EMCSF 2.10
V1

Remedial Investigation/Feasibility Study

Preliminary Site Characterization Summary

Volume I

Sections 1-3

Prepared for:
FMC Corporation
J.R. Simplot Company

for the
Eastern Michaud Flats Site

January 1994

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PSCS Overall Contents

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Acronyms and Abbreviations

ADB	Arimo-Downey-Bahem
AFM	Andersen filter media
AFR	American Falls Reservoir
AOC	Administrative Order on Consent
B	reported value less than CRDL but greater or equal to IDL
BAPCO	Bannock Paving Company
bgs	below ground surface
BLM	U.S. Bureau of Land Management
BOD	biological oxygen demand
CEC	cation exchange capacity
CFR	Code of Federal Regulations
cfs	cubic feet per second
CHV	Camelback-Hades-Valmar
CL	95-percent confidence limit
COC	chemical of concern
COD	chemical oxygen demand
cpm	counts per minute
COPC	chemical of possible concern
CRDL	contract-required detection limit
CV	cold vapor
DO	dissolved oxygen
DOE	U.S. Department of Energy
DQO	data quality objective
E&E	Ecology & Environment, Inc.

EIS	environmental impact statement
EMF	Eastern Michaud Flats
EOP	former east overflow pond
EP	extraction procedure
EPA	U.S. Environmental Protection Agency
FFA	FMC Facility Assessment
FIA	Federal Insurance Administration
FS	feasibility study
GC/ECD	Gas Chromatography/Electron Capture Detector
GC/MS	Gas Chromatography/Mass Spectroscopy
GEL	General Engineering Laboratories
GIS	geographical information system
gpm	gallons per minute
GPS	global positioning system
HASL	Health and Safety Laboratory
HDPE	high-density polyethylene
H_2SO_4	sulfuric acid
hp	horsepower
I-86	Interstate Highway 86
ICP	inductively coupled plasma
ICW	industrial clarified water
ID	inner diameter
IDHW-DEQ	Idaho Department of Health and Welfare, Division of Environmental Quality
IDL	instrument detection limit

IJ	Inkom-Joesvar
IWW	industrial wastewater
J	estimated value
LCD	local climatological data
Ma	million years ago
MCL	maximum contaminant level
mEq/l	milliequivalents per liter
mS/m	millisiemens per meter
MG	million gallons
mg/l	milligrams per liter
mph	miles per hour
MSA	Mountain States Analytical, Inc.
MSL	mean sea level
N/A	not applicable/not available
NA	not analyzed
NC	not calculated
NCDC	National Climatic Data Center
ND	not detected/below detection limit
NEIC	National Enforcement Investigation Center (EPA)
NGVD	National Geodetic Vertical Datum
NH_3-N	ammonia-nitrogen
NM	not measured
NOA	number of samples analyzed
NOAA	National Oceanic and Atmospheric Administration
NOS	number of samples analyzed in statistical calculation

NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NS	not sampled
NWS	National Weather Service
OD	outside diameter
ORP	oxidation reduction potential, mv
OSHA	Occupational Safety and Health Administration
OTTN	EPA's Office Technology Transfer Network
P_2O_5	phosphorus pentoxide
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
pCi/g	picocuries per gram
pCi/l	picocuries per liter
PEI	PEDCo Environmental, Inc.
pH	measure of acidity or alkalinity
PM_{10}	particulate matter less than 10 microns in size
ppm	parts per million
PRDL	project-required detection limit
PSCS	Preliminary Site Characterization Summary
PVC	polyvinyl chloride
QA	quality assurance
QAPP	EMF Quality Assurance Project Plan
QC	quality control
redox	reduction/oxidation potential
R	rejected value

RCRA	Resource Conservation and Recovery Act
RI	remedial investigation
RI/FS	remedial investigation/feasibility study
RR	railroad
RRL	Ririe-Rexburg-Lanoak
SAP	safety analysis plan
SB	subsurface soil sample
SC	site characterization
SD	standard deviation
SCS	Soil Conservation Service, U.S. Department of Agriculture
SO_2	sulfur dioxide
SS	surface soil sample
STP	sewage treatment plant (owned by City of Pocatello)
SVOC	semivolatile organic compound
TCA	1,1,1-trichorethane
TCE	trichloroethene
TCLP	toxicity characteristic leaching procedure
TDS	total dissolved solids
TOC	total organic compound; top of casing
TPH	total petroleum hydrocarbons
TSCA	Toxic Substances Control Act
TSP	total suspended particulates; triple superphosphate area
TSS	total suspended solids
TV	tolerance value
U	not detected

µmhos	specific conductance
µs/m	microsiemen per meter
UPRR	Union Pacific Railroad
USC&GS	U.S. Coast & Geodetic Survey
USDA	U.S. Department of Agriculture
US FWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VOC	volatile organic compound
WMU	waste management unit

OVERALL FINDINGS

Human and ecological exposure to site-related constituents present in groundwater and soils as a result of past releases is minimal. Changes in material handling and work management practices at both facilities have led to and will continue to lead to environmental improvements and minimization of any future releases.

BACKGROUND

FMC Corporation (FMC) and J.R. Simplot Company (Simplot) are neighboring phosphate ore processing facilities located near Pocatello, Idaho. FMC manufactures elemental phosphorus, and Simplot produces phosphate fertilizers. The two companies began a remedial investigation (RI) of the Eastern Michaud Flats (EMF) site after entering into an Administrative Order on Consent (AOC) with the U.S. Environmental Protection Agency (EPA) on May 30, 1991.

PURPOSE OF PRELIMINARY SITE CHARACTERIZATION SUMMARY

This Preliminary Site Characterization Summary (PSCS) presents the preliminary results of the RI and fulfills the objective to provide an initial characterization of the site. The AOC specifies that the PSCS will:

- Describe the investigative activities that have been conducted at the EMF site
- Document the location and characteristics of physical features and the presence and characteristics of constituents of potential concern
- Describe the nature and extent of constituent migration through each affected environmental medium.

In addition to reporting the RI's preliminary findings, this PSCS provides information that will help with the development of a human health and environmental risk assessment for the EMF study area.

AREAS OF INVESTIGATION

The investigations completed to date characterize potential sources of releases, onsite and offsite soils, groundwater, surface water, and sediments, and include a survey of ecological resources, demography, and land uses within the EMF study area. The study has involved a two-phased approach to enhance data collection and fill data gaps. These two phases have been termed "Phase I" and "Phase II" throughout this report. Investigations currently in progress but not included in this document are the air pathway and ecological assessments, which will be described in future reports.

SCOPE OF INVESTIGATION

During Phases I and II of the investigation, 2,176 samples of groundwater, surface water, sediments, soils, and potential sources (defined as industrial feedstocks, byproducts, and wastes associated with the industrial processes at FMC and Simplot) were collected. Each sample was analyzed, on average, for 48 individual constituents. These included inorganic constituents (metals, major common ions, nutrients), radionuclides, and—in many groundwater and soil samples—a variety of organic compounds. In all, 105,950 specific chemical or radiochemical analyses were performed. The purpose of this sampling was twofold:

- To identify the potential sources of contamination at the site
- To determine the nature and extent of environmental impacts that may be attributed to releases from these sources

The analytical results from this sampling program are maintained in an electronic database already delivered to the EPA.

Potential Sources and Soils Sampling

One-hundred five locations at FMC and 101 locations at Simplot were selected to characterize potential sources of releases and to investigate onsite soil conditions in proximity to these sources. In addition, offsite soil samples were also collected at 144 locations (108 locations in Phase I and 36 in Phase II) beyond the facilities' boundaries to assess the potential impact of airborne releases. These samples were collected in a radial pattern up to 4 miles from the facilities and analyzed for inorganic constituents and radionuclides.

Surface Water and Sediment Sampling

Twenty-four locations were sampled to evaluate surface water quality in the Portneuf River and contributing springs. The locations ranged from approximately 6 miles upstream from the facilities to more than 2.5 miles downstream in the Fort Hall Bottoms of the Portneuf River near the American Falls Reservoir. In addition, samples of sediments within the channel of the Portneuf River and contributing springs were collected at 30 locations during Phase I. These were supplemented with samples from an additional 13 locations during Phase II.

Groundwater Sampling

A total of 128 wells have been sampled over as many as five quarterly sampling events as part of the RI. These include 59 wells sampled by FMC (including 24 wells

sampled under its Resource Conservation and Recovery Act [RCRA] groundwater monitoring rpogram), 36 wells at Simplot, and 33 wells beyond the boundaries of the facilities. In addition, data for seven quarters of sampling (1990 through 1993) collected from FMC under its RCRA monitoring program have also been utilized. The monitoring well locations are shown in Figure 2.4-1.

INVESTIGATION FINDINGS

Key observations concerning the characteristics of potential sources, groundwater, soils, surface waters, and surface water sediments have been reached during this investigation. These observations are summarized below.

With regard to potential sources:

- The principal feed stock processed at the EMF facilities is phosphate rock mined from the Phosphoria Formation. This phosphate ore contains apatite, a mineral containing calcium, phosphate, and fluoride. The ore also contains trace levels of arsenic, cadmium, chromium (total), vanadium, natural uranium (and related decay products), zinc, and other elements. The processing operations at the EMF facilities separate these components into various products, byproducts, and wastes.
- The constituents of potential concern that are found in common in the solid fraction of major feedstocks, byproducts, and waste materials at FMC and Simplot are cadmium, chromium (total), fluoride, total phosphorus, vanadium, and zinc.
- Additional constituents, and or elevated levels of the constituents listed above, are found in the solid fraction of specific wastes and byproducts. At FMC, these constituents include cadmium, lead, silver, and zinc in precipitator slurry and phossy waste solids; and chromium, iron, and vanadium in ferrophos. At Simplot, these constituents include calcium, fluoride, total phosphate, and sulfate in gypsum.
- Certain constituents are also associated with process waters from potential sources. At FMC, these include total phosphorus in all materials; arsenic in phossy water; arsenic and selenium in calciner wastewater; and fluoride, zinc, gross alpha, and gross beta in precipitator slurry. At Simplot, these include arsenic, calcium, sulfate, total phosphorus, and low pH in gypsum transport water; and a variety of process-related constituents in the process water managed at the former east overflow pond (recently removed from service).

- The largest volume solid byproducts generated at both facilities (slag and ferrophos at FMC and gypsum at Simplot) do not leach constituents above levels used to classify a material as a hazardous waste by either the EP or TCLP analytical methods.

With regard to groundwater:

- On-site shallow groundwater (within the boundaries of the FMC and Simplot facilities) has been impacted by releases from unlined waste management facilities at both FMC and Simplot. The primary constituents associated with these impacts are arsenic, chloride, fluoride, nitrate, selenium, sodium, and sulfate.
- A limited number of constituents in offsite groundwater exceed screening levels and MCLs but only immediately adjacent to the plants' northern boundaries and only in the uppermost groundwater.
- Impacts on offsite groundwater are minimized by capture in the Simplot production wells.
- Constituents that are associated with site activities have been found at Batiste Spring and Swanson Road Spring. These constituents are arsenic, nitrate, orthophosphate, total phosphorus, and sulfate. Lithium was also found at Batiste Spring.
- Further evaluation of the hydraulic influence of potential sources and onsite pumping wells to groundwater flow patterns is in progress. The results of this study will be include in the RI report.
- Control measures already taken by the companies, including closures of unlined waste management facilities at both FMC and Simplot, have already substantially reduced releases of constituents of potential concern. These measures continue to improve groundwater quality.
- The natural alkaline pH of the loess soils in the EMF study area is an important factor in attenuating metals (e.g., cadmium, chromium, lead) in the groundwater.

With regard to onsite soils:

- Naturally occurring soils on a large portion of both facilities have been enriched by being mixed with production byproducts (such as slag) or by the placement of slag or other materials over these soils as fill, building foundations, embankments, or road surfaces.

- Subsurface soil quality has been impacted only where either a sustained hydraulic head has transported constituents from source materials into underlying soils, or where mechanical actions have mixed source material with the native soils. Constituents present in impacted soils include cadmium, chromium, copper, lead, nickel, silver, vanadium, zinc, fluoride, phosphate, and sulfate. In some cases, soils impacted by sustained head act as secondary sources of constituent migration to groundwater.
- In cases where a sustained hydraulic head is absent, constituents are largely immobile.
- The natural alkaline pH of the loess soils in the EMF study area is an important factor in reducing the bioavailability of metals (e.g., cadmium, chromium, lead) present in the surface soils.

With regard to offsite soils:

- The highest concentrations of EMF-related constituents were found immediately north and east of the facilities, where windblown ore has been deposited in a pattern consistent with the prevailing winds. Constituent concentrations decrease rapidly with increasing distance from the facilities. This impact was observed in undisturbed soils.
- The distribution and concentration of constituents (fluoride, total phosphorus, zinc, and cadmium) to the north/northwest of the facility suggest a EMF-related airborne source of particulates. Further investigation is being performed as part of the air pathways investigation.
- Offsite subsurface soils have not been impacted by airborne releases. An exception is in several samples taken near Interstate 86 just north of the facilities, where mechanical turning of surface soils during highway construction may have introduced minor levels of constituents into the subsurface.
- Although surface soils near the facilities have been impacted by an accumulation of phosphate ore particles through wind dispersal of ore from the facilities, only low concentrations of constituents of concern were found. In addition, most of these areas are owned or controlled by the companies.
- Process changes have been made at both plants in ore handling that have greatly reduced the dispersal of fugitive dust from ore handling. At Simplot, all mechanical handling of ore at the plant has been eliminated. The ore is now transported to the plant by pipeline as an ore/water slurry. At FMC, dust suppressants and specialized ore-handling equipment

have been installed and are used to minimize the potential for dust generation or dispersal.

With regard to surface water and river bottom sediments:

- Stormwater runoff is retained within the FMC and Simplot facilities and does not discharge to the Portneuf River.
- There is no indication of site-related impact downstream from the facilities. Rather, there are specific points along the Portneuf River where localized enrichment from other sources, followed by dilution, takes place.
- The elevated levels of site-related constituents observed in samples of discharge from the FMC industrial outfall, collected during Phase I of sampling, were not detected in samples collected during Phase II. Portneuf River sediments collected at the FMC outfall contained particles of phosphate ore and precipitator dust or phossy waste solids. These were not found downstream.
- EMF-related constituents were observed at Batiste Spring and Swanson Road Spring only. At the point were the springs discharge to the river, river water quality is not impacted and generally improves.
- The river sediment study arrived at the same conclusion as the surface water study: there are no observable general impacts on sediment quality from any given source on the river. There are local impacts from various anthropogenic activities. The only sediment sample that had the characteristic EMF-constituent associations was collected at station 17 (the FMC outfall). Samples collected over a wider area at and just downstream from station 17 confirmed the presence of these constituents at the outfall and their absence at distances greater than 30 feet downstream. The sediment samples collected during the study were obtained from locations likely to record past releases from the EMF facilities, based on the characteristics of the river and sediment deposition patterns.

SUMMARY OF FINDINGS

The sampling results generated to date demonstrate that there is minimal human or ecological exposure to site-related constituents in groundwater, surface water, sediments, onsite soils, and offsite soils. Elevated levels of constituents of potential concern are not found offsite with minor exceptions noted below. Operational practices minimize releases and exposures from potential sources. Most constituents in the onsite soils are relatively immobile. Much of the onsite groundwater is captured and utilized by the Simplot production wells and mitigated

by the site geochemistry and hydrogeology. The only offsite exceedences observed are for a limited number of constituents found in soils immediately north of the facilities, in surface water and sediment in the Portneuf River near station 17, in surface water in Batiste Spring at station 14, and in the uppermost groundwater immediately north of the facilities.

FUTURE ACTIVITIES

The RI has been successful in characterizing potential sources, soils, surface water and sediments, and groundwater. Further monitoring of the discharge from the FMC outfall will be performed to confirm the absence of site-related constituents. Further investigation of potential air pathways is ongoing. After incorporation of review comments made by the EPA, this PSCS will become a major portion of the RI report for the EMF study area; publication of the RI report is anticipated by the summer of 1994. The RI report will include the results of the human health and environmental risk assessment which the companies have proposed to the EPA to conduct. The need for remedial actions, if any, will be identified by the risk assessment. A feasibility study of potential remedial actions will follow the RI report.

Section 1

Introduction

The Preliminary Site Characterization Summary (PSCS) for the Eastern Michaud Flats (EMF) site is a compilation and interpretation of physical and chemical data collected during Phase I and Phase II of the Remedial Investigation (RI) and that reported in previous investigations.

The purpose of this PSCS is to:

- Present and interpret physical data collected during the field investigations and use these data to describe the potential pathways for migration of constituents of potential concern.
- Describe the constituents of potential concern and their distribution in groundwater, surface water, soils, and sediments using the results of laboratory analyses of environmental samples collected during the field investigation.
- Present a conceptual model of the nature and extent of constituents of potential concern within and beyond the boundaries of the site.
- Furnish data for use in the baseline risk assessment.
- Furnish data for use in identifying potential remedial action objectives.
- Provide a technical foundation and source of information for feasibility studies of potential remedial action alternatives.

Information on the original scope and objectives of the RI is available in previously published documents: RI/FS Work Plan (Bechtel, 1992), the Phase II Work Plan (Bechtel, 1993), plus "Response to EPA Comments on Phase II Site Investigation Plan," by FMC and Simplot (dated August 9, 1993).

The RI was performed in accordance with the Administrative Order of Consent (AOC) for Remedial Investigation/Feasibility Study (RI/FS) for the EMF site, issued by the U.S. Environmental Protection Agency (EPA) on May 30, 1991, and entered into voluntarily by FMC Corporation (FMC) and J.R. Simplot Company (Simplot). These two EMF facilities encompass approximately 2,600 acres in Power and Bannock counties (see Figure 1-1). The EMF facilities as shown in a photograph of the study area (Figure 1-2), with the American Falls Reservoir in the background. FMC is also a RCRA treatment, storage and disposal facility (EPA Identification Number IDD 070929518) under the Resource Conservation and Recovery Act (RCRA).

The PSCS is an interim submittal required by the AOC; the report addresses previous and recently completed investigations of the following: potential sources, onsite soils, offsite soils, surface water and sediments, groundwater, climate, demography, and ecology. The report will be augmented with a risk assessment and a fate and transport section, and will be resubmitted as the RI report. An ongoing

study of the fate and transport of fugitive dust and industrial stack emissions will be presented as a supplement to the PSCS. Further investigation of ecological resources is being planned; when completed, the results will also be presented in a supplemental report.

The objective of Section 1 of the PSCS is to introduce the EMF facilities in terms of facility operations conducted at FMC and Simplot, previous investigations conducted within the EMF study area, and the site conceptual model as defined to date. Accordingly, Section 1.1 discusses the FMC facility manufacturing, byproduct handling, and waste management operations, and Section 1.2 discusses the same for the Simplot facility. Previous investigations are summarized in Section 1.3, and Section 1.4 presents the site conceptual model. Section 1.5 discusses the format, content, and organization of the remainder of the PSCS.

1.1 FMC SITE HISTORY

The FMC Corporation Elemental Phosphorus Plant (FMC) is located approximately 3 miles (4.8 km) northwest of Pocatello, Idaho, and 1 mile (1.6 km) southwest of the Portneuf River, a tributary of the Snake River. The facility covers an estimated 1,500 acres and adjoins the western boundary of the J.R. Simplot (Simplot) plant. The facility plan of the FMC plant is shown in Figure 1.1-1.

A Union Pacific Railroad (UPRR) right-of-way parallels the northern boundary of the facility. Access to FMC is provided by Interstate Highway 86 (I-86) and U.S. Highway 30.

1.1.1 Summary of FMC Operations

Three types of operations are conducted at the FMC facility: manufacture of elemental phosphorus from ore; management of byproducts generated during phosphorus production; and management of wastes generated as a result of the above operations. The following is a brief overview of these operations.

The FMC plant produces elemental phosphorus from phosphate-bearing shale ore mined regionally. At present, the ore is shipped to FMC via the UPRR during the summer months. Since ore cannot be shipped during the winter months, it is stockpiled on the facility property to ensure a steady supply for processing throughout the year. The estimated quantity of ore processed at the plant is 1.5 million tons per year.

Elemental phosphorus production operations at the facility have changed little since plant operations began in 1949. Ore from the stockpiles is sized, briquetted, calcined, and proportioned for feeding into any one of the four electric arc furnaces. The furnace reaction yields gaseous elemental phosphorus in addition to other byproducts. The elemental phosphorus is subsequently condensed to a liquid state and stored in tanks prior to shipment offsite as product. Elemental phosphorus will burn upon contact with air. Therefore, to prevent oxidation, the condensed product is covered with water from the time it is generated through its transport off the site.

The primary byproduct streams are calcium silicate slag, ferrophos, and carbon monoxide. Byproduct management generally involves cooling the byproducts and either storing them in stockpiles at the site (slag and ferrophos) or reuse in elemental phosphorus production operations (carbon monoxide).

The primary waste stream generated at FMC is wastewater, which contains various suspended and dissolved solids as well as minor amounts of elemental phosphorus. Additional wastes generated are associated with scrubbers and filters located in the furnace and calcining areas and include scrubber blowdowns and used filter media.

Liquid wastes are managed in a series of surface impoundments. Examples of other types of solid waste management units include landfills, treatment units, and waste storage areas. Because of the age of the facility, most of the waste management units identified are inactive and no longer receive wastes.

Sections 1.1.2 through 1.1.4 discuss the FMC plant product manufacturing, byproduct handling, and waste management operations.

1.1.2 Elemental Phosphorus Production

Elemental phosphorus manufacturing operations conducted at the FMC facility are discussed below. A general process flow diagram is included as Figure 1.1-2.

Stockpiled ore received via railcars is prepared for use as furnace feed material, by first blending, reclaiming, screening, crushing, and sorting, thus providing a consistent size for forming briquettes. The sized ore is formed into charcoal-sized briquettes using continuous roll presses. The briquettes are subsequently heat-hardened at two continuous-grate calciners to drive off any remaining moisture and organic constituents that may be present.

From 1949 to 1966, the heat-hardened briquettes were sent to kilns located in approximately the same areas as the two calciners. The calciners have been operational at the plant since 1966.

The calcining process produces an off-gas stream containing particulates and naturally occurring radionuclides; these constituents are removed by a series of primary and secondary wet scrubbers located in the calcining area. Calcined briquettes are cooled and transferred to the proportioning building, where they are blended with predetermined ratios of silica and coke.

The furnace operation is considered the central processing step for the production of elemental phosphorus. Furnace burden is gravity fed to the designated furnace; each furnace is equipped with three graphite electrodes, and operates at temperatures ranging from 4,170°F (2,300°C) to 4,890°F (2,700°C). The ensuing reaction yields gaseous elemental phosphorus as well as other byproducts.

These gases are cleaned of entrained dust in a two-stage electrostatic precipitator process, and then condensed in primary and secondary water spray condensers to recover the elemental phosphorus. The molten phosphorus is collected in sumps and either offloaded at the product loading area (phos dock) onto rail cars for shipment, or loaded into tanks for interim storage. The phos dock is equipped with Andersen scrubbers to control fume emissions. Current annual production of elemental phosphorus at FMC is estimated to be 240 million pounds (109 million kg).

1.1.3 Byproduct Handling

Byproducts at FMC are generated during reactions within the electric arc furnaces and consist of carbon monoxide gas; calcium silicate slag, also referred to as slag; and cast pieces of ferrophos.

The carbon monoxide gas is passed through the secondary condenser for further phosphorus recovery. The gas is then used as primary fuel for the calcining process, or flared.

The molten material that remains in the furnaces (during elemental phosphorus production) consists of slag and ferrophos. Each of these materials is tapped from the furnaces several times per day. The tapping process is performed in a hood-type arrangement to allow for collection of any fumes generated during the tapping process. These fumes first pass through a Medusa wet venturi action scrubber, and then through Andersen filter dry scrubbers.

The molten slag flows out of the tap holes and into a slag pit, where it is sprayed with water for cooling and fractioning. The cooled, vitrified slag is loaded into haul trucks for placement in the slag piles. Historically, this material has been used extensively for paving and as fill material on the facility property and in the City of Pocatello. Sale of slag was voluntarily ceased by FMC in June 1990.

Analyses of slag characteristics have resulted in the following conclusions:

- The material contains detectable levels of aluminum, arsenic, boron, cadmium, calcium, chromium, fluoride, total phosphorus, sodium, potassium, vanadium, and zinc.
- Slag passes the Toxicity Characteristic Leaching Procedure (TCLP) test prescribed by RCRA, as codified in 40 CFR 261 (i.e., concentrations of specific constituents in slag, such as cadmium and arsenic, do not exceed hazardous waste threshold concentrations for corresponding constituents specified by RCRA).
- Migration of constituents of potential concern from this material into the subsurface is not considered to be of concern.

The third byproduct of furnace operations, ferrophos, is a phosphorus and iron alloy, which also contains detectable levels of chromium, nickel, silver, and vanadium. It is collected in sand molds and cooled in the furnace building. The ferrophos is transferred to ferrophos piles located on the site, and subsequently sold.

1.1.4 Waste Management Practices

Phosphorus production operations at FMC require the use of large quantities of water. To prevent oxidation, elemental phosphorus is stored under water, as are wastes containing elemental phosphorus. The characteristics of elemental phosphorus also require that extensive supplies of fire water be maintained at the facility site. Additionally, water is required for other purposes, including use as makeup water to wet scrubbers, washdown in the furnace building, cold water spray on condensers, and slurrying of precipitator dust from electrostatic precipitators.

Water consumed at the plant is obtained onsite from either the production wells (fresh water) or various surface impoundments or ponds (recycled water). Surface impoundments are crucial for maintenance of the overall water management system at the plant for the following reasons:

- Solids must be covered with water to prevent oxidation and to allow for settling.
- The use of recycled water for process operations requires a high quality of water (i.e., low solids content).
- The amount of wastewater produced exceeds the amount of recycled water required for process operations. In addition to providing for settling of solids, surface impoundments provide the requisite evaporative surface area.

As a result, the primary waste stream generated by FMC during its operational history has been wastewater. Most of the wastewater has been managed in surface impoundments.

Other waste streams at the plant include pond solids dredged from the surface impoundments, filter media from the Andersen scrubbers, laboratory wastes, and small quantities of wastes generated as a result of ancillary facility operations. In general, these wastes have been stored at various waste storage areas, shipped offsite, or disposed of at the onsite landfills.

The characteristics, source, and disposition of the FMC waste streams are summarized in Section 1.1.4.1 below. Associated waste management facilities are described in Section 1.1.4.2.

1.1.4.1 Waste Description

Waste streams at the FMC facility consist primarily of wastewater. These waste streams and other wastes generated are described below.

Wastewater. Wastewater generated at the facility can be categorized as phossy water, precipitator slurry, scrubber blowdown, or noncontact cooling water.

Phossy Water. Phossy water is defined as any water that has come into contact with elemental phosphorus throughout the process. In the past, all phossy water has been considered hazardous (under RCRA) and has been managed through a series of ponds at the facility. These ponds are the slag pit sump, Pond 8S, the lined Ponds 15S and 16S, and the Phase IV ponds (Ponds 11S, 12S, 13S, and 14S).

As of September 1, 1993, FMC has recharacterized the hazardous nature of phossy water and has split the stream into nonhazardous phossy water, which is directed to the Phase IV ponds for clarification, and hazardous phossy water, which is directed to Pond 16S. Closure plans were submitted in 1993 for Pond 8S, Pond 15S, and the slag pit sump. These units are currently inactive. Ponds 8S and 15S receive nonhazardous water only, for level control. Additional surface impoundments that also received phossy water in the past include the old settling ponds (Ponds 1S, 2S, 3S, 4S, 5S, 6S, 7S, 9S, and 10S) and the old evaporation ponds (Ponds 1E, 2E, 3E, 4E, 5E, 6E, and 7E).

Precipitator Slurry. This waste stream consists of slurried precipitator dust from the furnace electrostatic precipitator operations. The waste is pumped to the lined Pond 8E, an interim storage pond designed to hold 1 year's supply of slurried dust. Precipitator slurry is dredged from Pond 8E to lined Pond 9E for solids settlement. Decant from Pond 9E was formerly received by lined Pond 15S, and currently by lined Pond 16S, as part of the facility's integrated water management system. Prior to July 23, 1990, precipitator slurry was dried in Pond 9E, and the dried precipitator dust was removed and stockpiled at an excavated area (to minimize wind erosion) referred to as Area 9S and then sold.

In the 1980s, FMC employed a fluid bed drier unit to dry and oxidize precipitator slurry, which was then sent to the old landfill or to Pond 10S. Pond 10S is a lined inactive pond that contains dried precipitator dust. The fluid bed drier unit has been removed; the area is now the location of the secondary condensers used to condense furnace gases.

Additional former impoundments that received precipitator slurry include the old settling ponds, and the old evaporation ponds.

Scrubber Blowdown. The blowdown from the calciner and the Medusa scrubbers is discharged to the onsite wastewater treatment unit for pH adjustment. The treated blowdown is clarified in the lined calciner ponds (Ponds 1C, 2C, 3C, and 4C) before being recycled back to the plant as makeup water for the calciner scrubbers. In the past, calciner scrubber blowdown was sent to the old calciner ponds (Ponds 1C and 2C), which were located in an area now occupied by Ponds 3C and 4C.

In the past, blowdown from scrubbers associated with the former kilns (which were subsequently replaced by the calciners in 1966) was discharged to the three kiln scrubber ponds.

Noncontact Cooling Water. Noncontact cooling water consists primarily of fresh water, and is used for activities such as secondary cooling loops, furnace cooling, and calciner water beams. This water is typically sent to the industrial wastewater (IWW) basin for cooling; from there it is discharged to Portneuf River via the IWW ditch (NPDES Permit ID-000022-1). Water from the IWW basin can also be sent back to the plant for use as recycled water.

Andersen Filter Media (AFM) Wastes. AFM is used in scrubbers in the furnace tapping and phos dock fume treatment operations. In 1990, when the plant became subject to RCRA, the AFM was found to contain arsenic and cadmium. Since 1990, the AFM has been sent to an offsite RCRA-permitted landfill. In 1991, FMC began treatment of the media through a washing unit. The rinse waters generated are subsequently treated along with the calciner and Medusa scrubber blowdowns at the wastewater treatment unit. Used AFM is stored at the facility until a full shipment can be sent offsite for disposal. Prior to 1990, AFM was disposed of at the onsite landfill.

Miscellaneous Wastes. Other wastes generated at FMC include small quantities of waste paint, spent solvents (from degreasing and laboratory operations), office trash, asbestos waste, and used transformer oil. Office trash, asbestos waste, and used Andersen filter media (prior to regulation) have been disposed of at the onsite landfill. Transformer oil has been shipped to various handlers through the years, and is currently being shipped to Aptus. Spent laboratory and degreasing solvents have been shipped offsite to FMC-approved disposers.

Air Emissions. Air emissions from the FMC facility are regulated by the State of Idaho (Air Permit 1260-00050). The FMC facility permit covers the shale handling/ crushing operations, the calciners, various material handling systems, the four electric arc furnaces, the electrostatic precipitators, the carbon monoxide flaring system, and the phos dock. Parameters regulated include phosphorus, sulfur (contained in fuel), and particulate emissions.

1.1.4.2 Waste Management Facilities and Other Potential Source Areas

This section briefly describes the waste management facilities and potential source areas at the FMC facility. The locations of these waste management facilities are shown in Figure 1.1-1. Some of these facilities are RCRA waste management units. Descriptions of waste management units are provided in the RCRA Part B permit application submitted to the EPA on March 1, 1991.

Surface Impoundments. As discussed previously, most of the waste generated at the FMC facility is wastewater. Currently, the various wastewater streams are managed in the following 11 lined ponds:

- Phase IV ponds (Ponds 11S, 12S, 13S, and 14S) – nonhazardous phossy water
- Precipitator ponds (Ponds 8E and 9E) – precipitator slurry
- Pond 16S – hazardous phossy water, precipitator slurry
- Calciner ponds (Ponds 1C, 2C, 3C, and 4C) – treated stream from wastewater treatment

In 1993, FMC submitted closure plans for three surface impoundments: Ponds 15S and 8S, and the slag pit sump. All of these units are currently inactive. Ponds 8S and 15S are receiving only nonhazardous water for level control. Also in 1993, FMC's RCRA Part B permit application was revised to reflect the change in service to nonhazardous operations and delay of closure for the Phase IV ponds.

In addition, at least 24 former ponds have been identified as having been used to manage wastewater on the FMC facility property; they are as follows:

- Old settlement ponds (Ponds 00S, 0S, 1S, 2S, 3S, 4S, 5S, 6S, 7S, 9S, and 10S)
- Old evaporation ponds (Ponds 1E, 2E, 3E, 4E, 5E, 6E, and 7E)
- Kiln scrubber and overflow ponds (consisting of three kiln scrubber ponds which overflowed to one overflow pond)
- Old calciner ponds (Ponds 1C and 2C)

These ponds were removed from service. Several of the active surface impoundments were later constructed over these former ponds as shown in Figure 1.1-1. Determination of the extent of these former ponds is based on examination of aerial photographs since design and construction records for these ponds are not available, and only approximate dimensions and capacities, and limited information on associated structures (if any), are known.

IWW Basin and Ditch. The IWW basin, used to cool noncontact cooling water, is 131 feet (40 m) by 102 feet (31 m), and 4 feet 6 inches deep (1.4 m). Wastewater from this unit is either sent back to the plant for reuse, or discharged to the Portneuf River via the IWW ditch that exits the facility at the northeast corner of the property (see Figure 1.1-1). The ditch is approximately 1,700 feet (518 m) long, and averages about 6 feet (1.8 m) in width and 3 feet (0.9 m) in depth. Both the basin and the ditch are unlined.

Landfills. The FMC facility contains two landfills, only one of which is currently active. The inactive (old) landfill was removed from service and covered with slag

in 1980, upon construction of the new landfill. Reportedly, the old landfill received used AFM, facility trash and debris, asbestos wastes, and fluid bed drier wastes. The new landfill has received used AFM, office trash, and asbestos wastes.

Miscellaneous Areas. Other potential source areas at the FMC facility include the following.

Railroad Swale. This unit is a ditch, approximately 12 feet (3.6 m) wide, running along the railroad tracks on the north edge of the facility. The swale receives storm water runoff from the FMC property, which subsequently percolates through the ground. There are no specific dimensions, structures, or associated drawings available for this unit.

Chemical Laboratory Seepage Pit. Prior to 1980, inorganic and organic chemical wastes from the laboratory were disposed of in the chemical laboratory seepage pit located beneath the main parking lot. Buried drain lines carried chemical waste to the covered pit by way of an isolated drainage system. Since 1980, chemicals have been shipped off the site. The seepage pit was removed from service in 1993.

Waste Oil Storage Area. A drum storage area now overlies former Pond 2S. The dimensions of the area are approximately 20 feet (6 m) by 100 feet (30 m). Various heavy lube oils, sludges, and transformer oil containing less than 50 parts per million (ppm) polychlorinated biphenyls (PCBs) are stored in 55-gallon drums in this area prior to offsite treatment/disposal. A concrete pad and dike were constructed for the waste oil storage area in November 1990.

PCB Storage Shed. FMC has not stored any PCB equipment at the facility since 1992. The PCB storage shed was used to store drums of transformer oil with concentrations of PCBs greater than 50 ppm prior to offsite treatment/disposal. The shed was also used to store PCB capacitors. The shed walls and foundation are concrete.

Transformer Salvage Area. The transformer salvage area, located near the inactive Pond 1S, was a storage area for used transformers. Any residual oils remaining in these transformers contain PCB concentrations less than 50 ppm. The transformers have been removed and the area cleaned and graded.

Calciner Pond Sediment Area – Former Calciner Ponds. This area was used to manage calciner sludge and soil excavated from the former calciner ponds prior to construction of the new lined calciner ponds. The excavated material was placed on land south of the calciner pond area and allowed to dry.

Calciner Pond Sediment Area. This area has been used to manage treated calciner sludge recently removed from the ponds. The sediment was placed on land

south of the calciner fines area and allowed to dry. The material was very gelatinous and took several months to dry.

Boiler Fuel Tanks and Pipeline. The boiler fuel tanks and pipeline contained fuel oil for operating the boilers. Each tank had an approximate capacity of 20,000 gallons. The fuel tanks were located north of the phos dock in a diked area with a compacted soil base. The fuel oil was pumped via a pipeline from the tanks to the boilers. Petroleum hydrocarbon leaks from piping have occurred historically in this area.

Septic Tank Areas. The FMC facility uses septic tanks and drainfields for disposal of sanitary sewage. Until 1991, the main change house was served by two large drainfields. Since 1991, the change house sanitary wastes have been discharged directly to the Pocatello Sewage Treatment Plant (STP). In 1993, the main office building and chemical laboratory wastewaters were added to the discharge going to the STP. There are an additional eight drainfields for the mobile shop, the furnace building, the Burden business building, the briquetting building, the water treatment building, the kiln building, the main office building, and the crusher control building.

Secondary Condenser/Fluid Bed Drier Area. The secondary condenser is used to collect additional elemental phosphorus from the furnace exhaust gases. It is in the same area as the former fluid bed drier unit. The fluid bed drier was used in the early 1980s to dry and oxidize precipitator slurry to remove elemental phosphorus so that the precipitator dust could be sold for recycling.

8S Recovery Process. The 8S recovery process was built in 1983 to recover elemental phosphorus from Pond 8S. The process unit was built and operated as a test facility. Because of climatic conditions, it was operated primarily during the summer months. The processing equipment was located on a concrete pad with a dike. This unit was dismantled in the summer of 1993 in accordance with the 8S Closure Plan.

Pipeline Cleanout Areas. Phossy water and precipitator slurry are transferred via pipelines to the lined Phase IV ponds. Because of the high solids content and the physical state of the elemental phosphorus, cleanout taps are provided along the pipeline at locations where solids may tend to accumulate, such as where the pipeline bends or changes direction.

Area West of Mobile Shop. This area was used to store and maintain equipment, fuel, motor oil, and lubricants.

Surface Roads. There are over 15 miles (24 km) of roads on the FMC facility property. Roads are primarily constructed of slag. Historically, oil has been used as a dust suppressant on these roads.

1.2 SIMPLOT SITE HISTORY

The J.R. Simplot Company Don Plant (Simplot), approximately 2.5 miles (4 km) west of Pocatello, Idaho, began production of single superphosphate fertilizer in 1944. Phosphoric acid production began in 1954. The facility covers approximately 1,130 acres and adjoins the eastern property boundary of the FMC facility. The Simplot facility lies approximately 500 feet (150 m) southwest of the Portneuf River. A facility plan of the Simplot plant is provided in Figure 1.2-1.

A UPRR right-of-way parallels the northern property line of the facility. Access to Simplot is provided by I-86 and U.S. Highway 30.

1.2.1 Summary of Simplot Operations

The Simplot plant produces phosphoric acid from phosphate ore using a wet (aqueous) process. Phosphate ore was formerly transported from the Gay, Conda, and Smoky Canyon mines to the plant via railcar. As of September 1991, the Simplot plant began receiving phosphate ore through a slurry pipeline solely from the Smoky Canyon mine.

In preparation for transport, the phosphate ore is crushed and beneficiated (physically washed) at the Smoky Canyon phosphate mining/processing plant. Fine and coarse materials generated from the crushing process are separated in sequence by classifiers and a hydroclone system. The beneficiation process yields a 31-percent equivalent phosphorus pentoxide (P_2O_5) concentrate suitable for production of phosphoric acid. The slurry is transported to the Simplot facility through the buried pipeline.

Upon arrival at the plant, the slurried phosphate ore is thickened to approximately 70 percent solids content before being stored in agitated tanks. It is pumped directly into the phosphoric acid reactor from the storage tanks. The phosphoric acid is further processed into a variety of solid and liquid fertilizers. The plant produces 12 principal products, including five grades of solid fertilizers and four grades of liquid fertilizers.

The plant is an integration of several different processing units, each unit producing either an intermediate or a final product. A block flow diagram summarizing Simplot's operational processes is provided in Figure 1.2-2. Summaries of each plant and its respective products are presented below.

1.2.1.1 Phosphoric Acid Plant

The ground ore is digested for several hours with sulfuric acid to produce phosphoric acid (26- to 30-percent equivalent P_2O_5) and a hydrated calcium sulfate

byproduct (gypsum). Phosphoric acid process descriptions refer to equivalent P_2O_5 levels at each stage of production because the acid is sold according to its equivalent P_2O_5 content. The phosphoric acid/gypsum slurry is pumped to a vacuum filtration system for separation of the gypsum solids from the phosphoric acid liquid. The phosphoric acid is then used to make the various grades of fertilizers either as is or after concentration to 44- to 52-percent equivalent P_2O_5 by vacuum evaporation. The gypsum slurry is thickened to 25- to 40-percent solids to minimize water consumption, and is then pumped to the gypsum stack.

1.2.1.2 Sulfuric Acid Plant

Simplot produces sulfuric acid (H_2SO_4) used primarily for the production of phosphoric acid. Liquid sulfur is burned with air to form sulfur dioxide (SO_2), which is then reacted with oxygen over a catalyst to form sulfur trioxide (SO_3). The SO_3 is absorbed in water, in the presence of 98-percent sulfuric acid, to form H_2SO_4.

1.2.1.3 Ammonium Phosphate Plants

Several grades of solid fertilizers are produced in the ammonium phosphate (ammo-phos) plants. Phosphoric acid, sulfuric acid, and ammonia are mixed in a reactor to form a slurry. The slurry is combined with recycled ammo-phos product in a granulator. The slurry coats the recycled particles, forming a larger particle of ammo-phos. The granulated product is then dried and screened, with the intermediate-sized particles being the final product. The oversized material is crushed and recycled with the fines.

1.2.1.4 Ammonium Sulfate Plant

Ammonium sulfate is a solid fertilizer produced by the reaction of ammonia and sulfuric acid under vacuum. The vacuum crystallization reaction forms product crystals which are separated from liquid by centrifuging. The crystals are dried and stored as product, and the liquid is recycled. A major source of ammonium sulfate to the plant is an ammonium solution from the Amm SO_x scrubber on the #3 sulfuric acid plant.

1.2.1.5 Triple Superphosphate Plant

Triple superphosphate is a solid fertilizer currently produced by a patented process. The resulting acidulated solid is granulated, dried, and screened. Dicalcium phosphate is also manufactured at the plant for use as an animal feed supplement.

1.2.1.6 Super Acid Plant

Super phosphoric acid (68-percent equivalent P_2O_5) is produced by concentrating phosphoric acid through vacuum evaporation. The water vapor that is removed in the super acid plant is condensed and returned to the phosphoric acid plant for reuse.

1.2.1.7 Liquid Fertilizer Plant

Liquid ammo-phos is produced by reacting ammonia, water, and super phosphoric acid.

1.2.1.8 UAN-32 Plant

UAN-32 is a liquid solution of urea and ammonium nitrate used as a fertilizer. It is produced by combining ammonium nitrate and urea solution to produce a 32-percent nitrogen solution. Nitric acid is also produced at the facility, by the conversion of ammonia into nitric oxides and subsequent solution in water. The ammonium nitrate is produced by the reaction of nitric acid and ammonia. Urea is produced by a reaction between carbon dioxide and ammonia in an autoclave.

1.2.1.9 Ammonia Plant

The ammonia used in plant processes is produced at the facility using natural gas, steam, and air. Steam and natural gas are passed over a catalyst at high temperature and pressure to form hydrogen and carbon monoxide. Air is mixed with this gas stream, and the carbon monoxide is subsequently converted to carbon dioxide which is absorbed in a recirculating UCARSOL solution. Unabsorbed carbon dioxide is reacted with hydrogen in a methanator forming methane and water. The major process gas stream now contains hydrogen, nitrogen, and water. The water is removed, and the process gas stream is compressed and reacted over a catalyst to form ammonia. The absorbed carbon dioxide is recovered and used in the production of urea or sold to Airco.

1.2.2 Waste Description

The main waste streams generated at the Simplot facility are the gypsum solids and liquids generated in phosphoric acid production. Other waste streams generated at the site include waste oils and various solvents. The Simplot facility also treats noncontact water in a series of three water treatment ponds. The treated water is nutrient rich and is sold for irrigation and fertilization.

1.2.2.1 Gypsum Solids and Liquids

The gypsum produced from the phosphoric acid process is slurried (25- to 40-percent solids) and pumped to the top of the gypsum stack. A series of perforated high-density polyethylene (HDPE) pipes located beneath the gypsum stacks collects some of the water used to slurry the gypsum and recycles it for further use in plant processes.

1.2.2.2 Waste Oils and Solvents

Waste oils are separated from water in a waste oil separator prior to collection in a waste oil storage tank. These waste oils are collected weekly for recycling by Cowboy Oil. Spent solvents are collected by Safety Kleen for recycling.

1.2.2.3 Noncontact Water and Laboratory Wastes

Boiler and cooling tower blowdown, compressor coolant water, demineralizer regeneration water, storm water, and laboratory wastes (i.e., acids, ammonia, and sodium hydroxide) are collected and treated in a series of lined ponds described in Section 1.2.3.3.

1.2.2.4 Irrigation Water

Nutrient-rich noncontact water and stormwater treated in the series of three lined ponds, north of the plant between Highway 30 and the Portneuf River, have been sold for irrigation/fertilization since July 1980 under a joint land-application permit with the City of Pocatello. Prior to July 1980, the treated water was discharged to the Portneuf River (NPDES Permit D000067).

The EPA funded the Joint Waste Treatment Feasibility Study, Project EPA P0000080-03, which evaluated effluent handling alternatives available to the Pocatello STP and local industries. The study evaluated the suitability of wastewaters for irrigation, including characteristics of nutrient level, salinity, organic loading, sodium absorption ratio, and trace elements. The trace elements evaluated included aluminum, arsenic, boron, cadmium, chromium, cobalt, copper, fluoride, iron, lead, manganese, nickel, selenium, and zinc. The recommendations from the study in Report No. 219 concluded that "the EPA and the State Division of Environment should, where possible, assist and encourage the City of Pocatello and J.R. Simplot Company toward the completion of the land application project. Implemented by: Idaho Department of Health and Welfare and EPA." The recommendation was given force by an EPA Administrative Order of Consent (AOC) in 1978.

Under the AOC, Simplot chose to eliminate discharges to the Portneuf River by land application of the nutrient-rich water under the State of Idaho Land Application

permit system. A permit has been issued to Simplot and the City of Pocatello for operation of part of the system.

A comparison of analytical data for Simplot's irrigation water against the EPA's land-application limits for wastewater shows that the concentrations of the various inorganic compounds are considerably below the EPA-recommended concentration limits.

1.2.2.5 Air Emissions

Air emissions from the Simplot facility are regulated by the State of Idaho (Air Permit 1260-0060). The permit covers gaseous and/or particulate emissions from ore handling activities, individual process plants, and the reclaim cooling towers. Simplot has made a number of plant modifications to substantially reduce particulate matter emissions. Included in the plant modifications was the elimination of calciner units in 1990 and exposed raw ore handling facilities in 1991. Elimination of calciner units reduced total plant carbon monoxide and oxides of nitrogen emissions. Elimination of the exposed raw ore handling facilities through the use of a slurry pipeline greatly reduced not only the total particulate matter emissions but fluoride and radionuclide emissions as well.

1.2.3 Waste Management Facilities

There are currently two gypsum stacks and several ponds at the Simplot facility. In addition, a solid waste landfill and a trash landfill are also used at the facility. A brief summary of each of these waste management facilities, including the types of wastes contained, is presented below.

1.2.3.1 Gypsum Stacks

There are two gypsum stacks on the facility grounds south of the plant operating areas. The original gypsum stack is the northernmost of the two stacks. The southernmost stack has been in use since 1966. Together, the two gypsum stacks occupy an area of approximately 340 acres. Simplot is in the process of raising the level of the lower, northernmost stack and merging the two stacks into one.

1.2.3.2 Former East Overflow Pond

The former east overflow pond was an unlined surface impoundment approximately 0.8 acre in size. It is located east of the plant operational areas. When operational, this pond received surface water runoff as well as excess process water from the plant water reclaim system in the event of a power failure or other process upset. Reclaimed system water included gypsum filter wash water, scrubber water, and cooling tower water. Water collected in this pond was pumped back to the

reclaim water system. The pond also had an emergency discharge system that enabled discharge of water to the water treatment ponds via gravity flow through an underground pipeline. Use of the former east overflow pond was discontinued in August 1993 when a lined replacement pond (Reclaim Water Pond No. 1), adjacent to the original pond, was put into service.

1.2.3.3 Water Treatment Ponds

A series of three lined ponds, north of the plant between Highway 30 and the Portneuf River, is used to treat the noncontact water, laboratory wastes, and storm water referenced in Section 1.2.2.3. The noncontact water is collected by a facility drainage system, flows through a pipe under Highway 30, enters an open unlined ditch, and flows either into a plastic-lined holding pond for pH adjustment or into an equalization pond.

Water in the holding pond is pH-adjusted with soda ash before it flows to a concrete-lined settling pond for clarification. After the suspended solids have settled out of the water, the treated water flows to the equalization pond where it is combined with the water that did not require pH adjustment. The equalization pond is constructed of compacted soil to which a chemical sealant has been added. Equalization pond water is pumped to a large surge pond for storage prior to being used for irrigation and fertilization. The treated water is nutrient-rich and has been sold for irrigation/fertilization since July 1980 under a joint land application permit with the City of Pocatello. From time to time, sediments have been dredged from the ponds and transferred to an unlined dewatering pit adjacent to the ponds.

1.2.3.4 Return Water Equalization/Surge Pond

Return water from the southern gypsum stack was initially carried by pipeline to a pressure reduction and surge pond located near the southwest corner of the northern gypsum stack. From there, the return water was again conveyed by pipeline to the operating facilities for recycling. This pond was removed from service in the spring of 1992, and replaced with a 10,000 gallon, above-ground steel tank. This tank now serves the pressure reduction and surge functions of the original pond.

1.2.3.5 Landfills

A solid waste landfill is located just east of the former gypsum decant pond between the gypsum stacks. It lies partly on native soil and partly on the northernmost gypsum stack. The initial date of operation of this landfill is unknown. Construction wastes, demolition rubbish, and neutralized solid wastes from spills are all disposed of in the solid waste landfill.

Simplot used to dispose of general office waste and garbage from the lunchroom in two trash landfills. The more recently used landfill is located above the southernmost gypsum stack; the older landfill is northwest of the more recently used landfill. Simplot now sends trash offsite.

1.3 SUMMARY OF PREVIOUS INVESTIGATIONS

The EMF study area has been the subject of a number of historical investigations, conducted to address a variety of resource and ecological issues. It should be noted that the findings of the previous investigations are presented in this section (and in Appendix A) as reported by the study authors, and do not necessarily reflect the findings of the RI. The scope of these studies ranged from peer reviewed papers to unpublished undergraduate studies. The investigations focused on specific media, as follows:

- Regional studies of the EMF study area—media investigated include springs, groundwater, surface water, river sediments, aquatic ecology, terrestrial wildlife and habitats, vegetation, and air quality.
- Studies on the FMC facility property—media investigated include soils and groundwater.
- Studies on the Simplot plant property—media investigated include groundwater.

This section summarizes the previous investigations performed in the EMF study area, and at the FMC and Simplot facilities. Only brief overviews of the area-wide investigations are provided in this section. These investigations are discussed in more detail in Appendix A. Section 4 of the PSCS presents a comparative analysis of these data and develops the findings of the RI.

This section is organized to focus first on regional investigations conducted in the EMF study area (Sections 1.3.1 to 1.3.6), and then on the EMF facilities (Sections 1.3.7 and 1.3.8). With respect to the area-wide studies, the general water chemistry of springs and groundwater is presented initially, as it provides an overview of the sources and movement of unimpacted surface water and groundwater. This information is followed by characterizations of the sources of water and the relationship of spring and groundwater chemistry, leading to a better understanding of source and distribution of constituents of potential concern.

Accordingly, Section 1.3 is organized as follows:

- Section 1.3.1 discusses the general water chemistry for both springs and groundwater in what is now referred to as the EMF study area.
- Sections 1.3.2 to 1.3.4 identify the constituents present in specific media at the EMF study area – specifically, in Batiste Spring (the only spring that had been identified by previous investigations as being impacted by anthropogenic activities in the EMF study area), in groundwater, and in surface water and sediments.

- Section 1.3.5 discusses previous investigations concerning aquatic ecology at Portneuf River and terrestrial wildlife and habitats within the EMF study area.
- Section 1.3.6 summarizes previous investigations of air quality in the EMF study area.
- Sections 1.3.7 and 1.3.8 summarize past investigations conducted at the FMC and Simplot facilities, respectively.

Figure 1.3-1 provides the regional setting of the EMF study area.

1.3.1 Characterization of General Water Chemistry

Previous investigations conducted in the EMF study area involved the characterization of general water chemistry of springs (downgradient to the EMF facilities) and groundwater quality. Towards this end, basic water chemistry data on the naturally occurring ions were collected and analyzed for these media. This section presents the results of and conclusions drawn by the previous investigations for the springs studied, followed by the same for groundwater. Additional details on each investigation are presented in Appendix A.

1.3.1.1 Springs

Previous investigations conducted at springs along the Portneuf River within the EMF study area are as follows:

- Perry et al. (1990) and Goldstein (1981) attempted to characterize the source(s) of springs studied.
- Jacobson (1982, 1984, and 1989) monitored the water quality of Batiste Springs as part of hydrogeologic investigations over a period of 7 years.

In general, data collected during each investigation showed that most of the spring waters along the Portneuf River belong to a calcium bicarbonate system. Perry et al. (1990) went on to classify 27 of the 28 springs studied into four groupings of springs within the overall calcium bicarbonate system, based on additional characteristic parameters (such as conductivity, selected nutrients, and fluoride). These four groups (indicated in Figure 1.3-2) were identified as follows:

- Batiste System (Group I)
- Swanson Road System (Group II)
- East Side System (Group III)
- Papoose System (Group IV)

The Perry study did not include Willow Spring (see Figure 1.3-1) in the four groupings because it was markedly different, as it had sodium/potassium chloride water chemistry and overall higher ionic concentrations than any other spring studied.

Both Perry et al. (1990) and Goldstein (1981) attempted to characterize the source of water for the springs sampled in each respective study. However, conclusions drawn by both studies could only be tentative, as each study examined only limited data. The Perry study examined a narrow geographical area (less than 2 square miles), and the Goldstein study examined a restricted number of springs (seven).

Both Perry and Goldstein suggested that the springs in the Portneuf River basin issue from the Michaud Gravel and the American Falls Lake Bed Formation, which also underlie the EMF study area (see Figure 1.3-1). Additionally, Perry noted that, based on water chemistry, Groups II, III, and IV each included springs from both the east and west side of the Portneuf River, suggesting that the river is not a hydraulic barrier to subsurface flow in the area north of I-86. Additional data collected during the RI indicate that the river is, in fact, a hydraulic barrier north of I-86.

Perry described the water chemistry of these three groups as representing downgradient (downstream) gradation (i.e., paralleling the discharge of the Portneuf River), suggesting that these springs may represent underflow from the river. Both authors suggested that springs in the Batiste System represent a different source of water from the other springs studied.

As part of the USGS hydrogeologic investigations, Jacobson collected water chemistry data for five springs in 1980 (Jacobson, 1982). Additional water chemistry data were collected for two of these springs (Batiste and Twenty-West in 1981 and 1982 (Jacobson, 1984), and for Batiste Spring from 1982 through 1987 (Jacobson, 1989). The investigations were initiated as a result of degraded water quality found in the Pilot House Well in 1972. The data were collected to monitor changes in groundwater and spring quality in the Michaud Flats area. Incidental to the main focus of the investigation, the study concluded that Batiste Spring had been impacted, and noted the proximity of the spring to the industrial ponds (at the EMF facilities). No attempt was made by Jacobson to characterize the nature of the impact.

A more comprehensive discussion of the source of water for springs is presented in Section 4 of the PSCS. It includes additional data collected during the remedial investigation.

1.3.1.2 Groundwater

This section briefly discusses previous investigations of groundwater chemistry, based on data collected during the following studies:

- Perry et al., 1990
- Jacobson, 1982, 1984, and 1989
- Goldstein, 1981

Water chemistry data were collected from various springs along the Portneuf River and from 16 wells in the EMF study area. These wells are identified in Figure 1.3-3.

In summary, the studies concluded that most of the wells belong to a calcium-bicarbonate system. Furthermore, most of these wells were found to be comparable to one or more of the four spring groups identified by Perry et al. (1990) (see Section 1.3.1.1). Eight wells were found to have water chemistry comparable to the Papoose System: Papoose Springs Fish Farm, Pumping Station, New Pilot House, Idaho Power Kinport, Michaud/USGS-1, FMC-3, Williamsen, and Tank Farm wells. Two wells were comparable to the Swanson Road System: Rowland and Carlson wells. One well was comparable to the Batiste System: SWP-4. One well was intermediate between the Batiste and Papoose systems: SWP-5. The Perry study likened two wells, Lindley and FMC-1, to a Batiste/Papoose System, with increased levels of chloride. One well, Crockett, was not comparable to any of the four spring groups, but was comparable to the sodium chloride water chemistry of Willow Spring. One well, Old Pilot House, was not comparable to any spring and had a sodium/potassium carbonate water chemistry.

1.3.2 Characterization of Constituents of Potential Concern in Batiste Spring

This section addresses Batiste Spring (see Figure 1.3-1) since it is the only spring identified by previous investigations (e.g., Perry et al., 1990, and Goldstein, 1981) as being impacted by anthropogenic activities at the EMF facilities. Previous investigations conducted at Batiste Spring are as follows:

- Perry et al., 1990.
- Goldstein, 1981 – The final report also included a report on a previous study conducted by Balmer and Noble (1979) of water resources for the Fort Hall Indian Reservation, including Batiste Spring.
- USGS, 1977 – Batiste Spring was addressed in an environmental impact statement (EIS) prepared by the USGS.
- Ecology and Environment, Inc. (E&E), 1988.

Both the Perry and Goldstein studies showed increased sulfate, calcium, and nutrient concentrations at Batiste Spring relative to the other springs studied. Water quality of Batiste Spring was described by Balmer and Noble (Goldstein, 1981) as showing an increase in levels of hardness, chloride, sulfate, phosphate, nitrate, and ammonia

from 1930 through the 1970s. The report also found fluctuating concentrations of mercury, arsenic, and cadmium in Batiste Spring in the 1970s.

Additional investigations identified elevated levels of phosphate in Batiste Spring (USGS, 1977; E&E, 1988). The phosphate levels were attributed by these investigations to discharges to the Portneuf River from the (EMF) facilities.

A more comprehensive discussion on these previous investigations is found in Appendix A of this report.

1.3.3 Characterization of Constituents of Potential Concern in Groundwater

Previous investigations that examined constituents in groundwater are as follows:

- Goldstein, 1981 – The final report also included a report on a previous study conducted by Balmer and Noble (1979) of water resources for the Fort Hall Indian Reservation, which included groundwater.
- Jacobson, 1982, 1984, and 1989.
- E&E, 1988.

These previous investigations reported the presence of elevated levels of metals and some general water quality parameters in groundwater.

The Goldstein and Jacobson studies attributed the elevated parameters in the Crockett well to the (EMF) facilities; however, this interpretation is too simplistic. Section 4 of this PSCS provides a complete explanation for the source of elevated parameters in the Crockett well. The E&E investigation also found elevated concentrations of metals in the wells examined; furthermore, the study correlated the findings to some potential sources at the (EMF) facilities.

The EMF site was placed on the National Priorities List (NPL) on the basis of E&E's findings.

Further details on these investigations are presented in Appendix A.

1.3.4 Characterization of Constituents of Potential Concern in Surface Water and Sediments

This section summarizes the results of previous investigations of constituents of potential concern both in surface water and sediments of the Portneuf River. This discussion is based on the following previous investigations:

- Surface water quality was examined by Ecology Consultants (1977) and Campbell et al. (1992).

- Perry (1977) studied the impacts of effluent discharges from various sources on the Portneuf River.
- Mazanowski (1992) attempted to characterize sediment quality with respect to heavy metal concentrations for the Portneuf River sediments.

Figure 1.3-4 shows locations of surface water and sediment sampling points included in these studies and, for reference purposes, surface water and sediment sampling points for the RI.

The presence of elevated nutrients in surface water was investigated by Ecology Consultants and Campbell et al. The Ecology Consultants study found an increase in nutrient concentrations at stations 4 and 7 (see Figure 1.3-4), based on samples collected in August 1977.

The Campbell investigation included a comparison of data collected in 1972 and 1991-1992, from locations indicated in Figure 1.3-4. The study concluded that while some stations showed decreased phosphate levels, overall phosphate levels in the river had not changed over the 20-year period. Increased phosphate levels found at one station were attributed by Campbell to possibly the Pocatello STP (see Figure 1.3-1), Batiste Spring, or "gradual saturation of the river bottom sediments with phosphates as a result of eutrophication."

The 1977 Perry study presented the results of a water quality sampling program to characterize effluent impact on the Portneuf River (see Figure 1.3-4 for sampling locations). The sampling program concluded that the surface water quality was impacted (during the period of the study) as a result of operations at the (EMF) facilities, as well as the STP, Batiste Springs Fish Farm, and Papoose Springs Fish Farm.

The 1992 Mazanowski study attempted to quantify four heavy metals (cadmium, copper, lead, and zinc) associated with the clay-silt fraction of sediment from the Portneuf River. Figure 1.3-4 depicts the locations of samples collected for this effort. The investigation found elevated metal concentrations above mean concentrations within the study area.

1.3.5 Ecological Investigations

This section summarizes the results of previous investigations of the EMF study area ecology. These investigations included aquatic surveys at Portneuf River and studies of terrestrial wildlife and habitats. Additional information on investigations addressed in this section is found in Appendix A.

1.3.5.1 Aquatic Surveys

Aquatic surveys of Portneuf River that were conducted in the past are as follows:

- Minshall and Andrews, 1973
- Buikema, 1975
- Ecology Consultants, 1977
- City of Pocatello, 1989

Surveys of aquatic ecology were conducted from the late 1960s to the mid-1970s. Note that because of the changed discharge practices at the EMF facilities, and other conditions at the river, the data provided by these dated references may have limited relevance to this site characterization study. The most recent aquatic ecology investigations of the Portneuf River are summarized in Section 3 of this PSCS.

Aquatic surveys were conducted by Minshall and Andrews (1973) over the approximately 98-mile (157-km) long course of the Portneuf River. The study examined the distribution of benthic invertebrates along the stream course. The investigation indicated the possibility of toxic conditions below the (EMF) facility discharges. The 1975 Buikema survey examined the macrobenthos in the Portneuf River, along an approximate 655-foot (200-m) stretch of the river above and below the FMC and Simplot facility outfalls. Generally, the Buikema data obtained downstream from the effluents showed no major impact of these outfalls on the benthos. Another aquatic survey, prepared by Ecology Consultants (1977), addressed benthic fauna as well as attached algae (periphyton). The study concluded that the discharges had an effect upon most of the aquatic parameters studied.

Aquatic habitat between Interstate Highway 86 (I-86) and Siphon Road was investigated by the City of Pocatello (1989) to evaluate possible effects of treated wastewater on the biology and chemistry of the Portneuf River. The area of focus for the bioassessment was the Portneuf River in the immediate vicinity of the sewage treatment plant's (STP's) outfall. Sampling sites were selected above the outfall, within the mixing zone, and downstream from the zone of mixing. Two seasonal sampling periods (autumn 1988 and summer 1989) were specified for the bioassessment. The study concluded that the ammonia-nitrogen load contained in the STP's effluent increased the ammonia content of the Portneuf River below the Roland creamery, and that a zone along the west bank of the river appeared to have been impacted minimally by the STP's effluent. The report further concluded that results of taxanomic analysis of benthic samples suggest that there is environmental stress associated with the effluent discharged from the STP.

1.3.5.2 Terrestrial Investigations

Previous investigations regarding terrestrial wildlife and habitats are as follows:

- State of Idaho and Others, 1965 - 1992
- Henny and Burke, 1990
- Low and Mullins, 1990
- Severson and Gough, 1979

The Department of Health and Welfare, Division of Environment Quality, State of Idaho directed studies of fluoride levels in vegetation to be conducted in the area surrounding the EMF facilities from the late 1960s to 1992. These investigations were conducted by the University of Idaho, Department of Agricultural Biochemistry and Soils (1965-1971), Department of Bacteriology and Biochemistry (1972-1980), and by Miller (1986-1987, 1990-1992). One shortcoming of these investigations as related to the present site characterization is that the species collected for the study were not identified. Specifically, with the data presented, it could not clearly be determined in many cases whether the plants sampled were annuals or perennials. Therefore, conclusions could not be made regarding the relationship of fluoride deposition and uptake by wildlife feeding on the vegetation and, hence, none are presented here.

Similarly, the results of the Henny and Burke (1990) study, which documented fluoride concentrations in black-crowned night herons, are not discussed in this section. The herons evaluated were not year-round residents and migrated to Mexico, where they were potentially exposed to other chemical constituents, such as the pesticide DDT. In addition, the study itself concluded that further research was needed to distinguish age effects from fluoride effects in wild avian populations.

Low and Mullins (1990) conducted a reconnaissance investigation of water quality, bottom sediment, and biota associated with irrigation drainage in the American Falls Reservoir area from 1988-1989 (an area outside the EMF study area). The purpose of the study was to determine whether potentially toxic compounds associated with irrigated drainage existed in surface, groundwater, bottom sediment, aquatic plants, benthic invertebrates, fish, and waterbirds in the American Falls Reservoir area. The authors concluded that, based upon general observations on health and diversity of biota during the field season, the study area did not appear to have a serious avian reproductive, habitat destruction, or food-chain biomagnification problem that could be associated with irrigation drainage.

Severson and Gough (1979) conducted a study in May 1975 to assess potential impacts of emissions from the (EMF) facilities on sagebrush and grasses. Vegetation samples were collected from distances of up to 40 miles (64 km) upwind (to the

south) and downwind (to the north) of the facilities, and analyzed for 70 elements. The authors concluded that seven elements (cadmium, chromium, fluorine, selenium, uranium, vanadium, and zinc) were related to emissions from the (EMF) facilities' operations. The study also found a correlation between constituent concentrations in the plants with distance from the facilities.

1.3.6 Air Quality

This section discusses previous air quality investigations conducted at the EMF study area. Over the past 20 years, ambient air quality monitoring has been performed by the State of Idaho and the FMC and Simplot facilities. The monitoring was performed to ascertain and monitor regional and local trends in ambient air quality, and focused on state and federal ambient air quality standards.

Historically, monitoring has been conducted for total suspended particulate (TSP) matter, particulate matter whose size is less than 10 microns (PM_{10}), sulfur dioxide (SO_2), and fluorides. The following are brief descriptions of the monitoring programs corresponding to each parameter.

1.3.6.1 Particulate (TSP and PM_{10}) Monitoring

Particulate monitoring for TSP at the EMF facilities began in 1971-1972, when the State of Idaho installed TSP monitors at the Pocatello STP. This equipment was later augmented by PM_{10} monitors in 1986. In 1988, PM_{10} monitors were also installed at locations 3 to 4 miles from the Simplot facility. In addition, FMC has conducted a program of particulate (TSP) monitoring since 1975 (later enhanced with PM_{10} monitors in 1984), with the installation of two monitors within the facility boundaries, and a third about 50 feet away from the monitor at the Pocatello STP.

As a result of these monitoring programs, the EMF study area has been identified as part of a TSP nonattainment area, and later, part of the PM_{10} nonattainment area.

1.3.6.2 Sulfur Dioxide (SO_2) Monitoring

Ambient SO_2 monitoring has been conducted by Simplot since 1978. Simplot has operated SO_2 monitors at the following locations: the Pocatello STP; north of the Rowland creamery; the vicinity of the Simplot water treatment ponds; in Chubbuck, approximately a quarter mile (0.4 km) from Rio Vista; approximately 1 mile (1.6 km) south-southeast of the Pocatello STP SO_2 monitor, coincident with the site 1 meteorological station at Simplot's surge pond; and a quarter mile (0.4 km) east of the Pocatello STP on Batiste Road. This last location was added in 1984 because the

area was identified by atmospheric dispersion modeling as the calculated point of maximum SO_2 concentrations impacting on local elevated terrain.

Data from these monitoring stations indicated that SO_2 emissions from all sources are well under the threshold concentrations specified by state and federal ambient air quality standards.

1.3.6.3 Fluoride Monitoring

Under State of Idaho air quality rules, fluoride levels in forage material are required to be monitored. Fluoride (forage) sampling has been conducted in the area since the 1950s.

Historically, elevated levels of forage fluoride have been observed in the immediate vicinity of the FMC and Simplot facilities. Plants from areas having the highest fluoride readings typically are east and southeast of the facilities. Vegetation in these areas is sparse, consisting primarily of sagebrush and scrubgrass.

1.3.6.4 Airborne Deposition and Soils Impacts

In May 1975, Severson and Gough (1979) conducted a survey for the USGS to assess potential impacts of emissions from phosphate-processing facilities to offsite soils. Samples were collected from distances up to 40 miles (64 km) upwind (to the south) and downwind (to the north) of the facilities. Surficial soil samples and subsurface samples (average sampling depth of 3 feet [0.9 m]) were collected.

According to the study, analyses of 58 elements showed that nine were related to (EMF) facility operations (these constituents included beryllium, fluorine, iron, lead, lithium, potassium, rubidium, thorium, and zinc), for surficial soils. However, the study did not find a correlation between element concentrations in subsurface soils and the (EMF) facilities.

1.3.7 FMC Facility Investigations

Previous investigations conducted at the FMC facility are as follows:

- Geraghty and Miller, Inc. (G&M), 1982a and 1982b
- FMC Corporation, 1991b

G&M reviewed groundwater analytical data from the FMC onsite wells, offsite wells, and nearby springs to determine the effect of FMC's operations on groundwater quality. Nineteen monitoring wells were installed, and groundwater samples were collected at quarterly intervals from August 1980 through November 1981. G&M reported elevated total dissolved solids concentrations extending from

Pond 7E (see Figure 1.3-5) to the Portneuf River, as well as a smaller warm water plume suspected of being caused by the slag operation. The total dissolved solids plume followed the groundwater flow and discharged into the Portneuf River through a series of small springs on the west bank of the Portneuf River, two of which are Swanson Road Spring and Batiste Spring (Geraghty and Miller, Inc., 1982a and 1982b).

An FMC Facility Assessment (FFA) was also conducted from September to December 1990 (FMC, 1991b). The FFA further characterized the hydrogeologic conditions and established a groundwater monitoring program to comply with applicable RCRA requirements. The field investigation conducted in 1990 included collection of one round of groundwater samples, surface soil samples, and subsurface soil samples.

The hydrogeologic investigation consisted of the following:

- Installation of 36 onsite wells
- Collection and analysis of groundwater samples
- Aquifer testing
- Measurement of groundwater levels

Groundwater samples were collected from each of the newly installed wells immediately after development, and from 28 onsite and offsite existing wells. The locations of wells sampled during the FFA are shown in Figure 1.3-5. Wells installed by G&M are identified with a "TW" prefix; wells installed in 1990 are numbered between 101 and 137; and wells currently or previously used as facility production wells are identified with the prefix "FMC." Named wells are private water supply wells.

The FFA identified three areas where the distribution of constituents in groundwater were elevated within the FMC facility boundary. Three dissolved constituents (arsenic, nitrate, and selenium) were found to be at elevated levels. In addition, dissolved constituents (iron, lead, manganese, potassium, sodium, alkalinity, chloride, fluoride, sulfate, total dissolved solids, total phosphorus, and orthophosphate) were detected in underlying shallow groundwater at levels higher than the background levels identified by G&M as characteristic of the area. Elevated levels were restricted to the uppermost (shallow) interval.

During the FFA, 12 surface soil samples and 105 subsurface soil samples were also collected. In the surface soils samples, nine parameters (cadmium, chromium, lead, silver, vanadium, zinc, fluoride, total phosphorus, and orthophosphate) were detected at elevated concentrations (above background). In the subsurface soils

samples, arsenic, cadmium, zinc, fluoride, orthophosphate, and total phosphorus were detected at elevated concentrations.

1.3.8 Simplot Facility Investigations

In 1984, PEDCo Environmental, Inc. (PEI), under contract to the EPA, installed six monitoring wells at the Simplot facility. The PEI (1985) investigation detected low levels of arsenic and cadmium concentrations in groundwater. Low concentrations of barium, chromium, lead, vanadium, and zinc were also detected in the groundwater samples. Since PEI's installation of the groundwater monitoring wells, Simplot has collected and analyzed samples from these wells quarterly. Analytical data indicate that groundwater in the shallow zone directly downgradient of the original gypsum stack and in the deeper zones directly downgradient of the newer gypsum stack is generally of lower quality than the upgradient groundwater present in the deeper zones. Wells with the prefix "PEI" were installed during these investigations. Wells with the prefix "SWP" are Simplot facility production wells.

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- Demography and land use
- Ecological characterization

Section 4 describes distribution of constituents of concern potentially present in the EMF study area. The discussion is based on the results of the Phase I and Phase II investigations conducted for the RI, relative to the following media:

- Potential sources/onsite soils
- Offsite surface and subsurface soils
- Offsite soil
- Groundwater
- Surface water and sediments

Section 5 presents a summary of the scope and results of the site investigations.

The text of this report and supporting tables and figures are presented in the initial volumes, with Appendices A through N following.

1.5 REPORT ORGANIZATION

The organization of the PSCS is based on the suggested RI report format provided in the EPA document "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA" (EPA, 1988). This PSCS is an interim submittal describing the data collected during Phase I and Phase II of the RI sampling program. The report consists of four main sections. Additional sections describing constituent fate and transport and baseline risk assessment will be included with these four sections in the RI report to be issued later.

Section 1 introduces the FMC and Simplot facilities and incorporates site histories. In addition, this section summarizes previous investigations conducted in what is now referred to as the EMF study area, and introduces the site conceptual model.

Section 2 provides summaries of field activities, data collection procedures, and analytical methods used during Phase I and Phase II of the RI. The information is presented relative to the following media:

- Potential source and onsite soils
- Air pathways
- Offsite surface soils
- Geology and subsurface soils
- Groundwater
- Surface water and sediments
- Drainage
- Demography
- Ecology

Section 3 describes the physical characteristics of the EMF study area based on the results of the Phase I and Phase II investigations conducted for the RI, and includes information on the following:

- Regional hydrology and geology
- Drainage and surface water hydrology
- Site geology
- Site hydrogeology
- Onsite and offsite soils
- Climate

1.4 SITE CONCEPTUAL MODEL

This section presents the conceptual model of the EMF study area as refined by information gathered during the field investigations. The conceptual site model identifies potential release sources and associated migration pathways and receptors. It is a working hypothesis used to provide a framework for evaluating the data collected during the field investigations and is subject to modification as additional data become available.

Figure 1.4-1 is a detailed schematic of potential sources, release mechanisms, and receptors in the EMF study area. To have a complete picture of the model, the actual physical chemical properties of the sources along with their potential interaction with the native soils and surface waters and groundwaters also need to be placed in the schematic.

1.4.1 Site Characteristics

With the exception of the far northcentral area underlying the Simplot plant, most of the study area is underlain by some depth of calcareous silts and clays. These silts and clays have an average pH of greater than 8 and, because of their calcareous nature, a high buffering capacity. This means that they will act to neutralize acidic materials, precipitate cations that form carbonates out of solution, and provide for numerous cation exchange opportunities for trace metals. The silts are greatest in depth in the western and central portions of FMC and to the south of both facilities. They generally reach a depth of over 100 feet beneath the upper gypsum stack at Simplot.

The EMF study area is located in a semiarid region, with approximately 11 inches of total precipitation during the year. Hence, there is a net negative evapotranspiration rate. This means that very little infiltration of naturally occurring water is expected at the facilities and virtually none to depth. The practical impact of this is that in order for soluble materials to move into the subsurface soils, a facility-generated liquid head must be applied to them to provide for a transport mechanism.

Groundwater flow patterns and aquifer transmissivities play a major role in the appearance and concentrations of site-related constituents. Three flow regimes have been identified at the EMF facilities. In the western portion of the facilities area, groundwater moves from the southwest and west to the east towards the Portneuf River. Across the southern boundary of the facility to the west, and most of the facilities area to the east, water flows north to northeasterly from the Bannock Range. Finally there is a highly transmissive flow regime that comes out of the Portneuf River Valley in the east and flows in a generally northwest direction. All three of these systems interact within the EMF study area. In addition to the natural

flow patterns, both facilities operate production wells. The principal FMC wells are in the northwestern corner of the facility and pump from the deeper portion of the aquifer at a combined rate of approximately 2,000 gpm. The Simplot production wells are located in the central portion of their plant area and pump approximately 3,000 to 6,000 gpm from both the shallow and deeper portions of the aquifer.

The Portneuf River, which lies to the east and north, is the major surface water body near the facilities. To the south of I-86, it is a losing stream and groundwater can not enter it. To the north of I-86, it becomes a gaining stream being fed by groundwater underflow and a system of springs. The facilities are engineered so that all plant runoff is captured before it can leave the facility boundaries.

1.4.2 Source Chemical Physical Properties.

Physical properties of constituents are described below.

Phosphate ore. The physical matrix of phosphate ore is such that most constituents are not readily soluble. Hence there should be little potential for subsurface migration.

Gypsum slurry. The solids in this slurry are created under highly acidic conditions. They are unlikely to be soluble under less acidic or dry conditions. The supernatant contains varying concentrations of anions, alkali metals, alkaline earth metals, trace metals, and radionuclides. These are available for migration into the subsurface.

Precipitator slurry. The solids in this slurry are created under acidic conditions. They are unlikely to be soluble under less acidic or dry conditions. The supernatant contains varying concentrations of anions, alkali metals, alkaline earth metals, trace metals, and radionuclides. These are available for migration into the subsurface.

Former east overflow pond wastewater and solids. The solids in this slurry are created under highly acidic conditions. They are unlikely to be soluble under less acidic or dry conditions. The supernatant contains varying concentrations of anions, alkali metals, alkaline earth metals, trace metals, and radionuclides. These are available for migration into the subsurface.

Slag. Slag is a hard, vitrified material consisting primarily of calcium silicate and impurities. The pyroclastic matrix makes leaching of constituents from it very difficult and slow. Migration from this material is not expected.

Calciner wastewater and pond sediments. The solids in this slurry are created under acidic conditions. They are unlikely to be soluble under less acidic or dry conditions. The supernatant contains varying concentrations of anions, alkali metals, alkaline earth metals, trace metals, and radionuclides. These are available for migration into the subsurface.

- Given groundwater flow patterns, the springs most likely to be influenced by groundwater flowing beneath the EMF facilities are the Swanson Road Spring and Batisite Spring.
- Given groundwater flow patterns and transmissivities, springs to the north of Batiste and east of the Portneuf River are not likely to be influenced by groundwater flowing beneath the EMF facilities.
- Given the topography and annual precipitation rates, sediment loading in the Portneuf River is more influenced by upstream sources than those in the immediate area of the EMF facilities. This loading will be most pronounced during spring melt in the mountains.
- The size and shape (sinuosity) of the Portneuf River is such that point and chute bars should exist on the river that give a record of sedimentation sufficient to judge whether there has been an EMF-related impact on these sediments.
- Air deposition of constituents onto the Portneuf River, while possible, is not expected to produce a measurable effect.

Phossy water/solids. The solids in this slurry are created under acidic conditions. They are unlikely to be soluble under less acidic or dry conditions. The supernatant contains varying concentrations of anions, alkali metals, alkaline earth metals, trace metals, and radionuclides. These are available for migration into the subsurface.

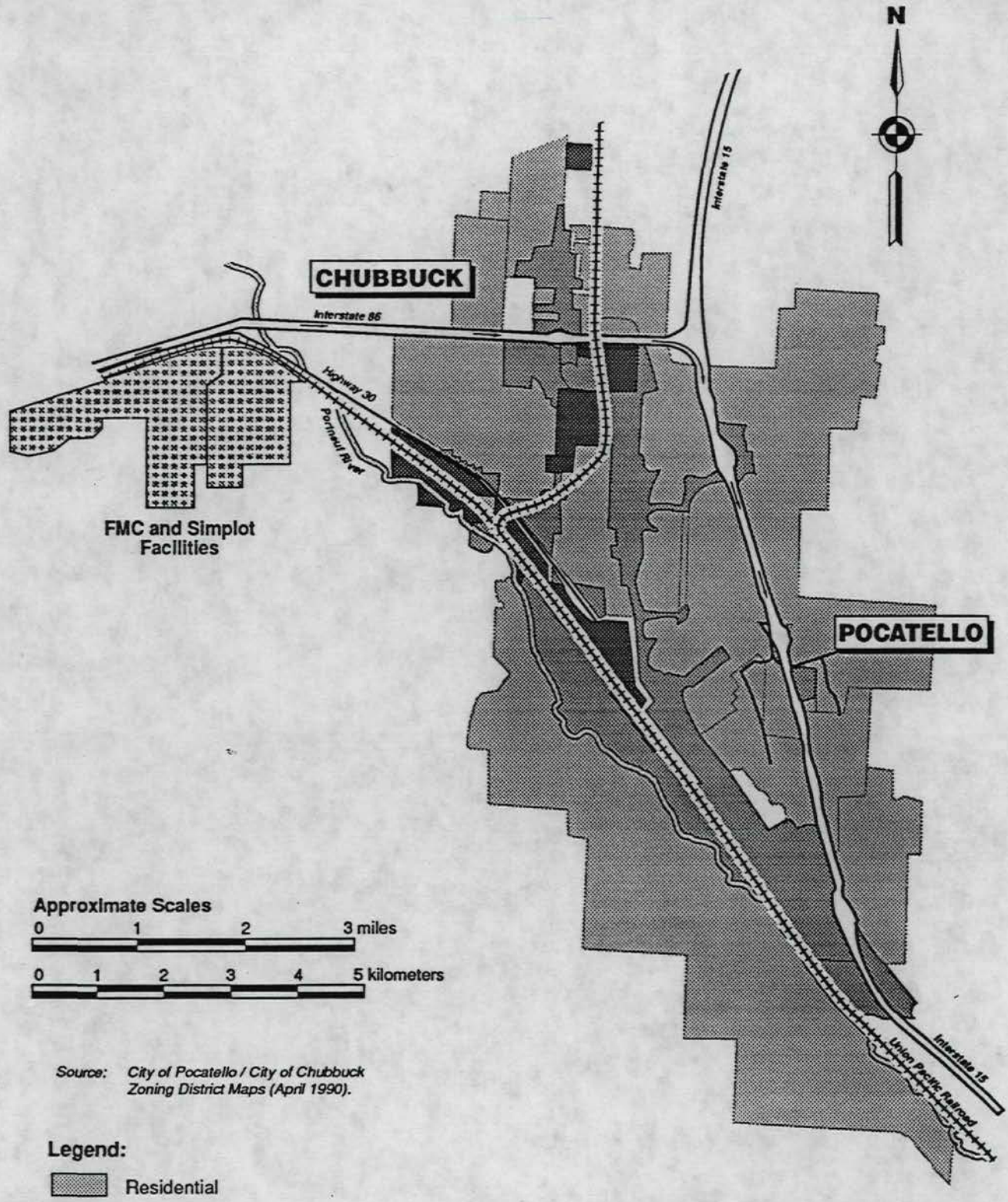
Stacks and vents. Stacks and vents emit constituents related to specific processes into the air.

IWW ditch/FMC outfall. The ditch and outfall contain noncontact cooling water and may contain minor amounts of phosphate ore particulate blown from ore piles.

1.4.3 Conceptual Model Hypotheses

On the basis of the above discussion, the hypotheses of the conceptual model are as follows:

- Solids deposited by mechanical action by the facilities (e.g., in storage piles or as fill) are unlikely to leach into the subsurface soils due to their insoluble form and the lack of a transport mechanism. They will, however, be subject to windblown dispersion as fugitive dusts.
- Because of the engineered structures at the facilities, all runoff is contained. Hence, there cannot be any transport offsite by overland flow of surficial materials.
- Where hydraulic heads have been applied (e.g., former unlined ponds, current unlined ditches and the gypsum stack), dissolved constituents have the potential to migrate into the subsurface and to the groundwater. The nature of the native soils in most areas of the facilities is such that trace metals and other constituents subject to precipitation under high pH, calcareous conditions, and soils favorable to cation exchange will be attenuated in the near surface (within 20 feet). Alkali metals, alkaline earth metals, and anions (including oxyanions of selenium and arsenic) will generally not be completely attenuated and will reach groundwater (see Figures 1.4-2 and 1.4-3).
- In areas where the subsurface is unfavorable to attenuation (gravels such as are found near the east overflow pond), there is more potential for the impact of groundwater by trace metals as well as the alkali and alkaline earth metals and anions.
- Fugitive dust/gaseous emissions deposition, as well as stack and vent deposition, should be found primarily in the downwind (north/northeast) areas of the EMF facilities. These depositions should be greatest near the facilities' boundaries and fall off with distance.



Approximate Scales

0 1 2 3 miles

0 1 2 3 4 5 kilometers

Source: City of Pocatello / City of Chubbuck Zoning District Maps (April 1990).

Legend:

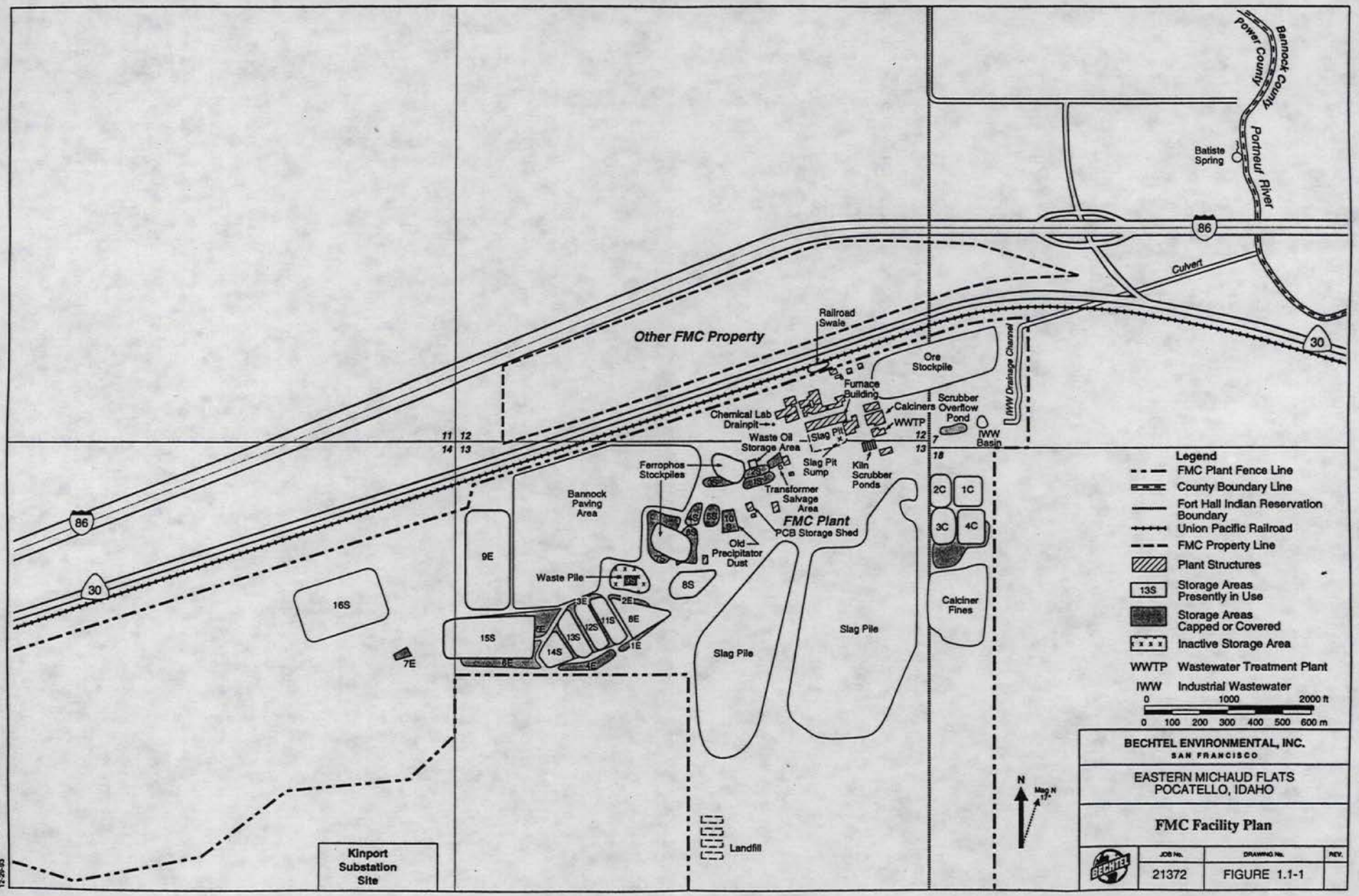
- Residential
- Commercial
- Industrial
- FMC and Simplot Facilities

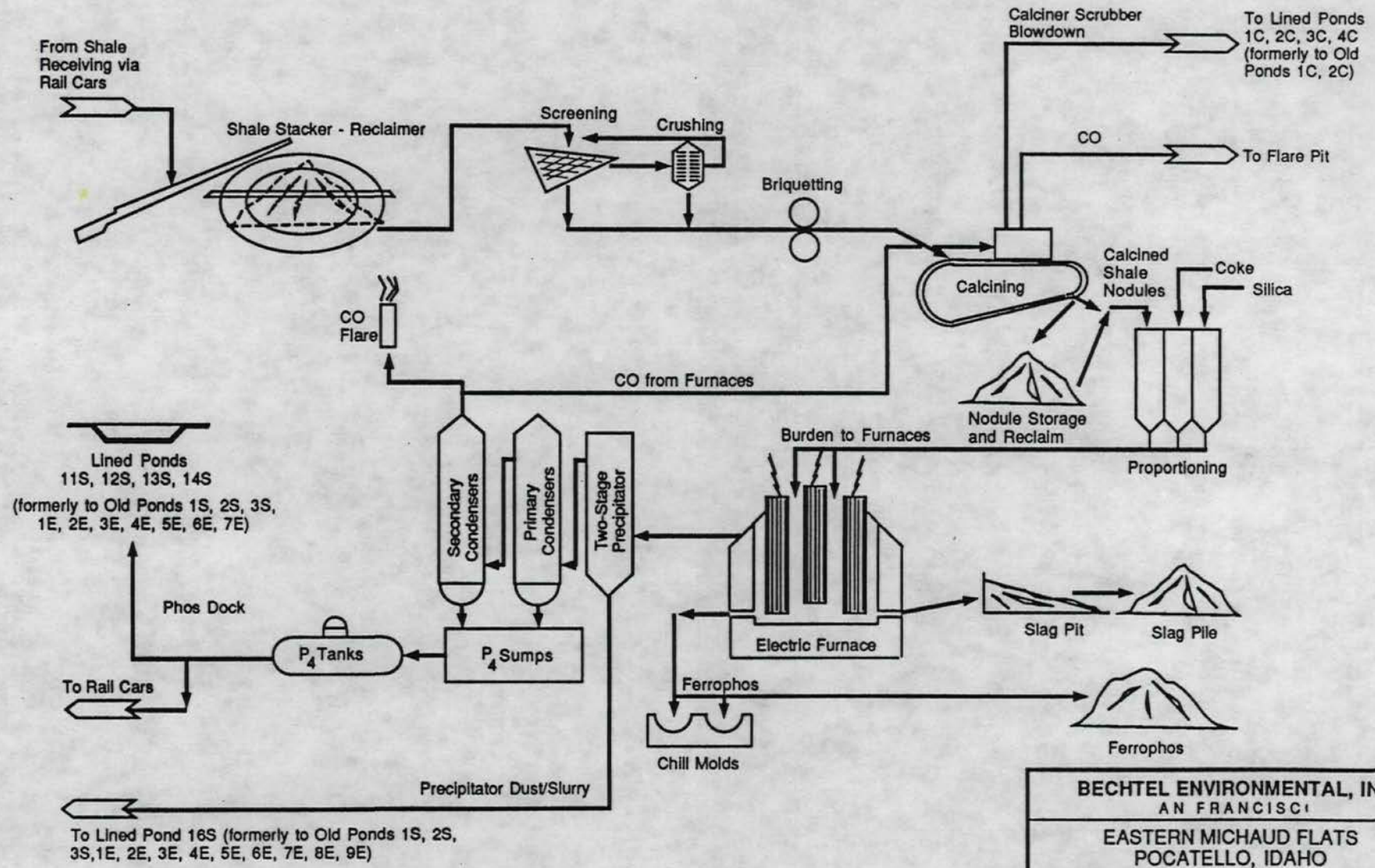
BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO			
EASTERN MICHAUD FLATS POCATELLO, IDAHO			
EMF Site Location Map			
BECHTEL	JOB No.	DRAWING NO.	REV.
	21372	FIGURE 1-1	

93-1477b.032
11-14-93 pc/hw: 5

BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO			
EASTERN MICHAUD FLATS POCATELLO, IDAHO			
Photograph of EMF Facilities			
	JOB No.	DRAWING NO.	REV.
	21372	FIGURE 1-2	

93-1477b.204
11-14-93 hw/ 0

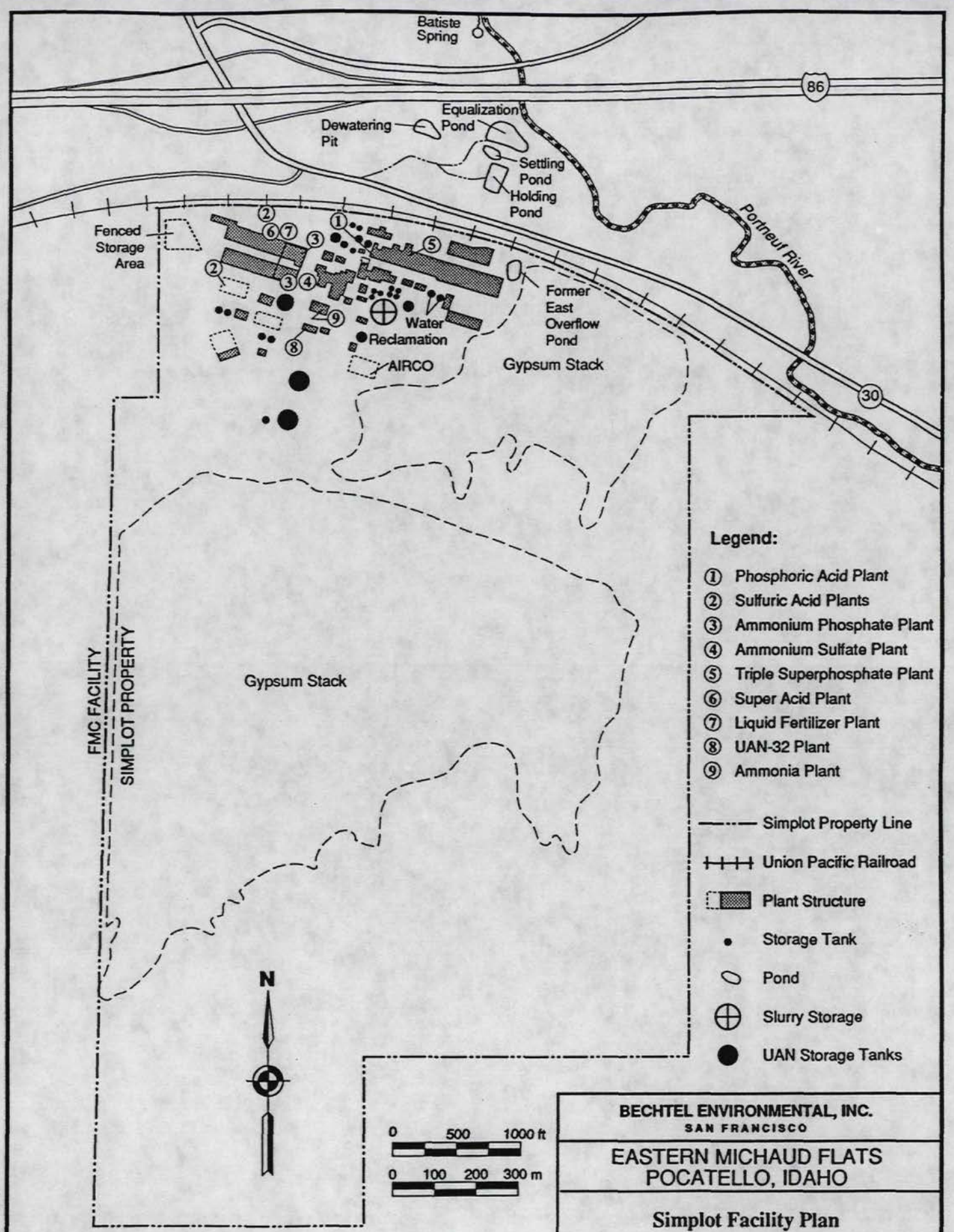

Other FMC Property
Railroad Swale
Ore Stockpile
Furnace Building
Calciners
Scrubber Overflow Pond
IWW Drainage Channel
IWW Basin
WWTP
Chemical Lab Drainpit
Waste Oil Storage Area
Slag Pit
Slag Pit Sump
Kiln Scrubber Ponds
Transformer Salvage Area
FMC Plant
PCB Storage Shed
Old Precipitator Dust
Ferrophos Stockpiles
Bannock Paving Area
Waste Pile
Slag Pile
Calciner Fines
Landfill
Kinport Substation Site
Batiste Spring
Power County
Bannock County
Portneuf River
Culvert
86
30
Legend
FMC Plant Fence Line
County Boundary Line
Fort Hall Indian Reservation Boundary
Union Pacific Railroad
FMC Property Line
Plant Structures
Storage Areas Presently in Use
Storage Areas Capped or Covered
Inactive Storage Area
WWTP Wastewater Treatment Plant
IWW Industrial Wastewater
0 1000 2000 ft
0 100 200 300 400 500 600 m
N
Mag N 17°
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO
EASTERN MICHAUD FLATS
POCATELLO, IDAHO
FMC Facility Plan
JOB No. 21372
DRAWING No. FIGURE 1.1-1
REV.



Note:"Old Ponds" are those that are no longer operational.

BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO		
EASTERN MICHAUD FLATS POCATELLO, IDAHO		
FMC General Flow Diagram		
JOB No.	DRAWING No.	REV.
21372	FIGURE 1.1-2	

93-1477b.018
12-29-93 vk/ms:36



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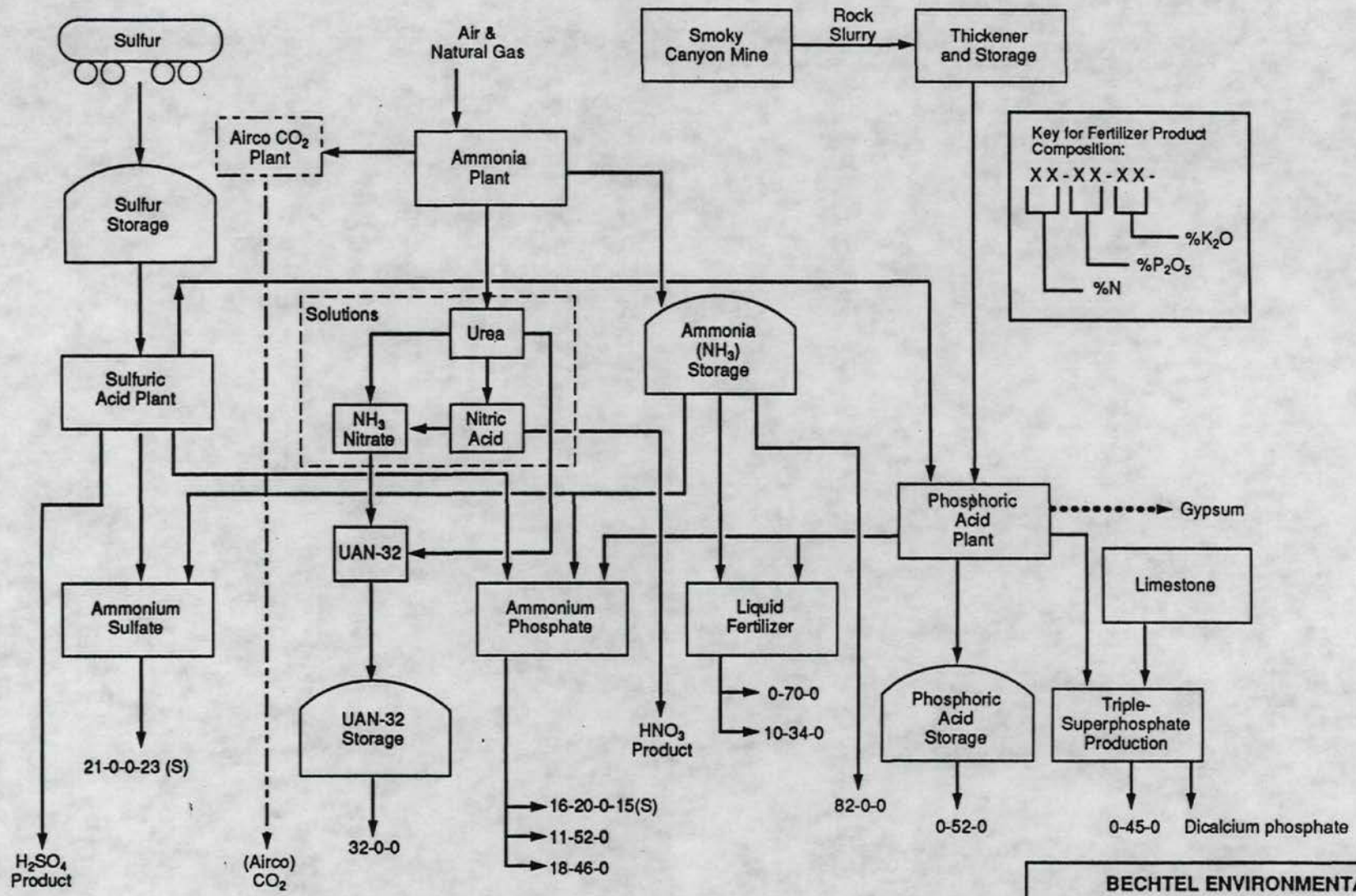
Simplot Facility Plan

JOB No.	DRAWING NO.	REV.
21372	FIGURE 1.2-1	

93-1477b.024 12-28-93 ms/ms 2



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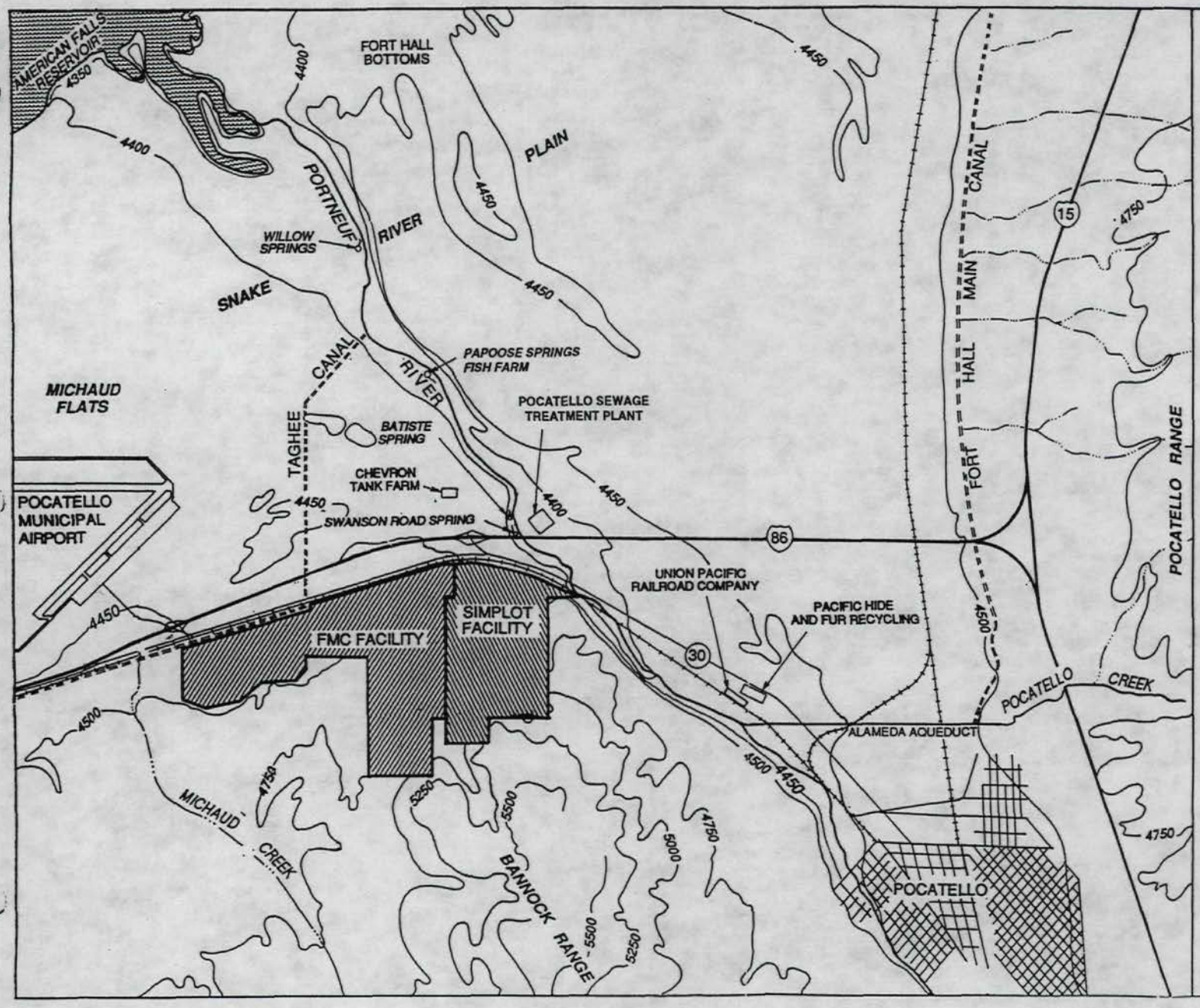
POCATELLO, IDAHO

Simplot General Flow Diagram

JOB No.	DRAWING NO.	REV.
21372	FIGURE 1.2-2	

93-1477b.026 12-29-93 ms/ms :4



EXPLANATION

- RIVER
- INTERMITTENT STREAM
- SPRING
- TOPOGRAPHIC CONTOUR
- UNION PACIFIC RAILROAD
- CANAL

Contour Intervals
Above 4500 ft. elevation: 250 ft.
Below 4500 ft elevation: 50 ft.

Note:
Base map adapted from Trimble, 1976, and from USGS Michaud (1971) and Pocatello North (1971) 7.5 minute topographic quadrangles.

0 1 2
SCALE IN MILES

BECHTEL ENVIRONMENTAL, INC.
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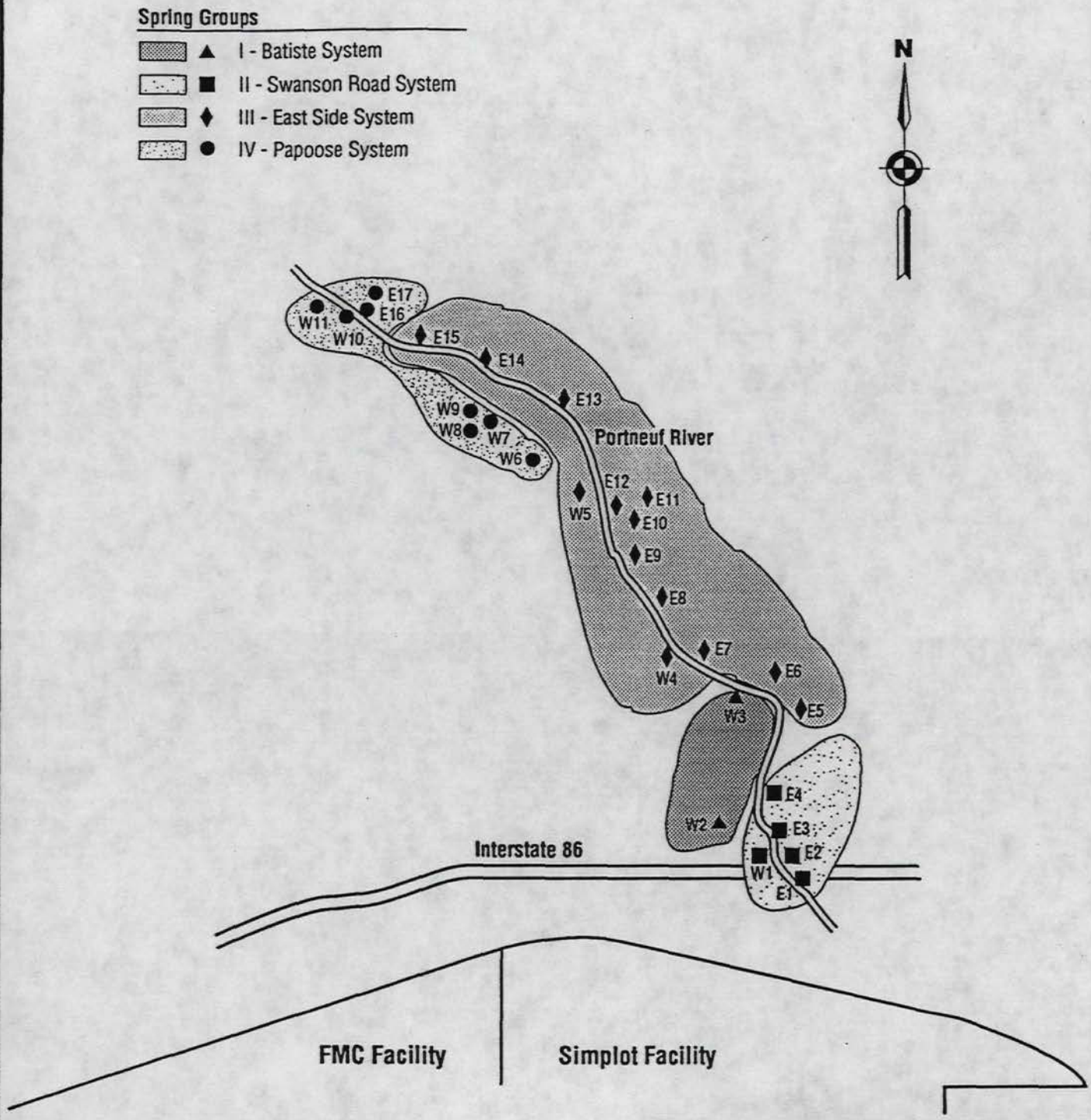
EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Regional Setting

JOB No.	DRAWING NO.	REV.
21372	FIGURE 1.3-1	



Note:
Modification of map by Perry et al. (1990) showing location of springs, with the four "spring groups" defined with cluster analysis of water chemistry.

