DRAFT

PHASE I RFI/RI WORK PLAN

ROCKY FLATS PLANT

700 AREA

OPERABLE UNIT NO. 8

U.S. DEPARTMENT OF ENERGY

Rocky Flats Plant

Golden, Colorado

ENVIRONMENTAL RESTORATION PROGRAM

May 1992

Supplements: June 22, 1992

Volume I - Text Sections 1 - 11

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REVIEWED FOR CLASSIFICATION/UCNI
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1.0 INTRODUCTION

This document presents the Work Plan for the Phase I Resource Conservation and Recovery Act (RCRA) Facility Investigation/Remedial Investigation (RFI/RI) for Operable Unit No. 8 (OU8) at the U.S. Department of Energy (DOE) Rocky Flats Plant (RFP) in Jefferson County, Colorado.

This investigation is part of a comprehensive, phased program of site characterization, remedial investigations, feasibility studies, and remedial/corrective actions currently in progress at RFP. These investigations are pursuant to an Interagency Agreement (IAG) between DOE, the U.S. Environmental Protection Agency (EPA), and the State of Colorado Department of Health (CDH) dated January 22, 1991 (DOE, 1991a). The IAG addresses RCRA and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) issues. Although the IAG requires general compliance with both RCRA and CERCLA, CERCLA regulations apply to remedial investigations at OU8. In accordance with the IAG, the CERCLA terms "remedial investigation" and "feasibility study" as used in this document are considered equivalent to the RCRA terms "RCRA Facility Investigation" and "Corrective Measures Study" (CMS), respectively. Also in accordance with the IAG, the term "Individual Hazardous Substance Site" (IHSS) is equivalent to the term "Solid Waste Management Unit" (SWMU).

1.1 WORK PLAN SCOPE

As required by the IAG, this Phase I Work Plan addresses characterization of sources of contamination and environmental media at each IHSS in OU8. It will also address the nature and extent of contamination at each IHSS, migration pathways, and receptor exposure.

In this Work Plan, the existing information is summarized to characterize OU8, data gaps or other requirements are identified, data quality objectives (DQOs) are established, and a Field Sampling and Analysis Plan (FSAP) is presented to characterize site physical features, define

contaminant sources, and assess the extent of contamination. Also included are plans to conduct a human health risk assessment plan (Section 8).

The Phase I RFI/RI will be conducted in accordance with the Interim Final RCRA Facility Investigation (RFI) Guidance (EPA, 1989a) and Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (EPA, 1988). Unless otherwise explained and rationale provided, the minimum investigative action required by the IAG, Attachment 2, Section VI, and Table 5 (See Appendix A) will be performed at each IHSS within OU8. Existing data and data generated by the Phase I RFI/RI will be used to begin developing and screening remedial alternatives and to estimate the risks to human health and the environment posed by sources within OU8.

1.2 ENVIRONMENTAL RESTORATION PROGRAM AT RFP

The Environmental Restoration (ER) Program, designed for investigation and cleanup of environmentally contaminated sites at DOE facilities, is being implemented in five phases. Phase 1 (Installation Assessment) includes preliminary assessments and site inspections to assess potential environmental concerns. Phase 2 (Remedial Investigations) includes planning and implementation of sampling programs to delineate the magnitude and extent of contamination at specific sites and evaluate potential contaminant migration pathways. Phase 3 (Feasibility Studies) includes evaluation of remedial alternatives and development of remedial action plans to mitigate environmental problems identified during remedial investigations as needing corrective actions. Phase 4 (Remedial Design/ Remedial Action) includes design and implementation of site-specific remedial actions selected on the basis of feasibility studies. Phase 5 (Compliance and Verification) includes monitoring and performance assessments of remedial actions as well as verification and documentation of the adequacy of remedial actions carried out under Phase 4.

Initial Phase 1 actions have been completed at RFP (U.S. DOE, 1986); in addition, Phase 2 actions are currently in progress for OU8. This Work Plan is intended to complete the additional

Phase 1 activities to further locate and assess potential and known release sites and provide supplemental sampling and analytical data to evaluate the extent and magnitude of contamination onsite and offsite of individual IHSSs and OU8.

1.3 OVERVIEW OF WORK PLAN

This Work Plan presents an evaluation and summary of previous data and investigations, defines data quality objectives (DQOs) and data needs based on that evaluation, specifies Phase I RFI/RI tasks, and presents the Field Sampling and Analysis Plan (FSAP) activities and procedures to be implemented during the OU8 Phase I RFI/RI.

This Work Plan is organized as follows:

- Section 1.0 provides introductory information and a general characterization of RFP. This includes a description of the Work Plan Scope, Environmental Restoration Program at RFP, an Overview of the Work Plan, Regional and Plant Site Background Information, and Previous Investigations. Included in this are discussions of the Physical Setting for topography and drainage, geology and soils, and hydrogeology.

- Section 2.0 presents a comprehensive review and analysis of the available historical information, previous environmental investigations, recently published reports, available data, past and present activities pertinent to OU8, and interrelation of OU8 activities with those of other OUs.

  The Initial Evaluation of IHSSs within OU8, includes conceptual models for contaminant migration and exposure pathways based on release mechanisms, site physical characteristics, and available information regarding the nature of contaminants and knowledge of Potential Areas of Concern (PACs). PACs are similarly evaluated and related to evaluation of contamination occurring at IHSSs within the immediate proximity. This initial characterization provides the basis for establishing data needs, DQOs, and for developing protocols, procedures and rationale for activities to be conducted during implementation of the FSAP.

- Section 3.0 presents potential sitewide Applicable or Relevant and Appropriate Requirements (ARARs), as required by the IAG, and a discussion of their application to the RFI/RI activities at OU8.

- Section 4.0 discusses the Sampling Rationale and the DQOs for the Phase I RFI/RI.

- Section 5.0 provides a discussion of the tasks planned in this Phase I RFI/RI Work Plan Tasks and includes a preliminary schedule for performance of those activities, including conformance with the IAG Schedule.

- Section 6.0 outlines the Preliminary Remedial Action Alternatives, including those for surface water and sediments, surficial materials and soils, groundwater, and air.

- Section 7.0 presents the FSAP for the Phase I RFI/RI to satisfy the data needs pursuant to section 5.0 and DQOs outlined in Section 10.0. This includes the Field Sampling Rationale; Phase I RFI/RI Objective; Integration with RFP Standard Operating Procedures; Sampling Design, Location, and Frequency; Sample Collection and Analysis; and QA/QC Procedures and Addendum.

- Section 8.0 provides the Human Health Risk Assessment Plan. This includes the baseline risk assessment approach (BRA), Data Evaluation and Identification of Chemicals of Potential Concern, Toxicity Assessment, Exposure Assessment, Risk Characterization, Uncertainty Analysis, Derivation of Chemical Goals, Risks from Radionuclides, and Risk Assessment Report.

- Section 9.0 discusses the plans to perform an Ecological Evaluation at OU8.

- Section 10.0 provides a the Quality Assurance/Quality Control Procedures and Addendum as supplied by EG&g for OU8.

- Section 11.0 lists references cited throughout this Work Plan.

- Appendix A provides Tables 5 and 6 from the IAG which outline the recommended scope of investigative activities for each OU8 IHSS and the schedule for completion of RI/RFI milestones.

- Appendix B presents additional information on the history of operations and current conditions of each IHSS that was obtained during the preparation of this Work Plan.

- Appendix C contains the a tabular summary of wells and boreholes surrounding OU8.

- Appendix D contains geologic logs and well-construction diagrams for wells and boreholes included in geologic cross sections presented in this Plan.

1.4 REGIONAL AND PLANT SITE BACKGROUND INFORMATION

1.4.1 Facility Background

RFP is a government-owned, contractor-operated facility, which is part of the nationwide Nuclear Weapons Complex. The plant was operated for the U.S. Atomic Energy Commission (AEC) from its inception in 1951 until the AEC was dissolved in January 1975. At that time, responsibility for the plant was assigned to the Energy Research and Development Administration (ERDA), which was succeeded by DOE in 1977. Dow Chemical U.S.A., an OU of the Dow Chemical Company, was the prime operating contractor of the facility from 1951 until June 30, 1975. Rockwell International was the prime contractor responsible for operating RFP from July 1, 1975 until December 31, 1989. EG&G Rocky Flats, Inc. became the prime contractor at RFP on January 1, 1990.

1.4.2 Rocky Flats Plant Operations

Operations at RFP consist of fabrication of nuclear weapons components from plutonium, uranium, and other nonradioactive metals (principally beryllium and stainless steel). Parts made at the plant are shipped elsewhere for assembly. In addition, the plant reprocesses components after they are removed from obsolete weapons for recovery of plutonium. Other activities at RFP include research and development in metallurgy, machining, nondestructive testing, coatings, remote engineering, chemistry, and physics. Both radioactive and nonradioactive wastes are generated in the various production processes. Current waste handling practices involve onsite and offsite recycling of hazardous materials, offsite disposal of solid radioactive materials at another DOE facility, and onsite storage of hazardous and radioactive mixed wastes. However, RFP operating procedures historically included both onsite storage and disposal of hazardous, radioactive, and radioactive mixed wastes. Preliminary assessments under the ER Program have identified many of the past onsite accidental release sites and storage and disposal locations as potential sources of environmental contamination.

1.5 PREVIOUS INVESTIGATIONS

Various sitewide studies have been conducted at RFP to characterize environmental media and to assess the extent of radiological and chemical contaminant releases to the environment. The investigations performed prior to 1986 were summarized by Rockwell International (1986a) and include the following:

1. Detailed description of the regional geology. (Malde, 1955; Spencer, 1961; Scott, 1960, 1963, 1970, 1972, and 1975; Van Horn, 1972 and 1976; Dames and Moore, 1981; and Robson, et al., 1981 and 1981a).

2. Several drilling programs beginning in 1960 that resulted in construction of approximately 60 monitoring wells by 1982.

3. An investigation of surface water and ground water flow systems by the U.S. Geological Survey USGS (Hurr, 1976).

4. Environmental, ecological, and public health studies that culminated in an Environmental Impact Statement (EIS) (DOE, 1980).

5. A summary report on groundwater hydrology using data from 1960 to 1985 (Hydro-Search, 1985).

6. A preliminary electromagnetic survey of the RFP perimeter (Hydro-Search, 1986).

7. A soil-gas survey of the RFP perimeter and buffer zone (Tracer, 1986).

8. Routine environmental monitoring programs addressing air, surface water, groundwater, and soils (Rockwell, 1975 through 1985, and 1986b).

In 1986, two major investigations were completed at RFP. The first was the DOE Comprehensive Environmental Assessment and Response Program (CEARP) Phase 1 Installation Assessment (DOE, 1986), which included analyses and identification of current operational activities, active and inactive waste sites; current and past waste management practices; and potential environmental pathways through which contaminants could be transported. CEARP was succeeded by the Environmental Restoration Program. A number of sites that could potentially have adverse impacts on the environment were identified. These sites were designated as

SWMUs by Rockwell International (1987a). In accordance with the IAG, SWMUs are now designated as IHSSs, which were divided into three categories:

1. Hazardous substance sites that will continue to operate and require a RCRA operating permit;

2. Hazardous substance sites that will be closed under RCRA interim status; and

3. Inactive hazardous substance sites that will be investigated and cleaned up under CERCLA or Section 3004(u) of RCRA.

The second major investigation completed at RFP in 1986 involved a hydrogeologic and hydrochemical characterization of the plant site. Plans for this study were presented by Rockwell International (1986c and 1986d), and study results were reported by Rockwell International (1986d). Investigation results identified areas considered to be significant contributors to environmental contamination.

1.6 PHYSICAL SETTING

1.6.1 Location

RFP is located in northern Jefferson County, Colorado, approximately 16 miles northwest of Denver (Figure 1-1). Other surrounding cities include Boulder, Westminster, and Arvada, all of which are located less than 10 miles to the northwest, east, and southeast, respectively. The plant consists of approximately 6,550 acres of federal land in Sections 1 through 4, and 9 through 15 of Township 2 South, Range 70 West, 6th P.M. The majority of buildings located within the RFP site are concentrated on approximately 400 acres. RFP is surrounded by essentially an unoccupied buffer zone of approximately 6,150 acres (Figure 1-2).

RFP is bounded on the north by State Highway 128, on the east by Jefferson County Highway 17 (also known as Indiana Street), on the south by agricultural and industrial properties and State Highway 72, and on the west by State Highway 93.

OU8 is located on approximately 150.85 acres in the north-central industrialized area of the RFP. The boundary of OU8 is polygonal in shape and encompasses a majority of the Production (high-security) Area of the plant site. Figure 1-3 locates the 38 IHSSs for which Phase I RFI/RI activities are planned and discussed in this Work Plan.

Information presented in the following discussion of IHSSs (Sections 2.3 and 2.5) is taken from descriptions presented in the Historical Release Report (DOE, 1992) for the RFP, engineering designs drawings, and facilities drawings. For several IHSSs, this information was recently updated by Doty & Associates, Boulder, Colorado as part of a subtask to preparing this Work Plan (Appendix B). This research has been included in the IHSS descriptions provided below. This research includes additional background information regarding release mechanisms, revisions to IHSS size and location, and the nature of operations and potential contaminants occurring at a given site.

1.6.2 Surrounding Land Use and Population Density

The population, economics, and land use of areas surrounding RFP are described in a 1989 Rocky Flats vicinity demographics report prepared by DOE (DOE, 1991a). This report divides general use of areas within zero to five miles of RFP into residential, commercial, industrial, parks and open spaces, agricultural and vacant, and institutional classifications and outlines current and future land use near the plant.

The majority of residential use within 5 miles (8 km) of RFP is located northwest, west, southwest and south of the existing RFP. Figure 1-4 shows the 1990 population distribution within a 5-mile radius from the center of RFP. Commercial development is concentrated near the residential developments around Standley Lake, primarily north and southwest, and around the Jefferson County Airport (Jeffco), which is located approximately three miles (4.8 km) northeast of RFP. Active industrial land use within 5 miles (8 km) of the plant is limited to quarrying and mining operations located on lands directly west and southwest of RFP property.

There are several pockets of industrially zoned property located all around the property, both directly adjacent and nearby. This property is not likely to be developed any time in the near future due to a lack of water for fire protection. These properties must be accepted into a fire protection district in order to be developed for commercial or industrial use. To date, no Fire Protection District has been willing to accept the property, and it is anticipated that these properties will remain undeveloped in the near future. Open Space lands are located northeast of RFP near the City of Broomfield, and in small parcels adjoining major drainages and small neighborhood parks in the cities of Westminster and Arvada. Standley Lake is surrounded by Standley Lake Park. Irrigated and non-irrigated croplands, producing primarily wheat and barley, are located northeast of RFP near the cities of Broomfield, Lafayette, and Louisville, north of RFP near Louisville and Boulder, and in scattered parcels adjacent to the eastern boundary of the plant. Several horse operations and small hay fields are located south of RFP.

Future Population and Land Use Projections

Future land use in the vicinity of RFP most likely will involve continued suburban expansion, increasing the density of residential, commercial and industrial land use in the surrounding areas. The expected trend in population growth in the vicinity of RFP is addressed in the DOE demographics study (DOE, 1991a). This report considers expected variations in population density by comparing the current (1989) setting to population projections for the years 2000 and 2010. A 21-year profile of projected population growth in the vicinity of RFP can thus be examined. The DOE projections are based primarily upon long-term population projections developed by the Denver Regional Council of Governments (DRCOG). Expected population density and distribution around RFP for the years 2000 and 2010 are shown in Figures 1-5 and 1-6, respectively. Table 1-1 summarizes the population data presented in Figures 1-4, 1-5, and 1-6.

1.6.3 Topography

RFP is situated along the eastern edge of the southern Rocky Mountain region immediately east of the Colorado Front Range. RFP is at an average elevation of approximately 5,950 feet above mean sea level (MSL). The site is located on a broad, eastward-sloping alluvial surface. The surface of the alluvium is nearly flat but slopes gently eastward at 50 to 100 feet per mile (EG&G, 1991b). At RFP, the alluvial surface is dissected by a series of east-northeast trending stream-cut valleys. The valleys containing Rock Creek, North and South Walnut Creeks, and Woman Creek are cut 50 to 200 feet below the level of the older alluvial surface in the vicinity of RFP.

1.6.4 Climate and Meteorology

Atmospheric transport of contaminants from RFP is controlled by climate, local meteorology, topography and land surfaces, on-site structures, and contaminant type and concentration. This information is necessary when evaluating the environmental and human health aspects attributable to atmospheric dispersion of OU8 IHSS site contaminants.

1.6.4.1 Climate

The climate at RFP is strongly influenced by the Front Range of the Rocky Mountains. Dry cool winters with some snow cover and warm moderately moist summers are typical. The temperatures at RFP averages a maximum of 24.4°C (76°F) and a minimum of -5.56°C (22°F); Annual mean temperature approximates 9.78°C (49.6°F). Recorded RFP temperature extremes range from 38.89°C (102°F) in July to -32.22°C (-2°F) in January (Schleicher and Schuell, 1982). Infrequent cloud cover over the region allows intense solar heating of the ground surface. The low absolute humidity permits rapid radiant cooling at night. Relative humidity averaged 46% for the period from 1954-1976 (Rockwell, 1989).

Colorado has inconsistent visual air quality conditions. The atmosphere over much of the Rocky Mountains is aesthetically satisfactory. However, the Denver "brown cloud" and visibility problems commonly associated with individual Front Range communities exemplify the consequences of low-level atmospheric stagnation that can occur with air pollutants emitted in Colorado (EG&G, 1990).

Regional topography and upper-level wind patterns combine to create a semiarid climate along the foothills of the Front Range of the Rocky Mountains. Average annual precipitation is approximately 15 inches with more than 80 percent of this falling as rain between April and September. The remaining precipitation is snow (Rockwell, 1989).

1.6.4.2 Meteorology

Meteorology is influenced by local topography, regional mountain ranges, and large-scale weather systems. The orientation of the Front Range of the Rocky Mountains greatly affects local winds. The RFP lies in a belt of prevailing northwesterly winds that are normally channeled across the eastern geological bench called Rocky Flats. High velocity winds have been recorded at the RFP under these meteorological conditions. High winds occur most frequently in the spring.

The RFP is affected by drainage winds from Front Range canyons. These channeled airflows are especially pronounced under conditions of strong atmospheric stability. Similarly, daily cycles of mountain and valley breezes occur at RFP. The general upslope air pattern condition for the Denver area is north to south with flows moving up the South Platte River Valley and entering Front Range canyons. After sunset the air that contacts mountain surfaces begins to cool and move downslope, thereby flowing in a pattern generally the inverse to upslope movements. Downslope flows converge with the South Platte River Valley flow and move toward the north-northeast.

Strong surface air convections commonly produce thunderstorms during the summer. This activity causes severe and locally unpredictable anomalies in normal air flows. Late winter and spring conditions can also be influenced by chinook windstorms. Chinooks consist of strong winds that move from west to east over the continental divide and often reach 70-80 mph. Chinooks have been recorded in excess of 120 mph at RFP (Rockwellb, 1989).

The mean wind speed at the RFP for 1990 was 9.0 mph. The highest reported wind speed was 88.6 mph. Figure 1.7 illustrates the annual RFP wind frequency distribution facing true bearing compass point directions. The predominance of northwesterly winds and the low frequency of winds greater than 15.6 mph (7 m/s) with easterly components is typical for RFP (EG&G, 1990).

Precipitation in the RFP area primarily occurs as snowfall or short-duration thunderstorms. These localized thunderstorms are generally one hour or less in duration, and their areal extent is usually limited to approximately one square mile (ASI, 1991a). The precipitation data are collected and recorded in the West Buffer Zone Meteorological Station (MetSta). Over the long term, the average annual precipitation at RFP has averaged nearly 15.2 inches (ASI, 1991b).

Although RFP-site-specific data are limited, annual evaporation at the RFP site is estimated to be between 31 and 38 inches. This is based upon long-term records at Cherry Creek Dam and Fort Collins, respectively (ASI, 1991b).

1.6.5 Ecology

A variety of plant life is found within RFP. The dominant vegetation found on the western portion of the site is disturbed mixed prairie, a mixture of both short and mid-length grasses. The eastern portion of RFP is generally highly disturbed through overgrazing, and short grasses are dominant. Sedges (*Carex nebraskensis*) and rushes (*Juncus arcticus*) are found in stream floodplains and wet valley-bottoms. Cottonwoods (*Populus sargentii*) and cattails (*Typha latifolia*) line many riparian areas.

Since acquisition of the buffer-zone property, vegetative recovery has occurred, as evidenced by the presence of disturbance-sensitive species such as big bluestem (*Andropogon gerardii*) and side oats grams (*Bouteloua curtipendula*). One vegetative species, Ute Ladies'-tresses (*Spiranthes diluvialis*), has been identified as a threatened species on the Threatened and Endangered Species list. The plants habitat has been identified as riparian areas of Colorado, specifically in riparian meadows in the City of Boulder, Boulder County and along Clear Creek in Jefferson County. RFP is located on a flat that divides two drainages feeding into Boulder County and Clear Creek. The plant has not been identified on plant site to date. No vegetative stresses attributable to hazardous waste contamination have been identified.

Animal populations within RFP are representative of western prairie regions. The presence of a chain-link fence surrounding the production area effectively limits the occurrence of the most common large mammal, the mule deer (*Odocoileus hemionus*), to the buffer zone. The permanent population of *Odocoileus hemionus* is estimated to be 100 to 125. There are a number of small carnivores, such as the coyotes (*Canis latrans*), red fox (*Vulpes fulva*), striped skunk (*Mephitis mephitis*), and the long-tailed weasel (*Mustela frenata*). Small herbivores are common throughout the plant complex and buffer zone, including the pocket gopher (*Thomomys sp.*), white-tailed jackrabbit (*Lepus townsendii*), and the meadow vole (*Microtus pennsylvanicus*) (DOE, 1980).

Commonly observed birds included horned larks (*Eremophila alpestris*), western meadowlarks (*Sturnella neglecta*), mourning doves (*Zenaidura macroura*), vesper sparrows (*Pooectes gramineus*), western kingbirds (*Tyrannus vociferans*), black-billed magpies (*Pica pica*), American robins (*Turdus migratorius*), and yellow warblers (*Dendroica magnolia*). Mallards (*Anas platyrhynochos*) and other ducks (*Anas sp.*) often nest and rear young on several of the ponds. Killdeer (*Chradrius vociferus*) and red-winged black birds (*Agelaius phoeniceus*) are found in areas adjacent to the ponds. Birds of prey commonly seen in the area include marsh hawks (*Circus cyaneus*), red-tailed hawks (*Buteo jamaicensis*), ferruginous hawks (*Buteo regalis*), rough-legged hawks (*Buteo lagopus*), and great horned owls (*Bubo virginianus*) (DOE, 1980).

Rattlesnakes (*Crotalus sp.*) and bull snakes (*Pituophis melanoleucus*) are the most frequently appearing reptiles. Eastern yellow-bellied racers (*Coluber constrictor falviventris*) have also been seen. The eastern short-horned lizard (*Phrynosoma douglassi brevirostre*) has been reported on the site, but these and other lizards are not commonly seen. The western painted turtle (*Chrysemys picta*) and the western plains garter snake (*Thamnophis radix*) are found in and around many of the ponds (DOE, 1980).

Section 9 discusses in further detail the nature and extent of threatened and endangered species in and around RFP. This section also provides a matrix with additional information regarding threatened and endangered species.

1.6.6 Surface Water Hydrology

Three Streams -- Rock Creek, Woman Creek, and Walnut Creek -- drain the RFP area and flow generally from west to east (Figure 1-8). Rock Creek, an intermittent stream, drains an area of the RFP buffer zone generally to the northwest of the RFP Controlled Area, flowing into Coal Creek offsite to the north. Coal Creek flows west and north of RFP and is joined by Rock Creek northeast of RFP. Coal Creek flows into Boulder Creek, then St. Vrain Creek, and eventually the South Platte River.

Woman Creek, a perennial stream, originates to the west of RFP, drains the southern buffer zone area, and flows westward. The South Interceptor Ditch (SID) is located between the RFP Controlled Area and Woman Creek; collects runoff from the southern part of RFP and diverts this to Pond C-2. Waters from Pond C-2 are pumped, treated, and discharged into Walnut Creek downstream of the eastern RFP boundary. Most of the remaining surface-water runoff in the Woman Creek drainage outside of the SID. Drainage flows offsite to the east and in part into Mower Reservoir and primarily into Standley Lake.

Walnut Creek is formed by the combined flows from north Walnut Creek and South Walnut Creek, which drain the central and northern areas of RFP, respectively, along with an unnamed tributary draining a northern part of the RFP area. These three tributaries join in the buffer zone, and Walnut Creek flows towards the Great Western Reservoir to the east. However, Walnut Creek flows generally are diverted around Great Western Reservoir into Big Dry Creek through the Broomfield Diversion Ditch.

Eight ditches convey water throughout the general RFP area: South Boulder Diversion Canal, Last Chance Ditch, Upper Church Ditch, McKay Ditch Bypass, Smart Ditch, Smart 2 Ditch, Mower Ditch and Kinnear Ditch. The Upper Church Ditch, McKay Ditch Bypass, Kinnear Ditch and Last Chance Ditch all divert water from Coal Creek to the east; the Smart Ditch diverts water from Rocky Flats Lake to the east; and the Smart 2 Ditch diverts water from the Smart Ditch to a Woman Creek tributary. The Mower Ditch diverts water from Woman Creek into Mower Reservoir. The South Boulder Diversion Canal is located west of RFP and is unlined in the vicinity of the RFP, except for a cement-lined 100-meter aqueduct that crosses the Woman Creek drainage. Other ditches around RFP are unlined and tend to lose water through seepage into the underlying subsurface materials.

In addition to the ditches described above, other surface-water management controls also are in operation at RFP. The West Interceptor Canal diverts runoff from the headwaters of North Walnut Creek via the McKay Ditch Bypass to Walnut Creek west of Indiana Street. In addition to ditches and canals, a series of detention ponds have been constructed to control the release of RFP discharges and to collect surface runoff.

The surface-water drainage areas from OU8 were analyzed using the information presented by Lee Wan and Associates (LWA) (1987), Wright Water Engineers, Inc. (1991) and EG&G (1991d; 1991i; 1991f). For the purposes of this analysis, the outer boundary of OU8 (EG&G, 1991e) was superimposed over the drainage-basin map (see Figure 1-9) to assess which drainage areas are located wholly or partly within the OU. From this analysis, flow paths of the runoff leaving the

OU were tracked through ditches, swales, culverts, storm sewer systems, and ponds to evaluate what areas located outside the OU8 boundary are receiving runoff originating from within the OU8 boundary.

The major drainage basins that receive runoff from OU8 are as follows:

1) North Walnut Creek, and

2) South Walnut Creek

Figure 1-9 shows the OU8 boundary with the surface-water drainage basins outlined. Figure 1-10 provides an overall schematic diagram of the RFP site area surface-water drainage system with the boundary of OU8 indicated. This Plant-site map indicates the layout of the different major drainageways and shows the location of the OU8 boundary in relation to these surface-water drainage systems. Figure 1-11 provides a schematic diagram of surface-water diversion structures at the A-series and B-series ponds.

The North Walnut Creek basin collects drainage from the northern part of the RFP Controlled Area (CA), including approximately 71 acres located within the OU8 boundary. Runoff in the upper part normally bypasses Ponds A-1 and A-2 and is collected in Pond A-3 (see Figure 1-11). Water may be diverted to Ponds A-1 and A-2 which are used exclusively for spill control (EG&G, 1991d). Pond A-4 is the terminal pond on North Walnut Creek and receives water released from Pond A-3 (EG&G, 1991f). Water from Pond A-4 is discharged to North Walnut Creek in accordance with the National Pollutant Discharge Elimination System (NPDES) permit for the Sewage Treatment Plant, the Federal Facilities Compliance Agreement (FFCA) and the Agreement in Principle (AIP) (EG&G, 1991f). North Walnut Creek is a perennial stream, whereas the tributary that carries the runoff from OU8 to North Walnut Creek is an intermittent stream, with flow occurring primarily after precipitation and snowmelt events.

The surface-water runoff leaving OU8 flows north to North Walnut Creek. Upon reaching North Walnut Creek, the runoff enters OU6 which encompasses the A-series ponds. Other OUs having IHSSs also located within the OU8 boundary are OU4, OU6, OU9, OU10, OU12, OU13, OU14, OU15, and OU16. Table 1.2 provides a listing of each OU and the associated IHSSs which are located within the boundary of OU8 (EG&G, 1991e). The OU8 IHSSs which are located within the North Walnut Creek drainage basin are listed in Table 1.3 and shown on Figure 1-12.

South Walnut Creek begins on Rocky Flats property and receives runoff from the site, including approximately 78 acres located within the OU8 boundary. This basin can be further divided into upper South Walnut Creek and lower South Walnut Creek drainage basins (LWA, 1987) (Figures 1-11 and 1-11). Lower South Walnut Creek is an intermittent stream and upper Walnut Creek is a perennial stream.

The upper South Walnut Creek drainage basin receives storm runoff from approximately 69 acres within OU8. This runoff flows through a storm sewer system and is discharged into a "natural" drainageway of South Walnut Creek near the southeast corner of the Protected Area. This drainageway flows into a storm sewer system which discharges on the east side of the Protected Area back into the natural channel . This channel then drains east to a culvert system under the Northeast Perimeter Road and into a diversion structure located just upstream from Pond B-1 (see Figure 1-11). This runoff is normally diverted around Ponds B-1, B-2, and B-3 through a bypass line to Ponds B-4, although it may be diverted into Pond B-1 (see Figure 1-11). Pond B-4 has limited storage capacity and generally passes water directly to Pond B-5 (EG&G, 1991f).

Ponds B-1 and B-2 are spill-control ponds (EG&G, 1991d) which receive water from the South Walnut Creek basin. Water levels in Pond B-1 and B-2 are kept low in order to maintain capacity for spill control. Pond B-3 collects effluent discharged via a pipeline from the STP. Excess water in Pond B-3 is discharged in accordance with provisions of the STP NPDES permit to Pond B-4 and thence to Pond B-5.

Pond B-5 is the terminal pond on South Walnut Creek. Water from Pond B-5 was historically treated and discharges to South Walnut Creek. Currently, excess water in Pond B-5 is transferred by a new pipeline to Pond A-4, where it is treated and discharged to Walnut Creek according to the NPDES permit, the FFCA and the AIP (EG&G, 1991f).

The surface-water runoff leaving OU8 flows east into OU6, which encompasses the B-series ponds located along South Walnut Creek (Figure 1-10). The OU8 IHSSs which are located within the upper South Walnut Creek sub-basin are listed in Table 1.4 and shown on Figure 1-12.

The lower South Walnut Creek drainage basin receives storm runoff from approximately 9 acres within OU8. The primary drainage structure of this drainage basin is the manmade drainage ditch along the south side of Central Avenue. Runoff from this basin is conveyed to a diversion structure located on the west side of the Northeast Perimeter Road. This runoff can be diverted north to the Upper South Walnut Creek drainage subsystem or east to south Walnut Creek between Ponds B-4 and B-5 (Figure 1-10).

1.6.7 Soils, Geology, and Hydrogeology

At the RFP, core drilling and logging have been used extensively to characterize the subsurface geology. The geological description of OU8 was derived mainly from the Geological Characterization Report (EG&G, 1991h), logs of boreholes and wells. The surficial geology for the RFP and vicinity is shown on Figure 1-13. The surficial geology for OU8 specifically is shown on Figure 1-14, including well and borehole locations. Data for selected wells and boreholes within and immediately adjacent to OU8 are presented in Table 1.5. Hydrogeologic data for these 75 wells and 18 boreholes include location, type and thickness of surficial materials, elevation to the top of bedrock, and its lithology, screened interval of wells, and high and low water level information. Well completion, hydrologic, and geologic information for these wells and boreholes are contained in Table 1.7 and Appendices C and D.

1.6.7.1 Quaternary Geology and Soils

The RFP is located on gravelly alluvium that covers an eastward sloping pediment. The surficial deposits covering the pediment in the immediate vicinity of the RFP comprise the Rocky Flats Alluvium. The alluvium is Quaternary in age, and was deposited as a broad, flat, eastward sloping alluvial fan with its apex near the mouth of Coal Creek Canyon. Lithologically, it is composed of poorly to moderately sorted, poorly stratified gravel, sand, cobbles, silt, and clay. The coarse clastic materials were derived primarily from Front Range provenance areas which are composed of Precambrian crystalline metaquartzites, metabasalts, pelitic schists, and younger granitoids of the Boulder Creek and Silver Plume Granites. Locally, bedrock is exposed along streams that have dissected the pediment.

The Rocky Flats Alluvium underlies nearly all building structures at the RFP, provided it has not been removed and replaced with artificial fill materials. Within the RFP thickness of the alluvium ranges up to 100 feet or is absent where it has been removed by erosion and downcutting of Walnut Creek and Woman Creek. From west to east across the RFP, approximately 3.4 miles, the depositional surface declines approximately 300 feet in elevation, a slope of 88 feet per mile.

Based on mapping conducted by Hurr (1976), nearly all of the Controlled Area (CA) at the Plant is underlain by Rocky Flats Alluvium. These sediments are covered by thin soils, colluvium, artificial fill materials, and RFP structures. In this area, the thickness of the Rocky Flats Alluvium ranges from slightly more than 50 feet to less than 10 feet. Table 1.5 lists the thickness of Rocky Flats Alluvium as intersected in core within and adjacent to OU8.

Geologic materials native to the site (Rocky Flats Alluvium) and imported materials have been used as fill at the Plant for road grade and berm construction, recontouring peripheral to structures, local valley fill, and fill of topographic lows for construction of surface impoundments. Artificial fill thicknesses have been described in drill intercepts and are tabulated in Table 1.5.

Crushed rock has been used for landscaping and levelling at the site. Throughout most of the OU8 area the land surface is covered with pavement and imported gravel, in addition to buildings and disturbed ground.

Locally, colluvial deposits are present on steeper slopes flanking stream drainages that extend across the RFP. These deposits are derived from the Rocky Flats Alluvium and that of bedrock, the Arapahoe formation. Throughout the RFP, most bedrock is concealed beneath colluvial material. Occurrence of these materials are limited at OU8 but exist in the southeastern corner of the OU as shown on Figure 1-14. Thickness and occurrence of colluvium is identified in the core intercept data furnished in Table 1.5.

Along the bottoms of the stream valleys Quaternary age valley-fill alluvium is deposited and may exhibit minor linear wetlands on these alluvial materials (EG&G, 1990).

Within the RFP, three types of soils and their distribution have been described by the Soil Conservation Service (1983). The soils at OU8 consist of the Flatiron Series, located on Rocky Flats Alluvium; the Nederland Series, commonly located on the upper slopes flanking Rocky Flats Alluvium; and the Denver-Kutch-Midway Series, located on slopes flanking the previous soils. The dominant soil in the OU8 area is the Flatiron series and is mapped as shown on Figure 1-15. These soils are very cobbly sandy loams that exhibit a slow infiltration rate and typically are located on slopes of 0 to 3 percent. The next most abundant soil in the area is the Denver-Kutch-Midway Series which is restricted to the northern area and the southeastern portion of OU8. These soils are clay loams, also exhibiting a slow infiltration rate, are developed on Arapahoe Formation claystones where slopes range from 9 to 25 percent. Limited occurrences of Nederland Series soils are present in the northwestern corner and the southeastern corner of OU8. The Nederland soils developed adjacent to the Flatiron Series along the periphery of the Rocky Flats Alluvium where slopes are 15 to 50 percent. The Nederland soils exhibit a moderate infiltration rate. At the RFP, all three soils are partly obscured by fill materials, gravel, or buildings and other structures. No soils are distinguished in the core data given in Table 1.5.

Quaternary Erosion

It has been suggested (EG&G, 1991h) that the top of the bedrock surface reflects the remnants of the pre-Wisconsin pediment as well as the effects of recent stream incisement (Figure 1-26). Within the bedrock surface the Arapahoe Formation No. 1 Sandstone channel confinement (by flanking claystones) has been locally breached by two erosional processes.

The earlier event was a result of pre-Wisconsin pedimentation imparting distinctive paleoridges with flanking paleodrainages. Immediately south of OU8 the top of the bedrock beneath the CA forms a paleoridge trending east-west. Diverting from this ridge, in the vicinity of the southwest corner of OU8, a second paleoridge extends north-northeast beneath the central portion of OU8. The paleodrainages flanking each side of the second paleoridge exhibit initial northeasterly gradients ranging between 10 to 20 feet per 1,000 feet, steepening to 40 to 50 feet in the northeast area beneath OU8.

The latter event was a result of headward erosion of North and South Walnut Creeks with erosion of the Rocky Flats Alluvium. As a consequence, the Arapahoe Formation has been locally exposed in these drainages (Figure 1-9). The No. 1 Sandstone and confining claystone have been partially eroded in the vicinity of the eastern side of OU8 (Figures 1-19 and 1-20). This geologic framework has important implications to the hydrogeologic control of the ground and surface water in the area of OU8.

1.6.7.2 Cretaceous Stratigraphy and Structural Geology

Figure 1-16 is a generalized stratigraphic section showing bedrock units exposed near the east edge of the Front Range in the Golden-Morrison area, a few miles south of the RFP. Figure 1-17 is a generalized stratigraphic section of the youngest units at the RFP. These units dip generally eastward, as shown in Figure 1-13, and are locally exposed at the surface and occur throughout the subsurface beneath the RFP.

The generalized upper Cretaceous and younger stratigraphy in the vicinity of the RFP is presented in Figure 1-17. The upper Cretaceous Arapahoe Formation unconformably underlies the surficial material at the RFP (Spencer, 1961). This formation was weathered and eroded during pedimentation and eventually covered by the Rocky Flats Alluvium. According to the Geologic Characterization Report for RFP (EG&G, 1991h), the Arapahoe Formation is 150 feet thick beneath the central portion of the RFP. However, results from a recent field mapping project (EG&G, 1992h) suggest that the Arapahoe Formation is generally less than 50 feet thick. The position of the Arapahoe Formation and underlying Laramie Formation is unresolved. This contact has been proposed for palynology and biographic studies in an attempt to locate the boundary and identify reliable or recognizable lithologic markers for use in interpretation and correlation of drill cores. Lithologically, composition of the Arapahoe formation is mainly claystone and silty claystone, with sandstone bodies present. Most sandstone is very-fine to medium-fine grained, poorly to moderately sorted, subangular to subrounded, silty and clayey. Some coarse-grained to conglomeratic sandstone is also present. The sandstone bodies are thought to be lenticular and laterally discontinuous and are interpreted as channel, point bar, and overbank deposits of a fluvial system (EG&G, 1991h).

The Laramie Formation unconformably underlies the Arapahoe (Weimer, 1973) and is approximately 800 feet thick at the RFP. The formation is divided into two intervals: a lower unit (about 300 feet thick) of sandstone, siltstone, claystone with coal layers, and an upper claystone unit (Weimer, 1973 and EG&G, 1991a). The sandstones are fine to coarse grained, poorly sorted, subangular, and silty. The upper interval is about 500 feet thick at the RFP, consisting of light to medium gray kaolinitic claystones with some dark grey to black carbonaceous claystones (EG&G, 1991h). The Laramie Formation is interpreted as having been deposited in a coastal or transitional marine environment.

Structurally, the RFP is located on the western flank of the Denver Basin, approximately four miles east of steeply dipping strata on the east flank of the Front Range uplift. The generalized west to east geologic structure beneath the RFP is shown on Figure 1-18. The most prominent

feature is a monoclinal fold which strikes approximately north-south. Bedrock dips steeply eastward in the western portion of the RFP, as reflected by the 50 degree dip of the Fox Hills sandstone and Laramie claystone Formations. Beneath the Controlled Area (CA) the bedrock flattens to a dip of no more than 1 to 2 degrees.

There are 16 wells within and immediately adjacent to OU8 in which a sandstone interval subcrops at the Arapahoe Formation - Rocky Flats Alluvium unconformity. Listings of the lithologies which occurred in these wells is presented in Table 1.5. The uppermost subcropping sandstone in the majority of these wells is the No. 1 Sandstone, as defined by the Geological Characterization Report (EG&G, 1991h). In general, the sandstone unit is very fine grained to fine grained, well sorted, sub-angular to sub-rounded, moderately friable, highly weathered, and is heavily iron stained. The thickness of subcropping sandstone units ranges from 0.5 feet in well 2086 to greater then 11.5 feet in well 3186. Usually, the sandstone unit is underlain and flanked by finer units such as siltstone or claystone.

Figures 1-19 and 1-20 are isopach maps based on geologic models set forth in The Geological Characterization Report, which present two interpretations for the No. 1 Sandstone in the OU8 area. These maps are highly interpretive since subsurface control is limited. Interpretation 1 suggests a single continuous meandering channel system. Channel and point bar deposits are both recognized (Figure 1-20); however, channel fill deposits are dominant. Interpretation 2 (Figure 1-20) depicts a multiple channel system containing laterally migrated channel and point bar deposits.

Figure 1-19 also suggests that the uppermost Arapahoe Formation unit (No. 1 Sandstone) occurs as a localized sandstone beneath the OU8 area. Moreover, Interpretation 1 presents a southwestern source for the channel sand which propagated eastward in a single sinuous, tight meander belt. The fluvial system is interpreted as entering from the southwest flowing north re-entering the north-central area of OU8, where channel sands were distributed southerly, and then departed at the south-central area south of OU8. The fluvial channel then changed direction

continuing eastward only to re-enter the southeast portion of OU8 and finally exiting OU8 and continuing northeasterly (EG&G, 1991h).

Pre-Wisconsin age paleodrainages developed on the pediment surface of Arapahoe Formation claystones and sandstones, and later headward erosion of South Walnut Creek have truncated part of the eastern-most channel sandstone (EG&G, 1991i). As shown on Figure 1-19 and selected geological cross sections, in the vicinity beneath IHSS 173 (east of the Mound Areas), partial erosion of the No. 1 Sandstone is indicated. As a consequence, the area of truncated sandstone results in a lateral permeability connection to alluvial sediments in Walnut Creek. This interpretation is further substantiated by results of several drill cores near borehole 2287BR.

Figure 1-20 alternately suggests that the No. 1 Sandstone may be found as two laterally distributed channels underlying the OU8 area. Moreover, Interpretation 2 presents these two distinct channels to have developed separately and migrated eastward from positions west of OU8. Fluvial channel sand development and transport direction for the northerly channel may have extended across the northwestern area beneath OU8 and continued to the northeast. At possibly the same time a separate fluvial channel appears to have also transported sand across the southern area of OU8 also exiting eastwardly. The pre-Wisconsin age erosional event (EG&G, 1991c) described above, near IHSS 173, (east of the Mound Area) is also applicable to the No. 1 Sandstone in Interpretation 2 with the result and apparent permeability connection.

Both interpretations recognize that the No. 1 Sandstone consists of more then one fining upward sequence. The Geological Characterization Report states that a minimum of three fining upward sequences are recognized where penetration of the No. 1 Sandstone is complete. Fining upward sequences and presence of the No. 1 Sandstone in wells with subcropping sandstone units is shown in Table 1.6. Fining upward sequences such as at well P209189 (Table 1.6) indicate a decrease of sediment transport energy. This sedimentation sequence has been noted at several wells where the sandstones have been fully penetrated during drilling; similar fining upward

sequences are subjectively interpreted in wells where only the upper, finer parts of the sandstone are penetrated.

Figures 1-21 through 1-25 present five geological cross sections across OU8. These cross sections are presented at the same scale as that of the surface maps, Figures 1-19 and 1-20. Sections A-A' and B-B' are generally oriented west to east while C-C', D-D', and E-E' are oriented north to south. In order to graphically display subsurface geologic and hydrologic data previously collected at wells along the lines of section, the vertical scale has been exaggerated. Accordingly, the intersected surfaces such as topography, water tables, bedrock unconformity and formation boundaries are proportionately inclined greater than actual slopes interpolated to the next adjacent well.

Along the ground surface profile of each section, the scaled position of each IHSS intersected or in close proximity are indicated, as are intersections or ties to other cross sections. Well screen intervals and the extremes of the observed water level are also shown. Closed triangle symbols indicate the measured water level position extremes for the uppermost hydrostratigraphic unit (HSU 1) which includes the alluvium and the hydrologically connected No. 1 Sandstone of the Arapahoe Formation. Open triangles indicate other water levels which relate to the deeper interbedded claystones, siltstones, and thin sandstones which have no direct hydrologic connection to HSU 1.

Interpretation 1 for Arapahoe Formation No. 1 Sandstone beneath OU8 is the presence of three fluvial segments of a single, meandering subsurface channel. Cross Sections A-A', B-B', D-D', and E-E' (Figures 1-21, 1-22, 1-24, and 1-25) show an idealized conceptual model for this interpretation. Cross Section B-B' shows three intersections with a single channel meander. The sandstone is depicted as subcropping in the central channel, but the lateral extent of the eastern and lateral and vertical extent of the western channels are not clearly defined. The thickest No. 1 Sandstone interval (21 feet) occurs in well P209189 as shown in Cross Sections A-A' and D-D'. The consequence of Interpretation 1 postulates that where the No. 1 Sandstone is confined,

the selective permeability and migration of groundwater would be along the channel directions rather than confirmed within areas where claystone is present. As a result groundwater flow would favor north-south directions (Figure 1-19).

Interpretation 2 for Arapahoe Formation No. 1 Sandstone beneath OU8 suggests the presence of two sandstone channels in the southeastern and northwestern portions of the operable unit. The thickest No. 1 Sandstone unit, found in well P209189, is in the northern sandstone channel. Other significant occurrences of No. 1 Sandstone subcropping are indicated at well P209389 located in the northern channel and at wells BH31-87, BH32-87, and BH34-87, which are located in the southern channel in the southeast portion of OU8. Cross sections A-A', B-B', D-D', and E-E' show an interpretation of these two sandstone channels. The consequence of Interpretation 2 postulates that where the No. 1 Sandstone is confined, the selective permeability and transport of groundwater would be along the channel directions and not with areas where claystone is present. As a result groundwater flow would favor west-east directions (Figure 1-20).

1.6.7.3 Hydrogeology

Hydrostratigraphic units that exist in the strata beneath the Rocky Flats site in the surficial materials and the underlying Cretaceous bedrock are shown in Figures 1-17 and 1-18. The RFP is situated in a regional groundwater recharge area. The groundwater system is dynamic, that is, rapid changes in water table elevations occur in response to short-term or incident precipitation events and variations in recharge. Generally water levels are highest in spring and early summer and lowest during the winter months.

Characterization of the groundwater flow regime in OU8 is based on boring logs, water level measurements, and well completion data from piezometers and monitoring wells. There are 54 wells and piezometers within the boundary of OU8 (Table 1.7). Water levels are measured monthly in piezometers; water levels are measured monthly and groundwater samples are collected quarterly in groundwater monitoring wells. All of the wells and piezometers are either

RCRA Regulatory wells or Non-regulatory Characterization wells with the exception of well 43-86, which is a CERCLA Characterization well (EG&G, 1991c).

Hydrostratigraphic Units

The uppermost hydrostratigraphic unit (HSU 1), a water table aquifer, occurs primarily in unconsolidated surficial material. It includes the Rocky Flats Alluvium, which is present on broad topographic highs, colluvium along valley slopes, and the valley fill alluvium present in modern stream drainages. In the western part of the RFP, where the thickness of the surficial material is greatest, the depth to the water table is 50 to 70 feet below the surface. Although the water table depth is variable, it becomes shallower from west to east as the surficial material thins. In the stream drainages, seeps are common at the base of the Rocky Flats Alluvium (EG&G, 1991k) and where individual Arapahoe Formation sandstones are exposed.

Generally, groundwater within the water table aquifer flows along the contact of the surficial material with the Arapahoe Formation claystones in a downgradient direction to the east. The claystones have a low hydraulic conductivity, on the order of 1×10^{-7} cm/s (EG&G, 1991k), effectively constraining much of the flow within the water table aquifer to the surficial material above the bedrock unconformity. Interpretation of well logs indicate that locally a hydraulic connection exists between the uppermost Arapahoe Formation No. 1 Sandstone and the surficial materials (Table 1.5) so that within the limited area the sandstones are part of HSU 1 (Figures 1-19 and 1-20).

The uppermost Arapahoe Formation No. 1 Sandstone occurs as HSU 1 in some areas of OU8 where it outcrops and subcrops beneath the surficial material, existing in hydraulic connection with the surficial materials (Figures 1-27 and 1-28). Generally the groundwater flows within the water-bearing materials and along the contact of the claystones and silty claystones of the Arapahoe Formation from west to east, with minor diversions along drainages and off

paleotopographic highs (paleoerosional surfaces). The saturated thickness may thin considerably during the winter months when some wells are seasonally dry in the OU8 area (Table 1.7).

Other hydrostratigraphic units at the RFP include sandstone units of the Arapahoe Formation which exist under confined conditions beneath most of the Rocky Flats Plant site. The confining layers for the sandstones are claystones and silty claystones. There are numerous bedrock monitoring wells in the OU8 area. In places where the uppermost sandstone is separated from the surficial materials by claystones and silty claystones, the sandstone may exist for a limited area as a confined aquifer. Deeper bedrock wells are screened in stratigraphically lower sandstones and are bounded by relatively impermeable Arapahoe Formation claystones and silty claystones and exist as confined aquifers (Table 1.7). Water levels measured in bedrock wells in other areas of the RFP indicate a strong downward vertical hydraulic gradient (EG&G, 1991k). This is conformable with the fact that the RFP site is on a topographic high and is within a regional recharge area.

The Laramie/Fox Hills aquifer crops out at the west end of the RFP and dips at 45 to 50 degrees to the east. Gradually the dip decreases to less than two degrees beneath the central part of the RFP where the older Laramie and Fox Hills formations are separated from the overlying Arapahoe Formation (Hurr, 1976; EG&G, 1991k). The claystone within the lower Arapahoe and upper Laramie formations are of low hydraulic conductivity and would tend to retard downward groundwater movement to the Laramie and Fox Hills aquifer.

Recharge and Discharge

Groundwater recharge occurs as infiltration of precipitation to confined aquifers where bedrock crops out in the western portion of the RFP along the west limb of the monoclinal fold, and to the unconfined saturated zone to unconsolidated surficial materials and subcropping permeable bedrock throughout the RFP area (Figure 1-13). Recharge also occurs as a result of infiltration of surface water from streams, ditches, and ponds. At the local level, there are areas of discharge

as well as recharge. Baseflow of some of the perennial streams is sustained by runoff (drainage) or groundwater discharge. Surface water runoff and groundwater migrating via building footing drains or within the surficial materials and underlying permeable bedrock (Arapahoe Formation sandstones) discharge at drain outfalls or seeps along side slopes in the valleys and becomes surface water or evaporates.

Within OU8, there are areas of recharge and discharge. As a result of extensive paving and building construction at OU8 it is estimated that less than 40 percent of the natural surface materials are exposed directly to incident precipitation. The majority of the precipitation runoff is diverted to trenches, culverts and stormwater drains to be conveyed to two surface drainages. One unnamed surface drainage within the northwestern portion of OU8 (Figure 1-9) receives baseflow contribution from groundwater discharge most of the year as evidenced by marshes along its extent. The other drainage is South Walnut Creek, an intermittent stream, gaining during high precipitation in spring and early summer, while losing during the low precipitation of late summer and fall. Recharge to the groundwater system also occurs as a result of groundwater flow from upgradient areas west of OU8 and possibly as seepage from ponds and ditches in the area.

Hydraulic Conductivities

The Arapahoe and the surficial hydrostratigraphic units at the RFP have relatively low hydraulic conductivities and therefore, are not generally believed to be capable of producing amounts of water of economic significance (ASI, 1991; EG&G, 1991k). Hydraulic conductivity values are based on packer tests performed in 1986 and 1989. No data on hydraulic conductivity of the Arapahoe outside the RFP was discovered.

No conclusive data are available for Recent and colluvial deposits; however, a pumping test conducted near Woman Creek in OU1 indicates a relatively high hydraulic conductivity of 1.8 x 10^{-2} cm/sec (pumping well 0-3) for the Valley Fill Alluvium (Doty, 1992b). The Draft Final Geologic Characterization Report (EG&G, 1991k) reports a range of hydraulic conductivities

from 5 X 10^{-6} to 3 X 10^{-3} for the valley fill alluvium. Hydraulic conductivities reported for the Rocky Flats Alluvium of HSU 1 range from 7 x 10^{-5} cm/sec to 1 x 10^{-2} cm/sec. The reported range of hydraulic conductivities for the highly weathered and unconsolidated subcropping Arapahoe sandstone which also forms a part of HSU 1 is 2 x 10^{-6} cm/sec to 4 x 10^{-5} cm/sec. Both of these values are greater than the hydraulic conductivities of the Arapahoe claystones which are approximately 1 x 10^{-7} to 1 x 10^{-8} cm/sec for both weathered and unweathered claystone (EG&G, 1991k).

In the subsurface, unweathered, confined HSU 1 sandstones in the Arapahoe Formation have hydraulic conductivities ranging from 4 x 10^{-8} cm/sec to 2 x 10^{-6} cm/sec. This value is intermediate to that of the hydrostratigraphic units in the Rocky Flats Alluvium and weathered subcropping Arapahoe sandstones and the Arapahoe claystones (EG&G, 1991k). This information is summarized and presented in Table 1-8.

Water Level Maps

Monthly water levels measured in OU8 wells and the surrounding area over the last 3 to 6 years indicate that the overall saturated thickness of HSU 1 was greatest in April 1992 (Table 1.7). Figure 1-2 is a high water level map of the uppermost hydrostratigraphic unit for water levels measured in April 1992. This figure indicates the groundwater gradient direction in HSU 1 is almost due east.

The same water level data also indicates that the saturated thickness of HSU 1 was the least in January 1991 (Table 1.7). A low water level map of HSU 1 is presented as Figure 1-28 and shows that the groundwater gradient is similar to high water level periods.

TABLE 1.1

CURRENT AND PROJECTED POPULATION IN THE VICINITY OF THE ROCKY FLATS PLANT

Sector	Segment B	C	D	E	F	G	H	Sum
Year: 1989								
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	5	13	0	0	0	17	0	35
4	0	22	0	283	46	50	215	616
5	300	13	25	3,671	477	578	2,355	7,419
SUM	305	48	25	3,954	523	645	2,570	8,070
Year: 2000								
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	5	13	0	0	0	17	0	35
4	0	214	7	472	96	50	630	1,469
5	1,289	566	25	4,372	542	1,259	6,457	14,510
SUM	1,294	793	32	4,844	638	1,326	7,087	16,014
Year: 2010								
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	5	13	0	0	0	17	0	35
4	0	389	14	644	142	50	1,007	2,246
5	2,189	1,069	25	5,009	601	1,879	10,186	20,958
SUM	2,194	1,471	39	5,653	743	1,946	11,193	23,239

Source: DOE (1991)

TABLE 1.2

Description of IHSS Contaminants and Affected Surface-Water Drainage Basins*

Drainage Basin/IHSS	Released Contaminants[1]	Type[2]	Monitoring Site[3]			
			Downstream		Upstream	
			Surface	Sediment	Surface	Sediment
I. NORTH WALNUT CREEK						
•118.1 Solvent Spill, W. End of Bldg. 730	Carbon Tetrachloride Trichloroethelyene	D	SW102	SED120	None	None
•135 Cooling Tower Blowdown, S.E. of Bldg. 374	Tritium Chromium Phosphate	A B C	SW043	SED010	None	None
•137 Cooling Tower Blowdown, Bldg. 774	Chromium	B	SW102	SED120	None	None
•138 Cooling Tower Blowdown, Bldg. 779	Alpha Chromium Phosphate	A B C	SW085	None	None	None
•139.1(N) Hydroxide Tank Area (Bldg. 774)	Sodium Hydroxide	B	SW086	SED120	SW084	SED124
•139.1(S) Hydroxide Tank Area (Bldg. 771)	Potassium Hydroxide	B	SW102	SED120	None	None
•139.2 Hydrofluoric Acid Tank Area (Bldg. 714)	Hydrofluoric Acid	C	SW102	SED120	None	None

* Refer to Figure 1-12 for location of Drainage Basins.

1) Source: Hazardous Release Report, January, 1992 (DOE, 1992)
2) Contaminant Types:
A - Radionuclides B - Trace Metals C - Inorganics D - Volatile Organics
3) Surface-water and sediment monitoring sites which are located nearest downstream from the IHSS.

TABLE 1.2 - Continued

Description of IHSS Contaminants and Affected Surface-Water Drainage Basins*

Drainage Basin/IHSS	Released Contaminants[1]	Type[2]	Monitoring Site[3]			
			Downstream		Upstream	
			Surface	Sediment	Surface	Sediment
•144 Sewer Line Breaks, Bldg. 730, Tanks 776 A-D	Rad. Process WW Alpha High-Level Rad. Sludge	A	SW102	SED120	None	None
•150.1 Radioactive Site, N. of Bldg. 771	Plutonium Americium Nitric Acid	A	SW084 SW124	SED124	None	None
•150.2 Radioactive Site, W. of Bldg. 771	Plutonium	A	SW018	SED010	None	None
•150.3 Radioactive Site, Between Bldgs. 771 and 774	Plutonium Process WW (Low-Level Rad)	A	SW084	SED120	None	None
•150.6 Radioactive Site, S. of Bldg. 779	Unknown Rads	A	SW085		None	None
•150.7 Radioactive Site, S. of Bldg. 776	Plutonium	A	SW018	SED010	None	None
•150.8 Radioactive Site, N.E. of Bldg. 779	Unknown Rads	A	SW085	SED09	None	None

* Refer to Figure 1-12 for location of Drainage Basins.

1) Source: Hazardous Release Report, January, 1992 (DOE, 1992)

2) Contaminant Types:
A - Radionuclides B - Trace Metals C - Inorganics D - Volatile Organics

3) Surface-water and sediment monitoring sites which are located nearest downstream from the IHSS.

TABLE 1.2 - Continued

Description of IHSS Contaminants and Affected Surface-Water Drainage Basins*

Drainage Basin/IHSS	Released Contaminants[1]	Type[2]	Monitoring Site[3]			
			Downstream		Upstream	
			Surface	Sediment	Surface	Sediment
•151 Fuel Oil Leak, N. of Bldg. 374	No. 2 Diesel Fuel	D	SW043	SED010	None	None
•163.1 Radioactive Site, 700 Area Site #3, Wash Area N.E. of Bldgs. 774	Low-Level Rads Inorganic Compounds Organic Compounds	A C D	SW120 SW119	SED120	None	None
•163.2 Radioactive Site, 700 Area Site #3, Buried Slab N. of Bldgs. 771 and 774	Americium	A	SW124	SED124	None	None
•172 Central Avenue Waste Spill	Plutonium Uranium Berylium Acetone Perchloroethane Trichloroethane	A D	SW018	SED010	None	None
•188 Acid Leak (SE of Bldg. 374)	Hydrochloric Acid Nitric Acid	C	SW018	SED010	None	None

* Refer to Figure 1-12 for location of Drainage Basins.

1) Source: Hazardous Release Report, January, 1992 (DOE, 1992)

2) Contaminant Types:
A - Radionuclides B - Trace Metals C - Inorganics D - Volatile Organics

3) Surface-water and sediment monitoring sites which are located nearest downstream from the IHSS.

TABLE 1.2 - Continued

Description of IHSS Contaminants and Affected Surface-Water Drainage Basins*

Drainage Basin/IHSS	Released Contaminants[1]	Type[2]	Monitoring Site[3]			
			Downstream		Upstream	
			Surface	Sediment	Surface	Sediment
II. SOUTH WALNUT CREEK						
•118.2 Solvent Spill S. End of Bldg. 776	Carbon Tetrachloride Benzene Dichloromethane 1,1,1-Trichloroethane Methylethylketone Petrolium Distillates	D	SW122	SED011	None	None
•123.1 Valve Vault 7, S.W. of Bldg. 707	Process WW	A	SW122	SED011	None	None
•150.4 Radioactive Site, E. of Bldg. 750	Decon Water Plutonium (suspected)	A	SW122	SED011	None	None
•150.7 Radioactive Site, S. of Bldg. 776	Plutonium	A	SW122	SED011	None	None

* Refer to Figure 1-12 for location of Drainage Basins.

1) Source: Hazardous Release Report, January, 1992 (DOE, 1992)

2) Contaminant Types:
A - Radionuclides B - Trace Metals C - Inorganics D - Volatile Organics

3) Surface-water and sediment monitoring sites which are located nearest downstream from the IHSS.

TABLE 1.2 - Continued

Description of IHSS Contaminants and Affected Surface-Water Drainage Basins*

Drainage Basin/IHSS		Released Contaminants[1]	Type[2]	Monitoring Site[3]			
				Downstream		Upstream	
				Surface	Sediment	Surface	Sediment
•172	Central Avenue Waste Spill	Perclene Plutonium Uranium Solvent Oil Carbon Tetrachloride	A D	SW022 SW059	SED011	None	None
•173	Radioactive Site, 900 Area (Storage Vaults near Bldg. 991)	Plutonium Uranium Berylium Acetone Perchloroethane Trichloroethane	A D	SW056	SED011	SW122	None
•184	Radioactive Site, Bldg. 992 Steam Cleaning Area	Decon. Water (unknown)	A	SW060	SED011	SW056	None

* Refer to Figure 1-12 for location of Drainage Basins.

1) Source: Hazardous Release Report, January, 1992 (DOE, 1992)

2) Contaminant Types:
A - Radionuclides B - Trace Metals C - Inorganics D - Volatile Organics

3) Surface-water and sediment monitoring sites which are located nearest downstream from the IHSS.

Table 1.3

Relationship of Other OUs and IHSS's[1] to OU8 and Drainage Basins at Rocky Flats Plant, Colorado

OU Number	IHSS Number	Drainage Basin
OU4	101	North Walnut Creek
OU6[2]	143	North Walnut Creek
OU9[1]	121	North Walnut Creek and lower South Walnut Creek
	123.2 (150.5)	
	124.1-124.3	North Walnut Creek
	125	North Walnut Creek
	126	North Walnut Creek
	127	North Walnut Creek
	132	North Walnut Creek
	146.1-146.6	North Walnut Creek
	147.1	upper South Walnut Creek
	149	North Walnut Creek
	159	North Walnut Creek and lower South Walnut Creek
	215	North Walnut Creek
OU10	175	upper South Walnut Creek
	176	North Walnut Creek and upper South Walnut Creek
	206	North Walnut Creek
	210	upper South Walnut Creek
OU13	117.1	North Walnut Creek and upper South Walnut Creek
	117.2	upper South Walnut Creek
	128[3]	North Walnut Creek
	137[3]	North Walnut Creek
	158	North Walnut Creek and upper South Walnut Creek
	171[3]	North Walnut Creek
	186	North Walnut Creek
	190	upper South Walnut Creek
OU14	156.1[3]	North Walnut Creek
	162	North Walnut Creek and upper South Walnut Creek
OU16	185	upper South Walnut Creek
	192	upper South Walnut Creek
	194	upper South Walnut Creek
	197	North Walnut Creek and upper South Walnut Creek

1) Location of IHSSs reflect assignment as per CDH letter dated April 21, 1992.
2) Located downstream of OU8.
3) Located within the area that drains onto OU8. Not located within the OU8 boundary.

