	0.180
		Na Sodium	170.000	2.600
		Ni Nickel	14.000	1.300
		Pb Lead	88.000	3.800
		V Vanadium	15.000	0.720
		Zn Zinc	150.000	0.180
	NSWS15SS01	Al Aluminum	3900.000	4.100
		Ba Barium	51.000	0.180
		Be Beryllium	0.180	0.092

B = Detected in Blank, result not corrected

S = Result determined by Method of Standard Addition

Table 4.2. STREAM SEDIMENT SAMPLES CONTAINING ANALYTES DETECTED
 AT OR ABOVE LABORATORY DETECTION LIMITS.

Sample Location	Sample Identification	Analyte		Result	Detection Limit
WS1	WSWS15SS01	Ca	Calcium	3700.000	0.920
		Cd	Cadmium	0.590	0.370
		Co	Cobalt	4.900	0.640
		Cr	Chromium	15.000	0.640
		Cu	Copper	14.000	0.550
		Fe	Iron	7000.000 B	0.640
		Mg	Magnesium	2300.000	2.800
		Mn	Manganese	94.000	0.180
		Na	Sodium	170.000	2.700
		Ni	Nickel	16.000	1.400
		Pb	Lead	65.000	3.900
		V	Vanadium	15.000	0.730
		Zn	Zinc	150.000	0.180
WS2	WSWS21SS0101	Al	Aluminum	4800.000	4.300
		Ba	Barium	79.000	0.190
		Be	Beryllium	0.260	0.095
		Ca	Calcium	1500.000 S	0.950
		Cd	Cadmium	0.700	0.380
		Co	Cobalt	7.000	0.660
		Cr	Chromium	14.000	0.660
		Cu	Copper	8.700	0.570
		Fe	Iron	7900.000 B	0.660
		Mg	Magnesium	1600.000	2.800
		Mn	Manganese	144.000 S	0.190
		Na	Sodium	86.000 B	2.700
		Ni	Nickel	8.500	1.400
		Pb	Lead	13.000	4.000
		V	Vanadium	25.000	0.760
		Zn	Zinc	42.000 B	0.190
	WSWS21SS0102	Al	Aluminum	6900.000	4.300
		Ba	Barium	76.000 S	0.190
		Be	Beryllium	0.340	0.094
		Ca	Calcium	1700.000 B	0.940
		Co	Cobalt	6.200	0.660
		Cr	Chromium	16.000	0.660
		Cu	Copper	7.900	0.570
		Fe	Iron	10000.000 B	0.660
		Mg	Magnesium	2000.000	2.800
		Mn	Manganese	140.000 S	0.190
		Na	Sodium	110.000 B	2.700
		Ni	Nickel	11.000	1.400

B = Detected in Blank, result not corrected

S = Result determined by Method of Standard Addition

Table 4-2. STREAM SEDIMENT SAMPLES CONTAINING ANALYTES DETECTED
 AT OR ABOVE LABORATORY DETECTION LIMITS.

Sample Location	Sample Identification	Analyte	Result	Detection Limit
WS21	NSWS21SS0102	V Vanadium	30.000	0.760
		Zn Zinc	75.000 B	0.190
	NSWS21SS0103	Al Aluminum	6600.000	4.500
		Ba Barium	96.000	0.200
		Be Beryllium	0.360	0.100
		Ca Calcium	2000.000 B	1.000
		Co Cobalt	5.800	0.700
		Cr Chromium	16.000	0.700
		Cu Copper	9.300	0.600
		Fe Iron	11000.000 B	0.700
		Mg Magnesium	2300.000	3.000
		Mn Manganese	150.000	0.200
		Na Sodium	120.000 B	2.900
		Ni Nickel	9.900	1.500
		V Vanadium	32.000	0.300
		Zn Zinc	30.000 B	0.200
WS22	NSWS22SS0101	Al Aluminum	8200.000	4.100
		Ba Barium	250.000	0.180
		Be Beryllium	0.440	0.092
		Ca Calcium	3500.000 B	0.920
		Cd Cadmium	0.470	0.370
		Co Cobalt	8.000	0.640
		Cr Chromium	19.000	0.640
		Cu Copper	16.000	0.550
		Fe Iron	12000.000	0.640
		K Potassium	470.000	280.000
		Mg Magnesium	3400.000	2.800
		Mn Manganese	150.000	0.180
		Na Sodium	240.000 B	2.700
		Ni Nickel	20.000	1.400
		V Vanadium	27.000	0.730
		Zn Zinc	40.000	0.180
	NSWS22SS0102	Al Aluminum	4300.000	4.200
		Ba Barium	230.000	0.100
		Be Beryllium	0.240	0.093
		Ca Calcium	1600.000 B	0.930
		Co Cobalt	5.800	0.650
		Cr Chromium	16.000	0.650
		Cu Copper	9.400	0.560
		Fe Iron	7600.000	0.650

B = Detected in Blank, result not corrected

Table 4-2. STREAM SEDIMENT SAMPLES CONTAINING ANALYTES DETECTED
 AT OR ABOVE LABORATORY DETECTION LIMITS.

Sample Location	Sample Identification	Analyte	Result	Detection Limit
WS22	NSWS22SS0102	Mg Magnesium	1900.000	2.800
		Mn Manganese	130.000	0.190
		Na Sodium	110.000 B	2.700
		Ni Nickel	14.000	1.400
		Tl Thallium	4.700	4.700
		V Vanadium	18.000	0.740
		Zn Zinc	45.000	0.190
	NSWS22SS0103	Al Aluminum	2100.000	4.200
		Ba Barium	28.000	0.190
		Be Beryllium	0.130	0.093
		Ca Calcium	800.000 B	0.930
		Co Cobalt	4.000	0.650
		Cr Chromium	12.000	0.650
		Cu Copper	6.000	0.560
		Fe Iron	4400.000	0.650
		Mg Magnesium	930.000	2.800
		Mn Manganese	82.000	0.190
		Na Sodium	66.000 B	2.700
		Ni Nickel	9.200	1.400
		V Vanadium	11.000	0.740
		Zn Zinc	14.000	0.190
WS23	NSWS23SS01	Al Aluminum	1700.000	4.300
		Ba Barium	60.000	0.190
		Ca Calcium	880.000 B	0.960
		Cd Cadmium	1.300	0.380
		Co Cobalt	4.000	0.670
		Cr Chromium	25.000	0.670
		Cu Copper	8.800	0.580
		Fe Iron	3900.000 B	0.670
		Mg Magnesium	1000.000	2.900
		Mn Manganese	96.000	0.190
		Na Sodium	78.000 B	2.800
		Ni Nickel	10.000	1.400
		Pb Lead	40.000	4.000
		V Vanadium	10.000	0.770
		Zn Zinc	86.000 B	0.190
WS28	NSWS28SS01	Ag Silver	0.820	0.670
		Al Aluminum	2100.000	4.300
		Ba Barium	33.000	0.190

B = Detected in Blank, result not corrected

Table 4-2. STREAM SEDIMENT SAMPLES CONTAINING ANALYTES DETECTED
 AT OR ABOVE LABORATORY DETECTION LIMITS.

Sample Location	Sample Identification	Analyte	Result	Detection Limit
WS28	NSWS28SS01	Be Beryllium	0.110	0.095
		Ca Calcium	1400.000	0.950
		Cd Cadmium	1.000	0.380
		Co Cobalt	1.900	0.670
		Cr Chromium	14.000	0.670
		Cu Copper	27.000	0.570
		Fe Iron	3600.000 B	0.670
		Mg Magnesium	1200.000	2.900
		Mn Manganese	110.000	0.190
		Na Sodium	74.000	2.800
		Ni Nickel	3.600	1.400
		Pb Lead	16.000	4.000
		V Vanadium	5.500	0.760
		Zn Zinc	47.000	0.190
WS29	NSWS29SS01	Al Aluminum	2500.000	4.400
		Ba Barium	66.000	0.190
		Be Beryllium	0.190	0.097
		Ca Calcium	1100.000	0.970
		Cd Cadmium	13.000	0.390
		Co Cobalt	10.000	0.680
		Cr Chromium	15.000	0.680
		Cu Copper	13.000	0.580
		Fe Iron	5200.000 B	0.680
		Mg Magnesium	1400.000	2.900
		Mn Manganese	330.000 S	0.190
		Na Sodium	70.000	2.800
		Ni Nickel	19.000	1.500
		Pb Lead	28.000	4.100
		V Vanadium	18.000	0.780
		Zn Zinc	320.000 S	0.190
SW8240 - GC/MS Method for Volatile Organics, ug/Kg				
WS1	NSWS1SS01	methylene chloride	7.900 *B	3.900
WS2	NSWS2SS0101	methylene chloride	4.600 *B	3.900
	NSWS2SS0102	methylene chloride	8.000 *B	4.000
	NSWS2SS0103	methylene chloride	6.000 *B	3.800

B = Detected in Blank, result not corrected

S = Result determined by Method of Standard Addition

* = Estimated result less than 5 times the detection limit

Table 4-2. STREAM SEDIMENT SAMPLES CONTAINING ANALYTES DETECTED
 AT OR ABOVE LABORATORY DETECTION LIMITS.

Sample Location	Sample Identification	Analyte	Result	Detection Limit
WS3	NSWS3SS0101	methylene chloride	5.400 *B	3.600
	NSWS3SS0102	methylene chloride	8.600 *B	3.500
WS4	NSWS4SS0101	acetone	9.300 *B	9.200
	NSWS4SS0102	dichlorodifluoromethane	8.000 *	4.800
WS5	NSWS5SS0101	acetone	25.000 *B	14.000
	NSWS5SS0102	acetone	11.000 BJ	11.000
	NSWS5SS0103	acetone	12.000 *B	11.000
WS7	NSWS7SS0101	dichlorodifluoromethane	27.000 *	5.700
		toluene	130.000	8.700
	NSWS7SS0102	acetone	12.000 *B	11.000
WS8	FDWS8SS01	toluene	20.000 *	7.700
	NSWS8SS01	toluene	15.000 *	8.000
WS12	NSWS12SS01	1,1-dichloroethene	11.000 *	6.300
		1,2-dichloroethene (total)	2.300 *	2.100
WS13	NSWS13SS0101	acetone	11.000 *B	9.600
	NSWS13SS0102	acetone	11.000 *B	9.200
WS14	FDWS14SS0101	dichlorodifluoromethane	36.000	5.700
	NSWS14SS0101	methylene chloride	6.300 *B	4.500
		toluene	13.000 *	9.500

B = Detected in Blank, result not corrected

* = Estimated result less than 5 times the detection limit

J = Detected at less than detection limit

Table 4-2. STREAM SEDIMENT SAMPLES CONTAINING ANALYTES DETECTED
 AT OR ABOVE LABORATORY DETECTION LIMITS.

Sample Location	Sample Identification	Analyte	Result	Detection Limit
	NSWS14SS0102	dichlorodifluoromethane	45.000	5.300
	NSWS14SS0103	dichlorodifluoromethane	110.000	5.700
		methylene chloride	11.000 *B	4.100
WS22	NSWS22SS0101	methylene chloride	8.000 *B	3.400
	NSWS22SS0102	methylene chloride	7.000 *B	3.200
	NSWS22SS0103	methylene chloride	5.000 *B	3.200
WS23	NSWS23SS01	trichloroethene	2.800 *	2.500
<u>SW8270 - Extractable Priority Pollutants (Base/Neutral and Acid), ug/Kg</u>				
WS1	NSWS1SS01	bis(2-ethylhexyl)phthalate	430.000 *B	220.000
WS2	NSWS2SS0101	bis(2-ethylhexyl)phthalate	410.000 *B	230.000
	NSWS2SS0102	bis(2-ethylhexyl)phthalate	330.000 *B	230.000
	NSWS2SS0103	bis(2-ethylhexyl)phthalate	460.000 *B	220.000
WS3	NSWS3SS0101	bis(2-ethylhexyl)phthalate	280.000 *B	210.000
WS4	NSWS4SS0101	di-n-butylphthalate	270.000 *B	200.000
	NSWS4SS0103	di-n-butylphthalate	200.000 BJ	200.000
		phenol	170.000 *	120.000
WS5	NSWS5SS0101	di-n-butylphthalate	350.000 *B	290.000
		phenol	290.000 *	170.000
	NSWS5SS0103	di-n-butylphthalate	450.000 *B	230.000
		phenol	220.000 *	140.000

B = Detected in Blank, result not corrected

* = Estimated result less than 5 times the detection limit

J = Detected at less than detection limit

Table 4-2. STREAM SEDIMENT SAMPLES CONTAINING ANALYTES DETECTED
 AT OR ABOVE LABORATORY DETECTION LIMITS.

Sample Location	Sample Identification	Analyte	Result	Detection Limit
WS6	FDWS6SS0101	bis(2-ethylhexyl)phthalate	74000.000	1100.000
	NSWS6SS0101	di-n-butylphthalate	750.000 *B	220.000
	NSWS6SS0102	bis(2-ethylhexyl)phthalate	330.000 *	220.000
		di-n-butylphthalate	890.000 *B	220.000
	NSWS6SS0103	bis(2-ethylhexyl)phthalate	240.000 *	210.000
		di-n-butylphthalate	720.000 *B	210.000
	NSWS7SS0101	bis(2-ethylhexyl)phthalate	280.000 *B	230.000
		di-n-butylphthalate	550.000 *B	230.000
WS7	NSWS7SS0102	di-n-butylphthalate	700.000 *B	230.000
	NSWS7SS0103	di-n-butylphthalate	910.000 *B	250.000
WS8	FDWS8SS01	bis(2-ethylhexyl)phthalate	18000.000	210.000
		di-n-butylphthalate	830.000 *B	210.000
		fluoranthene	290.000 *	190.000
		pyrene	210.000 *	160.000
	NSWS8SS01	bis(2-ethylhexyl)phthalate	470.000 *	220.000
		di-n-butylphthalate	670.000 *B	220.000
		fluoranthene	300.000 *	200.000
		naphthalene	300.000 *	140.000
		pyrene	280.000 *	170.000
WS9	NSWS9SS01	bis(2-ethylhexyl)phthalate	390.000 *	200.000
		di-n-butylphthalate	690.000 *B	200.000
WS10	NSWS10SS01	bis(2-ethylhexyl)phthalate	820.000 *B	240.000
		butylbenzylphthalate	280.000 *	240.000
		di-n-butylphthalate	770.000 *B	240.000
		fluoranthene	510.000 *	210.000
		phenol	240.000 *	140.000
		pyrene	410.000 *	180.000
WS12	NSWS12SS01	anthracene	210.000 *	160.000

B = Detected in Blank, result not corrected

* = Estimated result less than 5 times the detection limit

Table 4-2. STREAM SEDIMENT SAMPLES CONTAINING ANALYTES DETECTED
 AT OR ABOVE LABORATORY DETECTION LIMITS.

Sample Location	Sample Identification	Analyte	Result	Detection Limit
WS12	NSWS12SS01	benzo(a)pyrene	680.000 *	210.000
		benzo(b)fluoranthene	480.000 *	410.000
		benzo(g,h,i)perylene	350.000 J	350.000
		benzo(k)fluoranthene	940.000 *	210.000
		bis(2-ethylhexyl)phthalate	320.000 *	210.000
		chrysene	810.000 *	210.000
		di-n-butylphthalate	420.000 *B	210.000
		fluoranthene	1100.000	190.000
		phenanthrene	690.000 *	460.000
		phenol	240.000 *	130.000
		pyrene	1200.000	160.000
WS13	NSWS13SS0101	di-n-butylphthalate	330.000 *B	200.000
	NSWS13SS0102	di-n-butylphthalate	250.000 *B	210.000
		phenol	190.000 *	120.000
	NSWS13SS0103	di-n-butylphthalate	300.000 *B	220.000
		phenol	210.000 *	130.000
WS14	FDWS14SS0101	di-n-butylphthalate	290.000 *B	240.000
	NSWS14SS0101	bis(2-ethylhexyl)phthalate	1100.000 *B	270.000
		di-n-butylphthalate	540.000 *B	270.000
	NSWS14SS0102	di-n-butylphthalate	420.000 *B	220.000
	NSWS14SS0103	di-n-butylphthalate	560.000 *B	240.000
WS15	FDWS15SS01	benzo(a)pyrene	530.000 *	210.000
		benzo(k)fluoranthene	530.000 *	210.000
		bis(2-ethylhexyl)phthalate	1400.000	210.000
		chrysene	670.000 *	210.000
		di-n-butylphthalate	880.000 *B	210.000
		fluoranthene	930.000 *	190.000
		phenanthrene	650.000 *	460.000
		pyrene	1100.000	160.000
	NSWS15SS01	benzo(a)pyrene	490.000 *	210.000
		benzo(g,h,i)perylene	350.000 *	340.000
		benzo(k)fluoranthene	510.000 *	210.000

B = Detected in Blank, result not corrected

* = Estimated result less than 5 times the detection limit

J = Detected at less than detection limit

Table 4-2. STREAM SEDIMENT SAMPLES CONTAINING ANALYTES DETECTED
 AT OR ABOVE LABORATORY DETECTION LIMITS.