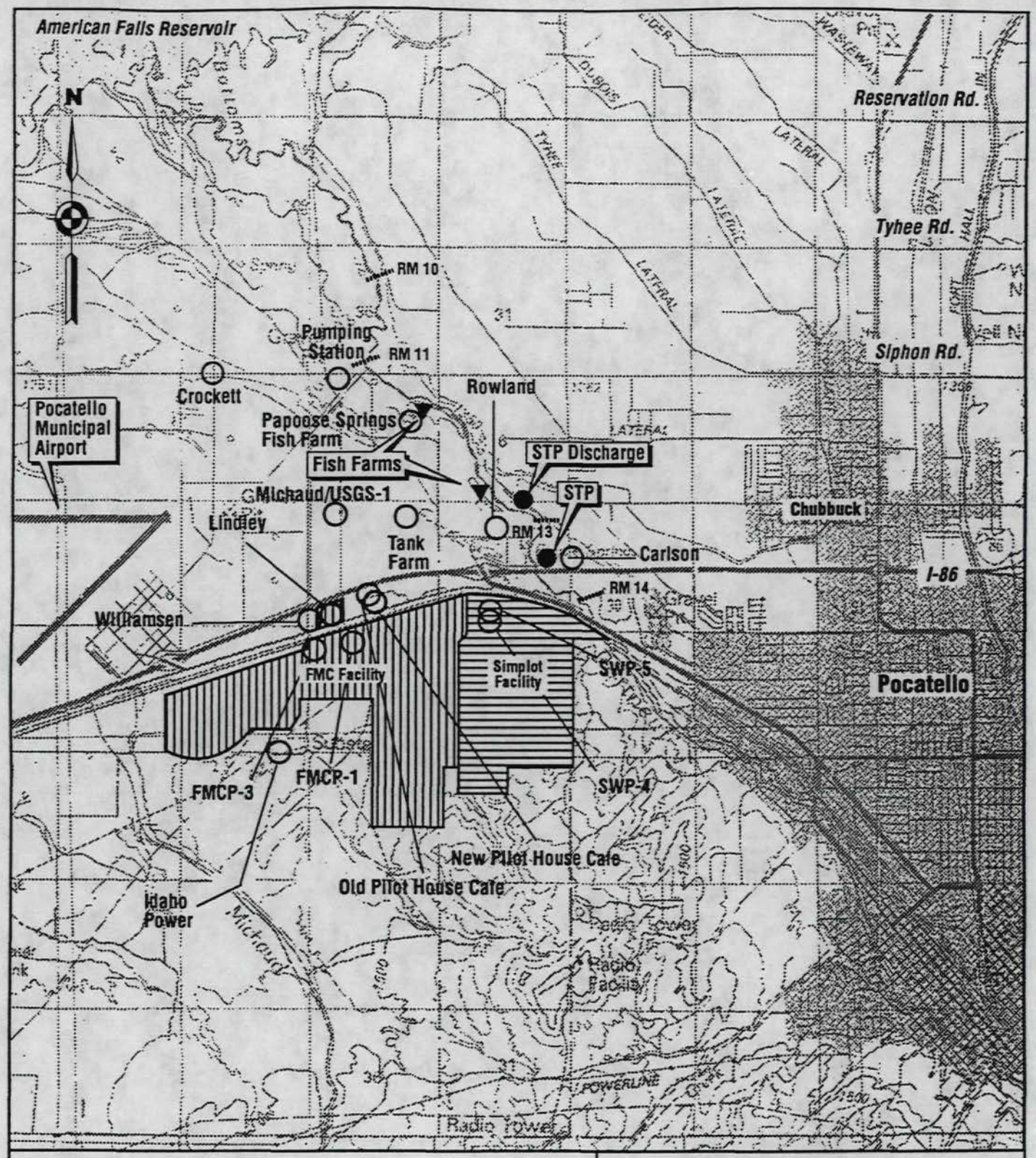
Scales

0 — 1 mile

0 — 1 — 2 kilometers

BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO		
EASTERN MICHAUD FLATS POCATELLO, IDAHO		
Location of Spring Groups on Portneuf River		
JOB No.	DRAWING NO.	REV.
21372	FIGURE 1.3-2	

93-1477b.007 m2
11-14-93 lw/ :7



Legend:

STP Pocatello Sewage Treatment Plant

RM River Mile

○ Location of well sampled (1980)

0 1 2 miles

0 1 2 3 kilometers

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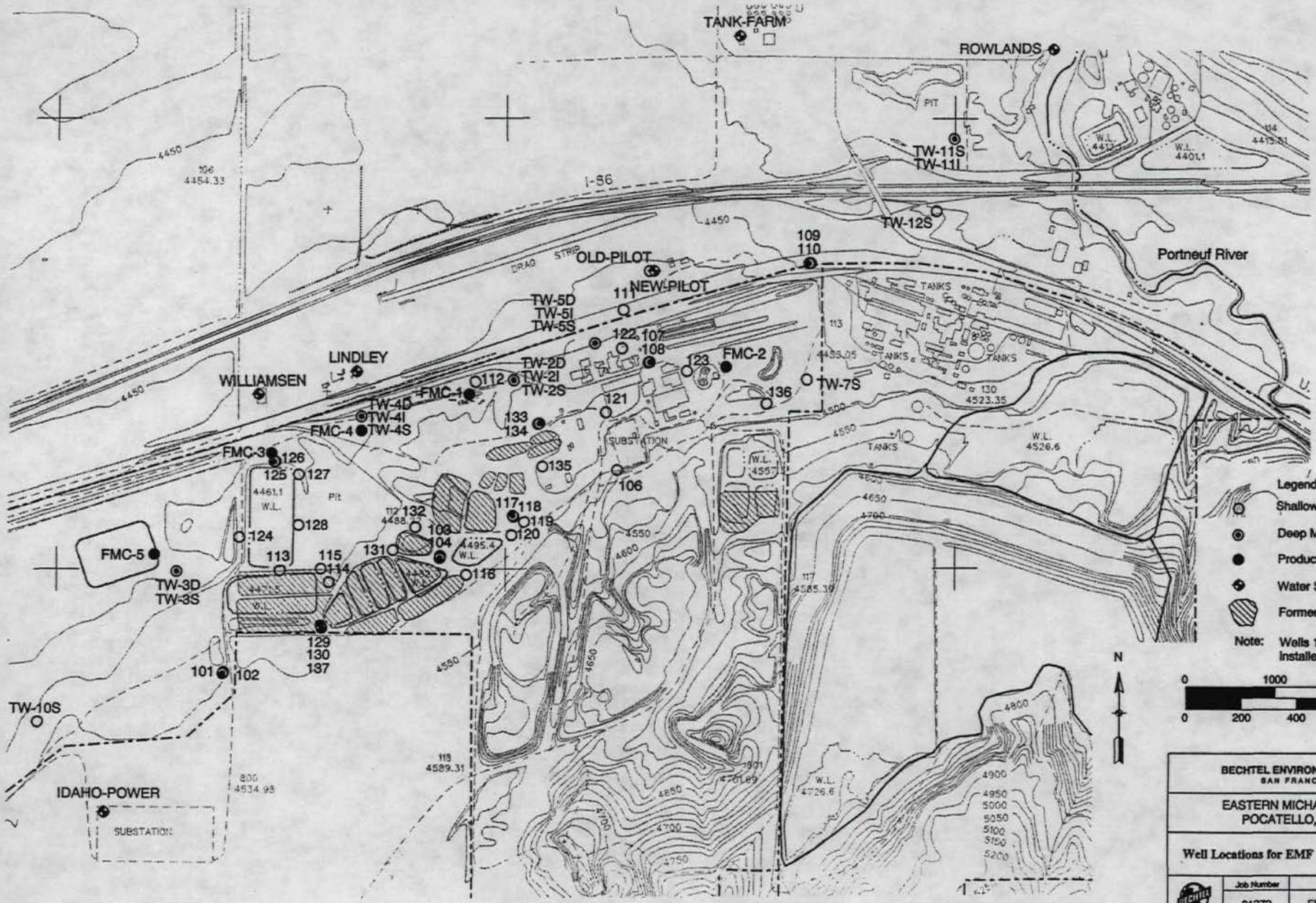
POCATELLO, IDAHO

Location of Wells Sampled During Previous Investigations

JOB No.	DRAWING NO.	REV.
21372	FIGURE 1.3-3	0

93-1477b.012 m3
1-10-94 lw/ms :8



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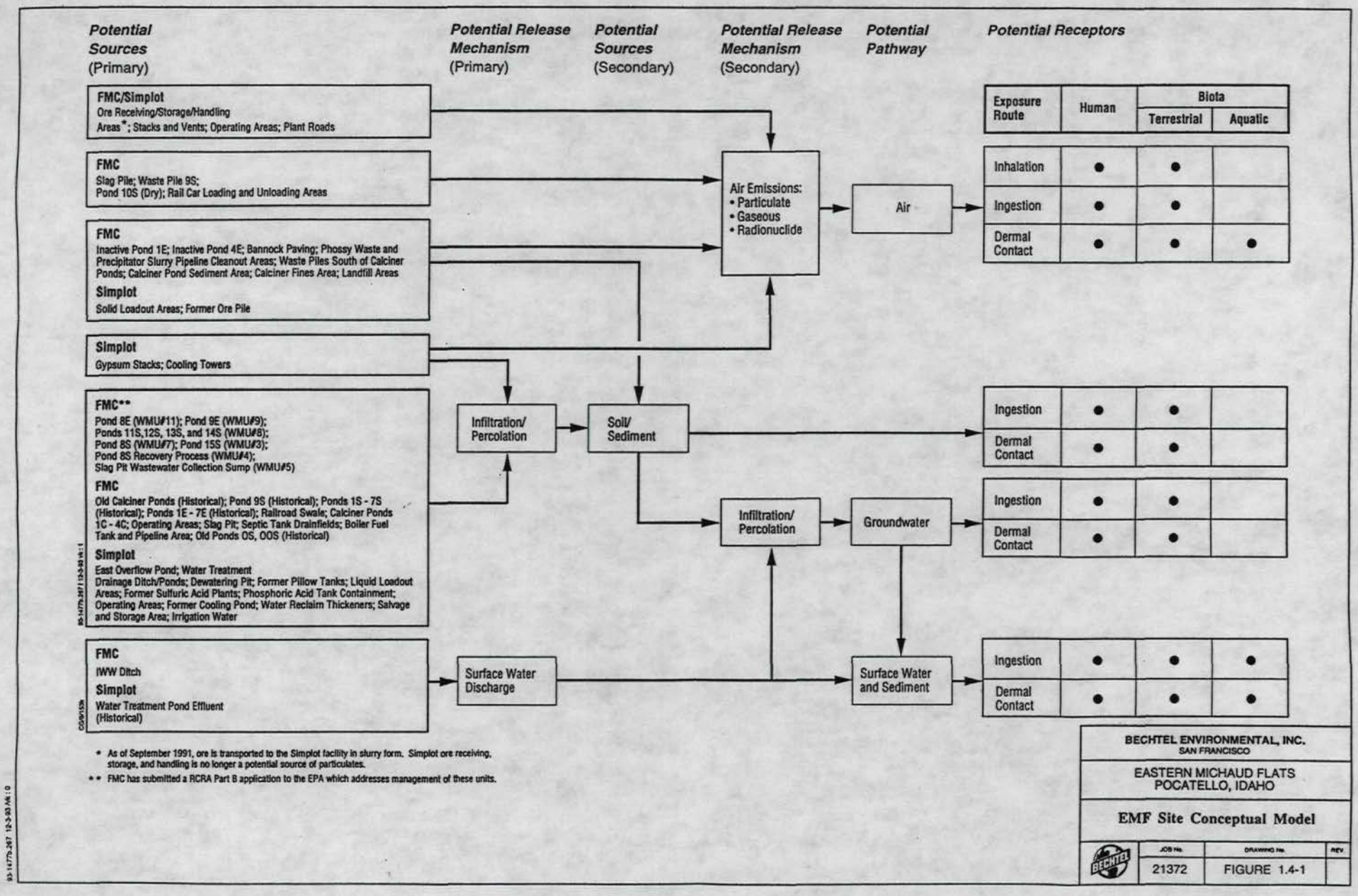
EASTERN MICHAUD FLATS
POCATELLO, IDAHO

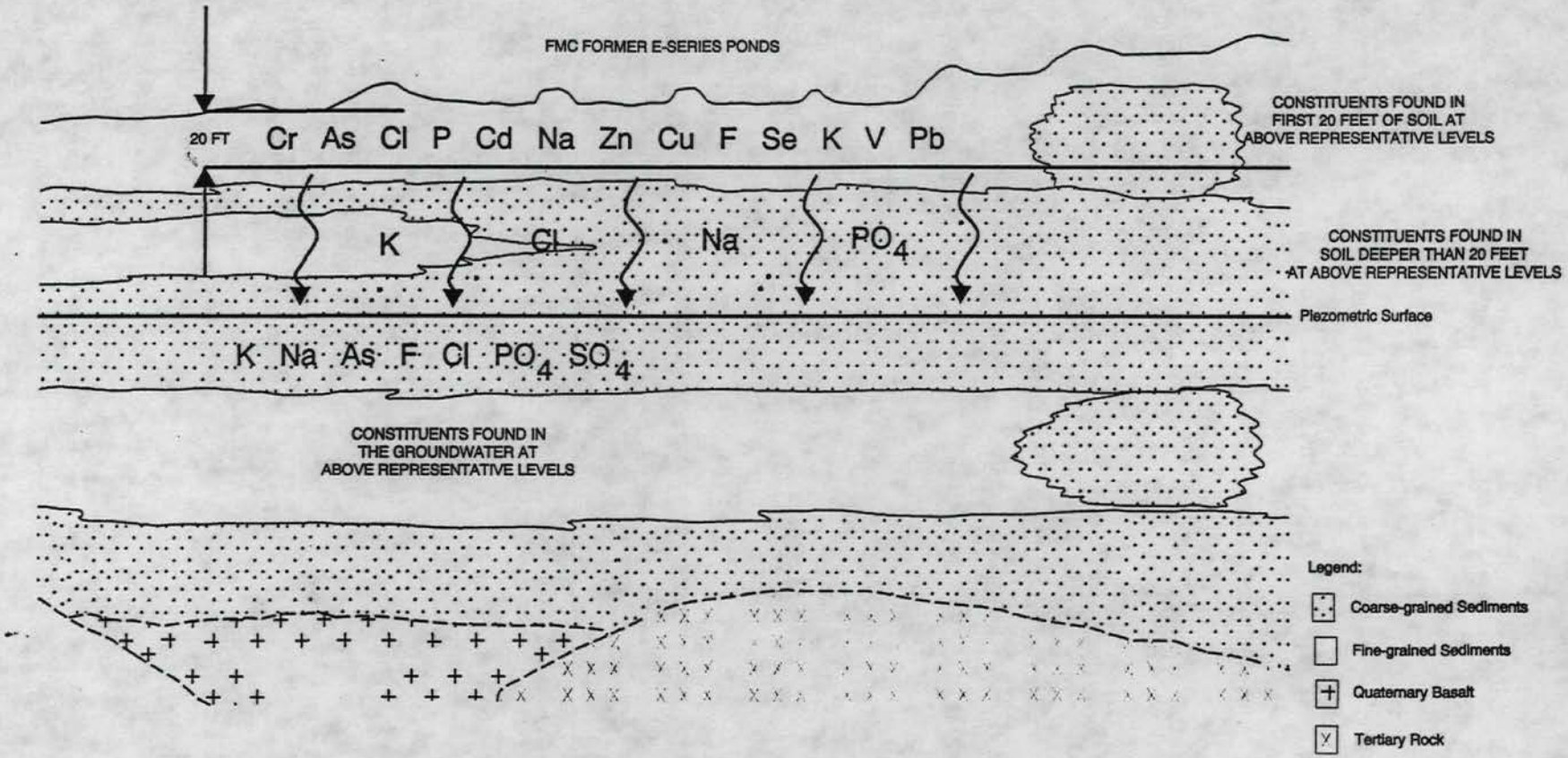
Well Locations for EMF 1990 Field Program

Job Number	Drawing No.	Rev.
21372	FIGURE 1.3-5	



* As of September 1991, ore is transported to the Simplot facility in slurry form. Simplot ore receiving, storage, and handling is no longer a potential source of particulates.

** FMC has submitted a RCRA Part B application to the EPA which addresses management of these units.



BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Conceptual Model of Areas with Sustained Head - FMC

Job Number	Drawing No.	Rev.
21372	FIGURE 1.4-2	

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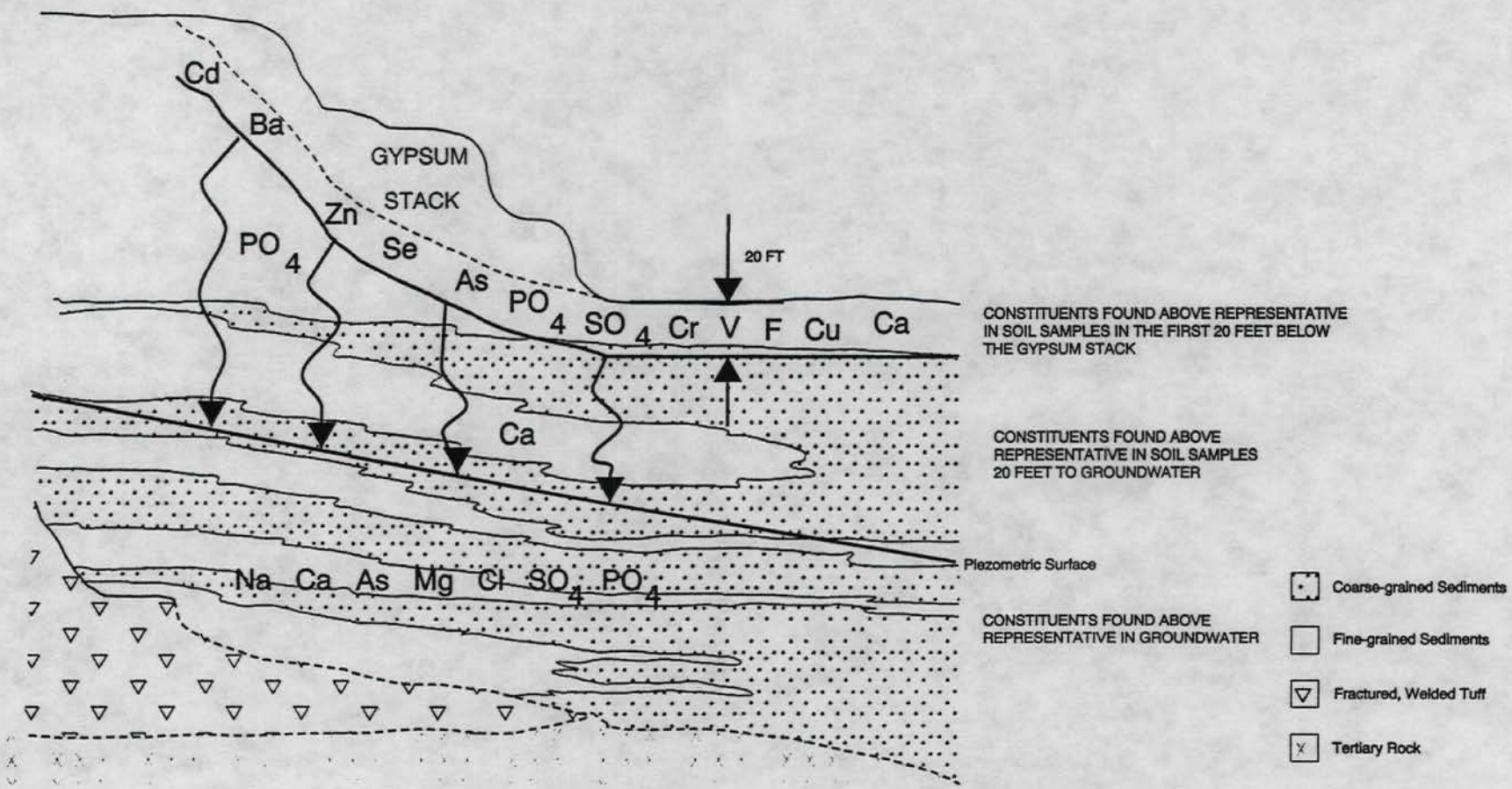

BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

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POCATELLO, IDAHO

Conceptual Model of Areas with Sustained Head - Simplot

Job Number	Drawing No.	Rev.
21372	FIGURE 1.4-3	

Section 2

Study Area Investigations

This section describes the field activities, data collection and management procedures, and analytical methods used during Phase I and Phase II of the Remedial Investigation (RI) conducted in the EMF study area.

During the RI, numerous borings were drilled, samples of various media collected, and relevant data (i.e., field readings) recorded. The RI sampling activities resulted in the generation of large amounts of analytical data. The results of these activities (analytical results and field data) are discussed in detail in Sections 3 and 4.

The information presented in Section 2 is organized in terms of the media investigated. Specifically, data collection activities are discussed as follows:

- Potential source and onsite soil investigations – Section 2.1
- Air pathways investigation – Section 2.2
- Offsite surface soil investigation – Section 2.3
- Hydrogeologic and geologic subsurface investigations – Section 2.4
- Surface water and sediment investigation – Section 2.5
- Investigations of land use and demography – Section 2.6
- Ecological investigation – Section 2.7

For each investigation, the field activity, sampling and analytical methods, sampling procedures, and a brief description of the quality assurance/quality control (QA/QC) documentation are presented. As with all large investigations, there are special cases where protocol was deviated from or where special activities were performed. Such activities are also included in Section 2.

2.1 POTENTIAL SOURCE AND ONSITE SOIL INVESTIGATION

The potential source and onsite soil investigation was conducted to evaluate hypotheses relevant to the conceptual site model presented in the RI/FS Work Plan (Bechtel, 1992a). These hypotheses were developed from knowledge of historic and present product and byproduct handling operations and previous site investigations. The sampling program was developed to investigate areas which historic data and current plant operations indicated were most likely to have been potential sources of releases or where placement of raw materials or byproducts would have occurred. Potential sources at the EMF facilities may be divided into several categories:

- Materials that may have been released to surface waters
- Materials whose release may result in impact on surface or subsurface soils
- Materials whose release may result in groundwater impacts
- Materials and plant activities that may impact the air pathway

Sample collection procedures and the rationale for analytical parameters are described in Section 2.1.1. Materials that may have impacted various media listed above (other than air) are addressed in Section 2.1.2 for the FMC facility and in Section 2.1.3 for the Simplot facility. Materials and plant activities that may have impacted the air pathways are discussed in Section 2.2.

2.1.1 Collection Procedures and Analytical Parameters

The following section describes the documentation, sampling, and decontamination procedures during the Phase I and Phase II potential source and onsite soil investigation. The section also describes the basis for the analytical parameters selected.

2.1.1.1 Quality Assurance/Quality Control

Sample custody procedures were followed through sample collection and transfer to ensure that the integrity of samples was maintained. All samples were collected in accordance with EPA chain-of-custody guidelines as prescribed in EPA National Enforcement Investigation Center (NEIC) Policies and Procedures (EPA, 1984a). Field sampling personnel maintained field log books and chain-of-custody records containing the following information:

- Sample identification numbers
- Sample collection dates and approximate times
- Sample matrix

- Sample location and depth
- Sample appearance
- Sample field measurements (if applicable)
- Sample preservatives (if applicable)
- Type of sampling equipment used
- Type and number of sample containers
- Sampler's name(s)
- Custody seal number(s)

A sample label was affixed to each individual sample collected. The following information was recorded on each label:

- Project name and location
- Project number
- Date
- Time
- Sampler's initials
- Sample identification number
- Analysis required and preservative used

A custody seal, signed and dated, was also affixed to each sample collected. Chain of custody was maintained using a multi-ply version of the chain-of-custody form included in Appendix A of the RI/FS Sampling and Analysis Plan (SAP) (Bechtel, 1992b). These forms accompanied the samples from the field to the laboratory.

2.1.1.2 *Sampling Procedures*

The sampling procedures followed during the potential source and onsite soil investigation are described below for each medium sampled.

Solid and Liquid Material, Surface Water, and Sediment Samples. Samples were collected with stainless steel trowels, shovels, sediment samplers, hand augers, or laboratory-cleaned collection jars. Phossy water and precipitator slurry samples containing elemental phosphorus were sampled from sampling ports by FMC personnel.

Typically, the samples collected were grab samples. However, collection of location- or time-composite samples was occasionally warranted, depending on the nature of

the material that was to be tested. Location-composite samples were collected if the material was largely homogeneous (such as sampling at active surface impoundments). On the other hand, concern with irregularities of material characteristics (such as flow rates combined with chemical composition) resulted in time-composite sampling of the material.

Where collection of location-composite samples was required, samples were obtained from either the four corners or from the centers of the four sides of the unit, in equal amounts. The samples were subsequently composited into one sample following standard protocol.

Time-composite samples consisted of four grab samples taken at the same location at 6-hour intervals within a 24-hour period. These samples were then composited into one sample in accordance with standard protocol.

Shallow and Road Soil Samples. Shallow soil samples were collected using stainless steel garden trowels, shovels, or hand-driven augers, or with a hollow-stem auger rig with a modified California split-spoon sampler. Samples were collected from the soil surface at a depth of approximately zero to 2 inches* below asphalt, gravel, or road base, and at a depth of 2 feet* below ground surface, if possible. Each sample was obtained with properly decontaminated equipment and transferred into a precleaned widemouthed glass jar.

Subsurface Soil Samples. Subsurface soil samples were collected in selected areas for chemical analysis as part of the geologic subsurface investigation (as described in Section 2.4), using the dual-wall percussion/hammer or rotary drilling method as applicable. The methods used during subsurface soil sampling were identified on geologic boring logs maintained during drilling activities. Details of the sample, such as color, lithology, texture, bedding, cementation, grain size distribution, structure, consistency, density, and moisture were also recorded on a geologic log form. (See Appendix A of the RI/FS SAP for sample form [Bechtel, 1992b].)

Subsurface soil samples were collected at one of two alternative depth locations: (a) sampling to 10 feet below fill or (b) sampling to groundwater or bedrock (i.e., refusal). The criterion used for selecting the depth location was the presence of a hydraulic driving force at the area. Specifically, if the area to be drilled was known to have had an applied hydraulic head in the past (such as former ponds) or was observed to contain liquid materials at the time of sampling, the area (or vicinity) was sampled to groundwater or to refusal. Samples were collected to 10 feet in areas not subject to applied hydraulic head other than natural precipitation.

The subsurface samples were collected in brass liners using a modified California sampler. The soil sample was obtained with properly decontaminated equipment

* To convert inches to centimeters, multiply by 2.54; to convert feet to meters, divide by 0.304.

and transferred into a precleaned widemouthed glass jar as described in Section 2.1.1.3.

2.1.1.3 *Decontamination of Sampling Equipment*

All equipment that came into contact with potentially contaminated soil, drilling fluids, or water was decontaminated. Sampling equipment was either cleaned at the drilling or sample location, or was steam-cleaned along with other equipment at the decontamination station. Trowels and samplers were steam-cleaned or washed with a nonphosphate detergent scrub, followed by fresh water and deionized water rinses. Equipment was decontaminated over plastic sheeting or other containment, and clean equipment was stored on plastic sheeting or packaged in plastic bags.

Containerized decontamination fluids were transferred to FMC's and Simplot's ponds, as appropriate.

2.1.1.4 *Analytical Parameters*

The list of selected analytes for each medium (i.e., solid and liquid materials, soils, surface water, and sediments) was developed through consideration of the following factors:

- Characteristics of the phosphate-bearing ore processed by the two facilities—Principle constituents of potential concern present in the ores are metals and other inorganics, and radionuclides.
- Historical data previously collected by FMC—FMC had tested some of its waste streams for the presence of RCRA-regulated constituents, when the plant became subject to RCRA in 1990. Therefore, Phase I analytes for these waste streams consisted only of parameters not previously tested.
- Preliminary list of constituents provided by the EPA in its Data Needs Document (Ecology & Environment, 1991)—This list was incorporated directly into the Phase I RI parameters list, with the following exceptions: asbestos, silica, rubidium, and certain radionuclides.
- Potential of parameters to migrate from a potential source via a given pathway to a given environmental medium.

The analyte lists for the different media were essentially the same, with the exception of parameters that were specific only to a particular media (e.g., water quality parameters on water samples only; total organic carbon on sediment samples only; and dissolved oxygen on surface water samples only). For Phase II, potassium and sulfates were added to the analytical parameter list, as indicated in the following sections.

2.1.1.5 *Data Management*

Data from field observations and environmental sample analysis are stored in a database designed to comply with the EPA Region 10 monitoring data-handling requirements. Separate files within the database store information on the sampling locations, groundwater elevation, information about analytes, and sample analysis results. The tables contain keys and indexes that allow the various files to be used relationally.

Sample analysis results for individual sample matrices such as groundwater, surface water, potential source, offsite soils, and vegetation sampling are stored in separate tables. Results of radiological analyses for each matrix are stored in separate files. Each record of an analysis contains a field indicating the level of validation and a data qualifier as appropriate. Field measurements, such as temperature, are stored in the sample analysis results tables; field data were not validated.

Analytical results were reviewed for accuracy prior to incorporation into the database. All data were reviewed for transcription errors as well as contract compliance screening, and for consistency with other data obtained from the site. Where inconsistencies were found, the affected data were subjected to full Data Quality Objectives (DQO) Level IV validation (review of chain of custody, analysis laboratory notes, calculations, instrument printouts, and calibration information) to determine the quality of the data. Where the data were consistent with other site data, 10 percent of the sample delivery groups were subjected to full validation. Data issues raised by consistency checks and data validation were tracked. All changes to data made after loading the data transmittal from the laboratory were tracked. A complete description of the database may be found in "RI/FS Data Dictionary for the Eastern Michaud Flats Site" (Bechtel, 1993a).

2.1.2 FMC Areas of Investigation

Potential release sources (including areas that may have been potential sources in the past) at the FMC facility are listed in Table 2.1-1 (taken from the EMF Sampling and Analysis Plan – Addendum, June 1992) and are shown in Figures 2.1-1 and 2.1-2. Table 2.1-1 also provides the sampling rationale, media sampled, sample depths, number of locations, sample intervals, and analytes tested at each area of the FMC facility. Sample identification numbers of the Phase I and Phase II samples collected during the investigation are included in this table.

2.1.2.1 *FMC Process Sources*

This section describes potential release sources from the FMC processes.

Phosphate Ore. Phosphate ore, the primary raw material for the production of elemental phosphorus at the FMC facility, is the material from which metals,

radionuclides, and other trace elements found in FMC wastes are originally derived. Consequently, a composite sample of the ore (FOSFPO01) was collected with a hand trowel from the southern ore pile, as shown in Figure 2.1-2. The sample was analyzed for the inorganic and radiological parameters specified in Table 2.1-2 to confirm the appropriateness of the analytical parameter list.

Wastewater and Byproducts. FMC wastewater and byproduct streams that were discharged to active units, such as ponds, were sampled and analyzed. These were as follows:

- Water in the railroad swale (FWWRRS01, location-composite) from stormwater runoff
- Water discharged to the calciner ponds (FSWCPW01, time-composite) from plant operations
- Industrial wastewater (IWW) ditch discharge to the Portneuf River (FSWIWW01) from industrial wastewater
- Phossy water discharged to the lined Phase IV ponds (Ponds 11S through 14S) and indirectly to Ponds 15S and 8S (FSWPWSIV, time-composite)
- Precipitator slurry discharged to the lined Ponds 8E and 9E (FSWPS88E, time-composite)

All samples, except those containing elemental phosphorus, were collected using laboratory sample containers. Samples containing elemental phosphorus were collected in a metal bucket for safety considerations and subsequently transferred into glass sample containers. Field parameters for the above samples are presented in Table 2.1-3.

Based on the findings of the Phase I investigation of the IWW ditch discharge, a more detailed evaluation was conducted as part of Phase II. Fourteen 24-hour composite samples were obtained over a 2-week period; of these, six (representing three highest and three lowest flowrates) were selected for analyses. Analytical parameters for these samples are listed in Table 2.1-4, and include sulfate and potassium. Sample identifiers and field parameters are presented in Table 2.1-5.

Sediments and sludges at the site that came into contact with the waste streams, identified above, were also collected and analyzed. These samples were:

- Railroad swale (FSDRRS01, location-composite)
- Calciner ponds (FSDCPW01, location-composite)
- IWW ditch (FSDIWW01 through FSDIWW05)
- IWW basin (FSDIWW06, location-composite)

- Pond 15S (FWSP1501, location-composite) and Pond 8S (FWS8S01, location composite)
- Pond 9E (FWSP9E01, location-composite)

The following potential sources and byproducts were also sampled:

- Phosphate ore (FOSFPO01, location-composite)
- Slag from storage pile areas (FWSSSA01 through FWSSSA06)
- Ferrophos from storage pile areas (FWSFSA01 through FWSFSA03)

Slag, a byproduct of furnace operations, is stored on the site in large piles south of the plant operations areas. Samples were collected with a hand trowel at six random locations as shown in Figure 2.1-2. Samples were analyzed for the parameters listed in Table 2.1-4, and for toxicity characteristic leachate procedure (TCLP) metals.

Ferrophos is an iron-rich byproduct of furnace operations which is collected in sand molds and stored on the site. Ferrophos samples were collected with a hand trowel at three random locations as shown in Figure 2.1-2. Samples were analyzed for the parameters listed in Table 2.1-2 and for TCLP metals.

All samples collected were analyzed for trace metals, other inorganics (fluoride and phosphorus), radiological parameters, and natural constituents present in the phosphate ore. Water samples were also analyzed for basic water-quality parameters, including major cations and anions. Specific analytical parameters corresponding to FMC wastewaters and byproducts are identified in Tables 2.1-2, 2.1-3, and 2.1-4. Locations of these sample points are shown in Figure 2.1-2.

2.1.2.2 *FMC Onsite Soil*

Onsite soil investigations at the FMC facility were developed on the basis of historical data on types and locations of plant operations byproduct storage, wastewater handling and impoundments, current operations, source materials, byproducts, and wastes, as described in Section 6.1 of the Work Plan (Bechtel, 1992a). The purpose of these investigations was to evaluate areas most likely to have been impacted by raw materials (ore), byproducts, wastes, and wastewaters from former or present facility operations. Investigations of onsite soils focused on these areas. The purpose of these investigations was to identify the extent to which impact may have occurred, and to evaluate these areas as possible secondary sources of consituents of potential concern to the air pathway or the groundwater pathway.

The FMC boring and sample locations identified and discussed below are shown in Figure 2.1-1 unless otherwise stated. All samples were analyzed for the parameters

listed in Table 2.1-2 unless otherwise indicated. Individual descriptions and actual sample depths are provided in Table 2.1-6.

Pond 8S. Pond 8S is an unlined pond containing phossy wastes from previous operations. Two borings (B12, B13) and one well (Well 150) were drilled (April 1992) at the perimeter of the pond area to characterize the soils in the vicinity of the pond. Soil samples were also collected at 10-foot intervals until groundwater was encountered (at approximately 120 feet).

Three additional borings (F124B, F125B, F126B) were also drilled with a hand auger in the fall of 1992. Soil samples were collected at the ground surface and at a depth of 2 feet.

Old Calciner Ponds. The area occupied by the former calciner ponds (Ponds 1C and 2C) is now the site of the existing calciner ponds (Ponds 3C and 4C). A boring (F023B) was drilled south of existing calciner pond 3C. In addition, soil samples were also collected at the ground surface and at 10-foot intervals until the drill rig reached refusal at 72 feet.

Former Pond 4E. Former Pond 4E was located in the same general area as the existing Phase IV ponds. One boring (F024B) was drilled at this location to characterize the soils. Soil samples were also collected at the ground surface and at 10-foot intervals until groundwater was encountered at 76.5 feet.

Former Ponds 5E and 6E. Former Ponds 5E and 6E were located in the same general area as the existing lined pond, 15S. Soils data previously collected at these locations are presented in the FMC Facility Assessment (FFA) (FMC, 1991a). To further characterize the soils in the area of these former ponds, one boring was drilled at the location of each former pond (borings F025B and F026B). Soil samples were collected at the ground surface and at 10-foot intervals until groundwater was encountered at 71.5 feet (Pond 5E) and 61.5 feet (Pond 6E). Sample recovery was hampered at both borings due to the sand and gravel matrix of the soil. Actual sample recovery data are presented in Table 2.1-6.

Active Landfill. The active landfill is located south of the slag pile. Potential impact of the active landfill on the soils in the vadose zone was evaluated by drilling one boring (F027B) in a location downgradient of this landfill. The boring location is shown in Figure 2.1-1. In addition, soil samples were collected at the ground surface and at 10-foot intervals until bedrock was encountered at 140 feet. No groundwater was encountered during the drilling of this boring.

Chemical Laboratory Seepage Pit. The chemical laboratory seepage pit beneath the main parking lot was used for the disposal of organic and inorganic chemical wastes from the laboratory prior to 1980. Two borings were drilled at this area, one south of the seepage pit (F029B) and one to the northeast (F028B). In addition, soil samples

were collected at the ground surface, and at 10-foot intervals until groundwater was encountered at 71.5 feet for both borings. Sample recovery was hampered due to the soil matrix. Actual sample intervals and recoveries are presented in Table 2.1-6.

Industrial Wastewater Basin/Ditch. The IWW basin is used to cool noncontact cooling water. The IWW ditch conveys wastewater from the basin to its discharge point at the Portneuf River. Soils in the area of the IWW basin and ditch were characterized by drilling a boring (F030B) near the outlet to the IWW ditch. Soil samples were also collected at 10-foot intervals until groundwater was encountered at 75 feet.

Boiler Fuel Tank and Pipeline Area. The boiler fuel tanks and pipeline contained fuel oil for operating the boilers. Two borings (B14 and B15) were drilled (in May 1992) in the area of the boiler fuel storage tanks and associated pipeline to a depth of 50 feet. Soil samples were also collected at the ground surface and at 5-foot intervals to a depth of 50 feet in boring B14 and 30 feet in boring B15 due to sample refusal. Samples were analyzed for total petroleum hydrocarbons (TPH), as well as the parameters listed in Table 2.1-2.

Former Pond 1E. Former Pond 1E was located in the same general area as the existing lined Ponds 8E and 11S. One boring (F033B) was drilled in the location of this former pond to characterize the soils in the area. Soil samples were also collected from below the pond fill (at 4.5 feet) and at 5-foot intervals to a depth of 15 feet below fill.

Area 9S. Area 9S was a storage pile for dried precipitator dust, and has not been in use since July 1990. One boring (F034B) was drilled in the location of this former pond. Soil samples were collected at the ground surface and at 5-foot intervals to a depth of 15 feet below fill.

Old Precipitator Slurry Ponds (Ponds 00S, 0S, 1S through 7S, 9S and 10S). As discussed in the RI/FS Work Plan, these ponds are inactive and the residual materials remaining at their former locations are likely to contain buried pockets of elemental phosphorus that could be exposed should these ponds be investigated.

These ponds were very similar in nature to Pond 8S, which is currently in the process of being closed under RCRA regulation. Methods of investigation and chemical analysis were developed that would provide safe sample collection and handling, and representative analytical results. However, even with the special conditions, this work was considered very hazardous, both in the field and the laboratory, and it is also extremely expensive.

Because all of the former unlined ponds were managed in the same general manner as Pond 8S, the effects in the subsurface should be similar. Therefore, it was proposed that the analysis of subsurface conditions done for Pond 8S be considered

representative of subsurface conditions at all of these former precipitator slurry pond locations.

As discussed under Area 9S above, Pond 9S has been excavated, and no longer contains waste.

Pond 10S was constructed with a single liner. There is no indication that the pond liner has been breached. Also, material that was placed in Pond 10S, although chemically similar to the other ponds, had a much lower water content, reducing the amount of fluid in the pond that could have entered the subsurface should a leak occur. As with currently active lined ponds, drilling within the pond area was not done so that the integrity of the liner would not be compromised.

To evaluate the effects of these ponds further, estimates were made of the volume of material placed in each pond. These estimates were made on the basis of the size of the pond, the duration of pond operation, and the production rates of the facility during that time period. These estimates will be provided under separate cover.

Old Phossy Water Ponds 2E, 3E, and 7E. As discussed in the RI/FS Work Plan, these ponds are inactive. The sediments from Pond 2E were excavated and placed in Pond 4E prior to construction of Pond 8E on this site. The sediments in Pond 3E were also excavated prior to the construction of the Phase IV ponds on this site. Pond 7E was dried in 1981.

All three of these former unlined ponds were managed in the same general manner as Pond 8S, and the subsurface effects should be similar. Therefore, it was proposed that the analysis of subsurface conditions conducted for Pond 8S be considered representative of subsurface conditions at all of these former phossy water pond locations.

To evaluate the effects of these ponds further, estimates were made of the volume of material placed in each pond. These estimates were made on the basis of the size of the pond, the duration of pond operation, and the production rates of the facility during that time period.

Transformer Salvage Area. The transformer salvage area, located near inactive Pond 1S, was a storage area for used transformers. Two borings (F035B and F036B) were drilled in the area to evaluate existing soil conditions. Soil samples were collected below the road surface and at 2.5-foot intervals to a depth of 10 feet below fill. Samples were analyzed for PCBs and the parameters indicated in Table 2.1-2.

The surface soils of F035B were resampled for PCBs during Phase II to assist in validating Phase I results.

Waste Oil Storage Area. A drum storage area (for management of drummed heavy lube oil, sludges, and transformer oil) overlies old Pond 2S. Two borings (F037B and F038B) were drilled in the location of the waste oil storage area to evaluate existing soil conditions. Soil samples were attempted below the fill (gravel/slag) and at 2.5-foot intervals to a depth of 10 feet below fill. Elemental phosphorus was encountered at multiple locations, and the borings were abandoned with one sample obtained. This sample was analyzed for PCBs and TPH, as well as the parameters indicated in Table 2.1-2.

Railroad Swale. The railroad swale is a ditch running along the railroad tracks at the north edge of the facility. This ditch receives stormwater runoff from the FMC property. The soils in this area were evaluated by drilling four borings (F039B, F040B, F041B, F042B) to a depth of 10 feet. Elemental phosphorus was encountered during drilling in one boring (F040B) in multiple locations; the boring was abandoned with two samples obtained. Soil samples were collected below fill (gravel/slag), at the ground surface, and at 2.5-foot intervals to a depth of 10 feet below fill. Sample recovery was hampered due to the soil matrix. Actual sample intervals and recoveries are presented in Table 2.1-6.

As a result of Phase I sampling, one additional boring (F131B) was drilled during the Phase II investigation in the summer of 1993. This boring was drilled to groundwater, and was placed near boring F040B. Soil samples were taken at 10-foot intervals below the fill starting at 20 feet. Sample recovery was hampered on many samples due to the soil matrix. The last attempt to collect a soil sample was in the saturated zone at 80 feet with no recovery. No groundwater sample was obtained due to silty conditions, making it impractical to field filter the sample with available equipment. Actual sample intervals and recoveries are presented in Table 2.1-6. Soil samples were analyzed for metals, general minerals, and radiological parameters as specified in Table 2.1-2, plus sulfate and potassium.

PCB Storage Shed. The PCB storage shed was used to store drums of transformer oil with concentrations of PCBs in excess of 50 ppm prior to offsite treatment/disposal. The soils in this area were evaluated by drilling three borings (F043B, F044B, F045B) to a depth of 10 feet below fill. Soil samples were collected below fill (gravel/slag) at the ground surface and at 2.5-foot intervals to a depth of 10 feet below fill. Samples were analyzed for PCBs, as well as the parameters listed in Table 2.1-2.

Septic Tank Areas. At the FMC plant, septic tanks and drainfields are used for disposal of sanitary sewage. Until 1991, two large drainfields served the main change house. There are also eight drainfields for the main plant. Four borings (F046B, F047B, F048B, F049B) were drilled in the drainfields to evaluate existing soil conditions. Soil samples were collected at the ground surface and at 2.5-foot intervals to a depth of 10 feet below fill. Sample recovery was hampered in boring F046B due to the soil matrix. Only three of the five samples were obtained. Actual

sample intervals and recoveries are presented in Table 2.1-6. Samples were analyzed for nitrates, as well as the parameters listed in Table 2.1-2.

Calciner Pond Sediment Areas. These areas manage calciner sludge and soil extracted from the old calciner ponds, and treated calciner pond sludge from the existing calciner Pond 1C. Two borings (F050B, F051B) were drilled in these areas to evaluate existing soil conditions. Soil samples were collected at the ground surface and at 2.5-foot intervals to a depth of 10 feet below fill.

Based on the findings of the Phase I investigation, one additional boring (F127B) was drilled for Phase II. This boring was placed near F051B, and was advanced into rock at 38 feet. The boring was sampled at 10-foot intervals starting at the ground surface. Soils were analyzed for metals, general minerals, and radiological parameters, as specified in Table 2.1-2, plus sulfate and potassium.

Secondary Condenser/Fluid Bed Drier. The fluid bed drier was used in the early 1980s to dry and oxidize precipitator slurry to remove elemental phosphorus. The area is now occupied by the secondary condenser. Soils in this area were evaluated by drilling two borings (F052B, F053B). Soil samples were collected at the ground surface and at 2.5-foot intervals to a depth of 10 feet below fill.

Kiln Scrubber and Overflow Pond. Three kiln scrubber ponds, formerly located under existing calciner 2, and one overflow pond located under the existing calciner fines pile, were used to manage kiln scrubber blowdown in the past. One boring (F054B) was drilled in the vicinity of the former overflow pond so that soils in this area could be evaluated. Soil samples were collected below fill (gravel/slag) at the ground surface and at 2.5-foot intervals to a depth of 10 feet below fill.

Based on the Phase I investigation results, one additional boring (F130B) was drilled for Phase II. This boring was placed near boring F054B, and was advanced to groundwater at 90 feet. The boring was sampled at 10-foot intervals starting at the ground surface below fill. The last soil sample was taken in the saturated zone. Soils were analyzed for metals, general minerals, and radiological parameters as specified in Table 2.1-2, plus sulfate and potassium.

Former Pond 7S Tree-Line Area. Former Pond 7S has been removed from service and currently serves as a storage area for ferrophos. Three borings (F055B, F056B, F057B) were drilled in the this area to evaluate existing soil conditions. Soil samples were collected at the ground surface and at a depth of 2 feet below fill (gravel/slag). Samples were analyzed for PCBs as well as the parameters indicated in Table 2.1-2.

Borings F056 and F057 were resampled for PCBs during Phase II to validate Phase I results.

8S Recovery Process. The 8S recovery process was built in 1983 to recover elemental phosphorus from Pond 8S; the unit was dismantled in 1993 in accordance with the 8S Closure Plan. Two borings (F058B, F059B) were drilled in this area to evaluate existing soil conditions. Soil samples were collected below fill (gravel/slag) at the ground surface and at a depth of 2 feet below fill. Sample recovery was hampered on boring F059B due to the soil matrix. Actual sample intervals and recoveries are presented in Table 2.1-6. Samples were analyzed for PCBs and TPH, as well as the parameters indicated in Table 2.1-2. Borings F060B and F061B were resampled during Phase II to verify Phase I results.

Area West of Mobile Shop. The area west of the mobile shop was used to store and maintain equipment, fuel, motor oil, and lubricants. Samples were collected at two locations (F060B, F061B). Samples from both locations were collected at the ground surface and at a depth of 2 feet below fill. They were analyzed for PCBs and TPH, as well as the parameters listed in Table 2.1-2.

Long-Term Phosphorus Storage Tanks. FMC uses several tanks to store elemental phosphorus on the south side of a railroad spur west of the furnace building. Soils in this area were evaluated by sampling at two locations (F062B, F063B). Soil samples were collected below the fill (gravel/slag) at the ground surface and at a depth of 2 feet below fill. They were analyzed for the parameters indicated in Table 2.1-2.

Phos Dock Area (Paved). The phos dock area manages elemental phosphorus. Historically, this area has been reported to be the site of spills. Surface samples were collected in one location (F064B). Although a second location (F065B) was planned, it was physically inaccessible.

Paved Area between Phos Dock and Furnace Building. The elemental phosphorus is loaded into rail cars in the area between the phos dock and the furnace building. Surface samples were collected in four locations (F066B, F067B, F068B, F069B). Soil samples were collected at the soil surface (i.e., below pavement, road base, or slag where they exist) and at a depth of 2 feet below fill.

Phossy Waste Pipeline and Precipitator Slurry Pipeline Cleanouts. Phossy waste is transferred via pipelines to the lined Phase IV ponds. Because of the high solids content and the physical state of the elemental phosphorus, cleanout taps are located along the pipelines at locations where solids may tend to accumulate, such as where the pipelines bend or change direction. Soils in the pipeline cleanout areas were evaluated by sampling at 10 locations (F070B through F079B). Soil samples were collected at the soil surface (i.e., below pavement, road base, or slag where they exist) and at a depth of 2 feet below fill.

Bannock Paving Company Areas. The Bannock Paving Company leases land from FMC in the northcentral portion of the FMC property. Slag, coke, and other

materials are stored throughout the leased property. Soil samples were collected at five locations (F080B through F084B) throughout the leased property. At each location, samples were collected at the soil surface (i.e., below pavement, road base, or slag where they exist) and at a depth of 2 feet below fill. Samples were analyzed for TPH and PCBs, as well as the parameters listed in Table 2.1-2.

Railcar Loading and Unloading Areas. These areas are used for the unloading of shale ore and coke, and the loading of elemental phosphorus product, crushed ferrophos, and slag. Soil samples were collected at six locations (F083B, F084B, F088B, F089B, F093B, F094B). Borings F089B, F093B, and F094B, located within shale ore handling areas, are discussed below to minimize repetition. At each sample location, samples were collected at the soil surface (i.e., below pavement, road base, or slag where they exist) and at a depth of 2 feet below fill. Samples were analyzed for TPH and PCBs as well as the parameters listed in Table 2.1-2. Boring F084B was resampled for PCBs during Phase II to validate Phase I results.

Shale Ore Handling Areas. Ore received at FMC is unloaded into a below-ground hopper and added to an existing stockpile; it is subsequently processed along with silica and coke. Soil samples were collected at six locations (F089B through F094B) at these areas. At each location, samples were collected at the soil surface (i.e., below pavement, road base, or slag where they exist) and at a depth of 2 feet below fill. Samples were analyzed for TPH and PCBs, as well as the parameters listed in Table 2.1-4. Sample recovery was hampered at boring F089B due to the soil matrix. Actual sample intervals and recoveries are presented in Table 2.1-6.

Based on the findings of the Phase I investigation, one additional boring, F132B, was drilled for Phase II. This boring was placed near F090B and was advanced to 10 feet below fill. The boring was sampled at 2.5-foot intervals starting at the ground surface. The soil was analyzed for metals, general minerals, and radiological parameters, plus sulfate and potassium (see Table 2.1-2).

Surface Roads. There are over 15 miles (24 km) of surface roads within the FMC facility property. Soil samples were collected at approximately 20 locations (F101R through F113R, F114R, F115R, F119R through F123R) throughout the facility. At each location, samples were collected at the soil surface (i.e., below pavement or slag where they exist) and at a depth of 2 feet below fill. Samples were analyzed for TPH and PCBs, as well as the parameters listed in Table 2.1-2

During Phase I, borings were drilled at several locations along the plant roads to examine the areas where past spills may have occurred, where oils which may have contained PCBs might have been applied for dust control, and to evaluate the leaching which may have occurred from byproducts used as fill and applied to the road areas. Based on the Phase I findings, one additional boring (F129B) was drilled during Phase II. This boring was placed near F112R, and was advanced to a depth of 25 feet. The boring was sampled at 2.5-foot intervals starting at the soil surface (i.e.,

below pavement, road base, or slag where they exist). Soils were analyzed for metals, general minerals, and radiological parameters, as specified in Table 2.1-2, plus sulfate and potassium. Additional selected locations were resampled for PCBs during Phase II to validate Phase I results; sample identifiers are presented in Table 2.1-6.

2.1.3 Simplot Areas of Investigation

Potential release sources and areas that might have been potential sources in the past which were investigated at the Simplot facility are listed in Table 2.1-7 and shown in Figures 2.1-3 and 2.1-4. These areas have been separated into two groupings: process sources and onsite soils. Discussions of these two groupings are presented in the following sections. Table 2.1-7 also provides the sampling rationale, sample depths, number of locations, location references, sample intervals, and analytes for each area.

2.1.3.1 Simplot Process Sources

Phosphate Ore. Phosphate ore, the primary ingredient in the production of phosphoric acid at the Simplot facility, is the material from which trace metals, radionuclides, and other inorganic constituents found in Simplot wastes are originally derived. Consequently, a composite sample of the ore slurry (S3040R1) was collected and dried. The solid portion of the sample was analyzed for the parameters in Table 2.1-2 to confirm the appropriateness of the analytical parameter list. The sample location is shown in Figure 2.1-4.

Wastewater. Wastewater streams at the Simplot facility discharged to active units, such as ponds, were collected and analyzed. These streams are:

- Wastewater discharged to the water treatment ponds (SWWWP101, SWWWP201, SWWWP301, time-composite samples)
- Former east overflow pond water (SWWEOP01, time-composite sample)
- Gypsum slurry discharged to the gypsum stacks (S304GP1, SGSFEF01)

Twenty-four-hour time-composite samples were collected with sample jars from the first two process streams to confirm historical data on the content of these streams. The solid portion of the gypsum slurry sample (S304GP1) was composited over a 1-month period and dried prior to analysis. The liquid portion of the gypsum slurry sample composite (SGSFEF01) was a 24-hour composite that was filtered, and the filtrate was submitted for analysis. Field parameters for the above samples are presented in Table 2.1-8.

A composite sediment/sludge sample was collected with a dredge sampler from each of Simplot's ponds—the former east overflow pond (SSDEOP01) and the three water treatment ponds (SSDWP101, SSDWP201, SSDWP203)—and from the dewatering pit (SSDDWP01).

Irrigation Water. To characterize the Simplot water treatment pond effluent, a location composite sample (SSWIRR01) of the effluent was analyzed for the parameters listed in Table 2.1-4. The sample location is shown in Figure 2.1-4.

2.1.3.2 *Simplot Onsite Soil*

Boring locations are shown in Figure 2.1-3. Samples were analyzed for the parameters listed in Table 2.1-2. Generalized individual sample descriptions and actual sample depths are shown in Table 2.1-9.

Gypsum Stacks. In addition to analysis of the gypsum slurry as described in Section 2.1.3.1, soil beneath the gypsum stacks was also characterized. Two borings (S001B, S002B) were drilled through the top of the northernmost (lower) gypsum stack to groundwater at 146 to 136 feet, respectively. Four borings (S003B through S006B) were drilled through the top or north face of the southernmost (upper) gypsum stack to groundwater ranging from 155 to 220 feet. Soil samples were collected at 10-foot intervals beginning at the interface between the gypsum and native soil. Sample recovery was occasionally hampered by the soil matrix. Actual sample intervals and recoveries are presented in Table 2.1-9.

Settling Pond. The settling pond was at one time approximately twice its current size, occupying its current location and the area immediately to the east. For this reason, boring S007B was drilled to groundwater immediately east of the current pond as a substitute for sampling soils beneath the active pond. Because the water transferred to the settling pond is of essentially the same quality as water transferred to the holding pond, and of poorer quality than water that enters the equalization pond, soil samples collected in this boring should provide a relatively conservative estimate of any release to the soil that may have occurred as a result of leakage from the three ponds. Samples were collected at the surface and at 10-foot intervals thereafter. The last sample, in the saturated zone at 26 feet, was taken from the boring cuttings. This was necessary because no recovery was obtained with the split spoon due to the large amount of gravel at this depth.

Unlined Ditch to Water Treatment Ponds. To evaluate existing soil conditions at the unlined drainage ditch, soil was sampled with a hand auger at six locations along the ditch (SSSUDP01 through SSSUDP06) as indicated in Figure 2.1-4. At each location, samples were collected at the bottom of the ditch and approximately 2 feet below the ditch bottom (SBSUDP01 through SBSUDP06). The samples were analyzed for the parameters indicated in Table 2.1-2. These sample points were

subsequently resampled (SSSODP01 through SSSODP06, and SBSODP01 through SBSODP03) for mercury during Phase II.

Based on Phase I findings, one boring (S097B) was drilled during Phase II (between SSSUDP03 and SSSUDP05), and advanced to groundwater at 25 feet. The boring was sampled at 5-foot intervals, starting at the surface, to 25 feet. In addition, a grab groundwater sample was also obtained. Soil and groundwater samples were analyzed for the parameters specified in Tables 2.1-2 and 2.1-10, plus sulfate and potassium.

The wastewater, soil, and sediment/sludge samples were analyzed for inorganics and radioactivity, natural constituents, or characteristics of the phosphate ore. Water samples were also analyzed for basic water quality parameters including major cations and anions. Locations of these sample points are shown in Figure 2.1-4. Specific analytical parameters for the samples collected are included in Tables 2.1-2 and 2.1-3.

Dewatering Pit. To evaluate subsurface soils underlying the dewatering pit, soil boring S008B was drilled from the bottom of the pit to groundwater at 26 feet. A soil sample was collected at the interface between pond sludges and native soil and every 10 feet thereafter.

Former Pillow Tank Area. Until 1991, Simplot stored phosphoric acid and UAN-32 (urea and ammonium nitrate) products in thirteen 200,000-gallon pillow, or hypalon, tanks in a series of cells carved out of native soils to a depth of approximately 8 feet. To assess the extent of any releases to the soil, two borings (S010B, S011B) were drilled through the former pillow tank area. Samples were collected at the bottom of the cells to a depth of approximately 10 feet, at intervals of approximately 2.5 feet.

Loadout Areas. The loadout areas fall into three categories: ammonium phosphate loadout area; ammonium sulfate and triple superphosphate loadout areas; and phosphoric acid and sulfuric acid loading areas. Sampling of soils in these areas was conducted to assess the potential impact of constituents resulting from loadout activities on, and known spills soils.

Ammonium Phosphate Areas. Soil samples were collected in the truck-loading and railcar-loading areas. Given the absence of any driving force other than natural precipitation for the movement of the solid products and their trace constituents through the soils, samples were only collected immediately below the paved surface and at a depth approximately 2 feet below the interface of pavement and soil during Phase I.

There are two ammonium phosphate loadout areas: sample borings taken from each location (S030B through S033B and S038 through S041B) are shown in Figure

2.1-3. One proposed boring (S039B) could not be completed because the location was physically inaccessible. Sample recovery was occasionally hampered by the presence of gravel, cobbles, or boulders. Actual sample intervals and recoveries are presented in Table 2.1-9.

During Phase I, refusal was encountered at 1.5 feet for borings S030B and S031B in the vicinity of the No. 1 ammonium phosphate plant. The materials encountered were composed of fills; to determine the depth of these fill materials and to evaluate impact on subsurface soils, boring S107B was drilled during Phase II near boring S033B. Boring S107B was advanced to 10 feet and soil samples were taken at 2.5-foot intervals starting at the ground surface below the pavement. The soils were analyzed for metals, general minerals, and radioactivity parameters, as specified in Table 2.1-2, plus sulfate and potassium.

The materials encountered in the vicinity of the No. 2 ammonium phosphate plant during Phase I were also composed of fills. Boring S108B was drilled near boring S044B during Phase II. This boring was advanced to 10 feet and sampled at 2.5-foot intervals starting at the ground surface below pavement. The soils were analyzed for metals, general minerals, and radiological parameters, as specified in Table 2.1-2, plus sulfate and potassium.

In addition to sampling in the ammonium phosphate loadout areas, samples were collected at four locations along the north sides of each of the ammonium phosphate storage buildings (borings S034B through S037B and S042B through S045B). Front-end loaders move along the north sides of these buildings carrying reclaim product from the ammonium phosphate production areas, losing some product along the way. These areas are also paved. Samples were collected along the north sides of the two buildings immediately below the pavement and at a depth of approximately 2 feet. Approximate sample locations are shown in Figure 2.1-3. Sample recovery was occasionally hampered by the presence of gravel, cobbles, or boulders. Actual sample intervals and recoveries are presented in Table 2.1-9.

During Phase I, refusal was encountered in the vicinity of the No. 1 ammonium phosphate plant loading area. The materials encountered were composed of fills; boring S106B was drilled near boring S035B during Phase II. Boring S016B was advanced to 10 feet and soil samples were taken at 2.5-foot intervals starting at the ground surface below the pavement. The soils were analyzed for metals, general minerals, and radiological parameters, as specified in Table 2.1-2, plus sulfate and potassium.

Ammonium Sulfate and Triple Superphosphate Areas. Soil samples were collected in the truck-loading and railcar-loading areas. Given the absence of any driving force other than natural precipitation for the movement of the solid products and their trace constituents through the soils, samples were only collected immediately below the paved surface and at a depth approximately 2 feet below the

interface of pavement and soil. Boring locations for samples collected at the sulfate and triple superphosphate loadout areas (S046B through S049B and S050B through S053B, respectively) are shown in Figure 2.1-3. Sample recovery was occasionally hampered by the presence of gravel, cobbles, or boulders. Actual sample intervals and recoveries are presented in Table 2.1-9.

The materials encountered during Phase I sampling at the ammonium sulfate plant were composed of fill. To determine the depth of these fill materials and to evaluate subsurface soil conditions, one boring, S109B, was placed near S048B during Phase II. It was advanced to 20 feet below the ground surface. The boring was sampled at 2.5-foot intervals starting at the ground surface. The soils were analyzed for metals, general minerals, and radiological parameters, as specified in Table 2.1-2, plus sulfate and potassium.

The materials encountered on the south side of the triple superphosphate building (sample borings S050B through S053B) during Phase I were composed of fill. A 10-foot boring (S098B) was subsequently placed near boring S052B during Phase II. The boring was sampled at 2.5-foot intervals starting at the soil surface below the pavement. The soils were analyzed for metals, general minerals, and radiological parameters, as specified in Table 2.1-2, plus sulfate and potassium.

Phosphoric Acid and Sulfuric Acid Areas. Two of the liquids produced by Simplot are phosphoric acid and sulfuric acid. As with the solid loadout areas, loadout areas for these two liquid products are paved. Borings advanced at the loadout areas are indicated in Figure 2.1-3 (borings S066B and S067B and S058B through S061B, respectively) along with the boring location in the former phosphoric acid loading area, more recently used for railcar-cleaning (S056B, S057B). Proposed boring S057B was not advanced because of physical access restrictions.

Soil sampling in these areas was extended to a depth of 10 feet below fill because of the liquid nature of the materials managed in these areas. Soil samples were collected immediately below any paved surface and at 2.5-foot intervals thereafter. Borings S060B, S061B, S066B, and S067B reached refusal at 5, 8, 4, and 2.5 feet respectively, due to drilling conditions. Actual sample intervals and recoveries are presented in Table 2.1-9.

Two 10-foot borings (S066B and S067B) were planned in the vicinity of the phosphoric acid loading dock during Phase I. Auger refusal was encountered at 6.5 feet in boring S066B and at 2 feet in S067B; no samples were obtained at these depths. The materials encountered during the drilling were fill. Another boring, S105B, was therefore drilled in the vicinity of boring S067B during Phase II. This boring was advanced to 15 feet, and soil samples were taken at 2.5-foot intervals starting at the surface below the pavement. The soils were analyzed for metals, general minerals, and radiological parameters, as specified in Table 2.1-2, plus sulfate and potassium.

Auger refusal in the vicinity of the former phosphoric acid railcar-cleaning area also occurred at 2 feet, and only one sample was collected during Phase I. The sample was in a silt and gravel fill. Based on Phase I findings, boring S103 was attempted during Phase II, using a different drilling method. This boring was advanced to 9 feet where refusal was met. Soil samples were taken at 2.5-foot intervals starting at the surface. The soils were analyzed for metals, general minerals, and radiological parameters, as specified in Table 2.1-2, plus sulfate and potassium.

Former Sulfuric Acid Plants. Soils were sampled at the former No. 1 and No. 2 sulfuric plants (borings S062B through S065B), as shown in Figure 2.1-3. Using the same rationale provided for borings in the loadout areas, borings were drilled at each of the locations in the former sulfuric plants areas to a depth of 10 feet below fill. At each location, samples were collected at the soil surface and at 2.5-foot intervals thereafter. Borings in this area reached refusal due to drilling conditions before reaching the desired completion depth. Actual sample intervals and recoveries are presented in Table 2.1-9.

Auger refusal in the vicinity of the former No. 1 sulfuric acid plant was encountered at 8 feet in S063B and at 10 feet in S062B; no samples were obtained at these depths during Phase I. The materials encountered during the drilling were fills. Another boring, S104B, was attempted in the vicinity of boring S062B during Phase II. This boring was advanced to 25 feet and soil sample were taken at 5-foot intervals starting at the surface. The soils were analyzed for metals, general minerals, and radiological parameters, as specified in Table 2.1-2, plus sulfate and potassium.

Phosphoric Acid Containment. The phosphoric acid containment area receives leakage from phosphoric acid tanks or pipes within the containment; the spilled material flows over the paved surface to a concrete sump, from where it is pumped back to the phosphoric acid reactor or filter. Soil was sampled at two locations (borings S054B and S055B) in this area. Using the same rationale provided for the phosphoric and sulfuric acid loadout areas, a boring was drilled at both locations to depths of 10 feet. A sample was collected immediately beneath the pavement and at 2.5-foot intervals thereafter. Borings S054B and S055B did not reach their target depth due to drilling conditions or sample refusal at 2.5 and 7 feet, respectively. Actual sample intervals and recoveries are presented in Table 2.1-9.

Cooling Tower and Former Cooling Pond Area. Saturation of soils occurs in the vicinity of Simplot's cooling towers owing to spray or condensation of reclaim water from the towers. Soils were sampled in the vicinity of the towers and in the area of the former pond at the locations (S068B through S071B) indicated in Figure 2.1-3 to assess the presence of constituents of potential concern.

Sample recovery was occasionally hampered by drilling conditions or sample refusal. Boring S069B was the only boring not able to reach its target depth (10 feet)

due to gravel refusal at 2 feet. Actual sample intervals and recoveries are presented in Table 2.1-9.

Auger refusal in the vicinity of the water-cooling tower area was encountered at 9 feet in boring S068B and at 1.5 feet in boring S069B; no samples were obtained at these depths during Phase I. The materials encountered during the drilling were fill. Another boring, S101B, was attempted in the vicinity of boring S069B during Phase II. This boring was advanced to 15 feet and soil samples taken at 2.5-foot intervals starting at the surface. Results of analyses of boring samples S070B and S071B indicate that soils at a depth of 10 feet were still in the zone impacted by facility operations. Another boring, S100B, was therefore attempted in the vicinity, during Phase II. This boring was sampled at 2.5-foot intervals to 15 feet, and at 10-foot intervals to groundwater (which was reached at 75 feet). Additionally, a grab sample of the groundwater encountered was also obtained. The soil and groundwater samples were analyzed for metals, general minerals, and radiological parameters, as specified in Tables 2.1-2 and 2.1-10, plus sulfate and potassium.

Water Reclaim Area. Wetting of soils occurs in the water reclaim area as a result of pipe leakage. For this reason, samples were collected at two locations (borings S072B and S073B) in the water reclaim area. Samples were collected at the soil surface and at a depth of approximately 2.5 feet.

The materials encountered during the drilling were composed of fill. To determine the depth of these materials and to assess subsurface conditions, boring S102B was attempted during Phase II. This boring was placed near boring S073B. It was advanced to 25 feet and sampled at 2.5-foot intervals starting at the ground surface. The soils were analyzed for metals, general minerals, and radiological parameters, as specified in Table 2.1-2, plus sulfate and potassium.

Former Ore Pile Area. Prior to the completion of Simplot's phosphate ore slurry pipeline, dry phosphate ore was brought to the facility by rail and stockpiled in the former ore pile. To evaluate soil characteristics at this area, surface soil samples were collected at five locations (borings S074B through S078B) within the area. Given the absence of any driving force other than natural precipitation for the movement of residual phosphate ore and its trace constituents through the soils, samples were only collected at the surface and at a depth of approximately 2 feet.

Salvage and Storage Area. Soil samples were collected at three locations (S079B through S081B) in the salvage and storage area. Samples were collected at the soil surface and at a depth of approximately 2 feet. Collected samples were analyzed for the parameters listed in Table 2.1-2, as well as for TPH and PCBs.

Roads. Soil samples were collected along the roads at approximately 500-linear-foot intervals to assess the potential impact from the application of oils and dust suppressants throughout the facility's history. Most of the roads are paved,

although some sections are unpaved and/or covered with gravel/slag. At each sample location (borings S082B through S096B), samples were collected at the soil surface (i.e., below pavement, gravel, or slag where they exist) and at a depth of approximately 2 feet. Boring S092B, proposed within the plant, was inaccessible due to the presence of underground utilities. The samples were analyzed for TPH and PCBs in addition to the parameters listed in Table 2.1-2.

Additional selected road sampling locations were resampled for PCBs during Phase II to validate Phase I sampling. Sample identifiers are presented in Table 2.1-9.

Former East Overflow Pond. To investigate the potential impact on soils from the former east overflow pond, boring S099B was placed during Phase II at the northwest corner of the pond next to the berm. This boring was advanced to groundwater at 50 feet. Soil samples were taken at the surface and at 10-foot intervals thereafter. The last soil sample taken was in the saturated zone. A grab groundwater sample was also obtained. The soil and groundwater samples were analyzed for metals, general minerals, and radiological parameters, as specified in Tables 2.1-2 and 2.1-8, plus sulfate and potassium.

2.2 AIR PATHWAYS INVESTIGATION

An extensive air pathways investigation is being conducted at the Simplot and FMC facilities. The purpose of this program is to characterize sources of airborne constituents and to assess the nature and extent of these potential releases. These emission sources and other aspects of the EMF facilities present unusual features not typically found at National Priorities List (NPL) sites:

- The FMC and Simplot facilities are operating facilities with air emissions already regulated by federal and state permits.
- The FMC and Simplot facilities have more potential source types (i.e., point, area, line, and volume sources) and hundreds of individual sources more than most NPL sites, which typically have only a ground-level area source and several individual sources.

In addition, an extensive (ongoing) historical database of air quality monitoring results and meteorological data has been collected at several sampling sites on and off the site.

At the time of this report's preparation, air pathways investigations completed or in progress are as follows:

- To assess whether air is a significant migration pathway for constituents of potential concern originating from the facilities, all existing air quality, emissions, and meteorological data related to the facilities and surrounding areas collected by FMC and Simplot, as well as the EPA, National Weather Service (NWS), and Idaho Division of Environmental Quality, were compiled, reviewed, and summarized into a comprehensive emission inventory. These data served as input to a comprehensive atmospheric dispersion modeling analysis.
- On the basis of a review of the emissions inventory, additional sources at both FMC and Simplot have been further characterized.
- Dispersion modeling analysis was performed to address two objectives:
  - To estimate concentrations at receptors of interest using input emission rate data based on field measurements or emission model predictions.
  - To design an air monitoring program (i.e., selecting monitoring locations and periods, constituents of potential concern, and sampling requirements) and to assist in the interpretation of monitoring results.

- An extensive field monitoring program has been implemented and is in progress. This program is designed to evaluate dispersion model performance, assess existing EMF study area ambient conditions, and establish a solid technical basis for future potential site remediation.

Results of the air pathways investigation will be presented in a supplement to this report. The report will include results from the field monitoring program and a comprehensive modeling effort coordinated with field monitoring data and updated emissions information.

2.2.1 Emissions Inventory

Comprehensive emissions inventories were prepared for FMC and Simplot using data taken from many sources. The inventories were presented in a separate report (Bechtel, 1993b). The inventories were compiled to support a subsequent atmospheric dispersion model. During the development of the inventories, information gaps were identified and resolved through use of assumptions based on historical data, engineering judgment, and generic source emission data.

Two types of emission rates were calculated to determine maximum short-term air pathway impacts and annual average impacts. The first was a maximum daily emission rate, i.e., the maximum emission rate if a process was operated full time at design capacity, and the average annual emission rate, i.e., the average emission rate produced by normal operations. The emission inventories were prepared for EPA criteria pollutants and constituents of potential concern.

The EPA criteria pollutants are:

- Particulate matter less than 10 microns (PM_{10})
- Total suspended particulates (TSPs)
- Sulfur dioxide
- Oxides of nitrogen
- Carbon monoxide
- Lead

The constituents of potential concern are:

- Ammonia
- Volatile organic compounds (VOCs)
- Sulfuric acid mist
- Fluorides

- Particulate metals, i.e., arsenic, cadmium, total chromium, nickel, and vanadium
- Crystalline silica
- Phosphorus pentoxide (P_2O_5)

A radionuclide emission inventory was not prepared.

Currently, several air pathway sources at FMC and Simplot are being sampled and analyzed to better characterize their potential emissions. The results will be presented in a separate report along with a revised emission inventory.

2.2.2 Meteorological Data

Available meteorological and climatological data were reviewed for the EMF study area. Information was obtained from the following sources:

- National Oceanic and Atmospheric Administration (NOAA)
- EPA's Office Technology Transfer Network (OTTN) electronic bulletin board system
- National Weather Service (NWS) offices at the airports in Pocatello, Idaho, and Salt Lake City, Utah
- National Climatic Data Center (NCDC) in Ashville, North Carolina
- *Climate of the States*, Volume I, by J.A. Ruffner (1978)
- Simplot in Pocatello, Idaho

Information provided by these sources is described below.

NOAA information used included the 1989 *Local Climatological Data (LCD) Annual Summary with Comparative Data for Pocatello, Idaho* (NOAA, 1989). Additional NOAA information used was the mean monthly, seasonal, and annual pan evaporation data for the Pocatello area (NOAA, 1982).

The EPA's OTTN electronic bulletin board system provided the meteorological surface data from the NWS in Pocatello, Idaho, and the meteorological upper air data from the NWS in Salt Lake City, Utah, for the years 1985 to 1989. Meteorological data not available in electronic form were obtained from the NCDC in Ashville, North Carolina.

Currently, there are no mixing height data for Pocatello. Discussions with the EPA regarding these data from the NWS at the Salt Lake City airport indicated that this location was the most representative. Although Salt Lake City is approximately

150 miles (240 km) south of Pocatello, sufficient similarities exist between the elevation and terrain of Salt Lake City and that of the EMF facilities. These data were used in atmospheric dispersion modeling studies performed for this site characterization report.

Ruffner provided additional climatological information about eastern Idaho in *Climates of the States* (1978). This document was used to supplement information in the NOAA's LCD.

Simplot provided meteorological data for the Pocatello area. This dataset serves as an alternative to the NWS data set. Simplot currently operates two meteorological stations: site 1 and site 7 (shown in Figure 2.2-1). Simplot's site 1 is a tower located north of Simplot and Interstate Highway I-86 (I-86), near the City of Pocatello Sewage Treatment Plant (STP). Wind speed, direction, temperature, and relative humidity are monitored at the 65-foot level of the tower. Mixing height is measured at the same location as the towers (site 1). Simplot's site 7 is located approximately 1 mile (1.6 km) south-southeast of site 1 on a hill at an elevation of approximately 400 feet above the Simplot plant grade. Site 7 monitors temperature, wind speed, and direction at the 10-meter level above local ground level. Sites 1 and 7 have been operating continuously since 1976 and 1986, respectively.

2.2.3 Atmospheric Dispersion Modeling

Atmospheric dispersion modeling was conducted in support of a proposed air pathways ambient monitoring program. Information for this modeling, such as emission rates and source operating parameters, was gathered from many sources. Most of the data were obtained from the FMC and Simplot plant operators and the EPA publication AP-42, *A Compilation of Emission Factors from Stationary Sources* (EPA, 1985). These and other sources are discussed in more detail in Air Dispersion Modeling for Monitoring Site Locations for the Eastern Michaud Flats Site (Bechtel, 1993b).

2.2.4 Air Pathways Monitoring Program

An air pathway monitoring program is being conducted in the EMF study area as an element of the RI/FS. The main purpose of the program is to aid in the characterization of the offsite impact on air quality attributable to potential airborne releases from the facilities. The data obtained will be used to calibrate the air pathway model. This program has been designed to collect and analyze several types of samples:

- Two types of particulate samples (PM_{10} and TSP) are being obtained at seven monitoring stations (see Figure 2.2-1) at a frequency of once every second day. A portion of these 24-hour-duration samples is being chemically

analyzed for a group of metals, radionuclides, and other constituents associated with potential onsite sources. In addition to the 24-hour particulate samples, low-volume air samples are also being collected at four of these stations and chemically analyzed for a similar set of constituents. Each low-volume sample provides a record of airborne concentrations over the duration of a 30-day sampling interval.

- Air samples are being analyzed for silica and gaseous/particulate fluoride at four monitoring stations.
- Ammonia, sulfuric acid, and phosphoric acid are being studied to determine if acceptable monitoring methods can be identified for these constituents.

Table 2.2-1 shows the site parameters.

A start-up test of this program was conducted between August 17 and 23, 1993. The purpose of this test was to evaluate the feasibility of meeting the analytical detection levels for the monitoring constituents requested by the EPA.

The monitoring program began on October 2, 1993. Its expected duration is between 6 months and 1 year. Refinements to the scope and duration of the program are being based on several comparisons:

- A comparison will be made between sampling results and projections for these constituents developed from air dispersion modeling techniques. An agreement between monitoring results and modeled projections will confirm the credibility of modeling techniques to estimate air quality in future seasons and proposed reductions in the program.
- A comparison will be made between sampling results and screening levels established by the EPA. Constituents found to be consistently at or below these levels may, subject to approval by the EPA, be removed from the scope of the analytical program.

Routine monthly reports are being submitted to the EPA. A comparison of monitoring results with modeled projections will also be submitted. The results of this air pathways investigation program will be provided to the EPA in a separate report.

2.3 OFFSITE SURFACE SOIL INVESTIGATION

The offsite surface soil investigation in the EMF study area was conducted as part of the air pathways program. The objectives of this investigation were to:

- Establish current levels of chemicals and radionuclides over a broad area of surface soils in the vicinity of the FMC and Simplot facilities
- Identify trends, if any, in surface soil concentrations related to soil associations and distance from the FMC and Simplot facilities
- Assess the degree to which air emissions from the FMC and Simplot facilities may have impacted soils in the area

In Phase I, the offsite surface soil sampling program:

- Sampled the major soil associations in the EMF study area at the surface (0 to 2 inches) and at a depth of 2 to 2.5 feet
- Provided data about the aerial distribution of chemicals within the vicinity of the facilities

The Phase II offsite sampling program augmented Phase I information to:

- Further delineate distribution of constituents of potential concern in soils north of the site
- Increase the sample location density in the southwest (predominantly upwind) directions from the site
- Resample specific locations that show potentially anomalous data from the Phase I investigation

2.3.1 Sampling Location Selection Process

Sixteen equally spaced transects were extended from a center point located on the northern boundary between the FMC and Simplot facilities. This center point was selected to be roughly equidistant between the major air emission sources at the two facilities: FMC's furnace building and material handling area, and Simplot's main process building.

Sample locations were then selected along the transects in a pattern whereby the intervals between the sampling points increased with distance from the center point. Four sample locations were identified at regular intervals within the first mile, three locations within the second mile, and two locations within the third mile. This distribution pattern was based on previous studies (USGS, 1977; J.R.

Simplot, 1990) of the vicinity, which indicated that the highest levels of metals and fluoride had been found in soils and vegetation within 1 mile of the two facilities.

A completely systematic grid sampling program would have produced a number of sample locations within the operating plant boundaries. Because this investigation was designed to target undisturbed soils, no sample locations were chosen within the facility boundaries. (Section 2.1 addresses surface soil sampling within the FMC and Simplot facility boundaries.) The sampling points were extended to the fourth mile to the south of the plant because the facility boundaries extend the farthest in that direction. The sample locations were adjusted and new locations added on the basis of the following considerations:

- Soil type
- Topography
- Land use

A subset of these sample locations, forming a "checkerboard" design, was selected for radiological analysis.

Supplemental samples of soil north of the site were collected to assess the distribution of constituents of potential concern. The locations of the sampling points are shown in Figures 2.3-1 and 2.3-2. The soil samples were analyzed for metals, general minerals, and radioactivity parameters as specified in Table 2.3-1. A summary of samples collected is presented in Table 2.3-2.

Because of the EPA concern that surface soil sampling density in the southwest (predominantly upwind) direction was not sufficient, eight additional samples were collected in this quadrant at distances of up to 3 miles (4.8 km) from the facility boundaries during Phase II (shown in Figure 2.3-1). Samples were collected at the surface and at a depth of 2 feet (where possible). In addition, five Phase II surface soil samples were also collected from an area southeast of the site in the general region of Pocatello. This area also lies in a prevailing upwind location.

Finally, polonium-210 was detected 2 feet below the surface at location 315-3B (see Figure 2.3-1), but not in the surface sample. To confirm the presence of polonium-210 at this location and depth, this location was resampled during Phase II.

2.3.1.1 Soil Types

Separate soil surveys have been conducted by the U.S. Soil Conservation Service (SCS) in the Fort Hall and Bannock County areas. While soil-naming conventions differ between the published reports, there appears to be a strong similarity between the major soil associations defined by the SCS (1977, 1987) for each area. For

purposes of this soil sampling program, soil associations with similar characteristics were considered as one (see Table 2.3-3).

Sample locations were selected in each major soil association because levels of naturally occurring metals and radionuclides may differ from one soil association to another. Samples were collected in areas least likely to have been disturbed by agriculture or other land uses.

Figure 2.3-3 shows the locations of the offsite surface-soil sampling points, together with the soil associations for both Fort Hall and Bannock County soil surveys. There are 12 sampling locations for the Camelback-Hades-Valmar association, which occupies a relatively small part of the total sampling area. There is an average of 10 sampling locations per soil association, with a range from 1 to 21. One hundred eight locations were sampled.

2.3.1.2 Topography

The region southeast of the FMC and Simplot facilities contains topographic high points which may be areas particularly susceptible to aerial deposition caused by local meteorological conditions. Sampling locations in this region were adjusted to include locations on these topographic highs.

2.3.1.3 Land Use

Collecting undisturbed samples was difficult in some areas because of current land use practices. Sample locations were selected to reflect undisturbed conditions as much as possible. "Undisturbed" refers to the absence of chemical or physical influences from agricultural or other human activities. "Impacted" describes soils that may have been subjected to aerial deposition. In many areas, it was not possible to find undisturbed conditions in the selected surface sampling locations. In these areas, sampling locations were adjusted on the basis of available information about land use combined with field observations. These locations were chosen in an order of preference from most preferred to least preferred as indicated below:

- Unused/undisturbed (e.g., BLM land, private property)
- Agricultural fields (samples taken at the edge of fields in areas of least disturbance and minimum fertilizer usage)
- Other land use (e.g., roadsides, parks, yards, airport)

It is difficult to obtain undisturbed samples in highly residential areas. The southeastern portion of the sampling region extends into the City of Pocatello. These areas were identified from available maps, and the sample locations adjusted accordingly.

2.3.2 Sampling Procedures

This section describes the QA/QC, sampling, and decontamination procedures followed during the offsite surface-soil sampling investigation. The section also describes the laboratory procedures used for chemical and radiological analyses of the samples collected. These procedures were followed for both Phase I and Phase II sampling, except where noted.

2.3.2.1 QA/QC Procedures

The offsite surface-soil sampling program adhered to the EMF Quality Assurance Project Plan (QAPP) (Bechtel, 1992b). Field sampling personnel maintained field log books that contained the following information:

- Sample identification numbers
- Sample collection dates and approximate times
- Sample matrix
- Sample location and depth
- Sample appearance
- Type of sampling equipment used
- Sampler's name
- Chain-of-custody number

A label was affixed to each individual sample collected and included the following information:

- Project name and location
- Project number
- Date
- Time
- Sampler's initials
- Sample identification number
- Analysis required and preservative used

To ensure quality control, rinsate samples were collected after decontamination of the offsite soil sampling equipment. One rinsate sample was collected at every twentieth soil sample location. Rinsate samples were collected using the following procedure:

- All equipment to be used was gathered at the sample location.
- The trowel was placed inside the auger and over the stainless steel sieve and pan.
- Deionized water was poured over the trowel and auger into the stainless steel sieve and pan.
- The rinsate water was then immediately transferred to either a decontaminated plastic bowl or new plastic bag.
- Rinsate solution was transferred into the appropriate sample jars.

This entire procedure took approximately 10 to 20 minutes. The rinsate samples were preserved by the same methods used for other water samples and then shipped to the laboratory for analysis. Logging and chain-of-custody procedures were the same as those used for the soil samples. Rinsate samples were analyzed for the parameters listed in Table 2.3-1.

2.3.2.2 *Offsite Soil Sampling Procedures*

At each sampling location, a center point was staked and recorded using a global positioning system (GPS) satellite location. Differential correction of the GPS satellite location provided a final accuracy within approximately ± 33 feet of the true planar location. Four subsampling points were selected at random from undisturbed areas (or the least disturbed areas) within a 20-foot radius of the center of the sample location. A stainless steel trowel was used to clear the vegetation at each point, and approximately 200 grams of soil (equal aliquots) were collected per point. The four subsamples were then composited in the field by thorough mixing in a new, sealable plastic bag or a decontaminated plastic bowl.

At each subsurface location, a stainless steel hand auger was used to collect a sample from a depth of approximately 2 to 2.5 feet near the center of the four surface sample points. If, due to bedrock or rocky soil conditions, a sample could not be obtained starting at the 1.5-foot depth, the sampler attempted, at a minimum, six other pilot holes within a 100-foot radius of the center of the sampling location. Samples collected between 1.5 and 2 feet were noted in the field log as abnormal samples.

All soil samples were thoroughly mixed and passed through a number 4 sieve (approximately the size of coarse sand) to remove the larger soil particles that were less likely to have been transported by wind. The finer fractions were transferred into precleaned wide-mouth 250-ml glass jars and packaged for shipment to the

laboratory for analysis. Sample custody procedures are described in Section 3 of the QAPP (Bechtel, 1992b).

2.3.2.3 *Decontamination of Sampling Equipment*

After use, all sampling equipment was decontaminated by:

- Spraying with a solution of deionized water and phosphate-free detergent
- Scrubbing with a steel or plastic brush
- Spraying again with deionized water and phosphate-free detergent
- Rinsing thoroughly with deionized water
- Drying by hand with paper towels or by air
- Sealing in plastic bags or containers until further use

All decontamination solutions were contained and disposed of in the Simplot wastewater treatment system.

2.3.2.4 *Chemical and Radiological Analyses Laboratory Procedures*

All soil samples collected during the offsite surface soils investigation were analyzed for trace metals, fluoride, and total phosphorus. Selected sample locations were also analyzed for potassium-40, lead-210, uranium-238, and polonium-210. Chemical analyses were conducted by Mountain States Analytical, Inc. (MSA), and radiological analyses were conducted by General Engineering Laboratories (GEL).

All analytical methods were performed in accordance with the RI/FS Work Plan (Bechtel, 1992a), and the SAP, including the QAPP (Bechtel, 1992b). Table 2.3-4 summarizes the methods and detection limits for analysis of the offsite surface soil.

The results of the total metals, general minerals, and radiological analyses of the offsite soil samples are given in Section 4.3.

2.4 HYDROGEOLOGIC AND GEOLOGIC SUBSURFACE INVESTIGATIONS

This section describes the various procedures used to collect field data and soil/rock samples, and other activities associated with hydrogeologic and geologic site characterization. The activities described occurred as part of the Phase I and Phase II investigations (Bechtel, 1992a; Bechtel, 1993c).

2.4.1 Summary of Field Activities

During the Phase I and II hydrogeologic investigations conducted in 1992 and 1993, the following field activities were performed:

- Drilling and logging of 71 borings
- Installation of 70 monitoring wells (one each in all but one of the borings)
- Laboratory testing of 49 soil samples from 14 borings
- Slug testing in 20 wells
- Conduct of four aquifer pumping tests
- Downhole geophysical logging (gamma and temperature) in 34 wells
- Quarterly collection of groundwater samples from Phase I and selected pre-Phase I wells from April 1992 through April 1993
- Collection of groundwater samples from pre-Phase I, Phase I, and Phase II wells during the June and September 1993 sampling events and their analysis

In addition, seven existing wells were grouted (plugged) and abandoned, and one well (Well 311) was abandoned and replaced (Well 329) due to high pH from grout contamination.

Other field activities involving soil borings were performed concurrently with the hydrogeologic investigation. These activities included drilling and backfilling borings to collect soil samples for physical and chemical analyses, and installing a water production well. Groundwater samples were collected from a total of 122 monitoring wells on a quarterly schedule beginning in June 1992.

2.4.2 Boring and Well Location Selection Process

Selection of boring and well locations was guided by the need to define subsurface stratigraphy and to monitor subsurface contaminant occurrence and migration. Since subsurface lateral migration occurs mainly within permeable zones below the water table, borings and wells were drilled and installed to:

- Define the vertical and lateral extent of saturated coarse-grained intervals
- Determine aquifer characteristics
- Monitor water quality and contaminant levels
- Obtain hydraulic head measurements

Figure 2.4-1 shows the locations of borings and wells drilled and installed in 1990, 1992, 1993, and selected wells installed before 1990. The borings and wells are generally at the location specified in the RI/FS Work Plan (Bechtel, 1992a), the Sampling and Analysis Plan (Bechtel, 1992b), and the Phase II Site Investigation Plan (Bechtel, 1993c). The borings and wells were numbered as follows:

- 139 through 154, 158 and 159 at the FMC facility (continuing the sequence 101 through 138 begun in 1990 by Bechtel [1991])
- 300 through 333 at the Simplot facility (303 and 314 were not drilled)
- 500 through 520 for borings and wells outside the main plant boundaries of the two facilities (offsite wells)

Wells installed in these borings were assigned the same number as the boring number. Solitary wells were generally screened in the shallowest saturated coarse-grained interval. Well pairs were installed to screen one well in the shallowest saturated coarse-grained interval and the other well in a deeper saturated coarse-grained interval. Table 2.4-1 indicates which well numbers correspond to the shallow and which to the deeper wells of the well pair or cluster.

A tabulation of drilling and well completion data is provided in Appendix B. These data are summarized for the Phase I and Phase II wells; for older wells installed in 1990; for wells installed by PEI Associates in 1984 and Geraghty and Miller, Inc., in 1980 and 1981; and for FMC and Simplot production wells installed in the 1940s through the 1960s. Appendix B contains the geologic drill logs and well construction diagrams of all wells installed by Bechtel, from both the Phase I and II investigations and from the 1990 investigation for FMC.

2.4.3 Drilling Methods

The subsurface investigations utilized two drilling contractors: Layne Environmental, Inc., and Boyles Brothers Drilling Company. Layne Environmental, Inc. used a truck-mounted AP-1000 drill rig. This drill rig used a 9.75-inch outer-diameter (OD) and 6-inch inner-diameter (ID) dual-wall casing driven by a rig-mounted diesel-powered percussion hammer with reverse-air circulation. The drive pipe maintained an open hole in loose, unconsolidated materials and minimized both potential circulation loss and cross-contamination between water-bearing intervals.

To install 8-inch nominal-diameter test wells for aquifer pumping tests (Wells 152 and 322), two borings were drilled using triple-wall casing that consisted of the 9.75-inch OD dual-wall casing inside an 11.75-inch OD outer casing with a 12.4-inch OD bit casing. This method allows the dual-wall casing to be removed after reaching the desired depth, and allows a large-diameter well or rotary drill string to be lowered within a hole cased by the remaining outer "triple" wall. Where very hard rock was encountered in two borings (142 and 144), a truck-mounted TH-60 air-rotary downhole hammer drill rig was employed with either a 5.625-inch OD rotary bit (using the dual-wall casing as a conductor casing) or a 9.25-inch OD rotary bit (using the triple wall as a conductor casing).

Boyles Brothers Drilling Company used two truck-mounted Schramm T685DH reverse-air rotary drilling rigs. One rig was equipped for ODEX drilling, which consists of a special down-hole, air-powered hammer and bit, and 9-inch OD casing. Once below the bottom of the casing, the ODEX bit, upon rotation of the drill string, expands about an eccentric pivot to an effective diameter of 9.625 inches. The larger hole allows the casing to follow the advancing bit. Reversing the rotation of the drill string causes the ODEX bit to return to its smaller diameter, allowing the drill string to be retracted back into the casing.

The other drill rig was equipped with a conventional down-hole air-powered hammer and bit, and 9-inch OD casing, which was advanced with a rig-mounted, air-powered casing driver. The conventional drill bit was used to advance the boring several feet ahead of the casing, and then the bit was retracted back up into the casing. The casing was then advanced to the bottom of the hole, or deeper, using the rig-mounted air-powered hammer. Finally, the conventional drill bit drilled out the cuttings inside the casing before further advancing the boring.

Bechtel hydrogeologists performed geologic logging by observing drill cuttings which, with the reverse-air circulation drilling methods, were rapidly lifted and expelled out of a rig-mounted cyclone separator. A number of split-spoon soil samples were collected to augment the cuttings and/or for submittal for laboratory testing. The samplers were advanced with a 140-pound 30-inch drop hammer.

Seventy soil samples were collected and submitted to geotechnical laboratories for determination of grain-size distribution and moisture content.

Boyles Brothers and Layne Environmental, Inc., used Mobile B-80 hollow-stem auger drilling rigs for shallower soil borings not intended for completion as monitoring wells. These borings were primarily drilled in conjunction with the potential source and onsite soil investigations, and to collect additional subsurface soil samples and lithologic information where needed.

The drillers used 8.5-inch OD hollow-stem augers. A split-spoon sampler was used down the hollow-stem of the augers to collect soil samples. The split-spoon sampler was advanced with a 140-lb 30-inch drop hammer, with blow counts recorded for every 6 inches of penetration. Refusal was defined as needing more than 50 blows to penetrate 6 inches of material. Sample recovery and depth intervals were also recorded on the boring logs.

After drilling and sampling were completed, all onsite borings, except for those drilled under asphalt paving of the Simplot facility, were backfilled with grout to ground surface. Borings under asphalt paving at Simplot were backfilled with grout to 5 feet to ground surface, and then backfilled with sand to the ground surface to minimize settlement. The decontamination of drilling and sampling equipment and the handling of cuttings and wastewater are described in Section 2.4.11.

A tabulation of drilling and well completion data is provided in Appendix B.

2.4.4 Construction

Borings were drilled, and monitoring or test wells installed in accordance with federal (EPA, 1986 and 1989a) and state (Idaho Department of Water Resources, 1989) requirements.

Monitoring wells were typically constructed with a 4-inch nominal-diameter, flush-jointed polyvinyl chloride (PVC) well casing and screen. Schedule 40 PVC well casing was usually used in the construction of wells that extended to depths of 150 feet or less; Schedule 80 well casing was used to construct wells that extended to depths greater than 150 feet. Well screens used in the construction of the monitoring wells were manufactured or machine cut with 0.020-inch transverse slots. The annulus of each well was packed with clean, well-sorted sand (10-20 sieve size) manufactured by Colorado Silica Sand, Inc. The filter pack was placed from the bottom of the open hole to a level at least 2 feet above the screen interval. A bentonite seal was placed on top of the filter pack interval, and the remaining annulus was backfilled with a cement-bentonite grout placed with a tremie pipe.

This well construction design was modified for those wells in which pumping tests were planned. Specifically, Wells 152 and 322 were constructed with 8-inch

nominal-diameter PVC well casing with a 0.030-inch slotted well screen, surrounded by a coarse (4-16 sieve size) material for the filter pack. (Schedule 80 PVC casing was placed in Well 322.) In addition, the construction of Wells 144 and 312 differed only in the use of 6-inch rather than 4-inch PVC casing and screen; Schedule 80 PVC casing was used in Well 144.

Well construction diagrams of all wells installed during the Phase I and Phase II investigations are presented in Appendix B.

2.4.5 Well Development

During Phase I, both drilling contractors used designated crews to perform well development, accomplished by bailing, surging, airlifting, and/or pumping techniques. Well development was initiated and continued until field-measured parameters of temperature, pH, and electrical conductivity stabilized; the discharge water appeared to be clear and relatively free of sediment; or 10 well volumes were removed from the well. (The decontamination of well development equipment and the handling of well development water are described in Section 2.4.11.) During Phase II, similar methods were employed by Layne Environmental, Inc.; however, no airlifts were conducted.

2.4.6 Groundwater Sampling

Wells installed during the Phase I and Phase II investigations were developed, purged, and sampled. The first groundwater samples obtained from the Phase I monitoring wells were collected by Bechtel during April 1992; subsequently, these wells were placed on a quarterly groundwater sampling program along with existing groundwater monitoring wells. This quarterly sampling program was implemented by Hydrometrics, Inc., beginning in June 1992. Phase II monitoring wells were added as part of the regular quarterly groundwater sampling event in July 1993. Phase I and Phase II well development records and Bechtel sampling field notes are presented in Appendix C. Quarterly monitoring records prepared by Hydrometrics, Inc., previously submitted to the EPA, include the field records for purging and sampling and are discussed in Section 3.

After Phase I well development, an initial sample of groundwater was collected from each well by a Bechtel representative and submitted for chemical analyses. In addition, five existing PEI wells at the Simplot facility were purged and sampled. The well sampling records for the initial round of sampling are included in Appendix C, which also incorporates well development data for the new wells. (In two instances, well development was completed on a day preceding well sampling, and the initial well sampling records lack well development data. Well development data are appended to these sampling records [Wells 309 and 310].)

Phase II wells were added to the quarterly groundwater sampling program after all Phase II wells were installed.

The following subsections describe the sampling and decontamination procedures followed during groundwater sampling. QA/QC procedures followed during sample collection and transfer are described in Section 2.1.1.1.

2.4.6.1 *Groundwater Sampling Procedures*

During the April 1992 sampling event, the wells were purged using a bailer, an electric submersible pump, or by air-lift apparatus, depending on the diameter and capacity of the well. Wells from which samples for volatile and semi-volatile organic analysis were collected were purged using methods other than airlifting. A minimum of three casing volumes was removed from each well. When a well was pumped dry during purging, it was pumped dry two times, allowing 80-percent water level recovery between purges and prior to sampling. During purging, indicator parameters (pH, conductivity, and temperature) were monitored to verify that the water to be sampled was representative of groundwater from the formation. Following purging, samples were collected using a stainless steel or PVC bailer, or a discharge port from the airlifting or pumping apparatus.

During the subsequent sampling events conducted by Hydrometrics, the wells were purged using an electric submersible pump. Well purging procedures followed by Hydrometrics were similar to those followed during the April 1992 sampling event. Following purging, all samples except for volatile and semivolatile organic samples, were collected using a discharge port from the pumping apparatus. Volatile and semivolatile organic samples were collected using a stainless steel bailer.

Water supply wells (e.g., New Pilot House well) were purged for 5 minutes directly from the sample ports prior to sampling collection. Details of the sampling procedure followed at each well were entered in a field notebook. The following information was recorded at the time of sampling:

- Sampler's name
- Date and time of sample collection
- Well identification
- Depth to groundwater prior to sampling
- Weather conditions
- Purging method and equipment
- Purged volume and pumping rate (note if volume limited by low well yield)

- Measurements of indicator parameters (e.g., temperature, electrical conductivity, pH)
- Water appearance and odor (if any)
- Sampling method and equipment
- Sample number
- Volume and type of sample containers used
- Field treatment or preservatives

Groundwater samples were collected during Phase I and Phase II using the following procedures:

- Samples were transferred from a precleaned disposable, stainless steel, or PVC bailer, or pumping apparatus directly to the appropriate sample containers. The types of containers and volume of water to be collected and preservation methods for each analysis type, and packaging procedures for sample shipment are presented in Section 7 of the SAP (Bechtel, 1992b).
- Samples to be analyzed for volatile organics were collected using a stainless steel single or double-check valve bailer and/or a precleaned disposable bailer.
- Containers were labeled as described in Section 3 of the QAPP (Bechtel, 1992b).
- Field notes were recorded in ink in appropriate log books. Corrections were initialed and dated.
- Chain-of-custody records were filled out as described in Section 3 of the QAPP (Bechtel, 1992b).

Samples designated for metals and orthophosphate analyses were filtered in the field using a peristaltic pump. Groundwater samples were field-filtered using the following procedures:

- Samples were collected directly into or transferred from the bailer or pump to a precleaned, unpreserved glass or polyethylene sample container.
- The sample was then filtered using tygon, silicon, or other compatible tubing connected to a 0.45-micron disposable filter. The sample was filtered directly into a sample container with preservatives, or preservatives were added immediately afterwards.

- The type of container, volume of water to be collected, and preservation methods were the same for filtered and unfiltered samples that were analyzed for metals.
- Filters and tubing were discarded and replaced after each use.

2.4.6.2 *Decontamination of Sampling and Measurement Equipment*

Bailers, tubing, and cord used for collection of groundwater samples were cleaned at the start of each job and between each well by steam cleaning or with a nonphosphate detergent wash followed by a tap-water rinse and a final deionized water rinse.

Steel tapes, water-level indicators, transducers, and water quality meters (pH, temperature, specific conductivity) were rinsed in deionized water or cleaned in a nonphosphate detergent solution and rinsed with fresh tap water.

2.4.7 Chemical and Radiological Groundwater Analyses

Groundwater samples were analyzed for the general water quality parameters, heavy metals, radium, gross alpha, and gross beta. Volatiles and semivolatiles were analyzed once during selected groundwater sampling events. Table 2.1-10 lists the specific groundwater analyses that were performed. MSA in Salt Lake City, Utah, performed the chemical analyses, and GEL in Charleston, South Carolina, conducted the radiological analyses. Results of the groundwater sampling are discussed in Section 4 of the PSCS.

All analytical methods were performed in accordance with the RI/FS Work Plan and the SAP, including the QAPP (Bechtel, 1992a and 1992b). The method reference and QA objectives for groundwater methods are summarized in Table 2.4-2.

2.4.8 Well Abandonment and Boring Backfill Methods

All borings greater than 10 feet in depth and not completed as monitoring or test wells, such as boring 302, were backfilled with cement-bentonite grout placed with a tremie pipe and sealed from the bottom of the hole to ground surface. Shallow borings (less than 5 feet deep) and the upper few feet of some deeper borings overlain by asphalt on the Simplot facility were backfilled with sand.

In the past few years, a number of wells at the EMF facilities have been abandoned. During the Phase I investigation, Wells 153, TW-3S, FMC-5, PEI-1 through PEI-3, and PEI-5 were abandoned; during Phase II, Well 311 was abandoned in accordance with Idaho Department of Water Resources (1989) regulations.

2.4.9 Down-Hole Geophysical Logging

Down-hole temperature and gamma logging was performed in 34 selected wells from June 9 through June 15, 1992.

Temperature logging was performed to determine the vertical temperature profiles in selected wells for two reasons. First, low-temperature geothermal waters (bottom hole temperatures of 85-212°F) are a regulated resource in the State of Idaho (Idaho Department of Water Resources, 1989). Second, geothermal waters frequently contain elevated concentrations of metals and could therefore be a natural source of constituents that may also be under consideration as potential source constituents.

Previous investigations have encountered elevated groundwater temperatures in wells within the EMF study area. These investigators have postulated as thermal sources both the FMC furnace building (Geraghty and Miller, 1982) and natural upwelling of geothermal waters along fracture zones and permeable units (Morrison-Knudsen, 1989).

The temperature logging was performed using a Mount Sopris Instrument Company Model 1000-C portable borehole logger and Model DLP Temperature Probe with a range of 0-30°C (32-86°F). Wells were selected to provide a general areal distribution across the EMF facilities and to investigate the impact of possible thermal sources such as the FMC furnace building. Where a choice existed among several wells in close proximity, the deepest well was selected.

Prior to temperature logging, a well was allowed to remain undisturbed for several days to permit the temperature of the water in the well to reach thermal equilibrium with the formation outside the well casing. Both thermal and gamma logs were run during the same logging session, but the temperature log was performed first, beginning at the ground surface and ending at the bottom of the well. This method allowed the instrument to record the temperature of the undisturbed water in the well.

During logging, the probe was lowered at an approximate rate of 15 feet per minute. The resulting temperature records consisted of a line trace on a chart paper. These records were later converted to a digital database from which the temperature logs in Appendix D were generated. The temperature profiles recorded above the water level are not considered useful and have been omitted from the logs.

Gamma logging was performed in the wells to determine vertical profiles of naturally occurring gamma radiation. Gamma logs can be a useful tool to augment drill logs for correlation purposes as well as to detect anomalously high radioactivity. The selection of wells to be logged for gamma was primarily determined by the temperature logging needs. For the reasons stated above, gamma logging was performed after temperature logging. The portable borehole logger was

used with a Model G375/A Standard Combination Probe, which produced results expressed in counts per second (cps). During logging, the probe was raised at an approximate rate of 15 feet per minute. As with the temperature logs, the gamma log trace was converted to a digital database from which the logs in Appendix D were generated.

2.4.10 Hydrogeologic Testing

This section describes the pumping tests, slug tests, and laboratory tests performed during the Phase I and Phase II hydrogeologic testing. Hydrogeologic testing was performed during previous investigations, and are discussed in Section 3.2.1. Slug tests were performed in 20 wells to estimate hydraulic conductivity of individual, saturated, coarse-grained intervals. Pumping tests were performed in four wells to provide data for calculation of the transmissivity, hydraulic conductivity, and storativity of separate, saturated, coarse-grained intervals and to assess the degree of hydraulic connection, both laterally and vertically, within the saturated materials.

2.4.10.1 Pumping Tests

Constant-discharge pumping tests were performed in four wells: 150, 312, 322, and FMC-6. Well 152 was originally to be used in the pump testing program due to low well yields. This well could not sustain a 9-gpm flow rate during step-testing. Well 150 yielded 30 gpm with much less drawdown during the step-test; therefore, the constant-rate pumping test was performed in Well 150. Wells 150 and 312 are open to the shallowest, saturated, coarse-grained interval, and Wells 322 and FMC-6 are open to deeper, saturated, coarse-grained intervals. Well FMC-6 was installed as a production well and was constructed with a much longer screened interval than Well 322. The tests were performed by pumping water at a constant rate from a selected well for an extended period, and measuring the water-level response in that well and in nearby wells.

Each pumping test required several days of preparation to determine static groundwater levels and pumping rates for the test. For some wells, water levels and pumping rates measured during well development were sufficient for preparing the pumping test. Based on these data as well as the limitations (if any) of the well, the pump size and pumping rate were selected for a constant-discharge test. Constant-discharge tests ran for 18 to 24 hours, followed by a recovery monitoring period. Observation wells were selected within the vicinity of each pumping well. The pumping tests are described below.

Well 150. A pumping test was conducted in Well 150 for a 24-hour period between June 11-12, 1992. A constant-discharge rate of 40 gallons per minute (gpm) was obtained using a 3-horsepower (hp) submersible pump. Water levels were monitored in nearby observation Wells 120 and 152, using an In-Situ, Inc., Hermit

Environmental Data Logger with three pressure transducers. A portable water-level indicator was used to monitor groundwater levels in secondary observation wells (103, 104, 116, 117, 118, 119, 130, 133, 134, 137, and 151). Water pumped from Well 150 was discharged into nearby Pond 8S. Following the pumping period, water levels were monitored for 6 hours during the recovery interval.