Table 1.4

Relationship of OU8 IHSSs to Surface Water Drainage Basins

I. Drainage Basin	IHSSs	
A. North Walnut Creek	118.1	146.1 to 146.6
	125	149
	126.1	150.1
	126.2	150.2
	127	150.3
	132	150.4
	135	150.6
	137	150.8
	138	151
	139.1 (N & S)	163.1
	139.2	172
	144	188
B. Upper South Walnut Creek	118.2	150.7
	123.1	159
	123.2	172
	150.2	173
	150.4	184
	150.5	

Table 1.5
List of Wells and Boreholes at Operable Unit 08 Area
Rocky Flats Plant

	Well No.	State North	State East	Surface Elevation	T.O.C. Elevation	TD	TD Elevation	Type Alluvium	Thick All.+Fill	El. Top Bedrock	Upper Bedrock	High Water Level Below Surface	High Water Level Elevation	Low Water Level Below Surface	Low Water Level Elevation	Open Interval
42	BH36-87	749502	2086149	5969.4	**	26	5,943.40	Qrf	20.60	5,948.80	Claystone					
43	BH37-87	749610	2086128	5968.8	**	28	5,940.80	Qrf	14.00	5,954.80	Claystone					
44	B208789	751755	2084450	5907.1	5909.03	14.4	5,892.70	Qal	4.50	5,902.60	Caliche					2.88 - 10.93
45	P114089	749,461	2,083,653	5,996.70	5,998.49	19.0	5,977.70	Qrf	9.30	5,987.40	Claystone	6.39	5990.31	Dry		21.1 - 27.60
46	P114789	749,940	2,082,610	6,010.70	6,012.40	31.0	5,979.70	Qrf	26.00	5,984.70	Claystone	5.65	6005.05	9.81	6000.89	21.81 - 26.23
47	P114889	749,926	2,082,127	6,016.60	6,018.26	18.0	5,998.60	Qrf	13.80	6,002.80	Claystone	4.96	6011.64	5.87	6010.73	8.66 - 15.55
48	P115489	749,507	2,082,135	6,023.40	6,025.10	31.0	5,992.40	Qrf	26.00	5,997.40	Claystone	6.77	6016.63	11.76	6011.64	20.70 - 27.75
49	P115589	749,551	2,082,658	6,014.10	6,015.77	33.6	5,980.50	Qrf	29.00	5,985.10	Claystone	2.68	6011.42	8.33	6005.77	24.05 - 30.90
50	P115689	749,532	2,083,019	6,006.90	6,008.71	23.5	5,983.40	Qrf	19.70	5,987.20	Claystone	5.72	6001.18	12.40	5994.50	14.9 - 21.31
51	P207389	750195	2084468	5981.02	5982.77	23.3	5,957.72	Qrf	7.00	5,974.02	Claystone	4.73	5976.29	7.10	5973.92	9.35 - 16.40
52	P207489	750197	2084481	5980.71	5982.64	10	5,970.71	Qrf	6.50	5,974.21	Claystone	4.37	5976.34	6.93	5973.78	2.25 - 8.60
53	P207589	750395	2084843	5974.06	5975.96	29.1	5,944.96	Qrf	9.50	5,964.56	Silty Claystone	23.87	5950.19	24.60	5949.46	13.4 - 25.10
54	P207689	750398	2085318	5966.32	5967.88	18.2	5,948.12	Qrf	12.60	5,953.72	Silty Claystone	5.29	5961.03	7.18	5959.14	3.00 - 14.36
55	P207789	750392	2085343	5965.88	5967.75	32.3	5,933.58	Qrf	12.90	5,952.98	Silty Claystone	27.49	5938.39	28.07	5937.81	16.9 - 28.63
56	P207889	750671	2085343	5962.82	5964.9	10.5	5,952.32	Qrf	8.50	5,954.32	Claystone	2.66	5960.16	5.24	5957.58	2.5 - 8.95
57	P207989	750671	2085330	5963.09	5965.17	26.2	5,936.89	Qrf	5.80	5,957.29	Claystone	18.63	5944.46	19.70	5943.39	10.0 - 21.73
58	P208889	751086	2085249	5947.3	5949.25	105.1	5,842.20	Qc	5.50	5,941.80	Siltstone	ND	ND	ND	ND	86.75 - 99.60
59	P208989	751044	2084839	5962.53	5964.56	28.6	5,933.93	Qrf	3.50	5,959.03	Claystone	10.13	5952.40	15.02	5947.51	14.4 - 26.12
60	P209089	750,566	2084910	5972.16	5974.25	31.5	5,940.66	Qrf	11.50	5,960.66	Silty Claystone	25.94	5946.22	22.93	5949.23	15.5 - 27.21
61	P209189	750762	2084309	5980.66	5982.21	38.3	5,942.36	Qrf	10.30	5,970.36	Sandstone	8.63	5972.03	12.80	5967.86	12.3 - 36.08
62	P209289	750863	2,084,139	5,981.59	5,983.42	17.8	5,963.79	Qrf	13.80	5,967.79	Sandstone	11.90	5969.69	12.86	5968.73	7.40 - 13.40
63	P209389	750864	2,084,130	5,981.47	5,983.39	34.2	5,947.27	Qrf	13.80	5,967.67	Sandstone	15.23	5966.24	17.98	5963.49	15.85 - 30.10
64	P209489	750991	2084634	5977.98	5980.1	48	5,929.98	Qrf	9.00	5,968.98	Claystone	24.38	5953.60	27.23	5950.75	14.40 - 37.00
65	P209589	751071	2085286	5948.17	5950.04	30.3	5,917.87	Qrf	4.10	5,944.07	Silty Claystone	16.49	5931.68	17.40	5930.77	8.07 - 19.77
66	P209689	750533	2085514	5962.63	5964.43	30.2	5,932.43	Qrf	12.20	5,950.43	Sandy Claystone	26.65	5935.98	26.22	5936.41	16.2 - 27.93
67	P209789	750579	2085481	5962.63	5964.75	17.5	5,945.13	Qrf	12.20	5,950.43	Silty Claystone	2.58	5960.05	7.80	5954.83	2.5 - 13.75
68	P209889	751194	2084984	5940.28	5942.4	23.9	5,916.38	Qrf	3.90	5,936.38	Silty Claystone	2.37	5937.91	3.34	5936.94	7.90 - 19.63
69	P209989	751565	2084649	5898.1	5900.4	12	5,886.10	Qc	7.70	5,890.40	Silty Claystone	Dry		Dry		2.50 - 9.58
70	P210089	751564	2084639	5898.4	5900.4	28	5,870.40	Qc	7.20	5,891.20	Silty Claystone	17.21	5881.19	17.06	5881.34	11.2 - 22.93
71	P210189	750,752	2084410	5980.82	5982.4	38.6	5,942.22	Qrf	14.60	5,966.22	Clayey Siltstone	10.39	5970.43	13.50	5967.32	19.4 - 37.13
72	P210289	750564	2085223	5967.03	5969.19	26	5,941.03	Qrf	6.60	5,960.43	Silty Claystone	ND	ND	20.20	5946.83	10.57 - 22.27
73	P213689	749,460	2,083,736	5,994.30	5,996.04	23.0	5,971.30	Qrf	13.00	5,981.30	Claystone	6.80	5987.50	8.29	5986.01	8.10 - 14.80
74	P214689	749,943	2,083,044	6,004.00	6,005.76	26.0	5,978.00	Qrf	22.00	5,982.00	Silty Claystone	6.52	5997.48	12.07	5991.93	16.55 - 23.85
75	P215789	749,470	2,083,430	6,002.00	6,003.66	22.0	5,980.00	Qrf	18.00	5,984.00	Claystone	12.21	5989.79	14.50	5987.50	13.00 - 19.69
76	P218089	749,941	2,084,020	5,985.80	5,987.55	16.0	5,969.80	Qrf	6.00	5,979.80	Claystone	3.41	5982.39	Dry		2.5 - 8.69
77	P418289	748,952	2,082,653	6,016.90	6,018.20	33.0	5,983.90	Qrf	23.00	5,993.90	Claystone	5.01	6011.89	10.23	6006.67	8.2 - 26.7
78	P218389	750831	2085648	5956.2	5958.45	22	5,934.20	Qrf	12.00	5,944.20	Claystone	6.58	5949.62	12.48	5943.72	7.00 - 14.00
79	P218489	751,127	2,084,117	5,949.10	•	5.0	5,944.10	0-5 Fill	•	•	•	ND	ND	ND	ND	•
80	P219189	751,222	2,084,010	5,941.20	5,943.15	21.0	5,920.20	Qrf	11.00	5,930.20	Claystone	7.82	5933.38	10.95	5930.25	6.00 - 12.9
81	P219489	750415	2085651	5959.5	5961.15	32	5,927.50	Qrf	22.40	5,937.10	Claystone	12.83	5946.67	18.78	5940.72	17.30 - 24.55
82	P219589	750268	2085536	5963.8	5965.7	16.7	5,947.10	Qrf	17.20	5,946.60	Sandstone	22.04	5941.76	24.75	5939.05	20.10 - 27.25
83	P313489	748,913	2,083,062	6,011.70	6,013.58	24.0	5,987.70	Qrf	20.60	5,991.10	Claystone	7.48	6004.22	Dry		15.00 - 22.37

Table 1.5
List of Wells and Boreholes at Operable Unit 08 Area
Rocky Flats Plant

	Well No.	State North	State East	Surface Elevation	T.O.C. Elevation	TD	TD Elevation	Type Alluvium	Thick All.+Fill	El. Top Bedrock	Upper Bedrock	High Water Level Below Surface	High Water Level Elevation	Low Water Level Below Surface	Low Water Level Elevation	Open Interval
1	460	***	***	5962	***	***	***	***	***	***	***					***
2	987BR	749068	2085347	5980.22	5981.22	37.5	5,942.72	Qrf	12.70	5,967.52	***	13.83	5966.39	19.20	5961.02	***
3	1087	748945	2085289	5981.95	5983.52	17	5,964.95	Qrf	11.30	5,970.65	Silty Sandstone	11.48	5970.47	12.05	5969.90	3.5 - 12.1
4	1587	749010	2086248	5971.27	5972.79	27	5,944.27	Qrf	21.85	5,949.42	Silty Claystone	11.45	5959.82	21.32	5949.95	5.00 - 22.53
5	1687BR	749129	2086248	5969.49	5970.79	174	5,795.49	Qc	22.20	5,947.29	Claystone	85.16	5884.33	87.50	5881.99	99.50-125.50
6	1986	750,893	2,083,296	5,943.08	5,943.86	16.5	5,926.58	Qc	11.50	5,931.58	Claystone	1.56	5941.52	2.20	5940.88	2.5 - 12.5
7	1987	749623	2086172	5967.98	5969.91	16.1	5,951.88	Qrf	10.80	5,957.18	Silty Claystone	5.01	5962.97	Dry		3.00 - 12.15
8	2086	751112	2084358	5960.47	***	22	5,938.47	Qc	12.50	5,947.97	Clayey Sandstone	ND	ND	ND	ND	3.00 - 11.00
9	2087BR	749634	2086154	5968.66	5970.77	126.2	5,842.46	Qrf	11.80	5,956.86	Silty Claystone	108.38	5860.28	106.42	5862.24	105.96-116.56
10	2186	750,854	2,082,500	6,004.76	6005.96	78.0	5,926.76	Qrf	23.60	5,981.16	Sandy Claystone	31.47	5973.29	31.66	5973.10	35.00 - 67.24
11	2187	749968	2085799	5928.43	5929.69	17	5,911.43	Qrf	8.00	5,920.43	Claystone	8.98	5919.45	9.69	5918.74	3.00-11.00
12	2286	750718	2084410	5978.77	5979.55	266	5,712.77	Qrf	11.00	5,967.77	Sandstone	6.34	5972.43	9.83	5968.94	2.50 - 11.40
13	2287BR	749923	2085821	5931.18	5932.8	111	5,820.18	Qrf	12.80	5,918.38	Claystone	ND	ND	ND	ND	80.37 - 89.00
14	2386	750338	2084258	5982.46	5982.46	130.5	5,851.96	Qrf	8.20	5,974.26	Claystone	83.93	5898.53	93.82	5888.64	112.0 - 117.5
15	2387	749404	2085910	5972.79	5974.49	45.3	5,927.49	Qrf	15.25	5,957.54	Sandy Claystone	9.55	5963.24	17.56	5955.23	16.25 - 37.85
16	2486	750338	2084276	5982.45	5983.56	12	5,970.45	Qrf	7.20	5,975.25	Claystone	6.44	5976.01	Dry		2.50 - 7.70
17	2586	750411	2084830	5975.24	5977.76	89.6	5,885.64	Qrf	13.00	5,962.24	Caliche	27.91	5947.33	25.24	5950.00	66.10 - 83.60
18	2686	750411	2084841	5975.42	5977.17	17	5,958.42	Qrf	10.50	5,964.92	Claystone	ND	ND	ND	ND	3.1 - 12.20
19	2786	750780	2085237	5962.89	5963.88	157	5,805.89	Qrf	11.00	5,951.89	Claystone	79.63	5883.26	86.92	5875.97	127.0 - 135.7
20	2886	750802	2085239	5962.38	5964.38	15.5	5,946.88	Qrf	8.50	5,953.88	Claystone	2.75	5959.63	6.99	5955.39	2.7 - 9.7
21	2986	750598	2085687	5959.58	5960.68	22.5	5,937.08	Qrf	8.50	5,951.08	Claystone	6.33	5953.25	Dry		2.5 - 9.1
22	3086	751078	2084921	5957.42	5958.39	16	5,941.42	Qrf	2.50	5,954.92	Claystone	2.96	5954.46	4.64	5952.78	2.20 - 15.10
23	3186	751050	2084763	5964.98	5967.05	22	5,942.98	Qrf	0.50	5,964.48	Sandstone	Dry		Dry		2.40 - 18.30
24	3286	751050	2084742	5966.08	5967.92	135	5,831.08	Qrf	1.00	5,965.08	Sandstone	57.25	5908.83	52.46	5913.62	114.0 - 126.0
25	3386	749950	2085002	5951.4	5952.42	16.8	5,934.60	Qc	6.80	5,944.60	Claystone	4.95	5946.45	Dry	5951.40	2.50 - 7.50
26	3787	750493	2085223	5967.52	5968.99	15.2	5,952.32	Qrf	8.00	5,959.52	Claystone	4.45	5963.07	7.83	5959.69	3.00 -9.75
27	3887	705395	2085094	5972.15	5973.9	15.2	5,956.95	Qrf	7.80	5,964.35	Silty Claystone	6.72	5965.43	9.05	5963.10	3.00 - 9.75
28	3987BR	751080	2085268	5946.95	5948.42	138	5,808.95	0-5.2' Fill	3.50	5,943.45	Claystone	ND	ND	ND	ND	109.2 - 117.65
29	4386	749404	2085868	5972.91	5974.46	22	5,950.91	Qrf	17.00	5,955.91	Sandstone	11.35	5961.56	Dry		3.00 - 16.80
30	4486	749,254	2,082,234	6,019.93	6,021.96	33.0	5,986.93	Qrf	25.00	5,994.93	Silty Claystone	4.22	6015.71	12.40	6007.53	2.50 - 25.60
31	5687	750,638	2084422	5978.39	5979.77	13.4	5964.99	Qrf	9.4	5968.99	Silty Claystone	5.55	5972.84	7.60	5970.79	3.00 - 10.20
32	6186	749,198	2,083,717	5,999.47	6,000.76	18.5	5,980.81	Qrf	11.50	5,987.97	Silty Claystone	7.59	5991.88	9.57	5989.90	4.0 - 12.5
33	BH22-87	748778	2085646	5978.5	**	27.2	5,951.30	Qrf	22.20	5,956.30	Claystone					
34	BH24-87	748829	2086190	5953.6	**	12.3	5,941.30	Qc	4.90	5,948.70	Claystone					
35	BH28-87	748794	2086241	5946.7	**	15	5,931.70	Qc	5.90	5,940.80	Claystone					
36	BH29-87	749068	2085348	5980.22	***	***	5,980.22	Qrf	***	5,980.22	Silty Claystone					
37	BH31-87	749486	2085405	5973.8	**	15.9	5,957.90	Qrf	15.90	5,957.90	Silty Sandstone					
38	BH32-87	749485	2085405	5971.7	**	20.5	5,951.20	Qrf	7.70	5,964.00	Sandstone					
39	BH33-87	749488	2085766	5967.9	5969.78	20.8	5,947.10	Qrf	9.20	5,958.70	Claystone					15.00 - 20.00
40	BH34-87	749463	2085893	5971.4	**	24.7	5,946.70	Qrf	16.70	5,954.70	Silty Sandstone					
41	BH35-87	749430	2086069	5970.5	**	20.3	5,950.20	Qrf	14.30	5,956.20	Sandy Claystone					

Table 1.5
List of Wells and Boreholes at Operable Unit 08 Area
Rocky Flats Plant

	Well No.	State North	State East	Surface Elevation	T.O.C. Elevation	TD	TD Elevation	Type Alluvium	Thick All.+Fill	El. Top Bedrock	Upper Bedrock	High Water Level Below Surface	High Water Level Elevation	Low Water Level Below Surface	Low Water Level Elevation	Open Interval
84	P317989	748,891	2,084,272	5,990.90	5,992.84	16.0	5,974.90	Qrf	6.40	5,984.50	Claystone	1.94	5988.96	7.93	5982.97	2.5 - 9.0
85	P320089	748,799	2,083,280	6,009.90	6,011.87	20.9	5,989.00	Qrf	18.80	5,991.10	Silty Claystone	8.22	6001.68	13.67	5996.23	13.00 - 20.08
86	P414189	749,059	2,082,986	6,010.60	6,012.18	28.0	5,982.60	Qrf	18.00	5,992.60	Claystone	3.30	6007.30	8.84	6001.76	13.0 - 20.00
87	SP01-87	750790	2084310	5982.7	**	30.2	5,952.50	Qaf/Qrf	13.20	5,969.50	Sandstone					
88	SP02-87	750970	2084640	5976.6	**	15	5,961.60	Qaf/Qrf	10.50	5,966.10	Sandstone					
89	SP03-87	750480	2084630	5978.7	**	19.7	5,959.00	Qaf/Qrf	13.00	5,965.70	Claystone					
90	SP04-87	750560	2084920	5971.8	**	37	5,934.80	Qrf	12.00	5,959.80	Claystone					
91	SP05-87	750870	2084910	5971.6	**	21.8	5,949.80	Qrf	16.30	5,955.30	Claystone					
92	SP06-87	750900	2085200	5972.9	**	30.7	5,942.20	Qaf/Qrf	18.00	5,954.90	Claystone					
93	SP07-87	750471	2085200	5973.6	**	31	5,942.60	Qaf/Qrf	20.80	5,952.80	Claystone					
94	SP08-87	748749	2078136	6099.52	***	***	6,099.52	Qd/Qc	***	6,099.52	Claystone					
95	SP11-87	751585	2084450	5904.5	**	34	5,870.50	Qc	21.50	5,883.00	Silty Claystone					
96	SP16-87	***	***	***	***	***	***	***	***	***	Silty Claystone					

TABLE1.6: Geological Lithology of Selected Wells and Boreholes Located Within and Adjacent to Operable Unit 8

Well No.	Within OU8	Elevation Top of Bedrock	Amount of Bedrock Penetrated (Feet)	(1) Presence of No. 1 Sandstone	Fining Upward Sequences	(2) Lithology from Top Bedrock to TD	Depth of Top of Lithology (Feet)	Thickness of Lithology (Feet)	(3) Comments from Lithologic Logs
32-86 (Continued)						Silty Claystone	17.0	10+	Moderately weathered, slightly friable, Fe in fractures trace carbon and CaCO3, small silt lenses.
43-86	Yes	5,955.91	5.0	No. 1 SS		Sandstone	17.0	1.0	Vfg, trace silt, highly weathered, moderately friable
					Variable	Silty Sandstone	18.0	2.8	Highly weathered, moderately friable
						Sandstone	20.8	1.2	Highly weathered, slightly to moderately friable, vfg well sorted, rounded to well-rounded
P209189	Yes	5,970.38	28.0	No. 1 SS		Sandstone	10.2	7.0	Fg grading to mg (fining upward), well sorted, subangular to sub-rounded, scattered lignite
				No. 1 SS	Yes	Silty Claystone	17.0	1.0	Vfg sand - 20%
						Sandstone	18.2	1.6	Interbedded with silty claystone, fg and vfg, well-sorted, sub-angular to angular
				No. 1 SS	Yes	Silty Claystone	19.8	0.5	Vfg sand - 20%
					Yes	Silty Sandstone	20.3	1.0	Vfg, well-sorted, sub-angular to angular 80% sand
						Sandstone	21.3	5.0	Some clay, wet
				No. 1 SS		Sandstone Interbedded w/Claystone	26.3	2.0	Fg sand, wet, increasing clay content with depth
						Claystone Interbedded w/Sandstone	28.3	2.0	Vfg sand, wet, 15% sand, 85% clay
				No. 1 SS		Clayey Siltstone	30.3	2.0	Vfg sand, wet, 15% sand, 85% clay
						Sandy Claystone	33.3	1.0	Interbedded with sandy silty claystone, fg, well-sorted, Subangular, moist, 20% sand, 80% clay
						Silty Claystone	34.3	3.0+	Dry
P209289	Yes	5,967.79	4.0	No. 1 SS	Coarsening Upward	Sandstone	13.2	2.0	Damp to moist
						Claystone	15.2	2.0+	Interbedded with sandstone, vfg to fg, sub-rounded to rounded, moist
P209389	Yes	5,967.67	20.4	No. 1 SS	Coarsening Upward	Sandstone	13.8	4.4	Fg, well-sorted, subangular to angular, damp. 65% sand
						Silty Sandstone	18.2	10.2	Fg, well-sorted, subangular to sub-rounded, damp. 65% sand
						Claystone	28.4	6.0	Dry
						Silty Claystone	23.0	6.4	Weathered, iron staining, decreasing silt content with depth
						Claystone	29.4	3.6+	

Notes:
(1) Presence of No. 1 Sandstone is based on the Geological Characterization Report, Appendix A (EG&G, 1991)
(2) Lithology is based well logs found in the Geological Characterization Report, Appendix ??? (EG&G, 1991)
(3) Additional well data is located in Table 2.1.

TABLE 1.6 Geological Lithology of Selected Wells and Boreholes Located Within and Adjacent to Operable Unit 8

Well No.	Within OU8	Elevation Top of Bedrock	Amount of Bedrock Penetrated (Feet)	(1) Presence of No. 1 Sandstone	Fining Upward Sequences	(2) Lithology from Top Bedrock to TD	Depth of Top of Lithology (Feet)	Thickness of Lithology (Feet)	(3) Comments from Lithologic Logs
10-87		5,970.65	6.7	No.1 SS	?	Silty Claystone	11.3	5.7+	Very weathered, fine to very fine, some carbonate mineralization, and black mineralization
BH-31-87	Yes	5,957.90		No. 1 SS		Silty Sandstone	7.6	2.2	Highly weathered, slightly friable, vfg
						No Sample	9.8	0.3	
				*May be bedrock		Claystone	10.1	5.9	Some caliche and silt, tr. fine sand, localized iron staining
BH 32-87	Yes	5,964.00	12.8	No. 1 SS	?	Sandstone	7.7	7.7	Silty, fg to vfg, calcareous mineralization as possible fracture fills, limonite staining, highly weathered
						Sandy Siltstone	14.7	14.7	Gradational contact, highly weathered, fg, calc. mineralization
						No Sample	15.2	15.2	
						Sandy Siltstone	15.5	15.5	Same as above, no calc. mineralization
BH 34-87		5,954.70	8.0	No. 1 SS	?	Silty Sandstone	16.7	8.0+	Gradational contact, highly weathered, highly friable, vfg, well sorted, iron-staining, possible Mg. staining.
20-86	Yes	5,938.47	9.5	Absent	?	Clayey Sandstone	12.5	.05	Sub-angular to sub-rounded, well sorted, sand is vfg - fg; abundant iron-staining
						No Sample	13.0	1.7	
						Silty Claystone	14.7	5.7	Highly weathered, mod.-poorly friable with abundant carb, Fe staining, tr sand at top of interval
22-86	Yes	5,967.77	255.	?	Coarsening Upward	Sandstone	10.5	3.5	vfg, some Fe staining, well sorted
						Silty Claystone	14.0	10+	Some Fe staining, tr. calcite, carb. material
31-86	Yes	5,964.48	21.5	No. 1 SS	?	Sandstone	0.5	11.5	Highly weathered, mod. friable, vfg, well sorted, calcareous fracture fill
						No Sample	12.0	1.0	
						Sandstone	13.0	2.0	Same as above, abundant Fe staining
						Siltstone	15.0	1.2	Highly weathered, mod. friable; trace vfg sand
						Silty Claystone	16.2	0.8	Gradational contact, highly weathered, slightly friable, Fe staining locally on fractures.
						Silty Sandstone	17.0	17.9	Highly weathered, abundant Fe staining
						Siltstone	17.9	4.1+	Highly weathered, slightly friable, tr. vfg sand, tr. clay, no water encountered while drilling
32-86	Yes	5,965.08	134	No. 1 SS	?	Sandstone	1.0	8.3	Well sorted, silt to vfg sand, grading to moderate to highly weathered Moderate to highly, thinly stratified
						Clayey Siltstone	9.3	7.7	Moderately weathered, moderately friable, some Fe staining, some carb. in fracture (90 degrees), some vfg sand

Table 1.7
Water Level Measurements
of Wells In and Near OU8

Well No.	Depth from T.O.C.	DATE
460	8	01-Feb-82
460	2	01-May-82
460	4	01-Aug-82
460	5	01-Dec-82
460	2	01-Jun-83
460	4.5	10-Aug-83
460	5	01-Sep-83
460	6	01-Nov-83
460	2	01-May-84
460	4	01-Jun-84
460	4	01-Mar-85
460	6.31	27-Mar-85
460	5.5	01-Jul-85
460	7.8	28-Aug-86
460	8.01	29-Aug-86
460	8.05	02-Sep-86
460	8.29	03-Sep-86
460	7.25	01-Jan-87
460	8.94	01-Feb-87
460	1.67	19-Mar-87
460	1.54	08-May-87
460	2.9	08-Jul-87
460	6.2	10-Sep-87
460	7.3	21-Oct-87
460	7.5	09-Nov-87
460	7.4	22-Dec-87
460	7.4	27-Jan-88
460	6.4	29-Feb-88
460	5.8	21-Mar-88
460	4.6	18-Apr-88
460	4.9	17-May-88
460	4.4	15-Jun-88
460	4.1	15-Jul-88
460	4.7	18-Aug-88
460	5.2	15-Sep-88
460	6	22-Oct-88
460	7	15-Nov-88
460	7.4	15-Dec-88
460	7.5	15-Jan-89
460	6	24-Feb-89
460	4.9	31-Mar-89
460	5	27-Apr-89
460	3.2	26-May-89
460	4.5	30-Jun-89
460	5.4	28-Jul-89
460	5.4	30-Aug-89
460	6.31	15-Nov-89
460	7.59	17-Jan-90
460	0.7	15-Mar-90
460	3.11	30-Apr-90
460	3.54	11-May-90
460	4.92	10-Jul-90
460	6.57	20-Aug-90
460	6.34	03-Oct-90
460	6.85	01-Nov-90
460	7.84	08-Jan-91
460	6.9	24-Apr-91
460	4.6	10-Jun-91
460	5.29	03-Jul-91
460	5.14	05-Aug-91
460	6.86	01-Oct-91
460	7.04	07-Oct-91
460	6.38	07-Jan-92
460	6.8	20-Jan-92
460	6.8	20-Jan-92
460	2.6	02-Apr-92
987	15.77	13-Apr-90
987	17.16	08-Jun-90
987	17.85	12-Jul-90
987	18.8	17-Sep-90
987	18.86	02-Oct-90
987	19.78	12-Dec-90
987	20.2	03-Jan-91
987	20.75	07-Mar-91
987	20.98	02-Apr-91
987	19.85	15-May-91
987	18.25	05-Jul-91
987	18.24	16-Aug-91
987	19.33	04-Oct-91
987	18.83	16-Dec-91
987	19.57	05-Feb-92
987	19.39	06-Mar-92
987	14.83	07-Apr-92
1087	-1	04-Aug-87
1087	13.2	09-Nov-87
1087	12.85	01-Dec-87
1087	13	21-Dec-87
1087	11.1	11-Jan-88
1087	12.9	29-Feb-88
1087	13	21-Mar-88
1087	13.1	18-Apr-88
1087	13.2	16-May-88
1087	13.4	15-Jun-88
1087	13.6	15-Jul-88
1087	13.6	18-Aug-88
1087	13.6	15-Sep-88
1087	-1	22-Oct-88
1087	-1	15-Nov-88
1087	13.6	15-Dec-88
1087	13.3	15-Jan-89
1087	12.1	14-Feb-89
1087	13	27-Apr-89
1087	13	28-May-89
1087	13.2	30-Jun-89
1087	13.55	21-Jul-89
1087	-1	25-Aug-89
1087	13.4	08-Dec-89
1087	12.98	19-Jan-90
1087	11.18	08-Mar-90
1087	13.14	13-Apr-90
1087	13.05	05-Jun-90
1087	13.56	12-Jul-90
1087	13.22	14-Aug-90
1087	13.17	17-Sep-90

Table 1.
Water Level Measurements
of Wells In and Near OU8

Well No.	Depth from T.O.C.	DATE
1087	12.45	25-Sep-90
1087	12.94	02-Oct-90
1087	11.32	09-Nov-90
1087	13.08	10-Dec-90
1087	13.08	12-Dec-90
1087	13.62	03-Jan-91
1087 DRY		14-Mar-91
1087 DRY		02-Apr-91
1087	11.93	07-May-91
1087	17.86	11-Jun-91
1087	13.05	05-Jul-91
1087	12.89	08-Aug-91
1087	13.02	26-Aug-91
1087	13.6	05-Sep-91
1087	13.99	04-Oct-91
1087 DRY		04-Oct-91
1087	11.29	08-Nov-91
1087	12.96	05-Feb-92
1087 DRY		05-Mar-92
1087	13.05	07-Apr-92
1587	20.8	29-Sep-87
1587	20.4	11-Nov-87
1587	20.55	01-Dec-87
1587	20.1	21-Dec-87
1587	22.3	11-Jan-88
1587	20.2	29-Feb-88
1587	20	21-Mar-88
1587	19.6	18-Apr-88
1587	20.2	16-May-88
1587	19.2	15-Jun-88
1587	20.7	15-Jul-88
1587	21.1	18-Aug-88
1587	22	15-Sep-88
1587	22.6	22-Oct-88
1587	22.8	15-Nov-88
1587	22.8	15-Dec-88
1587	22.4	15-Jan-89
1587	21.6	14-Feb-89
1587	19.7	27-Mar-89
1587	19.8	27-Apr-89
1587	20.1	25-May-89
1587	16.7	30-Jun-89
1587	8.3	21-Jul-89
1587	19.78	25-Aug-89
1587	20.03	12-Sep-89
1587	22.1	04-Dec-89
1587	23.31	15-Jan-90
1587	22.59	23-Jan-90
1587	13.98	16-Apr-90
1587	19.32	25-Jun-90
1587	19.99	12-Jul-90
1587	20	09-Aug-90
1587	21.09	17-Sep-90
1587	21.1	18-Sep-90
1587	21.13	03-Oct-90
1587	21.65	08-Nov-90
1587	20.98	27-Nov-90
1587	21.39	04-Dec-90
1587	22.84	07-Jan-91
1587	23.72	10-Jan-91
1587	22.53	15-Apr-91
1587	20.83	03-May-91
1587	14.06	10-Jun-91
1587	17.31	03-Jul-91
1587	19.19	01-Aug-91
1587	19.58	03-Sep-91
1587	19.58	04-Sep-91
1587	20.87	01-Oct-91
1587	21.8	01-Nov-91
1587	19.24	18-Dec-91
1587	20.26	06-Jan-92
1587	20.88	03-Feb-92
1587	21.59	24-Feb-92
1587	21.93	03-Mar-92
1587	21.92	05-Mar-92
1587	12.97	06-Apr-92
1687	104.3	29-Sep-87
1687	85.2	11-Nov-87
1687	85.47	01-Dec-87
1687	85	21-Dec-87
1687	79.5	11-Jan-88
1687	76.4	29-Feb-88
1687	86.4	21-Mar-88
1687	79.5	18-Apr-88
1687	87.2	16-May-88
1687	79.6	15-Jun-88
1687	77.6	15-Jul-88
1687	81.3	15-Sep-88
1687	79.1	22-Oct-88
1687	91.9	15-Nov-88
1687	86.6	15-Dec-88
1687	78.4	15-Jan-89
1687	90.8	14-Feb-89
1687	80.8	27-Mar-89
1687	78.3	27-Apr-89
1687	78	26-May-89
1687	80.9	30-Jun-89
1687	78.48	21-Jul-89
1687	78.18	25-Aug-89
1687	94.72	16-Apr-90
1687	80.13	26-Jun-90
1687	101.34	12-Jul-90
1687	81.12	18-Sep-90
1687	102.14	03-Oct-90
1687	82.5	27-Nov-90
1687	88.8	07-Jan-91
1687	88.5	08-Jan-91
1687	80.93	15-Apr-91
1687	81.78	03-Jul-91
1687	77.83	04-Sep-91
1687	82.96	01-Oct-91
1687	81.01	20-Nov-91
1687	86.6	06-Jan-92
1687	79.8	24-Feb-92

Table 1..
Water Level Measurements
of Wells In and Near OU8

Well No.	Depth from T.O.C.	DATE
1687	86.46	06-Apr-92
1986	3.95	16-Sep-86
1986	3.98	17-Sep-86
1986	4.02	18-Sep-86
1986	3.83	13-Oct-86
1986	3.37	26-Nov-86
1986	3.25	01-Jan-87
1986	2.9	25-Feb-87
1986	2.75	26-Mar-87
1986	2.75	08-May-87
1986	3.2	03-Jun-87
1986	3.2	08-Jul-87
1986	4.5	04-Aug-87
1986	3.6	10-Aug-87
1986	3.4	03-Sep-87
1986	3.5	14-Sep-87
1986	3.1	28-Oct-87
1986	3.1	09-Nov-87
1986	3.1	17-Nov-87
1986	3.3	22-Dec-87
1986	2.6	01-Feb-88
1986	2.9	29-Feb-88
1986	2.9	21-Mar-88
1986	2.8	18-Apr-88
1986	3.3	16-May-88
1986	3.5	15-Jun-88
1986	3.4	15-Jul-88
1986	3.4	18-Aug-88
1986	3.5	15-Sep-88
1986	3.4	22-Oct-88
1986	3.1	15-Nov-88
1986	2.9	15-Dec-88
1986	2.9	15-Jan-89
1986	2.5	24-Feb-89
1986	2.2	31-Mar-89
1986	3.1	27-Apr-89
1986	2.6	25-May-89
1986	3.4	30-Jun-89
1986	3.58	28-Jul-89
1986	3.57	30-Aug-89
1986	3.07	12-Sep-89
1986	2.98	03-Nov-89
1986	2.96	18-Jan-90
1986	2.81	12-Feb-90
1986	2.41	25-Apr-90
1986	2.85	09-May-90
1986	3.19	11-Jul-90
1986	3.15	25-Jul-90
1986	3.35	15-Aug-90
1986	3.53	04-Sep-90
1986	3.28	03-Oct-90
1986	3.24	18-Oct-90
1986	3.12	02-Nov-90
1986	2.98	04-Jan-91
1986	2.16	03-Jun-91
1986	2.16	03-Jun-91
1986	2.67	03-Jul-91
1986	3.06	31-Jul-91
1986	2.89	05-Aug-91
1986	3.01	04-Sep-91
1986	3.01	01-Oct-91
1986	3.15	02-Oct-91
1986	2.84	04-Nov-91
1986	2.57	03-Dec-91
1986	2.71	07-Jan-92
1986	2.55	30-Jan-92
1986	2.68	06-Feb-92
1986	2.78	02-Mar-92
1986	2.34	02-Apr-92
1986	2.53	08-Apr-92
1987	7.8	09-Nov-87
1987	11.77	01-Dec-87
1987	7.5	21-Dec-87
1987	13.3	11-Jan-88
1987	12.6	29-Feb-88
1987	12.7	21-Mar-88
1987	12.6	18-Apr-88
1987	12.7	16-May-88
1987	11.8	15-Jun-88
1987	12.8	15-Jul-88
1987	13.4	18-Aug-88
1987	12.5	15-Sep-88
1987	-1	22-Oct-88
1987	13.6	15-Nov-88
1987	-1	15-Dec-88
1987	-1	15-Jan-89
1987	-1	24-Feb-89
1987	-1	31-Mar-89
1987	-1	27-Apr-89
1987	-1	26-May-89
1987	12.1	30-Jun-89
1987	12.9	28-Jul-89
1987	-1	30-Aug-89
1987	-1	12-Sep-89
1987	-1	04-Dec-89
1987	-1	15-Jan-90
1987	13.54	12-Apr-90
1987	12.41	22-May-90
1987	12.98	10-Jul-90
1987	13.25	25-Jul-90
1987 DRY		01-Oct-90
1987 DRY		07-Nov-90
1987 DRY		02-Jan-91
1987 DRY		02-Jan-91
1987 DRY		02-Apr-91
1987	11.19	02-Jul-91
1987	12.85	14-Aug-91
1987	13.93	04-Oct-91
1987 DRY		04-Oct-91
1987 DRY		03-Jan-92
1987	6.94	06-Apr-92
2087	108.5	29-Sep-87
2087	112.5	09-Nov-87
2087	108.91	01-Dec-87

Table 1
Water Level Measurements
of Wells In and Near OU8

Well No.	Depth from T.O.C.	DATE
2087	112.2	21-Dec-87
2087	101.6	11-Jan-88
2087	98	29-Feb-88
2087	113.7	21-Mar-88
2087	108.5	18-Apr-88
2087	115.3	16-May-88
2087	109.9	15-Jun-88
2087	105.5	15-Jul-88
2087	103.7	18-Aug-88
2087	106.9	15-Sep-88
2087	104.7	22-Oct-88
2087	113.4	15-Nov-88
2087	111.1	15-Dec-88
2087	103.8	15-Jan-89
2087	112	24-Feb-89
2087	106.9	31-Mar-89
2087	104.1	27-Apr-89
2087	103.6	25-May-89
2087	105.5	30-Jun-89
2087	102.7	28-Jul-89
2087	101.67	30-Aug-89
2087	108.28	12-Apr-90
2087	103.95	22-May-90
2087	108.89	10-Jul-90
2087	106.85	27-Jul-90
2087	107.58	01-Oct-90
2087	103.62	08-Nov-90
2087	108.53	02-Jan-91
2087	101.02	18-Mar-91
2087	114.79	02-Apr-91
2087	108.86	09-May-91
2087	108.86	09-May-91
2087	109.78	02-Jul-91
2087	104.69	14-Aug-91
2087	109.58	04-Oct-91
2087	102.75	05-Dec-91
2087	112.31	03-Jan-92
2087	105.54	24-Feb-92
2087	110.49	06-Apr-92
2186	-1	29-Aug-86
2186	49.23	19-Nov-86
2186	45.5	20-Nov-86
2186	44.01	21-Nov-86
2186	38.79	24-Nov-86
2186	41.26	25-Nov-86
2186	32.79	01-Jan-87
2186	32.6	25-Feb-87
2186	32.58	25-Mar-87
2186	32.4	08-May-87
2186	32.47	03-Jun-87
2186	33	08-Jul-87
2186	32.5	04-Aug-87
2186	33	03-Sep-87
2186	33.1	14-Sep-87
2186	33.3	06-Oct-87
2186	33.3	09-Nov-87
2186	33.3	17-Nov-87
2186	33.1	22-Dec-87
2186	33.1	01-Feb-88
2186	32.9	29-Feb-88
2186	32.9	21-Mar-88
2186	32.9	18-Apr-88
2186	32.9	17-May-88
2186	33.1	15-Jun-88
2186	33.3	15-Jul-88
2186	33.3	18-Aug-88
2186	33.9	15-Sep-88
2186	33.7	22-Oct-88
2186	34.7	15-Nov-88
2186	33.7	15-Dec-88
2186	33.1	15-Jan-89
2186	32.9	24-Feb-89
2186	33	31-Mar-89
2186	32.8	27-Apr-89
2186	32.8	26-May-89
2186	32.9	30-Jun-89
2186	32.85	28-Jul-89
2186	32.99	30-Aug-89
2186	33.54	12-Sep-89
2186	32.9	07-Nov-89
2186	32.69	18-Jan-90
2186	32.36	28-Feb-90
2186	32.27	25-Apr-90
2186	32.18	11-May-90
2186	32.48	11-Jul-90
2186	32.56	02-Aug-90
2186	32.88	02-Oct-90
2186	32.81	06-Nov-90
2186	32.86	04-Jan-91
2186	32.91	03-Jun-91
2186	33.2	03-Jul-91
2186	33.21	08-Aug-91
2186	33.36	01-Oct-91
2186	33.35	15-Oct-91
2186	32.92	07-Jan-92
2186	32.72	28-Jan-92
2186	32.67	02-Apr-92
2187	7.3	12-Nov-87
2187	-1	01-Dec-87
2187	7.2	22-Dec-87
2187	7.4	27-Jan-88
2187	7.1	29-Feb-88
2187	8.4	21-Mar-88
2187	7.8	18-Apr-88
2187	8.8	17-May-88
2187	9.7	15-Jun-88
2187	8.5	15-Jul-88
2187	8	18-Aug-88
2187	7.9	15-Sep-88
2187	7.6	22-Oct-88
2187	9.5	15-Nov-88
2187	9.4	15-Dec-88
2187	9.2	15-Jan-89
2187	8.6	24-Feb-89

Table
Water Level Measurements
of Wells In and Near OU8

Well No.	Depth from T.O.C.	DATE
2187	9	31-Mar-89
2187	5.6	27-Apr-89
2187	5.4	25-May-89
2187	6.4	30-Jun-89
2187	6.11	28-Jul-89
2187	5.94	30-Aug-89
2187	8.01	11-Sep-89
2187	7.05	10-Nov-89
2187	10.35	17-Jan-90
2187	9.69	06-Feb-90
2187	8.33	24-Apr-90
2187	7.5	18-May-90
2187	8.69	10-Jul-90
2187	6.42	05-Sep-90
2187	10.29	01-Oct-90
2187	8.96	11-Dec-90
2187	10.95	04-Jan-91
2187	7.93	23-Apr-91
2187	8.97	10-Jun-91
2187	10.27	03-Jul-91
2187	8.52	05-Aug-91
2187	8.7	01-Oct-91
2187	8.41	16-Oct-91
2187	9.71	08-Jan-92
2187	9.56	15-Jan-92
2187	9.08	26-Feb-92
2187	10.24	02-Apr-92
2286	8.38	12-Sep-86
2286	8.52	13-Sep-86
2286	8.25	15-Sep-86
2286	8.22	16-Sep-86
2286	8.28	17-Sep-86
2286	8.22	19-Sep-86
2286	7.22	13-Oct-86
2286	7.35	26-Nov-86
2286	8.5	01-Jan-87
2286	7.29	25-Feb-87
2286	6.17	24-Mar-87
2286	5.71	08-May-87
2286	6.8	03-Jun-87
2286	6.25	08-Jul-87
2286	6.8	04-Aug-87
2286	5.6	27-Aug 87
2286	5.9	03-Sep-87
2286	8	21-Oct-87
2286	8.4	09-Nov-87
2286	8	21-Dec-87
2286	6.6	11-Jan-88
2286	7.3	29-Feb-88
2286	7.2	21-Mar-88
2286	6.7	18-Apr-88
2286	7	17-May-88
2286	6.7	15-Jun-88
2286	7	15-Jul-88
2286	7.7	18-Aug-88
2286	7.7	15-Sep-88
2286	8.1	22-Oct-88
2286	9.4	15-Nov-88
2286	9.5	15-Dec-88
2286	9.6	15-Jan-89
2286	8.2	24-Feb-89
2286	7.6	31-Mar-89
2286	7.5	27-Apr-89
2286	5.9	25-May-89
2286	7.3	30-Jun-89
2286	8.22	28-Jul-89
2286	7.04	30-Aug-89
2286	6.62	11-Sep-89
2286	8.33	06-Nov-89
2286	10.26	17-Jan-90
2286	10.54	16-Feb-90
2286	7.34	25-Apr-90
2286	7.6	09-May-90
2286	8.86	11-Jul-90
2286	7.87	27-Jul-90
2286	8.37	02-Oct-90
2286	8.66	12-Oct-90
2286	10.61	04-Jan-91
2286	10.75	07-Jan-91
2286	7.6	29-May-91
2286	8.21	03-Jul-91
2286	8.52	30-Jul-91
2286	9.75	01-Oct-91
2286	9.74	03-Oct-91
2286	9.79	07-Jan-92
2286	9.98	09-Jan-92
2286	7.12	02-Apr-92
2287BR	80.8	11-Sep-89
2287BR	80.45	10-Nov-89
2287BR	78.7	17-Jan-90
2287BR	80.3	08-Feb-90
2386	107.75	01-Oct-86
2386	91.79	17-Nov-86
2386	113.25	18-Nov-86
2386	115.61	19-Nov-86
2386	113.22	25-Nov-86
2386	93.92	01-Jan-87
2386	79.25	25-Feb-87
2386	73	18-Mar-87
2386	104.38	08-May-87
2386	94.02	03-Jun-87
2386	113.05	08-Jul-87
2386	98.6	04-Aug-87
2386	87.8	03-Sep-87
2386	87.8	23-Sep-87
2386	95.1	28-Oct-87
2386	94.9	09-Nov-87
2386	94.5	21-Dec-87
2386	95	29-Feb-88
2386	89.7	21-Mar-88
2386	104.9	18-Apr-88
2386	93.6	17-May-88
2386	103.6	15-Jun-88
2386	93	15-Jul-88

Table .
Water Level Measurements
of Wells In and Near OU8

Well No.	Depth from T.O.C.	DATE
2386	88.5	18-Aug-88
2386	105.9	15-Sep-88
2386	98.1	22-Oct-88
2386	26.1	15-Nov-88
2386	105	15-Dec-88
2386	79.5	24-Feb-89
2386	78.1	31-Mar-89
2386	89.1	27-Apr-89
2386	55.67	12-Sep-89
2386	47.2	06-Nov-89
2386	91.42	17-Jan-90
2386	71.81	22-Mar-90
2386	102.96	25-Apr-90
2386	91.55	25-May-90
2386	97.17	11-Jul-90
2386	85.45	13-Aug-90
2386	95.27	02-Oct-90
2386	80.73	14-Nov-90
2386	93.82	04-Jan-91
2386	62.56	24-Apr-91
2386	101.51	30-May-91
2386	103.44	03-Jul-91
2386	92.27	31-Jul-91
2386	91.22	01-Oct-91
2386	89.08	07-Oct-91
2386	79.5	13-Jan-92
2386	83.93	02-Apr-92
2387	17.7	29-Sep-87
2387	18.4	09-Nov-87
2387	16.1	01-Dec-87
2387	18.1	21-Dec-87
2387	18.2	11-Jan-88
2387	16.5	29-Feb-88
2387	16.4	21-Mar-88
2387	15.5	18-Apr-88
2387	16.6	16-May-88
2387	16.6	15-Jun-88
2387	14.7	15-Jul-88

Well No.	Depth from T.O.C.	DATE
2387	18	18-Aug-88
2387	17.9	15-Sep-88
2387	18.9	22-Oct-88
2387	19.6	15-Nov-88
2387	19.7	15-Dec-88
2387	19.3	15-Jan-89
2387	16.5	24-Feb-89
2387	17	27-Mar-89
2387	17.1	27-Apr-89
2387	17.1	25-May-89
2387	15.4	30-Jun-89
2387	17.85	28-Jul-89
2387	17.37	30-Aug-89
2387	12.17	12-Apr-90
2387	15.52	01-Jun-90
2387	17.63	10-Jul-90
2387	33.68	13-Aug-90
2387	17.9	01-Oct-90
2387	17.62	09-Nov-90
2387	19.26	02-Jan-91
2387	18.96	08-Mar-91
2387	19.23	02-Apr-91
2387	17.41	19-Apr-91
2387	15.28	02-Jul-91
2387	15.22	19-Aug-91
2387	18.53	04-Oct-91
2387	15.56	23-Nov-91
2387	17.13	03-Jan-92
2387	19.73	28-Feb-92
2387	11.25	06-Apr-92
2486	-1	16-Sep-86
2486	-1	13-Oct-86
2486	-1	26-Nov-86
2486	-1	01-Jan-87
2486	-1	25-Feb-87
2486	-1	18-Mar-87
2486	-1	08-May-87
2486	-1	03-Jun-87

Well No.	Depth from T.O.C.	DATE
2486	8.65	08-Jul-87
2486	-1	04-Aug-87
2486	-1	03-Sep-87
2486	-1	24-Sep-87
2486	-1	28-Oct-87
2486	-1	09-Nov-87
2486	-1	21-Dec-87
2486	-1	11-Jan-88
2486	-1	29-Feb-88
2486	-1	21-Mar-88
2486	8.7	18-Apr-88
2486	8.2	15-Jun-88
2486	-1	15-Jul-88
2486	8.7	18-Aug-88
2486	8.7	15-Sep-88
2486	-1	22-Oct-88
2486	-1	15-Nov-88
2486	8.7	15-Dec-88
2486	8.4	15-Jan-89
2486	-1	24-Feb-89
2486	-1	31-Mar-89
2486	-1	27-Apr-89
2486	8.7	26-May-89
2486	-1	30-Jun-89
2486	-1	28-Jul-89
2486	-1	30-Aug-89
2486	8.58	11-Sep-89
2486	-1	06-Nov-89
2486	-1	17-Jan-90
2486	8.55	25-Apr-90
2486 DRY		20-May-90
2486 DRY		11-Jul-90
2486 DRY		10-Aug-90
2486 DRY		22-Aug-90
2486 DRY		05-Sep-90
2486 DRY		02-Oct-90
2486 DRY		01-Nov-90
2486 DRY		02-Nov-90

Table
Water Level Measurements
of Wells In and Near OU8

Well No.	Depth from T.O.C.	DATE
2486 ∞.∞		04-Jan-91
2486 DRY		24-Apr-91
2486	7.36	07-Jun-91
2486	7.51	11-Jun-91
2486 DRY		03-Jul-91
2486 DRY		02-Aug-91
2486 DRY		04-Sep-91
2486	9.11	01-Oct-91
2486 DRY		01-Oct-91
2486 DRY		04-Nov-91
2486	7.54	03-Dec-91
2486 DRY		07-Jan-92
2486	8.65	06-Feb-92
2486 DRY		02-Mar-92
2486	7.55	02-Apr-92
2586	71.05	30-Sep-86
2586	77.93	01-Oct-86
2586	71.42	13-Oct-86
2586	76.73	21-Oct-86
2586	74.59	28-Oct-86
2586	74.24	05-Nov-86
2586	78.65	06-Nov-86
2586	79.52	07-Nov-86
2586	71.94	26-Nov-86
2586	31.83	01-Jan-87
2586	23.92	25-Feb-87
2586	21.75	18-Mar-87
2586	35.38	08-May-87
2586	27.25	03-Jun-87
2586	71.7	08-Jul-87
2586	24.7	04-Aug-87
2586	32.6	27-Aug-87
2586	31.4	03-Sep-87
2586	28.6	09-Nov-87
2586	28.4	21-Dec-87
2586	21	11-Jan-88
2586	34.6	29-Feb-88
2586	27.8	21-Mar-88
2586	40.7	18-Apr-88
2586	28.6	17-May-88
2586	45.2	15-Jun-88
2586	31	15-Jul-88
2586	27.3	18-Aug-88
2586	58.1	15-Sep-88
2586	41.6	22-Oct-88
2586	27.8	15-Nov-88
2586	72.6	15-Dec-88
2586	34.5	15-Jan-89
2586	27.6	24-Feb-89
2586	25.9	31-Mar-89
2586	35.9	27-Apr-89
2586	29.4	26-May-89
2586	41.5	30-Jun-89
2586	30.31	28-Jul-89
2586	25.15	30-Aug-89
2586	67.23	11-Sep-89
2586	35.52	08-Nov-89
2586	30.75	17-Jan-90
2586	24.4	22-Feb-90
2586	35	24-Apr-90
2586	26.87	25-May-90
2586	41.52	10-Jul-90
2586	26.16	28-Aug-90
2586	48.15	01-Oct-90
2586	42.19	10-Oct-90
2586	28.18	04-Jan-91
2586	27.76	07-Jan-91
2586	22.58	10-Jun-91
2586	60.32	03-Jul-91
2586	44.22	23-Jul-91
2586	32.77	01-Oct-91
2586	29.38	15-Oct-91
2586	28.74	07-Jan-92
2586	26.25	22-Jan-92
2586	26.25	22-Jan-92
2586	30.43	03-Apr-92
2786	111.22	30-Sep-86
2786	130.6	01-Oct-86
2786	130.48	13-Oct-86
2786	129.41	17-Oct-86
2786	127.5	21-Oct-86
2786	124.17	28-Oct-86
2786	123.1	05-Nov-86
2786	131.6	07-Nov-86
2786	115.94	26-Nov-86
2786	78.71	01-Jan-87
2786	99.04	25-Feb-87
2786	61.25	19-Mar-87
2786	107.04	08-May-87
2786	88.22	03-Jun-87
2786	115.15	08-Jul-87
2786	92.4	04-Aug-87
2786	74.5	03-Sep-87
2786	67.6	22-Sep-87
2786	100.7	21-Oct-87
2786	87.1	09-Nov-87
2786	70.1	22-Dec-87
2786	82.8	27-Jan-88
2786	70.5	29-Feb-88
2786	64.4	21-Mar-88
2786	99.3	18-Apr-88
2786	79.4	17-May-88
2786	95	15-Jun-88
2786	77.1	15-Jul-88
2786	71.8	18-Aug-88
2786	109.6	15-Sep-88
2786	91.5	22-Oct-88
2786	73.9	15-Nov-88
2786	123.5	15-Dec-88
2786	84.8	15-Jan-89
2786	74	24-Feb-89
2786	70.6	31-Mar-89
2786	85.2	27-Apr-89
2786	75.9	26-May-89

Table 1..
Water Level Measurements
of Wells In and Near OU8

Well No.	Depth from T.O.C.	DATE
2786	90.5	30-Jun-89
2786	76.4	28-Jul-89
2786	67.29	30-Aug-89
2786	63.44	11-Sep-89
2786	85.42	30-Oct-89
2786	81.82	17-Jan-90
2786	71.11	13-Feb-90
2786	79.2	24-Apr-90
2786	126.5	14-May-90
2786	86.08	10-Jul-90
2786	75.43	03-Aug-90
2786	83.56	01-Oct-90
2786	67.61	13-Nov-90
2786	87.91	04-Jan-91
2786	57.35	24-Apr-91
2786	94.65	10-Jun-91
2786	110.92	03-Jul-91
2786	95.12	23-Jul-91
2786	80.12	01-Oct-91
2786	77.16	08-Oct-91
2786	71.77	07-Jan-92
2786	66.31	27-Jan-92
2786	80.62	02-Apr-92
2886	10.54	12-Sep-86
2886	10.67	13-Sep-86
2886	10.36	15-Sep-86
2886	10.78	16-Sep-86
2886	10.8	17-Sep-86
2886	10.63	18-Sep-86
2886	9.1	13-Oct-86
2886	8.51	26-Nov-86
2886	8.79	01-Jan-87
2886	7	25-Feb-87
2886	3.25	19-Mar-87
2886	4.38	08-May-87
2886	5.73	03-Jun-87
2886	5.65	08-Jul-87
2886	7.4	04-Aug-87
2886	8	03-Sep-87
2886	8.9	21-Oct-87
2886	8.7	09-Nov-87
2886	8.7	22-Dec-87
2886	5.8	27-Jan-88
2886	5.6	29-Feb-88
2886	5.8	21-Mar-88
2886	5.7	18-Apr-88
2886	6.3	17-May-88
2886	6.1	15-Jun-88
2886	6.2	15-Jul-88
2886	6.5	18-Aug-88
2886	6.8	15-Sep-88
2886	7.5	22-Oct-88
2886	8.4	15-Nov-88
2886	8.5	15-Dec-88
2886	8.8	15-Jan-89
2886	7.9	24-Feb-89
2886	7.9	31-Mar-89
2886	7.3	27-Apr-89
2886	6.2	26-May-89
2886	6	30-Jun-89
2886	7.03	28-Jul-89
2886	7.13	30-Aug-89
2886	5.42	11-Sep-89
2886	7.2	30-Oct-89
2886	8.5	17-Jan-90
2886	8.75	13-Feb-90
2886	4.9	24-Apr-90
2886	5.7	15-May-90
2886	6.78	10-Jul-90
2886	6.84	03-Aug-90
2886	7.14	10-Aug-90
2886	7.61	05-Sep-90
2886	8.06	01-Oct-90
2886	8.61	02-Nov-90
2886	7.51	13-Nov-90
2886	8.99	04-Jan-91
2886	8.43	23-Apr-91
2886	5.99	07-Jun-91
2886	6.13	10-Jun-91
2886	6.98	03-Jul-91
2886	7.38	23-Jul-91
2886	7.48	02-Aug-91
2886	7.95	04-Sep-91
2886	8.48	01-Oct-91
2886	8.65	09-Oct-91
2886	8.95	01-Nov-91
2886	7.45	03-Dec-91
2886	8.11	07-Jan-92
2886	8.34	27-Jan-92
2886	8.46	06-Feb-92
2886	8.9	02-Mar-92
2886	4.75	02-Apr-92
2986	-1	12-Sep-86
2986	-1	24-Sep-86
2986	-1	13-Oct-86
2986	-1	26-Nov-86
2986	-1	01-Jan-87
2986	-1	25-Feb-87
2986	-1	19-Mar-87
2986	8.85	08-May-87
2986	9.82	03-Jun-87
2986	-1	08-Jul-87
2986	-1	04-Aug-87
2986	-1	03-Sep-87
2986	-1	21-Oct-87
2986	-1	09-Nov-87
2986	-1	22-Dec-87
2986	-1	27-Jan-88
2986	-1	29-Feb-88
2986	-1	21-Mar-88
2986	-1	18-Apr-88
2986	8.3	15-Jun-88
2986	10.2	15-Jul-88
2986	-1	18-Aug-88

Table
Water Level Measurements
of Wells In and Near OU8

Well No.	Depth from T.O.C.	DATE
2986	10.2	15-Sep-88
2986	-1	22-Oct-88
2986	-1	15-Nov-88
2986	-1	15-Dec-88
2986	-1	15-Jan-89
2986	-1	24-Feb-89
2986	-1	31-Mar-89
2986	10.2	27-Apr-89
2986	10.1	26-May-89
2986	10	30-Jun-89
2986	-1	28-Jul-89
2986	-1	30-Aug-89
2986	-1	11-Sep-89
2986	-1	30-Oct-89
2986	-1	17-Jan-90
2986	7.65	24-Apr-90
2986	8.82	16-May-90
2986 DRY		10-Jul-90
2986 DRY		02-Aug-90
2986 DRY		10-Aug-90
2986 DRY		05-Sep-90
2986 DRY		01-Oct-90
2986 DRY		19-Oct-90
2986 DRY		02-Nov-90
2986 DRY		04-Jan-91
2986 DRY		04-Jan-91
2986	8.96	07-Jun-91
2986	9.05	10-Jun-91
2986 DRY		03-Jul-91
2986 DRY		02-Aug-91
2986 DRY		04-Sep-91
2986	10.6	01-Oct-91
2986 DRY		01-Oct-91
2986 DRY		04-Nov-91
2986 DRY		03-Dec-91
2986 DRY		07-Jan-92
2986 DRY		06-Feb-92
2986 DRY		02-Mar-92
2986	7.43	02-Apr-92
3086	12.33	12-Sep-86
3086	11.94	13-Sep-86
3086	8.67	15-Sep-86
3086	9.67	16-Sep-86
3086	8.87	17-Sep-86
3086	8.66	18-Sep-86
3086	8.14	19-Sep-86
3086	5.07	13-Oct-86
3086	6.21	26-Nov-86
3086	9.33	01-Jan-87
3086	5.9	25-Feb-87
3086	4.58	23-Mar-87
3086	4.79	08-May-87
3086	5.62	03-Jun-87
3086	5.7	08-Jul-87
3086	6.5	04-Aug-87
3086	6.1	03-Sep-87
3086	6.1	23-Sep-87
3086	6.4	21-Oct-87
3086	6.5	09-Nov-87
3086	6.5	17-Nov-87
3086	6.4	22-Dec-87
3086	5.9	01-Feb-88
3086	5.1	29-Feb-88
3086	5	21-Mar-88
3086	4.9	18-Apr-88
3086	5.3	15-Jun-88
3086	5.8	15-Jul-88
3086	5.9	18-Aug-88
3086	5.7	15-Sep-88
3086	5.6	22-Oct-88
3086	5.8	15-Nov-88
3086	5.4	15-Dec-88
3086	6.2	15-Jan-89
3086	5.5	24-Feb-89
3086	4.1	31-Mar-89
3086	4.4	27-Apr-89
3086	4.4	26-May-89
3086	4.5	30-Jun-89
3086	5.35	28-Jul-89
3086	5.45	30-Aug-89
3086	5.29	12-Sep-89
3086	5.47	08-Nov-89
3086	5.6	17-Jan-90
3086	5.53	07-Feb-90
3086	4.58	25-Apr-90
3086	5.01	31-May-90
3086	5.65	10-Jul-90
3086	5.42	14-Aug-90
3086	6.17	02-Oct-90
3086	5.61	04-Jan-91
3086	5.35	29-Apr-91
3086	3.95	29-May-91
3086	4.93	05-Jul-91
3086	5.85	06-Aug-91
3086	4.85	01-Oct-91
3086	6.73	10-Oct-91
3086	6.07	07-Jan-92
3086	5.78	28-Jan-92
3086	3.93	02-Apr-92
3186	-1	12-Sep-86
3186	-1	13-Oct-86
3186	-1	09-Nov-86
3186	-1	26-Nov-86
3186	-1	01-Jan-87
3186	-1	25-Feb-87
3186	-1	23-Mar-87
3186	-1	08-May-87
3186	-1	03-Jun-87
3186	-1	08-Jul-87
3186	-1	04-Aug-87
3186	-1	03-Sep-87
3186	-1	24-Sep-87
3186	-1	21-Oct-87
3186	-1	09-Nov-87

Table 1
Water Level Measurements
of Wells In and Near OU8

Well No.	Depth from T.O.C.	DATE
3186	-1	22-Dec-87
3186	-1	01-Feb-88
3186	-1	29-Feb-88
3186	-1	21-Mar-88
3186	-1	18-Apr-88
3186	16.9	15-Jun-88
3186	-1	15-Jul-88
3186	-1	18-Aug-88
3186	-1	15-Sep-88
3186	-1	22-Oct-88
3186	-1	15-Nov-88
3186	-1	15-Dec-88
3186	-1	15-Jan-89
3186	-1	24-Feb-89
3186	-1	31-Mar-89
3186	-1	27-Apr-89
3186	19.4	26-May-89
3186	-1	30-Jun-89
3186	-1	28-Jul-89
3186	-1	30-Aug-89
3186	-1	12-Sep-89
3186	-1	14-Nov-89
3186	-1	17-Jan-90
3186 DRY		25-Apr-90
3186 DRY		07-May-90
3186 DRY		10-Jul-90
3186 DRY		25-Jul-90
3186 DRY		02-Oct-90
3186 DRY		25-Oct-90
3186 DRY		04-Jan-91
3186 DRY		04-Jan-91
3186 DRY		11-Jun-91
3186 DRY		03-Jul-91
3186	19.7	01-Oct-91
3186 DRY		01-Oct-91
3186 DRY		08-Jan-92
3186 DRY		02-Apr-92
3286	54	22-Sep-86

Well No.	Depth from T.O.C.	DATE
3286	66.34	13-Oct-86
3286	103.5	17-Oct-86
3286	101.52	21-Oct-86
3286	89.67	28-Oct-86
3286	89.2	04-Nov-86
3286	112.6	05-Nov-86
3286	119.77	06-Nov-86
3286	115.89	07-Nov-86
3286	72.32	26-Nov-86
3286	54.92	01-Jan-87
3286	53.77	25-Feb-87
3286	53.33	23-Mar-87
3286	110	24-Mar-87
3286	64.33	08-May-87
3286	55.74	03-Jun-87
3286	82.1	08-Jul-87
3286	57	04-Aug-87
3286	54.4	03-Sep-87
3286	58.3	21-Oct-87
3286	54.4	09-Nov-87
3286	54.4	17-Nov-87
3286	54.1	22-Dec-87
3286	54.8	01-Feb-88
3286	54	29-Feb-88
3286	54.7	21-Mar-88
3286	57.2	18-Apr-88
3286	55.7	15-Jun-88
3286	54.3	15-Jul-88
3286	53.8	18-Aug-88
3286	61.7	15-Sep-88
3286	55.8	22-Oct-88
3286	54.1	15-Nov-88
3286	74.5	15-Dec-88
3286	54.5	15-Jan-89
3286	53.7	24-Feb-89
3286	53.5	31-Mar-89
3286	54.7	27-Apr-89
3286	53.8	26-May-89

Well No.	Depth from T.O.C.	DATE
3286	59.5	30-Jun-89
3286	54.25	28-Jul-89
3286	53.6	30-Aug-89
3286	53.5	12-Sep-89
3286	54.65	14-Nov-89
3286	54.14	17-Jan-90
3286	53.16	12-Mar-90
3286	55.51	25-Apr-90
3286	65.51	10-Jul-90
3286	53.93	31-Aug-90
3286	58.42	02-Oct-90
3286	55.1	23-Oct-90
3286	54.3	04-Jan-91
3286	53.03	25-Apr-91
3286	57.55	30-May-91
3286	59.06	03-Jul-91
3286	54.71	06-Aug-91
3286	55.43	01-Oct-91
3286	54.9	14-Oct-91
3286	54.12	08-Jan-92
3286	53.43	03-Mar-92
3286	59.09	02-Apr-92
3286	53.12	21-Jun-92
3386	-1	12-Sep-86
3386	-1	13-Oct-86
3386	-1	26-Nov-86
3386	-1	01-Jan-87
3386	-1	25-Feb-87
3386	-1	24-Mar-87
3386	-1	08-May-87
3386	-1	03-Jun-87
3386	-1	08-Jul-87
3386	-1	04-Aug-87
3386	-1	03-Sep-87
3386	-1	24-Sep-87
3386	-1	21-Oct-87
3386	-1	09-Nov-87
3386	-1	01-Dec-87

Table 1.
Water Level Measurements
of Wells In and Near OU8

Well No.	Depth from T.O.C.	DATE
3386	-1	21-Dec-87
3386	-1	11-Jan-88
3386	-1	29-Feb-88
3386	-1	21-Mar-88
3386	-1	18-Apr-88
3386	-1	15-Jun-88
3386	8.5	15-Jul-88
3386	-1	18-Aug-88
3386	-1	15-Sep-88
3386	-1	22-Oct-88
3386	-1	15-Nov-88
3386	-1	15-Dec-88
3386	-1	15-Jan-89
3386	-1	24-Feb-89
3386	-1	31-Mar-89
3386	-1	27-Apr-89
3386	-1	25-May-89
3386	-1	30-Jun-89
3386	-1	28-Jul-89
3386	-1	30-Aug-89
3386	-1	12-Sep-89
3386	-1	16-Nov-89
3386	-1	17-Jan-90
3386	6.64	24-Apr-90
3386	7.08	17-May-90
3386	8.29	11-Jul-90
3386 DRY		03-Aug-90
3386 DRY		01-Oct-90
3386 DRY		07-Nov-90
3386 DRY		04-Jan-91
3386 DRY		04-Jan-91
3386	6.15	11-Jun-91
3386	8.1	03-Jul-91
3386 DRY		05-Aug-91
3386	9.2	01-Oct-91
3386 DRY		01-Oct-91
3386 DRY		05-Mar-92
3386	5.97	02-Apr-92

Well No.	Depth from T.O.C.	DATE
3787	6.9	12-Nov-87
3787	6.6	22-Dec-87
3787	6.8	27-Jan-88
3787	6.3	29-Feb-88
3787	7	21-Mar-88
3787	6.6	18-Apr-88
3787	7	17-May-88
3787	6.7	15-Jun-88
3787	9.3	15-Jun-88
3787	6.5	15-Jul-88
3787	6.7	18-Aug-88
3787	7	15-Sep-88
3787	7.5	22-Oct-88
3787	8.4	15-Nov-88
3787	8.6	15-Dec-88
3787	8.8	15-Jan-89
3787	7.8	24-Feb-89
3787	7.8	31-Mar-89
3787	6.9	27-Apr-89
3787	6.2	26-May-89
3787	6.5	30-Jun-89
3787	7.09	28-Jul-89
3787	7.1	30-Aug-89
3787	6.33	11-Sep-89
3787	8	20-Nov-89
3787	8.98	17-Jan-90
3787	6.21	05-Mar-90
3787	5.96	24-Apr-90
3787	6.08	02-May-90
3787	6.87	10-Jul-90
3787	7.4	10-Aug-90
3787	7.42	21-Aug-90
3787	7.72	05-Sep-90
3787	8.13	01-Oct-90
3787	8.5	16-Oct-90
3787	8.67	02-Nov-90
3787	9.3	04-Jan-91
3787	6.53	03-Jun-91

Well No.	Depth from T.O.C.	DATE
3787	6.53	04-Jun-91
3787	6.92	19-Jun-91
3787	7.2	03-Jul-91
3787	7.49	30-Jul-91
3787	8.59	02-Aug-91
3787	7.9	04-Sep-91
3787	8.74	01-Oct-91
3787	8.94	09-Oct-91
3787	9.44	01-Nov-91
3787	7.5	03-Dec-91
3787	8.01	07-Jan-92
3787	8.35	22-Jan-92
3787	8.43	06-Feb-92
3787	8.96	26-Feb-92
3787	9.15	02-Mar-92
3787	5.92	02-Apr-92
3887	8.3	12-Nov-87
3887	8.2	21-Dec-87
3887	-1	27-Jan-88
3887	-1	29-Feb-88
3887	-1	21-Mar-88
3887	-1	18-Apr-88
3887	-1	17-May-88
3887	9.7	15-Jul-88
3887	9.7	18-Aug-88
3887	9.4	15-Sep-88
3887	9.8	22-Oct-88
3887	10.4	15-Nov-88
3887	10.6	15-Dec-88
3887	10.6	15-Jan-89
3887	10.6	24-Feb-89
3887	10.6	31-Mar-89
3887	10.6	27-Apr-89
3887	9.3	26-May-89
3887	8.9	30-Jun-89
3887	9.46	28-Jul-89
3887	9.55	30-Aug-89
3887	9.65	11-Sep-89

Table
Water Level Measurements
of Wells In and Near OU8

Well No.	Depth from T.O.C.	DATE
3887	9.95	16-Nov-89
3887	10.8	17-Jan-90
3887	10.95	23-Feb-90
3887	8.72	24-Apr-90
3887	9.22	23-May-90
3887	9.67	10-Jul-90
3887	9.93	23-Aug-90
3887	10.34	04-Oct-90
3887	10.55	08-Nov-90
3887	10.8	04-Jan-91
3887	11.02	24-Apr-91
3887	9.18	04-Jun-91
3887	9.54	03-Jul-91
3887	10.02	30-Jul-91
3887	11.41	01-Oct-91
3887	11.78	10-Oct-91
3887	10.17	07-Jan-92
3887	10.4	21-Jan-92
3887	10.4	21-Jan-92
3887	8.47	03-Apr-92
3987BR	23.9	12-Nov-87
3987BR	23.6	22-Dec-87
3987BR	40.2	01-Feb-88
3987BR	46.6	29-Feb-88
3987BR	108.6	21-Mar-88
3987BR	86	18-Apr-88
3987BR	86.5	16-May-88
3987BR	101.6	15-Jun-88
3987BR	99.1	15-Jul-88
3987BR	86.8	18-Aug-88
3987BR	102.5	15-Sep-88
3987BR	95	22-Oct-88
3987BR	83.9	15-Nov-88
3987BR	109.8	15-Dec-88
3987BR	89.9	15-Jan-89
3987BR	83.2	24-Feb-89
3987BR	82	31-Mar-89
3987BR	91.6	27-Apr-89
3987BR	85.7	26-May-89
3987BR	94.3	30-Jun-89
3987BR	85.55	28-Jul-89
3987BR	78.9	30-Aug-89
3987BR	110.45	12-Sep-89
3987BR	82.37	20-Nov-89
3987BR	92.6	17-Jan-90
3987BR	91.6	30-Jan-90
4386	-1	10-Oct-86
4386	-1	13-Oct-86
4386	16.76	26-Nov-86
4386	18.33	01-Jan-87
4386	16.75	01-Feb-87
4386	15.42	11-Mar-87
4386	13.1	08-May-87
4386	14.87	02-Jun-87
4386	14.2	07-Jul-87
4386	16.1	27-Jul-87
4386	16.8	04-Aug-87
4386	16.5	01-Sep-87
4386	18	29-Sep-87
4386	18.3	03-Nov-87
4386	16.75	01-Dec-87
4386	-1	21-Dec-87
4386	-1	11-Jan-88
4386	17.1	29-Feb-88
4386	16.9	21-Mar-88
4386	16.2	18-Apr-88
4386	17	16-May-88
4386	17	15-Jun-88
4386	18.1	15-Jul-88
4386	18.2	18-Aug-88
4386	18.2	15-Sep-88
4386	-1	22-Oct-88
4386	-1	15-Nov-88
4386	-1	15-Dec-88
4386	-1	15-Jan-89
4386	18.4	14-Feb-89
4386	17.5	27-Mar-89
4386	17.5	27-Apr-89
4386	17.8	28-May-89
4386	16	30-Jun-89
4386	18.11	21-Jul-89
4386	17.47	30-Aug-89
4386	17.83	12-Sep-89
4386	-1	06-Dec-89
4386	-1	15-Jan-90
4386	13.45	12-Apr-90
4386	16.02	05-Jun-90
4386	17.92	10-Jul-90
4386	17.38	09-Aug-90
4386 DRY		13-Aug-90
4386	18.23	10-Sep-90
4386	18.19	01-Oct-90
4386	18.41	11-Oct-90
4386 DRY		06-Nov-90
4386	18.36	07-Dec-90
4386 DRY		02-Jan-91
4386 DRY		02-Jan-91
4386 DRY		02-Apr-91
4386	16.21	07-May-91
4386	13.85	11-Jun-91
4386	15.99	02-Jul-91
4386	17.25	06-Aug-91
4386	15.98	19-Aug-91
4386	17.35	04-Sep-91
4386	18.73	04-Oct-91
4386 DRY		04-Oct-91
4386 DRY		08-Nov-91
4386	15.75	03-Dec-91
4386	17.51	03-Jan-92
4386		03-Feb-92
4386 DRY		03-Mar-92
4386 DRY		05-Mar-92
4386	12.9	08-Apr-92
4486	5.8	10-Nov-86

Table 1.
Water Level Measurements
of Wells In and Near OU8

Well No.	Depth from T.O.C.	DATE
4486	6.62	13-Nov-86
4486	8.5	01-Jan-87
4486	9.08	08-May-87
4486	6.89	02-Jun-87
4486	6.15	08-Jul-87
4486	8.7	04-Aug-87
4486	9.6	21-Aug-87
4486	9.1	01-Sep-87
4486	10.7	29-Sep-87
4486	11.6	02-Nov-87
4486	11.6	11-Nov-87
4486	12	21-Dec-87
4486	12	11-Jan-88
4486	6.7	29-Feb-88
4486	6.5	21-Mar-88
4486	6.2	18-Apr-88
4486	6.9	16-May-88
4486	7.3	15-Jun-88
4486	7.7	15-Jul-88
4486	8	18-Aug-88
4486	7.2	15-Sep-88
4486	11.8	22-Oct-88
4486	9.1	15-Nov-88
4486	14.5	15-Dec-88
4486	8.4	15-Jan-89
4486	6.8	17-Feb-89
4486	6.8	27-Mar-89
4486	6.8	27-Apr-89
4486	6.2	19-May-89
4486	6.4	29-Jun-89
4486	7.8	14-Jul-89
4486	7.87	25-Aug-89
4486	5.85	13-Sep-89
4486	13.87	06-Dec-89
4486	12.97	16-Jan-90
4486	5.6	23-Mar-90
4486	5.98	12-Apr-90
4486	7.72	14-Jun-90
4486	6.68	10-Jul-90
4486	6.91	15-Aug-90
4486	7.15	27-Aug-90
4486	7.64	14-Sep-90
4486	7.32	04-Oct-90
4486	7.33	05-Nov-90
4486	8.1	07-Dec-90
4486	8.22	11-Dec-90
4486	14.43	03-Jan-91
4486	7.61	18-Mar-91
4486	7.27	02-Apr-91
4486	5.69	06-May-91
4486	5.87	07-Jun-91
4486	6.67	20-Jun-91
4486	7.65	05-Jul-91
4486	6.1	08-Aug-91
4486	6.38	14-Aug-91
4486	7.87	03-Sep-91
4486	8.87	04-Oct-91
4486	8.51	04-Nov-91
4486	7.68	08-Nov-91
4486	6.44	07-Dec-91
4486	8.61	09-Jan-92
4486	8.23	03-Feb-92
4486	8.24	05-Feb-92
4486	6.8	05-Mar-92
4486	6.25	06-Apr-92
5687	6.7	29-Feb-88
5687	7.8	21-Mar-88
5687	6.7	18-Apr-88
5687	6.2	17-May-88
5687	6.4	15-Jun-88
5687	6.4	15-Jul-88
5687	6.5	18-Aug-88
5687	7.8	15-Sep-88
5687	7.7	22-Oct-88
5687	8.1	15-Nov-88
5687	8.2	15-Dec-88
5687	8.4	15-Jan-89
5687	7.8	24-Feb-89
5687	7.6	31-Mar-89
5687	7	27-Apr-89
5687	6.5	26-May-89
5687	6.4	30-Jun-89
5687	6.88	28-Jul-89
5687	6.41	30-Aug-89
5687	7.53	11-Sep-89
5687	8.2	20-Nov-89
5687	9.21	17-Jan-90
5687	9.1	15-Feb-90
5687	6.82	25-Apr-90
5687	6.72	10-May-90
5687	7.84	11-Jul-90
5687	7.49	31-Jul-90
5687	9.32	10-Aug-90
5687	8.11	05-Sep-90
5687	7.8	02-Oct-90
5687	8.01	22-Oct-90
5687	9.68	02-Nov-90
5687	8.98	04-Jan-91
5687	9.7	08-Jan-91
5687	7.52	29-May-91
5687	9.32	07-Jun-91
5687	7.46	03-Jul-91
5687	7.45	23-Jul-91
5687	9.39	02-Aug-91
5687	7.44	04-Sep-91
5687	7.94	01-Oct-91
5687	7.97	03-Oct-91
5687	9.23	04-Nov-91
5687	8.18	03-Dec-91
5687	8.24	07-Jan-92
5687	8.31	09-Jan-92
5687	9.23	06-Feb-92
5687	9.08	02-Mar-92
5687	7.08	02-Apr-92