Sample Location	Sample Identification	Analyte	Result	Detection Limit
WS15	MSWS15SS01	bis(2-ethylhexyl)phthalate	1300.000	210.000
		butylbenzylphthalate	1100.000	210.000
		chrysene	590.000 *	210.000
		di-n-butylphthalate	850.000 *B	210.000
		fluoranthene	990.000	180.000
		indeno(1,2,3-cd)pyrene	300.000 J	300.000
		phenanthrene	590.000 *	440.000
		pyrene	930.000	160.000
WS21	MSWS21SS0101	bis(2-ethylhexyl)phthalate	250.000 *B	210.000
		di-n-butylphthalate	700.000 *B	210.000
	MSWS21SS0102	di-n-butylphthalate	450.000 *B	200.000
	MSWS21SS0103	di-n-butylphthalate	1300.000 B	200.000
		phenol	210.000 *	120.000
WS23	MSWS23SS01	bis(2-ethylhexyl)phthalate	840.000 *B	240.000
		di-n-butylphthalate	990.000 *B	240.000
		phenol	210.000 *	140.000
WS28	MSWS28SS01	bis(2-ethylhexyl)phthalate	620.000 *	260.000
		di-n-butylphthalate	950.000 *B	260.000
		pyrene	200.000 *	190.000
WS29	MSWS29SS01	bis(2-ethylhexyl)phthalate	350.000 *	210.000
		di-n-butylphthalate	610.000 *B	210.000

B = Detected in Blank, result not corrected

* = Estimated result less than 5 times the detection limit

J = Detected at less than detection limit

5.0 SUMMARY AND RECOMMENDATIONS

Information obtained during this preliminary field investigation indicates that manufactured organic compounds and metals exist in some of the creeks and drainages at McClellan AFB. This investigation is an initial screening of surface water and stream sediment and is not intended to fully define the extent, distribution or source of contaminants. This initial screening included only 27 sampling points and was performed in the winter, the wettest season at McClellan AFB. The results are not specific for any Sites or Potential Release Locations and may not represent conditions prevailing during drier seasons. The presence and concentrations of contaminants in the surface water or stream sediment cannot be attributed to any specific location along the course of drainages because soils outside of the drainage were not sampled or analyzed.

The presence of manufactured organic compounds in surface water and sediments indicates that contaminants have entered streams and have migrated from several areas on McClellan AFB and perhaps from off-base areas. The evaluation of metal results was focused on those metals considered to be persistent and bioaccumulative toxic substances by the State of California. Several of these metals increase in concentration in surface water and sediment along the course of streams as they cross McClellan AFB. The presence and increase in concentrations suggest that the metals have also entered surface water from on-base sources.

Surface Water Analysis Results

McClellan AFB discharges treated effluent from its Groundwater Treatment Plant (GWTP) under a National Pollution Discharge Elimination System (NPDES) permit issued by the California Regional Water Quality Control Board, Order No. 87-194. The NPDES permit sets maximum limits for the concentration of contaminants in groundwater that may be discharged as plant effluent into Magpie Creek. Table 5-1 lists the maximum concentrations that were Table 5-1 established for effluent discharges. The effluent concentrations were established only for discharges to Magpie Creek at a point upstream from its exit point from McClellan AFB. The effluent limits were not established for other drainages either on or at the exit point from McClellan AFB. The use of the effluent discharge limits for comparison is not intended as a statment or determination that the limits are applicable as remediation objectives or goals. The limits are presented only to provide a basis of comparison for surface water analyses.

TABLE 5-1. CONCENTRATION LIMITS FOR EFFLUENT DISCHARGE
 FROM GROUNDWATER TREATMENT PLANT TO MAGPIE CREEK

Constituents	Units	Daily Maximum	Monthly Average
Acetone	mg/l	--	1.0
Methyl Ethyl Ketone	mg/l	--	1.0
Methyl Isobutyl Ketone	mg/l (ppm)	--	1.0
Other Volatile Organic Compounds	ug/l (ppb)	Nondetectable ¹	--
Base Neutral and Acid Extractable Compounds	ug/l	Nondetectable ¹	--
Aldrin	ug/l	--	<0.003
<u>Heavy Metals</u>			
Chromium, Total	mg/l	0.05	0.011
Zinc, Total	mg/l	0.150	0.050
Lead, Total	mg/l	0.050	0.025
Selenium, Total	mg/l	0.010	0.010
Cadmium, Total	mg/l	0.010	0.002
Mercury	mg/l	0.002	0.001
Nickel, Total	mg/l	0.073	0.037
Copper, Total	mg/l	0.02	0.008
Antimony	mg/l	0.04	0.04

¹ Based on U.S. EPA Methods 601 and 602 analysis detectable limits. For those contaminants with no established detection limit, nondetectable is less than 0.5 ug/l.

² Based on U.S. EPA Method 625 analysis detectable limits. For those contaminants with no established detection limit, nondetectable is less than 1.0 ug/l.

The discharge shall not have a pH less than 6.5 nor greater than 8.5.

Acetone was detected in samples of surface water from 24 sampling points along Robla Creek, Don Julio Creek, Magpie Creek, Storm Drainage North, Storm Drainage South, and at location WS28. Concentrations detected range from 7.7 to 49.0 ug/L. Acetone was also detected in method blanks run with 10 of those samples. The only other volatile organic compound detected in a surface water sample was dichlorodifluoromethane (9.2 ug/L) at WS1. Acetone is a common laboratory contaminant.

The semivolatile organic compound bis(2ethylhexyl)phthalate was detected in surface water samples and in method blanks run with samples from 11 locations. This compound is also a common laboratory contaminant. The compound 4-nitrophenol was detected at 3.8 to 7.8 ug/L in 3 samples along Magpie Creek but not at the datum point or exit point from McClellan AFB. The compounds 4-nitrophenol and phenol were detected at 7.9 ug/L and 1.8 ug/L, respectively, in one sample (WS17) from the Storm Drainage North. Phenol at 1.8 ug/L was also detected with 4-nitrophenol in one sample (WS10) from Magpie Creek. Pentachlorophenol was detected in one sample from Robla Creek.

In comparing volatile organic compounds to the effluent limits, only dichlorodifluoromethane, detected in one sample from Robla Creek exceeds the effluent limit of "nondetectable" for other volatile organics. However, the sample was collected in an on-base location. The compound was not detected in the water sample taken where Robla Creek exits McClellan AFB. Acetone, although detected in 24 samples and 10 blanks, occurred at a maximum concentration of 49.0 ug/L which is well below the effluent limit of 1 mg/L (1,000 ug/L).

The semivolatile compounds, bis(2ethylhexyl)phthalate, phenol, 4-nitrophenol, and pentachlorophenol detected in surface water samples exceed the NPDES effluent limit of nondetectable for base neutral and acid extractable volatile compounds. However, bis(2methylhexyl)phthalate exceeded the effluent limit at only 2 locations where drainages exit from McClellan AFB. Sampling point WS3, where Storm Drainage North leaves McClellan AFB for a short distance (see Plate 1), and WS7, where Don Julio Creek exits, had detectable concentrations of bis(2methylhexyl)-phthalate. The compound was also detected in blanks run with both samples.

Concentration limits for 9 metals are established in the NPDES permit for the effluent from the GWTP (Table 5-1). Surface water samples were analyzed for both total metal concentration and dissolved metal concentration. Only total metal

concentration limits are established in the NPDES permit. The following discussion describes any samples with total or dissolved metal concentration exceeding the effluent limits.

Chromium, zinc, lead cadmium, nickel, and copper were metals from the effluent limit list which were detected in surface water on McClellan AFB. The effluent discharge limits for one or more metals were exceeded in five samples. None of the five samples were collected within 1,000 feet of an exit point from McClellan AFB.

A* sample location WS6 on Don Julio Creek, the daily maximum effluent limit was exceeded for total lead, total copper, and total nickel in the sample. The dissolved metal concentrations for nickel and zinc also exceeded the daily maximum effluent limits. However, no metals exceeded the effluent limits in the samples from WS7, the point at which Don Julio Creek exits McClellan AFB.

In the sample from WS8, taken from Magpie Creek at its entry point to McClellan AFB, the daily maximum effluent limit concentration was exceeded for total and dissolved zinc. Zinc concentrations were below the effluent limit at WS14 where Magpie Creek exits McClellan AFB.

Total and dissolved analytical concentrations for nickel 12 mg/L and 0.7 mg/L, respectively, and the total concentration for copper (0.14 mg/L) exceeded the effluent concentration limits in the sample from WS18, which was collected at a point where the Storm Drainage North reenters McClellan AFB after flowing through an off-base area. The metals did not exceed effluent limits at sampling locations either upstream or downstream from WS18 along the Storm Drainage North.

The total concentrations of copper (0.25 mg/L) and lead (0.05 mg/L) in the sample from WS21, in a drainage that flows into Magpie Creek, exceed the effluent concentration limits shown in Table 5-1. Copper and lead concentrations downstream from WS21 at WS14 where Magpie Creek exits McClellan AFB, were less than the effluent limit.

The dissolved concentration of copper in the sample from WS25 was 0.04 mg/L. The location of WS25 is a holding pond near Don Julio Creek. Copper did not exceed the effluent concentration limit in the downstream sampling point, WS7, where Don Julio Creek exits McClellan AFB.

No other metal, volatile organic compound, or semivolatile concentrations detected in surface water samples exceeded the effluent concentration limit.

Stream Sediment Analysis Results

There are no concentration criteria established with which to compare stream sediment analytical data. The effluent limits established by the NPDES permit for GWTP discharges to Magpie Creek may be used in comparison with contaminant concentrations in surface waters but not to stream sediments. Concentrations of contaminants detectable in stream sediments may have accumulated in the sediments over a period of time. The contaminants in the sediments may have been deposited locally from surface water passing through the sediments, or the sediments carrying adsorbed contaminants may have been transported from upstream locations to their sampling points by the movement of surface water in the drainage.

Volatile organic compounds, semivolatile organic compounds, metals, cyanide, and petroleum hydrocarbons were detected in stream sediment samples. The compounds detected in the sediments may be considered less mobile than the compounds detected in surface water as a result of being loosely to tightly bound to the sediment grains at the time of sampling, even though surface water was flowing in most of the drainages. The degree of immobility caused by the attraction of compounds to sediment grains cannot be assessed with the data available. However, concentrations of semivolatile organic compounds, cyanide, petroleum hydrocarbons, oil and grease analysis, and several metals were much greater in the sediments than in the surface waters.

Metals were detected in all stream sediment samples. Of the metals detected which are Persistent and Bioaccumulative Toxic Substances (as listed in Title 22, California Code of Regulations), barium, cobalt, chromium, copper, nickel, vanadium, and zinc were detected most frequently. Beryllium, cadmium, silver, and arsenic were detected in a fraction of the samples. The presence of these metals in sediment samples may be due, in part, to dissolution of naturally occurring minerals. However, some of the metals that increase in concentration between the datum and the exit sampling points along drainages may be present as a result of localized historic discharges or runoff from base operations areas.

Seven volatile organic compounds were detected in stream sediment samples from twelve sampling points. Methylene chloride and acetone were detected in 17 samples, but the compounds were also detected in method blanks. Both compounds are common laboratory contaminants. Dichlorodifluoromethane was detected at concentrations of 8 to 110 ug/kg in 5 sediment samples from sampling points in three drainages. Toluene was detected at 13 to 20 ug/kg at 2 sampling points on Magpie Creek. One sampling point was the datum point; the second was the exit point for Magpie Creek from McClellan AFB. The compounds 1,1-dichloroethene (1.1 ug/kg) and 1,2-dichloroethene (2.3 ug/kg) were detected in one sample at WS12 on Magpie Creek. Trichloroethene was detected at 2.8 ug/L in one sample in a drainage on the south end of McClellan AFB.

Fifteen semivolatile organic compounds were detected in thirty-eight sediment samples. Bis(2-ethylhexyl)phthalate and di-n-butylphthalate were the most commonly detected compounds in samples and method blanks. The compounds are common laboratory contaminants. Twelve semivolatile compounds were detected in the surface sample taken at WS12 on Magpie Creek. The compounds occur in concentrations from 210 to 1200 ug/kg. In samples taken at points downstream from WS12, only di-n-butylphthalate, bis(2-ethylhexyl)phthalate and phenol were detected. Eleven semivolatile compounds were detected with concentrations of 300 to 1300 ug/L in one sample taken at WS15 in Storm Drainage North near the east boundary of McClellan AFB. None of the compounds were detected in samples taken downstream from WS15.

The greatest concentration of any semivolatile compound, 74,000 ug/kg of bis(2-ethylhexyl)phthalate was detected in a field duplicate sample taken at WS6 on Don Julio Creek. Bis(2-ethylhexyl)phthalate was also detected at 18,000 ug/kg in a field duplicate sample from WS8 at the point where Magpie Creek enters McClellan AFB.

Although it was not detected in any surface water sample, total cyanide was detected at concentrations of 5 to 14 mg/kg in sediments from five locations, WS6, WS9, WS15, WS28, and WS29 on five different drainages. Cyanide was not detected in any sample taken downstream from any of the five sampling points.

Thirteen samples were analyzed for total petroleum hydrocarbons and total oil and grease. Of the thirteen samples, only six had detectable concentrations (170 to 500 mg/kg) of total petroleum hydrocarbons and concentrations (200 to 800 mg/kg) of total recoverable oil and grease. The same six samples contained both types of

hydrocarbons. The six samples were taken from four sampling points, WS5 and WS6 on Don Julio Creek and WS12 and WS14 on Magpie Creek. Sampling point WS14 is the point at which Magpie Creek exits McClellan AFB.

Recommendations

Because sampling of water or sediments from small tributary drainages or of soils outside drainages at potential release locations on or off McClellan AFB was not undertaken by this program, the surface water and stream sediment data cannot be interpreted to locate specific sources of contaminants. The data suggest that a variety of contaminant compounds and metals are migrating or have historically migrated through drainages crossing McClellan AFB.

This sampling and analysis program was a screening level investigation conducted during one month in 1989. The data presented do not necessarily represent concentrations in surface water that may be presented in other seasons or in any other year.

To determine the concentration and extent of contaminants and the need for remedial actions in surface water drainages, the following recommendations are presented:

- Evaluate these data during the development of sampling and analysis plans for surface soils and surface waters in upcoming operable unit remedial investigations; and
- Develop a sampling and analysis plan to periodically monitor water quality of surface waters at points where drainages enter and exit McClellan AFB.

6.0 REFERENCES

California Code of Regulations, Title 17, Chapter 5, Environmental.
"Public Health" Subchapter 4, Radiation, Section 30355 Appendix A.

California Code of Regulations, Title 22, Division 4, Title 22. "Environmental Health," Chapter 30. Article 11, Section 66699.

Code of Federal Regulations, Title 10, "Energy," Nuclear Regulatory Commission, Chapter 1, Part 20, "Standards for Protection Against Radiation."

National Council on Radiation Protection. "A Handbook of Radioactivity Measurements, Procedures with Nuclear Data for Some Biologically Important Radionuclides," National Council on Radiation Protection Report No. 58, Washington, D.C., December 1978.

Radian Corporation, 1989. "McClellan AFB Quality Assurance Project Plan". Prepared for U.S. Air Force, Occupational and Environmental Health Laboratory (USAFOEHL), Technical Services Division, Brooks AFB, Texas. August.