Well 312. A pumping test was conducted in Well 312 for a 24-hour period between October 17-18, 1992. A constant-discharge rate of 213 gpm was obtained using a 15-hp submersible pump. Water levels were monitored in Well 312 and nearby observation Well 311 using the data logger and pressure transducers. Water levels were monitored in two additional observation wells, 309 and 310, with a portable water-level indicator. Water pumped from Well 312 during testing was discharged into a conduit leading to Simplot's water treatment ponds. Following the pumping test, water levels were monitored for approximately 8 additional hours.

Well 322. A pumping test was conducted in Well 322 for an 18-hour period between June 23-24, 1992. A constant-discharge rate of 410 gpm was obtained using a 15-hp submersible pump. Water levels were monitored in nearby observation Wells 321, PEI-4, and PEI-6 using the data logger and pressure transducers. Water levels in observation Wells 506 and 507 were monitored with a portable water-level indicator. Water pumped from the well was discharged into a conduit leading to Simplot's water treatment ponds. The constant-discharge test was terminated after 18 hours of pumping when the water treatment ponds had filled to capacity. Following the pumping test, water levels were monitored for an additional 12 hours.

Well FMC-6. A pumping test was conducted in the new FMC production well (FMC-6) for a 24-hour period between July 29-30, 1992. A constant-discharge rate of 700 gpm was obtained using a submersible pump. Water levels were monitored in nearby Wells TW-2S and TW-2I using a portable water-level indicator. Following the pumping period, water levels were monitored for an additional 4 hours. Approximately 1 million gallons were removed from the well during the test and were discharged through a temporary FMC pipeline into an irrigation canal.

2.4.10.2 Slug Tests

Slug tests were performed in both shallow and deeper, saturated, coarse-grained intervals across the EMF facilities. The majority of these tests were conducted in wells open to the shallowest, saturated, coarse-grained interval. Slug tests involved measuring the recovery time of the water level in a well following sudden displacement of the static water level. A slug was fabricated using a 6-foot-long section of Schedule 40 PVC pipe with an outer diameter of approximately 2.4 inches. The PVC pipe was filled with clean sand and distilled water, capped at both ends, and attached to a plastic-coated rope. Water-level displacement and recovery to

static conditions were monitored using a Model 2000 Hermit Environmental Data Logger and pressure transducer manufactured by In-Situ, Inc.

Prior to each slug test, the static water level was measured using a portable water-level indicator. The pressure transducer was lowered into the well to a depth where it would remain underwater during the test. If the transducer itself caused a measurable change in water level, then the water level was allowed time to restabilize to a static level. Output from the transducer was monitored at the data logger and calibrated to the static waterlevel depth determined by the portable water-level indicator. The slug test was then performed by lowering the slug into the water as rapidly and smoothly as possible.

The slug displaced a known volume of water, and the changes in water levels were recorded by the data logger until a return to stable, static conditions was achieved. This portion of the test is known as the "falling head" phase. The slug was then withdrawn from the well as rapidly and smoothly as possible, and the water level was monitored for the "rising head" phase of the test until it returned to a stable, static condition. The pressure transducer was removed from the well at the completion of the slug test.

The rate at which the water level recovers from the sudden displacement, and the manner in which this rate varies over time, are controlled by the hydraulic characteristics of the formation in the immediate vicinity of the well screen. Methods of data analysis differ, depending on the degree of confinement of the aquifer and the response characteristics. Further discussion is presented in Section 3.

2.4.10.3 Laboratory Tests

Laboratory tests were performed on selected soil samples to identify physical and hydrogeologic parameters in vadose and saturated zones. Seventy soil samples were collected from 16 borings and analyzed for grain size distribution (ASTM D 4220-63) and moisture content (ASTM D 2216-80). Forty-nine of these samples were also analyzed for saturated hydraulic conductivity (ASTM D 2434-68). The soil samples were collected with split-spoon samplers fitted with brass sample tubes. Most of the samples were collected from the vadose zone. The results of the laboratory testing are discussed in Section 4.3.

2.4.11 Decontamination and Handling of Waste Materials

Drill rigs, well-development rigs, and associated drill bits, rods, casing, samplers, and other equipment were steam-cleaned upon arrival at the EMF facilities and after completion of work at each hole. Layne Environmental, Inc., set up a decontamination pad at the FMC facility near Well 114, and Boyles Brothers Drilling

Company set up a decontamination pad between the upper and lower gypsum stacks at the Simplot facility. Soil sampling equipment was decontaminated between each use with a three-stage wash consisting first of a tap water and nonphosphate detergent wash, then a tap water rinse, and finally a rinse with deionized water.

All decontamination fluids were contained at the decontamination pads for disposal in designated industrial ponds at each facility. Drill cuttings were handled in a variety of ways. Soil cuttings expelled from the rig-mounted cyclone separators were collected in troughs, plastic-lined pits, front-end loaders, or drums, and were transported by front-end loader, dump truck, or in drums on a flatbed truck for disposal at a designated area at each facility. Water expelled with the soil cuttings was collected in tubs or plastic-lined pits and pumped into truck-mounted tanks for transport for disposal in industrial ponds at each facility. Well-development water was pumped into truck-mounted tanks for transport to designated ponds at each facility. Discharge fluids from aquifer testing were directed to designated disposal sites through hoses and pipelines.

Cuttings from the first 30 to 60 feet (9 to 18 m) in each boring drilled on the FMC facility received special handling due to the potential presence of elemental phosphorous. The drill cuttings were discharged from the cyclone separator directly into steel drums which were then sealed and transported to a designated temporary storage area within the FMC facility.

2.4.12 Surveying

Locations and elevations of the EMF borings and wells were surveyed either by Bithell Engineering, Inc., or by Simplot. The survey results are tabulated with those of older wells in the Boring Logs and Well Construction Diagrams in Appendix B. The location coordinates and elevations are shown on the individual geologic drill logs and well-construction diagrams (Appendix B). Elevations were surveyed to a hundredth of a foot, and coordinates to a tenth of a foot. For wells, the surveyed locations are measuring points at the top of each well casing for gauging groundwater depth. The measuring points are either permanent marks or notches cut into the plastic casing. For backfilled borings, the approximate center point at the ground surface was surveyed.

The location coordinates are in the Idaho State Coordinate System, in feet northing and easting, relative to the U.S. Coast & Geodetic Survey (USC&GS) Control Station McDougall-2, and updated to the North American Datum of 1983 (NAD83). Existing U.S. Geological Survey (USGS) topographic maps (USGS, 1971/74, 1984) display the Idaho State Coordinate System of NAD27, which is about 25 feet greater in northing and about 155,986 feet less in easting. Elevations are in feet above mean sea level relative to control station BM Y-96, based on the 1968 adjustment of the National

Geodetic Vertical Datum of 1929 (NGVD29), the same as the USGS topographic maps.

2.4.13 Water-Level Monitoring

Water depths in each newly completed well were measured during development and sampling. Static water-level depths in all existing Phase I and Phase II wells, and in selected wells constructed prior to 1992, were measured on June 26, 1992, and during subsequent quarterly groundwater sampling rounds. Depths to water were measured with a portable water-level indicator to the nearest ±0.01 foot from the gauging mark or notch cut at the top of the well casing.

Six monitoring wells (TW-3D, TW-5D,TW-11I, 108, 129, and 144) had been previously equipped with submersible pumps to allow for more efficient sampling. In some cases, these pumps masked the measuring mark at the top of casing (TOC) which had to be estimated when taking water-level measurements at these wells. Water-level data for all these wells should therefore be considered approximate (within two- or three-tenths of a foot margin of error).

2.5 SURFACE WATER AND SEDIMENT INVESTIGATION

A surface water and sediment investigation was conducted to identify the potential impacts of industrial activities on the Portneuf River. Segments of the Portneuf River and associated springs and ponds were sampled to identify differences in water quality along the river. Section 2.5.1 discusses data collection activities related to surface water investigation, while sediment investigation is addressed in Section 2.5.2.

The surface water and sediment sample locations that were investigated are listed in Table 2.5-1. Locations where samples were collected during July 1992 are shown in Figure 2.5-1. Subsequent surface water samples were collected at 24 locations when weather and river conditions permitted. The samples were collected quarterly from July 1992 through April 1993. Supplementary sediment samples were collected during December 1992. In addition, surface water and sediment samples were collected during the Phase II field activities in July 1993.

Concurrent with the sampling of surface water, Portneuf River flow rates were measured at five of the sampling locations when weather and river conditions permitted. These locations are also identified in Table 2.5-1. Flow rates were measured during each of the four rounds of surface water sampling. Streamflow measurements were also take at distant locations upstream (sample site number 25 upstream of the City of Pocatello) and downstream (sample site number 01 - river mile 10) of the site. Stream flow rates were measured to develop a waterflow budget for the river so that additional flow contributions from springs and streams along the river could be estimated.

2.5.1 Surface Water Investigation

The surface water sampling investigation was designed to provide information to evaluate the potential impacts of chemical loading to the water quality of the Portneuf River as a result of anthropogenic activities.

2.5.1.1 Sampling Locations Selection Process

The specific surface water sample locations were selected to provide:

- Samples from upstream and downstream of the EMF facilities
- Samples at seeps and springs that discharge to the Portneuf River
- Samples below outfalls or other anthropogenic discharges to the Portneuf River watershed

Two sets of sample locations specified in the RI/FS Work Plan were eliminated. The first, consisting of springs believed to be in the proximity of the Rowland creamery, was eliminated because the springs could not be located. The second set, consisting of the "old Simplot discharge" and the "old FMC discharge" points, was eliminated because they were found to be the same as sediment sampling location 18 (see Figure 2.5-1).

The sample location point numbering system was subsequently changed as a result of these field check activities.

Surface water samples were taken in areas representative of the flowing river or springs. Samples were generally not taken in stagnant water unless the water was representative of overall stream conditions at that sampling location.

During previous sampling events, above-background levels of some of the constituents of potential concern have been observed in sediment samples in the vicinity where the FMC outfall discharges into the Portneuf River. The location of this outfall is shown as location 17 in Figure 2.5-1. It appears from the physical description of the sediment obtained from this location, that slag from the FMC facility may be present in the sample. The IWW basin and the drainage ditch that leads to the outfall were lined with slag, and slag particles scoured from the ditch may have been carried by the discharge water to the outfall. Where the discharge enters the stream, the slag could have been deposited due to the drop in velocity at the discharge point.

To evaluate this possibility, additional sediment samples were collected during Phase II (July 1993) field activities in the vicinity of the outfall, and at two other locations. Also, at this time, surface water samples were collected in a profile across the river at location 17. For this profile, samples were collected at seven locations across the channel, both at depth within the river channel and just below the water surface. The soil and water samples were analyzed for the metals, general minerals, and radioactivity parameters specified in the RI/FS SAP Addendum, Tables 5-2a and 5-4a (Bechtel, 1992b). Sulfate and potassium were added to the list of parameters for sediment analysis.

2.5.1.2 *Sampling Investigation Procedures*

This section describes the QA/QC, sampling, and decontamination procedures followed during the surface water sampling investigation.

Quality Assurance/Quality Control. At a minimum, two sets of duplicates, matrix spike duplicates, and rinsates were collected for each quarterly round of surface water sampling. Each quarterly round of surface water sampling was scheduled for sampling at a minimum of 24 locations. Four additional surface water sampling

locations were sampled in April 1993. In some cases, specific locations were deleted because of weather and river conditions.

The surface water sampling investigation adhered to the EMF QAPP (Bechtel, 1992b). Field sampling personnel maintained field log books that contained the following information for each sample:

- Sample identification number
- Sample collection date and approximate time
- Sample location description or location sketch
- Sample matrix
- Sample location and depth
- Sample appearance
- Type of sampling equipment used
- Sampler's name
- Chain-of-custody number

A label was affixed to each individual sample collected and included the following information:

- Project name and location
- Project number
- Date
- Time
- Sampler's initials
- Sample identification number
- Analysis required and sample preservative used

All sample locations were indicated on a sample location map. To help identify to the sampling area, a minimum of one orange fiberglass survey marker labeled with the sample identification number was installed at each location.

Surface Water Sampling. All surface water samples were collected in a manner that minimized the amount of sediment in the sample. During the first and second quarters of sampling, grab samples were collected by direct submergence of the sampling bottles, with the exception of those samples that required filtering or a sample preservative. Samples requiring filtering were collected in a clean sample

jar and then filtered into the appropriate container, usually within 1 hour of the time of collection. Samples requiring preservatives were collected in a clean sample jar and then emptied into a sample container containing a preservative. In order to split samples with the EPA during the third quarter, samples were collected in decontaminated plastic buckets and then transferred to the appropriate sample bottles. Third quarter samples requiring filtering were then filtered through a 0.45 micron filter into the appropriate container, usually within 1 hour of the time of collection. During the fourth quarter, samples requiring filtering were collected in decontaminated plastic buckets and then immediately filtered through a 0.45 micron filter into the appropriate container. The sample containers, preservatives, and holding times for surface water samples are summarized in Table 2.5-2.

Dissolved oxygen, electrical conductivity, pH, and temperature were determined in the field. The results of these field measurements are summarized in Table 2.5-3 for Phase I and Phase II. Surface water samples were also analyzed for the parameters listed in Table 2.5-4.

Decontamination of Sampling and Measurement Equipment. The samples were collected directly into the sample containers. Third-quarter samples were collected in plastic buckets due to heavy snow/icy conditions that prevented easy access. Samples which required filtering or a sample preservative were also collected in decontaminated buckets. For those items requiring filtering or preservation, each sample was placed in a collection jar or bucket, then filtered or transferred to the appropriate container. These containers were decontaminated by rinsing with a solution of deionized water and phosphate-free detergent, thoroughly rinsing with deionized water, and then thoroughly rinsing with river water at the next sample location.

Dissolved oxygen meters, pH meters, and electrical conductivity meters were decontaminated by thoroughly rinsing with deionized water.

Because of extremely cold weather conditions during the third quarter of sampling, the phosphate-free detergent and deionized water rinses were eliminated from the decontamination procedure.

Chemical and Radiological Analyses of Samples. All surface water samples collected were analyzed for trace metals, standard water quality parameters, orthophosphate, total phosphorus, and radiological parameters, as indicated in Table 2.5-4. Both filtered (dissolved) and unfiltered (total) surface water samples were analyzed for heavy metals. The Mountain States Analytical, Inc., laboratory in Salt Lake City, Utah, performed the chemical analyses. General Engineering Laboratories in Charleston, South Carolina, conducted the radiological analyses. Table 2.5-5 lists the parameters, EPA method number, and project-required detection

limits (PRDL) for surface water analyses. Results of the surface water sampling are discussed in Section 4.5.

All analytical methods were performed in accordance with the RI/FS Site Work Plan and the SAP, including the QAPP (Bechtel, 1992a and 1992b). The method reference and QA objectives for surface water and sediment methods are summarized in Table 2.5-5.

The results of the total metals, general minerals, and radiological analyses of the surface water and sediment samples are presented in Section 4.5. Surface water sampling was conducted in accordance with the RI/FS Work Plan and the SAP (Bechtel, 1992a and 1992b), except as follows:

- February 1993 - Surface Water Sampling
  - Unfiltered samples were collected using a decontaminated plastic bucket and then transferred to sample containers. Samples requiring filtering were then filtered through a 0.45 micron filter into the appropriate container.
  - Because of extremely cold weather conditions during the sampling event, the phosphate-free detergent rinse and deionized water rinse were eliminated from the decontamination procedure.
  - The stream gauging station at surface water sampling location 25 was not accessible because of snow and ice.
- April 1993 - Surface Water Sampling
  - Four additional surface water sampling locations were added.
  - Samples requiring filtering were collected in decontaminated plastic buckets and then immediately filtered through a 0.45 micron filter into the appropriate container.

Sediment sampling results are discussed in Section 4.5.

2.5.1.3 Stream Gauging Procedures

At each stream gauging point, a cross section was established, and river depth and velocity were then measured at points across the width of the river. These points were spaced approximately 3 to 4 feet apart. Total river flow was then calculated by summing flow through each of the subsections. This procedure was employed at the sampling locations 01, 03, 10, 16, and 25, weather and river conditions permitting.

Channel cross sections for stream gauging were chosen on the basis of their stable geometries, lack of inlets or outlets in the immediate vicinity of measurements, and for the uniform flow over a range of water depths. Actual measurements were conducted using the following procedure:

- At each designated cross-section, a surveyor's tape was set or held on the stake at either bank.
- The measurements were taken by proceeding across the river width with the tape and the current meter, moving along a line normal to the flow.
- The river depth and distance from the stake were recorded every 3 to 4 feet of width.
- At these same points, one (or two if the section was greater than approximately 3 feet deep) flow velocity measurement(s) were taken according to the following procedure:
  - The current meter was mounted on a vertical rod and faced into the river flow.
  - Care was taken not to stand in front of current meter.
  - If one measurement was made, the velocity was recorded at a point 0.6 x (total river depth below the water surface).
  - If two measurements were made, velocities were recorded at 0.2 and 0.8 x (total river depth below the water surface).

Total flow through each cross-section was derived by using the following calculations:

1. The average velocity at each point across the channel width is equal to the velocity measured at 0.6 x (total river depth below the water surface) or the average of the velocities at 0.2 and 0.8 x (total river depth below the water surface).

2a. The partial area associated with each average velocity comprises a rectangle extending horizontally from half the distance from the preceding depth location to half the distance to the next depth location, and vertically from the water level to the measured depth.

*Example 1: Three depths of 0.6, 1.3, and 2.4 ft were measured at locations 4.0, 6.5, and 9.0 ft from the on-bank stake marking the cross section. The partial area for the second location 6.5 ft from the stake is 3.25 ft^2: 1.3 ft depth x [1/2 *(6.5 ft - 4.0 ft) + 1/2*(9.0 ft - 6.5 ft)]*

2b. The partial area associated with depth measurements adjacent to each bank is the depth multiplied by half the distance to the next depth location.

Example 2: Utilizing the points of example 1, the partial area associated with the first reading (4.0 ft from the stake) is 0.75 ft^2: 0.6 ft depth x (1/2 x (6.5 ft - 4.0 ft).

3. The partial flow at each measurement location is the product of the average velocity and its associated partial area.

Example 3: If the three points listed in example 1 had average velocities of 0.1, 0.9 and 1.5 ft/sec respectively, the partial flows for the first two sections are approximately 0.08 ft^3/sec (0.1 ft/sec x 0.75 ft^2) and 2.93 ft^3/sec (0.9 ft/sec x 3.25 ft^2).

4. All of the calculated partial flows through the cross section were summed to obtain the total flow.

2.5.2 Sediment Investigation

This section describes the rationale used to select the sediment sampling locations and their relationship to the surface water sampling locations.

2.5.2.1 *Sampling Locations Selection Process*

Sediment sampling locations were selected in the same vicinity as the surface water sampling locations to aid in evaluating stream loading. An exception to this rationale was the additional sediment sampling which took place from November to December 1992. Two locations, A1 and A2, were located between surface water sampling locations 22 and 23, nearer to 23 and upstream from the FMC and Simplot facilities. Four other locations (O212DB1, O212DC1, O212DC2, and O212DC4) were located downstream of all surface water monitoring points. Specific locations were chosen in areas of quiet water, where sediments were most likely to have settled. These areas were usually near the bank or behind a barrier (e.g., a fallen tree branch, gravel bar, or island).

No sediment sample was collected from the fish hatchery because the bottom is concrete and sediment had not accumulated there. This is an exception to the RI/FS Work Plan (Bechtel, 1992a).

2.5.2.2 *Sampling Procedures*

The following section describes the QA/QC, sampling, and decontamination procedures followed during sediment sampling. The section also describes

laboratory procedures used for chemical and radiological analyses of samples collected during both onsite surface water and sediment sampling.

Quality Assurance/Quality Control. The sediment sampling program adhered to the EMF QAPP (Bechtel, 1992b). One rinsate sample was collected for each round of sediment sampling. Rinsate samples consisted of deionized water that was poured over or through sampling equipment after decontamination. Rinsate samples were analyzed for the parameters listed in Table 2.5-6.

One duplicate sample set was submitted to MSA for every 20 sediment samples collected. Duplicate samples were analyzed for the parameters listed in Table 2.5-6.

Sediment Sampling Procedures. The sample locations chosen were away from strongly flowing stream areas. Samples were collected using a piston-type tubular sampler during the August 1992 sampling, or either a piston-type or hammer-driven sampler for subsequent samples (November to December 1992). The samplers were driven to a depth of approximately 6 inches into the river bed and withdrawn carefully so that the sample was contained in the samplers and was as undisturbed as possible. The samples were extruded from the tube into appropriately labeled sample jars with the aid of a stainless steel spatula.

One sample location (C3) did not contain sufficient depth of fine-grained sediments to allow sample collection with tubular (piston-type or hammer-driven) samplers. For this sample location only, a dredge bucket apparatus was used to obtain a sample with as much fine-grained sediments as possible.

Sampling Equipment Decontamination. In July 1992, all sampling equipment was decontaminated after use by spraying it with a solution of deionized water and phosphate-free detergent and then scrubbing with a steel or plastic brush. It was then sprayed again with deionized water and phosphate-free detergent and thoroughly rinsed with deionized water.

In December 1992, subzero weather conditions restricted the use of spray bottles. The sampling equipment was decontaminated with an identical sequence of detergent, scrubbing, detergent and rinse, but the liquids were poured rather than sprayed.

In addition, a different sediment sampler was used during the December 1992 sampling which allowed use of a new, clean plastic sleeve to contain each sediment sample.

Chemical and Radiological Analysis of Samples. All sediment samples collected were analyzed for heavy metals, fluoride, orthophosphate, total phosphorus, PCBs, pH, total organic carbon (TOC), and radiological parameters. Table 2.5-6 lists the specific sediment analyses that were performed. Sulfate and potassium were added

to the list of parameters for the July 1993 sediment samples. Table 2.5-5 lists the parameters, EPA method number, and the PRDL for sediment sample analyses. MSA performed the chemical analyses, and GEL conducted the radiological analyses.

2.5.3 Drainage Investigation

An investigation of drainage at the EMF study area was necessary to determine if there were opportunities for the exchange of onsite and offsite surface waters to occur. The investigation consisted of a 2-day site and map inspection by a qualified hydrologist on December 2 and 3, 1992, research of published climatological and hydrological data, and hydrologic evaluations to analyze the quantity of storm runoff at the site.

The nature of the investigation was affected by the arid environment of the EMF study area. Because surface runoff occurs only during rainstorms or snowmelt, none was observable during the site inspection. However, drainage boundaries and flow paths were apparent from site topography.

It is clear from the regional topography that the Portneuf River would be the receiving water for any uncontrolled surface drainage from the EMF facilities. Following the site and map investigation, discussions with plant personnel, and preliminary evaluations, it became apparent that no surface runoff is released from a typical rainstorm. The drainage system relies on the containment of runoff. At FMC, surface water is retained on the site in local depressions. At Simplot, runoff is collected in ponds for later use either on the site or, after treatment, as irrigation water. Further investigations therefore focused on establishing whether the drainage system could contain runoff from storm or snowmelt events.

The *Superfund Exposure Assessment Manual* (EPA, 1988) does not include guidance on selecting a storm event for drainage system analysis. Existing data from the Pocatello Airport Weather Service Office was examined, and the largest storm event recorded in over 40 years of operation of the facilities was selected for stormwater drainage analysis. Analysis of stormwater runoff from this storm demonstrates that the drainage systems at the facilities prevent stormwater releases from occurring.

Climatological data collected and analyzed included rainfall records of the Pocatello Airport Weather Service Office, published by the National Weather Service. Historical snow course measurements for the Wildhorse Divide SNOTEL site were obtained from the U.S. Soil Conservation Service (SCS) office in Boise, Idaho. Data needed to compute a storm depth-duration-frequency table were obtained from the NOAA atlas for Idaho. Independent storm event statistics were extracted from an EPA report (EPA, 1989b).

The EMF facilities property was divided into independent drainage areas for analysis. The separate drainage areas were modeled using the hydrologic model

HEC-1, developed by the U.S. Army Corps of Engineers. Where applicable, storage routing through ponds was established and maximum water levels were calculated. Because runoff from the Michaud Creek and the western portion of the FMC facility collect in the same depression, both drainage areas were modeled together. The results of all calculations are presented in Section 3.2.

2.6 LAND USE AND SOCIOECONOMIC SURVEY

Investigations were conducted to characterize the demographics and land use within the EMF study area. Information regarding potential receptors of facility-related constituents and groundwater usage within the study area was also collected.

Demographic data describing the populations living within the study area were collected from Bannock and Power counties' planning agencies, and the cities of Pocatello and Chubbuck. This information is presented in Section 3.6.

Current land uses were determined based on zoning maps of the cities of Pocatello and Chubbuck, and Bannock County; 1992 aerial photographs; and a windshield reconnaissance in October 1992. The aerial photographs and windshield survey verified current land uses outlined on zoning maps. Land use in Power County was determined based on windshield reconnaissance and 1992 aerial photographs.

Future land uses were determined based on comprehensive plans of the cities of Pocatello and Chubbuck, and Bannock County. Power County does not have a comprehensive plan but is in the process of developing one.

Locations of groundwater wells within the study area were obtained from the Idaho Department of Water Resources data files. Wells in these data files were not recorded to distinguish between potable, irrigation, or livestock uses. Locations were mapped and are presented in Section 3.6.

Locations of potentially sensitive receptor populations, as defined in the RI/FS Work Plan (Bechtel, 1992a), were determined through agency contacts, and are discussed in Section 3.6.

A well canvas was not conducted during the investigation. However, state records were searched and any private wells registered within the EMF study area were noted. The results of this activity can be found in Section 3.6.

2.7 ECOLOGICAL INVESTIGATION

The Phase I ecological activities were designed to collect data on the terrestrial and aquatic biological resources on and in the vicinity of the EMF facilities. These data can be used to prepare the EPA Site Risk Assessment. A phased approach was used for the preliminary site characterization. Phase I included a literature review and site reconnaissance to identify special status species and habitats in the area as well as areas of biological importance (Bechtel, 1992a).

The initial Phase I study area had a 3-mile (4.8-km) radius. This area was selected to be studied concurrently with other Phase I investigations, including those regarding potential sources, groundwater and offsite soils, sediment, and surface water quality. Field reconnaissance was conducted in September 1992, February 1993, and June 1993. During the September 1992 reconnaissance, local experts and government agencies were contacted regarding biological resources in the EMF study area, which include special status species as well as habitats and species targeted for human consumption. Special status species include those that are listed as threatened or endangered by the state or federal government and those that are candidates for listing. Sensitive habitats include wetlands, streams and riparian zones, critical habitats designated for threatened or endangered species, and habitats designated by state and federal agencies as special.

The field reconnaissance in September involved a 4-day ground survey of the study area. Representatives of the EPA and U.S. Fish and Wildlife Service (U.S. FWS) participated in the reconnaissance survey of the surrounding areas. All major habitat types were examined, including wetlands delineated by the U.S. FWS within the study area (U.S. FWS, 1980). Prevalent plant and animal species were noted, as were signs of any observed stress.

Because of the time of year, prevalent plant species were identified only on the basis of vegetative characteristics. Further investigation in May 1993 provided additional information on plant species composition, characteristics of plant communities, and existing stresses in the study area. Agricultural areas were surveyed, and fallow land, crop land, and wooded areas were noted.

In September 1992, the Portneuf River was examined at street and highway bridges in Pocatello (near river mile 17 and downstream). The river was also examined by boat between the bridge at Interstate Highway 86 (river mile 13.4) and Siphon Road (river mile 11), and from Interstate Highway 86 to Reservation Road (near river mile 8.2). The river near the FMC and Simplot facilities (river mile 13.5) was examined on foot. Bottom substrate, macroinvertebrates, fish, general water quality, macrophytes, and adjacent riparian wetland vegetation composition were noted qualitatively. In October 1992, habitats adjacent to sediment and water quality sampling locations were characterized during water quality sampling. In addition to

the parameters noted during the September trip, water depth and flow, and bank height were determined, as were the general community structures and species composition of the adjacent riparian and wetland habitats.

During the reconnaissance, a vegetation cover and habitat map were prepared based on aerial photographs and field verification. Wetlands identified by the U.S. FWS wetland inventory maps (1980) were also visually checked for presence, condition, and species composition.

In February 1993, the Portneuf River was floated on three successive days from approximately 8:30 a.m. to 12:00 p.m. to characterize use by waterfowl and raptors along the river.

The May 1993 field reconnaissance included a 4-day ground survey that examined sensitive habitats that may have been affected by chemicals of potential concern from the EMF facilities. The purpose of the survey was to look for evidence of existing stresses and to further identify the occurrence and use of habitats by sensitive species in the study area. Areas for reconnaissance were selected on the basis of the analysis of water quality, sediments, and soils. Particular emphasis was placed on areas in which the concentrations of constituents of potential concern were found to be higher than background. Habitats were examined for general conditions of vegetation, including species composition. These conditions were evaluated by floating the river from Batiste Springs to the mouth of the Portneuf River and field reconnaissance of Michaud Creek. The habitats of nesting raptors, nesting colonial waterbirds, and waterfowl along the Portneuf River, Michaud Creek, and the cliff habitat south of the EMF facilities were examined.

The potential habitat for Townsend's big-eared bat in the bluffs south of the EMF facilities (see Section 3.7.1) was searched for evidence of the species. Cliff areas above the Simplot gypsum stack on the southern portion of the Simplot property were examined in particular. Two personnel were positioned to observe any flying bats from sundown to one hour after sundown. In addition, reported nesting locations of golden eagles and prairie falcons in this area were examined for evidence of active raptor nests.

2.8 REFERENCES

Bechtel, 1991. Draft Work Plan for an RI/FS to be Conducted at the Eastern Michaud Flats Site, Bechtel Environmental, Inc., August.

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Tables

Table 2.1-1
FMC Potential Source Investigation

Potential Source	Sample ID	Location in Report	Sampling Rationale	Media	Sample Depth	No. of Locations	Sample Intervals	Analytes	Notes
Phase I									
Pond 8S	F020B-F022B	Fig. 2.1-1	Unlined pond, phossy wastes	Soil	to GW	3	SS, 10'	Table 2.1-2	(a)
Old Ponds 1C, 2C	F023B	Fig. 2.1-1	Old ponds-calciner sludge	Soil	to GW	1	SS, 10'	Table 2.1-2	
Pond 4E (dried)	F024B	Fig. 2.1-1	Old ponds-phossy water, ppt. dust	Soil	to GW	1	SS, 10'	Table 2.1-2	
Old Pond 5E	F025B	Fig. 2.1-1	Old ponds-phossy water	Soil	to GW	1	SS, 10'	Table 2.1-2	
Old Pond 6E	F026B	Fig. 2.1-1	Old ponds-phossy water	Soil	to GW	1	SS, 10'	Table 2.1-2	
Landfill, active	F027B	Fig. 2.1-1	Potential solid wastes-AFM	Soil	to GW	1	SS, 10'	Table 2.1-2, Organics	
Chemical Lab Drain Pit	F028B, F029B	Fig. 2.1-1	Drainfield-potential lab chemicals, organics	Soil	to GW	2	SS, 10'	Table 2.1-2, Organics	(b)
IWW Basin/Ditch	F030B	Fig. 2.1-1	Cooling water-potential biocides, corrosion inhibitors	Soil	to GW	1	SS, 10'	Table 2.1-2	
Boiler Fuel Tank and Pipeline Area	B14, B15	Fig. 2.1-1	Potential pipeline leak, spills-TPH	Soil	50 feet	2	5.0'	Table 2.1-2, TPH	
Pond 1E (dried)	F033B	Fig. 2.1-1	Old ponds-phossy water, ppt. dust	Soil	15 feet	1	SS, 5'	Table 2.1-2	(b)
Area 9S	F034B	Fig. 2.1-1	Old ponds-phossy water, ppt. dust	Soil	15 feet	1	SS, 5'	Table 2.1-2	(b)
Transformer Salvage Area	F035B, F036B	Fig. 2.1-1	Potential PCB leaks	Soil	10 feet	2	SS, 2.5'	Table 2.1-2, PCBs	(b)
Waste Oil Storage Area	F037B, F038B	Fig. 2.1-1	Old ponds-phossy water, ppt. dust, PCBs, TPH	Soil	10 feet	2	SS, 2.5'	Table 2.1-2, PCBs, TPH	(b,c)
Railroad Swale	F039B-F042B	Fig. 2.1-1	Potential phos dock spills-phossy water, phosphorus	Soil	10 feet	4	SS, 2.5'	Table 2.1-2	(b,c)
PCB Storage Shed	F043B-F045B	Fig. 2.1-1	Potential PCB spills	Soil	10 feet	3	SS, 2.5'	Table 2.1-2, PCBs	
Septic Tank Areas incl. East of FMC Electric Sign	F046B-F049B	Fig. 2.1-1	Sewage drainfield-nitrate plume	Soil	10 feet	4	SS, 2.5'	Table 2.1-2, Nitrate	
Calciner Pond Sediment Areas South of Calciner Ponds	F050B, F051B	Fig. 2.1-1	Unlined pile-selenium plume, calciner sludge	Soil	10 feet	2	SS, 2.5'	Table 2.1-2	(b)
Secondary Condenser/Fluid Bed Drier Area	F052B, F053B	Fig. 2.1-1	Potential phosphorus spills, leaks	Soil	10 feet	2	SS, 2.5'	Table 2.1-2	
Kiln (Scrubber) Overflow Pond (under calciner fines pile)	F054B	Fig. 2.1-1	Old ponds-selenium, arsenic	Soil	10 feet	1	SS, 2.5'	Table 2.1-2	(d)
Old Pond 7S Treo-Line Area	F055B-F057B	Fig. 2.1-1	Potential PCB spills	Soil	2 feet	3	SS+2'	Table 2.1-2, PCBs	
8S Recovery Process	F058B, F059B	Fig. 2.1-1	Potential spills-arsenic, TPH, PCBs	Soil	2 feet	2	SS+2'	Table 2.1-2, PCBs, TPH	
Area West of Mobile Shop	F060B, F061B	Fig. 2.1-1	Potential oil & lubricant spills-PCBs, TPH	Soil	2 feet	2	SS+2'	Table 2.1-2, PCBs, TPH	
Long-Term Phosphorus Storage Tanks	F062B, F063B	Fig. 2.1-1	Potential phosphorus spills	Soil	2 feet	2	SS+2'	Table 2.1-2	
Phos Dock Area	F064B, F0565B	Fig. 2.1-1	Potential phosphorus spills	Soil	Surface	2	SS	Table 2.1-2	
Paved Area North of Furnace Bldg. incl. Phos Dock	F066B-F069B	Fig. 2.1-1	Potential phosphorus spills	Soil	Surface	4	SS	Table 2.1-2	
Phossy Waste Pipeline Cleanout Areas and Intervals	F070B-F074B	Fig. 2.1-1	Potential spills-arsenic	Soil	2 feet	5	SS+2'	Table 2.1-2	(c)
Precipitator Slurry Pipeline Cleanout Areas and Intervals	F075B-F079B	Fig. 2.1-1	Potential spills-arsenic	Soil	2 feet	5	SS+2'	Table 2.1-2	(b,c)

Table 2.1-1 (Cont'd)

Potential Source	Sample ID	Location in Report	Sampling Rationale	Media	Sample Depth	No. of Locations	Sample Intervals	Analytes	Notes
Bannock Paving Areas	F080B-F082B	Fig. 2.1-1	Potential spills, oils, deposition-TPH, PCBs	Soil	2 feet	3	SS+2'	Table 2.1-2, PCBs, TPH	
Railcar Loading & Unloading Areas-BPC	F083B, F084B	Fig. 2.1-1	Potential spills, oils, deposition	Soil	2 feet	2	SS+2'	Table 2.1-2, PCBs, TPH	
Railcar Loading & Unloading Areas-FMC	F085B-F088B	Fig. 2.1-1	Potential spills, oils, deposition	Soil	2 feet	4	SS+2'	Table 2.1-2, PCBs, TPH	
Shale Ore Handling Areas	F089B-F094B	Fig. 2.1-1	Potential deposition	Soil	2 feet	6	SS+2'	Table 2.1-2, PCBs, TPH	
Surface Roads FMC & BPC	F101B-F123B	Fig. 2.1-1	Potential spills, oils, deposition-TPH, PCBs	Soil	2 feet	20	SS+2'	Table 2.1-2, PCBs, TPH	
Water in Railroad Swale	FWWRRS01	Fig. 2.1-2	Potential phosphorus spills	Water	Composite	4	NA	Table 2.1-3	(e)
Water Discharged to Calciner Ponds	FSWCPW01	Fig. 2.1-2	Potential selenium	Water	Composite	1	6 hrs	Table 2.1-3	(f)
IWW Ditch Discharge to Portneuf River	FSWIWW01	Fig. 2.1-2	Cooling water-potential biocides, corrosion inhibitors	Water	Composite	1	6 hrs	Table 2.1-3	(b,f)
Phossy Water Discharged to Phase IV Ponds	FSWPWSTV	Fig. 2.1-2	Phosphorus	Water	Composite	1	6 hrs	Table 2.1-3	(a,f)
Precipitator Slurry Discharged to Pond 8E	FSWPS88E	Fig. 2.1-2	Phosphorus	Slurry	Composite	1	6 hrs	Table 2.1-3	(a,f)
Slag Pile Storage Areas	FWSSSA01 - 06	Fig. 2.1-2	Potential spills, oils, deposition	Soil	Surface	6	NA	Table 2.1-2, TCLP	
Ferrophos Storage Areas	FWSFSA01 - 03	Fig. 2.1-2	Potential spills, oils, deposition	Soil	Surface	3	NA	Table 2.1-2, TCLP	
IWW Ditch Sediments	FSOIWW01 - 06	Fig. 2.1-2	Cooling water-potential biocides, corrosion inhibitors	Soil	Surface	5	NA	Table 2.1-2	(b)
Phosphate Ore	FOSFPO01	Fig. 2.1-2	Potential source of trace elements/radioactivity	Ore		1	NA	Table 2.1-2	
Calciner Pond Sediment Areas	F127B,	Fig. 2.1-2	F050B	Soil	to GW	1	SS, 5'	Table 2.1-2, Sulfate, Potassium	
	F128B	Fig. 2.1-2	F051B	Soil	100 feet	1	SS, 10'	Table 2.1-2, Sulfate, Potassium	
Road Sample	F129B	Fig. 2.1-2	F112R	Soil	25 feet	1	SS, 2.5'	Table 2.1-2, Sulfate, Potassium	
Kiln Scrubber and Overflow Pond	F130B	Fig. 2.1-2	F054B	Soil	to GW	1	0, 10'	Table 2.1-2, Sulfate, Potassium	
Railroad Swale	F131B	Fig. 2.1-2	F040B	Soil	to GW	1	10', 20'	Table 2.1-2, Sulfate, Potassium	
Shale Ore Handling Area	F132B	Fig. 2.1-2	F090B	Soil	10 feet	1	SS, 2.5'	Table 2.1-2, Sulfate, Potassium	
Road Samples	F035B, F056B, F057B, F060B, F061B, F081B, F084B, F101B, F105B, F123B	Fig. 2.1-2	Phase I PCB Validation	Soil	4 feet	10	SS, 2.5'	PCBs	
IWW Ditch Discharge to Portneuf River	0O307IWA thru O307IWQ	Fig. 2.1-2	FSWIWW01	Water	Surface & Subsurface	14	NA	Table 2.1-3	

Notes:

(a) Risk of encountering elemental phosphorus is high.
(b) Investigated during 1990 drilling program.
(c) Risk of encountering elemental phosphorus is low.
(d) Depth is into native soil.
(e) Location-composite sample.
(f) 24-hr composite sample.
GW = Groundwater.
NA = Not analyzed.
PCBs = Polychlorinated biphenyls.
SS = Surface sample.
TCLP = Toxicity characteristics leaching procedure.
TPH = Total petroleum hydrocarbons.

Table 2.1-2
Analytical Parameters for Phosphate Ore, Waste, Sludge, and Soil Samples

I. Heavy Metals	
Aluminum	
Antimony	
Arsenic	
Barium	
Beryllium	
Boron	
Cadmium	
Chromium	
Cobalt	
Copper	
Iron	
Lead	
Lithium	
Manganese	
Mercury	
Molybdenum	
Nickel	
Selenium	
Silver	
Thallium	
Vanadium	
Zinc	
II. General Mineral	
Fluoride	
Phosphorus (total)	
Phosphorus (orthophosphate)	
Elemental phosphorus (FMC site only)	
II. Radioactivity	
Gross alpha	
Gross beta	
Gamma spectroscopy[a,b]	
Uranium-238[b]	
Polonium-210[b]	
IV. Total Petroleum Hydrocarbons (TPH)[c]	
V. Polychlorinated Biphenyls (PCBs)[c]	
Aroclor 1016	
Aroclor 1221	
Aroclor 1232	
Aroclor 1242	
Aroclor 1248	
Aroclor 1254	
Aroclor 1260	
VI. Volatile Organics[c]	
	Chloromethane
	Bromomethane
	Vinyl chloride
	Chloroethane
	Methylene chloride
	Acetone
	Carbon disulfide
	1,1-dichloroethene
	1,1-dichloroethane
	Trans-1,2-dichloroethene
	Chloroform
	1,2-dichloroethane
	2-Butanone
	1,1,1-trichloroethane
	Carbon tetrachloride
	Vinyl acetate
	Bromodichloromethane
	1,2-dichloropropane
	cis-1,3-dichloropropene
	Trichloroethene
	Dibromochloromethane
	1,1,2-trichloroethane
	Benzene
	Trans-1,3-dichloropropene
	2-chloroethylvinylether
	Bromoform
	4-methyl-2-pentanone
	2-hexanone
	Tetrachloroethene
	1,1,2,2-tetrachloroethane
	Tetrahydrofuran
	Toluene
	Chlorobenzene
	Ethylbenzene
	Styrene
	Total xylenes
VII. Semivolatile Organics[c]	
	Phenol
	bis(2-chloro-ethyl)ether
	2-chlorophenol
	1,3-dichlorobenzene
	1,4-dichlorobenzene
	benzyl alcohol
	1,2-dichlorobenzene
	2-methylphenol

Table 2.1-2 (Cont'd)

VII. Semivolatile Organics (Cont'd)	
bis(2-chloroisopropyl)ether	4,6-dinitro-2-methylphenol
4-methylphenol	N-Nitrosodiphenylamine
n-nitroso-dipropylamine	4-Bromophenyl phenyl ether
Hexachloroethane	Hexachlorobenzene
Nitrobenzene	Pentachlorophenol
Isophorone	Phenanthrene
2-nitrophenol	Anthracene
2,3-dimethylphenol	Di-n-butyl phthalate
Benzoic acid	Fluoranthene
bis(2-chloroethoxy)methane	Pyrene
2,4-dichlorophenol	Butyl benzyl phthalate
1,2,4-trichlorobenzene	3,3"-dichlorobenzidine
Naphthalene	Benzo(a)anthracene
4-chloroaniline	bis(2-ethylhexyl)phthalate
Hexachlorobutadiene	Chrysene
4-chloro-3-methylphenol	Di-n-octyl phthalate
2-methylnaphthalene	Benzo(b)fluoranthene
Hexachlorocyclopentadiene	Benzo(k)fluoranthene
2,4,6-trichlorophenol	Benzo(a)pyrene
2,4,5-trichlorophenol	Indeno(1,2,3-c,d)pyrene
2-chloronaphthalene	Dibenzo(a,h)anthracene
2-nitroaniline	Benzo(g,h,l)perylene
Dimethyl phthalate	(1-methylethyl)-Benzene
Acenaphthylene	
3-nitroaniline	
Acenaphthylene	**VIII. Toxicity Characteristics Leaching Procedure (TCLP)[d]**
2,4-dinitrophenol	
4-nitrophenol	
Dibenzofuran	**IX. Other**
2,4-dinitrotoluene	Nitrate[c]
2,6-dinitrotoluene	pH
Diethyl phthalate	
4-chlorophenyl phenyl ether	
Fluorene	
4-nitroaniline	

Notes:

(a) Ore, waste, and sludge samples only.

(b) Selected offsite soil samples only.

(c) Select samples analyzed for one or more of the following: PCBs, TPH, volatile organic compounds, semivolatile organic compounds, and nitrates. See Tables 2.1-1 and 2.1-7.

(d) Selected samples analyzed for the eight RCRA metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver) after being subjected to the TCLP extraction procedure. See Table 2.1-1.

Table 2.1-3
Phase I FMC Potential Source Field Parameter Data Summary

Sample ID	Date	Temp (°C)	Specific Conductance ($x10^3$ mS/cm)	pH
FWWRRS01	1 September 92	19.8	1.90	10.16
FSWCPW01	3 September 92	38.0	3.50	4.67
FSWIWW01	3 September 92	25.0	0.130	7.12
FSWPWSIV	3 September 92	23.0	0.375	7.99
FSWPS88E	3 September 92	19.8	1.206	10.47

Table 2.1-4
Analytical Parameters for Potential Source Water/Waste and Surface Water

I. Heavy Metals[a]	II. Water Quality Parameters	III. Radioactivity
Aluminum	Alkalinity (bicarbonate)	Gross Alpha
Antimony	Alkalinity (carbonate)	Gross Beta
Arsenic	Ammonia	Radium-226
Barium	Calcium	Radium-228
Beryllium	Chloride	
Boron	Conductivity	
Cadmium	Dissolved oxygen[b]	
Chromium	Fluoride	
Cobalt	Magnesium	
Copper	Nitrate	
Iron	pH	
Lead	Phosphorus (total)	
Lithium	Phosphorus (orthophosphate)	
Manganese	Potassium	
Mercury	Sodium	
Molybdenum	Sulfate	
Nickel	Temperature	
Selenium	Total Dissolved Solids	
Silver	Total Suspended Solids[b]	
Thallium		
Vanadium		
Zinc		

Notes:
(a) Both unfiltered and filtered surface water samples submitted for metals analysis.
(b) Surface water samples only.

Table 2.1-5
Phase II IWW Ditch Data Summary – Field Parameters

Days	Sample ID	Date	Time	Location	COC (w/filter media)	Est. Flow (gpm)	Avg. Temp	ORP (mv)	Field Parameters pH	Temp (°C)	Conductivity ($x10^3$ mS/cm)	DO (mg/l)	Notes
1	0307IW A[a]	8/6/93	07:30	(b)	5999	916	80	120	8.8	22.2	1.351	6.2	Original QA sample
	0307IW B[a]	8/6/93	07:30	(b)	6000	916	80	120	8.8	22.2	1.351	6.2	MS sample
	0307IW C[a]	8/6/93	07:30	(b)	5301	916	80	120	8.8	22.2	1.351	6.2	MSD sample
2	0307IW D	7/27/93	07:30	(b)	5959	1712	75	77	8.9	18.5	0.592	6.4	
3	0307IW E[a]	7/28/93	07:30	(b)	5971	2036	78	103	8.7	22.1	0.644	6.5	
4	0307IW F[a]	7/29/93	07:30	(b)	5990	2002	78	98	8.7	23.3	0.684	6.2	
5	0307IW G[a]	7/30/93	07:30	(b)	5991	1964	78	81	8.8	24.2	0.20	6.2	
	0307IW H[a]	7/30/93	07:30	(b)	5992	1964	78	81	8.8	24.2	0.20	6.2	Blind duplicate
6	0307IW I	7/31/93	07:30	(b)	5993	1705	77	53	8.9	22.0	0.846	6.1	
7	0307IW J	8/1/93	07:30	(b)	5994	1658	77	72	8.9	21.5	0.786	6.3	
8	0307IW K	8/2/93	07:30	(b)	5995	1688	78	146	9.0	21.6	0.944	6.3	
9	0307IW L	8/3/93	07:30	(b)	5996	1891	79	95	8.8	21.0	0.803	6.1	
10	0307IW M	8/4/93	07:30	(b)	5997	1562	80	111	8.7	21.3	0.848	6.3	
11	0307IW N[a]	8/5/93	07:30	(b)	5998	998	80	101	8.5	18.7	0.696	6.2	
12	0307IW O	8/7/93	07:30	(b)	5302	1239	80	114	8.9	19.8	0.984	6.4	
13	0307IW P[a]	8/8/93	07:30	(b)	5303	1225	80	101	9.0	19.9	0.712	6.1	
14	0307IW Q	8/9/93	07:30	(b)	5304	1271	81	82	8.9	20.4	0.731	6.2	
	0307IW R1[a]	7/25/93	15:00	BEI trailer	5988	–	–						Rinsate

Notes:

(a) Samples submitted for full analysis.
(b) Location for IWW ditch sampling same as EMF Phase I (September 1992) FSWIWW01.
ORP = oxidation reduction potential, mv

93-1477c.053/SH/sh/R4

Table 2.1-6
FMC Potential Source and Onsite Soil Boring Summary

Phase I

Phase I Sample ID	Generalized Sample Description	Actual Sample Depth, ft	Date Drilled	General Location
B-12	Sampled at 10-foot intervals	20-95	27-Apr-92	Pond 8S
B-13	Sampled at 10-foot intervals	10-110	28-Apr-92	Pond 8S
150	Sampled at 10-foot intervals	10-100	29-Apr-92	Pond 8S
B-14	Sampled at 5-foot intervals	5-30	14-May-92	Boiler Fuel Tank & Pipeline
B-15	Sampled at 5-foot intervals	5-30	14-May-92	Boiler Fuel Tank & Pipeline
F023B000	Sandy silt, light brown, dry	0	11-Sep-92	Old pond 1C & 2C
F023B010	Clayey silt, strong brown	10	11-Sep-92	Old pond 1C & 2C
F023B020	Clayey silt, strong brown	20	11-Sep-92	Old pond 1C & 2C
F023B030	Clayey silt, strong brown	30	11-Sep-92	Old pond 1C & 2C
F023B040	Sandy gravel, dark yellowish brown	40	11-Sep-92	Old pond 1C & 2C
F023B050	Sandy gravel, dark yellowish brown, angular	50	11-Sep-92	Old pond 1C & 2C
F023B060	Sandy gravel, dark yellowish brown	60	11-Sep-92	Old pond 1C & 2C
F023B070	No recovery	70	11-Sep-92	Old pond 1C & 2C
F024B000	Fill and brown silt	0	16-Sep-92	Pond 4E
F024B010	Silt, brown	10	16-Sep-92	Pond 4E
F024B020	Silt, brown	20	16-Sep-92	Pond 4E
F024B030	Silt, brown	30	16-Sep-92	Pond 4E
F024B040	Silt, brown	40	16-Sep-92	Pond 4E
F024B050	Silt, brown, very moist	50	16-Sep-92	Pond 4E
F024B060	Sandy gravel, brown	60	16-Sep-92	Pond 4E
F024B070	Brown, gravelly sand	70	16-Sep-92	Pond 4E
F024B080	Silt, light yellowish-brown	75	16-Sep-92	Pond 4E
F025B000	Silt, dark olive green - 5 ft.	5	15-Sep-92	Old pond 5E
F025B010	Silt, dark olive green - 5 ft.	10	15-Sep-92	Old pond 5E
F025B020	Silt, light brown	20	15-Sep-92	Old pond 5E
F025B030	Sandy gravel, light brown	30	15-Sep-92	Old pond 5E
F025B040	No recovery	40	15-Sep-92	Old pond 5E
F025B050	No recovery	50	15-Sep-92	Old pond 5E
F025B060	Gravely silt, strong brown	60	15-Sep-92	Old pond 5E
F025B070	Silt, light brown, moist	70	15-Sep-92	Old pond 5E
F026B000	Silt, light yellow-brown - 1.3/1.5 ft.	0	15-Sep-92	Old pond 6E
F026B010	Silt light yellow brown (wet) - 1.35/1.5 ft.	10	15-Sep-92	Old pond 6E
F026B020	No recovery - sandy gravel, grayish brown	20	15-Sep-92	Old pond 6E

Table 2.1-6 (Cont'd)

Phase I Sample ID	Generalized Sample Description	Actual Sample Depth, ft	Date Drilled	General Location
F026B030	No recovery - gravel/small boulders	30	15-Sep-92	Old pond 6E
F026B040	No recovery	40	15-Sep-92	Old pond 6E
F026B050	No recovery	50	15-Sep-92	Old pond 6E
F026B060	Silt, brown, wet	60	15-Sep-92	Old pond 6E
F027B000	Light brown silt	0	14-Sep-92	Landfill
F027B010	Silt, brownish-yellow	10	14-Sep-92	Landfill
F027B020	Silt, brownish yellow	20	14-Sep-92	Landfill
F027B030	Silt, brownish yellow	30	14-Sep-92	Landfill
F027B040	Silt, brownish yellow	40	14-Sep-92	Landfill
F027B050	Silt, yellowish-brown	50	14-Sep-92	Landfill
F027B060	Gravelly silt, yellowish-brown	60	14-Sep-92	Landfill
F027B070	Silt, yellowish-brown	70	14-Sep-92	Landfill
F027B080	Silt, yellowish-brown	80	14-Sep-92	Landfill
F027B090	Silt, yellowish-brown	90	14-Sep-92	Landfill
F027B100	Silt, yellowish-brown	100	14-Sep-92	Landfill
F027B110	Silt, yellowish-brown	110	14-Sep-92	Landfill
F027B120	Silt, yellowish-brown	120	14-Sep-92	Landfill
F027B130	Weathered gravel	130	14-Sep-92	Landfill
F027B140	Tuff, light gray	140	14-Sep-92	Landfill
F028B000	Silt/reddish-brown	0	12-Sep-92	N.E. of Chem Lab Seep Pit
F028B010	Silt, reddish-brown	10	12-Sep-92	N.E. of Chem Lab Seep Pit
F028B020	Silt, reddish-brown	20	12-Sep-92	N.E. of Chem Lab Seep Pit
F028B030	Sandy, medium grain (moist)	30	12-Sep-92	N.E. of Chem Lab Seep Pit
F028B040	No recovery	40	12-Sep-92	N.E. of Chem Lab Seep Pit
F028B050	No recovery	50	12-Sep-92	N.E. of Chem Lab Seep Pit
F028B060	No recovery	60	12-Sep-92	N.E. of Chem Lab Seep Pit
F028B070	Clayey silt, brown	70	12-Sep-92	N.E. of Chem Lab Seep Pit
F029B000	Gravelly silt, yellowish-brown	1	12-Sep-92	South of Chem Lab Seep Pit
F029B010	No recovery	10	12-Sep-92	South of Chem Lab Seep Pit
F029B020	Silt, brown	20	12-Sep-92	South of Chem Lab Seep Pit
F029B030	Silt, brown	30	12-Sep-92	South of Chem Lab Seep Pit
F029B040	Sandy gravel, dark yellowish-brown	40	12-Sep-92	South of Chem Lab Seep Pit
F029B050	No recovery	50	12-Sep-92	South of Chem Lab Seep Pit
F029B060	Sand-brown, coarse grain	60	12-Sep-92	South of Chem Lab Seep Pit
F029B070	Silt, brown	70	12-Sep-92	South of Chem Lab Seep Pit
F030B000	Sandy/gravel	0	11-Sep-92	IWW Ditch

Table 2.1-6 (Cont'd)

Phase I Sample ID	Generalized Sample Description	Actual Sample Depth, ft	Date Drilled	General Location
F030B010	Brown clayey silt	10	11-Sep-92	IWW Ditch
F030B020	Brown sandy silt (fine grain)	20	11-Sep-92	IWW Ditch
F030B030	Gravel and silty sand, yellowish-brown	30	11-Sep-92	IWW Ditch
F030B040	Gravel and silty sand, yellowish-brown	40	11-Sep-92	IWW Ditch
F030B050	Silty sand, brown, fine grain	50	11-Sep-92	IWW Ditch
F030B065	Silty/sand, dark brown, medium coarse grain	65	11-Sep-92	IWW Ditch
F030B070	Sandy silty gravel, dark brown, moist	75	11-Sep-92	IWW Ditch
F031B	Number not used - skipped sequence	NA	NA	NA
F032B	Number not used - skipped sequence	NA	NA	NA
F033B000	Silt, brownish-yellow	4.5	19-Sep-92	Pond 1E
F033B005	Silt, brownish-yellow	9.5	19-Sep-92	Pond 1E
F033B010	Silt, brownish-yellow	14.5	19-Sep-92	Pond 1E
F033B015	Silt, brownish-yellow	19.5	19-Sep-92	Pond 1E
F034B000	Silt, pale brown	5	19-Sep-92	Area 9S
F034B005	Silt, pale brown	10	19-Sep-92	Area 9S
F034B010	Sandy gravel, reddish-yellow	15	19-Sep-92	Area 9S
F034B015	Sandy gravel, reddish-yellow	20	19-Sep-92	Area 9S
F034R999	Rinsate	NA	18-Sep-92	Area 9S
F035B000	Silt, reddish yellow	2	19-Sep-92	Transformer Salvage Area
F035B002	Silt, reddish yellow	4.5	19-Sep-92	Transformer Salvage Area
F035B005	Silt, reddish brown	7	19-Sep-92	Transformer Salvage Area
F035B007	Silt, reddish brown	9.5	19-Sep-92	Transformer Salvage Area
F035B010	Silt, reddish yellow	12	19-Sep-92	Transformer Salvage Area
F036B000	Silt, light brown	1	19-Sep-92	Transformer Salvage Area
F036B002	Silt, light brown	3.5	19-Sep-92	Transformer Salvage Area
F036B005	Silt, light brown	6	19-Sep-92	Transformer Salvage Area
F036B007	Silt, light brown	8.5	19-Sep-92	Transformer Salvage Area
F036B010	Silt, light brown	11	19-Sep-92	Transformer Salvage Area
F037B000	Silt, whitish-gray	20	19-Sep-92	Waste Oil Storage Area
F037B002	Silt, whitish-gray	22.5	19-Sep-92	Waste Oil Storage Area
F038B	No sampling due to Phos	NA	19-Sep-92	Waste Oil Storage Area
F039B000	Silty gravel, dark yellowish-brown	0	21-Sep-92	Railroad Swale
F039B002	Silt, dark brown	2.5	21-Sep-92	Railroad Swale
F039B005	Sandy gravel, brown	5	21-Sep-92	Railroad Swale
F039B007	Silt, dark grayish-brown	7.5	21-Sep-92	Railroad Swale
F039B010	Silt, dark grayish-brown	10	21-Sep-92	Railroad Swale

Table 2.1-6 (Cont'd)

Phase I Sample ID	Generalized Sample Description	Actual Sample Depth, ft	Date Drilled	General Location
F040B000	Silt, yellowish-brown	14	20-Sep-92	Railroad Swale
F040B002	Gravel, coarse sand, brown	16.5	20-Sep-92	Railroad Swale
F040B005	No recovery	19	20-Sep-92	Railroad Swale
F040R999	Rinsate		20-Sep-92	Railroad Swale
F041B000	Dark black, high gravel	7.5	16-Sep-92	Railroad Swale
F041B002	Dark black silt	10	16-Sep-92	Railroad Swale
F041B005	Dark black silt	12.5	16-Sep-92	Railroad Swale
F041B007	No recovery	15	16-Sep-92	Railroad Swale
F041B010	No recovery	17.5	16-Sep-92	Railroad Swale
F041R999	Equipment rinsate from split spoon and sampling trowel	NA	16-Sep-92	Railroad Swale
F042B000	Fill, dark brown	7.5	16-Sep-92	Railroad Swale
F042B002	Silt, brown	10	16-Sep-92	Railroad Swale
F042B005	Silt, brown	12.5	16-Sep-92	Railroad Swale
F042B007	No recovery	15	16-Sep-92	Railroad Swale
F042B010	No recovery	17.5	16-Sep-92	Railroad Swale
F043B000	Dark yellowish brown silt	17	18-Sep-92	PCB Storage Shed
F043B002	Dark yellowish brown silt	19.5	18-Sep-92	PCB Storage Shed
F043B005	Dark yellowish brown silt	22	18-Sep-92	PCB Storage Shed
F043B007	Dark yellowish brown silt	24.5	18-Sep-92	PCB Storage Shed
F043B010	Dark yellowish brown silt	27	18-Sep-92	PCB Storage Shed
F044B000	Dark grayish brown silt (fill)	2	18-Sep-92	PCB Storage Shed
F044B002	Dark grayish brown silt (fill)	4.5	18-Sep-92	PCB Storage Shed
F044B005	Brown silt	7	18-Sep-92	PCB Storage Shed
F044B007	Brown silt	9.5	18-Sep-92	PCB Storage Shed
F044B010	Brown silt	12	18-Sep-92	PCB Storage Shed
F045B000	Yellowish-brown silt (fill)	3	18-Sep-92	PCB Storage Shed
F045B002	Yellowish-brown silt (fill)	5.5	18-Sep-92	PCB Storage Shed
F045B005	Yellowish-brown silt (fill)	8	18-Sep-92	PCB Storage Shed
F045B007	Yellowish-brown silt (fill)	10.5	18-Sep-92	PCB Storage Shed
F045B010	Yellowish-brown silt (fill)	13	18-Sep-92	PCB Storage Shed
F045R999	Rinsate	NA	18-Sep-92	PCB Storage Shed
F046B000	Dark yellowish-brown silt	0	20-Sep-92	Septic Tank Areas
F046B002	Slag gravel (coarse) and mud (black)	2.5	20-Sep-92	Septic Tank Areas
F046B005	Slag gravel	5	20-Sep-92	Septic Tank Areas
F046B007	Silt, dark yellowish-brown	7.5	20-Sep-92	Septic Tank Areas

Table 2.1-6 (Cont'd)

Phase I Sample ID	Generalized Sample Description	Actual Sample Depth, ft	Date Drilled	General Location
F046B010	Silt, dark yellowish-brown	10	20-Sep-92	Septic Tank Areas
F047B000	Top soil, dark brown	0	20-Sep-92	Septic Tank Areas
F047B002	Silt, dark yellowish-brown	2.5	20-Sep-92	Septic Tank Areas
F047B005	Silt, dark brown	5	20-Sep-92	Septic Tank Areas
F047B007	Silt, dark brown	7.5	20-Sep-92	Septic Tank Areas
F047B010	Silt, dark brown	10	20-Sep-92	Septic Tank Areas
F048B000	Top soil and silt (yellowish-brown)	0	20-Sep-92	Septic Tank Areas
F048B002	Silt, yellowish-brown	2.5	20-Sep-92	Septic Tank Areas
F048B005	Silt, yellowish-brown	5	20-Sep-92	Septic Tank Areas
F048B007	Silt, yellowish-brown	7.5	20-Sep-92	Septic Tank Areas
F048B010	Silt, yellowish-brown	10	20-Sep-92	Septic Tank Areas
F049B000	Silt, yellowish-brown	1.5	21-Sep-92	Septic Tank Areas
F049B002	Silt, light yellowish-brown	4	21-Sep-92	Septic Tank Areas
F049B005	Silt, light yellowish-brown	6.5	21-Sep-92	Septic Tank Areas
F049B007	Silt, light yellowish-brown	9	21-Sep-92	Septic Tank Areas
F049B010	Silt, light yellowish-brown	11.5	21-Sep-92	Septic Tank Areas
F049R999	Rinsate	NA	21-Sep-92	Septic Tank Areas
F050B000	Red brown clay/silt with sand	0	24-Sep-92	Calciner Pond Sediments
F050B002	Red brown clay/silt with sand - moist	2	24-Sep-92	Calciner Pond Sediments
F050B005	Red brown silt/sand clay - moist	4	24-Sep-92	Calciner Pond Sediments
F050B007	Red brown moist silty clay	6	24-Sep-92	Calciner Pond Sediments
F050B010	Red brown moist silty clay	10	24-Sep-92	Calciner Pond Sediments
F051B000	Red brown silty sand	5	24-Sep-92	Calciner Pond Sediments
F051B002	Red brown to tan silty sand	7	24-Sep-92	Calciner Pond Sediments
F051B005	Red brown to tan silty sand	9	24-Sep-92	Calciner Pond Sediments
F051B007	Red brown silty sand	11	24-Sep-92	Calciner Pond Sediments
F051B010	Red brown silty sand	14	24-Sep-92	Calciner Pond Sediments
F052B000	Brown silt @ 11 ft. - slag on top	10	22-Sep-92	Secondary Condenser
F052B002	Brown silt	12.5	22-Sep-92	Secondary Condenser
F052B005	Brown silt - trace gravel	15	22-Sep-92	Secondary Condenser
F052B007	Brown fine silt - trace gravel (slag) - slightly moist	17.5	22-Sep-92	Secondary Condenser
F052B010	Brown silt - moist	20	22-Sep-92	Secondary Condenser
F053B000	Brown fine silt (moist)	10	22-Sep-92	Secondary Condenser
F053B002	Brown silt with slag	12.5	22-Sep-92	Secondary Condenser
F053B005	Brown fine silt	15	22-Sep-92	Secondary Condenser

Table 2.1-6 (Cont'd)

Phase I Sample ID	Generalized Sample Description	Actual Sample Depth, ft	Date Drilled	General Location
F053B007	Brown silt	17.5	22-Sep-92	Secondary Condenser
F053B010	Brown silt	20	22-Sep-92	Secondary Condenser
F054B000	Silt, reddish-yellow	40	20-Sep-92	Under Calciner Fines
F054B002	Silt, reddish-brown	42.5	20-Sep-92	Under Calciner Fines
F054B005	Silt, reddish-yellow	45	20-Sep-92	Under Calciner Fines
F054B007	Silt, reddish-yellow	47.5	20-Sep-92	Under Calciner Fines
F054B010	Silt, reddish-brown	50	20-Sep-92	Under Calciner Fines
F054R999	Rinsate	NA	20-Sep-92	Under Calciner Fines
F055B000	Brown silt	3	23-Sep-92	Old Pond 7S-tree line
F055B002	Brown silt	5	23-Sep-92	Old Pond 7S-tree line
F056B000	Tan brown silt	5	23-Sep-92	Old Pond 7S-tree line
F056B002	Tan silt to black (tar)	7	23-Sep-92	Old Pond 7S-tree line
F057B000	Tan fine silt	5	23-Sep-92	Old Pond 7S-tree line
F057B002	Tan sand/silt with gray clay	7	23-Sep-92	Old Pond 7S-tree line
F058B000	Gravel slag/sludge - black/gray silty/sludge	7	24-Sep-92	8S Recovery Process
F058B002	Black gray sludge to dark brown silt	9	24-Sep-92	8S Recovery Process
F059B000	1st sample 8 in. slag/black gray	10	24-Sep-92	8S Recovery Process
F059B002	Brown sandstone - no recovery	17	24-Sep-92	8S Recovery Process
F060B000	Dark brown silt with gravel	1	25-Sep-92	Area west of mobile shop
F060B002	Dark brown-black sandy silt with gravel	2	25-Sep-92	Area west of mobile shop
F061B000	Dark brown sandy silt with gravel	1	25-Sep-92	Area west of mobile shop
F061B002	Gray black silty sand with gravel	2	25-Sep-92	Area west of mobile shop
F062B000	Tan brown silt	1	26-Sep-92	Long term Phos. Strge
F062B002	Tan brown silt	3	26-Sep-92	Long term Phos. Strge
F063B000	Brown silt (with slag top 1 in.)	5	26-Sep-92	Long term Phos. Strge
F063B002	Brown silt	7	26-Sep-92	Long term Phos. Strge
F063R999	Rinsate	NA	26-Sep-92	Long term Phos. Strge
F064B000	Brown sandy silt with gravel (slag)	2.5	21-Sep-92	Phos Dock Area
F064B002	Brown silt with trace gravel	4.5	21-Sep-92	Phos Dock Area
F065B	No sample, inaccessible due to physical restrictions for access	NA	NA	Phos Dock Area
F066B000	Tan brown silt/sand	3	23-Sep-92	Paved Area N of Fur Bldg
F066B002	Tan brown silt/sand with slag	5	23-Sep-92	Paved Area N of Fur Bldg
F067B000	Tan brown silt with gravel (slag)	5	25-Sep-92	Paved Area N of Fur Bldg
F067B002	Tan brown silt with gravel (slag)	9	25-Sep-92	Paved Area N of Fur Bldg
F068B000	Red brown silt	3	23-Sep-92	Paved Area N of Fur Bldg

Table 2.1-6 (Cont'd)

Phase I Sample ID	Generalized Sample Description	Actual Sample Depth, ft	Date Drilled	General Location
F068B002	Tan brown silt	5	23-Sep-92	Paved Area N of Fur Bldg
F069B000	Brown silt	3	23-Sep-92	Paved Area N of Fur Bldg
F069B002	Tan brown fine silt	5	23-Sep-92	Paved Area N of Fur Bldg
F070B000	Brown silt	3	26-Sep-92	Phossy/Slurry Cleanouts
F070B002	Brown tan silt	5	26-Sep-92	Phossy/Slurry Cleanouts
F071B000	Brown silt trace gravel	5	25-Sep-92	Phossy/Slurry Cleanouts
F071B002	Gray gravel/silt 6 in. - brown silt	7	25-Sep-92	Phossy/Slurry Cleanouts
F072B000	Brown silt (wet-pipeline) trace slag -standing water @ 5 ft. bgs	8	25-Sep-92	Phossy/Slurry Cleanouts
F072B002	Brown wet silt	10	25-Sep-92	Phossy/Slurry Cleanouts
F073B002	Slag 2-3 in. to brown silt	14	25-Sep-92	Phossy/Slurry Cleanouts
F073B002	Brown silt	16	25-Sep-92	Phossy/Slurry Cleanouts
F074B000	Gravel/slag fill - tan brown silt with black sand/silt bend in middle ≈ 2 in. thick	10	25-Sep-92	Phossy/Slurry Cleanouts
F074B002	Brown silt	12	25-Sep-92	Phossy/Slurry Cleanouts
F075B000	Brown silt with trace gravel	5	25-Sep-92	Phossy/Slurry Cleanouts
F075B002	Brown silt	7	25-Sep-92	Phossy/Slurry Cleanouts
F076B000	Brown silt	15	26-Sep-92	Phossy/Slurry Cleanouts
F076B002	Brown silt	17	26-Sep-92	Phossy/Slurry Cleanouts
F077B000	Gravel to 3 ft. - brown sandy silt with gravel	5	26-Sep-92	Phossy/Slurry Cleanouts
F077B002	Gravel fill down to 14 ft. - Brown silt to gravel	14	26-Sep-92	Phossy/Slurry Cleanouts
F078B000	Tan silt interface @ 23-25 ft.	25	26-Sep-92	Phossy/Slurry Cleanouts
F078B002	Brown silt	27	26-Sep-92	Phossy/Slurry Cleanouts
F079B000	Red brown clayey silt	5	23-Sep-92	Phossy/Slurry Cleanouts
F079B002	Red brown silt	7	23-Sep-92	Phossy/Slurry Cleanouts
F080B000	Tan-brown silt	5	24-Sep-92	Bannock Paving
F080B002	Tan-brown silt	7	24-Sep-92	Bannock Paving
F081B000	Tan-brown silt (moist)	4	24-Sep-92	Bannock Paving
F081B002	Tan-brown silt	7	24-Sep-92	Bannock Paving
F082B000	Tan-brown sandy silt	5	24-Sep-92	Bannock Paving
F082B002	Brown silt with sand	9	24-Sep-92	Bannock Paving
F083B000	Brown tan silt	5	24-Sep-92	RR loading BPC
F083B002	Brown silt	9	24-Sep-92	RR loading BPC
F084B000	Tan-brown silt with gravel (slag)	5	24-Sep-92	RR loading BPC
F084B002	Brown silt	7	24-Sep-92	RR loading BPC
F085B	No sample, inaccessible due to underground utilities	NA	NA	RR loading FMC

Table 2.1-6 (Cont'd)

Phase I Sample ID	Generalized Sample Description	Actual Sample Depth, ft	Date Drilled	General Location
F086B	No Sample-Duplicate boring of F093B	Dup	Dup	RR loading FMC
F087B	No Sample-Duplicate boring of F094B	Dup	Dup	RR loading FMC
F089B000	Gravel fill and tan silt	Dup	Dup	RR loading FMC
F089B002	No sample	5	23-Sep-92	Shale Ore Handling
F090B000	Dark brown silt with trace gravel	3	21-Sep-92	Shale Ore Handling
F090B002	Dark brown silt	5	21-Sep-92	Shale Ore Handling
F091B000	Tan-red-brown silt with gravel	0	21-Sep-92	Shale Ore Handling
F091B002	Brown silt with gravel	2	21-Sep-92	Shale Ore Handling
F092B000	Red-brown to black-gray to light tan silty sand with gravel	0	21-Sep-92	Shale Ore Handling
F092B002	Brown silt with gravel	2	21-Sep-92	Shale Ore Handling
F093B000	Brown-red brown silt (shale)	3	22-Sep-92	Shale Ore Handling
F093B002	Red-brown silt	5	22-Sep-92	Shale Ore Handling
F094B000	Dark brown to tan silt/sand	6	23-Sep-92	Shale Ore Handling
F094B002	Dark brown silt	8	23-Sep-92	Shale Ore Handling
F095B	Number not used, skipped sequence	NA	NA	NA
F096B	Number not used, skipped sequence	NA	NA	NA
F097B	Number not used, skipped sequence	NA	NA	NA
F098B	Number not used, skipped sequence	NA	NA	NA
F099B	Number not used, skipped sequence	NA	NA	NA
F100B	Number not used, skipped sequence	NA	NA	NA
F101B000	Brown silt with slag gravel	5	22-Sep-92	Road Sample
F101B002	Brown silt	7	22-Sep-92	Road Sample
F101R000	Dark brown silty sand trace gravel	0.5	26-Sep-92	Road Sample-Redo
F101R002	Gray sandy silt w/trace gravel	1.5	26-Sep-92	Road Sample-Redo
F102B000	Tan-brown silt	3	24-Sep-92	Road Sample
F102B002	Tan-brown moist silt	5	24-Sep-92	Road Sample
F103B000	Tan-brown silt	3	24-Sep-92	Road Sample
F103B002	Tan-brown silt	5	24-Sep-92	Road Sample
F104R000	Gray slag	0.5	26-Sep-92	Road Sample
F104R002	Gray slag	1.5	26-Sep-92	Road Sample
F105B000	Dark grayish brown silt (fill)	1	18-Sep-92	Road Sample
F105B002	Dark grayish brown silt (fill)	3	18-Sep-92	Road Sample
F106B000	Tan brown silt	1	24-Sep-92	Road Sample
F106B002	Tan silt	3	24-Sep-92	Road Sample
F107R000	Slag gravel	0.5	26-Sep-92	Road Sample

Table 2.1-6 (Cont'd)

Phase I Sample ID	Generalized Sample Description	Actual Sample Depth, ft	Date Drilled	General Location
F107R002	Slag/gravel/brown silt - Contact @ ≈ 2.7 to 3 ft	1.5	26-Sep-92	Road Sample
F108B000	Tan silt with gravel	0.5	21-Sep-92	Road Sample
F108B002	Dark tan silt	2.5	21-Sep-92	Road Sample
F109B000	Road surface gypsum/slag/gravel @ 1/2 ft. - Tan brown silt trace gravel	0.5	21-Sep-92	Road Sample
F109B002	Tan silt	2.5	21-Sep-92	Road Sample
F110B000	Dark brown/black silt with gravel	0.5	21-Sep-92	Road Sample
F110B002	Brown to dark brown/black silt with trace gravel	2.5	21-Sep-92	Road Sample
F111R000	Gray silt with slag (gravel) (gravel ≈ 10%)	0.5	26-Sep-92	Road Sample
F111R002	Gray silt with slag (gravel)	2	26-Sep-92	Road Sample
F112R000	Gray silt with slag (slag coarse/fine ≈ 20%)	0.5	26-Sep-92	Road Sample
F112R002	Gray silt with trace slag (fine < 10%)	2	26-Sep-92	Road Sample
F113R000	Dark brown/gray sand silt trace gravel	0.5	26-Sep-92	Road Sample
F113R002	Tan brown sandy silt	2	26-Sep-92	Road Sample
F113R999	Rinsate	NA	29-Sep-92	Road Sample
F113R9MS	Rinsate	NA	29-Sep-92	Road Sample
F113RMSD	Rinsate	NA	29-Sep-92	Road Sample
F114R000	Dark brown/gray silt/sand (heavy) trace gravel slag	0.5	26-Sep-92	Road Sample
F114R002	Brown sandy silt	2	26-Sep-92	Road Sample
F115R000	Dark brown sandy silt	0.5	26-Sep-92	Road Sample
F115R002	Tan-brown silt	2	26-Sep-92	Road Sample
F116B	No sample, inaccessible due to plant operations & utilities	NA	NA	Road Sample
F117B	No sample, inaccessible due to plant operations & utilities	NA	NA	Road Sample
F118B	No sample, inaccessible due to plant operations & utilities	NA	NA	Road Sample
F119R000	Red brown fine silt (shale ore)	0.5	26-Sep-92	Road Sample
F119R002	Dark red brown silt (shale ore)	2	26-Sep-92	Road Sample
F120B	No sample-duplicate boring		Dup	Road Sample
F121R000	Gray silt/slag (heavy fine) - Rock 2-8 in. in size below surface	0.5	26-Sep-92	Road Sample
F121R002	Gray silt (slag) with gravel (coarse ≈ 30%)	2	26-Sep-92	Road Sample
F122B000	Clean fill - brown silt	0	25-Sep-92	Road Sample
F122B002	Clean fill - brown silt	2	25-Sep-92	Road Sample
F123B000	Brown sandy silt trace gravel (on haul road dusty trucks passing)	2	24-Sep-92	Road Sample
F123B002	Brown silt	4	24-Sep-92	Road Sample

Table 2.1-6 (Cont'd)

Phase I Sample ID	Generalized Sample Description	Actual Sample Depth, ft	Date Drilled	General Location
F124B000	Slag/gravel - slag 0-5 ft.	10	26-Sep-92	Road Sample
F124B002	Tan-brown silt/sandstone	12	26-Sep-92	Road Sample
F125B000	Tan fine silt	1	26-Sep-92	Road Sample
F125B002	Brown silt	3	26-Sep-92	Road Sample
F126B000	Tan silt with gravel	0	30-Sep-92	Road Sample
F126B002	Tan silt with gravel	2	30-Sep-92	Road Sample
F200R999	Rinsate	NA	21-Sep-92	Road Sample

Table 2.1-6 (Cont'd)

Phase II

Phase II Sample ID	Generalized Sample Description	Actual Sample Depth, ft	Date Drilled	General Location
F127B000	Sludge	0	23-Jun-93	Calciner Pond Sediments
F127B005	Tan silt	5	23-Jun-93	Calciner Pond Sediments
F127B015	Tan silt	15	23-Jun-93	Calciner Pond Sediments
F127B025	Tan silt	25	23-Jun-93	Calciner Pond Sediments
F127B035	Tan silt (wet)	35	23-Jun-93	Calciner Pond Sediments
F127R999	Rinsate	NA	23-Jun-93	@ Calciner Pond Sediments
F128B000	Tan silt with gravel	0	22-Jun-93	Calciner Pond Sediments
F128B010	Tan silt	10	22-Jun-93	Calciner Pond Sediments
F128B020	Tan silt	20	22-Jun-93	Calciner Pond Sediments
F128B030	Tan silty sandy gravel	30	22-Jun-93	Calciner Pond Sediments
F128B040	Tan silt	40	22-Jun-93	Calciner Pond Sediments
F128B050	Gravel	50	22-Jun-93	Calciner Pond Sediments
F128B060	Sandy gravel	60	22-Jun-93	Calciner Pond Sediments
F128B070	Sandy gravel	70	22-Jun-93	Calciner Pond Sediments
F128B080	Sandy gravel	80	22-Jun-93	Calciner Pond Sediments
F128B090	No recovery @ 90 feet (no sample)	NA	22-Jun-93	Calciner Pond Sediments
F128B100	Tan silt with gravel	100	22-Jun-93	Calciner Pond Sediments
F129B000	Gravel (fill)	0	27-Jun-93	Furnace Haul Road
F129B005	Tan silt	5	27-Jun-93	Furnace Haul Road
F129B010	Tan silt	10	27-Jun-93	Furnace Haul Road
F129B015	Tan silt	15	27-Jun-93	Furnace Haul Road
F129B020	Tan silt	20	27-Jun-93	Furnace Haul Road
F129B025	Tan silt	25	27-Jun-93	Furnace Haul Road
F130B000	Tan silty sand	0	27-Jun-93	Calciner fines pile (F054B)
F130B010	Tan silt	10	27-Jun-93	Calciner fines pile (F054B)
F130B020	Tan silt	20	27-Jun-93	Calciner fines pile (F054B)
F130B030	Sandy gravel	30	27-Jun-93	Calciner fines pile (F054B)
F130B040	Sandy gravel	40	27-Jun-93	Calciner fines pile (F054B)
F130B050	Sandy gravel	50	27-Jun-93	Calciner fines pile (F054B)
F130B060	Sandy gravel	60	27-Jun-93	Calciner fines pile (F054B)
F130B070	Sandy silt	70	27-Jun-93	Calciner fines pile (F054B)
F130B080	Gravel	80	27-Jun-93	Calciner fines pile (F054B)
F130B090	Sandy gravel	90	27-Jun-93	Calciner fines pile (F054B)
F131B000	No recovery	NA	28-Jun-93	RR Swale

Table 2.1-6 (Cont'd)

Phase II Sample ID	Generalized Sample Description	Actual Sample Depth, ft	Date Drilled	General Location
F131B010	No recovery	NA	28-Jun-93	RR Swale
F131B020	Gravel	NA	28-Jun-93	RR Swale
F131B030	Sandy gravel	NA	28-Jun-93	RR Swale
F131B040	Sand	40	28-Jun-93	RR Swale
F131B050	Gravel	NA	28-Jun-93	RR Swale
F131B060	Tan silty clay	60	28-Jun-93	RR Swale
F131B070	Brown clay	70	28-Jun-93	RR Swale
F131B080	Sandy gravel	80	28-Jun-93	RR Swale
F131R999	Rinsate	NA	28-Jun-93	@ RR Swale
F132B000	Gravelly silt	0	25-Jul-93	Shale Handling Area
F132B002	Gravelly silt	2	25-Jul-93	Shale Handling Area
F132B005	Tan silt	5	25-Jul-93	Shale Handling Area
F132B007	Tan silt	7	25-Jul-93	Shale Handling Area
F132B010	Tan silt	10	25-Jul-93	Shale Handling Area
F132B012	Tan silt	12	25-Jul-93	Shale Handling Area
F132R999	Rinsate	NA	26-Jul-93	@ Shale Handling Area
	Soil samples from well installations			
F158B093	Brown sandy silt	93	23-Jun-93	Well upgradient of 8S
F159B096	Tan silty clay	96	26-Jun-93	Well downgradient of 8S
	PCB resampling locations			
F035B000	Tan silt	2	6-Aug-93	Transformer Salvage Area
F056B002	Brown silt	5	6-Aug-93	Old Pond 7S-tree line
F057B000	Tan silt	5	6-Aug-93	Old Pond 7S-tree line
F057B002	Tan silt	7	6-Aug-93	Old Pond 7S-tree line
F060B000	Brown silt with gravel	1	6-Aug-93	Area west of mobile shop
F060B002	Brown silt with gravel	2	6-Aug-93	Area west of mobile shop
F061B000	Brown sandy silt	1	6-Aug-93	Area west of mobile shop
F061B002	Gray/brown sandy silt	2	6-Aug-93	Area west of mobile shop
F081B000	Tan silt	4	6-Aug-93	Bannock Paving
F084B000	Brown silt	5	6-Aug-93	RR loading BPC
F084B002	Brown silt	7	6-Aug-93	RR loading BPC
F101B000	Tan silt	5	6-Aug-93	Road Sample
F105B000	Tan silt	1	6-Aug-93	Road Sample
F123B000	Tan silt	2	6-Aug-93	Road Sample

Table 2.1-6 (Cont'd)

Phase II Sample ID	Generalized Sample Description	Actual Sample Depth, ft	Date Drilled	General Location
F123B002	Brown silt	4	6-Aug-93	Road Sample
F060R999	Rinsate	NA	6-Aug-93	@ boring F060B

Notes:
IWW = Industrial wastewater.
NA = Not analyzed.
PCBs = Polychlorinated biphenyls.

Table 2.1-7
Simplot Potential Source and Onsite Soil Investigation

Potential Source	Sample ID	Location In Report	Sampling Rationale	Media	Sample Depth	No. of Locations	Sample Intervals	Analytes
Phase I								
Ore Slurry	S304OR1	Fig. 2.1-4	Trace elements	Slurry	Composite-Time	1	NA	Table 2.1-2
Gypsum Slurry	S304GP1, SGSFEF01	Fig. 2.1-4	Trace elements	Slurry	Composite-Time	1	NA	Table 2.1-2
Pond Waters	SWW9101, SWWWP201, SWWWP301, SWWE0P01	Fig. 2.1-4	Trace elements		Composite-Time	4	NA	Table 2.1-3
Pond Sediments	SSDWP101, SSDWP201, SSDWP301, SSDE0P01	Fig. 2.1-4	Trace elements		Composite-Location	4	NA	Table 2.1-2
Gypsum Stacks	S001B thru S006B	Fig. 2.1-3	Gypsum water migration	Soils	to GW	6	10'	Table 2.1-2
Unlined Ditch to Water Treatment Ponds	SSSUDP01 thru SSSUDP06, SBSJDP01 thru SBSJDP06	Fig. 2.1-4	Ditch water migration	Soils	2 feet	6	SS+2'	Table 2.1-2
Former East Overflow Pond	S099B	Fig. 2.1-3	Pond water migration	Soils	to GW	1	10'	Table 2.1-2
Water Treatment Ponds:								
Settling Pond (Active)	S007B	Fig. 2.1-3	Potential pond water migration	Soils	to GW	1	10'	Table 2.1-2
Dewatering Pit	S008B	Fig. 2.1-3	Pit water migration	Soils	to GW	1	10'	Table 2.1-2
Former Pillow Tank Area	S010B - S011B	Fig. 2.1-3	Potential tank leakage	Soils	10 feet	2	2.5'	Table 2.1-2
Loadout Areas (soils):		Fig. 2.1-3	Potential product spillage	Soils				
Ammonium Phosphate #1 (solid)								
Rail	S030B, S031B				2 feet	2	SS+2'	Table 2.1-2
Truck and Front-End Loader	S032B, S037B				2 feet	6	SS+2'	Table 2.1-2
Ammonium Phosphate #2 (solid)								
Rail	S038B, S039B				2 feet	2	SS+2'	Table 2.1-2
Truck and Front-End Loader	S040B, S045B				2 feet	6	SS+2'	Table 2.1-2
Ammonium Sulfate (solid)								
Rail	S046B, S047B				2 feet	2	SS+2'	Table 2.1-2
Truck	S048B, S049B				2 feet	2	SS+2'	Table 2.1-2
Triple Superphosphate (solid)								
Rail	S050B, S051B				2 feet	2	SS+2'	Table 2.1-2
Truck	S052B, S053B				2 feet	2	SS+2'	Table 2.1-2
Phosphoric Acid (liquid)								
Truck	S066B, S067B				10 feet	2	2.5'	Table 2.1-2
Former Phosphoric Acid (liquid)/Rail Car Cleaning								
Rail	S056B, S057B				10 feet	2	2.5'	Table 2.1-2
Sulfuric Acid (liquid)								
Rail	S058B, S059B				10 feet	2	2.5'	Table 2.1-2
Truck	S060B, S061B				10 feet	2	2.5'	Table 2.1-2

Table 2.1-7 (Cont'd)

Potential Source	Sample ID	Location In Report	Sampling Rationale	Media	Sample Depth	No. of Locations	Sample Intervals	Analytes
Former #1 Sulfuric Plant	S001B-062, S001B-063	Fig. 2.1-3	Potential plant leakage	Soils	10 feet	2	2.5'	Table 2.1-2
Former #2 Sulfuric Plant	S001B-064, S001B-065	Fig. 2.1-3	Potential plant leakage	Soils	10 feet	2	2.5'	Table 2.1-2
Phosphoric Acid Tank Containment	S001B-054, S001B-055	Fig. 2.1-3	Potential tank leakage	Soils	10 feet	2	2.5'	Table 2.1-2
Cooling Tower Area	S001B-068, S001B-069	Fig. 2.1-3	Cooling tower spray	Soils	10 feet	2	2.5'	Table 2.1-2
Former Cooling Pond	S001B-070, S001B-071	Fig. 2.1-3	Pond water migration	Soils	10 feet	2	2.5'	Table 2.1-2
Water Reclaim Area	S001B-072, S001B-073	Fig. 2.1-3	Potential pipe/pump leakage	Soils	2 feet	2	SS+2'	Table 2.1-2
Former Ore Pile Area	S001B-074 thru S001B-078	Fig. 2.1-3	Residual ore	Soils	2 feet	5	SS+2'	Table 2.1-2
Salvage and Storage Area	S001B-079 thru S001B-081	Fig. 2.1-3	Answer persistent questions	Soils	2 feet	3	SS+2'	Table 2.1-2, PCBs, TPH
Roads (paved, unpaved, slag covered)	S001B-082 thru S001B-096	Not Shown	Dust suppressant application	Soils	2 feet	15	SS+2'	Table 2.1-2, PCBs, TPH
Phase II								
Irrigation Water		Not Shown	Trace elements		Composite	1	NA	Table 2.1-3
Unlined Ditch	S097B	Fig. 2.1-3	Phase I Sampling	Soils	to GW	1	SS, 5'	Table 2.1-2, sulfate, potassium
Triple Superphosphate Area	S098B	Fig. 2.1-3	S052B	Soils	10 feet	1	SS, 2.5'	Table 2.1-2, sulfate, potassium
Former East Overflow Pond	S099B	Fig. 2.1-3	Pond water migration	Soils	50 feet	1	SS, 10'	Table 2.1-2, sulfate, potassium
Cooling Pond	S100B	Fig. 2.1-3	S070B and S071B	Soils	to GW	1	SS, 2.5 - 10'	Table 2.1-2, sulfate, potassium
Cooling Tower	S101B	Fig. 2.1-3	S069B	Soils	15 feet	1	SS, 1.5'	Table 2.1-2, sulfate, potassium
Water Reclaim Area	S102B	Fig. 2.1-3	S073B	Soils	25 feet	1	SS, 2.5'	Table 2.1-2, sulfate, potassium
Railcar Cleaning	S103B	Fig. 2.1-3	S056B	Soils	9 feet	1	SS, 2.5'	Table 2.1-2, sulfate, potassium
Former #1 Sulfuric Plant	S104B	Fig. 2.1-3	S062B	Soils	25 feet	1	SS, 5'	Table 2.1-2, sulfate, potassium
Phos Acid Loading	S105B	Fig. 2.1-3	S067B	Soils	15 feet	1	SS, 2.5'	Table 2.1-2, sulfate, potassium
Ammonium Phosphate #1	S106B	Fig. 2.1-3	S035B	Soils	10 feet	1	SS, 2.5'	Table 2.1-2, sulfate, potassium
Ammonium Phosphate #1	S107B	Fig. 2.1-3	S033B	Soils	10 feet	1	SS, 2.5'	Table 2.1-2, sulfate, potassium
Ammonium Phosphate #2	S108B	Fig. 2.1-3	S044 B	Soils	10 feet	1	SS, 2.5'	Table 2.1-2, sulfate, potassium
Ammonium Sulfate	S109B	Fig. 2.1-3	S048B	Soils	20 feet	1	SS, 2.5 and 5'	Table 2.1-2, sulfate, potassium
Road Samples	S063B, S079B, S080B, S085B, S088B, S090B, S094B, S098B	Fig. 2.1-3	Phase I PCB Validation	Soils	Surface	8	SS	PCB
Unlined Ditch	SSSODP01 thru SSSODP06, SBSODP01 thru SBSODP03	Fig. 2.1-3	Phase I Sampling	Soils	2 feet	9	SS, 2'	Hg

Notes:
GW = Groundwater.
NA = Not analyzed.
PCBs = Polychlorinated biphenyls.
SS = Surface sample.
TPH = Total petroleum hydrocarbons.

Table 2.1-8
Phase I – Simplot Potential Source Field Data (averaged readings)

Sample ID	Date	pH	Conductivity ($x10^3$ mS/cm)	Temperature (deg F)
SWWWP101[a]	31 August 92	1.0	3035	77
SWWWP201[a]	31 August 92	7.6	860	69
SWWWP301[a]	31 August 92	8.3	2625	72
SWWEOP01[a]	31 August 92	1.0	9500	70
SSWIRR01[b]	28 October 92	7.5	3840	64

Notes:
(a) Denotes 24-hour time-composite sample.
(b) Location-composite sample.

Table 2.1-9
Simplot Potential Source and Onsite Soil Boring Summary

Phase I

Phase I Borings	Generalized Sample Description	Actual Sample Depth, ft	Date Drilled	General Location
S001B000	Silt, very dark grayish-brown	65	9/27/92	North Gyp to GW
S001B010	Silt, yellowish-brown	75	9/27/92	North Gyp to GW
S001B020	Sandy-gravel, light brown-gray	85	9/27/92	North Gyp to GW
S001B030	Sandy-gravel, light grayish brown	95	9/27/92	North Gyp to GW
S001B040	Sandy-gravel, light grayish brown	105	9/27/92	North Gyp to GW
S001B050	Silt, pale brown	115	9/27/92	North Gyp to GW
S001B060	Silt, pale brown	125	9/27/92	North Gyp to GW
S001B070	Sandy gravel, yellowish brown	135	9/27/92	North Gyp to GW
S001B080	Dark gray-brown, sandy pea gravel	145	9/27/92	North Gyp to GW
S001R999	Rinsate	NA	9/27/92	North Gyp to GW
S002B000	Silt, dark brown	65	9/23/92	North Gyp to GW
S002B010	Dark brown silt	75	9/23/92	North Gyp to GW
S002B020	Silt/gravel, pinkish-gray	85	9/23/92	North Gyp to GW
S002B030	Silty-gravel, pinkish-gray	95	9/23/92	North Gyp to GW
S002B040	Silty gravel, pinkish-gray	105	9/23/92	North Gyp to GW
S002B050	Silt, yellowish-brown	115	9/23/92	North Gyp to GW
S002B060	Sandy gravel, yellowish brown	125	9/23/92	North Gyp to GW
S002B070	Silt, brownish-yellow	135	9/23/92	North Gyp to GW
S003B000	Silty pea gravel-pale brown	61	10/9/92	South Gyp to GW
S003B010	Silt, brownish yellow (moist)	70	10/9/92	South Gyp to GW
S003B020	Silt, brownish yellow	80	10/9/92	South Gyp to GW
S003B030	Silt, brown	90	10/9/92	South Gyp to GW
S003B040	Silty gravel	100	10/9/92	South Gyp to GW
S003B050	Silty sand, brown	115	10/9/92	South Gyp to GW
S003B060	Clayey sand, gray and brownish orange	135	10/9/92	South Gyp to GW
S003B070	Clayey sand, gray and brownish orange	145	10/9/92	South Gyp to GW
S003B080	Sand with gravel	155	10/9/92	South Gyp to GW
S003R999	Rinsate	NA	10/11/92	South Gyp to GW
S003	Rinsate	NA	10/13/92	South Gyp to GW
S03AR999	Rinsate	NA	10/13/92	South Gyp to GW
S03AR9MS	Rinsate	NA	10/13/92	South Gyp to GW
S03ARMSD	Rinsate	NA	10/13/92	South Gyp to GW
S004B000	Silt, pale brown	53	10/1/92	South Gyp to GW

Table 2.1-9 (Cont'd)

Phase I Borings	Generalized Sample Description	Actual Sample Depth, ft	Date Drilled	General Location
S004B010	Silt, pale brown	60	10/1/92	South Gyp to GW
S004B020	Silt, pale brown	70	10/1/92	South Gyp to GW
S004B030	Silt, light brown	80	10/1/92	South Gyp to GW
S004B040	Silt, light brown	90	10/1/92	South Gyp to GW
S004B050	Silt, light brown	100	10/1/92	South Gyp to GW
S004B060	Silt, light brown (small bits pea gravel)	110	10/1/92	South Gyp to GW
S004B070	Tuff, light gray	120	10/1/92	South Gyp to GW
S004B080	Silty sand, very pale brown	130	10/1/92	South Gyp to GW
S004B090	Silty-sand, light brown	140	10/1/92	South Gyp to GW
S004B100	Light gray clay	150	10/1/92	South Gyp to GW
S004B110	Light brown silt and clay	160	10/1/92	South Gyp to GW
S005B000	Silt, yellowish brown	40	10/14/92	South Gyp to GW
S005B010	Silt, yellowish brown	50	10/14/92	South Gyp to GW
S005B020	Silt, yellowish brown	60	10/14/92	South Gyp to GW
S005B030	Silt, yellowish brown	70	10/14/92	South Gyp to GW
S005B040	Silt, yellowish brown	80	10/14/92	South Gyp to GW
S005B050	Silt, yellowish brown	90	10/14/92	South Gyp to GW
S005B060	Silt, yellowish brown	100	10/14/92	South Gyp to GW
S005B070	Silt, yellowish brown (≈10% gravel)	110	10/14/92	South Gyp to GW
S005B080	Silt, yellowish brown	120	10/14/92	South Gyp to GW
S005B090	Silt, yellowish brown	130	10/14/92	South Gyp to GW
S005B100	Sandy silt, moderate yellowish brown	140	10/14/92	South Gyp to GW
S005B110	Sandy silt, moderate yellowish brown	150	10/14/92	South Gyp to GW
S005B120	Sandy silt, moderate yellowish brown	160	10/14/92	South Gyp to GW
S005B130	Sandy silt, moderate yellowish brown	170	10/14/92	South Gyp to GW
S005B140	Sandy silt, moderate yellowish brown	180	10/14/92	South Gyp to GW
S005B150	Sandy silt, moderate yellowish brown	190	10/14/92	South Gyp to GW
S005B160	Sandy silt, moderate yellowish brown	200	10/14/92	South Gyp to GW
S005B170	Silty sand, pale yellowish brown	210	10/14/92	South Gyp to GW
S005B180	Silty sand, pale yellowish brown	220	10/14/92	South Gyp to GW
S006B000	Sandy, gravelly silt	44.6	10/21/92	South Gyp to GW
S006B010	Silty, sandy gravel	55	10/21/92	South Gyp to GW
S006B020	Silty, sandy gravel	65	10/21/92	South Gyp to GW
S006B030	Brown/tan silt	70	10/21/92	South Gyp to GW
S006B040	Yellowish brown silty/sandy/gravel	85	10/21/92	South Gyp to GW

Table 2.1-9 (Cont'd)

Phase I Borings	Generalized Sample Description	Actual Sample Depth, ft	Date Drilled	General Location
S006B050	Yellowish brown silty/sandy/gravel	95	10/21/92	South Gyp to GW
S006B060	Yellowish brown silty/sandy/gravel	105	10/21/92	South Gyp to GW
S006B070	Yellowish brown silt embedded in gravel (silty/sandy/gravel)	115	10/21/92	South Gyp to GW
S006B080	Yellowish brown silty/sandy/gravel	125	10/21/92	South Gyp to GW
S006B090	Yellowish brown silty/sandy/gravel	135	10/21/92	South Gyp to GW
S006B100	Yellowish brown silty/sandy/gravel	145	10/21/92	South Gyp to GW
S006B110	Yellowish brown silty/sandy/gravel	155	10/21/92	South Gyp to GW
S006B120	Red sand, coarse-grained	165	10/21/92	South Gyp to GW
S006B130	Red sand, coarse-grained	169	10/21/92	South Gyp to GW
S007B000	Light yellowish brown silty gravel	0	10/24/92	Settling Pond to GW
S007B010	Brown silty sand with small boulders (very limited amount of recovery)	15	10/24/92	Settling Pond to GW
S007B020	Coarse-grained sandy gravel	25	10/24/92	Settling Pond to GW
S008B000	Coarse-grained sand/pea gravel	0	10/25/92	Dewatering Pit to GW
S008B001	Gypsum	2.5	10/25/92	Dewatering Pit to GW
S008B010	Coarse-grained sandy gravel (light yellowish brown)	10	10/25/92	Dewatering Pit to GW
S008B020	Light yellowish brown silty/sandy/gravel	20	10/25/92	Dewatering Pit to GW
S008B030	Gravel (wet) various colors	26	10/25/92	Dewatering Pit to GW
S009B	Inaccessible (to be done in spring of 93). Former East Overflow Pond in use at time of drilling	NS	Inaccess-ible	Former East Overflow Pond
S010B000	Tan fine silt - dry	10.5	10/12/92	Former Pillow Tank Area
S010B002	Tan fine silt	13	10/12/92	Former Pillow Tank Area
S010B005	Tan silt	15.5	10/12/92	Former Pillow Tank Area
S010B007	Tan silt	18	10/12/92	Former Pillow Tank Area
S010B010	Tan silt	20.5	10/12/92	Former Pillow Tank Area
S011B000	Tan silt	9	10/13/92	Former Pillow Tank Area
S011B002	Tan silt	11.5	10/13/92	Former Pillow Tank Area
S011B005	Tan silt	14	10/13/92	Former Pillow Tank Area
S011B007	Tan silt	16.5	10/13/92	Former Pillow Tank Area
S011B010	Tan silt	19	10/13/92	Former Pillow Tank Area
S011R999	Rinsate	NA	10/13/92	Former Pillow Tank Area
S030B000	Road base/sandy gravel (up to 1 in.)	0.5	10/14/92	Ammo #1
S030B002		2	10/14/92	Ammo #1
S031B000	Gray brown sandy gravel (up to 1 in.)	0.5	10/14/92	Ammo #1
S031B002		NS	10/14/92	Ammo #1

Table 2.1-9 (Cont'd)

Phase I Borings	Generalized Sample Description	Actual Sample Depth, ft	Date Drilled	General Location
S032B000	Road base/gravel (gypsum)	0.5	10/14/92	Ammo #1
S032B002	Red tan silt - moist	2	10/14/92	Ammo #1
S033B000	Tan sandy gravel and road base	0.5	10/14/92	Ammo #1
S033B002	Brown sandy gravel	2	10/14/92	Ammo #1
S033R999	Rinsate		10/14/92	Ammo #1
S034B000	Tan-brown sandy silt with gravel	0.5	9/18/92	Ammo #1
S034B002	Brown silty sand with fine gravel	2	9/18/92	Ammo #1
S035B000	Brown-tan silt with gravel	0.5	9/23/92	Ammo #1
S035B002	Dark brown-tan silt/sand w/gravel	2	9/23/92	Ammo #1
S036B000	Brown silty sand with fine gravel	0.5	9/23/92	Ammo #1
S036B002	Tan silt with gravel	2	9/23/92	Ammo #1
S037B000	Brown silty sand with fine gravel	0.5	9/23/92	Ammo #1
S037B002	Tan silt with gravel	2	9/23/92	Ammo #1
S038B000	Brown-tan silt	0.5	10/14/92	Ammo #2
S038B002	Tan silty sand - moist	2	10/14/92	Ammo #2
S038R999	Rinsate	NA	10/13/92	Ammo #2
S039B	Inaccessible due to utilities & building structures	NA	10/14/92	Ammo #2
S040B000	Tan sandy gravel	0.5	10/14/92	Ammo #2
S040B002	Gravel	2	10/14/92	Ammo #2
S041B000	Tan sandy gravel (up to 1 in.)	0.5	10/14/92	Ammo #2
S041B002	Gravel	2	10/14/92	Ammo #2
S042B000	Tan sandy gravel (coarse up to 1 in.)	0.5	10/13/92	Ammo #2
S042B002	Tan sandy gravel	2	10/13/92	Ammo #2
S042R999	Rinsate	NA	10/13/92	Ammo #2
S043B000	Brown tan sandy gravel (coarse up to 1 in.)	0.5	10/13/92	Ammo #2
S043B002	Sandy gravel (coarse) - 2nd run red-brown silty sand	2	10/13/92	Ammo #2
S044B000	Tan sandy gravel (1/8-1/4 in.)	0.5	10/13/92	Ammo #2
S044B002	Tan sandy gravel (coarse)	2	10/13/92	Ammo #2
S044R999	Rinsate	NA	10/13/92	Ammo #2
S045B000	Tan sandy gravel (fine <1/8 in.)	0.5	10/13/92	Ammo #2
S045B002	Tan sandy silt - damp	2	10/13/92	Ammo #2
S046B000	Dark brown sandy gravel/sand with gravel (<=1/2 in.)	0.5	10/11/92	Amm Sulfate
S046B002	Tan sandy gravel	2	10/11/92	Amm Sulfate
S047B000	Dark brown silty gravel (fine <1/8 in.)	0.5	10/11/92	Amm Sulfate

Table 2.1-9 (Cont'd)

Phase I Borings	Generalized Sample Description	Actual Sample Depth, ft	Date Drilled	General Location
S047B002	Sandy gravel	2	10/11/92	Amm Sulfate
S048B000	Dark brown clayey silt with gravel	0.5	9/23/92	Amm Sulfate
S048B002	Dark brown clayey silt with gravel	2	9/23/92	Amm Sulfate
S049B000	Dark brown clayey silt with gravel	0.5	9/23/92	Amm Sulfate
S049B002	Dark brown clayey silt with gravel	2	9/23/92	Amm Sulfate
S050B000	Black-gray silty gravel	0.5	10/9/92	Triple superphosphate area
S050B002	Tan silt	2	10/9/92	Triple superphosphate area
S051B000	Dark brown silt trace fine gravel	0.5	10/9/92	Triple superphosphate area
S051B002	Brown sandy silt gravel (up to 1 in.)	2	10/9/92	Triple superphosphate area
S052B000	Brown silt with fine gravel	0.5	10/9/92	Triple superphosphate area
S052B002	Brown silt	2	10/9/92	Triple superphosphate area
S053B000	Dark brown silt with gravel	0.5	10/9/92	Triple superphosphate area
S053B002	Tan silty clay with gravel	2	10/9/92	Triple superphosphate area
S054B000	Tan gray sandy gravel	0.5	10/15/92	Phos Acid Cont
S054B002	Gypsum fill	2.5	10/15/92	Phos Acid Cont
S054R999	Rinsate	NA	10/15/92	Phos Acid Cont
S055B000	Tan-brown sandy gravel	0.5	10/16/92	Phos Acid Cont
S055B002	Tan-brown sandy gravel	2.5	10/16/92	Phos Acid Cont
S055B005	Tan sandy gravel	5	10/16/92	Phos Acid Cont
S055B007	Tan sandy gravel	7	10/16/92	Phos Acid Cont
S056B000	Dark gray silt gravel	0.5	10/14/92	Railcar Cleaning
S056B002	Dark gray silt gravel	2	10/14/92	Railcar Cleaning
S057B	Inaccessible due to new plant structures	NA	10/14/92	Railcar Cleaning
S058B000	Tan sandy gravel	0.5	10/14/92	Sulfuric Loading
S058B002	Tan silt - moist	2.5	10/14/92	Sulfuric Loading
S058B005	Tan silt	5	10/14/92	Sulfuric Loading
S058B007	Tan sand/sandy gravel (fine)	7.5	10/14/92	Sulfuric Loading
S058B010	Tan sandy gravel	10	10/14/92	Sulfuric Loading
S059B000	Tan brown sandy gravel (<=1 in.)	0.5	10/15/92	Sulfuric Loading
S059B002	Tan silt	2.5	10/15/92	Sulfuric Loading
S059B005	Tan silt	5	10/15/92	Sulfuric Loading
S059B007	Tan silt	7.5	10/15/92	Sulfuric Loading
S059B010	Tan silt - silty gravel	10	10/15/92	Sulfuric Loading
S060B000	Gray sandy gravel	0.5	10/14/92	Sulfuric Loading
S060B002	Tan silt	2.5	10/14/92	Sulfuric Loading

Table 2.1-9 (Cont'd)

Phase I Borings	Generalized Sample Description	Actual Sample Depth, ft	Date Drilled	General Location
S060B005	Tan sandy gravel	5	10/14/92	Sulfuric Loading
S060R999	Rinsate	NA	10/14/92	Sulfuric Loading
S061B000	Tan sandy gravel (<=1 in.)	0.5	10/15/92	Sulfuric Loading
S061B002	Tan silt	2.5	10/15/92	Sulfuric Loading
S061B005	Tan silt (damp)	5	10/15/92	Sulfuric Loading
S061B007	Tan sandy gravel - damp	7.5	10/15/92	Sulfuric Loading
S061B010	Tan sand with gravel - damp	8	10/15/92	Sulfuric Loading
S061R999	Rinsate	NA	10/14/92	Sulfuric Loading
S062B000	Silty sand - slight odor	0.5	10/11/92	Fmr #1 Sulf Plnt
S062B002	Tan silt	2.5	10/11/92	Fmr #1 Sulf Plnt
S062B005	Tan silt	5	10/11/92	Fmr #1 Sulf Plnt
S062B007	Silty gravel	7.5	10/11/92	Fmr #1 Sulf Plnt
S062B010	Silty gravel	10	10/11/92	Fmr #1 Sulf Plnt
S063B000	Brown sandy gravel	0	10/11/92	Fmr #1 Sulf Plnt
S063B002	Sandy gravel (up to 1 in.)	2.5	10/11/92	Fmr #1 Sulf Plnt
S063B005	Sandy gravel	5	10/11/92	Fmr #1 Sulf Plnt
S063B007	Refusal-Cobbles (1-2 in.)	7.5	10/11/92	Fmr #1 Sulf Plnt
S063R999	Rinsate	NA	10/11/92	Fmr #1 Sulf Plnt
S064B000	Tan sandy gravel	0.5	10/11/92	Fmr #2 Sulf Plnt
S064B002	Decomposed tuff boulder/sandy gravel	2.5	10/11/92	Fmr #2 Sulf Plnt
S064B005	Brown silt	5	10/11/92	Fmr #2 Sulf Plnt
S065B000	Brown sand with trace gravel	0.5	10/11/92	Fmr #2 Sulf Plnt
S065B002	Tan silt	2.5	10/11/92	Fmr #2 Sulf Plnt
S065B005	Tan-brown silt	5	10/11/92	Fmr #2 Sulf Plnt
S065B007	Tan-brown silt	7.5	10/11/92	Fmr #2 Sulf Plnt
S065R999	Rinsate	NA	10/11/92	Fmr #2 Sulf Plnt
S066B000	Brown silty gravel (fine - coarse)	0.2	10/11/92	Phos Acid Loading
S066B002	Tan brown silty gravel (coarse up to 2 in.)	2.5	10/11/92	Phos Acid Loading
S066B005	Silty gravel	4	10/11/92	Phos Acid Loading
S067B000	Brown silty gravel	0.5	10/11/92	Phos Acid Loading
S067B002	Tan-brown silty gravel	2.5	10/11/92	Phos Acid Loading
S068B000	Brown sandy silt with trace gravel	0	10/8/92	Cooling Tower Area
S068B002	Silty gravel	2.5	10/8/92	Cooling Tower Area
S068B005	Brown sandy gravel (fine)	5	10/8/92	Cooling Tower Area
S068B007	Sandy gravel (fine <=1/4, mostly 1/8 or smaller) damp	7.5	10/8/92	Cooling Tower Area

Table 2.1-9 (Cont'd)

Phase I Borings	Generalized Sample Description	Actual Sample Depth, ft	Date Drilled	General Location
S068B010	Gravel	9	10/8/92	Cooling Tower Area
S069B000	Dark brown silty sand trace gravel	0	10/8/92	Cooling Tower Area
S069B001	Gray gypsum	0.5	10/8/92	Cooling Tower Area
S069B002	Tan silt	2	10/8/92	Cooling Tower Area
S070B000	Dark brown silt - damp	0	10/9/92	Former Cooling Pond
S070B002	Tan sandy gravel	2.5	10/9/92	Former Cooling Pond
S070B005	Tan sand-gravel (< gravel) tuff boulder	5	10/9/92	Former Cooling Pond
S070B007	Tan silty sand	7.5	10/9/92	Former Cooling Pond
S070B010	Tan silty sand	10	10/9/92	Former Cooling Pond
S071B000	Dark brown sandy silt tr/gravel (damp)	0	10/9/92	Former Cooling Pond
S071B002	Gray black wet silt	2.5	10/9/92	Former Cooling Pond
S071B005	Gray black silt - sandy gravel	5	10/9/92	Former Cooling Pond
S071B007	Tan silty sand with trace gravel	7.5	10/9/92	Former Cooling Pond
S071B010	Silty sand	10	10/9/92	Former Cooling Pond
S072B000	Dark brown silty gravel	0	10/10/92	Water Reclaim Area
S072B002	Tan silt to 1.8 ft. - tan sandy gravel	3	10/10/92	Water Reclaim Area
S073B000	Dark brown sand with gravel	0	10/10/92	Water Reclaim Area
S073B002	Tan sandy silt	3.5	10/10/92	Water Reclaim Area
S074B000	Brown sandy silt with trace gravel (1/4 or smaller)	0.5	10/9/92	Former Ore Pile Area
S074B002	Tan-brown silt	2	10/9/92	Former Ore Pile Area
S075B000	Tan silt with trace fine gravel	0.5	10/9/92	Former Ore Pile Area
S075B002	Tan-brown silt	2	10/9/92	Former Ore Pile Area
S076B000	Brown silt with trace gravel	0	10/10/92	Former Ore Pile Area
S076B002	Tan-brown silt	2	10/10/92	Former Ore Pile Area
S077B000	Dark red brown silt with gravel	0	10/10/92	Former Ore Pile Area
S077B002	Tan silt	2	10/10/92	Former Ore Pile Area
S078B000	Red-brown fine silt	0	10/10/92	Former Ore Pile Area
S078B002	Tan silt	2	10/10/92	Former Ore Pile Area
S079B000	Dark brown sandy silt with gravel (<=1/8 to 1/4 in.)	0	10/10 & 15	Bone Yard
S079B002	Tan silt	2	10/10 & 15	Bone Yard
S080B000	Brown sandy silt	0	10/10 & 15	Bone Yard
S080B002	Brown-tan silt	2	10/10 & 15	Bone Yard
S081B000	Tan-brown silt trace fine gravel	0	10/10 & 15	Bone Yard
S081B002	Tan-brown silt	2	10/10 & 15	Bone Yard

Table 2.1-9 (Cont'd)

Phase I Borings	Generalized Sample Description	Actual Sample Depth, ft	Date Drilled	General Location
S082B000	Tan silt	0.5	11/12/92	Road Sample
S082B002	Brown-tan silt	2	11/12/92	Road Sample
S083B000	Tan-brown silt	0.5	11/12/92	Road Sample
S083B002	Tan-brown silt	2	11/12/92	Road Sample
S084B000	Light tan fine silt	0.5	11/12/92	Road Sample
S084B002	Light tan fine silt	2	11/12/92	Road Sample
S085B000	Brown silt sand with gravel	0	10/10/92	Road Sample
S085B002	Tan-brown silt to silty sandy gravel	2	10/10/92	Road Sample
S086B000	Tan-brown silt trace gravel	0	10/10/92	Road Sample
S086B002	Tan silt	2	10/10/92	Road Sample
S087B000	Dup with S067B000		10/10/92	Road Sample
S087B002	Dup with S067B002-Refusal		10/10/92	Road Sample
S088B000	Red-brown sandy silt with gravel	0.5	10/10/92	Road Sample
S088B002	Brown silt	2	10/10/92	Road Sample
S089B000	Red-brown sandy silt with gravel	0	10/10/92	Road Sample
S089B002	Brown silt	2	10/10/92	Road Sample
S090B000	Red-brown silt trace gravel	0.5	10/10/92	Road Sample
S090B002	Brown silt	2	10/10/92	Road Sample
S091B000	Dup with S063B000		10/10/92	Road Sample
S091B002	Dup with S063B002		10/10/92	Road Sample
S091R999	Rinsate	NA	10/11/92	Road Sample
S092B000	Inaccessible - center of plant underground utilities	NS	10/11/92	Road Sample
S092B002	Inaccessible - center of plant underground utilities	NS	10/11/92	Road Sample
S093B000	Brown silt with trace gravel	0	10/10/92	Road Sample
S093B002	Tan silt	2	10/10/92	Road Sample
S094B000	Gray gypsum	0.5	10/8/92	Road Sample
S094B002	Tan-brown silt	2	10/8/92	Road Sample
S095B000	Dark brown sandy silt with fine gravel	0	10/10/92	Road Sample
S095B002	Tan silt (moist in shoe)	2	10/10/92	Road Sample
S096B000	Tan-brown silt	0.5	10/12/92	Road Sample
S096B002	Tan silt	2	10/12/92	Road Sample

Table 2.1-9 (Cont'd)

Phase II

Phase II Borings	Generalized Sample Description	Actual Sample Depth, ft	Date Drilled	General Location
S097B000	Silty gravel	0	7/14/93	Unlined ditch
S097B002	Sandy gravel	2	7/14/93	Unlined ditch
S097B005	Gravel	NS	7/14/93	Unlined ditch
S097B007	Sandy gravel	7	7/14/93	Unlined ditch
S097B010	Silty sandy gravel	10	7/14/93	Unlined ditch
S097B015	Silty gravel	15	7/14/93	Unlined ditch
S097B020	Sandy gravel	20	7/14/93	Unlined ditch
S097B025	Gravel	25	7/14/93	Unlined ditch
S097B030	Gravels (wet)	NS	7/14/93	Unlined ditch
S098B000	Sandy gravel	0.5	7/9/93	Triple superphosphate area
S098B002	Tan silt	2	7/9/93	Triple superphosphate area
S098B005	Tan silt	5	7/9/93	Triple superphosphate area
S098B007	Tan silt	7	7/9/93	Triple superphosphate area
S098B010	Tan silt (wet)	10	7/9/93	Triple superphosphate area
S099B000	Gypsum fill	0	7/12/93	Downgradient of EOP
S099B010	Sandy gravel	10	7/12/93	Downgradient of EOP
S099B020	Gravel	NS	7/12/93	Downgradient of EOP
S099B030	Sandy gravel	30	7/12/93	Downgradient of EOP
S099B040	Gravel	NS	7/12/93	Downgradient of EOP
S099B050	Gravel	50	7/12/93	Downgradient of EOP
S099R999	Rinsate	NA	7/13/93	Bechtel Trailer
S100B000	Gravelly sandy silt	0	7/11/93	Former Cooling Pond
S100B002	Tan silt	2	7/11/93	Former Cooling Pond
S100B005	Fill (sandstone)	5	7/11/93	Former Cooling Pond
S100B007	Fill (sandstone)	7	7/11/93	Former Cooling Pond
S100B010	Fill (sandstone)	10	7/11/93	Former Cooling Pond
S100B012	Fill (sandstone)	12	7/11/93	Former Cooling Pond
S100B015	Sandy gravel	15	7/11/93	Former Cooling Pond
S100B025	Gravel	25	7/11/93	Former Cooling Pond
S100B035	Gravel	NS	7/11/93	Former Cooling Pond
S100B045	Gravel	45	7/11/93	Former Cooling Pond
S100B055	Tan silt	55	7/11/93	Former Cooling Pond
S100B065	Sandy gravel	65	7/11/93	Former Cooling Pond
S100B080	Clay	80	7/11/93	Former Cooling Pond

Table 2.1-9 (Cont'd)

Phase I Borings	Generalized Sample Description	Actual Sample Depth, ft	Date Drilled	General Location
S101B000	Gravel	0	7/10/93	Cooling Tower
S101B002	Sandy gravel	2	7/10/93	Cooling Tower
S101B005	Silty gravel	5	7/10/93	Cooling Tower
S101B007	Sandy gravel	7	7/10/93	Cooling Tower
S101B010	Silty sandy gravel	10	7/10/93	Cooling Tower
S101B012	Sandy gravel	12	7/10/93	Cooling Tower
S101B015	Silty sandy gravel	15	7/10/93	Cooling Tower
S101B017	Tan silty gravel	17	7/10/93	Cooling Tower
S101B020	Silty sandy gravel	NS	7/10/93	Cooling Tower
S101R999	Rinsate	NA	7/10/93	@ Cooling Tower
S102B000	Silty sandy gravel	0	7/12/93	Water Reclaim
S102B002	Gravelly tan silt	2	7/12/93	Water Reclaim
S102B005		NS	7/12/93	Water Reclaim
S102B007	Tan silt	7	7/12/93	Water Reclaim
S102B010	Sandy gravel	10	7/12/93	Water Reclaim
S102B012	Gravel	NS	7/12/93	Water Reclaim
S102B015	Sandy gravel	15	7/12/93	Water Reclaim
S102B017	Sandy gravel	NS	7/12/93	Water Reclaim
S102B020	Sandy gravel	20	7/12/93	Water Reclaim
S103B000	Sandy gravel	0	7/13/93	RR Clean-out
S103B002	Sandy gravel	2	7/13/93	RR Clean-out
S103B005	Gravelly silt	5	7/13/93	RR Clean-out
S103B007	Gravelly silt	7	7/13/93	RR Clean-out
S103R999	Rinsate	NA	7/13/93	RR Clean-out
S104B000	Gravelly silt	0	7/24/93	Fmr #1 Sulf Plnt
S104B005	Tan silt	5	7/24/93	Fmr #1 Sulf Plnt
S104B010	Silty sandy gravel	10	7/24/93	Fmr #1 Sulf Plnt
S104B015	Gravel	15	7/24/93	Fmr #1 Sulf Plnt
S104B020	Gravel	20	7/24/93	Fmr #1 Sulf Plnt
S104B025	Sandy gravel	25	7/24/93	Fmr #1 Sulf Plnt
S104B030	Gravels	NS	7/24/93	Fmr #1 Sulf Plnt
S104B040	Gravels	NS	7/24/93	Fmr #1 Sulf Plnt
S105B000	Silty sandy gravel	0.5	7/24/93	Phos Acid Loading
S105B002	Gravelly silt	2	7/24/93	Phos Acid Loading
S105B005	Tan silt	5	7/24/93	Phos Acid Loading

Table 2.1-9 (Cont'd)

Phase I Borings	Generalized Sample Description	Actual Sample Depth, ft	Date Drilled	General Location
S105B007	Silty sandy gravel	7	7/24/93	Phos Acid Loading
S105B010	Sandy gravel	10	7/24/93	Phos Acid Loading
S105B015	Gravel	15	7/24/93	Phos Acid Loading
S105B020	Gravels	NS	7/24/93	Phos Acid Loading
S105B025	Gravels	NS	7/24/93	Phos Acid Loading
S105R999	Rinsate	NA	7/25/93	@ Phos Acid Loading
S106B000	Tan silt	0.5	7/10/93	Ammo #1
S106B002	Tan silt	2	7/10/93	Ammo #1
S106B005	Tan silt	5	7/10/93	Ammo #1
S106B007	Tan silt	7	7/10/93	Ammo #1
S106B010	Sandy gravel	10	7/10/93	Ammo #1
S107B000	Brown silty sandy gravel	0	7/10/93	Ammo #1 Loading
S107B002	Gravelly silt	2	7/10/93	Ammo #1 Loading
S107B005	Gravelly silt	NS	7/10/93	Ammo #1 Loading
S107B007	Sandy gravel	7	7/10/93	Ammo #1 Loading
S107B010	Sandy gravel	10	7/10/93	Ammo #1 Loading
S107B012	Sandy gravel	NS	7/10/93	Ammo #1 Loading
S108B000	Tan silt	0	7/9/93	Ammo #2
S108B002	Tan silt	2	7/9/93	Ammo #2
S108B005	Sandy gravel	5	7/9/93	Ammo #2
S108B007	Sandy gravel	7	7/9/93	Ammo #2
S108B010	Sandy gravel	10	7/9/93	Ammo #2
S109B000	Silty gravel	0	7/13/93	Phos Storage Loading
S109B002	Tan silt	2	7/13/93	Phos Storage Loading
S109B005	Gravelly sand	5	7/13/93	Phos Storage Loading
S109B007	Gravel	NS	7/13/93	Phos Storage Loading
S109B010	Sandy gravel	10	7/13/93	Phos Storage Loading
S109B015	Gravel	15	7/13/93	Phos Storage Loading
S109B020	Gravel	20	7/13/93	Phos Storage Loading
S332B070	Gravel	70	7/9/93	Well upgradient of EOP
S333B160	Sandy gravel	160	7/19/93	Simplot Fenceline well

Table 2.1-9 (Cont'd)

Phase I Borings	Generalized Sample Description	Actual Sample Depth, ft	Date Drilled	General Location
	PCB Road Resampling Locations			
S063B000	Sandy gravel	0	8/5/93	Fmr #1 Sulf Plnt
S067B000	Silty gravel	NS	8/5/93	Phos Acid Loading
S079B000	Sandy silt w/ gravel	0	8/5/93	Bone Yard
S080B000	Brown sandy silt	0	8/5/93	Bone Yard
S085B000	Silt sand w/ gravel	0	8/5/93	Road Sample
S088B000	Sandy silt w/ gravel	0.5	8/5/93	Road Sample
S090B000	Brown silt	0.5	8/5/93	Road Sample
S094B000	Gypsum	0.5	8/5/93	Road Sample
S098B000	Sandy gravel	0.5	8/5/93	Triple Superphosate area
	Separate data group - groundwater from borings			
S100W085	Groundwater screening	NA	7/11/93	Former Cooling Pond
S099W059	Groundwater screening	NA	7/12/93	Former East Overflow Pond
S097W035	Groundwater screening	NA	7/14/93	Unlined Ditch
S097WRRA	Rinsate	NA	7/14/93	QA/QC
S097WRRB	Rinsate	NA	7/14/93	Matrix Spike
S097WRRC	Rinsate	NA	7/14/93	Matrix Spike Dup

Notes:
All water sample parameters are field-filtered.
EOP = Former east overflow pond.
NA = Not analyzed.
NS = Not sampled.
GW = Groundwater.