Table 1
Water Level Measurements
of Wells In and Near OU8

Well No.	Depth from T.O.C.	DATE
5687	6.93	06-Apr-92
6186	10.5	12-Dec-86
6186	10.93	15-Dec-86
6186	10.13	01-Jan-87
6186	8.33	10-Mar-87
6186	9.04	08-May-87
6186	-1	03-Jun-87
6186	10.85	24-Jun-87
6186	9.8	08-Jul-87
6186	10.2	06-Aug-87
6186	9.3	25-Aug-87
6186	9.9	01-Sep-87
6186	9.1	28-Oct-87
6186	8.8	02-Nov-87
6186	9.1	21-Dec-87
6186	9.3	11-Jan-88
6186	10.82	04-Feb-88
6186	9.9	29-Feb-88
6186	9.9	21-Mar-88
6186	9.4	18-Apr-88
6186	10	16-May-88
6186	10.1	15-Jun-88
6186	8.5	15-Jul-88
6186	10.2	18-Aug-88
6186	10	15-Sep-88
6186	10.5	22-Oct-88
6186	10	15-Nov-88
6186	10.4	15-Dec-88
6186	10.4	15-Jan-89
6186	6.9	17-Feb-89
6186	9.9	27-Mar-89
6186	10.9	27-Apr-89
6186	8.5	19-May-89
6186	10	29-Jun-89
6186	10.18	21-Jul-89
6186	9.43	25-Aug-89
6186	9.05	14-Sep-89
6186	10.3	06-Dec-89
6186	10.35	18-Jan-90
6186	7.75	23-Mar-90
6186	9.14	26-Apr-90
6186	9.82	18-May-90
6186	9.78	11-Jul-90
6186	9.82	03-Aug-90
6186	9.89	15-Aug-90
6186	9.86	07-Sep-90
6186	9.84	03-Oct-90
6186	10.28	02-Nov-90
6186	10.37	13-Dec-90
6186	10.86	04-Jan-91
6186	9.98	12-Jun-91
6186	9.92	03-Jul-91
6186	9.53	05-Aug-91
6186	9.33	07-Aug-91
6186	10.2	05-Sep-91
6186	9.9	02-Oct-91
6186	10.3	17-Oct-91
6186	9.49	04-Nov-91
6186	9.32	03-Dec-91
6186	10.29	07-Jan-92
6186	9.75	21-Jan-92
6186	9.75	21-Jan-92
6186	10.27	06-Feb-92
6186	10.49	02-Mar-92
6186	8.88	06-Apr-92
P114789	10.66	15-Jan-90
P114789	8.13	25-Apr-90
P114789	9	12-Jul-90
P114789	9.6	09-Aug-90
P114789	9.59	10-Sep-90
P114789	9.87	03-Oct-90
P114789	9.52	05-Nov-90
P114789	10.3	04-Dec-90
P114789	11.51	03-Jan-91
P114789	10.23	02-Apr-91
P114789	8.61	01-May-91
P114789	7.87	07-Jun-91
P114789	9.48	02-Jul-91
P114789	7.64	08-Aug-91
P114789	9.63	04-Sep-91
P114789	9.67	04-Oct-91
P114789	9.13	04-Nov-91
P114789	7.86	02-Dec-91
P114789	9.44	02-Jan-92
P114789	9.3	03-Feb-92
P114789	10.01	02-Mar-92
P114789	7.35	01-Apr-92
P114889	10.04	19-Jan-90
P114889	7.33	25-Apr-90
P114889	5.78	11-Jul-90
P114889	5.6	09-Aug-90
P114889	5.62	10-Sep-90
P114889	5.71	03-Oct-90
P114889	6.35	05-Nov-90
P114889	6.98	04-Dec-90
P114889	7.53	03-Jan-91
P114889	7.35	02-Apr-91
P114889	6.83	01-May-91
P114889	5.84	11-Jun-91
P114889	5.44	02-Jul-91
P114889	5.18	08-Aug-91
P114889	5.22	04-Sep-91
P114889	5.57	04-Oct-91
P114889	6.13	04-Nov-91
P114889	6.56	02-Dec-91
P114889	6.93	02-Jan-92
P114889	7.17	03-Feb-92
P114889	7.04	02-Mar-92
P114889	6.62	01-Apr-92
P115489	11.97	15-Jan-90
P115489	9.47	12-Jul-90
P115489	9.7	09-Aug-90
P115489	10.23	11-Sep-90
P115489	10.87	04-Oct-90

Table 1
Water Level Measurements
of Wells In and Near OU8

Well No.	Depth from T.O.C.	DATE
P115489	11.22	05-Nov-90
P115489	11.54	05-Dec-90
P115489	13.46	03-Jan-91
P115489	12.51	02-Apr-91
P115489	10.46	02-May-91
P115489	8.9	11-Jun-91
P115489	10.74	08-Jul-91
P115489	9.57	08-Aug-91
P115489	10.21	04-Sep-91
P115489	11.56	04-Oct-91
P115489	11.58	05-Nov-91
P115489	10.07	02-Dec-91
P115489	11.11	03-Jan-92
P115489	10.97	03-Feb-92
P115489	11.87	02-Mar-92
P115489	8.47	01-Apr-92
P115589	7.73	09-Jan-90
P115589	8.34	15-Jan-90
P115589	5.63	12-Jul-90
P115589	6.39	09-Aug-90
P115589	6.86	11-Sep-90
P115589	7.4	04-Oct-90
P115589	7.3	05-Nov-90
P115589	7.94	05-Dec-90
P115589	10	03-Jan-91
P115589	9.01	02-Apr-91
P115589	5.76	02-May-91
P115589	4.55	11-Jun-91
P115589	6.82	05-Jul-91
P115589	4.82	08-Aug-91
P115589	7.33	04-Sep-91
P115589	7.84	04-Oct-91
P115589	6.7	04-Nov-91
P115589	4.77	02-Dec-91
P115589	7.11	03-Jan-92
P115589	7.25	03-Feb-92
P115589	8.6	02-Mar-92
P115589	4.35	01-Apr-92

Well No.	Depth from T.O.C.	DATE
P115689	8.7	15-Sep-89
P115689	12.55	15-Jan-90
P115689	9.37	12-Jul-90
P115689	10.26	10-Aug-90
P115689	10.79	10-Sep-90
P115689	11.56	04-Oct-90
P115689	11.53	05-Nov-90
P115689	12.2	04-Dec-90
P115689	14.21	03-Jan-91
P115689	13.29	02-Apr-91
P115689	9.81	02-May-91
P115689	7.61	11-Jun-91
P115689	10.35	05-Jul-91
P115689	8.85	08-Aug-91
P115689	11.49	04-Sep-91
P115689	12.82	04-Oct-91
P115689	12.35	04-Nov-91
P115689	9.42	04-Dec-91
P115689	11.57	09-Jan-92
P115689	11.18	03-Feb-92
P115689	12.36	02-Mar-92
P115689	7.53	01-Apr-92
P207389	6.66	11-Sep-89
P207389	7.14	21-Sep-89
P207389	7.83	17-Jan-90
P207389	5.94	14-Mar-90
P207389	6.65	26-Apr-90
P207389	6.83	05-Jun-90
P207389	6.97	11-Jul-90
P207389	7.54	21-Aug-90
P207389	8.49	17-Dec-90
P207389	8.85	04-Jan-91
P207389	8.15	25-Mar-91
P207389	6.65	30-May-91
P207389	7.36	03-Jul-91
P207389	7.16	06-Aug-91
P207389	6.81	02-Oct-91
P207389	6.81	23-Oct-91

Well No.	Depth from T.O.C.	DATE
P207389	6.99	08-Jan-92
P207389	6.68	03-Mar-92
P207389	6.48	03-Apr-92
P207489	7.28	11-Sep-89
P207489	7.13	20-Sep-89
P207489	7.63	17-Jan-90
P207489	6	14-Mar-90
P207489	6.66	26-Apr-90
P207489	6.94	01-Jun-90
P207489	7.29	11-Jul-90
P207489	7.6	10-Aug-90
P207489	7.63	14-Aug-90
P207489	7.99	05-Sep-90
P207489	7.85	02-Nov-90
P207489	8.28	17-Dec-90
P207489	8.86	04-Jan-91
P207489	8.07	30-Apr-91
P207489	6.68	30-May-91
P207489	6.68	30-May-91
P207489	7.58	03-Jul-91
P207489	7.56	06-Aug-91
P207489	7.15	04-Sep-91
P207489	7.02	02-Oct-91
P207489	8.73	23-Oct-91
P207489	7.17	04-Nov-91
P207489	6.73	03-Dec-91
P207489	7.17	08-Jan-92
P207489	6.72	06-Feb-92
P207489	6.76	03-Mar-92
P207489	6.3	03-Apr-92
P207589	24.67	11-Sep-89
P207589	24.87	21-Sep-89
P207589	25.74	17-Jan-90
P207589	23.42	05-Mar-90
P207589	25.96	24-Apr-90
P207589	25.83	03-May-90
P207589	25.76	10-Jul-90
P207589	25.66	19-Jul-90

Table 1.
Water Level Measurements
of Wells In and Near OU8

Well No.	Depth from T.O.C.	DATE
P207589	25.49	01-Oct-90
P207589	26.77	17-Dec-90
P207589	26.5	04-Jan-91
P207589	25.57	25-Mar-91
P207589	25.85	10-Jun-91
P207589	26.59	03-Jul-91
P207589	26.23	24-Jul-91
P207589	25.78	01-Oct-91
P207589	25.62	15-Oct-91
P207589	25.58	07-Jan-92
P207589	25.38	28-Jan-92
P207589	25.77	03-Apr-92
P207689	7.71	17-Jul-89
P207689	7.57	11-Sep-89
P207689	7.11	14-Sep-89
P207689	8.49	17-Jan-90
P207689	8.35	31-Jan-90
P207689	6.82	24-Apr-90
P207689	6.94	30-Apr-90
P207689	7.68	10-Jul-90
P207689	8.18	01-Oct-90
P207689	8.42	15-Oct-90
P207689	8.74	04-Jan-91
P207689	8.69	25-Mar-91
P207689	7.52	31-May-91
P207689	7.82	03-Jul-91
P207689	8.06	02-Aug-91
P207689	8.69	01-Oct-91
P207689	8.94	09-Oct-91
P207689	8.24	07-Jan-92
P207689	8.18	15-Jan-92
P207689	6.85	02-Apr-92
P207789	29.45	11-Sep-89
P207789	29.41	14-Sep-89
P207789	28.64	17-Jan-90
P207789	28.53	01-Feb-90
P207789	29.34	24-Apr-90
P207789	29.2	08-May-90
P207789	29.53	10-Jul-90
P207789	29.04	21-Aug-90
P207789	29.47	01-Oct-90
P207789	28.58	11-Dec-90
P207789	29.94	04-Jan-91
P207789	29.14	24-Apr-91
P207789	29.91	05-Jun-91
P207789	30.17	03-Jul-91
P207789	29.63	05-Aug-91
P207789	29.58	01-Oct-91
P207789	29.46	09-Oct-91
P207789	29.15	07-Jan-92
P207789	29	21-Jan-92
P207789	29	21-Jan-92
P207789	29.36	02-Apr-92
P207889	5.12	11-Sep-89
P207889	4.95	15-Sep-89
P207889	7.17	17-Jan-90
P207889	7.22	01-Feb-90
P207889	4.75	01-May-90
P207889	4.75	02-May-90
P207889	5.74	10-Jul-90
P207889	5.94	19-Jul-90
P207889	6.79	01-Oct-90
P207889	6.88	10-Oct-90
P207889	7.32	04-Jan-91
P207889	8.66	25-Mar-91
P207889	5.32	10-Jun-91
P207889	6.87	03-Jul-91
P207889	6.09	24-Jul-91
P207889	7.43	01-Oct-91
P207889	7.57	08-Oct-91
P207889	6.19	07-Jan-92
P207889	6.25	21-Jan-92
P207889	6.25	21-Jan-92
P207889	4.25	02-Apr-92
P207889	4.74	07-Apr-92
P207989	17.12	11-Sep-89
P207989	16.94	14-Sep-89
P207989	17.08	17-Jan-90
P207989	16.46	01-Feb-90
P207989	18.45	01-May-90
P207989	18.45	02-May-90
P207989	18.19	10-Jul-90
P207989	15.59	28-Aug-90
P207989	20.49	01-Oct-90
P207989	16.35	12-Dec-90
P207989	21.78	04-Jan-91
P207989	17.65	25-Mar-91
P207989	18.88	05-Jun-91
P207989	21.35	03-Jul-91
P207989	19.86	24-Jul-91
P207989	18.5	01-Oct-91
P207989	18.14	08-Oct-91
P207989	17.51	07-Jan-92
P207989	15.18	05-Mar-92
P207989	21.03	02-Apr-92
P207989	20.71	06-Apr-92
P208989	14.91	12-Sep-89
P208989	14.64	28-Sep-89
P208989	16.61	17-Jan-90
P208989	16.45	09-Mar-90
P208989	14.34	25-Apr-90
P208989	15.01	08-May-90
P208989	16.34	10-Jul-90
P208989	16.1	31-Jul-90
P208989	16.63	02-Oct-90
P208989	16.75	16-Oct-90
P208989	17.05	04-Jan-91
P208989	17.37	25-Mar-91
P208989	14.74	30-May-91
P208989	15.54	03-Jul-91
P208989	16.27	08-Aug-91
P208989	17.02	01-Oct-91
P208989	17.1	09-Oct-91
P208989	16.92	08-Jan-92

Table 1.
Water Level Measurements
of Wells In and Near OU8

Well No.	Depth from T.O.C.	DATE
P208989	17.05	29-Jan-92
P208989	12.16	02-Apr-92
P209089	25.03	12-Sep-89
P209089	24.79	26-Sep-89
P209089	24.95	17-Jan-90
P209089	27.04	24-Apr-90
P209089	26.62	08-May-90
P209089	26.35	10-Jul-90
P209089	25.57	31-Jul-90
P209089	25.83	01-Oct-90
P209089	25.25	15-Oct-90
P209089	25.02	04-Jan-91
P209089	22.55	25-Mar-91
P209089	25.63	12-Jun-91
P209089	27.76	03-Jul-91
P209089	26.54	01-Aug-91
P209089	25.82	07-Oct-91
P209089	28.2	23-Oct-91
P209089	25.23	07-Jan-92
P209089	23	18-Mar-92
P209089	28.03	03-Apr-92
P209189	7.71	12-Sep-89
P209189	10.5	27-Sep-89
P209189	14.18	17-Jan-90
P209189	10.16	25-Apr-90
P209189	10.32	01-Jun-90
P209189	10.9	10-Jul-90
P209189	10.74	31-Aug-90
P209189	10.81	02-Oct-90
P209189	10.7	08-Nov-90
P209189	14.35	04-Jan-91
P209189	14.33	22-Mar-91
P209189	10.26	05-Jun-91
P209189	11.38	03-Jul-91
P209189	11.1	24-Jul-91
P209189	12.81	01-Oct-91
P209189	13.24	09-Oct-91
P209189	13.32	07-Jan-92
P209189	14.62	02-Mar-92
P209189	10.18	02-Apr-92
P209289	14.67	12-Sep-89
P209289	-1	25-Sep-89
P209289	-1	17-Jan-90
P209289	14.66	25-Apr-90
P209289	14.68	30-May-90
P209289	DRY	11-Jul-90
P209289	14.65	13-Aug-90
P209289	14.65	15-Aug-90
P209289	14.38	05-Sep-90
P209289	14.24	02-Oct-90
P209289	DRY	24-Oct-90
P209289	14.66	02-Nov-90
P209289	14.69	04-Jan-91
P209289	14.71	25-Mar-91
P209289	14.1	29-May-91
P209289	15.43	29-May-91
P209289	14.68	03-Jul-91
P209289	14.69	23-Jul-91
P209289	DRY	02-Aug-91
P209289	14.67	04-Sep-91
P209289	14.64	01-Oct-91
P209289	14.66	03-Oct-91
P209289	14.46	04-Nov-91
P209289	14.24	03-Dec-91
P209289	14.69	07-Jan-92
P209289	14.71	13-Jan-92
P209289	DRY	15-Jan-92
P209289	DRY	06-Feb-92
P209289	14.67	26-Feb-92
P209289	DRY	02-Mar-92
P209289	13.73	02-Apr-92
P209389	17.62	12-Sep-89
P209389	17.16	18-Sep-89
P209389	19.56	17-Jan-90
P209389	16.25	16-Mar-90
P209389	17.98	25-Apr-90
P209389	20.88	31-May-90
P209389	18.5	11-Jul-90
P209389	17.54	23-Aug-90
P209389	17.31	02-Oct-90
P209389	18.64	25-Oct-90
P209389	19.9	04-Jan-91
P209389	19.55	25-Mar-91
P209389	17.56	30-May-91
P209389	19.23	03-Jul-91
P209389	19.65	23-Jul-91
P209389	19.4	01-Oct-91
P209389	18.69	07-Oct-91
P209389	19.15	07-Jan-92
P209389	19.46	22-Jan-92
P209389	18.91	26-Feb-92
P209389	17.15	02-Apr-92
P209489	28.53	12-Sep-89
P209489	28.55	20-Sep-89
P209489	-1	17-Jan-90
P209489	27.87	25-Apr-90
P209489	28.52	31-May-90
P209489	28.68	10-Jul-90
P209489	28.58	15-Aug-90
P209489	28.65	02-Oct-90
P209489	28.88	25-Oct-90
P209489	29.35	04-Jan-91
P209489	29.95	25-Mar-91
P209489	28.58	03-Jul-91
P209489	29.58	01-Aug-91
P209489	29.01	01-Oct-91
P209489	29.32	15-Oct-91
P209489	29.41	07-Jan-92
P209489	29.6	29-Jan-92
P209489	26.5	02-Apr-92
P209589	16.68	12-Sep-89
P209589	16.59	19-Sep-89
P209589	17.99	17-Jan-90
P209589	17.62	30-Jan-90

Table 1.7
Water Level Measurements
of Wells In and Near OU8

Well No.	Depth from T.O.C.	DATE
P209589	17.9	25-Apr-90
P209589	16.55	24-May-90
P209589	19.02	10-Jul-90
P209589	20.78	28-Aug-90
P209589	19.79	02-Oct-90
P209589	18.49	06-Nov-90
P209589	19.27	04-Jan-91
P209589	17.58	25-Mar-91
P209589	18.74	05-Jun-91
P209589	19.99	03-Jul-91
P209589	18.7	31-Jul-91
P209589	18.73	01-Oct-91
P209589	18.78	03-Oct-91
P209589	18.63	07-Jan-92
P209589	18.54	09-Jan-92
P209589	18.36	02-Apr-92
P209689	26.47	13-Sep-89
P209689	28.19	17-Jan-90
P209689	27.6	15-Mar-90
P209689	29.11	25-Apr-90
P209689	28.99	30-Apr-90
P209689	28.63	10-Jul-90
P209689	28.49	19-Jul-90
P209689	28.41	01-Oct-90
P209689	28.4	02-Oct-90
P209689	28.3	10-Oct-90
P209689	28.02	04-Jan-91
P209689	28	07-Jan-91
P209689	28.44	25-Mar-91
P209689	28.98	04-Jun-91
P209689	27.15	12-Jun-91
P209689	29.28	03-Jul-91
P209689	28.81	31-Jul-91
P209689	28.58	01-Oct-91
P209689	28.19	07-Jan-92
P209689	28.02	21-Jan-92
P209689	28.02	21-Jan-92
P209689	28.45	02-Apr-92
P209789	5.18	13-Sep-89
P209789	8.82	17-Jan-90
P209789	3.34	15-Mar-90
P209789	5.07	25-Apr-90
P209789	5.53	04-May-90
P209789	7.11	10-Jul-90
P209789	6.65	24-Jul-90
P209789	8.42	01-Oct-90
P209789	8.85	19-Oct-90
P209789	9.92	04-Jan-91
P209789	10.36	22-Mar-91
P209789	6.59	07-Jun-91
P209789	7.42	03-Jul-91
P209789	7.59	01-Aug-91
P209789	9	01-Oct-91
P209789	9.41	11-Oct-91
P209789	8.42	07-Jan-92
P209789	8.89	20-Jan-92
P209789	8.89	20-Jan-92
P209789	4.7	02-Apr-92
P209889	4.68	12-Sep-89
P209889	5.22	26-Sep-89
P209889	5.15	17-Jan-90
P209889	4.52	09-Mar-90
P209889	4.43	25-Apr-90
P209889	4.5	23-May-90
P209889	5.06	10-Jul-90
P209889	5	22-Aug-90
P209889	4.98	02-Oct-90
P209889	5.15	29-Oct-90
P209889	5.46	04-Jan-91
P209889	5.02	25-Mar-91
P209889	4	04-Jun-91
P209889	4.51	03-Jul-91
P209889	4.47	06-Aug-91
P209889	5.25	01-Oct-91
P209889	5.34	14-Oct-91
P209889	5.01	07-Jan-92
P209889	5.21	22-Jan-92
P209889	5.3	27-Feb-92
P209889	4.49	02-Apr-92
P209989	-1	31-Aug-89
P209989	-1	11-Sep-89
P209989	-1	17-Jan-90
P209989	DRY	11-Apr-90
P209989	DRY	11-May-90
P209989	DRY	10-Jul-90
P209989	DRY	24-Jul-90
P209989	DRY	07-Aug-90
P209989	DRY	11-Sep-90
P209989	DRY	03-Oct-90
P209989	DRY	10-Oct-90
P209989	DRY	07-Nov-90
P209989	DRY	06-Dec-90
P209989	DRY	01-Apr-91
P209989	DRY	06-May-91
P209989	10.32	07-Jun-91
P209989	10.69	02-Jul-91
P209989	10.72	08-Jul-91
P209989	DRY	07-Aug-91
P209989	DRY	05-Sep-91
P209989	11.89	01-Oct-91
P209989	DRY	01-Oct-91
P209989	DRY	05-Nov-91
P209989	DRY	04-Dec-91
P209989	DRY	03-Jan-92
P209989	DRY	03-Feb-92
P209989	DRY	03-Mar-92
P209989	10.29	02-Apr-92
P210089	18.38	05-Sep-89
P210089	23.79	12-Sep-89
P210089	18.69	17-Jan-90
P210089	18.83	27-Feb-90
P210089	18.83	27-Feb-90
P210089	20.8	11-Apr-90
P210089	18.72	05-Jun-90

TABLE 1-8

Hydraulic Conductivities For Geologic Materials At RFP

Hydrostratigraphic Unit	*Hydraulic Conductivity, k, cm/sec*	
Recent and colluvial sediments	Untested	
Valley Fill Alluvium	1.8×10^{-2}	(Doty, 1992b)
Valley Fill Alluvium	3×10^{-3} - 5×10^{-6}	(EG&G, 1991k)
Rocky Flats Alluvium of HSU 1	1×10^{-2} - 7×10^{-5}	
Arapahoe sandstone of HSU 1 (weathered, unconfined)	4×10^{-5} - 2×10^{-8}	
Arapahoe sandstone of HSU 1 (unweathered, confined)	2×10^{-6} - 4×10^{-8}	
Arapahoe claystone (flanking HSU 1 sandstones)	1×10^{-7} - 1×10^{-8}	(EG&G, 1991k)

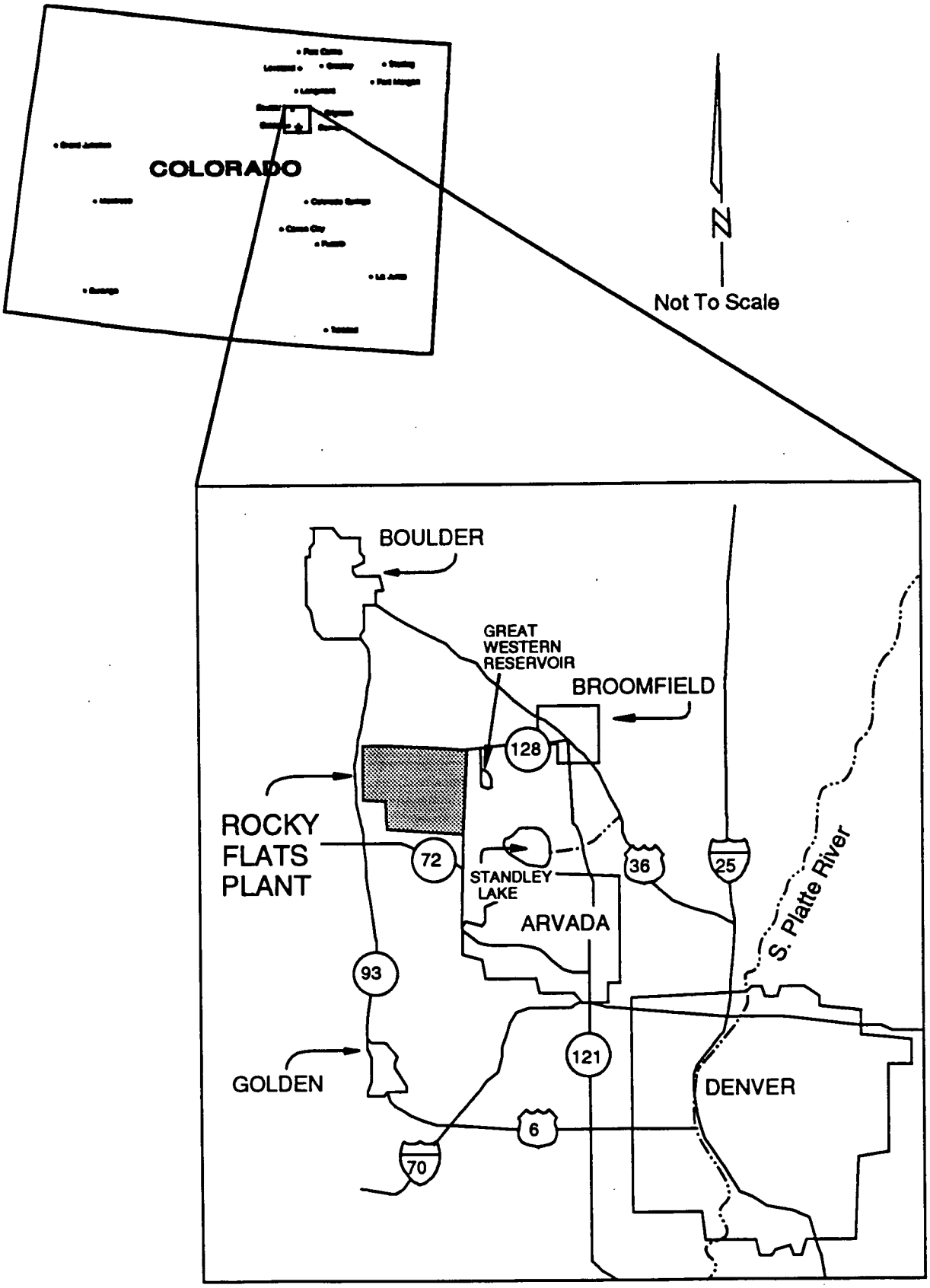


FIGURE 1-1
SITE LOCATION MAP - ROCKY FLATS PLANT

OPERABLE UNIT NO. 8
PHASE I RFI/RI WORK PLAN

U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant, Golden, Colorado

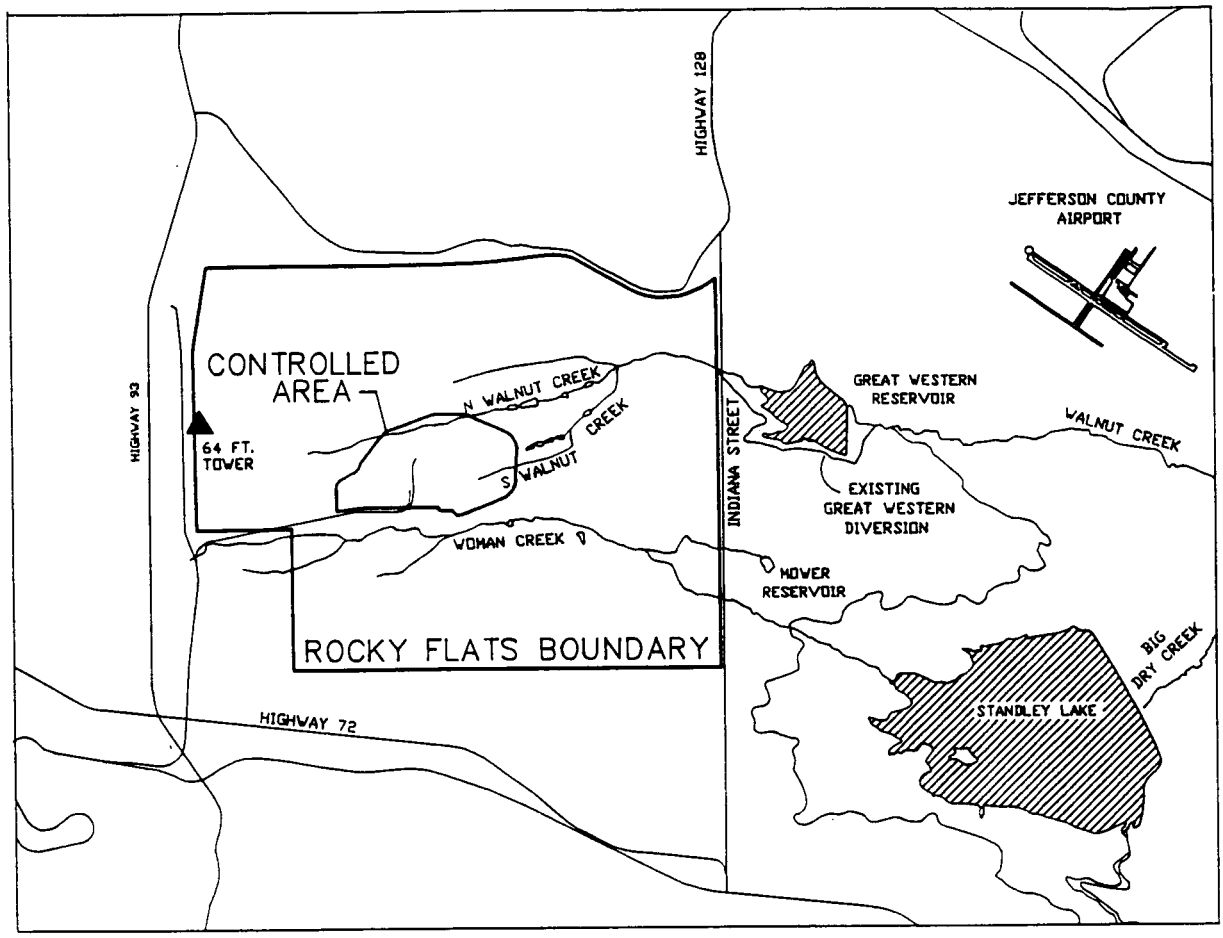
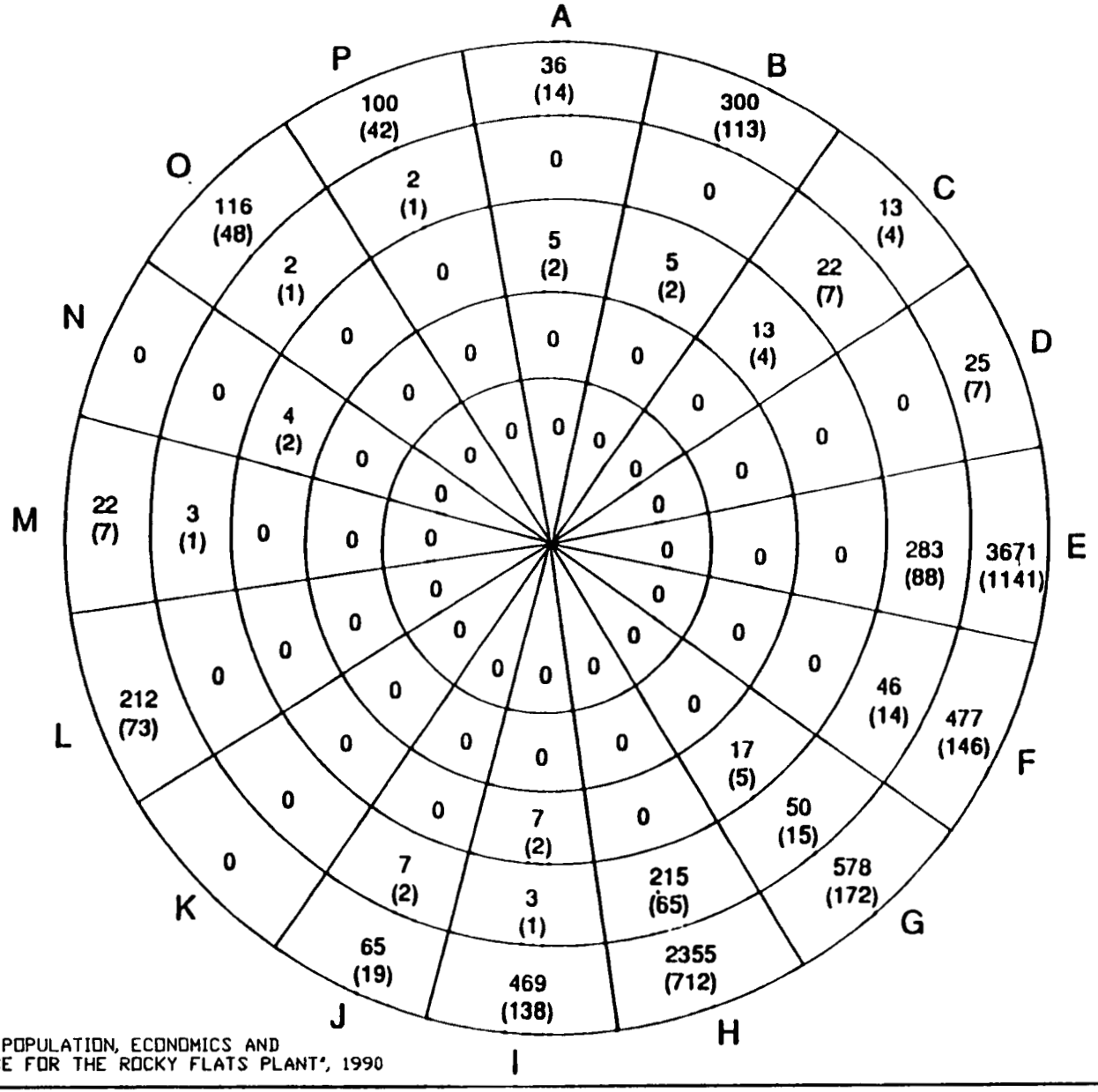
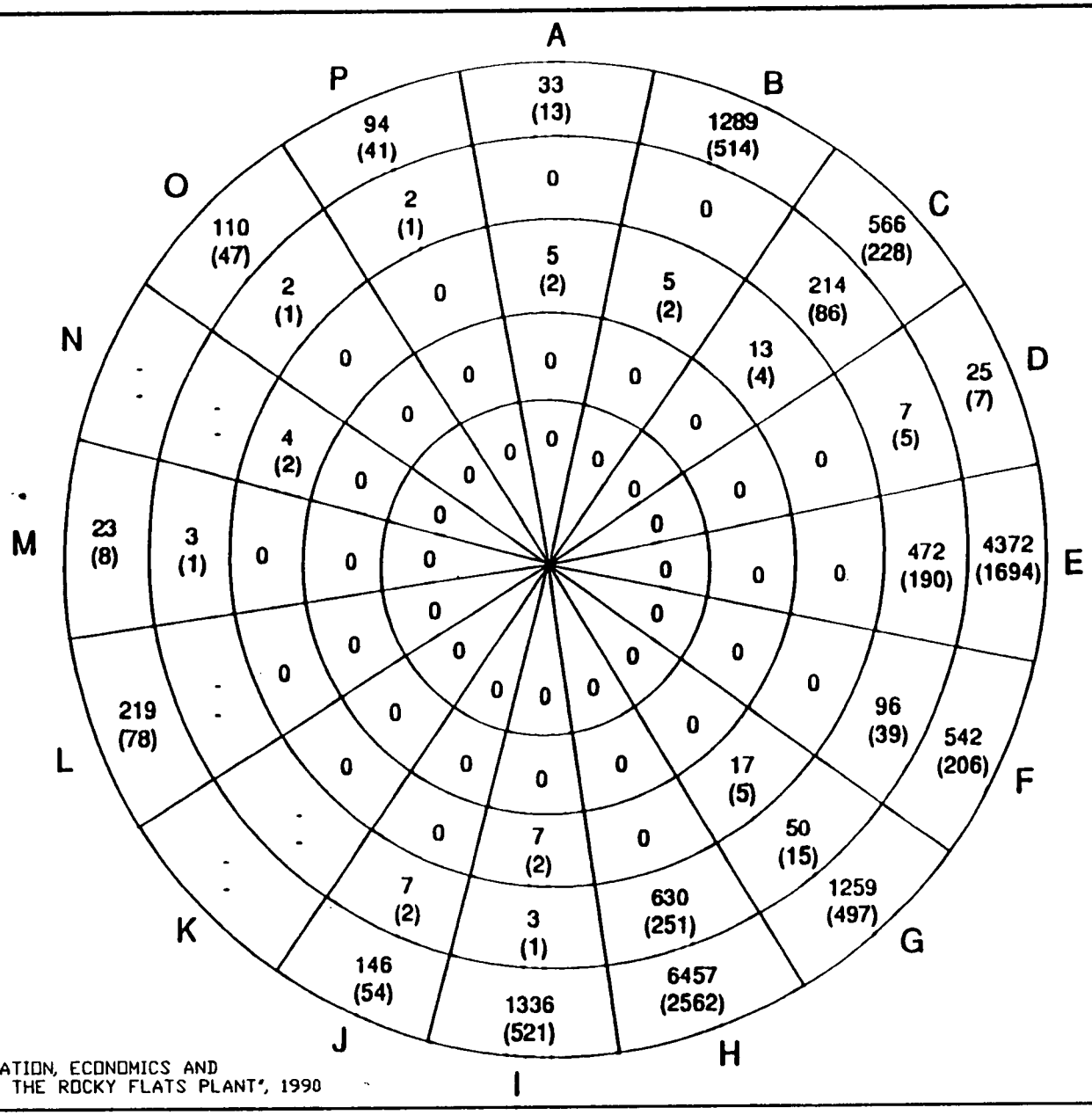


FIGURE 1-2
ROCKY FLATS PLANT

OPERABLE UNIT NO. 8
PHASE I RFI/RI WORK PLAN

U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant, Golden, Colorado


A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
36 (14)
0
5 (2)
300 (113)
0
5 (2)
13 (4)
22 (7)
0
25 (7)
0
283 (88)
3671 (1141)
46 (14)
477 (146)
17 (5)
50 (15)
578 (172)
215 (65)
2355 (712)
7 (2)
3 (1)
469 (138)
65 (19)
7 (2)
0
212 (73)
0
22 (7)
3 (1)
0
4 (2)
0
116 (48)
2 (1)
0
100 (42)
2 (1)
0
13 (4)
0
0
0



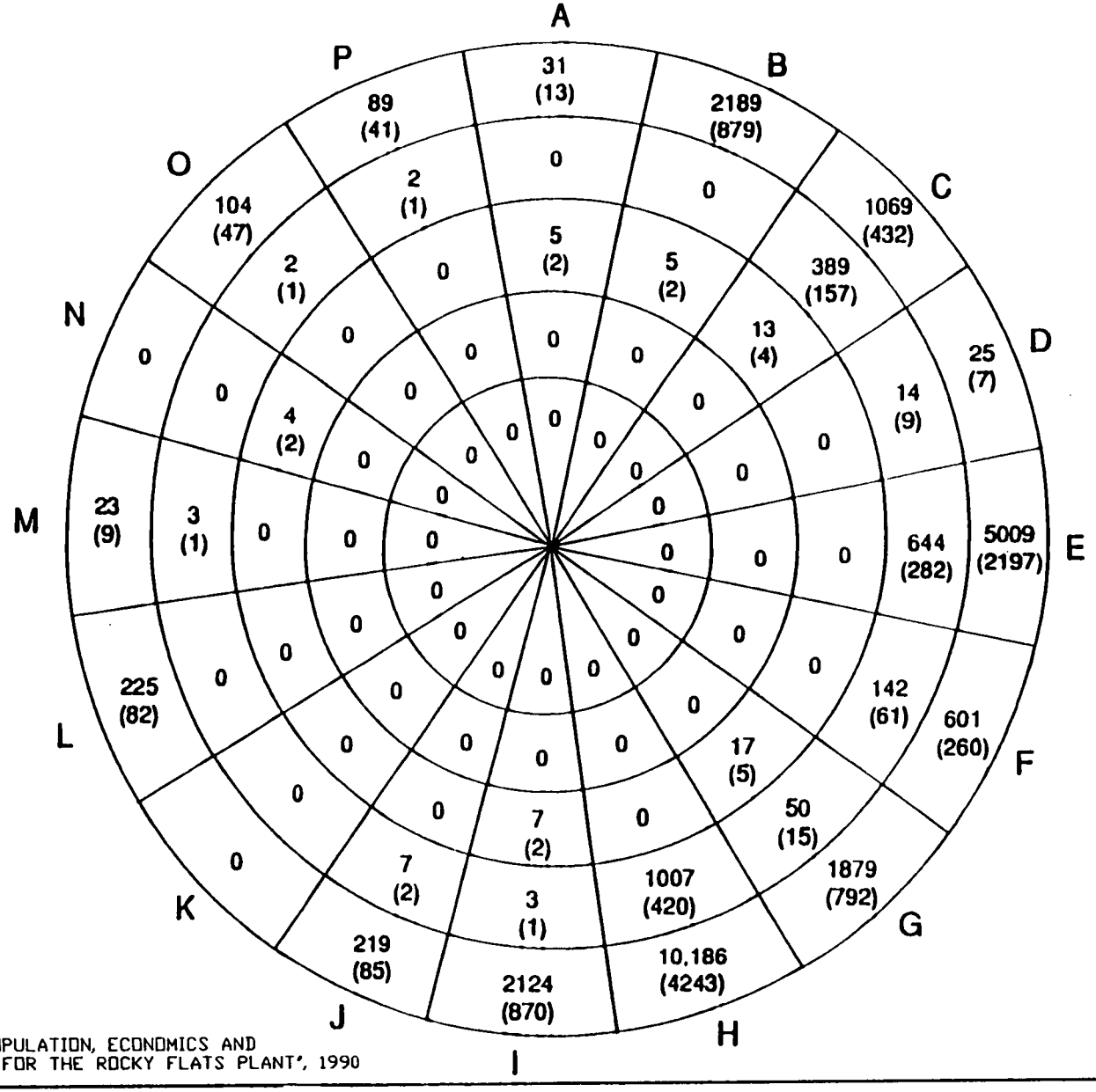
SOURCE: DOE, "1989 POPULATION, ECONOMICS AND LAND USE DATA BASE FOR THE ROCKY FLATS PLANT", 1990

FIGURE 1-5

EXPECTED POPULATION AND DENSITY DISTRIBUTION AROUND THE ROCKY FLATS PLANT IN THE YEAR 2000

OPERABLE UNIT NO. 8
PHASE I RFI/RI WORK PLAN

U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant, Golden, Colorado



Miles	Sector Name
0-1	Sector 1
1-2	Sector 2
2-3	Sector 3
3-4	Sector 4
4-5	Sector 5

SOURCE: DOE, "1989 POPULATION, ECONOMICS AND LAND USE DATA BASE FOR THE ROCKY FLATS PLANT", 1990

N

NOT TO SCALE

FIGURE 1-6

EXPECTED POPULATION AND DENSITY DISTRIBUTION AROUND THE ROCKY FLATS PLANT IN THE YEAR 2010

OPERABLE UNIT NO. 8
PHASE I RFI/RI WORK PLAN

U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant, Golden, Colorado

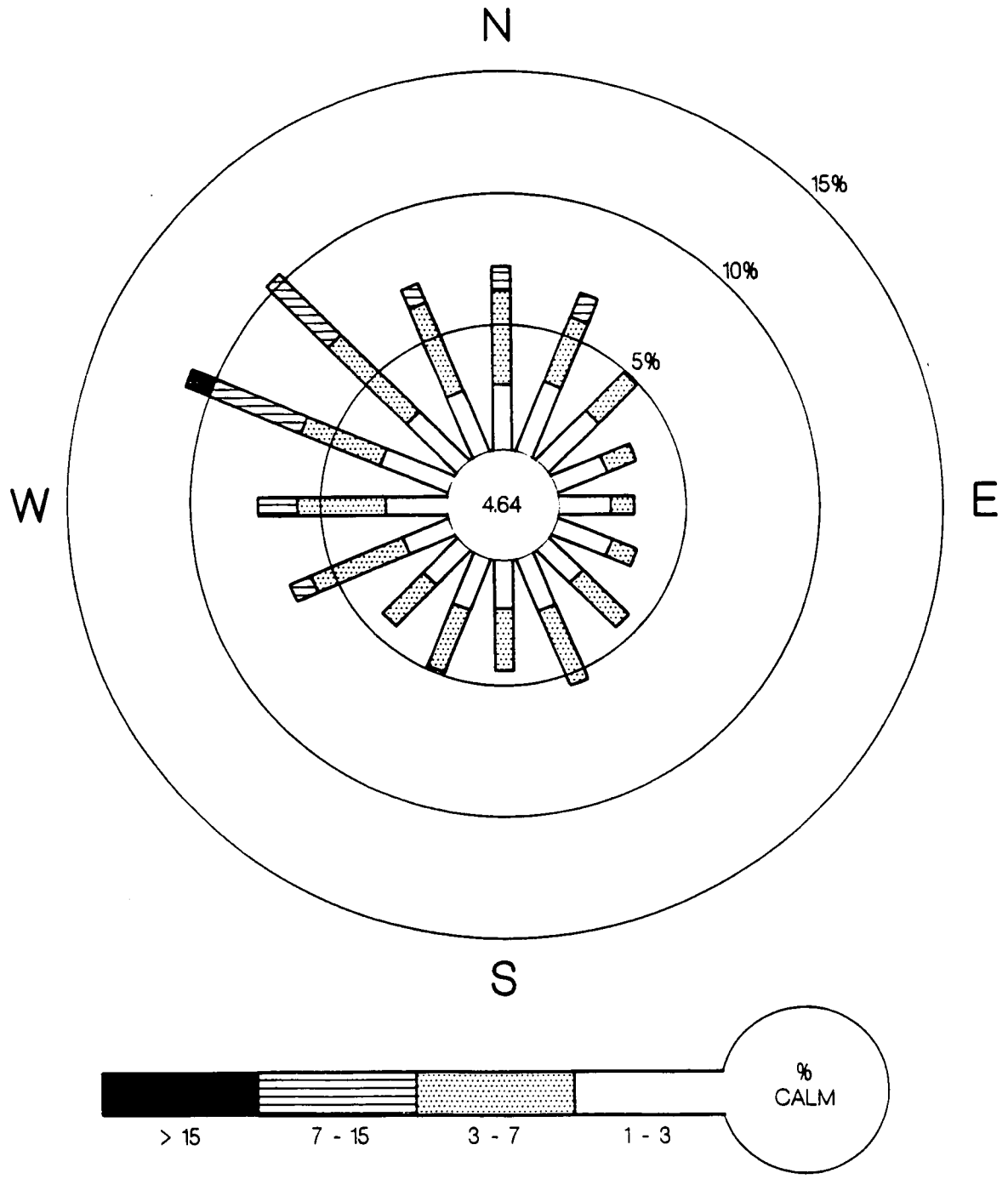
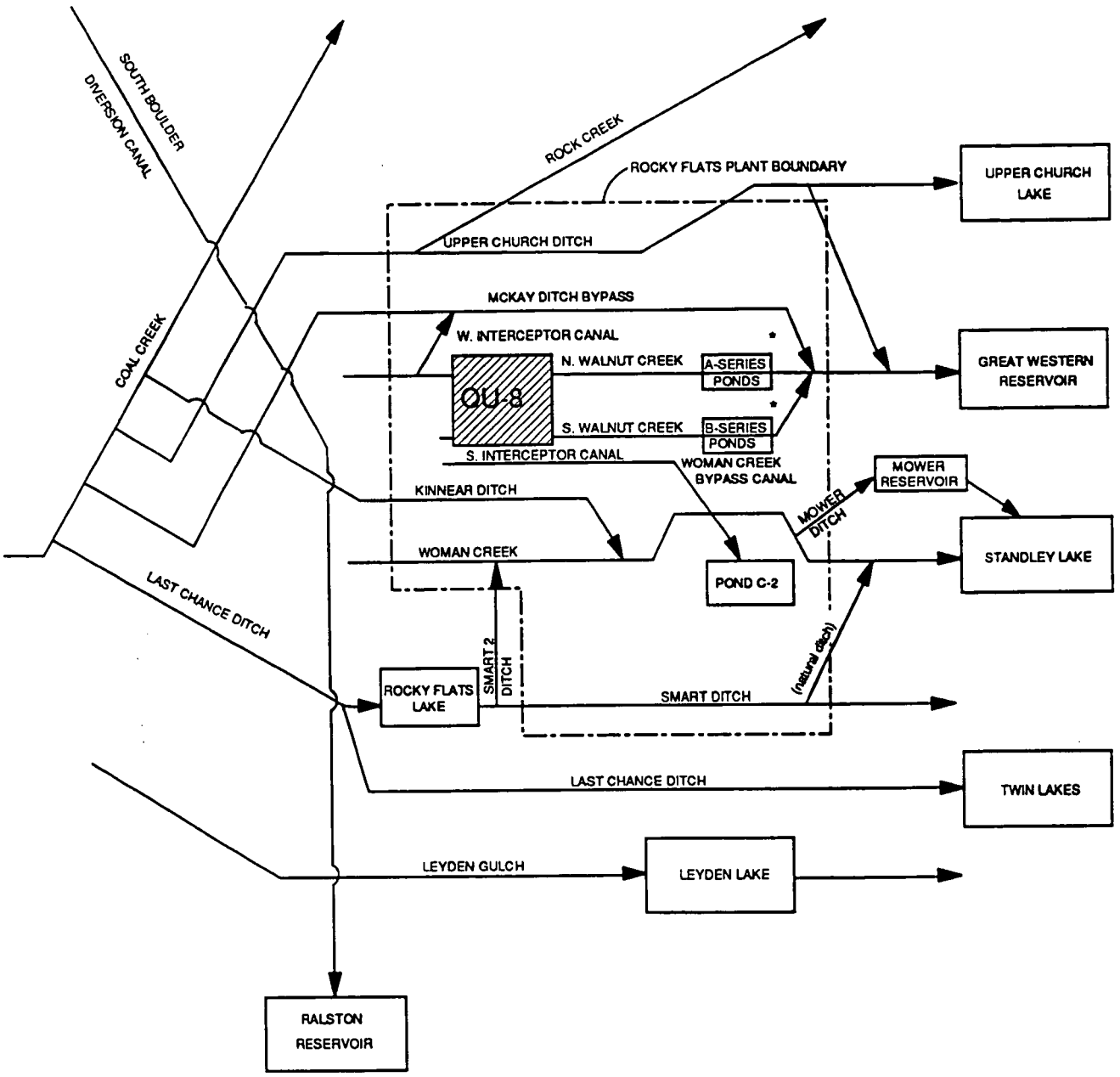


FIGURE 1-7
WIND ROSE FOR THE
ROCKY FLATS PLANT, 1990

OPERABLE UNIT NO. 8
PHASE I RFI/RI WORK PLAN

U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant, Golden, Colorado



• See Figure 1-11 for details.

Adapted from HURR (1976)

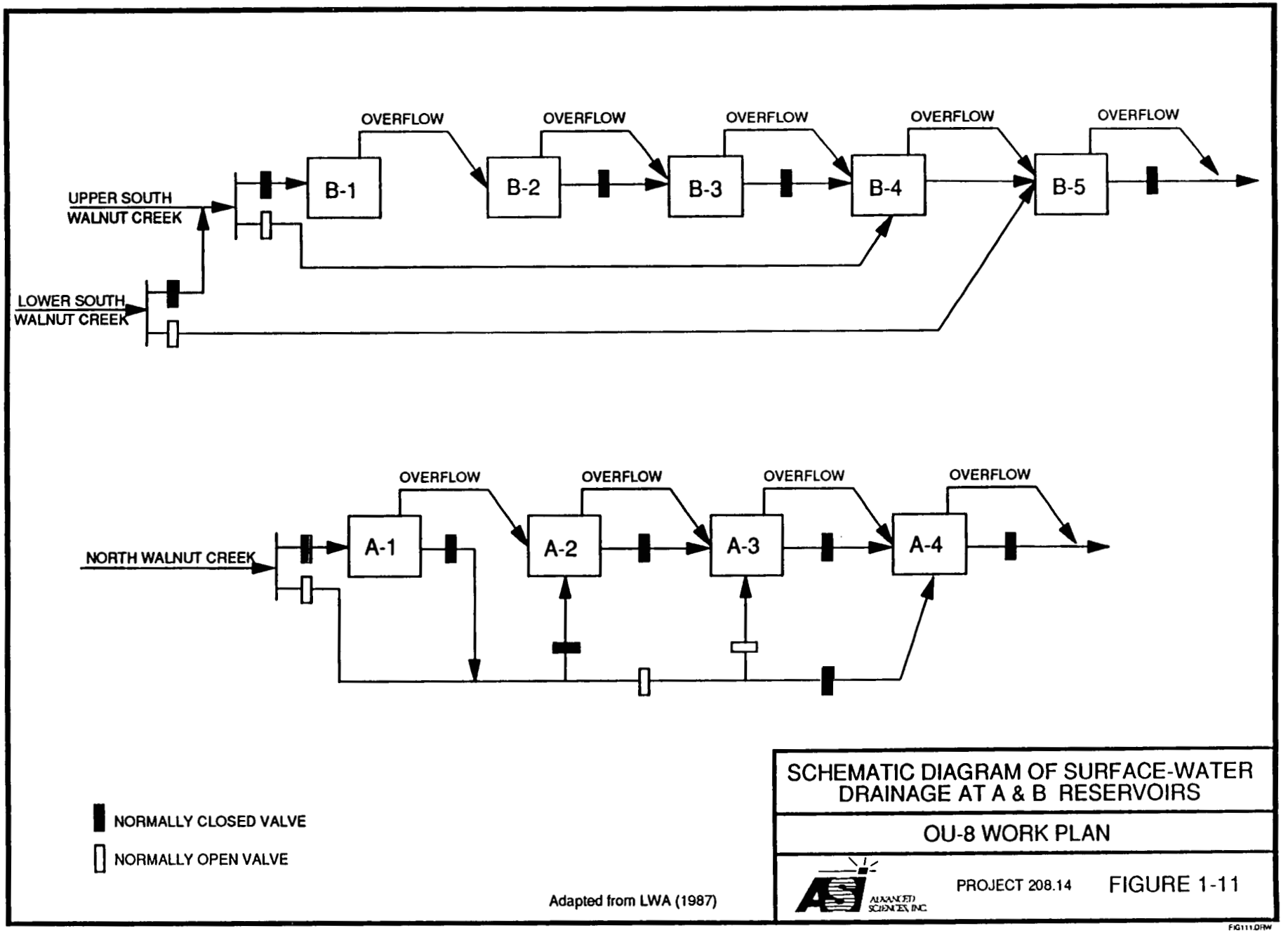
SCHEMATIC DIAGRAM OF SURFACE-WATER SYSTEM

OU-8 WORK PLAN

ADVANCED SCIENCES, INC.

PROJECT 208.14 FIGURE 1-10

FIG118.DRW



Adapted from LWA (1987)

SCHEMATIC DIAGRAM OF SURFACE-WATER DRAINAGE AT A & B RESERVOIRS

OU-8 WORK PLAN

ADVANCED SCIENCES, INC.

PROJECT 208.14 FIGURE 1-11

FIG111.DRW

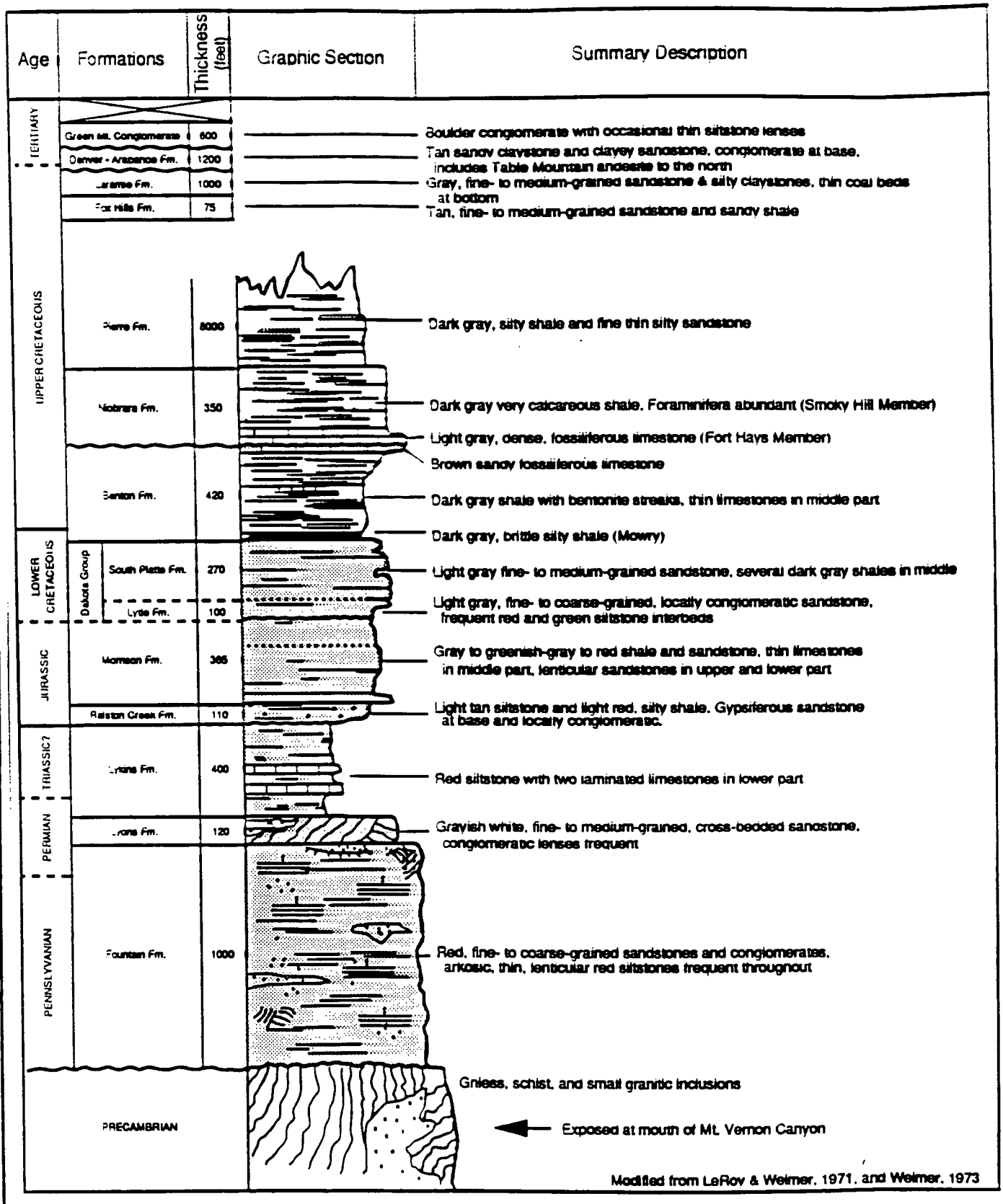


FIGURE 1-16
GENERALIZED STRATIGRAPHIC SECTION, GOLDEN - MORRISON AREA

OPERABLE UNIT NO. 8
PHASE I RFI/RI WORK PLAN

U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant, Golden, Colorado

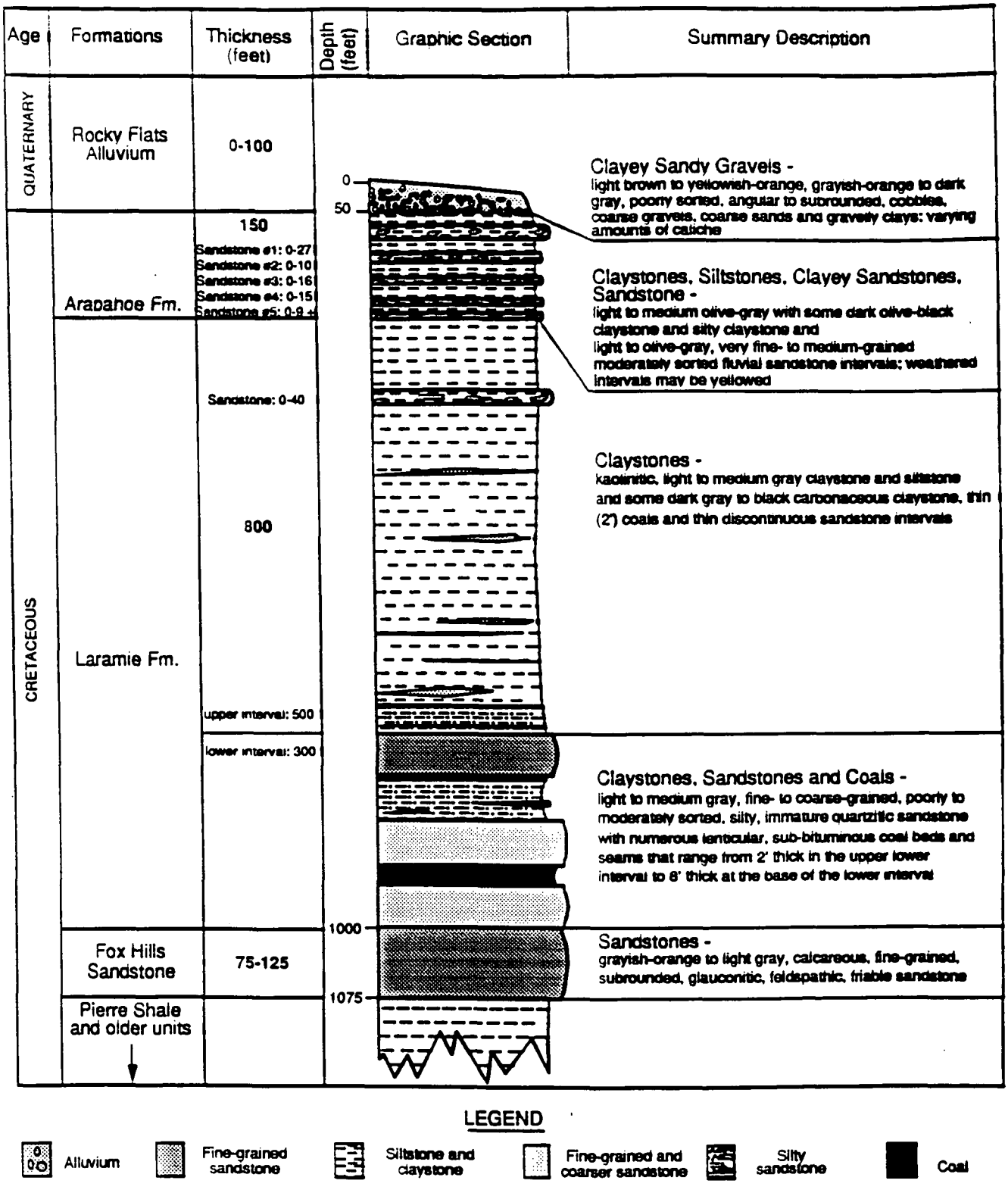


FIGURE 1-17
GENERALIZED STRATIGRAPHIC SECTION, ROCKY FLATS PLANT

OPERABLE UNIT NO. 8
PHASE I RFI/RI WORK PLAN

U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant, Golden, Colorado

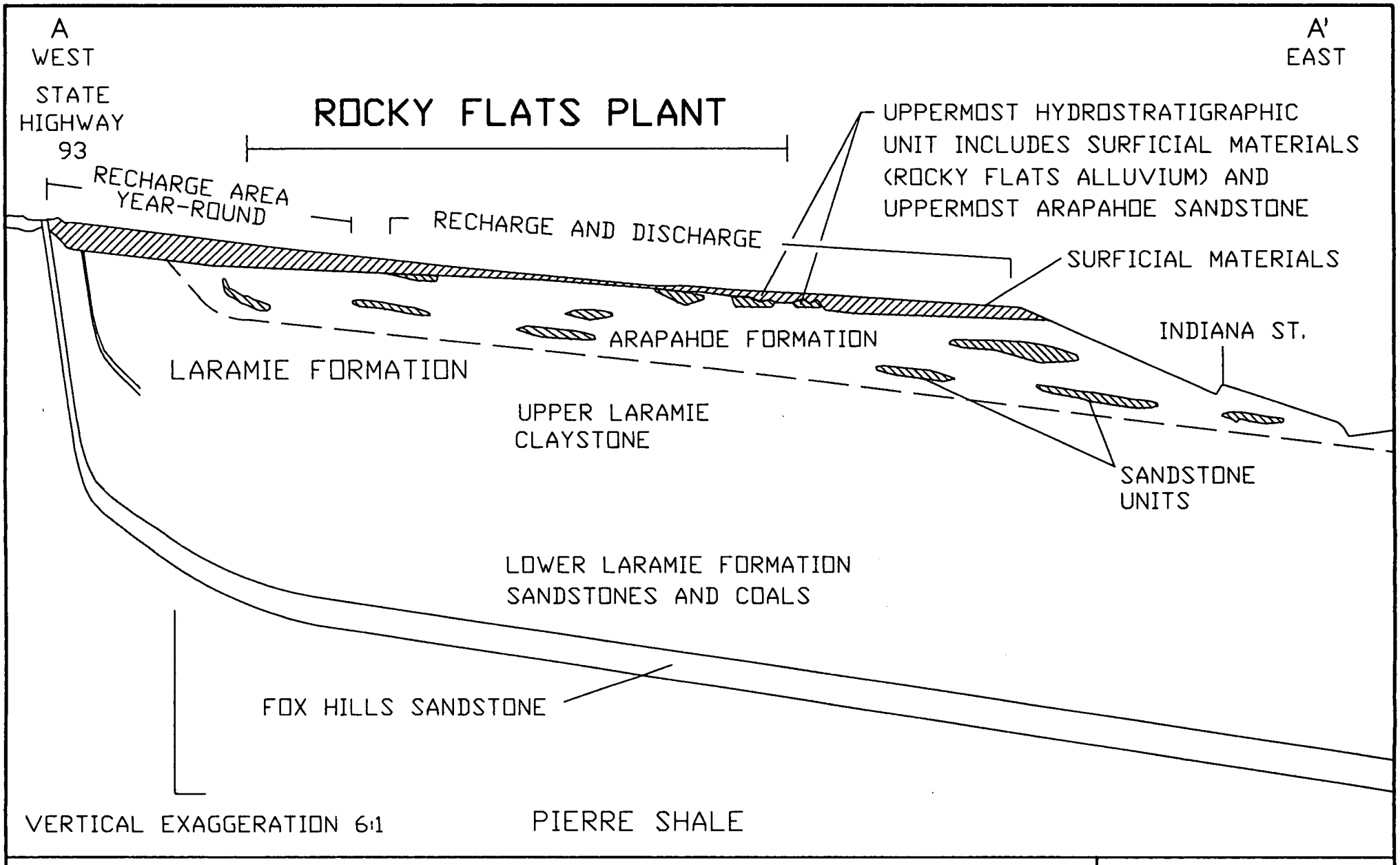


FIGURE 1-18

SCHEMATIC WEST TO EAST STRUCTURAL CROSS SECTION

OPERABLE UNIT NO. 8
PHASE I RFI/RI WORK PLAN

U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant, Golden, Colorado

2.0 OPERABLE UNIT 8 SITE CHARACTERIZATION

Information presented in the following discussion of IHSSs is taken from descriptions presented in the Historical Release Report (DOE, 1992) for the RFP, engineering designs drawings, and facilities drawings. For several IHSSs, this information was recently updated by Doty & Associates, Golden, Colorado, as part of a subtask to preparing this Work Plan. This research has been included in the IHSS descriptions provided below. This research includes additional background information regarding release mechanisms, revisions to IHSS size and location, and the nature of operations and potential contaminants occurring at a given site.

2.1 PREVIOUS INVESTIGATIONS AT OU8

Due to its location within the RFP and its size, OU8 is adjacent to and/or overlain by several other OUs, including:

OU2 - 903 Pad, Mound and East Trenches
OU4 - Solar Ponds
OU6 - Walnut Creek Drainage
OU9 - Original Process Waste Lines
OU10 - Other Outside Closures
OU12 - 400/800 Area Sites
OU13 - 100 Area
OU14 - Radioactive Sites
OU15 - Inside Building Closures and,
OU16 - Low Priority Sites.

Several of these OUs are either currently undergoing studies or have had studies completed recently that are likely to provide data supporting the determination of the nature and extent of contamination at OU8. The OU2 RFI/RI Work Plan has been provisionally accepted by regulatory agencies for implementation.

In addition, several investigations and studies have been undertaken at OU8, in response to spills and other incidents related to the individual IHSSs. These investigations and studies include the following:

"774 Spill-Tank 66 Analytical Report," L.P. Johnson, 1981, EG&G Internal Report.

"776 Utilities Compressor House Oil Spill," R.E. Smith, 1986, EG&G Internal Report.

"Building 559 Groundwater Contamination," M.V. Werkema, 1977, EG&G Internal Report.

CEARP Phase I, Effluent Pipe, 700 Area.

"Decontamination of Building 76 and Environs Following Incident of June 12, 1964," J.B. Owen, 1964.

"Disposition of South Section of Clay Lined Pond in Relation to Proposed Building 79," E.S. Ryan, 1962.

"Engineering and Geologic Investigation for Two Additions to Building No. 774, AEC Rocky Flats Facility," Woodward-Clevenger & Associates, 1970.

Evaporation Ponds, A.H. Voight, 1971.

"Final SIR 87-6-774.1 Caustic Spill," D.O. Kissell and F.P. McMenus, 1987.

"Fire--Building 71, September 11, 1957," J.B. Owen, 1957.

"History of 207 Solar Evaporation Ponds and Nitrate in Walnut Creek," J.B. Owen, 1974.

"Investigation of Radioactivity Found in 701 Building Sanitary Sewer Backflow and in 995 Building Outfall, June 7-13, 1972," Werkema, 1972.

"Oil Spill Documentation," M.L. Paricio, 1986.

"RCRA Closure Plan Tanks T-40, T-66, T-67, T-68 Hazardous Waste Management Unit 55 for USDOE - Rocky Flats Plant Transuranic Mixed Waste," Rockwell International, 1989.

"Report of Investigation on a Recent Process Waste Pipeline Leak," C.T. Illsley, 1980.

"The Composition of Pond 2A," R.L. Delnay, 1959.

Figure 2-1 illustrates the location of all known IHSSs and Potential Areas of Concern (PACs) that are currently known within the boundaries of OU8. Investigations regarding the potential for contamination to exist at many of these IHSS will be undertaken according to the schedule of investigations pertaining to the respective Operable Unit. Table 2.1 lists the IHSS numbers and names of each site to be investigated during implementation of the Work Plan for Operable Unit 8. Table 2.2 lists the number of all IHSSs located within OU8 exclusive of those planned to be investigated in this Work Plan (Table 2.1), and all PACs and the Operable Unit in which it is currently located.

2.2 REGULATORY BACKGROUND AT OU8

The Phase I RFI/RI and all response activities performed by DOE under the IAG are planned so as to be consistent with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the National Contingency Plan (NCP), the Resource Conservation and Recovery Act (RCRA), the Colorado Hazardous Waste Act, and pertinent EPA guidance documents. However, the primary source of the scope of work for the OU8 Phase I RFI/RI is the IAG, which formulates a phased approach for investigation and remediation tailored to the particular requirements of RFP. According to the IAG, the Phase I RFI/RI will determine, for each IHSS, the source and extent of contamination in soil, sediments, surface water, groundwater and air, identify additional investigations work needed, and provide information for a Human Health Risk Assessment. If further characterization of contamination within the OU8 area is required involving groundwater (alluvium and Arapahoe Formation), surface water, and biota, it is anticipated these will be addressed in a Phase II RFI/RI.

2.3 CURRENT CONDITIONS AT IHSSs WITHIN OU8

The current conditions described in this subsection are based on historical reports, review of historical photographs, site visits, and interviews with former and present RFP employees. The locations and sizes of IHSSs presented in this Work Plan are based on research of records and

interviews with RFP employees performed by Doty and Associates (Appendix B). This work was performed to support the preparation of this work plan and to provide up-to-date information on current conditions on each IHSS. This same information was utilized by Doty and Associates to compile and prepare a final HRR scheduled for submission in May 1992.

2.3.1 IHSS 118.1 - Solvent Spills West End of Building 730

IHSS 118.1 has been defined as a 50- by 180-foot area between Buildings 776 and 701 (EG&G, 1990e). HRR information indicates that the tank was located adjacent to the west of Building 730. It has proposed that this IHSS be redefined as a 20- by 40-foot area centered around the former tank location adjacent to the west of Building 730 (EG&G, 1992). More recent information provided by Doty & Associates (Appendix B), indicate that IHSS 118.1 be redefined as a 30- by 13-foot area located adjacent to the east side of building 701 (Figure 1-3).

A 5,000-gallon underground steel carbon tetrachloride storage tank was located adjacent to the west side of Building 730, just north of Building 776. On June 18, 1981, the tank failed, releasing carbon tetrachloride into the sump. The tank was subsequently removed following this failure (EG&G, 1992).