APPENDIX A
Surface Water Field Data

TABLE A-1. SURFACE WATER FIELD DATA

Sample Location	pH	Specific Conductance (umhos)	Temperature (degrees Celsius)	Flow Rate (cfs)	Depth of Water (feet)
WS 1	7.14	170.0	6.0	0.22	0.2
WS 3	7.67	180.0	7.0	2.90	0.8
WS 5	7.98	100.0	4.0	0	0.9
WS 6	7.79	120.0	7.0	0	1.6
WS 7	6.78	150.0	5.0	2.7	0.6
WS 8	7.16	230.0	9.0	0.3	0.2
WS 9	7.54	230.0	10.0	7.0	0.7
WS 10	6.85	230.0	8.0	29.0	1.8
WS 11	7.92	200.0	11.0	0	1.0
WS 12	7.61	260.0	7.0	6.2	1.0
WS 13	7.55	260.0	7.0	11.5	0.8
WS 14	6.80	250.0	4.0	8.9	1.2
WS 15	7.68	280.0	5.0	0.1	0.2
WS 16	8.21	60.0	7.0	0	1.1
WS 17	7.64	240.0	9.0	0.7	0.9
WS 18	7.72	150.0	8.0	0.8	1.2
WS 19	7.77	150.0	10.0	2.0	0.2
WS 20	7.20	130.0	9.0	0	0.4
WS 21	6.70	110.0	8.0	0	0.5
WS 23	7.07	210.0	10.0	0.5	0.3
WS 24	8.36	700.0	6.0	N/A	2.0
WS 25	8.59	660.0	6.0	N/A	2.0
WS 26	8.53	330.0	6.0	N/A	6.9
WS 27	7.77	320.0	7.0	N/A	7.1

N/A - Not applicable
umhos - micro mho
cfs - cubic feet per second

APPENDIX B

Stream Sediment Field Data

TABLE B-1. STREAM SEDIMENT FIELD DATA

Sample Location	Sediment Description	Flow Rate (cfs)	Depth of Water (feet)
WS 1	SM - Sand, fine-grained, silty, trace clay, brown, saturated.	0.2	0.1
WS 2	SC - Sand, fine, clayey, dark gray, saturated.	0	0.3
WS 3	SM - Sand, fine-grained, silty, trace clay, brown, saturated.	0	0.4
WS 4	CL - Clay, silty, sandy, brown, saturated.	0	0.2
WS 5	CL - Clay, silty, sandy, brown, saturated.	0	0.9
WS 6	CL - Clay, silty, sandy, brown, saturated.	0	1.3
WS 7	SM - Sand, fine-grained, silty, trace clay, brown, saturated.	1.0	0.3
WS 8	SW - Sand, fine to coarse, minor gravel, dark brown, saturated.	0.5	0.6
WS 9	SW - Sand, fine to coarse, minor gravel, brown, saturated.	1.2	0.6
WS 10	SP - Sand, fine to medium, olive brown, saturated.	1.3	0.5
WS 11	SM - Sand, fine-grained, silty, trace clay, brown, saturated.	1.5	0.3
WS 12	SW - Sand, fine to coarse, trace silt, brown, saturated.	6.0	0.5
WS 13	CL - Clay, silty, sandy, brown, saturated.	11.0	0.8
WS 14	SC - Sand, fine to coarse, clayey, brown, saturated.	12.0	1.3
WS 15	SP - Sand, fine to medium, dark brown, saturated.	0.1	0.1

cfs = cubic feet per second

TABLE B-1. (Continued)

Sample Location	Sediment Description	Flow Rate (cfs)	Depth of Water (feet)
WS 21	CL - Clay, silty, sandy, brown, saturated.	0	0
WS 22	SP - Sand, coarse, clayey, brown, moist.	0	0
WS 23	SP - Sand, fine to medium, brown, saturated.	0	0.2
WS 28	SM - Sand, fine to coarse, clayey, silty, dark gray, saturated.	0	2.6
WS 29	SM - Sand, fine to coarse, clayey, silty, brown, saturated.	0	0

CFS -
Source:

APPENDIX C

Quality Assurance/Quality Control Results

The analytical data meet the quality assurance objectives stated in the QAPP. The term "qualified data" refers to data that did not meet the quality assurance objectives of the program; valid data meet the quality assurance objectives of the program. Out of a total of 20,819 individual analytical results, 120 were qualified, and are listed in Table A-3 which is located on page 13. This corresponds to a completeness of greater than 99 percent.

C.1 Blanks

Several different types of blanks were analyzed during this sampling period to assess contamination from the laboratory, ambient, or other sources. These included reagent blanks, trip blanks, and ambient blanks.

C.1.1 Reagent Blanks

Reagent blanks are used to demonstrate that all glassware and reagents used in the analytical procedure are free of interferences and compounds of primary interest. The required frequency for analyzing reagent blanks consists of at least one per day for each method or instrument and/or one per extraction batch.

Several analytes had qualified results based on the associated reagent blank results. A complete listing of samples flagged as qualified, together with the reason for qualification may be found in Table 3-3. For lead analysis, seven samples had reagent blank concentrations in the range of the sample concentration. The lead results for these seven samples were qualified because of probable blank contamination. For the metals analysis, Method SW6010 was used and five metals were reported in water reagent blanks. However, four of the metals reported did not indicate high enough concentrations in the reagent blank to affect the reported sample concentrations. Iron was reported at relatively low concentrations in the samples, so reagent blank contamination was determined to be significant for this metal. For Method SW8240, volatile organics analysis, acetone contamination was common to all samples and it was concluded that acetone was most likely introduced in the laboratory during analysis. The laboratory has been notified of this problem and corrective action has been initiated. Acetone results are qualified for all samples, both water and sediment matrices. This was the most significant problem identified by the quality assurance assessment. For semi-volatile organics analysis, U.S. EPA Method 8270, the common laboratory contaminants bis(2-ethylhexyl)phthalate and di-n-butylphthalate were

identified in reagent blanks. The phthalates are commonly found as contaminants since they are present in plastic tubing and apparatus used in the laboratory. Bis(2-ethylhexyl)phthalate was identified in a reagent blank analyzed with surface water samples and resulted in qualification of results for that compound. Di-n-butylphthalate was not identified in any water samples and is not significant for surface water results. For sediment samples, three compounds were identified in reagent blanks: acetophenone, di-n-butylphthalate, and bis(2-ethylhexyl)phthalate. Acetophenone was not identified in any samples and, therefore, is not considered a significant data quality problem. Bis(2-ethylhexyl)phthalate results were qualified in 9 sediment samples, and di-n-butylphthalate results were qualified in 19 sediment samples.

C.1.2 Trip Blanks

A trip blank is used to identify volatile contaminants introduced during sample transport or handling. Trip blanks are prepared with ASTM Type I reagent-grade water, filled in a contaminant-free environment, (in this case, the gas chromatography laboratory), carried to the field, and returned to the laboratory unopened. Type I water is of a higher quality than the Type II water required and is certified by Gas Chromatography analysis as being free of organics.

Nine trip blanks were collected and analyzed using Method SW8240. Acetone and methylene chloride were both identified below the detection limit. Dichlorofluoromethane was found in one trip blank. This compound is commonly used in the laboratory for various extractions, and was probably introduced into the trip blank in the laboratory. No dichlorofluoromethane was found in any sediment samples, therefore no results were qualified due to trip blanks.

C.1.3 Ambient Blanks

The ambient blank is similar to the trip blank except that the ambient blank is opened and poured from one container to another at the sampling location, and then closed and analyzed along with the other samples. Ambient blanks provide a measure of contamination introduced during the sampling procedure, specifically from airborne contaminants or from other sources distinct from the sampling equipment.

Two ambient blanks were collected and analyzed, one for Method SW8240, and one for Method SW8270. Methylene chloride (Method SW8240) and

bis(2-ethylhexyl)phthalate (Method SW8270) were identified at levels below method detection limits. Both the trip blanks and the ambient blanks indicate that there were no significant effects to the data from sample collection, transport, and handling, nor from possible ambient sources of contamination.

C.2 Duplicates

Duplicate samples were collected and duplicate analyses of matrix spiked samples were performed using the following procedures.

C.2.1 Duplicate Samples

Duplicate samples (or field duplicates) are collected and analyzed to evaluate the precision of the measurement system and estimate variability in the sampling process. If the relative percent difference (RPD) between duplicate sample results is greater than 50 percent, an investigation is initiated to identify the source(s) of variability and determine if the results should be qualified for interpretation. The RPD is calculated using the following formula:

$$\text{RPD (\%)} = 2(X_1 - X_2)/(X_1 + X_2) \times 100\%$$
where X_1 and X_2 are the concentrations of the duplicate pair.

Duplicate sample pairs were collected at the required frequency for each method and sample matrix. One of six duplicate pairs for lead (Method 239.2), had a high RPD, probably due to reagent blank contamination. For Method SW6010, 3 of 10 duplicate pairs had RPDs for one or more analytes outside the objective. All three of these analyte pairs were from sediment samples, collected at three sample locations. The analytes with high RPDs were varied, and did not indicate a systematic problem. Seven field duplicate pairs were analyzed for volatile organics (Method SW8240). One sample, a stream sediment sample, had a high RPD for acetone. However, because all Method SW8240 results are qualified for acetone due to reagent blank contamination, this may account for the high RPD. Methylene chloride was qualified in one sediment sample due to high RPD. This was probably caused by laboratory contamination. Toluene and 4-methyl-2-pentanone were also qualified in two separate samples. The cause of this variability is unknown. For Method SW8270, semi-volatile organics, five samples had high RPDs for bis(2-ethylhexyl)phthalate. One sample pair had a high

RPD for di-n-butylphthalate. These compounds were also found in reagent blanks associated with these sample pairs, and the increased variability is probably due to laboratory contamination.

C.2.2 Matrix Spike Duplicates

Matrix spike/matrix spike duplicates (MS/MSDs) estimate the variability in the analytical portion of the sampling and analytical process; the presence of the analyte is not required in order to obtain useful results. Both matrix effects, analytical variability, and accuracy are assessed from the results of the same sample. This allows the requirement for duplicate analyses to be 5 percent instead of 10 percent. The quality assurance objective for matrix spike duplicates is to have an RPD of 30 percent or less.

Seven MS/MSD pairs were analyzed for metals using Method SW6010. Zinc had low and variable spike recoveries that caused variable RPDs. Variable spike recoveries, in this case, were possibly due to matrix effects. Lead had high RPDs in one sample, probably for the same reasons. These results were qualified. For Method SW8270, six MS/MSD pairs were analyzed. Pentachlorophenol had a high RPD in two of three pairs for water samples. 4-Nitrophenol had a high RPD in two of three water sample MS/MSDs. Matrix effects are suggested by these results.

C.3 Matrix Spike Recoveries

A matrix spike is a solution of method analytes, at known concentrations, that is spiked into a field sample before extraction (if applicable). The results of the analysis of the spiked samples are then used to measure the percent recovery of each spiked compound. This percent recovery is a measure of the accuracy of the method. Specific acceptance criteria for each standard method and parameter measured have been established and are listed in the applicable method description. Since matrix spikes have been paired with duplicate analyses, the required frequency is 5 percent.

Matrix spikes were performed at the required frequency, using the concentrations and conditions specified for each analytical method. Overall, matrix spike recoveries were of acceptable quality, with most unacceptable recoveries due to random error or matrix effects. For Method SW6010, silver had a uniformly low recovery, indicating matrix effects. Iron also exhibited probable matrix effects, although

it was spiked in only one sample. Manganese, zinc, and lead also had matrix effects causing low or high recoveries. For Method 335.2, total cyanide, one of five matrix spikes had a low recovery. This seems to be due to random error. Random error also seems to be the cause of a low matrix spike recovery of 1,1-dichloroethene for Method SW8240. No other matrix spikes for volatile organics were outside the method quality control limits. For Method SW8270, three matrix spikes were performed. Two of these had no quality problems; however, one sample, WS26, was extracted incorrectly. This may have caused low spike recoveries for this sample.

C.4 Analytical Spikes Recoveries

Analytical spikes are the final step used in clearly determining matrix effects for metals analysis. An analytical spike solution is added to a sample and if the recovery is outside of quality control limits, the method of standard addition is used to obtain the correct concentration of the analyte. One analytical spike is performed for each sample analyzed.

Approximately 10 percent of analytical spikes performed on water samples had high thallium recoveries. Manganese had variable spike recoveries, both above and below quality control limits. Zinc and barium also were outside of quality control limits; these were probably due to random error. For Method 245.1, mercury, 3 of 52 analytical spikes were outside allowable limits. The cause is probably also random error.

C.5 Surrogate Spike Recoveries

Surrogate spikes are a group of compounds, other than method analytes, selected for each organic compound analysis. The percent recovery of the surrogate compounds is monitored to determine ability of the laboratory and the method to identify an individual analyte. Surrogate spikes analyzed in this data set were generally within quality control guidelines. However, due to a laboratory error, one sample was extracted with the wrong solvent that caused low recoveries of the surrogate spikes d5-nitrobenzene and 2-fluorophenol. There was also one sample with a low recovery of 2-fluorophenol. These two samples, WS1 and WS26, had qualified results for all Method SW8270 analytes.

C.6 Performance Evaluation Samples

Performance evaluation (PE) samples simulate typical water samples collected in this program. For each parameter of interest, samples were prepared to assess analytical accuracy at concentrations expected for McClellan AFB samples. A matrix blank sample was provided for each parameter to estimate the chance of false positive results for samples at concentrations near the method detection limits. Performance evaluation samples were submitted to the laboratory along with regularly collected samples. Performance evaluation samples were submitted as sets of three samples; each set of three samples consisted of a matrix blank and two samples spiked at levels representative of field samples.

Acetone was identified in both gas chromatography/mass spectrometry (GC/MS) volatile analytes as a false positive, with both being below the method detection limit (MDL). However, all acetone occurrences have been qualified due to reagent blank contamination. Toluene had low recoveries for both the low range and high range samples. Method spikes performed by the laboratory during the same period were within acceptable accuracy limits. Surrogate spikes were also within the method quality assurance limits. A cause for low toluene recoveries in the PE samples cannot be determined at this time. Toluene was identified in one field sample and its field duplicate at less than five times the detection limit. A second sample had toluene identified at 130 micrograms per liter (ug/L). Therefore, although the PE sample results show low recoveries of toluene, all the internal laboratory QA/QC (method spikes, surrogate recoveries, and previous EPA and other external audits) suggest that the toluene results are reliable. Dichlorofluoromethane and phenol had one false positive result each; both were near the MDL. Finally, phenanthrene had a low recovery for the high level audit sample. These results did not affect field sample data since none of these compounds were detected and since the low recovery was for only one analyte in one PE sample and was close to the acceptable lower limit.

The report from Radian's independent Quality Assurance Audit is contained in Appendix D.

TABLE C-1. SUMMARY OF QUALIFIED DATA, PRELIMINARY PATHWAYS ASSESSMENT, MCCLELLAN AFB

Sample Identification	U.S. EPA Method	Analyte(s)	Qualification	Type of Reason
NSWS1SS01	8240	Methylene chloride	RB	Detected in reagent blank
NSWS1SW01	8270	Base-neutral extractables	B	Low surrogate recovery
NSWS2SS0101	8240	Methylene chloride	RB	Detected in reagent blank
NSWS2SS0102	8240	Methylene chloride	RB	Detected in reagent blank
NSWS2SS0103	8240	Methylene chloride	RB	Detected in reagent blank
NSWS2SS0101	6010	Manganese	A	Low spike recovery
NSWS2SS0102	6010	Manganese	A	Low spike recovery
NSWS3SW01	8240	Methylene chloride	RB	Detected in reagent blank
NSWS3SS0102	8240	Methylene chloride	RB	Detected in reagent blank
NSWS4SW01	239.2	Lead (dissolved)	RB	Detected in reagent blank
NSWS4SS0101	6010	Zinc	RB	Detected in reagent blank
NSWS4SS0102	6010	Zinc	RB	Detected in reagent blank
NSWS4SS0103	6010	Zinc	RB	Detected in reagent blank
NSWS5SS0101	6010	Zinc	A	Low spike recovery
NSWS6SS0101	418.1	Oil and grease	PF	High RPD
NSWS6SS0101	6010	Calcium	PF	High RPD
NSWS6SS0103	6010	Manganese	A	High spike recovery
NSWS6SS0101	6010	Thallium	PF, A	High RPD, high recovery
NSWS6SS0102	6010	Thallium	A	High spike recovery
NSWS6SS0103	6010	Thallium	A	High spike recovery
NSWS6SW01	8240	Acetone	PF	High RPD
NSWS7SS0101	6010	Manganese	A	High spike recovery
NSWS7SS0102	6010	Manganese	A	High spike recovery
NSWS8SW01	6010	Iron (dissolved)	RB	Detected in reagent blank
NSWS8SS01	6010	Barium	PF	High RPD
NSWS8SS01	6010	Chromium	PF	High RPD
NSWS8SS01	6010	Lead	PF	High RPD
NSWS8SS01	6010	Nickel	PF	High RPD
NSWS8SS01	6010	Magnesium	PF	High RPD
NSWS8SS01	6010	Iron	PF	High RPD
NSWS9SW01	239.2	Lead	PF	High RPD
NSWS9SW01	6010	Thallium (total)	A	High spike recovery
NSWS9SW01	6010	Thallium (dissolved)	A	High spike recovery
NSWS9SS01	6010	Zinc	A	Low spike recovery

(Continued)

TABLE C-1. (Continued)