Table 2.1-10
Analytical Parameters for Groundwater Samples

I. Heavy Metals

Aluminum
Antimony
Arsenic
Barium
Beryllium
Boron
Cadmium
Chromium
Cobalt
Copper
Iron
Lead
Lithium
Manganese
Mercury
Molybdenum
Nickel
Selenium
Silver
Thallium
Vanadium
Zinc

II. General Water Quality Parameters

Alkalinity (bicarbonate)
Alkalinity (carbonate)
Ammonia
Calcium
Chloride
Conductivity
Fluoride
Magnesium
Nitrate
pH
Phosphorus (total)
Phosphorus (orthophosphate)
Potassium
Sodium
Sulfate
Temperature
Total Dissolved Solids

III. Radionuclides

Gross Alpha
Gross Beta
Radium - 226[a]
Radium - 228[a]

IV. Volatile Organics[b]

Chloromethane
Bromomethane
Vinyl chloride
Chloroethane
Methylene chloride
Acetone
Carbon disulfide
1,1-dichloroethene
1,1-dichloroethane
Trans-1,2-dichloroethene
Chloroform
1,2-dichloroethane
2-Butanone
1,1,1-trichloroethane
Carbon tetrachloride
Vinyl acetate
Bromodichloromethane
1,2-dichloropropane
cis-1,3-dichloropropene
Trichloroethene
Dibromochloromethane
1,1,2-trichloroethane
Benzene
Trans-1,3-dichloropropene
2-chloroethylvinylether
Bromoform
4-methyl-2-pentanone
2-hexanone
Tetrachloroethene
1,1,2,2-tetrachloroethane
Tetrahydrofuran
Toluene
Chlorobenzene
Ethylbenzene
Styrene
Total xylenes

V. Semivolatile Organics[b]

Phenol
bis(2-chloro-ethyl)ether
2-chlorophenol
1,3-dichlorobenzene
1,4-dichlorobenzene
benzyl alcohol
1,2-dichlorobenzene
2-methylphenol

Table 2.1-10 (Cont'd)

V.	Semivolatile Organics (Cont'd)	
	bis(2-chloroisopropyl)ether	4,6-dinitro-2-methylphenol
	4-methylphenol	N-Nitrosodiphenylamine
	n-nitroso-dipropylamine	4-Bromophenyl phenyl ether
	Hexachloroethane	Hexachlorobenzene
	Nitrobenzene	Pentachlorophenol
	Isophorone	Phenanthrene
	2-nitrophenol	Anthracene
	2,3-dimethylphenol	Di-n-butyl phthalate
	Benzoic acid	Fluoranthene
	bis(2-chloroethoxy)methane	Pyrene
	2,4-dichlorophenol	Butyl benzyl phthalate
	1,2,4-trichlorobenzene	3,3"-dichlorobenzidine
	Naphthalene	Benzo(a)anthracene
	4-chloroaniline	bis(2-ethylhexyl)phthalate
	Hexachlorobutadiene	Chrysene
	4-chloro-3-methylphenol	Di-n-octyl phthalate
	2-methylnaphthalene	Benzo(b)fluoranthene
	Hexachlorocyclopentadiene	Benzo(k)fluoranthene
	2,4,6-trichlorophenol	Benzo(a)pyrene
	2,4,5-trichlorophenol	Indeno(1,2,3-c,d)pyrene
	2-chloronaphthalene	Dibenzo(a,h)anthracene
	2-nitroaniline	Benzo(g,h,l)perylene
	Dimethyl phthalate	(1-methylethyl)-Benzene
	Acenaphthylene	
	3-nitroaniline	
	Acenaphthylene	
	2,4-dinitrophenol	
	4-nitrophenol	
	Dibenzofuran	
	2,4-dinitrotoluene	
	2,6-dinitrotoluene	
	Diethyl phthalate	
	4-chlorophenyl phenyl ether	
	Fluorene	
	4-nitroaniline	

Notes:

(a) Groundwater samples are analyzed for radium-226 and radium-228 only if gross alpha or beta levels exceed levels reported for samples from upgradient wells.

(b) Groundwater samples were analyzed for volatile and semivolatile organic compounds during the second round of groundwater monitoring because of the extended time in which groundwater samples will be collected during the first round.

Table 2.2-1
EMF Air Monitoring Program
Site Parameters (October 1993)

Parameter	Site							
	1	2	3	4	5	6	7	8[a]
TSP fluoride	X	X	X	X	X	X	X	X
TSP (13 metals and total phosphorus)	X	X	X	X	X	X	X	X
Low-volume[b] (13 metals and 6 radionuclides)			X[a]	X	X	X		
PM_{10} (13 metals and total phosphorus)	X	X	X	X	X	X	X	X
PM_{10} (6 radionuclides)	X	X	X	X	X	X	X	X
Silica[c]	X	X				X	X	
Gaseous and particulate fluorides[c]	X	X				X	X	

Notes:

(a) Co-located samplers.

(b) Sampling limited to community sites as agreed upon at June 8, 1993, EPA meeting.

(c) Sampling sites limited to potential high concentration areas pending evaluation of initial data and methodology.

Table 2.3-1
Analytical Parameters for
Offsite Surface Soil Samples and QA/QC Samples

I. Heavy Metals	**II. General Minerals**
Aluminum	Fluoride
Antimony	Phosphorus (total)
Arsenic	Phosphorus (orthophosphate)
Barium	Potasium[a]
Beryllium	Sulfate[a]
Boron	
Cadmium	**III. Radioactivity[b]**
Chromium	Gamma spectrometry[c]
Cobalt	Potassium-40
Copper	Polonium-210
Iron	Uranium-238
Lead	
Lithium	**IV. Other**
Manganese	pH.
Mercury	
Molybdenum	
Nickel	
Selenium	
Silver	
Thallium	
Vanadium	
Zinc	

Notes:

(a) Phase II offsite soil samples also analyzed for these parameters.
(b) Radiological analyses were performed on samples from every other sample location along each of the 16 transects.
(c) Includes identification of lead-210.

Table 2.3-2
Offsite Soil Sample Summary

Phase I

Phase I Sample ID	SS Chem	SS Rad	BS Chem	BS Rad	Date Sampled	Land Use
SS/BS 000 1 A	1	1	1	1	7/24/92	Not in use
SS/BS 000 1 B	1		1		7/24/92	Not in use
SS/BS 000 1 C	1	1	1	1	7/30/92	Agriculture
SS 000 1 D	1				7/30/92	Agriculture
SS/BS 000 2 A	1	1	1	1	7/31/92	Park
SS/BS 000 2 B	1		1		8/3/92	Canal
SS/BS 000 2 C	1	1	1	1	8/4/92	Private/Pasture/Horse
SS/BS 000 3 A	1		1		8/5/92	Canal
SS/BS 000 3 B	1	1	1	1	8/5/92	Private/Pasture
SS/BS 023 1 A	1		1		7/24/92	Not in use
SS/BS 023 1 B	1	1	1	1	7/24/92	Not in use
SS 023 1 C	1				7/30/92	Not in use
SS 023 1 D	1	1			7/31/92	Park
SS/BS 023 2 A	1		1		8/3/92	Private/Pasture
SS/BS 023 2 B	1	1	1	1	8/3/92	Canal
SS/BS 023 2 C	1		1		8/3/92	Private/Day Care
SS/BS 023 3 A	1	1	1	1	8/4/92	Private/Pasture/Horse
SS 023 3 B	1				8/4/92	Private/Pasture/Horse
SS/BS 045 1 A	1	1	1	1	7/24/92	Not in use
SS/BS 045 1 B	1	1	1	1	7/24/92	Not in use
SS 045 1 C	1	1			7/30/92	Not in use
SS 045 1 D	1				7/31/92	Park
SS/BS 045 2 A	1	1	1	1	7/31/92	Not in use
SS/BS 045 2 B	1		1		7/31/92	Canal
SS 045 2 C	1	1			7/31/92	Private-undist.
SS/BS 045 3 A	1		1		8/5/92	Private
SS/BS 045 3 B	1	1	1	1	8/5/92	Road/Canal
SS/BS 068 1 A	1		1		7/25/92	Not in use
SS/BS 068 1 B	1	1	1	1	7/25/92	US-86
SS/BS 068 1 C	1		1		7/25/92	Wastewater
SS/BS 068 1 D	1	1	1	1	7/31/92	Wastewater
SS/BS 068 2 A	1		1		7/31/92	Private/Pasture/Horse
SS/BS 068 2 B	1	1	1	1	8/5/92	Private/Pasture/Horse
SS/BS 068 2 C	1		1		7/31/92	Private/Pasture/Sheep
SS/BS 068 3 A	1		1		8/5/92	Canal
SS/BS 068 3 B	1	1	1	1	8/5/92	Private
SS/BS 090 1 B	1	1	1	1	7/20/92	US-30
SS/BS 090 1 C	1		1		7/20/92	Park

Table 2.3-2 (Cont'd)

Phase I Sample ID	SS Chem	SS Rad	BS Chem	BS Rad	Date Sampled	Land Use
SS/BS 090 1 D	1	1	1	1	7/20/92	Park
SS/BS 090 2 A	1		1		7/30/92	Agriculture
SS 090 2 B	1	1			8/7/92	Quarry
SS 090 2 C	1				8/7/92	Residential
SS/BS 090 3 A	1	1	1	1	8/7/92	Residential/agriculture
SS/BS 090 3 B	1		1		8/6/92	Pasture
SS/BS 113 2 A	1	1	1	1	7/30/92	Grazing
SS 113 2 B	1				8/7/92	Grazing
SS/BS 113 3 A	1	1	1	1	8/7/92	US-30
SS/BS 120 2 C	1	1	1	1	8/7/92	Grazing
SS/BS 125 3 A	1	1	1	1	8/6/92	Public Land
SS/BS 130 3 B	1		1		8/6/92	Public Land
SS/BS 135 2 A	1	1	1	1	7/29/92	Public Land
SS/BS 135 2 B	1		1		7/28/92	Public Land
SS/BS 135 2 C	1	1	1	1	7/28/92	Public Land
SS 135 3 A	1				8/9/92	Public Land
SS/BS 135 3 B	1	1	1	1	8/6/92	Public Land
SS/BS 158 2 B	1	1	1	1	7/28/92	Public Land
SS/BS 158 2 C	1		1		7/28/92	Public Land
SS 158 3 A	1				7/28/92	Public Land
SS/BS 158 3 B	1	1	1	1	7/29/92	Public Land
SS/BS 158 4 A	1		1		8/9/92	Public Land
SS 180 2 C	1				8/20/92	Public Land
SS/BS 180 3 A	1	1	1	1	8/10/92	Public Land
SS 180 3 B	1				8/10/92	Public Land
SS 180 4 A	1	1			8/9/92	Public Land
SS/BS 203 3 A	1	1	1	1	7/23/92	Not in use
SS/BS 203 3 B	1		1		7/23/92	Not in use
SS/BS 203 4 A	1	1	1	1	7/23/92	Agriculture
SS/BS 225 2 A	1	1	1	1	7/22/92	Not in use
SS/BS 225 2 B	1		1		7/22/92	Not in use
SS/BS 225 2 C	1	1	1	1	7/22/92	Not in use
SS/BS 225 3 A	1		1		7/22/92	Not in use
SS/BS 225 3 B	1	1	1	1	7/22/92	Not in use
SS/BS 248 3 B	1	1	1	1	8/1/92	Not in use
SS/BS 248 4 A	1		1		8/1/92	Pocatello Sod Farm/ Residential
SS/BS 270 1 D	1	1	1	1	7/20/92	Racetrack
SS/BS 270 2 A	1		1		8/3/92	Canal
SS 270 2 B	1	1			10/23/92	Airport

Table 2.3-2 (Cont'd)

Phase I Sample ID	SS Chem	SS Rad	BS Chem	BS Rad	Date Sampled	Land Use
SS 270 2 C	1	1			10/23/92	Airport
SS 270 3 A	1	1			10/23/92	
SS/BS 270 3 B	1	1	1	1	10/23/92	
SS/BS 293 1 A	1		1		7/20/92	Not in use
SS/BS 293 1 B	1		1		7/23/92	US-86
SS/BS 293 1 C	1		1		7/23/92	Agriculture
SS/BS 293 1 D	1	1	1	1	7/23/92	Agriculture
SS/BS 293 2 A	1		1		8/3/92	Agriculture
SS/BS 293 2 B	1		1		7/21/92	Not in use
SS/BS 293 2 C	1	1	1	1	7/21/92	Quarry
SS 293 3 A	1	1			10/23/92	
SS/BS 293 3 B	1	1	1	1	10/23/92	
SS/BS 315 1 A	1	1	1	1	7/20/92	Not in use
SS/BS 315 1 B	1		1		7/23/92	Agriculture
SS 315 1 C	1	1			7/27/92	Agriculture
SS/BS 315 1 D	1		1		7/27/92	Agriculture
SS/BS 315 2 A	1	1	1	1	8/4/92	Agriculture
SS 315 2 B	1				8/3/92	Agriculture
SS/BS 315 2 C	1	1	1	1	7/21/92	Not in use/Residential
SS/BS 315 3 A	1		1		7/21/92	Home on FHIR
SS/BS 315 3 B	1	1	1	1	7/21/92	Not in use
SS/BS 338 1 A	1		1		7/24/92	Not in use
SS/BS 338 1 B	1	1	1	1	7/24/92	Not in use
SS 338 1 C	1				7/30/92	Agriculture
SS/BS 338 1 D	1	1	1	1	7/27/92	Agriculture
SS/BS 338 2 A	1		1		8/3/92	Not in use
SS 338 2 B	1	1			8/3/92	Not in use
SS/BS 338 2 C	1	1	1	1	7/21/92	Not in use
SS/BS 338 3 A	1		1		7/21/92	Not in use
SS/BS 338 3 B	1		1		7/21/92	Not in use
Total	108	59	84	47		

Table 2.3-2 (Cont'd)

Phase II

Phase II Sample ID	SS Chem	SS Rad	BS Chem	BS Rad	Date Sampled	Land Use
SS/BS 045 1 A 1	1	1	1	1	6/24/93	US-86
SS/BS 045 1 A 2	1	1	1	1	6/24/93	Not in use
SS/BS 045 1 A 3	1	1	1	1	6/24/93	Not in use
SS/BS 045 1 A 4	1	1	1	1	6/30/93	Not in use
SS/BS 090 1 B 1	1	1	1	1	6/24/93	Ball field
SS/BS 090 1 B 2	1	1			6/24/93	US-30
SS/BS 090 1 B 3	1	1			6/24/93	US-30
SS/BS 090 1 B 4	1	1			6/25/93	EMF field trailer
SS/BS 090 1 B 5	1	1	1	1	6/27/93	Agriculture
SS/BS 090 1 C 5	1	1	1	1	6/27/93	Agriculture
SS/BS 205 3 A	1	1	1	1	7/7/93	FHIR fee land
SS/BS 205 3 B	1	1	1	1	7/7/93	FHIR fee land
SS/BS 205 4 A	1	1	1	1	7/22/93	FHIR fee land
SS/BS 230 3 A	1	1	1	1	7/7/93	Not in use
SS/BS 230 3 B	1	1	1	1	7/7/93	Private-Not in use
SS/BS 230 4 A	1	1	1	1	7/7/93	FHIR fee land
SS/BS 240 3 A	1	1	1	1	7/7/93	FHIR fee land
SS/BS 240 3 B	1	1	1	1	7/7/93	FHIR fee land
SS/BS 293 1 A 1	1	1	1	1	6/26/93	Not in use
SS/BS 293 1 A 2	1	1	1	1	6/25/93	Not in use
SS/BS 293 1 A 3	1	1	1	1	6/25/93	Not in use
SS/BS 293 1 A 4	1	1	1	1	6/26/93	Race track
SS/BS 293 1 B 1	1	1	1	1	6/26/93	US-86
SS/BS 293 1 B 3	1	1	1	1	6/26/93	Race track
SS/BS 293 1 B 4	1	1	1	1	6/26/93	US-86
SS/BS 293 1 B 5	1	1	1	1	6/27/93	FMC mail box
SS/BS 315 3 B 1	1	1	1	1	7/8/93	FHIR fee land
SS/BS 315 3 B 2	1	1	1	1	7/8/93	FHIR fee land
SS/BS 315 3 B 3	1	1	1	1	7/8/93	FHIR fee land
SS/BS 315 3 B 4	1	1	1	1	7/8/93	FHIR fee land
SS BKG D 0 1	1	1			7/23/93	I-15 and Center Street
SS BKG D 0 2	1	1			7/23/93	So. of State campus golf course
SS BKG D 0 3	1	1			7/23/93	Ross Park annex
SS BKG D 0 4	1	1			7/23/93	City of Pocatello
SS BKG D 0 5	1	1			7/23/93	Private - Not in use

Notes:

1 = Sample analyzed for this suite of analytes.
SS = Surface soil sample.
BS = Sample from 2-foot depth.
Chem = Chemical analyses performed on sample.
Rad = Radiological analyses perfomed on sample.

Table 2.3-3
Soil Types in Vicinity of FMC and Simplot Facilities

Fort Hall Area (a)	Bannock County Area (b)
Soils on Flood Plains and Low Terraces	
Snake-Philbon: Nearly level, deep and very deep silt loams and peats on bottom lands.	Inkom-Joesvar: Very deep, moderately well-drained, and well-drained soils that formed in silty alluvium.
Soils on Alluvial Terraces and Fans	
Paniogue-Declo: Nearly level to strongly sloping loamy coarse sands and sandy loams on alluvial fans and terraces. Paniogue-Broncho: Nearly level to moderately steep loams and gravely loams on alluvial fans and terraces.	Arimo-Downey-Bahem: Very deep, well-drained soils that formed in loess and silty alluvium overlying sand, gravel, cobbles, and stones.
Soils on High Terraces	
Pocatello-Wheeler-Portneuf: Nearly level to very steep silt loams on loess-mantled basalt plains and dissected low plateaus.	Ririe-Rexburg-Lanoak: Very deep, well-drained soils that formed in loess and in silty alluvium derived from loess.
Soils on Foothills and Mountains	
	Camelback-Hades-Valmar: Very deep to moderately deep, well-drained, noncalcareous soils that formed in alluvium, colluvium, and residuum derived from quartzite and related rocks.

Notes:
(a) Source: SCS, 1977.
(b) Source: SCS, 1987.

Table 2.3-4
Methods Used for Chemical Analysis of Offsite Surface Soils

Parameter	Method Number	Method	Method Detection Limits (ppm)
A. Heavy Metals[a]	EPA 6010/EPA 7000[b]	AA/ICP[f]	0.0003-0.075
Mercury	EPA 7471A[b]	CV[g]	0.0002
B. General Minerals			
Phosphorus (total)	EPA 365.3[c]	Colorimetric	0.01
Phosphorus (orthophosphate)	EPA 365.3[c]	Colorimetric	0.01
C. Radioactivity			
Gross alpha	EPA 900.0[d]	Proportional counter	1 pCi/g[h]
Gross beta	EPA 900.0[d]	Proportional counter	1 pCi/g[h]
Radium-226	EPA 903.0[d]	Alpha spectroscopy	1 pCi/g[h]
Radium-228	EPA 904.0[d]	Liquid scintillation	1 pCi/g[h]
Gamma spectrometry	EPA 901.1	Gamma spectrometry	1 pCi/g[h]
Uranium-238	HASL 300[e]	Alpha spectroscopy	0.1 pCi/g
Polonium-210	HASL 300[e]	Alpha spectroscopy	0.1 pCi/g
D. pH	EPA 9045[d]	Electrometric	

Notes:

(a) The specific metals analyzed are listed in Table 2.3-1.
(b) Analytical methods obtained from EPA-SW846 (EPA, 1990)
(c) Analytical methods obtained from EPA-600/4-79-020 (EPA, 1983).
(d) Analytical methods obtained from EPA-SW846 (EPA, 1984b)
(e) HASL = Health and Safety Laboratory. Analytical method obtained from Harley, J. H., ed., EMF Procedures Manual, HASL-300, Environmental Measurement Lab, U.S. DOE, New York, 1972.
(f) ICP = inductively coupled plasma.
(g) CV = cold vapor.
(h) Method and counting time used to obtain the detection limit.

Table 2.4-1
Well Pair Clusters Showing Shallow and Deep Screen Designations

Deep Wells	Shallow Wells
101	102
104	103
108	107
110	109
118	117
126	125
137	129
	130
134	133
145	144
310	309
316	315
318	317
320	319
312	311[a]
	329
331	330
501	500
505	504
507	506
509	508
511	510
513	512
503	519
TW-5S	TW-5D
	TW-5I
TW-11S	TW-11I
TW-2S	TW-2D
	TW-2I
TW-4S	TW-4D
	TW-4I
TW-5S	TW-5D
	TW-5I

Note:
(a) Abandoned.

Table 2.4-2
Analytical Methods Used on Groundwater Samples

Parameter	Method Number	Method	Method Detection Limits (ppm)[a]
A. Volatile organics	EPA 8240A[c]	GC/MS[g]	0.005
B. Semivolatile organics	EPA 8270A[c]	GC/MS[g]	0.010
C. Heavy metals	EPA 6010/EPA 200.7[c]	ICP[i]	0.0003-0.075
Mercury	EPA 7470A[c]	CV[x]	0.0002
Arsenic	EPA 7060A[c]	GFAA[h]	0.001
Cadmium	EPA 7131[a]	GFAA[h]	0.0001
Chromium	EPA 7191[a]	GFAA[h]	0.0001
Lead	EPA 7421[a]	GFAA[h]	0.001
Selenium	EPA 7740[a]	GFAA[h]	0.002
D. Water Quality Parameters			
Alkalinity (bicarbonate)	EPA 310.1[b]	Titrimetric	All ranges
Alkalinity (carbonate)	EPA 310.1[b]	Titrimetric	All ranges
Ammonia	EPA 350.3[b]	Ion Selective Electrode	0.03
Calcium[d]	EPA 6010A/EPA 200.7[c]	ICP[i]	0.0003-0.075
Chloride	EPA 325.3[b]	Titrimetric	All ranges
Conductivity[l]	EPA 120.1[b]	Conductivity Meter	N/A[e]
Dissolved Oxygen[l]	EPA 360.1[b]	Membrane Electrode	N/A[e]
Fluoride	EPA 340.2[b]	Ion Selective Electrode	0.1
Nitrate	EPA 352.1[b]	Colorimetric	0.1
pH[p]	EPA 150.1[b]	Electrometric	N/A[e]
Phosphorus (total)	EPA 365.4[b]	Colorimetric	0.01
Phosphorus (orthophosphate)	EPA 365.1[b]	Colorimetric	0.01
Sulfate	EPA 375.3[b]	Gravimetric	10
Temperature(p)	EPA 170.1[b]	Thermometric	N/A
Total Dissolved Solids	EPA 160.1[b]	Gravimetric	10
Total Suspended Solids	EPA 160.2[b]	Gravimetric	10

Table 2.4-2 (Cont'd)

Parameter	Method Number	Method	Method Detection Limits (ppm)[a]
E. Radioactivity			
Gross Alpha	EPA 9310[a]	Scintillation Meter	1 pCi/L[j]
Gross Beta	EPA 9310[a]	Scintillation Meter	1 pCi/L[j]
Radium-226	EPA 9320[a]	Beta-counter	1 pCi/L[j]
Radium-228	EPA 9320[a]	Beta-counter	1 pCi/L[j]

Notes:

(a) Analytical methods obtained from EPA-SW846 (EPA, 1984b)

(b) Analytical methods obtained from EPA-600/4-79-020 (EPA, 1983).

(c) Analytical methods obtained from EPA-SW846 (EPA, 1990)

(d) Analytical method EPA 6010A for calcium will also be used for the parameters of magnesium, potassium, and sodium.

(e) N/A = Not applicable.

(f) CV = Cold vapor.

(g) GC/MS = Gas chromatograph/Mass spectrometer.

(h) GFAA = Graphite furnace atomic absorption.

(i) ICP = Inductively coupled plasma.

(j) Method and counting time will be established to obtain the detection limit.

(k) Quantification limits for metals, volatile organic compounds, semivolatile organic compounds, and PCBs are provided in the Sampling and Analysis Plan (Bechtel, 1992b).

(l) These parameters may be measured in the field.

Table 2.5-1
Surface Water and Sediment Investigation
Sampling Summary (1992 - 1993)

Location	Sampling Date				Flow Rate Measured				Location Description
	1992		1993		07/92	10/92	02/93	04/93	
OFFSW01	28-Jul	28-Oct	4-Feb	1-May	Yes	Yes	Yes	Yes	River Mile 10
OFFSW02	28-Jul	28-Oct	5-Feb	1-May					Eastern Springs
OFFSW03	28-Jul	28-Oct	4-Feb	30-Apr	Yes	Yes	Yes	Yes	River at Siphon Road
OFFSW04	28-Jul	28-Oct	5-Feb	30-Apr					Springs at Siphon Road
OFFSW05	29-Jul	29-Oct	4-Feb	30-Apr					River at Fish Farm
OFFSW05E				30-Apr					Channel at Fish Farm - West Fork
OFFSW05F				30-Apr					Channel at Fish Farm - East Fork
OFFSW06	29-Jul	28-Oct	7-Feb	29-Apr					Pond at Fish Farm
OFFSW07	29-Jul	27-Oct	7-Feb	29-Apr					Springs at Fish Farm
OFFSW07E				29-Apr					River across from Fish Farm
OFFSW08	29-Jul	27-Oct	4-Feb	29-Apr					River at FMC Park
OFFSW09	29-Jul	28-Oct	2-Feb	29-Apr					Springs at FMC Park
OFFSW10	30-Jul	27-Oct	4-Feb	29-Apr	Yes	Yes	Yes	Yes	River at Batiste Springs discharge
OFFSW11	30-Jul	27-Oct	7-Feb	29-Apr					Batiste Springs at creamery
OFFSW12	30-Jul	27-Oct	4-Feb	29-Apr					River above STP discharge
OFFSW12E				29-Apr					River at STP discharge
OFFSW13	30-Jul	28-Oct	2-Feb	29-Apr					Springs near STP
OFFSW14	31-Jul	27-Oct	3-Feb	28-Apr					Batiste Springs
OFFSW15	31-Jul	26-Oct	2-Feb	28-Apr					Springs near Batiste Road
OFFSW16	31-Jul	26-Oct	3-Feb	28-Apr	Yes	Yes	Yes	Yes	River at Batiste Road
OFFSW17	31-Jul	26-Oct	3-Feb	28-Apr					River at FMC discharge
OFFSW18		26-Oct[a]							River at old FMC discharge
OFFSW19	1-Aug	26-Oct	6-Feb	28-Apr					River near gypsum stack
OFFSW20	1-Aug	5-Nov	6-Feb	27-Apr					River near gypsum stack
OFFSW21	1-Aug	26-Oct	6-Feb	27-Apr					River upstream of gypsum stack
OFFSW22	2-Aug	26-Oct	3-Feb	27-Apr					River Mile 15
OFFSW23	2-Aug	26-Oct	5-Feb	27-Apr					River downstream of RR sites
OFFSW24	2-Aug	26-Oct	2-Feb	27-Apr					River upstream of RR sites
OFFSW25	2-Aug	26-Oct	2-Feb	27-Apr	Yes	Yes	(b)	Yes	River upstream of Pocatello

Notes:
(a) Sample not required for compliance with EMF RI/FS sampling plan.
(b) Measurement not possible because of river ice.

Table 2.5-2
Sample Containers, Preservatives, and Holding Times for Surface Water Samples

Parameter	Container	Preservation	Holding Time[a]
A. **Heavy Metals**[b]			
General heavy metals	Polyethylene	HNO_3 to pH<2; cool to 4°C	6 months
Mercury	Polyethylene	HNO_3 to pH<2; cool to 4°C	28 days
B. **Water Quality Parameters**			
Alkalinity (bicarbonate)	Polyethylene	Cool to 4°C	14 days
Alkalinity (carbonate)	Polyethylene	Cool to 4°C	14 days
Ammonia	Polyethylene	H_2SO_4 to pH<2; cool to 4°C	28 days
Calcium	Polyethylene	HNO_3 to pH<2; cool to 4°C	6 months
Chloride	Polyethylene	None required	28 days
Conductivity	Polyethylene	Cool to 4°C	28 days
Dissolved Oxygen	Polyethylene	None required	Analyze immediately
Fluoride	Polyethylene	None required	28 days
Hardness[c]	Polyethylene	HNO_3 to pH<2	6 months
Nitrate	Polyethylene	Cool to 4°C	48 hours
pH	Polyethylene	None required	Analyze immediately
Phosphorus (total)	Polyethylene	H_2SO_4 to pH<2; cool to 4°C	28 days
Phosphorus (orthophosphate)	Polyethylene	Filter immediately, Cool to 4°C	48 hours
Sulfate	Polyethylene	Cool to 4°C	28 days
Temperature	Polyethylene	None required	Analyze immediately
Total dissolved solids	Polyethylene	Cool to 4°C	7 days
Total suspended solids	Polyethylene	Cool to 4°C	7 days
C. **Radioactivity**			
Gross alpha	Polyethylene	HNO_3 to pH<2	6 months
Gross beta	Polyethylene	HNO_3 to pH<2	6 months
Radium-226/228	Polyethylene	HNO_3 to pH<2	6 months
Uranium-234/238[d]	Polyethylene	HNO_3 to pH<2	6 months

References: EPA-SW 846 (EPA, 1984b) and EPA-600/4-79-020 (EPA, 1983).
Notes:

(a) The specific metals that were analyzed are listed in Table 2.5-3.
(b) Added for third and fourth quarters.
(c) Added for third quarter only.

Table 2.5-3
Surface Water Field Data Summary

Phase I Sample ID	OFFSW01	OFFSW02	OFFSW03	OFFSW04	OFFSW05	OFFSW05E	OFFSW05F	OFFSW06	OFFSW07	OFFSW07E	OFFSW08	OFFSW09	OFFSW10	OFFSW11	OFFSW12	OFFSW12E	OFFSW13
Dissolved Oxygen (mg/l)																	
Jul-92	9.2	7.8	5.5	5.0	6.2	Not Sampled	Not Sampled	9.4	8.1	Not Sampled	7.4	10.6	7.6	8.8	9.2	Not Sampled	8.6
Oct-92	8.6	8.4	8.8	7.4	8.3	Not Sampled	Not Sampled	8.7	7.2	Not Sampled	7.9	9.2	7.0	13.4	8.3	Not Sampled	7.6
Feb-93	10.2	8.0	10.8	7.5	9.0	Not Sampled	Not Sampled	7.8	5.7	Not Sampled	10.0	8.3	8.8	7.1	10.4	Not Sampled	8.3
Apr-93	9.8	7.0	7.9	7.2	8.0	8.2	9.4	8.5	8.8	10.2	8.0	11.9	7.6	7.4	8.0	7.3	7.8
pH																	
Jul-92	7.31	7.63	7.32	7.51	7.75	Not Sampled	Not Sampled	7.67	7.69	Not Sampled	7.78	7.64	7.85	7.63	7.28	Not Sampled	7.35
Oct-92	7.70	7.65	7.59	7.5	7.6	Not Sampled	Not Sampled	7.67	7.57	Not Sampled	7.8	7.35	7.21	8.02	7.36	Not Sampled	7.1
Feb-93	8.11	8.41	9.93	8.13	8.11	Not Sampled	Not Sampled	7-8(b)	7-8(b)	Not Sampled	7.88	8.25	7.78	7-8(b)	7.72	Not Sampled	8.27
Apr-93	8.0	8.0	8.0	8.0	8.0	8.0	8.2	8.2	8.1	7.9	8.0	8.0	8.0	7.6	7.9	8.0	7.5
Conductivity (umhos/cm)																	
Jul-92	584	402	644	455	433	Not Sampled	Not Sampled	449	442	Not Sampled	619	672	497	531	705	Not Sampled	705
Oct-92	738	488	761	467	645	Not Sampled	Not Sampled	519	522	Not Sampled	803	645	856	585	816	Not Sampled	777
Feb-93	1280	510	1320	720	690	Not Sampled	Not Sampled	(c)	(c)	Not Sampled	1030	1007	1120	(c)	1020	Not Sampled	1070
Apr-93	605	485	616	485	618	519	535	519	523	617	634	647	649	711	806	614	759
Temperature (deg F)																	
Jul-92	63.8	69.6	67.3	71.4	57.9	Not Sampled	Not Sampled	60.4	59.3	Not Sampled	69.8	67.7	58.2	61.1	66.3	Not Sampled	66.5
Oct-92	62.6	52.0	64.6	59.4	61.5	Not Sampled	Not Sampled	59.3	59.1	Not Sampled	59.8	59.2	60.2	58.8	56.0	Not Sampled	66.4
Feb-93	45.0	50.2	64.6	42.7	49.2	Not Sampled	Not Sampled	51.6	53.6	Not Sampled	42.5	45.5	41.1	43.0	42.3	Not Sampled	40.0
Apr-93	55.0	63.0	52.3	53.2	52.2	54.3	56.1	54.9	54.7	51.6	54.0	59.9	53.6	53.6	54.0	52.7	55.2

Table 2.5-3 (cont'd)

Phase I Sample ID	OFFSW14	OFFSW15	OFFSW16	OFFSW17	OFFSW18	OFFSW19	OFFSW20	OFFSW21	OFFSW22	OFFSW23	OFFSW24	OFFSW25
Dissolved Oxygen (mg/l)												
Jul-92	7.6	3.6	8.3	7.8	Not Sampled	7.8	7.5	8.9	6.7	7.8	6.3	17.0
Oct-92	7.2	4.3	9.8	10.4	10.4	9.8	10.2	10.2	10.4	9.8	11.2	12.2
Feb-93	14.9	10.5	14.0	12.8	Not Sampled	11.8	14.1	(d)	16.4	12.8	13.5	15.2
Apr-93	4.8	6.2	10.0	9.6	Not Sampled	11.0	9.8	10.6	10.5	9.8	9.8	8.8
pH												
Jul-92	7.45	7.04	7.61	8.48	Not Sampled	8.16	8.19	8.32	8.24	8.46	8.44	8.74
Oct-92	7.51	7.38	8.68	8.68	8.64	8.74	9.7	8.7	8.65	8.47	8.42	8.46
Feb-93	7.95	7.98	8.83	8.61	Not Sampled	7-8(b)	8.72	(d)	8.68	8.64	8.03	8.24
Apr-93	6.8	7.4	8.4	8.4	Not Sampled	8.0	8.5	8.5	8.4	8.4	8.4	8.4
Conductivity (umhos/cm)												
Jul-92	484	773	601	708	Not Sampled	542	512	522	616	662	683	734
Oct-92	642	1090	863	880	875	768	863	847	850	873	873	879
Feb-93	1230	1245	2140	1350	Not Sampled	(c)	1190	(d)	1160	1290	1082	943
Apr-93	1192	860	572	626	Not Sampled	583	567	574	566	573	566	578
Temperature (deg F)												
Jul-92	56.5	59.9	64.7	78.5	Not Sampled	68.6	71.9	75.9	70.5	73.1	71.6	80.8
Oct-92	58.4	55.0	54.6	53.5	54.3	69.0	54.8	60.0	58.6	56.3	57.6	57.2
Feb-93	44.1	44.5	46.0	41.8	Not Sampled	32.0	32.5	(d)	42.0	36.6	39.1	35.0
Apr-93	56.1	54.7	51.1	59.0	Not Sampled	51.8	53.2	53.2	52.5	51.1	50.9	50.0

Surface Water Field Data Summary from Cross-Sectional Survey @ SW17

Phase II Sample ID	0307W17A	0307W17B(a)	0307W17C(a)	0307W17D	0307W17E(a)	0307W17F	0307W17G	0307W17H	0307W17I	0307W17J
Dissolved Oxygen (mg/l)										
27-Jul-93	8.2	8.2	8.2	7.4	7.4	8.6	8.0	7.6	8.4	8.2
pH										
27-Jul-93	8.6	8.6	8.6	8.7	8.7	8.6	8.6	8.5	8.4	8.8
Conductivity (umhos/cm)										
27-Jul-93	954	954	954	964	964	904	892	894	896	864
Temperature (deg F)										
27-Jul-93	64.8	64.8	64.8	64.0	64.0	62.1	61.2	61.0	61.2	62.2

Notes: (a) Denotes QA/QC sample. (b) Measured with pH paper.
(c) Not measured. (d) Inaccessible due to river ice.

Table 2.5-4
Analytical Parameters for Surface Water Samples

I. Heavy Metals[a]	II. Water Quality Parameters
Aluminum	Alkalinity (bicarbonate)
Antimony	Alkalinity (carbonate)
Arsenic	Ammonia
Barium	Calcium
Beryllium	Chloride
Boron	Conductivity
Cadmium	Dissolved oxygen
Chromium	Fluoride
Cobalt	Hardness[b]
Copper	Magnesium
Iron	Nitrate
Lead	pH
Lithium	Phosphorus (total)
Manganese	Phosphorus (orthophosphate)
Mercury	Potassium
Molybdenum	Sodium
Nickel	Sulfate
Selenium	Temperature
Silver	Total dissolved solids
Thallium	Total suspended solids
Vanadium	
Zinc	**III. Radioactivity**
	Radium 226/228
	Gross alpha and beta
	Uranium-234/238[c]

Notes:
(a) Both unfiltered and filtered surface water samples submitted for metals analysis.
(b) Third and fourth quarters only.
(c) Third quarter only.

Table 2.5-5
Analytical Methods and Project-Required Detection Limits*
I. Surface Water Parameters

Parameter	EPA Method Number	Method	PRDL[a] (mg/l)
A. Metals	EPA 6010[b] Series unless otherwise indicated		
Aluminum		ICP[c]	0.1
Antimony		ICP	0.25
Arsenic	7061	HAA[d]	0.01
Barium		ICP	0.1
Beryllium		ICP	0.005
Cadmium	7131	GFAA[d]	0.0005
Calcium		ICP	0.01
Chromium	7191	GFAA	0.0005
Cobalt		ICP	0.05
Copper		ICP	0.02
Iron		ICP	0.05
Lead	7421	GFAA	0.005
Lithium		ICP	0.02
Magnesium		ICP	0.002
Manganese		ICP	0.02
Mercury	7470	CVAA[d]	0.0005
Molybdenum		ICP	0.1
Nickel		ICP	0.04
Potassium		ICP	0.04
Selenium	7741	HAA	0.005
Silver		ICP	0.01
Sodium		ICP	0.05
Thallium	7841	GFAA	0.002
Thallium		ICP	0.1
Vanadium		ICP	0.1
Zinc		ICP	0.02

* All notes are given on the last page of this table.

Table 2.5-5 (Cont'd)

I. Surface Water Parameters

Parameter	EPA Method Number	Method	PRDL (mg/l)
B. Water Quality	MCAWW[e] Series		
Alkalinity-bicarbonate	310.1	Titrimetric	1
Alkalinity-carbonate	310.1	Titrimetric	1
Ammonia	350.2	Titrimetric	0.2
Boron	212.3	AA[d]	0.05
Chloride	325.3	Titrimetric	0.5
Fluoride	340.2	Ion selective electrode	0.1
Nitrate	353.3	Colorimetric	0.05
Sulfate	375.4	Turbidimetric	2
Total dissolved solids	160.1	Gravimetric	10
Total suspended solids	160.2	Gravimetric	4
Phosphorus-total	365.3	Colorimetric	0.02
Phosphorus-ortho	365.3	Colorimetric	0.02
Hardness	130.2	Titrimetric	
C. Radioactivity			
Gross alpha	900.0[f]	Proportional counter	2 pCi/1
Gross beta	900.0[f]	Proportional counter	3 pCi/1
Radium-226	903.0[f]	Alpha spectroscopy	
Radium-228	904.0[f]	Liquid scintillation	
Uranium-238 (third quarter only)	901.1	Gamma spectroscopy	
Lead-210	901.1	Gamma spectroscopy	
Potassium-40	901.1	Gamma spectroscopy	

Table 2.5-5 (Cont'd)

II. Sediment Parameters

Parameter	EPA Method Number	Method	PRDL (mg/l)
A. Metals	EPA 6010 Series unless otherwise indicated		
Aluminum		ICP	10
Antimony		ICP	25
Arsenic	7061	HAA	01
Barium		ICP	10
Beryllium		ICP	5
Cadmium		ICP	0.5
Calcium		ICP	1
Chromium		ICP	5
Cobalt		ICP	5
Copper		ICP	2
Iron		ICP	5
Lead	7421	GFAA	0.5
Lead		ICP	5
Lithium		ICP	2
Magnesium		ICP	2
Manganese		ICP	2
Mercury	7470	CVAA	2
Molybdenum		ICP	10
Nickel		ICP	4
Potassium		ICP	4
Selenium	7741	HAA	0.5
Silver		ICP	1
Sodium		ICP	1
Sulfate		EPA 375.3	2
Thallium	7841	GFAA	0.2
Thallium		ICP	10
Vanadium		ICP	10
Zinc		ICP	2
B. General Minerals	MCAWW Series		
Boron	212.3	Colorimetric	
Fluoride	340.2	Ion selective electrode	
Phosphorus-total	365.3	Colorimetric	
Phosphorus-ortho	365.3	Colorimetric	

Table 2.5-5 (Cont'd)

II. Sediment Parameters

Parameter	EPA Method Number	Method	PRDL (mg/l)
C. Radioactivity			
Gross alpha	900.0[k]	Proportional counter	2 pCi/1
Gross beta	900.0[k]	Proportional counter	3 pCi/1
Uranium-238	901.1	Gamma spectroscopy	
Lead-210	901.1	Gamma spectroscopy	
Potassium-40	901.1	Gamma spectroscopy	
Polonium-210	903.0	Alpha spectroscopy	
D. pH	9045[a]	Electrometric	N/A[g]
E. Total organic carbon	9060[a]	Oxidation or combustion	

Notes:

(a) PRDL - the detection limit required for the EMF RI.

(b) Analytical methods obtained from EPA-SW846 (EPA, 1984b).

(c) ICP = Inductively Coupled Plasma.

(d) AA = Atomic Absorption. CVAA = Cold Vapor Atomic Absorption.
GFAA = Graphite Furnace Atomic Absorption. HAA = Hydride Atomic Absorption.

(e) Analytical methods obtained from EPA-600/4-79-020 (EPA, 1983).

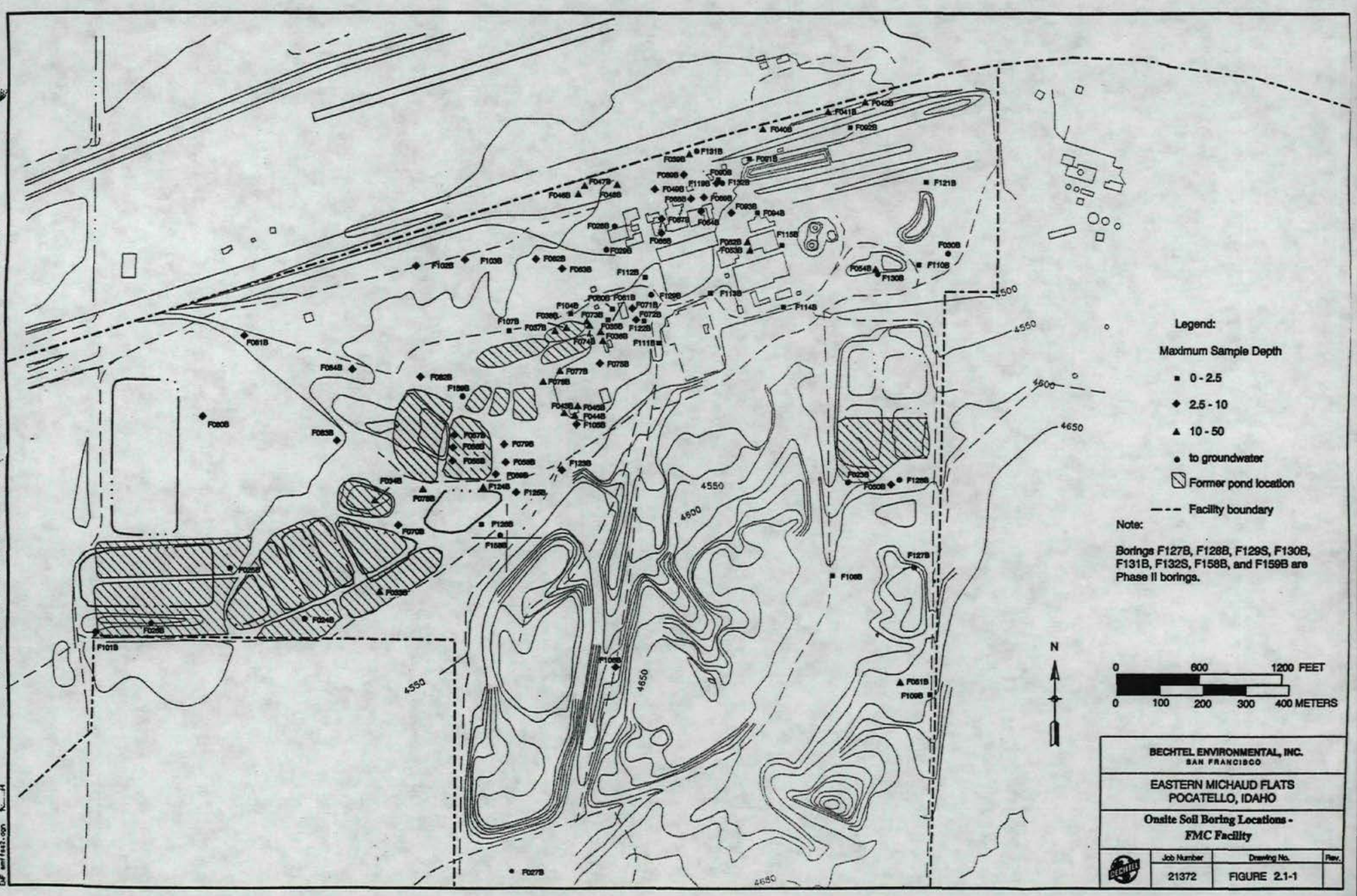
(f) Analytical method obtained from EPA-600/4-80-032 (EPA, 1980)

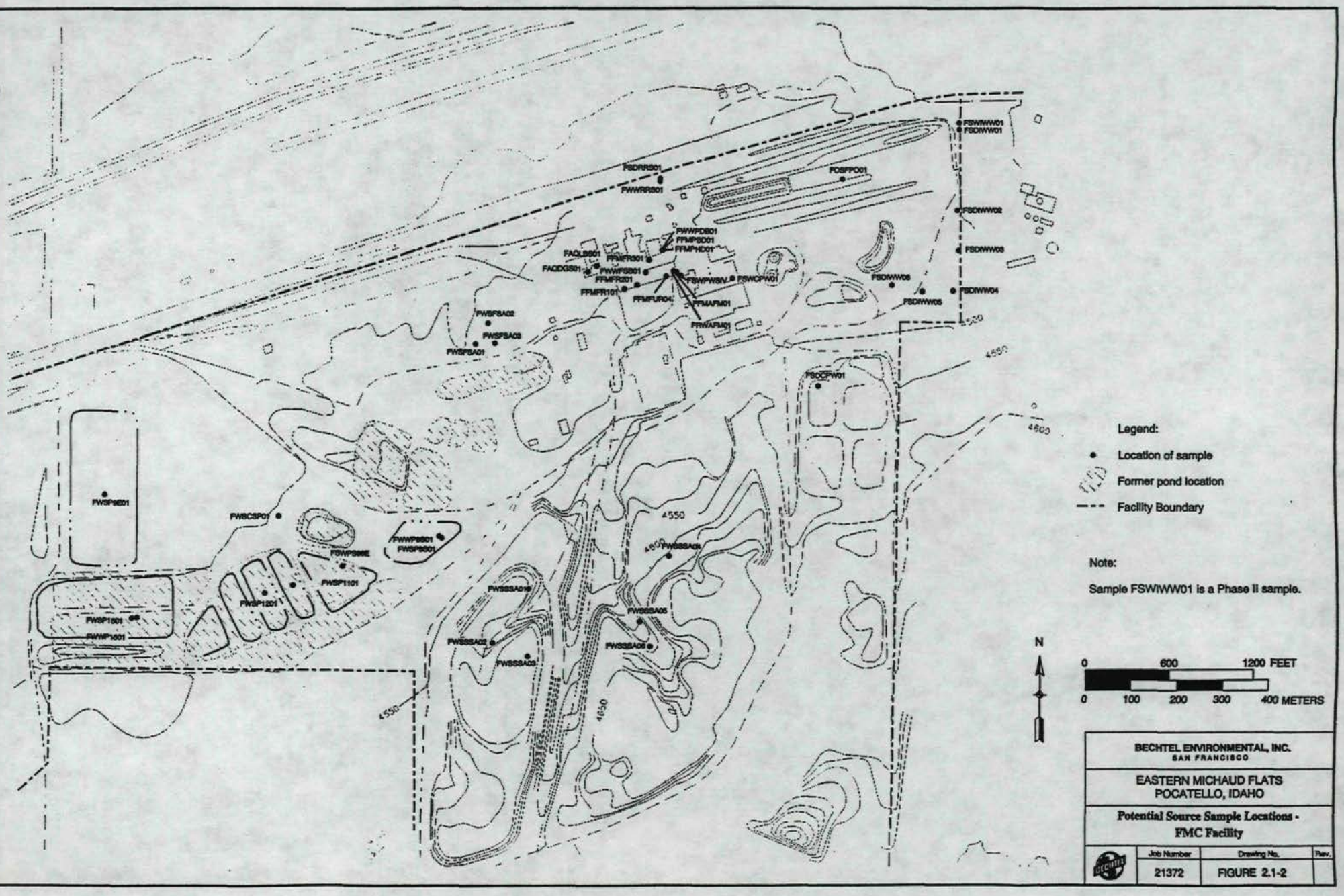
(g) N/A = Not Applicable.

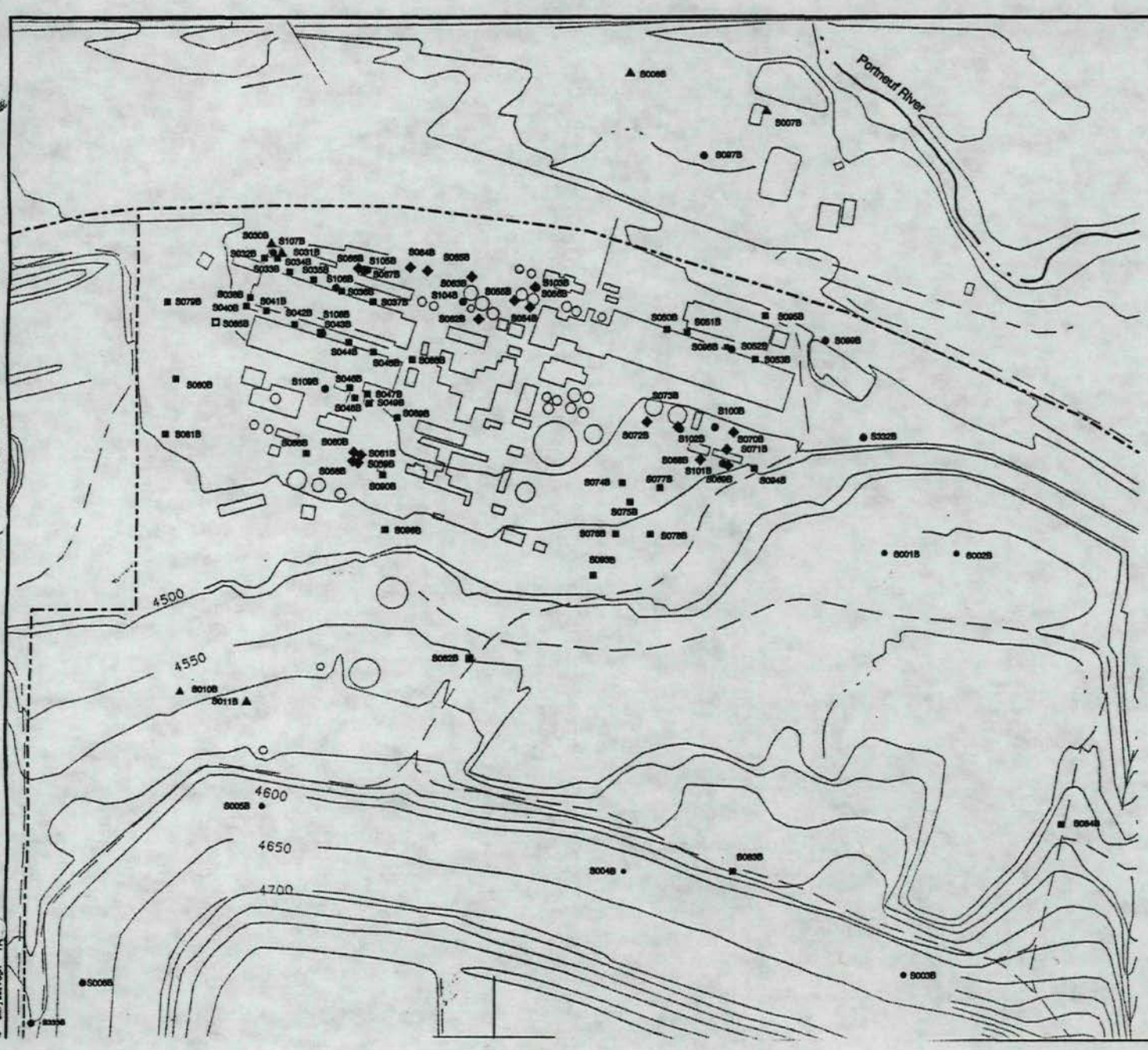
Table 2.5-6
Analytical Parameters for Sediment Samples

I.	Heavy Metals	II.	General Minerals
	Aluminum		Fluoride
	Antimony		Phosphorus (total)
	Arsenic		Phosphorus (orthophosphate)
	Barium		Sulfate[a]
	Beryllium		Potassium[a]
	Boron	III.	Radioactivity
	Cadmium		Gamma spectrometry
	Chromium		Gross alpha and beta
	Cobalt	IV.	Other
	Copper		pH
	Iron		Total organic carbon (TOC)
	Lead		Polychlorinated biphenyls (PCBs)
	Lithium		
	Manganese		
	Mercury		
	Molybdenum		
	Nickel		
	Selenium		
	Silver		
	Thallium		
	Vanadium		
	Zinc		

Note:
(a) July 1993 sediment samples were also analyzed for this parameter.


Legend:
Maximum Sample Depth
0 - 2.5
2.5 - 10
10 - 50
to groundwater
Former pond location
Facility boundary
Note:
Borings F127B, F128B, F129S, F130B, F131B, F132S, F158B, and F159B are Phase II borings.
N
0 600 1200 FEET
0 100 200 300 400 METERS
4550
4600
4650
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO
EASTERN MICHAUD FLATS
POCATELLO, IDAHO
Onsite Soil Boring Locations - FMC Facility
Job Number
21372
Drawing No.
FIGURE 2.1-1
Rev.


FSWIWW01
FSDIWW01
FSDRRS01
FWWRRS01
FOSFPO01
FSDIWW02
FSDIWW03
FSDIWW04
FSDIWW05
FSDIWW06
FWWPDB01
FFMPBD01
FFMPHD01
FAQLBS01
FFMFR301
FAQDGS01
FWWFSB01
FFMFR201
FFMFR101
FSWPWSIV
FSWCPW01
FFMFUR04
FFMAFM01
FRWAFM01
FWSFSA02
FWSFSA03
FWSFSA01
FSDCPW01
FWSP9E01
FWSCSP01
FWWP8S01
FWSP8S01
FWSP1101
FWSP1201
FWSP1501
FWWP1501
FWSSSA01
FWSSSA02
FWSSSA03
FWSSSA05
FWSSSA06
4550
4600
4650
Legend:
Location of sample
Former pond location
Facility Boundary
Note:
Sample FSWIWW01 is a Phase II sample.
N
0 600 1200 FEET
0 100 200 300 400 METERS
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO
EASTERN MICHAUD FLATS
POCATELLO, IDAHO
Potential Source Sample Locations -
FMC Facility
Job Number
21372
Drawing No.
FIGURE 2.1-2
Rev.



Legend:

- Facility Boundary

Maximum Sampling Depth:

- ■ 0 - 2.5 ft.
- ◆ 2.5 - 10 ft.
- ▲ 10 - 50 ft.
- ● to groundwater (depth is variable)

Note:

Borings S9097B through S109B and S332B and S333B are Phase II borings.

N

0 400 800 FEET

0 100 200 300 METERS

BECHTEL ENVIRONMENTAL, INC.
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EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Onsite Soil Boring Locations - Simplot Facility

Job Number	Drawing No.	Rev.
21372	FIGURE 2.1-3	

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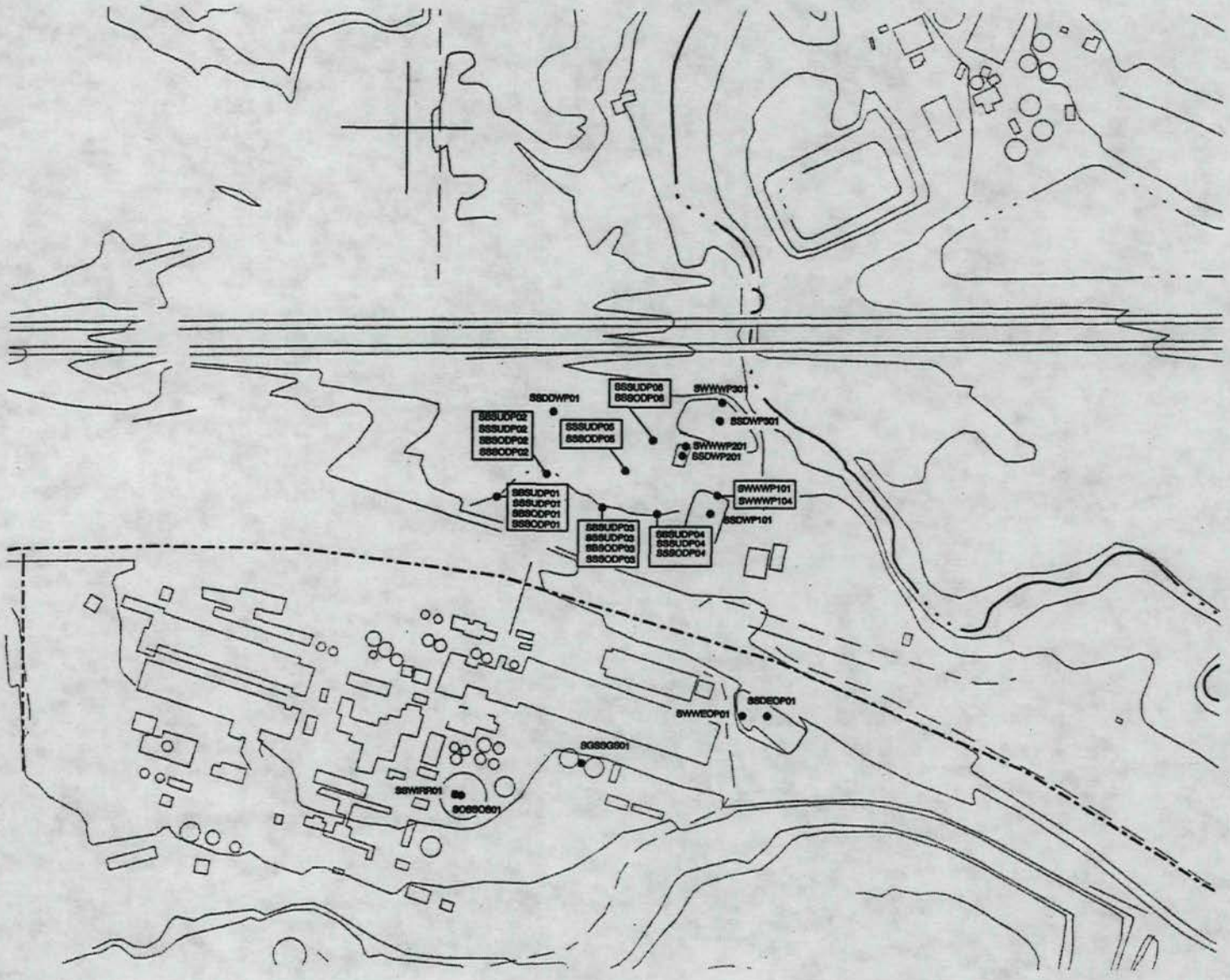

Legend:

- Location of sample

Note:

The following are Phase II samples:

SBSODP01, SSSODP01, SBSODP02
SSSODP02, SBSODP03, SSSODP03
SSSODP04, SSSODP05, SSSODP06

0 400 800 FEET

0 100 200 300 METERS

BECHTEL ENVIRONMENTAL, INC.
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EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Potential Source Sample Locations - Simplot Facility

Job Number	Drawing No.	Rev.
21372	FIGURE 2.1-4	

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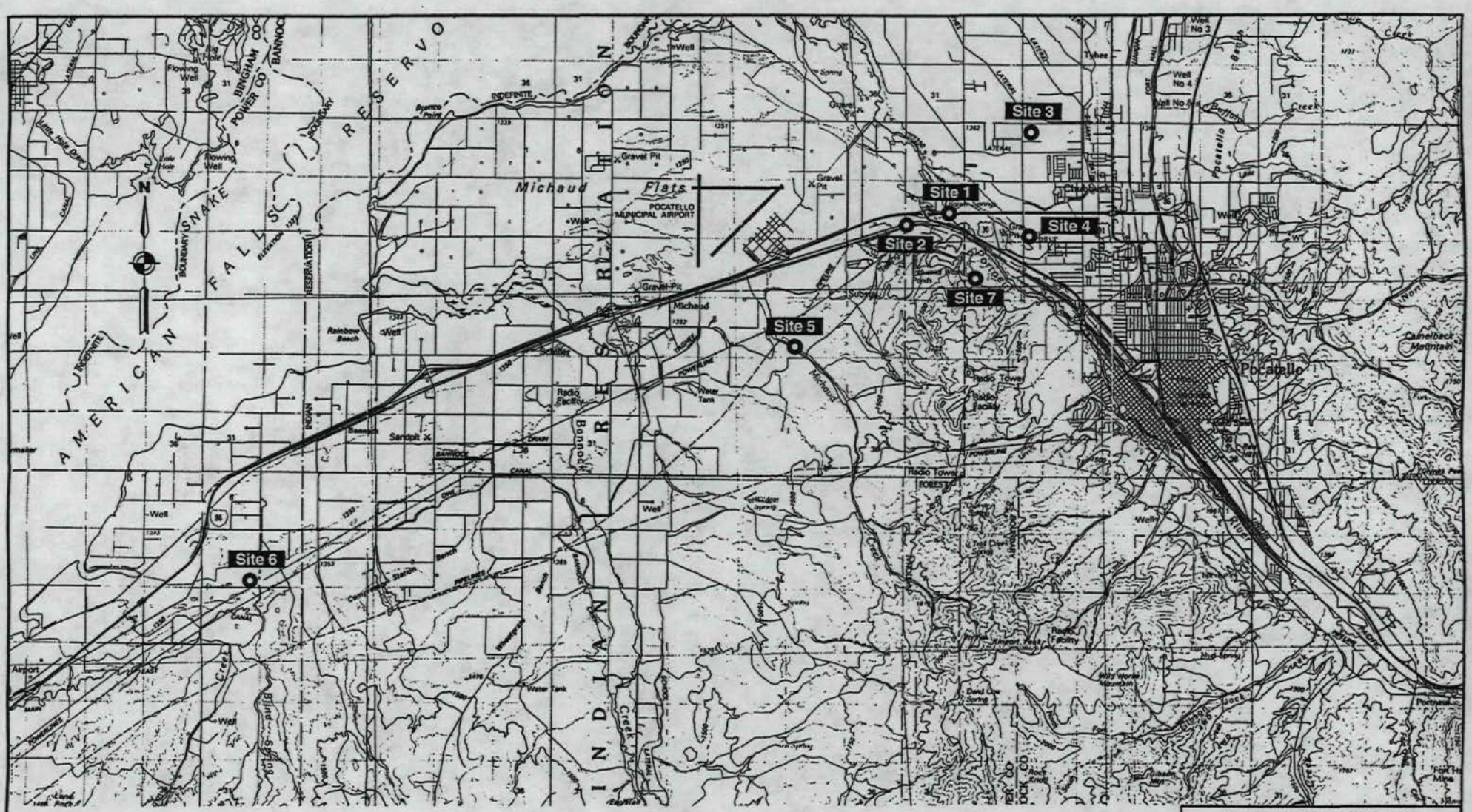

Legend: O - Monitoring Site

SCALES

0 1 2 3 miles

0 1 2 3 4 5 kilometers

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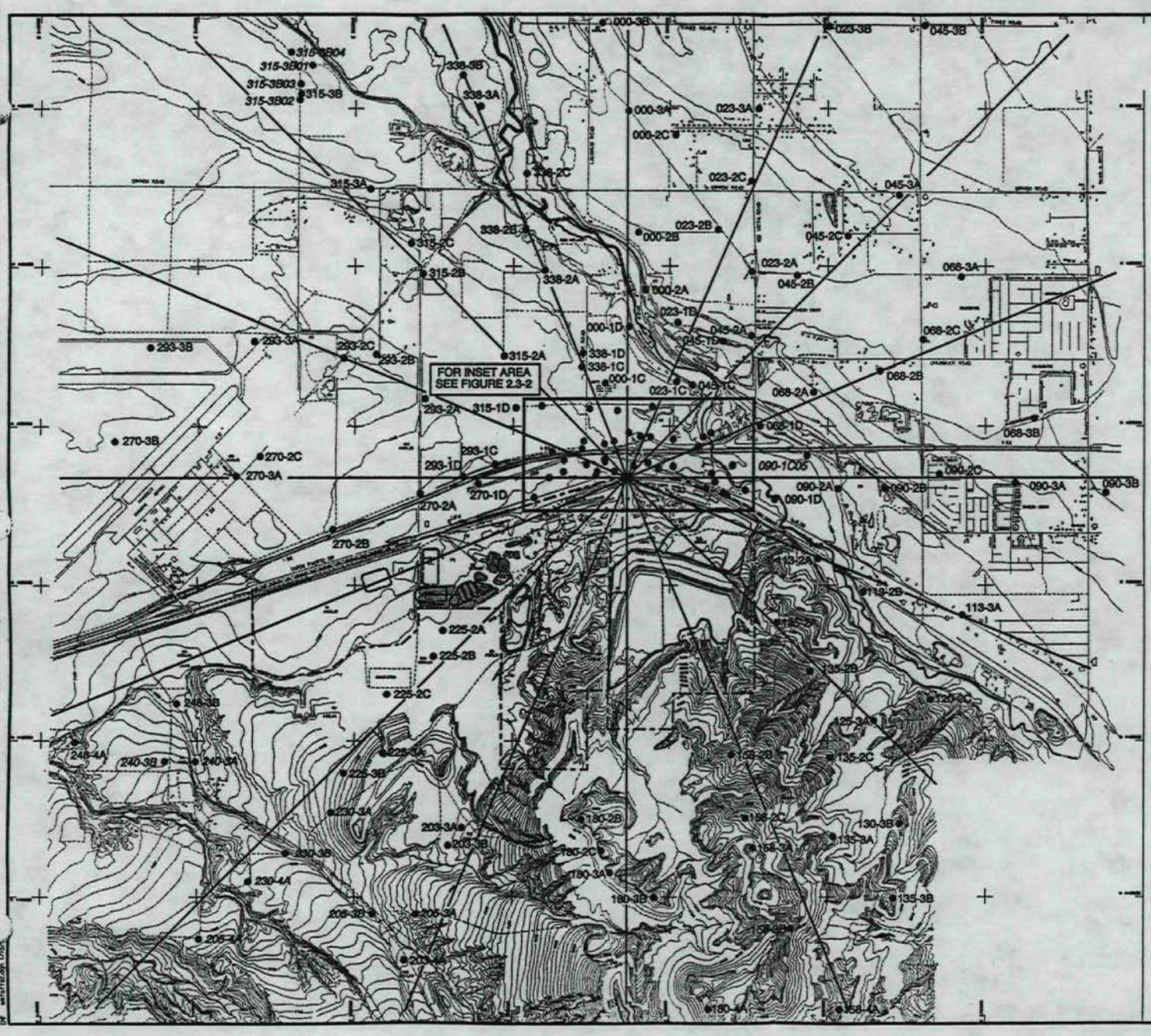
EASTERN MICHAUD FLATS
POCATELLO, IDAHO

EMF Air Monitoring Sites

JOB No.	DRAWING NO.	REV.
21372	FIGURE 2.2-1	



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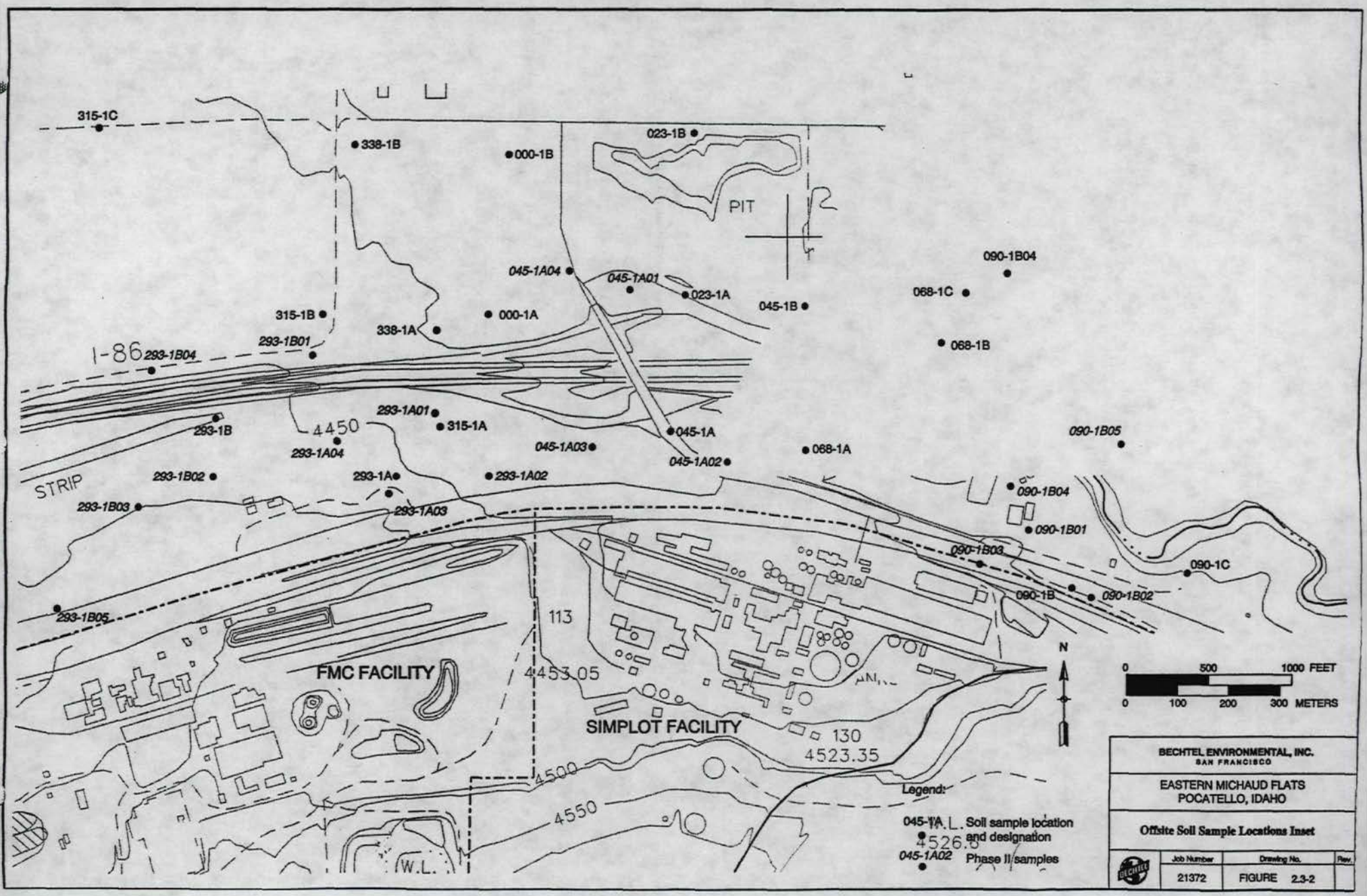
EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Offsite Soil Sample Locations

Job Number	Drawing No.	Rev.
21372	FIGURE 2.3-1	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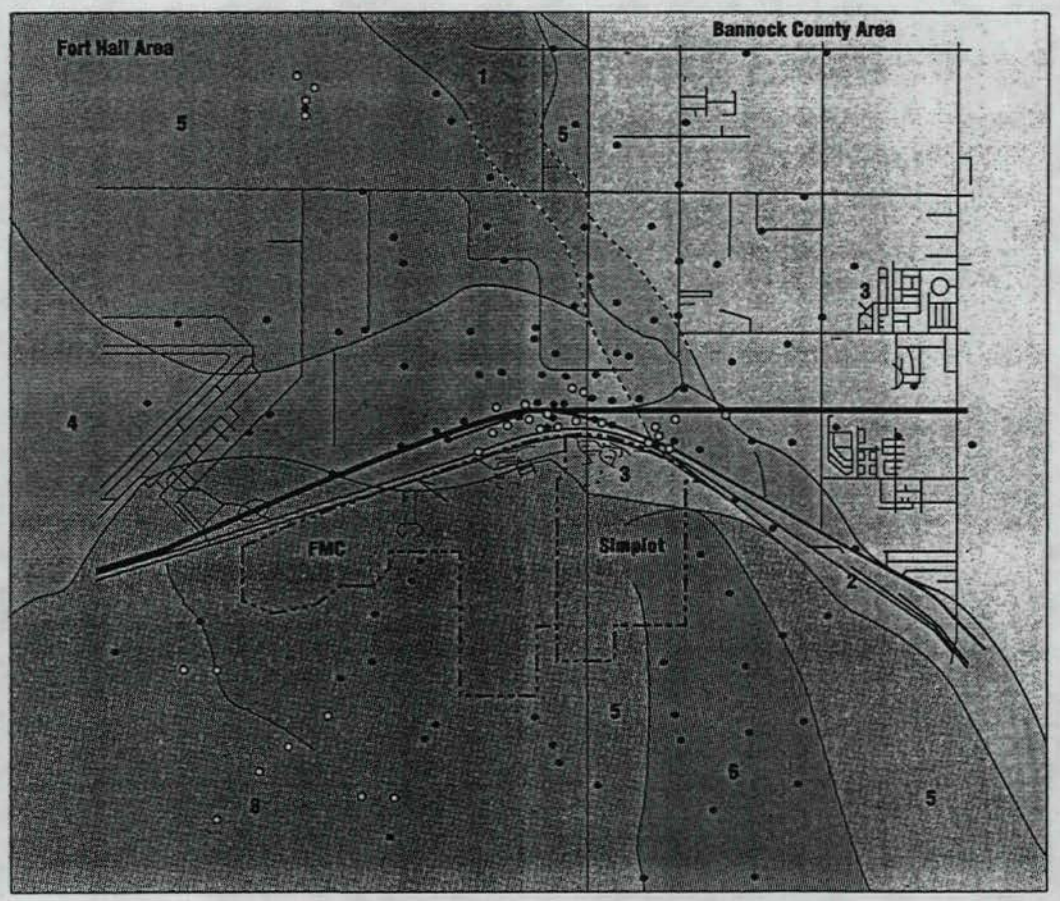
338-1B
000-1B
023-1B
PIT
045-1A04
045-1A01
023-1A
045-1B
090-1B04
068-1C
315-1B
000-1A
338-1A
293-1B01
I-86
293-1B04
068-1B
293-1A01
293-1B
4450
315-1A
045-1A
090-1B05
293-1A04
045-1A03
045-1A02
068-1A
STRIP
293-1B02
293-1A
293-1A02
090-1B04
293-1B03
293-1A03
090-1B01
090-1B03
090-1C
090-1B
090-1B02
293-1B05
113
FMC FACILITY
4453.05
SIMPLOT FACILITY
130
4523.35
4500
4550
W.L.
4526.5
N
0 500 1000 FEET
0 100 200 300 METERS
Legend:
045-1A Soil sample location and designation
045-1A02 Phase II samples
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO
EASTERN MICHAUD FLATS
POCATELLO, IDAHO
Offsite Soil Sample Locations Inset
Job Number
21372
Drawing No.
FIGURE 2.3-2
Rev.



Soil Associations

Fort Hall Area

Nearly Level to Moderately Sloping Soils on Bottom Lands, Low Terraces, and Alluvial Fans

1 Snake Philbon association: Nearly level, deep and very deep silt loams and peats on bottom lands

Nearly Level to Very Steep Soils on High Fans and Low Dissected Plateaus

4 Paniogue-Declo association: Nearly level to moderately sloping loams and silt loams on alluvial fans and terraces

5 Paniogue-Broncho association: Nearly level to moderately steep loams and gravelly loams on alluvial fans and terraces

8 Pocatello-Wheeler-Portneuf association: Nearly level to very steep silt loams on loess-mantled basalt plains and dissected low plateaus

Bannock County Area

Soils on Flood Plains and Low Terraces

2 Inkom-Joevar: Very deep, moderately well drained and well drained soils that formed in silty alluvium

Soils on High Terraces

3 Arimo-Downey-Bahem: Very deep, well drained soils that formed in loess and silty alluvium overlying alluvial sand, gravel, cobbles, and stones

Soils on Fan Terraces and Foothills

5 Ririe-Rexburg-Lanoak: Very deep, well drained soils that formed in loess and in silty alluvium derived from loess

Soils on Foothills and Mountains

6 Camelback-Hades-Valmar: Very deep to moderately deep, well drained calcareous soils that formed in alluvium colluvium, and residuum derived from quartzite and related rocks

N

Legend:

----- Modified from original soils maps to provide continuity between associated soil types.

• Phase I sampling location.

o Phase II sampling location.

Notes:

Sampling locations are labelled in Figures 2.3-1 and 2.3-2.

Numbers on soil associations correspond to original numbers on the Soil Conservation Service soil surveys for Fort Hall Area (SCS, 1977) and Bannock County Area (SCS, 1987).

Refer to Table 2.3-3 for a comparison of the associations between the two areas.

Scales

0 1 2 miles

0 1 2 3 kilometers

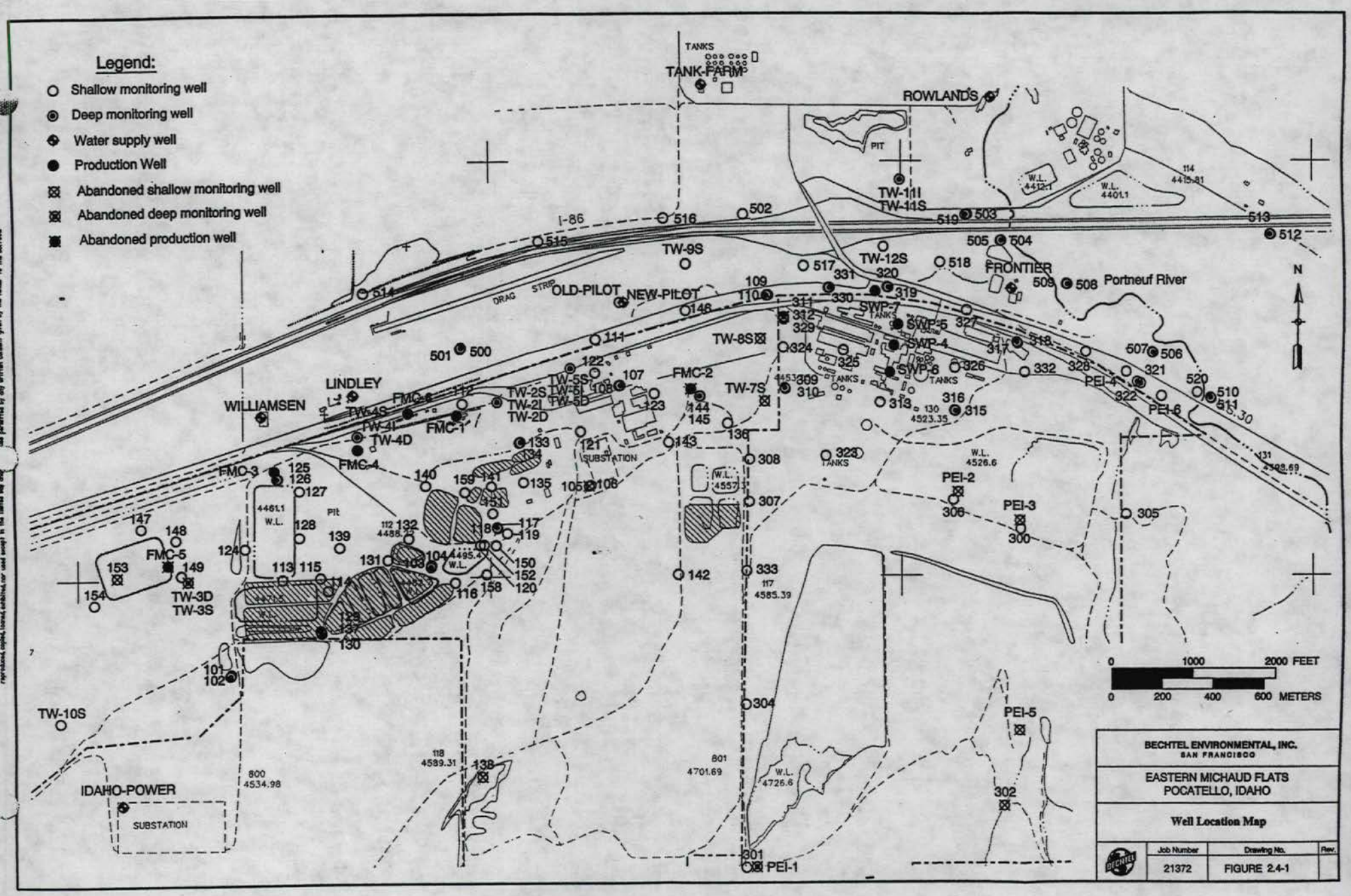
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Offsite Soil Sampling Locations with Soil Types in EMF Study Area

JOB No.	DRAWING No.	REV.
21372	FIGURE 2.3-3	

83-1477b.067
1:10-94 Ref 4


Legend:
Shallow monitoring well
Deep monitoring well
Water supply well
Production Well
Abandoned shallow monitoring well
Abandoned deep monitoring well
Abandoned production well
TANK-FARM
ROWLANDS
FRONTIER
Portneuf River
OLD-PILOT
NEW-PILOT
LINDLEY
WILLIAMSEN
IDAHO-POWER
SUBSTATION
DRAG STRIP
I-86
TW-11I
TW-11S
TW-9S
TW-12S
TW-8S
TW-7S
TW-2S
TW-2I
TW-2D
TW-5S
TW-5I
TW-5D
TW-4S
TW-4I
TW-4D
TW-3D
TW-3S
TW-10S
FMC-1
FMC-2
FMC-3
FMC-4
FMC-5
FMC-6
SWP-4
SWP-5
SWP-6
SWP-7
PEI-1
PEI-2
PEI-3
PEI-4
PEI-5
PEI-6
N
0 1000 2000 FEET
0 200 400 600 METERS
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO
EASTERN MICHAUD FLATS
POCATELLO, IDAHO
Well Location Map
Job Number
21372
Drawing No.
FIGURE 2.4-1
Rev.

Missouring Fig 2.5-1

Section 3

Physical, Demographic, and Ecological Characteristics

This section describes the physical setting of the EMF study area. Information presented here is derived primarily from data gathered as part of the Remedial Investigation (RI). In addition, a significant body of previously completed work exists that describes specific aspects of the geology, hydrogeology, hydrology, land use, and ecology characteristics of the EMF study area. Where appropriate, information from these studies has been incorporated into this section. (These studies can also be referred to for additional details regarding specific aspects of the study area.)

This section discusses the following characteristics of the study area:

- Section 3.1 describes regional and site geology (including local stratigraphy).
- Section 3.2 describes the characteristics of the surface water hydrology, including characteristics of river morphology, sediment deposition, and site runoff.
- Section 3.3 describes the occurrence of groundwater and groundwater flow characteristics, and summarizes the groundwater system and conceptual model.
- Section 3.4 describes the soil types and distributions.
- Section 3.5 addresses the area climate.
- Section 3.6 discusses site demographics and potential receptors, in addition to surrounding land use.
- Section 3.7 summarizes the ecological characteristics in terms of terrestrial and aquatic ecosystems, and identifies sensitive species and habitat.

The information presented in this section provides a context, along with information on sources of constituents of potential concern presented in Section 1, for interpreting investigations of soil, water, and air quality performed during this study. This interpretation is presented in Section 4.

3.1 GEOLOGY

Previous investigations conducted in the EMF study area provide a regional framework description of the underlying and surrounding geology. This information is summarized in Section 3.1.1. Site-specific geology, including a description of the local stratigraphy such as depth of bedrock, bedrock surface contour, and unconsolidated sediments, is summarized in Section 3.1.2. The results of thermal and gamma geophysical logging are presented in Section 3.1.3. An overview of EMF study area geology is presented on page 3.1-2.

The EMF study area is located at the base of the northern slope of the Bannock Range, where it merges with the Snake River Plain. The northern part of the EMF study area is located at the southeastern edge of Michaud Flats. The southern part extends onto the north slope of the Bannock Range.

The stratigraphy of the study area can be generally described as discontinuous layers of unconsolidated sediments deposited on an erosional surface that was incised in volcanic bedrock. The sedimentary unit immediately above the bedrock is a gravel derived from volcanic rocks.

Overlying the gravel are varying thicknesses of fine-grained silts, clays, and sands that form a discontinuous, semi-confining unit. The fines are overlain by another coarse-grained unit, called Michaud Gravel, that consists of quartzite, chert, and volcanic gravels, cobbles, and boulders.

Above the second gravel unit is another fine-grained facies that consists of interfingered silts, clays, and sands. In the western part of the EMF study area, a separate but discontinuous third coarse-grained layer is present. Finally, deposits of windblown silt (loess) and a colluvial silt layer of variable thickness mantle the area. The loess layer ranges from 2 to over 100 feet (0.6 to 30 m) thick at the EMF facilities, and is calcareous. To the north and east, the Michaud Gravel occurs in scoured channels. The fine-grained layers present in the western and central areas of the facilities are generally absent here.

A more detailed description of the regional and local geological features in the EMF study area is presented in the following pages.

Overview of Geology
(Section 3.1)

Regional Geology *(Section 3.1.1)*:	■ EMF study area is located within portions of the Bannock Range, Snake River Plain, and Michaud Flats. ■ Shallow stratigraphy where the Michaud Flats merges with the Bannock Range includes interbedded and reworked volcanics of the Starlight Formation, primarily interfingered with the Sunbeam Formation. These are, in general, overlain by Michaud and Aberdeen Terrace gravels. Recent alluvial deposits and loess mantle these older units to varying degrees.
Site Geology *(Section 3.1.2)*:	■ Southern part of study area at higher elevations is characterized by loess deposits, colluvium, and volcanic gravels overlying bedrock. ■ Central and northern parts of study area are, in general, loess, and quartzitic Michaud Gravel overlying or incised with silt and clay units. Deeper gravels are volcanics derived from Bannock Range. ■ Area north of Simplot production wells is underlain by very coarse Michaud Gravels with little or no interbedded fine-grained units.
Geophysical Logging Results *(Section 3.1.3)*:	■ Temperature logging does not indicate the presence of geothermal waters beneath EMF study area. ■ Gamma log results support conclusion that volcanic bedrock contains a relative abundance of naturally occurring radioactive material, whereas Michaud Gravel does not. However, areas of fill in the EMF study area were recognizable by their gamma spikes.

3.1.1 Regional Geology

The EMF study area is located at the juncture between two major physiographic provinces (Dohrenwend, 1987): the Basin and Range province to the south and the Snake River Plain to the north.

The Basin and Range province is a major physiographic province of North America, extending from eastern California across Nevada into Utah and from Oregon and Idaho into New Mexico and Mexico. The Basin and Range province is characterized by relatively evenly spaced, subparallel, north- to northwest-trending mountain ranges and intervening basins formed by high-angle extensional faulting, active mainly in mid to late Tertiary time.

The Snake River Plain is a 70- by 200-mile (112- by 32-km) Quaternary valley, filled to a depth of more than 10,000 feet (3,050 m) with volcanic rocks and intercalated volcanic-derived sediments (Whitehead, 1986). Being a younger structural feature, it bisects the northern portion of the Basin and Range province, isolating Basin and Range structures north of the Snake River Plain. The Snake River plain extends from Yellowstone Park in a broad southwest-trending arc (Stearns et al., 1938). The Snake River flows close to the southeastern margin of the Snake River Plain. Since the EMF study area is situated on the eastern portion of the Snake River Plain, all subsequent references to the Snake River Plain relate only to the eastern portion.

The Michaud Flats is a portion of the Snake River Plain north and west of Pocatello, Idaho. The EMF study area lies at the southeastern margin of Michaud Flats, about 3 miles (5 km) northwest of Pocatello. The Michaud Flats is a roughly elliptical area about 9 miles (14 km) long and 5 miles (8 km) wide, bounded on the west by Bannock Creek, on the north by American Falls Reservoir, on the east by the Portneuf River, and on the south by the Bannock Range (USGS, 1984).

The general geology in the vicinity of the EMF study area is shown in Figure 3.1-1 (a and b). Site topography is presented in Figure 3.1-2. Stratigraphy and geologic history are presented from oldest strata to youngest, and the discussion draws from Trimble's USGS Professional Paper 1400 (1976). Briefly, the stratigraphy is summarized as follows: Precambrian basement metamorphic and marine sedimentary rocks, minor local occurrences of Paleozoic rocks, widespread Tertiary volcanics, and Pleistocene to Recent alluvial, lacustrine, and eolian deposits.

The Bannock Range, and probably the Snake River Plain, are underlain by a basement complex of Precambrian to Cambrian metamorphosed to unmetamorphosed marine sedimentary and volcanic rocks (older than

570 million years ago [Ma] to 505 Ma) (Ludlum, 1942 and 1943). Rocks representing the next 500 Ma are absent from the region except for localized Paleozoic rocks outcropping in the northern Pocatello Range (Figure 3.1-1).

Compressional folding and thrusting occurred as recently as 66 Ma, when large thin plates of basement complex rocks were thrust eastward on low-angle faults. Such rocks are found exposed about 3 miles (4.8 km) south of the EMF study area in the Bannock Range, and are part of a 6,000-square-mile (15,400-square-km) thrust sheet that extends southward to Ogden, Utah. The crustal compression also caused regional uplift, resulting in extensive erosion and a regional unconformity.

The erosional surface was disrupted when crustal extension caused block faulting and created the Basin and Range province (Trimble, 1976; Peterson, 1988). Basin and Range deformation began 35 Ma, peaked approximately 17 to 14 Ma, and continues episodically through the present (Dohrenwend, 1987).

Structurally, the Bannock and Pocatello ranges constitute a single block of the Basin and Range. A north-trending, down-to-the-west fault or series of faults of large but unknown displacement is on the west side of the Bannock Range. The age of major movement is older than about 10 Ma (Trimble, 1976 and Kellogg, 1992, p. 107). These faults occur about 3 miles (4.8 km) south of the study area.

The known fault closest to the site is a short northeast-trending fault more than a mile south of the EMF study area (Trimble, 1976). The fault apparently does not continue north toward the study area, as it is not mapped in deposits exposed immediately north of the fault.

The Snake River Plain was formed by a downward movement of the earth's crust where the crust is effectively cut by faults; the block of crust that drops down is a graben. Faults bounding this graben run across the north-south trending structures of the Basin and Range province. Therefore, the Snake River Plain truncates, or cuts across, Basin and Range structures. Graben development was accompanied by volcanism and caldera subsidence beginning 12 to 2 Ma, depending on the location. The volcanoes provided large amounts of ash, lava, and debris, filling the valley as the crust moved downward. Near the EMF site, the Picabo volcanic center was active about 10 Ma (Pierce and Morgan, 1992). The Picabo field produced voluminous silicic lavas and pyroclastic debris, including ignimbrite deposits, ash tuffs, welded tuffs, and rhyolitic flows.

In the vicinity of the EMF study area, volcanic rocks and sediments are called the Starlight Formation and originate from the Picabo eruptions (Trimble, 1976). The Starlight Formation was divided into three members (Trimble, 1976):

- A lower member of mostly nonporphyritic basalt flows with basaltic tuff and breccia, bedded rhyolitic tuff, marl, claystone, gravel, and conglomerate
- A relatively thin middle member of welded to unwelded rhyolitic ash flow tuffs
- An upper member of bedded rhyolitic tuff capped in the immediate vicinity of the EMF site by a porphyritic trachyandesite (latite porphyry)

In addition, Trimble (1976) described a younger rhyolite deposited in late Pliocene to early Pleistocene time (about 1.6 Ma). For this investigation, no distinction is made between Starlight Formation members.