Drawings, including D-13491A, D-13492A, and D-13493A, provide dimensions and details of the tank which may be of importance when planning the environmental investigation of the area.

The length of the tank (north/south) was approximately 14 feet, and the diameter was approximately 8 feet. The south end of the tank was enclosed in a concrete structure which provided maintenance access and encased the piping. The dimensions of the concrete structure were approximately 6 feet wide, 12 feet long, and 12 feet deep. The wall thickness was approximately 9 inches. An 18-inch square sump pit located in the southwestern corner at the bottom of the structure provided drainage. The bottom elevation of the interior of the structure

was at 5,976 feet and the top of the structure was at 5,988 feet. The ground surface around the structure was approximately 1 foot below the top of the structure.

This structure encased only approximately 3 feet of the south end of the tank. The tank was supported by the concrete structure and a concrete footing approximately 3 feet wide located at the north end. It is unclear from the design drawings how deeply the north portion of the tank (that was not enclosed in the structure) was buried. The material which had surrounded the north portion of the tank is unknown.

The area is relatively flat and includes both paved and unpaved surfaces. Prior to 1968, the entire area was unpaved. The location is highly congested with overhead, ground-level, and underground pipes and utilities. The ground surface around the tank location was diked (EG&G, 1990c).

2.3.2 IHSS 118.2 - Solvent Spill South End of Building 776

IHSS 118.2 has been defined as a 30- by 70-foot area south of Building 776 (EG&G, 1990c). The HRR more precisely locates this IHSS between the north side of Building 707 and the alleyway south of Building 778. More recent information provided by Doty & Associates (Appendix B) indicates that IHSS 118.2 be redefined as an area approximately 30- by 20-feet adjacent to the north side of Building 707 (Figure 1-3). The area appears on the IHSS map to occupy part of the long, narrow alley between Buildings 707 and 778.

Available references state that IHSS 118.2 consists of organic solvent tanks located inside Building 776 at the south end, and a 5,000 gallon, above ground carbon tetrachloride tank located within a bermed area between the north side of Building 707 and the alleyway south of Building 778. Degreasing solvents which may have been stored in the organic solvent tanks include carbon tetrachloride, petroleum distillates, benzene and dichloromethane paint thinner, 1,1,1-

trichloroethane (TCA) and methyl ethyl ketone (MEK). Solvent held in carbon tetrachloride tank is used in Buildings 776 and 707.

The surrounding area is flat and fully paved, and receives moderate traffic.

2.3.3 IHSS 123.1 - Valve Vault 7 Southwest of Building 707

IHSS 123.1 is defined as a 30- by 30-foot area southwest of building 708. More specifically, the area is centered around Valve Vault 7, immediately adjacent to the Protected Area (PA) between the Protected Area inner fence and the perimeter road (EG&G, 1990c). The Historical Release Report (HRR) states that IAG maps have mislocated this IHSS in the same area as the Original Process Waste Line (OPWL) valve vault several hundred feet to the north (EG&G, 1992). The HRR suggests that based on this information, the proposed boundaries defining this IHSS in the IAG be extended to include the storm runoff collection system ditch near Eighth Street and Sage Avenue and continue to the extent of Pond B-1 (EG&G, 1992). More recent information provided by Doty & Associates (Appendix B), indicates that IHSS 123.1 consists of the area where the valve vault was located south of Sage Avenue (an area of approximately 40- by 40-feet), and the drainage ditch south of Sage Avenue and west of Ninth Street. Since the spill entered a pipeline at the intersection of Sage Avenue and Ninth Street, the IHSS does not extend beyond this point (Figure 1-3).

Valve Vault 7 is part of the New Process Waste Line system and it controls the 800 Area main process waste line. This valve vault was constructed to replace the original vault (also designated Valve Vault 7), which was located west of Building 707 several hundred feet to the north. The original Valve Vault 7 was removed in March 1973; the location now constitutes IHSS 123.2 (EG&G, 1990c).

The transfer of liquid waste from the holding tanks at Building 881 was discontinued after a leak was identified. Temporary dikes were constructed to contain the overflow. A dam was

constructed in the ditch east of the guard shack at Portal #1 and another dam was placed just west of Guard Shack 762. Drainage from the area was diverted to Pond B-1 (EG&G, 1992).

Accounts of the April 4, 1983 process wastewater spill indicate drainage is east from the system ditch near the Eighth Street and Sage Avenue toward South Walnut Creek and the B-Series drainage ponds. Runoff was noticed flowing across the former 750 Parking Lot, through the Building 991 normal runoff drainage (EG&G, 1992).

The IHSS slopes gently to the east and includes both paved and unpaved surfaces. Access to the south of the area is restricted by the PA, while the perimeter road to the north is heavily travelled by RFP traffic. Overhead electric lines and underground process waste lines exist in the area. The valve vault presently is covered by a wood and polyethylene shelter (EG&G, 1990).

2.3.4 IHSS 135 - Cooling Tower Blowdown - Southeast of Building 374

IHSS 135 has been defined as a 100- by 150-foot area southeast of Building 374, but the cooling tower is actually northeast of the building (EG&G, 1990). HRR information indicates that the pond was north of Building 374 at the turn in the asphalt road (EG&G, 1992). This IHSS is irregularly shaped and is approximately 130 feet wide by 65 to 85 feet long and has a pan handle that extends approximately 210 feet to the northeast (Figure 1-3). The ground surrounding the cooling tower is unpaved and flat, and is lightly used for storage (EG&G, 1990c).

Aerial photographs indicate the cooling tower was present as early as 1978. A June 1, 1980 photo indicates a pond-like structure north of Building 374 at the turn in the asphalt road (EG&G, 1992). Utility drawings support this as the location of the cooling tower retention pond, indicating a "holding pond" where Tank 808A and Tank 808B are now located (EG&G, 1992). According to the HRR (EG&G, 1992) there is documented use of a Building 373 cooling tower pond.

Prior to 1980, water from the cooling tower was allowed to drain into North Walnut Creek (EG&G, 1992). Persons interviewed for the CEARP Phase I report indicated that areas near the Building 374 cooling tower were affected by blowdown water. Building 374 personnel stated that blowdown water is routed through an underground pipe into the RFP's sanitary sewer system for treatment (DOE, 1992). The underground blowdown water pipe runs out through the southwest corner of the cooling tower.

2.3.5 IHSS 137 - Cooling Tower Blowdown - Building 774

IHSS 137 has been defined as a 50- by 150-foot area south of Building 774. It has been proposed to change the dimensions to a 50- by 120-foot area and that the boundaries of IHSS 137 be redefined to encompass the south ends of Building 712 and Building 713 (EG&G, 1990) (Figure 3-1). Two cooling towers, Buildings 712 and 713, are located in the immediate vicinity of, and are associated with, Building 776 (EG&G, 1992). The land surrounding Buildings 712 and 713 is flat and unpaved. Numerous underground interferences (possibly PWLs) are evident (EG&G, 1990e).

The Building 776 cooling towers blowdown water is treated in the wastewater treatment plant. It is thought that the blowdown water drains from the cooling towers through underground pipes outside the south ends of the buildings (EG&G, 1992).

RFP utilities personnel have indicated that the two cooling towers near IHSS 137 serve Building 776 (not 774) and have been in operation since Building 776 was built in the late 1950s. The towers are alternated seasonally; the west tower (Building 712), which has a higher cooling capacity, operates in the summer, while the east tower (Building 713) operates in the winter. Blowdown water from these facilities is routed into the RFP's sanitary sewer system for treatment (EG&G, 1990c). The cooling tower blowdown pipes leave the towers on their south sides.

2.3.6 IHSS 138 - Cooling Tower Blowdown - Building 779

IHSS 138 has been defined as a 75- by 75-foot area northeast of Building 779 (EG&G, 1990c). The area of the cooling tower water line break is of a smaller extent and located farther to the east than presented in the IAG as IHSS 138. It has been proposed that IHSS 138 be redefined as a 50- by 50-foot area north of Building 727 (EG&G, 1992) (Figure 1-3). The area surrounding the towers is unpaved and relatively flat, and is heavily congested with trailers and storage containers (EG&G, 1990c).

A group of several cooling towers (Buildings 783-787) is located in the vicinity (EG&G, 1990). The present Building 779 cooling towers were built in the early 1980's to replace old towers which were removed from the same location. The original towers had been in operation since Building 779 was completed in the late 1950s (EG&G, 1990c).

2.3.7 IHSS 139.1(N) and 139.1(S) - Hydroxide Tank Area (Buildings 771 and 774)

IHSS 139.1 has been identified as a 25- by 250-foot area south of Building 771. This IHSS actually consists of two separate areas surrounding two aboveground caustic storage tanks and two aboveground condensate receiving tanks (EG&G, 1990c). It has been proposed that IHSS 139.1 be informally separated into two units. 139.1(N) consisting of both the NaOH and the steam condensate tanks and 139.1(S) consisting of the KOH tank. It has been proposed that 139.1(N) be comprised of two discrete sites: a 25- by 25-foot area around the NaOH tank, and a 30 by 40 foot area centered around the west condensate receiving tank. It has been proposed that 139.1(S) consist of an "L"-shaped area 25 feet wide and 140 feet long that includes the KOH tank and the line that transfers KOH into Building 771 (EG&G, 1992). More recent information presented by Doty & Associates (Appendix B), indicate that the 139.1 (N) site consists of the two areas described above but with redefined dimensions of approximately 20- by 20-feet and 70- by

35-feet (Figure 1-3). This recent information also indicates that IHSS 139.1(S) be redefined as a 35- by 25-foot rectangle (Figure 1-3).

The KOH tank is located approximately 55 feet south and 35 feet east of the southeast corner of Building 771 (Rockwell, 1987). It was built some time between 1955 and 1964 (Rockwell, 1964, 1955). The 5,400-gallon tank is of welded construction, and appears to be in good condition presently. It is on a concrete base, which is also in good condition, and is surrounded by a small, eroded, earthen berm (Doty & Associates, 1992 [Appendix B]). It has been suggested that this tank site be identified as IHSS 139.1(S).

The 6,500-gallon NaOH tank is located adjacent to the north side of Building 774. The NaOH tank was built some time between 1955 and 1964 (Rockwell, 1964, 1955). It is vertical and surrounded by insulation, which is in poor condition. Through the holes in the insulation, it is apparent that the sides of the tank are corroded, as is the base of the tank. The tank is surrounded by a corroded berm which is approximately 18 inches high (Doty & Associates, 1992 [Appendix B]).

In addition to the two tanks described above, any discussion of this IHSS should include two 8,000-gallon tanks, which were once used as steam condensate tanks, and are located approximately 45 feet north of the NaOH tank (Rockwell, 1987), and at a lower elevation. These tanks were built some time between 1971 and 1978 (Rockwell, 1978, 1971). The westernmost tank receives overflow and contained liquid from the bermed area around the NaOH tank. The easternmost tank receives overflow from the westernmost tank. These two tanks, T-107 and T-108, have riveted construction. Currently, there is standing water around the tanks. The bottom of the tanks appear to be corroded, and there is rust on the tops and sides of the tanks (Doty & Associates, 1992 [Appendix B]).

Existing wells in the area include #19189, #19089 (in the north area), and #89389 (in the south area). They were constructed in 1989.

2.3.8 IHSS 139.2 - Hydrofluoric Acid Tank Area (Building 714)

IHSS 139.2 has been defined as a 40- by 60-foot area south of Building 771. More specifically, the area encompasses the hydrofluoric acid (HF) shed (Building 714) south of Building 771 (EG&G, 1990c). The information compiled on IHSS 139.2 for the HRR indicates that the location presented in the IAG is inaccurate. It has been proposed that the location of IHSS 139.2 be redefined to represent the location of the HF storage shed, Building 714. Building 714 is 40 feet south and 10 feet east of the southeast corner of Building 771. This is approximately 350 feet south and 250 feet west of the location presented in the IAG as IHSS 139.2 (EG&G, 1992). More recent information presented by Doty & Associates (Appendix B), indicates that IHSS 139.2 be located approximately 45 feet south of the southeast corner of Building 771 and that its boundaries be reduced to approximately 25- by 35-feet. The area is flat, includes both paved and unpaved surfaces, and is heavily used. A large above-ground potassium hydroxide storage tank is immediately east of the site (EG&G, 1990c).

Two horizontal, 1,300-pound, HF cylinders, each with a 1,200-pound capacity (Doty & Associates, 1992 [Appendix B]), are located in Building 714, a small shed approximately 4 feet east and 29 feet south of the southeastern corner of Building 771 (Rockwell, 1987). The HF is delivered to the RFP in portable cylinders, which are replaced when empty. No open transfer of the acid takes place (EG&G, 1990). The acid is piped to, and used in, Building 771 (Doty & Associates, 1992 [Appendix B]).

It should be noted that previous discussions of this IHSS indicate that the shed contains two 1,200-gallon aboveground HF tanks. This, however, is not the case. The HF is contained in two 1,300-pound cylinders.

In addition, there is a portable, refillable nitric acid dumpster located just north and west (approximately 25 feet) of the HF storage area discussed in the IHSS 139.2 description. More precisely, the dumpster is located at the southeast corner of Building 771.

The dumpster involved supplies nitric acid to the Building 771 chemical makeup area. The acid is delivered to the 218 tank farm near Building 444 by an outside supplier. One of two available dumpsters is picked up at Building 771, taken to the bulk supply, and filled by Building 774 Chemical Operators. The dumpster is then returned to Building 771. This process occurred on a daily basis when Building 771 was operational as a plutonium recovery facility (Doty & Associates, 1992 [Appendix B]).

2.3.9 IHSS 144 - Sewer Line Breaks (Building 730, Tanks 776 A-D, Leaks near Buildings 701 and 770)

IHSS 144 has been defined as a 20- by 50-foot area between Building 777 and 779 (EG&G, 1990c). It has been proposed that the location of IHSS 144 be redefined to include the location of the clean-out plug overflow east of Building 730 (EG&G, 1992). More recent information provided by Doty & Associates (Appendix B), indicates that IHSS 144 should be divided into two separate sites, 144(N) and 144(S). IHSS 144(N) should have dimensions of 25- by 70-feet and be located east of Building 701. Since the exact location of the sewer line break between Buildings 777 and 779 is unknown, the boundaries of 144(S) should include more of the alleyway and be expanded to 15- by 170-feet (Figure 1-3).

There are four underground waste holding tanks located north of Building 776 and east of Building 701, in a small structure identified as Building 730. They are designated as Tanks 776 A through D. They were built in approximately 1956 (Rockwell, 1976), and were taken out of service in the 1980s. They are now used as plenum deluge tanks (Personal Communication, Ron Teel, RFP Employee, April 10, 1992). The tanks would, therefore, normally be dry. The area between Buildings 777 and 779 is a narrow, paved alley which slopes down from the north to a level several feet lower than the surrounding ground, giving the appearance that it was excavated. The alley has been paved since 1968, and has sloped to the south since the two buildings were constructed (EG&G, 1990c).

Engineering drawings, specifically D-13493 and 28714-X51, provide additional information about these tanks. The tanks are underground concrete tanks which are beneath a pumphouse. To gain access to the pumphouse, one must go through a ground-level doorway and descend 9.67 feet down stairs. At this level, one is essentially standing on the tanks, which have manhole covers (Doty & Associates, 1992 [Appendix B]).

The top of the pumphouse, which is slightly above the ground surface, is at an elevation of 5,988.0 feet. The floor of the pumphouse, also the roof of the tanks, is at an elevation of 5,978.33 feet. The base of the tanks are approximately 12 feet below the floor of the pumphouse, indicating an approximate base elevation of 5,966.33 feet. The concrete surrounding the pumphouse and tanks is approximately 1 foot thick (Doty & Associates, 1992 [Appendix B]).

The tanks are concrete, and have a 26-foot depth. They are not able to be inspected. The capacity of Tanks 776 A and B are 22,500 gallons each, and the capacity of Tanks 776 C and D are 4,500 gallons each. The dimensions of 776 A and B are 25'x15'x10' each, and those of 776 C and D are 5'x15'x10' each (Rockwell, 1976). Tanks 776 A and B are laundry waste holding tanks, and Tanks 776 C and D are process waste holding tanks. Their design is such that if tanks C and D overflowed, the excess liquid could drain into tanks A and B, and vice versa (Werkema, 1972).

From approximately 1969 until 1973, laundry waste could be transferred through the sewer lines to the sanitary sewer system 3004(U). A pipe header at the tanks allowed alternatives of pumping the laundry water to the sanitary sewer system, the Solar Evaporation Ponds, or Building 774 (Doty & Associates, 1992 [Appendix B]).

On approximately June 1, 1972, a revision of a Building 776 radiography vault floor drain was completed. Apparently, previous transfers of laundry waste water from Tanks 776 A and B resulted in backflow into the vault. The revision to the floor drain, involving relocation of the

drain pipe connection, would allow the waste to be transferred at higher pressures (Werkema, 1972).

Groundwater wells #1986 and #2386, which were installed in 1986, and Well #09389, which was installed in 1989, are the only wells in the general vicinity of this IHSS.

2.3.10 IHSS 150.1 - Radioactive Site North of Building 771

IHSS 150.1 has been defined as a 50- by 450-foot area north of Building 771 (EG&G, 1990c). Information developed on this unit for the HRR indicates that the waste storage and handling also occurred west of Building 770 and possibly north of Building 774. It is proposed that the boundaries for IHSS 150.1 presented in the IAG be revised. Due to the leaking drum incident in June 1968, it is proposed that the IHSS boundaries should be extended to the east approximately 120 feet. In addition, photographs clearly show that in March 1974, over 30 cargo containers were present immediately west of Building 770. The photographs also include close-up shots of the containers and the ground. This area is not presently within the IHSS boundaries. Thus, it is proposed to extend the boundaries of IHSS 150.1 to include the area west of Building 770 (EG&G, 1992). Recent information provided by Doty & Associates (Appendix B), indicate the IHSS boundaries to be approximately 360- by 60-feet (Figure 1-3).

This IHSS consists of an area north of Building 771, affected by a radioactive leak. The area encompassing this IHSS is paved, occupied by numerous trailers, auxiliary buildings and storage areas. The surface was repaved 4 to 5 years ago; prior to this the asphalt was badly deteriorated, with soil exposed in many areas (EG&G, 1990c). The soil beneath the pavement is compacted fill because the area had been a fairly steep hillside sloping to the north before the area was developed. The thickness of the compacted fill material varies across the site and increases to the north.

A small prefabricated building used for storage is located west of Building 770. This building was present in 1969 photographs and has been used for equipment storage.

Wastes from Building 771 and materials to be reprocessed in Building 771 were frequently handled and stored in the area north of the building. Building 770, located north of 771, was built in 1965 and has been used as a residue storage area in the past.

From approximately 1962 until approximately 1968, a 5,000-gallon stainless-steel tank was located approximately 30 feet north of Building 771. The tank was on six-foot legs and was approximately 8 feet in diameter. Two overhead pipes from Room 114 in Building 771 connected to the tank; one of which was a vacuum vent to control transfer in and out of the other. The tank was used in the Filtrate Recovery Ion Exchange system, which concentrated plutonium and americium for recovery. Americium was concentrated on an ion exchange column and was transferred at a predetermined concentration to the tank.

The tank was taken out of service following the discovery of a leak and was eventually disposed of (Doty & Associates, 1992 [Appendix B]).

The paved area between Buildings 771 and 770 was used for the storage of residue (unspecified substance as per HRR) in drums prior to processing in Building 771. A June 1969 photograph shows over one hundred drums stored in rows on the pavement. A fence parallel to Building 771 also encloses the west entrance to Building 770 and defines a storage area. During the period that the area was used for storage, the paved area also functioned as the access road for Buildings 771 and 774. Drums were also stored in the courtyard south of Building 770 between the access road and the building. This location has since been altered. In the 1960s, there was a concrete embankment wall along the southern and eastern sides of the courtyard, and there is currently no embankment wall. Construction changes in this area are not clear. More information may be found at a future date regarding the physical alteration of the area. Drums of waste from the

1969 fire in Building 776 were stored in the area for counting prior to shipment (Doty & Associates, 1992 [Appendix B]).

The material stored consisted primarily of residues which had a high plutonium content and were destined for plutonium recovery operations in Building 771. Materials were stored in drums on pallets or in cargo containers.

Due to environmental concerns related to the clean-up activities at the 903 storage area and the triangle storage area, sitewide efforts were made in the early 1970s to move all radioactively contaminated materials to indoor storage. The Building 771 area was used for storage until approximately 1974 when Building 776 was used for such storage. Building 770 was then used for the storage of equipment, and also as an equipment assembly facility prior to the installation in other buildings (Doty & Associates, 1992 [Appendix B]).

Several test wells were drilled in the area north of Building 771 in 1962 in preparation for the construction of an addition. One boring was located in the northeastern corner of Building 771 and was drilled to a depth of 36 feet from an elevation of 5,946 feet. Fill existed to a depth of 1 foot, highly weathered claystone to a depth of 15 feet, and weathered claystone to the bottom of the hole. The water table was encountered at 6 feet, although the date of the borings was not provided (Doty & Associates, 1992 [Appendix B]).

Surface water on the pavement generally drains to the west. Prior to the mid-1960s, some surface runoff was able to drain into a strip of grass west of Building 770 between the access road and the Building 771 parking lot. The grass strip was reduced in width in the late 1960s and finally was paved entirely. The area immediately north of Building 770 has a grated collection channel which directs collected water to the east toward a small pond ("Bowman's Pond"). The water in the pond is collected in the Interceptor Trench Pump House system associated with the solar ponds (Doty & Associates, 1992 [Appendix B]).

2.3.11 IHSS 150.2 - Radioactive Site West of Buildings 771

The IHSS 150.2 Has been defined as a 70- by 250-foot area west of Building 771 (EG&G, 1990c). This area west of Building 771 was contaminated by a radioactive leak. The information developed for the HRR indicates that the location for IHSS 150.2 presented in the IAG is inaccurate. It has been proposed that the IHSS be redefined as a 75- by 600-foot area west of Buildings 776 and 771 (EG&G, 1990c). More recent information presented by Doty & Associates (Appendix B) indicates that the boundaries of IHSS 150.2 have been expanded to 245 feet long along the west sides of Buildings 778, 776, and 771. The width of this IHSS ranges from approximately 70 to 90 feet (Figure 1-3).

The surface west of Building 771 steps down steeply to the north, with numerous retaining walls, paved and unpaved storage pads, and loading docks. The storage areas hold drums, electrical equipment, and sheds. This surface west of Building 776 is relatively flat and mostly paved. The area was first paved in 1968 (EG&G, 1990c).

2.3.12 IHSS 150.3 - Radioactive Site Between Buildings 771 and 774

IHSS 150.3 has been defined as a 100- by 140-foot area east of Building 771 (EG&G, 1990c). More recent information provided by Doty & Associates (Appendix B) indicate that the boundaries of this IHSS have been changed to approximately 155- by 25-feet with the east end extending up to the south west corner of Building 774 (Figure 1-3). This IHSS consists of an area between Buildings 771 and 774 that was contaminated by a radioactive leak. The south side of the area is relatively flat and mostly paved, while the north side slopes steeply to the north into an unpaved courtyard between Buildings 771 and 774 (EG&G, 1990).

A cement tunnel slopes down from Building 771 to Building 774. This tunnel entered Building 774 on the south wall prior to the southward expansion of the building in 1972. Now the tunnel enters Building 774 from the west wall of the building. The additions to Building 774 account

for the apparent discrepancies between drawings of the juxtaposition of the tunnel to Building 774. This tunnel had been under several feet of soil when originally built. However, due to major modifications of the hillside between Buildings 771 and 774, the top of the tunnel is now exposed near Building 774 and is probably not under more than 1 foot of soil at any point. At the northern edge of the tunnel on the slope of the hillside down to the 771/774 courtyard changes from steep to nearly vertical (Doty & Associates, 1992 [Appendix B]).

2.3.13 IHSS 150.4 - Radioactive Site East of Building 750

IHSS 150.4 has been defined as a 120- by 180-foot area northeast of Building 750 (EG&G, 1990). This IHSS consists of an area northwest of Building 750 contaminated by a radioactive leak. According to the HRR, it is proposed that the location of IHSS 150.4 be redefined as an area to the northwest of Building 750 (EG&G, 1992). More recent information provided by Doty & Associates (Appendix B), indicate that IHSS 150.4 is located in the courtyard of Building 750 which is between Buildings 707 and 750. The dimensions of this IHSS are approximately 155- by 145-feet (Figure 1-3).

The surface in this area is flat, mostly paved, and used for storage, parking, and loading/unloading for Building 750. The area has been paved since construction of Building 750 in 1969. The area is behind a security fence, and must be accessed through the main gate on the south side of Building 750 (EG&G, 1990c).

As discussed above, in IHSS 150.2 in May 1969 a fire occurred in Building 776-777. Following the fire, the tanks and pumps that handled the decontamination fluid were placed into the Building 750 courtyard. This area was later paved and used for parking (EG&G, 1992c).

2.3.14 IHSS 150.5 - Radioactive Site West of Building 707

Recent information obtained by Doty & Associates (Appendix B, May 28,1992) indicates that IHSS 150.5 is actually the same as IHSS 123.2. Additionally, the leading agencies (CDH, April 21, 1992) have transferred IHSS 123.2 to OU9. Therefore, IHSS 150.5, as with IHSS 123.2, has been removed from the OU8 Work Plan.

2.3.15 IHSS 150.6 - Radioactive Site South of Building 779

IHSS 150.6 is described as a 100- by 200-foot area south of Building 779 (EG&G, 1990c). However, according to the IAG, the dimensions of this IHSS are closer to those shown on Figure 1-3 (approximately 185- by 50-feet). The IAG also indicates the location of this IHSS to be south of Building 779 and encompassing the northern portions of Buildings 705 and 706. Since no hard information contradicting the IAG boundaries has been found to date, these boundaries will remain as stated above. The surface in this area is relatively flat and mostly paved. The area is heavily used by pedestrian traffic. Several overhead pipes serving Building 779 overlie the area, and a permanent trailer (T779A) is also present (EG&G, 1990c).

In June 1969, Building 779 contained an unknown number of drums of radioactive waste. Following a release in 1969, an unknown number of drums of soil were removed for off-site disposal (EG&G, 1990c).

2.3.16 IHSS 150.7 - Radioactive Site South of Building 776

IHSS 150.7 is a 100- by 500-foot area between Buildings 776 and 707. It has been proposed that IHSS 150.7 be redefined as a 40- by 350-foot area between Buildings 776 and 778 due to the contamination resulting from the May 1969 fire in Building 776/777 (EG&G, 1990c). Doty & Associates have provided updated information that indicates the boundaries of this IHSS are approximately 40 by 330 feet (Figure 1-3). This area is occupied by Building 778, a long,

narrow, east-west structure. Very narrow, flat "courtyards" separate Building 778 from Building 707 on the south and from Building 776 on the north. These courtyards are isolated by enclosed hallways between the buildings (EG&G, 1990c).

An asphalt roadway was completed in the area on July 22, 1969 (EG&G, 1992). Much of the area between Buildings 776 and 778 is unpaved and inaccessible to vehicles, and is used for light storage and by pedestrians (EG&G, 1990c).

2.3.17 IHSS 150.8 - Radioactive Site Northeast of Building 779

IHSS 150.8 has been defined as an 80- by 120-foot area east of Building 779 (EG&G, 1990). This IHSS consists of an area east of Building 779 that was contaminated by a radioactive leak. Doty & Associates have provided updated information (Appendix B) that indicates the boundaries of this IHSS are approximately 110 by 40 feet (Figure 1-3).

The area is flat and includes both paved and unpaved surfaces. It receives moderately heavy use from RFP traffic and as a storage area. Several overhead electric lines servicing Building 779 are present (EG&G, 1990).

2.3.18 IHSS 151 - Fuel Oil Leak (Tank 262 North of Building 374)

IHSS 151 has been defined as a 30- by 35-foot area centered over Tank 262 north of Building 374 (EG&G, 1990). Doty & Associates have provided updated information (Appendix B) that indicates the boundaries of this IHSS are approximately 45- by 60-feet (Figure 1-3).

Tank 262 is a steel, 47,500-gallon, underground storage tank (for #2 fuel oil) installed in 1980. It is overlain by a 15- by 25-foot concrete pad containing control valves and gauges (EG&G, 1990).

The surface around the pad is flat and unpaved (EG&G, 1992).

2.3.19 IHSS 163.1 - Radioactive Site Northwest of Building 774

IHSS 163.1 has been defined as a 60- by 150-foot area northwest of Building 774 (EG&G, 1990c). Recent information provided by Doty & Associates (Appendix B), indicates that IHSS 163.1 is actually located northeast of Building 774 and is approximately 125- by 50-feet (Figure 1-3). The eastern half of the area is mostly flat and paved and is covered in part by trailer T771G. The area was repaved 4 or 5 years ago. The western half is unpaved, slopes to the north, and is crossed by an unpaved solar evaporation ponds access road (EG&G, 1990c).

CEARP Phase I interviewees indicated the area north of Building 774 was used to wash radioactively contaminated equipment. Building 774 personnel did not recall this area ever being used to wash equipment (EG&G, 1992).

Aerial photos from 1969 and 1971 show two areas east of this IHSS that were covered with mounds of soil. RFP personnel interviewed did not recall these mounds. The mounds are believed to be unrelated to IHSS 163.1 (EG&G, 1990c and 1992).

2.3.20 IHSS 163.2 - Radioactive Site North of Building 771 and 774

IHSS 163.2 has been defined as a 50- by 50-foot area north of Buildings 771 and 774, outside the Protected Area just southeast of Parking Area #71 (EG&G, 1990c). Approximate Rocky Flats coordinates are N751,400; E2,084,050 (EG&G, 1992). Recent information provided by Doty & Associates (Appendix B), indicates that IHSS 163.2 is approximately 60- by 40-feet (Figure 1-3).

Information for the development of the following discussion was gathered from the review of documents, historical drawings, and historical engineering drawings as well as interviews with

Building 771 employees. The information identified for this OU Work Plan found inconsistencies with the discussion presented in RCRA 3004(u).

An americium-contaminated slab is buried in the area near Building T771A by the Perimeter Road. The slab is approximately 8 feet square and 10 inches thick. From approximately 1962 until approximately 1968, the slab served as a foundation for a 5,000-gallon stainless steel tank located approximately 30 feet north of Building 771. The tank was used in the Filtrate Recovery Ion Exchange system which concentrated plutonium and americium for recovery. Americium was concentrated on an ion exchange column and was transferred at a predetermined concentration to the tank.

Around 1968, the tank was temporarily sealed following the discovery of a leak. Once emptied, the tank was taken out of service. The tank remained in place until it was taken to the size-reduction facility in Building 776 sometime shortly thereafter. When the tank was removed to the size-reduction facility, the concrete slab was decontaminated. The slab was moved to a ditch directly north of the area and buried. The area was paved sometime prior to June 1969. In the mid-1970s, Building T771A, a prefabricated structure, was constructed in the same general area. None of the persons interviewed for this investigation recalled any subsequent excavation of the slab (Doty & Associates, 1992 [Appendix B]). The slab lies underground near or beneath the east end of T771A at a probable depth of less than 10 feet.

An environmental summary report from 1973 does not record the incident in the summary of environmental incidents impacting the soil at the RFP; however, the report does have a notation of the slab on a map of the area north of Building 771. The report indicates an area farther to the north of where the slab is believed to be buried and states that it was later excavated and the contaminated portion cut away for off-site disposal (Doty & Associates, 1992 [Appendix B]). This is not believed to be the case. The location indicated on the map cannot be accurate because it is in an area that was paved several years before the slab became contaminated. As

stated above, there has been no verification that the slab was subsequently excavated (Doty & Associates, 1992 [Appendix B]).

The 8- by 8-foot slab is probably still buried beneath the pavement near Building T771A. There was no mention of americium-contaminated soil being buried with the slab. However, because the slab had been located on soil, it is likely that some soil from beneath the slab was also deposited when the slab was pushed into the ditch. Therefore, it is not likely that there is a significant amount of contaminated soil surrounding the slab. Other material of an unknown source was backfilled into the ditch prior to the area being graded and paved (Doty & Associates, 1992 [Appendix B]).

The ditch the slab was buried in formerly directed surface drainage to the west into a tributary to North Walnut Creek. It is not known how long the slab remained in the ditch before the area was paved (Doty & Associates, 1992 [Appendix B]).

The area is on a steep hillside into the North Walnut Creek drainage. The Building 771 parking lot is over approximately 40 feet of fill material right in the drainage. Building 771 was built into the hillside with the roof of the two-story building at ground level along the south wall. The location of the slab is in an area of varying depths of fill over weathered clay bedrock (Doty & Associates, 1992 [Appendix B]).

2.3.21 IHSS 172 - Central Avenue Waste Spill

IHSS 172 follows the path formerly used by vehicles to transport drums of waste between the 903 Pad, where the drums were stored, and the waste treatment facility in Building 771. It spans a distance of approximately 1 mile, crossing the Protected Area southeast of Building 374, and includes: the westbound lane(s) of Central Avenue between the 903 Pad and Sixth Street; the northbound lane(s) of Sixth Street between Central Avenue and the northwestern corner of Building 771; and the dock area, still in use, at the northwestern corner of Building 771 (EG&G,

1990c). Based upon information presented below, it is recommended that IHSS 172 be redefined to exclude those portions of the roadway subsequently removed. These include Central Avenue between Eighth and Tenth Streets (approximately 1,050 ft) and Sixth Street between Sage Avenue and the Protected Area perimeter road (approximately 320 feet) (EG&G, 1990c). Recent information obtained by Doty & Associates (Appendix B), indicate that the boundaries of this be extended, since the roadway was contaminated to the west dock of Building 774 (Figure 1-3).

An unknown amount of "low-level material" reportedly spread to the ditch along the northern side of Central Avenue as a result of this spill. 1969 aerial photographs of RFP show that this ditch ran along essentially the entire affected length of Central Avenue. Most of the ditch has since been paved over, lined with concrete, or filled in by subsequent construction (EG&G, 1990c).

Most of the affected roadway has since been repaved and remains heavily used. A section of Central Avenue between Eighth and Tenth Streets was removed in August 1970 and placed in an asphalt dumping area east of Building 881. The section of Sixth Street between Sage Avenue (outside the Protected Area) and the perimeter road within the Protected Area was removed during construction between late 1980 and late 1982. The fate of the removed asphalt is not known (EG&G, 1990c).

2.3.22 IHSS 173 - Radioactive Site - 900 Area (Storage Vaults near Building 991)

This IHSS encompasses Building 991 and associated underground storage vaults (or tunnels) 996, 997, 998 and 999 (these original plant structures have been in operation since 1952). The area lies within the South Walnut Creek drainage, primarily on the south-sloping north side of the drainage (EG&G, 1990c). The IAG indicates the entire building and the area over the tunnels and vaults should be included in the IHSS primarily because of the age of the structures. The building and the vaults were used to assemble and store final products, which consisted of nickel-plated plutonium. They were not considered a radioactive threat, and there was no

documentation found indicating any contamination. It is therefore proposed that this PAC be reduced in size to the south dock area only. Even though there was no documentation found indicating potential for contamination of this area, it is believed from interviews with retired RFP personnel involved with the activities of this area that the south dock would have a greater probability than the building or vaults of being potentially contaminated. The southern half of the building was used for offices and the northern half for laboratories and research. No documentation exists for the entire building being considered potentially contaminated (EG&G, 1992) (Figure 1-3).

The surface around Building 991 is paved, receives moderate to heavy traffic, and is enclosed by a security fence. This area has been paved for over 20 years; the pavement has been disrupted at times by construction and was extended to encompass Building 984, just south of 991, which was built in the 1980s. The remainder of the area is unpaved and lightly used (EG&G, 1990c).

The south dock of Building 991 is located on the west side of the building and is a loading facility for the tunnels. Small parts and equipment were washed in the dock area. Final products containing plutonium and uranium were shipped from the dock, but no raw products were involved in the operations ongoing within Building 991. Acetone and perchloroethene were the solvents used within the building.

2.3.23 IHSS 184 - Radioactive Site - Building 992 Steam Cleaning Area

IHSS 184 has been defined as a 50- by 50-foot area near Building 992, just southwest of Building 991 (EG&G, 1990c). Recent information obtained by Doty & Associates (Appendix B), indicate that the boundaries of this IHSS are approximately 55- by 75-feet located south of Building 991 (Figure 1-3).

The Low-Priority Sites report states that this area possibly was used between 1953 and 1978 to steam clean radioactively contaminated equipment and drums. The rinse water was collected in a sump for treatment in the RFP's process waste system.

Building 991 personnel indicated that steam cleaning was done in an area within the southwestern corner of the Building 991, not beside the guard shack or elsewhere outside the building. This was discontinued around 1969 when new cleaning facilities became available. The area was used to clean stainless-steel containers needed to ship materials to other U.S. AEC (now DOE) facilities. These containers were returned empty to Building 991 by the other facilities and were steam cleaned prior to reuse. The steam cleaning was not intended to decontaminate the containers, only to clean them. The cleaning was done on a concrete floor which is still in place. Wash water ran into an outside drain which flowed south and east beneath pavement before emptying into an unlined ditch just southeast of the building. The drain system is also still in place (EG&G, 1990c).

Building 991 personnel indicated that steam cleaning was discontinued prior to the aerial photo date (EG&G, 1990c).

2.3.24 IHSS 188 - Acid Leak (Southeast of Building 374)

IHSS 188 is an area of unspecified size southeast of Building 374 (EG&G, 1990). The surface was flat and unpaved at the time of the acid leak and was later paved in the mid-1980s (EG&G, 1990). Recent information developed indicates that the IHSS location presented in the IAG is inaccurate. HRR information indicates that the site should be closer to Building 371 and 374 (EG&G, 1992). Additionally the dimensions that are currently shown for this IHSS are approximately 110- by 65-feet (Figure 1-3).

This IHSS consists of an area southeast of Building 374, contaminated by an acid leak in 1983. The mixed acid most likely was waste metal leaching solution from the 400 complex, and might have contained very trace amounts of heavy metals.

2.4 NATURE AND EXTENT OF CONTAMINATION

The description of the nature and extent of contamination presented in this subsection is based on historical reports, review of historical photographs, site visits, interviews with former and present RFP employees, and review of analytical data obtained from the Rocky Flats Environmental Database System (RFEDS). Appendix F contains all available analytical data for surficial materials (i.e., artificial fill and alluvium), bedrock, and groundwater samples from wells and boreholes discussed in this subsection. All available analytical data for surface water and sediment samples from monitoring sites relevant to OU8 are presented in Appendix G. Validated data are identified in the tables in these appendices and in the summary tables in this subsection by a V (validated and valid), an R (validated and rejected), or an A (validated and acceptable with qualifications). J indicates that data are present but below the detection limit, and B indicates that the constituent was also detected in laboratory blanks.

Analytical data available from RFEDS for the area in and around OU8 are limited, and much of the available analytical data have not been validated. The quality of the unvalidated data is unknown and is included here for planning purposes only. Without the unvalidated data, the amount of data available would not be sufficient for making initial decisions regarding the nature and extent of contamination or for determining the number and locations of sampling points for the RFI/RI.

As noted on the summary tables presented in this subsection, the concentration units indicated in RFEDS for several constituents appear to be incorrect. Where such discrepancies were apparent, the units reported are those indicated in RFEDS but it is noted that the units appear to

be incorrect. No attempt was made to resolved these apparent discrepancies during the preparation of this Work Plan.

The available analytical data presented in this subsection are compared to background data to characterize the nature and extent of contamination. The background data discussed in this subsection are those provided in the Background Geochemical Characterization Report for 1989 (EG&G, 1990). The Background Geochemical Characterization Report identifies separate environmental media, and through statistical analyses provides background concentrations for each media, or group of media. In that report, where sufficient data were available, tolerance intervals were calculated for each parameter. When there was an insufficient number of samples or an insufficient number of detectable concentrations for a given constituent for the calculation of tolerance intervals, the Background Geochemical Characterization Report provides the maximum detected value. The analytical data obtained for OU8 were compared to the upper tolerance limit (or both upper and lower tolerance limits for pH) or the maximum detected concentration for each parameter to determine if the concentration exceeded background. In addition, when the upper tolerance limit was exceeded the concentrations were compared to the maximum concentration detected in background samples as an additional indicator of whether the concentration detected may be evidence of a release to the environment. When the pH of a sample was greater than the upper tolerance limit or less than the lower tolerance limit it was also compared to the range of background values.

Background data for media relevant to the discussion of the nature and extent of contamination associated with OU8 are summarized in Tables 2.3 to 2.6. For the purposes of this discussion, analytical data for surficial materials identified as artificial fill on borehole logs were compared to background data for North Rocky Flats Alluvium. Regardless of whether borehole logs identified bedrock as being weathered or not, all bedrock data were compared to the background concentrations for weathered bedrock.

2.4.1 Contamination in the Vicinity of IHSSs Within OU8

Subsections 2.4.1.1 through 2.4.1.24 discuss the nature and extent of contamination associated with each IHSS within OU8. These discussions are based primarily on the documented events related to each release within an IHSS and the available analytical data for borehole and groundwater samples. Data on surface-water and sediment monitoring are generally not discussed on an IHSS-specific basis due to the fact that the monitoring locations for these media are such that contamination attributable to individual IHSSs cannot be defined. Summaries of the data available for these media are provided in Subsection 2.4.2.

The analytical data for wells that were completed as piezometers are limited to borehole samples taken when the wells were drilled. Figure 2-2 is a map of the wells and boreholes in the vicinity of OU8 showing those for which analytical data were requested from RFEDS and the types of data available for each well. The data available for each well discussed in the following subsections are included in Appendix F and are summarized in tables presented in the following subsections. Each of the summary tables provides data for those constituents that were detected in concentrations exceeding background, and only above-background concentrations are provided for each constituent.

Groundwater data relevant to each IHSS were selected primarily based on the direction of groundwater flow indicated by the high and low water table maps in Figures 1-27 and 1-28. Control for the potentiometric surface shown in those maps is lacking in several locations because of the lack of water level measurements in those locations. In these instances, wells were also selected for this evaluation based on plausible alternative interpretations of the water table configuration in those locations.

It should be recognized that all of the conclusions in the following subsections are tenuous in that they are based upon data of insufficient quantity and quality. The wells and boreholes discussed in these subsections were not installed for the purpose of defining the nature and extent of

contamination associated with the individual OU8 IHSSs. Thus, the wells and boreholes are not ideally located for such a purpose and are often not sampled for the constituents of interest to a particular IHSS. In addition, most of these wells and boreholes are located downgradient from more than one OU8 IHSS as well as other potential sources of contamination not addressed by this Work Plan.

2.4.1.1 IHSS 118.1 - Solvent Spills West End of Building 730

Recent information indicates that IHSS 118.1, which consists of a 5,000-gallon underground carbon tetrachloride storage tank, is defined by a 30-foot by 13-foot area located adjacent to the east side of building 701. In the 1970s, tank overflows occurred during filling operations. Persons interviewed for the CEARP report recalled a spill of 100 to 200 gallons of trichloroethene (TCE) north of Building 776 prior to 1970. These persons did not recall any mitigation efforts to control the spill or clean-up operations. However, the practice at that time was to flush the affected areas with large volumes of water. It has been speculated that this spill may actually have been carbon tetrachloride. However, there are conflicting sources indicating the released constituent to be either trichlorethylene or carbon tetrachloride. No documentation was found detailing response to spills which occurred during filling operations in the 1970s (EG&G, 1992a).

On February 26, 1976, corroded piping leaked carbon tetrachloride into the tank's sump pit. What has been described as a "considerable" quantity leaked and was subsequently pumped out of the pit onto the ground. Other documents indicate that this leak was the result of a leaking valve (EG&G, 1992a).

In March of 1976, a small amount of leakage from the pipes in the tank pit was evident. During this time, Health Sciences was continuing soil-gas monitoring beneath the end tank. Industrial Hygiene reported air samples were typically averaging 10 mg/l of carbon tetrachloride. During the month prior to April 15, 1976, the average concentration rose to near 2,000 mg/l of carbon

tetrachloride. It was speculated that the tank or its associated pipes in the sump could have been releasing the carbon tetrachloride into the ground (EG&G, 1992a).

During these winter and spring months, there were documented efforts to stop the leakage from the pipes. Documentation was found which detailed the cleanup of spilled liquid, including that pumped onto the ground (Doty & Associates, 1992a).

On June 18, 1981, the tank failed, releasing carbon tetrachloride into the sump. The sump subsequently pumped some of the liquid out onto the ground surface. Temporary storage tanks were to be obtained to collect the liquid. No documentation was found which details the actual use of the temporary storage tanks. The tank was subsequently removed following this failure. One Building 776 employee present at the time of the tank's removal recalled that it appeared sound with no obvious leaks or significant corrosion (Doty & Associates, 1992a).

Documentation was not found of monitoring or sampling programs undertaken to determine the nature and extent of contamination potentially associated with this IHSS. There are no wells or boreholes in the vicinity of the IHSS in the upgradient or downgradient directions. The nearest upgradient well is P114689 which is located approximately 1,150 southwest of the IHSS (Figure 2-2). This well was drilled in 1989 and completed as a piezometer in the alluvial aquifer. The nearest wells to this IHSS are wells P209189 and P209389, completed in bedrock, and well P209289, an alluvial well. According to the water table maps presented in Figures 1-27 and 1-28, these wells are not located downgradient of IHSS 118.1. However, as discussed in the following paragraphs, due to the nature of the compounds believed to have been released from this IHSS and geologic and hydrogeologic conditions in the vicinity of the IHSS, the potential exists for these compounds to have migrated to these well locations.

Groundwater elevation measurements near this site are limited. The following discussion is based on two nearby wells, P209389 and P209289, both of which indicate a hydraulic connection of the surficial material with the underlying Arapahoe sandstone. This hydraulic interconnection

may exist at the IHSS and if so provides a pathway for contaminant transport into the bedrock aquifer. Water levels in wells P209389 and P209289 rise to within 12 feet of the ground surface. These two wells are completed at different depths, one higher stratigraphically and open to both the surficial material and the sandstone; the other lower stratigraphically and open only to the sandstone. The second well's water levels are lower than the first indicating a vertical hydraulic gradient. Given that the surficial material underlying this IHSS is of a coarse nature and of a relatively high permeability, and the quantity and geochemical nature of the chemicals believed to have been released to the surficial materials (carbon tetrachloride and TCE both of which are dense non-aqueous phase liquids (DNAPLs)), it is possible that the groundwater has been impacted. If these compounds have entered the alluvial aquifer, they may migrate along the surface of the pre-Rocky Flats Alluvium pediment surface (Figure 1-26) to the location of these wells.

Analytical data for well P114689 are limited to analyses of volatile organic compounds (VOCs), metals, inorganic constituents, and radionuclides in surficial material and bedrock samples taken during the drilling of this well in September 1989. Sampling and analysis of groundwater have not been performed at this well. Due to the distance between this well and IHSS 118.1, possible other sources of contamination between this well and the IHSS, and the lack of groundwater monitoring data from this well, the available data for this well are of limited use in defining the nature and extent of contamination associated with IHSS 118.1.

Borehole samples were collected from wells P209189 and P209289 during drilling. Groundwater samples have been collected quarterly from well P209189 since September 1989. Tables 2.7 to 2.9 provide summaries of the analytical data available for these wells. Analyses of groundwater from well P209289 have been limited since that well is dry during most times of the year. The only analytical data for groundwater from this well are the results of the analysis of one sample of groundwater taken on May 31, 1991. The only analytical data available for well P209389 are the results of inorganic analyses of groundwater samples collected quarterly since September

1989. Nitrate/nitrite and sulfate were detected in concentrations exceeding background but the concentrations of sulfate detected were less than the maximum background concentration.

The only VOC detected in borehole samples from well P209189 was methylene chloride. With the exception of the concentration in one sample of bedrock, methylene chloride was detected in concentrations less than the method detection limit. Laboratory blank contamination with methylene chloride was not indicated for any borehole sample from this well. Acetone was also detected in several samples, but contamination of laboratory blanks was indicated for those samples. Aluminum, arsenic, barium, calcium, lead, potassium, and vanadium were detected in surficial materials in concentrations exceeding their respective upper tolerance limits, but none were detected in concentrations greater than maximum background concentrations. The only metal that exceeded background in samples of bedrock was arsenic. The concentrations of arsenic, however, did not exceed the maximum background concentration for weathered bedrock. Only one sample of surficial materials was analyzed for radionuclides. The levels of gross alpha, radium-226, tritium, uranium-233,234, and uranium-238 in this sample exceeded background but only gross alpha, tritium, and uranium-238 were detected in concentrations greater than maximum background concentrations for alluvium. Plutonium-239/240 and tritium were detected in concentrations exceeding background in all samples of bedrock from this well analyzed for these isotopes.

Several VOCs were detected in samples of surficial materials and bedrock from well P209289. Benzene, chlorobenzene, methylene chloride, toluene and TCE were detected in samples of both surficial materials and bedrock. Most of these compounds were detected in concentrations less than detection limits. With the exception of methylene chloride, the only samples of surficial materials that contained these compounds were those taken immediately above the alluvium-bedrock contact. Acetone, chloroform, and 1,1-dichloroethene (1,1-DCE) were also detected in samples of surficial materials. Metals detected in concentrations greater than background were arsenic, barium, copper, manganese, and zinc in surficial materials and arsenic, beryllium, iron, and zinc in bedrock. None of the concentrations of metals detected were greater than their

respective maximum background concentrations. Americium-241, radium-226, tritium, uranium-233,234, and uranium-238 were detected in above-background concentrations in samples of surficial materials. The concentrations of americium-241 and tritium exceeded maximum background concentrations. Analysis of radionuclides was not performed on bedrock samples.

Groundwater samples from well P209189 have contained a number of VOCs including carbon tetrachloride, chloroform, 1,1-dichloroethane (1,1-DCA), 1,2-dichloroethane (1,2-DCA), 1,1-DCE, 1,2-dichloroethene (1,2-DCE), perchloroethene (tetrachloroethene, PCE), and TCE. The concentrations of these compounds detected are generally less than method detection limits. Many of these compounds, 1,1-DCA, 1,2-DCA, 1,1-DCE and 1,2-DCE, are degradation products of PCE and TCE (Figure 2-3). Calcium and iron have been detected in concentrations exceeding background in groundwater from this well, however, the concentrations of calcium detected have all been less than the maximum background concentration. Magnesium was also detected at a concentration greater than background on one occasion. Americium-241, cesium-137, plutonium-239/240, radium-226 and tritium have been detected in groundwater samples in concentrations exceeding background. Cesium-137 and radium-226 concentrations have exceeded background only once each. Bromomethane and chloroform were detected in the one sample of groundwater from well P209289. This sample was not analyzed for metals or radionuclides.

The available analytical data indicate that releases from IHSS 118.1 may have impacted groundwater. This conclusion is tenuous in that it is based upon data of limited quantity and quality. Data on soil and groundwater conditions at the IHSS site and immediately upgradient and downgradient from this IHSS are lacking and are needed in order to define the source of the contaminants detected in wells near the IHSS and to further define any possible hydraulic interconnection that may exist in this area. As discussed above, the data available for well P114689 is of limited use in establishing upgradient conditions at this time due to the considerable distance between this well and the IHSS and due to the lack of data for groundwater from this well. The data available for this well may be useful in future investigations when establishing upgradient conditions for this, and other, IHSSs.

Borehole sample and groundwater data from wells P209189 and P209289 indicate that a wide variety of VOCs have impacted soils and groundwater in the vicinity of these wells. In addition to the detection of carbon tetrachloride, the detection of PCE, TCE, and a number of degradation products of these compounds in groundwater is notable. These data indicate that the possibility that TCE may have been released during the documented spill cannot be ruled out at this time. Several metals and radionuclides have been detected in concentrations exceeding background in borehole and groundwater samples from these wells. There is no history of the release of these types of materials from IHSS 118.1, but additional data are required to determine if the concentrations detected are indicative of contamination and the source(s) of such contamination.

2.4.1.2 IHSS 118.2 - Solvent Spill South End of Building 776

In June 1981, one of the tanks ruptured and leaked solvent onto the ground, contaminating the soil. An unknown amount of carbon tetrachloride was released in this incident. The tank and the area of the spill were subsequently cleaned up. No documentation was found which further details response to this occurrence. It is not known whether sampling and analysis was conducted to verify the complete removal of soil contamination (EG&G, 1992b). IHSS 118.2 is adjacent to the north side of Building 707, and has dimensions of approximately 30-feet by 20-feet.

In addition, leaks, spills, and overflows of unknown quantity have occurred from the tanks during routine filling operations. Table 5 of the IAG indicates that elevated gamma radiation was detected at IHSS 118.2. This elevated level has been attributed to contamination from other nearby sources, such as the 1969 fire in Building 776 (EG&G, 1990).

No wells or boreholes are located in the immediate vicinity of this IHSS. The nearest upgradient well is P114689 which is located approximately 900 feet southwest of the IHSS (Figure 2-2). As discussed in Subsection 2.4.1.1 for IHSS 118.1, the data available for well P114689 are of limited use at this time for defining the nature and extent of contamination associated with this

IHSS due to the separation between the well and the IHSS and the lack of groundwater data for this well. The nearest downgradient wells, 2386, completed in bedrock, and 2486, completed in alluvium, which are located approximately 450 feet to the east-northeast (Figure 2-2). Groundwater samples from well 2386 have been collected quarterly since March 1987. A summary of the analytical data for these samples is presented in Table 2.12. The only analytical data available for well 2486 are the results of the analysis of VOCs and inorganic constituents in one groundwater sample collected on June 12, 1991. No VOCs were detected and nitrate/nitrite concentrations exceeded background in this sample.

The two wells downgradient of this IHSS provide some information on the hydrogeologic conditions that may exist at the IHSS. The surficial materials are underlain by Arapahoe Formation claystones and silty claystones. There is 8.2 feet of gravel above bedrock in well 2386 and 7.2 feet of clayey gravel, caliche and clay in well 2486. The surficial material is thin in both of these wells. Well 2486, open to the surficial materials, is dry most of the time.

Carbon tetrachloride, methylene chloride, trans-1,2-dichloroethene (trans-1,2-DCE), and TCE have been detected in groundwater samples from well 2386. Carbon tetrachloride and TCE were detected in this well only one time each. Blank contamination with methylene chloride was indicated for one of the four samples that contained detectable concentrations of methylene chloride. Calcium concentrations in groundwater from this well routinely exceed the upper tolerance limit but do not exceed the maximum background concentration. No radionuclides have been detected in concentrations greater than background in groundwater from this well. Sulfate concentrations in groundwater samples from this well exceed the upper tolerance limit but, with the exception of one sample, the concentrations are less than the maximum background concentration.

Based on the limited amount of data available, it appears that groundwater in the vicinity of IHSS 118.2 may have been impacted by releases from the IHSS. Although they have been detected only sporadically, the presence of a number of VOCs in groundwater downgradient from this

IHSS points to the need for further research into the types and quantities of materials that may have been released from this IHSS. Research into other possible sources of contamination in the vicinity and information regarding groundwater conditions immediately upgradient of the IHSS are also needed.

2.4.1.3 IHSS 123.1 - Valve Vault 7 Southwest of Building 707

On April 4, 1983, a check valve in Valve Vault 7 malfunctioned, allowing process wastewater to backflow into the sump. The vault filled with process wastewater and overflowed. The high-water-level alarm system in Valve Vault 7 was apparently inoperative at the time of the overflow. The process wastewater drained into an adjacent storm runoff collection system ditch near the Eighth Street and Sage Avenue and flowed east toward South Walnut Creek and the B-Series drainage ponds. Runoff was noticed flowing across the former 750 Parking Lot and through the Building 991 normal runoff drainage (Doty & Associates, 1992a). IHSS 123.1 consists of the area where the valve vault was located south of Sage Avenue (an area of approximately 40- by 40-feet), and the drainage ditch south of Sage Avenue and west of Ninth Street. Since the spill entered a pipeline at the intersection of Sage Avenue and Ninth Street, the IHSS does not extend beyond this point.

The release consisted of process wastewater from the 800 and 400 areas, which historically has been known to contain uranium, solvents, oils, beryllium, nitric acid, hydrochloric acid, and fluoride. Other potential materials released at RFP include those listed in Attachment 4 of the IAG (Appendix A). The transfer of liquid waste from the holding tanks at Building 881 was discontinued after personnel verified that wastewater was flowing out of Valve Vault 7. Temporary dikes were constructed to contain the overflow. A dam was constructed in the ditch east of the guard shack at Portal #1, and another dam was placed just west of Guard Shack 762. Drainage from the area was diverted to Pond B-1. Attempts were made to remove oil by using chemical absorbent bats. Environmental samples were taken from the vault and other areas of concern. Water was pumped out of the vault and the containment dikes and transferred to Waste

Processing by tanker truck. Snow-melt water was retained in the ditch for several days and later transferred to Process Waste Storage (EG&G, 1992a).

The malfunctioning check valve was repaired or replaced, the sump pump was replaced, and repair of the electrical system was initiated. A new type of check valve was ordered for all the check valves in the waste transfer system. The ditch along Sage Avenue between Valve Vault 7 and Ninth Street was cleaned of all visible contamination. The excavated material was stored for drying in the old Building 771 parking lot (EG&G, 1992a).

The HRR states that based on information found in documents reviewed for the HRR, this site has been mislocated on IAG maps in the same area as the OPWL valve vault several hundred feet to the north (Doty & Associates, 1992a). The HRR suggests that based on this information, the proposed boundaries defining this IHSS in the IAG be extended to include the storm runoff collection system ditch near Eighth Street and Sage Avenue and continue to the extent of Pond B-1 (Doty & Associates, 1992a).

Other than sampling that was performed at the time of the release, no documentation was found of monitoring activities that have been performed to assess contamination associated with this IHSS. The nearest upgradient sampling points are three piezometers completed in alluvium P213689, P214089, and P215789 (Figure 2-2). Borehole samples were collected from P213689 and P214089 during drilling in 1989 (the data for these borehole samples are included in Appendix F). No borehole sampling was conducted during the drilling of well P215789. Groundwater samples have not been collected from these piezometers. The nearest downgradient well is alluvial monitoring well P218089, located approximately 400 feet northeast of the IHSS. Surficial material and bedrock samples were collected during the drilling of well P218089 (Table 2.11). Groundwater samples for analyses of VOCs were collected once during 1990 and once during 1991 and for analysis of radionuclides twice during 1990 and twice during 1991 (Table 2.12). Inorganic constituents were also analyzed in several of these samples.

Acetone was detected in concentrations less than the detection limit in several borehole samples from well P218089. Contamination of laboratory blanks was not indicated for these samples. Methylene chloride was also detected in a sample of bedrock, but laboratory blank contamination was indicated for this sample. Metals detected in concentrations greater than background in surficial materials were barium, calcium, chromium, copper, lead, magnesium, vanadium, and zinc. The concentrations of these metals did not exceed the maximum background concentration for alluvium. Barium, calcium, and magnesium were detected in concentrations greater than background in bedrock samples with only barium being detected in concentrations exceeding the maximum background concentration for bedrock. No inorganic constituents were detected in concentrations exceeding background in any sample. Borehole samples were not analyzed for radionuclides.

The only VOC detected in groundwater from well P218089 was methylene chloride in a sample taken May 31, 1990. No laboratory blank contamination with methylene chloride was indicated for this sample. Methylene chloride was also detected in another sample analyzed for VOCs, but laboratory blank contamination was indicated for this sample. Bicarbonate, chloride, nitrate/nitrite, and sulfate concentrations have exceeded background concentrations on at least one occasion. Radionuclides detected at levels exceeding background levels in groundwater from this well were U-233,234, U-235, and U-238 in samples taken during 1990. Analysis of uranium isotopes was not performed on samples collected during 1991. Groundwater samples taken from this well have not been analyzed for metals.

Based on the information that is currently available for borehole and groundwater samples from wells in the vicinity of IHSS 123.1, it is not possible to make any conclusions regarding the nature and extent of contamination potentially associated with the IHSS. The lack of data regarding groundwater chemistry upgradient of the IHSS and the insufficient quantity of data available for downgradient locations hinders any meaningful interpretation of the data that is currently available. It is possible that the above-background concentrations of uranium isotopes detected in groundwater samples from well P218089 during 1990 may be attributable to releases

from this IHSS but analysis of groundwater upgradient of the IHSS and additional analyses of samples from well P218089 would be required to substantiate such a conclusion.

2.4.1.4 IHSS 135 - Cooling Tower Blowdown - Southeast of Building 374

During routine cooling tower operations, evaporation gradually concentrates dissolved solids in the cooling water. To prevent salt buildup, a portion of the water is removed and replaced with fresh water. This is done continuously in some RFP towers and as needed in others. The removed blowdown water is treated either in the RFP's sanitary sewer system or in the waste treatment system, whichever is more convenient to the particular tower. The water typically contains a corrosion-inhibiting additive. Since the late 1970s, RFP has used phosphate for this purpose; prior to this time, a chromate additive was used. It is possible that prior to 1980, effluent from the cooling tower may have contained tritium, although it is not certain what the tritium source would be (EG&G, 1992). Standard chlorine bleach or a similar biocide is also added to the water to prevent algae growth (EG&G, 1990).

Persons interviewed for the CEARP Phase I report indicated that areas north of the Building 374 cooling tower were affected by blowdown water. The possibility exists that surficial materials in the vicinity of the tower may have been impacted by releases from the cooling tower. Building 374 personnel stated that blowdown water is routed through an underground pipe into the RFP's sanitary sewer system for treatment. They recalled no leaks or other incidents involving blowdown water from Building 374. Any leakage or blowdown water from a source other than the underground pipe would be contained within the cooling tower building and would not affect soils around the tower (EG&G, 1990).

According to the HRR (1992) there is documented use of a Building 373 cooling tower pond. The first documented use was on June 12, 1981. The cooling tower was cleaned, and the slurry portion was pumped into a small retention pond. During the night, some of the water leaked through the dirt dike and gate valve and drained into Walnut Creek (EG&G, 1992).

A June 1, 1980, photo indicates a pond-like structure north of Building 374. Utility drawings support this as the location of the cooling tower retention pond, indicating a "holding pond" where Tank 808A and Tank 808B are now located. The drawings indicate a sluice gate at the northeast corner of the pond with connecting culvert that extends from it in a northeasterly direction. It is possible that the leak mentioned above was able to flow through this culvert to North Walnut Creek (EG&G, 1992). This IHSS is irregularly shaped and is approximately 130 feet wide by 65 to 85 feet long and has a pan handle that extends approximately 210 feet to the northeast.

No documentation was found of sampling activities that have been performed to attempt to determine if contamination exists in the vicinity of this IHSS. There are no monitoring wells located upgradient of the IHSS. Several piezometers, P114589, P114789, P114889, and P119389 are located upgradient of the IHSS but no groundwater monitoring data is available from these locations. Well 1986, an alluvial monitoring well, is located approximately 500 feet northeast of the IHSS, and well 2186, a bedrock monitoring well, is located approximately 250 feet northwest of the IHSS (Figure 2-2). Both of these wells are downgradient of the IHSS. Groundwater samples from both of these wells were collected once during 1986 and quarterly since March 1987 (Tables 2.13 and 2.14).

Trans-1,2-DCE, carbon tetrachloride, and methylene chloride have been detected in groundwater samples collected from well 2186. Acetone has also been detected in unquantifiable concentrations less than the method detection limit. Laboratory blank contamination with acetone and methylene chloride was also indicated for several samples from this well. Metals detected in concentrations exceeding their respective upper tolerance limits include aluminum, calcium, iron, nickel, and zinc. The concentrations of calcium and zinc detected, however, were all less than maximum background concentrations. Dissolved chromium concentrations in all samples have been less than background. Gross alpha, gross beta, plutonium-239/240, radium-226, strontium-89,90, and uranium-235 have been detected in concentrations exceeding background in groundwater samples from this well. The concentrations of gross beta and uranium-235 have,

however, been less than maximum background concentrations. Tritium has not been detected in groundwater from this well since monitoring began.

Several VOCs, acetone, 1,1-DCE, trans-1,2-DCE, methylene chloride, PCE, 1,1,1-trichloroethane (1,1,1-TCA), and TCE, have been detected in groundwater samples collected from well 1986. The detection of these compounds has been sporadic with many only being detected once (Table 2.13). Calcium, iron, magnesium, manganese, and sodium concentrations in this well generally exceed their respective upper tolerance limits. The concentrations of calcium, magnesium, and sodium are typically less than maximum background concentrations. Barium and nickel have also been detect in concentrations greater than background on one occasion each. Chromium has not been detected in concentrations exceeding background in this well. Gross beta, plutonium-239/240, strontium-89,90, and uranium-233,234 concentrations in groundwater from this well have also exceeded background concentrations. Gross beta and tritium were detected once each in concentrations exceeding background. Tritium has generally not been detected in samples from this well. Inorganic constituents detected in concentrations exceeding background include bicarbonate, chloride, and sulfate.

Due to the insufficient quantity and quality of data currently available, it is not possible to attribute the contamination detected in wells 1986 and 2186 to possible releases from IHSS 135. The lack of information regarding upgradient groundwater quality and the presence of other potential sources of contamination in the vicinity of these wells limits the usefulness of the existing data in determining the nature and extent of contamination associated with this IHSS. With the exception of one sample from well 1986 that contained an above-background concentration of tritium, none of the constituents believed to have been released from this IHSS (chromium, phosphate, and tritium) have been detected in groundwater from wells 1986 and 2186. Analysis of phosphate in these wells has not been performed.

2.4.1.5 IHSS 137 - Cooling Tower Blowdown - Building 774

Buildings 712 and 713 are both cooling tower facilities associated with Building 776. Interviewees for CEARP mentioned a release of cooling water south of Building 774 that flowed into Walnut Creek. This water contained 50 mg/l total chromium. It is speculated that they were recalling a release from the Building 779 cooling tower in December 1976 (EG&G, 1992).

The Building 776 cooling towers blowdown water is treated in the wastewater treatment plant. It is thought that the blowdown water drains from the cooling towers through underground pipes outside the south ends of the buildings (EG&G, 1992).

A leak in a cooling tower within the Protected Area was reported to have occurred between August 20 and September 6, 1990. A memorandum was sent to utilities personnel expressing the need to fix the leaks caused by corroded metal sides. Contact with the author of the document verified that the leak came from either Building 712 or Building 713. The leak has been estimated at a flow rate of between 5 and 20 gallons per minute. The duration of the leak is unknown but could have occurred over several months prior to reporting (EG&G, 1992). The affected area is approximately 120-feet by 50-feet.

It is believed that the cooling tower blowdown pipes leave the towers on their south sides (EG&G, 1992). These pipes are considered the most probable source of any blowdown water contamination around the cooling towers. It is possible that surficial materials in the vicinity of the towers have been impacted by releases of cooling water.

No documentation of sampling activities associated with releases from IHSS 137 was found. There are no wells located upgradient of this IHSS. The nearest downgradient wells are P209289 and P209389. The data available for these wells were presented in Subsection 2.4.1.1 for IHSS 118.1. Based on the current understanding of the material released from this IHSS, these data do not indicate any contamination that would be attributable to this IHSS. Chromium was not

detected in borehole or groundwater samples taken from these wells. Several VOCs and radionuclides have been detected in borehole and groundwater samples from these locations. It appears that the VOCs detected may be attributable to releases from other IHSSs such as IHSS 118.1, however, additional data are needed to determine the source(s) of these compounds. These wells are also located downgradient of several other OU8 IHSSs which may have contributed to the contamination detected. In particular, these wells are downgradient of IHSS 144(S) which may account for the above-background concentrations of radionuclides detected (see Subsection 2.4.1.9).

2.4.1.6 IHSS 138 - Cooling Tower Blowdown - Building 779

IHSS 138 is defined as a 50- by 50-foot area east of Building 779 and north of Building 727. On December 8, 1976, about 400 gallons of cooling tower water containing chromium and some radioactivity leaked into a storm drain east of Building 779. The spilled water was believed to have flowed toward collection trench number six. Utilities personnel at RFP recalled that the 1976 spill occurred when an underground cooling tower water line broke east of Building 779 and adjacent to the northwest of Building 727. The cooling tower water was sampled following the incident and found to contain 50 mg/l total chromium and approximately 3,000 dpm/l alpha activity. The ruptured line was excavated and repaired. The cooling tower water line which ruptured in the incident was removed when the original cooling towers were replaced (EG&G, 1992).

On December 8, 1990, an estimated 1,000 gallons of cooling tower water overflowed from the Building 783 number 2 cooling tower onto the ground. The released water was sampled and was known to contain "Nalco 2826," an inorganic phosphate rust inhibitor. There is no documentation to describe clean-up efforts for this spill (EG&G, 1992). It is possible that surficial materials in the vicinity of the tower have been impacted by such releases.

Other than sampling that occurred at the time of the releases from this IHSS, no documentation was found regarding sampling activities that may have been conducted to define the nature and extent of contamination attributable to those releases. The nearest downgradient sampling points are wells 2586, P207589, and P209089, bedrock groundwater monitoring wells, and well 2686, an alluvial monitoring well. Groundwater samples have been collected from well 2586 on a quarterly basis since March 1987 (Table 2.15). The only data available for well 2686 are the analyses of inorganic constituents in groundwater. Chloride, nitrate/nitrite, bicarbonate, and sulfate have been detected in concentrations exceeding background in this well. Borehole samples were collected from wells P207589 and P209089 during drilling (Tables 2.16 and 2.17), and groundwater samples have been collected from these wells on a quarterly basis since 1990. Table 2.18 provides a summary of the analytical data available for groundwater samples from well P209089. As discussed below, the data available for groundwater from well P207589 are limited. Wells 2386 and 2486 are located upgradient from IHSS 138. The data available for these wells are discussed in Section 2.4.1.2 for IHSS 118.2.

Several VOCs have been detected in groundwater samples from well 2586. The compounds detected include acetone, benzene, carbon tetrachloride, chlorobenzene, trans-1,2-DCE, cis-1,3-dichloropropene, ethylbenzene, methylene chloride, styrene, toluene, and total xylenes. Aluminum, cadmium, calcium, chromium, copper, iron, magnesium, nickel, and strontium have all been detected in concentrations exceeding background. Sodium concentrations in groundwater from this well have also exceeded the upper tolerance limit but are less than the maximum background concentration. Radionuclides detected in concentrations greater than background include gross alpha, gross beta, radium-226, strontium-89,90, and uranium-238. The concentrations of uranium-238 detected, however, are less than the maximum background concentration. Bicarbonate and sulfate concentrations in groundwater from this well have also exceeded background.

Acetone, 2-butanone (methyl ethyl ketone (MEK)), methylene chloride, and 4-methyl-2-pentanone were detected in borehole samples from well P207589. With the exception of the detection of

methylene chloride and MEK in a few samples, blank contamination was indicated for all of these compounds. Metals detected in concentrations exceeding background in samples of surficial materials were barium, calcium, lead, magnesium, mercury, and strontium. In addition to exceeding their respective upper tolerance limits, the concentrations of mercury in one sample and strontium in several samples also exceeded maximum background concentrations. Arsenic, barium, calcium, chromium, copper, iron, lead, magnesium, nickel, vanadium, and zinc were detected in concentrations greater than background in bedrock samples. The concentrations of arsenic and vanadium exceeded maximum background concentrations. Nitrate/nitrite concentrations in samples of both surficial materials and bedrock exceeded background. Borehole samples from this well were not analyzed for radionuclides.

Groundwater samples from well P207589 have been analyzed only for VOCs and metals. No VOCs or metals have been detected in concentrations exceeding background in these samples.