Sample Identification	U.S. EPA Method	Analyte(s)	Qualification	Type of Reason
NSWS10SW01	239.2	Lead (dissolved)	RB	Detected in reagent blank
NSWS10SW01	6010	Thallium	A	High spike recovery
NSWS11SW01	6010	Zinc (dissolved)	RB	Detected in reagent blank
NSWS12SW01	239.2	Lead (total)	RB	Detected in reagent blank
NSWS12SS01	6010	Zinc	PL, A	High RPD, low spike recovery
NSWS12SW01	6010	Silver (total)	A	Low spike recovery
NSWS12SW01	6010	Silver (dissolved)	A	Low spike recovery
NSWS12SW01	6010	Iron (dissolved)	RB	Detected in reagent blank
NSWS12SS01	335.2	Total cyanide	A	Low spike recovery
NSWS13SW01	6010	Thallium (dissolved)	A	High spike recovery
NSWS13SW01	6010	Iron (dissolved)	RB	Detected in reagent blank
NSWS14SW01	6010	Iron	RB	Detected in reagent blank
NSWS14SS0101	6010	Cadmium	PF	High RPD
NSWS14SS0101	6010	Chromium	PF	High RPD
NSWS14SS0101	6010	Zinc	PF	High RPD
NSWS14SS0103	6010	Manganese	A	High spike recovery
NSWS14SS0101	8240	Toluene	PF	High RPD
NSWS14SS0101	8240	Methylene chloride	PF	High RPD
NSWS15SS01	6010	Iron	A	High spike recovery
NSWS15SS01	6010	Silver	A	Low spike recovery
NSWS15SW01	8270	Pentachlorophenol	PL	High RPD
NSWS15SW01	8270	4-Nitrophenol	PL	High RPD
NSWS20SW01	6010	Iron (dissolved)	RB	Detected in reagent blank
NSWS20SW01	6010	Zinc (dissolved)	RB	Detected in reagent blank
NSWS20SW01	8270	Pentachlorophenol	PL	High RPD
NSWS20SW01	8270	4-Nitrophenol	PL	High RPD
NSWS21SW01	6010	Iron (dissolved)	RB	Detected in reagent blank
NSWS21SW01	6010	Zinc (dissolved)	RB	Detected in reagent blank
NSWS21SS0101	6010	Manganese	A	Detected in reagent blank
NSWS21SS0102	6010	Manganese	A	Detected in reagent blank
NSWS21SS0102	6010	Barium	A	Detected in reagent blank
NSWS22SS0101	8420	Methylene chloride	RB	Detected in reagent blank
NSWS22SS0102	8240	Methylene chloride	RB	Detected in reagent blank
NSWS22SS0103	8240	Methylene chloride	RB	Detected in reagent blank

(Continued)

TABLE C-1. (Continued)

Sample Identification	U.S. EPA Method	Analyte(s)	Qualification	Type of Reason
NSWS23SW01	239.2	Lead (total)	RB	Detected in reagent blank
NSWS23SW01	245.1	Mercury (dissolved)	A	Low spike recovery
NSWS24SW01	239.2	Lead (total)	RB	Detected in reagent blank
NSWS24SW01	239.2	Lead (dissolved)	RB	Detected in reagent blank
NSWS24SW01	245.1	Mercury (total)	A	Low spike recovery
NSWS25SW01	239.2	Lead (total)	RB	Detected in reagent blank
NSWS25SW01	239.2	Lead (dissolved)	RB	Detected in reagent blank
NSWS26SW01	239.2	Lead (total)	RB	Detected in reagent blank
NSWS26SW01	6010	Silver (total)	A	Low spike recovery
NSWS26SW01	6010	Silver (dissolved)	A	Low spike recovery
NSWS26SW01	8240	1,1-Dichloroethene	A	Low spike recovery
NSWS26SW01	8270	Acenaphthene	PL	High RPD
NSWS26SW01	8270	1,4-Dichlorobenzene	PL	High RPD
NSWS26SW01	8270	2,4-Dinitrotoluene	PL	High RPD
NSWS26SW01	8270	4-Chloro-3-methylphenol	PL	High RPD
NSWS26SW01	8270	n-Nitroso-di-n-propylamine	A	Low spike recovery
NSWS26SW01	8270	Acid extractables	B	Low spike recovery
NSWS26SW01	8270	Base-neutral extractables	B	Low spike recovery
NSWS27SW01	239.2	Lead (total)	RB	Detected in reagent blank
NSWS29SS01	6010	Lead	PL	High RPD
NSWS29SS01	6010	Manganese	PL,A	High RPD
NSWS29SS01	6010	Zinc	PL,A	High RPD
TBSS01	8240	Methylene chloride	RB	Detected in reagent blank
TBSS03	8240	Methylene chloride	RB	Detected in reagent blank
All water and sediment samples	8240	Acetone	RB	Detected in reagent blank
All water and sediment samples	8270	Bis(2-ethylhexyl)phthalate	RB	Detected in reagent blank
All water and sediment samples	8240	Di-n-butylphthalate	RB	Detected in reagent blank

A - Qualified as inaccurate due to matrix or analytical spike recoveries outside the limits.

B - Qualified as biased due to surrogate recoveries outside of limits.

PL - Qualified as estimated due to high laboratory variability as measured by laboratory duplicates.

FF - Qualified as estimated due to high field variability as measured by field duplicates.

RPD - Relative percent difference.

RB - Detected in reagent blank.

APPENDIX D

Preliminary Audit Report

PRELIMINARY AUDIT REPORT

227-005-09-31

20 February 1989

TO: Distribution
FROM: K.W. Rozacky and J.M. Youngerman
PROJECT: McClellan Air Force Base
SUBJECT: Preliminary Results for January 1989 Performance Audit Samples

1.0 INTRODUCTION

On January 9, 1989 performance evaluation (PE) samples were prepared and submitted to Barbara St. Germaine for distribution to the laboratories conducting analyses for the McClellan Air Force Base Program. This audit was conducted as part of the quality assurance effort for that program.

Performance evaluation samples simulating typical water samples were developed by the R&E QA Group because no such samples were commercially available. For each parameter of interest, samples were designed to estimate the analytical accuracy at concentrations expected for McClellan samples. A matrix blank sample was provided for each parameter to estimate the chance of false positive results for samples at concentrations near the method detection limits. Samples were submitted to Radian's Sacramento Production Chemistry Gas Chromatography/Mass Spectroscopy (SPCGC/MS) Laboratory. Analytical data for the audit samples were received by the R&E QA Group on February 3, 1989.

In general, the results for the January 1989 performance audit indicate that related field measurement data meet the purpose of the McClellan program. QA concerns at this time based on the preliminary results received by the R&E QA Group include:

- Accuracy of toluene by Method 624 outside the project objectives;
- False positive results for acetone by Method 624 at levels below the expected MDL;
- Suspected false positive results for dichlorodifluoromethane, by Method 624 at levels well above the expected MDL;
- Accuracy of phenanthrene by Method 625 outside the project objectives; and,
- False positive results for phenol by Method 625 near the expected MDL.

Results for the audit samples are assumed to be representative of the quality of the data for water samples analyzed by Method 624 and Method 625 during the same time period.

Section 2 of this report presents Information Requests (IRs). Discussions concerning the basis for making these recommendations and other potential problems indicated by the preliminary results is presented in Section 3.

2.0 ADDITIONAL INFORMATION REQUIRED

Based on the preliminary results for these performance evaluation samples, three Information Requests (IRs) are being issued at this time. The IRs have been issued to the cognizant supervisor and copies are included as Attachment A of this report. Discussion concerning the basis for making each request is presented in Section 3.

IR#: 51 - Review and confirm results for toluene in samples PESW01 and PESW03.

IR#: 52 - Review and confirm results for dichlorodifluoromethane in sample PESW01.

IR#: 53 - Review and confirm results for phenanthrene in sample PESW04.

IR#: 54 - Review and confirm results for phenol in samples PESW02 and PESW06.

3.0 DISCUSSION

The audit or performance evaluation (PE) samples used for the January 1989 laboratory performance audits were submitted as sets of three samples. Each set of three samples consisted of a matrix blank and two samples spiked at levels representative of expected McClellan AFB field samples. Audit samples were prepared by spiking standards prepared from neat materials into organic-free, ultra-pure water.

A scoring system has been developed to summarize performance evaluation sample results. The system weights 40% of the score to qualitative performance, 40% to quantitative performance and 20% to the accuracy of the reporting and qualification of the data. These method evaluation scores are included with each discussion of results presented in this report.

Potential for false positive results were indicated by the results for volatile organics in water samples by EPA Method 624, and semi-volatile organics by Method 625. Analytical data for field samples may indicate the same compounds as present. There is a possibility that the results are due to contribution from an outside source.

Potential for accuracy outside the project objectives were indicated by the results of volatile organics in water samples by EPA Method 624 and semi-volatile organics by Method 625. The possibility exists that the uncertainty may be greater than originally expected for this measurement data.

3.1 Volatiles in Water Samples by EPA Method 624

Performance evaluation samples of water matrix were prepared and submitted to SPCGC/MS for analysis by EPA Method 624. Three samples, one low level, one high level, and a matrix blank sample were submitted. The samples were spiked at concentrations ranging from four to sixty-four times the expected method detection limit. These samples were designed to evaluate

analytical accuracy for a typical McClellan sample. The matrix blank sample was provided to assess the chance of false positive results at low levels. The results of the analyses of the spiked samples are presented in Table 1.

Overall Method Evaluation Score

<u>Category</u>	<u>Possible</u>	<u>Deductions</u>	<u>Score</u>
Qualitative	40 points	0 MI, 0 FP, 1 SFP	39 points
Quantitative	40 points	2 MQ, 0 FN	30 points
Reporting	20 points	5 points	15 points

Target Compounds = 8			Total 84/100 points

MI = Missed Identification FP = False Positive FN = False Negative
MQ = Missed Quantitation SFP = Sporadic False Positive

The method evaluation indicates that quantitation was outside the program objectives for two of the eight target compounds. These results indicate potential for accuracy to be outside the project accuracy objectives. Dichlorodifluoromethane was detected in measurable quantities in one of the performance evaluation samples. Since this compound was not detected in the matrix blank, this is considered a sporadic false positive. An undefined asterisk was present on this report; this is considered a reporting error. IRs are being issued to verify the target compound recoveries for these samples.

3.1 Semi-volatiles in Water Samples by EPA Method 625

Performance evaluation samples of water matrix were prepared and submitted to SPCGCMS for analysis by EPA Method 625. Three samples, one low level, one high level, and a matrix blank sample were submitted. The samples were spiked at concentrations ranging from five to seventy times the expected method detection limit. These samples were designed to evaluate analytical accuracy for a typical McClellan sample. The matrix blank sample was provided to assess the chance of false positive results at low levels. The results of the analyses of the spiked samples are presented in Table 2.

Overall Method Evaluation Score

<u>Category</u>	<u>Possible</u>	<u>Deductions</u>	<u>Score</u>
Qualitative	40 points	0 MI, 1 FP, 0 SFP	35 points
Quantitative	40 points	1 MQ, 0 FN	35 points
Reporting	20 points	0 points	20 points

Target Compounds = 8			Total 90/100 points

MI = Missed Identification FP = False Positive FN = False Negative
MQ = Missed Quantitation SFP = Sporadic False Positive

The method evaluation indicates that quantitation was outside the program objectives for one of the eight target compounds. These results indicate potential for accuracy to be outside the project accuracy objectives for this compound. Phenol was detected near the detection limit in the matrix blank and one of the spiked samples. These results are being considered a false positive. IRs are being issued to verify the target compound recoveries for this sample.

TABLE 1. JANUARY 1989 PERFORMANCE AUDIT RESULTS FOR VOLATILES IN
WATER SAMPLES - EPA METHOD 624 - (SPGCC - SACRAMENTO, CA)

Parameter	Expected Method Detection Limit ^a (ug/L)	Expected Range of Recovery ^b (%)	Project #	Audit Value (ug/L)	Reported Value (ug/L)	Sample Recovery ^c (%)	Audit Value (ug/L)	Reported Value (ug/L)	Sample Recovery ^c (%)	Matrix Blank Reported Value (ug/L)
Benzene	4.4	3/ 151		23.7	10*	42 ^d	23/	94	40	RB
Toluene	6.0	4/ 162		23.4	8.0*	34 ^d	234	75	32 ^d	RB
Xylenes	4.6	NS		23.4	9.4*	40	234	89	38	RB
Methylene Chloride	2.8	10-221		17.9	13	73	179	170	67	RB
<u>Unexpected Compounds</u>										
Acetone	7.5	NS		0	3.9 ^f	0	0	3.2 ^f	0	3.6 ^f
Dichlorodifluoromethane	3.9	NS		0	21	0 ^f	0	NR	0	RB
<u>Surrogate Spike Recovery</u>										
1,2-Dichloroethane	NS	NS		NR	NR	99	NR	NR	99	99
Toluene-d8	NS	NS		NR	NR	99	NR	NR	100	99
Bromofluorobenzene	NS	NS		NR	NR	100	NR	NR	107	107

^aDetection limit as specified by the laboratory.

^bExpected range of recovery specified by EPA Method 624.

^cSample Recovery (%) = $\frac{\text{Reported Value}}{\text{Audit Value}} \times 100$.

^dRecovery outside the accuracy objectives (underlined for emphasis.)

^eNot contained in audit sample.

^fBelow the laboratory reported detection limit.

^gCannot be calculated or calculation not meaningful.

ND - Not Detected.

NR - Not Reported.

NS - Not Specified.

FP - False Positive.

D - Detected.

* - Undefined laboratory footnote.

TABLE 2. JANUARY 1989 PERFORMANCE AUDIT RESULTS FOR BASE NEUTRAL EXTRACTABLE SEMI-VOLATILE ORGANICS IN WATER SAMPLES - EPA METHOD 625 (SPCCGMS - SACRAMENTO, CA)

Parameter	Expected Method Detection Limit ^a (ug/L)	Expected Range of Recovery ^b (%)	Project #		PE-3002		PE-3004		PE-3006	
			Audit Value (ug/L)		Reported Value (ug/L)	Sample Recovery ^c (%)	Audit Value (ug/L)	Reported Value (ug/L)	Sample Recovery ^c (%)	Matrix Blank Reported Value (ug/L)
<u>Base Neutral Fraction Target Compounds</u>										
Chrysene	2.5	17-168	15		10	67	150	61	41	ND
Hexachloroethane	1.6	40-113	10		6.1	61	100	58	56 ^d	ND
Phenanthrene	5.4	54-120	30		22	73	300	130	43 ^d	ND
1,2-Dichlorobenzene	1.9	32-129	13		9.2	71	130	93	73	ND
<u>Unexpected Base Neutral Compounds</u>										
Phenol	1.5	5-112	e		1.1 ^f	44	e	ND	8	1.7 ^h
<u>Base Neutral Surrogate Spike Recoveries</u>										
d5-Nitrobenzene	NS	35-114	NR		NR	70	NR	NR	70	72
d14-Terphenyl	NS	33-141	NR		NR	91	NR	NR	93	95
2-Fluorobiphenyl	NS	43-116	NR		NR	65	NR	NR	69	73

^aLaboratory reported detection limit for an undiluted sample (concentration factor = 1.0).

^bExpected range of recovery (accuracy objectives) specified by EPA Method 625.

^cSample Recovery (%) = $\frac{\text{Reported Value}}{\text{Audit Value}} \times 100$.

^dRecovery outside the accuracy objectives (underlined for emphasis).

^eNot contained in the audit sample.

^fBelow laboratory detection limit.

^gCannot be calculated or calculation is not meaningful.

^hLess than 3.3 times the MDL.

ND - Not Detected

NR - Not Reported

NS - Not Specified

FP - False Positive

INFORMATION REQUEST

IR #: 51
TO: Larry Kruper
FROM: Jean Youngerman
DATE: 20 February 1989

Distribution Copies To: BSG

Project Reference: PESW01
PESW03
Information Required:

LAB/SAM Reference: S9-01-055-01
S9-01-055-02

Review and confirm results for Toluene in samples PESW01 and PESW03.

Support Documentation Required: ☐ Yes ☒ No

Date Information Required: 27 February 1989

Response:

Follow-up Required: ☐ Yes ☐ No

Additional Comments:

Date Resolved: _____

Verified By: _____

WHITE: Return with information

YELLOW: Retain for your records

PINK: File Copy

GOLD: Company's Copy

Revision 0: 5/88

1 88 30369

INFORMATION REQUEST

IR #: 52
TO: Larry Kruper
FROM: Jean Youngerman
DATE: 20 February 1989

Distribution Copies To: BGG

Project Reference: PESW01

LAB/SAM Reference: S9-01-055-01

Information Required:

Review and confirm results for dichlorodifluoromethane in sample PESW01.

Support Documentation Required: ☐ Yes ☒ No

Date Information Required: 27 February 1989

Response:

Follow-up Required: ☐ Yes ☐ No

Additional Comments:

Date Resolved: _____

Verified By: _____

WHITE: Return with information

YELLOW: Retain for your records

PINK: File Copy

GOLD: Original's Copy

INFORMATION REQUEST

IR #: 53
TO: Larry Kruper
FROM: Jean Youngerman
DATE: 20 February 1989

Distribution Copies To: BGG

Project Reference: PESW04
Information Required:

LAB/SAM Reference: S9-01-056-07

Review and confirm results for phenanthrene in PESW04.

Support Documentation Required: ☐ Yes ☒ No

Date Information Required: 27 February 1989

Response:

Follow-up Required: ☐ Yes ☐ No

Additional Comments:

Date Resolved: _____

Verified By: _____

WHITE Return with information

YELLOW Retain for your records

PINK File Copy

GREEN Distribution Copy

INFORMATION REQUEST

IR #: 54
TO: Larry Kruper
FROM: Jean Youngerman
DATE: 20 February 1989

Distribution Copies To: BSG

Project Reference: PESW02
PESW06
Information Required:

LAB/SAM Reference: S9-01-056-06
S9-01-056-08

Review and confirm results for Phenol in samples PESW02 and PESW06.