In more recent geologic time, a different type of volcanism occurred in the Snake River Plain. These are the Pleistocene basalt flows. In the Portneuf River Valley and along the Snake River are the following late Pleistocene basalt flows: the Big Hole Basalt; the Cedar Butte Basalt; and the basalt of the Portneuf River Valley (about 33,000 years old; Trimble, 1976).

The Cedar Butte Basalt dammed the Snake River near American Falls, forming an ancient lake that extended up to the Bannock Range foothills in the EMF study area (Stearns et al., 1938). The ancient lacustrine sediments were named the American Falls Lake Beds by Carr and Trimble (1963) and are mostly clay with minor silt, sand, and localized gravel.

The Sunbeam Formation was deposited at roughly the same time as the American Falls Lake Beds. The Sunbeam Formation includes the stream, floodplain, and delta deposits surrounding the ancient lake.

The lake bed deposits are interbedded with the coarser fluvial and deltaic strata of the Sunbeam Formation. Lacustrine and subaerial deposits are difficult to delineate at the lake margins due to fluctuating lake levels, meandering stream channels, and variable sediment supply.

Pediment gravels which are exposed to southeast of the site (Figure 3.1-1a) were described by Trimble (1976) as gravel and rubble deposits several miles wide mantling pediment surfaces cut on Tertiary rocks at the mountain fronts of the Bannock and Pocatello ranges. The gravel and rubble deposits consist almost entirely of locally-derived basement complex rocks. Trimble (1976) interprets the age of the pediment gravel deposits to be late Pleistocene, and older than the Big Hole Basalt but younger than the American Falls Lake Beds.

About 15,000 years ago, a catastrophic flood from ancient Lake Bonneville in northern Utah flowed down the Portneuf River Valley onto the Snake River Plain and into the basalt-dammed lake (Scott et al., 1982; Houser, 1992). The divide between Lake Bonneville and the Portneuf River Valley was rapidly downcut, releasing as much as 380 cubic miles (1,560 cubic km) of water over an estimated peak-flow period of 6 weeks (Malde, 1968). The flood waters filled the ancient basalt-dammed lake, then flowed over the Cedar Butte Basalt lava dam. The flood deposited extremely coarse-grained sediments named the Michaud Gravel along the Portneuf River Valley and into the Michaud Flats (Trimble and Carr, 1961). The Michaud Gravel consists of mostly quartzite and other quartz-rich metamorphic lithologies, with minor basalt. Sediment can be exceptionally coarse in the flood channels; quartzite and basalt boulders up to 8 feet (2.5 m) in diameter occur in downtown Pocatello (Trimble, 1976).

The Aberdeen Terrace gravels were deposited on the Michaud Gravel and the American Falls Lake Beds during the waning stages of the Lake Bonneville flood (Trimble, 1976). North of the EMF study area, Aberdeen Terrace gravels occur in braided abandoned channels (shallow swales) on Michaud Flats near the Portneuf River and as blanket deposits farther west (Trimble, 1976).

Late Pleistocene to Recent deposits of silt, sand, and gravel in the site vicinity were named older alluvium (Trimble, 1976). Younger alluvial deposits of silt, sand, and gravel cover the floors of major streams and other drainages. Extensive deposits of windblown silt (loess) cover the northern and western flanks of the Bannock Range and the northern portion of the Pocatello Range (Trimble, 1976, pl. 1). Loess was derived from the Pleistocene glaciers and is a "rock flour" that is made when glaciers scour bedrock and grind rock into very fine particles. Loess is then transported off the glaciers by winds and eventually deposited away from the glacier.

In summary, the shallow stratigraphy where Michaud Flats merge with the Bannock Range includes the interbedded volcanics and reworked volcanics of the Starlight Formation, American Falls Lake Beds interfingered with the Sunbeam Formation and overlain by Michaud Gravel, which are overlain by the Aberdeen Terrace gravels. Recent alluvial deposits and loess mantle these older units to varying degrees.

3.1.2 EMF Study Area Geology

This section presents the results of the RI drilling and geologic logging program. These results are discussed within the framework of the regional geology. Several

key elements of this discussion are critical when discussing the EMF study area hydrogeology in Section 3.3.

As described in Section 3.1.1, the study area is located at the northern base of the Bannock Range, where it merges with the Snake River Plain (Figure 1.3-1). The boundary between these features is seen in a scarp that runs through the EMF facilities, with 50 to 70 feet (15 m to 21 m) of relief (Figure 1.3-1).

The Portneuf River passes northeast of the Simplot facility and Michaud Creek passes the FMC facility immediately to the west. The floodplain of the Portneuf River near the study area is approximately 0.5 mile (0.8 km) wide. The riverbed lies entrenched in the Michaud Flats at a depth of about 20 to 40 feet (6 m to 12 m). The entrenched depth increases toward the American Falls Reservoir. Several steep dry draws extend in the Bannock Range and continue northward to the flats, and occur as sediment-filled channels in the subsurface.

In general terms, the EMF study area is underlain by a sequence of Starlight Formation volcanics and sediments, overlain by the interfingered American Falls Lake Beds-Sunbeam Formation. These are overlain by Michaud Gravel and Aberdeen Terrace deposits. Finally, a mantling of loess is present at higher elevations and a veneer of alluvium covers lower areas. Loess deposits are much thicker in portions of drainages where they have been reworked and redeposited.

The Starlight Formation has three distinct members, which vary lithologically from volcanic gravels, silts, and sands to intact volcanics. Because of the marked relief on the erosional surface of the Starlight Formation, any given location can be underlain by any one of a number of Starlight lithologies. The relationship between the volcanic deposits and the overlying sedimentary deposits is conceptualized in Figure 3.1-3 and shown in greater detail in Figures 3.1-4 through 3.1-11. The upper surface of volcanic deposits can be difficult to distinguish in drill cuttings because there are places where younger Sunbeam deposits overlie similar unconsolidated Starlight Formation deposits. Inferred contours on the upper surface of the Starlight Formation and basalts are shown in Figure 3.1-12. Boring logs and well construction details are presented in Appendix B.

Basalt was encountered beneath the EMF facilities in six borings (FMC-4, TW-2D, 129, 130, 139, and 304). The basalt in boreholes 139 and 304 was encountered beneath volcanic tuffs, indicating that the basalts may be part of the Tertiary deposits. The presence of basalt in the other four borings suggests that a late Pleistocene basalt flow may exist beneath part of the FMC facility. This basalt could be a distal lobe of the Big Hole Basalt or a part of one of the many other basalt flows in the area.

The unconsolidated sediments include Sunbeam Formation-American Falls Lake Beds, Michaud Gravel, and possibly Aberdeen Terrace Deposits. These units occur as alternating intervals of coarse-grained sediments (generally sand and gravel) and relatively fine-grained sediments (clay and silt). These units are laterally correlative between borings, although they also merge and pinch out as shown in Figures 3.1-5 through 3.1-11.

Beneath the northern portion of the FMC facility, the thicknesses of both the coarse- and fine-grained intervals are relatively consistent. In the southern portion of FMC, the extent and thickness of different deposits is much more viable. Beneath the Simplot facility and near the Portneuf River, the fine-grained intervals are variable in thickness and extent. There is a transition zone near the FMC-Simplot boundary where fine-grained intervals are more numerous and considerably thinner.

Locally, relatively thick accumulations of clay occur beneath the Simplot facility near the edge of Michaud Flats (sections C-C' and D-D', Figures 3.1-7 and 3.1-8). These clay deposits are distal from incised bedrock valleys. The incised valleys are typically filled with coarser sediments. The sediment distribution relative to the bedrock valleys indicates that these valleys were waterways, depositing coarser sediments under higher energy conditions and depositing fine-grained sediments down in the flats or over the banks. Near the Portneuf River, the thin, fine-grained layers pinch out or are truncated by flood deposits. The northernmost cross-section G-G' reveals a clay layer in the Michaud Flats that pinches out from west to east (see Figure 3.1-11). This clay layer occurs within the saturated sediments, and acts as a local confining unit.

Many borings encountered a coarse-grained interval composed of angular volcanic gravels immediately above hard Tertiary rock. These gravels are most likely derived locally and appear to be Sunbeam Formation. The overlying fine-grained interval is composed mostly of silt and clay with minor sand and gravel. This fine-grained unit may be part of the Sunbeam Formation or the American Falls Lake Beds.

The fine-grained interval identified as the American Falls Lake Beds/Sunbeam Formation is overlain by the Michaud Gravel, composed of rounded gravel, cobbles, and boulders of quartzite, chert, and volcanics. These gravels represent the Bonneville flood deposits which are relatively uniform in thickness beneath the northwestern half of the EMF facilities. The Michaud Gravel increases in thickness toward the east, truncating the underlying fine-grained interval and probably deeper units as well. The thicker deposits of the Michaud Gravel appear to be in a scoured channel confined by the Pocatello Range and Bannock Range. When the

Bonneville Floods reached the Michaud Flats, the waters spread and lost energy, dropping out most of the coarsest sediments along the eastern margin of the EMF facilities and depositing finer gravels to the west.

Above the Michaud Gravel is another fine-grained/coarse-grained couplet. This couplet may be Aberdeen Terrace deposits or it may be part of the Michaud Gravel. Since the Aberdeen Terrace deposits are reworked Michaud Gravel, it is very difficult to distinguish between the two. For characterizing the geology beneath the EMF facilities, it makes little difference which name is attached to these units.

Eolian deposits of loess and fine sand mantle the lower slopes of the Bannock Range and terrace or pediment deposits near the margin of the Michaud Flats. Loess deposits are particularly thick in the lower portions of drainages, where the silty material may be reworked and redeposited (for example, Section D-D', Figure 3.1-8).

Finally, recent (Holocene Era) fluvial and alluvial sediments were deposited in and near present-day stream channels.

3.1.3 Results of Geophysical Logging

Thermal and gamma geophysical logging was performed in 32 deep monitoring wells. Thermal logging was performed to determine if hydrothermal waters were present beneath the site. Hydrothermal waters are a regulated resource in the State of Idaho, and hydrothermal waters occurring in volcanic rocks may contain high levels of dissolved metals and other constituents. Thermal logging was not done until heat released during grout hydration had sufficient time to dissipate. Down-hole gamma logging was performed to augment visual field descriptions of samples and cuttings of soil and rock and to detect possible anomalous sources of radioactivity. Geophysical logs are presented in Appendix D.

Thermal logging results indicate a wide range of vertical temperature profiles. Negligible vertical temperature gradients are discernible in logs for Wells 102, 109, 133, 300, 301, 306, 307, 308, 313, 321, and 502. Although the temperature in each of these logs does not change with depth, the temperatures in the different wells range between the low 50s and mid 60s (degrees Fahrenheit) (approximately 10-14°C and 17-19°C, respectively).

Temperatures gradually decrease with depth in logs for Wells 309, 317, and 503. In several wells temperatures are as high as 70°F (21°C) and deep temperatures range between the mid 60s and mid 50s (degrees Fahrenheit) (approximately between 17-19°C and 12-14°C). The steepest temperature gradient occurs in Well 107, where shallow temperatures exceed the 86°F (30°C) limit of the logging tool, then gradually

decrease with depth to the mid 60s (degrees Fahrenheit) (or to approximately 18°C). The log for Well 319 indicates temperatures of about 70°F (21°C) for the shallowest 20 feet (6 m) of water, then drops abruptly to the low 60s (degrees Fahrenheit) (approximately 15-18°C) before slowly decreasing with depth to the upper 50s (degrees Fahrenheit) (approximately 13-15°C).

Temperatures gradually increase with depth in 13 wells (117, 125, 130, 142, 144, 153, 304, 305, 315, 504, 506, 508, and 512), with an average temperature difference of 3°F between the shallow and deep wells.

None of the logs indicate natural significant geothermal gradients, and except for Well 107, none indicate temperatures greater than 70°F (21°C). The high temperature at shallow depths in Well 107 is probably due to the proximity of the furnace building and slag pit. The higher temperatures in Well 319 are most likely indicative of the thermal plume from the FMC slag pit. The existence of the thermal plume in this area is confirmed by the consistently high temperatures recorded (18-23°C) in Well 320, which is the shallow well of the 319/320 pair. Phase II Well 517, which is projected to be in this plume, also has elevated temperatures. Most of the wells near the Portneuf River exhibit low temperatures in the low to mid 50s (approximately 12-14°C), especially in the shallower portion of the aquifer.

The log for Well 500 exhibits anomalous temperature changes that occur with depth. Logging for Well 500 was performed three days after the well was completed. The anomalous temperatures logged in Well 500 are restricted to depths above the filter pack and therefore could be due to heat released during grout hydration.

In summary, results of temperature logging do not indicate the existence of geothermal waters beneath the EMF facilities, but local thermal effects from the slag pit were evident.

Gamma logs measure the decay of radioactive elements in the subsurface. These elements are typically concentrated in clays, silts, and silicic igneous rocks from natural processes such as weathering or magmatic fractionation. Gamma logs can be used in some geologic settings to correlate geologic units when certain units contain a higher level of radioactive elements.

In the EMF study area, only weak correlations were observed in the gamma logs. In general, the fill areas showed a relative peak or spike in the gamma readings and there were minor peaks associated with some silt and clay units. There were also high gamma counts associated with the silicic volcanic bedrock. Michaud Gravel had very low gamma signatures.

Gamma logs and temperature logs are included with a more detailed discussion of the results in Appendix D.

In summary, the gamma log results support the conclusion that the volcanic bedrock contains a relative abundance of naturally occurring radioactive material, whereas the Michaud Gravel does not. The silt and clay units do not contain a sufficient amount of radioactive elements to provide a consistent sharp signature on the gamma logs, reducing the resolution of the gamma logs, for use in correlating these units. However, areas of fill were sometimes very recognizable by their gamma spikes. This is supported by radioactivities found in some source materials during the potential source investigation (Section 4.2).

3.2 DRAINAGE AND SURFACE WATER HYDROLOGY

An understanding of the characteristics of surface waters and drainage patterns is essential to the evaluation of the distribution of potential constituents of concern. Once constituents find their way into surface waters, their distribution is influenced by the physical and chemical characteristics of the hydrologic system. Section 3.2.1 presents the regional characteristics of surface waters in the EMF study area. This includes a description of river morphology, sediment deposition patterns, and general surface water quality. Section 3.2.2 discusses site-specific drainage patterns and potential runoff associated with storm events.

To evaluate the potential for particulate from the EMF facilities to be transported to the Portneuf River and subsequently to be deposited in American Falls Reservoir, water and sediment budgets were compiled for the Snake and Portneuf rivers and American Falls Reservoir. These data indicate that under average conditions, the Snake River contributes over 90 percent of the sediment deposited in the American Falls Reservoir.

Sediment transport volumes, depositional characteristics, and flow rates of the Portneuf River indicate that fine-grained sediments are deposited along the river in point bars and a local floodplain. Although the riverbed is not aggrading, or building up, the morphology indicates there are numerous chutes and bars between the FMC outfall and the American Falls Reservoir, where constituents from the site, if introduced into the Portneuf River, may be deposited.

Due to the topography of the EMF facilities, during typical storm events surface water runoff will not emanate from the site. As discussed in Section 3.2.2, the runoff produced by the maximum observed storm would not exceed the holding capacity.

General water quality of surface water near the EMF facilities is variable, but overall falls into a bicarbonate classification. Water chemistry at numerous springs along the Portneuf River shows impacts from various anthropogenic activities including agriculture, sewage treatment, and the EMF facilities. These impacts are discussed in detail in Section 4.5.

Overall surface water quality of the Portneuf River shows relatively strong seasonal signatures and also shows the relative signature from groundwater discharge to the river. Where the river is recharged by groundwater, river water pH is lower than upstream sections of the river.

3.2.1 Regional Hydrology and River Morphology

Major surface water features of the region include the Snake River, Portneuf River, and the American Falls Reservoir (Figure 3.2-1). The reservoir is an impoundment of the Snake and Portneuf rivers and Bannock Creek, among others; both rivers discharge into the reservoir at its east end. Figure 3.2-1 also summarizes data with respect to the drainage areas and the contribution of inflow of water and sediment from the rivers to the reservoir. The Snake River data are from the Snake River gauging station near Blackfoot (gauge 13069500); the Portneuf River is gauged at Pocatello (gauge 1307550), 17 miles upstream of the reservoir and at Tyhee Station, near Tyhee Road.

A more detailed discussion of the data on water flow and sediment transport of the Snake River, Portneuf River, and American Falls Reservoir is presented in Section 3.2.1.1. Also included is a discussion of river morphology and associated sediment deposition patterns.

Snake River

The Snake River is a moderately straight river channel, downcut into the basalts of the Snake River Plain. In places, the river is significantly entrenched into the basalts.

Up to the American Falls Reservoir, the Snake River drainage is 11,310 square miles (2.9 million hectares), including watersheds of Blackfoot River, Henry's Fork, Teton River, and portions of western Wyoming (see Figure 3.2-2). Sediments deposited in the American Falls Reservoir may originate from a large number of watersheds and reflect anthropogenic activities throughout this area.

A fraction of the sediments transported by the Snake River and subsequently deposited in the American Falls Reservoir is derived from the Phosphoria Formation, which crops out extensively throughout the upper Snake River drainage basin in western Wyoming and eastern Idaho (Swanson et al., 1953). Phosphoria Formation sediments will likely be found in the fine-grained suspended sediment load because the Phosphoria Formation is a shale, which weathers rapidly to clay and silt.

Portneuf River

The Portneuf River drainage area is approximately 1,250 square miles. In geomorphologic terms, the Portneuf River displays two distinct channel types: one is a high sinuosity pattern associated with bars and a low width/depth ratio; the

Table 3.2-1
Summary of Sediment Transport Data

Portneuf River, Pocatello Idaho

Date	Time	Discharge (cfs)	Suspended Sediment (mg/l)	Sediment Load (tons/day)
07-Jun-74	0925	455	159	195
07-Jun-74	1050	455	159	195
25-Sep-74	1040	121	53	17
25-Jun-75	1140	713	210	404
23-Sep-77	1020(a)	118	97	31
08-Nov-77	0945	210	152	86
12-May-80	1150	915	589	1,453
20-May-81	1245	247	85	57
09-Jul-81	1315	51	21	3
15-Nov-90	1000	172	16	7
15-Mar-91	1500	265	134	96
16-May-91	1415	471	199	253
09-Jul-91	1415	62	58	10
18-Sep-91	1115	85	16	4
18-Nov-92	(a,b)	276	15	11

Snake River, Blackfoot River Station

Date	Time	Discharge (cfs)	Suspended Sediment (mg/l)	Sediment Load (tons/day)
07-Jun-76	0925(c)	52,200	1180	166,063
08-Jun-76	1050(c)	43,900	612	72,433
14-Jun-76	1040(c)	11,600	137	4,284
16-Jun-76	1140(c)	9,350	155	3,907
17-Jun-76	1020(a,c)	8,980	190	4,600
17-Jul-89	0945	2,970	23	184
19-Sep-89	1150	2,730	14	103
21-Sep-89	1245	2,400	5	32
16-Mar-90	1315	2,010	12	65
08-May-90	1000	1,230	15	50
12-Sep-90	1500	2,980	13	104
19-Nov-91	1415	3,000	8	65
19-Mar-92	1415	1,650	14	62
13-May-92	1115	2,960	20	160
30-Jul-92	1330	1,300	3	11
22-Sep-92	1530	1,560	4	17

Table 3.2-1 (Cont'd)

Portneuf River, Tyhee Station

Date	Time	Discharge (cfs)	Suspended Sediment (mg/l)	Sediment Load (tons/day)
17-Jul-89	0945	105	7	2
		110	11	3
19-Sep-89	1150	182	2	1
21-Sep-89	1245	239	3	2
16-Mar-90	1315	250	6	4
08-May-90	1000	259	10	7
12-Sep-90	1500	268	10	7
19-Nov-91	1415	354	8	8
19-Mar-92	1415	448	10	12
13-May-92	1115	470	40	51
30-Jul-92	1330	480	19	25
22-Sep-92	1530	508	61	84

Notes:

(a) Flow estimated from daily average.

(b) Time not available.

(c) Flow and sediment impacted by Teton Dam failure.

other is a moderately straight pattern (low sinuosity) with a high width/depth ratio (Figure 3.2-3). Channel characteristics are associated with flow rates and riverbed gradient. The types of deposits sampled during the RI field investigation were predominantly fine-grained deposits collected from point bars, chute bars, and the local floodplain of the river (Figure 3.2-4). Results of this sampling are discussed in Section 4.

Upgradient of the EMF facilities, the river flows in a relatively steep valley between the Pocatello and Bannock Ranges (Figure 1.3-1). Near the EMF study area, the river emerges onto the Michaud Flats along the base of the Bannock Range. The Portneuf River downgradient is entrenched into the Michaud Flats, which are underlain by the coarse-grained Michaud Gravel and the fine-grained American Falls Lake Beds. The river runs across the flats incised in a shallow, flat-bottomed valley that widens from about 0.5 mile (0.8 km) at the Bannock Range to over 1.5 miles (2.4 km) near the reservoir. At the reservoir, the broad flat-bottomed area is called the Fort Hall Bottoms (Figure 3.2-5).

The river course increases in sinuosity from the Bannock Range area to the Fort Hall Bottoms. Where there is a distinct increase in gradient (typically 0.19 percent), the river becomes moderately straight. Where the gradient decreases (typically 0.11 percent), the river follows a high sinuosity pattern (Figure 3.2-4).

American Falls Reservoir

The American Falls Reservoir covers 88 square miles (22,800 hectares), and has a capacity of 1.7 million acre-feet (2,097 million cubic meters). The reservoir level fluctuate seasonally, with high levels occurring during peak runoff in spring. The maximum potential elevation of 4,354.5 feet above mean sea level is controlled by the height of the dam at American Falls. During high water levels, the reservoir floods much of the Fort Hall Bottoms, as evidenced by stressed trees along the banks (Fenwick, 1993a). Some erosion along the banks was observed below the high-water mark, indicating sediments have been washed into the Portneuf River from the banks in this area.

3.2.1.1 Sediment Load Analysis

An analysis of the average annual sediment load from the Snake and Portneuf rivers was performed to provide a basis for comparing the relative contribution of sediment to American Falls Reservoir. Sediment-discharge curves were developed for three gauges on the Snake and Portneuf rivers from suspended sediment data collected by the USGS. Daily sediment loads for each station were estimated by

applying the sediment-discharge curves to daily flow data also collected by the USGS and retrieved from the National Water Data Storage and Retrieval System (WATSTORE).

Daily flow measurements are recorded by the USGS for the Snake River at Blackfoot, Idaho, station and for the Portneuf River at Pocatello and at Tyhee Road (Figure 3.2-1). The Pocatello and Snake River stations have continuous flow records from 1950 through 1989; however, the Tyhee Road station only has records from May 1985 to September 1989 and after October 1990. The drainage area tributary to the Snake River gauge is 11,310 square miles, and the Portneuf River tributary at the Pocatello gauge is 1,250 square miles. The drainage area tributary to the Portneuf River at the Tyhee gauge is not listed by the USGS.

Sediment samples have been taken sporadically at all three gauging stations by the USGS; the sediment data are presented in Table 3.2-1. Data from the Snake River for June of 1976 were affected by the Teton Dam failure on June 6, 1976, and were not used for this analysis.

By correlating the sediment data versus flow data, a sediment-discharge rating curve was estimated by a Least-Squares Regression analysis to find the best fit of the data to an equation of the form:

$$Q_s = a\,Q^N$$

where

Q_s = The daily sediment load, in tons (T) per day,

Q = The flow rate, in cubic feet per second (cfs),

a and N = Constants that define the equation.

The constants a and N were derived for each station, as well as the correlation coefficient. These values are presented in the following table. Figure 3.2-1 presents the measured and predicted sediment load versus stream flow for each station.

Station	Constants		Correlation Coefficient (R)
	a	N	
Snake River at Blackfoot	0.0000335	1.8727	0.74
Portneuf at Pocatello	0.001290	1.9409	0.91
Portneuf at Tyhee	0.0000916	2.015	0.81

The derived equations were used to estimate the daily sediment load using the measured daily average flow. For the Tyhee station, flow data are only available from May 1985 to September 1989, and after October 1990. Therefore, for the Tyhee station, only the sediment load for 1985-1990 was calculated. The flow records for the Blackfoot and Pocatello stations permit calculation of sediment loads for the period from 1950 through 1989. The daily sediment loads were used to compute monthly totals, which are presented in Table 3.2-2. The calculated sediment loads only represent suspended sediment. An additional component of sediment load is the bed load, which was not measured by the USGS and was not included in this analysis.

The Portneuf River at Tyhee gauge, located downstream from the Pocatello gauge, was found to have a lower sediment load for the years that the gauge records overlap. The 1986-1988 average load for the Portneuf River at Pocatello was 67,300 T/year. For the same period, the average load of the Portneuf River at Tyhee was only 16,200 T/year. This is despite the fact that the 1986-1989 average flow at Pocatello was 340 cfs while at Tyhee the average flow was 570 cfs. As discussed in more detail in Section 3.3, the increase in flow between the two stations is due to recharge from underflow and springs along the Portneuf River. While the annual sediment loads are calculated estimates based on limited sediment transport data, such a large decrease between the two stations indicates a significant reduction in sediment transport by the Portneuf River.

The probable causes for the reduction of sediment load between the Pocatello and Tyhee gauges are irrigation water diversion dams and a decrease in river gradient between the two gauging stations. These two factors will decrease flow velocities, reducing the sediment load of the river. The diversion dams probably have a marked impact on sediment accumulation along the lower reaches of the Portneuf River, causing relatively large amounts of the fine-grained sediments to be deposited. The decrease in gradient is evident by the meandering nature of the

Portneuf River along the lower reach, and fine-grained sediment deposition is more pronounced along the lower reaches of the Portneuf River, especially in the Fort Hall Bottoms, where spring high water will also erode sediments along the reservoir banks.

Some of the difference in the calculated sediment load between Pocatello and Tyhee could be due to the limited data available. Only 10 to 15 data points were collected for each station under a limited range of flow conditions which may not be representative of long-term conditions. The derived sediment load rating curves were extrapolated to determine the load for flows both higher and lower than the sediment sampling data. Given the large natural variability in suspended sediment data, the derived load estimates should be used only for crude comparisons.

The average annual sediment load from 1950 to 1989 for the Portneuf River at Pocatello was 54,500 T/yr, and for the Snake River at Blackfoot, 183,200 T/yr. The average annual flow for the same period for the Portneuf River at Pocatello was 310 cfs and 5,160 cfs for the Snake River. Further downstream on the Portneuf River at Tyhee, the average annual sediment load was 14,510 T/yr and the average flow was 516 cfs for the period from 1985 to 1990. Since the years of record for the Snake River and the Portneuf River at Tyhee gauges are not the same, their averages are not strictly comparable. A comparison of flows and sediment loads for a 3-year period for which records were available for both the Blackfoot and Tyhee gauging stations was therefore made to evaluate the representativeness of this analysis.

For the three years 1986 to 1988, the average annual load for the Snake River gauge was 178,500 T/yr, which is 97 percent of the 1950 to 1989 average of 183,200 T/yr. This indicates that the period from 1986 to 1988 is fairly representative of the long-term average with regard to sediment transport. The 1986-1988 average sediment load for the Portneuf River gauge at Tyhee was 16,250 T/yr. The 1986-1988 sediment load to American Falls Reservoir would therefore be 194,750 T/yr, with 8 percent supplied by the Portneuf River and 92 percent supplied by the Snake River. This corresponds closely to the proportion of average annual inflow to the reservoir for the same period, which is 9 percent (516 cfs) from the Portneuf River and 91 percent (5,160 cfs) from the Snake River. Thus, it appears that the long-term average contribution of the Portneuf to the sediment load in the American Falls Reservoir is less than 10 percent of the total.

3.2.1.2 *General Surface Water Quality*

This section describes general surface water quality of the EMF study area in terms of common ions, nutrients, and physical parameters.

Surface water in the EMF study area includes the Portneuf River and numerous springs and associated spring drainage channels along the river that flow to the Portneuf River.

Surface water sampling stations are shown in Figure 2.5-1.

General water chemistry data of naturally occurring common ions were collected and analyzed. Naturally occurring common ions include the following:

- Cations
  - Calcium
  - Magnesium
  - Sodium
  - Potassium
- Anions
  - Sulfate
  - Alkalinity as bicarbonate
  - Alkalinity as carbonate
  - Chloride

Characterization of General Water Chemistry of Springs. As discussed in Section 1.3 and Appendix A, the springs in the EMF study area are classified into four systems:

- Batiste System – containing Batiste Spring
- Swanson Road System – containing the Swanson Road Spring
- East Side System – containing springs near the Pocatello STP, and the spring-fed pond at the FMC park
- Papoose System – containing Papoose Spring, Siphon Road Spring, and Twenty Spring-East

Examination of water chemistry parameters (such as potassium, bicarbonate, sulfate, and chloride) for samples collected from the 12 spring and spring-drainage locations shows that calcium-bicarbonate systems predominate all springs sampled. When comparing the water chemistry of springs and spring drainages with the groundwater chemistry of the three hydrogeochemical regimes in the EMF study area:

- The Batiste and Papoose systems were found to be comparable to the low-chloride Bannock Range hydrogeochemical regime.
- The Swanson Road and the East Side systems were found to be comparable to the Portneuf River Valley hydrogeochemical regime.

Two springs (Batiste and Swanson Road) had detectable impacts that may be attributable to the EMF facilities. The remaining springs had no observable site-

related impacts. The Batiste and Swanson Road springs are the closest to the EMF facilities on the western side of the river.

Locations of these springs are shown in Figure 1.3-2. As described in Section 4.4.1, groundwater in two of the three hydrogeochemical regimes in the EMF study area has a calcium-bicarbonate general chemistry. Specifically, the Portneuf River Valley hydrogeochemical regime is comparable to Perry's Swanson Road System, and the Bannock Range hydrogeochemical regime is roughly comparable to Perry's Papoose System.

Table 4.5-12 presents a comparison of spring water chemistry data for the RI sampling program with mean concentrations for water chemistry parameters and additional parameters identified by Perry et al. (1990). Appendix E presents a tabulation of water chemistry results and validation qualifiers for individual surface water samples collected during each round of RI sampling.

During four rounds of sampling, some parameters (nutrients) were only detected in one or two samples. Therefore, to calculate the mean concentrations of the parameters (listed in Table 4.5-12), rather than use a value to replace the nondetected value, that round of sampling was not included in the calculation. This approach results in a higher mean value reported for certain parameters. Means are reported as not detected (ND) if all sample results for a given spring are below detection. Calcium results from the July 1992 sampling event are not included in the water chemistry assessment involving cation/anion ratios because many of the concentrations are anomalously low. The anomalously low concentrations appear to be due to analysis of nonhomogenous sample aliquots (i.e., aliquots taken from the samples without shaking).

Common Ions and Physical Parameters. Figure 3.2-6 shows Piper and Stiff diagrams of general water chemistry for the 10 spring locations. The Piper diagram presents cation/anion ratios in percent milliequivalents per liter (mEq/l) and the Stiff diagrams compare cation/anion concentrations in mEq/l. (Because the July 1992 data were heavily qualified by the validation process, these diagrams use the mean of results for the October 1992 and February 1993 sampling events only.)

Based on the Piper diagram analysis, three clusters of springs can be identified:

- Batiste Spring (SW14) and Swanson Road Spring (SW15), with higher proportions of sulfate
- Papoose Spring (SW07) and the spring-fed pond at FMC Park (SW09), with higher proportions of bicarbonate

- The remaining six springs and spring drainage with intermediate proportions of sulfate and bicarbonate

The 10 springs cluster tightly in the cation triangle of the Piper diagram, showing the similarity in cation ratios between all springs. In the anion triangle, however, the increased proportion of sulfate anions in one case (SW14 and SW15), and the increased proportion of bicarbonate anions in a second case (SW07 and SW09), results in separation of these four springs from the main grouping of springs.

The Stiff diagrams presented in Figure 3.2-6 show the similarity between 10 springs. All 10 springs have calcium-bicarbonate general water chemistry, and the Stiff diagram shapes are generally similar.

Mean concentrations of water chemistry parameters for springs and spring drainages sampled from 1992 to 1993 were compared with historical concentrations (Perry et al., 1990). This comparison shows a striking change in the water chemistry of sampling points in the Batiste System (SW14 and SW11) and in the water chemistry of Swanson Road Spring (SW15).

For the two Batiste System sampling points, mean concentrations of all common ions are lower compared to historical concentrations from Perry et al. (1990). Specific conductance (773 and 609 µmhos) is also lower when compared to the historical level (946.3 µmhos). Mean sulfate concentrations (113 and 51 mg/l) are less than Perry's Batiste System mean (150 mg/l).

Swanson Road Spring mean concentrations of all common ions except bicarbonate have increased as compared to historical concentrations from Perry et al. (1990). Specific conductance (907.7 µmhos) is greater than the historical level (732.5 µmhos). The mean sulfate concentration (104 mg/l), mean calcium concentration (92.7 to 98.5 mg/l), and mean sodium concentration (55.7 mg/l) show the greatest increases compared to Perry's Swanson Road System measurements (40, 79.5, and 41.4 mg/l, respectively).

Nutrients and Other Parameters.

- Nutrients
  - Ammonia as nitrogen (NH_3 as N)
  - Nitrate as nitrogen (NO_3 as N)
  - Orthophosphate (PO_4 as P)
  - Total phosphorus

- Other parameters
  - Fluoride

Mean ammonia concentrations are either at or below the detection limit (0.3 mg/l) in six of the ten spring and spring drainages. Where detected (SW11, SW15, SW07, and SW05), mean ammonia concentrations are low (0.3 to 0.5 mg/l).

Nitrate was detected at all spring-related sampling stations at concentrations from 1.40 to 4.44 mg/l. Highest nitrate concentrations (2.64 to 4.44 mg/l) were found at the following four springs:

- Batiste Spring (SW14) – 4.44 mg/l
- Swanson Road Spring (SW15) – 2.64 mg/l
- Spring at the STP (East Side System) (SW13) – 3.41 mg/l
- Papoose Spring (SW07) – 2.98 mg/l

Note that the STP spring lies on the east side of the river. EMF-related groundwater does not discharge into this spring because groundwater from the EMF facilities does not cross beneath the Portneuf River (Section 3.3).

Mean nitrate concentrations were lower for sampling points in the drainage channels of Batiste Spring (SW11 at 1.99 mg/l) and Papoose Spring (SW06 at 2.14 mg/l and SW05 at 2.15 mg/l).

Mean orthophosphate and total phosphorus concentrations were at or near the detection limit (0.03 mg/l) for East Side System springs (SW13 and SW09) and for all but one of the Papoose System sampling points (SW07, SW06, SW04, and SW02).

Mean orthophosphate concentrations were highest for Batiste Spring (SW14), with orthophosphate at 2.36 mg/l and total phosphorus at 2.71 mg/l. Mean orthophosphate and total phosphorus concentrations decreased downstream in the Batiste Spring drainage channel (0.59 and 0.48 mg/l). Mean orthophosphate and total phosphorus concentrations at Swanson Road Spring (SW15) were 0.99 and 1.05 mg/l, respectively.

Mean fluoride concentrations for all 10 spring-related sampling points are within the range of 0.3 to 0.8 mg/l. The two springs with the highest fluoride concentrations were Siphon Road Spring (SW04, 0.8 mg/l) and Twenty Spring (SW02, 0.7 mg/l). Based on a common ion and physical parameter analysis, these two springs have not shown any EMF facilities-related impacts. Historical analysis

of fluoride in springs (Perry et al., 1990) indicated that the Papoose System springs generally had higher fluoride than springs in the systems closer to the EMF facilities.

From 1978 to 1980, fluoride concentrations were four to five times greater (1.32 mg/l) in the Papoose System (Group IV) compared with fluoride concentrations in the other three spring groups (0.30 to 0.44 mg/l). In the current sampling program, the highest mean fluoride concentrations (0.7 and 0.8 mg/l) are still found in Papoose System springs (Twenty Springs-East and Siphon Road, respectively). The two East Side System springs (near the STP and the spring-fed pond at FMC park) still have fluoride concentrations in the 0.30 to 0.44 mg/l range. However, mean fluoride concentrations for the Batiste System (0.6 mg/l) and Swanson Road System (0.5 mg/l) are greater than the historical means for these groups and are comparable to fluoride concentrations (0.5 and 0.6 mg/l) at the three Papoose System springs.

Information on fluoride concentrations at Batiste Spring was collected from FMC and Simplot facility files for the period of 1944 through 1990. This information was combined with fluoride data collected during the RCRA and RI sampling programs (1990 through 1993). Figure 4.5-15 shows that fluoride concentrations have varied greatly over this period. From 1944 through 1966, mean fluoride concentrations were between 0.7 and 1.57 mg/l. From 1968 through 1984, mean concentrations were between 0.34 and 0.5 mg/l, consistent with the mean concentration for fluoride (0.44 mg/l) calculated by Perry et al. (1990) using data from 1978 to 1980. From 1985 to 1991, the data (Figure 4.5-15) show mean concentrations increasing slightly to concentrations between 0.4 and 0.6 mg/l. Current RI sampling data (1992 to 1993) show a mean fluoride concentration of 0.6 mg/l for Batiste Spring. Although this concentration is higher than the historical system mean calculated by Perry, it is consistent with an increase in fluoride concentrations that occurred after Perry's sampling events.

Seasonal Trends for General Water Chemistry of Springs. The changes in concentrations of common ions, physical parameters, and nutrients were analyzed over the four quarters (July and October 1992 and February and April 1993) in which surface water samples were collected. Common ions, iron, aluminum, etc. generally exhibit the same concentration trends.

At Batiste Spring, the July 1992 concentrations of most parameters were approximately equal or increased slightly through February 1993, but showed a substantial increase in April 1993. An exception to this trend was fluoride, which remained relatively constant at Batiste Spring drainage channel (SW11) and actually decreased at Batiste Spring (SW14) between the February and April 1993 sampling dates. In contrast to fluoride, total phosphorus concentrations remained relatively

constant throughout the first three quarters of sampling, but increased approximately eight-fold in samples collected during April 1993.

At Swanson Road Spring (SW15), changes in concentrations of individual parameters over four quarters show that parameters increased slightly between the July 1992 and October 1992 sampling rounds and then decreased in February 1993 (Appendix E). The April 1993 concentrations are comparable to or below the July 1992 concentrations. Fluoride was an exception to this trend. Fluoride increased in concentration in the fourth sampling event (April 1993). In contrast to fluoride, total phosphorus concentrations fluctuated, the April 1993 concentration falling to less than 50 percent of the average of the first three quarterly total phosphorus concentrations.

For the two sampling points in the East Side System, springs near the STP (SW13) and the spring-fed pond at FMC park (SW09), concentrations were relatively constant over the four quarters of data collection (Appendix E). An exception was the value for bicarbonate alkalinity from SW09. For October 1992, bicarbonate concentrations at SW09 increased to over 600 mg/l compared with the mean concentration of 388 mg/l. Total phosphorus concentrations in samples from both SW09 and SW13 also increased substantially in October 1992, and remained at approximately 0.05 mg/l in samples taken from both locations during the two remaining sampling rounds. Variations in bicarbonate and total phosphorus are most likely caused by activities on the east bank of the Portneuf River that are not related to the EMF facilities.

In the Papoose System, concentrations of common ions, physical parameters, and nutrients were relatively constant at each location for all four quarters of surface water sampling. An exception was alkalinity, as bicarbonate, in samples from SW07, which increased from 200 mg/l to almost 450 mg/l between July 1992 and October 1992. The alkalinity of samples collected both in February 1993 and April 1993 was approximately 200 mg/l.

Total phosphorus also varied in the Papoose System, not only between sample locations but also between sampling dates. Five samples were below the total phosphorus method detection limit. There were no readily observable patterns to this variation. When total phosphorus concentrations in one sample location increased between quarters, another sample location showed a decrease in total phosphorus concentrations between quarters. In all cases, total phosphorus concentrations were relatively low.

Characterization of General Water Chemistry of the Portneuf River. As discussed in Section 3.3, the Portneuf River is a losing stream (water table is below the

elevation of the base of the river) upstream of the I-86 bridge. It is a gaining stream (water table is above the elevation of the base of the river) downstream of the I-86 bridge. Ten stream sampling stations are within the losing reach of the river (SW16 through SW25). Five river sampling stations are within the gaining reach of the river (SW01, SW03, SW08, SW10, and SW12). Sampling stations 7E and 12E, which were added for the April 1993 event, are in the gaining portion of the river.

In the gaining reach of the Portneuf River, groundwater flows into the river and/or outfalls at springs which then drain into the river. Any constituents present in groundwater enter along the gaining reach of the river.

In the losing reach of the Portneuf River, groundwater does not flow into the river, and constituents present in groundwater along the losing reach will not enter the river.

A comparison of mean concentrations of general water chemistry parameters (common ions) and additional parameters for river samples is presented in Table 4.5-13. Mean concentrations are provided for the following subsets of river data:

- Each individual river sampling station
- The combined set of all 17 river sampling stations
- The combined set of nine river sampling stations in the losing reach of the river (all stations except SW17; i.e., SW16 and SW18 through SW25)
- The combined set of seven river sampling stations in the gaining reach of the river (SW01, SW03, SW07E, SW08, SW10, SW12E, and SW12)

Mean concentrations are calculated with four rounds of sampling data. Appendix E presents a tabulation of individual water chemistry results and validation qualifiers for surface water samples.

During four rounds of sampling, some parameters were only detected in one or two samples. Therefore, when the mean concentrations were calculated, that round of sampling was not included. This results in a higher mean value for certain parameters. Means are reported as not detected (ND) if all sample results for a given river sampling station are below detection. Group means are reported as ND if all station means are at or below detection limits, or if the parameter is reported only sporadically or in a limited number of river sampling stations in the group.

Many river samples from the July 1992 round of sampling have anomalously low calcium concentrations apparently due to the analysis of nonhomogenous sample

aliquots (i.e., aliquots taken from samples without shaking) due to incorrect analytical procedures. These samples are used with caution and are not included in the water chemistry assessment involving cation/anion ratios. Table 4.5-13 presents a second row of mean calcium concentrations in parentheses. These mean calcium concentrations are calculated without the July 1992 data. Other common ion parameters analyzed by similar methodology (sodium, magnesium, and potassium) may also have artificially low concentrations.

The mean concentration for the set of all 17 river sampling stations for each parameter is given in the first column of values in Table 4.5-13. This mean concentration is used as the average to compare mean concentrations in the gaining reach to mean concentrations in the losing reach of the river.

Common Ions and Physical Parameters. The river sampling stations in the gaining reach have lower than average magnesium, potassium, and chloride concentrations and higher than average sodium and sulfate concentrations (Table 4.5-13). Conversely, as a group, river sampling stations in the losing reach have higher than average magnesium, potassium, and chloride concentrations and lower than average sodium and sulfate concentrations.

River sampling station SW17 is located downstream from the FMC outfall. As shown by the difference between water chemistry at SW17 and other river sampling stations, the FMC outfall was impacting surface water. SW17 is within the losing reach of the Portneuf River but is significantly different from either group; mean magnesium and bicarbonate concentrations are lower than the average for all river sampling stations and also lower than either the group mean for the losing reach or the group mean for the gaining reach. Additionally, mean sulfate and chloride concentrations for SW17 were higher than the averages for both gaining and losing reaches. Mean conductivity at SW17 was greater than the average for all river sampling stations and greater than the group means for both the losing and gaining reaches.

Calcium-bicarbonate systems predominate for all river locations sampled during the RI. (These diagrams use the mean of results for the October 1992 and February 1993 sampling events only.) In all three portions of the Piper diagram (quadrilateral, cation triangle, and anion triangle), all river samples cluster tightly, with the exception of SW17 (FMC outfall). This separation of SW17 emphasizes the difference between water chemistry at this station and water chemistry at other river sampling stations. At location SW17, chloride and sulfate proportions were higher with respect to bicarbonate.

The mean concentrations of common ions are distinguishable for gaining reach versus losing reach (Table 4.5-13). In the Piper diagram (Figure 3.2-7), losing-reach symbols are slightly separated from gaining-reach symbols. However, general water chemistry is not grossly different between losing and gaining reaches. The two groups plot within the same portion of the diagram. The Stiff diagrams in Figure 3.2-7 demonstrate the similarity between the river sampling stations; with the exception of SW17, the Stiff diagrams for river sampling stations from the losing and gaining reaches are not obviously different.

Concentrations of potassium, sodium, and sulfate in river water samples for SW12 are greater than concentrations for other gaining-stream river sampling stations. The higher concentrations are probably the result of the STP discharge.

In terms of physical parameters, only pH shows a strong difference between losing- and gaining-reach river sampling stations. Losing-reach river sampling stations, including SW17, have a mean pH of 8.5, with a range from 8.2 to 8.7. Gaining-reach river sampling stations have a lower mean pH of 7.7, with a range from 7.5 to 8.0.

Nutrients and Additional Parameters. The additional parameters listed in Table 4.5-13 indicate other differences between losing and gaining reaches of the Portneuf River. These parameters include:

- Nutrients
  - Ammonia (NH_3 as N)
  - Nitrate (NO_3 as N)
  - Orthophosphate (PO_4 as P)
  - Total phosphorus
- Additional Parameters
  - Fluoride
  - Dissolved oxygen

The mean concentrations of these parameters for all the river sampling stations as a group are provided in the first column of values listed in Table 4.5-13. The mean for all river sampling stations is used as the average against which to compare losing and gaining reaches.

Losing-reach river sampling stations have lower than average concentrations of all four nutrient parameters (ammonia, nitrate, orthophosphate, and total phosphorus). Mean ammonia concentrations are generally below detection limit

(0.3 mg/l). Mean orthophosphate concentrations are at or near the detection limit (0.03 mg/l), with a range of ND to 0.07 mg/l. Mean total phosphorus concentrations range from 0.02 to 0.16 mg/l.

Gaining-reach river sampling stations have higher than average mean concentrations of ammonia (1.4 mg/l), nitrate (2.07 mg/l), orthophosphate (0.55 mg/l), and total phosphorus (0.59 mg/l). These concentrations are similar to those detected at spring sampling points. Nutrients are related to discharge from the STP and to agricultural activities that are conducted in the Portneuf River floodplain and the Michaud Flats areas.

During Phase I, river sampling station SW17 was found to have higher than average concentrations of orthophosphate (0.32 mg/l), total phosphorus (0.64 mg/l), nitrate (1.29 mg/l), and fluoride (0.7 mg/l). Mean orthophosphate and nitrate concentrations for SW17 were greater than group mean concentrations for other losing-reach stations. As was the case for other river sampling stations in the losing reach of the Portneuf River, ammonia was not detected at SW17. The above-average concentrations of nitrate and total phosphorus parameters at SW17 were attributed to the FMC outfall during the four periods sampled (Table 4.5-2). Subsequent sampling conducted during Phase II at SW17, however, did not confirm Phase I findings. Analytical results indicate that concentrations are not different from those in upstream surface water; it appears that the FMC outfall at this sampling time was not affecting surface water quality.

Seasonal Trends for General Water Chemistry of River Water. The changes in concentrations of common ions, physical parameters, and nutrients were analyzed over the four quarters (July and October 1992 and February and April 1993) in which surface water samples were collected. Parameters representative of naturally occurring surface water quality will generally exhibit the same changes in concentrations (i.e., concentrations increase or decrease together).

3.2.2 EMF Facilities Hydrology and Drainage

Surface runoff within both the Simplot and FMC facilities is infrequent and is contained within the facilities. In this section, the term runoff is used to refer to rainwater that does not infiltrate at the point of contact with the ground, but rather is transported by overland flow to another location at the facilities. As discussed in Section 3.5, historic rainfall totals have not been particularly high. Consequently, when storm runoff does occur it does not actually run off of the site but is contained in the storm drainage facilities in onsite ponds and depressions for eventual use in plant operations, evaporation, or infiltration.

The site investigation found no channels by which stormwater would normally discharge from the FMC or the Simplot facilities, other than the NPDES-permitted IWW ditch discharge from the FMC property to the Portneuf River. The facilities area is separated from the Portneuf River by the Union Pacific Railroad and Highway 30. The bed of the railroad is raised above the terrain of the industrial areas and forms a barrier separating the plants from the river.

To evaluate the hydrologic response from more severe storm conditions, the maximum 24-hour storm of record (1.82 inches) was analyzed. Runoff from this storm would be completely contained on the site by the current drainage system. The hydrologic response to a 24-hour, 2-year storm (1.15 inches) was also analyzed to assess the ability of the FMC and Simplot drainage systems to contain stormwater under storm conditions. This storm was selected based on guidance from the Superfund Exposure Assessment Manual (EPA/540/1-88). Section 2.4 of the manual provides a method for quantitative analysis of surface water contamination. The recommended procedure is based on a calculation of the potential amount of contaminated soil transported by surface runoff releases from a site during an average storm. This analysis indicates that no surface water would be released during a 24-hour, 2-year storm at the EMF facilities. Thus, no contaminants would be released from unpermitted stormwater runoff.

For this analysis, the EMF study area was divided into seven major drainage areas based on the existing topography and drainage features. Several of these areas were further subdivided for the purpose of runoff calculation. Two of the areas are on the Simplot property, and five are on the FMC property (Figure 3.2-8). Each of these drainage areas is discussed in detail in the following subsections. The HEC-1 hydrologic simulation model was used to perform all runoff calculations.

3.2.2.1 Method of Analysis

Each drainage area described in this section was analyzed for runoff volume using the hydrologic simulation model HEC-1, developed by the U.S. Army Corps of Engineers (1990). The SCS curve number method was used to compute the rainfall excess for each watershed. The SCS curve number reflects the nonlinear relationship between rainfall excess and total storm depth; large storms have significantly larger runoff proportional to the rainfall than small storms. A detailed description of the SCS curve number method and how curve numbers were estimated is included in Appendix F.

The curve numbers used for the analysis are listed in Table 3.2-3. The curve number is related to the soil and cover condition of the watershed and was

determined on the basis of observations conducted during the site reconnaissance in December 1992 and from the study of soil survey data obtained from the SCS.

The catchment areas were estimated by use of a planimeter and the site topographic maps prepared by Walker Associates (1992). Likewise, the capacity of ponding areas at FMC and on the Simplot gypsum stacks were estimated from the Walker maps. The estimated capacity of the other ponds at Simplot was provided by Simplot personnel.

Hydrographs of runoff were computed for each watershed using the SCS unit hydrograph method. This method requires a single parameter, the lag time, to define the distribution of runoff from a watershed in response to a unit of rainfall excess. The lag time was estimated as 0.6 times the travel time of the longest flow path in the watershed. The travel time was estimated from the length, slope, and roughness characteristics of watershed.

The seven separate drainage areas analyzed are described below and shown in Figure 3.2-8. The drainage area, curve number, and lag time for each area are presented in Table 3.2-3. Table 3.2-4 presents the results of the hydrologic analysis for the 2-year, 24-hour storm and maximum observed 24-hour storm scenarios.

3.2.2.2 Simplot

The natural drainage features of the Simplot property originally consisted of five small ephemeral stream gullies that combined and entered the Portneuf River near the I-86 bridge. The combined drainage area for the five gullies is 825 acres (335 hectares). The lower third of the gullies has been covered by Simplot's gypsum stacks. Runoff from the upper watershed of the gullies now flows to the top of the gypsum stacks.

The Simplot main plant covers the area from the gypsum stacks north to the Union Pacific Railroad. The bed of the railroad is higher than the adjacent plant area and forms a barrier that isolates surface water on the plant. Surface water potentially leaves the plant area via three routes: the main plant stormwater and noncontact water drainage line; the east drain; and a pipe which drains a small undeveloped containment area along the northeast boundary of the Simplot plant.

The main plant stormwater and noncontact water drainage line and the east drain flow into the water treatment pond system, just north of Highway 30. Water from the treatment system is then pumped across the Portneuf River to the surge pond for subsequent delivery to irrigators.

The small undeveloped containment area has a drainpipe (installed by Union Pacific Railroad) to the Portneuf River that serves as an overflow outlet in the unlikely event that the swale behind the railroad grade fills with runoff. Since this area is undeveloped and largely outside the Simplot property, it was not considered further in this analysis.

The following subsections describe the separate drainage areas on the Simplot property. The drainage area location map, Figure 3.2-8, shows their locations. Each area was modeled for a 24-hour, 2-year storm of 1.15 inches (3 cm) of rainfall and for the maximum 24-hour storm of record, 1.82 inches (4.6 cm). The results are included with the area descriptions.

Gypsum Stack Area (SIM1). The area on top and above the gypsum stack forms an isolated drainage area indicated as SIM1 on the drainage area map (Figure 3.2-8). It includes the upper reaches of four small intermittent streams that drain onto the gypsum stack from the south. The total drainage area is about 825 acres (335 hectares).

Gypsum, a byproduct of Simplot's manufacturing process, is pumped to the top of the gypsum stack as a gypsum water slurry. As the gypsum settles out of the slurry, the water evaporates or infiltrates through the gypsum stack. To prevent excess accumulation of water on top of the stack, four 18-inch (46 cm) diameter drain lines with 8-inch (20 cm) diameter standpipes collect seepage and decant ponded water from the stack. As the stack rises over time due to accumulation of gypsum, the drain lines are extended to the south, and additional standpipes are emplaced. Gypsum dikes, a minimum of 3 feet (0.9 m) high, surround the top of the gypsum stack and contain the slurry water and stormwater that accumulate on top of the gypsum stack.

Under normal operation, all water, including stormwater, that collects on top of the gypsum stacks either infiltrates, evaporates, hydrates with calcium and silica present in the waste facilities, or is collected by the drain lines for reuse in the plant or as slurry water. The drainlines discharge into a 10,000-gallon (38 cubic meter) decant tank on the lower, northernmost gypsum stack. A 24-inch (61 cm) high-density polyethylene (HDPE) pipe conveys water from the decant tank to the process sump.

The native soils in this drainage are largely silt loams of hydrologic soil group B. Plant personnel have never observed rainwater running off of the gypsum stack, indicating that it also has a low curve number. A curve number was estimated as 75.

To test the ability of the gypsum stack to contain storm runoff, an estimate of the storm runoff was calculated using the HEC-1 model. From the maximum 24-hour storm of record, the total runoff was estimated to be 6.70 MG (25,360 cubic meters). The total runoff ponding on the gypsum stacks from a 24-hour, 2-year storm was estimated to be 1.30 million gallons (MG) (4,920 cubic meters). The ponded water would accumulate in three separate areas: the lower northernmost gypsum stack, and the eastern and western halves of the upper gypsum stack, which are separated by a dike. The combined storage capacity of the gypsum stacks is 125 MG (473,100 cubic meters), well in excess of what is needed to contain the runoff.

The analysis indicates that the drainage areas on top of the gypsum stacks can contain the runoff from both a 24-hour, 2-year storm and the historic maximum 24-hour rainstorm. The analysis was based on existing topography as presented in the Walker maps of August 1992. In the future, the configuration of the gypsum stack and dike could change as additional gypsum accumulates.

Main Plant Area (SIM2). The drainage area around the Simplot main plant, designated SIM2 in Figure 3.2-8, extends from approximately the property boundary bordering FMC on the west, to the Union Pacific Railroad on the north, to the dike on top of the gypsum stacks on the south, and the lower gypsum stack on the east. This area was further subdivided into five sub drainages, as listed in Table 3.2-3, for analysis. The combined drainage area is 185 acres.

The southern portion of this area (subdrainage PTB) encompasses most of the north flank of the gypsum stacks and a small portion of the FMC facility adjacent to the IWW pond. The curve number for this area was estimated to be 73. Runoff is directed to sewer inlets and conveyed by branch sewer lines to the 32-inch (81-cm) HDPE main plant drainage line running from south to north through the center of the main plant area. A 30-inch (76-cm) culvert conveys the water under the railroad and highway to a ditch leading to the holding pond within the water treatment pond system. Drainage from around the main plant facilities (subdrainage plant) is also collected by the plant drainage line. The curve number for the plant area was estimated to be 93.

Most of the eastern portion of the area (subdrainages ROAD and OGS) drains into an area contained by a new stormwater containment berm which provides a storage capacity of 1.5 MG (5,700 cubic meters). This area includes portions of the slopes of the gypsum stacks and was estimated to have a curve number of 75. An area (subdrainage PSA) of approximately 10 acres (4 hectares) is not contained by this berm but drains to the process sump. Its curve number was estimated to be 80. The sump combines decant water from the gypsum stack, reclaimed wastewater, and

storm runoff. Up to 35,000 gpm (2.20 cubic meters per second) are regularly pumped from the sump back into the phosphoric acid production process. Additional capacity exists to pump up to 6,000 gpm (0.4 cubic meter per second) of slurry or water from the sump to the ponds on top of the upper gypsum stack. Overflow from the sump would flow to a newly constructed lined pond which has replaced (and which is adjacent to) the former east overflow pond via a 24-inch (61-cm) HDPE pipe.

The pond that has replaced the former east overflow pond, besides receiving overflow from the sump, collects some local surface runoff from the area between the lower gypsum stack and the Union Pacific Railroad. The pond has a capacity of approximately 1 MG (3,800 cubic meters). Overflow from the pond is conveyed by the east drain, a 24-inch HDPE pipe, under the railroad to the holding pond within the water treatment pond system.

Water from the 1.25 MG (4,700 cubic meters) capacity holding pond is released to the 1.25 MG (1,500 cubic meters) equalization pond after treatment, then pumped to the 13 MG (49,000 cubic meters) surge pond north of the Portneuf River. The maximum pumping capacity is 1,800 gpm (6.8 cubic meters per second).

During a storm equivalent to the maximum historic 24-hour storm, the peak flow of runoff from the plant area tributary to the main plant drainage culvert was estimated to be 31,000 gpm (1.9 cubic meters per second), including 350 gpm (0.02 cubic meter per second) of normal process water. This is well below the culvert's capacity of 60,000 gpm (3.78 cubic meters per second). There would be no flow through the east drain. The total volume of storm runoff conveyed to the holding pond would be 2.51 MG (9,500 cubic meters), of which 1.62 MG (6,100 cubic meters) would be pumped to the surge pond during the storm. Therefore, no stormwater would be released to the river.

Portneuf River Floodplain. An attempt was made to investigate the location of the plant with respect to the 100-year floodplain of the Portneuf River as designated by the National Flood Insurance Program. This program, part of the Federal Insurance Administration, publishes maps of select regions of the United States designating 100-year and 500-year flood boundaries. Flood insurance rate maps for both Bannock County and the City of Pocatello, Idaho, were reviewed; no studies were conducted for Power County. Neither of the studies reviewed encompassed the Portneuf River in the EMF study area.

3.2.2.3 FMC

The original drainage at FMC has been significantly modified by the placement of slag piles and holding ponds at the facility. In general, the FMC property is now highly compartmented with respect to the handling of stormwater. There are parts of five separate drainage areas on the property, separated by natural ridges, slag piles, and dikes.

In addition to the five main drainage areas, there are several process water storage ponds on the site with a minimum of 2 feet (0.6 m) of freeboard. The ponds are contained by dikes rising well above the surrounding terrain and are not subject to runon from other areas. The freeboard of 2 feet (0.6 m) is more than adequate to contain rainfall in these ponds for a storm of less than 2 inches (5 cm).

The following subsections describe the separate drainage areas on the FMC property (shown in Figure 3.2-8). Each area was modeled for a 24-hour, 2-year storm of 1.15 inches (3 cm) and for the historical maximum 24-hour storm of 1.82 inches (4.6 cm). The results are included with the area description and in Table 3.2-4.

Drainage Area FMC1. This area includes the IWW basin, and is bounded by the east slope of the slag piles, the west slope of the Simplot gypsum stack, and extends south to a natural ridge approximately 1 mile (1.6 km) south of the FMC plant buildings. The total drainage area is about 114 acres (46 hectares).

The capacity of the 12-inch (30 cm) IWW discharge pipe was estimated as 2,150 gpm (0.14 cubic meter per second), slightly more than the maximum historical monthly average flow of 2,130 gpm (0.13 cubic meter per second) recorded by FMC in March 1993.

The native soils in this area is silt loam, classified as hydrologic soil group B by the SCS. These are overlain by coarse slag and ore stockpiles in some areas. A curve number of 71 was estimated.

There are two places where water ponds onsite in this area, in a depression adjacent to the plant haul road and adjacent to the main plant ore stockpile. The ponding storage capacity of these are, respectively, 1.1 MG (4,200 cubic meters) and 0.95 MG (3,600 cubic meters). The maximum historic storm would produce only 0.6 MG (2,300 cubic meters) of runoff; therefore all runoff would be contained onsite. The 2-year storm would produce only 0.1 MG (380 cubic meters) of runoff.

Drainage Area FMC2. This area consists of the slag pit and the slag piles immediately to the south. The total drainage area is 94 acres (38 hectares). The soils

are silt loam covered by coarse slag; a curve number of 71 was estimated. Runoff from this area would flow down to the slag pit just south of FMC's furnace building. A total of 0.51 MG (1,930 cubic meters) would result from the maximum historic storm, and a total of 0.08 MG (340 cubic meters) of runoff would result from a 24-hour, 2-year storm. The slag pit has a storage capacity of 5.7 MG (22,000 cubic meters), well in excess of the total runoff. Therefore, no releases from this area could occur.

Drainage Area FMC3. This area consists of the main plant area, excluding the western portion of the employee parking lot, which is served by storm sewers.

The total drainage area of 28.5 acres (11.5 hectares) is substantially covered by parking lots and buildings. A curve number of 93 was estimated based on the SCS recommendation for industrial facilities.

The railroad swale, which receives the runoff from the area around the plant buildings, is a long, narrow depression about 30 feet (9 m) wide and 1,000 feet (300 m) long. While it is about 8 feet (2.5 m) deep at its western end, near the plant headquarters, the ground level above the swale slopes downward to the east so that it is about only 2 feet (0.6 m) deep at its east end. The storage volume is about 0.6 MG (2,300 cubic meters).

The runoff volume from the maximum historic 24-hour storm was estimated to be 0.89 MG (3,400 cubic meters) and from a 24-hour, 2-year storm, runoff was estimated to be 0.44 MG (1,700 cubic meters). Overflow from the railroad swale would flow onto the Simplot facility and be captured by the Simplot plant sewer. This overflow was included in the calculation of runoff discussed above for area SIM1. Such an overflow has never been observed to actually occur according to both Simplot and FMC personnel.

Drainage Area FMC4. This area consists of a small valley south of the slag pile that surrounds FMC's landfill. The valley extends 1.2 miles (1.9 km) south to a ridge in the Bannock Hills. The watershed is about 485 acres (195 hectares) in area and, south of the landfill, it remains undeveloped. The area is predominantly covered by silt loam soils, with some rocky slopes at the higher elevations. A curve number of 80 was estimated.

The southwestern two-thirds of the basin are outside of the FMC property boundary. The slag pile completely fills the bottom of the north end of the valley, effectively blocking the flow of surface water. At the lowest point in the valley, the top of the slag pile is at elevation 4,588 feet (1,398 m) above MSL, whereas the valley floor is at 4,550 feet (1,387 m) above MSL. Thus, a 38-foot-deep (12-m-deep) depression is

formed behind the slag pile. The storage capacity of this depression was estimated to be 54.7 MG (207,000 cubic meters).

The total runoff volume from the maximum historic 24-hour storm was estimated to be 6.0 MG (2,300 cubic meters) and from a 24-hour, 2-year storm, 1.7 MG (6,400 cubic meters). Therefore, no releases would result.

Drainage Area FMC5. This area consists of all FMC property west of the main plant area and slag piles. It includes the Bannock Paving facility, the western side of the slag piles, the western portion of the employee parking lot, and the undeveloped land west of the main FMC plant bounded roughly by Michaud Creek on the west, Taghee ditch on the north, and the south entrance road. The total drainage area within the FMC property is about 1,200 acres (480 hectares).

Site topography indicates that storm runoff in this area drains to the west to the undeveloped land just west of FMC's Ponds 9E and 15S. A depression is formed bounded by the foot of the Bannock Hills on the south, the elevated Taghee Canal and Union Pacific Railroad bed on the north. The ground rises gradually to the east and west. The total area of the depression is about 248 acres (100 hectares). At its lowest point, it is 9 feet (2.7 m) below the embankment of the Union Pacific Railroad and the Taghee Canal. The total volume of the depression is about 463 MG (1,750,000 cubic meters).

For the purpose of hydrologic modeling, drainage area FMC5 was divided into three subdrainages: Michaud, Bannock, and Local, as listed in Table 3.2-3. The Bannock subdrainage encompasses the Bannock Paving area and some surrounding areas, including about one-half of the employee parking lot. The curve number for the Bannock area was estimated to be 90. The Local area represents the remaining land within the FMC facilities, including the large, predominantly undeveloped field west of the operating area. The curve number was estimated to be 71. The Michaud area represents all of the Michaud Creek drainage, which is discussed below.

The runoff from the Bannock and Local areas was estimated using the HEC-1 model. Runoff from the maximum historic 24-hour storm was estimated to be 8.7 MG (33,000 cubic meters), well below the capacity of the depression. The ponded area is indicated in Figure 3.2-8. For the 24-hour, 2-year storm, the runoff volume was estimated to be 1.96 MG (7,400 cubic meters).

Just west of the FMC property boundary is Michaud Creek, an ephemeral stream that, when flowing, is captured by the Taghee Canal. Between the mouth of the valley where Michaud Creek flows north, out of the foothills, to the Taghee Canal, the creek crosses an alluvial fan formed from deposited sediment. The alluvial fan

and stream channel are at a higher elevation than the FMC facility, and, therefore, runoff from the plant is blocked from reaching the stream. However, floodwaters from Michaud Creek could overflow the banks and cause flooding at FMC, leading to stormwater releases.

To investigate this scenario, Michaud Creek was included in the model of the western portion of the FMC facility. The stream valley is 7,488 acres (3,030 hectares) in area. It is entirely undeveloped rangeland with silt loam soils which belong to hydrologic group B. A curve number of 71 was estimated.

Flooding of a stream on an alluvial fan is highly unpredictable, and could flow in any direction from the valley mouth. The most conservative assumption is that after exceeding the capacity of Taghee Canal, the remainder of Michaud Creek would flow toward FMC.

For the maximum historical 24-hour storm, the runoff from Michaud Creek was estimated to be 40.7 MG (154,000 cubic meters). Combined with the flow from FMC, the total runoff would be 46.6 MG (187,000 cubic meters), well below the storage capacity of the depression. For the 2-year, 24-hour storm, a total of 4.56 MG (17,200 cubic meters) of runoff would result from Michaud Creek. Combined with the flow from FMC, the peak storage in the west field depression would be 6.52 MG (24,700 cubic meters).

3.3 HYDROGEOLOGY

The hydrogeologic characteristics of a site have a major influence on the distribution of constituents of potential concern when they are released into groundwater beneath the site. Section 3.3.1 discusses the regional hydrogeologic setting, while Section 3.3.2 presents the results of site-specific investigations. This information is synthesized with data on site geology and surface water hydrology in Section 3.3.3, which presents a conceptual model of groundwater flow for the EMF study area.

During the RI, the investigators found several lines of evidence that run counter to conclusions from previous investigations. These points are discussed briefly in Section 3.3.1 and analyzed in greater detail in Section 3.3.2.

Numerous lines of data indicate a consistent definition of groundwater flow patterns in the EMF study area. Shallow groundwater emanating from most of the area occupied by the FMC and Simplot production and waste management facilities appears to flow toward the Simplot production wells. (A portion emanating from the EMF facilities appears to contribute to the water flowing into Batiste and Swanson Road springs.) Additional analyses of groundwater flow and its relationship to the springs are in progress. Deeper groundwater appears to flow further out into Michaud Flats and discharges to the Portneuf River and associated groundwater system. The data indicate that deeper groundwater is semiconfined and hydraulically isolated from most of the waste management facilities. Actual flowpaths have not been determined.

3.3.1 Regional Hydrogeology

This section describes the features of the regional hydrogeology and the results of an evaluation of groundwater geochemistry.

3.3.1.1 Dominant Features and Processes

The regional hydrogeology in the EMF study area is influenced by numerous factors. The dominant features and processes in the regional hydrogeology are:

- The Michaud Gravel, the Portneuf River, and springs along the river
- Irrigation canals and numerous agricultural supply wells
- Precipitation patterns

The Michaud Gravel is a productive aquifer associated with the highly permeable deposits of the Bonneville Flood. There are numerous agricultural production wells in the Michaud Flats. The groundwater wells in the area (discussed in Section 3.7) tap into an aquifer that is typically less than 100 feet below ground surface, with aquifer thicknesses greater than 150 feet. A deep, confined, bedrock aquifer exists in the Big Hole Basalt beneath the Michaud Flats. In some areas, the uppermost aquifer is unconfined (Jacobson, 1982 and 1984); in other areas, the uppermost aquifer is semiconfined, as evidenced by storativity values calculated from RI data.

The nature of the aquifer in the Michaud Flats (unconfined versus semiconfined) depends on the occurrence of fine-grained units within the saturated zone. In some areas, fine-grained units may act as local aquitards, and, in other areas, the upper aquifer appears to be truly unconfined. The fine-grained units occur more frequently nearer to the Bannock Range, which is expected because the Bannock Range is a source of colluvial and alluvial materials deposited onto the Michaud Flats. On a regional scale, little distinction can be made between shallow and deep zones in the Michaud Gravel based solely on aquifer-aquitard relationships since there does not appear to be a regionally contiguous aquitard.

The Portneuf River flows along the old track of the Bonneville Floods, and is underlain by the very coarse, permeable Michaud Gravel. The Portneuf River shows a transition near the Interstate 86 (I-86) bridge from a losing stream in its upstream portion to a gaining stream. A losing stream is one that "loses" water into the ground because the water table is lower than the river level; a gaining stream has the opposite relationship. The gaining section of the Portneuf River is associated with numerous springs and a large flux of groundwater that occurs as underflow. This is discussed in greater detail in Section 3.3.2.

Agricultural production wells withdraw water primarily from the shallow aquifer beneath Michaud Flats. While a portion of this water is lost through evapotranspiration, the remainder can reenter the shallow aquifer or discharge to the Portneuf River through runoff. Section 3.7 provides further information on local irrigation systems.

The areal and temporal (seasonal) distribution of precipitation also influences hydrogeologic characteristics. Precipitation patterns in this region are strongly linked to topography, with larger amounts of snow and overall precipitation falling at higher elevations. The higher elevations (i.e., the Bannock Range and Pocatello Range) serve as recharge areas for aquifers in the valleys. Section 3.5 provides information on precipitation patterns in the Pocatello area.

3.3.1.2 Groundwater Geochemistry

An evaluation of the general groundwater chemistry in the immediate vicinity of the EMF study area was carried out during the RI using Stiff and Piper diagrams as a tool. A detailed discussion of methodology and findings is found in Section 4.4.1. The results of the evaluation indicate there are three distinct groundwater types in the EMF study area (Figure 3.3-1) that make up the single aquifer underlying the study area. These are:

- Michaud Flats Hydrogeochemical Regime—This system enters the EMF study area from the southwest and west and occupies the northwestern area of FMC. It has a higher sodium chloride content than the other two types. This system is not discernible north and east of Simplot.
- Bannock Range Hydrogeochemical Regime—This system enters the study area from the south and occupies the southern portion of the FMC facility and most of the eastern to northeastern portion. Simplot and most of the area to the north of Simplot are entirely Bannock Range. Water can be described primarily as a calcium-bicarbonate system.
- Portneuf River Valley Hydrogeochemical Regime—This system is not a part of the facility groundwater regime. It lies to the east and north along the Portneuf River. Water is similar to Bannock Range water but is more alkaline.

Figure 3.3-1 illustrates the areal extent of the hydrogeochemical regimes and hydrogeologic areas. Hydrogeochemical regimes are delineated by groundwater geochemistry whereas hydrogeologic areas are delineated by geology (lithologies), hydraulic conductivities, hydraulic gradients, and, to some degree, topography. There is a mixing zone of Bannock Range and Michaud Flats water on the FMC property and to the north. There is also an occurrence of Bannock Range water in the western Portneuf River area. This can be seen in the higher chloride values in the Bannock Range water found in the southwestern portion of the EMF study area. There is also a mixing zone of Bannock Range and Portneuf River Valley water to the north and east of Simplot. This is discussed in more detail in the following sections.

A knowledge of the water types has facilitated the evaluation of flow direction and allowed for the identification of surface water sources. For example, the Portneuf River and springs located on its eastern bank all bear the Portneuf groundwater system characteristics. This is true all along the river, even when it becomes a gaining-reach with the introduction of a large amount of groundwater underflow, as indicated by the difference in flow volumes. Hence, Bannock Range water is not

being introduced at a sufficiently high volume to affect overall chemistry in the river, and is probably not involved at all with the eastern springs. The Bannock Range characteristics are, however, found in all the springs north of the Swanson Road Spring (Batiste, Papoose, etc.). Hence, it appears that the source of water for these springs is the Bannock Range system, the same water that flows under the EMF facilities.

The 500-series wells that are placed along the Portneuf River all have Portneuf River Valley water, which implies that the mixing zone between the Bannock Range and the Portneuf is further to the west. This distinction also implies that the river itself, as opposed to the springs to the west, probably cannot be impacted by water coming from the facilities to the south. A detailed discussion of these relationships is found in Section 4.5.

The chemical composition of the groundwater types is provided in Table 3.3-1. This table includes summary statistical properties (mean and mean plus two standard deviations) for constituents detected in 16 wells that comprise the network of representative monitoring wells at the site. The data analysis of the EMF study area that led to the recognition of these three groundwater types is presented in Section 4.4.1. Section 3.2 included a detailed discussion of general surface water quality. A more detailed discussion of general groundwater quality is not presented here because there is a distinct progression from general groundwater quality to defining and delineating impacted groundwater.

3.3.2 Local Hydrogeology

The hydrogeologic characteristics beneath the EMF facilities and immediately adjacent areas are described in this section. For clarity, this discussion refers to three hydrogeologic areas which were delineated using the geologic data, hydraulic conductivity data (see Figure 3.3-2), and, to some degree, the groundwater geochemical data. The areas delineated include the Bannock Range, Portneuf River, and Michaud Flats (Figure 3.3-1). These areas are described below:

- Bannock Range Area—This area has very low hydraulic conductivity values, steep hydraulic gradients, and typically thinner saturated thicknesses of volcanic gravels.
- Portneuf River Area—The geology in this area is generally very thick deposits of highly permeable Michaud Gravel. Hydraulic conductivities are very high; there appear to be few, if any, fine-grained units within the gravels.

- Michaud Flats Area—The geology of this area is Michaud Gravel, Aberdeen Terrace deposits (reworked Michaud Gravel), and local fine-grained units with abundant caliche deposits. Deeper gravels can be volcanics, especially where the Michaud Flats area merges with the Bannock Range area.

Figures 3.3-3A through 3.3-3E are groundwater elevation contour plots for quarterly groundwater levels measured in shallow saturated gravels. The geologic and hydrogeologic data delineate these areas in terms of physical characteristics, but the geochemical data do not yield the same delineation, as shown in Figure 3.3-1. The Bannock Range groundwater flows into Michaud Flats, mixing with the Michaud Flats groundwater, eventually underflowing into the Michaud Flats hydrogeologic area and into the Portneuf River hydrogeologic area.

The following discussions describe in more detail the hydrogeologic characteristics beneath the EMF facilities and in nearby offsite areas.

3.3.2.1 Hydraulic Conductivity and Saturated Thickness

Hydraulic conductivity values were calculated from slug tests performed in 43 monitoring wells and pumping tests performed in seven monitoring wells and two production wells. In three cases (Wells 320, 331, and 513), rapidly stabilized or oscillating water levels recorded during the tests suggest that hydraulic conductivity in the formation near the wells was too high to be measured by slug test methods. Details of the pumping and slug tests as well as laboratory permeability test results are presented in Appendix G.

Hydraulic conductivities in the uppermost saturated gravels beneath the Michaud Flats area range from 43.94 feet per day (ft/day) up to 1,006.3 ft/day (0.016 cm/s to 0.355 cm/s). Hydraulic conductivities in deeper gravels are similar to those in the shallow gravels at Wells 500 and 133, but lower nearer the Bannock Range area in Wells 129 and 103. The lower hydraulic conductivities in the deeper zone are associated with volcanic gravels and sands that typically contain a higher proportion of silt and clay fines than the shallower gravels, which are quartzitic Michaud Gravel.

In the southern portion of the EMF facilities within the Bannock Range area, hydraulic conductivities are significantly lower, ranging from 0.03 ft/day to 1.87 ft/day (0.000011 cm/s to 0.00066 cm/s). Further north, where the Bannock Range area meets the Portneuf River and Michaud Flats areas, the hydraulic conductivities increase to 28.91 ft/day to 106.3 ft/day (0.01 cm/s to 0.038 cm/s). In the Portneuf River area the hydraulic conductivities are the highest, ranging from 793.7 ft/day to

4,762.2 ft/day (0.28 cm/s to 1.7 cm/s). Deeper wells in the Portneuf River area also have higher hydraulic conductivities, up to 1,644.09 ft/day (0.58 cm/s) in Well 512.

The saturated thicknesses of gravels influence groundwater gradients and head distributions because thicker permeable units need less gradient to move equal volumes of water than do thinner units (assuming hydraulic conductivities are similar).

Gravel units tend to "pinch out" toward the Bannock Range area. This is typical of wedge-shaped alluvial and colluvial deposits along the base of the mountains. There is also a sharp increase in gravel deposit thickness near the Portneuf River where Michaud Gravel is present from the surface to depths over 150 feet. The overall saturated thickness of the unconsolidated sediments overlying the Tertiary bedrock is highly variable, which may exert an influence on saturated thickness of gravels if the Tertiary bedrock is much less permeable than the overlying sediments.

3.3.2.2 Groundwater Gradients and Flow Velocities

Groundwater gradients provide a good estimate of overall horizontal groundwater flow patterns; however, vertical gradients must also be evaluated to permit a reasonable understanding of potential pathways in deeper groundwater.

Horizontal Gradients. The horizontal gradients throughout the EMF facilities area vary considerably, as illustrated in Figures 3.3-3A through 3.3-3E. These figures are contour plots of groundwater elevations in the uppermost saturated gravels. In general, these figures illustrate the overall consistency in groundwater contour patterns from season to season. Although water levels vary from quarter to quarter in individual wells, the variation is consistent throughout the study area. Water levels in less permeable areas such as the Bannock Range area and lower permeability areas of the Michaud Flats area vary by as much as 2 feet from season to season. Water levels in the Portneuf River area vary only about 0.5 foot.

Groundwater elevation contours illustrate several persistent features. In the western areas of the EMF facilities, groundwater moves southeast from the Michaud Flats and meets northwest-moving groundwater from the Bannock Range where flow direction changes to northeast. Groundwater moving through this area mixes with groundwater flowing northward from the south-central portion of the FMC facility.

Another feature in these groundwater contours is the pattern of groundwater flow along the northeastern portion of the EMF facilities area and the Portneuf River. In this area the river is a losing-reach, discharging water to the underlying gravel

aquifer. Groundwater flowing off the Bannock Range enters this area, flowing northeast. The river water recharge and the Bannock Range groundwater meet in a highly permeable zone along the western side of the river, where the net flow is to the northwest.

There is a distinct steepening of hydraulic gradients in the north-central portion of the EMF study area, between the FMC and Simplot facilities. The gradient steepens, but there does not appear to be distinct change in hydraulic conductivities or lithologies through the area. Saturated thicknesses of the unconsolidated materials decrease as a result of a bedrock high that extends through this area. This decrease provides preliminary evidence that the bedrock and intercalated sediments may have overall lower hydraulic conductivities than the unconsolidated materials, and may in effect make the bedrock surface an impermeable boundary to groundwater flow.

Simplot production Wells SWP-4 and SWP-5 create a large cone of depression from continuous pumping at combined flow rates of 4,000 to 5,000 gallons per minute (gpm) (15.1 to 18.9 cubic meters per minute). The approximate cone of depression is illustrated on the groundwater contour plots by using estimated drawdowns in Wells SWP-4 and SWP-5. These drawdowns were approximated using the drawdowns observed during a pumping test performed in a new production well, SWP-7. When Well SWP-7 is in full operation, the shape of the cone of depression may change. Well SWP-7 is located approximately 250 feet northwest of Well SWP-5.

Horizontal flow velocities were calculated for the uppermost saturated gravels. The deeper well spacing made it difficult to calculate groundwater seepage velocities in the deeper gravels. Flow velocities are a function of hydraulic conductivity, gradient, and porosity, expressed in the following equation:

$$V = (K \times i) / n$$

where

V = groundwater seepage velocity

K = hydraulic conductivity in feet per day

i = hydraulic gradient in feet per feet (dimensionless)

n = porosity (expressed as decimal fraction).

Horizontal flow velocities were plotted as vectors (Figure 3.3-4). This figure illustrates seepage velocities of approximately 12 ft/day in the Portneuf River area

and 0.4 ft/day in the Bannock Range area. The Michaud Flats area has variable seepage velocities due to the variable gradients and hydraulic conductivities. Seepage velocities beneath the former ponds at FMC, where gradient is relatively flat, the calculated seepage velocity is approximately 1.0 ft/day. The steeper gradient observed at the northern areas of the EMF facilities, near the FMC/Simplot boundary, causes seepage velocities to increase to approximately 11 ft/day. Seepage velocities beneath the easternmost portion of the Simplot facility are approximately 1.7 ft/day.

These seepage velocities appear to be relatively consistent from quarter to quarter since there are no significant changes in gradient; they also provide a good overall picture of the relationships between the aquifer thicknesses, hydraulic conductivities, and gradients beneath the EMF facilities.

Vertical Gradients. Vertical groundwater gradients are indicated by potentiometric head differences measured in well pairs screened through different zones. Figures 3.3-5A through 3.3-5E show head differences between well pairs.

Vertical gradients are upward except near the western edge of the EMF study area, where slight negative head differences occur (0.3 foot or less). Head differences become slightly positive (i.e., upward) near Pond 8S, and more strongly positive near the FMC/Simplot boundary. These positive gradients imply some hydraulic confinement of the lower pervious zone. Gradients remain strongly positive across the eastern part of the study area, except near the losing-reach of the Portneuf River, where gradients are slightly positive. The area of strongly positive gradients may reflect the influence of the Simplot production wells superimposed on a natural positive gradient. The sudden falloff in head differential to very small values near the losing-reach portion at the Portneuf River suggests the existence of a single permeable zone with no significant confinement across the monitored interval. This indicates horizontal flow in this area. A strongly positive gradient is reestablished in the well cluster in the vicinity of the I-86 bridge, however, as the groundwater appears to discharge into the Portneuf River.

The elevation of the water surface of the Portneuf River was measured at three locations on June 26, 1992: beneath the U.S. Highway 30 bridge, at the Simplot pipeline overpass, and at the Batiste Lane bridge. Surface water elevations beneath the Highway 30 bridge and the pipeline overpass were approximately 3 feet higher in elevation than that of the groundwater measured in nearby shallow monitoring wells, indicating the Portneuf River was a losing stream along this reach. Further downstream beneath the Batiste Lane bridge, the surface elevation of the river is approximately 1.5 feet lower than that of the groundwater measured in shallow

monitoring Well 503, located to the west of the bridge. The comparison of the elevation of the surface water in the river to the shallow groundwater contours suggest the river is gaining water near I-86. This is also evidenced by the numerous springs between I-86 and the American Falls Reservoir. Based on a seepage study in the fall of 1980, Jacobson (1982) estimated that the Portneuf River was gaining approximately 560 cfs (251,000 gpm) between the river gauging station in Pocatello to the American Falls Reservoir. Jacobson also postulated that essentially no water is gained or lost in the first 7-mile reach of the river, downstream from the Pocatello gauging station. Data collected in the RI, however, indicate that this not correct.

3.3.3 Conceptual Site Model of Groundwater Flow

A conceptual site model of groundwater flow for the EMF study area is built on a framework of hydrogeologic information coupled with climatic data. Past geologic processes influenced the distribution of aquifers and aquitards beneath the study area, and the climate controls the water available to recharge the aquifers.

Section 3.1 provided a framework illustrating the geologic units throughout the study area. The distribution and thicknesses of the units can be seen in Figures 3.1-5 through 3.1-11. As previously discussed, the main water-bearing zones are the Michaud Gravel, the Starlight Formation, and the Sunbeam Formation. The permeable units of the Starlight Formation are generally not correlative across the study area due to the highly variable erosional surface on these deposits. Permeable units of the Sunbeam Formation are wedge-shaped, thin near the Bannock Range and thicker toward the Michaud Flats. The Michaud Gravel deposits are very thick near the Portneuf River area, gradually thinning toward the west, rapidly thinning to the south.

Precipitation patterns and topography are linked to the aquifers and aquitards in that higher elevations receive higher amounts of precipitation. Higher elevations act as recharge areas, with precipitation infiltrating and migrating downslope into the flats.

3.3.3.1 Hydraulic Conductivity

When the hydraulic conductivity values are viewed alone, there are three spatial trends (Figure 3.3-2). Starting in the Bannock Range near the FMC/Simplot boundary and going east or northeast to the Portneuf River, there is a very rapid increase in hydraulic conductivities. There is another increasing trend, although less pronounced, directly west toward FMC. There is also an area of relatively low hydraulic conductivities in the Michaud Flats between the FMC and Simplot

property. The third trend is vertical. Hydraulic conductivities in the deeper saturated zones are typically less than those of the shallow zone when nearby shallow and deep wells are compared. This is not true in the Portneuf River area.

These trends are indicative of the stratigraphy in these areas. The high values in the Portneuf River area are due to the very coarse-grained deposits found there, while the lack of vertical trend in this area is explained by the depth of the Michaud Gravel. The rapid increase in hydraulic conductivities in the Portneuf River area, as one moves off the Bannock Range, is explained by the distinct change in the depositional environment. It is a very short distance from the least permeable Starlight Formation bedrock and loess deposits to the Sunbeam Formation volcanic gravels (alluvial deposits), to the highly permeable Michaud Gravel.

The east-west trend across FMC reflects a more gradual transition from low-permeability bedrock to more permeable sand and silty gravel. This is followed by a transition into the Michaud Gravel, where permeabilities are lower than those found in the Michaud Gravel near the Portneuf River due to a lower-energy depositional environment. The Bonneville Flood waters lost energy as they emerged into the Michaud Flats. The decrease in energy led to a decrease in overall grain size to the west and south, as illustrated by the boring log descriptions of gravels (e.g., west to east: on a northern plane would be boring logs 147, 109, 317, and 506, and on a southern plane, 102, 106, and 300).

Vertical hydraulic conductivity differences are dependent on the sediment types and depositional environment. The shallower Michaud Gravel is a coarse-grained quartzitic gravel not derived locally and deposited in a very high-energy environment, thereby lacking a significant quantity of silt and clay in most places. The deeper gravels (Sunbeam Formation) are primarily volcanic clasts derived locally and deposited in a lower-energy environment that did not thoroughly winnow away the finer grained sediments. The higher percentage of fine-grained material in the deeper gravel accounts for the lower hydraulic conductivities.

3.3.3.2 Flowpaths

Patterns of hydraulic gradient are used to identify sources of recharge and locations of discharge or sinks. Steeper gradients indicate higher flow through an aquifer, thinning of the aquifer, or lower hydraulic conductivity. Flatter gradients may indicate higher hydraulic conductivity, thickening of the aquifer, or less groundwater flow.

Review of groundwater elevation contours in the uppermost saturated zone indicates that there is a site-wide seasonal fluctuation on the order of 2 feet. However, major seasonal shifts in the overall contour patterns are not evident. Because the contour patterns are very consistent from quarter to quarter, one contour plot (December 1992) was selected as representative of long-term conditions in the shallow aquifer (Figure 3.3-3C). The hydraulic gradient is estimated by the "density" or the perpendicular distance between contours.

The main features that are evident in the contour plot are the steep gradient across the Bannock Range area, the broad, shallow gradient along the western portion of the site, and the unusual pattern of contours associated with the Portneuf River and the Simplot production wells. There is also a region of relatively steep gradient near the Simplot/FMC north-central boundary. This region is associated with the region of lower hydraulic conductivities and/or thinner saturated thickness of unconsolidated sediment mentioned previously, and the flanks of the sediment-filled valley that emanates from the Bannock Range.

There a strong influence of sources and sinks on the groundwater contours. To illustrate this, groundwater flowpaths were plotted using the groundwater contour plots and the hydraulic conductivity values throughout the site. These flowpaths were generated using the computer program GWPATH, as presented in Figure 3.3-4. The flowpaths and flow velocities computed in the model assumed that equilibrium conditions in groundwater flow exist beneath the site. These flowpaths were further constrained by the areal distribution of hydraulic conductivity values determined during the RI.

Preliminary evaluation of hydraulic data suggests that groundwater from the Bannock Range begins its flowpath in a northerly direction and is diverted to the northeast. Groundwater from the Michaud Flats flows east and then is deflected to the northeast. Relative flow velocities and general flow directions are illustrated in the 500-day groundwater particle paths shown in Figure 3.3-6. Analytical modeling is in progress to fully evaluate these data and develop a refined understanding of flowpaths. Actual flowpaths from the EMF facilities have not been determined. Study results will be presented in the RI report.

Flowpaths also reveal that water recharged to the Michaud Gravel along the losing reach of the Portneuf is apparently discharged back into the river near the I-86 bridge along with considerably more water from the Portneuf River Valley system. The underflow recharging the Portneuf River appears to be a major source for the increased flow downstream of the I-86 bridge and it is Portneuf River Valley system water, not Bannock Range water. This is further supported by flow measurements

collected at the Bannock Range system-fed Batiste Spring. Flow rates increase along the Portneuf River near the bridge, from a low of 80 cfs up to 200 cfs or more. This increase cannot be accounted for by simply summing the flows from the various springs, the water treatment plant, and the FMC outfall. Therefore, underflow recharge is a major contributor to riverflow downstream of the bridge. (See Section 4.5 for a more detailed discussion.)

Of major interest is the Simplot production wells capture zone established in the shallow saturated zone, which appears to be a primary flowpath from the area of the gypsum stack. Well SWP-4 is screened across the shallow and deep zones; therefore, this well will draw water from both zones. Well SWP-5 is screened only in the deeper zone. Pumping from SWP-5 affects the shallow zone, but probably not to the degree SWP-4 does. Recently installed production Well SWP-7 will be fully operational in 1994. The influence of the well will be included in the analytical modeling study previously mentioned.

Well SWP-4 creates a cone of depression in the shallow aquifer that can be directly observed in groundwater levels between Well TW-12S (higher) and Well 320 (lower). Water levels in Well 320 are typically equal to or 0.10 foot less than water levels in Well TW-12S. This gradient relationship indicates shallow groundwater flows from the area of Well 320 to the production well. Other local groundwater elevations also support this conclusion. In addition, the shallow groundwater flowpaths indicate that Bannock Range water flows off the northeastern slopes, parallels the Portneuf River, and is probably captured by the production wells.

The Simplot production wells may also be capturing groundwater that flows near the FMC furnace building and slag pit. This high water temperature is also seen in Well 108, directly downgradient from the FMC furnace building. A flowpath connecting these two points and extended beyond the 319/320 well pair may ultimately terminate at the Simplot production wells.

The temperature of water in Well 320 (made during routine quarterly sampling) and the temperature of water in Well 319 (made during geophysical logging) are higher than ambient groundwater temperatures across the EMF study area. Well 319 is the deeper member of the 319/320 well pair.

Vertical groundwater head differentials have been previously illustrated for five quarterly monitoring events. These data are nearly as consistent as the shallow horizontal contour plots. The distribution of vertical gradients shows a slight downward gradient in the Bannock Range area, along the western portion of the study area. This is most likely a recharge area. The downward vertical gradient in

well pair 125/126 is probably associated with groundwater pumping from Well FMC-3, a production well that pumps from the deeper zone only.

The high vertical gradients in the vicinity of the Simplot production wells may reflect an artesian effect from the Bannock Range. However, it is likely that the gradient represents a cone of depression caused by the production wells. The difference in permeabilities between the lower and upper zones of pumping influence would tend to lower the shallow system (less transmissive) while it would have very little effect on the lower zone (highly transmissive).

The upward vertical gradients in the Michaud Flats reflect a slight confining effect as Bannock Range water moves along deeper flowpaths. The source of this water is much higher in the Bannock Range than the shallower groundwater, possibly from near the highest elevations south of the ore-processing facilities. Head distributions in the deeper zones indicate that groundwater flows further north before beginning its eastward path to the Portneuf River.

3.3.4 Summary

Groundwater flowpaths in the EMF study area have been characterized using numerous lines of data. The geochemical data, temperature logs, geologic data, geophysical logs, and hydrogeologic data support the following conclusions. Additional evidence and discussion is provided in Section 4.4.

Groundwater emanating from most of the FMC and Simplot production and waste management facility areas appears to flow to the Simplot production wells. However, the water from beneath the EMF facilities appears to influence Batiste and Swanson Road springs. Shallow groundwater appears to move along direct flowpaths to these sinks, whereas the deeper groundwater flows further out into Michaud Flats, with a more gradual diversion to the Portneuf River. Along the portion of the Portneuf River upstream from the I-86 bridge, river water flows into the shallow aquifer only to be returned to the river further downstream, in a gaining reach. Consequently, potentially impacted groundwater from the EMF study area cannot enter the river in this upstream portion.

Groundwater migrates relatively slowly (on the order of 0.5 foot per day) off the Bannock Range and is swept up by the groundwater flow beneath Michaud Flats and the Portneuf River. Groundwater beneath Michaud Flats in the western part of the EMF facilities area flows generally northeastward at an estimated rate of about 1 foot per day under relatively low gradients (about 0.0007). Underflow in the highly transmissive gravels beneath the Portneuf River at the eastern margin of the study

area migrates northwestward at a rate estimated to be about 12 feet per day, also under a relatively low gradient of about 0.0008.

In the area between the FMC and Simplot processing plants, the gradient is relatively steep (about 0.004) toward the east-northeast; here the groundwater flow rate is estimated to be about 11 feet per day.

3.4 STUDY AREA SOILS

This section describes the origin of soils in the EMF study area and their geographical distribution (Section 3.4.1), hydrogeological properties (Section 3.4.2), and geochemical properties (Section 3.4.3). Soil descriptions and distribution are based primarily on the U.S. Soil Conservation Service (SCS) surveys for the Fort Hall area and Bannock County. Different portions of the facilities fall within the Fort Hall and Bannock County surveys. A graphic overview of study area soils is presented on page 3.4-2.

The origin of each soil type is important in determining the properties of the soil. Soils within the EMF study area originate from deposition by rivers and streams (alluvium), collection at the base of slopes (colluvium), weathering in place (residuum), and deposition by wind (loess).

In general, the southern portion of the FMC facility is situated on silty soils primarily derived from loess and colluvium. The soils in the northern portion of the FMC facility are derived primarily from loess and deposits of silty sand and gravel (alluvium). The soils in the southern portion of the Simplot facility are less consistent; the soils in the southwestern area consist of nearly homogeneous silt (loess and silty colluvium), while soils in the southeastern area are more variable and include alluvium, colluvium, and residuum. The soils in the northern portion of the Simplot facility consist primarily of sandy gravels (alluvium) in the central part, with silty soils (loess and fine-grained alluvium) on the east and west.

In terms of hydrogeological properties, study area soils, which consist primarily of silt (loess and some fine-grained colluvium and alluvium), have relatively lower permeability than other soil types. Alluvial soils generally are coarser grained, with correspondingly greater hydraulic conductivity. Alluvial soils also generally have greater hydraulic conductivity in the horizontal direction than in the vertical direction due to the "bedded" nature of their deposition. Colluvium and residuum are variable, depending on grain size and weathering characteristics of their source materials.

Geochemical characteristics of the soils are a function of the source materials. In general, native soils in the area around Pocatello are alkaline; that is, their pH is greater than 7. This is significant, as alkaline soils tend to retain metals and prevent their migration (leaching) through the soil horizons to the groundwater. The greater the soil's alkalinity, the greater is the soil's ability to retard migration of the metal ions.

Overview of Study Area Soils (Section 3.4)

Soil Types *(Section 3.4.1):*

- EMF study area soil descriptions and distribution based on the U.S. Soil Conservation Service surveys for the Fort Hall area and Bannock County.
- In major portions of both facilities, naturally occurring soils have been modified by mixing with other soils or byproducts, or placement of fill materials (such as slag) over them.
- Soil types of both facilities are as follows:

	Simplot	FMC
Northern Portion	Sandy gravels alluvium) in central part; silty soils (loess and fine-grained alluvium) on the east and west	Loess and alluvial deposits
Southern Portion	Homogenous silt (loess and silty alluvium) to the west; more variable (alluvium, colluvium, and residuum) to the east	Silty soil derived primarily from loess and colluvium

Hydrogeologic Properties *(Section 3.4.2):*

- Homogenous silt has relatively lower permeability when compared with other study area soil types.
- Alluvial soil has greater permeability in the horizontal direction than the vertical.
- Other study area soil types are more variable in permeability.

Geochemical Properties *(Section 3.4.3):*

- Native soils are generally alkaline due to their calcareous nature.
- Alkaline pH causes the soil to retain metals and minimizes leaching of the metals to groundwater.

3.4.1 Soil Types

Soils in the Fort Hall area and Bannock County have been surveyed by the SCS as part of its nationwide soil mapping and classification program. In the SCS surveys, the soil profile is described as extending from the surface down into the underlying unconsolidated material. The underlying unconsolidated material is defined as a region devoid of plant roots, burrowing macroinvertebrates, and microbiological activity. Further, its mineral structure has not been altered by biological activity. For the EMF study area, the underlying unconsolidated materials region begins at approximately 2 feet from the soil surface.

It should be noted that the soil associations shown in the general soil map for the Fort Hall area soil survey (U.S. Soil Conservation Service, 1977) and the Bannock County soil survey (U.S. Soil Conservation Service, 1987b) do not entirely match where the survey areas overlap. Differences in soil names from one area to the next are partly a function of the differences in soil patterns and associations, and partly a function of the naming conventions used by SCS personnel. The two soil surveys were conducted nearly 10 years apart.

The major soil associations in the vicinity of the EMF study area that were identified in these two soil surveys are shown in Figure 2.3-1. A soil association consists of one or more major soil types and at least one minor soil type; the soil association is named for the major soils. The soils in one association may occur in another, but in different combinations. The soil associations identified in the vicinity of the EMF study area in the Fort Hall area are Snake-Philbon, Paniogue-Delco, Paniogue-Broncho, and Pocatello-Wheeler-Portneuf. Soil associations in the vicinity of the EMF study area in Bannock County are the Inkom-Joesvar, Arimo-Downey-Bahem, Ririe-Rexburg-Lanoak, and Camelback-Hades-Valmar. Table 3.4-1 summarizes the general characteristics of individual soils within these soil associations. Properties of the soil associations are summarized in Table 2.3-3.

The major portion of the FMC facility is in an area of occurrence of the Pocatello-Wheeler-Portneuf soil association. These soils are described as silt loams, formed primarily in loess (material transported and deposited by wind and consisting of primarily silt-sized particles). The northern portion of the FMC facility extends into an area of the Paniogue-Declo association. These soils are more variable, ranging from gravelly coarse sand to silt loam, developed primarily from alluvial fans and terraces, which accounts for their greater range of particle size and permeability.

Except for the western and southern portions of the FMC facility, these naturally occurring soils have been modified either by mixing with other soils and byproducts (such as slag), or by placing slag or other fill materials over them to provide level

foundations for facility structures, improve drainage, or to provide roads for access or embankments for ponds.

The southern portion of the Simplot facility is divided between the Ririe-Rexburg-Lanoak (RRL) and the Camelback-Hades-Valmar (CHV) soil associations. The RRL soils are very deep silt loams formed in loess, and are similar to the Pocatello-Wheeler-Portneuf soils. The CHV soils are more variable, ranging in texture from gravelly silt loams to extremely stony silt loams formed in alluvium, colluvium, and residuum.

The northern portion of the Simplot facility extends into the Arimo-Downey-Bahem (ADB) soils and the northeastern corner extends into Inkom-Joesvar (IJ) soils. The ADB soils formed in loess and silty alluvium. This soil association is similar to Paniogue-Declo soils, which occupy a small portion of the northwestern corner of the Simplot facility. Inkom-Joesvar soils are deep, moderately well-drained soils that formed in silty alluvium. Inkom-Joesvar soils occur along the Portneuf River Valley hydrogeochemical regime.

These naturally occurring soils have been modified either by mixing with other soils and byproducts (such as gravels and slag), or by placing other fill materials over them to provide level foundations for facility structures, improve drainage gradients, or to provide roads for access or embankments for ponds.

3.4.2 Hydrogeologic Properties

Soil hydrogeologic properties control the movement of water through the soils, both laterally and vertically. The hydraulic conductivity (permeability) of a soil is a measure of its ability to transmit water through the soil profile. The hydraulic conductivity usually varies with depth within the soil column, as well as laterally with variations in grain size and compaction of the soil.

Most of the study area soils are formed in materials derived from aeolian or alluvial deposition. On the slopes of the Bannock Hills, some of the soils are derived from colluvium or are residual (formed in place). The depositional process for alluvial deposits results in a "bedded" and "graded" character, which imparts a strong anisotropy to their permeability characteristics, especially over large areas. Alluvial deposits tend to vary more widely in permeability than do aeolian materials, typically by two to three orders of magnitude (Freeze and Cherry, 1979). The wide range of permeabilities reflects the range of the grain-size distribution within the deposit.

In comparison with the alluvial deposits in the study area, aeolian silts (loess) are less permeable and more isotropic in nature, although fractures, root channels, and animal burrows can cause secondary permeability that can greatly exceed the primary permeability of the original soil mass. Grain-size tests were not conducted on study area soils; however, typical permeabilities for unconsolidated soils range from about 10^{-13} cm^2 for fine-grained soils (silty clays) to 10^{-6} cm^2 for coarse-grained soils (sandy gravels). Typical soil porosities range from 35 to 70 percent for silts and clays, to 25 to 50 percent for sands and gravels (Freeze and Cherry, 1979).

3.4.3 Geochemical Properties

Soil geochemical properties are important for predicting movement of chemicals through soils. They also control the bio-availability (potential for uptake by plants or animals) of chemicals. Geochemical properties that can be involved in controlling chemical movement and bio-availability are pH, redox potential, cation exchange capacity (CEC), mineralogy, base saturation, salinity, and organic matter content. The relative importance of these properties in controlling movement and bio-availability depends upon soil chemistry and soil type.

Laboratory measurements of geochemical properties of the "onsite" soils (within the FMC and Simplot facilities) were determined from soil samples collected in the potential source program. These measurements varied widely, primarily as a result of the influence of industrial operations on the onsite soils. To develop a better understanding of the effects of industrial activities on the soils within the facilities, sample data were evaluated, and a subset of sample locations was selected to determine "representative" characteristics for both surface and subsurface soils. The methodology for the selection of these locations is explained in Section 4. The concentrations of various chemical constituents within these representative soils are provided in Table 4.2.1-1.

The native soils in the EMF study area are generally alkaline (pH >7) because of their calcareous nature. This is consistent with most soils in the more arid regions of the western United States (Foth and Turk, 1972). The alkaline pH and calcareous nature of these soils minimize leaching of most metals, because the mobility of most of the metals is closely correlated with soil pH.

Table 3.4-1 includes geochemical data from the SCS soil surveys for the soil associations which occur onsite. It also provides estimates of texture, permeability, and other general soil properties.

3.5 CLIMATE

This section characterizes the EMF study area climate (see Section 3.5.1). Analyses of meteorological data gathered at three monitoring stations in the EMF study area are summarized in Section 3.5.2. A graphic overview of EMF study area climate is presented on page 3.5-2.

The EMF study area climate is semi-arid, characterized by a wide range of temperatures. Daily mean maximum temperature is 84.1°F (28.9°C) in the summer, and daily mean minimum temperature is 17.8°F (-7.9°C) in the winter. The annual mean precipitation for the study area is 10.86 in./yr (278 mm/yr), with the greatest amount of precipitation occurring during the spring. Prevailing winds are westerly for the region.

Section 3.5.2 discusses data obtained by Simplot from two meteorological stations closest to the EMF study area. Comparisons of the National Weather Service (NWS) Pocatello data with data from the two Simplot stations show differences, primarily in wind direction, windspeed, and temperature. These can be attributed to the effects of local terrain on the meteorological parameters.

3.5.1 Climatological Description

The EMF study area is located on the border of the upper Snake River Plains and Eastern Highlands climatic regions in southeastern Idaho (NOAA, 1982). Storms originating over the Pacific Ocean are the primary sources of precipitation in Idaho. Exceptions occur in the summer, when high levels of moisture-laden air brought in from the Gulf of Mexico and Caribbean region produce thundershowers (Ruffner, 1978).

The climate of eastern Idaho is influenced by Maritime Pacific air that is advected eastward by the prevailing westerly winds. The effects of the maritime air are most noticeable in the winter, which is characterized by greater average cloudiness, higher frequency of precipitation, and mean temperatures above those at locations of the same altitude and latitude in the mid-continent area (Ruffner, 1978). Eastern Idaho's climate is characterized by a wide range of temperatures between winter and summer and a reversal of the wet winter/dry summer pattern. The annual average percentage of sunshine is about 63 percent, which drops to 45 percent during the cloudy months of winter (NOAA, 1989).

The highest temperature recorded at the Pocatello Municipal Airport was 104°F (40°C) in August 1969. The lowest temperature recorded at the Pocatello airport was

Overview of the EMF Study Area Climate (Section 3.5)

Climatological Description *(Section 3.5.1):*	■ EMF study area climate is semi-arid, characterized by a wide range of temperatures, with a reversal of wet winter/dry summer pattern. ■ Maximum recorded 24-hour precipitation (water equivalent) in the last 40 years was 1.82 inches in 1976; annual mean precipitation is 10.86 inches per year. Mean evaporation during summer is 29.76 inches, and 3.36 inches during the winter. ■ Predominant wind direction is from the southwest, with a mean annual windspeed of 10.2 mph.
Site-Specific Meteorological Data *(Section 3.5.2):*	Comparison of data from the NWS Pocatello, Simplot site 1, and Simplot site 7 meteorological stations shows that differences in wind direction, wind speed, and temperature (Tables 3.5-1 to 3.5-3) are attributable to the effects of local terrain on meteorological parameters.

-33°F (-36°C) in February 1985. The warmest temperatures occur from June through August (daily mean maximum temperature 84.1°F [28.9°C]), and the coldest temperatures occur from December through February (with daily mean minimum temperature of 17.8°F [-7.9°C]) (NOAA, 1989).

The maximum mean number of days with thunderstorms recorded for a 3-month period was 15.3 days, which occurred during the summer. Thunderstorms occur mainly in the afternoon and are usually brief. Because of the dryness of the air, little rainfall reaches the ground (NOAA, 1989). The maximum mean number of days with heavy fog visibility, 0.25 mile (0.4 km) or less, occurred during the winter months. The mean number of days with heavy fog was 12 for the winter months.

The greatest amount of precipitation (3.30 inches, or 84.6 mm, for a 3-month period) occurs during the spring, March through May, and the least amount occurs during the next 3-month period (2.13 inches, or 54.6 mm). The maximum monthly precipitation (water equivalent) recorded at the Pocatello airport was 3.98 inches (102.1 mm) in August 1968. The minimum monthly precipitation (water equivalent) recorded at the Pocatello airport was in October 1952 and September 1987, when there was no precipitation. The maximum 24-hour precipitation (water equivalent) recorded at the Pocatello airport was 1.82 inches (46.7 mm) in October 1976. The maximum monthly snowfall recorded at the Pocatello airport was 33.7 inches (864.1 mm) in December 1983, and the maximum snowfall recorded during the winter months of 1983-1984 was 85.6 inches (190 mm). The annual mean precipitation for the EMF study area is 10.86 in./yr (278 mm/yr). These data are based on approximately 40 years of climatological data gathered at Pocatello, Idaho (NOAA, 1991).

The predominant wind direction is from the southwest, and the mean annual wind speed is 10.2 miles per hour (mph) (16.3 km per hour, or kmph) as measured at the airport. Simplot's data show that localized topography (Bannock Range) influences wind direction in the vicinity of the facilities. The peak wind gust recorded at the airport was 68 mph (109 kmph) from the southwest in January 1988 (NOAA, 1989).

The mean evaporation during the summer is 29.76 inches (762 mm) for the 3-month period, and 3.36 inches (86 mm) for the winter months. Mean evaporation was estimated with a form of the Penman equation using the parameters of wind speed, mean air temperature, mean dew point temperature, and daily solar radiation (NOAA, 1982).

3.5.2 Site-Specific Meteorological Data

Meteorological data were gathered and reviewed for air dispersion modeling. Data compared were taken from three meteorological stations: NWS Pocatello and Simplot sites 1 and 7 (Figure 2.2-1). The NWS meteorological data were for the years 1985 to 1989. These were the only data available from EPA's bulletin board service and NCDC. Simplot's site 1 data were for the years 1981 to 1983 and 1988 through 1991; site 7 data were for the years from 1988 to 1991. The methodology for meteorological data review and results was presented in "Report of the Analysis of Pocatello, Idaho, Meteorological Data for Use in Atmospheric Dispersion Modeling at the Eastern Michaud Flats Superfund Site" (Bechtel, 1992b).