The only VOCs detected in borehole samples from well P209089 were acetone and methylene chloride. Metals detected in concentrations exceeding their respective upper tolerance limits in samples of surficial materials were aluminum, barium, cadmium, calcium, lithium, magnesium, manganese, mercury, and potassium. The concentrations of cadmium, lithium, mercury, and potassium detected also exceeded maximum background concentrations. Copper, lead, magnesium, vanadium, and zinc exceeded upper tolerance limits in bedrock samples but all were less than maximum background concentrations. Radionuclides detected in concentrations above background in samples of surficial materials include americium-241, plutonium-239, radium-226, and tritium. Plutonium-239, tritium, uranium-233,234, uranium-235, and uranium 238 were detected in concentrations exceeding background in bedrock samples. The concentration of the uranium isotopes detected, however, did not exceed maximum background concentrations. The highest concentrations of americium-241 and plutonium-239 were detected in a sample of surficial materials taken at a depth of 0 to 3.2 feet. No inorganic constituents were detected in concentrations greater than background in samples of surficial materials. Nitrate/nitrite was detected in relatively high concentrations in two samples of bedrock. As indicated in Table 2.17,

the concentration detected in the sample taken from depths of 11.5 to 17.5 feet is questionable because the concentration in a duplicate of that sample was two orders of magnitude less.

Acetone, chloroform, ethylbenzene, methylene chloride, toluene, and total xylenes have been detected in groundwater samples from well P209089. As shown in Table 2.24, laboratory blank contamination was indicated for several of the results for acetone and methylene chloride. Analyses of metals and radionuclides in groundwater from this well have been limited. The one sample analyzed for metals contained a concentration of calcium that exceeded the upper tolerance limit, but the concentration was less than the maximum background concentration. Chromium was not detected in this sample. Gross alpha, uranium-238, bicarbonate, and sulfate have also been detected in concentrations exceeding background.

As discussed in Section 2.4.1.2 for IHSS 118.2, no radionuclides have been detected in concentrations exceeding background in groundwater from well 2386. Gross alpha and uranium-238 concentrations in groundwater from well P209089 have exceeded background. The quantity of data available for this well is limited. In addition, several radionuclides were detected in concentrations exceeding background in borehole samples from well P209089. These data indicate that releases from IHSS 118.2 may have impacted groundwater and soils. However, there are other IHSSs, 150.6 and 150.8, that are also located upgradient of well P209089 which may have contributed to the contamination detected. In addition, other potential sources of contamination may exist in this area that are not included in OU8. Based on the data currently available, it is not possible to conclude how much contamination, if any, that has been detected in groundwater and soils downgradient of IHSS 138 is attributable to releases from this IHSS.

2.4.1.7 IHSSs 139.1(N) and 139.1(S) - Hydroxide Tank Area (Buildings 771 & 774)

IHSS 139.1 consists of three separate sites, two sites which are identified as IHSS 139.1(N), and one site which is identified as IHSS 139.1(S). The two sites identified as IHSS 139.1(N) are located north of Building 774. One of the sites consists of a sodium hydroxide tank and is

adjacent to the north side of Building 774, the other site is located about 80 feet north of the first site and consists of two large steam condensate tanks. IHSS 139.1(S) is located south of Building 771 and consists of a potassium hydroxide tank.

The two caustic tanks, a 5,400-gallon potassium hydroxide (KOH) tank south of Building 771 and a 6,500-gallon sodium hydroxide (NaOH) tank north of Building 774, have been subject to spills and leaks in the past (Doty & Associates, 1992 [Appendix B]).

Of the two steam condensate tanks, the westernmost tank receives overflow and contained liquid from the bermed area around the NaOH tank. The easternmost tank receives overflow from the westernmost tank. These two tanks, T-107 and T-108, have riveted construction. Currently, there is standing water around the tanks. The bottom of the tanks appear to be corroded, and there is rust on the tops and sides of the tanks (Doty & Associates, 1992 [Appendix B]).

During the week ending May 5, 1978, a spill occurred during the routine filling of a caustic tank near Building 771. Neither the specific tank nor the quantity spilled was documented. The spilled caustic was contained by a dike below the tank, and was not released to the environment. During March 1985, a pinhole-sized leak was found in the piping from the NaOH tank at Building 774. The leak occurred inside the building, "and probably did not contribute to the caustic material found on the ground in the pit surrounding the tank." Apparently, the leak had seeped along the underground pipe to the outside of the building. The leak was later repaired. The "caustic material found in the pit" was attributed to a poor sampling technique which allowed the valve to drip on the ground. It was estimated that 80 to 100 gallons of caustics had spilled as a result of this method over the 30-year history of the tank. The pit was to be cleaned out and lined in response to the problem. No documentation was found detailing the cleaning or lining of the pit (Doty & Associates, 1992 [Appendix B]).

In May 1985, A small leak was found at the fitting of a thermocouple in the NaOH tank north of Building 774. The caustics had solidified at the fitting, and therefore had not run into the pit. The fitting was repaired (Doty & Associates, 1992 [Appendix B]).

On June 22, 1987, there was an overflow of NaOH during delivery operations to the 6,000-gallon Building 774 caustic supply tank because of a faulty level indicator. (It is believed that this was actually the 6,500-gallon NaOH tank.) Approximately 100 gallons of caustic material flowed into the bermed containment area of the tank and then drained to the caustic "catch" tank, T-108. Due to cracks in and deterioration of the concrete berm, caustic seeped onto the road. Tank T-108 was also found to be deteriorating, and showed signs of seepage. In response to the incident, the 1 to 2 gallons that had seeped onto the road was diluted with water and rinsed off the road. Work orders to repair the cracks in the berm were initiated, and the work was completed on June 24. A job order was submitted to replace the deteriorating catch tank, T-108. The liquid in T-108 was sampled and was to be subsequently pumped to the sanitary sewer system or Building 774. The level indicator on the caustic tank was repaired (Doty & Associates, 1992 [Appendix B]).

On November 13, 1989, approximately 5 gallons of 12 molar KOH was spilled when a vendor was refilling the holding tank near Building 771. Apparently, the tank was overfilled and the extra liquid spilled into an earthen berm surrounding the tank. The KOH was absorbed with approximately 100 pounds of "oil dry," a chemical absorbent, and the contaminated soil and "oil dry" were placed in an 83-gallon salvage drum. Soil samples were taken, and pH analyses were performed. It was determined that all KOH-contaminated material had been removed. The area was backfilled with new gravel. It is possible that the overflowing liquid infiltrated into the soil beneath Building 771 (Doty & Associates, 1992 [Appendix B]).

There are limited data available that would assist in the definition of the nature and extent of potential contamination associated with releases from IHSSs 139.1(N) and 139.1(S). The only well located near or downgradient from the site of the NaOH releases (IHSS 139.1(N)) is well

P219089, an alluvial well (Figure 2-2). This well is located adjacent to the NaOH tank near Building 774. Analytical data for well P219089 are limited to analysis of radionuclides and inorganic constituents in one groundwater sample collected in December 1989. Well P219189, a piezometer completed in alluvium, is located west-northwest of the tanks in this IHSS and is not downgradient of the IHSS. Borehole samples were collected from this well during drilling, but groundwater samples have not been collected from this well. Due to the lack of groundwater data for this well and the absence of wells downgradient of the IHSS, the analytical data for this well is of limited use in defining the nature and extent of contamination associated with this IHSS.

All of the tanks in this IHSS are above the high water level elevation based on water level elevations recorded for wells P219089 and P219189 since their installation in 1989. At both wells the alluvial material is thin, from 8 to 11 feet. Relatively impermeable materials at shallow depths (Arapahoe Formation claystone at about 8.0 feet below the surface in well P2119089 and clay at about 4.0 below the surface in P2119189) most likely prevent a downward migration of potential contaminants and limit saturated thickness. As indicated by the high water level map for the uppermost hydrostratigraphic unit depicted in Figure 1-27, groundwater flows in a strong northerly gradient toward North Walnut Creek, essentially ridding the groundwater system of potential contaminants as seeps into the surface water system along the drainage valley walls. Standing water described as currently existing around tanks T-107 and T-108 is most likely due to ponding of runoff which is held by low permeability surficial materials and does not reflect the level of the water table.

The pH of the one sample of groundwater collected from well P219089 exceeded the background pH. Although a relatively high pH in groundwater may be indicative of the release of NaOH, the lack of additional groundwater monitoring data from this well hinders a determination of whether this result represents actual groundwater conditions or may be spurious. Chloride and plutonium-239/240 were also detected in concentrations exceeding background. The concentration of plutonium-239/240 was, however, less than the maximum background

concentration. Uranium-233,234 was also detected in this sample. Interpretation of this uranium concentration is difficult in that the background concentration of uranium-233,234 is based on the analysis of only one sample.

The nearest wells to IHSS 139.1(S) are the same as those discussed in Subsections 2.4.1.1 and 2.4.1.2 for IHSSs 118.1 and 118.2 (Figure 2-2). As discussed in those subsections, however, these wells are not located downgradient of these IHSSs. Due to the nature of the liquids believed to have been released from IHSS 139.1(S), it is unlikely that the liquids could have migrated to the locations of the wells discussed in Subsection 2.4.1.1 and 2.4.1.2. Any detectable residual impact to environmental media would likely be confined to the immediate vicinity of the releases.

2.4.1.8 IHSS 139.2 - Hydrofluoric Acid Tank Area (Building 714)

IHSS 139.2 consists of two horizontal, 1,300-pound hydrofluoric acid (HF) cylinders, each with a 1,200-pound capacity, that are located in Building 714. The hydrofluoric acid is delivered to the RFP in portable cylinders, which are replaced when empty. No open transfer of the acid takes place. The acid is piped to and used in Building 771 (Doty & Associates, 1992 [Appendix B]).

During May 1971, there was a small vapor release from the hydrofluoric connection outside Building 771. No documentation was found which detailed a response to the release (Doty & Associates, 1992 [Appendix B]).

During the week ending August 13, 1976, a hydrofluoric acid leak above Building 771 was repaired. Apparently, the hoses had collected small amounts of the acid that appeared when the line was pressurized (Doty & Associates, 1992 [Appendix B]).

It is improbable that the acid releases have a residual impact on the air. There was no documentation of events that may have impacted the soil, surface water, or the groundwater. Additionally it is improbable that there was impact on surface water or groundwater (Doty & Associates, 1992 [Appendix B]).

In addition to the above description of IHSS 139.2, there is a portable, refillable nitric acid dumpster located just north and west (approximately 25 feet) of the hydrofluoric acid storage area discussed in the IHSS 139.2 description. More precisely, the dumpster is located at the southeast corner of Building 771. It is possible that leaks and spills in the vicinity of the dumpster have impacted the environment, as well as those effects on the environment resulting from incidents at the hydrofluoric acid supply area.

According to Supervisor Investigation Report #87-7-771.1 - Acid Spill, there was a release of approximately 35 gallons of 12 normal nitric acid at the dumpster on July 1, 1987. The cause was a leak in the supply hose. Neutralization was attempted by the use of potassium hydroxide flake and sodium bicarbonate. The following day, the soil was loosened and more sodium bicarbonate was added. An asphalt layer was discovered approximately 6 inches below the ground surface. The affected soil was removed, and new road mix was to be placed on the asphalt pad (Doty & Associates, 1992 [Appendix B]).

The dumpster involved supplies nitric acid to the Building 771 chemical makeup area. The acid is delivered to the 218 tank farm near Building 444 by an outside supplier. One of two available dumpsters is picked up at Building 771, taken to the bulk supply, and filled by Building 774 Chemical Operators. The dumpster is then returned to Building 771. This process occurred on a daily basis when Building 771 was operational as a plutonium recovery facility (Doty & Associates, 1992 [Appendix B]).

The nearest wells to this IHSS that may assist in evaluating the nature and extent of contamination associated with the IHSS are the same as those discussed in Subsection 4.2.1.1 for

IHSS 118.1 (Figure 2-2). These wells, however, are not located downgradient of IHSS 139.2. There are no wells located downgradient of this IHSS. Any residual impact from these releases, if detectable, would likely be confined to the immediate vicinity of the IHSS and would be unlikely to have impacted groundwater.

2.4.1.9 IHSS 144 - Sewer Line Breaks (Building 730, Tanks 776 A-D, Leaks near Buildings 701 and 779)

IHSS 144 consists of two separate sites, IHSS 144(N) and IHSS 144(S). IHSS 144(N) consists of four underground waste holding tanks located north of Building 776 and east of Building 701, in a small structure identified as Building 730. They are designated as Tanks 776 A through D. They were built in approximately 1956, and were taken out of service in the 1980s. They are now used as plenum deluge tanks. Therefore, the tanks would normally be dry (Doty & Associates, 1992 [Appendix B]).

The tanks are concrete and 26 feet deep. They are non-inspectable. The capacity of Tanks 776 A and B is 22,500 gallons each, and the capacity of Tanks 776 C and D is 4,500 gallons each. Tanks 776 A and B are laundry waste holding tanks, and Tanks 776 C and D are process waste holding tanks. If tanks C and D overflowed, the excess liquid could drain into Tanks A and B, and vice versa (Doty & Associates, 1992 [Appendix B]). Potential materials that may have been involved in releases from these IHSSs included those listed in Attachment 4 of the IAG (Appendix A).

From approximately 1969 until 1973, laundry waste could be transferred through the sewer lines to the sanitary sewer system. A pipe header at the tanks allowed alternatives of pumping the laundry water to the sanitary sewer system, the Solar Evaporation Ponds, or Building 774 (Doty & Associates, 1992 [Appendix B]).

On approximately June 1, 1972, a revision of a Building 776 radiography vault floor drain was completed. Apparently, previous transfers of laundry waste water from Tanks 776 A and B

resulted in backflow into the vault. The revision to the floor drain, involving relocation of the drain pipe connection, would allow the waste to be transferred at higher pressures (Doty & Associates, 1992 [Appendix B]).

On June 7 or 8, 1972, the increased pumping rate during a transfer of laundry wastewater from Tanks 776 A and B to Building 995 caused suspension of high-level sediment in the tanks and pressurization of the sanitary waste line. The pressurization of the line caused a toilet and sink in Building 701 to overflow and a patch to rupture in the line east of the waste holding tanks. Due to the overflow of the toilet and sink, the toilet, sink, and floor of Building 701, as well as the ground east of the building, were contaminated. The patch that ruptured was apparently located between Buildings 777 and 779, this location has been designated as IHSS 144(S). Since the exact location of the sewer line break between Buildings 777 and 779 is unknown, the boundaries of IHSS 144(S) include all of the alleyway. At the time of the incident, maintenance may have consisted of cleaning out a clean-out plug near Building 701, further increasing the potential impacts on the environment (Doty & Associates, 1992 [Appendix B]).

Activities of samples taken from the toilet bowl in Building 701 were as high as 136,000 pCi/l on June 7 and 8. A sludge sample taken from a clean-out plug in the Building 701 sanitary sewer line contained only minimal radioactivity. Analyses of the sediments from the bottoms of Tanks 776 A, B, and D indicated liquid phase activities of 68,000 pCi/l, 9,100 pCi/l, and 302,000 pCi/l, respectively (Doty & Associates, 1992 [Appendix B]).

Interviewees for CEARP Phase I recalled a sewer line break between Buildings 779 and 777, which was discovered when contamination was found in a restroom. It is believed that this is the same incident as the 1972 patch rupture discussed above.

The rupture in the line patch east of the tanks resulted in soil contamination. Approximately 50 drums of soil were removed to an undescribed location (EG&G, 1992). A conflicting document states that 38 drums of soil were removed. The contaminated soil around Building 701 was also

apparently removed. It is probable that residual soil contamination is present. As of June 8, 1972, 19 drums of soil had been removed. No soil count was detected at that time (Doty & Associates, 1992 [Appendix B]).

The radiometric survey performed in the late 1970s and early 1980s indicated no extremely contaminated (500,000 to 1,000,000 pCi/g) areas at or near this IHSS (Doty & Associates, 1992 [Appendix B]).

Following the 1972 pressurization incident, the Building 995 outfall and other downstream points were sampled daily. There was increased radioactivity in the 995 outfall. The highest sample concentration of total alpha-emitting radionuclides in the outfall was 417 pCi/l, on June 11, 1972 (Doty & Associates, 1992 [Appendix B]).

The nearest wells to IHSS 144(N) are the same wells discussed in Subsection 2.4.1.1 for IHSS 118.1. As discussed in that subsection, these wells are not located downgradient of these IHSSs. There are no wells located downgradient of IHSS 144(N).

There are no wells located immediately upgradient of IHSS 144(S). The nearest upgradient well is well P214689, located approximately 1,300 feet to the southwest. As discussed in Subsection 2.4.1.1, the data available from this well are of limited used in establishing upgradient groundwater conditions. Several wells and boreholes are located downgradient of the IHSS. Alluvial monitoring wells 2286, 5687, and P209289, and bedrock monitoring wells P209189, P209389, and P210189 are located downgradient of this IHSS (Figure 2-2). Summaries of the available analytical data for groundwater samples from wells 2286, 5687, and P210189 are provided in Tables 2.19 to 2.21. The available data for wells P209189, P209289, and P209389 are discussed in Subsection 2.4.1.1 for IHSS 118.1. Borehole samples were also collected from well P210189 during drilling (Table 2.22) In addition, borehole SP16-87 is located downgradient of IHSS 144(S). A summary of the analytical data available for borehole samples from borehole

SP16-87 is provided in Table 2.23. (Subsequent to its drilling, borehole SP16-87 was completed as well 5687).

As shown on Table 2.19, several VOCs have been detected in groundwater samples from well 2286. Many of these compounds are the same as those detected in groundwater samples from well P209189 (see Table 2.9). With the exception of TCE which has been detected routinely (Figure 2-4), most of these VOCs have been detected sporadically. Metals detected in concentrations exceeding background in groundwater from this well include aluminum, antimony, barium, calcium, chromium, iron, lead, lithium, magnesium, manganese, nickel, and sodium. The concentrations of calcium, magnesium, manganese, and sodium have all been less than maximum background concentrations. Radionuclides detected in concentrations greater than background are americium-241, cesium-137, plutonium-239/240, strontium-89,90, tritium, and uranium-233,234. Gross alpha and beta concentrations have also exceeded their respective upper tolerance limits but have not exceeded maximum background concentrations. Chloride, nitrate/nitrite, sulfate, and bicarbonate concentrations have also exceeded background. Groundwater samples collected from this well were analyzed for pesticides and polychlorinated biphenyls (PCBs) in September 1986 but none were detected.

Samples of groundwater collected from well 5687 have also contained a variety of VOCs many of which are the same as those detected in wells 2286 and P209189 (Table 2.20). PCE, TCE, 1,1,1-TCA, and their degradation products have been detected in most samples from this well (Figure 2-5). Metals detected in concentrations exceeding background in this well include calcium, copper, lead, mercury, nickel, sodium, and zinc. Calcium and sodium concentrations, however, have not exceeded maximum background concentrations. Chloride, nitrate/nitrate, sulfate, and bicarbonate concentrations have also exceeded background in groundwater samples from this well. Groundwater samples from this well have not been analyzed for radionuclides.

Samples of surficial materials and bedrock from borehole SP16-87 were analyzed for metals, radionuclides, and inorganic constituents. No analyses of VOCs were performed on these

samples. As indicated in Table 2.23, several metals were detected in concentrations greater than background in samples of both surficial materials and bedrock. Only copper, potassium, and zinc were detected in concentrations that exceeded both upper tolerance limits and maximum background concentrations in surficial materials. Cadmium, calcium, and manganese concentrations in bedrock exceeded both upper tolerance limits and maximum background concentrations. Americium-241, gross alpha, and plutonium-239/240 were detected in concentrations exceeding background in a sample of surficial materials taken from 0 to 2 feet deep. Uranium-233,234 and uranium-238 also exceeded upper tolerance limits but did not exceed maximum background concentrations. No radionuclides were detected in concentrations exceeding background in bedrock samples. Nitrate/nitrite concentrations exceeded background in samples of both alluvium and bedrock.

Methylene chloride and acetone were detected in several borehole samples from well P210189 but, with the exception of methylene chloride in one sample, blank contamination was indicated for those samples (Table 2.22). Several metals were detected in concentrations greater than background in samples of surficial materials, but only barium, cadmium, and potassium were detected in concentrations that exceeded both upper tolerance limits and maximum background concentrations. Chromium and vanadium were detected in concentrations exceeding upper tolerance limits and maximum background concentrations in one sample of bedrock. Several other metals were also detected in concentrations greater than upper tolerance limits but less than maximum background concentrations in bedrock samples. Gross alpha, gross beta, americium-241, plutonium-239/240, radium-226, strontium-90, tritium, uranium-233,234, uranium-235, and uranium-238 were all detected in concentrations exceeding background in surficial materials. Plutonium-239 and tritium were also detected in concentrations exceeding background in bedrock samples. Uranium-233,234 and uranium-238 concentrations in bedrock samples exceeded upper tolerance limits but did not exceed maximum background concentrations. Nitrate/nitrite was detected in concentrations exceeding background in samples of both surficial materials and bedrock. The pH of a sample of surficial materials taken from 0 to 3 feet deep also exceeded background.

As shown on Table 2.21, a variety of VOCs have been detected in groundwater samples from well P210189 many of which are the same as those detected in the other wells located downgradient of this IHSS. PCE, TCE, and degradation products of these two compounds have been detected in several samples collected from this well (Figure 2-6). Barium, calcium, iron, and mercury concentrations in groundwater from this well have exceeded their respective upper tolerance limits, but the concentrations of calcium detected have been less than the maximum background concentration. Plutonium-239/240, radium-226, tritium, and uranium-235 have also been detected in concentrations exceeding background. The concentrations of uranium-235 detected have not exceeded the maximum background concentration. Nitrate/nitrite and bicarbonate concentrations in groundwater from this well have also exceeded background concentrations.

The available data for wells downgradient of IHSS 144(S) indicate contamination that may be attributable, at least in part, to releases from this IHSS. Many of the constituents detected in samples from these wells are not known to have been released from this IHSS and may have resulted from releases from other OU8 IHSSs or other potential source of contamination. Insufficient information is currently available regarding the composition of materials released from this IHSS.

2.4.1.10 IHSS 150.1 - Radioactive Site North of Building 771

Wastes from Building 771 and materials to be reprocessed in Building 771 were frequently handled and stored in the area north of the building. Building 770, north of 771, was built in 1965 and has been used as a residue storage area in the past. Activities in and around Building 770 have contributed contamination to this site (EG&G, 1990). IHSS 150.1 is an area approximately 360- by 60-feet and is adjacent to the north side of Building 771.

The following is a chronological breakdown of incidents that have occurred in this area and utilization changes. In addition to the released substances cited below, potential exists for other

undocumented releases to have occurred. These releases may have included radionuclides such as plutonium and americium.

On September 11, 1957, the RFP's first major fire occurred in Building 771. A plenum was breached releasing an unknown amount of radioactivity around the building, particularly to the north. The impact the airborne radioactivity may have had on the access road was not quantified; however, fire clean-up activities followed the incident (Doty & Associates, 1992 [Appendix B]).

From approximately 1962 until approximately 1968, a 5,000-gallon stainless-steel tank was located approximately 30 feet north of Building 771. The tank was on 6-foot legs and was approximately 8 feet in diameter. Two overhead pipes from Room 114 in Building 771 connected to the tank, one of which was a vacuum vent to control transfer in and out of the other. The tank was used in the Filtrate Recovery Ion Exchange system, which concentrated plutonium and americium for recovery. Americium concentrated on an ion exchange column and was transferred at a predetermined concentration to the tank. The resulting liquid contained in the tank was a nitrate solution high in americium with some plutonium (Doty & Associates, 1992 [Appendix B]).

In approximately 1968, a pinhole leak developed in the tank and dripped onto the slab foundation. The tank was temporarily sealed to mitigate the leak until the tank could be emptied through the processing of the contained solution. Once emptied, the tank was taken out of service and remained in place until it was moved to the size-reduction facility in Building 776 sometime shortly after. Once size-reduced, the tank was disposed of as radioactive waste. When the tank was removed to the size-reduction facility, the concrete slab was decontaminated until the point where smear samples did not detect further removable radioactivity. Paint was applied to the concrete to secure the fixed radioactivity. The slab was moved to a ditch directly north of the area and buried (IHSS 163.2). The area was paved sometime prior to June 1969 (Doty & Associates, 1992 [Appendix B]).

On June 11, 1968, during the removal of drums from the 903 Storage area, a drum leaked on the roadways as it was being transported to Building 774. The forklift carrying the leaking drum traveled across the access road north of Building 771. The area near Building 774 was contaminated at the time. The road in front of Building 771 was apparently not considered to be impacted by the incident. Further details of this incident are provided in the IHSS 172 description (Doty & Associates, 1992 [Appendix B]).

The paved area between Buildings 771 and 770 was used for the storage of residue in drums prior to processing in Building 771. A June 1969 photograph shows over one hundred drums stored in rows on the pavement. A fence parallel to Building 771 also encloses the west entrance to Building 770 and defines a storage area. Drums were also stored in the courtyard south of Building 770 between the access road and the building. This location has since been altered, because in the 1960s there was a concrete embankment wall along the south and east sides of the courtyard. There is currently no embankment wall. Construction changes in this area are not clear. More information may be found regarding the physical alteration of the area. Drums of waste from the 1969 fire in Building 776 were stored in the area for counting prior to shipment (Doty & Associates, 1992 [Appendix B]).

Another specific incident of contamination occurred on November 16, 1970 when residue leaked out of a drum of filters as it was being transported from a storage area (triangle area east of the solar ponds) to Building 771 for processing. The ground area near the dock at Building 771 as well as the truck and cargo container the drum had come in contact with were all contaminated. The leak was detected while in transit, and the area was decontaminated. It was noted in March 1971 that a significant increase in the number of "hot waste" drums were stored outside in the area north of Building 771. These drums contained residues for the Building 771 incinerator and the number of drums in storage was becoming problematic for the Health Physics Operations Group (Doty & Associates, 1992 [Appendix B]).

On June 11, 1971, a leaking drum on the pavement caused the contamination of approximately 115 square feet of asphalt. Soil and approximately 200 square feet of asphalt were removed for off-site disposal. A recommendation was made to lease cargo carriers to protect the drums. A waste drum was found to be leaking shortly after that on July 2, 1971 and was determined to contain nitric acid from non-line generated waste. A rainstorm spread the contamination, affecting between 2,300 and 2,500 square feet of asphalt and gravel with levels of contamination ranging from 500 to 1,000,000 cpm plutonium. The incident prompted a request for additional cargo carriers and the use of Building 776 for storage. It was then determined that these incidents in June and July 1971 resulted in contamination of the area ranging from 100,000 to 300,000 dpm/100 cm^2 on the asphalt (Doty & Associates, 1992 [Appendix B]).

In August 1972, a punctured scrap box stored inside Building 770 contaminated 3,600 square feet inside the building and 500 square feet outside. Levels of radioactivity ranged up to 200,000 dpm/cm^2. Removal of asphalt and soil for off-site disposal began immediately following the incident.

Finally, on September 15, 1972, a 55-gallon drum containing spent ion exchange resin residue leaked inside Building 770 onto the concrete floor. Contamination was tracked between Buildings 771 and 770 and covered 600 square feet, including 50 drums and a forklift. Levels of contamination ranged from 5,000 to 100,000 cpm plutonium. The area was noted to be decontaminated, but details of these activities were not found (Doty & Associates, 1992 [Appendix B]).

The specific locations of these incidents were not recorded; however, the paved area north of Building 771 and west of Building 770 was used for storage in a structured manner since before 1969 and probably as early as 1964. The storage area was bounded on the north by a fence that was parallel to Building 771 and extended north to enclose the west entrance of Building 770. During the time of storage, the paved area still functioned as the access road for Buildings 771 and 774 (Doty & Associates, 1992 [Appendix B]).

The material stored consisted primarily of residues that had a high plutonium content and were destined for plutonium recovery operations in Building 771. Materials were stored in drums on pallets or in cargo containers. No documentation was found that provided any hazardous waste characteristics that may have been associated with the plutonium residue. Decontamination activities conducted after specific incidents would have been focused on radioactive contamination. It is likely that residual contamination from hazardous constituents may have remained (Doty & Associates, 1992 [Appendix B]).

Due to environmental concerns related to the clean-up activities at the 903 storage area and the triangle storage area, efforts were made sitewide in the early 1970s to move all radioactively-contaminated materials to indoor storage. The Building 771 area was used for storage until approximately 1974 when Building 776 was used for such storage. Building 770 was then used for the storage of equipment and also a facility for equipment assembly prior to installation in other buildings (Doty & Associates, 1992 [Appendix B]).

The results of the Radiometric Survey, performed at RFP during the late 1970s and early 1980s, indicate no extremely contaminated areas (stated to be 500,000 to 1,000,000 pCi/g) north of Building 771 (Doty & Associates, 1992 [Appendix B]).

Information developed on this unit for the HRR indicates that the waste storage and handling also occurred west of Building 770 and possibly north of Building 774. It is proposed that the boundaries for IHSS 150.1 presented in the IAG be revised. Presently the boundaries are a 50-by 450-foot area just south of Building 770. Due to the leaking drum incident in June 1968, it is proposed that the IHSS boundary should be extended to the east approximately 120 feet. In addition, photographs clearly show that in March 1974, over 30 cargo containers were present immediately west of Building 770. The photographs also include close-up shots of the container and the ground. This area is not presently within the IHSS boundaries. Thus, extending the boundaries of IHSS 150.1 to include the area west of Building 770 has been proposed (EG&G, 1992).

Based on the boundaries of IHSS 150.1 discussed above, there are no wells or boreholes located downgradient of this IHSS. The nearest well to the IHSS is well P219189, a piezometer completed in alluvium, located near the northeast corner of the IHSS (Figure 2-2). Borehole samples of both surficial materials and bedrock were collected from this well during drilling in 1989 (Table 2.24). 1,1-DCA was detected in concentrations less than the method detection limit in several samples. Methylene chloride was also detected in several samples, but blank contamination was indicated for those samples.

Metals detected in concentrations greater than background in surficial materials from well P219189 were arsenic, barium, copper, iron, lead, magnesium, manganese, and zinc. Only the concentrations of zinc exceeded maximum background concentrations. Aluminum, arsenic, barium, chromium, iron, lead, magnesium, nickel, vanadium, and zinc concentrations exceeded background in bedrock samples. The concentrations of lead and zinc detected in these samples were also greater than maximum background concentrations. As shown in Table 2.30, several radionuclides were detected in concentrations exceeding background. The concentrations of americium-241, radium-226, radium-228, tritium, and uranium-235 in samples of surficial materials and of radium-226, radium-228, and tritium in bedrock samples exceeded both upper tolerance limits and maximum background concentrations. None of the samples collected were analyzed for plutonium.

The available analytical data for well P219189 indicate that RFP operations have impacted surficial materials and bedrock in the vicinity of IHSS 150.1. However, these data are not sufficient to enable a determination of impacts that are attributable to this IHSS. The lack of data regarding groundwater quality in the vicinity of the IHSS, particularly in the downgradient direction, hinders any determination of the nature and extent of contamination potentially associated with this IHSS. As discussed in Subsection 2.4.1.12 for IHSS 150.3, the contamination detected in this well may also be attributable to releases from other IHSSs or other sources of contamination.

2.4.1.11 IHSS 150.2 - Radioactive Site West of Building 771

On September 11, 1957, a fire was discovered in Room 108 of Building 771. Fires in the box exhaust booster filters and main filter plenum were discovered soon after. An explosion in the main exhaust duct probably contributed to the release of plutonium from the stack. The September 1957 fire in Building 771 released radioactive contamination primarily north and southwest of the building (EG&G, 1992).

During fire-fighting (fire-fighting methods unknown) and decontamination activities at Building 771, access to the main filter plenum was gained through a hatchway on the west side of the building. This activity was the main cause of the spread of contamination on the west side of Building 771 at the time of the fire (EG&G, 1992).

On May 11, 1969, a fire occurred in Building 776-777. Plutonium was tracked outside of Building 776 by fire-fighting and support personnel and was detectable on the ground around the building. The tracking of contamination was confined to an area of 20 by 100 feet adjacent to the west of the building. Another source states that the contaminated area extended from the south wall of Building 778 to the north wall of the maintenance addition to Building 776 in a strip about 30 feet wide along the west wall of Building 776. Following the fire, rain carried the contamination into the soil. Airborne contamination from the May 1969 fire was carried predominantly to the west-southwest, the average wind direction at the time. Contamination was found outside the building to a maximum of 200 feet following the fire. In May 1971, a study of the steps, dock, and ramp areas on the west side of Building 776 showed radioactive contamination as high as 6,000 c/m (EG&G, 1992).

The EG&G Phase I RFI/RI Work Plan indicates that in September 1969, 320 tons of soil and asphalt containing an estimated 14 milligrams of plutonium were removed for off-site disposal. This action and date is not confirmed by information presented in the draft HRR. The HRR indicates that in June 1969, an estimated 320 tons (the same amount described in the EG&G

Phase I Work Plan) of asphalt and soil contaminated by plutonium at the time of the May 1969 fire were removed and buried in trenches. It is not clear, however, whether these trenches are on- or off-site. Additional interviews with individual(s) who made this claim or additional research of RFP records may provide details regarding disposal of these materials.

In December 1969, contaminated soil and asphalt were removed from behind Building 776 to fill an area to the east of Building 881. In May 1971, contaminated steps and dock and ramp areas on the west side of Building 776 were covered with an epoxy paint. Areas of contamination outside Building 776 were covered with asphalt. In June 1980, contaminated asphalt was removed from the west side of building 776 and boxed as hot waste (EG&G, 1992).

There are no wells or boreholes located in the immediate vicinity of this IHSS. The nearest downgradient well is well 1986 located approximately 250 feet west of the northwest corner of the IHSS (Figure 2-2). There are no wells located upgradient of the IHSS. The available analytical data for well 1986 were presented in Subsection 2.4.1.4 for IHSS 135. Several VOCs have been detected in groundwater samples collected from this well (Table 2.13). In addition, several metals, radionuclides, and inorganic constituents have been detected in concentrations exceeding background. In particular, gross alpha, gross beta, americium-241, plutonium-239/240, strontium-89,90, and uranium-233,234 concentrations in groundwater from this well have exceeded background concentrations.

The analytical data available for well 1986 suggest that groundwater in the vicinity of IHSS 150.2 may have been impacted by releases from this IHSS. The presence of above-background concentrations of several radionuclides in groundwater samples from this well may be attributable to releases from this IHSS. However, the lack of information on upgradient groundwater quality and the potential that other sources of contamination exist in this area, makes such a conclusion tenuous at this time.

2.4.1.12 IHSS 150.3 - Radioactive Site Between Buildings 771 and 774

During excavation for construction between Buildings 771 and 774 in August 1971, a cement tunnel containing PWLs, which had previously been used as an exhaust ventilation duct for Building 774, was exposed. Three cracks in the concrete walls were found to be contaminated. This incident released plutonium (concentrations not specified) to the soil. In September 1971, construction resulted in the exposure of the tunnel. As a result of these incidents, the cracks that were contaminated were sealed, and eight drums of soil were removed for off-site disposal (location not identified) in January 1972 (EG&G 1992).

In December 1971 (or possibly early January 1972), construction activities in this area resulted in a broken PWL. Samples of the water showed an activity of about 1,000 pCi/l (isotope(s) or type of radiation detected not specified). Soil samples from the area were found to be only slightly contaminated. There is no documentation regarding further response to this incident (EG&G, 1992).

Personnel recall an incident in this area in the late 1970s or early 1980s. A flange in a line separated releasing an unspecified amount of aqueous process waste that reached the surface. Personnel recalled that the area was cleaned up (EG&G, 1992).

Other than the sampling activities described above, no documentation was found of sampling performed to determine the nature and extent of contamination potentially associated with this IHSS. Information on groundwater quality upgradient and downgradient of IHSS 150.3 is lacking. Well P219189, a piezometer completed in alluvium, is located downgradient of IHSS 150.3 (Figure 2-2). The nearest wells to the south of this IHSS are P209289, an alluvial monitoring well, and P209389, a bedrock monitoring well. Based on the water table maps presented in Figures 1-27 and 1-28, these wells may be upgradient of a portion of IHSS 150.3. However, as discussed in Subsection 2.4.1.1, the data available for these wells is limited. Groundwater samples from these wells have not been analyzed for metals or radionuclides.

Borehole samples were collected from well P219189 during drilling in 1989. The available analytical data for these samples were discussed in Subsection 2.4.1.10 for IHSS 150.1. As discussed in Subsection 2.4.1.10, several metals and radionuclides were detected in concentrations exceeding background in samples of both surficial materials and bedrock. Americium-241, radium-226, radium-228, tritium, and uranium-235 concentrations in surficial materials and radium-226, radium-228, and tritium concentrations in bedrock exceeded both upper tolerance limits and maximum background concentrations. These samples were not analyzed for plutonium.

It is difficult to draw any conclusions regarding the nature and extent of contamination associated with IHSS 150.3 based on the limited data currently available. Groundwater quality data in the vicinity of the IHSS is lacking. It is possible that the contamination, particularly radionuclide contamination, detected in borehole samples from well P219189 may be attributable to this IHSS, but the existing data are not sufficient to substantiate such a finding.

2.4.1.13 IHSS 150.4 - Radioactive Site East of Building 750

As discussed in Subsection 2.4.1.11 for IHSS 150.2, in May of 1969 a fire occurred in Building 776-777. Following the fire, the tanks and pumps that handled the decontamination fluid were placed into the Building 750 courtyard. Building 750 courtyard is located between Buildings 750 and 707 and has been defined as IHSS 150.4. This area was later paved and used for parking lots. In 1980 and 1981, there were several leaks from the manholes in these parking lots. This area is suspected to have residual contamination. No documentation is available which describes the contamination of the parking area by the decontamination tanks and pumps, nor is there a description of the several manhole leaks. The probable contaminant in this area is plutonium (EG&G, 1992).

There are no wells located upgradient of this IHSS. Bedrock groundwater monitoring wells 2386 and P207389 and alluvial monitoring wells 2486 and P207489 are located downgradient of the

IHSS (Figure 2-2). The available analytical data for groundwater samples collected from wells 2386 and 2486 were presented in Subsection 2.4.1.2 for IHSS 118.2. Summaries of the data available for borehole and groundwater samples from wells P207389 and P207489 are presented in Tables 2.25 to 2.28. None of the borehole and groundwater samples from these wells have been analyzed for radionuclides.

As discussed in Subsection 2.4.1.2, analytical data for well 2486 are limited to the analysis of VOCs and inorganic constituents in one groundwater sample collected on June 12, 1991. No VOCs were detected and nitrate/nitrite concentrations exceeded background in this samples. With the exception of the detection of several VOCs in groundwater samples from well 2386, the concentrations of most constituents in that well have generally been comparable to background concentrations.

The only VOCs detected in borehole samples from well P207389 were methylene chloride and acetone. Blank contamination was indicated for all of the samples that contained acetone. Blank contamination was not indicated for any of the samples containing methylene chloride. Aluminum, barium, calcium, lithium, magnesium, and zinc concentrations in samples of surficial materials exceeded background, but only lithium was detected in concentrations greater than the maximum background concentration. Calcium and strontium were detected in concentrations greater than background in samples of bedrock. The calcium concentrations, however, did not exceed the maximum background concentration for calcium. The only inorganic constituent that exceeded background was nitrate/nitrite in the 0 to 3 foot sample.

The results for borehole samples from well P207489 are very similar to those for well P207389. Methylene chloride and acetone were the only VOCs detected, and blank contamination was indicated for all samples containing acetone. Aluminum, barium, beryllium, calcium, chromium, copper, iron, magnesium, potassium, vanadium, and zinc concentrations in samples of surficial materials exceeded background, but only chromium and copper were detected in concentrations exceeding maximum background concentrations. No metals were detected in above-background

concentrations in bedrock samples. Nitrate/nitrite concentrations in the 0 to 3 foot sample from this well also exceeded background.

Acetone, chloroform, and methylene chloride have been detected in groundwater samples from well P207389. Only acetone was detected in a concentration greater than the method detection limit. Blank contamination was indicated for acetone and methylene chloride in several samples. Calcium and mercury have been detected in concentrations exceeding background in groundwater from this well. The concentrations of calcium have all been less than the maximum background concentration for calcium. Bicarbonate concentrations in this well have occasionally exceeded the upper tolerance limit but most concentrations are less than the maximum background concentration.

Groundwater samples collected from well P207489 have also contained a number of VOCs in concentrations less than the method detection limits. These compounds include acetone, carbon tetrachloride, and 1,1-DCE. Blank contamination with methylene chloride and acetone was also indicated for several samples. Calcium, magnesium, and manganese have been detected in concentrations exceeding their respective upper tolerance limits but less than maximum background concentrations. Bicarbonate, chloride, nitrate/nitrite, and sulfate concentrations in groundwater from this well have exceeded background but have generally been less than maximum background concentrations.

The available analytical data are of limited use at this time in defining the nature and extent of contamination associated with IHSS 150.4. Data on upgradient groundwater quality are lacking. The lack of analyses for radionuclides in borehole and groundwater samples from downgradient wells further limits the usefulness of these data. Several VOCs, generally in concentrations less than method detection limits, have been detected in groundwater samples from wells downgradient of this IHSS. At the location of wells 2386 and 2486, VOCs have only been detected in the bedrock well (well 2386) but have been detected in both the alluvial well (well P207489) and the bedrock well (well P207489) at the location of wells P207389 and P207489.

2.4.1.14 IHSS 150.5 - Radioactive Site West of Building 707

Recent information obtained by Doty & Associates (Appendix B) indicates IHSS 150.5 to be the same as IHSS 123.2 - Valve Vault West of Building 707. In accordance with a CDH letter to DOE dated April 21, 1992, the IHSS 123.2 was transferred to OU9. As such, IHSS 150.5 (and 123.2) will not be addressed further in this Work Plan for OU8.

2.4.1.15 IHSS 150.6 - Radioactive Site South of Building 779

In June 1969, radioactive contamination occurred due to an improperly opened waste drum in Building 779 and was spread by pedestrian tracking to areas east and south of the building (see also IHSS 150.8). The release consisted of radionuclides from radioactive waste. An unknown number of drums of soil were subsequently removed for off-site disposal. It is not known whether all areas affected by this incident were included in cleanup activities (EG&G, 1990). This IHSS has been identified as a 50- by 185-foot area south of Building 779 and encompassing the northern portions of Buildings 705 and 706.

Wells 2386, a bedrock monitoring well, and 2486, an alluvial monitoring well, are located upgradient of IHSS 150.6 (Figure 2-2). The data for these wells are presented in Subsection 2.4.1.2 for IHSS 118.2. As discussed in that subsection, the available data for well 2486 are limited. Carbon tetrachloride, trans-1,2-DCE, methylene chloride, and TCE have been detected in groundwater samples from well 2386. The concentrations of all other constituents analyzed in groundwater from these wells have generally been comparable to background concentrations.

Sampling locations downgradient of IHSS 150.6 include bedrock monitoring wells 2586 and P207589, and alluvial monitoring well 2686. The available data for wells 2586, 2686, and P207589 are presented in Subsection 2.4.1.6 for IHSS 138. The available data for well 2686 are limited to analyses of inorganic constituents in groundwater (see Subsection 2.4.1.6).

A comparison of the groundwater data available for wells 2386 and 2586 indicates that those VOCs that have been detected in groundwater from both wells (i.e., carbon tetrachloride, methylene chloride, and trans-1,2-DCE) have occurred in similar concentrations upgradient and downgradient of IHSS 150.6. Several additional VOCs have been detected in well 2586 downgradient of the IHSS. In addition, gross alpha, gross beta, radium-226, strontium-89,90, and uranium-238 have been detected in concentrations exceeding background in well 2586 but have not exceeded background in well 2386. Sulfate concentrations in groundwater from well 2586 are also higher than those detected in well 2386.

Groundwater samples from well P207589, which is located adjacent to well 2586, have been analyzed only for VOCs and metals. No VOCs or metals have been detected in concentrations exceeding background in these samples. Well P207589 is completed in claystone while well 2586 is completed in sandstone. The claystone likely prevents the migration of contaminants to the groundwater interval being sampled in well P207589.

The insufficient quality and quantity of the data available for wells located near IHSS 150.6 prevents any determination of the nature and extent of contamination associated with this IHSS. In particular, data are lacking regarding upgradient and downgradient groundwater quality within the uppermost flow system. Data for the two wells completed in alluvium, wells 2486 and 2686, are very limited. The data available for wells 2386 and 2586 indicate that groundwater near this IHSS has been impacted by RFP operations. In particular, increased concentrations of radionuclides are present in well 2586 downgradient of IHSS 150.6 as compared to upgradient well 2386. Several VOCs have also been detected in relatively low (i.e., less than method detection limits) concentrations in well 2586 but have not been detected in well 2386. The extent to which these contaminants may be attributable to IHSS 150.6 is not known.

2.4.1.16 IHSS 150.7 - Radioactive Site South of Building 776

This site, as with other IHSS 150 sites, was contaminated by the May 1969 fire which occurred in buildings 776/777 which are to the north of this site. Plutonium was tracked outside those buildings and onto this site by fire-fighting and support personnel and was detectable on the ground around the building. Following the fire, rain carried the contamination into the soil. The spread of contamination south of Building 776 can also be attributed to the runoff of fire water sprayed on the building to contain the fire. Sand and gravel between Building 777 and Building 778 were also contaminated before the rain. Airborne contamination from this incident was carried predominately to the west-southwest, the average wind direction at the time. Contamination was found up to 200 feet outside the building following the fire. Oil and gravel were placed over the contaminated soil as a temporary measure following the fire. The contaminated soil, oil, and gravel were removed on July 19, 1969 (disposal location not identified). An asphalt roadway was completed in the area on July 22, 1969. No further documentation was found regarding response to this occurrence (EG&G, 1992).

The nearest downgradient sampling points to IHSS 150.7 are alluvial monitoring well P209289 and bedrock monitoring well P209389 (Figure 2-2). The nearest upgradient groundwater monitoring well is well 4486 located approximately 2,000 feet southwest of this IHSS. The data available for wells P209289 and P209389 are discussed in Subsection 2.4.1.1 for IHSS 118.1. As discussed in Subsection 2.4.1.1, groundwater quality data is limited for wells P209289 and P209389, particularly with regard to radionuclide concentrations. Due to the limited quantity of groundwater data that is available for these wells, the distance between these wells and IHSS 150.7, and the presence of several other IHSSs between these wells and IHSS 150.7, the available data can not be used define the nature and extent of contamination associated with this IHSS.

2.4.1.17 IHSS 150.8 - Radioactive Site Northeast of Building 779

In June 1969, an improperly-opened waste drum in Building 779 radioactively contaminated areas inside and near the building. The contamination was spread by pedestrian tracking to the walkways east and south of the building as well as to the dock and adjacent ground. The release consisted of radionuclides from radioactive waste. The contaminated soil was placed in barrels and removed for off-site disposal (location not identified). It is not known whether all areas affected by this incident were included in cleanup activities (EG&G, 1992).

The nearest downgradient sampling locations to IHSS 150.8 are the same as those discussed for IHSS 138 in Subsection 2.4.1.6. These locations are bedrock monitoring wells 2586, P207589, and P209089 and alluvial monitoring well 2686 (Figure 2-2). The data for these wells is presented in Subsection 2.4.1.6. Wells 2386 and 2486 are the nearest upgradient sampling locations. In addition, borehole SP03-87 is located near what is believed to be the southeast corner of IHSS 150.8 (Figure 2-2). A summary of the data available for borehole samples from borehole SP03-87 is provided in Table 2.29.

As discussed in Subsection 2.4.1.6, the data available for groundwater samples from wells 2686, P207589, and P209089 are limited in the number of samples collected and/or the analyses performed on the samples collected. Data for well 2686 are limited to the analyses of inorganic constituents in groundwater. Bicarbonate, chloride, nitrate/nitrite, and sulfate have been detected in concentrations exceeding background in this well. Groundwater samples from well P207589 have been analyzed only for VOCs and metals. No VOCs or metals have been detected in concentrations exceeding background in these samples. Groundwater samples from well P209089 have contained several VOCs. Analyses of metals and radionuclides in groundwater from this well have been limited. Gross alpha and uranium-238 were detected in concentrations exceeding background in the two samples of groundwater analyzed for radionuclides.

Several VOCs have been detected in groundwater samples from well 2586 (see Table 2.15). In addition, several metals and radionuclides have been detected in concentrations exceeding background. Radionuclides detected in concentrations greater than background include gross alpha, gross beta, radium-226, strontium-89,90, and uranium-238. The concentrations of uranium-238 have all been less than the maximum background concentration for that isotope. Bicarbonate and sulfate concentrations in groundwater from this well have also exceeded background.

As discussed in Subsection 2.4.1.6, radionuclide concentrations in well 2386, upgradient of IHSSs 138 and 150.8, have not exceeded background. Gross alpha and uranium-238 concentrations in groundwater from well P209089 downgradient of these IHSSs exceeded background concentrations in the two samples analyzed for radionuclides. The limited quantity of data that is available for groundwater samples from well P209089 and the presence of other sources of contamination in this area limits the usefulness of these data in determining impacts attributable to IHSS 150.8.

Borehole samples from borehole SP03-87 were analyzed for VOCs, semivolatiles, metals, radionuclides, and inorganic constituents. One sample of alluvium was also analyzed for pesticides and PCBs but none were detected. Bis (2-ethylhexyl) phthalate, di-n-butyl phthalate, N-nitrosodiphenylamine, all semivolatile organic compounds, were detected in samples of both surficial materials and bedrock. The phthalates detected are common plasticizers and often result from the use of plastic containers during sampling and laboratory activities. VOCs detected include methylene chloride and chloroform in bedrock samples. Blank contamination with methylene chloride and TCE was indicated for several samples from this borehole.

No metals were detected in concentrations exceeding background in samples of surficial materials from borehole SP03-87. Aluminum, arsenic, calcium, chromium, lead, nickel, and vanadium were detected in concentrations greater than background in bedrock samples, but none of the concentrations exceeded maximum background concentrations. Uranium-233,234 and uranium-

238 were detected in concentrations greater than upper tolerance limits but less than maximum background concentrations in samples of surficial materials. Tritium concentrations in bedrock samples exceeded background concentrations. Nitrate/nitrite concentrations exceeded background in samples of both surficial materials and bedrock. Based on the current understanding of the materials released, the data for borehole samples from borehole SP03-87 do not indicate contamination attributable to IHSS 150.8.

2.4.1.18 IHSS 151 - Fuel Oil Leak (Tank 262 North of Building 374)

The first documented spill at this site was on August 12, 1981, when about 196 gallons of No. 2 diesel fuel were spilled on the ground north of Building 374. An estimated 400 cubic yards of soil were affected by the 1981 spill (EG&G, 1992). The spill was 30 by 35 feet. A second spill released 50 gallons of No. 2 diesel fuel in July 1982. In October 1982, 120 liters were spilled. While conducting a routine system circulation of Tank 262, another spill of 10 to 20 gallons occurred in September 1988 when a vent was left open. IHSS 151 is currently defined by a boundary of approximately 60 feet by 45 feet and is located north of Building 374.

Reports from the 1981 incident indicated that cleanup would be initiated when the ground dried. It is documented that cleanup of the saturated soil occurred adjacent to the tank surface foundation after the 1988 spill (disposal location not identified) and that the State Oil Inspector was notified. A site visit conducted for the Phase I RFI/RI indicated that only small areas of staining, 1 to 3 feet in diameter, remained around the pad, suggesting cleanup of a larger 1981 spill (EG&G, 1992).

The nearest downgradient sampling location to IHSS 151 is bedrock groundwater monitoring well 2186 (Figure 2-2). Groundwater data available for this well is presented in Subsection 2.4.1.4 for IHSS 135. Although several VOCs, metals, and radionuclides have been detected in concentrations greater than background in samples from this well, these data are not indicative of releases of No. 2 diesel fuel. It should be noted, however, that samples from this well have

not been analyzed for many of the constituents that would be expected to result from a release of diesel fuel (e.g., semivolatile organic compounds).

2.4.1.19 IHSS 163.1 - Radioactive Site Northwest of Building 774

CEARP Phase I interviewees indicated the area northwest of Building 774 was used to wash radioactively-contaminated equipment. However, recent information obtained by Doty & Associates (Appendix B), indicate that this IHSS is actually located northeast of Building 774. The wash water flowed onto the ground. Building 774 personnel did not recall this area ever being used to wash equipment (EG&G, 1992).

Aerial photos from 1969 and 1971 show two areas east of this IHSS that were covered with mounds of soil. RFP personnel interviewed did not recall these mounds (EG&G, 1992).

The draft HRR states that the wash water would have contained low levels of radionuclides and may also have contained various unspecified organic and inorganic compounds (EG&G, 1992). These compounds may consist of some of those listed in Attachment 4 of the IAG (Appendix A). No radioactivity above background levels was indicated at this location by a radiological survey conducted from 1977 through 1984 (EG&G, 1992).

There are no wells or boreholes located within, adjacent to or downgradient of IHSS 163.1.

2.4.1.20 IHSS 163.2 - Radioactive Site North of Buildings 771 and 774

IHSS 163.2 is an area of approximately 60- by 40-feet located north of Buildings 771 and 774. An americium-contaminated slab is buried in the area near Building T771A by the Perimeter Road. The slab is approximately 8 feet square and 10 inches thick. From approximately 1962 until approximately 1968, the slab served as a foundation for a 5,000-gallon stainless steel tank located approximately 30 feet north of Building 771. The tank was on 6-foot legs and was

approximately 8 feet in diameter. Two overhead pipes from Room 114 in Building 771 connected to the tank; one of which was a vacuum vent to control transfer in and out of the other. The tank was used in the Filtrate Recovery Ion Exchange system which concentrated plutonium and americium for recovery. Americium concentrated on an ion exchange column and was transferred at a predetermined concentration to the tank. The resulting liquid contained in the tank was a nitrate solution high in americium with some plutonium (Doty & Associates, 1992 [Appendix B]).

In approximately 1968, a pinhole leak developed in the tank and dripped onto the slab. The tank was temporarily sealed to mitigate the leak until the tank could be emptied through the processing of the contained solution. Once emptied, the tank was taken out of service and remained in place until it was taken to the size-reduction facility in Building 776 sometime shortly after. Once size-reduced, the tank was disposed of as radioactive waste. When the tank was removed to the size-reduction facility, the concrete slab was decontaminated until the point where smear samples did not detect further removable radioactivity. Paint was applied to the concrete to secure the fixed radioactivity. The slab was moved to a ditch directly north of the area and buried. The area was paved sometime prior to June 1969. In the mid-1970s, Building T771A, a prefabricated structure, was constructed in the same general area. None of the persons interviewed for this investigation recalled any subsequent excavation of the slab. The slab lies underground near or beneath the east end of T771A at a probable depth of less than 10 feet (Doty & Associates, 1992 [Appendix B]).

An environmental summary report from 1973 does not indicate the incident in the summary of environmental incidents impacting the soil at the RFP; however, the report does have a notation of the slab on a map of the area north of Building 771. The report indicates an area farther to the north of where the slab is believed to be buried and states that it was later excavated and the contaminated portion cut away for off-site disposal. This is not believed to be the case. The location indicated on the map cannot be accurate because it is in an area that was paved several

years before the slab became contaminated. As stated above, there has been no verification that the slab was subsequently excavated (Doty & Associates, 1992 [Appendix B]).

The results of the Radiometric Survey, conducted at the RFP during the late 1970s and early 1980s, indicate no extremely-contaminated areas (stated to be 500,000 to 1,000,000 $pCi/g)^3$ north of Building 771 (Doty & Associates, 1992 [Appendix B]).

An Aerial Radiological Survey of the RFP conducted during July 1989 did not indicate anomalous concentrations of americium-241 in the area north of Building 771. However, the survey was not structured to identify sources that occupied a small area (200 meters in diameter was the target size and less than 10 meters in diameter would not have been detected with confidence) (Doty & Associates, 1992 [Appendix B]).

The 8- by 8-foot slab is probably still buried beneath the pavement near Building T771A. There was no mention of americium-contaminated soil being buried with the slab; however, because the slab had been located on soil, it is likely that some soil from beneath the slab was also deposited when the slab was pushed into the ditch. The slab had as much contamination removed as possible and was then painted to seal the fixed contamination. Therefore, it is not likely that there is a significant amount of contaminated soil surrounding the slab. Other material of an unknown source was backfilled into the ditch prior to the area's being graded and paved (Doty & Associates, 1992 [Appendix B]).

There are no wells or boreholes located within, adjacent to or downgradient of IHSS 163.2.

2.4.1.21 IHSS 172 - Central Avenue Waste Spill

This IHSS is listed in the draft HRR as being assigned to no specific geographic area because it extends across much of the RFP. In June 1968, according to reference documents, one or two drums containing plutonium-tainted oil and oils with lathe coolant (70 percent hydraulic oil and

30 percent carbon tetrachloride) leaked along this path while in transit. Only the northbound and westbound lanes reportedly were affected (believed to include Sixth Street, 51 Drive and Central Avenue). It was speculated that the drum(s) were punctured by a forklift while being loaded at the 903 Pad and were not noticed by workers until the vehicle had reached its destination at Building 771. Affected pavement was radioactively contaminated with levels up to 140,000 dpm/100 cm^2 (EG&G, 1990).

A former Rockwell employee recalled a number of details about this incident. The leak occurred near the end of the work day. A forklift was dispatched to transport several drums of contaminated lathe coolant on a pallet from the 903 Pad to Building 771. The drums generally were transported by truck. However, these three drums represented some of the last remaining drums at the 903 Pad, and the small load may not have warranted a truck. Only one of the three drums leaked, and the drum released only a small portion of its contents, suggesting that the spill involved perhaps 10 gallons or less. The leak resulted from sloshing of the drum contents through an improperly sealed bung during transport. Because of this, no more material was likely to have spilled at stopping points than at other points along the route. The spill was detected when the forklift reached Building 771, and the affected roadway was quickly cordoned off. An effort was made to cleanup the spill, and the roadway was seal-coated before being reopened to RFP traffic (EG&G, 1990).

An unknown amount of "low-level material" reportedly spread to the ditch along the north side of Central Avenue as a result of this spill. Aerial photographs, taken in 1969, of RFP show that this ditch ran along essentially the entire affected length of Central Avenue. Most of the ditch has since been paved over, lined with concrete, or filled in by subsequent construction. Available references do not indicate what area(s) of the ditch received contamination. Because the release was relatively small and the cleanup response was very timely, significant contamination of the ditch is not expected (EG&G, 1990).

Most of the affected roadway has since been repaved and remains heavily used. A section of Central Avenue between Eighth and Tenth Streets was removed in August 1970 and placed in an asphalt dumping area east of Building 881. The section of Sixth Street between Sage Avenue (outside the Protected Area) and the perimeter road within the Protected Area was removed during Protected Area construction between late 1980 and late 1982. The fate of the removed asphalt is not known (EG&G, 1990).

Based upon the above information, it is recommended that IHSS 172 be redefined to exclude those portions of the roadway subsequently removed. These include Central Avenue between Eighth and Tenth Streets (approximately 1,050 ft) and Sixth Street between Sage Avenue and the Protected Area perimeter road (approximately 320 feet) (EG&G, 1990).

Because of the small quantities of material believed to have been released during the incidents described above, the cleanup efforts undertaken at the time of these incidents, and disturbance of the areas affected by construction activities and paving, it is unlikely that contamination attributable to these releases would be detectable in boreholes or wells located adjacent to or downgradient from the roadways. Any residual contamination from these releases is likely to be confined to the immediate vicinity of the roadway and unloading points.

2.4.1.22 IHSS 173 - Radioactive Site - 900 Area (Storage Vaults Near Building 991)

IHSS 173 is located adjacent to the southwest side of Building 991. Incidents involving very small quantities of plutonium, uranium, and beryllium have been noted in Building 991. The south dock of Building 991 is located on the west side of the building and is a loading facility for the tunnels. Small spills have occurred in the area. Small parts and equipment were washed in the dock area. No documentation was found detailing releases to the environment (EG&G, 1992).

According to CEARP Phase I, routine surveys of the vaults have indicated that they are free of radioactive contamination, with the exception of tunnel 996, which might be slightly uranium-infiltrated (EG&G, 1992). However, the August 1981 aerial radiological survey recorded 8,000 - 16,000 cpm of gross "man-made" radioactivity and 1,000 - 2,000 cpm of americium activity centered around Building 991 (EG&G, 1990). Final products containing plutonium and uranium were shipped from the dock, but no raw products were involved in the operations ongoing within Building 991. Acetone and perchloroethene were the solvents used within the building. No documentation was found detailing constituents which may be present in the dock area, nor was documentation available detailing responses to occurrences in the dock area (EG&G, 1992).

The IAG indicates the entire building and the area over the tunnels and vaults should be included in the IHSS primarily because of the age of the structures. However, interviews and documentation indicate that activities which may have affected the site took place only at the south dock of Building 991. The building and the vaults were used to assemble and store final products, which consisted of nickel-plated plutonium (not considered a radioactive threat). There was no documentation found indicating any contamination. Even though there was no documentation found indicating potential for contamination of this area, it is believed from interviews with retired RFP personnel involved with the activities of this area that the south dock would have a greater probability than the building or vaults of being potentially contaminated. Therefore, it was proposed in the HRR that this IHSS be reduced in size to include only the southwest corner of Building 991. The south half of the building was used for offices and the northern half for laboratories and research. No documentation exists for the entire building being considered potentially contaminated (EG&G, 1992).

Alluvial monitoring well 2187 and bedrock monitoring well 2287 are located downgradient of IHSS 173 approximately 450 feet to the east (Figure 2-2). Groundwater samples have been collected from these wells on a quarterly basis since March 1988. Summaries of the data available for these wells are provided in Tables 2.30 and 2.31. There are no wells located immediately upgradient from this IHSS.

Acetone and PCE have been detected in groundwater samples collected from well 2187. Carbon disulfide and methylene chloride were also detected at concentrations less than method detection limits. Blank contamination with methylene chloride was indicated for several samples collected from this well. Analyses of metals and radionuclides have been limited. One sample was analyzed for metals and calcium, copper, magnesium, nickel, sodium, and zinc were detected in concentrations exceeding background. The concentrations of magnesium and sodium detected were less than maximum background concentrations. Uranium-233,234 and uranium-235 have been detected in concentrations exceeding background in this well. One sample was analyzed for plutonium, but none was detected. Bicarbonate, chloride, and sulfate concentrations in this well have also exceeded background concentrations.

One groundwater sample collected from well 2287 contained a detectable concentration of PCE. One sample also contained MEK at a concentration less than the method detection limit. Acetone and methylene chloride were detected in several samples but blank contamination was indicated for those samples. Calcium concentrations in groundwater from this well have exceeded background but have all been less than the maximum background concentration for calcium. Americium-241, cesium-137, strontium-89,90, and uranium-235 have also been detected in concentrations exceeding background. Sulfate concentrations in this well have exceeded background but are generally less than the maximum background concentration.

The groundwater chemistry data available for wells 2187 and 2287 indicate that groundwater downgradient of IHSS 173 has been impacted by RFP operations. The detection of acetone and PCE in groundwater collected from well 2287 indicates that the possibility that these constituents may have been released from this IHSS can not be ruled out at this time. The above-background concentrations of several radionuclides detected in groundwater samples from both wells may also be attributable to releases from this IHSS. As discussed in Subsection 2.4.1.23, these wells are also downgradient of IHSS 184 which may also have contributed to the levels of radionuclides detected.

2.4.1.23 IHSS 184 - Radioactive Site - Building 992 Steam Cleaning Area

The Low-Priority Sites report states that this area possibly was used between 1953 and 1978 to steam clean radioactively-contaminated equipment and drums. The rinse water was collected in a sump for treatment in RFP's process waste system. Radiometric surveys have not detected radioactivity above background levels at this site (EG&G, 1990).

Building 991 personnel indicated that steam cleaning was done in an area within the southwest corner of the Building 991, not beside the guard shack or elsewhere outside the building. This was discontinued around 1969 when new cleaning facilities became available. The area was used to clean stainless-steel containers needed to ship materials to other U.S. AEC (now DOE) facilities. These containers were returned empty to Building 991 by the other facilities and were steam cleaned prior to reuse. They were screened for radioactive contamination as a shipping requirement before being returned to RFP; the steam cleaning was not intended to decontaminate the containers, only to clean them. The cleaning was done on a concrete floor which is still in place. Wash water ran into an outside drain which flowed south and east beneath pavement before emptying into an unlined ditch just southeast of the building. Although not included with this IHSS, the 400 linear feet downstream (east) of the IHSS will be investigated utilizing radiation surveys and possibly sediment sampling. The drain system is also still in place (EG&G, 1990). IHSS 184 is an area of approximately 55- by 75-feet, located south of Building 991.

The IAG indicates that spillage from IHSS 184 is visible on August 6, 1971 aerial photographs of the RFP. Originals of these photographs are relatively sharp but small-scale (approximately 1 in = 2,200 ft), and spillage emanating from the steam cleaning area was not identified under 10x stereoscope magnification. Small discolored areas perhaps are evident on the ground east of Building 991, but do not appear to originate at the steam cleaning area. Building 991 personnel indicated that steam cleaning was discontinued prior to the aerial photo date (EG&G, 1990).

The nearest downgradient wells to IHSS 184 are wells 2187 and 2287. The groundwater chemistry data available for these wells is discussed in Subsection 2.4.1.22 for IHSS 173. Acetone, PCE, several metals, and several radionuclides have been detected in concentrations exceeding background in these wells. As discussed in Subsection 2.4.1.22, the levels of radionuclides detected in groundwater samples from these wells may be attributable, at least in part, to releases from this IHSS.

2.4.1.24 IHSS 188 - Acid Leak (Southeast of Building 374)

IHSS 188 is an area of approximately 110 feet by 65 feet adjacent to the southeast side of Building 374. The surface was flat and unpaved at the time of the acid leak and was later paved in the mid-1980s.

The CEARP Phase I report documents a 55-gallon drum of mixed hydrochloric and nitric acids leaked near the east gate of Building 374 in 1983. The mixed acid most likely was waste metal leaching solution from the 400 complex, and might have contained very trace amounts of heavy metals. The byproducts of the neutralization occurring by buffering action of the soil (i.e., nitrate, chloride) would be relatively benign and highly mobile in the environment (EG&G, 1990).

There is a limited amount of data available that would assist in defining the nature and extent of contamination potentially associated with this IHSS. Hydrogeologic conditions in the area are expected to be similar to that found in well P114789 which is over 400 feet to the south of the IHSS. In this well 26 feet of clayey sand overly Arapahoe claystone. High water levels are within six feet of the ground surface. It is likely that a small acid spill at the IHSS with similar hydrogeologic conditions, would be rapidly diluted if it reached the water table given the 20-plus feet of saturated material that exist during periods of high water levels. The nearest downgradient well, 1986, is located approximately 900 feet to the northeast. Due to the distance between this well and the IHSS, the presence of other potential sources of contamination between

the well and the IHSS, and the small quantity (55 gallons maximum) of liquid released during the incident, it is improbable that any impacts attributable to this release would be detected in this well. Any residual impacts from this release, if detectable, would likely be confined to surficial materials in the immediate area of the release.

2.4.2 Current Conditions within OU8 - Surface Water and Sediments

The purpose of this section is to summarize probable surface-water impacts and data requirements associated with the planned Phase I RFI/RI efforts. To the extent possible, reference is made to available relevant data and information sources.

Subsections 2.4.2.1 through 2.4.2.3 discuss the nature and extent of contamination associated with each cluster of IHSSs within OU8. Data on surface-water and sediment monitoring are generally not discussed on an IHSS-specific basis due to the fact that the monitoring site locations are primarily within the drainageways downstream of multiple IHSSs. Therefore, a direct correlation between identified contaminants and an individual IHSS cannot accurately be made. These discussions are based primarily on the collective documented events related to a cluster of IHSSs.

Available sediment-chemistry and water-quality data from RFEDS database (EG&G, 1992) were retrieved for inclusion in this Work Plan for the following general categories of constituents:

A - Radionuclides;
B - Trace metals (including major cations and silicon);
C - Pesticides, major anions, and miscellaneous chemical constituents; and
D - Volatile Organic Compounds.

Relevant surface-water and sediment monitoring sites in the vicinity of OU8 are located on Figure 2-7. This figure also indicates the types of available data for each monitoring site. The data available for each monitoring site discussed in the following subsections are included in

Appendix G and are summarized in tables presented in the following subsections. Table 2.32 provides a listing of all the surface-water and sediment sites in the OU8 area for which RFEDS data were requested. Data for a total of 28 surface-water and 5 sediment monitoring sites were included. Data were requested for monitoring site SW010, but none were obtained. The RFEDS data files for SW119, SW120, and SW371 indicated no laboratory results.

A screening process was used to identify which monitoring sites and which type of contaminants at each site should be summarized in the tables. This screening resulted in reducing the number of surface-water sites to 16 (Table 2.32). The number of sediment sites for which data were evaluated remained at 5 (Table 2.32). For each monitoring site, the RFEDS data included files for four different categories of contaminants (A, B, C, and D), as described above . This resulted in 64 surface-water and 20 sediment data files. These categories were screened to identify which type of contaminant reportedly had been released from each IHSS, as indicated previously in Table 1.2. Data for the monitoring sites which have no data type identified were not evaluated because it was determined that no IHSSs located within OU8 contribute surface-water runoff to the available monitoring sites. This screening further reduced the number of data files from 64 to 42 for surface-water sites and from 20 to 13 for sediment sites.

The laboratory results in the remaining data files were summarized to facilitate an assessment of relevant data. Table 2.33 provides a summary of all the VOC data above detection limits, Table 2.34, provides a statistical summary of dissolved and total trace metals, Table 2.35 provides a statistical summary of the indicator radionuclides: total gross alpha and total gross beta concentrations, and Table 2.36 provides a statistical summary of selected inorganic water-quality variables.

The available surface-water and sediment monitoring sites are located downstream of the IHSSs but not necessarily in locations which collect runoff from single IHSSs. In all but three cases, are no monitoring sites located upstream of an IHSS (Table 1.2). Given the limits of monitoring-site locations in relation to the IHSSs within OU8, individual IHSSs have been clustered in

groups which contribute surface-water runoff to a common monitoring site. These are referred to as Cluster I through Cluster III. Table 2.37 provides a listing of the IHSSs located within each cluster and the category of contaminant(s) reported to have been released (Table 1.2). The resultant data were evaluated, and when applicable, selective comparisons were made with geochemical-characterization results reported in EG&G documents (EG&G,1990b; EG&G 1991c).

For development of this RFI/RI work plan, available data were compared, as appropriate, with the Colorado Department of Health's (CDH's) Water Quality Control Commission (WQCC) stream standards (ASI, 1991b; Appendix F), or the proposed groundwater concentration limits (EG&G, 1991e; Table 3.2). In addition, the applicable Federal and State of Colorado ARARs (EG&G, 1990b) were used for comparison.

It should be recognized that all of the conclusions in the following subsections are preliminary in nature in that they are based upon data of limited quantity and quality in OU8. The surface-water and sediment monitoring sites discussed in these subsections were not installed for the purpose of defining the nature and extent of contamination associated with the individual IHSSs for OU8. Thus, the monitoring sites are not ideally located for such a purpose and are often not sampled for the constituents of interest to a particular IHSS. In addition, most of these monitoring sites are located downstream from more than one IHSS in OU8, as well as other potential sources of contamination which relate to conditions in other OUs and that are not addressed by this Work Plan.

2.4.2.1 IHSS Cluster I - West OU8 Area Affecting North Walnut Creek

Cluster I consists of five IHSSs located in the northwest part of OU8. These IHSSs are identified by number as 135, 150.2, 150.7, 151, and 188. IHSS cluster I water-quality impacts are monitoring in large part at downstream surface-water site SW018. Concerns involve all 4 water-quality categories -- radionuclides, trace metals, indicator inorganics, and organic (priority-

pollutant) compounds; however, radionuclide potential impacts occur more frequently in this cluster (involving 3 of 5 IHSSs, see Table 2.37).

At site SW018, average dissolved gross-alpha and dissolved gross-beta concentrations (4.81 pCi/L and 8.95 pC/L, respectively, Table 2.35) were only slightly greater than those observed at site SW122 associated with IHSS cluster III (see Section 2.4.2.3 below) and less than those observed at the other sites (SW118 and SW093) involved in this assessment (see Section 2.4.2.2 below). Hence, radionuclide-related impacts associated with upstream IHSS cluster I appear to be relatively small compared to those associated with IHSS cluster II included in this assessment.