Support Documentation Required: ☐ Yes ☒ No

Date Information Required: 27 February 1989

Response:

Follow-up Required: ☐ Yes ☐ No

Additional Comments:

Date Resolved: _____

Verified By: _____

WHITE - Return with information

YELLOW - Retain for your records

PINK - File Copy

GOLD - Information Only

APPENDIX E

Preliminary Pathways Assessment

Geophysical Survey Report



February 17, 1989

Radian Corporation
10100 Old Placerville Road
Sacramento, CA 95827

Attention: Jim Diaz

Gentlemen:

This report presents the results of vertical magnetic gradiometer (VMG) and ground penetrating radar (GPR) surveys at McClellan Air Force Base, Sacramento, California. The surveys were conducted on February 2, 6, 7 and 8, 1989 by Kenneth Blom and William Black, NORCAL Geophysicists and James Wilder, NORCAL Technician. Logistical and field assistance was provided by Michael Boulay, Radian Corporation, and H. M. Hamilton, Environmental Management, McClellan A.F.B. Dr. F. L. Doyle of MITRE Corporation observed the field work on February 2, 1989. The geophysical surveys were authorized under Radian Purchase Order # 576728.

PURPOSE

The purpose of the surveys is to locate possible underground storage tanks at 5 sites on McClellan A.F.B. These sites are referred to by Radian as Sites T6, T10, T12, T36 and T66.

SITE DESCRIPTIONS

The 5 sites are located in and/or around specific buildings. Building numbers for each site as well as other pertinent information are shown on the survey location maps (Plates 1, 2, 4, and 6). Typically, the sites were paved with asphalt or concrete and did not have any direct evidence for the existence of any tanks. The boundaries of each survey area were defined in the field by Radian personnel prior to each survey.

VERTICAL MAGNETIC GRADIENT

By measuring the earth's total magnetic field with two sensors separated at a fixed vertical distance, we obtain an indication of the change in intensity of the total field with distance in the vertical plane. This is referred to as the vertical magnetic gradient. These measurements are useful in detecting buried



metal objects because they are less susceptible to interference than conventional total field readings, and are immune to diurnal changes in the earth's magnetic field. They are also more sensitive to horizontal variations. This facilitates the differentiation of anomalies caused by multiple sources.

The vertical gradient of the magnetic field over a buried ferris object is typically positive. That is, the intensity of the total field increases as elevation (and, therefore, distance from the target) decreases. However, negative anomalies may also be observed depending on the direction of magnetic polarization of the object and the proximity of the measurement point. For example, a vertical magnetic gradient reading of -30 to $+50$ gammas per meter may be observed directly above a single 55 gallon drum buried at a depth of 10 feet. However, several feet to one side of the object location, a negative value may be measured.

The instrument used for this survey, a Geometrics G-856, is a proton free-precession magnetometer that includes two sensors mounted at a fixed separation of 2.8 feet on an 8 foot long staff. The instrument features a digital read-out and stores the line number, the reading number, and the total field readings from both sensors in memory. It can also be interfaced with a printer or computer so that the stored data can be printed out and computer processed to calculate the station coordinates and vertical gradient values. This data can then be used to produce computer drawn magnetic profiles and/or contour maps.

Field Procedure

Our typical procedure was to take vertical magnetic gradient readings at 5 foot intervals, except where nearby cultural features caused too much interference. Horizontal control along each traverse was established using a fiberglass tape. The locations of the magnetometer traverses are shown on Plates 2, 4, and 6.

Data Analysis

The data stored in the magnetometer were downloaded to a micro computer and processed as follows:

- 1) the vertical magnetic gradient was computed from the dual sensor readings.
- 2) the locations of each reading point were assigned using the line numbers, reading numbers, and field notes.
- 3) the data were plotted and contoured by computer to produce the vertical magnetic gradient contour maps shown on Plates 2, 4, and 6.



In order to provide sufficient detail, the magnetic gradient data has been contoured at an interval of 20 gammas/ft. However, the steep gradients caused by cultural interference have resulted in a very large range of values. To simplify the contour maps we have limited the contouring to a range of -520 to +520 gammas/ft. Therefore, areas with values in excess of this range appear as blank spots on the maps.

Areas where the magnetic gradient varies by tens of gammas over relatively small distances, are considered anomalous. Such areas are identified on the maps by closely spaced contours, particularly those that form closures with amplitudes of several tens of gammas or more. The locations of anomalies considered to be significant were plotted on Plates 3, 5, and 7. This includes anomalies believed to be caused by buried objects as well as those caused by known surface objects such as fences.

GROUND PENETRATING RADAR

Ground penetrating radar (GPR) is a method that provides a continuous, high resolution cross-section depicting variations in the electrical properties of the shallow subsurface. The method is particularly sensitive to variations in electrical conductivity and electrical permittivity (the ability of a material to hold a charge when an electrical field is applied).

In operation, the system continuously radiates an electromagnetic pulse into the ground from a transducer (antenna) as it is moved along a traverse. Since most earth materials are transparent to electromagnetic energy, only a portion of the radar signal is reflected back to the surface from interfaces representing variations in electrical properties. When the signal encounters a metal object, however, all of the incident energy is reflected. The reflected signals are received by the same transducer and are transmitted to a graphical recorder. The resulting records can provide information regarding the stratification, the thickness and extent of fill material, the location of buried objects such as utilities, and changes in material conditions such as saturation and, in some instances, chemical differences (when the subsurface electrical properties are altered). Generally, relatively high electrical conductivities reduce the penetration capability and limit radar performance.

For this investigation we used a Geophysical Survey Systems, Inc. SIR-3 Subsurface Interface Radar System equipped with a 500 megaHertz (MHz) antenna. The frequency of this antenna is near the center of the available range and was used to provide high resolution at shallow depths.



Field Procedure

We obtained GPR data from parallel traverses distributed at five foot intervals across the areas of investigation. The locations of these traverses, along with the magnetic gradient traverses, are shown on Plates 1, 2, 4, and 5. Our procedure was to hand tow the antenna along the traverse at a slow walking pace. We performed a preliminary analysis of the GPR records in the field in order to tentatively locate buried objects and determine if additional traverses were necessary and where they should be located.

Data Analysis

The GPR records were examined for reflection patterns with a signature that is characteristic of buried pipes and/or UST's. The locations of any such patterns interpreted as buried objects of significant size were marked on the records, and plotted on Plates 3, 5, and 7.

RESULTS

The results of the MAG and GPR surveys for the five (5) sites surveyed are presented on Plates 1 through 7. Since Sites T-6 and T-10 are small localized areas and could only be surveyed with GPR, we have presented the survey coverage and results for both sites on Plate 1. For the remainder of the sites, the results are illustrated on two plates for each site.

The first of the two plates is a magnetic gradient contour map superimposed on a site survey coverage location map. The second is an anomaly map showing the locations of both MAG and GPR anomalies as well as other features such as underground pipelines, excavated and filled areas, buried concrete slabs, and possible buried tank locations.

The magnetic anomalies are areas where both positive and negative vertical magnetic gradients significantly exceed the background values. Many of the anomalous areas can be attributed to cultural features such as, fences, buildings, and utilities. The GPR anomalies are areas where subsurface reflection patterns characteristic of sources such as buried debris, abandoned facilities, foreign fill material, and possible tanks have been identified. Those features identified as buried pipelines, filled areas, and buried concrete slabs are based on our interpretation of the GPR profiles. Areas depicted as possible underground storage tank (UST) locations are based not only on our interpretation of the GPR data, but also on the existing background data. Therefore, we consider not only the presence of magnetic and/or GPR anomalies, but also the location of the anomalous area relative to surface structures and its proximity to existing and abandoned site utilities and other facilities.



To further define the relative certainty of the potential underground storage tank locations, we have differentiated them into categories of high and low probability. High probability tank areas are where both MAG and GPR anomalies with characteristic signatures exist and are within a likely location based on past information. Low probability locations are those exhibiting a MAG and/or GPR anomaly with a signature that is not typical of underground tanks, or that are situated in an unlikely location. The high probability locations are noted on the appropriate plates.

Site T6

This site was surveyed with GPR only since it is located inside of Building 640. The survey coverage referenced to Pillar 14A is shown on Plate 1. The GPR profiles exhibit reflection patterns characteristic of rebar spaced at 1 foot intervals within the concrete slab floor as well as concrete footings spaced every eight feet. There was no evidence of subsurface reflections characteristic of an underground tank.

Site T10

The survey coverage at the north end of Building 362C and the south side of Building 362A is shown on Plate 1. Several underground pipelines were delineated as shown. The sources of the three GPR anomalies indicated on the north end of Building 362C are uncertain due to their localized nature and the fact that they could not be surveyed in more detail because of their proximity to the building. Therefore, they should be considered as low probability tank areas.

Site T12

The survey location and magnetic gradient contour map for this site is presented as Plate 2. The contour map shows very strong magnetic gradients and interference over a majority of the site. These appear to be due to cultural features such as fences, buildings, and utilities because of their close proximity to the measurement points.

Various MAG and GPR anomalies as well as other features are shown on the Anomaly Map, Plate 3. MAG Anomaly A is a series of high amplitude positive and negative gradients surrounding Building 342. This anomalous zone appears to be due to numerous undifferentiated cultural sources. MAG Anomaly B appears to be due to the metal fence and other utilities that parallel this trend. It is characterized by several smaller amplitude anomalies associated with a major positive high amplitude anomaly.



Three possible tank areas are noted on Plate 3. Locations T1 and T2 should be considered as high probability due to the characteristic signature of the GPR reflections observed in these areas, the anomalously high magnetic gradient, and the previously reported indication of a possible tank at this location. At Location T3, however, the observed GPR anomaly could be due to a small tank or other isolated object, therefore it is considered as low probability.

Site T36

The survey location and magnetic gradient contour map are presented as Plate 4. The MAG contour map shows several areas with strong gradients. The locations of these anomalies as well as GPR anomalies, underground pipelines, and fill areas are shown on the Anomaly Map, Plate 5. MAG anomalies A through E appear to be due to cultural interferences such as a fence (Anomaly A); a dumpster and electrical utilities (Anomalies B and C); the building and associated utilities (Anomaly D); and metal debris on the ground (Anomaly E).

The distribution and shape of Anomalies B and C, and their asymmetrical relationship to the dumpster and high voltage box, suggest that they may be to an underground source to the east. Since, however, there are no GPR anomalies associated with these MAG anomalies, we interpret them as low probability tank locations.

Site T66

The survey location and magnetic gradient contour map is presented as Plate 6. Several strong positive and negative gradient areas have been defined along the eastern two-thirds of the site. The MAG and GPR Anomaly Map is presented as Plate 7.

Four MAG anomalies referred to as Anomalies A through D have been defined. Anomaly A is located at the west end of a surface pipeline. Anomaly B is associated with a vertical pipe and drain, and several GPR anomalies. Anomalies C and D are in close proximity to a concrete pad and are probably associated with several GPR anomalies. Possible tank locations are shown at each of these MAG anomalies. Location T1 is a high probability area because of the positive MAG anomaly and its location relative to the surface pipeline and vertical pipe. Location T2 should be considered high probability due to its proximity to 2 vertical pipes as well as several GPR anomalies. However, the negative MAG anomaly is not typical. At Location T3 the strong negative MAG anomaly is not typical of a buried tank and therefore should be considered as low probability. The GPR anomalies may be due to buried debris since it is within a fill area with known debris. Location T4 is low probability due to its close proximity to an open trench.

Radian Corporation
February 27, 1989
Page 7



STANDARD CARE AND WARRANTY

The scope of NORCAL's services for this project consisted of using ground penetrating radar and magnetic gradiometer to explore for underground tanks. The accuracy of our findings are subject to specific site conditions, access and limitations inherent to the techniques. In view of the limitations, it should be recognized that the prevailing conditions at the time of the survey may preclude some subsurface definition.

We performed our services in a manner consistent with the level of skill ordinarily exercised by members of the profession currently employing similar methods. No other warranty, with respect to the performance of services or products delivered under this agreement, expressed or implied, is made by NORCAL.

We appreciate having had the opportunity to provide our services on this project. If you have any questions or if we can be of further assistance, please contact us.

Yours very truly,

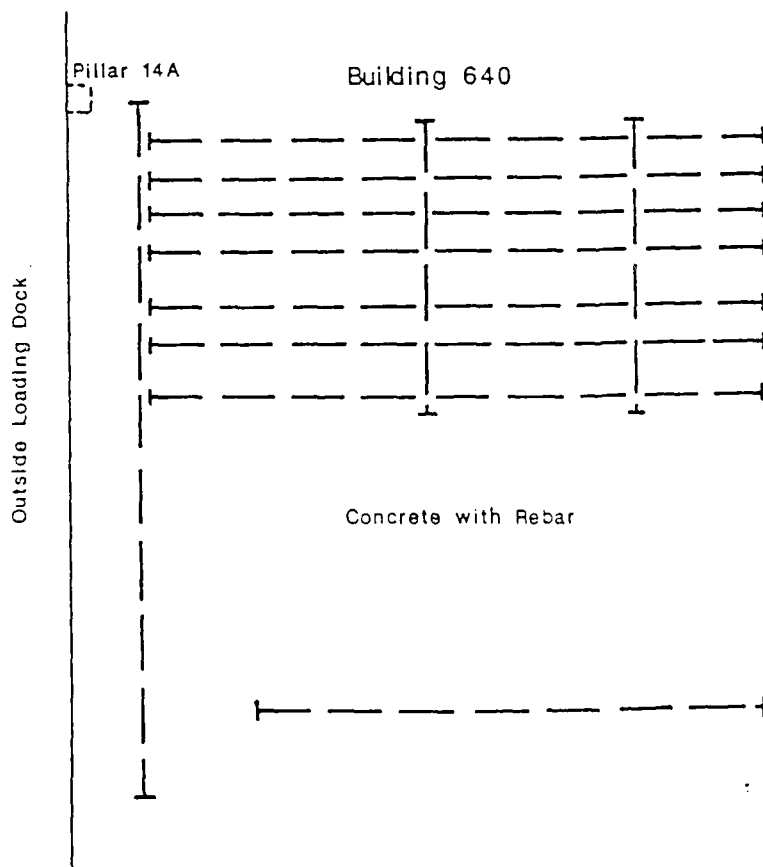
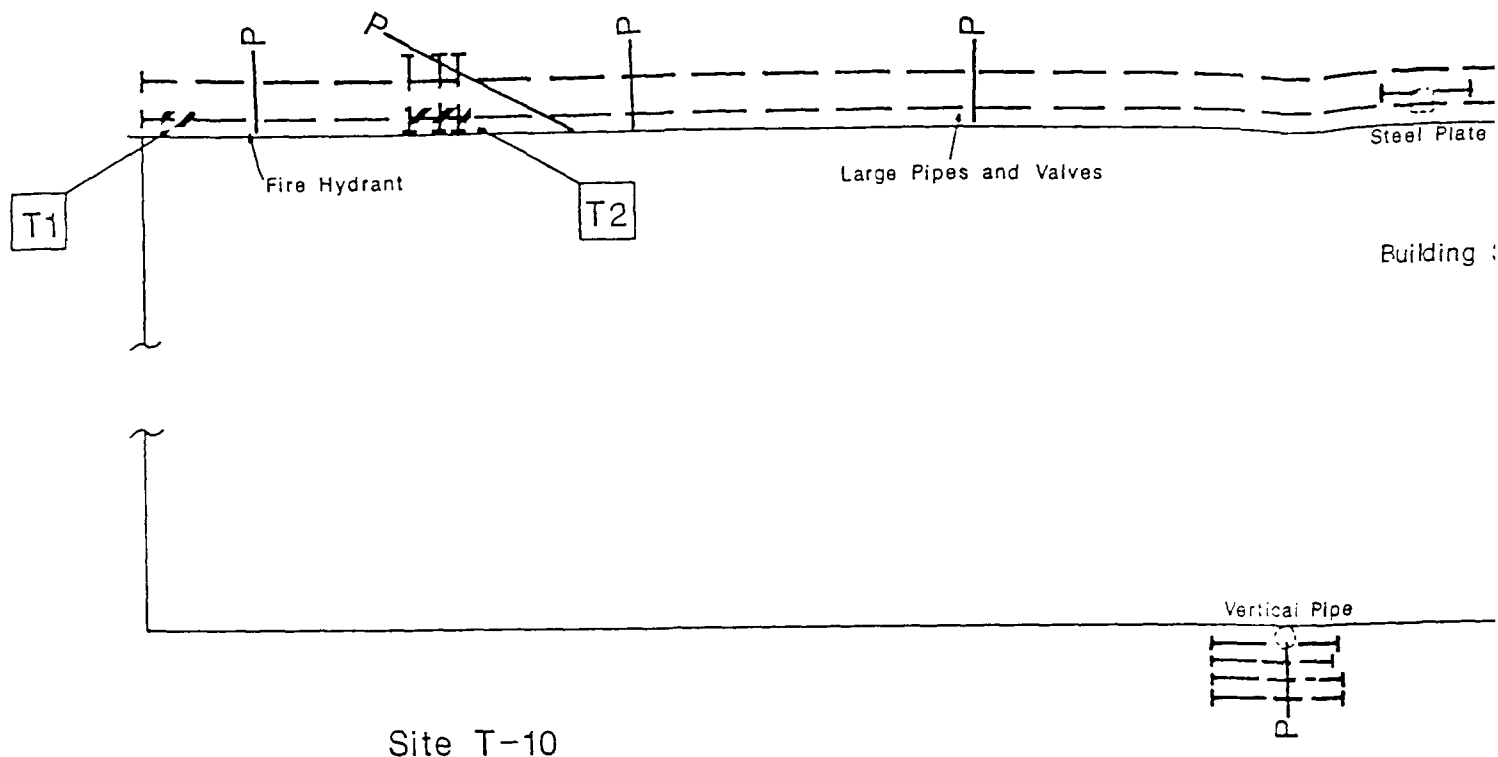
NORCAL Geophysical Consultants, Inc.