A comparison of the Pocatello airport and Simplot meteorological site 1 data shows that, although the two stations are only about 4 miles (6.4 km) apart, the local topography of the Bannock Range influences the local wind patterns. This influence is evidenced by wind roses of the two locations provided in Figures 3.5-1 and 3.5-2. The Pocatello airport data (Figure 3.5-1) show a prevailing wind direction from the south-southwest, with a strong predominance of wind from the entire southwest quadrant. The site 1 data (Figure 3.5-2) show a strong predominance for southwest to west-southwest winds and a secondary predominance from the southeast direction.

Meteorological data summaries of monthly mean values for the three monitoring sites are presented in Tables 3.5-1 through 3.5-3 for the NWS station and Simplot sites 1 and 7, respectively. These tables contain wind speed, wind direction, and temperature for the available years of data. The temperatures and wind speeds at the NWS station are generally higher than at site 1 and site 7. These differences are caused by the locations of the sites. Site 1 is located in gently rolling hills and is affected by mountain/valley influences of the Bannock Range. Site 7 is in the Bannock Range at a higher elevation than the NWS and site 1 stations. The NWS station is in a more open area of the EMF plain and is exposed to more heating and free wind flow than sites 1 and 7, and the close proximity to the Bannock Range shields sites 1 and 7 from winds.

3.6 DEMOGRAPHY AND LAND USE

The EMF study area includes portions of the cities of Pocatello and Chubbuck, unincorporated areas of Bannock and Power counties, the Fort Hall Indian Reservation, and U.S. Bureau of Land Management lands. Land use in the study area includes areas zoned for agriculture (43 percent) and various urban land uses, including residential, commercial, and industrial (40 percent). Future land uses are not expected to change significantly from current uses within the study area. Future zoning of the EMF facilities and surrounding area is also not expected to change from present zoning. Population projections for the study area do not show significant changes from current population numbers.

This section identifies and characterizes human populations and general occurrences of livestock and food crops in the EMF study area. Demographics of the site are presented in Section 3.6.1. Current and expected land uses are discussed in Section 3.6.2. Section 3.6.3 provides information on potentially sensitive populations. An overview of Section 3.6 is provided on the following page.

3.6.1 Demographics

The EMF study area includes the FMC and Simplot facilities and portions of the cities of Pocatello and Chubbuck (see Figure 1-1). The 1990 populations of Pocatello and Chubbuck were estimated at 46,080 and 7,791, respectively (U.S. Department of Commerce, 1991). Population projections for Pocatello by the Northern Bannock County Metropolitan Planning Department (data files) for 1995 and 2000 are 48,946 and 52,197, respectively, indicating a slight growth trend for the city. No data are available for future growth for Chubbuck.

In 1990, approximately 30 percent of the population of Pocatello was under the age of 18, and about 11 percent over the age of 65. Statistics for Chubbuck are not available (Smart, 1992). However, the demographics of this community are most likely similar to those of neighboring Pocatello.

Unincorporated areas surrounding the EMF study area in Bannock and Power counties are used principally for agriculture. However, scattered residences (mainly isolated farmhouses) do occur in the unincorporated areas, along with one small subdivision (see Section 3.6.2.1). Population statistics are not available for these unincorporated areas in Bannock County.

Overview of Demography and Land Use (Section 3.6)

Demography *(Section 3.6.1):*	■ 1990 populations for Pocatello and Chubbuck were estimated at 46,080 and 7,791, respectively. Only slight growth is projected for Pocatello.
Land Use *(Section 3.6.2):*	■ Land uses in the area include Fort Hall Indian Reservation (37%), U.S. Bureau of Land Management (13%), agricultural areas (6%), residential (10%), commercial (10.5%), and industrial and special-use district (30.5%) (Figure 3.6-1). ■ Minimal changes are expected in land use within the study area in the future (Figure 3.6-2).
Potential Receptors *(Section 3.6.3):*	■ Potential receptors include human populations in residential areas within the study area. ■ Some livestock and two fish farms on the Portneuf River occur in the study area. ■ Batiste Spring is a potable water source for the Pocatello yard of the Union Pacific Railroad. ■ Periodic public health warnings have been issued advising avoidance of contact recreational activities in the Portneuf River due to E. coli contamination from unauthorized discharges in Pocatello upstream from the EMF facilities.

3.6.2 Land Use

Current and expected future land uses within the EMF study area are described in this section. Land is used in the EMF study area for agricultural, residential, and industrial purposes, with little change expected in the future.

3.6.2.1 Current Land Use

The EMF study area includes portions of four jurisdictions: Fort Hall Indian Reservation, Bannock and Power counties, and the U.S. Bureau of Land Management lands. Portions of both Pocatello and Chubbuck are also within the EMF study area.

Current land use zoning for Chubbuck, Pocatello, and the four jurisdictions is shown in Figure 3.6-1. This information is based on city and county zoning maps. Aerial photographs and visual reconnaissance were used to confirm actual land uses. Estimated acreages and percentage of total land uses in the EMF study area are summarized in Table 3.6-1.

Land in the portions of Pocatello and Chubbuck within the EMF study area is zoned primarily for residential use. The closest area to the EMF facilities that is zoned for residential use is a little more than 1 mile (1.6 km) east of the Simplot facility, in Pocatello. This residential area is surrounded by various industrial, agricultural, and small commercial areas. Another residential area lies approximately 2 miles (3.2 km) northeast of the EMF facilities, in Chubbuck (see Figure 3.6-1).

The Pocatello Municipal Airport, which is annexed to the City of Pocatello, lies west of the EMF facilities. The airport is governed by its own master plan and is zoned as a special use district. The annexed area is predominantly commercial. Both the FMC and Simplot facilities, situated entirely within the EMF study area, are zoned as industrial. The FMC facility employs approximately 560 personnel, and Simplot employs 460.

Unincorporated land in Bannock and Power counties is mostly agricultural with scattered residences. A small area southeast of the EMF study area between the Portneuf River and Interstate Highway 86 (I-86) is zoned for industrial use.

The U.S. Bureau of Land Management land located immediately south of the EMF facilities is designated as multiple use and includes cattle grazing (Figure 3.6-1). Land use for the Fort Hall Indian Reservation within the EMF study area is mainly

agricultural. The FMC facility is adjacent to and partially within the Fort Hall Indian Reservation.

Gravel extraction operations also occur within the EMF study area.

3.6.2.2 Future Land Use

Future land use information presented in this section is based primarily on comprehensive plans (which are long-term planning documents) obtained from the offices of Chubbuck and Pocatello, and Bannock and Power counties, in addition to personal communications.

Future land use patterns projected for the EMF study area are shown in Figure 3.6-2. A comparison of this figure with Figure 3.6-1 shows that minimal changes are expected to land-use designations in this area in the future. In addition, upon final closure, FMC will record a notation on the deed to the facility property that will in perpetuity notify any potential purchaser of the property that the land use is restricted under 40 CFR 265, Subpart G, of the Resource Conservation and Recovery Act (RCRA).

No significant changes to land use designations are expected for the portions of Chubbuck, Pocatello, the unincorporated areas of Power County, and the U.S. Bureau of Land Management area located within the EMF study area. The area occupied by the Pocatello Municipal Airport is expected to continue to be zoned as a special use district. Similarly, there are no current plans for redesignating the FMC and Simplot facilities (zoned as industrial), or for county zoning amendments to land uses within a 1-mile (1.6-km) radius of these facilities.

The unincorporated area of Bannock County within the study area is zoned for development district multiple use (Figure 3.6-1), signifying the potential for changes to land use in the future. New uses in this district are screened for compatibility with existing uses to limit possible negative impacts (Feldberg, 1993).

The Shoshone-Bannock tribe is considering designating land southwest of I-86 to Michaud Creek as light industrial. Presently, this land, which is part of the Fort Hall Indian Reservation, is designated for agricultural uses. No plans have been finalized (Fenwick, 1993b).

3.6.3 Potential Receptors

In the characterization of the land use in the EMF study area, potential receptors of site-related constituents were generally noted during field reconnaissance, and are

discussed in Sections 3.6.3.2 to 3.6.3.4. Section 3.6.3.1 provides area conditions that influenced the identification of the potentially sensitive receptors.

3.6.3.1 Site Conditions

The prevailing southwesterly winds place Chubbuck and parts of Pocatello in the predominantly downwind direction of the EMF facilities.

Surface water and groundwater gradients are to the northwest and north along the Portneuf River. Predominant surface water features within the EMF study area are the Portneuf River, Michaud Creek, springs, and numerous irrigation canals.

Surface water recreational use in the lower reach of the Portneuf River is limited because of limited public access. The Idaho Fish and Game Department began a rainbow trout stocking program in 1992. Approximately 500 to 1,000 catchable trout, 10 to 12 inches (25-30 cm) in size, were released upstream of the Rowland dairy (located 1 mile [1.6 km] north of the EMF facilities near the Portneuf River) for recreational fishing (Mende, 1992). The Department plans to stock rainbow trout in 1993, and will evaluate continuance of the program depending on the success rate of the fishery takes. Other recreational uses such as boating are restricted by limited public access. In addition, periodic public health warnings are issued, advising avoidance of contact recreational activities in the Portneuf River because of E. coli contamination in unauthorized discharges in the City of Pocatello upstream from the EMF facilities (Low, 1993).

Batiste Spring is used as a potable water source for the Pocatello yard of the Union Pacific Railroad (Figure 1.3-1). The spring has also been developed for a privately stocked trout fishing club (City of Pocatello, 1989).

Irrigation canals (laterals) traverse agricultural lands in the counties; of these, only the Taghee Canal (Figure 1.3-1) passes through the EMF study area. Groundwater wells within the EMF study area, registered as of 1992 with the Idaho State Water Resources Department, are shown in Figure 3.6-3. These wells may be used for potable uses, livestock, or irrigation purposes. Table 3.6-2 lists location, ownership, and total diversion (i.e., withdrawal allowed) of these wells. Since this list was taken from the public record without independent verification, the information contained therein may have errors.

3.6.3.2 Human Populations

This section identifies the locations of schools, day-care facilities, hospitals, and nursing homes. These facilities are identified in Figure 3.6-4.

Two schools are located within the EMF study area in the City of Pocatello: Wilcox Elementary School and Hawthorne Junior High School. Six licensed day-care centers are also present within the study area. The Idaho State Air Craft Mechanics school, which admits students from 16 years of age and older, is located at the Pocatello airport.

One elementary school (Chubbuck Elementary School) and one retirement home (Cottonwood Cove Retirement Community) are located within a residential area of the City of Chubbuck.

There are no hospitals or nursing homes within the EMF study area. The entire Pocatello/Chubbuck region, including areas outside the study area, has 28 private and public schools (five private and 23 public), five senior living/nursing homes, two hospitals, and 73 licensed day-care centers.

3.6.3.3 Livestock and Food Crops

No commercial operating dairy farms occur within the EMF study area (Patten, 1992). The Rowland creamery is located approximately 1 mile (1.6 km) north of the EMF facilities near the Portneuf River. Milk products are processed at the creamery, but no herd is kept within the EMF study area.

Dairy cows, horses, goats, and sheep are kept by individual residences and farms within the unincorporated portion of the study area in Bannock County. In addition to agricultural areas (Figure 3.6-2) planted mostly in potatoes, grain, alfalfa, and wheat, individual residences may also maintain home vegetable gardens.

Two commercial fish farms, the Papoose Springs and Batiste Springs fish farms, are located on the Portneuf River within the EMF study area (see Figure 3.6-4). Fish raised at these facilities are sold both for stocking streams and human consumption.

3.6.3.4 Human Use of, or Access to, the Properties and Adjacent Areas

Both the FMC and Simplot facilities are operating plants and have controlled access. Both facilities have implemented programs for worker safety that comply with or exceed Federal Occupational Safety and Health Administration requirements (as codified in applicable portions of 29 CFR 1910 and 1920).

Areas adjacent to the EMF study area are subject to varying land uses, as discussed in Section 3.6.2.

3.7 ECOLOGICAL CHARACTERIZATION

The ecological characterization described below provides a context for placing the biological resources in the EMF study area. A summary of the terrestrial and aquatic ecosystems presented in this section focuses on important habitats and species occurring or potentially occurring in the study area. Section 3.7.1 describes important habitats and species in the terrestrial ecosystem, as well as the potential occurrence of federal and state protected species. Section 3.7.2 describes the aquatic ecosystem of the Portneuf River (the portion of the river that is within the EMF study area), and includes discussions on important habitats and sensitive species. A graphic overview of this section is presented on page 3.7-2.

3.7.1 Terrestrial Ecosystems

Major terrestrial vegetation cover types and wildlife habitats in the EMF study area include—in order of areal extent—agriculture (40 percent), sagebrush steppe (37 percent), and wetland/riparian (3 percent). The remainder of the study area is in residential, industrial, and commercial development (20 percent). The EMF facilities were originally in sagebrush steppe but are now largely disturbed and provide limited wildlife habitat. The Portneuf River is the major aquatic ecosystem in the EMF study area although the water quality is affected by anthropogenic influences from various sources along the Portneuf River within the city limits of Pocatello. No critical habitat of threatened or endangered plant or animal species is known to occur in the EMF facilities area.

Sensitive wildlife species (defined as species provided federal protection such as threatened or endangered species, migratory waterfowl, raptors [birds of prey], or, candidates for listing as threatened or endangered or species directly in the human food chain) known to occur in the study area include waterfowl (ducks and geese), white-tailed deer and mule deer, and upland game birds. Bald eagles may occasionally use habitats along the Portneuf River for hunting, and peregrine falcons are known to migrate through the study area. Several species of raptors also hunt and nest in the study area. Golden eagles have been observed nesting in undisturbed cliff habitat on the southern edge of the EMF facilities area.

The EMF study area is in a cold desert ecological province. Annual mean precipitation is 10.86 in./yr (278.5 mm/yr) (NOAA, 1989). Annual temperature extremes range from -33°F (-36°C) in the winter to 104°F (40°C) in the summer. The mountains forming the Portneuf River Basin are composed of volcanic rocks. The valleys are filled with the weathered products of these rocks, and with several recent lava flows. The topsoil is primarily loess. Land use practices in the EMF study area are described in Section 3.6.

Overview of Ecological Characterization (Section 3.7)

Terrestrial Ecosystems *(Section 3.7.1):*	■ Major terrestrial vegetation cover types and wildlife habitats in the EMF study area include agriculture (40%), sagebrush steppe (37%), and wetland/riparian (3%), as shown in Figure 3.7-1. ■ No important wildlife habitats are present in the EMF study area. ■ No critical habitats for threatened or endangered species, or special habitats, occur in the study area.
Aquatic Ecosystems *(Section 3.7.2):*	■ The only significant aquatic habitat in the study area is the Portneuf River. Water quality is reduced by numerous point and nonpoint sources discharging to the river. ■ No endangered or threatened species occur in the portion of the Portneuf River within the study area. ■ A number of important aquatic species and habitats are present in the study area (identified in Section 3.7.2.3.).

3.7.1.1 Vegetation Cover Types and Wildlife Habitats

The EMF study area is approximately 5 miles (8 km) southeast of the American Falls Reservoir, part of the Minidoka Wildlife Refuge System, and about 4 miles (6.4 km) south of the riparian/wetland-dominated floodplains at the mouths of the Portneuf and Snake rivers (Fort Hall Bottoms). At higher elevations, 5,000 feet (1,524 m) to the south and west of the EMF study area, Utah juniper woodland dominates the Bannock Range with pockets of aspen (*Populus tremuloides*), snowberry (*Symphoricarpus sp.*), and mountain mahogany (*Cerocarpus montanus*) in the draws. Sagebrush steppe occurs at lower elevations extending to the American Falls Reservoir.

The EMF study area includes urban (Chubbuck and Pocatello) and agricultural areas, as well as rangeland within the Fort Hall Indian Reservation and Bureau of Land Management (BLM) lands. Major vegetation cover and wildlife habitat types existing in the study area include sagebrush steppe, riparian/wetlands, agriculture, and disturbed/urban areas. In addition, cliffs to the south of the FMC and Simplot facilities provide cliff/cave habitats for some wildlife species, as described later in this section. Figure 3.7-1 shows the geographical distribution of the major vegetation cover types and associated wildlife habitats identified within the EMF study area, and Table 3.7-1 shows the total associated acreages. The vegetation and habitats are described briefly below.

Sagebrush Steppe. Sagebrush steppe vegetation occurs at elevations below 6,622 feet (2,019 m) on the Bannock Mountains within the EMF study area to the anthropogenically undisturbed alluvial plain of the Portneuf River. This vegetation type covers 34 percent (6,139 acres/2,485 ha) of the study area. In addition, most of the study area encompassing the Fort Hall Indian Reservation is in this vegetation type. Species of this vegetation type include big sagebrush (*Artemisia tridentata*), rabbit brush (*Chrysothamnous nauseosus*), Antelope bitterbrush (*Purshia tridentata*), arrow leaf balsamroot, tapertip hawksbeard, and bunch grasses including bluebunch grass (*Agropyron spicatum*), western wheat grass (*Agropyron smithii*), Indian rice grass (*Oryzopsis hymenoides*), needle-and-thread (*Stipa comata*), Idaho fescue (*Festuca idahoensis*), and squirreltail (*Sitanion hysterix*) (Cronquist et al., 1972). Other grasses include Nevada bluegrass, prairie junegrass, Sandberg bluegrass, and slender wheatgrass (U.S. Soil Conservation Service, 1987). The BLM land in the southern portion of the EMF study area and Fort Hall Indian Reservation lands to the south and west are in sagebrush steppe.

At elevations above 6,622 feet (2,019 m), and to the south of the FMC and Simplot facilities, Utah juniper (*Juniperus osteosperma*, a dominant of juniper woodland) intergrades along the sides of draws with the sagebrush-dominated slopes. Bitterbrush provides browse for mule deer (*Odocoileus hemionus*) in this area.

In addition to wildlife habitat, this vegetation type has continued to be used as rangeland for cattle grazing, both on the BLM land and Fort Hall Indian Reservation (Hogander, 1992).

Riparian/Wetlands. Riparian/wetland vegetation within the EMF study area occurs along portions of Michaud Creek, the Portneuf River, and in association with springs and seeps, gravel and borrow areas, and irrigation canals. This vegetation type makes up 3 percent (597 acres/242 ha) of vegetation/habitats in the study area. Locations of wetlands and riparian habitats identified on U.S. Fish and Wildlife Service (U.S. FWS) wetland inventory maps (U.S. FWS, 1980) are shown in Figure 3.7-1.

Wetlands provide a variety of functions. Major categories of wetland functions (Sather and Smith, 1984) relating to key functions within the EMF study area include the following:

- Sediment entrapment – This is an important function because it removes pollutants and sediments from moving waters.
- Nutrient retention and removal – The nutrient retention and removal function of wetlands involves the uptake or storage and modification of nutrients, especially nitrogen and phosphorus, in vegetation or the substrate.
- Food chain support/nutrient export – Food chain support refers to the function of removing nutrients and making them available to autotrophic (plants) consumers and a variety of hetrotrophic (animal) consumers.
- Fisheries habitat – Major factors influencing value of fisheries habitat include physical and chemical water quality and quantity including hydroperiod, flow and depth, and cover substrate and interspersion. Freshwater fisheries are primarily influenced by temperature and dissolved oxygen, with turbidity, alkalinity, and pH also being important. Cover refers to areas used by fish for protection from predators and climatic conditions, and substrate for feeding and reproduction. Interspersion refers to the relationship between open water and vegetation, types of vegetation, and various substrates.
- Wildlife habitat – Wildlife habitat value is based upon structure and species diversity of the vegetation, surrounding land uses, spatial patterns within and between wetlands, vertical and horizontal zonation, size, and water chemistry.
- Socioeconomic values – Socioeconomic values include those that provide direct and indirect social and economic benefits such as recreation, hunting, and aesthetics.

- Flood control – Factors affecting flood control include size, location within the drainage basin, texture of substrate, and lifeform of wetland vegetation.
- Shoreline anchoring – Factors influencing anchoring include type of vegetation that binds and stabilizes substrates and dissipates wave and current energy.
- Groundwater discharge and recharge – Factors affecting discharge and recharge are the nature of substrate, water permanence, the nature of surface outlets and amount of edge, type, and amount of vegetation.
- Disruption of erosive forces – Control of erosion depends upon vegetation, plant species involved, width of vegetated shoreline band, efficiency of vegetated band to soil composition, height and slope of bank, and elevation of the toe of the bank with respect to mean storm high water.

General evaluation of wetland functions and data collection during the Phase I fall (September 1992) reconnaissance focused on fisheries and wildlife habitats and socioeconomic values of hunting.

Michaud Creek. The portion of Michaud Creek within the EMF study area is intermittent, with riparian vegetation forming a corridor along the creek. Also, five wetland areas, as delineated on U.S. FWS wetland inventory maps (1980), occur along Michaud Creek (see Figure 3.7-1). These include three riverine open water perennial wetlands, in Sections 22 and 23 (T6S, R33E), a palustrine (marshy) emergent, seasonally persistent excavated wetland in Section 15 (T6S, R33E), and a palustrine wetland associated with an impounded area on the creek in Section 22 (T6S, R33E).

During field reconnaissance, prevalent tree species found along the creek included peachleaf willows (*Salix lasidandra*), alder (*Alnus tenufolia*), and cottonwood (*Populus angustifolia*). At the lower reach near Taghee lateral, Siberean elm, an introduced species, also occurred. Understory shrub vegetation included coyote willow (*Salix exigua*), rose (*Rosa sp.*), red-osier dogwood (*Cornus stolonifera*), chokecherry (*Prunnus virginnia*), and currant (*Ribes sp.*). Grasses and weedy species in the herbaceous layer included bluebunch wheatgrass, slender wheatgrass, bluegrass (*Poa palustris.*), cheatgrass (*Bromus tectorum*), annual sunflower (*Helianthus annulus*), Russian thistles (*Salsola kali*), and other species such as balsam root (*Balsamorhiza sogittata*) and lamb's-quarters (*Chenopodium alba*). Adjacent land use is cattle grazing. Cattle grazing also occurs in the riparian vegetation along the creek. Stresses on vegetation due to grazing effects, such as trampling of understory vegetation and soils, and compacted soils and grazing lines on trees and shrubs, were evident. No other stresses on vegetation were noted.

The riparian vegetation and isolated wetlands along the creek provide a wildlife habitat. Riparian vegetation along the creek is important to wildlife in the adjacent

sagebrush steppe habitat for food and water sources and cover as well as for movement corridors. Wetland areas on the creek are mostly associated with man-made impoundments near livestock pens and farmhouses.

Portneuf River. The most important wetlands in the EMF study area occur along the Portneuf River, from the end of channelization in the City of Pocatello to the EMF study area, through the Portneuf River floodplain on the Fort Hall Indian Reservation to the American Falls Reservoir. The wetlands along this portion of the river vary in width from an estimated few feet up to approximately 100 feet (30.5 m) in some areas. These wetlands provide habitat, food sources, and resting areas for a variety of wildlife species, such as beavers, ducks, geese, and waterbirds. They also probably provide some sediment trapping, nutrient retention, and cycling functions within the ecosystem. Sediment samples were collected in August and September 1992 at 24 sites along the river. Characterizations of these sites are contained in Section 3.7.2. An additional four sites were sampled in October 1992 downstream from river mile 10, and two additional sites between sampling points 23 and 22 upstream of the facility.

A variety of wetland and riparian vegetation occurs along the river, depending upon water and soil saturation conditions. The majority of these wetlands delineated by the U.S. FWS (1980) include riparian scrub shrub, deciduous and palustrine emergent vegetation.

The riparian vegetation along the river, including the riparian scrub shrub deciduous wetlands, is adapted to soil conditions that are saturated at least a portion of the year. This vegetation is well-developed and extends from the edges of the river to the drier uplands. The tree layer that occurs intermittently with an open canopy below Batiste Road is composed of peachleaf willow with a dense shrub understory. Shrub understory species are the most prevalent. The shrub understory is made up of coyote willows and other shrubs such as red-osier dogwood, rose, alder, currant, and chokecherry. Where the shrub layer is more open, grasses and herbaceous species occur including numerous grasses, such as bluegrass, bromes, and grasslike sedges, and dandelion (*Taraxacum offinale*). Above Batiste Road, the tree canopy is closed with mature peachleaf willows and alder up to 20 feet (6 m) high. The understory is dominated by grasses and herbs including bluegrass (*Poa sp.*) and sedges (*Carex*), bluebells (*Mertensia sp.*), starry solomon-plume (*Smilacina stellata*), bedstraw (*Galium trifolium*), lamb's-quarters (*Chenopodium alba*), clover (*Trifolium sp.*), and cow parsnip (*Heracleum lanatum*). Cover varies, based on ocular estimates, from 90 to 100 percent. No evidence of stresses on riparian vegetation (chlorotic conditions or lesions) was noted. Species composition along the river (from water quality stations 24 to 1) varies according to the amount of man-made disturbants and river flow conditions, which would be expected.

Palustrine wetlands along the river (Figure 3.7-1) are present where the soil is saturated most of the time. Species found in these wetlands include cattails, willows, sedges, smartweed (*Polygonum sp.*), and mint (*Mentha sp.*).

Other Wetlands. The U.S. FWS wetland inventory maps (1980) also identified four wetlands associated with excavated areas such as gravel and borrow pits and irrigation canals that are classed as palustrine (Figure 3.7-1). These areas were examined in the field during the September reconnaissance. The excavated areas were denuded of vegetation and, because of their location and level of human activity and disturbance, provide limited wildlife habitat.

Five palustrine emergent wetlands in agricultural fields in the EMF study area that were identified by the U.S. FWS (1980) were devoid of vegetation at the time of the reconnaissance (September) or could not be located. It is likely that the wetlands that could not be located had been altered and farmed or were not evident because of the time of year. Because these wetlands and the surrounding area have been disturbed for agriculture, they do not provide important wildlife habitats.

The five wetlands identified on the wetland inventory maps (U.S. FWS, 1980) along irrigation canals were associated with seepage areas. Species observed included cattails (*Typha latifolia*), sedges, and grasses. These wetlands provide some wildlife habitat for loafing and resting, but they are not significant because of the limited areal extent (less than 0.1 acre/0.04 hectare [ha]) and the varying water regimes in the irrigation canals.

Five palustrine emergent wetlands were identified on the Fort Hall Indian Reservation in association with springs (U.S. FWS, 1980). These were not examined in the field but, on the basis of their location, would be expected to provide good wildlife habitat for food, cover, and nesting.

Agricultural Areas. Agricultural areas, including fallow and disturbed areas (Figure 3.7-1), make up 40 percent (7,203 acres/2,916 ha) of the EMF study area. The predominant crops are potatoes and wheat.

Numerous clumps of even-aged old and dying cottonwood trees (*Populus angustifolia*) were noted adjacent to several old farmhouses in the agricultural areas (Figure 3.7-1). Most of these trees (over 40 feet [12 m] tall) were dead or dying, especially where the farmhouses were dilapidated or in shambles. These clumps appear to be dying from old age or from purposeful girdling. Other tree species adjacent to the cottonwoods, such as plum and ornamental junipers, appeared healthy. While some regeneration was noted on the cottonwoods, their appearance was typical of senescent cottonwood trees.

Other. Residential, industrial, and commercial areas make up approximately 40 percent of the EMF study area (Figure 3.7-1).

EMF Facilities—Onsite Vegetation and Habitat Types. Historically, the area of the FMC and Simplot facilities was sagebrush steppe. Because of the disturbance associated with the facilities, little of this vegetation/habitat type remains. Vegetation habitats are found in the southern part of the facilities (Figure 3.7-1).

Except for these areas and the bluffs to the south of the EMF facilities, the undeveloped areas on the sites have low potential as wildlife habitat due to the surface disturbance and continual activities onsite. Open disturbed areas in both facilities are weedy or mostly bare ground, providing limited cover for wildlife such as small rodents, quail, foxes, and rabbits. Plant species observed at the EMF facilities include Russian thistle and brome grass (*Bromus tectorum*), with occasional rabbitbrush.

Areas on the southern edge of the Simplot facility presently are sagebrush steppe. In addition, steep rugged cliffs in Sections 18 (T5S 34E), 23, and 24 (T6S R33E) provide habitat for nesting raptors and may be potential habitats for bats.

At the FMC facility, the industrial wastewater (IWW) ditch conveys noncontact IWW from the IWW basin to the Portneuf River. Vegetation growing along this ditch includes Russian olive, alder, and elm trees, and weedy herbaceous species such as Russian thistle, dandelion, stinging nettle, and wild lettuce (*Lactuca sp.*). The trees along the drainage ditch provide limited nesting and cover habitat for small birds.

However, because of the activity in the surrounding facility and because there is other more productive habitat nearby along the Portneuf River, this area does not provide important wildlife habitat. This is also true of other equivalent areas identified at the FMC and Simplot properties.

A small wetland area, approximately 0.02 acre (0.01 ha), is located at the entrance of the FMC plant, between the grassed welcome area next to the check-in station and railroad tracks. Cattails (*Typha latifolia*), willows (*Salix exigua*), annual sunflower, Russian thistle, and brome grass (*Bromus sp.*) were noted in this area. Given the size of this wetland, and its proximity to the railroad and entrance to the FMC facility, it is of limited wildlife value. The wetland probably serves as a small retention basin for runoff from the grassed welcome area, with runoff being impounded by the railroad tracks and entrance road.

Special Status Plant Species. According to the Idaho Conservation Data Center, Nongame and Endangered Wildlife Program, Idaho Department of Fish and Game, no rare, threatened, or endangered plant species are known to occur within the EMF study area (Stephens, 1992).

3.7.1.2 Sensitive Habitats and Wildlife

Sensitive habitats are defined as those that are critical habitats designated for threatened or endangered species, special habitats designated by state and federal agencies, and wetland and riparian habitats (Bechtel, 1992a).

Critical and Special Habitats. No critical habitat for threatened or endangered species or special habitats designated by the state or by federal agencies occur within the EMF study area, including at the EMF facilities.

The American Falls Reservoir, part of the Minidoka Wildlife Refuge System, occurs approximately 8 river miles downstream of the EMF facilities. Extensive wetland and riparian areas occur around the perimeter of the American Falls Reservoir. The northern area of the American Falls Reservoir, including the mouths of the Portneuf and Snake rivers (Portneuf and Fort Hall Bottoms), provides habitat for overwintering and nesting of a variety of migratory species including waterfowl, shorebirds, waterbirds, and special status species such as bald eagle and trumpeter swan. Use of habitats within the EMF study area by some species is influenced by the proximity of the habitats to the American Falls Reservoir.

Wetland and Riparian Habitats. Numerous wetland/riparian habitats associated with Michaud Creek, Portneuf River, and adjacent springs, borrow areas, and irrigation canals in the EMF study area are described in Section 3.7.1.1.

EMF Facilities—Onsite Sensitive Habitats. One wetland occurs within the EMF facilities area. This very small wetland on the FMC property provides limited value for wildlife because of its location, (next to a railroad bed and shale ore dumper), size, weedy species composition, and lack of structural cover. See Section 3.7.1.1 for further description of this wetland.

In an arid environment where water is a limiting factor, such as in the vicinity of the EMF facilities, open water is very attractive to a variety of wildlife, especially migratory waterfowl. Therefore, some discussion is warranted regarding open water as a habitat for sensitive waterfowl species.

Potentially, the surface impoundments (e.g., Ponds 8S, 8E, 11E, 12S, 13S, 14S, 15S, and 16S) at the FMC facility could attract waterfowl for loafing and resting in standing water. In cooperation with the Idaho Fish and Game Department, FMC has installed propane-operated Sonar® guns around these ponds to discourage waterfowl from landing. These devices operate 24 hours a day.

Standing water on the gypsum stacks on the Simplot facility potentially could attract waterfowl and other wildlife in the adjacent sagebrush steppe habitats. Waterfowl attraction to this area would be low and occasional due to sparse vegetative cover around the edges of the stacks, and the amount and distribution of standing water

on the stacks. No records are available of any wildlife use of these areas (Wolleson, 1992).

The Simplot dewatering pit, equalization pond, settling pond, and holding pond could also attract waterfowl and other waterbirds, although this would probably be limited to occasional loafing. Approximately 30 Franklin gulls were observed loafing on the surge pond northeast of Interstate Highway 86 (I-86) during field reconnaissance in September 1992. Use of these ponds, however, is probably not significant since little vegetation grows adjacent to the ponds that would provide cover and food, and higher quality habitats nearby along the Portneuf River would be preferable (see Figure 3.7-1).

Sensitive Wildlife. Sensitive wildlife is defined as those species that are state or federally designated as threatened and endangered, candidates for listing, and species directly in the human food chain.

Appendix I contains a list of all known wildlife species, both special status and nonspecial status, occurring on the Fort Hall Reservation and in habitats within the EMF study area.

The major habitats within the study area support species common to sagebrush steppe and riparian areas in southeastern Idaho (Groves and Marks, 1985). Because of the proximity of the study area to the American Falls Reservoir and the wetlands/riparian habitats associated with the Portneuf River and alluvial floodplain, other sensitive species that utilize habitats along the American Falls Reservoir also move up the Portneuf River and use its wetland and riparian habitats and the adjacent agricultural areas. However, the populations of waterfowl and other species present are not expected to be as large as those reported for the American Falls Reservoir and Snake River. The U.S. Bureau of Reclamation, as part of planning for the Management Resources Plan (1992) for the American Falls Reservoir, surveyed the reservoir wildlife resources and summarized areas used for overwintering, concentration areas, and nesting habitat for a variety of species including migratory waterfowl and special status species.

Riparian/wetland habitats along the Portneuf River within the Fort Hall Indian Reservation and those associated with springs in the EMF study area make up the most important habitat types within the study area. These areas provide food sources, cover, and nesting habitat as well as movement corridors for sensitive species including waterfowl, white-tail deer, and mule deer. No data are available on population sizes or trends in the study area for waterfowl, nesting colonial waterbirds, or upland game birds and big game species (Anderson, 1992; Trost, 1992; Christopherson, 1992).

The occurrence and use of habitats by special status species within the EMF study area are discussed below by species and species group.

Bald Eagles. Bald eagles (*Haliaeetus leucocephalus*) utilize habitats on and around the American Falls Reservoir as either winter migrants or nesting residents. The overwintering eagles are made up of two populations, one that uses the reservoir and Snake River, and one that uses habitats south of the American Falls Dam. The nesting residents occur along the Snake River near McTucker Island in Bingham County (Howard, 1992a), approximately 17 miles (30 km) northwest of the EMF facilities.

Since 1980, the U.S. FWS, BLM, and Idaho Department of Fish and Game have conducted midwinter bald eagle surveys to estimate the size of overwintering populations. Over the last 12 years, populations at the American Falls Reservoir have ranged from a high of 57 in 1981 to a low in 1986 of four (BLM data files). In 1990, counts totaled 16; in 1991, counts totaled 26; and in 1992, counts totaled 17 bald eagles. In the 1990 survey of the entire reservoir, 10 bald eagles were counted in the northeastern part of the reservoir, and in 1991, 17 bald eagles were counted in the same area (Idaho Department of Fish and Game, 1990-1991). These numbers provide a general index of the population of bald eagles using the northeastern portion of the reservoir, including the Portneuf River floodplain.

In the northeastern portion of the American Falls Reservoir, bald eagles are most frequently observed along the Snake River drainage and mouth of the Snake River in open water where waterfowl congregate and at the mouths of Spring Creek, Clear Creek, Portneuf River, and Bannock Creek. Use in these areas varies depending upon open water and the aggregation of waterfowl in the area. Waterfowl concentrations vary yearly, depending upon areas of open water (Idaho Department of Fish and Game data files and Howard, 1992b).

Sightings of bald eagles in the northeastern portion of the American Falls Reservoir for 1992 were summarized by the Bureau of Reclamation on GIS maps for the American Falls Resource Management Plan (U.S. Department of the Interior, 1992). Concentrations of wintering bald eagles were mainly in the Snake River Drainage and open waters of the American Falls Reservoir. Three bald eagle sightings were recorded in the Portneuf River floodplain in Sections 26 and 27 (R33E, T5S) in 1992 by Bureau of Reclamation biological consultants.

No night roost locations are known along the Portneuf River or the Portneuf floodplains; however, the U.S. FWS and Idaho State University experts (Howard, 1992a; Trost, 1992) indicated that eagles occasionally use trees as day roosts along the Portneuf River up to I-86. Eagles are thought to take wounded waterfowl that move up the Portneuf River for cover during waterfowl hunting season in the winter. Bald eagles also take fish in the 7- to 20-inch (18- to 51-cm) size classes. Other prey sources include black-tailed jackrabbit (*Lepus californicus*) and deer and livestock carrion (Howard, 1992a). During the February 1993 reconnaissance, an immature bald eagle was observed hunting along the Portneuf River in Section 26 R33E T6S.

No known eagle nest has been identified in the Portneuf River floodplains area. The closest known eagle nest to the American Falls Reservoir is on the Snake River in Bingham County, over 6 miles (9.6 km) northeast of the Portneuf River mouth (Howard, 1992a).

Bald eagles may occasionally use the Portneuf River for hunting, but this would depend upon the overwintering bald eagle population size in the northeastern part of the American Falls Reservoir, waterfowl concentrations and distributions, weather, and open water on the American Falls Reservoir.

Peregrine Falcon. Peregrine falcons (*Falco peregrinus*) are known to migrate through the vicinity of the American Falls Reservoir (Trost, 1992; Cooper, 1992) and could be expected to occasionally use habitats within the EMF study area for hunting during migration. Peregrine falcons forage in areas of low vegetation, and their prey base includes waterfowl and passerine birds.

Raptors. Most of the raptor species listed in Appendix I are common in the open country of southeastern Idaho. Migratory raptors include peregrine falcon, Gyrfalcon (*Falco rusticolus*), ferruginous hawk (*Buteo regalis*), rough-legged hawk (*Buteo lagopus*), Cooper's hawk (*Accipter cooperii*), osprey (*Pandion haliaetus*), and northern harrier (*Circus cyaneus*).

No census data are available for raptor populations in the EMF study area. Idaho Fish and Game Department biologists indicate that the populations are at carrying capacity (Anderson, 1992; Cooper, 1992) given the type of habitats in the area and agricultural activities. During the winter reconnaissance along the Portneuf River, five species of raptors were observed hunting along the river, including the rough-legged hawk, marsh hawk, red-tailed hawk, great horned owl, and golden eagle. During the spring reconnaissance, marsh hawks, kestrels, and golden eagles were observed within the EMF study area.

The golden eagle (*Aquila chryaestos*) and prairie falcon (*Falco mexicanus*), historically have nested south of the EMF facilities in the bluffs (Howard, 1992a; Renn, 1992; Hogander, 1992). Historic golden eagle nest sites are in the NE 1/4 of Section 19 R34E, T6S. Prairie falcon eyries have been located in both the SE 1/4 of Section 19 R34E, T6S and SE 1/4 of Section 24 R33E, T6S. Both species' nests were successful in 1990, according to Renn (1992). During the spring reconnaissance in June 1993, the golden eagle nest site listed above was active. Two eaglets were observed in the nest, and an adult was observed soaring in the vicinity. No active prairie falcon eyries were noted. A kestrel nest was noted in a juniper snag in Section 19 R34E, T6S.

Waterfowl. Numerous waterfowl species winter in the American Falls Reservoir area, and most of the species listed in Appendix I would be expected to occur in the wetlands and riparian habitats and open water along the Portneuf River. The Bureau of Reclamation GIS maps (1992) show waterfowl nesting and

brooding habitat as well as spring aggregation areas extending up along the Portneuf River and adjacent wetland riparian habitats to Section 36 R34E, T6S. The agricultural fields adjacent to the river also provide food for numerous species including Canada geese (*Branta canadensis*), goldeneye (*Bucephala clangula*), and ruddy ducks (*Oxyura jamaicensis*) (Trost, 1992).

Population sizes of waterfowl in the wetlands and riparian habitats along the Portneuf River are not available. Summaries are available of Idaho Fish and Game Department surveys as part of the U.S. FWS winter waterfowl surveys for Region 5 (American Falls Reservoir, Snake River to Massacre Rocks up to Blackfoot River and Fort Hall Bottoms). The winter survey counts for winter waterfowl (mallards, *Anas platyrhynchos*; gadwell, *Anas strepera*; wigeon *Anas americana*, green- and blue-winged teal, *Anas crecca* and *A. discors*; pintail; redhead, *Aytha americana*; goldeneyes; buffleheads, *Bucelphala albeola*; ruddy ducks; mergansers, *Mergus merganser*; Canada geese; snow geese, *Chen caerulescens*; swans, *Cygnus sp.*) are summarized in Table 3.7-2.

Duck and goose harvest data for the Fort Hall Bottoms of the Fort Hall Indian Reservation area (Shoshone-Bannock Tribe, 1992) are summarized in Table 3.7-3. Mallards are considered to be the most important of waterfowl species for hunting on the Fort Hall Indian Reservation (Christopherson, 1992).

The above-mentioned overwintering surveys covered a larger habitat area than that along the Portneuf River within the EMF study area. These estimates, however, provide a general index of fluctuations in population sizes and species in the area, which proportionally would be reflected in concentrations and occurrences along the Portneuf River and adjacent wetland and riparian habitats similar to those surveyed along the American Falls Reservoir. During winter reconnaissance along the Portneuf River, waterfowl groups dominated by mallards occurred in sizes up to 200 individuals. Other less numerous species observed in shallow, sheltered areas along the river include widgeon, goldeneye, redhead, teal, and Canada geese. During spring reconnaissance, up to 20 mallard pairs were flushed along the river from Batiste Springs Road to the mouth of the Portneuf River.

Colonial Nesting Waterbirds. Colonial nesting waterbirds are addressed in this characterization since they are at the top of the aquatic food chain, and use aquatic and riparian habitats along the Portneuf River. Three species of colonial nesting waterbirds – great blue herons (*Aredea herodias*), black-crowned night herons (*Nycticorax nycticorax*) and white pelicans (*Pelecanus erthrorhynchos*) – occur within the EMF study area along the Portneuf River. During spring reconnaissance, no nest sites were observed along the Portneuf River from Pocatello to the mouth of the Portneuf River.

Black-crowned night herons have been reported feeding at the fish farm at Batiste Springs (Henny and Burke, 1990; Trost, 1992). These birds are not considered year-long residents but migrate to Mexico (Trost, 1992).

The closest heron rookery documented during field reconnaissance occurs outside the EMF study area. This heron rookery (not active) was noted approximately 8 miles (13 km) downriver in Section 22 R33E T5S at the mouth of the Portneuf River. Approximately 10 nests were observed during the October 26-30, 1992, sediment sampling. Because of high waters and inclement weather in the spring, this area could not be examined for activity.

White pelicans also hunt along the Portneuf River on the Fort Hall Indian Reservation, taking suckers and carp (Christopherson, 1992). Maps for the Bureau of Reclamation (1992) of pelican use areas show that two concentration areas occur in the northwestern part of the American Falls Reservoir (about 15 miles [24 km] from the EMF site) and a smaller use area occurs between the Portneuf River mouth and 2 miles (3.2 km) north of Bronco Point along the reservoir. During spring reconnaissance, four white pelicans were observed on the river near river mile 10, and up to 50 were seen at the mouth of the Portneuf.

Upland Game Birds and Big Game. Numerous upland game birds and big game occur within the EMF study area. Appendix I lists the species and habitats in which they occur. No data are available from the Idaho Department of Fish and Game or Bureau of Land Management regarding harvest data or populations of upland game birds, mule deer, and white-tail deer within the EMF study area. Pheasant harvest data on the Fort Hall Indian Reservation in agricultural and wetland habitats show harvests of 675 in 1988, 1,090 in 1989, and 1,084 in 1990 (Shoshone-Bannock Tribe, 1992). Two chukar were observed in the EMF facilities area and on the face of the gypsum stack during spring reconnaissance.

Sage grouse occur in the sagebrush steppe habitats within the study area. However, no data are available on populations (Anderson, 1992; Christopherson, 1992).

While no harvest data are available for mule deer and white-tail deer (*Odocoileus virginianus*) in the EMF study area, both species are considered important hunting resources on the Fort Hall Indian Reservation.

Bats. Potential habitat of a Federal Category 2 species, the Townsend's big eared bat (*Plecotus townsendii*) occurs immediately south of the EMF facilities in the bluffs. This species, which is being proposed for listing as a threatened or endangered species, has been observed in habitats within 6.2 miles (10 km) of the bluffs in similar habitats (Wackenhut, 1992). No records occur on the Idaho Conservation Data List. Dr. Barry Keller, Curator of Mammals, Idaho Museum of Natural History, has also indicated a high probability of occurrence of this species based upon habitat (Keller, 1992). No bat activity was noted during spring

reconnaissance in the cliffs on or south of the EMF facilities. In addition, no sightings of bat activity were reported by the U.S. FWS, BLM, or the Idaho Department of Fish and Game.

3.7.2 Aquatic Ecosystems

The EMF study area includes the Portneuf River from Pocatello, about river mile 16.5, downstream to about river mile 9.5, which is about 2.5 river miles above the high water level of the American Falls Reservoir.

Aquatic habitat in the Portneuf River is generally shallow riffles with cobble and gravel substrate in the immediate area of the EMF facilities, changing gradually into deeper habitat with slower currents and more mud/silt substrates near Siphon Road. The low stream banks typically support temporarily flooded shrub communities. Springs and groundwater hydrology are major influences on the aquatic habitat near the EMF facilities and downstream. Groundwater and springs significantly increase the river flow and tend to be warmer in winter and cooler in summer than the upstream river water. This provides a more stable aquatic habitat by limiting temperature extremes in the river. Luxuriant growths of macrophytes occur in the sections of the river influenced by the numerous springs.

Water quality is reduced by numerous point and nonpoint sources both above and below the FMC outfall.

No endangered or threatened species and no critical habitats were identified within the EMF study area. Important aquatic species in the area include game fish and sucker (which are eaten by people), and mottled sculpin, which is probably the second most common fish in the Portneuf River and a significant food source for many of the higher vertebrates. Macroinvertebrates are also a major food source for fish, birds, amphibians, and other organisms, and are important in determining the well-being of those populations.

Two fish farms on the Portneuf River below the EMF facilities raise coho salmon and rainbow trout for stocking other streams and for human consumption.

3.7.2.1 Aquatic Habitats

The only significant aquatic habitat in the EMF study area is the Portneuf River. The hydrology and water quality of the Portneuf River are described in Sections 3.2 and 4.5, respectively. Surrounding land uses and water uses, according to the City of Pocatello (1989), have had a marked effect on the quality of the aquatic habitat in the Portneuf River. Public health warnings were issued during the study period regarding avoidance of contact sports in the river due to bacterial contamination

resulting from untreated sewage discharges (Low, 1993). Water quality improves markedly with the introduction of groundwater underflow and springs below I-86.

From I-86 downstream to the diversion dam near Siphon Road, the deepest portion of the Portneuf channel (the thalweg) changes from shallow riffle habitats with predominately cobble and gravel substrate habitats to deeper habitat with slower currents and mud/silt substrate habitats, as observed during field reconnaissance. The channel margins reflect depositional characteristics of the natural flow regime (i.e., point bars and chute bars). Further information on river morphology is found in Section 3.2.1. Discharge of the river varies seasonally from 50 cfs to 2,900 cfs (1 cms to 82 cms) (City of Pocatello, 1989). The amount of mud and silt in this portion of the river may also change with seasonal flow. The diversion dam at Siphon Road is removed each year before high water flow. Below this diversion dam, bottom materials are again predominantly cobble and gravels down to the Fort Hall Bottoms.

Hydrology. The hydrology of the Portneuf River is described in detail in Section 3.2 and only the information relevant to characterizing the aquatic habitat is summarized here.

The annual hydrograph of the Portneuf River (see Figure 3.7-2) is generally dominated by spring high water runoff from the melting of mountain snowpacks. Flows are at minimum levels during the summer months. RI data confirm this flow pattern.

The Portneuf River becomes a gaining stream north of I-86, and is recharged by underflow from groundwater. Within the EMF study area, numerous springs enter the river downstream (north) of I-86. (Flow quantities from these springs and other sources of the Portneuf River are described in Section 3.4.) The Pocatello Sewage Treatment Plant (STP) also discharges into the Portneuf River about 0.8 mile (1.3 km) below the EMF facilities, and 0.6 (1.0 km) mile downstream from I-86.

In addition to spring tributaries that have identifiable confluences with the Portneuf River, other areas of groundwater discharge within the river channel are visibly apparent as indicated by patterns of water clarity, temperature, and the distribution of aquatic macrophytes (Brock, 1989). The surface and groundwater hydrology of this reach of the Portneuf River is very complex and is a major influence on the aquatic habitat.

In the EMF study area, the Portneuf River ecosystem has two annual critical periods related to flow and pollution. The first is the high-flow or runoff season, which may create the following stresses on the river ecosystem:

- High-velocity water flows wash away food for aquatic organisms.

- Habitats are disrupted by the high flows (800 cfs [22 cms] or more).
- High levels of suspended sediments are washed into streams, covering up needed food and blocking the amount of sunlight that reaches the oxygen producers such as algae and macrophytes (rooted aquatic plants).
- Toxic materials can be washed into a stream at this time. (Note that runoff is controlled at the EMF facilities and does not enter the river.)
- There can be significant morphological changes as stream banks are cut and sloughed and meanders are altered.

The second critical period is during the summer when flow is low and stresses may be created by the following (McSorley, 1976):

- High temperatures, which reduce dissolved oxygen (DO) concentrations.
- Greater impacts of City of Pocatello wastewater discharge. (The City of Pocatello has minimized this impact since 1980 by diverting treated effluent to irrigation.)
- Tendency to concentrate toxic materials and nutrients in water.
- Reduced habitat (decreased areal extent of river) for macroinvertebrates and fish.

Table 3.7-4 shows the width, depth, and flow characteristics at selected locations on the Portneuf River observed in the field on October 27, 1992. River flow increases significantly below Batiste Road (and I-86) due to the groundwater underflow and spring discharges. Based upon field reconnaissance of the river in 1992, aquatic plants (both rooted and floating) appeared to be much more abundant below I-86 and in comparison to the stretches upstream of the EMF facilities.

Land Use and Vegetation. The predominant land use along the river is undeveloped with native riparian vegetation. A few areas near Pocatello are disturbed by construction or industrial activities; most other disturbances are due to agricultural activities, particularly livestock, and breakdown on river banks (see Section 3.6.2, Land Use, and Figure 3.7-1).

Stream banks along the Portneuf River typically support temporarily flooded shrub communities. Peachleaf willow and alder are the common overstory species while sedges, grasses, and forbs tend to dominate the herbaceous layer. Dense thickets of coyote willow are common in the intermediate shrub layer. The peachleaf willow and alder overstory commonly reach heights of 27 to 36 feet (8 to 11 m); the intermediate shrubs (e.g., coyote willow, rose, currant, and red osier dogwood) typically reach 5 to 10 feet (1.5 to 3 m) in height. The herbaceous layer typically included basin wildrye, brome, timothy, festucea, spiny hopsage, and thistle. The river canopy is mostly open, with scattered groups of peachleaf willow and

alder covering the river. The shrub and grass layers tend to be thick and overhang the banks. The riparian/wetlands along the river are also discussed in Section 3.7.1.2.

Water Quality. The quality of the groundwater and surface water is discussed in detail in Section 4 of this report. The information presented here emphasizes the ecological aspects. Water quality is one of the primary considerations in determining habitat quality for aquatic organisms.

Pollution sources such as the Pocatello STP, uncontrolled raw sewage discharges containing E. coli bacteria, and storm water runoff from the urbanized areas affect the water quality of the Portneuf River. Other important pollutants entering the Portneuf River include suspended solids from tilled croplands, organic wastes from cattle, nitrogen and phosphorus compounds from fields, and animal wastes (Minshall and Andrews, 1973). FMC currently discharges noncontact cooling water to the Portneuf River under an NPDES Permit. Until 1980, Simplot also discharged effluent from its water treatment ponds to the river. The nutrient-rich effluent is now collected and sold for irrigation and fertilization (Bechtel, 1992a).

Pocatello's STP discharges to the river from the east bank, about 0.9 mile (1.5 km) downstream (north) from FMC's wastewater discharge. According to the City of Pocatello (1989), the STP effluent has an organic content typical of well-operated secondary treatment facilities (5-day, biological oxygen demand, and total suspended solids are each typically lower than 20 mg/l). Ammonia is a normal degradation product of proteins. The STP was not designed to remove nitrogen-containing compounds in wastewater, but the form that nitrogen takes in the effluent can be altered, depending on the operational mode of the treatment process. Figure 3.7-3 illustrates the variability during the 1988-89 study period in ammonia-nitrogen content of the plant's effluent (City of Pocatello, 1989).

As reported by the City of Pocatello (1989), factors that are relevant to mixing characteristics of the STP effluent are the nature of the discharge (a straight pipe on the east bank of the river), and the presence of a medial bed of macrophytes that virtually divides the channel in two for the first 330 to 660 feet (100 to 200 m) downstream from the discharge point. The medial macrophyte bed and the discharge of a portion of Batiste Spring nearly opposite the effluent pipe combine to provide a zone along the west bank of the river which, according to the City of Pocatello, appeared to have been minimally impacted by the STP effluent (City of Pocatello, 1989).

Groundwater underflow and discharge from Batiste and Swanson Road springs also have an important impact on the water quality of the Portneuf River. Groundwater and springs tend to be warmer in winter and cooler in summer than water reaching the area from upriver. Like many rivers that attain their maximum water

temperature during minimum flow periods of summer, the lower Portneuf is warmest when the river flow is lowest. As indicated by the City of Pocatello (1989), the moderate temperatures found in the gaining reach influence ecological processes in several ways, including lowering of respiration rates, reducing the fraction of ammonia that is in an un-ionized (toxic) form, and increasing the solubility of dissolved gases, such as oxygen.

The DO concentration at a sample point in a river for a given time is a function of numerous factors operating upstream including: physical influences (temperature, pressure, gas solubility, and channel characteristics that affect reaeration); and the biomass and rates of activity of organisms that release and consume DO through life processes such as photosynthesis and respiration. Data reported by the City of Pocatello (1989) from the Portneuf River at the Rowland creamery follow a typical pattern of increasing DO during the day, associated with photosynthesis, and decreasing DO at night, due to respiratory processes (Figure 3.7-4). Diel swings (cyclic increases and decreases over the day) in DO at the Rowland creamery were more pronounced during the fall of 1988 than in the summer of 1989. The City of Pocatello maintains this is probably due to greater accumulation of plant biomass in the river channel later in the growing season. (The influx of groundwater and spring water to the Portneuf downstream from Batiste Road is accompanied by substantial macrophyte beds that typically cover half the channel.)

Downstream from the STP discharge, the minimum daily DO at dawn as measured by the City of Pocatello (1989) was in excess of 5.5 mg/l (60-percent saturation), even in midsummer. Such DO levels are considered adequate to maintain a salmonid fishery. In this study, DO levels tended to be slightly lower (about 0.5 mg/l) at the fish farm site than at the Rowland creamery. The City of Pocatello concluded that this would be expected, due to in-stream conversion of ammonia to nitrite and nitrate (nitrification), a chemoautotrophic process that requires oxygen. There was no evidence of toxic oxygen conditions associated with Pocatello's STP effluent in the study reach, even under conditions that would be potentially most stressful (i.e., maximum summer temperatures with minimal dilution of treatment plant effluent) (City of Pocatello, 1989).

According to the Idaho Department of Health and Welfare, Division of Environmental Quality (IDHW-DEQ) (1989), storm drain discharges from the City of Pocatello are a potential major source of contaminants to the river. Chemical analyses of drain water indicated levels of suspended solids, total solids, chemical oxygen demand, sodium, potassium, chloride, fluoride, arsenic, cadmium, hexavalent chromium, copper, iron, lead, manganese, and zinc higher than any of the three major NPDES discharges to the Portneuf River.

The occurrence of a thunderstorm while continuous monitoring equipment was operational near the Rowland creamery (upstream of the STP discharge) revealed

potential DO problems associated with storm runoff from the watershed. A localized storm of undocumented intensity (no rain was recorded at the Pocatello Municipal Airport weather station) on August 10, 1989, was followed by DO concentrations that fell to 3.5 mg/l during the early morning hours of August 11, and remained below the acute lethal threshold of 4.0 mg/l (EPA, 1986) for 2 to 3 hours (see Figure 3.7-4). The City of Pocatello (1989) postulated that these low oxygen levels were associated with chemical oxygen demand associated with organics washed into the channel by storm runoff as well as with organic deposits stirred up by the elevated flow of the river.

3.7.2.2 Sensitive Aquatic Species and Habitats

Sensitive aquatic species include the following categories:

- Endangered Species – Any species in danger of extinction throughout all or a significant portion of its Idaho range.
- Threatened Species – Any species likely to be classified as endangered within the foreseeable future throughout all or a significant portion of its Idaho range.

On the basis of discussions with the Natural Heritage Section of the Idaho Department of Fish and Game, and a review of the 1992 list of rare, threatened, and endangered plants and animals of Idaho (Moseley and Groves, 1992), it was determined that no endangered or threatened species occur in the Portneuf River within the EMF study area.

Sensitive habitats evaluated in this site characterization are classified as those that are critical habitat designated for threatened or endangered species, special habitats designated by state and federal agencies, and wetlands. No critical habitat for threatened or endangered species, or special habitats designated by state and federal agencies, occur within the EMF study area.

3.7.2.3 Important Aquatic Species and Habitats

These species include those fish used for human consumption and as food for other fish and macroinvertebrates. Also discussed are fish farms on the Portneuf River.

Aquatic Species Targeted for Human Consumption. Aquatic species that are targeted for human consumption are primarily game fish, which are identified in Table 3.7-5. These fish include trout (hatchery and wild rainbow, brown, and hybrid trout); kokanee salmon that have escaped from commercial fish farms; mountain whitefish, yellow perch, black crappie, and catfish (black bullhead, brown bullhead, and channel catfish). Sucker are also eaten sometimes (Sigler and Sigler, 1987). The

more important fish in the Portneuf River in the EMF study area are discussed in the following subsections.

In studies reported by the City of Pocatello (1989), fish populations were estimated for four study sections of the Portneuf River immediately above and below the STP. These data were summed for the four study sections and are presented in Figure 3.7-5. It should be noted that this field study was hampered by large quantities of floating vegetation.

These data show larger populations of nongame fish than game fish and more total fish present in the fall of 1988 than in the summer of 1989. In this study, game fish consisted of brown trout, rainbow trout, and rainbow-cutthroat trout hybrids. Nongame fish included whitefish, carp, sculpin, shiner, and dace. Many of the trout captured in this study were from the fish farm at Batiste Spring. Sculpin and dace, which are considered indicators of high-quality water, were scarce below the STP, due in part to changes in water quality or habitat. They were still among the most common fish reported in the Portneuf River, however (see Figure 3.7-6).

Rainbow Trout. Rainbow trout *(Oncorhynchus mykiss)* including hatchery, wild, and hybrids, are one of the most common game fish in the Portneuf River (Figure 3.7-6) and one of the most important game fish in the Great Basin (Sigler and Sigler, 1987). The Idaho Fish and Game Department stocked the Portneuf River with 500 to 1,000 catchable size rainbow trout (about 10 inches [25/4 cm] long) for the first time in 1992, but it has no formal management program because of poor access and low fishing pressure. These fish were part of an experimental program to measure catch success (Mende, 1992). Rainbow trout in this portion of the Portneuf River are nonmigratory.

The rainbow is the easiest and most economical of all trout to raise and is raised commercially at the Papoose Spring and Batiste Spring fish farms (see Figure 3.7-1). Adult nonmigratory rainbow trout average 2.0 to 4.0 pounds (0.9 to 1.8 kg) and are considered large at 5.9 to 7.9 pounds (2.7 to 3.6 kg). The life span of rainbow trout is fairly short, with few living beyond 5 years of age.

Rainbow trout generally spawn on stream gravel bars in the spring when water temperatures reach 50°F (10°C) or more. The female digs a redd in the gravel, and eggs and sperm are deposited in the depression. Rainbow and cutthroat trout that spawn in the same area often hybridize (Sigler and Sigler, 1987).

Young rainbow trout feed on small benthic invertebrates, primarily insects and crustaceans. Rainbow trout more than any other trout tend to feed on algae and, to a lesser extent, on vascular plants. The amount of nourishment received from plants and algae may be slight, however. The rainbow continues the primarily invertebrate diet until reaching a size of 1.1 to 2.0 pounds (0.5 to 0.9 kg), then it tends to turn to a fish diet when it is available. Rainbow trout are primarily drift feeders,

but will rise the surface and feed on surface insects. Where forage fish such as the Utah chub are available, the larger rainbow trout will eat them (Sigler and Sigler, 1987).

Brown Trout. Brown trout (*Salmo trutta*) are present in the Portneuf River but not in large numbers (see Figure 3.7-6). It is more aggressive than most trout and readily feeds on other fish. This trout is native to Europe and western Asia and was first introduced into North America in 1883. By 1910 it was regularly stocked in western streams, and is now present in most trout waters throughout the United States and Canada (Sigler and Sigler, 1987). However, the Portneuf River is not stocked with brown trout by the Idaho Fish and Game Department (Mende, 1992). Brown trout spawn in the riffle areas from late October to December.

Brown trout usually average 3.9 to 6.6 pounds (1.8 to 3 kg) by their sixth year, and fish weighing 7.9 to 11.9 pounds (3.6 to 5.4 kg) are not uncommon. They may live 10 years or longer. In both lakes and streams, juvenile brown trout feed heavily on zooplankton and bottom-dwelling insects. A typical stream feeding pattern for brown trout as it grows older is from drift organisms and zooplankton, to aquatic and terrestrial insects, to small fish, and finally to large fish. The change to feeding on forage fish occurs at an earlier age in brown trout than most trout. Brown trout less than 2.0 pounds (0.9 kg) live largely on such insects such as mayflies, caddisflies, stoneflies, and midge larvae and pupae. Other foods include earthworms, freshwater clams, crayfish, salamanders, frogs, and rodents (Sigler and Sigler, 1987).

Besides being caught by fishermen, brown trout are preyed upon by fish-eating birds, mammals, and other fish (Sigler and Sigler, 1987). The brown trout is listed as intermediate in tolerance to environmental stress by the U.S. EPA (1989).

Other Game Fish. Other game fish known to occur in Portneuf River include yellow perch, black crappie, black bullhead, brown bullhead, and channel catfish (see Table 3.7-5). These fish are all primarily associated with lakes and reservoirs, and probably enter the Portneuf River from the American Falls Reservoir at various times of the year. There are no known population estimates for these species.

Coho salmon have been raised at the fish hatcheries on the Portneuf River and could be present as escapees from the hatcheries. Coho probably do not reproduce in the river, however, and would be limited to the life span of the escapees (Mende, 1992). None were found in the 1988 and 1989 studies of the fish populations in the Portneuf River by Broderick et al. (1989).

Other Important Aquatic Species. Other important aquatic species, discussed below, include suckers, mottled sculpin, and various macroinvertebrates.

Suckers. Both the Utah sucker (*Catostomus ardens*) and largescale sucker (*Catostomus macrocheilus*) are found in the Portneuf River. Suckers are probably the

most common fish in the Portneuf River, both in terms of numbers and biomass (see Figure 3.7-6). The median size of these fish is about 10 inches (25 cm) with weights ranging from 2.0 to 3.1 pounds (0.9 to 1.4 kg). These fish are relatively fast-growing and live about 10 to 12 years. They are currently not considered a game fish. It is used today for human consumption, although to a far lesser extent than in the past. However, approximately 329,000 pounds (149,400 kg) of sucker were taken commercially in the last half of 1992 from the American Falls Reservoir for human consumption (Table 3.7-6). In addition to humans, suckers are also eaten by most piscivorous predators such as larger fish, mergansers, ospreys, and eagles (Sigler and Sigler, 1987).

Suckers feed on both plants and animals. As fry, suckers eat small zooplankton and as they grow larger and become bottom dwellers, they change their diets to aquatic insect larvae, diatoms, and other plant material. Large suckers feed on such bottom organisms as crustaceans, aquatic insect larvae, earthworms, and snails (Sigler and Sigler, 1987). The largescale sucker is listed as tolerant to environmental stress by the U.S. EPA (1989a).

Mottled Sculpin. The mottled sculpin (*Cottus bairdi*) is important because it is probably the second most common fish in the Portneuf River (see Figure 3.7-6) and provides a significant amount of food for trout and other game fish. This fish attains an age of 5 years and occasionally a total length of 6.0 inches (15.2 cm). Lengths of 3.0 to 4.0 inches (7.6 to 10.2 cm) are more common, however. The mottled sculpin eats almost entirely aquatic insects, with plant material and fish a minor part of the diet (Sigler and Sigler, 1987).

The preferred habitat of the mottled sculpin is clear, cool mountain streams of rapid to moderate current. The bottom typically consists of coarse gravel, small loose rocks, or rubble. Preferred summer temperatures vary from 55.4°F to 64.4°F (12.8°C to 18°C) and water depths are commonly 1.9 ft (0.6 m) or less. These fish associate with vegetation and live under stones or in moderately swift riffles (Sigler and Sigler, 1987). The Portneuf River seems to provide good habitat for the mottled sculpin. The mottled sculpin is listed as intermediate in tolerance for environmental stresses (U.S. EPA, 1989).

Macroinvertebrates. By convention, freshwater macroinvertebrates are those animals without backbones that are large enough to be seen without magnification. The main taxonomic groups of macroinvertebrates occupying freshwater environments are annelids, crustaceans, flatworms, mollusks, and insects (usually predominant) (Platts et al., 1983).

Macroinvertebrates are important intermediaries in the utilization of plant material, such as algae, vascular hydrophytes, leaves, and wood, and the recycling of nutrients in aquatic environments. They are a major food source for fish and serve

to determine the well-being of those populations. The macroinvertebrates possess several characteristics that make them useful for detecting environmental perturbations: in particular, (1) most members of this community possess limited mobility so that their status reflects conditions in the immediate vicinity of the collection site, and (2) most of the organisms (mussels are the main exception) have life spans of several months to a few years. Thus, their characteristics are a function of conditions during the relatively recent past, including sporadic influences that would be difficult to detect by periodic microbial or chemical analysis (Platts et al., 1983).

Many of the important vertebrate species discussed in previous sections depend directly or indirectly on the macroinvertebrate organisms living in the benthos (river bottom) of the Portneuf River. Macroinvertebrates are eaten by a large variety of fish, birds, amphibians, and other organisms, which are themselves eaten by the top-level consumers such as eagles, cormorants, and herons.

The most recent study of the macroinvertebrate community in the Portneuf River was conducted by the City of Pocatello (1989) to determine the effects of its STP. Results from taxonomic analysis of the benthic samples suggest that there is environmental stress associated with the effluent discharged from the STP. Species richness is the number of different types or taxa of macroinvertebrates found at a site. During August 1989, the average species richness decreased from 12 taxa above the effluent pipe (but below the EMF facilities) to eight taxa at two stations located within the STP effluent plume. The organisms that tended to avoid Pocatello's STP effluent were those groups that are associated with clean flowing water and are especially sensitive to environmental stress (Ephemeroptera [mayflies], Plecoptera [stoneflies], and Tricoptera [caddisflies]).

Figure 3.7-7 shows the abundance of selected macroinvertebrate taxa at the five sample locations in relation to the approximate location of the STP effluent plume. Benthic scientists have ranked macroinvertebrate groups based on their tolerance of environmental stress. The scale of tolerance values (TV) ranges from 1 to 10, with 1 being the most susceptible to stress, and 10 the most tolerant. The Chironomidae and Oligochaeta are wormlike animals with aquatic forms that can survive in polluted environments; these groups have TVs in the 6 to 10 range. Groups with low tolerance to environmental stress—the Baetidae, the Tricorythidae (mayflies) and the Brachycentridae and Hydropsychidae (caddisflies)—were clearly less abundant in the effluent plume during summer 1989. Thus, in this 1989 study, the invertebrate groups with the lowest tolerance to environmental stress were most abundant in the area below the EMF study area but upstream from the STP discharge. The Oligochaeta, on the other hand, were relatively more abundant in the STP effluent than upstream from the effluent (City of Pocatello, 1989).

The general conclusion of the macroinvertebrate portion of the study was that there was a predominance of toxic-tolerant organisms, and a reduction in species richness downstream from the STP effluent. Since the macroinvertebrate sample location that was farthest downstream (Station 5) had the highest species richness and greatest abundance of mayflies, the study concluded that the west (spring water) side of the Portneuf River had comparatively good environmental health. This conclusion is consistent with the water chemistry results, which indicated the presence of a channel of high-quality water around the effluent mixing zone (City of Pocatello, 1989). The City of Pocatello concluded that this west side of the Portneuf River, which contains the outfall from the FMC facility, supported comparatively good aquatic habitat in comparison to reaches above the EMF facilities.

Fish Farms. Two fish rearing facilities are located on the Portneuf River in the EMF study area, at about river miles 12.4 (Batiste Spring fish farm at the Rowland creamery) and 11.4 (Papoose Spring) (see Figure 3.7-1). Both of these properties are operated by Aqua Sea Inc. At the fish farm, coho salmon and rainbow trout are raised and sold for stocking other streams and processed elsewhere. Annual production rate for the rainbow trout is higher, since rearing coho salmon is still in the experimental stage. The fish facility at the Rowland creamery uses water from Batiste Spring, and the downriver facility uses water from Papoose Spring. The fish at these facilities are fed commercially prepared fish food and sold as either fingerlings (for stocking) or at about 1 to 1.5 years of age, for processing at the food plant. Production at the two fish facilities is estimated at about 49,896 pounds (22,680 kg) per year of stockers and 9,979 pounds (45,360 kg) per year of harvest for human consumption (Marquardt, 1992).

Kokanee salmon have been reported by the Shoshone-Bannock Tribe (1992) to be present in this stretch of the Portneuf River. However, Mr. Marquardt, plant manager of Aqua Sea Inc., could not recall ever raising Kokanee salmon at either of the fish farms.

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Table 3.2-1
Summary of Sediment Transport Data

Portneuf River, Pocatello Idaho

Date	Time	Discharge (cfs)	Suspended Sediment (mg/l)	Sediment Load (tons/day)
07-Jun-74	0925	455	159	195
07-Jun-74	1050	455	159	195
25-Sep-74	1040	121	53	17
25-Jun-75	1140	713	210	404
23-Sep-77	1020(a)	118	97	31
08-Nov-77	0945	210	152	86
12-May-80	1150	915	589	1,453
20-May-81	1245	247	85	57
09-Jul-81	1315	51	21	3
15-Nov-90	1000	172	16	7
15-Mar-91	1500	265	134	96
16-May-91	1415	471	199	253
09-Jul-91	1415	62	58	10
18-Sep-91	1115	85	16	4
18-Nov-92	(a,b)	276	15	11

Snake River, Blackfoot River Station

Date	Time	Discharge (cfs)	Suspended Sediment (mg/l)	Sediment Load (tons/day)
07-Jun-76	0925(c)	52,200	1180	166,063
08-Jun-76	1050(c)	43,900	612	72,433
14-Jun-76	1040(c)	11,600	137	4,284
16-Jun-76	1140(c)	9,350	155	3,907
17-Jun-76	1020(a,c)	8,980	190	4,600
17-Jul-89	0945	2,970	23	184
19-Sep-89	1150	2,730	14	103
21-Sep-89	1245	2,400	5	32
16-Mar-90	1315	2,010	12	65
08-May-90	1000	1,230	15	50
12-Sep-90	1500	2,980	13	104
19-Nov-91	1415	3,000	8	65
19-Mar-92	1415	1,650	14	62
13-May-92	1115	2,960	20	160
30-Jul-92	1330	1,300	3	11
22-Sep-92	1530	1,560	4	17

Table 3.2-1 (Cont'd)

Portneuf River, Tyhee Station

Date	Time	Discharge (cfs)	Suspended Sediment (mg/l)	Sediment Load (tons/day)
17-Jul-89	0945	105	7	2
		110	11	3
19-Sep-89	1150	182	2	1
21-Sep-89	1245	239	3	2
16-Mar-90	1315	250	6	4
08-May-90	1000	259	10	7
12-Sep-90	1500	268	10	7
19-Nov-91	1415	354	8	8
19-Mar-92	1415	448	10	12
13-May-92	1115	470	40	51
30-Jul-92	1330	480	19	25
22-Sep-92	1530	508	61	84

Notes:

(a) Flow estimated from daily average.

(b) Time not available.

(c) Flow and sediment impacted by Teton Dam failure.

Table 3.2-2
Computed Sediment Discharge (tons per month)

Portneuf River, Pocatello Idaho

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1950	3,020	4,850	8,640	12,960	16,160	7,370	1,160	660	1,600	2,670	3,450	3,100	65,600
1951	2,460	4,530	4,760	7,390	3,860	300	120	490	450	1,580	2,830	2,680	31,500
1952	2,420	1,970	3,020	13,340	18,040	1,730	370	460	540	680	2,420	3,030	48,000
1953	4,400	3,150	4,010	4,760	2,440	4,000	130	200	210	770	1,980	2,460	28,500
1954	2,220	2,580	3,870	4,010	590	130	70	70	120	300	870	1,580	16,400
1955	1,480	1,400	2,110	2,640	990	330	60	130	150	340	1,520	2,210	13,400
1956	2,810	1,880	4,480	7,680	2,870	190	30	80	120	350	1,520	1,940	24,000
1957	1,530	5,590	4,710	3,210	12,850	3,360	100	130	240	640	1,940	2,450	36,800
1958	2,270	5,100	5,420	8,370	6,980	240	60	160	240	460	1,830	2,640	33,800
1959	2,650	2,700	3,830	3,990	950	160	60	50	330	820	1,480	1,600	18,600
1960	1,500	1,740	6,390	6,090	570	60	20	100	110	260	450	1,300	18,600
1961	1,280	2,530	2,900	1,810	250	30	10	80	290	810	1,360	1,280	12,600
1962	1,150	23,330	7,830	9,980	3,930	240	50	60	80	380	1,100	1,480	49,600
1963	1,150	11,680	2,180	3,860	5,880	2,490	90	40	250	500	1,510	1,620	31,300
1964	1,570	1,440	1,700	8,290	10,500	5,100	480	100	120	370	1,740	7,070	38,500
1965	4,400	5,870	3,950	10,440	14,220	2,310	910	510	1,080	1,310	2,230	2,310	49,500
1966	2,250	1,920	5,830	6,200	1,070	80	10	20	50	220	790	1,370	19,800
1967	1,560	1,690	2,940	3,810	7,080	5,210	1,130	170	200	860	1,340	1,240	27,200
1968	1,370	3,320	4,870	3,960	2,290	1,350	100	850	440	760	1,780	1,770	22,900
1969	5,220	2,740	4,870	23,590	15,630	1,870	660	230	230	1,080	1,960	2,290	60,400
1970	4,600	2,810	3,250	3,140	9,840	3,580	220	190	470	1,220	2,200	2,340	33,900
1971	2,670	3,330	8,400	19,920	43,610	15,260	1,110	340	1,740	3,560	3,690	3,970	107,600
1972	4,930	4,760	22,370	25,800	29,570	7,980	780	720	1,410	3,030	3,530	2,980	107,900
1973	3,570	3,070	4,660	12,380	14,820	1,100	560	390	2,040	2,660	3,430	3,140	51,800
1974	3,240	2,810	13,860	22,430	26,510	3,700	390	380	430	1,650	2,940	2,750	81,100
1975	3,100	2,970	6,970	8,060	34,300	28,930	2,350	1,220	1,080	2,930	3,190	3,640	98,700
1976	2,600	2,480	5,770	22,680	36,980	4,050	370	630	940	2,470	2,420	2,290	83,700
1977	2,170	2,000	2,640	1,300	330	500	70	180	240	760	1,520	2,270	14,000
1978	2,370	2,590	6,040	12,510	11,360	2,110	170	140	570	1,020	1,710	1,760	42,400
1979	1,780	2,450	4,740	6,000	4,040	270	40	140	120	420	1,030	1,080	22,100
1980	7,070	8,940	4,690	9,020	22,170	10,920	440	170	420	1,480	1,870	2,120	69,300
1981	1,970	2,580	2,770	2,820	8,170	4,190	80	50	80	590	1,440	2,200	26,900
1982	1,700	3,180	6,290	13,780	37,060	10,550	1,800	510	1,680	3,310	3,130	2,830	85,800
1983	4,120	4,400	15,780	20,630	61,050	37,290	4,040	2,630	3,270	5,110	6,220	6,860	171,400
1984	7,370		9,480	23,450	108,290	53,480	5,350	3,090	4,660	5,060	6,130	6,400	239,000
1985	5,650	5,200	6,630	28,820	11,120	1,590	420	360	980	3,000	3,390	3,540	70,700
1986	3,650	16,460	29,740	40,110	37,250	8,770	1,140	2,200	6,350	6,410	5,070	4,060	161,200
1987	3,760	3,970	6,630	2,810	1,190	720	260	190	360	1,150	2,410	2,330	25,800
1988	2,430	2,500	4,080	2,810	510	120	70	60	70	200	720	1,430	15,000
1989	1,190	1,110	6,790	12,350	1,500	410	90	160	170	450	850	1,290	26,400
Average	2,920	4,350	6,500	10,930	15,670	5,800	630	460	850	1,540	2,270	2,620	54,500

Table 3.2-2 (Cont'd)

Snake River, Blackfoot Station

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1950	2,100	3,120	5,490	26,380	44,320	107,930	50,020	1,350	3,900	7,160	8,420	7,660	267,900
1951	5,880	10,130	15,030	35,910	77,530	50,420	9,520	11,750	2,780	7,500	9,450	6,400	242,300
1952	6,220	8,870	12,390	46,810	106,850	59,810	5,700	1,010	740	990	3,970	4,720	258,100
1953	6,690	4,520	4,240	5,730	9,850	60,710	3,880	660	600	1,780	4,330	4,010	107,000
1954	3,660	3,360	3,660	8,550	45,170	24,010	14,720	830	880	2,900	4,500	3,160	115,400
1955	2,380	1,980	3,260	5,720	11,720	16,060	2,760	720	460	1,260	4,290	8,060	58,700
1956	6,390	2,610	9,730	51,930	91,470	110,120	6,900	1,030	870	3,330	4,970	3,790	293,100
1957	1,990	3,870	9,590	13,620	84,080	16,990	1,050	830	990	2,240	4,800	5,140	145,200
1958	4,050	4,430	4,210	6,990	29,100	8,000	560	810	1,180	610	3,830	3,860	67,600
1959	3,430	3,490	3,720	3,310	1,580	2,950	3,370	2,880	6,030	3,270	4,180	3,630	41,800
1960	2,060	1,850	3,330	4,210	1,670	2,320	1,590	6,730	3,530	950	1,900	1,680	31,800
1961	1,730	2,140	2,090	2,450	1,450	900	1,190	1,330	1,770	1,630	2,040	2,120	20,800
1962	1,560	6,290	2,680	16,440	36,940	10,140	2,320	1,230	1,040	1,400	2,740	4,270	87,100
1963	1,750	3,730	2,240	1,610	30,330	77,460	420	540	690	430	2,460	2,430	124,100
1964	1,670	1,660	2,750	17,070	61,140	73,910	13,900	1,100	730	1,660	4,080	5,980	185,700
1965	7,240	21,550	43,520	52,520	48,420	28,230	18,120	4,470	4,230	6,060	8,180	11,490	254,000
1966	6,990	6,690	6,130	8,110	18,790	2,490	1,170	8,890	4,150	1,700	2,350	2,870	70,300
1967	2,500	2,180	2,300	2,050	23,540	47,460	22,140	1,830	440	3,340	5,150	5,800	118,700
1968	5,150	3,160	3,390	7,710	22,080	41,680	1,360	9,400	1,700	3,040	5,190	8,180	112,000
1969	10,300	8,480	15,140	67,730	27,680	11,590	3,040	1,570	1,130	2,870	3,050	2,540	155,100
1970	3,240	3,110	3,040	11,780	72,250	57,000	18,480	1,310	3,600	3,920	6,550	7,450	191,700
1971	8,710	12,120	31,450	106,070	138,860	85,300	48,480	4,690	15,400	30,340	16,290	10,720	508,400
1972	9,750	12,780	44,210	96,170	65,410	72,210	5,000	5,250	10,240	14,840	11,040	12,000	358,900
1973	8,000	8,890	7,930	11,640	19,970	10,890	8,310	2,150	1,930	2,440	4,070	4,000	90,200
1974	5,320	6,360	20,690	99,650	89,880	78,710	22,630	2,230	1,190	6,580	9,620	8,580	351,400
1975	8,010	6,630	18,470	46,460	70,730	39,400	25,100	4,620	1,600	6,380	8,590	9,990	246,000
1976	10,210	9,670	29,360	82,320	149,100	58,710	3,850	5,320	2,360	3,920	5,040	10,700	370,600
1977	7,130	2,610	1,330	1,740	5,330	1,910	1,350	2,950	360	230	1,180	1,680	27,800
1978	1,710	1,640	4,260	22,670	42,890	22,840	6,970	1,950	1,790	710	3,810	7,550	118,800
1979	9,240	8,700	17,190	19,910	11,640	9,490	7,510	1,850	170	870	1,530	2,180	90,300
1980	2,360	2,660	2,170	12,090	50,200	61,080	4,100	1,680	640	1,220	2,180	2,150	142,500
1981	1,910	2,040	1,550	6,100	29,660	52,200	1,550	590	260	790	1,400	1,710	99,800
1982	1,400	2,330	21,810	48,550	100,070	37,580	43,590	4,800	5,660	13,060	12,080	12,190	303,100
1983	15,320	8,800	12,770	27,480	101,590	106,550	60,690	9,340	3,010	13,950	20,010	22,390	401,900
1984	21,310	9,420	12,710	59,420	125,810	142,960	53,930	17,450	12,690	10,770	12,440	17,310	496,200
1985	18,950	11,560	11,340	37,230	70,840	17,540	1,510	1,240	2,440	3,000	4,300	4,480	184,400
1986	7,370	7,850	55,350	99,200	125,480	103,180	21,760	2,450	8,560	9,560	10,560	13,990	465,300
1987	11,200	5,170	3,970	4,870	7,770	5,700	2,890	1,180	730	1,170	1,970	1,530	48,200
1988	1,560	1,240	1,290	2,170	1,070	1,810	3,610	3,340	1,980	780	1,880	1,180	21,900
1989	920	1,010	1,840	4,440	19,330	4,170	1,340	1,290	1,410	N/A	N/A	N/A	35,800
Average	5,930	5,720	11,440	29,620	51,790	43,060	12,660	3,370	2,850	4,580	5,750	6,400	183,200
St. Dev.	4763.700781	4243.037585	13038.37511	31573.93898	41895.48409	37703.54601	16492.13689	3614.282069	3424.154434	5748.160065	4282.562437	4753.787623	138010.1743
Variance	22692845.13	18003367.95	169999225.4	996913623	1755231587	1421557382	271990579.2	13063034.87	11724833.59	33041344.13	18340341.03	22598496.76	19046808199

Table 3.2-2 (Cont'd)

Portneuf River, Tyhee Station

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1985	N/A	N/A	N/A	N/A	2,630	430	180	340	570	1,220	1,230	1,170	7,770
1986	1,230	3,270	5,480	7,260	6,570	1,570	410	840	1,640	1,950	1,630	1,400	33,250
1987	1,260	1,150	1,730	870	370	210	230	290	350	640	930	970	9,000
1988	980	980	1,250	930	280	50	100	150	170	340	530	730	6,490
1989	660	630	1,680	2,310	490	130	70	200	290	N/A	N/A	N/A	6,460
1990	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	440	590	640	1,670
Average	1,030	1,510	2,540	2,840	2,070	480	200	360	600	920	980	980	14,510

Table 3.2-3
HEC Model Input

Major Drainage	Subdrainage	SCS Curve Number	Area (acres)	Lag Time (minutes)[a]
SIM1	BANK1	75	535	18
	BANK2	75	231	18
	LGS	75	58.9	6
SIM2	PTB	73	81.9	18
	ROAD	75	29.5	6
	PSA	78	9.7	6
	OGS	75	13.4	6
	Plant	93	50.5	6
FMC1		71	114	11
FMC2		71	94	12
FMC3		93	28.5	7
FMC4		80	484	15
FMC5	Michaud	71	7488	164
	Local	71	1097	44
	Bannock	90	108.9	26

Note:

(a) A minimum lag time of 6 minutes was used for small drainages.

Table 3.2-4
Runoff Volumes for Evaluated Storms

Drainage	Area (Acres)	24-hour, 2-Year Storm (1.15 In.) (MG)	Maximum Observed 24-Hour Rainfall (MG)[a]	Contained?
SIM1	825	1.30	6.70	Yes
SIM2	185	1.00	2.60	Yes
FMC1	114	0.09	0.62	Yes
FMC2	94	0.08	0.51	Yes
FMC3	28	0.44	0.89	Yes
FMC4	484	1.70	6.00	Yes
FMC5	8,694[b]	6.52	49.4	Yes

Notes:

(a) Based on maximum 24-hour rainfall recorded at Pocatello Municipal Airport (1.82 inches, on October 2, 1976).

(b) Includes 7,488 acres from Michaud Creek drainage.

Table 3.3-1

Representative Levels for Common Ions and Physical Parameters in EMF Groundwater

Parameter	16 Representative Wells		Calcium Chloride Water Chemistry: Michaud Flats Regime		Calcium Bicarbonate Water Chemistry: Bannock Range Regime: High-chloride Subgroup		Calcium Bicarbonate Water Chemistry: Bannock Range Regime: Low-chloride Subgroup		Calcium Bicarbonate Water Chemistry: Bannock Range Regime: Combined Group		Calcium Bicarbonate Water Chemistry: Portneuf River Regime	
	Mean	Range (2 S.D.)(a)	Mean	Range (2 S.D.)	Mean	Range (2 S.D.)	Mean	Range (2 S.D.)	Mean	Range (2 S.D.)	Mean	Range (2 S.D.)
COMMON IONS (in mg/l)												
Alkalinity, bicarbonate	195	75 to 315	155	122 to 187	212	184 to 241	157	118 to 196	181	115 to 246	298	226 to 370
Alkalinity, carbonate	1.2	ND to 5	1.9	ND to 7	2.0	ND to 7	0.8	ND to 5	1.4	ND to 6	0.1	ND to 1
Calcium	72.6	40 to 105	85.0	66 to 104	74.2	52 to 97	53.7	35 to 73	62.4	33 to 91	75.4	50 to 101
Chloride	87.2	ND to 177	142	89 to 196	86.1	71 to 101	44.6	35 to 54	62.7	19 to 106	52.9	23 to 82
Magnesium	26.5	11 to 42	29.3	24 to 34	30.1	23 to 37	16.8	ND to 35	22.5	3 to 42	31.0	23 to 39
Potassium	8.3	4 to 13	9.3	5 to 13	9.5	6 to 13	7.7	4 to 12	8.5	4 to 13	6.5	5 to 8
Sodium	35.2	7 to 64	42.5	11 to 74	36.7	15 to 58	20.4	10 to 31	27.5	5 to 50	40.5	25 to 56
Sulfate	46	14 to 79	52	26 to 78	56	39 to 73	26	6 to 47	39	4 to 74	55	35 to 74
PHYSICAL PARAMETERS												
Specific conductance, at 25°C (in µmhos)	720	387 to 1052	840	621 to 1059	763	686 to 841	497	286 to 708	610	296 to 924	772	611 to 933
pH(b)		6.9 to 9.4		7.2 to 8.5		7.0 to 7.9		6.9 to 9.4		6.9 to 9.4		7.1 to 8.9
Temperature (in °C)	14.7	11.4 to 17.9	14.2	11 to 17	15.0	13 to 17	16.1	13 to 19	15.6	13 to 18	13.2	12 to 15
Total dissolved solids (in mg/l)	461	175 to 746	542	209 to 876	488	362 to 614	315	163 to 468	389	166 to 611	493	394 to 591
Redox(c)												
NUTRIENTS (in mg/l)												
Ammonia (NH_3 as N)	0.2	ND to 0.8	0.8	ND to 0.8	0.3	ND to 0.3	0.1	ND to 0.2	0.1	ND to 0.3	0.2	ND to 0.9
Nitrate (NO_3 as N)	2.1	ND to 4.5	2.8	ND to 5.7	1.8	0.8 to 2.7	1.0	0.3 to 1.7	1.3	0.2 to 2.4	2.6	0.9 to 4.3
Orthophosphate (PO_4 as P)	0.37	ND to 1.8	0.06	ND to 0.14	1.56	ND to 3.68	0.09	ND to 0.33	0.59	ND to 2.5	0.11	ND to 0.39
Phosphorus, total	0.67	ND to 3.1	0.32	ND to 1.9	2.02	ND to 4.94	0.09	ND to 0.31	1.1	ND to 4.0	0.05	ND to 0.13
Fluoride	0.4	0.03 to 0.7	0.5	0.2 to 0.7	0.2	0.1 to 0.3	0.5	0.1 to 0.8	0.4	0.003 to 0.7	0.2	0.1 to 0.4

Table 3.3-1 (Cont'd)

Parameter	16 Representative Wells		Calcium Chloride Water Chemistry		Calcium Bicarbonate Water Chemistry							
					Bannock Range Regime						Portneuf River Regime	
			Michaud Flats Regime		High-chloride Subgroup		Low-chloride Subgroup		Combined Group			
	Mean	Range (2 S.D.)(a)	Mean	Range (2 S.D.)	Mean	Range (2 S.D.)	Mean	Range (2 S.D.)	Mean	Range (2 S.D.)	Mean	Range (2 S.D.)
INORGANICS-METALS (in mg/l)												
Aluminum	0.18	ND to 0.68	ND	ND to ND	0.02	ND to 0.02	0.16	ND to 0.54	0.15	ND to 0.52	0.22	ND to 0.9
Antimony	0.12	0.04 to 0.20	ND	ND to ND	ND	ND to ND	0.14	0.04 to 0.23	0.14	0.04 to 0.23	0.10	ND to 0.10
Arsenic	0.013	ND to 0.032	0.010	0.002 to 0.019	0.027	0.015 to 0.039	0.008	ND to 0.021	0.017	ND to 0.039	0.005	0.001 to 0.009
Barium	0.12	0.02 to 0.22	0.16	0.07 to 0.24	0.08	0.06 to 0.10	0.09	0.02 to 0.16	0.08	0.03 to 0.14	0.13	0.07 to 0.19
Beryllium	0.002	0.0007 to 0.003	ND	ND to ND	ND	ND to ND	0.002	0.002 to 0.002	0.002	0.002 to 0.002	0.002	0.0004 to 0.004
Boron	0.17	ND to 0.36	0.11	0.04 to 0.19	0.22	0.03 to 0.40	0.14	ND to 0.39	0.17	ND to 0.40	0.19	ND to 0.37
Cadmium	0.003	0.001 to 0.006	0.004	0.003 to 0.005	0.004	0.003 to 0.005	0.003	ND to 0.006	0.003	0.001 to 0.006	0.001	ND to 0.002
Chromium	0.005	ND to 0.012	0.006	0.001 to 0.012	0.006	0.002 to 0.009	0.003	ND to 0.008	0.004	ND to 0.009	0.004	ND to 0.015
Cobalt	0.018	0.002 to 0.033	0.015	0.015 to 0.015	0.027	0.025 to 0.030	0.010	ND to 0.010	0.023	0.006 to 0.040	0.013	0.005 to 0.021
Copper	0.007	ND to 0.022	0.005	ND to 0.016	0.007	ND to 0.022	0.008	ND to 0.027	0.007	ND to 0.024	0.014	ND to 0.036
Iron	0.21	ND to 1.1	0.22	ND to 1.3	0.15	ND to 0.80	0.19	ND to 0.86	0.17	ND to 0.81	0.32	ND to 1.2
Lead	0.002	ND to 0.006	0.001	ND to 0.004	0.001	ND to 0.004	0.003	ND to 0.008	0.002	ND to 0.006	0.003	ND to 0.008
Lithium	0.031	ND to 0.062	0.050	0.028 to 0.072	0.027	0.008 to 0.046	0.008	0.003 to 0.013	0.017	ND to 0.040	0.031	0.020 to 0.043
Manganese	0.015	ND to 0.078	0.012	ND to 0.057	0.010	ND to 0.053	0.011	ND to 0.047	0.011	ND to 0.050	0.174	ND to ND
Mercury	0.0006	ND to 0.0013	0.0012	ND to 0.0012	ND	ND to ND	0.0004	ND to 0.0011	0.0004	ND to 0.0011	0.0005	ND to 0.0013
Molybdenum	0.03	ND to 0.07	ND	ND to ND	0.02	0.02 to 0.02	0.02	ND to 0.02	0.02	0.02 to 0.02	0.04	ND to 0.08
Nickel	0.01	0.01 to 0.01	ND	ND to ND	ND	ND to ND	0.01	ND to 0.01	0.01	ND to 0.01	ND	ND to ND
Selenium	0.003	ND to 0.007	0.003	0.0005 to 0.006	0.004	ND to 0.010	0.002	0.0002 to 0.005	0.003	ND to 0.008	0.003	0.0001 to 0.005
Silver	0.004	0.002 to 0.006	0.004	0.001 to 0.006	0.004	0.002 to 0.006	0.004	0.001 to 0.01	0.004	0.002 to 0.01	0.003	ND to 0.003
Thallium	0.040	0.04 to 0.040	ND	ND to ND	ND	ND to ND	0.040	ND to 0.040	0.040	ND to 0.040	0.040	ND to ND
Vanadium	0.024	ND to 0.124	0.007	0.003 to 0.011	0.008	0.004 to 0.012	0.026	ND to 0.103	0.017	ND to 0.073	0.115	ND to 0.331
Zinc	0.059	ND to 0.397	0.010	ND to 0.029	0.009	0.001 to 0.018	0.166	ND to 0.794	0.088	ND to 0.551	0.088	ND to 0.269

Notes:
(a) S.D. = Standard Deviation. Range is mean ± two times Standard Deviation.
(b) Range is actual values rather than two times Standard Deviation.
(c) Single Measurement--No statistics calculated
ND = Below Detection Limit.

Table 3.4-1
General Soil Properties: EMF Study Area

Soil Series	Depth (in inches) to: Bedrock	Depth (in inches) to: Seasonal High Water Table	Depth (in inches) from Surface	USDA Texture	Unified Soil Classification	Permeability (cm/S)	pH	Salinity
Paniogue	>60	>60	0 - 28	Loam and silt loam	ML or CL-ML	$4x10^{-4}$ - $1.4x10^{-3}$	7.4-9.6	Low, except moderate in some areas
			28 - 60	Coarse sand and gravelly coarse sand	SP or SP-SM	>$1.4x10^{-2}$	8.5-9.0	
Declo	>60	>60	0 - 47	Loam and silt loam	ML	$4x10^{-4}$ - $1.4x10^{-3}$	7.4-8.4	None
			47 - 60	Loamy coarse sand and coarse sand	SM	$4x10^{-3}$ - $1.4x10^{-2}$	7.9-8.4	None
Pocatello	>60	>60	0 - 60	Silt loam	ML	$4x10^{-3}$ - $1.4x10^{-2}$	7.9-9.6	None
Wheeler	>60	>60	0 - 60	Silt loam	ML	$4x10^{-3}$ - $1.4x10^{-2}$	7.4-8.4	None
Portneuf	>60	>60	0 - 60	Silt loam	ML, CL, or CL-ML	$4x10^{-3}$ - $1.4x10^{-2}$	6.6-9.0	None above a depth of 24", moderate below 24"
Inkom	>60	24-48	0 - 7	Silt loam	ML, CL-ML	$4.2x10^{-4}$ - $1.4x10^{-3}$	7.4-8.4	<4 mmhos/cm
			7 - 60	Silt loam	CL, CL-ML	$4.2x10^{-4}$ - $1.4x10^{-3}$	7.4-8.4	<4 mmhos/cm
Joevar	>60	>72	0 - 4	Silt loam	ML, CL-ML	$4.2x10^{-4}$ - $1.4x10^{-3}$	6.6-7.8	<2 mmhos/cm
			4 - 60	Silt loam	ML, CL-ML		7.4-8.4	<2 mmhos/cm
Arimo	>60	>72	0 - 18	Silt loam	ML, CL-ML	$4.2x10^{-4}$ - $1.4x10^{-3}$	6.6-7.8	<2 mmhos/cm
			18 - 33	Silt loam	ML, CL-ML	>$1.4x10^{-2}$	7.4-8.4	<2 mmhos/cm
			33 - 60	Extremely gravelly coarse sand	GP		7.4-8.4	<2 mmhos/cm
Downey	>60	>72	0 - 17	Gravelly silt loam	CL-ML, ML	$4.2x10^{-4}$ - $1.4x10^{-3}$	6.6-8.4	<2 mmhos/cm
			17 - 60	Very gravelly coarse sand, extremely gravelly coarse sand	GP	>10^{-2}	7.4-8.4	<2 mmhos/cm

Table 3.4-1 (Cont'd)

Soil Series	Depth (in inches) to: Bedrock	Depth (in inches) to: Seasonal High Water Table	Depth (in inches) from Surface	USDA Texture	Unified Soil Classification	Permeability (cm/S)	pH	Salinity
Bahem	>60	>72	0 - 11	Silt loam	ML, CL-ML	$4.2x10^{-4}$ - $1.4x10^{-3}$	7.4-7.8	<2 mmhos/cm
			11 - 49	Silt loam, silt	ML, CL-ML	$4.2x10^{-4}$ - $1.4x10^{-3}$	7.4-8.4	<2 mmhos/cm
			49 - 60	Extremely cobbly sand, extremely stony sand	GP, SP	$>10^{-2}$	—	<2 mmhos/cm
Ririe	>60	>72	0 - 12	Silt loam	ML, CL-ML	$4.2x10^{-4}$ - $1.4x10^{-3}$	6.6-8.4	<2 mmhos/cm
			12 - 60	Silt loam	ML, CL-ML	$4.2x10^{-4}$ - $1.4x10^{-3}$	7.4-9.0	<2 mmhos/cm
Rexburg	>60	>72	0 - 10	Silt loam	ML, CL-ML	$4.2x10^{-4}$ - $1.4x10^{-3}$	6.1-7.8	<2 mmhos/cm
			10 - 26	Silt loam	ML, CL-ML	$4.2x10^{-4}$ - $1.4x10^{-3}$	6.6-7.8	<2 mmhos/cm
			26 - 60	Silt loam, silt	ML	$4.2x10^{-4}$ - $1.4x10^{-3}$	7.4-8.4	<2 mmhos/cm
Lanoak	>60	>72	0 - 22	Silt loam	ML	$4.2x10^{-4}$ - $1.4x10^{-3}$	6.1-7.8	<2 mmhos/cm
			22 - 60	Silt loam	CL, CL-ML	$4.2x10^{-4}$ - $1.4x10^{-3}$	6.6-7.8	<2 mmhos/cm
Camelback	>60	>72	0 - 21	Extremely stony silt loam	GM-GC, GM	$4.2x10^{-4}$ - $1.4x10^{-3}$	6.1-7.3	<2 mmhos/cm
			21 - 60	Extremely gravelly silt loam, extremely cobbly silt loam	GM-GC, GC	$4.2x10^{-4}$ - $1.4x10^{-3}$	6.1-7.3	<2 mmhos/cm
Hades	>60	>72	0 - 7	Gravelly silt loam	CL-ML	$4.2x10^{-4}$ - $1.4x10^{-3}$	5.6-7.3	<2 mmhos/cm
			7 - 60	Gravelly silt loam, gravelly silty clay loam	CL, GC	$1.4x10^{-4}$ - $4.2x10^{-4}$	5.6-8.4	<2 mmhos/cm
Valmar	20-40	>72	0 - 9	Very cobbly silt loam	GM, GM-GC	$4.2x10^{-4}$ - $1.4x10^{-3}$	6.1-7.3	<2 mmhos/cm
			9 - 14	Very stony silt loam,very cobbly silt loam.	GM-GC, GC	$4.2x10^{-4}$ - $1.4x10^{-3}$	6.6-7.8	<2 mmhos/cm
			14 - 24	Extremely stony silt loam, extremely flaggy silt loam	GM-GC, GC	$4.2x10^{-4}$ - $1.4x10^{-3}$	6.6-7.8	<2 mmhos/cm
			24	Unweathered bedrock	—	—	—	—

Source: U.S. SCS (1987b).

Table 3.5-1
National Weather Service — Pocatello
Meteorological Data Summary
Monthly Mean Values

Parameter	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Wind	1985	5.8	9.6	9.4	11.6	10.5	9.8	8.3	10.1	10.1	11.4	11.9	6.0	9.5
Speed	1986	9.6	13.0	11.0	12.3	11.2	9.8	10.7	8.3	9.2	8.1	12.1	6.0	10.1
(mph)	1987	8.9	9.6	11.2	11.0	10.1	9.6	9.6	9.6	8.5	7.6	8.5	11.4	9.6
	1988	11.2	11.0	13.9	11.6	11.4	3.8	10.3	9.8	10.1	9.4	13.4	9.2	10.4
	1989	12.1	9.4	11.6	12.1	11.0	9.4	8.1	9.4	9.4	9.8	10.3	7.8	10.0
Wind	1985	330.8	321.7	309.3	283.5	198.3	208.1	322.9	219.2	189.3	194.1	182.9	345.5	258.8
Direction	1986	344.4	190.3	211.6	205.3	202.1	205.3	209.1	310.8	203.6	180.7	196.6	335.1	232.9
(°)	1987	179.4	175.7	181.6	202.3	207.5	206.5	199.7	202.2	212.5	186.8	179.7	181.7	192.9
	1988	166.9	181.2	191.8	201.7	209.0	212.1	223.2	206.6	200.6	205.1	205.2	342.3	212.1
	1989	178.9	311.1	200.5	195.6	221.1	197.5	209.1	212.1	176.6	199.0	193.0	308.4	216.9
Temperature	1985	-10.5	-7.3	-2.5	9.8	13.7	18.3	22.8	19.6	12.2	7.8	-2.8	-11.8	5.8
(°C)	1986	-4.9	1.7	6.7	7.2	12.2	19.9	19.8	22.0	12.1	8.4	2.2	-4.7	8.6
	1987	-6.6	0.3	4.0	11.5	14.5	18.8	20.0	20.1	16.3	10.1	2.0	-3.1	9.0
	1988	-5.7	0.0	3.0	9.6	12.9	21.1	23.8	21.3	14.8	12.9	2.0	-5.8	9.2
	1989	-6.7	-7.1	3.3	9.6	12.2	17.5	23.2	19.6	15.6	8.3	2.5	-3.4	7.9

Table 3.5-2
Simplot Site 1
Meteorological Data Summary
Monthly Mean Values

Parameter	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Wind	1981	9.5	10.3	10.5	12.9	13.2	14.9	12.5	10.1	9.6	9.5	9.7	12.3	11.3
Speed	1982	13.4	10.3	13.1	12.5	12.2	9.7	9.8	10.2	10.3	10.3	9.0	10.7	11.0
(mph)	1983	9.4	10.2	10.7	10.1	11.6	11.1	11.5	8.8	10.7	8.0	11.4	8.0	10.1
	1988	10.0	11.0	N/A	N/A	9.9	6.6	5.7	N/A	6.9	6.7	12.2	7.5	6.4
	1989	10.4	8.4	11.2	10.2	8.6	9.3	8.0	9.4	9.1	9.5	10.4	7.4	9.3
	1990	11.5	11.4	9.9	10.5	10.7	10.6	9.2	8.4	7.1	12.0	12.1	N/A	9.5
Wind	1981	157.8	187.8	191.0	209.4	201.9	206.0	197.7	191.9	201.3	188.9	177.7	199.0	192.5
Direction	1982	209.3	173.5	196.1	207.7	202.1	195.5	194.1	19.4	183.4	197.7	185.4	200.1	180.4
(°)	1983	197.1	201.8	191.8	176.7	196.9	196.9	185.4	181.4	197.1	189.3	190.0	329.5	202.8
	1988	190.5	174.1	193.7	N/A	195.6	182.7	209.6	N/A	195.7	179.5	197.3	346.2	206.4
	1989	194.5	316.2	196.6	187.6	206.1	183.5	186.7	193.5	177.7	190.2	202.1	319.2	212.8
	1990	191.5	195.3	186.2	183.5	186.3	194.6	204.4	190.6	359.5	208.9	186.1	N/A	207.9
Temperature	1981	-1.3	-1.3	3.5	9.2	10.0	16.6	22.1	23.2	17.3	7.3	3.3	-1.2	9.1
(°C)	1982	-5.6	-4.7	3.2	5.4	10.7	17.1	20.8	22.0	13.9	7.2	-0.4	-3.1	7.2
	1983	-0.5	0.2	4.0	5.9	12.2	17.2	20.9	22.9	14.5	8.6	3.6	-6.5	8.6
	1988	-3.9	0.6	3.3	10.0	12.9	21.3	22.3	N/A	13.4	12.0	0.6	-6.6	7.2
	1989	-7.6	-6.7	2.2	8.4	10.6	16.2	22.1	18.3	14.6	7.5	2.1	-3.7	7.0
	1990	-1.8	-2.5	3.8	9.1	9.9	16.2	20.5	19.9	17.4	8.0	1.6	N/A	8.5

N/A = Not available due to less than 75 percent data recovery for the month/year.

Table 3.5-3
Simplot Site 7
Meteorological Data Summary
Monthly Mean Values

Parameter	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Wind	1988	11.8	12.8	15.9	N/A	8.3	6.7	17.5	N/A	8.9	N/A	11.5	N/A	7.8
Speed	1989	10.3	10.4	12.7	13.0	11.9	8.2	6.4	7.9	7.5	8.0	10.3	N/A	8.9
(mph)	1990	10.3	10.4	9.9	9.5	8.8	9.9	N/A	6.4	5.4	10.4	9.8	7.2	8.2
Wind	1988	150.1	148.7	164.9	N/A	170.9	180.6	125.7	N/A	N/A	N/A	N/A	N/A	N/A
Direction	1989	N/A	N/A	N/A	N/A	N/A	192.4	210.0	206.1	192.1	214.6	220.3	N/A	N/A
(°)	1990	211.4	208.1	207.5	204.8	204.4	216.4	N/A	200.5	200.0	204.9	194.4	201.4	187.8
Temperature	1988	-4.8	0.3	2.6	8.2	10.5	18.9	N/A	N/A	11.6	10.9	-1.6	-7.4	4.1
(°C)	1989	-6.6	-6.9	3.0	9.2	11.5	17.0	21.4	16.5	13.1	6.2	0.6	-5.1	6.7
	1990	-3.8	-4.4	1.5	7.2	7.6	14.4	N/A	16.6	15.9	6.2	0.2	-11.5	4.2

N/A = Not available due to less than 75 percent data recovery for the month/year.

Table 3.6-1
EMF Study Area Land Uses and Areas

Land Use	Area		Percentage
	Acres	Hectares	
Agricultural	1,047	424	6
Residential	1,853	750	10
Commercial	93	38	0.5
Industrial	2,909	1,177	16
Special Use District	2,615	1,058	14.5
Unzoned	485	193	3
Fort Hall Indian Reservation: Agricultural	6,743	2,729	37
U.S. Bureau of Land Management: Multiple	2,337	946	13
Total	**18,082**	**7,315**	**100**

Sources: Acreage calculations derived from Figure 3.6-1, "Current Land Use."