Average trace-metals concentrations at downstream site SW018 in general are low, relative to comparable trace-metals concentrations observed for sites upstream and downstream on North Walnut Creek (Table 2.34, and see Section 2.4.2.2 below).

Based upon tabulated selected inorganic variables for samples collected at downstream site SW018 (Table 2.36), none of the indicator constituents (nitrate/nitrite, phosphorus, sulfate, chloride, and dissolved solids were used in this assessment) appears to exhibit excessive concentrations that might indicate adverse impacts of IHSSs.

Regarding detectable concentrations of organic priority pollutants (volatile/semivolatile compounds, see Table 2.33), carbon tetrachloride and methylene chloride were the constituents detected (2 analyses and 6 analyses, respectively). It is noteworthy for this assessment that priority-pollutant data were available for 4 samples collected during 1991 at this site.

Sediments

No sediment sampling data were available at monitoring site SED010 (Table 2.32). These data were requested from RFEDS but not received. It is uncertain if any data are available for monitoring site SED010.

2.4.2.2 IHSS Cluster II - Northeast OU8 Area Affecting North Walnut Creek Basin

Cluster II consists of fourteen IHSSs located in the northeast part of OU8 (Table 2.37). These IHSSs are identified by number as 118.1, 137, 138, 139.1(N), 139.1(S), 139.2, 144, 150.1, 150.3, 150.6, 150.7, 150.8, 163.1, and 163.2. IHSS cluster II water-quality impacts are monitored in large part by surface-water sites SW018 and SW118 (upstream) and SW093 (downstream). Concerns involve all 4 water-quality categories -- radionuclides, trace metals, indicator inorganics, and organic (priority-pollutant) compounds; however, radionuclide potential impacts occur more frequently (involving 9 of 14 IHSSs, see Table 2.37).

Upstream-downstream radionuclide-concentration comparisons for this IHSS cluster are made more complicated because of the relatively large gross-alpha and gross-beta concentrations exhibited in samples for upstream monitoring site SW118 (see Table 2.35). Based upon tabulated data, these radionuclide contributions more severely affect concentrations at downstream site SW093 than possible direct effects of IHSS clusters I and II. This conclusion is based upon the relatively reduced concentrations of these indicator radionuclides at site SW093 and the relatively low dissolved gross-alpha and gross-beta average concentrations observed at site SW018 presumably downstream from the IHSS cluster I potential impacts.

Average trace-metals concentrations at downstream site SW093 generally (with exceptions noted below) are greater than either upstream site (SW018 or SW118), which may indicate relative impacts of IHSS cluster II. Specific trace-metals species noted in this manner includes dissolved antimony, dissolved and total arsenic, dissolved beryllium, dissolved and total lead, dissolved manganese, dissolved nickel, dissolved and total selenium, dissolved and total silver, and dissolved and total vanadium (Table 2.34). A concern in making this judgment is the inability of evaluating relative flow contributions from either upstream site and from intervening drainage areas as they contribute to flow monitoring at site SW093. In several instances, inflow average concentrations from upstream site SW118 exceeded those observed for downstream site SW093, indicating possible adverse impacts from sources outside of the OU8 area. These involved the

following trace-metal species: total antimony, total cadmium, dissolved and total chromium, total manganese, total nickel, total vanadium, and dissolved zinc (Table 2.34). Also, relative concentrations of total lead and total zinc were higher at sites SW118 and SW093 compared to SW018 (Table 2.34), indicating existing conditions at these two North Walnut Creek monitoring sites. With these complicating factors, it was difficult with the areal monitoring coverage to discern impacts on stream trace-metals concentrations specific to IHSS cluster II.

Based upon tabulated selected inorganic variables for samples collected at upstream sites SW018 and SW118 and at downstream site SW093 (Table 2.36), none of the indicator constituents (nitrate/nitrite, phosphorus, sulfate, chloride, and dissolved solids were used in this assessment) appears to exhibit excessive concentrations that might indicate adverse impacts of IHSSs. Average concentrations at these sites are as follows (Table 2.36): (1) nitrate/nitrite, 1.6 mg/L at SW018; 0.45 mg/L at SW118, and 1.8 mg/L at SW093; phosphorus, 0.17 mg/L at SW018, 0.05 mg/L at SW118, and 0.18 mg/L at SW093; sulfate, 35 mg/L at SW018, 18 mg/L at SW118, and 35 mg/L at SW093; chloride, 54 mg/L at SW018, 39 mg/L at SW118, and 40 mg/L at SW093, and dissolved solids, 369 mg/L at SW081, 259 mg/L at SW118, and 317 mg/L at SW093.

Regarding detectable concentrations of organic priority pollutants (volatile/semivolatile compounds, see Table 2.33), carbon tetrachloride and methylene chloride were the constituents detected (2 analyses and 6 analyses, respectively) at upstream site SW018 (4 samples during 1991), and methylene chloride (3 analyses), di-n-butyl phthalate (1 analysis), and acetone (1 analysis) were found at upstream site SW118 (1 sample in 1990 and 2 samples in 1991). In contrast, a total of 27 detectable concentrations were found in 11 samples collected during 1990 and 1991, involving 9 priority-pollutant compounds; most commonly detected were methylene chloride, trichloroethene, 1,1-dichloroethane, acetone, and 1,1,1-trichloroethane (Table 2.33). Thus, the detectable concentrations of priority-pollutants appear to occur more frequently at the downstream monitoring site SW093, which may reflect organic-contamination impacts of OU8 IHSSs predominately in the identified cluster II.

Sediments

No sediment data were available along North Walnut Creek downstream of Cluster II. Data for monitoring site SED09 were requested from RFEDS but none were received.

2.4.2.3 IHSS Cluster III - South OU8 Affecting South Walnut Creek

A comparison of available water-quality data at surface-water site SW122 was made to assess possible OU8-related impacts at these monitoring locations in the RFP surface-water system. However, it needs to be kept in mind that water-quality impacts at these locations are possible (undoubtedly probable, see Table 1.3) from IHSSs included in other OUs.

Cluster III consists of five IHSSs located in the south part of OU8. These IHSSs are identified by number as 118.2, 123.1, 150.4, 150.7, and 172. IHSS cluster III (adjusted to exclude IHSSs 173 and 184) water-quality impacts are monitoring in large part at downstream surface-water site SW122. Concerns involve only 2 of the 4 water-quality categories -- radionuclides and organic (priority-pollutant) compounds.

At site SW122, average dissolved gross-alpha and dissolved gross-beta concentrations (3.48 pCi/L and 5.65 pC/L, respectively, Table 2.35) were less than those observed at the other sites (SW018, SW118, and SW093) involved in this assessment (see above discussions). Hence, radionuclide-related impacts associated with upstream IHSS cluster III appear to be less than those associated with other OU8 IHSS clusters included in this assessment.

Regarding detectable concentrations of organic priority pollutants (volatile/semivolatile compounds, see Table 2.33), methylene chloride (3 analyses), di-n-butyl phthalate (1 analysis), and acetone (1 analysis) were the constituents detected. It is noteworthy for this assessment that priority-pollutant data were available for 3 samples collected during late 1990 and 1991 at this downstream site.

Sediments

Sediment data were available along North Walnut Creek downstream of Cluster III. The nearest downstream sediment monitoring site is SED011. Further downstream is sediment monitoring site SED012.

2.5 CONCEPTUAL MODELS OF RELEASES AND RECEPTOR PATHWAYS

2.5.1 Summary of IHSS Conceptual Models

A conceptual model of exposure pathways was developed here for each of three IHSS groups in OU8 using the known site physical conditions and potential contaminant sources described in Sections 2.3 and 2.4. The conceptual models were developed for use in the evaluation of potential risks of OU8 contamination to human health and the environment. The IHSSs were organized into the three groups to simplify the conceptual models. The IHSSs are categorized based on contaminant source type and release mechanisms.

The three groups are as follows:

Group I - Leaks, Spills, and Overflows of Tanks and Pipelines Originating Below Ground Surface

Group II - Releases Associated with Fires and Explosions

Group III - Leaks, Spills, and Overflows of Tanks, Pipelines, and/or Drums Originating Above Ground Surface

The primary purpose of a conceptual model is to aid in identifying exposure pathways through which human and biotic receptors may be exposed to contaminants. The EPA defines an exposure pathway as "...a unique mechanism by which a population may be exposed to chemicals at or originating from the site..." (EPA, 1989a).

As shown in Figure 2.5-1, an exposure pathway includes a contaminant source, a release mechanism, a transport medium, an exposure route, and a receptor. An exposure pathway is not complete without each of these five components. The individual components of the exposure pathway are defined as follows:

- Contaminant Source: For purposes of the OU8 conceptual models, the contaminant source is divided into primary and secondary sources (media which that potentially been affected by these releases).

- Release Mechanism: Release mechanisms are physical and/or chemical processes through which contaminants are released or interact from one or more sources. The conceptual model identifies mechanisms that released contaminants directly from the primary sources (i.e., leaks, spills, overflows, etc.), and mechanisms that may release contaminants directly from the secondary contaminant sources.

- Transport Media: The environmental media into which contaminants are released from the source and from which contaminants are in turn released to a receptor are transport media. Potential transport media for OU8 include air, surface water, vadose zone, groundwater, and biota.

- Exposure Route: Exposure routes are avenues through which contaminants are physiologically incorporated by a receptor. Exposure routes for receptors at OU8 are inhalation, ingestion, and dermal contact.

- Receptor: Receptors are human or environmental populations that may be affected by the contamination released from an IHSS or group of IHSSs. Human receptors for OU8 include RFP workers and visitors. Offsite populations are considered receptors of secondary releases carried offsite by secondary release mechanisms. Environmental receptors are biota (both flora and fauna) indigenous to the OU8 environs.

2.5.2 OU8 Generalized Conceptual Model

A diagram of the conceptual models for potential contaminant sources, transport media, exposure routes, and potential receptors relating to the OU8 IHSSs is presented in Figure 2.5-2. The various aspects of the conceptual model are explained in the following sections.

2.5.2.1 Contaminant Sources

The 24 IHSSs that constitute OU8 are located inside and around the Protected Area of the RFP. This area is physically enclosed with a security fence. Access is restricted to authorized personnel or visitors escorted by authorized personnel.

Contamination sources within the various IHSSs include above-ground and underground tanks, underground pipelines, equipment decontamination areas, and releases inside buildings which may have affected areas around the buildings. Contaminants from these sources may have been introduced into the environment through spills on the ground surface, underground leakage and infiltration, explosion and/or fire, and in some cases through incident precipitation run-on and run-off. Contamination may still be entering the environment from some of the sources; in other areas, the sources may be exhausted or may have been physically mitigated through remediation at the time of the initial release.

Exclusive of volatilization to the atmosphere, the contaminants first enter the environment through the soil, and are transported by various mechanisms from affected soil to unaffected media. Therefore, for conceptual purposes, contaminated soils are considered a secondary contaminant source in each IHSS.

The chemical composition of the contaminants also varies widely between the IHSSs, ranging from low-level mixed wastes to nonradioactive organic and inorganic compounds.

In the unsaturated (vadose) zone, free liquids are expected to move generally downward to the water table, which varies in the OU8 area from a few to more than 10 feet depending upon location and time of year. If, however, the leakage or release rate exceeds the infiltration capacity of the soil, or if the surface is covered with an impermeable material (i.e., asphalt), then the liquid may pool or flow across the material surface to a more permeable material where infiltration can occur. In an instance where the release is from a pressurized source (i.e.,

pressurized pipeline), or the rate of leakage from an underground release exceeds the soil's infiltration capacity, the release may rise to the surface. This has occurred during a number of historical pipeline and valve vault leaks at the RFP. Liquids infiltrating the soil may also encounter a less permeable layer (low-flow boundary) and flow laterally through the more permeable soil along the boundary. At the RFP, such permeability contrasts are likely at the alluvium/bedrock contact.

Most RFP pipelines are believed to be bedded either in sand or in native soil backfill. Hydraulic conductivity in clean sand ranges from approximately 10^{-3} to 1 cm/sec. The hydraulic conductivity in the Rocky Flats Alluvium, the deposit in which the majority of RFP pipelines are located, ranges from approximately 1×10^{-2} to 7×10^{-5} cm/sec. The Valley Fill Alluvium, another common deposit at the RFP, has a hydraulic conductivity that ranges from 3×10^{-3} to 5×10^{-6} cm/sec (EG&G, 1991g and 1991k). The hydraulic conductivity of unconsolidated deposits such as the Rocky Flats Alluvium is expected to increase when the deposit is disturbed (i.e., excavated and replaced as backfill material) due to increased porosity in the disturbed material.

It is therefore considered likely that most pipeline releases initially flowed preferentially through the trench materials and permeated the surrounding native soils to a much lesser extent than the trench materials. Over time, the released materials may gradually have infiltrated surrounding native soil, particularly the soil beneath the trench. Thus, contaminant plumes from pipeline releases are expected to be strongly aligned along pipeline trenches, and perhaps to extend below the trenches into underlying soils. Groundwater that may periodically or perennially saturate pipe trenches can also be expected to flow preferentially through the trench materials. Any resulting spread of contamination should remain strongly oriented along the trench.

Contaminant plumes resulting from slow, gradual pipeline leaks may be less prevalent along pipeline trenches than those from releases with higher flow rates. It is probable that many leaks occurred from the pipelines that were never detected due to low flow rate. It is also probable that some major or catastrophic releases were preceded at the same location by a longer period

of slow leakage as the pipeline gradually failed. However, it is still considered likely that the relatively much higher hydraulic conductivity of the trench materials will control the orientation of contaminant plumes from gradual pipeline leaks, albeit to a lesser degree than those from more sudden releases.

Tank releases are most likely to occur at tank openings (i.e., overflows), tank/pipe connections, the base of the tank where residual waste collects, where underground tanks may be in contact with groundwater, at cold joints along the walls of concrete tanks, and at structural beams that could be affected by differential settlement of the tank bedding or supports.

Releases from such locations would likely affect the environment immediately surrounding the tank, particularly where the release is from an underground tank bedded in backfill. Based on these conceptual tank release locations, contamination will most likely exist beneath or near external connections and openings, near joints or corners around underground tanks, and beneath the base of the tank.

Most IHSSs in OU8 overlie or are immediately adjacent to other nearby IHSSs. Thus, it may not always be possible to differentiate between contamination from specific IHSSs. Therefore, the precise extent of contamination from a given IHSS, may be difficult or impossible to determine.

2.5.2.2. Potential Transport Mechanisms and Receptors

As mentioned above, potential transport mechanisms in OU8 include air, surface water, vadose zone, and groundwater. Air pathways will be addressed by surface soil, sediment, and soil gas characterization. The surface water pathway will be addressed by surface water and sediment sampling. The groundwater pathway will be addressed by subsurface soil and water sampling and hydrostratigraphic unit examination through the use of soil and bedrock boreholes and

groundwater wells. Individual IHSS potential contaminant pathways may commingle with pathways from other IHSSs.

Potential contaminant receptors include RFP workers, off-site residents, and terrestrial and aquatic biota. These receptors could be exposed to OU8 contaminants through ingestion, inhalation, or dermal contact (Figure 2.5-2).

Air

Potential movement of contaminants (particles) by wind is possible wherever contaminated soils exist or at IHSSs that are uncovered (i.e., no asphalt pavement or concrete). The likelihood of airborne contamination increases greatly if the site is disturbed by traffic, construction, or similar activity. Dust-borne contaminants mobilized by wind have been documented in some areas of the RFP.

Some releases involving constituents such as volatile organic compounds (VOCs), while impacting air quality for a time near the release, typically do not spread contamination to secondary media through the air transport mechanism. However, organic vapors emanating from soils in the vadose zone can serve as an indicator of subsurface releases and potential soil contamination. The movement of organic vapors through soil is controlled by the specific properties of the contaminant and the soil as well as other physical parameters and physical characteristics of the soil.

Surface Water and Sediments

Surface soils and sediments may have been affected by releases that originated at the ground surface or releases that have surfaced from underground leaks. Precipitation runoff across these areas could then move the contamination into nearby drainages or surface impoundments. A

system of collection ditches and ponds control runoff at the RFP. Some of these ditches and ponds are under investigation as separate IHSSs and sometimes separate OUs.

It is possible that surface water may also be indirectly affected by contaminated groundwater discharging to surface water bodies such as ditches, ponds, and creeks from footing drains beneath the 700 series buildings and natural seeps.

Vadose Zone and Groundwater

Groundwater recharge from incident precipitation may occur through uncovered ground surfaces within the RFP. It is anticipated that mobile constituents of contamination in uncovered areas may eventually migrate into the vadose (unsaturated) zone, or eventually to the groundwater system. Unlined drainages, both natural and manmade, are probably a primary source of groundwater recharge in the RFP. Contaminants underlying these sources can be expected to reach the water table more quickly. Soils overlain by pavement and buildings, on the other hand, may be subject to little or no downward percolation of water, and contaminants in such soils may remain relatively immobile.

2.5.3 GROUP-SPECIFIC CONCEPTUAL MODELS

This Section presents a general summary of the OU8 characteristics by group followed by descriptions of group-specific contaminant sources, release mechanisms, transport media, exposure routes, and receptors. Section 2.5.3 is summarized in Figure 2.5-2. Detailed descriptions of the backgrounds and physical settings of the IHSSs making up these groups were presented in Section 2.3. Section 2.4 presented detailed information on the nature and extent of contamination specific to each IHSS.

2.5.3.1 Group I - Leaks, Spills, and Overflows of Tanks and Pipelines Originating Below Ground Surface

Most of the IHSSs in this group are associated with either the Process Waste Lines (PWLs), or the Cooling Towers. This grouping is primarily based on similar contaminant types (generally process wastes), and release mechanisms (leaks and overflows). The Original Process Wastes Lines (OPWL) system is considered a separate Operable Unit (OU9). More specific information regarding OU9 may be found in the Final Phase I RFI/RI Work Plan for OU 9 (EG&G, 1991). The specific IHSSs associated with Group I are: IHSS 118.1 - Solvent Spills (West End of Building 730), 123.1 - Valve Vault 7 (West of Building 730), IHSS 135 - Cooling Tower Blowdown (Southeast of Building 374), IHSS 137 - Cooling Tower Blowdown (Building 774), IHSS 138 - Cooling Tower Blowdown (Building 779), IHSS 144 - Sewer Line Breaks (Building 730, Tanks 776 A-D, Leaks near Buildings 701 and 779), and IHSS 150.3 - Radioactive Site (Between Buildings 771 and 774). Figure 2.5-3 presents a schematic diagram of the conceptual model for Group I.

2.5.3.1.1 Contaminant Sources and Release Mechanisms

Primary Sources and Release Mechanisms

IHSS 118.1 - Solvent Spills West End of Building 730 (IAG Name: Multiple Solvent Spills West of Building 730

The primary source of contamination at IHSS 118.1 is considered to be a 5,000-gallon underground carbon tetrachloride storage tank that was located adjacent to the west side of Building 730. It is speculated that the tank or its associated pipes may have been releasing the carbon tetrachloride into the ground.

The primary release mechanisms at this IHSS are believed to be overflow and leakage. Several incidents involving leakage have been reported. In one such incident the tank failed, releasing

carbon tetrachloride into the tank's sump. The sump subsequently pumped some of the liquid onto the ground surface.

IHSS 123.1 - Valve Vault 7 (Southwest of Building 707)

The primary source of contamination at IHSS 123.1 is considered to be Valve Vault 7, which is located to the southwest of Building 707, adjacent to the north side of the PA inner fence. Valve Vault 7 controls the 800 Area main PWL.

The primary release mechanism at this IHSS is a leak/overflow. A check valve in Valve Vault 7 malfunctioned allowing process wastewater to backflow into the sump. The vault filled with process wastewater and overflowed. The process wastewater drained into an adjacent storm runoff collection system ditch near Eighth Street and Sage Avenue and flowed east toward South Walnut Creek and the B-Series drainage ponds. Runoff was noticed flowing across the former 750 Parking Lot, through the Building 991 normal runoff drainage.

IHSS 135 - Cooling Tower Blowdown (Southeast of Building 374)

The primary source of contamination at IHSS 135 is suspected to be the Building 374 cooling tower which may have released blowdown water to the area. Blowdown water is typically routed through an underground pipe into the RFP's sanitary sewer system for treatment.

The primary release mechanism at this IHSS is unknown. No leaks or other incidents involving blowdown water from Building 374 has been documented. The only known release involved the use of a Building 373 cooling tower pond. The cooling tower was cleaned and the slurry portion was pumped into a small retention pond. Overnight, some of the water leaked through the dirt dike and gate valve and drained into Walnut Creek.

IHSS 137 - Cooling Tower Blowdown (Building 774)

The primary source of contamination at IHSS 137 is considered to be a cooling tower (either in Building 712 or 713). It is speculated that the primary source may actually have been the Building 779 cooling tower. Cooling tower blowdown pipes leave the towers on their south sides. These pipes are considered the most probable source of any blowdown water contamination around the cooling towers.

The primary release mechanism at this IHSS was leakage. In one instance it was reported that cooling tower water was released south of Building 774 and flowed north into Walnut Creek. Another leak came from either Building 712 or Building 713. The leak has been estimated to have involved a flow rate of between 5 and 20 gallons per minute. The duration of the leak was unknown, but could have occurred several months prior to reporting.

IHSS 138 - Cooling Tower Blowdown Building 779

The primary source of contamination at IHSS 138 is considered to be an underground cooling tower water line east of Building 779. An additional source at this IHSS may also be the Building 783, #2 cooling tower.

The primary release mechanisms at this IHSS are thought to be a leak from a break in the cooling tower water line, and an overflow in the Building 783, #2 cooling tower.

IHSS 144 - Sewer Line Breaks (Building 730, Tanks 776 A-D, Leaks near Buildings 701 and 779)

The primary sources of contamination at IHSS 144 are considered to be four underground waste holding tanks located north of Building 776 and east of Building 701, in a small structure identified as Building 730. They are designated as Tanks 776 A through D. Tanks 776 A and B were laundry waste holding tanks, and Tanks 776 C and D were process waste holding tanks.

The primary release mechanisms associated with this IHSS are leaks and overflows. In 1972, increased pumping rate during a transfer of laundry waste water from Tanks 776 A and B to Building 995 caused suspension of high level sediment in the tanks and pressurization of the sanitary waste line. The pressurization of the line caused a commode and sink in Building 701 to overflow, and a patch to rupture in the line east of the waste holding tanks. Due to the overflow of the commode and sink, the toilet, sink, and floor of Building 701, as well as the ground east of the building, were contaminated. The patch which ruptured was apparently located between Buildings 777 and 779. At the time of the incident, maintenance may have been cleaning out a clean out plug near Building 701, further increasing the potential impacts on the environment.

IHSS 150.3 - Radioactive Site Between Buildings 771 and 774 (IAG Name: Radioactive Leak Between Buildings 771 and 774)

The primary source of contamination at IHSS 150.3 is believed to be process waste lines in a cement tunnel running between Buildings 771 and 774.

The primary release mechanism at this IHSS is leakage of the PWL.

IHSS 150.5 - Radioactive Site West of Building 707 (IAG Name: Radioactive Leak West of Building 707)

Pursuant to the Hazardous Release Report (DOE, 1992), IHSS 150.5 is described to be the same as IHSS 123.2 - Valve Vault West of Building 707. According to CDH directives, letter dated April 21, 1992, IHSS 123.2 is to be addressed during investigation activities planned for Operable Unit 9. As such, and due to its redundancy, IHSS 150.5 has not be addressed further in this Work PLan for OU8.

Secondary Sources and Release Mechanisms

Soils have been contaminated as a result of past releases associated with the IHSSs in Group I. It is possible that sediments, surface water, and groundwater have also been affected. Carbon tetrachloride, which is the contaminant involved in IHSS 118.1, has been detected in nearby wells. This indicates that soils are very likely affected at this IHSS. In light of this, soils, surface water and transported sediments, and groundwater should be considered as potential secondary sources within this group.

Secondary release mechanisms associated with Group I's soil contamination are considered to be leaching of contaminants from the soils and sediments by percolating groundwater, volatilization and dispersion of fugitive dust, and infiltration of contaminated groundwater and incident precipitation through uncovered or unlined land surfaces, depressions, and ditches.

2.5.3.1.2 Transport Media, Exposure Routes, and Receptors

Transport Media

Historical accounts of the IHSSs associated with Group I indicate that the releases could potentially have impacted the transport media of air, surface water, vadose zone, and groundwater through pathways illustrated in Figure 2.5-2.

Air

Air is considered a transport mechanism for Group I due to the likelihood of soils having been affected and their consideration as a secondary source. Potential movement of contaminants (particles and volatiles) by wind is possible wherever the ground surface is affected. The likelihood of airborne contamination increases greatly if the site is disturbed by traffic, construction, or similar activity.

Surface Water

Surface water is known to have been affected by releases associated with some IHSSs in this group, specifically IHSSs 123.1, 135, and 137. In addition, precipitation runoff across soils affected by Group I's IHSSs could move the contamination into nearby drainages or surface impoundments.

Surface water may also have been indirectly affected by contaminated groundwater discharging into surface water bodies such as ditches, ponds, and creeks from footing drains below the 700 series buildings and natural seeps.

Vadose Zone

The vadose zone is a potential transport media depending on the nature of the associated contaminant(s). If the contaminant is a "sinker," (i.e., an DNAPL) meaning that in its liquid state it is heavier than water, it will migrate through the vadose zone, into the water table, and to the bottom of the aquifer in question. Light non-aqueous phase liquids (LNAPLs) may also migrate through the vadose zone to the water table. In their vapor state, some contaminants could volatilize and rise to the ground surface if their molecular weight is lighter than that of air.

Groundwater

Groundwater recharge from incident precipitation occurs through uncovered ground surfaces within some of the IHSSs associated with Group I. It is possible that mobile constituents of contamination in uncovered areas eventually could leach into the groundwater system. Unlined drainages, both natural and manmade, are probably a primary source of groundwater recharge in the RFP, and contaminants underlying these features can be expected to reach the water table. In addition to contaminant migration to the water table, it is possible that direct releases to groundwater have occurred at IHSSs that involve underground storage tanks. The water table

at the RFP has been known to fluctuate several feet. During seasonal highs in the water table fluctuation cycle, the water table could rise above the base of the tank, making direct contamination likely.

Exposure Routes

Contaminants released from Group I IHSSs could potentially affect receptors through inhalation of airborne particles or vapors, and through ingestion of or dermal contact with contaminated source or transport media.

Receptors

Potential human receptors include RFP workers, visitors to the site, and off-site residents. Environmental receptors include biota (both flora and fauna) indigenous to the Group I IHSS localities and their environs.

2.5.3.2 Group II - Releases Associated with Fires and Explosions

IHSSs were included in this group if the releases were associated with fires or explosions in the filter system. They also have similar waste types in common (radionuclides). IHSSs associated with this group are: IHSS 150.1 - Radioactive Site (North of Building 771), IHSS 150.2 - Radioactive Site (West of Building 771), and IHSS 150.7 - Radioactive Site (South of Building 776). Figure 2.5-4 presents a schematic diagram of the conceptual model for Group II.

2.5.3.2.1 Contaminant Sources and Release Mechanisms

Primary Sources and Release Mechanisms

IHSS 150.1 - Radioactive Site North of Building 771 (IAG Name: Radioactive Liquid Leaks North of Building 771)

The primary sources of contamination at IHSS 150.1 are considered a fire in Building 771 and numerous releases of contaminated fluids from drums and tanks. The area is described as a 50- by 450-foot area north of Building 771. Wastes from Building 771 and materials to be reprocessed in Building 771 where frequently handled and stored here. This area is paved, and is occupied by numerous trailers, auxiliary buildings, and storage areas. The surface was repaved 4 to 5 years ago. Prior to this the asphalt was badly deteriorated with soil exposed in many areas. Through the course of the heavy use this area received, several unrelated incidents have occurred which impacted the area.

The primary release mechanisms associated with this IHSS were ignition, spills, and leaks. The most noteworthy incidents include the following:

- In the RFP's first major fire, a plenum was breached, which released an unknown amount of radioactivity around the building, particularly to the north.
- A tank used to store concentrated americium for recovery developed a pinhole leak and dripped an unknown quantity of the americium solution onto the slab foundation.
- A drum leaked on the roadways during the removal of drums from the 903 Storage area. The forklift carrying the leaking drum traveled across the access road north of Building 771.
- Residue leaked out of a drum of filters as it was being transported from a storage area to Building 771 for processing.

- A waste drum was found to be leaking and was determined to contain nitric acid from non-line generated waste. A rainstorm spread the contamination affecting between 2,300 and 2,500 square feet of asphalt and gravel.

- A punctured scrap box stored inside Building 770 contaminated 3,600 square feet inside the building and 500 square feet outside.

- A 55-gallon drum containing spent ion exchange resin residue leaked inside Building 770 onto the concrete floor. Contamination was tracked between Buildings 771 and 770 and covered 600 square feet.

Decontamination activities conducted after specific incidents would have been focused on radioactive contamination. Residual contamination from other hazardous constituents may have remained.

IHSS 150.2 - Radioactive Site West of Building 771 (IAG Name: Radioactive Liquid Leaks West of Building 771)

The primary source of contamination at IHSS 150.2 is considered to be a fire that was discovered in Room 108 of Building 771. The fire released radioactive contamination primarily north and southwest of the building. Fires in the box exhaust booster filters and main filter plenum were discovered soon after. An explosion in the main exhaust duct probably contributed to release of plutonium from the stack.

The primary release mechanisms associated with this IHSS were volatilization, explosion, and foot traffic. During fire fighting and decontamination activities, access to the main filter plenum was gained through a hatchway on the west side of the building. This activity caused the spread of contamination on the west side of Building 771.

IHSS 150.7 - Radioactive Site South of Building 776 (IAG Name: Radioactive Liquid Leaks South of Building 776)

The primary source of contamination at IHSS 150.7 is considered to be a fire that occurred in Building 776-777 as are discussed in the description of IHSS 150.2 in sections 2.3 and 2.4.

The primary release mechanism at this IHSS was foot traffic. Plutonium was tracked outside those buildings, and onto this site, by fire fighting and support personnel. Following the fire, rain carried the contamination into the soil. The spread of contamination south of Building 776 can also be attributed to the runoff of fire water sprayed on the building to contain the fire. Sand and gravel between Building 777 and Building 778 were also contaminated before the rain.

Secondary Sources and Release Mechanisms

Soil was affected in the vicinity of these IHSSs as a result of spills, leaks, fallout deposition, and as a result of fire-fighting activities. Soil may have been exposed in the area directly around Building 770 and beneath the concrete foundation slab of the americium tank. These areas have subsequently been paved. Though removal of contaminated soils was undertaken, it is likely that residual soil contamination still exists. Therefore, soils within the IHSSs associated with this group should be considered a potential secondary source.

Sediments may have been affected from contaminated fallout and from affected surface water. Sediments should also be considered a potential secondary source.

Secondary release mechanisms associated with Group II's soil contamination are considered to be leaching of contaminants from the soils and sediments by percolating groundwater, volatilization and dispersion of fugitive dust, and infiltration of contaminated groundwater.

2.5.3.2.2 Transport Media, Exposure Routes, and Receptors

Transport Media

Historical accounts of the IHSSs associated with Group II indicate that the releases could potentially have impacted the transport media of air, surface water, vadose zone, and groundwater through pathways illustrated in Figure 2.5-2.

Air

Movement of contaminants by wind was highly likely due to one of the primary release mechanisms being volatilization for all three IHSSs in Group II. Also, release of radionuclides has been documented as resulting from fire/explosion and transported via wind dispersion. Wind movement is also possible wherever the ground surface is affected. If the locations of these IHSSs have been covered with pavement, the likelihood of airborne contamination decreases greatly from the secondary sources.

Surface Water

Surface soils and sediments have been affected at the IHSSs in this Group. The activities associated with these IHSSs included the application of water to fight fires. Fire fighting water and precipitation runoff across these areas may have moved the contamination into the nearby drainages at the time of the incidents. Precipitation runoff subsequent to these incidents may have also moved contaminants from secondary sources to nearby drainages.

Surface water may also have been indirectly affected by contaminated groundwater discharging into surface water bodies such as ditches, ponds, and creeks from footing drains below the 700 series buildings and natural seeps.

Vadose Zone

The vadose zone is a potential transport media depending on the nature of the associated contaminant(s). If the contaminant is a "sinker," (i.e., an DNAPL) meaning that in its liquid state it is heavier than water, it will migrate through the vadose zone, into the water table, and to the bottom of the aquifer in question. LNAPLs may also migrate through the vadose zone to the water table. In their vapor state, some contaminants could volatilize and rise to the ground surface if their molecular weight is less than that of air.

Groundwater

Groundwater recharge from incident precipitation (and in this case--from fire-fighting activities) occurs through uncovered ground surfaces. All of the IHSSs associated with Group II occurred in and around uncovered ground surfaces. It is anticipated that mobile constituents of contamination in these uncovered areas have leached into the groundwater system. Contaminated soils subsequently overlain by pavement and buildings may be subject to little or no vertical infiltration of water, contaminants in such soils may remain relatively immobile.

Exposure Routes

Contaminants released from Group II IHSSs could potentially affect receptors through inhalation of airborne particles, and through ingestion of or dermal contact with contaminated source or transport media.

Receptors

Potential human receptors include RFP workers, visitors to the site, and off-site residents. Environmental receptors include biota (both flora and fauna) indigenous to the Group II IHSS localities and their environs.

2.5.3.3 Group III - Leaks, Spills, and Overflows of Tanks, Pipelines, and/or Drums Originating Above Ground Surface

This grouping is primarily based on similar release mechanisms. The IHSSs associated with this group are: IHSS 118.2 - Solvent Spill (South End of Building 776); IHSS 139.1(N) and (S) - Hydroxide Tank Area (Buildings 771 & 774); IHSS 139.2 - Hydrofluoric Acid Tank Area (Building 714); IHSS 150.4 - Radioactive Site (East of Building 750); IHSS 150.6 - Radioactive Site (South of Building 779); IHSS 150.8 - Radioactive Site (Northeast of Building 779); IHSS 151 -Fuel Oil Leak (Tank 262 North of Building 347); IHSS 163.1 - Radioactive Site (Northwest of Building 774); IHSS 163.2 - Radioactive Site (North of Buildings 771 & 774); IHSS 172 - Central Avenue Waste Spill; IHSS 173 - Radioactive Site - 900 Area (Storage Vaults Near Building 991); IHSS 184 - Radioactive Site - Building 992 (Steam Cleaning Area), and IHSS 188 - Acid Leak (Southeast of Building 374). Figure 2.5-5 presents a schematic diagram of the conceptual model for Group III.

2.5.3.3.1 Contaminant Sources and Release Mechanisms

Primary Sources and Release Mechanisms

IHSS 118.2 - Solvent Spill South End of Building 776 (IAG Name: Multiple Solvent Spills (South End of Building 776)

A 5,000-gallon above-ground carbon tetrachloride tank located within a bermed area between the north side of Building 707, and the alleyway south of Building 778 is believed to be the primary source of contamination at this site.

This tank is known to have ruptured and leaked solvent onto the ground, which contaminated the soil. An unknown amount of carbon tetrachloride was released. The tank and the area of the spill were cleaned up. No documentation was found that further details response to this occurrence.

IHSS 118.2 has been described as a 30- by 70-foot area south of Building 776. The primary source of contamination at this site is described as organic solvent tanks located inside Building 776 at the south end.

Leaks, spills, and overflows of unknown quantities are believed to have occurred from these tanks during routine filling operations.

IHSS 139.1 (N) and (S) - Hydroxide Tank Area, Buildings 771 and 774 (IAG Name: Caustic\Acid Spills)

The primary source of contamination at IHSS 139.1 is considered to be two caustic tanks, a 5,400-gallon potassium hydroxide (KOH) tank south of Building 771, and a 6,500-gallon sodium hydroxide (NaOH) tank north of Building 774. The KOH tank is located approximately 55 feet south and 35 feet east of the southeast corner of Building 771.

The primary release mechanisms at this IHSS are leaks, spills, and overflows. In several incidents spills occurred during the routine filling of the caustic tanks near Building 771. Neither the specific tanks nor the quantities involved have been thoroughly documented. In several of the instances, the spilled caustic was contained by a dike below the tank, and was not released to the environment. Some small leaks have been noted in the piping from the NaOH tank at Building 774. Some leaks that have been documented indicate seepage along the underground pipe to the outside of the building.

IHSS 139.2 - Hydrofluoric Acid Tank Area, Building 714 (IAG Name: Caustic/Acid Spills)

The primary sources of contamination at this IHSS are considered to be two horizontal, 1,300-pound hydrofluoric acid (HF) cylinders, each with a 1,200-pound capacity. They are located in Building 714, a small shed approximately 4 feet east and 29 feet south of the southeast corner of Building 771.

The primary release mechanism at this IHSS is leakage. A small vapor release from the HF connection outside Building 771 and an HF leak above Building 771 have been noted. Apparently, the hoses had collected small amounts of the acid which appeared when the line was pressurized.

IHSS 150.4 - Radioactive Site East of Building 750 (IAG Name: Radioactive Liquid Leaks East of Building 750)

The primary source of contamination and the primary release mechanism at IHSS 150.4 are unclear. IHSS 150.4 has been described as a 120- by 180-foot area northeast of Building 750. The surface is flat and mostly paved, and is used for storage, parking and loading/unloading for Building 750. The area has been paved since construction of Building 750 in 1969. In May of 1969 a fire occurred in Building 776-777. Following the fire, the tanks and pumps that handled the decontamination fluid were placed into the Building 750 courtyard. Several leaks have been noted from the manholes in this area since it was paved. This area is suspected to have residual contamination from the storage of the decontamination equipment, however, no documentation is available that describes the contamination of the parking area by the decontamination tanks and pumps, nor is there a description of the several manhole leaks.

IHSS 150.6 - Radioactive Site South of Building 779 (IAG Name: Radioactive Liquid Leaks South of Building 779)

The primary source of contamination at IHSS 150.6 is considered to be an improperly opened waste drum in Building 779. IHSS 150.6 has been described as a 100- by 200-foot area south of Building 779. The surface is relatively flat and mostly paved.

The primary release mechanism at this IHSS is unknown (i.e., how the contamination escaped the waste drum). The contamination was spread by pedestrian tracking to areas east and south of the building (see also IHSS 150.8). An unknown number of drums of soil were subsequently removed for off-site disposal.

IHSS 150.8 - Radioactive Site Northeast of Building 779 (IAG Name: Radioactive Liquid Leaks Northeast of Building 779)

As in IHSS 150.6, the primary source of contamination at IHSS 150.8 is considered to be the improperly opened waste drum in Building 779. IHSS 150.8 has been described as an 80- by 120-foot area east of Building 779. The area is flat and includes both paved and unpaved surfaces.

Again, the primary release mechanism at this IHSS is unknown, and the contamination was spread by pedestrian tracking. The contamination was spread to the walkways east and south of the building as well as the dock and adjacent ground.

IHSS 151 - Fuel Oil Leak (Tank 262 North of Building 374)

The primary source of contamination at IHSS 151 is considered to be Tank 262, a 47,500-gallon underground storage tank. The area has been described as a 30- by 35-foot area centered over Tank 262 north of Building 374. It is overlain by a 15-by-25 foot concrete pad.

The primary release mechanisms at this IHSS are several low volume (100 gallons or less) spills of No. 2 diesel fuel.

IHSS 163.1 - Radioactive Site Northwest of Building 774 (IAG Name: Radioactive Sites #3: Wash Area)

The primary source of contamination at IHSS 163.1 is considered to be decontamination wash water. IHSS 163.1 has been described as a 60- by 150-foot area northwest of Building 774. The eastern half of the area is mostly flat and paved and is covered in part by Trailer T771G. The area was repaved 4 to 5 years ago. The western half is unpaved, slopes to the north, and is crossed by an unpaved solar evaporation ponds access road.

It is believed that the area north of Building 774 was used to wash radioactively contaminated equipment, and that the wash water flowed onto the ground. However, Building 774 personnel did not recall this area ever being used to wash equipment.

IHSS 163.2 - Radioactive Site North of Buildings 771 and 774 (IAG Name: Radioactive Sites #3: Buried Slab)

It is unknown if contaminants are being released at this site, if so the primary source of contamination is considered to be an americium-contaminated slab buried in the area near Building T771A (by the Perimeter Road). IHSS 163.2 has been described as a 50- by 50-foot area north of Buildings 771 and 774, outside the Protected Area just southeast of Parking Area #71.

The slab, which measures approximately 8-feet square and 10-inches thick, originally served as a foundation for a 5,000-gallon stainless steel tank located approximately 30 feet north of Building 771. The tank was used to store a nitrate solution high in americium with some plutonium. The slab was contaminated from a leak in the tank. When the tank was removed, the concrete slab was decontaminated until the point where smear samples did not detect further removable radioactivity. Paint was applied to the concrete to secure the fixed radioactivity. The slab was moved to a ditch directly north of the area and buried. The area has subsequently been paved. There is evidence of subsequent excavation of the slab, however, it is not conclusive.

IHSS 172 - Central Avenue Waste Spill

The primary source of contamination at IHSS 172 is considered to be a drum that was being transported from the 903 drum storage area to Building 774 (or possibly Building 771). IHSS 172 follows the path formerly used by vehicles to transport drums of waste between the 903 Pad, where the drums were stored, and the waste treatment facility in Building 771.

The primary release mechanism at this IHSS is leakage. One or two drums containing plutonium tainted oil and oils with lathe coolant (70 percent hydraulic oil and 30 percent carbon tetrachloride) leaked along this path while in transit. It was speculated that the drum(s) were punctured by a forklift while being loaded at the 903 Pad, and were not noticed by workers until the vehicle had reached its destination at Building 771. An unknown amount of "low-level material" may spread to the ditch along the north side of Central Avenue as a result of this spill.

IHSS 173 - Radioactive Site - 900 Area (Storage Vaults near Building 991)

The primary source of contamination at IHSS 173 is not specifically known. Incidents involving very small quantities of plutonium, uranium, and beryllium, have been noted in Building 991. The south dock of Building 991 is located on the west side of the building and is a loading facility for the tunnels. This IHSS encompasses Building 991 and associated underground storage vaults (or tunnels) 996, 997, 998 and 999.

Release mechanisms are believed to be small spills that have occurred in the area and small parts and equipment decontamination in the dock area.

IHSS 184 - Radioactive Site - Building 991 Steam Cleaning Area

The primary source of contamination at IHSS 184 is considered to be steam cleaning that was done in an area within the southwest corner of the Building 991. IHSS 184 has been described as a 50- by 50-foot area near Building 992, just southwest of Building 991. It lies entirely within IHSS 173. This area possibly was used to steam clean radioactively contaminated equipment and drums. The rinse water was collected in a sump for treatment in the RFP's process waste system. The cleaning was done on a concrete floor that is still in place. Wash water ran into an outside drain which flowed south and east beneath pavement before emptying into an unlined ditch just southeast of the building. The drain system is also still in place.

IHSS 188 - Acid Leak, Southeast of Building 374

The primary source of contamination at IHSS 188 is considered to be a 55-gallon drum of mixed hydrochloric and nitric acids. IHSS 188 is an area of unspecified size southeast of Building 374. The surface was flat and unpaved at the time of the release and was later paved in the mid-1980s.

The primary release mechanism at this IHSS is leakage of the drum. The mixed acid was probably waste metal leaching solution from the 400 complex and might have contained trace amounts of heavy metals.

Secondary Sources and Release Mechanisms

Soils are known to have been contaminated as a result of past releases associated with some of the IHSSs in Group III. Though many releases that affected soils were immediately remediated, some residual contaminated soil may still be in place. It is possible that soils, sediments, and groundwater have been affected at all of the IHSSs within this group. Therefore soils, sediments and groundwater should be considered as potential secondary sources within this group.

Surface water has been affected by releases within this group introducing the potential for sediments having been affected. Since this potential exists, sediments should also be considered as a potential secondary source.

Secondary release mechanisms associated with Group III's soil contamination are considered to be volatilization and dispersion of fugitive dust, percolation of infiltrating precipitation through contaminated soils and sediments, surface water transport of contaminated sediments and soils, discharge of contaminated from footing drains, and movement of contaminated groundwater.

It is improbable that the spills and leaks of caustics or acids have a residual impact on the soils. Elements associated with these types of spills, such as potassium, sodium, oxygen, and hydrogen,

are all naturally occurring. Therefore, they would not be indicative of the releases, except by way of concentration. Concentrations have likely decreased through dilution over time. Carbon tetrachloride, which is the contaminant involved in IHSS 118.2, has been detected in nearby wells. This indicates that soils are very likely affected at these IHSSs. It is also possible that the heavy metals associated with IHSS 188 have had a residual impact to the soils, though likely minimal. In light of these findings, the soils at some of the IHSSs within this group can be considered a potential secondary contaminant source.

2.5.3.3.2 Transport Media, Exposure Routes, and Receptors

Transport Media

Historical accounts of the IHSSs associated with Group III indicate that the releases could potentially have impacted the transport media of air, surface water, vadose zone, and groundwater through pathways illustrated in Figure 2.5-2.

Air

Air is considered a potential transport medium for both carbon tetrachloride and hydrofluoric acid vapors and for surficial soils that may contain residual contamination. Potential movement of contaminants by wind is possible wherever the ground surface is affected. The likelihood of airborne contamination increases greatly if the site is disturbed by traffic, construction or similar activity. Air transport of vapors emanating from VOC spills, while impacting air quality for a time near the release, typically do not spread contamination to the unaffected media.

Surface Water

Surface soils, sediments, and collection ditches have been affected by releases which originated above the ground surface in Group III IHSSs. Precipitation runoff across these areas could then

move the contamination into nearby drainages or surface impoundments. IHSS 173 lies within the South Walnut Creek drainage, primarily on the south-sloping north side of the drainage.

Surface water may also be indirectly affected by contaminated groundwater discharging to surface water bodies such as ditches, ponds, and creeks from footing drains below the 700 series buildings and natural seeps.

Vadose Zone

The vadose zone is a likely transport media due to the nature of the contaminants associated with this group. No. 2 Diesel, in its vapor state, will volatilize and rise through the vadose zone to the ground surface. Carbon tetrachloride is a DNAPL which means that in its liquid state it is heavier than water and will migrate through the vadose zone, into the water table, and to the bottom of the aquifer in question. LNAPLs may also migrate through the vadose zone to the water table. In its vapor state, it will volatilize and rise to the ground surface if their molecular weight is less than that of air.

Groundwater

Groundwater recharge from incident precipitation occurs through uncovered ground surfaces within some of the IHSSs associated with Group III. Mobile constituents of contamination in uncovered areas may eventually leached into the groundwater system. Unlined drainages, both natural and manmade, are probably a primary source of groundwater recharge in the RFP, and contaminants underlying these features can be expected to reach the water table more quickly. Contaminated soils subsequently overlain by pavement and buildings may be subject to little or no infiltration of water, contaminants in such soils may remain relatively immobile.

Exposure Routes

Contaminants released from Group III IHSSs could potentially affect receptors through inhalation of airborne particles or vapors, and through ingestion of or dermal contact with contaminated source or transport media.

Receptors

Potential human receptors include RFP workers, visitors to the site, and off-site residents. Environmental receptors include biota (both flora and fauna) indigenous to the Group III IHSS localities and their environs.

Table 2.1

INDIVIDUAL HAZARDOUS SUBSTANCE SITES (IHSS)
DRAFT PHASE I RFI/RI WORK PLAN
OPERABLE UNIT 8 - ROCKY FLATS PLANT, COLORADO

118.1: West of Building 730

118.2: South End of Building 776

123.1: Valve Vault 7 Southwest of Building 707

Cooling Tower Blowdown Sites:

135: Cooling Tower Blowdown Southeast of Building 374

137: Cooling Tower Blowdown - Building 774

138: Cooling Tower Blowdown - Building 779

139.1 (North & South sites): Hydroxide Tank Area - Buildings 771 and 774

139.2: Hydrofluoric Acid Tank Area - Building 714

144: Sewer Line Break - near Building 730, Tanks 776 A-D

Radioactive Liquid Leaks (Site 150):

150.1: North of Bldg. 771

150.2: West of Bldg. 771

150.3: Between Bldgs. 771 & 774

150.4: East of Bldg. 750

150.5: West of Bldg. 707*

150.6: South of Bldg. 779

150.7: South of Bldg. 776

150.8: Northeast of Bldg. 779

151: Fuel Oil Leak - Tank 262 North of Building 374

Table 2.1 (cont.)

INDIVIDUAL HAZARDOUS SUBSTANCE SITES (IHSS)
OPERABLE UNIT 8 - ROCKY FLATS PLANT, COLORADO

Radioactive Sites:

163.1: Wash Area - 700 Area Site #3, Northeast of Building 774

163.2: Buried Slab - 700 Area Site #3, North of Buildings 771 & 774

173: Radioactive Site - 900 Area (Storage Vaults near Building 991)

172: Central Avenue Waste Spill

184: Building 992 Steam Cleaning Area

188: Acid Leak Southeast of Building 374

Source: DOE, 1992.

* = Pursuant to the Hazardous Release Report (DOE, 1992), IHSS 150.5 is described to be the same as IHSS 123.2. IHSS 123.2 was removed from OU8 investigations by CDH letter dated April 21, 1992, and transferred to OU9. Therefore, IHSS 150.5 is not addressed in this Work Plan.

Table 2.2

LISTING OF IHSSs, PACs, and UBCs LOCATED WITHIN OPERABLE UNIT 8 - ROCKY FLATS PLANT, COLORADO (refer to Figure 2-1)

Site No.	Site Name	OU Number
	IHSSs	
101	Solar Ponds	OU4
112	903 Pad	OU2
117.1	North Site Chemical Storage	OU13
117.2	Middle Site Chemical Storage	OU13
117.3	South Side Chemical Storage	OU13
121	Original Process Waste Lines	OU9
123.2	Valve Vault West of Building 707	OU9
124.1	30,000 Gallon Tank (Tank #68)	OU9
124.2	14,000 Gallon Tank (Tank #66)	OU9
124.3	14,000 Gallon Tank (Tank #67)	OU9
125	Same as IHSS 124.2	OU9
126.1	Westernmost Out-of-Service Waste Tank	OU9
126.2	Easternmost Out-of-Service Waste Tank	OU9
127	Low-Level Radioactive Waste Leak	OU9
132	Radioactive Site - 700 Area Site No. 4	OU9
143	Old Outfall - Building 771	OU6
146.1 to 146.6	7,500 Gallon Tanks (31,32,34W,34E,30,33)	OU9
147.1	Process Waste Line Leaks (Maas Area)	OU9
149	Effluent Pipe	OU9
150.5	Same as IHSS 123.2	OU9
152	Fuel Oil Tank	OU13
154	Pallet Burn Site	OU2
158	Radioactive Site - Building 551	OU13
159	Radioactive Site - Building 559	OU9
162	Radioactive Site - 700 Area Site #2	OU14
164.2	Radioactive Site - 800 Area Site #2, Building 886 Spills	OU14
164.3	Radioactive Site - 800 Area Site #2, Building 889 Storage Pad	OU14
165	Triangle Area	OU6
169	Waste Drum Peroxide Burial	OU13
175	S&W Building 980 Contractor Storage Facility	OU10
176	S&W Contractor Storage Yard	OU10
179	Building 865 Drum Storage Area	OU15
181	Building 334 Cargo Container Area	OU10
185	Solvent Spill	OU16
186	Valve Vault 12	OU13

Table 2.2 (cont.)

LISTING OF IHSSs, PACs, and UBCs LOCATED WITHIN OPERABLE UNIT 8

Site No.	Site Name	OU Number
	IHSSs (cont.)	
187	Sulfuric Acid Spill (Acid Leaks (2))	OU12
190	Caustic Leak	OU13
192	Antifreeze Discharge	OU16
194	Steam Condensate Leak	OU16
197	Scrap Metal Sites	OU16
206	Inactive D-836 Hazardous Waste Tank	OU10
210	Unit 16, Building 980 Cargo Container	OU10
213	Unit 15, 904 Pad Pondcrete Storage	OU10
214	750 Pad Pondcrete & Saltcrete Storage, Unit 25	OU10
215	Tank T-40, Unit 55.13	OU9
	PACs	
000-500	Sanitary Sewer System	NA
000-501	Roadway Spraying	NA
300-701	Valve Vault 13	NA
300-704	Roof Fire, Building 381	NA
300-705	Potassium Hydroxide Spill North of Bldg. 374	NA
300-706	Building 374, Tank 805	NA
300-707	Sanitizer Spill	NA
300-709	Sulfuric Acid Spill, Building 371	NA
300-710	Valve Vaults 11, 12, 13	NA
500-900	Transformer 515 Leak	NA
500-901	Transformer 555 Leak	NA
700-1100	French Drain North of Building 776/777	NA
700-1101	Laundry Tank Overflow - Building 732	NA
700-1102	Leaking Transformer - Building 776	NA
700-1103	Leaking Transformers - Building 707	NA
700-1104	Leaking Transformer - Building 708	NA
700-1105	Leaking Transformers - Building 779	NA
700-1106	Process Waste Spill - Portal 1	NA
700-1107	Compressor Waste Oil Spill- Building 776	NA
700-1108	771/774 Footing Drain Pond	NA
700-1109	Uranium Incident - Building 778	NA
700-1110	Nickel Carbonyl Burial West of Building 771	NA

Table 2.2 (cont.)

LISTING OF IHSSs, PACs, and UBCs LOCATED WITHIN OPERABLE UNIT 8

Site No.	Site Name	OU Number
	PACs (cont.)	
900-1301	Building 991 Enclosed Area	NA
900-1304	Chromic Acid Spill - Building 991	NA
900-1305	Building 991 Roof	NA
900-1306	Transformers 991-1 and 991-2	NA
900-1308	RO Plant Sludge Drying Beds	NA
	UBCs	
371	Building 371	NA
374	Building 374	NA
528	Building 528	NA
559	Building 559	NA
701	Building 701	NA
707	Building 707	NA
770	Building 770	NA
771	Building 771	NA
774	Building 774	NA
776	Building 776	NA
777	Building 777	NA
778	Building 778	NA
779	Building 779	NA

Source: DOE, 1992.

* = Exclusive of IHSSs included in RI activities planned in this Work Plan (see Table 2.1).

TABLE 2.3
BACKGROUND CONCENTRATIONS FOR ROCKY FLATS ALLUVIUM

Metals

	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium[1]	Cesium	Chromium[1]	Cobalt	Copper[1]	Iron	Lead[1]	Lithium[1]
Upper Tolerance Limit (mg/kg)	13419.4947	..	4.2988	79.4928	4.7040	..	8430.1986	..	19.9897	..	11.1314	13753.5715	12.1546	..
Maximum Concentration (mg/kg)	40800.0	33.2U	41.7	209.0	19.0	3.2	157000.0	968.0U	69.6	28.1	16.6	33700.0	25.7	31.3

	Magnesium	Manganese	Mercury[1]	Molybdenum[1]	Nickel[1]	Potassium	Selenium	Silver	Sodium	Strontium[1]	Thallium[1]	Tin[1]	Vanadium[1]	Zinc[1]
Upper Tolerance Limit (mg/kg)	2484.2373	234.9950	..	..	21.4229	1557.9829	..	..	..	..	..	..	37.1857	39.7143
Maximum Concentration (mg/kg)	5570.0	656.0	0.32	41.0	54.2	4020.0	12.0U	40.9	4840.0U	226	5.4U	312.0	70.0	77.6

Inorganic Constituents

	Bicarbonate	Carbonate	Chloride	Cyanide	pH	Nitrate/ Nitrite[1]	Sulfate
Upper Tolerance Limit (mg/kg except pH)	..	..	..	..	9.5174	..	..
Lower Tolerance Limit (mg/kg except pH)	NA	NA	NA	NA	6.3858	NA	NA
Maximum Concentration (mg/kg except pH)					9.1	4.3	
Minimum Concentration (mg/kg except pH)					7.0	NA	NA

Radionuclides

	Americium-241	Cesium-137	Alpha	Beta	Plutonium-239	Radium-226	Radium-228	Strontium-90	Tritium[2]	Uranium -233,234	Uranium-235	Uranium -238
Upper Tolerance Limit (pCi/g)	0.0135	0.0669	39.3636	36.8150	0.0150	0.6513	1.9561	0.7256	0.4147	0.6558	0.0741	0.6830
Maximum Concentration (pCi/g)	0.01	0.2	42.0	44.0	0.02	0.9	2.2	1.2	0.44	3.4	0.1	3.2

NA = Not applicable .. = Value not calculated U = Concentration below detection limit [1] Value for North Rocky Flats Alluvium [2] Concentration in pCi/ml

TABLE 2.4
BACKGROUND CONCENTRATIONS FOR COLLUVIUM, WEATHERED CLAYSTONE AND WEATHERED SANDSTONE

Metals

	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium[1]	Cesium	Chromium[1]	Cobalt	Copper[1]	Iron	Lead[1]	Lithium[1]
Upper Tolerance Limit (mg/kg)	10427.7752	..	4.0203	121.8903	3.4013	..	7566.5613	..	10.3477	..	16.2533	14726.3649	18.6811	11.6003
Maximum Concentration (mg/kg)	22900.0	16.2	10.8	491.0	10.3	2.6U	44300.0	516.0U	21.3	29.7	26.7	38100.0	28.2	48.4U

	Magnesium	Manganese	Mercury[1]	Molybdenum[1]	Nickel[1]	Potassium	Selenium	Silver	Sodium	Strontium[1]	Thallium[1]	Tin[1]	Vanadium[1]	Zinc[1]
Upper Tolerance Limit (mg/kg)	2799.1426	203.0125	..	13.4310	20.1842	..	..	..	..	64.0675	..	..	23.7320	62.3409
Maximum Concentration (mg/kg)	5580.0	737.0	0.44	48.4U	62.4	3090.0	12.8U	33.5	3680.0	113.0	5.0U	441.0	40.9	129.0

Inorganic Constituents

	Bicarbonate	Carbonate	Chloride	Cyanide	pH	Nitrate/ Nitrite[1]	Sulfate
Upper Tolerance Limit (mg/kg except pH)	..	..	..	..	9.5161	..	..
Lower Tolerance Limit (mg/kg except pH)	NA	NA	NA	NA	7.2914	NA	NA
Maximum Concentration (mg/kg except pH)					9.7	2.5	
Minimum Concentration (mg/kg except pH)					7.2	NA	NA

Radionuclides

	Americium-241	Cesium-137	Alpha	Beta	Plutonium-239	Radium-226	Radium-228	Strontium-90	Tritium[2]	Uranium -233,234	Uranium-235	Uranium -238
Upper Tolerance Limit (pCi/g)	..	0.0745	48.4255	34.1512	0.0209	1.1379	2.0537	0.6719	0.2875	0.9830	0.1756	1.0429
Maximum Concentration (pCi/g)		0.2	48.0	34.0	0.02	1.3	2.1	0.8	0.39	2.6	0.3	2.3

NA = Not applicable .. = Value not calculated U = Concentration below detection limit [1] Value for North Rocky Flats Samples [2] Concentration in pCi/ml

TABLE 2.5
BACKGROUND CONCENTRATIONS FOR UPPER MOST FLOW SYSTEM GROUNDWATER SAMPLES

Dissolved Metals

	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Cesium	Chromium	Cobalt	Copper	Iron	Lead	Lithium
Upper Tolerance Limit (mg/l)	..	..	..	..	..	..	62.5908	..	..	..	..	..	..	..
Maximum Concentration (mg/l)	0.32	0.5U	0.01U	0.222	0.005U	0.0111	196.0	2.5U	0.02U	0.05U	0.0477	0.944	0.0396	0.4

	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Potassium	Selenium	Silver	Sodium	Strontium	Thallium	Tin	Vanadium	Zinc
Upper Tolerance Limit (mg/l)	16.0851	0.2133	..	..	..	..	..	..	46.7359	..	..	..	..	..
Maximum Concentration (mg/l)	179.0	0.686	0.0008	0.5U	0.0432	11.3	0.221	0.03U	714.0	7.12	0.05U	1.0U	0.05U	0.141

Inorganic Constituents

	Bicarbonate	Carbonate	Chloride[1]	Cyanide	pH	Nitrate/ Nitrite	Sulfate
Upper Tolerance Limit (mg/l except pH)	249.3524	..	10.6716	..	8.2190	3.4338	67.0794
Lower Tolerance Limit (mg/l except pH)	NA	NA	NA	NA	6.3897	NA	NA
Maximum Concentration (mg/l except pH)	680.0	5.0U	28.0	0.01U	8.6	6.5	1800.0
Minimum Concentration (mg/l except pH)	NA	NA	NA	NA	6.3	NA	NA

Radionuclides

	Americium-241	Cesium-137	Alpha	Beta	Plutonium-239	Radium-226	Radium-228	Strontium-90	Tritium	Uranium -233,234	Uranium-235	Uranium -238
Upper Tolerance Limit (pCi/l)	0.0167	0.5061	55.0708	59.6331	0.0150	96.2939	..	0.9004	359.0676	..	2.0862	25.5702
Maximum Concentration (pCi/l)	0.034	0.5	200.0	220.0	0.03	170.0		2.13	430.0	0.1	7.74	76.9

NA = Not applicable .. = Value not calculated U = Concentration below detection limit [1] Value for North Rocky Flats Upper Most Flow System

TABLE 2.6
BACKGROUND CONCENTRATIONS FOR LOWER MOST FLOW SYSTEM GROUNDWATER SAMPLES

Dissolved Metals

	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Cesium	Chromium	Cobalt	Copper	Iron	Lead	Lithium
Upper Tolerance Limit (mg/l)	..	..	..	..	..	..	49.2824	..	..	..	..	..	..	..
Maximum Concentration (mg/l)	0.327	0.5U	0.0186	0.2U	0.005U	0.005U	167.0	2.5U	0.0177	0.05U	0.0695	0.0539	0.024	1.79

	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Potassium	Selenium	Silver	Sodium	Strontium	Thallium	Tin	Vanadium	Zinc
Upper Tolerance Limit (mg/l)	..	..	..	..	..	..	..	..	231.8338	..	..	..	..	0.2234
Maximum Concentration (mg/l)	45.7	0.846	0.0003	0.5U	0.04U	21.9	0.041	0.03U	454.0	2.03	0.04U	1.0U	0.05U	0.374

Inorganic Constituents

	Bicarbonate	Carbonate	Chloride[1]	Cyanide	pH	Nitrate/ Nitrite	Sulfate
Upper Tolerance Limit (mg/l except pH)	274.7981	28.6813	..	..	10.9077	6.4068	153.7200
Lower Tolerance Limit (mg/l except pH)	NA	NA	NA	NA	6.2443	NA	NA
Maximum Concentration (mg/l except pH)	390.0	25.0	230.0	0.01U	10.4	3.6	670.0
Minimum Concentration (mg/l except pH)	NA	NA	NA	NA	7.0	NA	NA

Radionuclides

	Americium-241	Cesium-137	Alpha	Beta	Plutonium-239	Radium-226	Radium-228	Strontium-90	Tritium	Uranium -233,234	Uranium-235	Uranium -238
Upper Tolerance Limit (pCi/l)	0.0556	0.7837	25.3930	30.4997	0.0113	..	..	0.8554	420.4114	..	0.9438	6.2485
Maximum Concentration (pCi/l)	0.082	0.85	38.9	43.8	0.01	0.6		1.0	340.0		1.7	11.59

NA = Not applicable .. = Value not calculated U = Concentration below detection limit [1] Value for North Rocky Flats Lower Most Flow System

TABLE 2.7
SUMMARY OF CONSTITUENTS DETECTED IN CONCENTRATIONS ABOVE BACKGROUND IN BOREHOLE SAMPLES FROM WELL P209189

Sample Number	Sample Depth (feet)	Methylene Chloride (µg/kg)	Aluminum (mg/kg)	Arsenic (mg/kg)	Barium (mg/kg)	Calcium (mg/kg)	Lead (mg/kg)	Potassium (mg/kg)	Vanadium (mg/kg)	Gross Alpha (pCi/l)	Plutonium-239/240 (pCi/g)	Radium-226 (pCi/g)	Uranium-233,234 (pCi/g)	Uranium-238 (pCi/g)	Tritium (pCi/ml)
SEP1989BR0002	0.0-1.3	1AJ	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEP1989BR0002D	0.0-1.3(Dup.)	2AJ	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEP1989BR0003	0.0-3.0	NA	--	6	128	12400	17	1980	38	62	NA	0.8	1.9	1.0	0.49
SEP1989BR0309	3.0-9.5	NA	15400	14	48	--	--	3750	--	NA	NA	NA	NA	NA	NA
SEP1989BR0406	4.3-6.3	2AJ	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEP1989BR0810	8.3-9.5	2AJ	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEP1989BR1016	10.3-16.3	NA	--	9	ND	--	--	--	--	--	0.07	--	--	--	1.1
SEP1989BR1214	12.3-14.3	3AJ	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEP1989BR1618	16.3-18.3	3AJ	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEP1989BR1622	16.3-22.3	NA	--	5	--	--	--	--	--	--	0.04	--	--	--	1.4
SEP1989BR1622D	16.3-22.3(Dup.)	NA	--	--	--	--	--	ND	--	NA	NA	--	--	--	1.4
SEP1989BR2021	20.3-21.3	2AJ	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEP1989BR2223	22.3-23.3	7V	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

V = Validated and valid
A = Validated and valid with qualifiers
J = Detected at concentration less than detection limit
ND = Not detected
NA = Not analyzed
B = Constituent detected in laboratory blank
-- = Constituent detected at concentration less than background

TABLE 2.8
SUMMARY OF CONSTITUENTS DETECTED IN CONCENTRATIONS ABOVE BACKGROUND IN BOREHOLE SAMPLES FROM WELL P209289

Sample Number	Sample Depth (ft)	1,1-Dichloro-ethene (ug/g) •	Acetone (ug/g) •	Benzene (ug/g) •	Chloro-benzene (ug/g) •	Chloro-form (ug/g) •	Methylene Chloride (ug/g) •	Toluene (ug/g) •	Trichloro-ethene (ug/g) •	Arsenic (mg/kg)	Barium (mg/kg)	Beryllium (mg/kg)
SEP20890002	0.0 - 1.2	ND	ND	ND	ND	ND	2 J	ND	ND	NA	NA	NA
SEP20890003	0.0 - 3.0	NA	NA	NA	NA	NA	NA	NA	NA	5	82	–
SEP20890309	3.0 - 9.2	NA	NA	NA	NA	NA	NA	NA	NA	6	91	–
SEP20890406	3.0 - 5.8	ND	ND	ND	ND	ND	2 J	ND	ND	NA	NA	NA
SEP20890810	7.8 - 9.2	ND	ND	ND	ND	ND	6	ND	ND	NA	NA	NA
SEP20890912	9.2 - 12.2	NA	NA	NA	NA	NA	NA	NA	NA	–	–	–
SEP20891214	11.8 - 12.2	2 J	8 J	2 J	2 J	8	6	2 J	2 J	NA	NA	NA
SEP20891418	13.8 - 17.8	NA	NA	NA	NA	NA	NA	NA	NA	7	–	7
SEP20891618	15.8 - 17.8	2 J	9 J	3 J	3 J	ND	8	3 J	3 J	NA	NA	NA

Sample Number	Sample Depth (ft)	Copper (mg/kg)	Iron (mg/kg)	Manganese (mg/kg)	Vanadium (mg/kg)	Zinc (mg/kg)	Americium -241 (pCi/g)	Radium -226 (pCi/g)	Tritium (pCi/ml)	Uranium -233,-234 (pCi/kg)	Uranium -238 (pCi/g)	Nitrate/ Nitrite (mg/kg)
SEP20890002	0.0 - 1.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEP20890003	0.0 - 3.0	12	–	249	–	42	0.15	0.7	1.1	0.7	–	19 AJ
SEP20890309	3.0 - 9.2	ND	–	456	–	–	0.03	–	1.0	–	–	11
SEP20890406	3.0 - 5.8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEP20890810	7.8 - 9.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEP20890912	9.2 - 12.2	–	–	238	–	–	ND	–	0.41	0.9	0.8	–
SEP20891214	11.8 - 12.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEP20891418	13.8 - 17.8	25	28,400	–	61	91	ND	–	–	–	–	ND
SEP20891618	15.8 - 17.8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

V = Validated and valid
A = Validated and valid with qualifiers
J = Detected at concentration less than detection limit
ND = Not detected
NA = Not analyzed
B = Constituent detected in laboratory blank
– = Constituent detected at concentration less than background
• The units indicated for this constituent in RFEDS appear to be incorrect. This apparent discrepancy was not resolved during the preparation of this work plan.