A handwritten signature in dark ink, appearing to read "Kenneth G. Blom".

Kenneth G. Blom
Geophysicist, GP-887

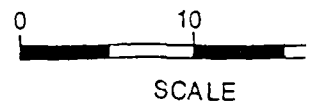
KGB/WEB/jh

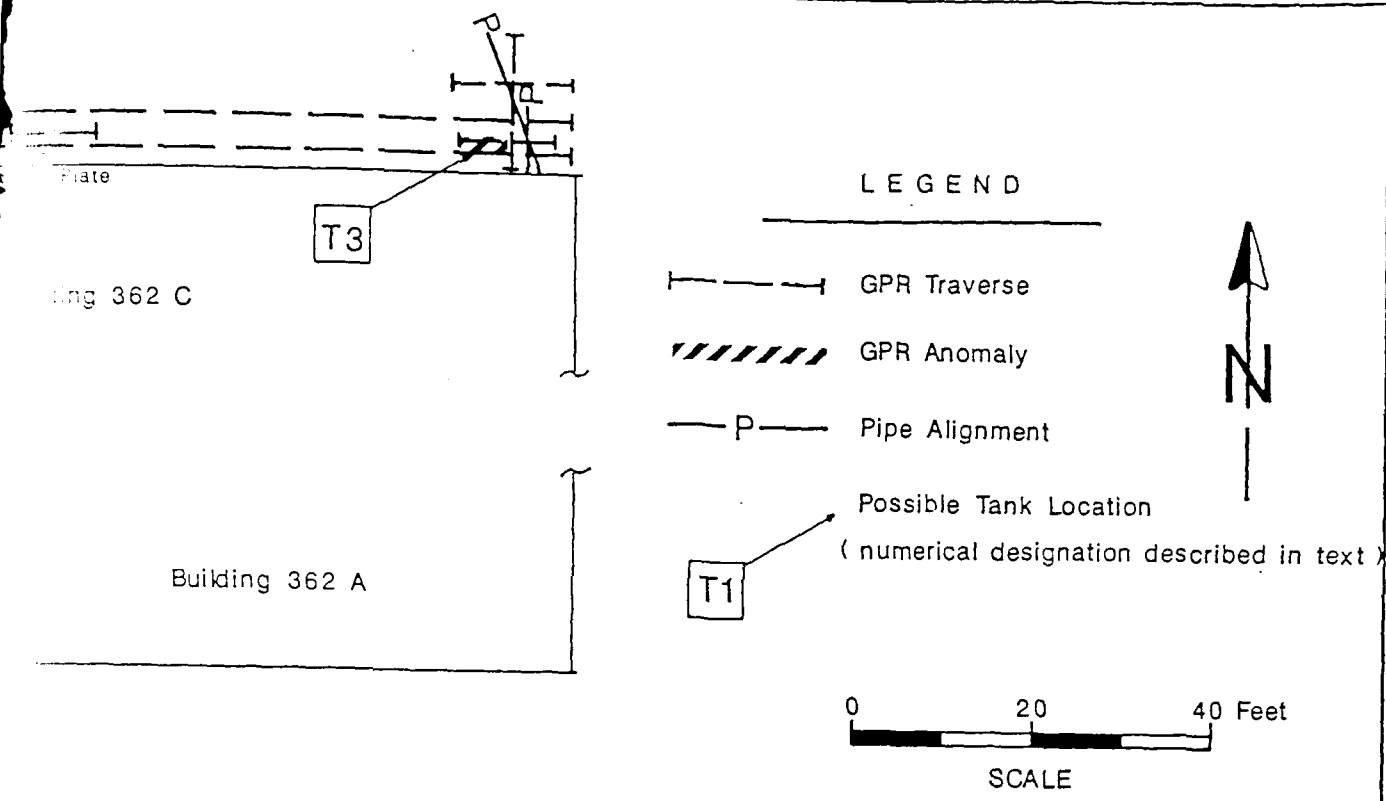
Enclosures: Plates 1 through 7



LEGEND

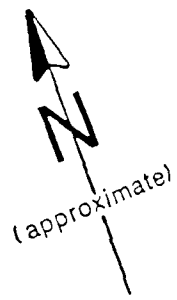
— GPR Traverse





LEGEND

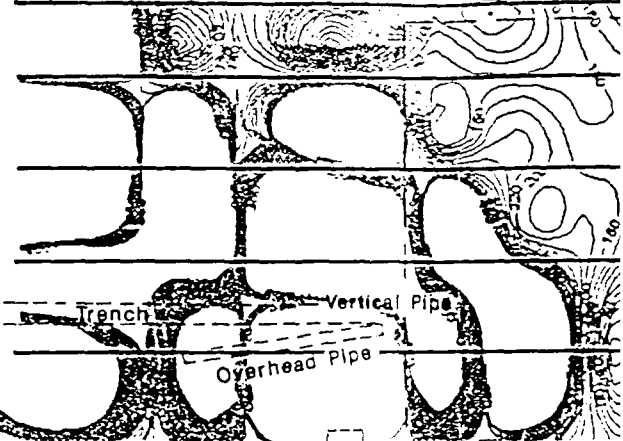
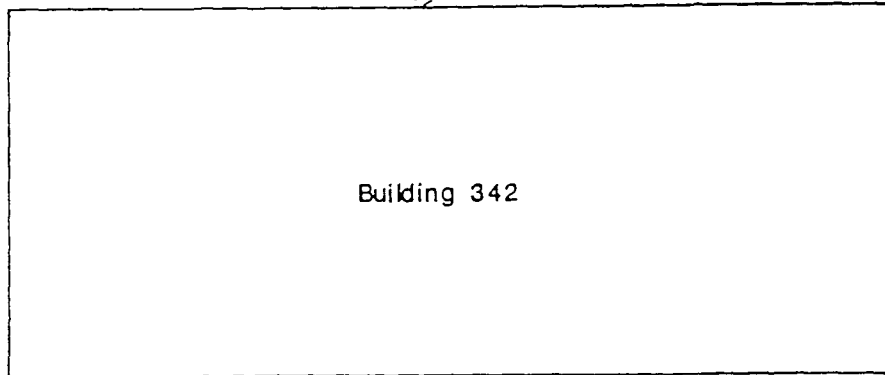
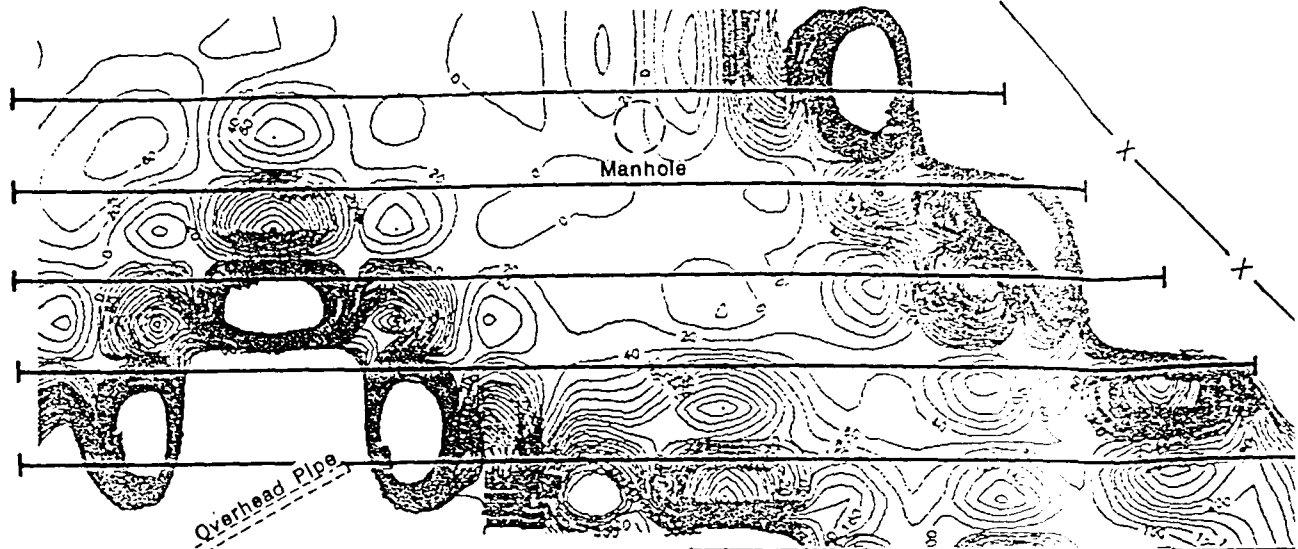
Traverse



20 Feet



NORCAL GEOPHYSICAL CONSULTANTS			SURVEY LOCATION MAP McClellan AFB, Sites T-6 & T-10 Sacramento, California	PLATE 1
JOB: 89-138.03	APPR:	DATE: 2/89		



Gravel



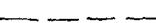
Gravel



Valve Boxes

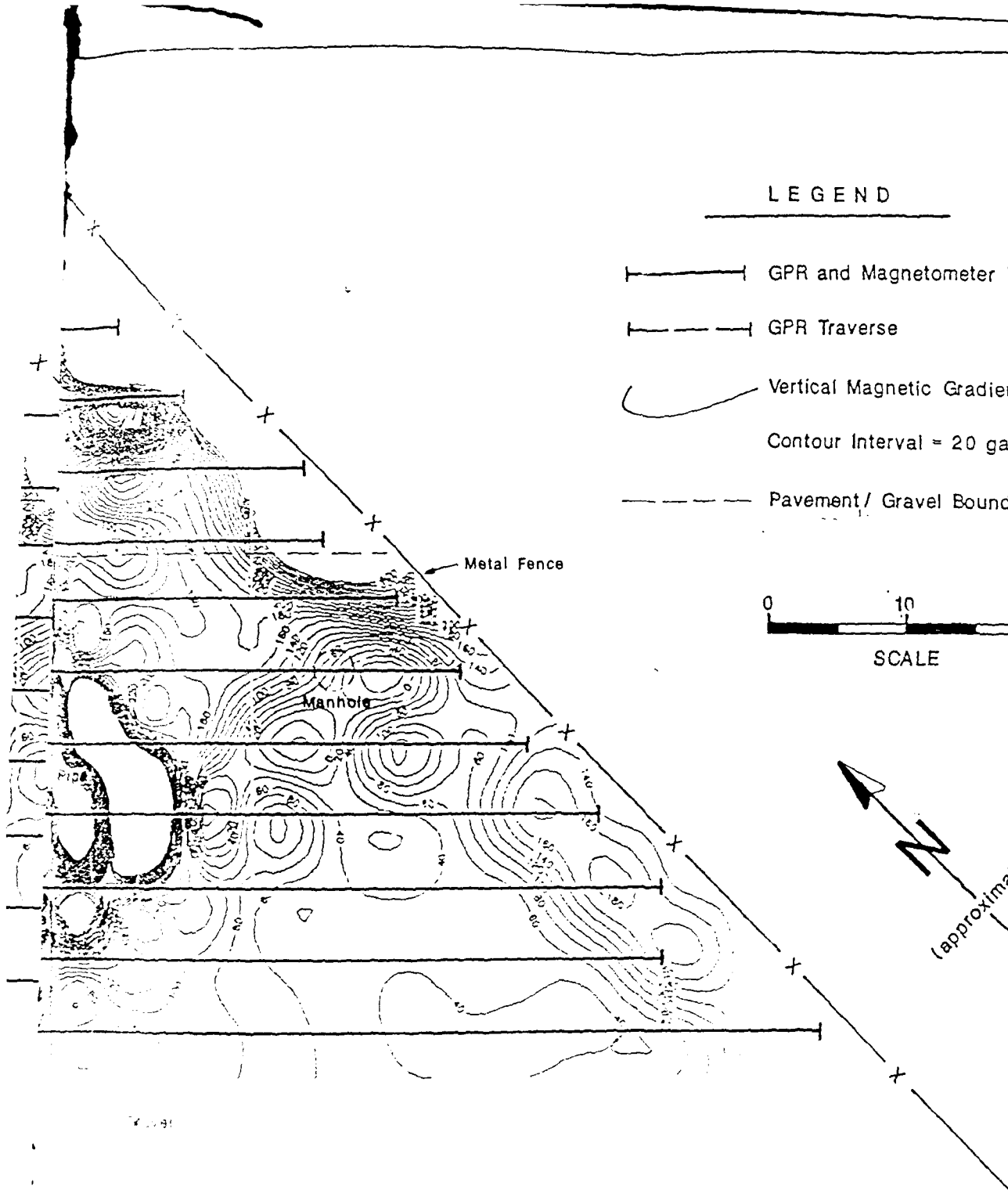
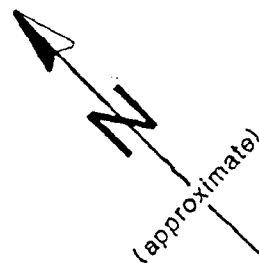
Pavement

LEGEND

-  GPR and Magnetometer Traverse
-  GPR Traverse
-  Vertical Magnetic Gradient Contours
Contour Interval = 20 gammas/ft.
-  Pavement/ Gravel Boundary

0 10 20 Feet

SCALE



NORCAL

GEOPHYSICAL CONSULTANTS



SURVEY LOCATION AND MAGNETIC
CONTOUR MAP

McClellan AFB, Site T-12
Sacramento, California

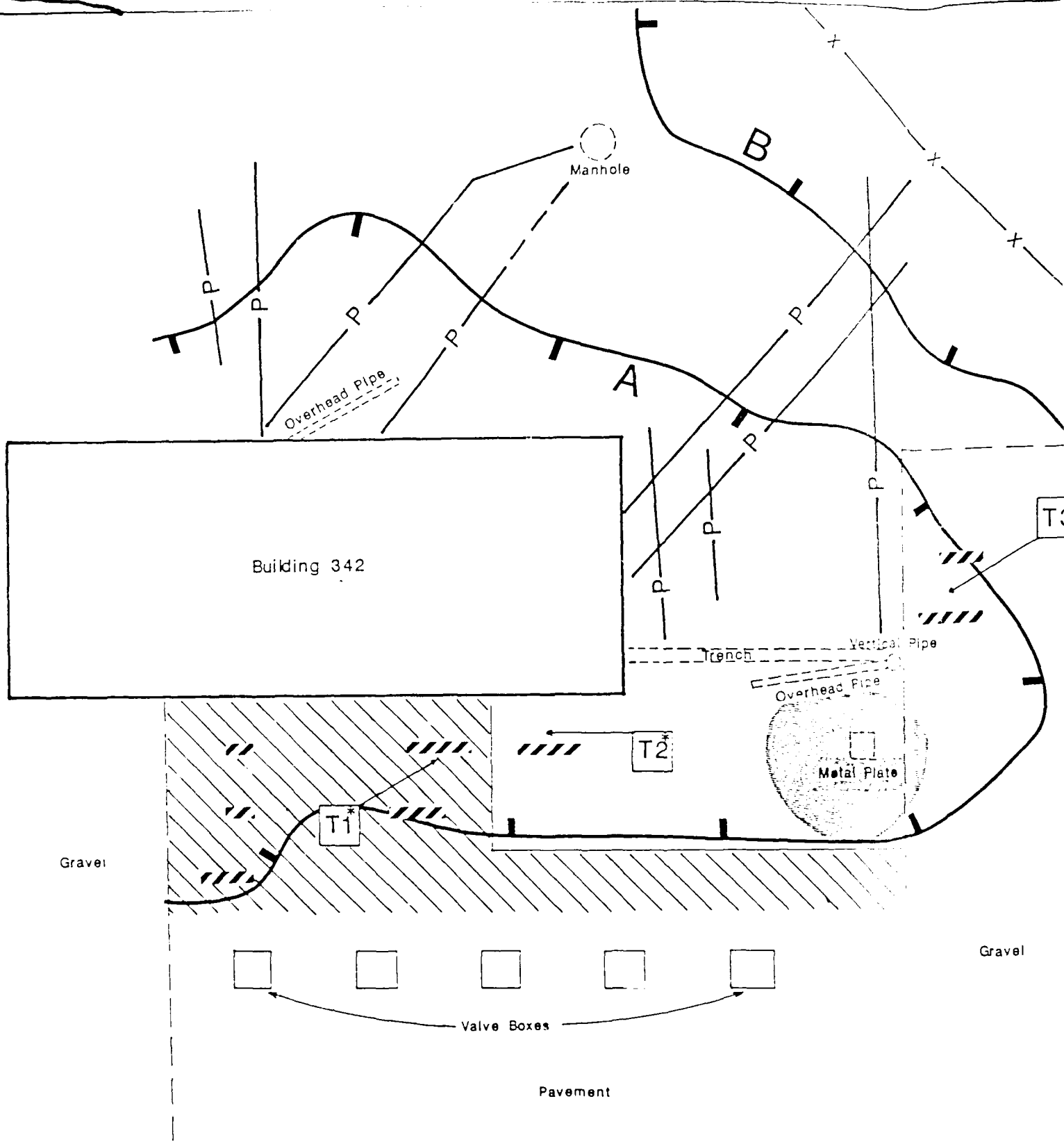
PLATE

2

JOB: 89-138.03

APPR:

DATE: 2/89



LEGEND



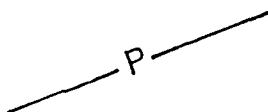
Magnetic Gradient Anomaly



GPR Anomaly



Fill Material with Scattered Debris

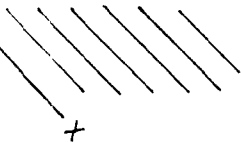


Pipe Alignment



Possible Tank Location (numerical designation described in text)

* High Probability



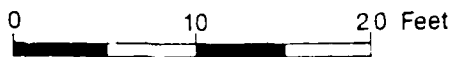
Two layers of Concrete and Rebar

Vertical Pipe

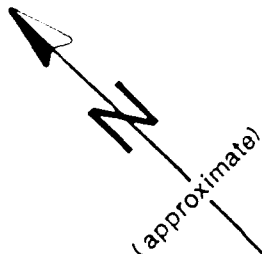
Plate

Manhole

Metal Fence



SCALE



NORCAL

GEOPHYSICAL CONSULTANTS



NORCAL

ANOMALY MAP

McClellan AFB, Site T-12

Sacramento, California

PLATE

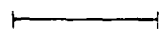
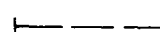
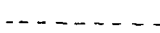
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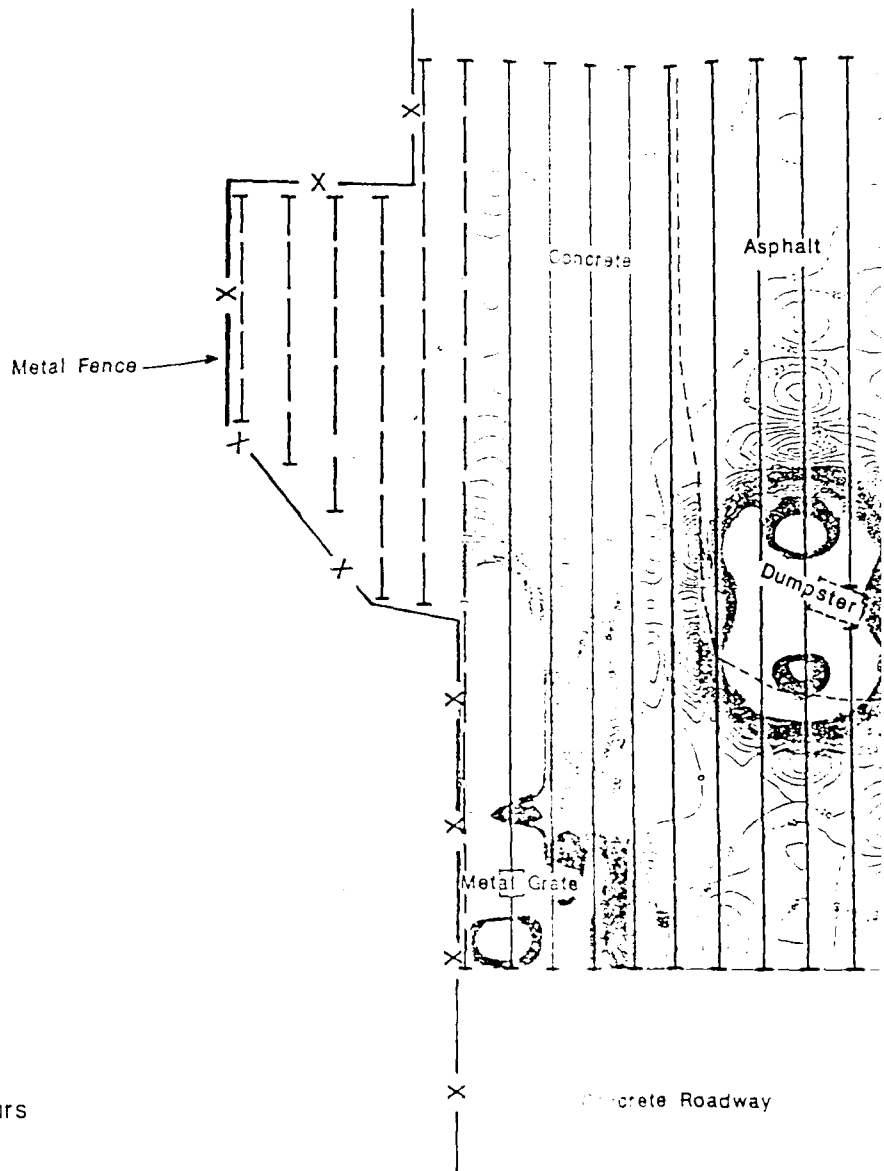
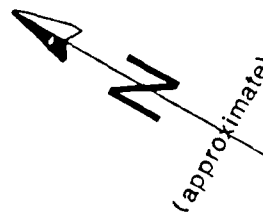
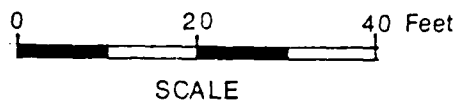
JOB: 89-138.03

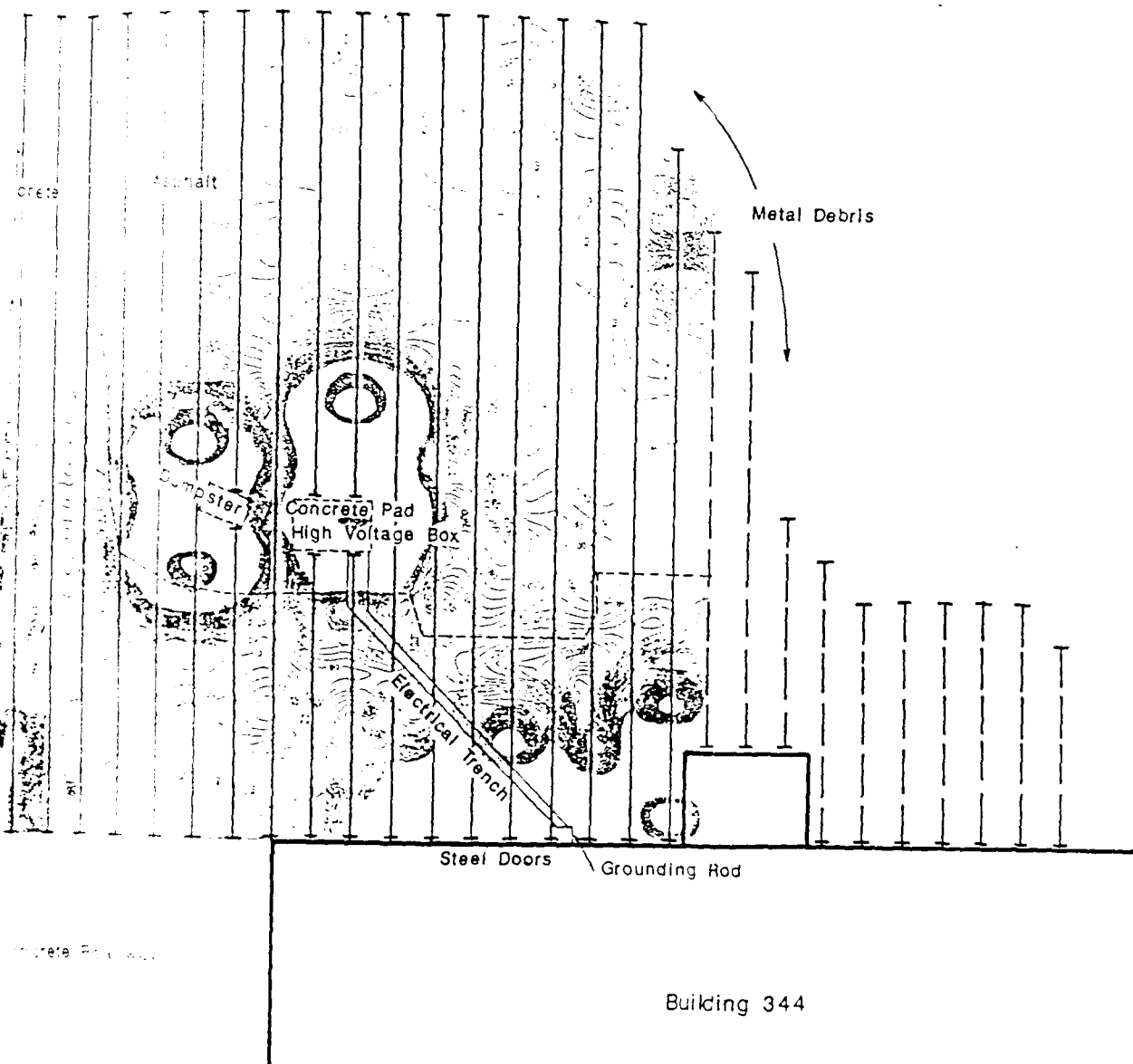
APPR:

DATE: 2/89

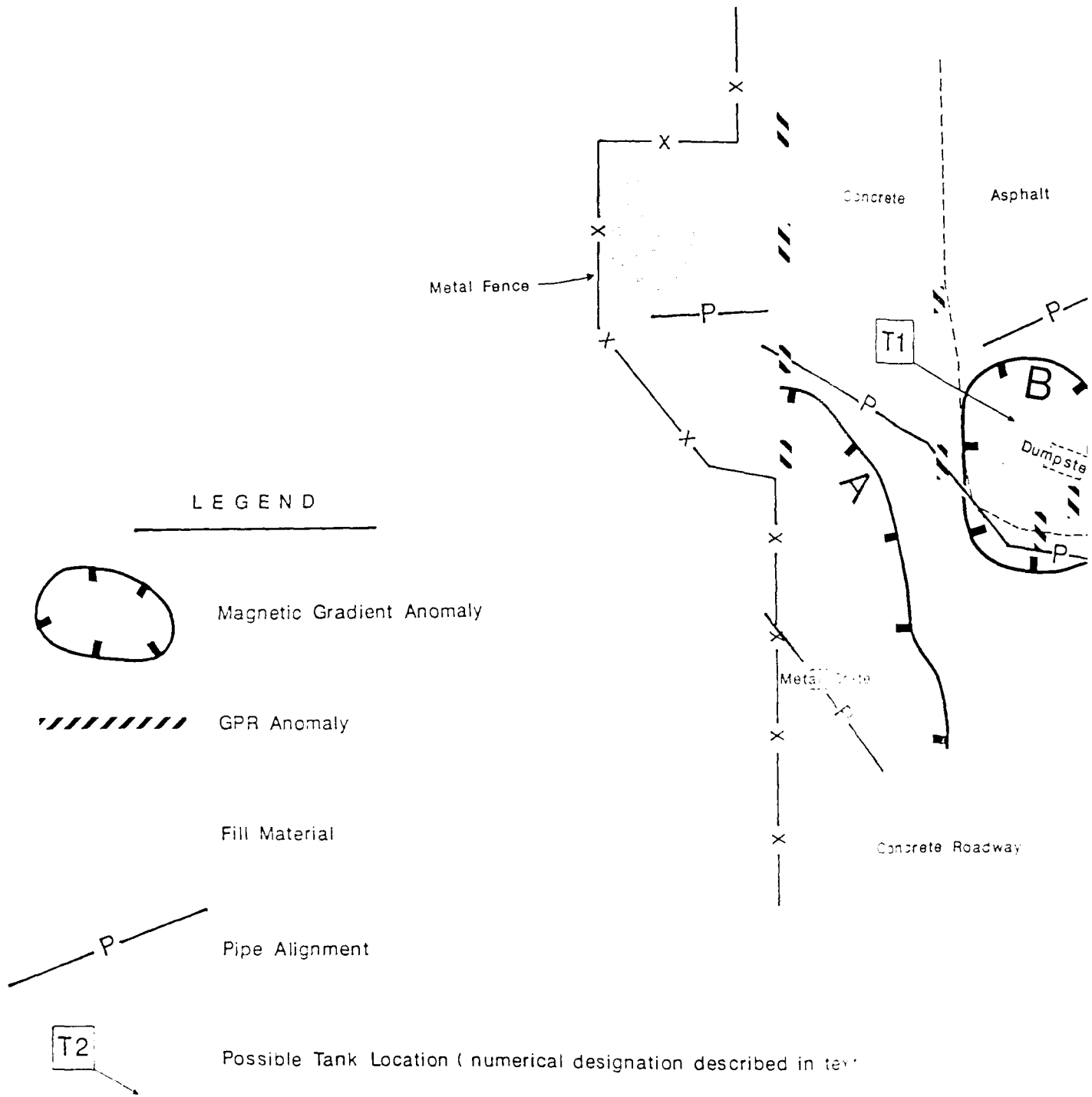
LEGEND

-  GPR and Magnetometer Traverse
-  GPR Traverse
-  Vertical Magnetic Gradient Contours
Contour Interval = 20 gammas/ft.
-  Asphalt / Concrete Boundary





NORCAL GEOPHYSICAL CONSULTANTS			SURVEY LOCATION AND MAGNETIC CONTOUR MAP McClellan AFB, Site T-36 Sacramento, California	PLATE 4
JOB: 89-138.03	APPR:	DATE: 2/89		



W. Hall

Metal Debris

T2

Dumpster
Concrete Pad
High Voltage Box

Electrical Trench

Steel Doors

Grounding Rod

Building 344

0 20 40 Feet
SCALE

N
(approximate)

NORCAL

GEOPHYSICAL CONSULTANTS



ANOMALY MAP

McClellan AFB, Site T-36
Sacramento, California

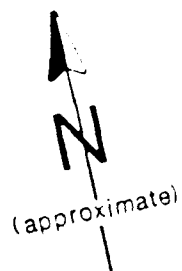
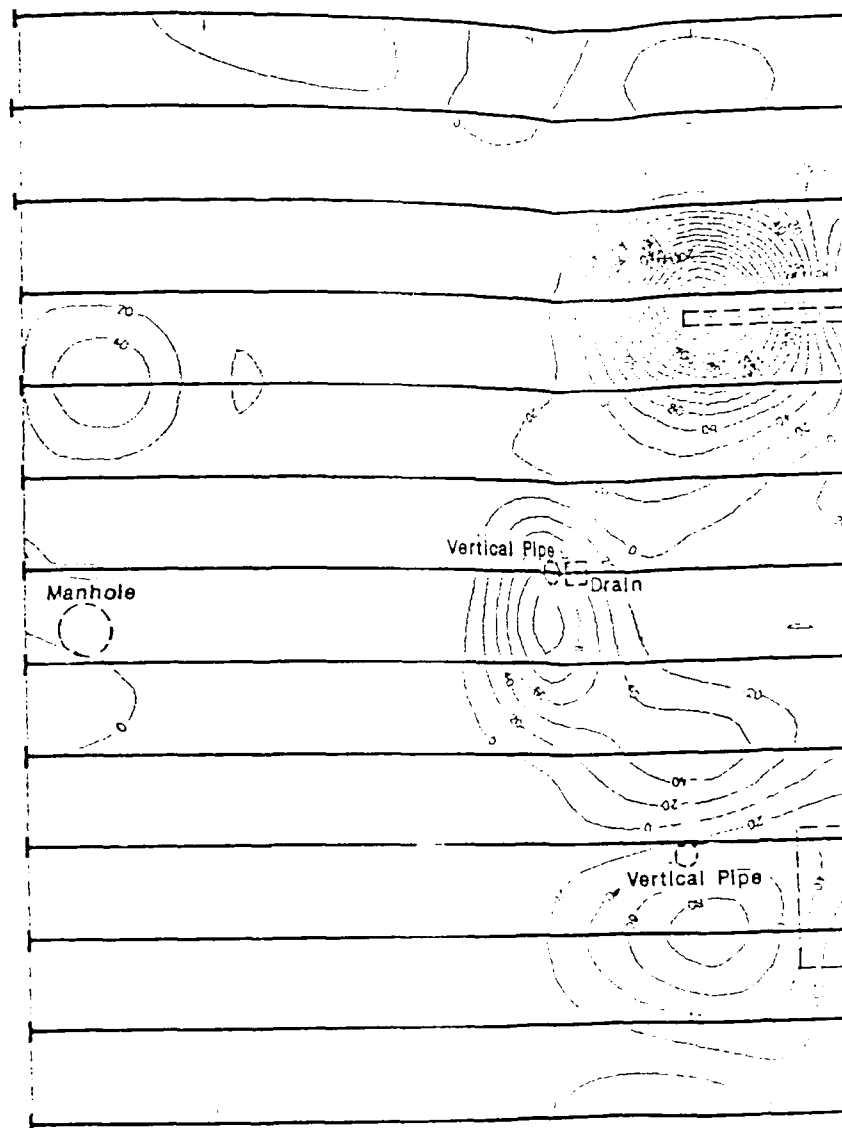
PLATE