Table 3.6-2
Well Registration Table

Tract	Owner	Total Diversion (cubic feet per second)
Township: 05S Range: 33E Section: 36		
NENE	Rhoades, W	0.04
NWNENE	Snook, D	0.04
SENE	Zitterkopf	0.06
Township: 05S Range: 34E Section: 31		
SENESE	Lacey, J	0.04
SWSE	Jackson, V	0.06
SWSE	Gould, R	0.04
SWSE	Scroggins, R	0.04
NESWSE	Labbee, L	0.08
NENENE	Mc Nabb, S	0.06
SESENE	Johnson, A	0.04
NENW	Naylor, G	0.08
NWNWNW	Bentel, J	0.04
Township: 05S Range: 34E Section: 32		
SWNWNW	Bentel, J	0.13
SWNW	Correll, G	0.04
SWNW	Nelson, D	0.04
SWNW	Hardenbrook, W	0.04
NESWNW	Valenty, J	0.25
NWSWNW	Heimer, J	0.06
NWSWNW	Howser, M	0.06
SENW	Moore, J	0.04
SENW	Larsen, N	0.24
SWSENW	McLaughlin	0.04
SWSENW	Beard, D	0.04
SWSENW	Butler, C	0.04
SWSENW	Patterson, J	0.04
SWSENW	Cunningham, J	0.04
NENWSE	Church of Jesus Christ, Latter Day Saints	0.24
SWSE	Allen, D	0.04

Table 3.6-2 (Cont'd)

Tract	Owner	Total Diversion (cubic feet per second)
Township: 05S Range: 34E Section: 32 (Cont'd)		
SWSE	Parkin, J	0.06
SWSE	Porter, R	0.06
SESWSE	Goosey, M	0.04
SESWSE	Fernau, L	0.03
SESESE	Johnson, A	0.04
Township: 05S Range: 34E Section: 33		
NENENE	Johnson, F	0.06
SESENE	Johnson, A	0.04
SESENE	Ganske, D	0.04
SWNWSW	Johnson, A	0.04
SESW	Hancock, D	0.04
SESESW	Johnson, A	0.04
NESE	Hancock, G	0.08
Township: 06S Range: 33E Section: 01		
NENE	Monric Inc.	4.46
SWNENE	Thousand Springs	75.14
SWNENE	Aqua Life Inc.	75.00
SWNENE	Aqua Life Inc.	0.14
SWNWNE	Thousand Spings	75.14
SWNWNE	Aqua Life Inc.	75.00
NWSENE	Aqua Life Inc.	0.10
NWSENE	Thousand Spings	75.14
NWSENE	Aqua Life Inc.	75.00
NENENW	Rowland, C	0.04
SWSESW	Rowland, C	3.60
SWSESW	Rowland, V	3.60
SWNESE	Douglass, W	1.18
SENESE	Douglass, W	0.66

Table 3.6-2 (Cont'd)

Tract	Owner	Total Diversion (cubic feet per second)
Township: 06S Range: 33E Section: 02		
NENE	Bowman, D	0.04
NWNENE	Peck, J	0.04
NWNENE	Thompson, L	0.08
SENWNE	Hull, R	0.04
SWSENE	Sharp, G	0.06
NENW	Jacobson, L	0.24
NENENW	Rhoades, A	0.18
SWNENW	Mason, J	0.12
NWNW	Leighton, W	0.20
NENWNW	Corbridge, K	0.09
NENWNW-1	Applebee, V	0.06
NENWNW	Jensen, B	0.06
NENWNW-2	Applebee, V	0.03
SENW	Harmon, D	0.18
NESE	Tharp, M	0.04
NESE	Michael, P	0.04
SESESE	Clark, J	0.06
Township: 06S Range: 33E Section: 04		
SENWNE-1	Deppe, V	0.63
SENWNE-2	Deppe, Y	0.10
SENWNE-1	Weaver, D	1.23
SENWNE	Deppe Trust, s	0.63
SENWNE-2	Waver, D	0.13
Township: 06S Range: 33E Section: 10		
NESE-1	City of Pocatello	3.34
NESE-2	City of Pocatello	1.92
Township: 06S Range: 33E Section: 11		
NWSE-1	Evans, J	2.60
NWSE-2	Evans, J	0.38

Table 3.6-2 (Cont'd)

Tract	Owner	Total Diversion (cubic feet per second)
Township: 06S Range: 33E Section: 12		
SENE	City of Pocatello	5.72
NWSWNW	Lindley, D	1.49
NWNWSW-1	Lindley, H	0.40
NWNWSW-2	Lindley, H	0.48
SESWSW-1	FMC Corporation	0.63
SESWSW-2	FMC Corporation	0.04
SESW	FMC Corporation	4.50
NESE	FMC Corporation	1.10
Township: 06S Range: 33E Section: 13		
NENW	FMC Coporation	4.00
NWNW	FMC Coporation	4.50
Township: 06S Range: 33E Section: 14		
SESE	Idaho Power Co.	0.02
Township: 06S Range: 33E Section: 15		
SWNE	City of Pocatello	2.20
SWNE	Smith, E	2.20
Township: 06S Range: 33E Section: 22		
NWNW	Smith, E	4.78
SWSW	Michaud Creek	2.00
SWSW	Michaud Creek	1.08
NESE-1	Feld, R	0.04
NESE-2	Feld, R	0.04
NESE	Buzzard, J	0.20
NWNESE	Herrman, J	0.20
NWNESE	Herrman, J	0.12
NWNESE	Herrman, J	0.04
NWNESE	Herrman, J	0.06
NWNESE	Lehman, M	0.16
NENWSE	Marshall, B	0.04
NWNWSE	Shimada, Jr.	0.04
SESE	Herrman, Sr.	0.04
SESE	Maxell, Jr.	0.04
NWSESE	Camara, K	0.04

Table 3.6-2 (Cont'd)

Tract	Owner	Total Diversion (cubic feet per second)
Township: 06S Range: 33E Section: 23		
SWSW-1	Ames, O	0.26
SWSW-2	Ames, O	0.26
Township: 06S Range: 34E Section: 04		
NENENE	Whitworth, G	0.04
NENENE	Lemmon, E	0.04
NENENE	Orton, K	0.04
NENENE	Lemmon, J	0.04
SENE	Edwards, B	0.06
NWNW	Church of Jesus Christ, Latter Day Saints	0.15
NWSWNW	Bodily, K	0.14
NWSW	Hanson, C	0.04
NWSW	Hanson, C	0.04
NWSW	Kautzsch, R	0.06
SWNWSW	Nanninga, F	0.06
SWSWSW	Bilbyeu, F	0.06
SESW	City of Chubbuck	4.45
NESE	Selders, L	0.06
SESWSE	Layne, M	0.06
Township: 06S Range: 34E Section: 05		
NENE	Gaskin, C	0.02
NENE	Cunningham, D	0.08
NENE	Henriksen, J	0.06
NENE	Wilson, L	0.05
NENENE	Pony Acres	0.16
NENENE	Shappart, D	0.06
SENENE	Lasley, J	0.07
NWNE	Pline, D	0.06
SWNWNE	Perkins, C	0.04
SWNWNE	Orchard, R	0.04
SWNWNE	Wilson, J	0.06
SWNE	Jensen, C	0.06

Table 3.6-2 (Cont'd)

Tract	Owner	Total Diversion (cubic feet per second)
Township: 06S Range: 34E Section: 05 (Cont'd)		
SWNE	Line, D	0.04
NWSWNE	Gouchnour, D	0.04
SESWNE	French, D	0.04
NESENE	Waters, R	0.08
NWSENE	O'Neil, D	0.04
NENW	Allen, J	0.04
NENW	Allen, S	0.04
SENW	Christensen, E	0.04
SENW	Nelson, S	0.04
NWSW	Rees, P	0.09
NWSW	Smith, N	0.16
SWNWSW	Lambert, L	0.04
SWSW	Talbot, D	0.04
SWSW	Gagon, Duane	0.04
SWSW	Smith, W	0.04
SWSW	Fisher, B	0.04
NWSWSW	Sidell, R	0.06
SESW	Roeder, J	0.08
SESW	Frasure, A	0.04
SESW	Roeder, E	0.04
SESW	Shipley, S	0.04
SESW	Buchholtz, Jr.	0.03
SESW	Hancock, L	0.06
SESW	Mowrey, C	0.04
SESW	Wuthrich, R	0.06
SESW	Christensen, B	0.04
NWSESW	Hall, K	0.04
SWSESW	Ground, G	0.04
SESESW	Shepherd, G	0.06
SESWSE	Armstrong, L	0.24

Table 3.6-2 (Cont'd)

Tract	Owner	Total Diversion (cubic feet per second)
Township: 06S Range: 34E Section: 06		
NESW	FMC	0.09
NWNWSW	Turner, E	0.17
SWNWSW	Douglass, E	0.04
SWNWSW	Madden, B	0.25
SWNWSW	Madden, B	0.04
SENWSW	Madden, B	0.04
NWSESW	Aqua Life Inc.	0.04
SESESW	Aqua Life Inc.	44.77
NESE	Eriksen, W	0.06
SENE	Jackson, V	0.04
SENE	Jackson Inc.	0.08
NENENW	Crapo, R	0.14
SWSWNW	Douglas, E	0.63
SESWNW	Thousand Springs	75.14
SESWNW	Aqua Life Inc.	75.00
SENW	Monroc Inc.	4.46
Township: 06S Range: 34E Section: 07		
NENE	City of Pocatello	12.13
NWNE	Rowland, R	0.02
NWNE	Rowland, E	0.56
SENWNE	Rowlands, Inc.	0.30
SWNE	City of Pocatello	9.28
SWNE	Union Pacific	1.48
NWNW	Chevron	1.00
NWNW	Chevron	0.56
NESW	J.R. Simplot	6.68
NESW-1	J.R. Simplot	5.57
NESW-2	J.R. Simplot	6.66
NESW	J.R. Simplot	0.10
SESW	J.R. Simplot	0.10
SESW	J.R. Simplot	6.68
SESW-1	J.R. Simplot	5.57

Table 3.6-2 (Cont'd)

Tract	Owner	Total Diversion (cubic feet per second)
Township: 06S Range: 34E Section: 07 (Cont'd)		
SESW-2	J.R. Simplot	6.66
NESE	J.R. Simplot	3.20
NESE	J.R. Simplot	0.22
NESE	J.R. Simplot	2.28
NWSE	J.R. Simplot	0.28
NWSE	J.R. Simplot	3.35
Township: 06S Range: 34E Section: 08		
NENE	Traughber, C	0.06
NWNE	Perkins, B	0.08
NWNE	Lowder, J	0.07
NWNE	Miles, D	0.04
NWNE	Traughber, F	0.09
NWNWNE	Artinger, M	0.04
NENW	Hansen, J	0.04
NENW	Fries, C	0.04
NENW	Sortor, H	0.06
NENW	Sortor, R	0.04
NENW	O'Brien, A	0.02
NENW	Hebdon, K	0.18
	Millard, D	
NENW	Sampson, R	0.06
NENW	Wilson, B	0.06
NENW	Anderson, L	0.06
NENENW	Hebdon, K	0.06
NENENW	Millard, D	0.06
NENENW	Anderson, K	0.06
NWNW	Wilson, L	0.06
SENW	J.R. Simplot	0.15
SENW	J.R. Simplot	0.15
SWSE	Baldwin, A	0.04

Table 3.6-2 (Cont'd)

Tract	Owner	Total Diversion (cubic feet per second)
Township: 06S Range: 34E Section: 09		
SWSWNW	McNabb, S	0.06
NESE	Cleaves, C	0.04
NESE	Eriksen, L	0.09
NESE	Jensen, T	0.06
SENESE	Cook, C	0.04
SWSE	Ward, O	1.00
SESE	Wright, M	0.02
SWSESE	Harrop, E	0.06
SWSESE	Harrop, C	0.06
Township: 06S Range: 34E Section: 10		
NENE	City of Pocatello	17.07
NENE	Taysom, A	0.02
NWNE	Ward, W	0.08
SWSENE	Jensen, M	0.06
SWSENE	Dalton, M	0.04
SWNW	McPherson, D	0.06
NWSWNW	Moss, M	0.08
SENW	Home Acres Wat.	0.10
NWSENW	Kiggins, T	0.04
NWSENW	Clezie, R	0.04
SESW	Michaud Creek	0.38
SESW	Great Western	3.25
Township: 06S Range: 34E Section: 16		
SESW	J.R. Simplot	3.20
SESW	J.R. Simplot	2.28
Township: 06S Range: 34E Section: 17		
SWNE	Baldwin, G	0.06
NESENE	Pocatello Read	0.24

Table 3.6-2 (Cont'd)

Tract	Owner	Total Diversion (cubic feet per second)
Township: 05S Range: 34E Section: 31		
NENE	Smith, D	0.04
NENE	Miles, B	0.11
NENENE	Ellis, R	0.06
NWNE	Davis, B	0.11
NENW	Spitzer, D	0.11
NWNW	McOmber	0.04
SWNW	Paul, S	0.06
SWSWNW	Lusk, E	0.04
SWSWNW	McGee, R	0.04

Source: Idaho Department of Water Resources, 1992 data files.

Table 3.7-1
Summary of Areal Extent of Vegetation/Habitat Types within the EMF Study Area

Vegetation/Habitat Type[a]	Areal Extent		Percentage of EMF Study Area
	Acres	Hectares	
Agriculture, includes 2,848 acres (1,153 ha) of fallow/disturbed areas	7,203	2,916	40
Sagebrush steppe, includes 481 acres (195 ha) of cliff habitat	6,620	2,680	37
Wetland/riparian	597	242	3
Residential, industrial, commercial	3,663	1,485	20
Total	18,083	7,323	100

Notes:

(a) See Figure 3.7-1 for map of vegetation/habitat distributions within the EMF study area. Table is based upon vegetation/habitat distributions shown in Figure 3.7-1.

Table 3.7-2
Summary of U.S. FWS Winter Waterfowl Surveys

Year	Number of Waterfowl
1981	151,149
1982	37,839
1983	9,571
1985	16,772
1986	5,135
1987	33,922
1988	21,391
1989	21,788
1990	70,770
1991	42,840

Source: Idaho Department of Fish and Game (1981-1991).

Table 3.7-3
Duck and Goose Harvest Data

Year	Number of Ducks	Number of Geese
1981	8,300	3,072
1982	8,363	2,289
1983	7,591	1,509
1984	7,396	1,818
1985	3,425	2,328
1986	3,738	1,602
1987	1,499	799
1988	2,388	3,833
1989	3,482	5,185
1990	1,698	4,728

Source: Shoshone-Bannock Tribe (1992).

Table 3.7-4
Width, Depth, and Flow Characteristics Measured at Selected Locations on the Portneuf River (on October 27, 1992)

Location[a]	River Mile	Width (meter)	Depth (meter)	Current (m/sec)	Flow (m^3/sec)
Main Street Bridge (SW25)	20.7	12.2	0.9	0.4	2.5
Batiste Lane (SW16) Bridge	13.3	11.9	0.7	0.5	2.3
River at Batiste Spring discharge (SW10)	12.0	26.2	1.1	0.7	5.4
Siphon Road Bridge (SW03)	11.0	25.0	2.4	0.5	9.5
Station 1 (SW01)	10.0	25.0	0.9	0.7	9.1

Note:

(a) See Figure 1.3-4 for surface water sampling locations.

Table 3.7-5
Game and Nongame Fish Species Found in the Portneuf River

Common Name	Scientific Name	Reference
GAME FISH		
Fish farm rainbow trout[a]	*Oncorhynchus mykiss*	Broderick et al., 1989
Wild rainbow trout	*Oncorhynchus mykiss*	Broderick et al., 1989; Shoshone-Bannock Tribe, 1992
Brown trout	*Salmo trutta*	Broderick et al., 1989; Shoshone-Bannock Tribe, 1992
Kokanee salmon[a]	*Oncorhyncus nerka*	Shoshone-Bannock Tribe, 1992
Coho salmon[a]	*Oncorhyncus kisutch*	Marquardt, 1992
Hybrid trout (Rainbow x Cutthroat)	*O. mykiss x O clarkii*	Broderick et al., 1989
Mountain whitefish	*Prosopium williamsoni*	Broderick et al., 1989; Johnson et al., 1977; Mohr, 1968; Shoshone-Bannock Tribe, 1992
Yellow perch	*Perca flavescens*	Johnson et al., 1977
Black crappie	*Pomoxis nigromaculatus*	Johnson et al., 1977
Black bullhead	*Ictalurus melas*	Johnson et al., 1977
Brown bullhead	*Ictalurus nebulosus*	Shoshone-Bannock Tribe, 1992
Channel catfish	*Ictalurus punctatus*	Shoshone-Bannock Tribe, 1992
NONGAME FISH		
Common carp	*Cyprinus carpio*	Broderick et al., 1989; Shoshone-Bannock Tribe, 1992
Large scale sucker	*Catostomus macrocheilus*	Broderick et al., 1989
Utah sucker	*Catostomus ardens*	Johnson et al., 1977; Shoshone-Bannock Tribe, 1992
Redside shiner	*Richardsonius balteatus*	Broderick et al., 1989; Mohr, 1968; Johnson et al., 1977; Shoshone-Bannock Tribe, 1992
Longnose dace	*Rhinichthys cataractae*	Broderick et al., 1989; Mohr, 1968
Speckled dace	*Rhinichthys osculus*	Broderick et al., 1989; Mohr, 1968
Mottled sculpin	*Cottus bairdi*	Broderick et al., 1989; Shoshone-Bannock Tribe, 1992
Utah chub	*Gila atraria*	Johnson et al., 1977; Shoshone-Bannock Tribe, 1992

Note:

(a) Fish farm escapees that are occasionally found in the Portneuf River.

Table 3.7-6
American Falls Reservoir Commercial Fishing Catch

Fish Species		Catch[a]	
Common Name	Scientific Name	pounds	(kilograms)
Suckers	*Catostomus ardens* and *C. macrocheilus*	329,000	(149,400)
Common carp	*Cyprinus carpio*	163,400	(74,200)
Utah chub	*Gila atraria*	9,600	(4,400)
	Total Catch	502,000	(228,000)

Note:

(a) Approximate commercial fishery catch for the American Falls Reservoir from July to November 1992 (Thompson, 1993).

EXPLANATION

- Qal — Younger Alluvium (Recent)
- Loess (Upper Pleistocene and Recent)
- Older Alluvium (Upper Pleistocene)
- Aberdeen Terrace Deposits (Upper Pleistocene)
- Qm — Michaud Gravel (Upper Pleistocene) -Commonly overlain by loess
- American Falls Lakebeds (Upper Pleistocene)
- Pediment Gravel (Upper Pleistocene)

UNCONFORMITY

- Tertiary Starlight Formation (Undifferentiated) -Late Miocene to Pliocene

UNCONFORMITY

- PC — Pre-Cambrian Basement Complex (Upper Pre- Cambrian)
- Normal Fault; u, Upthrown side

NOTE: Map adapted from Trimble, 1976

0 1 2

SCALE IN MILES

BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Regional Geology

JOB No.	DRAWING NO.	REV.
21372	FIGURE 3.1-1a	

QUATERNARY PERIOD

Holocene Epoch

Qa1 YOUNGER ALLUVIUM - sand, silt, and gravel fluvial, alluvial, colluvial, and aeolian deposits in active stream channels and mantling alluvial fans

Q1 LOESS - Aeolian deposit of silts.

Qalo OLDER ALLUVIUM - sand, silt, and gravel fluvial, alluvial, colluvial, and aeolian deposits in abandoned channels and older terraces.

Late-Pleistocene Epoch

Qa ABERDEEN TERRACE DEPOSITS - pebble gravel fluvial deposits of mostly reworked Michaud Gravel.

Qm MICHAUD GRAVEL - rounded gravel, boulder, sand fluvial deposits of ancient Bonneville flood.

Qam AMERICAN FALLS LAKE BEDS - mostly silt and clay lacustrine deposits of ancient American Falls Lake which was created by a basalt dam on the Snake River.

Qs SUNBEAM FORMATION - mostly unbedded to poorly bedded calcareous silt, sand, and gravel alluvial and colluvial deposits surrounding ancient American Falls Lake which was created by a basalt dam on the Snake River. Not exposed in study area.

Qb BIG HOLE BASALT - dense blue-gray to blue-black basalt deposited at about the same time as a number of other basalt flows in the region, one of which dammed the Snake River near American Falls. Not exposed in study area.

Qr RAFT FORMATION - clay to gravel lacustrine, fluvial, and alluvial deposits related to ancient Raft Lake which was created by a basalt dam on the Snake River near the confluence of the Raft River. Not exposed in study area.

Qg PEDIMENT GRAVELS - gravel and boulder aprons mantling pediment surfaces cut on Tertiary rock adjacent to the Bannock and Pocatello Ranges.

UNCONFORMITY

TERTIARY PERIOD

Late-Miocene to Pliocene Epoch

Tu STARLIGHT FORMATION (undifferentiated) - mostly bedded rhyolitic tuff with interbedded ashflow, rhyolite tuff, basaltic tuff and flows, vitrophyre, trachyandesite, and sedimentary deposits including conglomerate and breccia.

UNCONFORMITY

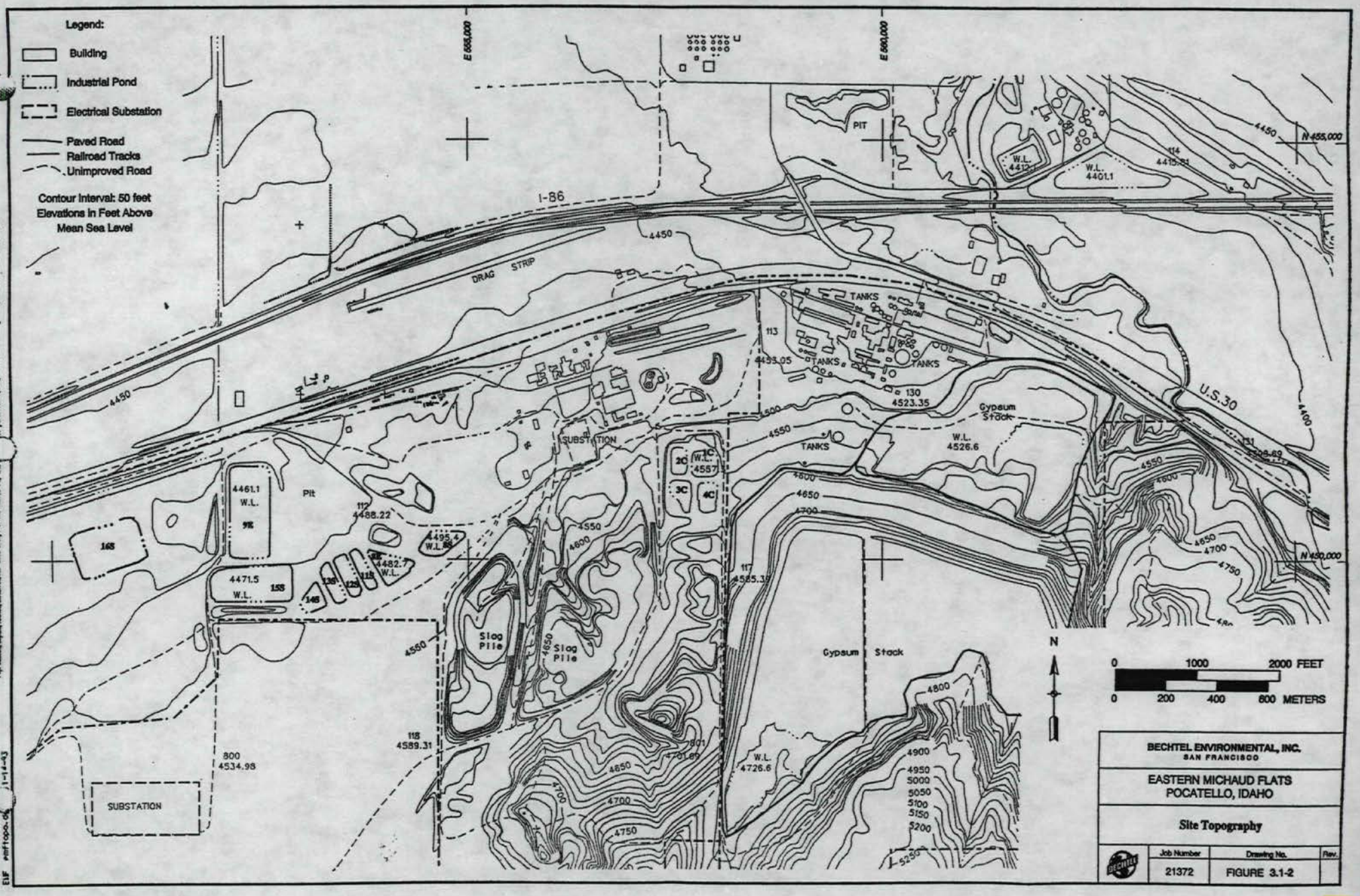
PRE-TERTIARY PERIOD

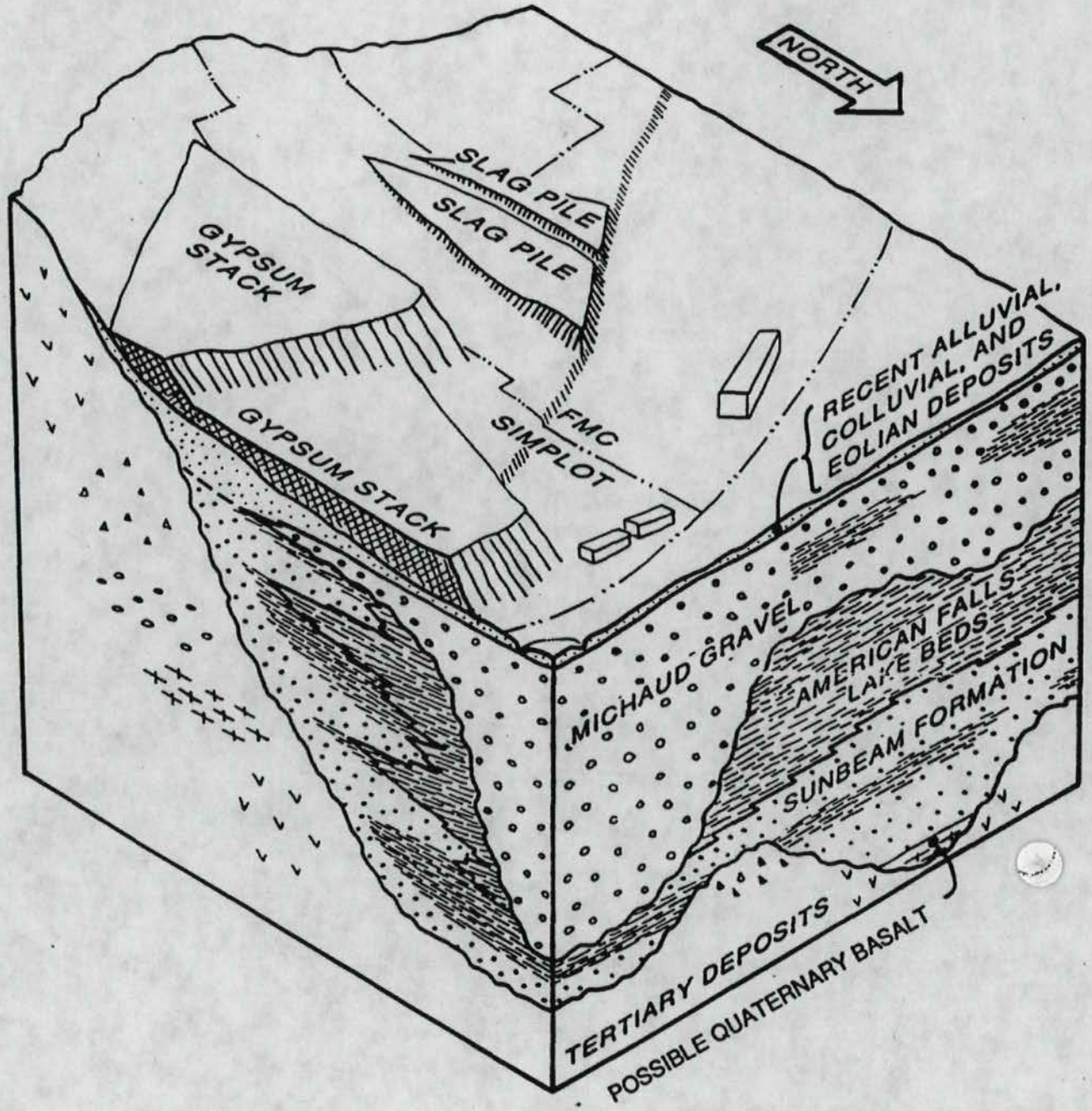
PRECAMBRIAN TO CAMBRIAN PERIOD

pCu-Cu BASEMENT COMPLEX (undifferentiated) - metamorphosed to unmetamorphosed marine sedimentary (carbonates and fine- to coarse-grained clastics) and volcanic rocks.

93-1477c.123/DW/R0

BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO			
EASTERN MICHAUD FLATS POCATELLO, IDAHO			
General Area Stratigraphy			
BECHTEL	JOB No.	DRAWING NO.	REV.
	21372	FIGURE 3.1-1b	


Legend:
Building
Industrial Pond
Electrical Substation
Paved Road
Railroad Tracks
Unimproved Road
Contour Interval: 50 feet
Elevations in Feet Above
Mean Sea Level
E 555,000
E 560,000
N 455,000
N 450,000
I-86
DRAG STRIP
U.S.30
PIT
TANKS
SUBSTATION
Gypsum Stack
Slag Pile
Pit
W.L. 4401.1
W.L. 4526.6
W.L. 4726.6
W.L. 4557
W.L. 4461.1
W.L. 4471.5
W.L. 4488.22
W.L. 4589.31
W.L. 4534.98
4523.35
4526.6
4585.39
4726.6
4450
4550
4600
4650
4700
4750
4800
4900
4950
5000
5050
5100
5150
5200
5250
N
0 1000 2000 FEET
0 200 400 600 METERS
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO
EASTERN MICHAUD FLATS
POCATELLO, IDAHO
Site Topography
Job Number
21372
Drawing No.
FIGURE 3.1-2
Rev.



EXPLANATION

FACILITY BUILDINGS

FACILITY PROPERTY BOUNDARIES

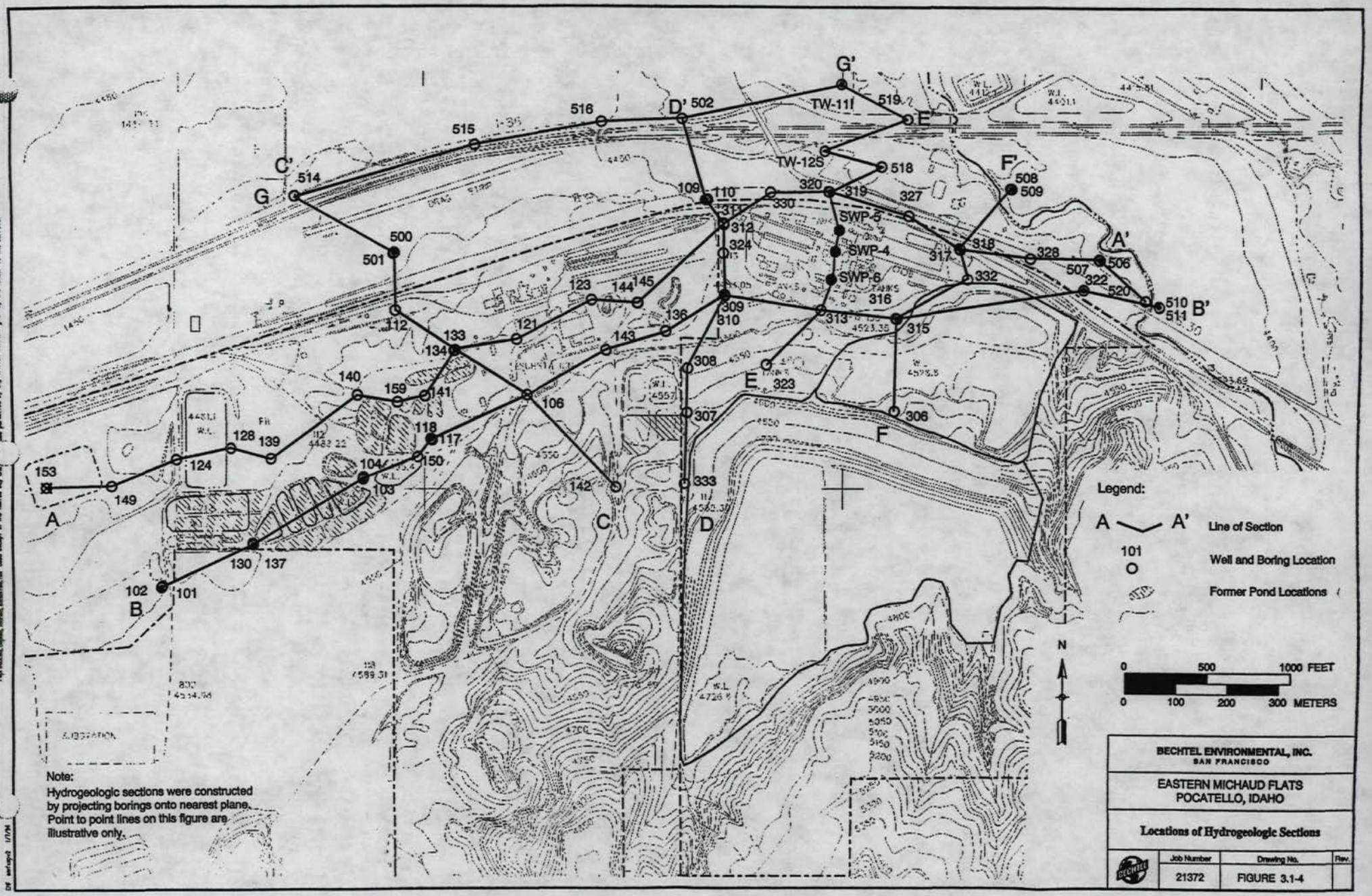
PORTNEUF RIVER

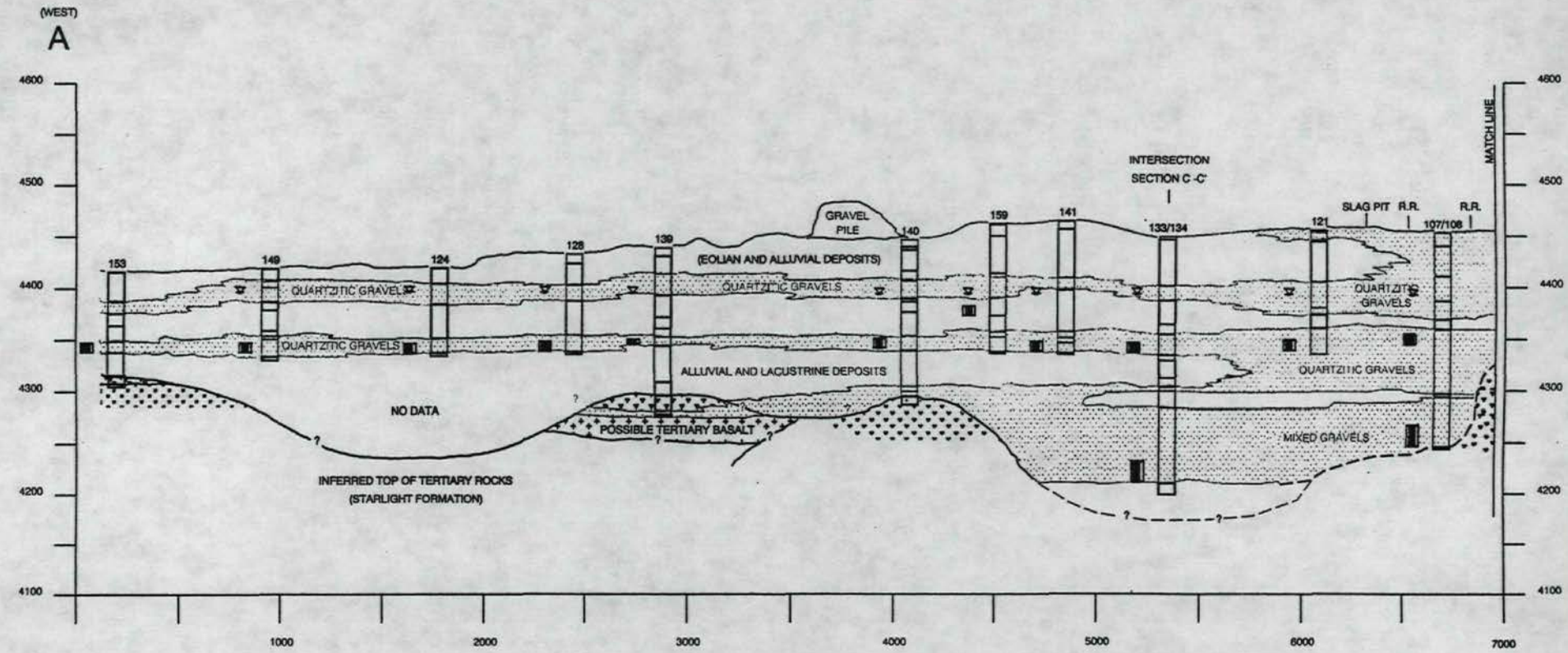
NOT TO SCALE -

SIDES OF BLOCK REPRESENT APPROXIMATELY 8000 FEET

HEIGHT OF BLOCK REPRESENTS APPROXIMATELY 400 FEET

BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO			
EASTERN MICHAUD FLATS POCATELLO, IDAHO			
Schematic Block Diagram Showing Stratigraphic Setting at EMF Facilities			
BECHTEL	JOB No.	DRAWING NO.	REV.
	21372	FIGURE 3.1-3	


A
A'
B
B'
C
C'
D
D'
E
E'
F
F'
G
G'
TW-11I
TW-12S
SWP-5
SWP-4
SWP-6
Legend:
Line of Section
Well and Boring Location
Former Pond Locations
0 500 1000 FEET
0 100 200 300 METERS
N
Note:
Hydrogeologic sections were constructed by projecting borings onto nearest plane. Point to point lines on this figure are illustrative only.
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO
EASTERN MICHAUD FLATS
POCATELLO, IDAHO
Locations of Hydrogeologic Sections
Job Number
21372
Drawing No.
FIGURE 3.1-4
Rev.



Legend:

- Water level
- Well screen

SAND
GRAVELLY SAND
SILTY SAND
CLAYEY SAND
SANDSTONE
GRAVEL
SAND AND GRAVEL
SILTY SANDY GRAVEL
SILTY GRAVEL
CLAYEY GRAVEL

SILT
CLAYEY SILT
SANDY SILT
GRAVELLY SILT

CLAY
SILTY CLAY
SANDY CLAY
GRAVELLY CLAY

BASALT
RHYOLITE
TUFF

CALICHE
PEAT

ASPHALT
CONCRETE
FILL

NOTES:

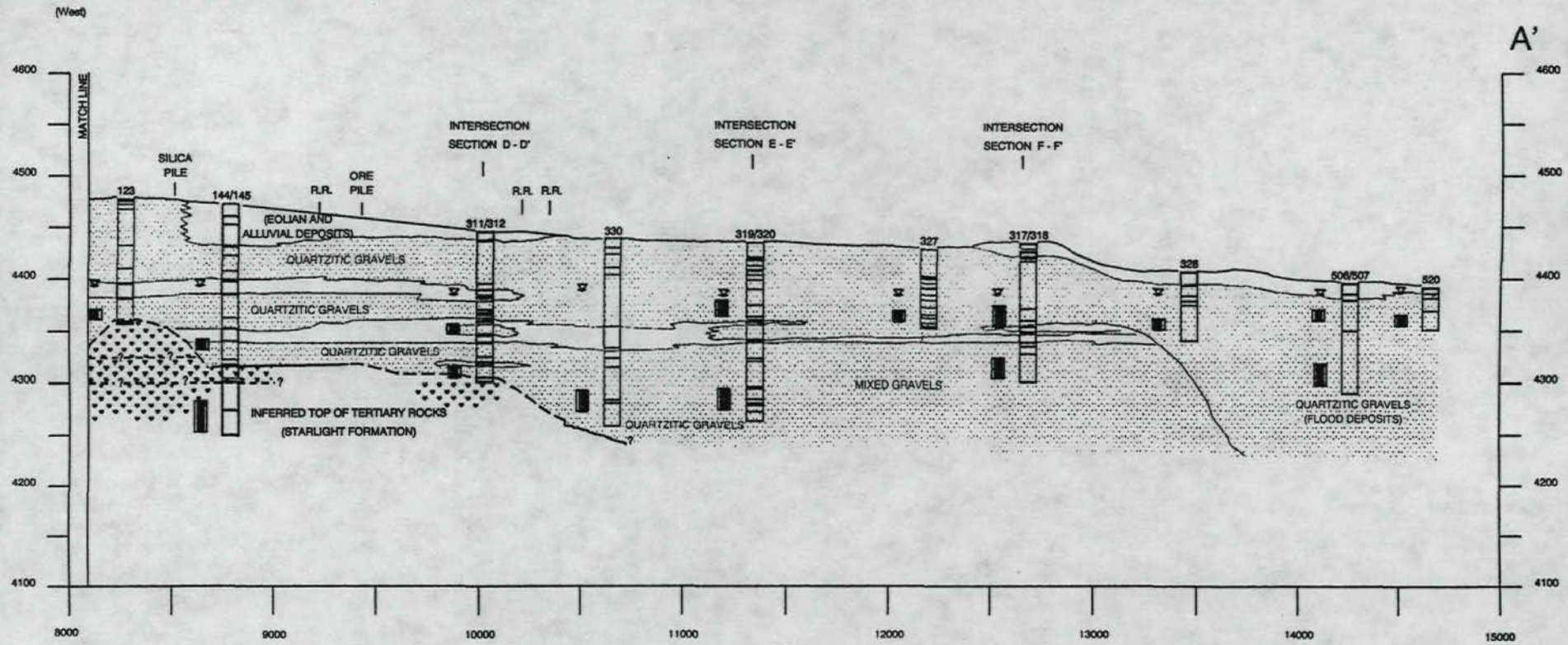
1. Ground surface line is generalized
2. Vertical scale is exaggerated 5 times horizontal

BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Hydrogeologic Cross-Section A-A'
(Sheet 1 of 2)

Job Number	Drawing No.	Rev
21372	FIGURE 3.1-5	



Legend:

- Water Level
- Well Screen

SAND
GRAVELLY SAND
SILTY SAND
CLAYEY SAND
SANDSTONE
GRAVEL
SAND AND GRAVEL
SILTY, SANDY GRAVEL
SILTY GRAVEL
CLAYEY GRAVEL

SILT
CLAYEY SILT
SANDY SILT
GRAVELLY SILT

CLAY
SILTY CLAY
SANDY CLAY
GRAVELLY CLAY

BASALT
RHYOLITE
TUFF

CALICHE
PEAT

ASPHALT
CONCRETE
FILL

NOTES:

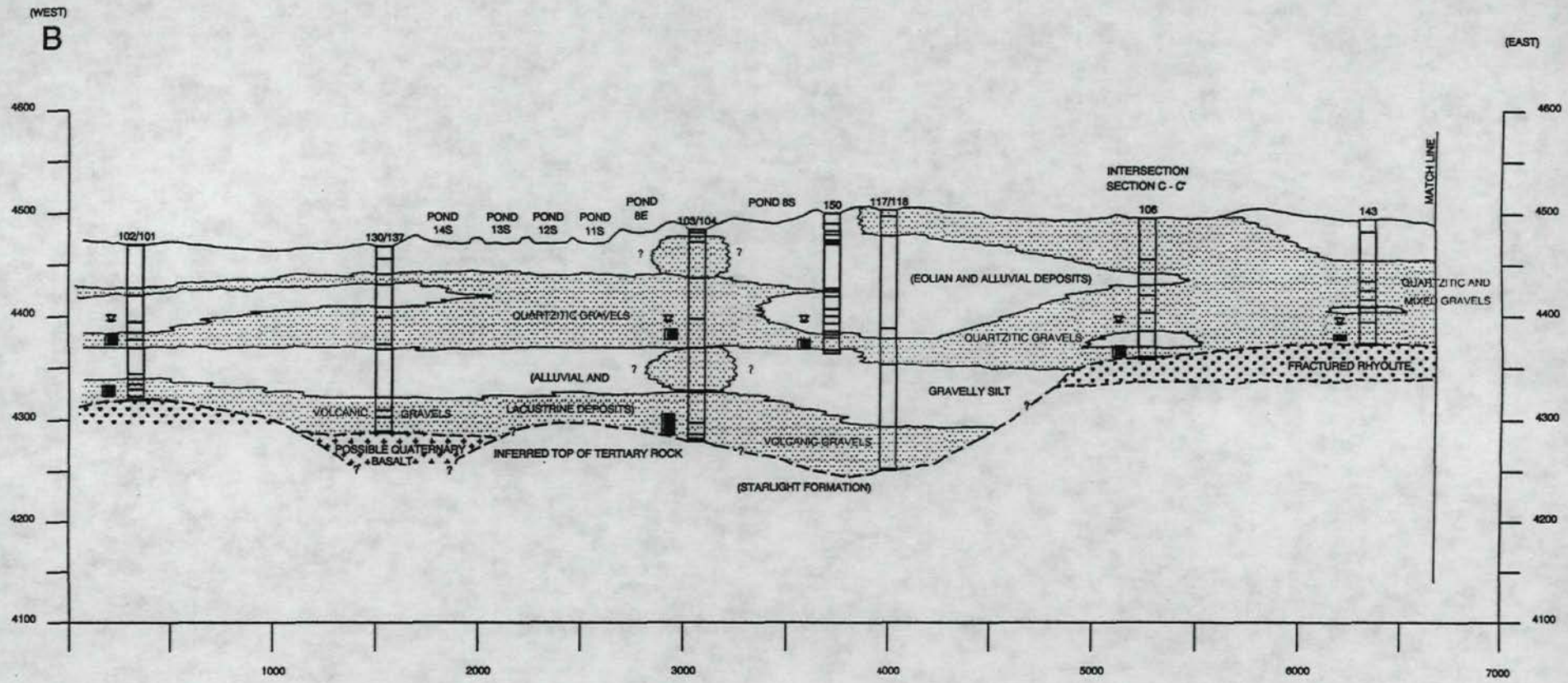
1. Ground surface line is generalized
2. Vertical scale is exaggerated 5 times horizontal

BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Hydrogeologic Cross-Section A-A'
(Sheet 2 of 2)

Job Number	Drawing No.
21372	FIGURE 3.1-5



Legend:

- Water level
- Well screen

SAND
GRAVELLY SAND
SILTY SAND
CLAYEY SAND
SANDSTONE
GRAVEL
SAND AND GRAVEL
SILTY, SANDY GRAVEL
SILTY GRAVEL
CLAYEY GRAVEL

SILT
CLAYEY SILT
SANDY SILT
GRAVELLY SILT

CLAY
SILTY CLAY
SANDY CLAY
GRAVELLY CLAY

BASALT
RHYOLITE
TUFF

CALICHE
PEAT

ASPHALT
CONCRETE
FILL

NOTES:

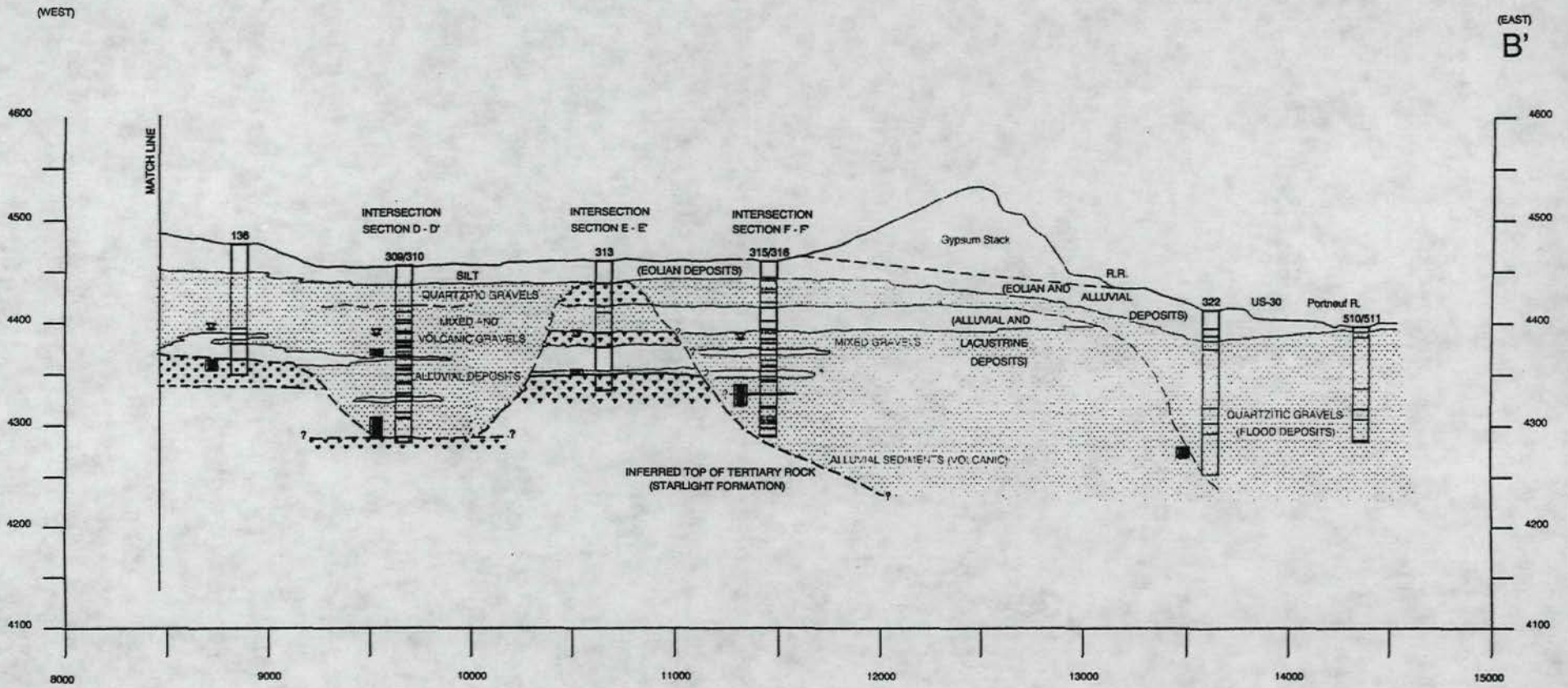
1. Ground surface line is generalized
2. Vertical scale is exaggerated 5 times horizontal

BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Hydrogeologic Cross-Section B-B'
(Sheet 1 of 2)

Job Number	Drawing No.	Rev.
21372	FIGURE 3.1-6	



Legend:

- Water level
- Well screen

SAND
GRAVELLY SAND
SILTY SAND
CLAYEY SAND
SANDSTONE
GRAVEL
SAND AND GRAVEL
SILTY SANDY GRAVEL
SILTY GRAVEL
CLAYEY GRAVEL

SILT
CLAYEY SILT
SANDY SILT
GRAVELLY SILT

CLAY
SILTY CLAY
SANDY CLAY
GRAVELLY CLAY

BASALT
RHYOLITE
TUFF

CALICHE
PEAT

ASPHALT
CONCRETE
FILL

NOTES:

1. Ground surface line is generalized
2. Vertical scale is exaggerated 5 times horizontal

BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Hydrogeologic Cross-Section B-B' (Sheet 2 of 2)

Job Number	Drawing No.	Re
21372	FIGURE 3.1-6	

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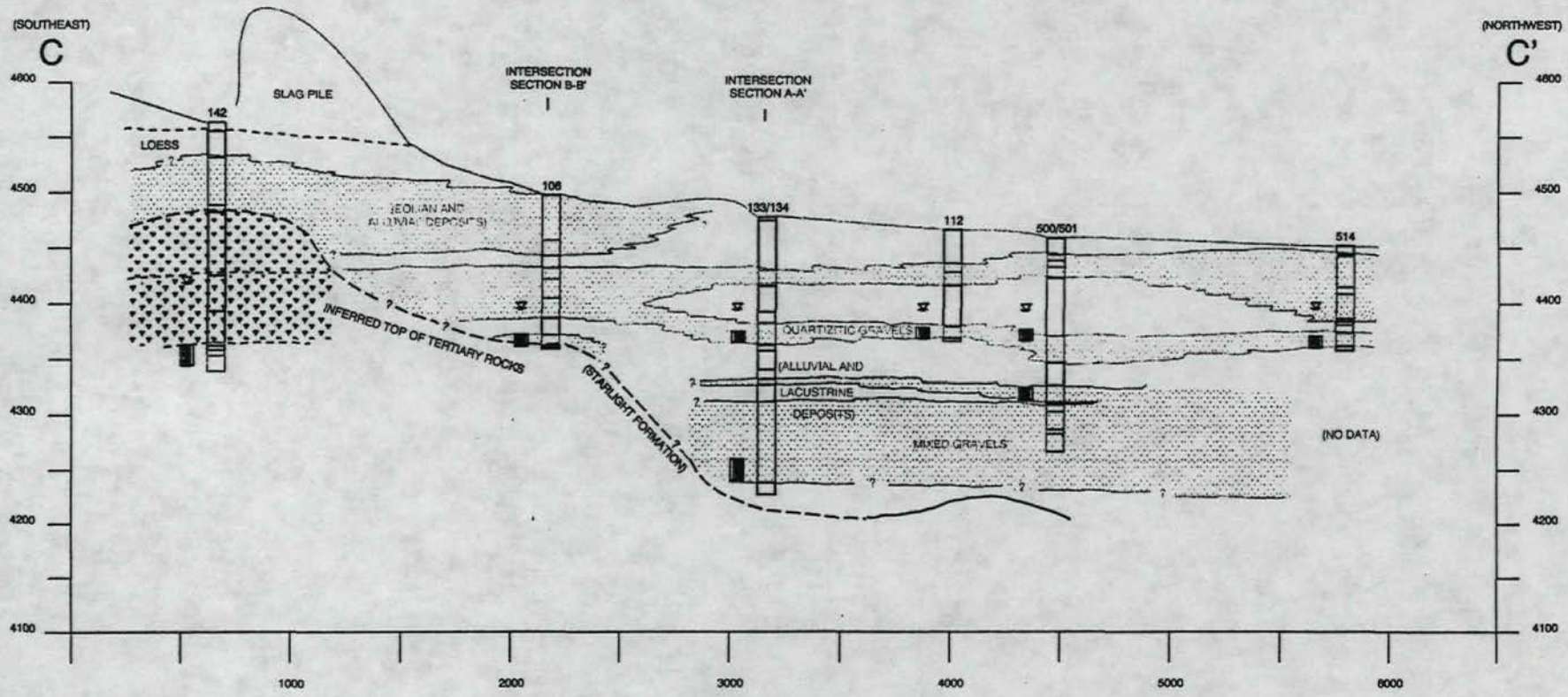

Legend:

- Water level
- Well screen

SAND
GRAVELLY SAND
SILTY SAND
CLAYEY SAND
SANDSTONE
GRAVEL
SAND AND GRAVEL
SILTY, SANDY GRAVEL
SILTY GRAVEL
CLAYEY GRAVEL

SILT
CLAYEY SILT
SANDY SILT
GRAVELLY SILT

CLAY
SILTY CLAY
SANDY CLAY
GRAVELLY CLAY

BASALT
RHYOLITE
TUFF

CALICHE
PEAT

ASPHALT
CONCRETE
FILL

NOTES:

1. Ground surface line is generalized
2. Vertical scale is exaggerated 5 times horizontal

BECHTEL ENVIRONMENTAL, INC.
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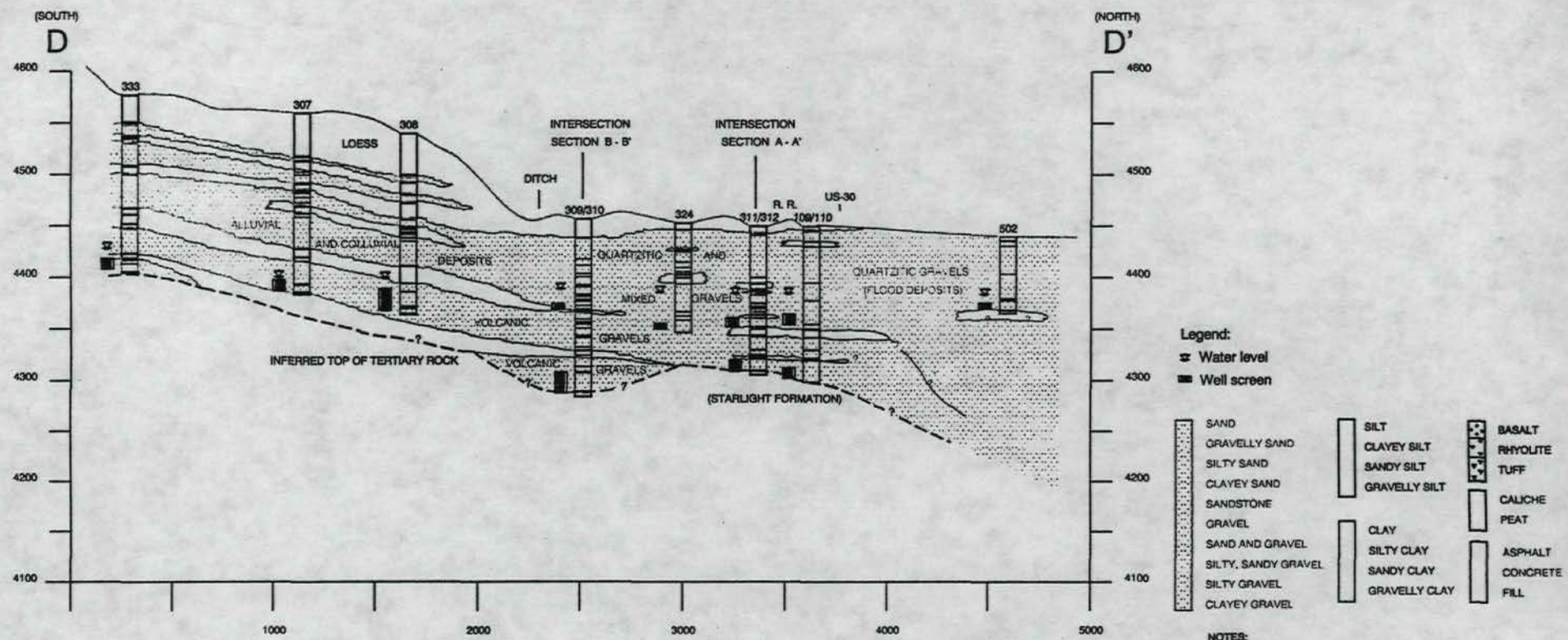
EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Hydrogeologic Cross-Section C-C'

Job Number	Drawing No.	Rev
21372	FIGURE 3.1-7	



NOTES:

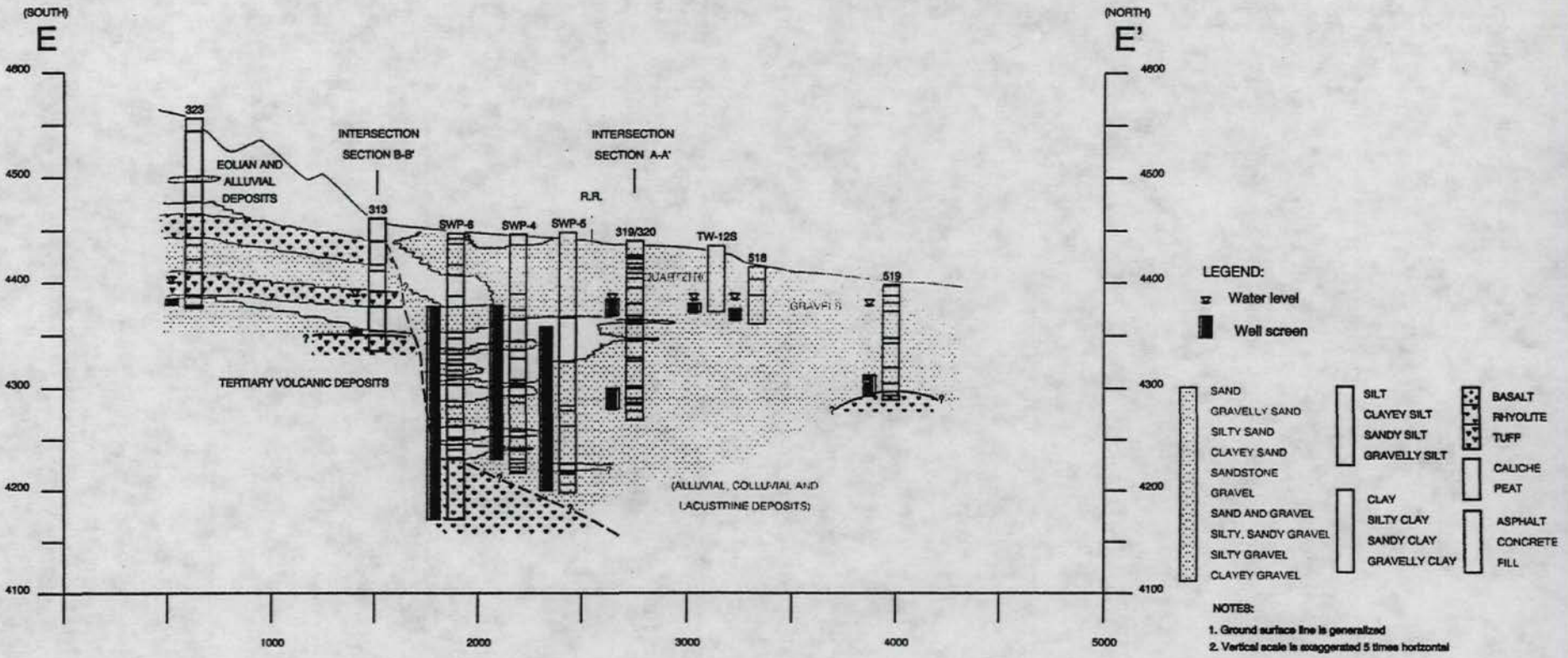
1. Ground surface line is generalized
2. Vertical scale is exaggerated 5 times horizontal

BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Hydrogeologic Cross-Section D-D'

Job Number	Drawing No.	Rev
21372	FIGURE 3.1-8	



BECHTEL ENVIRONMENTAL, INC.
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EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Hydrogeological Cross-Section E-E'

Job Number	Drawing No.	Rev
21372	FIGURE 3.1-9	

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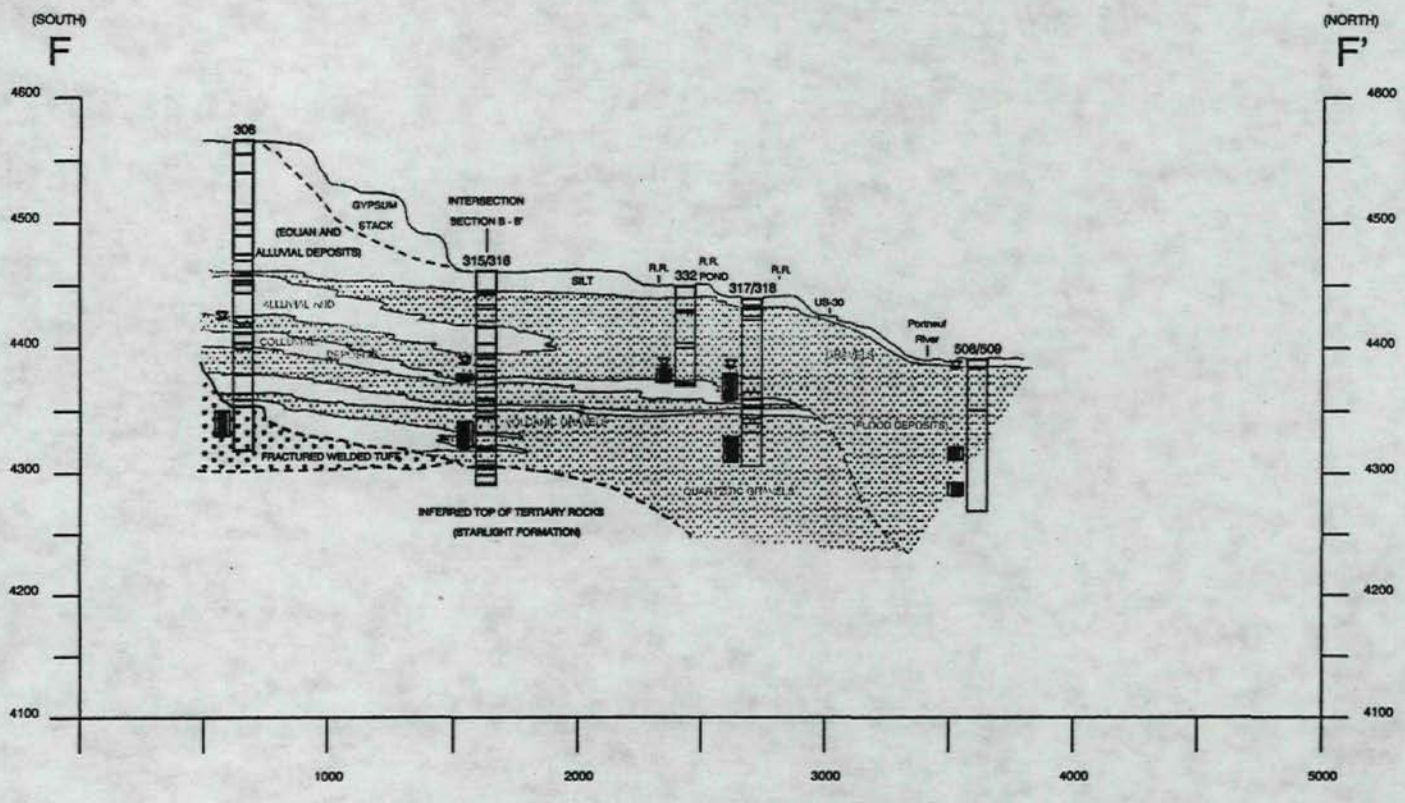

Legend:

- Water Level
- Well Screen

SAND
GRAVELLY SAND
SILTY SAND
CLAYEY SAND
SANDSTONE
GRAVEL
SAND AND GRAVEL
SILTY, SANDY GRAVEL
SILTY GRAVEL
CLAYEY GRAVEL

SILT
CLAYEY SILT
SANDY SILT
GRAVELLY SILT

CLAY
SILTY CLAY
SANDY CLAY
GRAVELLY CLAY

BASALT
RHYOLITE
TUFF

CALICHE
PEAT

ASPHALT
CONCRETE
FILL

NOTES:

1. Ground surface line is generalized
2. Vertical scale is exaggerated 5 times horizontal

BECHTEL ENVIRONMENTAL, INC.
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EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Hydrogeologic Cross-Section F-F'

Job Number	Drawing No.	Rev
21372	FIGURE 3.1-10	

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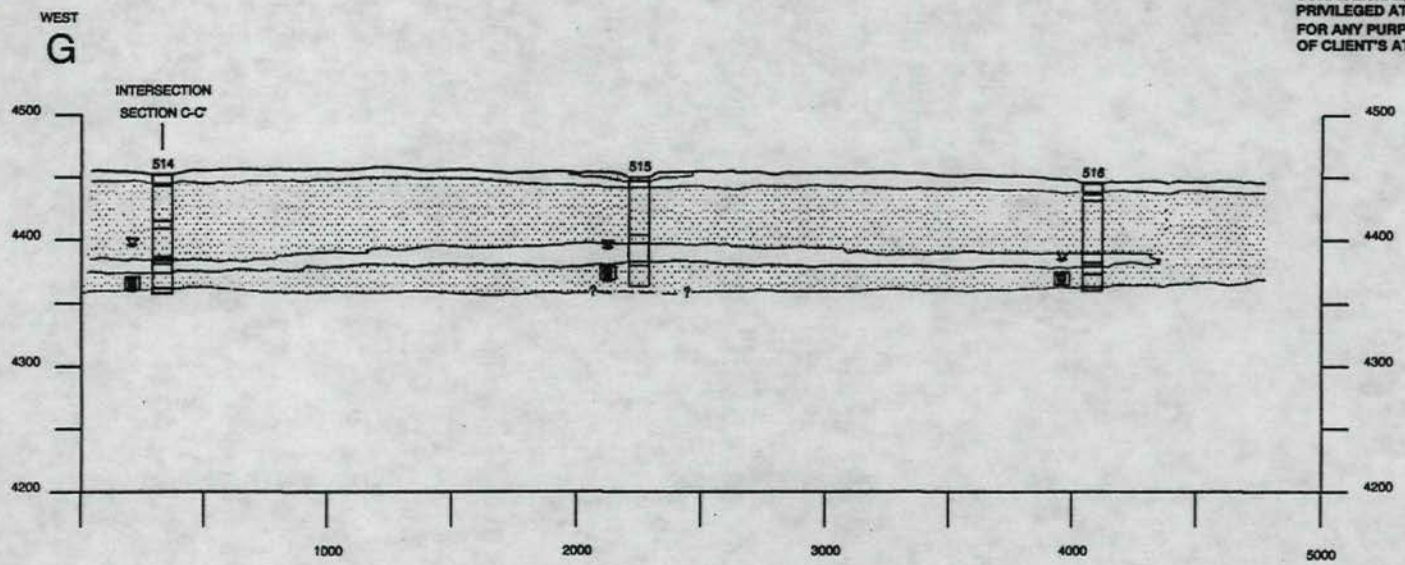

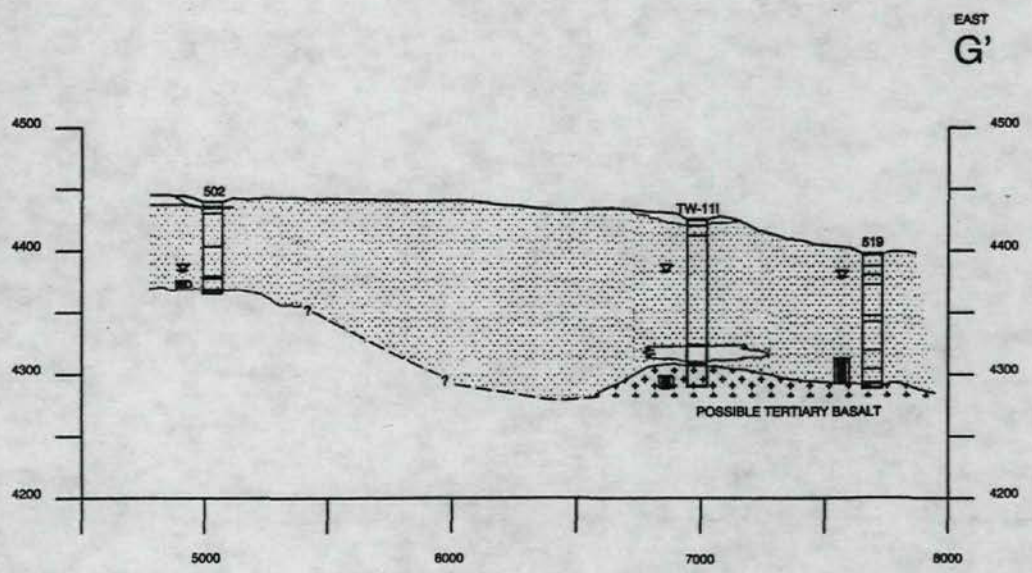

Legend:

Water Level

Well Screen

SAND
GRAVELLY SAND
SILTY SAND
CLAYEY SAND
SANDSTONE
GRAVEL
SAND AND GRAVEL
SILTY, SANDY GRAVEL
SILTY GRAVEL
CLAYEY GRAVEL

SILT
CLAYEY SILT
SANDY SILT
GRAVELLY SILT

CLAY
SILTY CLAY
SANDY CLAY
GRAVELLY CLAY

BASALT
RHYOLITE
TUFF

CALICHE
PEAT

ASPHALT
CONCRETE
FILL

NOTES:

1. Ground surface line is generalized
2. Vertical Scale is exaggerated 5 times horizontal

BECHTEL ENVIRONMENTAL, INC.
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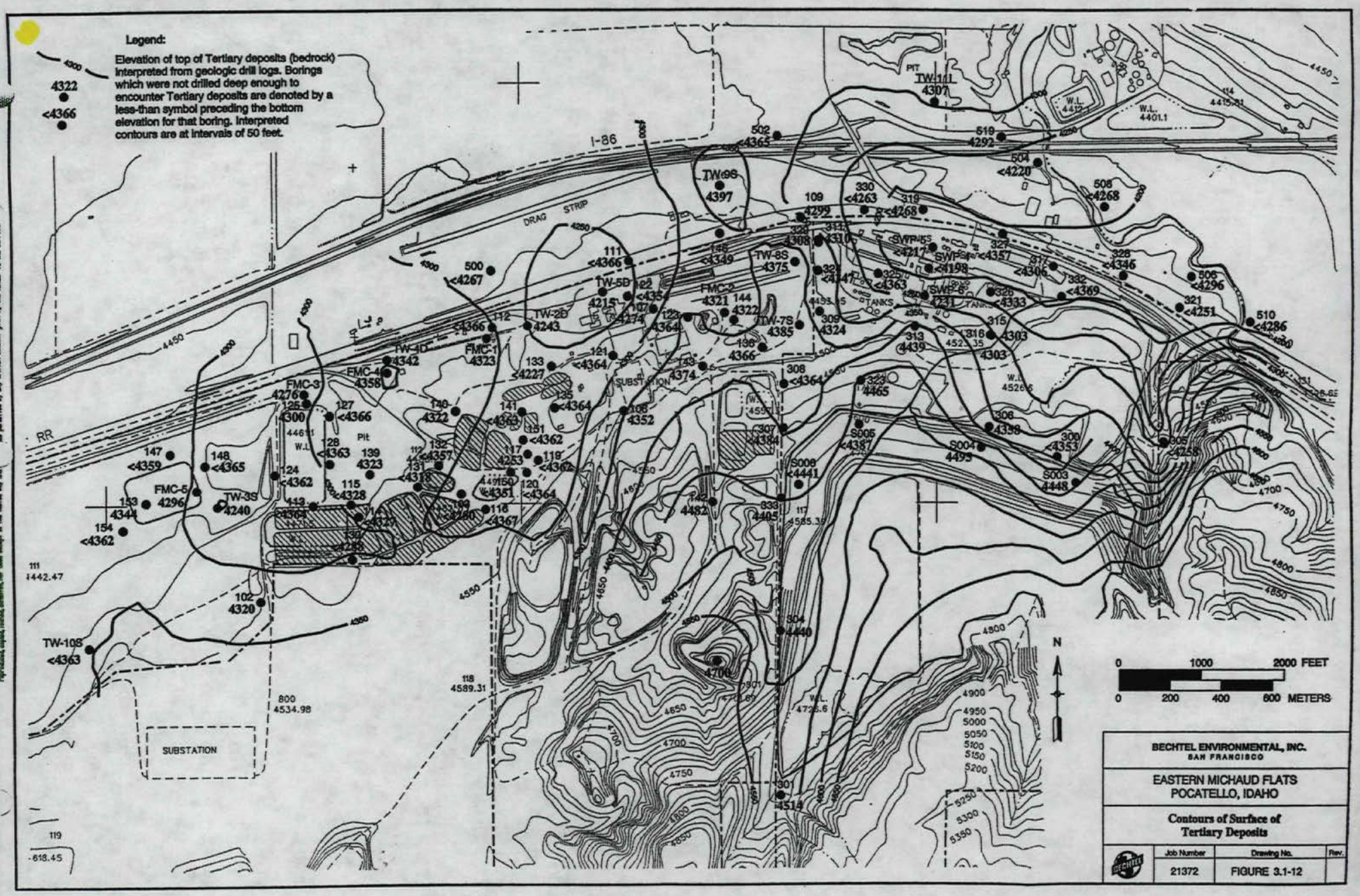
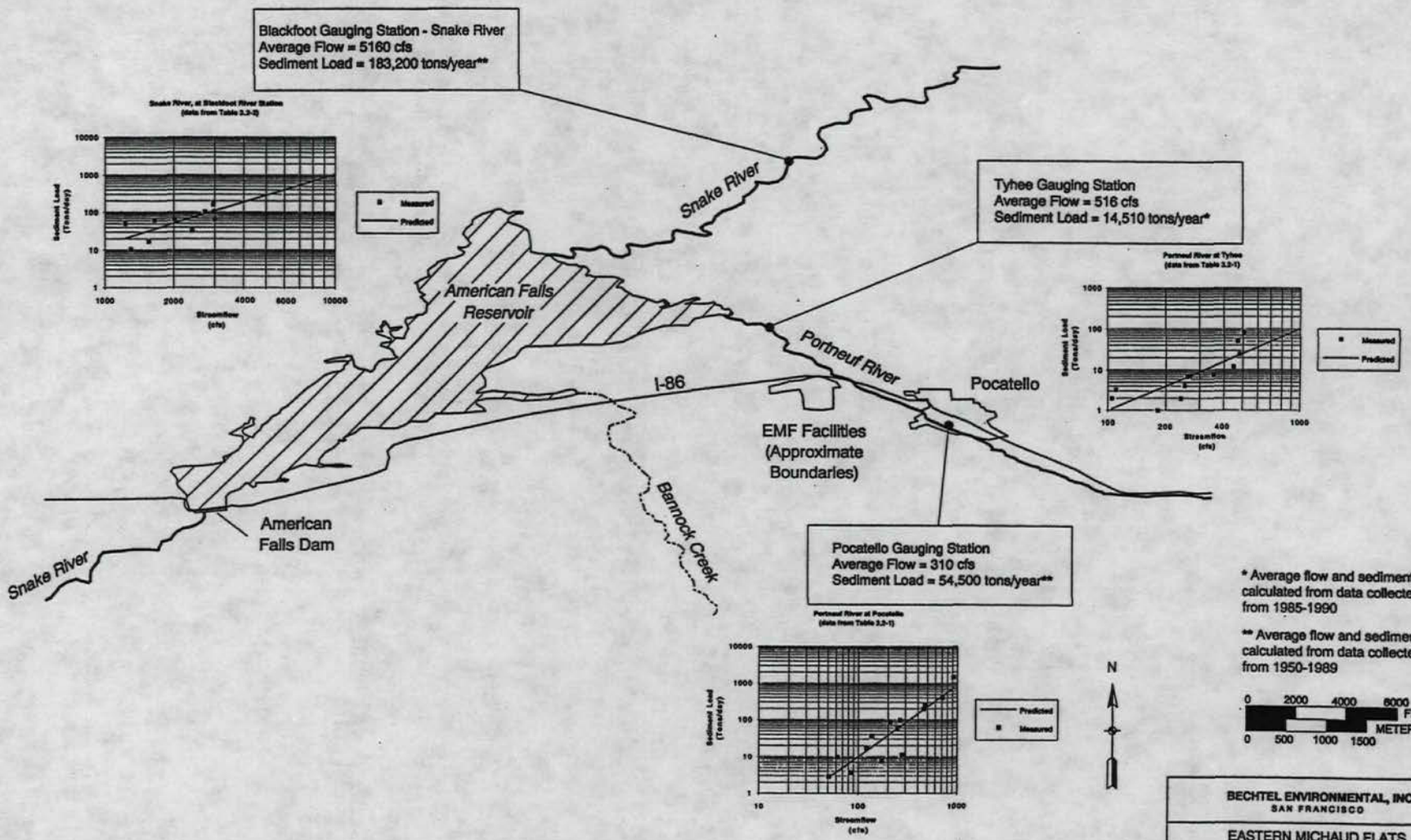
EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Hydrogeologic Cross-Section G-G'

Job Number	Drawing No.	Rev
21372	FIGURE 3.1-11	


Legend:
Elevation of top of Tertiary deposits (bedrock) interpreted from geologic drill logs. Borings which were not drilled deep enough to encounter Tertiary deposits are denoted by a less-than symbol preceding the bottom elevation for that boring. Interpreted contours are at intervals of 50 feet.
4322
<4366
I-86
DRAG STRIP
RR
SUBSTATION
TANKS
PIT
N
0 1000 2000 FEET
0 200 400 600 METERS
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO
EASTERN MICHAUD FLATS
POCATELLO, IDAHO
Contours of Surface of Tertiary Deposits
Job Number
21372
Drawing No.
FIGURE 3.1-12
Rev.



Reference: USGS Idaho Falls and Pocatello Topographic Maps, 1962 - 1:250,000 series

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EASTERN MICHAUD FLATS
POCATELLO, IDAHO

American Falls Reservoir and Environs

Job Number	Drawing No.	Rev.
21372	FIGURE 3.2-1	

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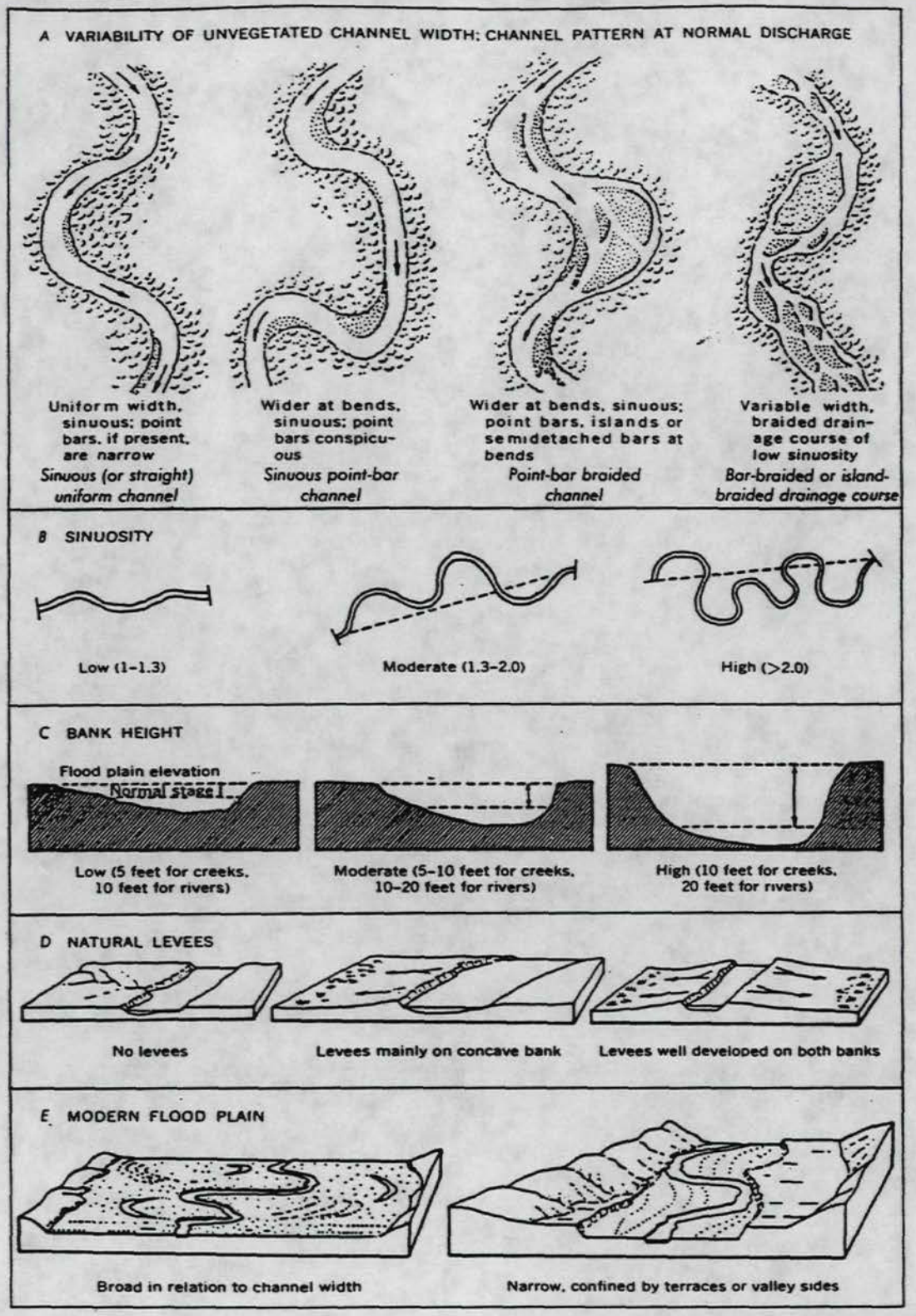
EMF emfefr.dgn 10/93



Reference: U.S.G.S., "Fluvial Sediment Concepts", Book 3, Chapter C1, 1970 (modified from Culbertson, Young, and Brice 1967).

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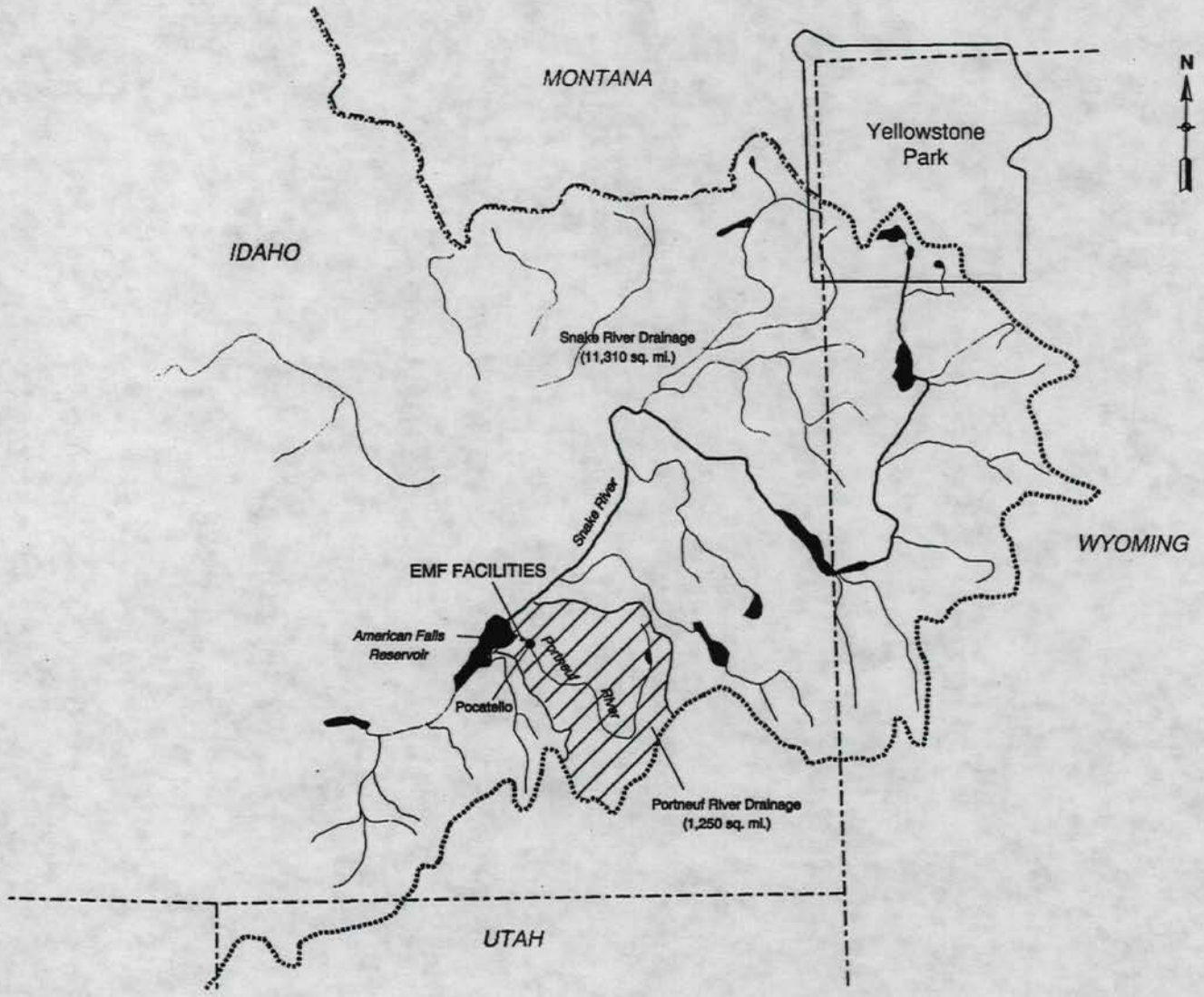
EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Deposition Patterns in Streams

Job Number	Drawing No.	Rev.
21372	FIGURE 3.2-2	



Legend:

- Rivers
- Portneuf River Drainage
- Snake River Drainage
- State boundaries

Reference: USGS Water Supply Paper 657, Plate 1

0 25 50 75 MILES

0 25 50 75 KM

BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Drainage Basins of Snake and Portneuf Rivers

Job Number	Drawing No.	Rev.
21372	FIGURE 3.2-3	

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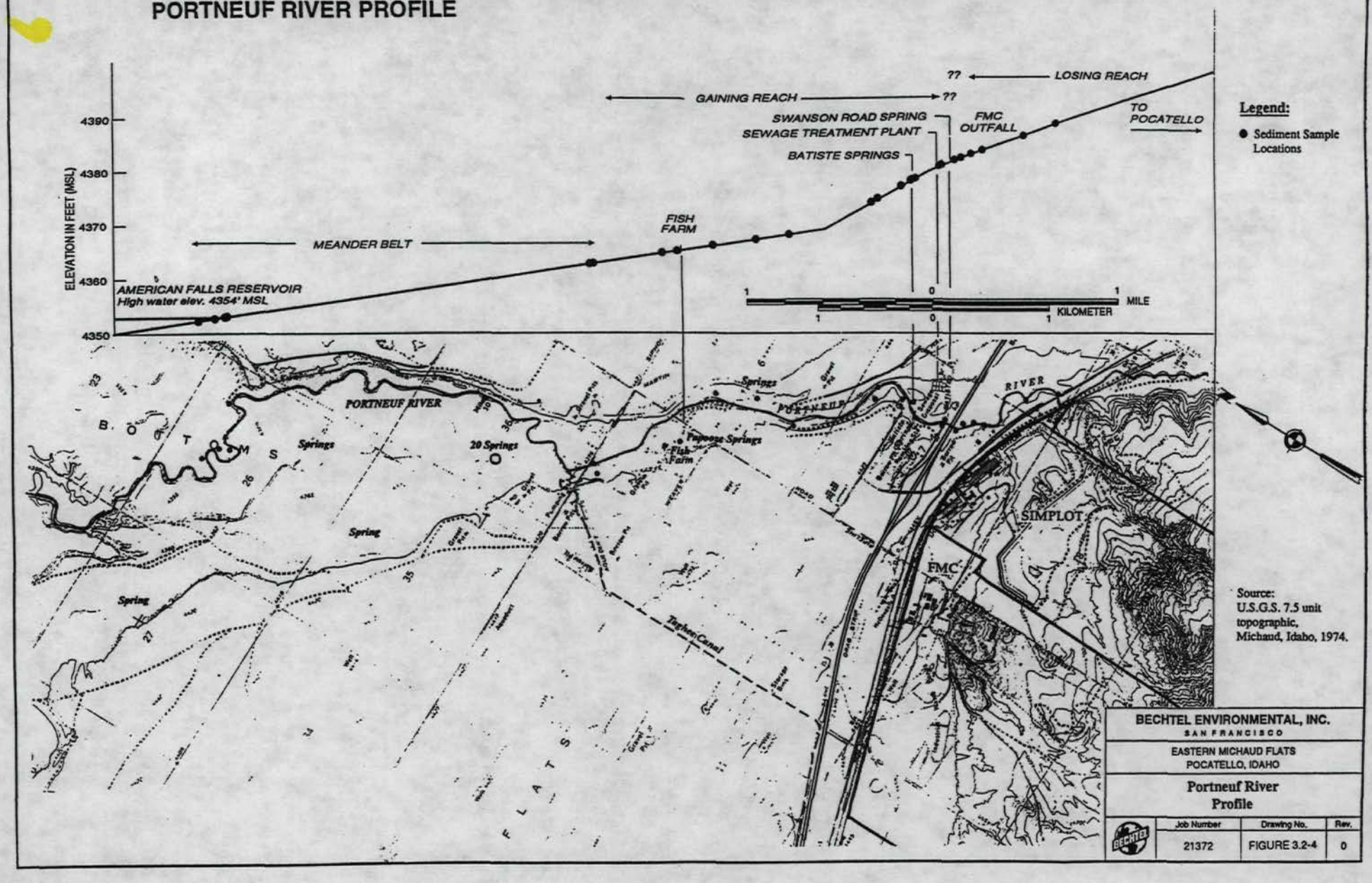
PORTNEUF RIVER PROFILE



BECHTEL ENVIRONMENTAL, INC.
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EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Portneuf River Profile

Job Number	Drawing No.	Rev.
21372	FIGURE 3.2-4	0

(Reference: Walker and Associates, 6/21/92)

0 0.5 1.0
SCALE IN MILES

BECHTEL ENVIRONMENTAL, INC.
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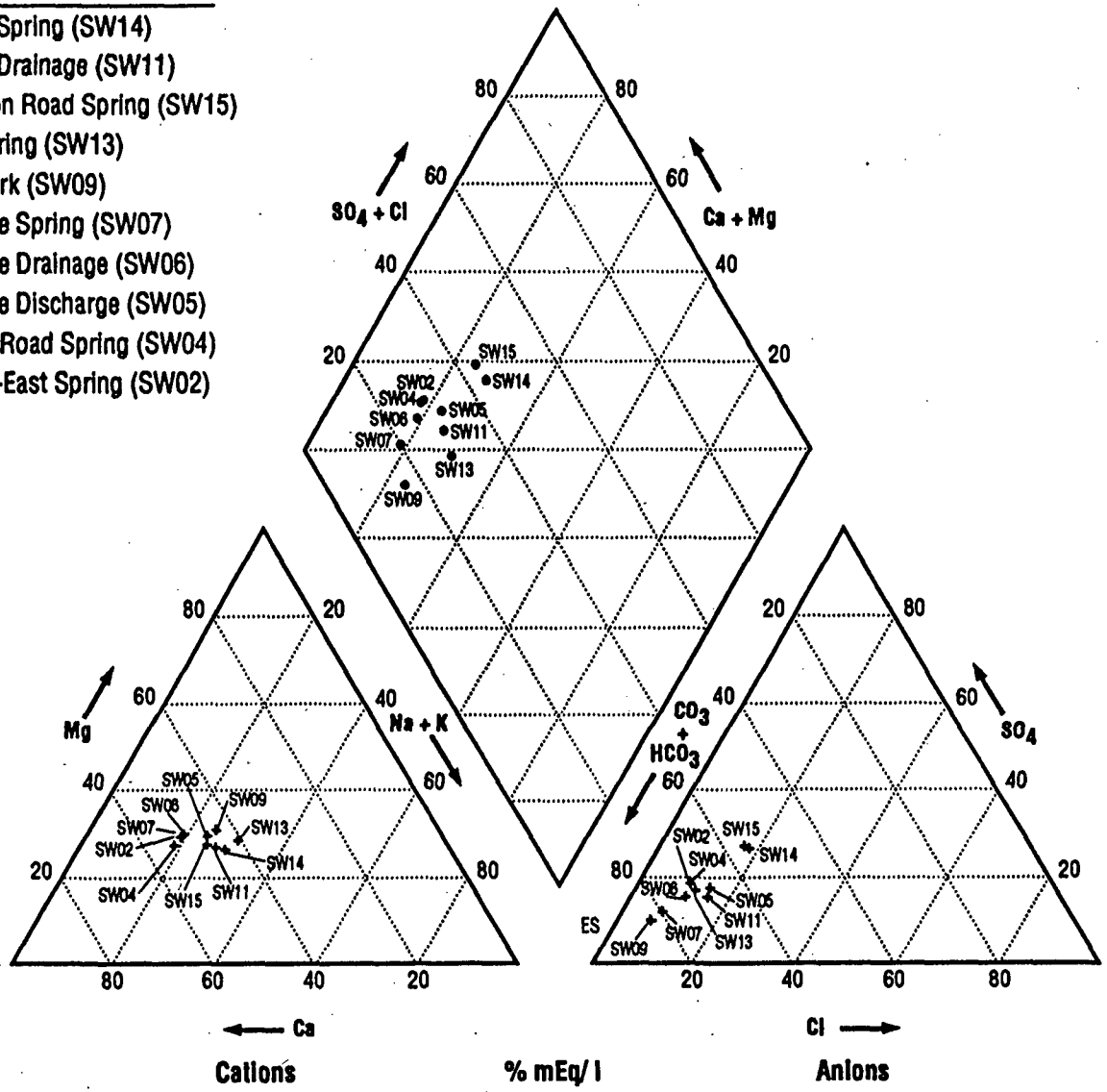
EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Aerial Photograph Showing Course of Portneuf River

BECHTEL	21372	FIGURE 3.2-5

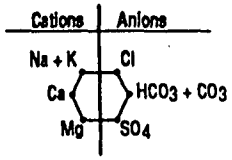
Sample Site

Batiste Spring (SW14)
Batiste Drainage (SW11)
Swanson Road Spring (SW15)
STP Spring (SW13)
FMC Park (SW09)
Papoose Spring (SW07)
Papoose Drainage (SW06)
Papoose Discharge (SW05)
Siphon Road Spring (SW04)
Twenty-East Spring (SW02)

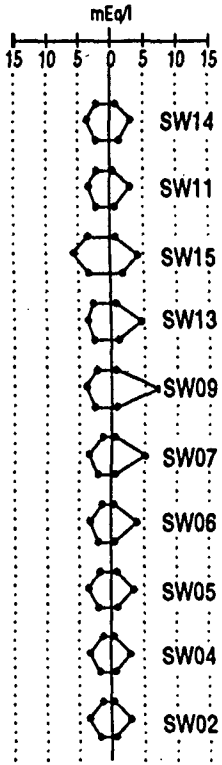


Piper Diagram

Legend



Stiff Diagram



BECHTEL ENVIRONMENTAL, INC.
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EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Piper and Stiff Diagrams Showing General Water Chemistry for Springs

JOB No.	DRAWING NO.	REV.
21372	FIGURE 3.2-6	

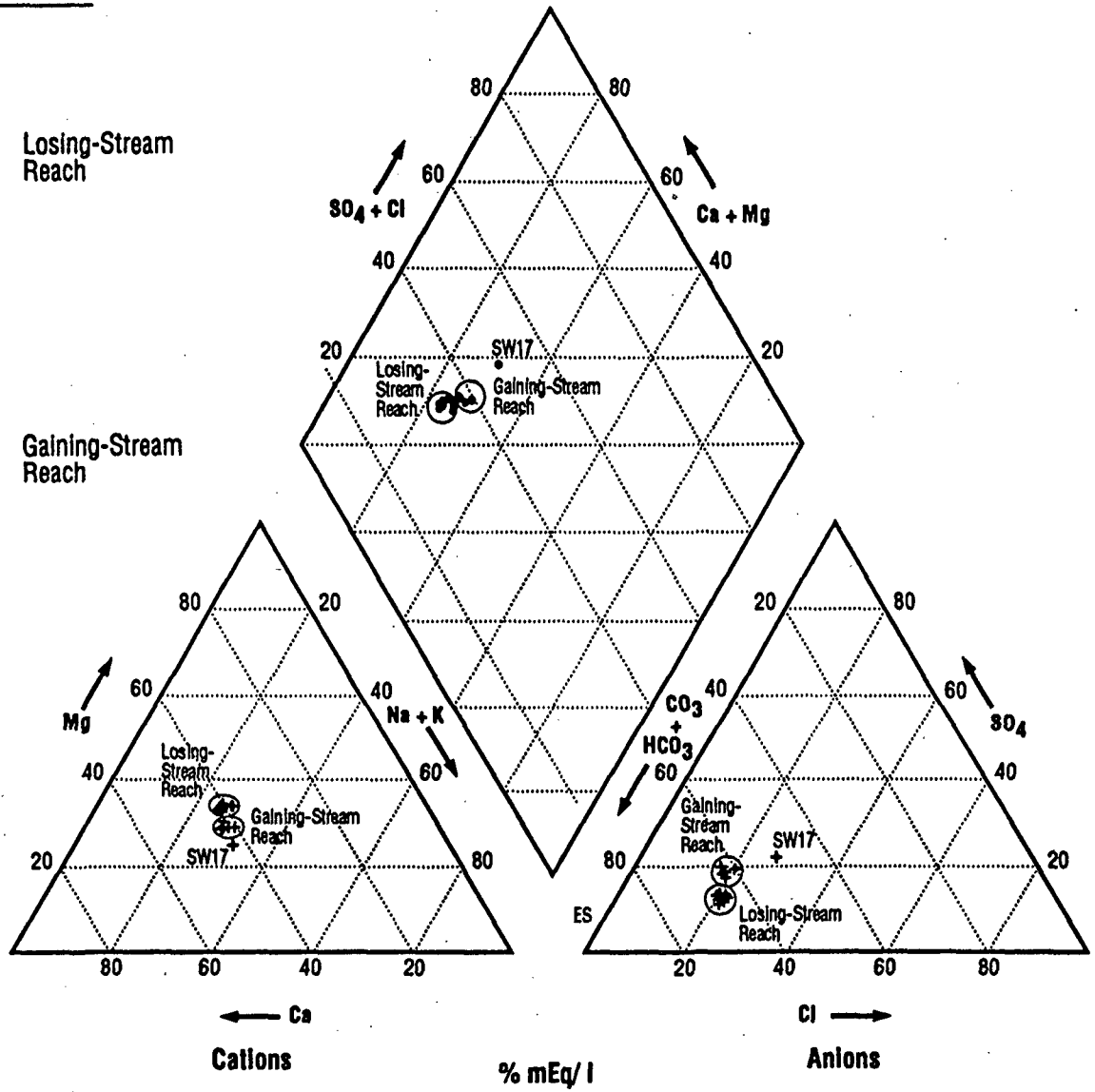
93-1477b.029
12-28-93 tp/ms :7

Sample Site

SW25
SW24
SW23
SW22
SW21
SW20
SW19
SW18
SW16
} Losing-Stream Reach

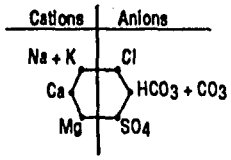
SW17

SW12
SW10
SW08
SW03
SW01
} Gaining-Stream Reach

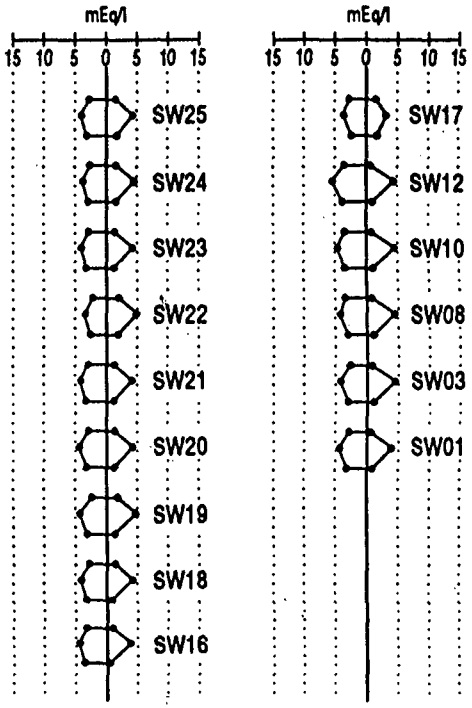


Piper Diagram

Legend

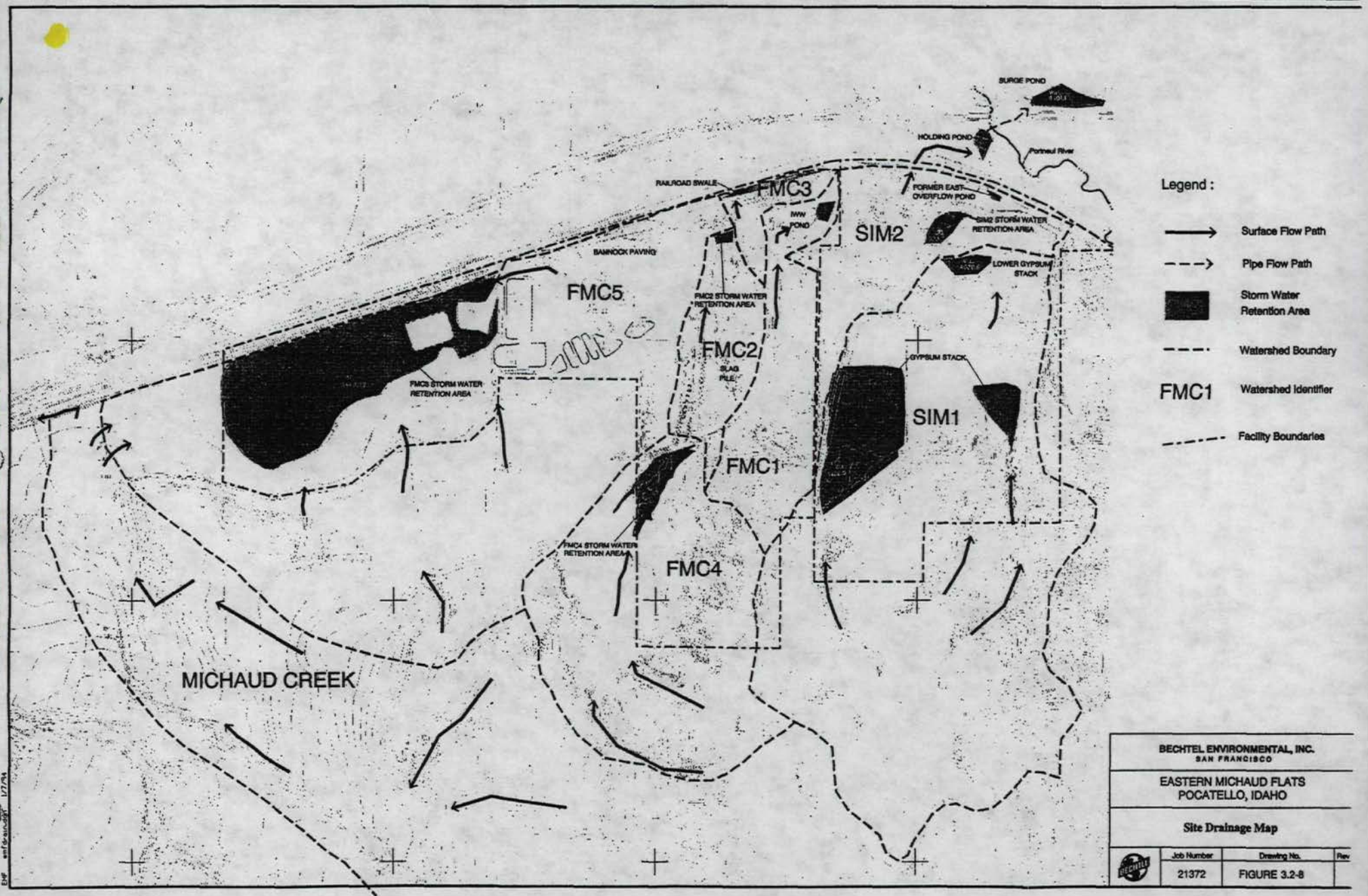


Stiff Diagram



BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO		
EASTERN MICHAUD FLATS POCATELLO, IDAHO		
Piper and Stiff Diagrams Showing General Water Chemistry for River Sampling Stations		
JOB No.	DRAWING NO.	REV.
21372	FIGURE 3.2-7	

93-1477b.030
12-28-93 tg/ma:7



BECHTEL ENVIRONMENTAL, INC.
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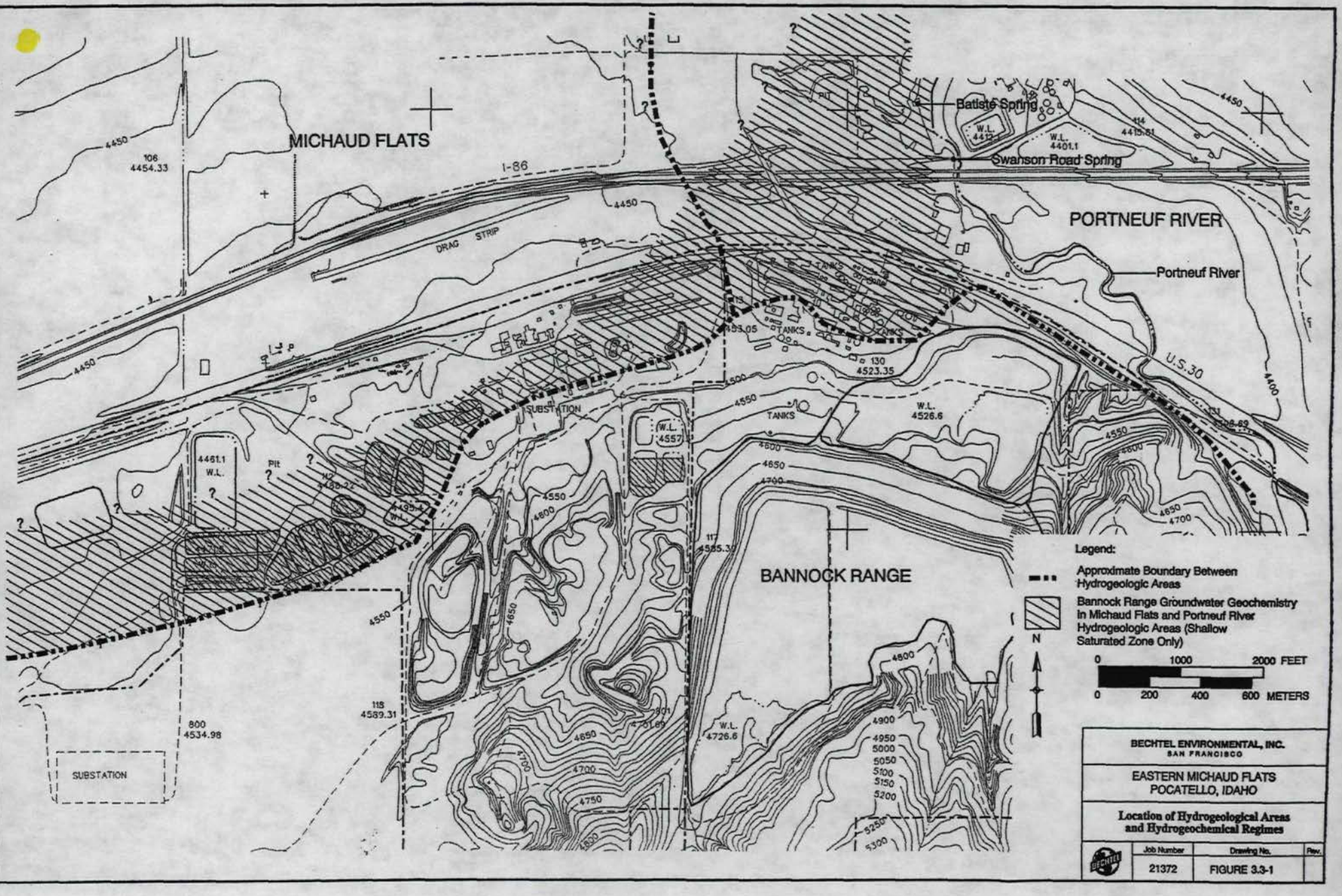
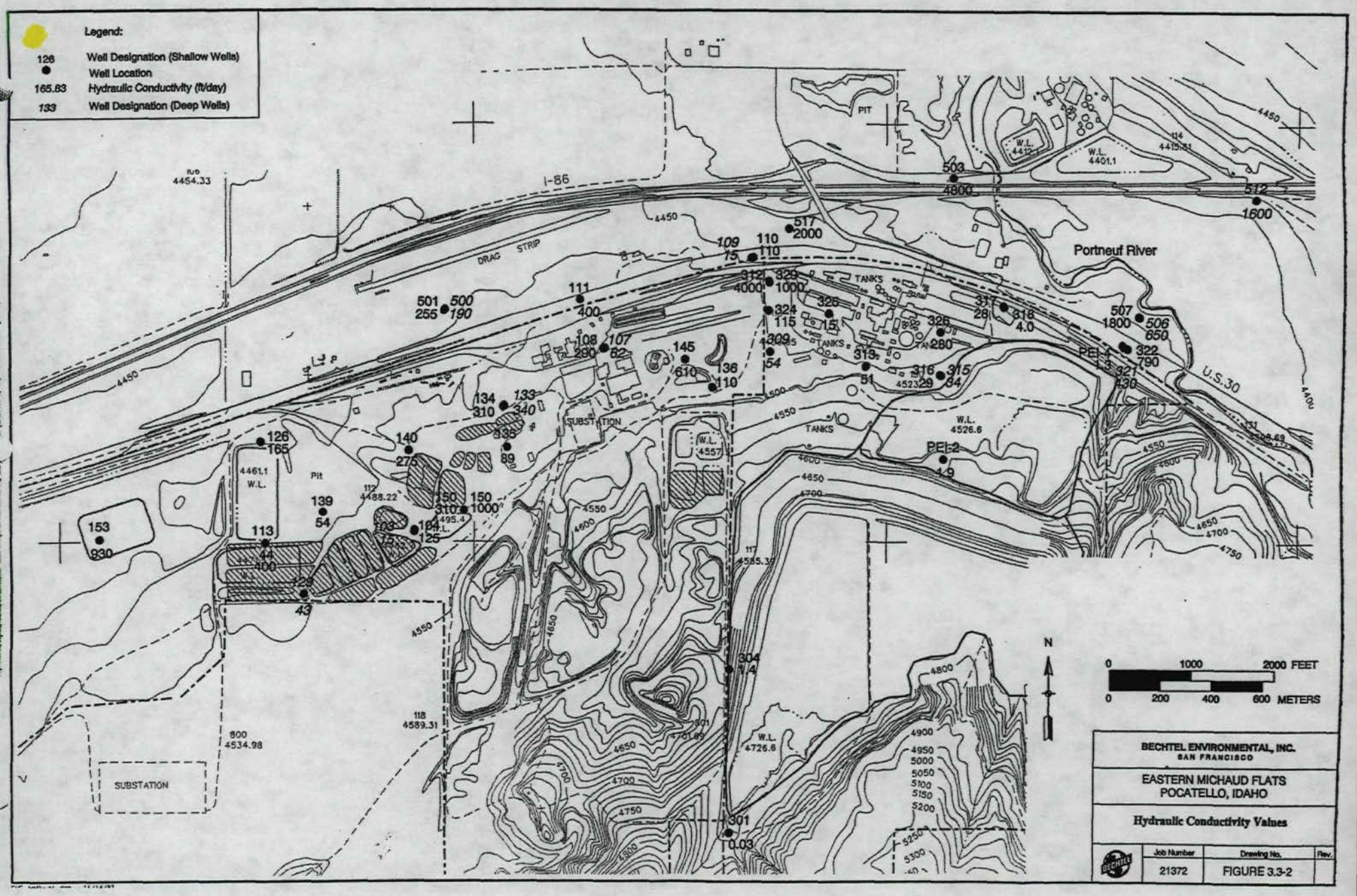
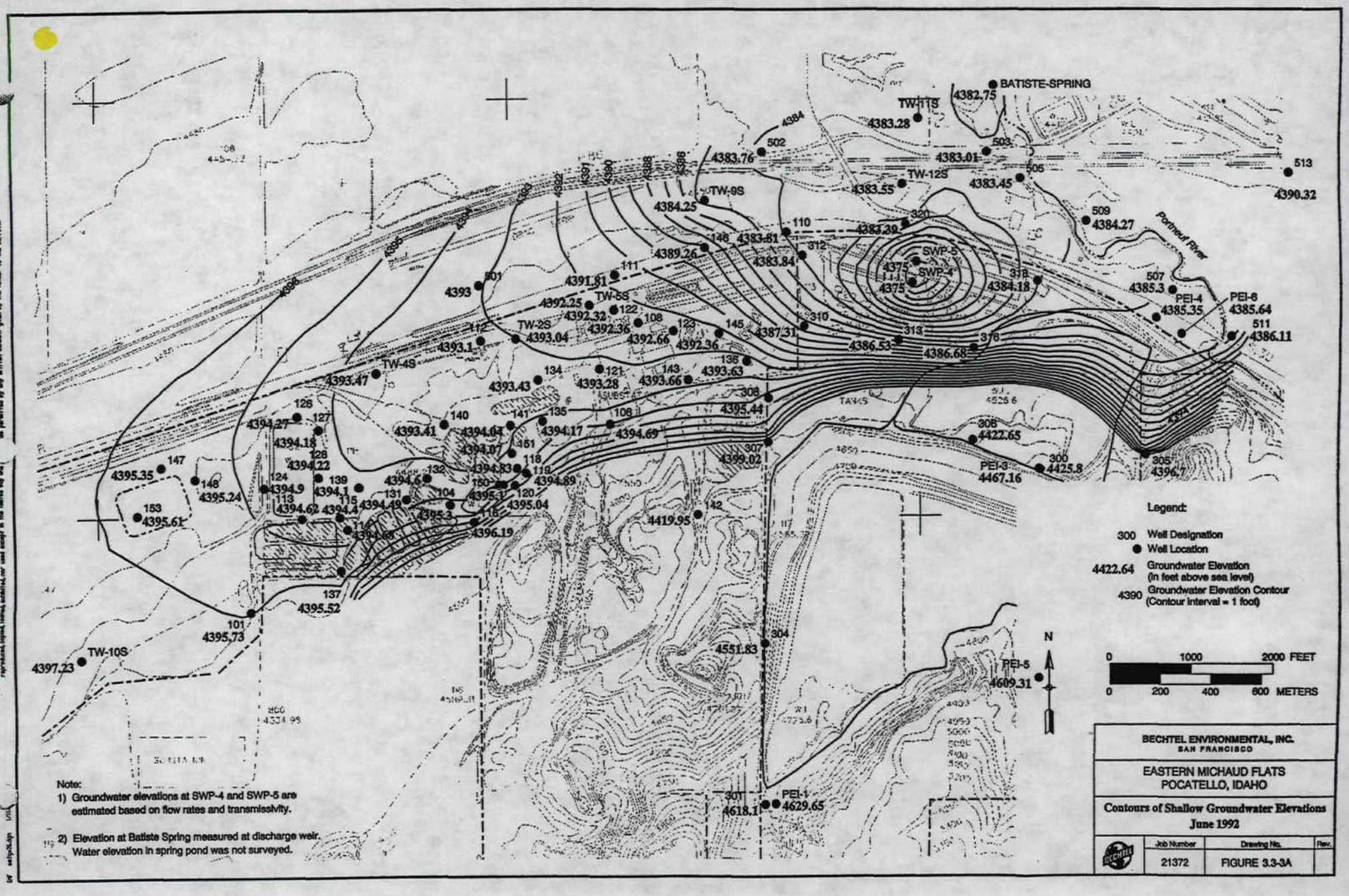
EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Site Drainage Map

Job Number	Drawing No.	Rev
21372	FIGURE 3.2-8	


MICHAUD FLATS
PORTNEUF RIVER
BANNOCK RANGE
Batiste Spring
Swanson Road Spring
Portneuf River
I-86
U.S.30
DRAG STRIP
SUBSTATION
TANKS
Pit
106
4454.33
4461.1
W.L.
W.L.
4557
W.L.
4526.6
W.L.
4726.6
W.L.
4401.1
130
4523.35
117
4585.30
118
4589.31
800
4534.98
4450
4500
4550
4600
4650
4700
4750
4800
4900
4950
5000
5050
5100
5150
5200
5250
5300
Legend:
Approximate Boundary Between Hydrogeologic Areas
Bannock Range Groundwater Geochemistry in Michaud Flats and Portneuf River Hydrogeologic Areas (Shallow Saturated Zone Only)
N
0 1000 2000 FEET
0 200 400 600 METERS
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO
EASTERN MICHAUD FLATS
POCATELLO, IDAHO
Location of Hydrogeological Areas and Hydrogeochemical Regimes
Job Number
21372
Drawing No.
FIGURE 3.3-1
Rev.