TABLE 2.9
SUMMARY OF CONSTITUENTS DETECTED IN CONCENTRATIONS ABOVE BACKGROUND IN GROUNDWATER SAMPLES FROM WELL P209189

Sample Number	Sample Date	Carbon Tetrachloride (µg/l)	Chloroform (µg/l)	1,1-Dichloroethane (µg/l)	1,2-Dichloroethane (µg/l)	1,1-Dichloroethene (µg/l)	1,2-Dichloroethene (µg/l)	Perchloroethene (µg/l)	Trichloroethene (µg/l)	Calcium (mg/l)
GSEP19890989001	27-SEP-89	ND	2J	2J	2J	ND	ND	3J	8	81
GSEP19890989001D	27-SEP-89(Dup.)	ND	3AJ	3AJ	ND	1AJ	ND	3AJ	8V	81
GSEP19890390001	02-MAR-90	ND	7	ND	ND	ND	7	14	28	115
SEP1989-0601-02-0830	01-JUN-90	ND	ND	ND	ND	ND	1J	2J	3J	68
GW00303IT	31-AUG-90	2J	2J	ND	ND	3J	ND	6	10	76
GW00617IT	08-NOV-90	1AJ	ND	2AJ	ND	2AJ	5V	4AJ	8V	76
GW01024IT	22-MAR-91	2AJ	ND	ND	ND	2AJ	7V	9V	15V	98
GW01389IT	06-JUN-91	ND	1J	ND	ND	ND	3J	4J	4J	65
GW01582IT	26-JUL-91	ND	ND	ND	ND	ND	ND	2J	3J	60
GW01814IT	10-OCT-91	ND	ND	ND	ND	ND	ND	ND	ND	70

Sample Number	Sample Date	Iron (mg/l)	Magnesium (mg/l)	Americium-241 (pCi/l)	Cesium-137 (pCi/l)	Plutonium-239/240 (pCi/l)	Radium-226 (pCi/l)	Tritium (pCi/l)
GSEP19890989001	27-SEP-89	ND	--	0.06	ND	0.34	NA	700
GSEP19890989001D	27-SEP-89(Dup.)	ND	--	0.06	ND	0.34	NA	700
GSEP19890390001	02-MAR-90	--	20	0.08	1.04	0.06	NA	NA
SEP1989-0601-02-0830	01-JUN-90	1.5	--	--	ND	0.03	NA	--
GW00303IT	31-AUG-90	0.2	--	NA	NA	NA	NA	NA
GW00617IT	08-NOV-90	--	--	0.54	ND	3.56	2.6	619
GW01024IT	22-MAR-91	--	--	--	ND	0.23	--	782
GW01389IT	06-JUN-91	0.3	--	NA	ND	0.15	NA	NA
GW01582IT	26-JUL-91	0.5	--	--	ND	0.15	NA	--
GW01814IT	10-OCT-91	--	--	0.10	ND	0.44	NA	--

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A = Validated and valid with qualifiers
J = Detected at concentration less than detection limit
ND = Not detected
NA = Not analyzed
B = Constituent detected in laboratory blank
-- = Constituent detected at concentration less than background

TABLE 2.10
SUMMARY OF CONSTITUENTS DETECTED IN CONCENTRATIONS ABOVE BACKGROUND IN GROUNDWATER SAMPLES FROM WELL 2386

Sample Number	Sample Date	Carbon Tetrachloride (µg/l)	trans-1,2-Dichloroethene (µg/l)	Methylene Chloride (µg/l)	Trichloroethene (µg/l)	Calcium (mg/l)	Iron (mg/l)
23-86-03-18-87	18-MAR-87	ND	4	NA	ND	NA	NA
23-86-06-24-87	24-JUN-87	ND	ND	NA	ND	NA	NA
23-86-09-23-87	23-SEP-87	ND	5	NA	ND	NA	NA
23-86-01-15-88	15-JAN-88	7	NA	13	ND	96	--
23-86-03-21-88	21-MAR-88	ND	NA	16	ND	99	0.13
23-86-05-23-88	23-MAY-88	ND	NA	ND	ND	96	--
23-86-09-08-88	08-SEP-88	ND	NA	ND	ND	NA	NA
23-86-11-30-88	30-NOV-88	ND	NA	ND	ND	NA	NA
23-86-03-01-89	01-MAR-89	ND	ND	ND	ND	NA	NA
G23861189004	06-NOV-89	ND	NA	ND	ND	294	ND
G23860390001	22-MAR-90	ND	NA	ND	ND	94	0.45
G-2386-0524-02-0910	25-MAY-90	ND	NA	5B	ND	NA	NA
GW00616IT	14-NOV-90	ND	NA	ND	6V	NA	NA
GW01199IT	24-APR-91	ND	NA	ND	ND	100	--
GW01364IT	31-MAY-91	ND	NA	7	ND	NA	NA
GW01581IT	01-AUG-91	ND	NA	ND	ND	NA	NA
GW01815IT	07-OCT-91	ND	ND	ND	ND	NA	NA
GW02224IT	13-JAN-92	ND	NA	ND	ND	NA	NA

V = Validated and valid
A = Validated and valid with qualifiers
J = Detected at concentration less than detection limit
ND = Not detected
NA = Not analyzed
B = Constituent detected in laboratory blank
-- = Constituent detected at concentration less than background

TABLE 2.11
SUMMARY OF CONSTITUENTS DETECTED IN CONCENTRATIONS ABOVE BACKGROUND IN BOREHOLE SAMPLES FROM WELL P218089

Sample Number	Sample Depth (ft)	Acetone (ug/kg)	Methylene Chloride (ug/kg)	Barium (mg/kg)	Calcium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Magnesium (mg/kg)	Vanadium (mg/kg)	Zinc (mg/kg)
OP03890002	0.0 - 1.2	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA
OP03890003	0.0 - 3.0	NA	NA	--	8950	53	11	18	--	--	--
OP03890204	2.0 - 3.3	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA
OP03890306	3.0 - 5.1	NA	NA	115	26,300	--	13	25	3950	40	47
OP03890406	4.0 - 5.1	5 AJ	ND	NA	NA	NA	NA	NA	NA	NA	NA
OP03890608	6.0 - 8.0	5 AJ	ND	NA	NA	NA	NA	NA	NA	NA	NA
OP03890610	8.0 - 10.0	NA	NA	538	15,800	--	13	13	4110	--	58
OP03890810	6.0 - 10.0	3 J	8 B	NA	NA	NA	NA	NA	NA	NA	NA

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A = Validated and valid with qualifiers
J = Detected at concentration less than detection limit
ND = Not detected
NA = Not analyzed
B = Constituent detected in laboratory blank
-- = Constituent present at concentration less than background

TABLE 2.12
SUMMARY OF CONSTITUENTS DETECTED IN CONCENTRATIONS ABOVE BACKGROUND IN GROUNDWATER SAMPLES FROM WELL P218089

Sample Number	Sample Date	Methylene Chloride (ug/l)	Bicarbonate (mg/l)	Chloride (mg/l)	Nitrate/ Nitrite (mg/l)	Sulfate (mg/l)	Uranium -233,-234 (pCi/l)	Uranium -235 (pCi/l)	Uranium -238 (pCi/l)
GOP3890290001	14-Feb-90	NA	NA	NA	NA	NA	84	2.3	22
OP-0389-0529-02-1300	31-May-90	10	NA	NA	6.8	NA	45.6	0.8	14.97
GW01410IT	12-Jun-91	1 BJ	400	10	4	230	NA	NA	NA

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A = Validated and valid with qualifiers
B = Constituent detected in laboratory blank
J = Detected at concentration less than detection limit
-- = Constituent present at concentration less than background
ND = Not detected

TABLE 2.13
SUMMARY OF CONSTITUENTS DETECTED IN CONCENTRATIONS ABOVE BACKGROUND IN GROUNDWATER SAMPLES FROM WELL 1986

Sample Number	Sample Date	Acetone (µg/l)	1,1-Dichloroethene (µg/l)	trans-1,2-Dichloroethene (µg/l)	Methylene Chloride (µg/l)	Perchloro-ethene (µg/l)	1,1,1-Trichloroethane (µg/l)	Trichloroethene (µg/l)	Barium (mg/l)	Calcium (mg/l)	Iron (mg/l)	Magnesium (mg/l)
G-198609860	18-SEP-86	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
19-86-03-26-87	26-MAR-87	ND	ND	4	ND	ND	ND	ND	0.23	214	ND	58
19-86-06-30-87	30-JUN-87	ND	ND	4	ND	ND	ND	ND	–	179	4	47
19-86-06-30-87FD	30-JUN-87	ND	ND	4	ND	ND	ND	ND	–	179	5	46
19-86-09-15-87	15-SEP-87	NA	ND	NA	NA	ND	ND	ND	–	124	4	38
19-86-12-18-87	18-DEC-87	ND	12	NA	13	10	5	8	–	127	4	36
19-86-03-16-88	16-MAR-88	5J	ND	NA	ND	ND	ND	ND	–	167	9	48
19-86-05-23-88	23-MAY-88	ND	ND	NA	ND	ND	ND	ND	–	151	5	46
19-86-09-07-88	07-SEP-88	ND	ND	NA	ND	ND	ND	ND	–	130	2	38
19-86-11-29-88	29-NOV-88	ND	ND	NA	ND	ND	ND	ND	–	121	5	34
19-86-02-27-8	27-FEB-89	ND	ND	ND	ND	ND	ND	ND	–	127	5	38
19-86-05-15-8	15-MAY-89	ND	ND	ND	ND	ND	ND	9 V	–	176	7	48
19-86-08-28-89	28-SEP-89	ND	ND	ND	ND	ND	ND	ND	–	165	6	44
G1986-1189004	03-NOV-89	21AJ	ND	ND	ND	ND	ND	21 AJ	ND	129	12	40
G19860290001	12-FEB-90	ND	ND	NA	ND	ND	ND	ND	ND	137	13	38
G19860290001D	12-FEB-90	ND	ND	NA	ND	ND	ND	ND	ND	135	13	38
G-1986-0509-02-1000	09-MAY-90	ND	ND	NA	3JB	ND	ND	ND	0.23	170	19	51
GW00054IT	25-JUL-90	13	ND	NA	8B	ND	ND	ND	–	153	13	48
GW00530IT	18-OCT-90	ND	ND	NA	ND	ND	ND	ND	–	130	9	38
GW01377IT	03-JUN-91	ND	ND	NA	1JB	ND	ND	ND	–	157	12	47
GW01583IT	31-JUL-91	ND	ND	NA	ND	ND	ND	ND	–	144	12	44
GW1800IT	02-OCT-91	ND	ND	ND	ND	ND	ND	ND	–	123	11	36
GW02200IT	30-JAN-92	ND	ND	NA	ND	ND	ND	ND	–	134	11	39

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TABLE 2.13 (continued)
SUMMARY OF CONSTITUENTS DETECTED IN CONCENTRATIONS ABOVE BACKGROUND IN GROUNDWATER SAMPLES FROM WELL 1986

Sample Number	Sample Date	Manganese (mg/l)	Nickel (mg/l)	Sodium (mg/l)	Gross Alpha (pCi/l)	Gross Beta (pCi/l)	Plutonium -239/240 (pCi/l)	Strontium -89, -90 (pCi/l)	Tritium (pCi/l)	Uranium -233, -234 (pCi/l)
G-198609860	18-SEP-86	NA	NA	NA	NA	NA	NA	NA	NA	NA
19-86-03-26-87	26-MAR-87	4	ND	230	102	100	ND	3.5	ND	2.4
19-86-06-30-87	30-JUN-87	3	–	205	–	62	ND	ND	ND	0.96
19-86-06-30-87FD	30-JUN-87	3	–	204	–	–	ND	ND	ND	4.1
19-86-09-15-87	15-SEP-87	3	ND	174	ND	ND	8.5	1.4	ND	5.4
19-86-12-18-87	18-DEC-87	3	ND	178	–	ND	ND	NA	ND	5.5
19-86-03-16-88	16-MAR-88	3	0.05	221	–	ND	ND	NA	ND	5.8
19-86-05-23-88	23-MAY-88	3	ND	183	–	–	ND	NA	ND	5.0
19-86-09-07-88	07-SEP-88	3	ND	189	ND	ND	ND	NA	ND	5.0
19-86-11-29-88	29-NOV-88	3	ND	183	ND	ND	ND	NA	ND	4.9
19-86-02-27-8	27-FEB-89	3	ND	180	–	–	NA	NA	ND	NA
19-86-05-15-8	15-MAY-89	4	ND	202	–	–	NA	NA	NA	NA
19-86-08-28-89	28-SEP-89	3	ND	216	–	–	ND	NA	NA	4.40
G1986-1189004	03-NOV-89	3	ND	200	–	–	0.02	–	–	2.99
G19860290001	12-FEB-90	3	ND	–	–	–	–	–	–	4.27
G19860290001D	12-FEB-90	3	ND	171	ND	–	–	–	–	3.22
G-1986-0509-02-1000	09-MAY-90	4	ND	230	–	–	ND	–	520	4.51
GW00054IT	25-JUL-90	3	ND	392	–	–	ND	1.9	ND	3.78
GW00530IT	18-OCT-90	3	ND	182	ND	–	ND	ND	–	2.89
GW01377IT	03-JUN-91	3	ND	218	ND	–	ND	–	–	5.47
GW01583IT	31-JUL-91	3	ND	214	ND	–	ND	1.3	ND	2.85
GW01800IT	02-OCT-91	3	ND	187	–	–	ND	0.9	ND	3.47
GW02200IT	30-JAN-92	3	–	193	NA	NA	NA	NA	NA	NA

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– = Constituent detected at concentration less than background

TABLE 2.13 (continued)
SUMMARY OF CONSTITUENTS DETECTED IN CONCENTRATIONS ABOVE BACKGROUND IN GROUNDWATER SAMPLES FROM WELL 1986

Sample Number	Sample Date	Bicarbonate (mg/l)	Chloride (mg/l)	Sulfate (mg/l)
G-198609860	18-SEP-86	NA	140	230
19-86-03-26-87	26-MAR-87	630	144	235
19-86-06-30-87	30-JUN-87	591	127	143
19-86-06-30-87FD	30-JUN-87	592	127	175
19-86-09-15-87	15-SEP-87	647	110	193
19-86-12-18-87	18-DEC-87	713	86	93
19-86-03-16-88	16-MAR-88	386	120	150
19-86-05-23-88	23-MAY-88	592	118	285
19-86-09-07-88	07-SEP-88	334	821	156
19-86-11-29-88	29-NOV-88	578	88	ND
19-86-02-27-8	27-FEB-89	750	79	--
19-86-05-15-8	15-MAY-89	632	225	--
19-86-08-28-89	28-SEP-89	599	118	174
G1986-1189004	03-NOV-89	790	88	120
G19860290001	12-FEB-90	890	120	110
G19860290001D	12-FEB-90	900	110	110
G-1986-0509-02-1000	09-MAY-90	610	170	236
GW00054IT	25-JUL-90	620	120	206
GW00530IT	18-OCT-90	610	110	130
GW01377IT	03-JUN-91	340	130	150
GW01583IT	31-JUL-91	670	130	140
GW1800IT	02-OCT-91	670	100	120
GW02200IT	30-JAN-92	620	170	170

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– = Constituent detected at concentration less than background

TABLE 2.14
SUMMARY OF CONSTITUENTS DETECTED IN CONCENTRATIONS ABOVE BACKGROUND IN GROUNDWATER SAMPLES FROM WELL 2186

Sample Number	Sample Date	Acetone (µg/l)	Carbon Tetrachloride (µg/l)	Methylene Chloride (µg/l)	Trans-1,2-Dichloroethene (µg/l)	Aluminum (mg/l)	Calcium (mg/l)	Chromium (mg/l)	Iron (mg/l)	Magnesium (mg/l)	Nickel (mg/l)
21-86-03-25-87	25-MAR-87	NA	ND	NA	4	ND	62	ND	ND	ND	ND
21-86-06-29-87	29-JUN-87	NA	ND	NA	4	ND	–	ND	ND	–	0.04
21-86-09-15-87	15-SEP-87	NA	NA	NA	NA	–	–	ND	–	–	0.04
21-86-01-05-88	05-JAN-88	ND	8	8	NA	ND	52	ND	–	–	ND
21-86-03-21-88	21-MAR-88	ND	ND	17	ND	0.4	–	ND	0.07	–	ND
21-86-11-29-88	29-NOV-88	ND	ND	4 BJ	ND	–	51	ND	–	–	ND
21-86-03-06-89	06-MAR-89	ND	ND	5 BJ	ND	–	–	–	ND	–	ND
21-86-08-28-89	28-AUG-89	ND	ND	ND	ND	–	50	ND	ND	–	ND
G2-1861-189-004	07-NOV-89	ND	ND	ND	NA	–	–	ND	ND	–	ND
G2186-029-0001	28-FEB-90	ND	ND	3 JB	NA	–	–	ND	ND	–	ND
G-21860510-02-1023	11-MAY-90	ND	ND	NA	NA	–	–	ND	ND	–	ND
GW00059IT	02-AUG-90	5 BJ	ND	2 J	NA	–	–	–	NA	–	NA
GW01379IT	04-JUN-91	ND	ND	1 BJ	NA	ND	–	ND	NA	–	ND
GW01637IT	09-AUG-91	7 J	ND	ND	NA	–	–	–	–	–	ND
GW01893IT	16-OCT-91	ND	ND	4 BJ	NA	–	–	–	–	–	ND
GW02255IT	29-JAN-92	ND	ND	ND	NA	–	–	0.08	4.3	0.09	0.06

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NA = Not analyzed
B = Constituent detected in laboratory blank
– = Constituent present at concentration less than background

TABLE 2.14 (continued)
SUMMARY OF CONSTITUENTS DETECTED IN CONCENTRATIONS ABOVE BACKGROUND IN GROUNDWATER SAMPLES FROM WELL 2186

Sample Number	Sample Date	Zinc (mg/l)	Gross Alpha (pCi/l)	Gross Beta (pCi/l)	Plutonium-239/240 (pCi/l)	Radium-226 (pCi/l)	Strontium-89, -90 (pCi/l)	Uranium-235 (pCi/l)	Bicarbonate (mg/l)	Sulfate (mg/l)
21-86-03-25-87	25-MAR-87	ND	27	33	0.73	NA	2.51	–	–	–
21-86-06-29-87	29-JUN-87	ND	28	–	ND	NA	ND	–	–	–
21-86-09-15-87	15-SEP-87	ND	–	–	ND	NA	ND	–	–	–
21-86-01-05-88	05-JAN-88	ND	–	–	ND	NA	ND	–	–	–
21-86-03-21-88	21-MAR-88	–	–	–	ND	NA	NA	–	–	–
21-86-11-29-88	29-NOV-88	ND	–	ND	ND	NA	NA	–	NA	NA
21-86-03-06-89	06-MAR-89	0.03	–	–	NA	NA	NA	–	NA	NA
21-86-08-28-89	28-AUG-89	ND	–	–	–	NA	NA	–	–	–
G2-1861-189-004	07-NOV-89	–	–	–	0.02	NA	–	–	–	–
G2186-029-0001	28-FEB-90	ND	–	–	–	NA	–	NA	–	–
G-21860510-02-1023	11-MAY-90	–	NA	NA	NA	NA	NA	NA	–	6,820
GW00059IT	02-AUG-90	NA	–	–	–	0.34	–	0.05	–	–
GW01379IT	04-JUN-91	ND	–	–	ND	NA	–	–	400	–
GW01637IT	09-AUG-91	NA	–	–	ND	NA	–	–	–	–
GW01893IT	16-OCT-91	–	NA	NA	NA	NA	NA	NA	–	–
GW02255IT	29-JAN-92	–	NA	NA	NA	NA	NA	NA	–	–

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J = Detected at concentration less than detection limit
ND = Not detected
NA = Not analyzed
B = Constituent detected in laboratory blank
– = Constituent present at concentration less than background

TABLE 2.15
SUMMARY OF CONSTITUENTS DETECTED IN CONCENTRATIONS ABOVE BACKGROUND IN GROUNDWATER SAMPLES FROM WELL 2586

Sample Number	Sample Date	Acetone (ug/l)	Benzene (ug/l)	2-Butanone (ug/l)	Carbon Tetra-chloride (ug/l)	Chloro-benzene (ug/l)	Ethyl-benzene (ug/l)	Trans-1,2-Dichloro-ethene (ug/l)	cis-1,3-Dichloro-propene (ug/l)	Methylene Chloride (ug/l)	Styrene (ug/l)	Toluene (ug/l)
25-86-03-18-87	18-Mar-87	ND	ND	ND	ND	ND	ND	4	ND	ND	ND	ND
25-86-06-24-87	24-Jun-87	ND	ND	ND	ND	ND	ND	4	ND	ND	ND	ND
25-86-08-28-87	28-Aug-87	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
25-86-01-15-88	15-Jan-88	ND	ND	ND	7	ND	ND	ND	ND	ND	ND	ND
25-86-03-21-88	21-Mar-88	ND	ND	ND	ND	ND	ND	ND	ND	17	ND	ND
25-86-05-18-88	18-May-88	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
25-86-09-13-88	13-Sep-88	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
25-86-12-06-88	06-Dec-88	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
25-86-03-06-89	06-Mar-89	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
25-86-05-17-89	17-May-89	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
25-86-08-29-89	28-Aug-89	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
G25861189004	08-Nov-89	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
G25860290001	22-Feb-90	ND	ND	ND	ND	ND	ND	ND	ND	3 JB	ND	ND
G25860524021140	25-May-90	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
GW00293IT	28-Aug-90	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
GW00471IT	11-Oct-90	7 JB	11 J	4 JB	ND	ND	ND	ND	1 J	3 JB	ND	ND
GW0847IT	08-Jan-91	ND	5 AJ	ND	ND	5 AJ	5 AJ	ND	5	1 A	5 AJ	5 AJ
GW01397IT	11-Jun-91	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
GW01600IT	24-Jul-91	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
GW02267IT	23-Jan-92	2 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

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NA = Not analyzed
A = Validated and valid with qualifiers
B = Constituent detected in laboratory blank
J = Detected at concentration less than detection limit
– = Constituent present at concentration less than background
ND = Not detected

TABLE 2.15 (continued)
SUMMARY OF CONSTITUENTS DETECTED IN CONCENTRATIONS ABOVE BACKGROUND IN GROUNDWATER SAMPLES FROM WELL 2586

Sample Number	Sample Date	Total Xylenes (ug/l)	Calcium (mg/l)	Chromium (mg/l)	Copper (mg/l)	Iron (mg/l)	Magnesium (mg/l)	Nickel (mg/l)	Sodium (mg/l)	Strontium (mg/l)
25-86-03-18-87	18-Mar-87	ND	192	ND	ND	ND	77	0.13	247	2.57
25-86-06-24-87	24-Jun-87	ND	268	ND	ND	ND	107	–	307	3.20
25-86-08-28-87	28-Aug-87	NA	209	–	–	ND	101	0.10	280	3.10
25-86-01-15-88	15-Jan-88	ND	234	0.04	–	–	100	0.08	283	3.15
25-86-03-21-88	21-Mar-88	ND	207	–	–	0.08	85	ND	259	3.04
25-86-05-18-88	18-May-88	NA	196	ND	–	ND	96	ND	–	–
25-86-09-13-88	13-Sep-88	NA	210	0.03	ND	–	96	ND	296	3.58
25-86-12-06-88	06-Dec-88	NA	249	ND	ND	0.09	93	ND	296	3.38
25-86-03-06-89	06-Mar-89	NA	271	–	–	0.15	112	ND	347	3.78
25-86-05-17-89	17-May-89	NA	235	ND	0.01	ND	96	0.04	297	3.30
25-86-08-29-89	28-Aug-89	NA	246	–	ND	ND	89	0.08	285	3.17
G25861189004	08-Nov-89	NA	227	ND	ND	ND	93	ND	276	2.87
G25860290001	22-Feb-90	ND	227	ND	ND	ND	97	ND	302	3.03
G25860524021140	25-May-90	NA	221	ND	ND	ND	93	ND	294	3.05
GW00293IT	28-Aug-90	NA	237	0.04	–	NA	95	NA	261	2.97
GW00471IT	11-Oct-90	2 J	240	0.03	–	0.09	93	–	279	2.96
GW0847IT	08-Jan-91	ND	241	0.03	NA	NA	91	NA	298	3.00
GW01397IT	11-Jun-91	NA	234	NA	ND	NA	94	NA	299	3.13
GW01600IT	24-Jul-91	NA	232	0.03	ND	NA	93	NA	299	2.95
GW02267IT	23-Jan-92	ND	245	ND	ND	NA	97	ND	285	3.16

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– = Constituent present at concentration less than background

TABLE 2.15 (continued)
SUMMARY OF CONSTITUENTS DETECTED IN CONCENTRATIONS ABOVE BACKGROUND IN GROUNDWATER SAMPLES FROM WELL 2586

Sample Number	Sample Date	Gross Alpha (pCi/l)	Gross Beta (pCi/l)	Plutonium -239/240 (pCi/l)	Radium -226 (pCi/l)	Strontium -89, -90 (pCi/l)	Uranium -238 (pCi/l)	Bicarbonate (mg/l)	Sulfate (mg/l)
25-86-03-18-87	18-Mar-87	140	116	ND	NA	1.8	7.0	410	1100
25-86-06-24-87	24-Jun-87	–	ND	ND	NA	2.3	–	390	400
25-86-08-28-87	28-Aug-87	–	54	ND	NA	ND	–	407	1060
25-86-01-15-88	15-Jan-88	ND	–	ND	NA	ND	–	437	1030
25-86-03-21-88	21-Mar-88	ND	ND	NA	NA	NA	–	–	1050
25-86-05-18-88	18-May-88	–	–	ND	NA	NA	–	373	1355
25-86-09-13-88	13-Sep-88	–	–	ND	NA	NA	–	NA	NA
25-86-12-06-88	06-Dec-88	ND	ND	NA	NA	NA	–	NA	NA
25-86-03-06-89	06-Mar-89	–	80	NA	NA	NA	NA	459	–
25-86-05-17-89	17-May-89	ND	ND	NA	NA	NA	–	413	1180
25-86-08-29-89	28-Aug-89	–	–	NA	NA	NA	–	368	1110
G25861189004	08-Nov-89	–	–	0.02	NA	ND	–	540	1000
G25860290001	22-Feb-90	–	–	0.03	NA	–	–	520	1200
G25860524021140	25-May-90	–	–	ND	NA	ND	NA	412	1120
GW00293IT	28-Aug-90	NA	NA	NA	NA	NA	NA	430	1100
GW00471IT	11-Oct-90	–	30	NA	0.64	NA	–	420	1300
GW0847IT	08-Jan-91	NA	–	NA	NA	NA	NA	410	1300
GW01397IT	11-Jun-91	ND	–	ND	NA	NA	–	–	1600
GW01600IT	24-Jul-91	ND	NA	NA	NA	NA	–	410	1000
GW01909IT	16-Oct-91	NA	NA	NA	NA	NA	NA	410	1500
GW02267IT	23-Jan-92	NA	NA	NA	NA	NA	NA	410	1200

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– = Constituent present at concentration less than background
ND = Not detected

TABLE 2.16
SUMMARY OF CONSTITUENTS DETECTED IN CONCENTRATIONS ABOVE BACKGROUND IN BOREHOLE SAMPLES FROM WELL P207589

Sample Number	Sample Depth (ft)	Acetone (µg/g) •	2-Butanone (µg/g) •	Methylene Chloride (µg/g) •	4-Methyl-2-Pentanone (µg/g) •	Arsenic (mg/kg)	Barium (mg/kg)	Calcium (mg/kg)	Chromium (mg/kg)
SEP0389BR0002	0.0 - 2.1	ND	ND	4 J	ND	NA	NA	NA	NA
SEP0389BR0003	0.0 - 3.0	NA	NA	NA	NA	–	193	115,000	–
SEP0389BR0309	3.0 - 9.4	NA	NA	NA	NA	ND	155	93,500	–
SEP0389BR0406	4.1 - 5.4	ND	ND	7 B	2 JB	NA	NA	NA	NA
SEP0389BR0810	8.1 - 9.7	14 B	ND	6 B	ND	NA	NA	NA	NA
SEP0389BR0915	9.4 - 15.4	NA	NA	NA	NA	17	128	8560	11
SEP0389BR1214	12.1 - 14.1	12 JB	ND	6 B	ND	NA	NA	NA	NA
SEP0389BR1521	15.4 - 21.4	NA	NA	NA	NA	–	ND	–	–
SEP0389BR1618	16.1 - 18.1	12 B	ND	6 B	ND	NA	NA	NA	NA
SEP0389BR2022	20.1 - 22.1	ND	2 J	6 B	2 JB	NA	NA	NA	NA

Sample Number	Sample Depth (ft)	Copper (mg/kg)	Iron (mg/kg)	Lead (mg/kg)	Magnesium (mg/kg)	Nickel (mg/kg)	Strontium (mg/kg)	Vanadium (mg/kg)	Zinc (mg/kg)	Nitrate/ Nitrite (mg/kg)
SEP0389BR0002	0.0 - 2.1	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEP0389BR0003	0.0 - 3.0	–	–	14	4,020	–	237	–	–	16 V
SEP0389BR0309	3.0 - 9.4	–	–	–	–	ND	354	–	–	13 V
SEP0389BR0406	4.1 - 5.4	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEP0389BR0810	8.1 - 9.7	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEP0389BR0915	9.4 - 15.4	24	30,500	–	4,030	43	ND	46	124	22 V
SEP0389BR1214	12.1 - 14.1	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEP0389BR1521	15.4 - 21.4	17	–	25	–	–	ND	–	–	–
SEP0389BR1618	16.1 - 18.1	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEP0389BR2022	20.1 - 22.1	NA	NA	NA	NA	NA	NA	NA	NA	NA

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NA = Not analyzed
B = Constituent detected in laboratory blank
– = Constituent present at concentration less than background
• = The units indicated for this constituent in RFEDS appear to be incorrect. This apparent discrepancy was not resolved during the preparation of this work plan.

TABLE 2.17
SUMMARY OF CONSTITUENTS DETECTED IN CONCENTRATIONS ABOVE BACKGROUND IN BOREHOLE SAMPLES FROM WELL P209089

Sample Number	Sample Depth (ft)	Acetone (g/g)*	Methylene Chloride (g/g)*	Aluminum (mg/kg)	Barium (mg/kg)	Cadmium (mg/kg)	Calcium (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Lithium (mg/kg)	Magnesium (mg/kg)	Manganese (mg/kg)	Mercury (mg/kg)
SEP1889BR0002	0.0 - 1.5	ND	9	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEP1889BR0002D	0 - 1.5 (Dup)	ND	4 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEP1889BR0003	0.0 - 3.2	NA	NA	–	–	12	24,300	–	–	–	–	–	0.4
SEP1889BR0309	3.5 - 8.6	NA	NA	17,300	196	60	80,800	–	–	36	3,730	269	ND
SEP1889BR0406	3.5 - 5.2	ND	2 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEP1889BR0810	7.5 - 8.6	5 J	1 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEP1889BR1214	11.5 - 13.5	4 J	10	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEP1889BR1218	11.5 - 17.5	NA	NA	–	–	ND	–	–	–	ND	–	–	ND
SEP1889BR1218D	11.5 - 17.5 (Dup)	NA	NA	–	–	ND	–	19	22	–	3,020	–	ND
SEP1889BR1618	15.5 - 17.5	ND	17	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEP1889BR1824	17.25 - 23.5	NA	NA	–	ND	ND	–	–	20	ND	–	–	–
SEP1889BR2022	19.5 - 21.5	ND	13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEP1889BR2426	23.5 - 25.5	ND	5J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

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– = Constituent present at concentrations less than background

* The units indicated for this constituent in RFEDS appear to be incorrect. This apparent discrepancy was not resolved during the preparation of this work plan.

TABLE 2.17 (continued)
SUMMARY OF CONSTITUENTS DETECTED IN CONCENTRATIONS ABOVE BACKGROUND IN BOREHOLE SAMPLES FROM WELL P209089

Sample Number	Sample Depth (ft)	Potassium (mg/kg)	Vanadium (mg/kg)	Zinc (mg/kg)	Americium-241 (pCi/g)	Plutonium-239 (pCi/g)	Radium-226 (pCi/g)	Tritium (pCi/ml)	Uranium-233, -234 (pCi/g)	Uranium-235 (pCi/g)	Uranium-238 (pCi/g)	Nitrate/Nitrite (mg/kg)
SEP1889BR0002	0.0 - 1.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEP1889BR002D	0.0 - 1.5(Dup)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEP1889BR0003	0.0 - 3.2	ND	–	–	0.8	1.6	0.9	–	ND	ND	ND	–
SEP1889BR0309	3.5 - 8.6	2,370	–	–	–	0.2	0.7	0.9	–	ND	–	–
SEP1889BR0406	3.5 - 5.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEP1889BR0810	7.5 - 8.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEP1889BR1214	11.5 - 13.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEP1889BR1218	11.5 - 17.5	–	–	–	ND	ND	0.7	4.3	1.4	0.2	1.3	–
SEP1889BR1218D	11.5 - 17.5 (Dup.)	ND	24	–	ND	0.1	–	4.0	1.0	ND	1.1	158
SEP1889BR1618	15.5 - 17.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEP1889BR1824	17.5 - 23.5	ND	–	101	ND	ND	–	ND	1.3	ND	1.1	182
SEP1889BR2022	19.5 - 21.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEP1889BR2426	23.5 - 25.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

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NA = Not analyzed
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– = Constituent present at concentrations less than background

• The units indicated for this constituent in RFEDS appear to be incorrect. This apparent discrepancy was not resolved during the preparation of this work plan.

TABLE 2.18
SUMMARY OF CONSTITUENTS DETECTED IN CONCENTRATIONS ABOVE BACKGROUND IN GROUNDWATER SAMPLES FROM WELL P209089

Sample Number	Sample Date	Acetone (g/l)	Chloroform (g/l)	Ethylbenzene (g/l)	Methylene Chloride (g/l)	Toluene (g/l)	Total Xylenes (g/l)	Calcium (mg/l)	Gross Alpha (pCi/l)	Uranium-238 (pCi/l)	Bicarbonate (mg/l)	Sulfate (mg/l)
GSEP18890989001	26-SEP-89	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
GSEP18890390001	05-MAR-90	ND	ND	ND	5 B	ND	ND	50	31	NA	420	--
SEP1889-0507-02-1000	08-MAY-90	ND	ND	3 J	3 JB	1 J	12	NA	NA	NA	NA	NA
GW00042IT	31-JUL-90	8 JB	ND	ND	4 JB	ND	ND	NA	NA	NA	NA	NA
GW00502IT	16-OCT-90	ND	ND	ND	ND	ND	ND	NA	52	19	NA	NA
GW01035IT	26-MAR-91	13 AJ	5 V	ND	1 AJ	ND	ND	NA	--	18	340	--
GW01424IT	13-JUN-91	ND	ND	ND	ND	ND	ND	NA	NA	NA	310	170
GW01634IT	02-AUG-91	ND	ND	ND	ND	ND	ND	NA	NA	NA	NA	NA
GW01913IT	23-OCT-91	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
GW02270IT	19-MAR-92	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

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NA = Not analyzed
B = Constituent detected in laboratory blank
-- = Constituent present at concentration less than background

TABLE 2.19
SUMMARY OF CONSTITUENTS DETECTED IN CONCENTRATIONS ABOVE BACKGROUND IN GROUNDWATER SAMPLES FROM WELL 2286

Sample Number	Sample Date	Acetone (g/l)	Carbon Tetrachloride (g/l)	Chloroform (g/l)	1,1-Dichloroethane (g/l)	1,2-Dichloroethane (g/l)	1,2-Dichloroethene (g/l)	trans-1, 2-Dichloroethene (g/l)	Methylene Chloride (g/l)	Perchloroethene (g/l)	1,1,1-Trichloroethane (g/l)
G228609860	09-SEP-86	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
22-86-03-24-87	24-MAR-87	NA	ND	100	NA	ND	28	28	NA	ND	1,400
22-86-06-24-87	24-JUN-87	NA	3,000	36	NA	8,000	ND	4 NA	NA	8	NA
22-86-08-28-87	28-AUG-87	NA	491	80	NA	NA	ND	NA	NA	ND	NA
22-86-12-18-87	18-DEC-87	4 J	161	38	ND	ND	ND	NA	10	ND	ND
22-86-03-16-88	16-MAR-88	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
22-86-05-17-88	17-MAY-88	ND	233	103	ND	ND	ND	NA	ND	ND	ND
22-86-09-09-88	09-SEP-88	ND	NA	NA	ND	ND	ND	NA	NA	ND	ND
22-86-08-28-89	28-AUG-89	NA	65	ND	ND	ND	ND	NA	NA	ND	NA
G22861189004	06-NOV-89	NA	79 J	37 J	ND	ND	ND	ND	4 AJB	ND	ND
G22860290001	19-FEB-90	ND	500	97	ND	ND	20	ND	ND	ND	ND
G-2286-0509-02-1236	09-MAY-90	ND	850	110	ND	ND	30	ND	2 JB	2 J	ND
GW00183IT	27-JUL-90	ND	580	120	ND	29	ND	ND	ND	ND	14 J
GW00543IT	12-OCT-90	10 JB	260	76	10	ND	25	ND	4 JB	ND	ND
GW00840IT	07-JAN-91	5 JB	ND	120	ND	ND	50	ND	7	5	ND
GW01349IT	29-MAY-91	ND	800	120	ND	ND	30	ND	17 JB	6 J	ND
GW01577IT	30-JUL-91	27	ND	ND	ND	ND	ND	ND	1J	ND	ND
GW01807IT	03-OCT-91	NA	670	130	ND	ND	ND	30	ND	7	ND
GW02205IT	10-JAN-92	ND	ND	61	ND	ND	17	ND	ND	4 J	ND

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B = Constituent detected in laboratory blank
J = Detected at concentration less than detection limit
-- = Constituent present at concentration less than background
ND = Not detected

TABLE 2.19 (continued)
SUMMARY OF CONSTITUENTS DETECTED IN CONCENTRATIONS ABOVE BACKGROUND IN GROUNDWATER SAMPLES FROM WELL 2286

Sample Number	Sample Date	Trichloroethene (g/l)	Aluminum (mg/l)	Antimony (mg/l)	Calcium (mg/l)	Chromium (mg/l)	Lead (mg/l)	Lithium (mg/l)	Magnesium (mg/l)	Manganese (mg/l)	Nickel (mg/l)
G228609860	09-SEP-86	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
22-86-03-24-87	24-MAR-87	650	–	ND	–	ND	ND	NA	–	–	–
22-86-06-24-87	24-JUN-87	6,000	0.03	ND	–	ND	–	NA	–	–	0.11
22-86-08-28-87	28-AUG-87	490	0.42	ND	–	ND	ND	NA	–	0.23	0.09
22-86-12-18-87	18-DEC-87	186	0.04	ND	65	–	NA	–	–	0.26	0.20
22-86-03-16-88	16-MAR-88	NA	–	ND	63	ND	NA	1.3	–	–	0.17
22-86-05-17-88	17-MAY-88	173	–	ND	78	ND	ND	NA	–	0.23	0.19
22-86-09-09-88	09-SEP-88	ND	–	ND	65	–	ND	NA	–	0.29	0.20
22-86-08-28-89	28-AUG-89	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA
G22861189004	06-NOV-89	110	ND	0.06	81	ND	ND	–	–	–	0.05
G22860290001	19-FEB-90	430	ND	ND	102	ND	ND	–	17	ND	–
G-2286-0509-02-1236	09-MAY-90	600	ND	ND	104	ND	ND	–	–	ND	–
GW00183IT	27-JUL-90	640	ND	ND	95	ND	ND	–	–	NA	0.06
GW00543IT	12-OCT-90	310	NA	NA	104	–	ND	–	–	NA	–
GW00840IT	07-JAN-91	ND	NA	NA	100	–	–	–	–	NA	NA
GW01349IT	29-MAY-91	630	NA	NA	119	NA	ND	0.5	17	–	0.05
GW01577IT	30-JUL-91	ND	–	NA	106	–	ND	0.6	–	–	–
GW01807IT	03-OCT-91	620	–	–	112	–	ND	0.8	16	–	–
GW02205IT	10-JAN-92	360	NA	NA	NA	NA	NA	NA	NA	NA	NA

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– = Constituent present at concentration less than background

TABLE 2.19 (continued)
SUMMARY OF CONSTITUENTS DETECTED IN CONCENTRATIONS ABOVE BACKGROUND IN GROUNDWATER SAMPLES FROM WELL 2286

Sample Number	Sample Date	Sodium (mg/l)	Americium -241 (pCi/l)	Cesium-137 (pCi/l)	Gross Alpha (pCi/l)	Gross Beta (pCi/l)	Plutonium 239/240 (pCi/l)	Strontium -89/90 (pCi/l)	Tritium (pCi/l)	Uranium-233, 234 (pCi/l)	Bicarbonate (mg/l)	Chloride (mg/l)	Nitrate/ Nitrite (mg/l)	Sulfate (mg/l)
G228609860	09-SEP-86	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	37	100	75
22-86-03-24-87	24-MAR-87	185	ND	NA	–	–	4.6	1.85	–	9.2	–	47	6.8	81
22-86-06-24-87	24-JUN-87	146	ND	NA	109	109	–	ND	ND	9.1	317	48	–	–
22-86-08-28-87	28-AUG-87	129	ND	NA	–	–	ND	5.7	723	5.8	335	40	–	–
22-86-12-18-87	18-DEC-87	79	ND	NA	–	–	ND	ND	–	5.6	308	29	–	70
22-86-03-16-88	16-MAR-88	87	ND	NA	–	–	ND	NA	–	6.3	–	44	–	–
22-86-05-17-88	17-MAY-88	76	ND	NA	–	–	ND	NA	390	5.4	262	58	–	–
22-86-09-09-88	09-SEP-88	85	0.05	NA	–	–	ND	NA	360	9.9	299	39	NA	NA
22-86-08-28-89	28-AUG-89	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	–
G22861189004	06-NOV-89	57	–	ND	–	–	0.02	–	–	4.1	340	17	6.6	–
G22860290001	19-FEB-90	76	NA	ND	NA	NA	NA	–	NA	NA	370	80	9.1	–
G-2286-0509-02-1236	09-MAY-90	63	ND	ND	–	–	ND	ND	480	5.1	284	54	7.8	–
GW00183IT	27-JUL-90	62	–	–	–	–	0.12	–	457	5.4	300	45	7.2	–
GW00543IT	12-OCT-90	–	–	ND	–	–	–	0.20	397	4.7	320	38	4.3	–
GW00840IT	07-JAN-91	62	–	ND	–	–	ND	–	373	6.3	310	43	6.1	–
GW01349IT	29-MAY-91	62	NA	NA	NA	NA	NA	NA	NA	NA	300	70	13	74
GW01577IT	30-JUL-91	64	0.06	ND	–	–	0.38	1.98	383	4.1	340	57	8.7	–
GW01807IT	03-OCT-91	74	0.08	1.06	–	–	0.94	ND	482	3.9	350	48	7.7	–
GW02205IT	10-JAN-92	NA	NA	NA	NA	NA	NA	NA	NA	NA	330	53	10	82

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NA = Not analyzed
B = Constituent detected in laboratory blank
– = Constituent present at concentration less than background

TABLE 2.20
SUMMARY OF CONSTITUENTS DETECTED IN CONCENTRATIONS ABOVE BACKGROUND IN GROUNDWATER SAMPLES FROM WELL 5687

Sample Number	Sample Date	Acetone (g/l)	Carbon Tetrachloride (g/l)	Chloroform (g/l)	1,1-Dichloro-ethane (g/l)	1,1-Dichloro-ethene (g/l)	1,2-Dichloro ethene (g/l)	trans-1,2-Dichloro-ethene (g/l)	1,2-Dichloro-propane (g/l)	Methylene Chloride (g/l)
56-87-03-16-88	16-Mar-88	ND	ND	6	6	4 J	ND	NA	ND	ND
59-87-05-23-88	23-May-88	ND	ND	ND	15	11	ND	NA	ND	ND
56-87-03-01-89-RR	01-Mar-89	ND	ND	ND	4 J	3 J	ND	ND	ND	ND
56-87-08-28-89	28-Aug-89	ND	ND	6	12	7	ND	ND	1 J	ND
G56871189004	20-Nov-89	ND	9	3 J	ND	6	ND	NA	ND	NA
G56870290001	15-Feb-90	17	ND	5	8	5	11	NA	ND	NA
G5687-0509-02-1425	10-May-90	ND	6	6	9	ND	13	NA	ND	3 JB
GW00055IT	31-Jul-90	8 JB	ND	6	10	7	16	NA	2 J	2 JB
GW00565IT	23-Oct-90	NA	ND	5	9	6	ND	NA	2 J	4 JB
GW0085IT	09-Jan-91	7 JB	ND	4 J	8	6	18	NA	1 J	ND
GW01348IT	30-May-91	ND	ND	5	10	6	15	NA	ND	ND
GW01808IT	04-Oct-91	ND	ND	5	10	6	ND	14	ND	ND
GW02203IT	10-Jan-92	ND	ND	4 J	7	ND	10	NA	ND	ND

V = Validated and valid
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J = Detected at concentration less than detection limit
ND = Not detected
NA = Not analyzed
B = Constituent detected in laboratory blank
– = Constituent present at concentration less than background

TABLE 2.20 (continued)
SUMMARY OF CONSTITUENTS DETECTED IN CONCENTRATIONS ABOVE BACKGROUND IN GROUNDWATER SAMPLES FROM WELL 5687

Sample Number	Sample Date	Perchloro-ethene (g/l)	1,1,1-Tri-chloroethane (g/l)	Trichloro-ethene (g/l)	Vinyl Chloride (g/l)	Calcium (mg/l)	Copper (mg/l)	Lead (mg/l)	Mercury (mg/l)	Nickel (mg/l)
56-87-03-16-88	16-Mar-88	4 J	29	57	ND	NA	NA	NA	NA	NA
59-87-05-23-88	23-May-88	7	ND	124	ND	NA	NA	NA	NA	NA
56-87-03-01-89-RR	01-Mar-89	2 J	3 J	43	ND	NA	NA	NA	NA	NA
56-87-08-28-89	28-Aug-89	4 J	7	84	ND	NA	NA	NA	NA	NA
G56871189004	20-Nov-89	8	ND	67	ND	139	0.19	--	0.0003	0.164
G56870290001	15-Feb-90	3 J	ND	59	1 J	NA	NA	NA	NA	NA
G5687-0509-02-1425	10-May-90	2 J	5	74	ND	140	0.11	0.17	ND	0.063
GW00055IT	31-Jul-90	5	7	77	2 J	NA	NA	NA	NA	NA
GW00565IT	23-Oct-90	4 J	6	72	2 J	NA	NA	NA	NA	NA
GW0085IT	09-Jan-91	4 J	4 J	68	2 J	NA	NA	NA	NA	NA
GW01348IT	30-May-91	3 J	5	71	3 J	NA	NA	NA	NA	NA
GW01808IT	04-Oct-91	4 J	6	70	3 J	NA	NA	NA	NA	NA
GW02203IT	10-Jan-92	3 J	4 J	55	ND	NA	NA	NA	NA	NA

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ND = Not detected
NA = Not analyzed
B = Constituent detected in laboratory blank
-- = Constituent present at concentration less than background

TABLE 2.20 (continued)
SUMMARY OF CONSTITUENTS DETECTED IN CONCENTRATIONS ABOVE BACKGROUND IN GROUNDWATER SAMPLES FROM WELL 5687

Sample Number	Sample Date	Sodium (mg/l)	Zinc (mg/l)	Bicarbonate (mg/l)	Chloride (mg/l)	Nitrate/ Nitrite (mg/l)	Sulfate (mg/l)
56-87-03-16-88	16-Mar-88	NA	NA	NA	NA	NA	NA
59-87-05-23-88	23-May-88	NA	NA	NA	NA	NA	NA
56-87-03-01-89-RR	01-Mar-89	NA	NA	NA	NA	NA	NA
56-87-08-28-89	28-Aug-89	NA	NA	NA	NA	NA	NA
G56871189004	20-Nov-89	271	1.5	--	54	--	--
G56870290001	15-Feb-90	NA	NA	410	53	NA	130
G5687-0509-02-1425	10-May-90	287	0.6	--	58	98	6960
GW00055IT	31-Jul-90	NA	NA	400	57	NA	170
GW00565IT	23-Oct-90	NA	NA	NA	NA	NA	NA
GW0085IT	09-Jan-91	NA	NA	NA	NA	95	NA
GW01348IT	30-May-91	NA	NA	340	43	90	160
GW01808IT	04-Oct-91	NA	NA	390	55	87	240
GW02203IT	10-Jan-92	NA	NA	370	66	77	210

V = Validated and valid
A = Validated and valid with qualifiers
J = Detected at concentration less than detection limit
ND = Not detected
NA = Not analyzed
B = Constituent detected in laboratory blank
-- = Constituent present at concentration less than background

TABLE 2.21
SUMMARY OF CONSTITUENTS DETECTED IN CONCENTRATIONS ABOVE BACKGROUND IN GROUNDWATER SAMPLES FROM WELL P210189

Sample Number	Sample Date	Acetone (g/l)	Bromomethane (g/l)	Carbon Disulfide (g/l)	Carbon Tetrachloride (g/l)	Chloroform (g/l)	Chloromethane (g/l)	1,1-Dichloroethane (g/l)	1,1-Dichloroethene (g/l)	1,2-Dichloroethane (g/l)
GSEP30890989001	28-SEP-89	ND	7 J	ND	ND	ND	4 J	ND	ND	ND
GSEP30890390001	01-MAR-90	680 J	ND	ND	ND	400	ND	ND	120	ND
GSEP30890390001D	01-MAR-90	ND	ND	ND	13,000	ND	ND	ND	ND	ND
SEP3089-0608-02-1410	08-JUN-90	ND	ND	ND	ND	ND	ND	1 J	8	2 J
GW00268IT	17-AUG-90	8 JB	ND	4 J	ND	ND	ND	ND	8	3 J
GW0066IT	09-NOV-90	ND	ND	ND	ND	ND	ND	ND	8	ND
GW01346IT	26-MAR-91	ND	ND	ND	ND	420	ND	ND	ND	ND
GW01344IT	29-MAY-91	110 J	ND	ND	ND	470	ND	ND	ND	ND
GW01632IT	06-AUG-91	ND	ND	ND	16,000	730	ND	ND	ND	ND
GW01908IT	14-OCT-91	ND	ND	ND	ND	390	ND	ND	ND	ND
GW02257IT	20-JAN-92	ND	ND	ND	ND	ND	ND	ND	7	3 J

Sample Number	Sample Date	1,2-Dichloroethene (g/l)	Methylene Chloride (g/l)	Perchloroethene (g/l)	1,1,2-Trichloroethane (g/l)	Trichloroethene (g/l)	Vinyl Chloride (g/l)	Aluminum (mg/l)	Barium (mg/l)	Calcium (mg/l)
GSEP30890989001	28-SEP-89	ND	ND	ND	ND	ND	ND	ND	0.22	130
GSEP30890390001	01-MAR-90	ND	78 JB	ND	ND	ND	ND	NA	NA	115
GSEP30890390001D	01-MAR-90	ND	ND	ND	ND	5,800	ND	NA	NA	105
SEP3089-0608-02-1410	08-JUN-90	150	4 JB	8	ND	5,300	ND	513	ND	122
GW00268IT	17-AUG-90	160	5	9	1 J	ND	3 J	NA	NA	126
GW0066IT	09-NOV-90	200	ND	13	ND	ND	2 J	NA	NA	117
GW01346IT	26-MAR-91	ND	ND	ND	ND	6,800	ND	NA	NA	114
GW01344IT	29-MAY-91	260	130 JB	ND	ND	5,600	ND	NA	NA	118
GW01632IT	06-AUG-91	ND	ND	ND	ND	7,900	ND	NA	NA	114
GW01908IT	14-OCT-91	77 J	ND	ND	ND	ND	ND	–	NA	115
GW02257IT	20-JAN-92	160	2 J	9	ND	ND	3 J	635	NA	122

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NA = Not analyzed
B = Constituent detected in laboratory blank
– = Constituent present at concentration less than background

TABLE 2.21 (continued)
SUMMARY OF CONSTITUENTS DETECTED IN CONCENTRATIONS ABOVE BACKGROUND IN GROUNDWATER SAMPLES FROM WELL P210189

Sample Number	Sample Date	Chromium (mg/l)	Iron (mg/l)	Mercury (mg/l)	Plutonium-239/240 (pCi/l)	Radium-226 (pCi/l)	Strontium-89,90 (pCi/l)	Tritium (pCi/l)	Bicarbonate (mg/l)	Nitrate/Nitrite (mg/l)
GSEP30890989001	28-SEP-89	ND	ND	ND	0.01	NA	ND	1,150	350	38
GSEP30890390001	01-MAR-90	ND	NA	NA	ND	NA	NA	NA	340	27
GSEP30890390001D	01-MAR-90	ND	NA	ND	ND	NA	NA	NA	340	29
SEP3089-0608-02-1410	08-JUN-90	ND	ND	ND	ND	NA	NA	NA	280	--
GW00268IT	17-AUG-90	ND	ND	0.0005	0.04	0.79	18.6	1,320	280	22
GW0066IT	09-NOV-90	ND	NA	--	0.02	--	--	1,095	--	11
GW01346IT	26-MAR-91	NA	NA	0.0004	--	NA	--	1,116	290	26
GW01344IT	29-MAY-91	NA	NA	ND	NA	NA	NA	NA	280	22
GW01632IT	06-AUG-91	ND	0.8	ND	ND	NA	ND	1,143	280	16
GW01908IT	14-OCT-91	--	1.6	ND	NA	NA	NA	NA	280	21
GW02257IT	20-JAN-92	0.012	1.1	ND	NA	NA	NA	NA	280	34

V = Validated and valid
A = Validated and valid with qualifiers
J = Detected at concentration less than detection limit
ND = Not detected
NA = Not analyzed
B = Constituent detected in laboratory blank
-- = Constituent present at concentration less than background

TABLE 2.22
SUMMARY OF CONSTITUENTS DETECTED IN CONCENTRATIONS ABOVE BACKGROUND IN BOREHOLE SAMPLES FROM WELL P210189

Sample Number	Sample Depth (ft)	Acetone (ug/kg)	Methylene Chloride (ug/kg)	Toluene (ug/kg)	Aluminum (mg/kg)	Arsenic (mg/kg)	Barium (mg/kg)	Cadmium (mg/kg)	Calcium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)
SEP3089BR0002	0.0 - 2.3	64 AJB	540 AJB	ND	NA	NA	NA	NA	NA	NA	NA
SEP3089BR0003	0.0 - 3.0	NA	NA	NA	21,100	4	228	4	--	--	--
SEP3089BR0309	3.0 - 9.0	NA	NA	NA	23,000	--	82	--	--	--	--
SEP3089BR0406	4.6 - 6.6	800 AJB	480 AJB	ND	NA	NA	NA	NA	NA	NA	NA
SEP3089BR0810	8.6 - 9.4	ND	380 AJ	ND	NA	NA	NA	NA	NA	NA	NA
SEP3089BR0915	9.0 - 14.6	NA	NA	NA	--	--	--	ND	--	--	--
SEP3089BR1214	12.6 - 13.6	990 AJB	450 AJB	ND	NA	NA	NA	NA	NA	NA	NA
SEP3089BR1521	14.6 - 20.6	NA	NA	NA	10,700	--	203	--	--	27	18
SEP3089BR1618	16.6 - 18.6	ND	540 AJB	ND	NA	NA	NA	NA	NA	NA	NA
SEP3089BR2022	20.6 - 22.6	2,700 AB	630 AJB	340 AJ	NA	NA	NA	NA	NA	NA	NA
SEP3089BR2127	20.6 - 26.6	NA	NA	NA	--	--	169	ND	7,920	12	24
SEP3089BR2426	24.6 - 26.6	1,700 AB	590 AJB	ND	NA	NA	NA	NA	NA	NA	NA

V = Validated and valid
A = Validated and valid with qualifiers
J = Detected at concentration less than detection limit
ND = Not detected
NA = Not analyzed
B = Constituent detected in laboratory blank
-- = Constituent present at concentration less than background
P = pH within background range

TABLE 2.22 (continued)
SUMMARY OF CONSTITUENTS DETECTED IN CONCENTRATIONS ABOVE BACKGROUND IN BOREHOLE SAMPLES FROM WELL P210189

Sample Number	Sample Depth (ft)	Iron (mg/kg)	Lead (mg/kg)	Magnesium (mg/kg)	Manganese (mg/kg)	Nickel (mg/kg)	Potassium (mg/kg)	Vanadium (mg/kg)	Zinc (mg/kg)	Americium-241 (pCi/g)	Gross Alpha (pCi/g)
SEP3089BR0002	0.0 - 2.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEP3089BR0003	0.0 - 3.0	18,100	16	3,830	--	--	4,320	49	63	NA	490
SEP3089BR0309	3.0 - 9.0	16,000	--	3,010	--	--	4,620	--	--	0.2	--
SEP3089BR0406	4.6 - 6.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEP3089BR0810	8.6 - 9.4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEP3089BR0915	9.0 - 14.6	--	--	--	--	--	--	--	--	0.1	--
SEP3089BR1214	12.6 - 13.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEP3089BR1521	14.6 - 20.6	21,200	--	--	533	22	--	31	83	--	--
SEP3089BR1618	16.6 - 18.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEP3089BR2022	20.6 - 22.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEP3089BR2127	20.6 - 26.6	21,200	--	--	382	22	--	58	--	--	--
SEP3089BR2426	24.6 - 26.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

V = Validated and valid
NA = Not analyzed
A = Validated and valid with qualifiers
B = Constituent detected in laboratory blank
J = Detected at concentration less than detection limit
-- = Constituent present at concentration less than background
ND = Not detected
P = pH within background range

TABLE 2.22 (continued)
SUMMARY OF CONSTITUENTS DETECTED IN CONCENTRATIONS ABOVE BACKGROUND IN BOREHOLE SAMPLES FROM WELL P210189

Sample Number	Sample Depth (ft)	Gross Beta (pCi/g)	Plutonium-239/240 (pCi/g)	Radium- 226 (pCi/g)	Strontium -90 (pCi/g)	Tritium (pCi/ml)	Uranium-233, -234 (pCi/g)	Uranium-235 (pCi/g)	Uranium-238 (pCi/g)	Nitrate/ Nitrite (mg/kg)	pH (pH units)
SEP3089BR0002	0.0 - 2.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEP3089BR0003	0.0 - 3.0	120	NA	1.0	ND	--	1.6	0.1	1.1	380 V	9.6
SEP3089BR0309	3.0 - 9.0	--	0.83	0.7	2.6	0.7	7.1	0.3	1.4	130 V	--P
SEP3089BR0406	4.6 - 6.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEP3089BR0810	8.6 - 9.4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEP3089BR0915	9.0 - 14.6	--	0.7	0.7	ND	0.7	0.7	ND	--	--	--P
SEP3089BR1214	12.6 - 13.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEP3089BR1521	14.6 - 20.6	--	0.08	--	ND	2.1	1.5	ND	1.4	11 V	--P
SEP3089BR1618	16.6 - 18.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEP3089BR2022	20.6 - 22.6	NA	NA	NA	NA	NA	NA	ND	NA	NA	NA
SEP3089BR2127	20.6 - 26.6	--	0.04	--	ND	2.1	1.2	NA	1.3	8 V	--P
SEP3089BR2426	24.6 - 26.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

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B = Constituent detected in laboratory blank
J = Detected at concentration less than detection limit
-- = Constituent present at concentration less than background
ND = Not detected
P = pH within background range

TABLE 2.23
SUMMARY OF CONSTITUENTS DETECTED IN CONCENTRATIONS ABOVE BACKGROUND IN BOREHOLE SAMPLES FROM SP16-87 (WELL 5687)

Sample Number	Sample Depth (ft)	Arsenic (mg/Kg)	Cadmium (mg/Kg)	Zinc (mg/Kg)	Chromium (mg/Kg)	Copper (mg/Kg)	Iron (mg/Kg)	Lead (mg/Kg)	Manganese (mg/Kg)	Potassium (mg/Kg)
SP168702FS	0.0 - 2.0	5	--	--	21	17	16363	--	--	4400
SP168708UC	6.0 - 8.0	14	3	--	--	--	--	--	--	--
SP168710CT	10.0 - 11.2	13	3	85844	18	--	--	21	--	--
SP168711BR	11.2 - 13.4	16	3	--	17	22	--	20	1258	--

Sample Number	Sample Depth (ft)	Zinc (mg/Kg)	Americium-241 (pCi/g)	Gross Alpha (pCi/g)	Plutonium-239/240 (pCi/g)	Uranium-233, -234 (pCi/g)	Uranium-238 (pCi/g)	Nitrate/Nitrite (mg/Kg)
SP168702FS	0.0 - 2.0	103	0.96	59	9	1.1	0.78	11
SP168708UC	6.0 - 8.0	--	ND	--	ND	--	--	12
SP168710CT	10.0 - 11.2	--	ND	--	ND	--	--	3
SP168711BR	11.2 - 13.4	--	ND	--	ND	--	--	--

V = Validated and valid
A = Validated and valid with qualifiers
J = Detected at concentration less than detection limit
ND = Not detected
NA = Not analyzed
B = Constituent detected in laboratory blank
-- = Constituent present at concentration less than background

TABLE 2.24
SUMMARY OF CONSTITUENTS DETECTED IN CONCENTRATIONS ABOVE BACKGROUND IN BOREHOLE SAMPLES FROM WELL P219189

Sample Number	Sample Depth (ft)	1,1-Dichloro-ethane (ug/kg)	Methylene Chloride (ug/kg)	Aluminum (mg/kg)	Arsenic (mg/kg)	Barium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Iron (mg/kg)	Lead (mg/kg)
P2191890002	0.0 - 1.0	ND	ND	NA	NA	NA	NA	NA	NA	NA
P2191890003	0.0 - 3.0	NA	NA	–	ND	102	–	15	–	14
P2191890204	2.0 - 4.0	ND	ND	NA	NA	NA	NA	NA	NA	NA
P2191890307	3.0 - 6.6	NA	NA	NA	NA	NA	NA	NA	NA	NA
P2191890307D	3.0 - 6.6(dup)	NA	NA	–	–	83	–	NA	NA	NA
P2191890406	4.0 - 5.8	ND	ND	NA	NA	NA	NA	NA	NA	NA
P2191890406D	4.0 - 5.8(dup)	ND	ND	NA	NA	NA	NA	NA	NA	NA
P2191890608	6.0 - 6.6	ND	ND	NA	NA	NA	NA	NA	NA	NA
P2191890711	7.0 - 11.0	NA	NA	–	6	84	–	12	14,400	20
P2191890810	8.0 - 8.9	4 AJ	ND	NA	NA	NA	NA	NA	NA	NA
P2191891012	10.0 - 11.0	ND	ND	NA	NA	NA	NA	NA	NA	NA
P2191891116	11.0 - 14.4	NA	NA	12,500	10	161	15	34	15,800	43
P2191891416	14.0 - 14.4	ND	4 JB	NA	NA	NA	NA	NA	NA	NA

V = Validated and valid
NA = Not analyzed
A = Validated and valid with qualifiers
B = Constituent detected in laboratory blank
J = Detected at concentration less than detection limit
– = Constituent present at concentration less than background
ND = Not detected

TABLE 2.24 (continued)
SUMMARY OF CONSTITUENTS DETECTED IN CONCENTRATIONS ABOVE BACKGROUND IN BOREHOLE SAMPLES FROM WELL P219189

Sample Number	Sample Depth (ft)	Magnesium (mg/kg)	Manganese (mg/kg)	Nickel (mg/kg)	Vanadium (mg/kg)	Zinc (mg/kg)	Americium-241 (pCi/g)	Radium-226 (pCi/g)	Radium-228 (pCi/g)
P2191890002	0.0 - 1.0	NA	NA	NA	NA	NA	NA	NA	NA
P2191890003	0.0 - 3.0	--	--	--	--	93	0.07	1.1	2.9
P2191890204	2.0 - 4.0	NA	NA	NA	NA	NA	NA	NA	NA
P2191890307	3.0 - 6.6	NA	NA	NA	NA	NA	NA	NA	NA
P2191890307D	3.0 - 6.6(dup)	--	248	--	--	116	--	1.2	--
P2191890406	4.0 - 5.8	NA	NA	NA	NA	NA	NA	NA	NA
P2191890406D	4.0 - 5.8(dup)	NA	NA	NA	NA	NA	NA	NA	NA
P2191890608	6.0 - 6.6	NA	NA	NA	NA	NA	NA	NA	NA
P2191890711	7.0 - 11.0	3,780	--	--	--	105	--	1.3	2.1
P2191890810	8.0 - 8.9	NA	NA	NA	NA	NA	NA	NA	NA
P2191891012	10.0 - 11.0	NA	NA	NA	NA	NA	NA	NA	NA
P2191891116	11.0 - 14.4	4,100	--	27	28	174	--	1.7	2.2
P2191891416	14.0 - 14.4	NA	NA	NA	NA	NA	NA	NA	NA

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A = Validated and valid with qualifiers
J = Detected at concentration less than detection limit
ND = Not detected
NA = Not analyzed
B = Constituent detected in laboratory blank
-- = Constituent present at concentration less than background

TABLE 2.24 (continued)
SUMMARY OF CONSTITUENTS DETECTED IN CONCENTRATIONS ABOVE BACKGROUND IN BOREHOLE SAMPLES FROM WELL P219189

Sample Number	Sample Depth (ft)	Tritium (pCi/ml)	Uranium-233, -234 (pCi/g)	Uranium-238 (pCi/g)	Nitrate/Nitrate (mg/kg)
P2191890002	0.0 - 1.0	NA	NA	NA	NA
P2191890003	0.0 - 3.0	1790	0.8	0.9	NA
P2191890204	2.0 - 4.0	NA	NA	NA	NA
P2191890307	3.0 - 6.6	NA	NA	NA	NA
P2191890307	3.0 - 6.6(dup)	1840	1.0	1.0	ND
P2191890406	4.0 - 5.8	NA	NA	NA	NA
P2191890406D	4.0 - 5.8(dup)	NA	NA	NA	NA
P2191890608	6.0 - 6.6	NA	NA	NA	NA
P2191890711	7.0 - 11.0	1940	1.1	1.0	2.8 V
P2191890810	8.0 - 8.9	NA	NA	NA	NA
P2191891012	10.0 - 11.0	NA	NA	NA	NA
P2191891116	11.0 - 14.4	1230	1.8	1.6	3.4 V
P2191891416	14.0 - 14.4	NA	NA	NA	NA

V = Validated and valid
A = Validated and valid with qualifiers
J = Detected at concentration less than detection limit
ND = Not detected
NA = Not analyzed
B = Constituent detected in laboratory blank
-- = Constituent present at concentration less than background

TABLE 2.25
SUMMARY OF CONSTITUENTS DETECTED IN CONCENTRATIONS ABOVE BACKGROUND IN BOREHOLE SAMPLES FROM WELL P207389

Sample Number	Sample Depth (ft)	Acetone (g/kg)	Methylene Chloride (g/kg)	Aluminum (mg/kg)	Barium (mg/kg)	Calcium (mg/kg)	Lithium (mg/kg)	Magnesium (mg/kg)	Strontium (mg/kg)	Zinc (mg/kg)	Nitrate/ Nitrite (mg/kg)
SEP0189BR0002	0.0 - 2.0	9 AJB	10 V	NA	NA	NA	NA	NA	NA	NA	NA
SEP0189BR0003	0.0 - 3.0	NA	NA	22,800 J	91.4	--	776	--	--	46.6	5.3 V
SEP0189BR0307	3.0 - 7.0	NA	NA	--	--	75,600	ND	2,760	--	--	ND
SEP0189BR0406	4.3 - 5.3	42 AB	9 V	NA	NA	NA	NA	NA	NA	NA	NA
SEP0189BR0713	7.0 - 13.0	NA	NA	--	--	36,500	ND	--	189	--	ND
SEP0189BR0810	8.3 - 10.3	62 AB	10 V	NA	NA	NA	NA	NA	NA	NA	NA
SEP0189BR1214	12.3 - 13.8	66 AB	4 AJ	NA	NA	NA	NA	NA	NA	NA	NA
SEP0189BR1319	13.0 - 19.3	NA	NA	--	--	--	ND	--	--	--	ND
SEP0189BR1618	16.3 - 18.3	34 AB	3 AJ	NA	NA	NA	NA	NA	NA	NA	NA
SEP0189BR1920	19.3 - 20.3	29 AB	3 AJ	NA	NA	NA	NA	NA	NA	NA	NA

V = Validated and valid A = Validated and valid with qualifiers J = Detected at concentration less than detection limit ND = Not detected
NA = Not analyzed B = Constituent detected in laboratory blank -- = Constituent present at concentration less than background

TABLE 2.26
SUMMARY OF CONSTITUENTS DETECTED IN CONCENTRATIONS ABOVE BACKGROUND IN GROUNDWATER SAMPLES FROM WELL P207389

Sample Number	Sample Date	Acetone (g/l)	Chloroform (g/l)	Methylene Chloride (g/l)	Calcium (mg/l)	Mercury (mg/l)	Bicarbonate (mg/l)
GSEP01890989001	21-SEP-89	ND	ND	ND	70	ND	380
GSEP1890390007	14-MAR-90	ND	ND	ND	NA	NA	400
SEP0189-0604-02-0940	05-JUN-90	17	ND	6	78	0.0003	329
GW00244IT	21-AUG-90	ND	ND	3 JB	76	ND	320
GW00799IT	18-DEC-90	5 AJB	2 AJ	1 ND	91	ND	410
GW01028IT	26-MAR-91	9 AJ	ND	ND	85	0.0006	310
GW01361IT	31-MAY-91	ND	ND	6	91	ND	320
GW01616IT	07-AUG-91	ND	ND	ND	86	ND	340
GW01895IT	24-OCT-91	ND	ND	ND	89	ND	310
GW02258IT	04-MAR-92	NA	NA	NA	NA	NA	330

V = Validated and valid
A = Validated and valid with qualifiers
J = Detected at concentration less than detection limit
ND = Not detected
NA = Not analyzed
B = Constituent detected in laboratory blank
-- = Constituent present at concentration less than background

TABLE 2.27
SUMMARY OF CONSTITUENTS DETECTED IN CONCENTRATIONS ABOVE BACKGROUND IN BOREHOLE SAMPLES FROM WELL P207489

Sample Number	Sample Depth (ft)	Acetone (g/kg)	Methylene Chloride (g/kg)	Aluminum (mg/kg)	Barium (mg/kg)	Beryllium (mg/kg)	Calcium (mg/kg)	Chromium (mg/kg)
SEP2890002	0.0 - 2.0	ND	3 AJ	NA	NA	NA	NA	NA
SEP2890003	0.0 - 3.0	NA	NA	--	--	--	13,700	--
SEP2890306	3.0 - 6.5	NA	NA	30,400	120	8.7	--	81.2
SEP2890406	4.0 - 5.0	38 AB	4 AJ	NA	NA	NA	NA	NA
SEP2890610	6.5 - 10.0	NA	NA	--	--	--	--	--
SEP2890810	8.0 - 10.0	40 AB	ND	NA	NA	NA	NA	NA

Sample Number	Sample Depth (ft)	Copper (mg/kg)	Iron (mg/kg)	Magnesium (mg/kg)	Potassium (mg/kg)	Vanadium (mg/kg)	Zinc (mg/kg)	Nitrate/Nitrite (mg/kg)
SEP2890002	0.0 - 2.0	NA	NA	NA	NA	NA	NA	NA
SEP2890003	0.0 - 3.0	--	--	--	--	--	--	8.3 V
SEP2890306	3.0 - 6.5	26.6	33,500	3,120	2,540	64.3	62.1	--
SEP2890406	4.0 - 5.0	NA	NA	NA	NA	NA	NA	NA
SEP2890610	6.5 - 10.0	--	--	--	ND	ND	--	ND
SEP2890810	8.0 - 10.0	NA	NA	NA	NA	NA	NA	NA

V = Validated and valid
NA = Not analyzed
A = Validated and valid with qualifiers
B = Constituent detected in laboratory blank
J = Detected at concentration less than detection limit
-- = Constituent present at concentration lass than background
ND = Not detected

TABLE 2.28
SUMMARY OF CONSTITUENTS DETECTED IN CONCENTRATIONS ABOVE BACKGROUND IN GROUNDWATER SAMPLES FROM WELL P207489

Sample Number	Sample Date	Acetone (g/l)	Carbon Tetrachloride (g/l)	1,1-Dichloroethene (g/l)	Methylene Chloride (g/l)	Calcium (mg/l)
GSEP02890989001	20-SEP-89	ND	1 J	2 J	ND	90
GSEP02890390001	14-MAR-90	8 J	ND	ND	4 JB	88
SEP0289-0531-02-1430	01-JUN-90	18 B	ND	ND	15 B	88
GW0023IT	14-AUG-90	ND	ND	ND	ND	NA
GW00800IT	18-DEC-90	ND	ND	ND	ND	NA
GW01195IT	01-MAY-91	ND	ND	ND	ND	NA
GW01362IT	31-MAY-91	ND	ND	ND	1 JB	96
GW01618IT	07-AUG-91	ND	ND	ND	ND	NA
GW01896IT	24-OCT-91	ND	ND	ND	ND	NA
GW02259IT	04-MAR-92	NA	NA	NA	NA	NA

Sample Number	Sample Date	Magnesium (mg/l)	Bicarbonate (mg/l)	Chloride (mg/l)	Nitrate/Nitrite (mg/l)	Sulfate (mg/l)
GSEP02890989001	20-SEP-89	23	360	25	–	78
GSEP02890390001	14-MAR-90	23	360	30	–	84
SEP0289-0531-02-1430	01-JUN-90	24	313	NA	–	NA
GW0023IT	14-AUG-90	NA	300	22	9.4	130
GW00800IT	18-DEC-90	NA	NA	NA	–	NA
GW01195IT	01-MAY-91	NA	300	26	4.3	72
GW01362IT	31-MAY-91	26	310	230	4.3	70
GW01618IT	07-AUG-91	NA	300	22	9.4	130
GW01896IT	24-OCT-91	NA	280	29	3.7	77
GW02259IT	04-MAR-92	NA	290	34	4.0	75

V = Validated and valid
A = Validated and valid with qualifiers
J = Detected at concentration less than detection limit
ND = Not detected
NA = Not analyzed
B = Constituent detected in laboratory blank
– = Constituent present at concentration less than background

TABLE 2.29
SUMMARY OF CONSTITUENTS DETECTED IN CONCENTRATIONS ABOVE BACKGROUND IN BOREHOLE SAMPLES FROM WELL SP03-87

Sample Number	Sample Depth (ft)	Chloroform (g/kg)	Bis(2-Ethylhexyl) phthalate (g/kg)	DI-n-Butyl Phthalate (g/kg)	Methylene Chloride (g/kg)	N-Nitro-sodiphenyl-amine (g/kg)	Trichloro-ethene (g/kg)	Aluminum (mg/kg)	Arsenic (mg/kg)	Calcium (mg/kg)
SP028702DH	2.0 - 3.5	ND	830	44 J	13 JB	83 J	9 JB	--	--	--
SP028703FS	4.0 - 4.6	ND	NA	NA	18 JB	NA	8 JB	NA	NA	NA
SP028711DH	10.3 - 11.6	ND	NA	NA	ND	NA	ND	--	--	--
SP028713CT	12.8 - 14.4	ND	NA	NA	18 J	NA	ND	--	--	--
SP028716BR	15.2 - 16.9	5 J	NA	NA	ND	NA	ND	10704	11	10348