5

JOB: 89-138.03

APPR:

DATE: 2/89



LEGEND

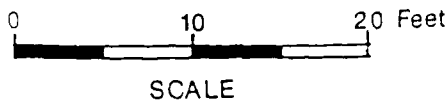
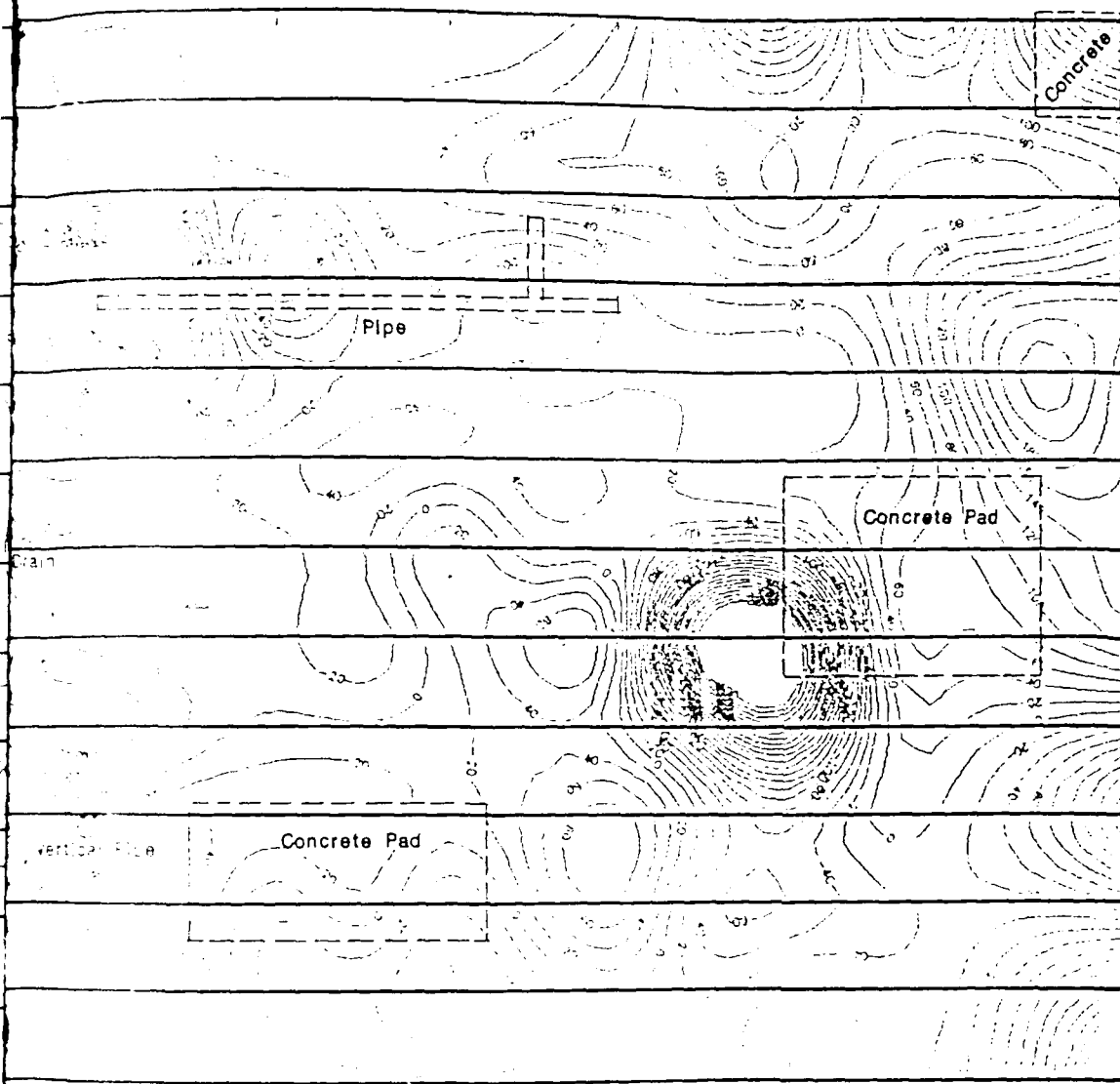
— GPR and Magnetometer Transect

— Vertical Magnetic Gradient Contours
 Contour Interval = 20 gamma/ft.

0

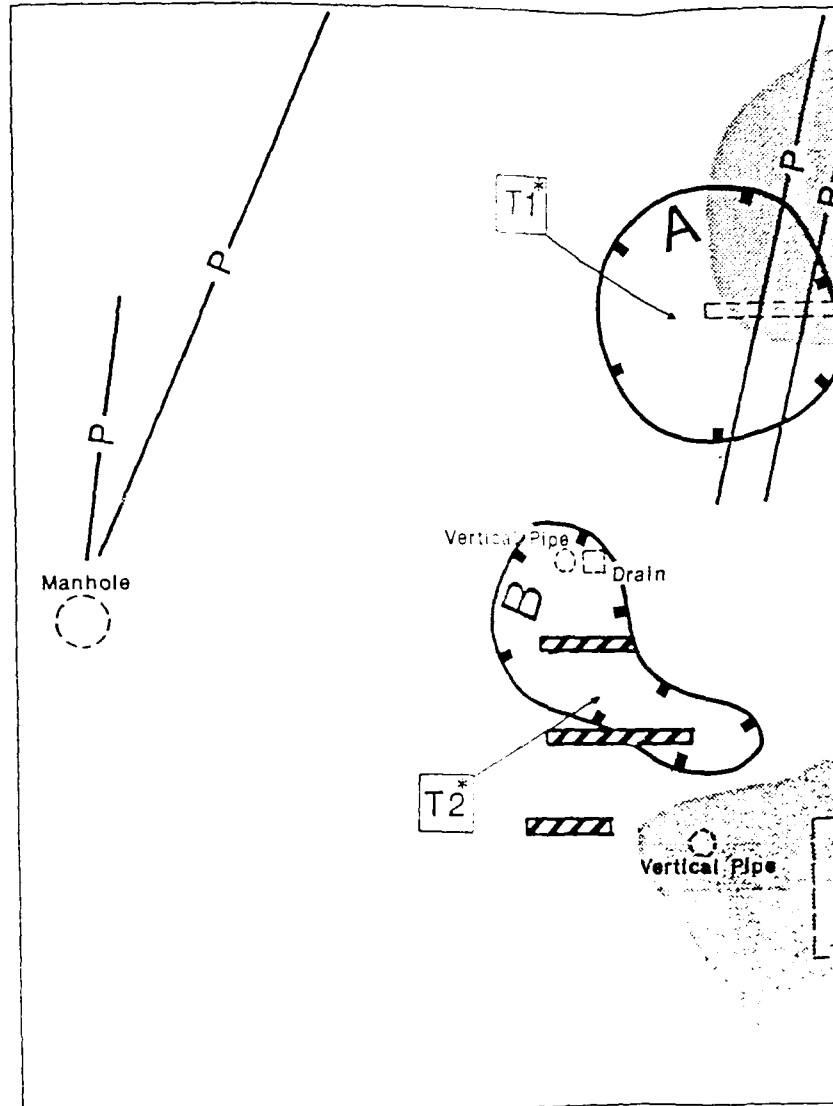
N

JOB



NORCAL GEOPHYSICAL CONSULTANTS 			SURVEY LOCATION AND MAGNETIC CONTOUR MAP McClellan AFB, Site T-66 Sacramento, California	PLATE 6
JOB: 89-138.03	APPR:	DATE: 2/89		

Area of Investigation



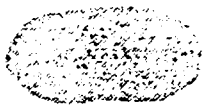
LEGEND



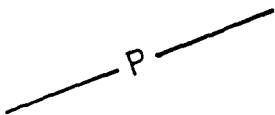
Magnetic Gradient Anomaly



GPR Anomaly



Fill Material with Buried Debris

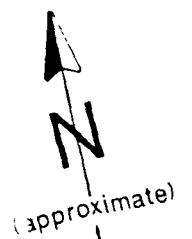


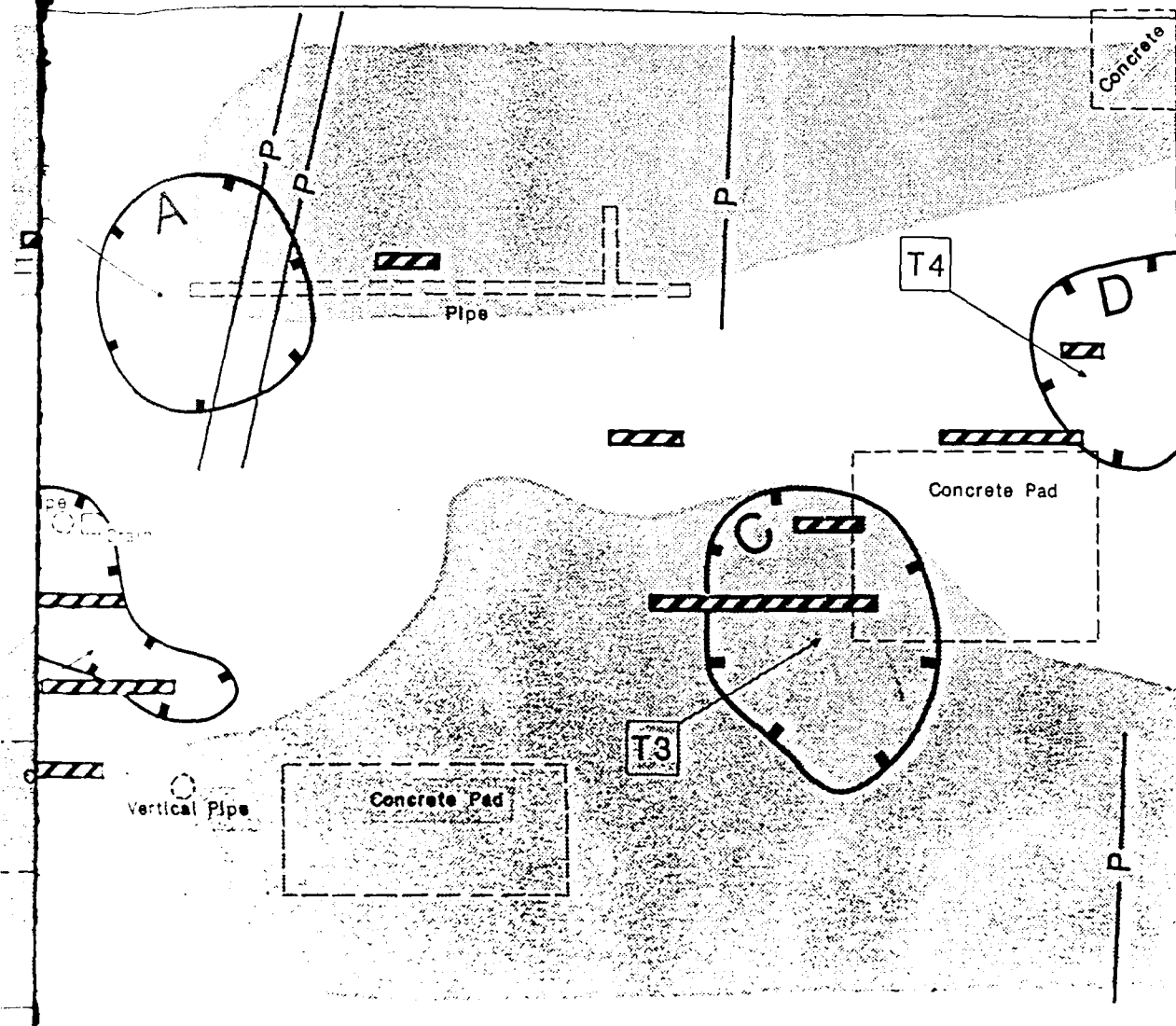
Pipe Alignment



Possible Tank Location (numerical designation described in text)

* High Probability





0 10 20 Feet
SCALE

N
(approximate)

NORCAL

GEOPHYSICAL CONSULTANTS



JOB: 89-138.03

APPR:

DATE: 2/89

ANOMALY MAP

McClellan AFB, Site T-66

Sacramento, California

PLATE

7

NCBA REEF

MAPE REEF

OLD MAPE
REEF CHANNEL

WS7

OLD MAPE REEF

WS14

WS21

MAPE REEF

WS13

WS14

WS15

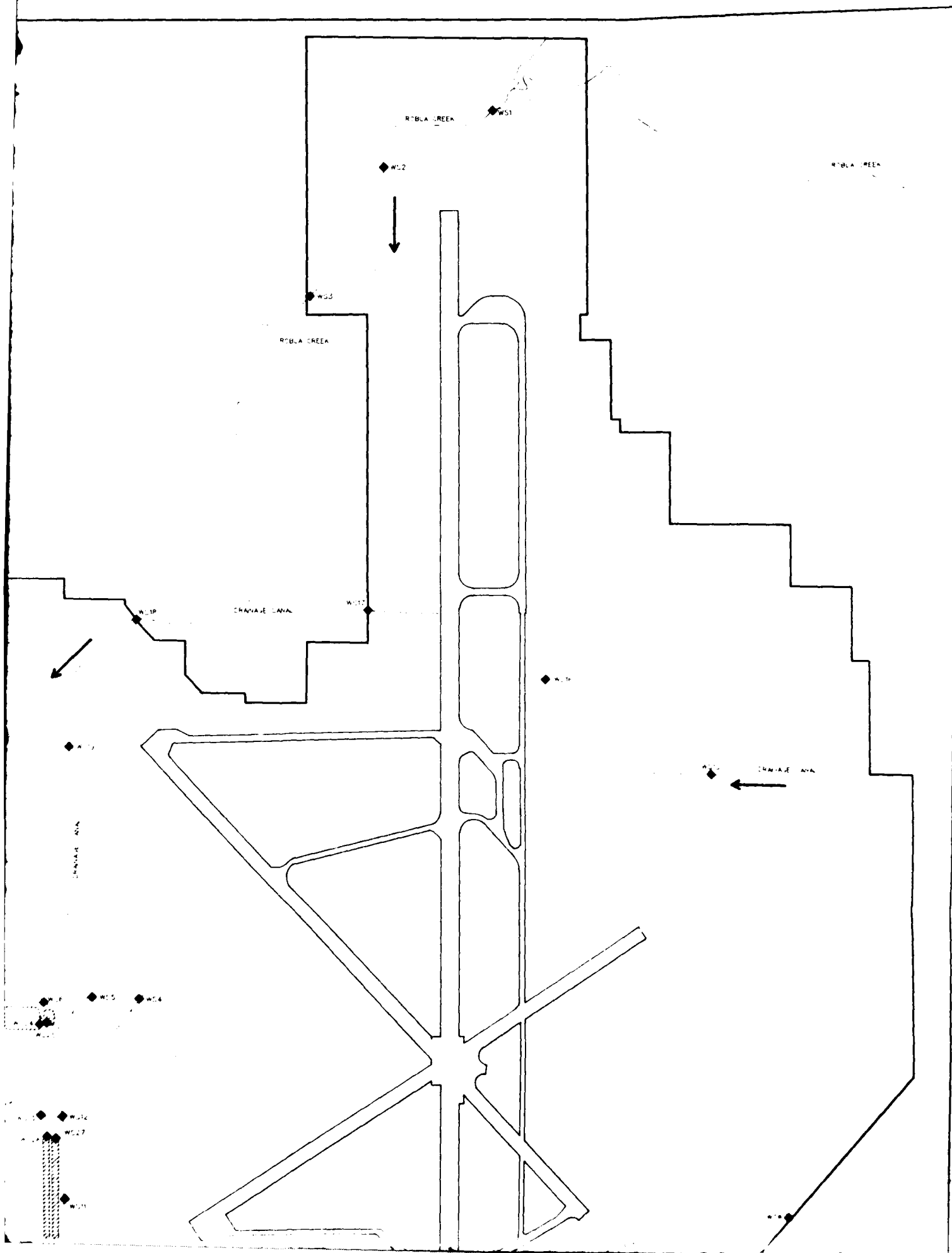
WS16

WS17

WS18

WS19

WS20



MAJIE REEK

OLD MAJIE
REEK CHANNEL

WS7

OPEN WILD CREEK

WS14

MAJIE REEK

PLATE 1.

SURFACE WATER AND
SEDIMENT SAMPLING LOCATIONS

McCLELLAN AFB

LEGEND:

- STREAMS
- DRAINAGES
- UNDERGROUND
DRAINAGE SYSTEM
- FLOW DIRECTION
- HOLDING POND/LAGOON
- SAMPLING LOCATIONS
- SCALE IN FEET
SCALE APPROXIMATE

RADIAN
CORPORATION