Legend:
126 Well Designation (Shallow Wells)
Well Location
165.83 Hydraulic Conductivity (ft/day)
133 Well Designation (Deep Wells)
I-86
DRAG STRIP
Portneuf River
U.S.30
TANKS
SUBSTATION
PIT
W.L. 4401.1
W.L. 4526.6
W.L. 4557
W.L. 4726.6
W.L. 4461.1
Pit
N
0 1000 2000 FEET
0 200 400 600 METERS
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO
EASTERN MICHAUD FLATS
POCATELLO, IDAHO
Hydraulic Conductivity Values
Job Number
21372
Drawing No.
FIGURE 3.3-2
Rev.



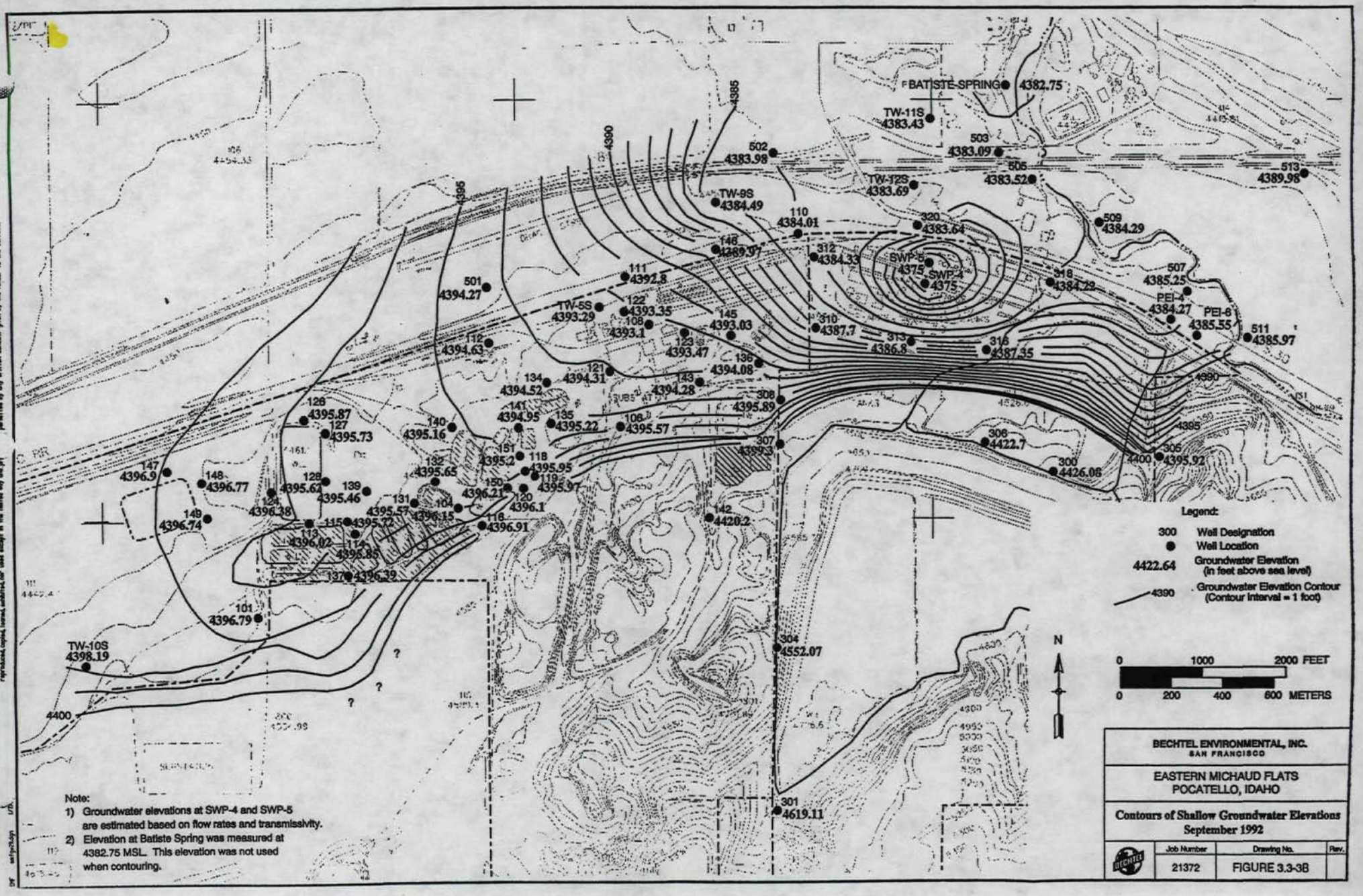
Note:
1) Groundwater elevations at SWP-4 and SWP-5 are estimated based on flow rates and transmissivity.
2) Elevation at Batiste Spring measured at discharge weir. Water elevation in spring pond was not surveyed.

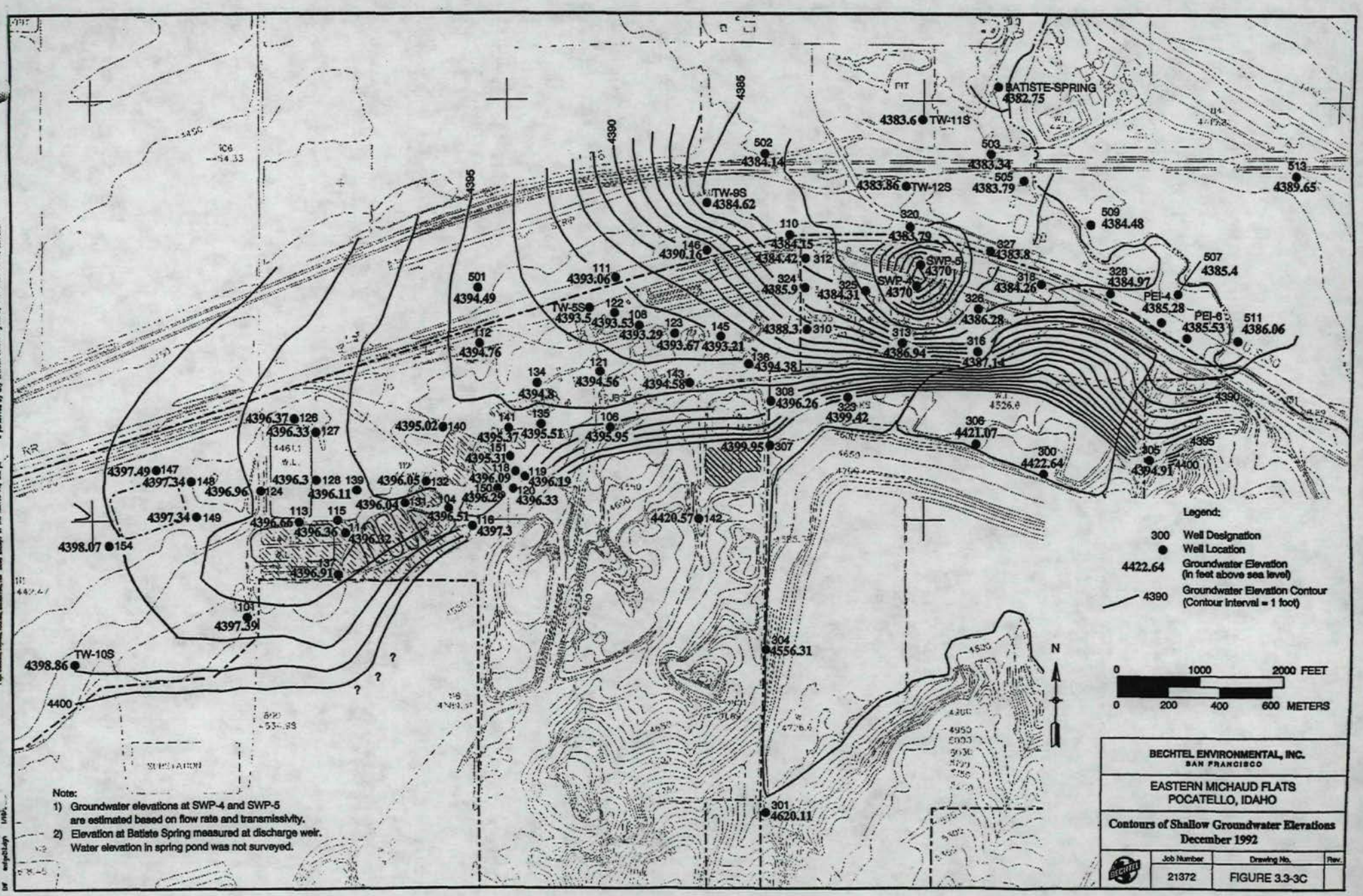
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

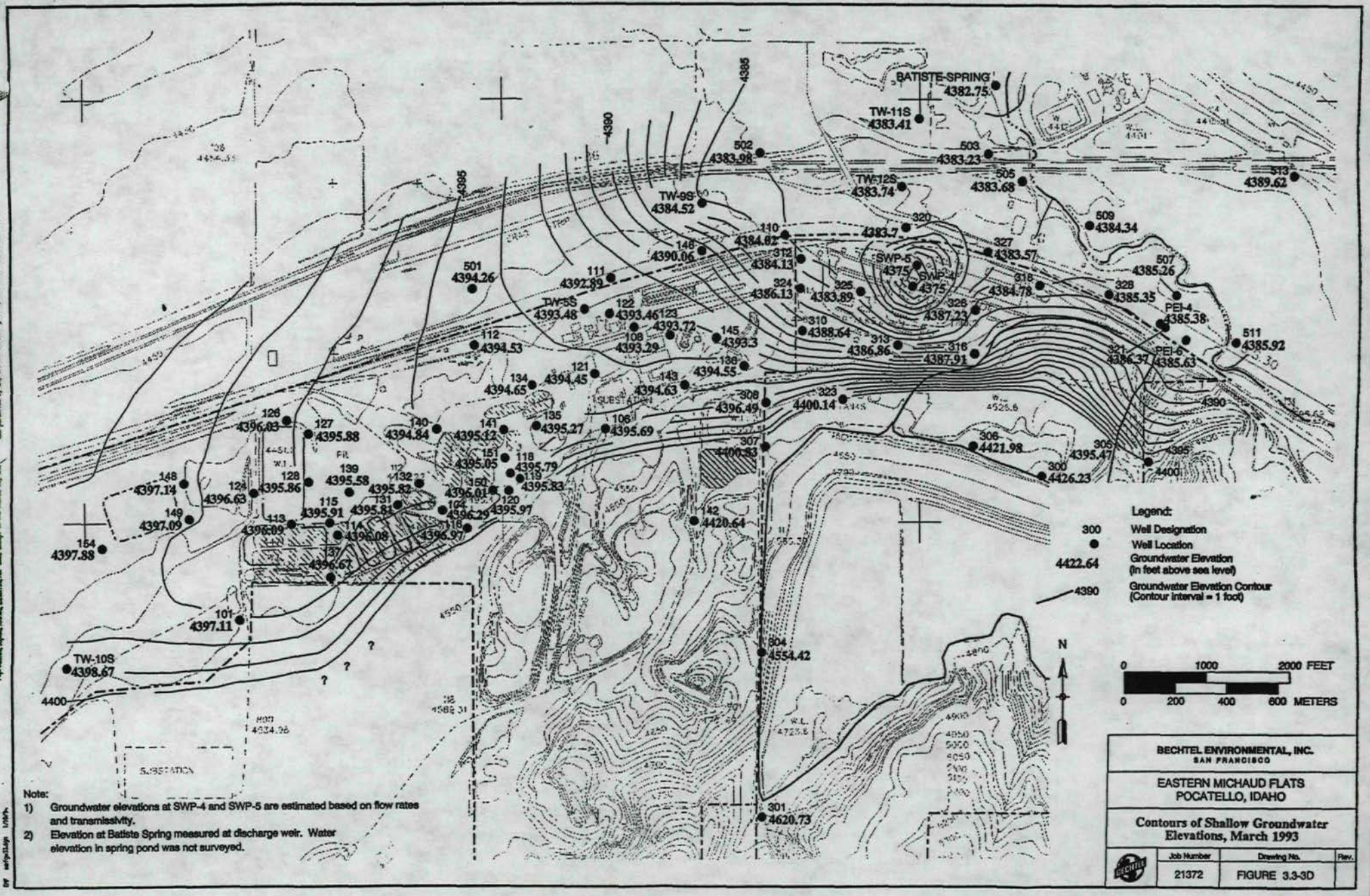
EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Contours of Shallow Groundwater Elevations
June 1992

Job Number	Drawing No.	Rev.
21372	FIGURE 3.3-3A	


BATISTE SPRING 4382.75
TW-11S 4383.43
503 4383.09
505 4383.52
513 4389.98
502 4383.98
TW-12S 4383.69
TW-9S 4384.49
110 4384.01
320 4383.64
509 4384.29
146 4389.97
312 4384.33
SWP-5 4375
SWP-4 4375
318 4384.22
507 4385.25
PEI-4 4384.27
PEI-6 4385.55
511 4385.97
501 4394.27
111 4392.8
TW-5S 4393.29
122 4393.35
108 4393.1
145 4393.03
310 4387.7
313 4386.8
316 4387.35
112 4394.63
123 4393.47
136 4394.08
134 4394.52
121 4394.31
143 4394.28
308 4395.89
126 4395.87
127 4395.73
140 4395.16
141 4394.95
135 4395.22
106 4395.57
307 4399.3
306 4422.7
300 4426.08
305 4395.92
147 4396.9
148 4396.77
128 4395.62
139 4395.46
151 4395.2
118 4395.95
119 4395.97
132 4395.65
150 4396.21
120 4396.1
124 4396.38
131 4395.57
104 4396.15
149 4396.74
115 4395.72
116 4396.91
142 4420.2
113 4396.02
114 4395.85
137 4396.39
101 4396.79
TW-10S 4398.19
304 4552.07
301 4619.11
4385
4390
4395
4400
Legend:
300 Well Designation
Well Location
4422.64 Groundwater Elevation (in feet above sea level)
4390 Groundwater Elevation Contour (Contour Interval = 1 foot)
N
0 1000 2000 FEET
0 200 400 600 METERS
Note:
1) Groundwater elevations at SWP-4 and SWP-5 are estimated based on flow rates and transmissivity.
2) Elevation at Batiste Spring was measured at 4382.75 MSL. This elevation was not used when contouring.
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO
EASTERN MICHAUD FLATS
POCATELLO, IDAHO
Contours of Shallow Groundwater Elevations
September 1992
Job Number
21372
Drawing No.
FIGURE 3.3-3B
Rev.


BATISTE SPRING
4382.75
TW-11S
4383.6
TW-12S
4383.86
TW-9S
4384.62
TW-5S
4393.5
TW-10S
4398.86
SWP-5
4370
SWP-4
4370
PEI-4
4385.28
PEI-6
4385.53
4385
4390
4395
4400
Legend:
300 Well Designation
Well Location
4422.64 Groundwater Elevation (in feet above sea level)
4390 Groundwater Elevation Contour (Contour Interval = 1 foot)
N
0 1000 2000 FEET
0 200 400 600 METERS
Note:
1) Groundwater elevations at SWP-4 and SWP-5 are estimated based on flow rate and transmissivity.
2) Elevation at Batiste Spring measured at discharge weir. Water elevation in spring pond was not surveyed.
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO
EASTERN MICHAUD FLATS
POCATELLO, IDAHO
Contours of Shallow Groundwater Elevations
December 1992
Job Number
21372
Drawing No.
FIGURE 3.3-3C
Rev.



Note:

1) Groundwater elevations at SWP-4 and SWP-5 are estimated based on flow rates and transmissivity.

2) Elevation at Batiste Spring measured at discharge weir. Water elevation in spring pond was not surveyed.

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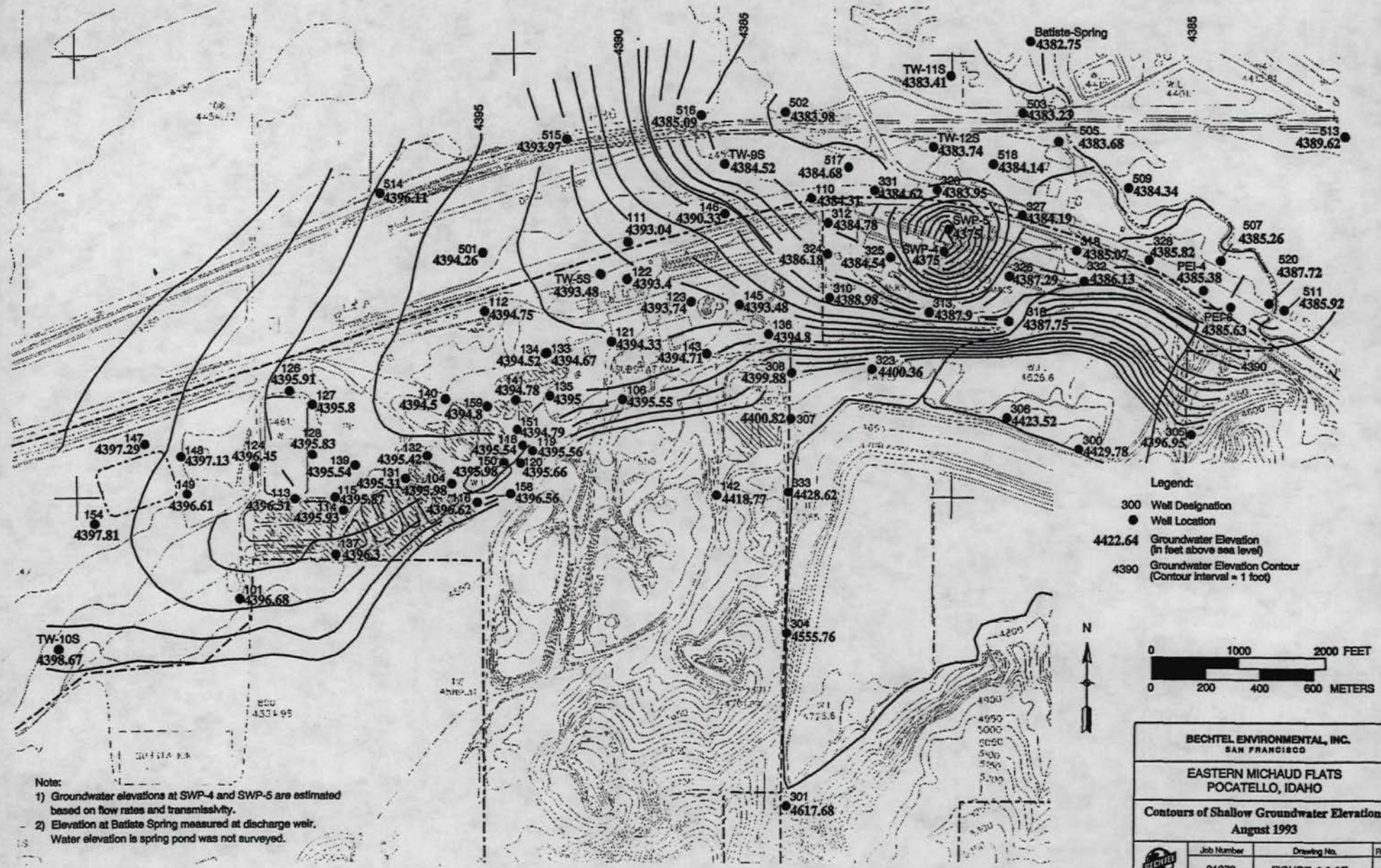
EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Contours of Shallow Groundwater Elevations, March 1993

Job Number	Drawing No.	Rev.
21372	FIGURE 3.3-3D	

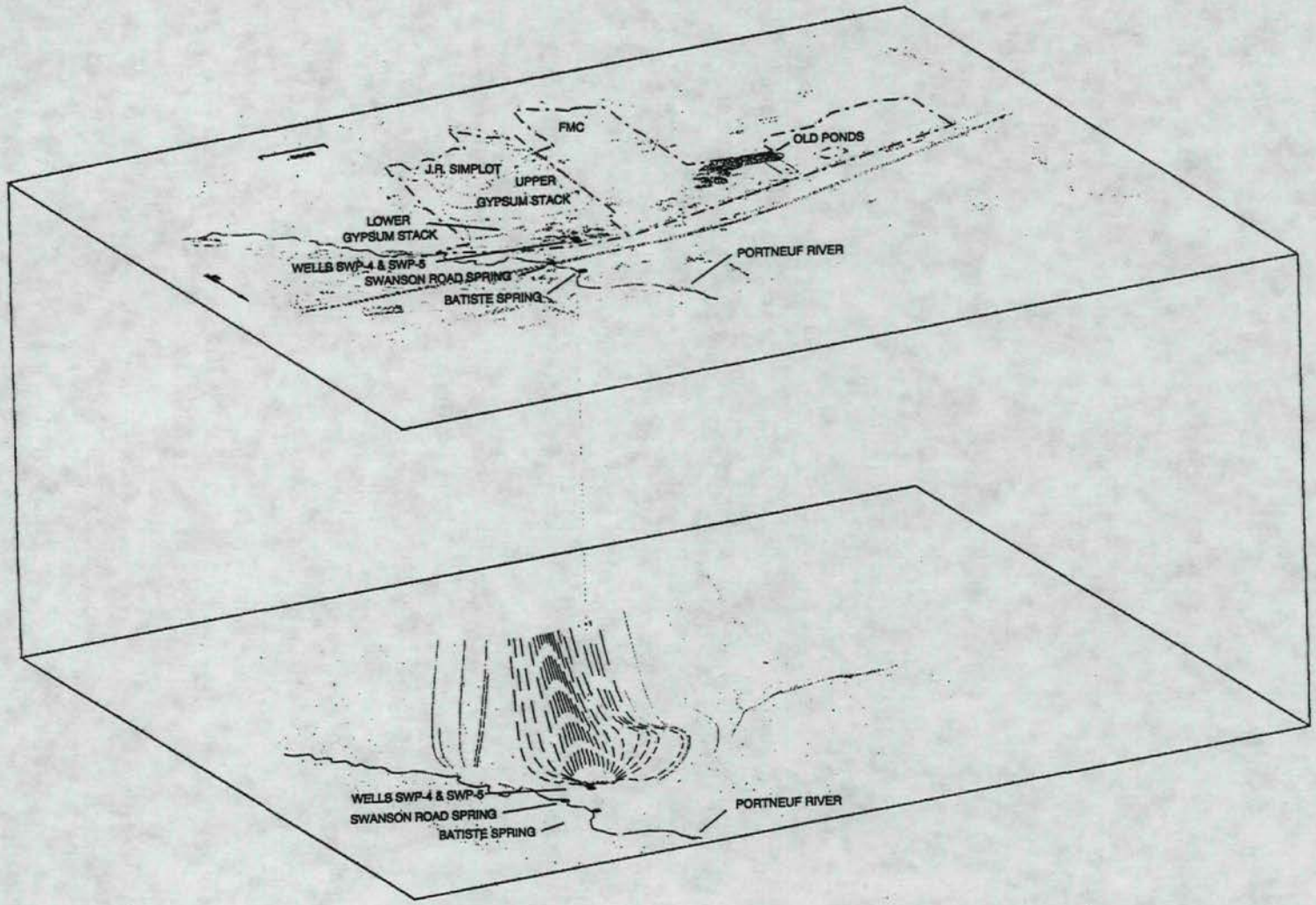


BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Contours of Shallow Groundwater Elevations
August 1993

Job Number	Drawing No.	Rev.
21372	FIGURE 3.3-3E	



EXPLANATION

GROUND WATER FLOW PATHS FROM SELECTED POINTS

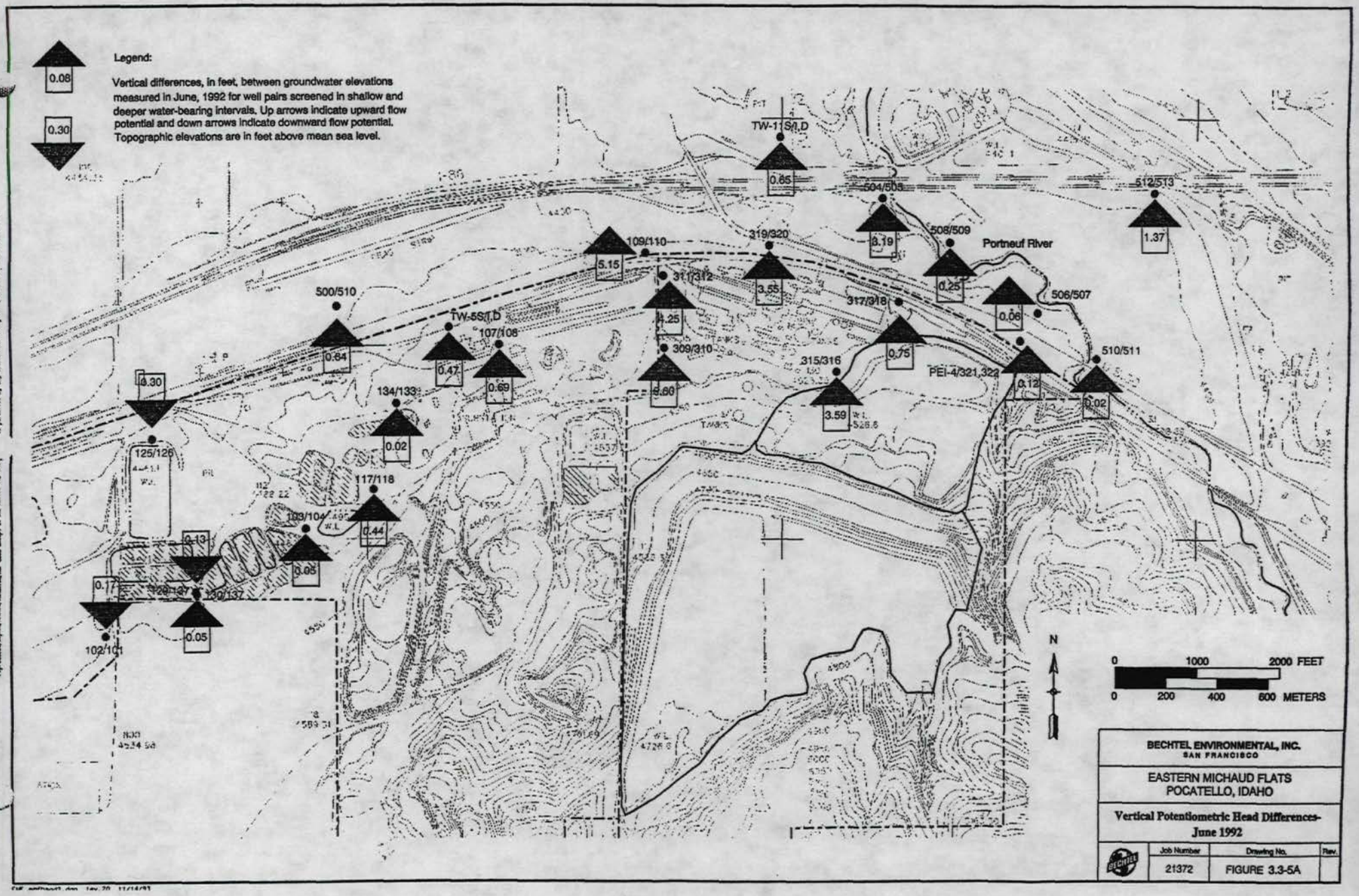
CAPTURE ZONE OF SIMPLOT PRODUCTION WELLS

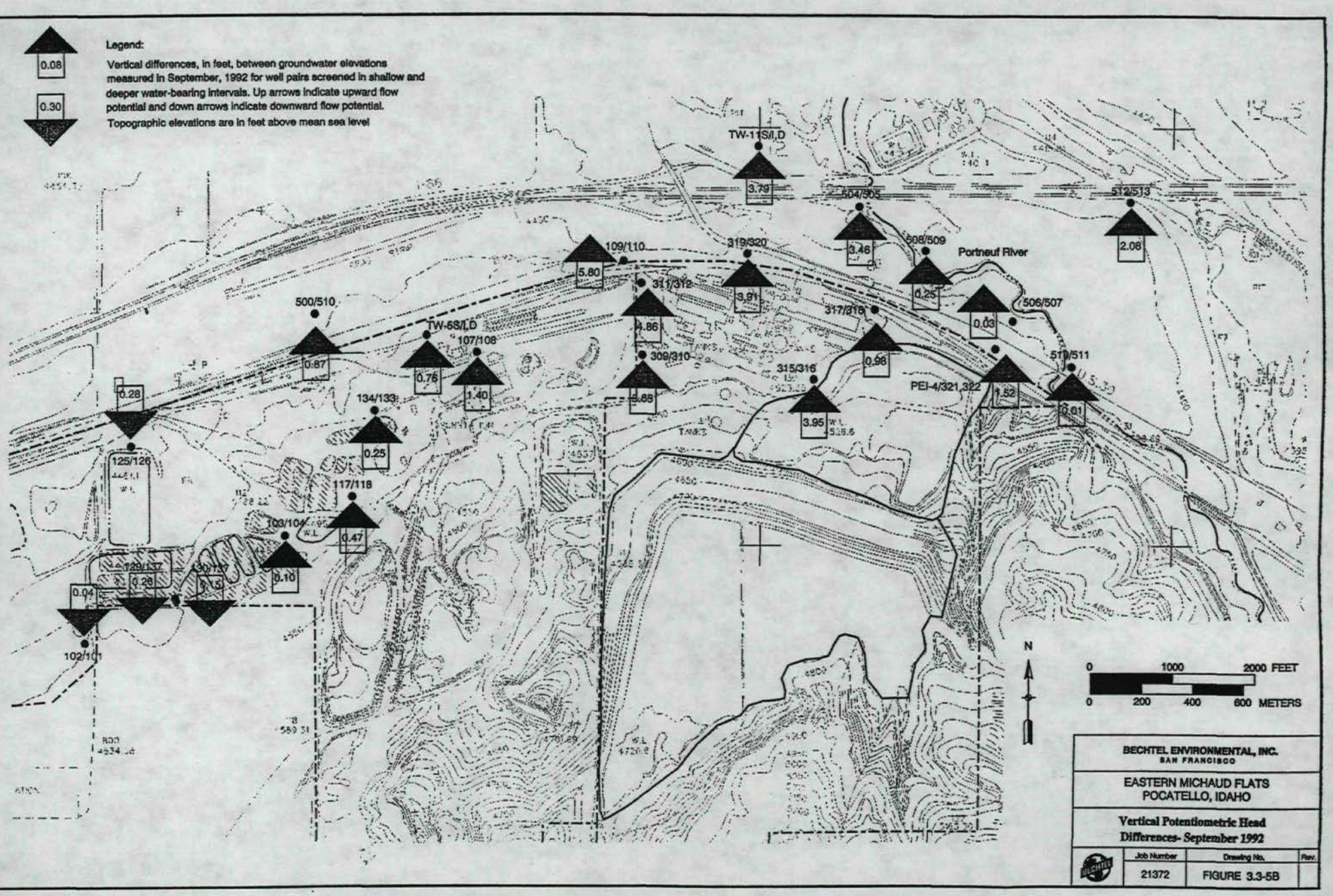
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

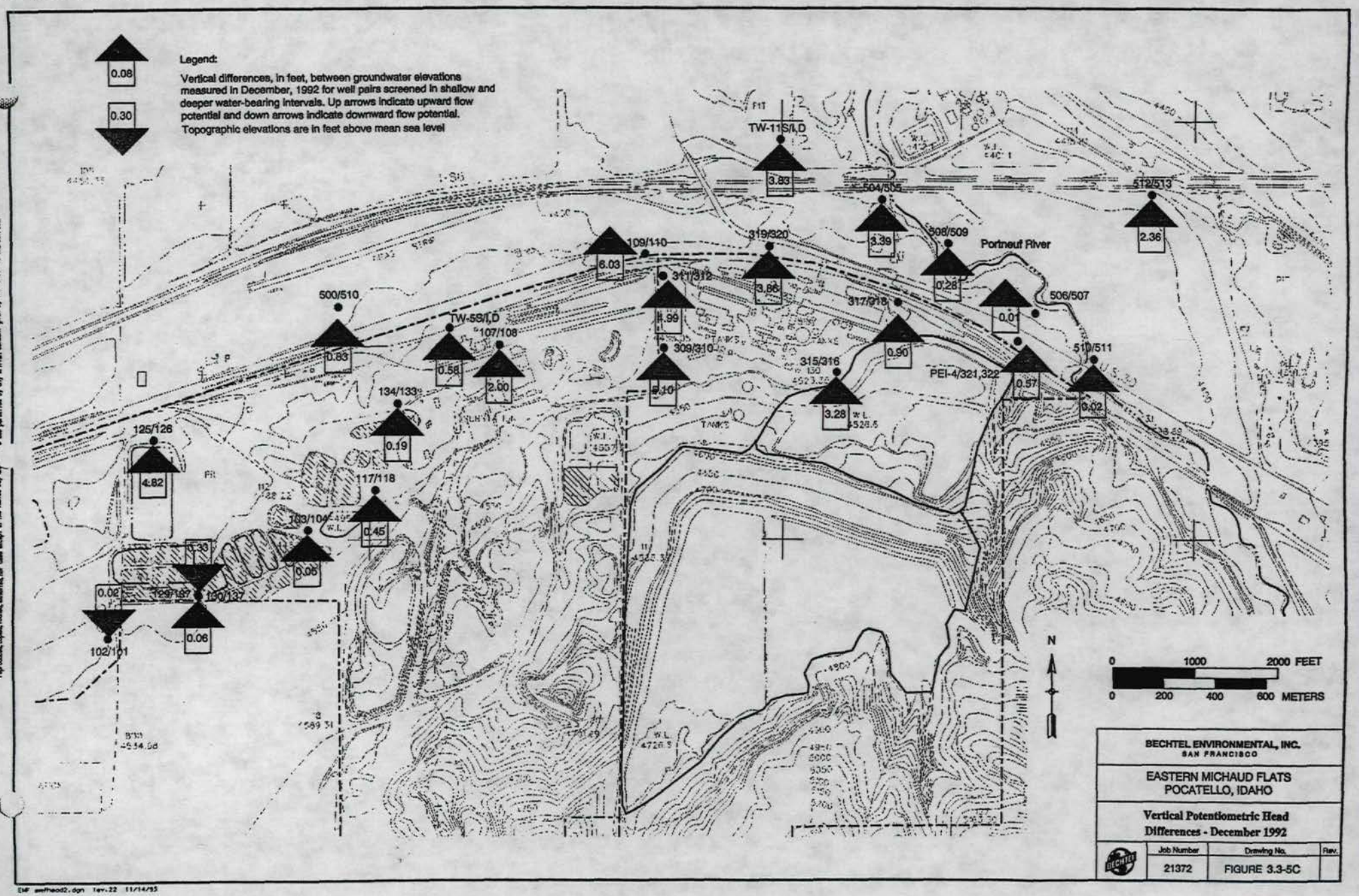
EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Groundwater Flowpaths and Capture Zone of Simplot Production Wells

Job Number	Drawing No.	Rev
21372	FIGURE 3.3-4	


Legend:
0.08
0.30
Vertical differences, in feet, between groundwater elevations measured in June, 1992 for well pairs screened in shallow and deeper water-bearing intervals. Up arrows indicate upward flow potential and down arrows indicate downward flow potential. Topographic elevations are in feet above mean sea level.
TW-11S/I,D
0.65
504/505
3.19
512/513
1.37
508/509
Portneuf River
0.25
506/507
0.06
510/511
0.02
PEI-4/321,322
0.12
319/320
3.55
109/110
5.15
311/312
4.25
317/318
0.75
315/316
3.59
309/310
5.60
500/510
0.64
TW-5S/I,D
107/108
0.47
0.69
134/133
0.02
117/118
0.44
103/104
0.05
0.30
125/126
0.13
0.17
129/137
130/137
0.05
102/101
N
0
1000
2000 FEET
0
200
400
600 METERS
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO
EASTERN MICHAUD FLATS
POCATELLO, IDAHO
Vertical Potentiometric Head Differences-
June 1992
Job Number
21372
Drawing No.
FIGURE 3.3-5A
Rev.


Legend:
Vertical differences, in feet, between groundwater elevations measured in September, 1992 for well pairs screened in shallow and deeper water-bearing intervals. Up arrows indicate upward flow potential and down arrows indicate downward flow potential.
Topographic elevations are in feet above mean sea level
0.08
0.30
TW-11S/I,D
3.79
504/505
3.46
512/513
2.08
508/509
0.25
Portneuf River
506/507
0.03
109/110
5.80
319/320
3.91
311/312
4.86
317/319
0.98
500/510
0.87
TW-6S/I,D
107/108
0.76
1.40
309/310
5.65
315/316
3.95
PEI-4/321,322
1.52
510/511
0.01
0.28
125/126
134/133
0.25
117/118
0.47
103/104
0.10
129/127
0.28
130/128
0.15
0.04
102/101
N
0
1000
2000 FEET
0
200
400
600 METERS
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO
EASTERN MICHAUD FLATS
POCATELLO, IDAHO
Vertical Potentiometric Head Differences- September 1992
Job Number
21372
Drawing No.
FIGURE 3.3-5B
Rev.



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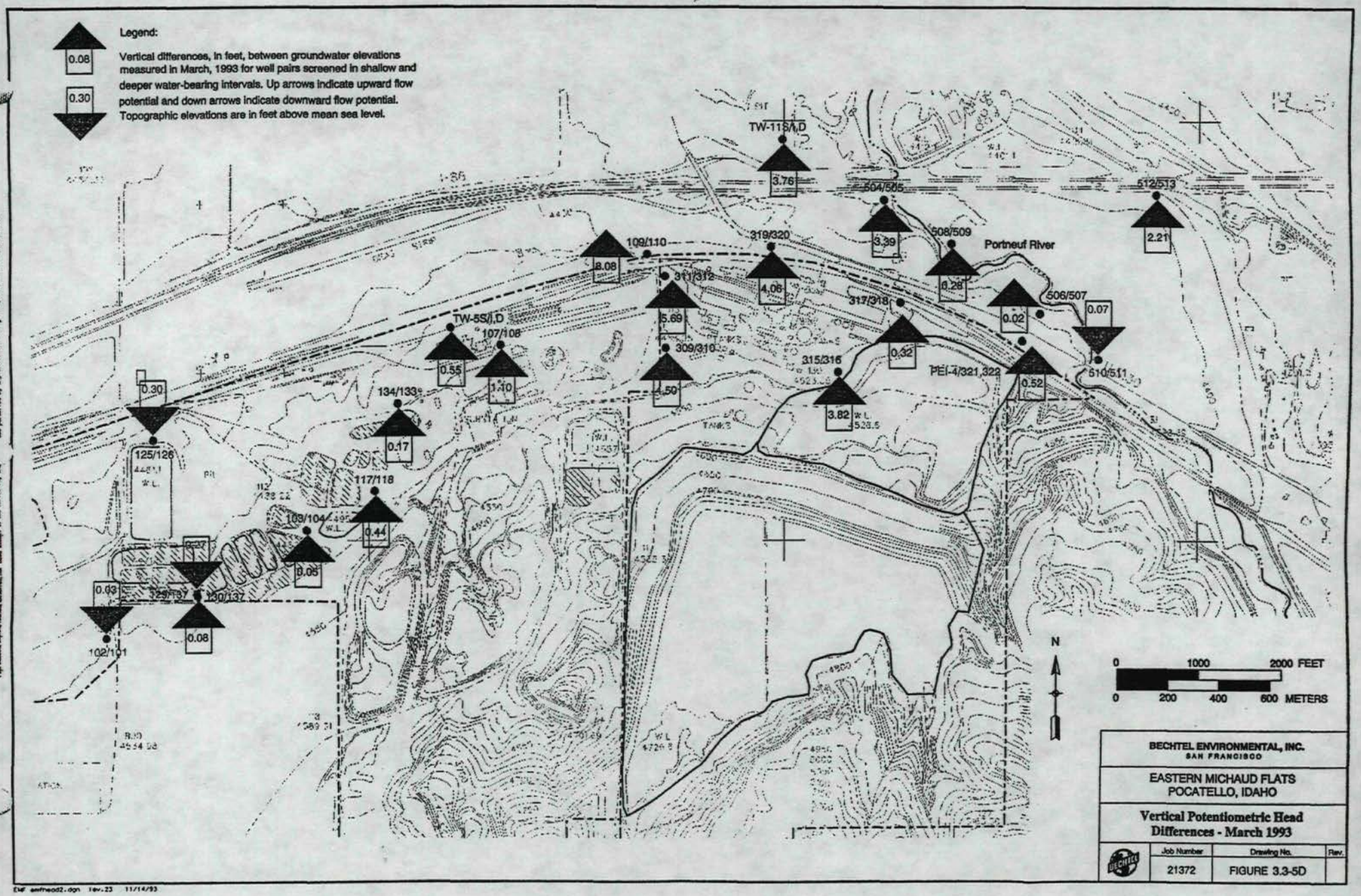
EMF swfhead2.dgn rev.22 11/14/95



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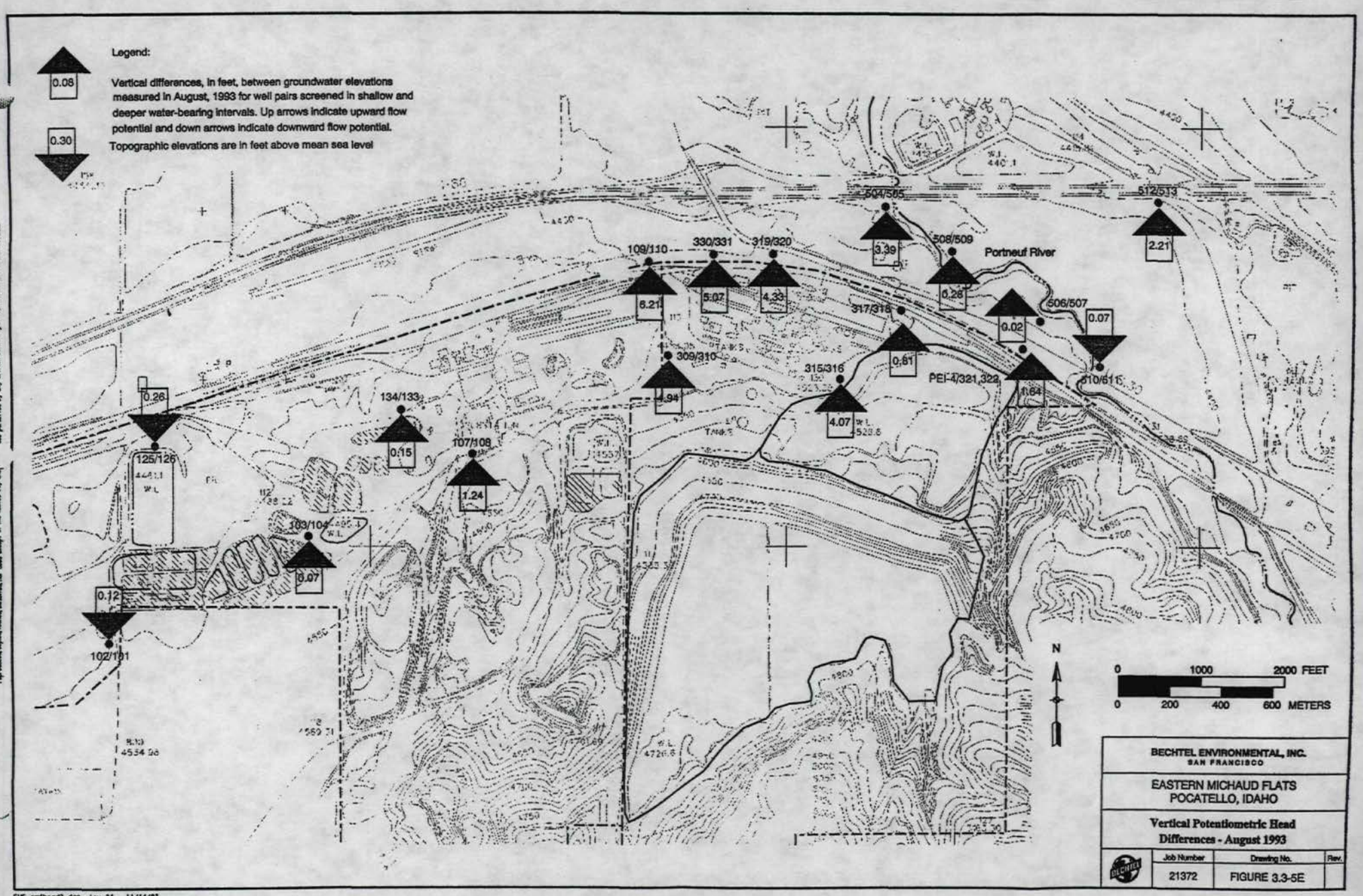
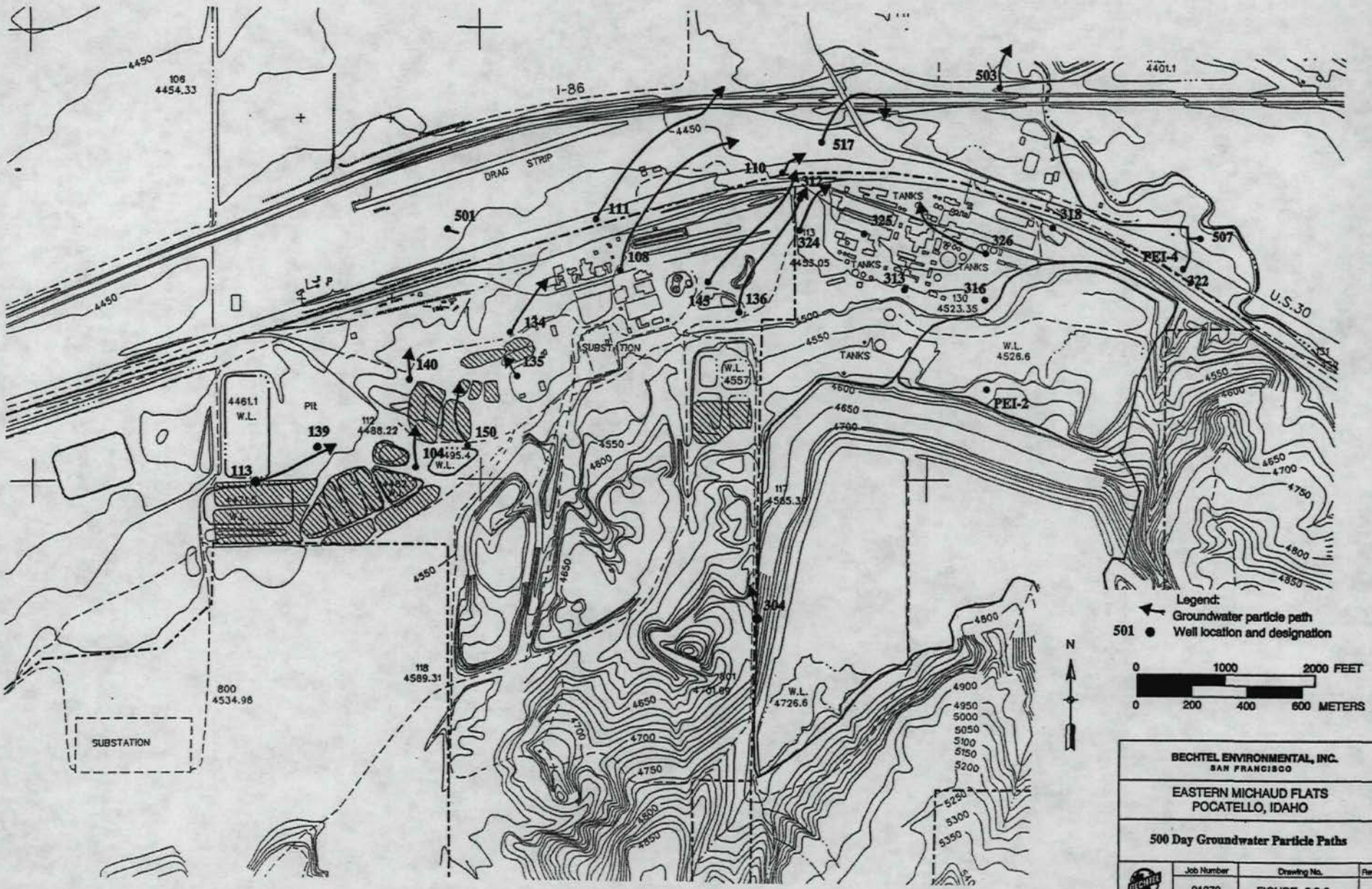
DGF emfhead2.dgn Rev.23 11/14/93


Legend:
0.08
0.30
Vertical differences, in feet, between groundwater elevations measured in August, 1993 for well pairs screened in shallow and deeper water-bearing intervals. Up arrows indicate upward flow potential and down arrows indicate downward flow potential.
Topographic elevations are in feet above mean sea level
Portneuf River
504/505
3.39
512/513
2.21
508/509
0.28
109/110
6.21
330/331
5.07
319/320
4.33
317/318
0.81
506/507
0.07
0.02
309/310
4.94
315/316
4.07
PEI-4/321,322
1.64
310/511
0.26
125/126
134/133
0.15
107/108
1.24
103/104
0.07
0.12
102/101
N
0 1000 2000 FEET
0 200 400 600 METERS
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO
EASTERN MICHAUD FLATS
POCATELLO, IDAHO
Vertical Potentiometric Head Differences - August 1993
Job Number
21372
Drawing No.
FIGURE 3.3-5E
Rev.



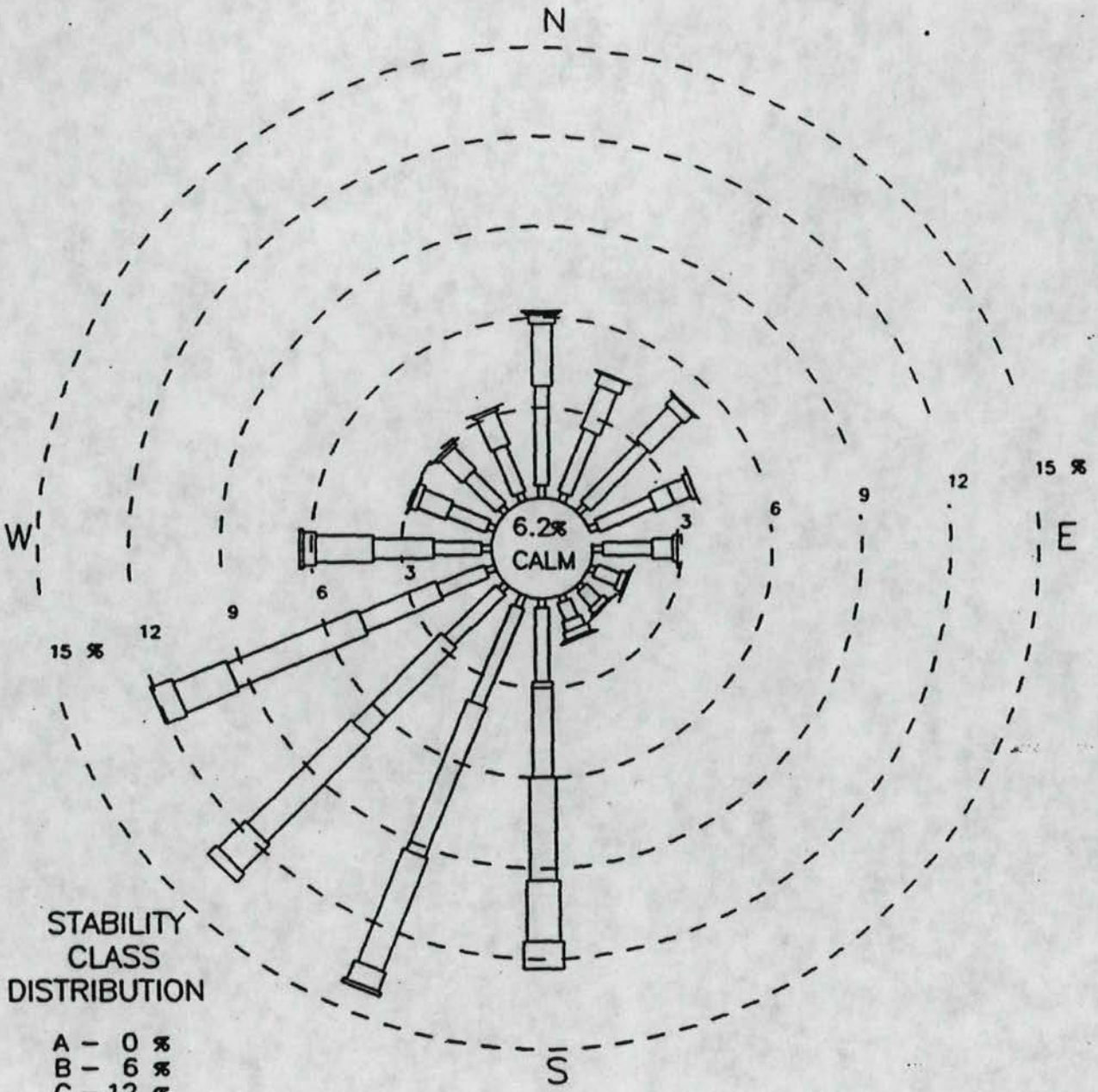
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

EASTERN MICHAUD FLATS
POCATELLO, IDAHO

500 Day Groundwater Particle Paths

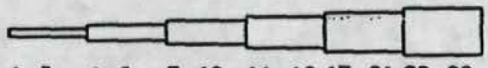
Job Number	Drawing No.	Rev.
21372	FIGURE 3.3-6	

Pocatello, Idaho



STABILITY CLASS DISTRIBUTION

A – 0 %
B – 6 %
C – 12 %
D – 51 %
E – 15 %
F – 15 %



1–3	4–6	7–10	11–16	17–21	22–99
(5 %)	(30 %)	(29 %)	(21 %)	(7 %)	(2 %)

WIND SPEED SCALE (KNOTS)

NOTE – WIND DIRECTION IS THE DIRECTION WIND IS BLOWING FROM

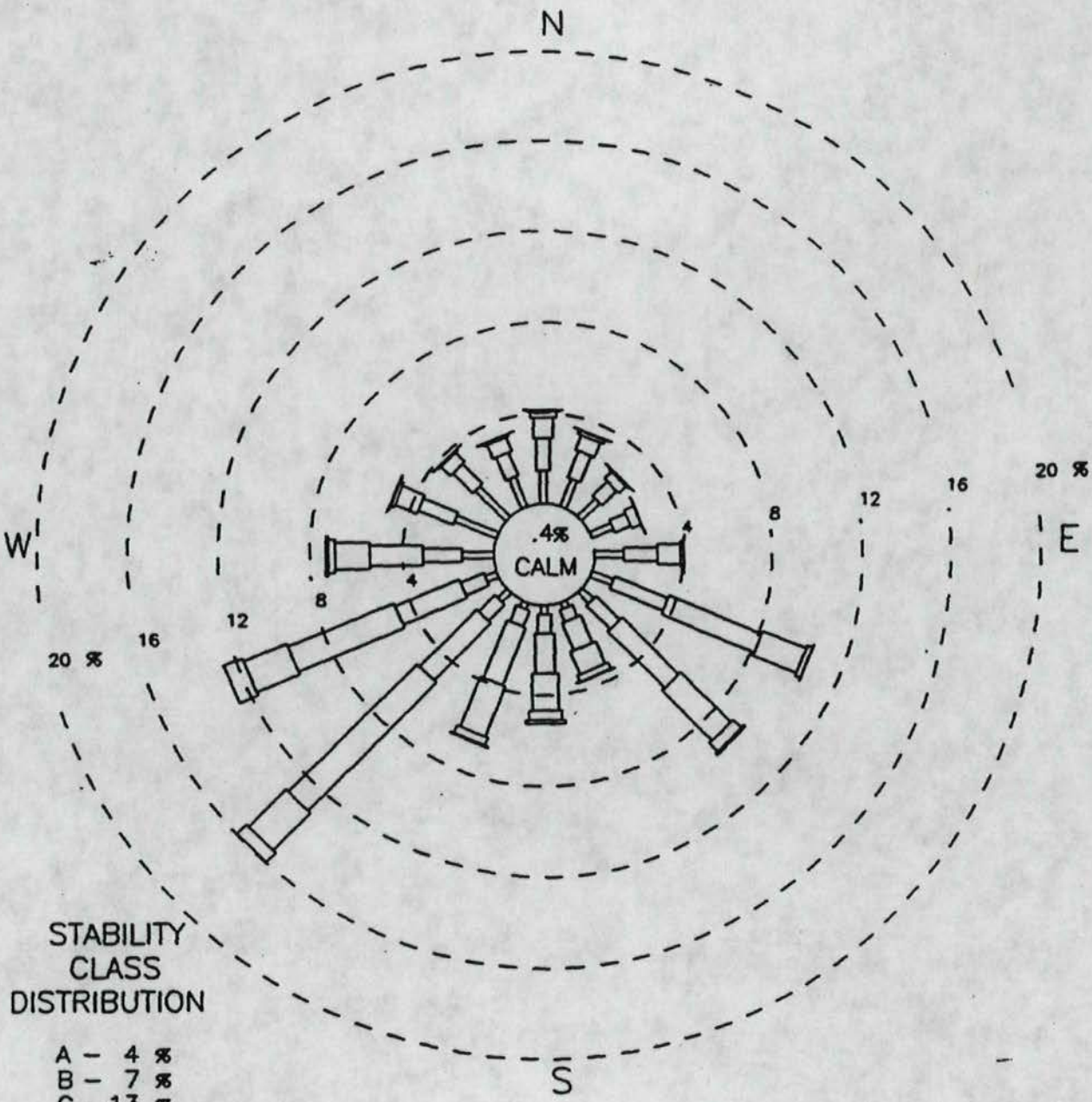
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Wind Rose, Pocatello Airport 1984 to 1989

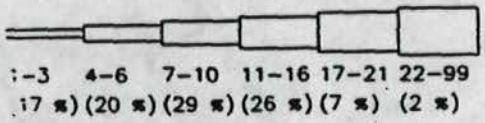
JOB No.	DRAWING NO.	REV.
21372	FIGURE 3.5-1	

JRS SITE 1 (STP) 1981 – 83, 1988, & 1989



STABILITY CLASS DISTRIBUTION

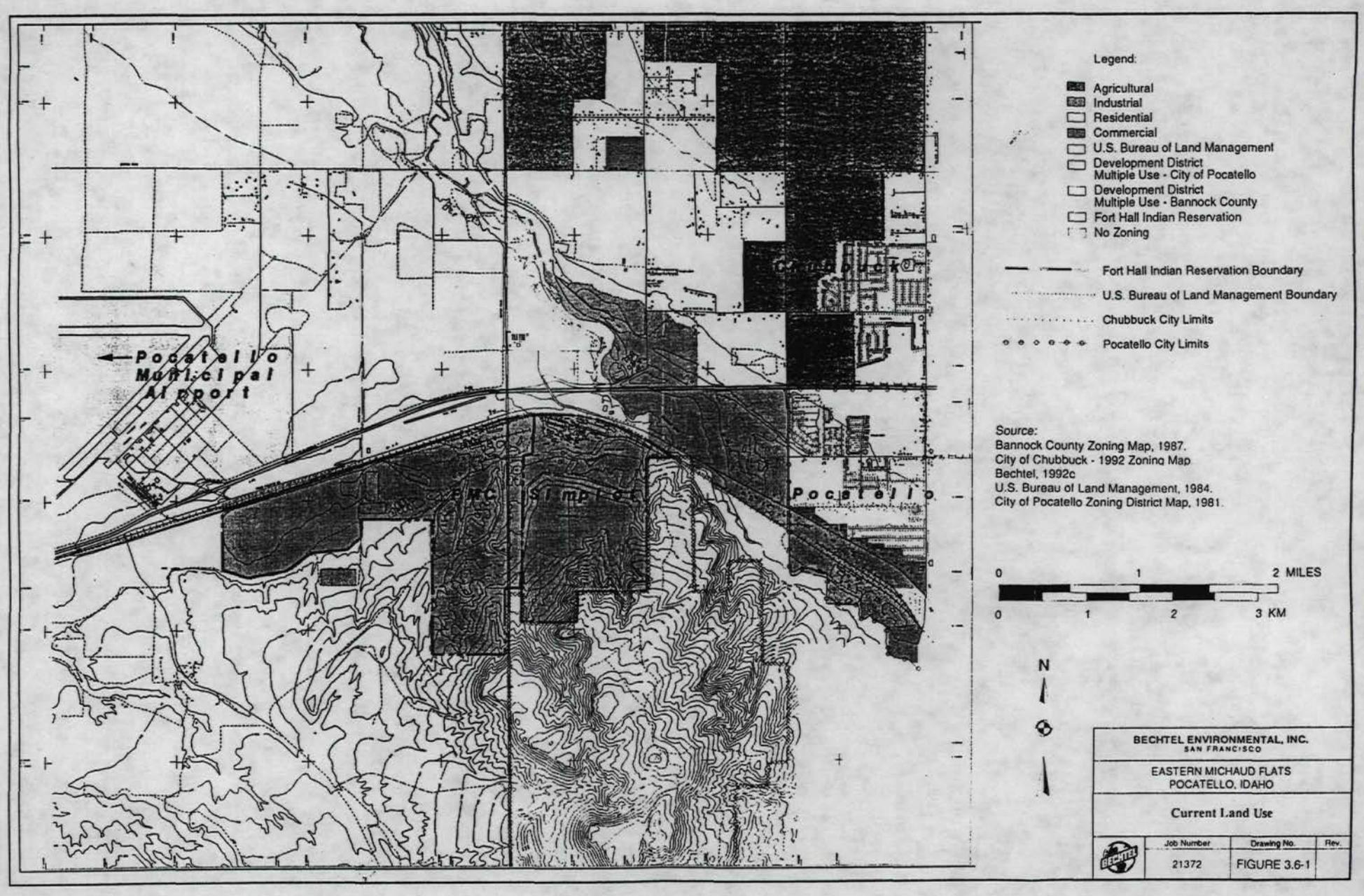
A – 4 %
B – 7 %
C – 13 %
D – 53 %
E – 13 %
F – 12 %

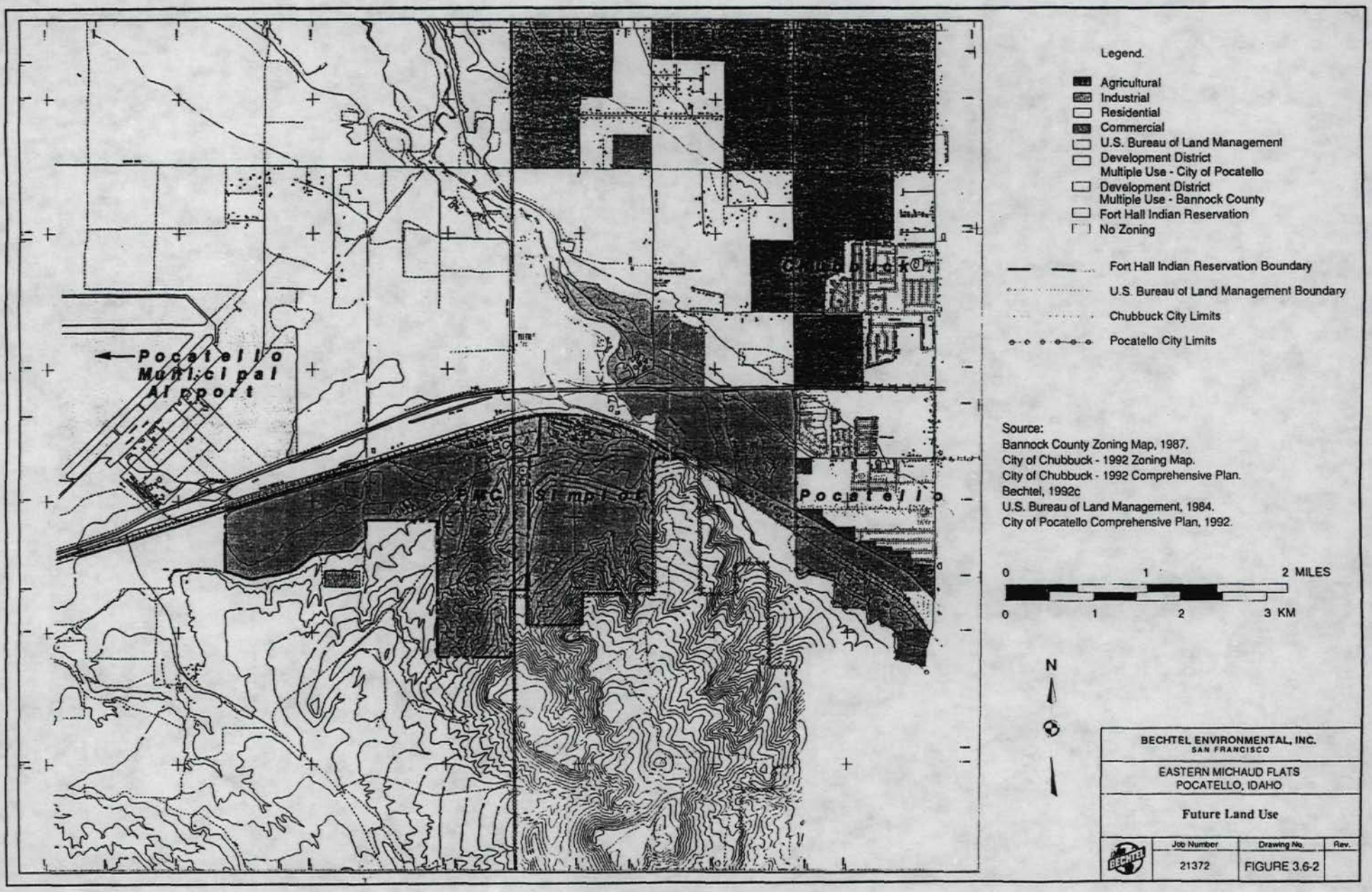


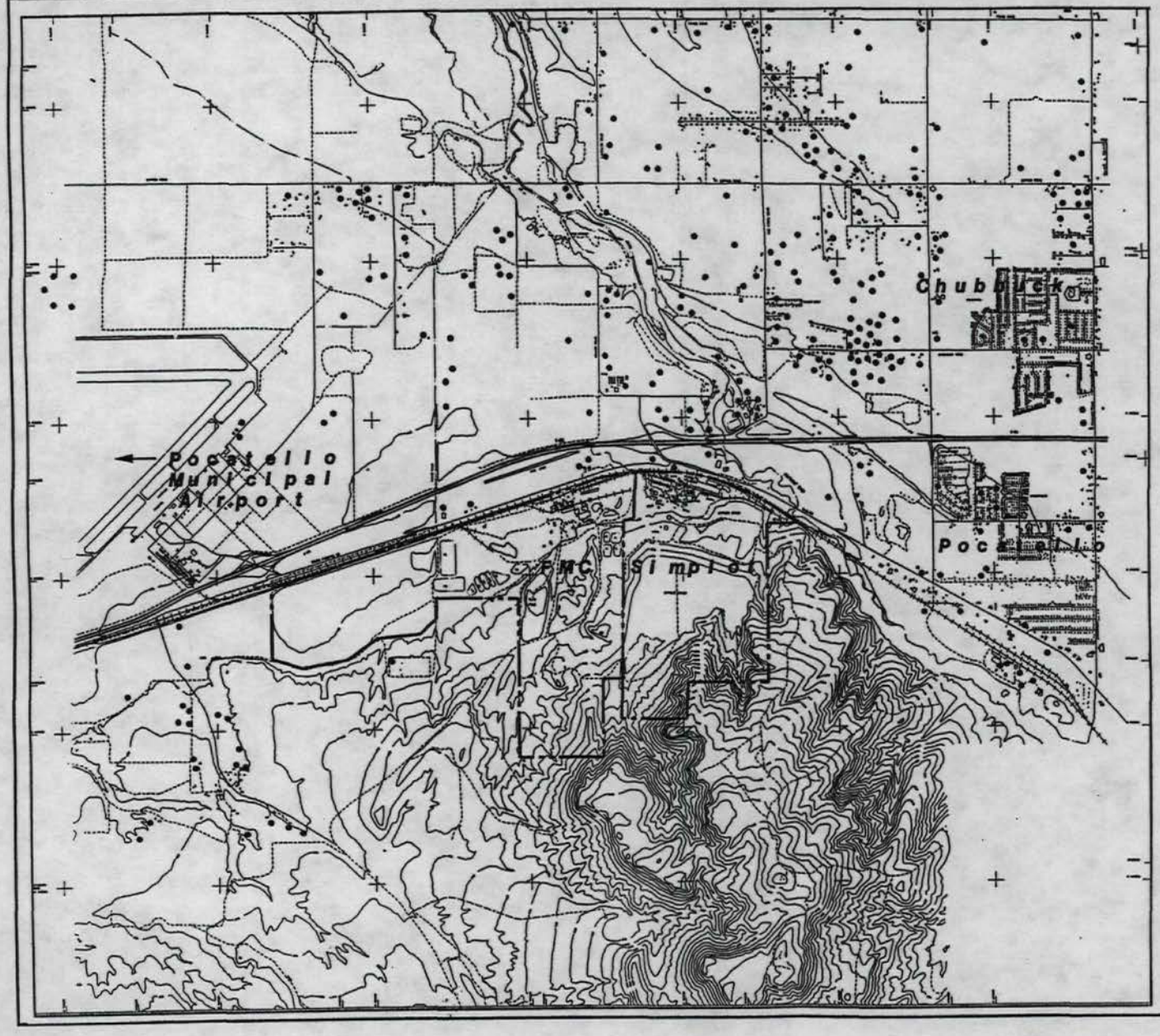
WIND SPEED SCALE (KNOTS)

NOTE – WIND DIRECTION IS THE DIRECTION WIND IS BLOWING FROM

BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO			
EASTERN MICHAUD FLATS POCATELLO, IDAHO			
Wind Rose, Simplot Site 1 5-Year Composite			
BECHTEL	JOB No.	DRAWING NO.	REV.
	21372	FIGURE 3.5-2	


Pocatello Municipal Airport
Pocatello
Legend:
Agricultural
Industrial
Residential
Commercial
U.S. Bureau of Land Management
Development District Multiple Use - City of Pocatello
Development District Multiple Use - Bannock County
Fort Hall Indian Reservation
No Zoning
Fort Hall Indian Reservation Boundary
U.S. Bureau of Land Management Boundary
Chubbuck City Limits
Pocatello City Limits
Source:
Bannock County Zoning Map, 1987.
City of Chubbuck - 1992 Zoning Map
Bechtel, 1992c
U.S. Bureau of Land Management, 1984.
City of Pocatello Zoning District Map, 1981.
0 1 2 MILES
0 1 2 3 KM
N
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO
EASTERN MICHAUD FLATS
POCATELLO, IDAHO
Current Land Use
Job Number
21372
Drawing No.
FIGURE 3.6-1
Rev.


Pocatello Municipal Airport
Pocatello
Legend.
Agricultural
Industrial
Residential
Commercial
U.S. Bureau of Land Management
Development District Multiple Use - City of Pocatello
Development District Multiple Use - Bannock County
Fort Hall Indian Reservation
No Zoning
Fort Hall Indian Reservation Boundary
U.S. Bureau of Land Management Boundary
Chubbuck City Limits
Pocatello City Limits
Source:
Bannock County Zoning Map, 1987.
City of Chubbuck - 1992 Zoning Map.
City of Chubbuck - 1992 Comprehensive Plan.
Bechtel, 1992c
U.S. Bureau of Land Management, 1984.
City of Pocatello Comprehensive Plan, 1992.
0 1 2 MILES
0 1 2 3 KM
N
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO
EASTERN MICHAUD FLATS
POCATELLO, IDAHO
Future Land Use
Job Number
21372
Drawing No.
FIGURE 3.6-2
Rev.



Legend:

● Groundwater well location. Wells may be used for drinking, livestock, or irrigation.

Note:

See Figure 2.4-1 for well location within FMC and Simplot Facility Boundary.

Source: Idaho Department of Water Resources data files, 1992.

0 1 2 MILES

0 1 2 3 KM

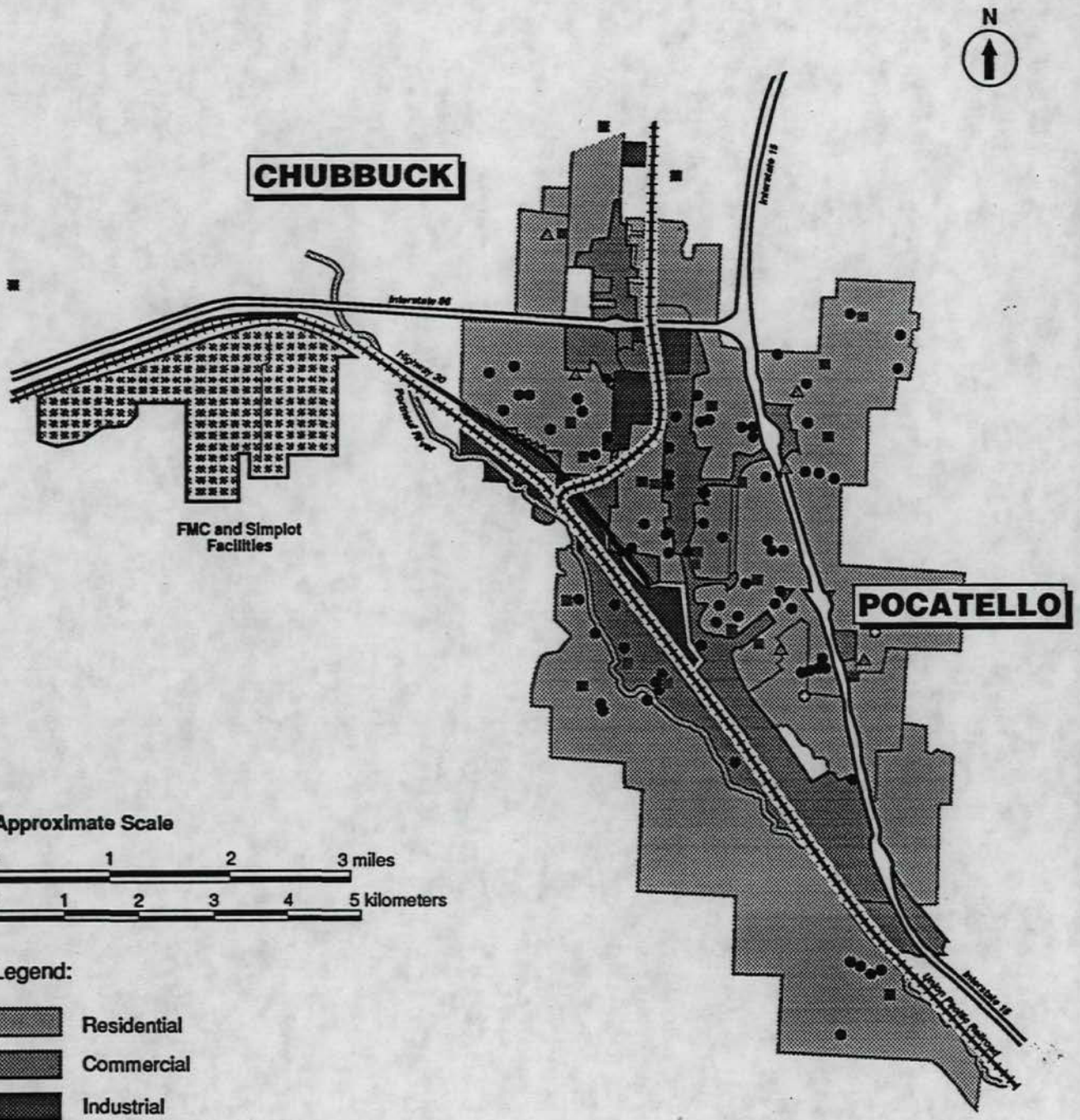
N

BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Wells in the EMF Study Area

Job Number	Drawing No.	Rev.
21372	FIGURE 3.6-3	



Approximate Scale

0 1 2 3 miles

0 1 2 3 4 5 kilometers

Legend:

- Residential
- Commercial
- Industrial
- EMF Facilities
- Licensed Day Care Facilities
- Public and Industrial/Technical Schools
- Nursing Homes / Senior Living
- Hospitals

Source: City of Pocatello / City of Chubbuck Zoning District Maps – April 1990

BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Sensitive Receptors General Locations

JOB No.	DRAWING NO.	REV.
21372	FIGURE 3.6-4	

93-1477b.066 lw/ 5

Legend:

- Agriculture
- Residential/ Industrial/ Commercial
- Cliff/ Caves
- Fallow/ Disturbed
- Riparian
- Sagebrush Steppe
- Wetland
- Fish Farm
- Cottonwood Trees

0 1 2 MILES

0 1 2 3 KM

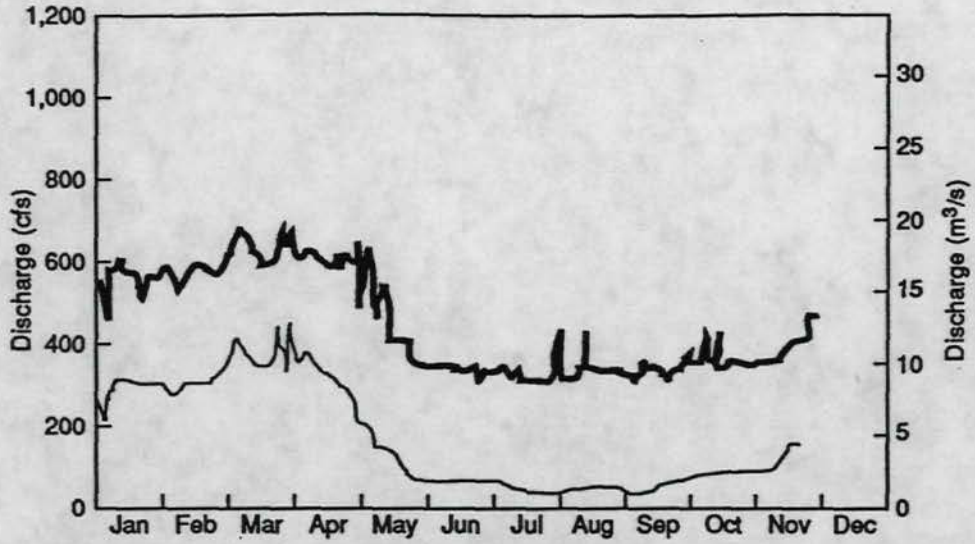
N

BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

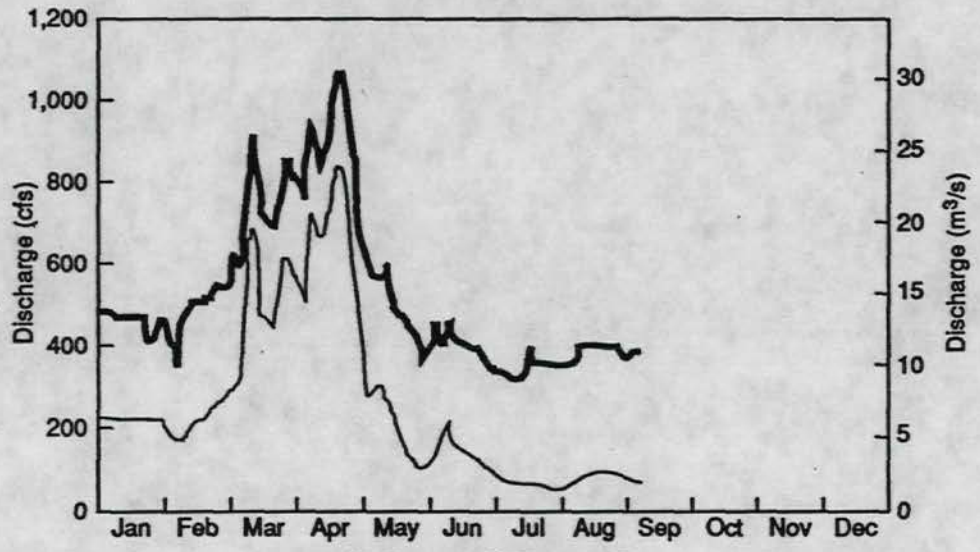
EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Habitat and Vegetation
Cover Types

Job Number	Drawing No.	Rev
21372	FIGURE 3.7-1	



(a) Portneuf River, 1988



(b) Portneuf River, 1989

Legend:

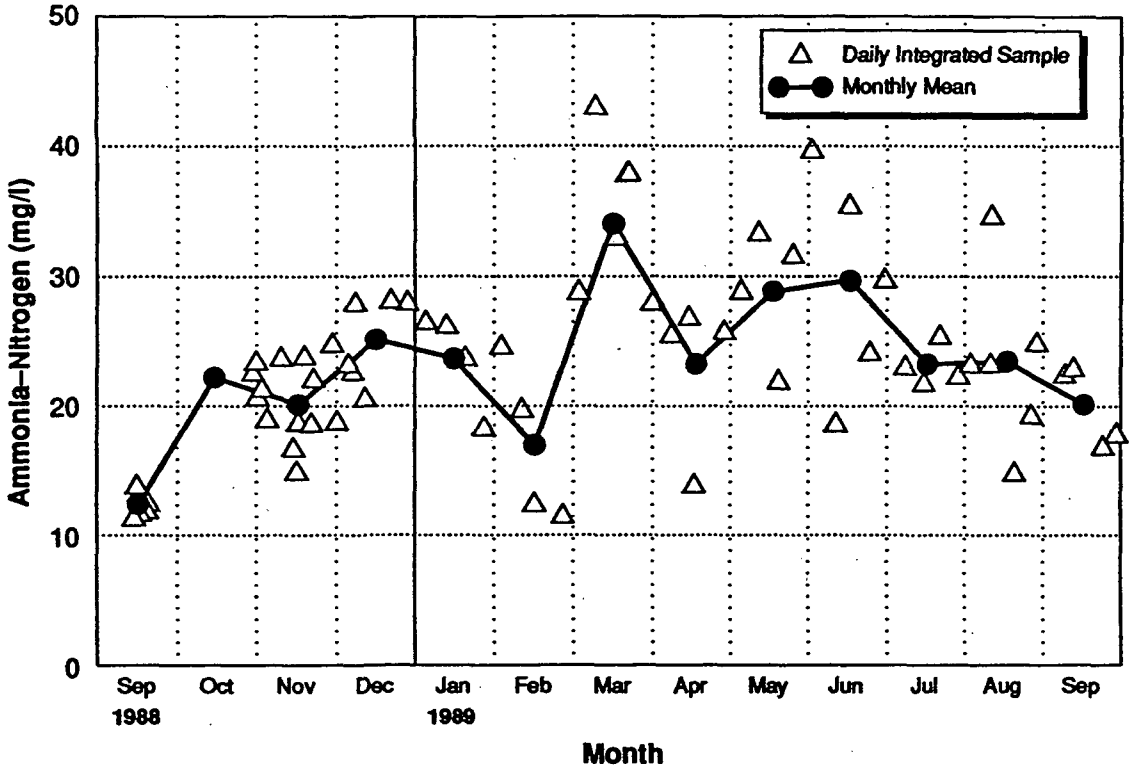
Tyhee plus Michaud Canal

Carson Street

Note:
Discharge of the Portneuf River at the Carson Street (River Mile 18) and Tyhee (River Mile 11) USGS gauging stations. A pumping station diverts water into the Michaud Canal at a point upstream from the Tyhee gauge. The Tyhee plus Michaud Canal plot is the estimated discharge immediately upstream from the Portneuf pumping station (Siphon Road), assuming no water is lost or gained from the channel between the pumping station and the gauge at Tyhee (City of Pocatello, 1989).

BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO			
EASTERN MICHAUD FLATS POCATELLO, IDAHO			
Discharges at USGS Gauging Stations on Portneuf River, 1988 and 1989			
	JOB No.	DRAWING NO.	REV.
	21372	FIGURE 3.7-2	

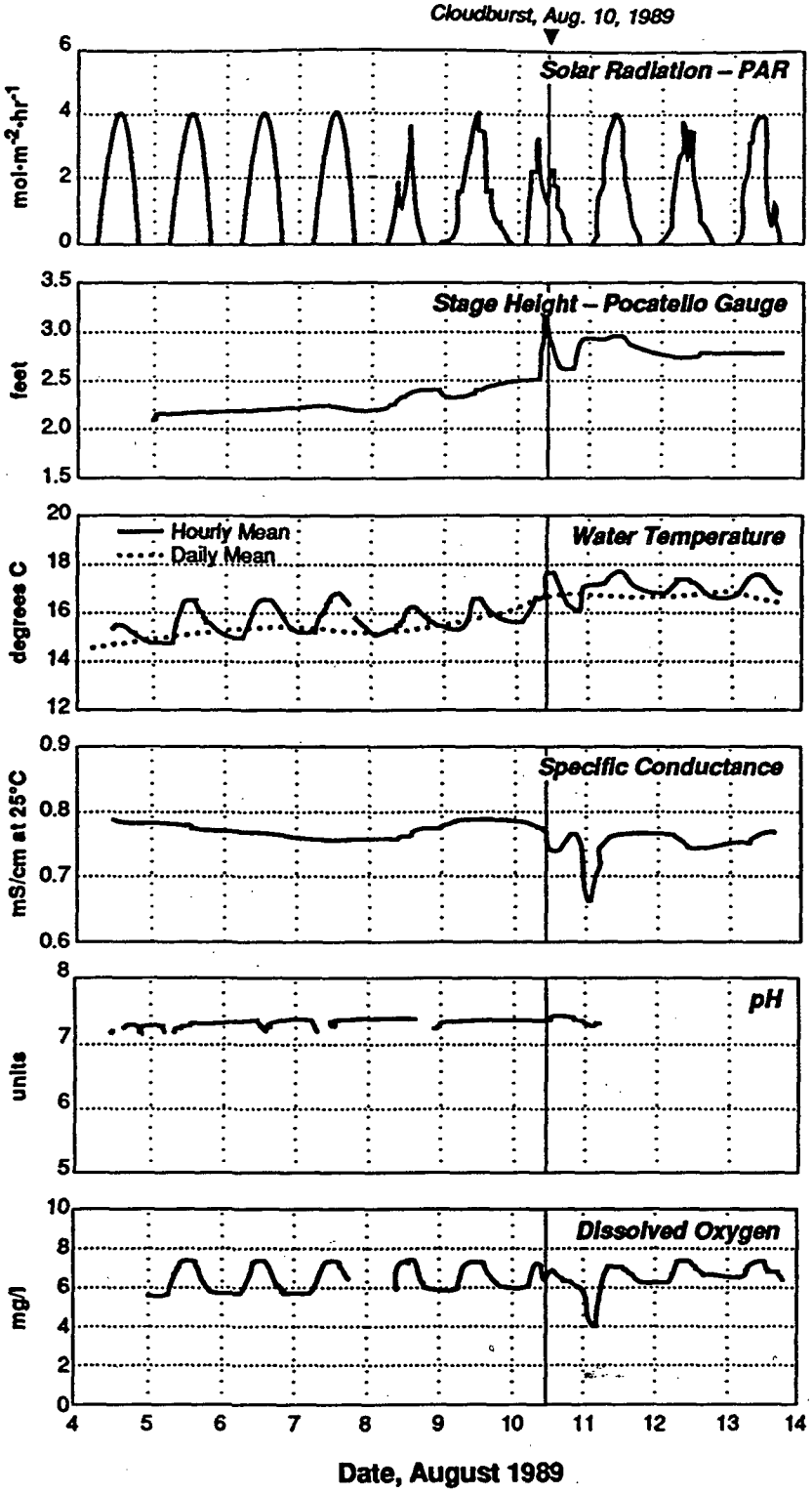
93-1477h.056 lw/ 4 10-7-93



Source: City of Pocatello, 1989.

BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO		
EASTERN MICHAUD FLATS POCATELLO, IDAHO		
Ammonia-Nitrogen Concentrations in Pocatello STP Effluent, September 1988 – September 1989		
JOB No.	DRAWING NO.	REV.
21372	FIGURE 3.7-3	

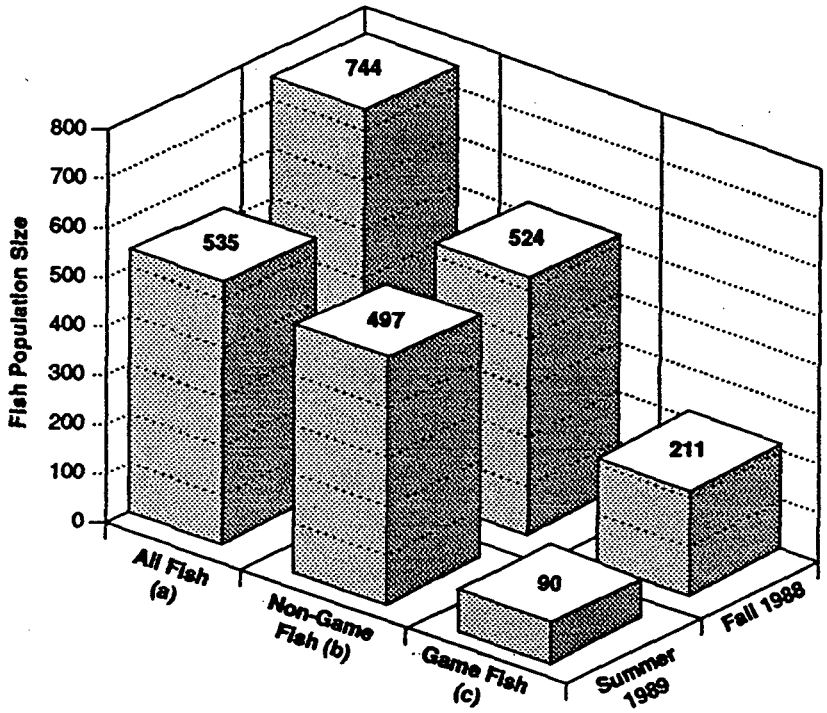
93-0103b.010



Note:

Results of continuous monitoring of water quality at the Rowland Creamery (about 100 m upriver from the STP outfall) on the Portneuf River during the period preceding and following the August 10, 1989, rainstorm (City of Pocatello, 1989).

BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO			
EASTERN MICHAUD FLATS POCATELLO, IDAHO			
Water Quality Monitoring Results at Rowland Creamery on Portneuf River			
BECHTEL	JOB No.	DRAWING NO.	REV.
	21372	FIGURE 3.7-4	



Notes:

Source: City of Pocatello, 1989.

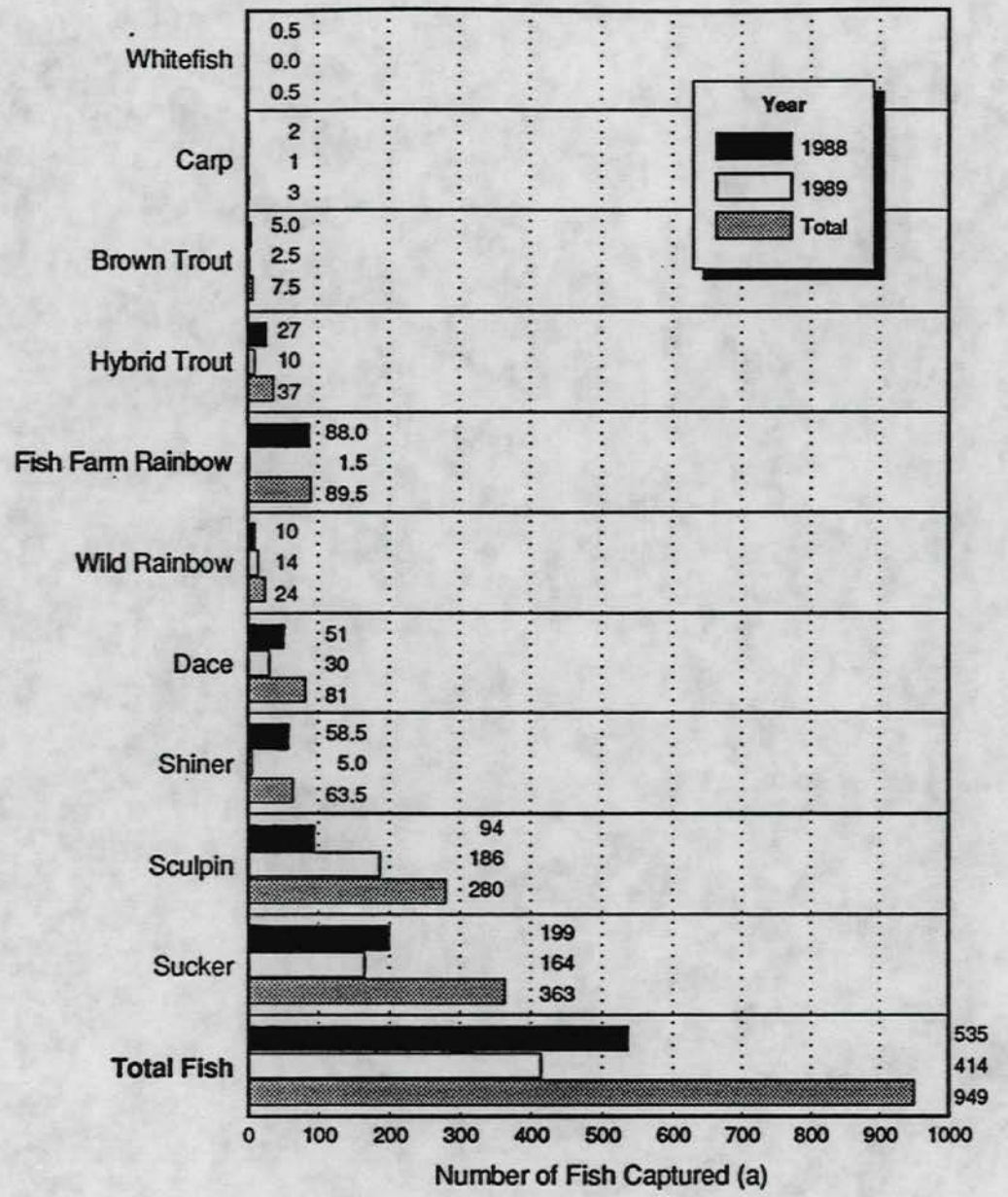
(a) Data for "All Fish" is independent of other categories; totals do not equal.

(b) Non-game fish: whitefish, carp, sculpin, shiner, dace.

(c) Game fish: brown trout, rainbow trout, rainbow-cutthroat trout hybrids.

BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO		
EASTERN MICHAUD FLATS POCATELLO, IDAHO		
Estimated Game and Non-Game Fish Populations—Portneuf River, 1988 and 1989		
JOB No.	DRAWING NO.	REV.
21372	FIGURE 3.7-5	

93-1477b.052 lw/ :5 10-7-93



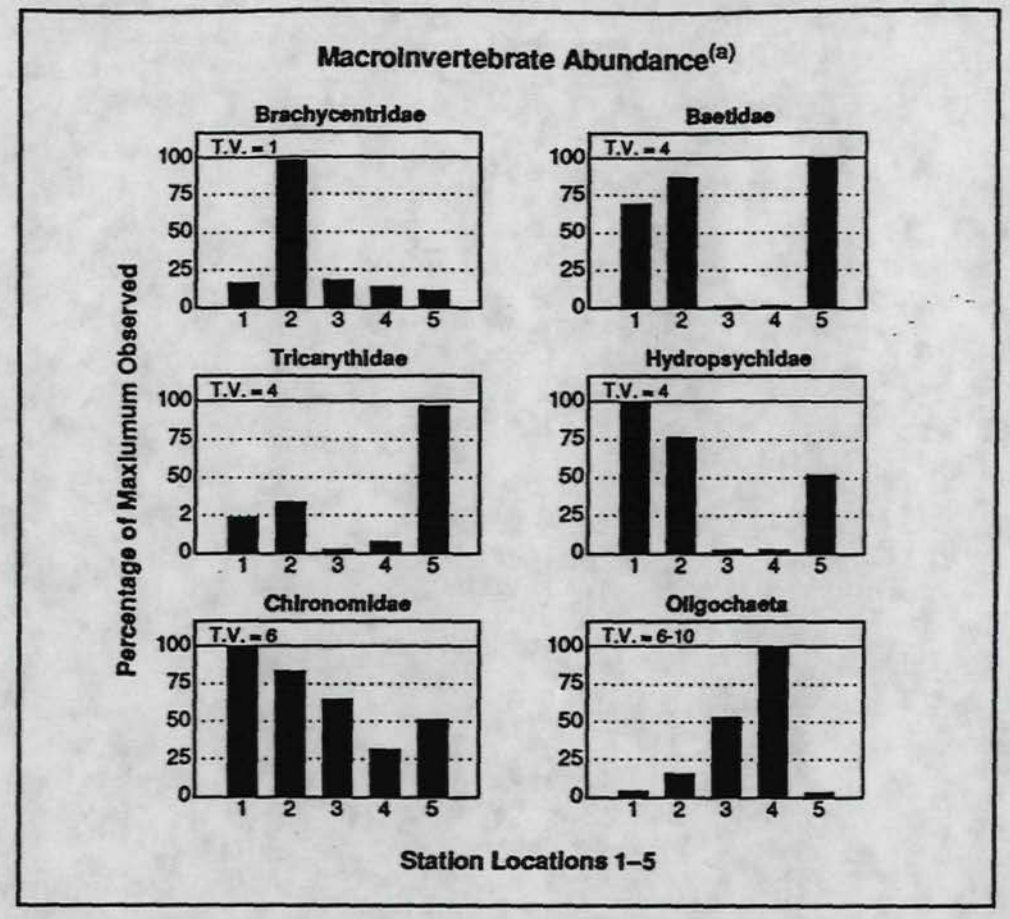
Notes:

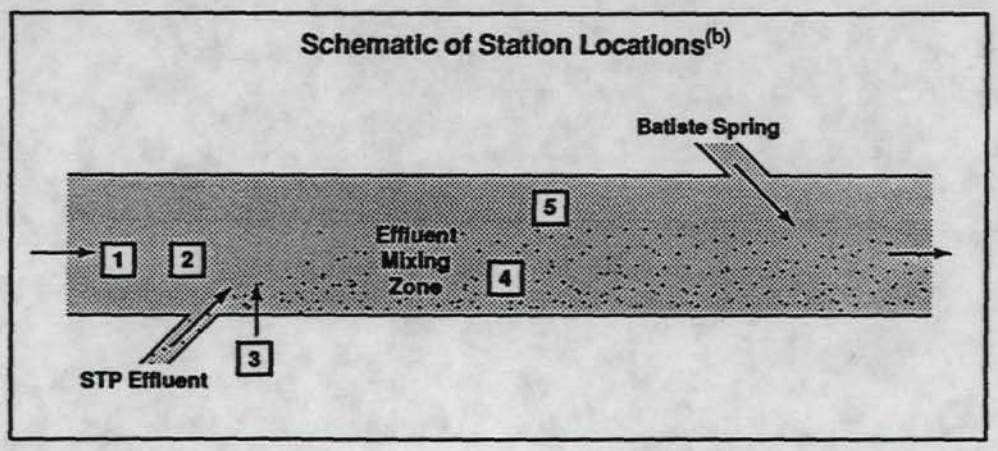
(a) Numbers represent catch per unit effort. Normalized for one hour.

Data from Broderick et al, 1989.

BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO		
EASTERN MICHAUD FLATS POCATELLO, IDAHO		
Total Number of Fish Captured in the Portneuf River—1988 and 1989		
JOB No.	DRAWING NO.	REV.
21372	FIGURE 3.7-6	

93-1477b.090 lw/ 2 10-6-93





Legend

1 Station Location

Notes:

(a) Abundance is expressed as the percentage of maximum observed in basket samplers with the greatest abundance equal to 100%. T.V. = Tolerance Value.

(b) Station locations in relation to the effluent mixing zone from the city's sewage treatment plant (STP) near River Mile 12.7. (City of Pocatello, 1989).

BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO		
EASTERN MICHAUD FLATS POCATELLO, IDAHO		
Macroinvertebrate Abundance for Selected Taxa in the Portneuf River—Summer 1989		
JOB No.	DRAWING NO.	REV.
21372	FIGURE 3.7-7	