Sample Number	Sample Depth (ft)	Chromium (mg/kg)	Lead (mg/kg)	Nickel (mg/kg)	Vanadium (mg/kg)	Tritium (pCi/ml)	Uranium -233,234 (pCi/g)	Uranium-238 (pCi/g)	Nitrate/ Nitrate mg/kg	pH (pH units)
SP028702DH	2.0 - 3.5	--	--	--	--	ND	1.3	1.1	NA	NA
SP028703FS	4.0 - 4.6	NA	NA	NA	NA	NA	NA	NA	NA	NA
SP028711DH	10.3 - 11.6	--	--	ND	--	ND	--	--	200	4.76
SP028713CT	12.8 - 14.4	13	19	ND	--	1.1	--	--	186	-- P
SP028716BR	15.2 - 16.9	--	--	23	30	2	--	--	260	-- P

V = Validated and valid
A = Validated and valid with qualifiers
J = Detected at concentration less than detection limit
ND = Not detected
NA = Not analyzed
B = Constituent detected in laboratory blank
-- = Constituent present at concentration less than background
P = pH within background range

TABLE 2.30
SUMMARY OF CONSTITUENTS DETECTED IN CONCENTRATIONS ABOVE BACKGROUND IN GROUNDWATER SAMPLES FROM WELL 2187

Sample Number	Sample Date	Acetone (g/l)	Carbon Disulfide (g/l)	Methylene Chloride (g/l)	Perchloroethene (g/l)	Calcium (mg/l)	Copper (mg/l)	Magnesium (mg/l)	Nickel (mg/l)
21-87-03-07-88	07-MAR-88	ND	ND	ND	6	NA	NA	NA	NA
21-87-05-02-88	02-MAY-88	ND	ND	ND	49	NA	NA	NA	NA
21-87-11-08-88	08-NOV-88	ND	ND	ND	4 J	NA	NA	NA	NA
G21871189004	10-NOV-89	ND	ND	ND	ND	NA	NA	NA	NA
21-87-08-15-89	15-AUG-89	ND	ND	ND	2 J	NA	NA	NA	NA
G21870290001	06-FEB-90	ND	ND	ND	ND	NA	NA	NA	NA
G-2187-0517-02-1116	18-MAY-90	68	1 J	3 J	ND	288	0.78	101	1.2
GW00755IT	12-DEC-90	ND	ND	ND	ND	NA	NA	NA	NA
GW01187IT	24-APR-91	ND	ND	ND	ND	NA	NA	NA	NA
GW01400IT	11-JUN-91	ND	ND	1 JB	ND	NA	NA	NA	NA
GW01613IT	06-AUG-91	ND	ND	ND	ND	NA	NA	NA	NA
GW01929IT	17-OCT-91	ND	ND	ND	ND	NA	NA	NA	NA
GW02520IT	27-FEB-92	NA	NA	NA	NA	NA	NA	NA	NA

V = Validated and valid
A = Validated and valid with qualifiers
J = Detected at concentration less than detection limit
ND = Not detected
NA = Not analyzed
B = Constituent detected in laboratory blank
-- = Constituent present at concentration less than background

TABLE 2.30 (continued)
SUMMARY OF CONSTITUENTS DETECTED IN CONCENTRATIONS ABOVE BACKGROUND IN GROUNDWATER SAMPLES FROM WELL 2187

Sample Number	Sample Date	Sodium (mg/l)	Zinc (mg/l)	Uranium 233, 234 (pCi/l)	Uranium 235 (pCi/l)	Bicarbonate (mg/l)	Chloride (mg/l)	Sulfate (mg/l)
21-87-03-07-88	07-MAR-88	NA	NA	NA	NA	NA	NA	NA
21-87-05-02-88	02-MAY-88	NA	NA	NA	NA	NA	NA	NA
21-87-11-08-88	08-NOV-88	NA	NA	NA	NA	NA	NA	NA
G21871189004	10-NOV-89	NA	NA	23.4	1.15	NA	NA	NA
21-87-08-15-89	15-AUG-89	NA	NA	NA	NA	NA	NA	NA
G21870290001	06-FEB-90	NA	NA	21.5	--	1100	--	--
G-2187-0517-02-1116	18-MAY-90	270	4.2	NA	NA	870	--	665
GW00108IT	05-SEP-90	NA	NA	NA	NA	920	--	640
GW00755IT	12-DEC-90	NA	NA	33.4	1.06	NA	NA	NA
GW01187IT	24-APR-91	NA	NA	27.3	0.63	850	--	650
GW01400IT	11-JUN-91	NA	NA	NA	NA	840	130	540
GW01613IT	06-AUG-91	NA	NA	NA	NA	840	120	810
GW01929IT	17-OCT-91	NA	NA	NA	NA	900	130	1100
GW02520IT	27-FEB-92	NA	NA	NA	NA	840	230	1200

V = Validated and valid
A = Validated and valid with qualifiers
J = Detected at concentration less than detection limit
ND = Not detected
NA = Not analyzed
B = Constituent detected in laboratory blank
-- = Constituent present at concentration less than background

TABLE 2.31
SUMMARY OF CONSTITUENTS DETECTED IN CONCENTRATIONS ABOVE BACKGROUND IN GROUNDWATER SAMPLES FROM WELL 2287

Sample Number	Sample Date	Acetone (g/l)	2-Butanone (g/l)	Methylene Chloride (g/l)	Perchloroethene (g/l)	Calcium (mg/l)
22-87-03-07-88	07-MAR-88	ND	9 J	ND	ND	--
22-87-05-02-88	02-MAY-88	ND	ND	ND	7	--
22-87-08-10-88	10-AUG-88	2 JB	ND	2 JB	ND	--
22-87-11-09-88	09-NOV-88	ND	ND	ND	ND	--
22-87-02-09-89	09-FEB-89	ND	ND	ND	ND	54
22-87-05-03-89	03-MAY-89	ND	ND	ND	ND	54
22-87-08-15-89	15-AUG-89	ND	ND	ND	ND	66
G22871189004	10-NOV-89	ND	ND	ND	ND	63
G22870290001	08-FEB-90	ND	ND	ND	ND	67
G-2287-0524-02-1410	25-MAY-90	ND	ND	ND	ND	67
GW00756IT	12-DEC-90	ND	ND	ND	ND	79
GW01198IT	24-APR-91	ND	ND	ND	ND	82
GW01402IT	11-JUN-91	ND	ND	1 JB	ND	65
GW01614IT	06-AUG-91	ND	ND	ND	ND	72
GW01927IT	24-OCT-91	ND	ND	ND	ND	68
GW02276IT	29-JAN-92	ND	ND	ND	ND	82

V = Validated and valid
A = Validated and valid with qualifiers
J = Detected at concentration less than detection limit
ND = Not detected
NA = Not analyzed
B = Constituent detected in laboratory blank
-- = Constituent present at concentration less than background

TABLE 2.31 (continued)
SUMMARY OF CONSTITUENTS DETECTED IN CONCENTRATIONS ABOVE BACKGROUND IN GROUNDWATER SAMPLES FROM WELL 2287

Sample Number	Sample Date	Americium-241 (pCi/l)	Cesium-137 (pCi/l)	Strontium -89, -90 (pCi/l)	Uranium-235 (pCi/l)	Sulfate (mg/l)
22-87-03-07-88	07-MAR-88	ND	NA	NA	0.18	--
22-87-05-02-88	02-MAY-88	ND	NA	NA	0.14	230
22-87-08-10-88	10-AUG-88	ND	NA	NA	ND	337
22-87-11-09-88	09-NOV-88	ND	NA	NA	ND	387
22-87-02-09-89	09-FEB-89	0.11	NA	NA	ND	458
22-87-05-03-89	03-MAY-89	NA	NA	NA	NA	460
22-87-08-15-89	15-AUG-89	NA	NA	NA	ND	478
G22871189004	10-NOV-89	ND	1.6	ND	0.11	480
G22870290001	08-FEB-90	--	NA	ND	ND	370
G-2287-0524-02-1410	25-MAY-90	--	ND	--	ND	480
GW00756IT	12-DEC-90	NA	ND	--	ND	480
GW01198IT	24-APR-91	ND	ND	5.5	ND	500
GW01402IT	11-JUN-91	ND	ND	--	ND	350
GW01614IT	06-AUG-91	ND	ND	--	ND	570
GW01927IT	24-OCT-91	NA	NA	NA	NA	530
GW02276IT	29-JAN-92	NA	NA	NA	NA	840

V = Validated and valid
A = Validated and valid with qualifiers
J = Detected at concentration less than detection limit
ND = Not detected
NA = Not analyzed
B = Constituent detected in laboratory blank
-- = Constituent present at concentration less than background

TABLE 2.32

RFEDS DATA FOR SURFACE-WATER AND SEDIMENT SAMPLING SITES

SURFACE-WATER SAMPLING SITE	CONTAMINANT TYPE
SW018	A,B,C,D
SW043	A,B,C,D
SW056	A,B,D
SW059	A,D
SW060	A,D
SW061	A,D
SW084	A
SW085	A,B,C
SW086	A,B
SW087	-
SW088	-
SW089	-
SW090	-
SW091	-
SW093	A,B,C,D
SW101	A,D
SW102	A,B,C,D
SW105	-
SW106	-
SW118	A,B,C,D
SW119	(empty)
SW120	(empty)
SW121	-
SW122	A,D
SW123	-
SW124	A
SW132	A,D
SW133	-
SW371	(empty)

SEDIMENT SAMPLING SITE	CONTAMINANT TYPE
SED09	Not Received
SED010	Not Received
SED011	A,D
SED012	A,D
SED118	A,B,C,D
SED120	A,B,C,D
SED124	A

A - Radionuclides B - Trace Metals C - Inorganics D - Volatile Organics

Table 2.33

Summary of Volatile Organic Compounds Detected in OU8 Surface Water and Sediment Samples

Location	Sample Date	Chemical	Qual	Result	Unit
SW018	30-May-91	CARBON TETRACHLORIDE	J	4	UG/L
SW018	30-May-91	CARBON TETRACHLORIDE	J	4	UG/L
SW018	30-May-91	METHYLENE CHLORIDE	B	6	UG/L
SW018	30-May-91	METHYLENE CHLORIDE	B	6	UG/L
SW018	17-Jun-91	METHYLENE CHLORIDE	B	36	UG/L
SW018	17-Jun-91	METHYLENE CHLORIDE	B	36	UG/L
SW018	09-Sep-91	METHYLENE CHLORIDE	B	9	UG/L
SW018	09-Sep-91	METHYLENE CHLORIDE	B	9	UG/L
SW043	19-Sep-86	2-BUTANONE	BJ	4	UG/L
SW043	19-Sep-86	N-NITROSODIPHENYLAMINE	BJ	6	UG/L
SW043	18-Dec-90	ACETONE	BJ	7	UG/L
SW043	18-Dec-90	METHYLENE CHLORIDE	BJ	1	UG/L
SW056	21-Jul-87	1,1-DICHLOROETHANE		143	UG/L
SW056	21-Jul-87	TETRACHLOROETHENE		72	UG/L
SW056	21-Jul-87	TRICHLOROETHENE		50	UG/L
SW056	13-Apr-89	ACETONE		130	UG/L
SW056	13-Apr-89	METHYLENE CHLORIDE		29	UG/L
SW056	13-Apr-89	TETRACHLOROETHENE		190	UG/L
SW056	13-Apr-89	TRICHLOROETHENE		120	UG/L
SW056	13-Apr-89	VINYL CHLORIDE	J	9	UG/L
SW056	11-May-89	1,1-DICHLOROETHANE		5	UG/L
SW056	11-May-89	1,1-DICHLOROETHENE	J	1	UG/L
SW056	11-May-89	1,1,1-TRICHLOROETHANE		9	UG/L
SW056	11-May-89	CARBON TETRACHLORIDE	J	3	UG/L
SW056	11-May-89	METHYLENE CHLORIDE	J	1	UG/L
SW056	11-May-89	TETRACHLOROETHENE		200	UG/L
SW056	11-May-89	TRICHLOROETHENE		140	UG/L
SW056	11-May-89	VINYL CHLORIDE	J	9	UG/L
SW056	07-Jun-89	1,1-DICHLOROETHANE	J	4	UG/L
SW056	07-Jun-89	1,1-DICHLOROETHENE	J	1	UG/L
SW056	07-Jun-89	1,1,1-TRICHLOROETHANE		9	UG/L
SW056	07-Jun-89	CARBON TETRACHLORIDE	J	3	UG/L
SW056	07-Jun-89	TETRACHLOROETHENE		190	UG/L
SW056	07-Jun-89	TRICHLOROETHENE		130	UG/L
SW056	07-Jun-89	VINYL CHLORIDE		15	UG/L
SW056	12-Jul-89	1,1-DICHLOROETHANE	J	6	UG/L
SW056	12-Jul-89	1,1,1-TRICHLOROETHANE	J	8	UG/L
SW056	12-Jul-89	ACETONE	JB	10	UG/L
SW056	12-Jul-89	CARBON TETRACHLORIDE	J	3	UG/L
SW056	12-Jul-89	METHYLENE CHLORIDE	B	36	UG/L
SW056	12-Jul-89	TETRACHLOROETHENE		280	UG/L
SW056	12-Jul-89	TRICHLOROETHENE		140	UG/L
SW056	12-Jul-89	VINYL CHLORIDE	J	12	UG/L
SW056	15-Nov-89	1,1-DICHLOROETHANE	J	3	UG/L
SW056	15-Nov-89	1,1,1-TRICHLOROETHANE	J	3	UG/L
SW056	15-Nov-89	1,2-DICHLOROETHENE		120	UG/L
SW056	15-Nov-89	ACETONE	B	10	UG/L

Table 2.33

Summary of Volatile Organic Compounds Detected in OU8 Surface Water and Sediment Samples

Location	Sample Date	Chemical	Qual	Result	Unit
SW056	15-Nov-89	CARBON TETRACHLORIDE	J	1	UG/L
SW056	15-Nov-89	CHLOROFORM	J	1	UG/L
SW056	15-Nov-89	METHYLENE CHLORIDE	B	6	UG/L
SW056	15-Nov-89	TETRACHLOROETHENE		110	UG/L
SW056	15-Nov-89	TRICHLOROETHENE		69	UG/L
SW056	15-Nov-89	VINYL CHLORIDE	J	8	UG/L
SW056	19-Dec-89	1,1-DICHLOROETHANE		50	UG/L
SW056	19-Dec-89	1,1,1-TRICHLOROETHANE		5	UG/L
SW056	19-Dec-89	2-BUTANONE	J	4	UG/L
SW056	19-Dec-89	ACETONE	J	9	UG/L
SW056	19-Dec-89	METHYLENE CHLORIDE		6	UG/L
SW056	19-Dec-89	TETRACHLOROETHENE		86	UG/L
SW056	19-Dec-89	TRICHLOROETHENE		69	UG/L
SW056	19-Dec-89	VINYL CHLORIDE		10	UG/L
SW056	25-Jan-90	1,2-DICHLOROETHENE		130	UG/L
SW056	25-Jan-90	TETRACHLOROETHENE		74	UG/L
SW056	25-Jan-90	TRICHLOROETHENE		50	UG/L
SW056	22-Feb-90	1,1-DICHLOROETHANE	J	4	UG/L
SW056	22-Feb-90	1,1,1-TRICHLOROETHANE		5	UG/L
SW056	22-Feb-90	1,2-DICHLOROETHENE		230	UG/L
SW056	22-Feb-90	CARBON TETRACHLORIDE	J	2	UG/L
SW056	22-Feb-90	METHYLENE CHLORIDE	B	5	UG/L
SW056	22-Feb-90	TETRACHLOROETHENE		120	UG/L
SW056	22-Feb-90	TRICHLOROETHENE		92	UG/L
SW056	22-Feb-90	VINYL CHLORIDE		11	UG/L
SW056	18-Apr-90	1,1-DICHLOROETHANE	J	3	UG/L
SW056	18-Apr-90	1,1-DICHLOROETHANE	J	4	UG/L
SW056	18-Apr-90	1,1-DICHLOROETHENE	J	1	UG/L
SW056	18-Apr-90	1,1,1-TRICHLOROETHANE		5	UG/L
SW056	18-Apr-90	1,1,1-TRICHLOROETHANE	J	2	UG/L
SW056	18-Apr-90	1,2-DICHLOROETHENE		170	UG/L
SW056	18-Apr-90	1,2-DICHLOROETHENE		180	UG/L
SW056	18-Apr-90	BIS(2-ETHYLHEXYL)PHTHALATE	JB	3	UG/L
SW056	18-Apr-90	BUTYL BENZYL PHTHALATE	J	1	UG/L
SW056	18-Apr-90	CARBON TETRACHLORIDE	J	3	UG/L
SW056	18-Apr-90	CARBON TETRACHLORIDE	J	2	UG/L
SW056	18-Apr-90	DI-n-BUTYL PHTHALATE	JB	1	UG/L
SW056	18-Apr-90	DI-n-BUTYL PHTHALATE	JB	3	UG/L
SW056	18-Apr-90	METHYLENE CHLORIDE	B	5	UG/L
SW056	18-Apr-90	METHYLENE CHLORIDE	B	5	UG/L
SW056	18-Apr-90	TETRACHLOROETHENE		120	UG/L
SW056	18-Apr-90	TETRACHLOROETHENE		120	UG/L
SW056	18-Apr-90	TRICHLOROETHENE		67	UG/L
SW056	18-Apr-90	TRICHLOROETHENE		67	UG/L
SW056	18-Apr-90	VINYL CHLORIDE	J	7	UG/L
SW056	18-Apr-90	VINYL CHLORIDE	J	8	UG/L
SW056	08-May-90	1,1,1-TRICHLOROETHANE	J	2	UG/L
SW056	08-May-90	1,2-DICHLOROETHENE		240	UG/L
SW056	08-May-90	CARBON TETRACHLORIDE	J	1	UG/L
SW056	08-May-90	METHYLENE CHLORIDE	JB	1	UG/L
SW056	08-May-90	TETRACHLOROETHENE		140	UG/L
SW056	08-May-90	TRICHLOROETHENE		75	UG/L

Table 2.33

Summary of Volatile Organic Compounds Detected in OU8 Surface Water and Sediment Samples

Location	Sample Date	Chemical	Qual	Result	Unit
SW056	08-May-90	VINYL CHLORIDE	J	2	UG/L
SW056	28-Jun-90	1,1-DICHLOROETHANE		5	UG/L
SW056	28-Jun-90	1,1-DICHLOROETHENE	J	1	UG/L
SW056	28-Jun-90	1,1,1-TRICHLOROETHANE		5	UG/L
SW056	28-Jun-90	CARBON TETRACHLORIDE	J	2	UG/L
SW056	28-Jun-90	TETRACHLOROETHENE		190	UG/L
SW056	28-Jun-90	TRICHLOROETHENE		120	UG/L
SW056	28-Jun-90	VINYL CHLORIDE		13	UG/L
SW056	29-Jun-90	METHYLENE CHLORIDE	B	5	UG/L
SW056	18-Jul-90	1,1-DICHLOROETHANE		5	UG/L
SW056	18-Jul-90	1,1-DICHLOROETHANE	DJ	5	UG/L
SW056	18-Jul-90	1,1-DICHLOROETHENE	J	1	UG/L
SW056	18-Jul-90	1,1,1-TRICHLOROETHANE		5	UG/L
SW056	18-Jul-90	1,1,1-TRICHLOROETHANE	DJ	4	UG/L
SW056	18-Jul-90	ACETONE	BDJ	3	UG/L
SW056	18-Jul-90	CARBON TETRACHLORIDE	J	3	UG/L
SW056	18-Jul-90	CARBON TETRACHLORIDE	DJ	2	UG/L
SW056	18-Jul-90	TOTAL XYLENES	BDJ	3	UG/L
SW056	18-Jul-90	TRICHLOROETHENE		100	UG/L
SW056	18-Jul-90	VINYL CHLORIDE		13	UG/L
SW056	11-Sep-90	1,1-DICHLOROETHANE		6	UG/L
SW056	11-Sep-90	1,1,1-TRICHLOROETHANE		5	UG/L
SW056	11-Sep-90	CARBON TETRACHLORIDE	J	3	UG/L
SW056	11-Sep-90	TOLUENE	J	1	UG/L
SW056	11-Sep-90	TRICHLOROETHENE		120	UG/L
SW056	11-Sep-90	VINYL CHLORIDE		16	UG/L
SW056	17-Dec-90	1,1,1-TRICHLOROETHANE	J	3	UG/L
SW056	17-Dec-90	1,2-DICHLOROETHENE		260	UG/L
SW056	17-Dec-90	ACETONE	BJ	16	UG/L
SW056	17-Dec-90	METHYLENE CHLORIDE	B	11	UG/L
SW056	17-Dec-90	TETRACHLOROETHENE		82	UG/L
SW056	17-Dec-90	TRICHLOROETHENE		65	UG/L
SW056	17-Dec-90	VINYL CHLORIDE	J	12	UG/L
SW056	26-Mar-91	1,1-DICHLOROETHANE	J	4	UG/L
SW056	26-Mar-91	1,1,1-TRICHLOROETHANE	J	4	UG/L
SW056	26-Mar-91	1,2-DICHLOROETHANE		23	UG/L
SW056	26-Mar-91	1,2-DICHLOROETHENE		240	UG/L
SW056	26-Mar-91	CARBON TETRACHLORIDE	J	3	UG/L
SW056	26-Mar-91	TETRACHLOROETHENE		93	UG/L
SW056	26-Mar-91	TRICHLOROETHENE		100	UG/L
SW056	26-Mar-91	VINYL CHLORIDE		15	UG/L
SW056	24-Apr-91	1,1-DICHLOROETHANE	J	4	UG/L
SW056	24-Apr-91	1,1,1-TRICHLOROETHANE		5	UG/L
SW056	24-Apr-91	1,2-DICHLOROETHENE		310	UG/L
SW056	24-Apr-91	CARBON TETRACHLORIDE	J	3	UG/L
SW056	24-Apr-91	TETRACHLOROETHENE		97	UG/L
SW056	24-Apr-91	TRICHLOROETHENE		92	UG/L
SW056	24-Apr-91	VINYL CHLORIDE		25	UG/L
SW056	29-May-91	1,1-DICHLOROETHANE	J	3	UG/L
SW056	29-May-91	1,1-DICHLOROETHANE	J	2	UG/L
SW056	29-May-91	1,1,1-TRICHLOROETHANE	J	3	UG/L

Table 2.33

Summary of Volatile Organic Compounds Detected in OU8 Surface Water and Sediment Samples

Location	Sample Date	Chemical	Qual	Result	Unit
SW056	29-May-91	1,1,1-TRICHLOROETHANE	J	3	UG/L
SW056	29-May-91	1,2-DICHLOROETHENE		210	UG/L
SW056	29-May-91	1,2-DICHLOROETHENE		230	UG/L
SW056	29-May-91	CARBON TETRACHLORIDE	J	3	UG/L
SW056	29-May-91	CARBON TETRACHLORIDE	J	3	UG/L
SW056	29-May-91	METHYLENE CHLORIDE	B	21	UG/L
SW056	29-May-91	METHYLENE CHLORIDE	B	7	UG/L
SW056	29-May-91	METHYLENE CHLORIDE	B	10	UG/L
SW056	29-May-91	TETRACHLOROETHENE		100	UG/L
SW056	29-May-91	TETRACHLOROETHENE		95	UG/L
SW056	29-May-91	TRICHLOROETHENE		73	UG/L
SW056	29-May-91	TRICHLOROETHENE		79	UG/L
SW056	29-May-91	VINYL CHLORIDE		13	UG/L
SW056	29-May-91	VINYL CHLORIDE		14	UG/L
SW056	17-Jun-91	1,1-DICHLOROETHANE	J	3	UG/L
SW056	17-Jun-91	1,1,1-TRICHLOROETHANE	J	3	UG/L
SW056	17-Jun-91	1,2-DICHLOROETHENE		270	UG/L
SW056	17-Jun-91	CARBON TETRACHLORIDE	J	2	UG/L
SW056	17-Jun-91	METHYLENE CHLORIDE	B	6	UG/L
SW056	17-Jun-91	TETRACHLOROETHENE		120	UG/L
SW056	17-Jun-91	TRICHLOROETHENE		73	UG/L
SW056	17-Jun-91	VINYL CHLORIDE		14	UG/L
SW056	19-Aug-91	1,1-DICHLOROETHANE	J	2	UG/L
SW056	19-Aug-91	1,1,1-TRICHLOROETHANE	J	3	UG/L
SW056	19-Aug-91	1,2-DICHLOROETHENE		280	UG/L
SW056	19-Aug-91	METHYLENE CHLORIDE	JB	3	UG/L
SW056	19-Aug-91	TETRACHLOROETHENE		110	UG/L
SW056	19-Aug-91	TRICHLOROETHENE		73	UG/L
SW056	07-Oct-91	1,1-DICHLOROETHANE	J	4	UG/L
SW056	07-Oct-91	1,1-DICHLOROETHENE	J	1	UG/L
SW056	07-Oct-91	1,1,1-TRICHLOROETHANE	J	4	UG/L
SW056	07-Oct-91	TETRACHLOROETHENE		140	UG/L
SW056	07-Oct-91	TRICHLOROETHENE		98	UG/L
SW056	07-Oct-91	VINYL CHLORIDE		27	UG/L
SW056	05-Feb-92	1,1-DICHLOROETHANE	J	4	UG/L
SW056	05-Feb-92	1,1,1-TRICHLOROETHANE	J	4	UG/L
SW056	05-Feb-92	1,2-DICHLOROETHENE		310	UG/L
SW056	05-Feb-92	CARBON TETRACHLORIDE	J	2	UG/L
SW056	05-Feb-92	TETRACHLOROETHENE		100	UG/L
SW056	05-Feb-92	TIC	J	7	UG/L
SW056	05-Feb-92	TIC	J	6	UG/L
SW056	05-Feb-92	TRICHLOROETHENE		110	UG/L
SW056	05-Feb-92	VINYL CHLORIDE		22	UG/L
SW059	21-Jul-87	1,1-DICHLOROETHENE		133	UG/L
SW059	21-Jul-87	CARBON TETRACHLORIDE		605	UG/L
SW059	21-Jul-87	CHLOROFORM		40	UG/L
SW059	21-Jul-87	TETRACHLOROETHENE		60	UG/L
SW059	21-Jul-87	TRICHLOROETHENE		62	UG/L
SW059	01-Jul-88	1,1,1-TRICHLOROETHANE		9.3	UG/L
SW059	01-Jul-88	CARBON TETRACHLORIDE		187	UG/L
SW059	01-Jul-88	CHLOROFORM		18.7	UG/L

Table 2.33

Summary of Volatile Organic Compounds Detected in OU8 Surface Water and Sediment Samples

Location	Sample Date	Chemical	Qual	Result	Unit
SW059	01-Jul-88	TETRACHLOROETHENE		45	UG/L
SW059	01-Jul-88	TRICHLOROETHENE		49	UG/L
SW059	20-Mar-89	1,1-DICHLOROETHENE	J	9	UG/L
SW059	20-Mar-89	1,1,1-TRICHLOROETHANE		42	UG/L
SW059	20-Mar-89	CARBON TETRACHLORIDE		430	UG/L
SW059	20-Mar-89	CHLOROFORM		82	UG/L
SW059	20-Mar-89	METHYLENE CHLORIDE	JB	20	UG/L
SW059	20-Mar-89	TETRACHLOROETHENE		270	UG/L
SW059	20-Mar-89	TRICHLOROETHENE		260	UG/L
SW059	11-May-89	1,1-DICHLOROETHANE	J	6	UG/L
SW059	11-May-89	1,1-DICHLOROETHENE	J	7	UG/L
SW059	11-May-89	1,1,1-TRICHLOROETHANE		36	UG/L
SW059	11-May-89	CARBON TETRACHLORIDE		310	UG/L
SW059	11-May-89	CHLOROFORM		66	UG/L
SW059	11-May-89	METHYLENE CHLORIDE	J	5	UG/L
SW059	11-May-89	TETRACHLOROETHENE		170	UG/L
SW059	11-May-89	TRICHLOROETHENE		180	UG/L
SW059	08-Jun-89	1,1-DICHLOROETHANE	J	2	UG/L
SW059	08-Jun-89	1,1-DICHLOROETHENE	J	3	UG/L
SW059	08-Jun-89	1,1,1-TRICHLOROETHANE		15	UG/L
SW059	08-Jun-89	ACETONE	J	3	UG/L
SW059	08-Jun-89	CARBON TETRACHLORIDE		200	UG/L
SW059	08-Jun-89	CHLOROFORM		20	UG/L
SW059	08-Jun-89	METHYLENE CHLORIDE	JB	2	UG/L
SW059	08-Jun-89	TETRACHLOROETHENE		57	UG/L
SW059	08-Jun-89	TRICHLOROETHENE		60	UG/L
SW059	06-Jul-89	1,1-DICHLOROETHANE	J	3	UG/L
SW059	06-Jul-89	1,1-DICHLOROETHENE	J	4	UG/L
SW059	06-Jul-89	1,1,1-TRICHLOROETHANE		10	UG/L
SW059	06-Jul-89	1,2-DICHLOROETHENE		56	UG/L
SW059	06-Jul-89	ACETONE	B	13	UG/L
SW059	06-Jul-89	CARBON TETRACHLORIDE		190	UG/L
SW059	06-Jul-89	CHLOROFORM		26	UG/L
SW059	06-Jul-89	METHYLENE CHLORIDE	B	9	UG/L
SW059	06-Jul-89	TETRACHLOROETHENE		56	UG/L
SW059	06-Jul-89	TRICHLOROETHENE		55	UG/L
SW059	18-Sep-89	1,1-DICHLOROETHANE	J	2	UG/L
SW059	18-Sep-89	1,1-DICHLOROETHENE	J	3	UG/L
SW059	18-Sep-89	1,1,1-TRICHLOROETHANE		9	UG/L
SW059	18-Sep-89	ACETONE	JB	3	UG/L
SW059	18-Sep-89	CARBON TETRACHLORIDE		190	UG/L
SW059	18-Sep-89	CHLOROFORM		23	UG/L
SW059	18-Sep-89	METHYLENE CHLORIDE	JB	4	UG/L
SW059	18-Sep-89	TETRACHLOROETHENE		53	UG/L
SW059	18-Sep-89	TRICHLOROETHENE		63	UG/L
SW059	03-Oct-89	1,1-DICHLOROETHENE	J	4	UG/L
SW059	03-Oct-89	BIS(2-ETHYLHEXYL)PHTHALATE	JB	2	UG/L
SW059	03-Oct-89	CARBON TETRACHLORIDE		160	UG/L
SW059	03-Oct-89	CHLOROFORM		25	UG/L
SW059	03-Oct-89	TETRACHLOROETHENE		43	UG/L
SW059	03-Oct-89	TRICHLOROETHENE		52	UG/L

Table 2.33

Summary of Volatile Organic Compounds Detected in OU8 Surface Water and Sediment Samples

Location	Sample Date	Chemical	Qual	Result	Unit
SW059	06-Nov-89	1,1,1-TRICHLOROETHANE		9	UG/L
SW059	06-Nov-89	1,2-DICHLOROETHENE		34	UG/L
SW059	06-Nov-89	ACETONE	B	38	UG/L
SW059	06-Nov-89	CARBON TETRACHLORIDE		140	UG/L
SW059	06-Nov-89	CHLOROFORM		21	UG/L
SW059	06-Nov-89	METHYLENE CHLORIDE	J	4	UG/L
SW059	06-Dec-89	1,1,1-TRICHLOROETHANE		12	UG/L
SW059	06-Dec-89	1,2-DICHLOROETHANE	J	1	UG/L
SW059	06-Dec-89	CARBON TETRACHLORIDE		190	UG/L
SW059	06-Dec-89	CHLOROFORM		28	UG/L
SW059	06-Dec-89	TETRACHLOROETHENE		43	UG/L
SW059	06-Dec-89	TRICHLOROETHENE		57	UG/L
SW059	23-Jan-90	1,1-DICHLOROETHENE	J	2	UG/L
SW059	23-Jan-90	1,1-DICHLOROETHENE	J	1	UG/L
SW059	23-Jan-90	1,1,1-TRICHLOROETHANE	J	1	UG/L
SW059	23-Jan-90	1,1,1-TRICHLOROETHANE	J	2	UG/L
SW059	23-Jan-90	CARBON TETRACHLORIDE		130	UG/L
SW059	23-Jan-90	CARBON TETRACHLORIDE		97	UG/L
SW059	23-Jan-90	CHLOROFORM		15	UG/L
SW059	23-Jan-90	CHLOROFORM		14	UG/L
SW059	23-Jan-90	METHYLENE CHLORIDE	JB	3	UG/L
SW059	23-Jan-90	METHYLENE CHLORIDE	JB	3	UG/L
SW059	23-Jan-90	TETRACHLOROETHENE		26	UG/L
SW059	23-Jan-90	TETRACHLOROETHENE		22	UG/L
SW059	23-Jan-90	TRICHLOROETHENE		33	UG/L
SW059	23-Jan-90	TRICHLOROETHENE		28	UG/L
SW059	09-Feb-90	1,2-DICHLOROETHENE		19	UG/L
SW059	09-Feb-90	CARBON TETRACHLORIDE		98	UG/L
SW059	09-Feb-90	CHLOROFORM	B	10	UG/L
SW059	09-Feb-90	TETRACHLOROETHENE		28	UG/L
SW059	09-Feb-90	TRICHLOROETHENE	B	16	UG/L
SW059	12-Mar-90	1,1-DICHLOROETHANE	J	2	UG/L
SW059	12-Mar-90	1,1-DICHLOROETHENE	J	3	UG/L
SW059	12-Mar-90	1,1,1-TRICHLOROETHANE		20	UG/L
SW059	12-Mar-90	1,2-DICHLOROETHENE		26	UG/L
SW059	12-Mar-90	ACETONE	B	11	UG/L
SW059	12-Mar-90	CARBON TETRACHLORIDE		40	UG/L
SW059	12-Mar-90	CHLOROFORM		9	UG/L
SW059	12-Mar-90	METHYLENE CHLORIDE	B	8	UG/L
SW059	12-Mar-90	TETRACHLOROETHENE		57	UG/L
SW059	12-Mar-90	TRICHLOROETHENE		54	UG/L
SW059	12-Mar-90	VINYL CHLORIDE	J	3	UG/L
SW059	23-May-90	1,1-DICHLOROETHANE	J	3	UG/L
SW059	23-May-90	1,1,1-TRICHLOROETHANE		11	UG/L
SW059	23-May-90	1,2-DICHLOROETHENE		53	UG/L
SW059	23-May-90	ACETONE	B	15	UG/L
SW059	23-May-90	CARBON TETRACHLORIDE		160	UG/L
SW059	23-May-90	CHLOROFORM		20	UG/L
SW059	23-May-90	METHYLENE CHLORIDE	B	9	UG/L
SW059	23-May-90	METHYLENE CHLORIDE	B	9	UG/L
SW059	23-May-90	TETRACHLOROETHENE		81	UG/L
SW059	23-May-90	TRICHLOROETHENE		71	UG/L

Table 2.33

Summary of Volatile Organic Compounds Detected in OU8 Surface Water and Sediment Samples

Location	Sample Date	Chemical	Qual	Result	Unit
SW059	26-Jun-90	1,1-DICHLOROETHANE	J	1	UG/L
SW059	26-Jun-90	1,1-DICHLOROETHENE	J	4	UG/L
SW059	26-Jun-90	1,1,1-TRICHLOROETHANE		10	UG/L
SW059	26-Jun-90	1,2-DICHLOROETHENE		47	UG/L
SW059	26-Jun-90	CARBON TETRACHLORIDE		120	UG/L
SW059	26-Jun-90	CHLOROFORM		18	UG/L
SW059	26-Jun-90	METHYLENE CHLORIDE	JB	4	UG/L
SW059	26-Jun-90	TETRACHLOROETHENE		56	UG/L
SW059	26-Jun-90	TRICHLOROETHENE		62	UG/L
SW059	23-Jul-90	1,1-DICHLOROETHANE	J	8	UG/L
SW059	23-Jul-90	1,1-DICHLOROETHENE	J	9	UG/L
SW059	23-Jul-90	1,1,1-TRICHLOROETHANE		23	UG/L
SW059	23-Jul-90	1,1,2,2-TETRACHLOROETHANE	J	3	UG/L
SW059	23-Jul-90	1,2-DICHLOROETHENE		130	UG/L
SW059	23-Jul-90	CARBON TETRACHLORIDE		270	UG/L
SW059	23-Jul-90	CHLOROFORM		43	UG/L
SW059	23-Jul-90	METHYLENE CHLORIDE	BJ	3	UG/L
SW059	23-Jul-90	TETRACHLOROETHENE		140	UG/L
SW059	23-Jul-90	TRICHLOROETHENE		200	UG/L
SW059	23-Jul-90	VINYL CHLORIDE	J	5	UG/L
SW059	22-Aug-90	1,1-DICHLOROETHANE	J	7	UG/L
SW059	22-Aug-90	1,1-DICHLOROETHENE		10	UG/L
SW059	22-Aug-90	1,1,1-TRICHLOROETHANE		20	UG/L
SW059	22-Aug-90	1,2-DICHLOROETHENE		110	UG/L
SW059	22-Aug-90	2-BUTANONE	BJ	5	UG/L
SW059	22-Aug-90	CARBON TETRACHLORIDE		240	UG/L
SW059	22-Aug-90	CHLOROFORM		44	UG/L
SW059	22-Aug-90	METHYLENE CHLORIDE	BJ	5	UG/L
SW059	22-Aug-90	TETRACHLOROETHENE		130	UG/L
SW059	22-Aug-90	TRICHLOROETHENE		170	UG/L
SW059	22-Aug-90	VINYL CHLORIDE	J	6	UG/L
SW059	25-Sep-90	1,1-DICHLOROETHANE	D	10	UG/L
SW059	25-Sep-90	1,1-DICHLOROETHANE	DJ	9	UG/L
SW059	25-Sep-90	1,1-DICHLOROETHANE	J	6	UG/L
SW059	25-Sep-90	1,1-DICHLOROETHANE		8	UG/L
SW059	25-Sep-90	1,1-DICHLOROETHENE		10	UG/L
SW059	25-Sep-90	1,1-DICHLOROETHENE	J	4	UG/L
SW059	25-Sep-90	1,1-DICHLOROETHENE	D	160	UG/L
SW059	25-Sep-90	1,1-DICHLOROETHENE	D	13	UG/L
SW059	25-Sep-90	1,1,1-TRICHLOROETHANE		11	UG/L
SW059	25-Sep-90	1,1,1-TRICHLOROETHANE		21	UG/L
SW059	25-Sep-90	1,1,2-TRICHLOROETHANE	DJ	2	UG/L
SW059	25-Sep-90	1,1,2-TRICHLOROETHANE	J	2	UG/L
SW059	25-Sep-90	1,2-DICHLOROETHANE	J	1	UG/L
SW059	25-Sep-90	1,2-DICHLOROETHENE		140	UG/L
SW059	25-Sep-90	1,2-DICHLOROETHENE		110	UG/L
SW059	25-Sep-90	2-BUTANONE	BJ	16	UG/L
SW059	25-Sep-90	ACETONE	B	23	UG/L
SW059	25-Sep-90	ACETONE	DJ	7	UG/L
SW059	25-Sep-90	ACETONE	BD	21	UG/L
SW059	25-Sep-90	BENZENE	D	150	UG/L
SW059	25-Sep-90	CARBON TETRACHLORIDE		110	UG/L

Table 2.33

Summary of Volatile Organic Compounds Detected in OU8 Surface Water and Sediment Samples

Location	Sample Date	Chemical	Qual	Result	Unit
SW059	25-Sep-90	CHLOROBENZENE	D	180	UG/L
SW059	25-Sep-90	CHLOROFORM		39	UG/L
SW059	25-Sep-90	CHLOROFORM		48	UG/L
SW059	25-Sep-90	ETHYLBENZENE	DJ	3	UG/L
SW059	25-Sep-90	METHYLENE CHLORIDE	DJ	4	UG/L
SW059	25-Sep-90	METHYLENE CHLORIDE	BD	12	UG/L
SW059	25-Sep-90	METHYLENE CHLORIDE	B	64	UG/L
SW059	25-Sep-90	TETRACHLOROETHENE		71	UG/L
SW059	25-Sep-90	TETRACHLOROETHENE	BD	150	UG/L
SW059	25-Sep-90	TETRACHLOROETHENE	B	140	UG/L
SW059	25-Sep-90	TRICHLOROETHENE		100	UG/L
SW059	25-Sep-90	TRICHLOROETHENE		180	UG/L
SW059	25-Sep-90	VINYL CHLORIDE	DJ	14	UG/L
SW059	25-Sep-90	VINYL CHLORIDE	DJ	10	UG/L
SW059	25-Sep-90	VINYL CHLORIDE		12	UG/L
SW059	16-Oct-90	1,1-DICHLOROETHANE	J	5	UG/L
SW059	16-Oct-90	1,1-DICHLOROETHENE	J	5	UG/L
SW059	16-Oct-90	1,1,1-TRICHLOROETHANE		11	UG/L
SW059	16-Oct-90	1,2-DICHLOROETHENE		94	UG/L
SW059	16-Oct-90	CARBON TETRACHLORIDE		140	UG/L
SW059	16-Oct-90	CHLOROFORM		33	UG/L
SW059	16-Oct-90	METHYLENE CHLORIDE	BJ	3	UG/L
SW059	16-Oct-90	TETRACHLOROETHENE		87	UG/L
SW059	16-Oct-90	TRICHLOROETHENE		110	UG/L
SW059	26-Nov-90	1,1,1-TRICHLOROETHANE		12	UG/L
SW059	26-Nov-90	1,2-DICHLOROETHENE		150	UG/L
SW059	26-Nov-90	ACETONE	J	5	UG/L
SW059	26-Nov-90	CARBON TETRACHLORIDE		150	UG/L
SW059	26-Nov-90	CHLOROETHANE	J	2	UG/L
SW059	26-Nov-90	CHLOROFORM		30	UG/L
SW059	26-Nov-90	TETRACHLOROETHENE		88	UG/L
SW059	26-Nov-90	TRICHLOROETHENE		110	UG/L
SW059	26-Nov-90	VINYL CHLORIDE		16	UG/L
SW059	12-Dec-90	1,1-DICHLOROETHANE		5	UG/L
SW059	12-Dec-90	1,1-DICHLOROETHENE		7	UG/L
SW059	12-Dec-90	1,1,1-TRICHLOROETHANE		14	UG/L
SW059	12-Dec-90	1,2-DICHLOROETHENE		120	UG/L
SW059	12-Dec-90	ACETONE	B	26	UG/L
SW059	12-Dec-90	CARBON TETRACHLORIDE		200	UG/L
SW059	12-Dec-90	CHLOROFORM		30	UG/L
SW059	12-Dec-90	TETRACHLOROETHENE		110	UG/L
SW059	12-Dec-90	TRICHLOROETHENE		140	UG/L
SW059	12-Dec-90	VINYL CHLORIDE	J	3	UG/L
SW059	09-Jan-91	1,1-DICHLOROETHANE	J	1	UG/L
SW059	09-Jan-91	1,1-DICHLOROETHENE	J	4	UG/L
SW059	09-Jan-91	1,1-DICHLOROETHENE	DJ	4	UG/L
SW059	09-Jan-91	1,1,1-TRICHLOROETHANE		31	UG/L
SW059	09-Jan-91	1,1,2,2-TETRACHLOROETHANE	J	2	UG/L
SW059	09-Jan-91	1,2-DICHLOROETHENE		50	UG/L
SW059	09-Jan-91	ACETONE	BJ	8	UG/L
SW059	09-Jan-91	ACETONE	BDJ	9	UG/L
SW059	09-Jan-91	BENZENE	DJ	3	UG/L

Table 2.33

Summary of Volatile Organic Compounds Detected in OU8 Surface Water and Sediment Samples

Location	Sample Date	Chemical	Qual	Result	Unit
SW059	09-Jan-91	CHLOROFORM		28	UG/L
SW059	09-Jan-91	TETRACHLOROETHENE		170	UG/L
SW059	09-Jan-91	TRICHLOROETHENE		140	UG/L
SW059	09-Jan-91	VINYL CHLORIDE	DJ	8	UG/L
SW059	09-Jan-91	VINYL CHLORIDE	J	9	UG/L
SW059	27-Mar-91	1,1,1-TRICHLOROETHANE		6	UG/L
SW059	27-Mar-91	CARBON TETRACHLORIDE		62	UG/L
SW059	27-Mar-91	CHLOROFORM		10	UG/L
SW059	27-Mar-91	TETRACHLOROETHENE		28	UG/L
SW059	27-Mar-91	TRICHLOROETHENE		31	UG/L
SW059	11-Apr-91	1,1,1-TRICHLOROETHANE		5	UG/L
SW059	11-Apr-91	1,2-DICHLOROETHENE		25	UG/L
SW059	11-Apr-91	BIS(2-ETHYLHEXYL)PHTHALATE	J	1	UG/L
SW059	11-Apr-91	CARBON TETRACHLORIDE		81	UG/L
SW059	11-Apr-91	CHLOROFORM		11	UG/L
SW059	11-Apr-91	TETRACHLOROETHENE		34	UG/L
SW059	11-Apr-91	TRICHLOROETHENE		35	UG/L
SW059	08-May-91	1,1,1-TRICHLOROETHANE		15	UG/L
SW059	08-May-91	CARBON TETRACHLORIDE		68	UG/L
SW059	08-May-91	CHLOROFORM		8	UG/L
SW059	08-May-91	TETRACHLOROETHENE		55	UG/L
SW059	08-May-91	TRICHLOROETHENE		39	UG/L
SW059	20-Jun-91	1,1-DICHLOROETHANE	J	4	UG/L
SW059	20-Jun-91	1,1-DICHLOROETHENE		5	UG/L
SW059	20-Jun-91	1,1,1-TRICHLOROETHANE		13	UG/L
SW059	20-Jun-91	1,2-DICHLOROETHENE		70	UG/L
SW059	20-Jun-91	CARBON TETRACHLORIDE		140	UG/L
SW059	20-Jun-91	CHLOROFORM		23	UG/L
SW059	20-Jun-91	TETRACHLOROETHENE		76	UG/L
SW059	20-Jun-91	TRICHLOROETHENE		69	UG/L
SW059	07-Aug-91	1,1,1-TRICHLOROETHANE		7	UG/L
SW059	07-Aug-91	1,2-DICHLOROETHANE	J	4	UG/L
SW059	07-Aug-91	1,2-DICHLOROETHENE		27	UG/L
SW059	07-Aug-91	ACETONE	JB	8	UG/L
SW059	07-Aug-91	CARBON TETRACHLORIDE		47	UG/L
SW059	07-Aug-91	CHLOROFORM		6	UG/L
SW059	07-Aug-91	METHYLENE CHLORIDE	B	10	UG/L
SW059	07-Aug-91	TETRACHLOROETHENE		36	UG/L
SW059	07-Aug-91	TRICHLOROETHENE		25	UG/L
SW059	17-Sep-91	1,1-DICHLOROETHANE	J	3	UG/L
SW059	17-Sep-91	1,1-DICHLOROETHENE	J	4	UG/L
SW059	17-Sep-91	1,1,1-TRICHLOROETHANE		11	UG/L
SW059	17-Sep-91	1,2-DICHLOROETHENE		69	UG/L
SW059	17-Sep-91	ACETONE	JB	7	UG/L
SW059	17-Sep-91	CARBON TETRACHLORIDE		130	UG/L
SW059	17-Sep-91	CHLOROFORM		21	UG/L
SW059	17-Sep-91	METHYLENE CHLORIDE	B	7	UG/L
SW059	17-Sep-91	TETRACHLOROETHENE		69	UG/L
SW059	17-Sep-91	TRICHLOROETHENE		79	UG/L
SW059	27-Jan-92	1,1-DICHLOROETHANE		5	UG/L
SW059	27-Jan-92	1,1-DICHLOROETHENE		7	UG/L

Table 2.33

Summary of Volatile Organic Compounds Detected in OU8 Surface Water and Sediment Samples

Location	Sample Date	Chemical	Qual	Result	Unit
SW059	27-Jan-92	1,1,1-TRICHLOROETHANE		17	UG/L
SW059	27-Jan-92	1,2-DICHLOROETHENE		110	UG/L
SW059	27-Jan-92	ACETONE	B	10	UG/L
SW059	27-Jan-92	CARBON TETRACHLORIDE		190	UG/L
SW059	27-Jan-92	CHLOROFORM		34	UG/L
SW059	27-Jan-92	METHYLENE CHLORIDE	J	3	UG/L
SW059	27-Jan-92	TETRACHLOROETHENE		99	UG/L
SW059	27-Jan-92	TIC	J	9	UG/L
SW059	27-Jan-92	TRICHLOROETHENE		110	UG/L
SW060	21-Jul-87	CARBON TETRACHLORIDE		173	UG/L
SW060	11-Nov-87	CARBON TETRACHLORIDE		145	UG/L
SW060	11-Nov-87	CHLOROFORM		10	UG/L
SW060	11-Nov-87	METHYLENE CHLORIDE		44	UG/L
SW060	11-Nov-87	TOLUENE		11	UG/L
SW060	11-Nov-87	TRICHLOROETHENE		25	UG/L
SW060	01-Jul-88	CARBON TETRACHLORIDE		46.5	UG/L
SW060	01-Jul-88	TETRACHLOROETHENE		10.3	UG/L
SW060	01-Jul-88	TRICHLOROETHENE		12.3	UG/L
SW060	16-Mar-89	ACETONE	J	3	UG/L
SW060	16-Mar-89	CARBON TETRACHLORIDE		88	UG/L
SW060	16-Mar-89	CARBON TETRACHLORIDE		75	UG/L
SW060	16-Mar-89	CHLOROFORM		14	UG/L
SW060	16-Mar-89	CHLOROFORM		12	UG/L
SW060	16-Mar-89	METHYLENE CHLORIDE	JB	3	UG/L
SW060	16-Mar-89	METHYLENE CHLORIDE	JB	4	UG/L
SW060	16-Mar-89	TETRACHLOROETHENE		14	UG/L
SW060	16-Mar-89	TETRACHLOROETHENE		11	UG/L
SW060	16-Mar-89	TOLUENE	J	1	UG/L
SW060	16-Mar-89	TRICHLOROETHENE		15	UG/L
SW060	16-Mar-89	TRICHLOROETHENE		12	UG/L
SW060	16-Mar-89	VINYL CHLORIDE	J	2	UG/L
SW060	15-May-89	1,1,1-TRICHLOROETHANE		12	UG/L
SW060	15-May-89	CARBON TETRACHLORIDE		92	UG/L
SW060	15-May-89	CARBON TETRACHLORIDE	B	65	UG/L
SW060	15-May-89	CHLOROFORM		9	UG/L
SW060	15-May-89	METHYLENE CHLORIDE	B	8	UG/L
SW060	15-May-89	TETRACHLOROETHENE		35	UG/L
SW060	15-May-89	TETRACHLOROETHENE		23	UG/L
SW060	15-May-89	TRICHLOROETHENE		20	UG/L
SW060	15-May-89	TRICHLOROETHENE		31	UG/L
SW060	09-Jun-89	CARBON TETRACHLORIDE		74	UG/L
SW060	09-Jun-89	CHLOROFORM		5	UG/L
SW060	09-Jun-89	TETRACHLOROETHENE		18	UG/L
SW060	09-Jun-89	TRICHLOROETHENE		13	UG/L
SW060	06-Jul-89	CARBON TETRACHLORIDE		18	UG/L
SW060	06-Jul-89	CHLOROFORM	J	2	UG/L
SW060	06-Jul-89	METHYLENE CHLORIDE		11	UG/L
SW060	06-Jul-89	TETRACHLOROETHENE	J	3	UG/L
SW060	06-Jul-89	TRICHLOROETHENE	J	3	UG/L
SW060	03-Oct-89	BIS(2-ETHYLHEXYL)PHTHALATE	JB	1	UG/L

Table 2.33

Summary of Volatile Organic Compounds Detected in OU8 Surface Water and Sediment Samples

Location	Sample Date	Chemical	Qual	Result	Unit
SW060	03-Oct-89	CARBON TETRACHLORIDE		21	UG/L
SW060	03-Oct-89	CHLOROFORM	J	1	UG/L
SW060	06-Nov-89	1,1,1-TRICHLOROETHANE	J	3	UG/L
SW060	06-Nov-89	ACETONE	JB	7	UG/L
SW060	06-Nov-89	ACETONE	B	57	UG/L
SW060	06-Nov-89	CARBON TETRACHLORIDE		23	UG/L
SW060	06-Nov-89	CARBON TETRACHLORIDE		23	UG/L
SW060	06-Nov-89	CHLOROFORM	J	3	UG/L
SW060	06-Nov-89	CHLOROFORM	J	3	UG/L
SW060	06-Nov-89	ETHYLBENZENE	J	2	UG/L
SW060	06-Nov-89	METHYLENE CHLORIDE	J	2	UG/L
SW060	06-Nov-89	METHYLENE CHLORIDE		5	UG/L
SW060	06-Nov-89	TOLUENE		5	UG/L
SW060	06-Nov-89	TOLUENE	J	4	UG/L
SW060	06-Dec-89	BENZENE	J	3	UG/L
SW060	06-Dec-89	CARBON TETRACHLORIDE		4	UG/L
SW060	06-Dec-89	CHLOROBENZENE		7	UG/L
SW060	23-Jan-90	1,1,2,2-TETRACHLOROETHANE	J	1	UG/L
SW060	23-Jan-90	CARBON TETRACHLORIDE	J	3	UG/L
SW060	23-Jan-90	CHLOROFORM	J	1	UG/L
SW060	23-Jan-90	METHYLENE CHLORIDE	JB	3	UG/L
SW060	23-Jan-90	TRICHLOROETHENE	J	2	UG/L
SW060	12-Mar-90	1,1-DICHLOROETHENE	J	2	UG/L
SW060	12-Mar-90	1,1,1-TRICHLOROETHANE		28	UG/L
SW060	12-Mar-90	1,2-DICHLOROETHENE	J	2	UG/L
SW060	12-Mar-90	ACETONE	JB	2	UG/L
SW060	12-Mar-90	CARBON TETRACHLORIDE		16	UG/L
SW060	12-Mar-90	CHLOROFORM	J	4	UG/L
SW060	12-Mar-90	METHYLENE CHLORIDE	B	8	UG/L
SW060	12-Mar-90	TETRACHLOROETHENE		77	UG/L
SW060	12-Mar-90	TRICHLOROETHENE		66	UG/L
SW060	23-May-90	CARBON DISULFIDE	J	2	UG/L
SW060	23-May-90	CARBON TETRACHLORIDE		23	UG/L
SW060	23-May-90	CHLOROFORM	J	3	UG/L
SW060	23-May-90	TETRACHLOROETHENE		9	UG/L
SW060	23-May-90	TRICHLOROETHENE		9	UG/L
SW060	23-Jul-90	1,1,1-TRICHLOROETHANE	J	2	UG/L
SW060	23-Jul-90	CARBON TETRACHLORIDE		20	UG/L
SW060	23-Jul-90	CHLOROFORM	J	3	UG/L
SW060	23-Jul-90	TETRACHLOROETHENE		7	UG/L
SW060	23-Jul-90	TRICHLOROETHENE		7	UG/L
SW060	22-Aug-90	ACETONE	BJ	6	UG/L
SW060	22-Aug-90	CARBON TETRACHLORIDE		9	UG/L
SW060	22-Aug-90	CHLOROFORM	J	1	UG/L
SW060	22-Aug-90	TETRACHLOROETHENE	J	3	UG/L
SW060	22-Aug-90	TRICHLOROETHENE	J	3	UG/L
SW060	26-Sep-90	CARBON TETRACHLORIDE		10	UG/L
SW060	26-Sep-90	CHLOROFORM	J	1	UG/L
SW060	26-Sep-90	TETRACHLOROETHENE	BJ	4	UG/L
SW060	26-Sep-90	TRICHLOROETHENE	J	4	UG/L

Table 2.33

Summary of Volatile Organic Compounds Detected in OU8 Surface Water and Sediment Samples

Location	Sample Date	Chemical	Qual	Result	Unit
SW060	16-Oct-90	1,2-DICHLOROETHENE	J	1	UG/L
SW060	16-Oct-90	2-BUTANONE	J	4	UG/L
SW060	16-Oct-90	2-HEXANONE	J	1	UG/L
SW060	16-Oct-90	ACETONE	BJ	2	UG/L
SW060	16-Oct-90	CARBON TETRACHLORIDE		6	UG/L
SW060	16-Oct-90	METHYLENE CHLORIDE	B	5	UG/L
SW060	16-Oct-90	TETRACHLOROETHENE	J	2	UG/L
SW060	16-Oct-90	TRICHLOROETHENE	J	2	UG/L
SW060	26-Nov-90	CARBON TETRACHLORIDE		9	UG/L
SW060	26-Nov-90	CHLOROFORM	J	1	UG/L
SW060	26-Nov-90	TETRACHLOROETHENE	J	3	UG/L
SW060	26-Nov-90	TRICHLOROETHENE	J	4	UG/L
SW060	07-Dec-90	1,1-DICHLOROETHANE	J	1	UG/L
SW060	07-Dec-90	1,1,1-TRICHLOROETHANE	J	2	UG/L
SW060	07-Dec-90	CARBON TETRACHLORIDE		10	UG/L
SW060	07-Dec-90	CHLOROFORM	J	1	UG/L
SW060	07-Dec-90	METHYLENE CHLORIDE	BJ	2	UG/L
SW060	07-Dec-90	TETRACHLOROETHENE	J	3	UG/L
SW060	07-Dec-90	TRICHLOROETHENE	J	3	UG/L
SW060	07-Dec-90	VINYL CHLORIDE	J	5	UG/L
SW060	22-Mar-91	CARBON TETRACHLORIDE		10	UG/L
SW060	22-Mar-91	CARBON TETRACHLORIDE		10	UG/L
SW060	22-Mar-91	METHYLENE CHLORIDE	JB	4	UG/L
SW060	11-Apr-91	1,1,1-TRICHLOROETHANE		8	UG/L
SW060	11-Apr-91	BIS(2-ETHYLHEXYL)PHTHALATE	J	4	UG/L
SW060	11-Apr-91	TETRACHLOROETHENE		20	UG/L
SW060	11-Apr-91	TRICHLOROETHENE		14	UG/L
SW060	08-May-91	1,1,1-TRICHLOROETHANE	J	5	UG/L
SW060	08-May-91	CARBON TETRACHLORIDE		35	UG/L
SW060	08-May-91	CHLOROFORM	J	3	UG/L
SW060	08-May-91	TETRACHLOROETHENE		17	UG/L
SW060	08-May-91	TRICHLOROETHENE		16	UG/L
SW060	20-Jun-91	CARBON TETRACHLORIDE		28	UG/L
SW060	20-Jun-91	TETRACHLOROETHENE		7	UG/L
SW060	20-Jun-91	TRICHLOROETHENE		8	UG/L
SW060	07-Aug-91	1,1,1-TRICHLOROETHANE	J	4	UG/L
SW060	07-Aug-91	1,1,1-TRICHLOROETHANE	J	4	UG/L
SW060	07-Aug-91	CARBON TETRACHLORIDE		19	UG/L
SW060	07-Aug-91	CARBON TETRACHLORIDE		19	UG/L
SW060	07-Aug-91	TETRACHLOROETHENE		13	UG/L
SW060	07-Aug-91	TETRACHLOROETHENE		13	UG/L
SW060	07-Aug-91	TRICHLOROETHENE		12	UG/L
SW060	07-Aug-91	TRICHLOROETHENE		12	UG/L
SW060	17-Sep-91	ACETONE	JB	7	UG/L
SW060	17-Sep-91	CARBON TETRACHLORIDE		7	UG/L
SW060	17-Sep-91	METHYLENE CHLORIDE	B	19	UG/L
SW060	17-Oct-91	ACETONE	B	49	UG/L
SW060	17-Oct-91	BIS(2-ETHYLHEXYL)PHTHALATE	J	1	UG/L
SW060	17-Oct-91	METHYLENE CHLORIDE	B	11	UG/L
SW060	17-Oct-91	TIC	J	5	UG/L

Table 2.33

Summary of Volatile Organic Compounds Detected in OU8 Surface Water and Sediment Samples

Location	Sample Date	Chemical	Qual	Result	Unit
SW060	17-Oct-91	TIC	J	10	UG/L
SW060	17-Oct-91	TIC	J	7	UG/L
SW060	17-Oct-91	TIC	J	8	UG/L
SW060	17-Oct-91	TIC	J	6	UG/L
SW060	17-Oct-91	TIC	J	9	UG/L
SW060	27-Jan-92	ACETONE	B	15	UG/L
SW060	27-Jan-92	CARBON TETRACHLORIDE		11	UG/L
SW060	27-Jan-92	TETRACHLOROETHENE	J	3	UG/L
SW060	27-Jan-92	TIC	J	6	UG/L
SW093	29-Jan-90	1,1-DICHLOROETHANE	J	1	UG/L
SW093	29-Jan-90	1,1-DICHLOROETHANE	J	1	UG/L
SW093	29-Jan-90	1,1-DICHLOROETHENE	%	90	UG/L
SW093	29-Jan-90	1,2-DICHLOROETHENE	J	1	UG/L
SW093	29-Jan-90	BENZENE	%	108	UG/L
SW093	29-Jan-90	BENZENE	S	5	UG/L
SW093	29-Jan-90	CHLOROBENZENE	%	103	UG/L
SW093	29-Jan-90	METHYLENE CHLORIDE	B	7	UG/L
SW093	29-Jan-90	METHYLENE CHLORIDE		6	UG/L
SW093	29-Jan-90	METHYLENE CHLORIDE		6	UG/L
SW093	29-Jan-90	TOLUENE	S	5	UG/L
SW093	29-Jan-90	TOLUENE	%	96	UG/L
SW093	29-Jan-90	TRICHLOROETHENE	S	5	UG/L
SW093	29-Jan-90	TRICHLOROETHENE	%	112	UG/L
SW093	21-Feb-90	METHYLENE CHLORIDE	JB	4	UG/L
SW093	22-Jun-90	1,1-DICHLOROETHANE	J	4	UG/L
SW093	22-Jun-90	ACETONE	JB	3	UG/L
SW093	22-Jun-90	METHYLENE CHLORIDE	JB	1	UG/L
SW093	30-Jul-90	1,1-DICHLOROETHANE	J	2	UG/L
SW093	30-Jul-90	1,1-DICHLOROETHANE	J	3	UG/L
SW093	30-Jul-90	1,1-DICHLOROETHANE	J	2	UG/L
SW093	30-Jul-90	1,1,1-TRICHLOROETHANE	J	2	UG/L
SW093	30-Jul-90	1,1,1-TRICHLOROETHANE	J	2	UG/L
SW093	30-Jul-90	1,1,1-TRICHLOROETHANE	J	2	UG/L
SW093	30-Jul-90	METHYLENE CHLORIDE	BJ	4	UG/L
SW093	30-Jul-90	METHYLENE CHLORIDE	BJ	4	UG/L
SW093	30-Jul-90	METHYLENE CHLORIDE	B	9	UG/L
SW093	30-Aug-90	1,1-DICHLOROETHANE	J	2	UG/L
SW093	30-Aug-90	1,1,1-TRICHLOROETHANE	J	2	UG/L
SW093	30-Aug-90	1,2-DICHLOROETHENE	J	2	UG/L
SW093	25-Sep-90	1,1-DICHLOROETHANE	J	2	UG/L
SW093	25-Sep-90	1,1,1-TRICHLOROETHANE	J	2	UG/L
SW093	17-Oct-90	1,1-DICHLOROETHANE	J	2	UG/L
SW093	17-Oct-90	1,1,1-TRICHLOROETHANE	J	2	UG/L
SW093	15-Apr-91	METHYLENE CHLORIDE		19	UG/L
SW093	26-Jun-91	1,1-DICHLOROETHANE	J	2	UG/L
SW093	14-Aug-91	ACETONE	JB	7	UG/L
SW093	14-Aug-91	METHYLENE CHLORIDE	B	38	UG/L
SW093	19-Sep-91	ACETONE	JB	7	UG/L

Table 2.33

Summary of Volatile Organic Compounds Detected in OU8 Surface Water and Sediment Samples

Location	Sample Date	Chemical	Qual	Result	Unit
SW093	19-Sep-91	METHYLENE CHLORIDE	B	6	UG/L
SW093	19-Sep-91	TETRACHLOROETHENE		6	UG/L
SW101	30-Jun-88	CHLOROFORM		79	UG/L
SW101	11-May-89	ANTHRACENE	J	2	UG/L
SW101	11-May-89	BENZO(a)ANTHRACENE	J	1	UG/L
SW101	11-May-89	BIS(2-ETHYLHEXYL)PHTHALATE	J	1	UG/L
SW101	11-May-89	BROMODICHLOROMETHANE	J	2	UG/L
SW101	11-May-89	CHLOROFORM		53	UG/L
SW101	11-May-89	CHRYSENE	J	1	UG/L
SW101	11-May-89	FLUORANTHENE	J	2	UG/L
SW101	11-May-89	METHYLENE CHLORIDE	J	3	UG/L
SW101	11-May-89	N-NITROSODIPHENYLAMINE	J	1	UG/L
SW101	11-May-89	PYRENE	J	2	UG/L
SW101	11-May-89	TETRACHLOROETHENE		14	UG/L
SW101	11-May-89	TOLUENE	J	4	UG/L
SW101	07-Jun-89	BROMODICHLOROMETHANE	J	2	UG/L
SW101	07-Jun-89	CHLOROFORM		66	UG/L
SW101	12-Jul-89	BROMODICHLOROMETHANE	J	2	UG/L
SW101	12-Jul-89	CHLOROFORM		67	UG/L
SW101	12-Jul-89	METHYLENE CHLORIDE	J	2	UG/L
SW101	09-Aug-89	ACETONE		65	UG/L
SW101	09-Aug-89	BROMODICHLOROMETHANE	J	2	UG/L
SW101	09-Aug-89	CHLOROFORM		57	UG/L
SW101	09-Aug-89	METHYLENE CHLORIDE	JB	3	UG/L
SW101	14-Sep-89	BROMODICHLOROMETHANE	J	2	UG/L
SW101	14-Sep-89	CHLOROFORM		38	UG/L
SW101	14-Sep-89	METHYLENE CHLORIDE	JB	4	UG/L
SW101	14-Sep-89	TETRACHLOROETHENE	J	2	UG/L
SW101	15-Nov-89	ACETONE	JB	5	UG/L
SW101	15-Nov-89	BROMODICHLOROMETHANE	J	1	UG/L
SW101	15-Nov-89	CHLOROFORM		30	UG/L
SW101	15-Nov-89	METHYLENE CHLORIDE	JB	4	UG/L
SW101	19-Dec-89	2-BUTANONE	J	4	UG/L
SW101	19-Dec-89	ACETONE	J	4	UG/L
SW101	19-Dec-89	CHLOROFORM		24	UG/L
SW101	19-Dec-89	METHYLENE CHLORIDE	J	2	UG/L
SW101	25-Jan-90	CHLOROFORM		38	UG/L
SW101	25-Jan-90	CHLOROFORM		38	UG/L
SW101	25-Jan-90	CHLOROFORM		39	UG/L
SW101	22-Feb-90	BROMODICHLOROMETHANE	J	1	UG/L
SW101	22-Feb-90	CHLOROFORM		27	UG/L
SW101	22-Feb-90	METHYLENE CHLORIDE	B	5	UG/L
SW101	22-Feb-90	TRICHLOROETHENE	J	2	UG/L
SW101	18-Apr-90	CHLOROFORM		6	UG/L
SW101	08-May-90	CHLOROFORM		6	UG/L
SW101	08-May-90	METHYLENE CHLORIDE	JB	3	UG/L
SW101	28-Jun-90	CHLOROFORM		8	UG/L

Table 2.33

Summary of Volatile Organic Compounds Detected in OU8 Surface Water and Sediment Samples

Location	Sample Date	Chemical	Qual	Result	Unit
SW101	18-Jul-90	1,1-DICHLOROETHENE	J	2	UG/L
SW101	18-Jul-90	ACETONE	BJ	4	UG/L
SW101	18-Jul-90	ACETONE	BJ	3	UG/L
SW101	18-Jul-90	BENZENE	J	2	UG/L
SW101	18-Jul-90	CHLOROBENZENE	J	2	UG/L
SW101	18-Jul-90	CHLOROFORM	J	2	UG/L
SW101	18-Jul-90	CHLOROFORM	J	2	UG/L
SW101	18-Jul-90	CHLOROFORM	J	2	UG/L
SW101	18-Jul-90	CHLOROFORM		7	UG/L
SW101	18-Jul-90	METHYLENE CHLORIDE	J	3	UG/L
SW101	18-Jul-90	METHYLENE CHLORIDE	BJ	1	UG/L
SW101	18-Jul-90	TOLUENE	J	2	UG/L
SW101	18-Jul-90	TRICHLOROETHENE	J	2	UG/L
SW101	11-Sep-90	CHLOROFORM		20	UG/L
SW101	11-Sep-90	TOLUENE	J	2	UG/L
SW101	17-Dec-90	BROMODICHLOROMETHANE	J	2	UG/L
SW101	17-Dec-90	CHLOROFORM		29	UG/L
SW101	26-Mar-91	CHLOROFORM		17	UG/L
SW101	25-Apr-91	CHLOROFORM		19	UG/L
SW101	30-May-91	ACETONE	B	25	UG/L
SW101	30-May-91	CHLOROFORM		18	UG/L
SW101	30-May-91	METHYLENE CHLORIDE	B	14	UG/L
SW101	18-Jun-91	CHLOROFORM		20	UG/L
SW101	18-Jun-91	CHLOROFORM		22	UG/L
SW101	16-Jul-91	CHLOROFORM		41	UG/L
SW101	16-Jul-91	CHLOROFORM		40	UG/L
SW101	16-Jul-91	METHYLENE CHLORIDE	B	6	UG/L
SW101	16-Jul-91	METHYLENE CHLORIDE	JB	3	UG/L
SW101	16-Jul-91	METHYLENE CHLORIDE	JB	4	UG/L
SW101	08-Oct-91	BIS(2-ETHYLHEXYL)PHTHALATE	J	1	UG/L
SW101	08-Oct-91	CHLOROFORM		22	UG/L
SW101	08-Oct-91	METHYLENE CHLORIDE	B	21	UG/L
SW101	08-Oct-91	TIC	J	7	UG/L
SW101	08-Oct-91	TIC	J	20	UG/L
SW101	08-Oct-91	TIC	J	10	UG/L
SW101	08-Oct-91	TIC	J	6	UG/L
SW101	08-Oct-91	TIC	JB	40	UG/L
SW101	08-Oct-91	TIC	JB	30	UG/L
SW102	08-Jul-88	CHLOROFORM	J	1	UG/L
SW102	08-Jul-88	METHYLENE CHLORIDE	JB	1	UG/L
SW102	20-Mar-90	METHYLENE CHLORIDE	B	5	UG/L
SW102	16-Apr-90	METHYLENE CHLORIDE	JB	4	UG/L
SW102	16-Apr-90	TETRACHLOROETHENE	J	2	UG/L
SW102	16-Apr-90	TRICHLOROETHENE	J	3	UG/L
SW102	26-Jun-90	METHYLENE CHLORIDE	JB	4	UG/L
SW102	26-Jun-90	METHYLENE CHLORIDE	JB	2	UG/L

Table 2.33

Summary of Volatile Organic Compounds Detected in OU8 Surface Water and Sediment Samples

Location	Sample Date	Chemical	Qual	Result	Unit
SW102	17-Jul-90	1,1-DICHLOROETHANE	J	2	UG/L
SW102	17-Jul-90	1,1,1-TRICHLOROETHANE	J	3	UG/L
SW102	17-Jul-90	1,2-DICHLOROETHENE	J	3	UG/L
SW102	17-Jul-90	CHLOROFORM		11	UG/L
SW102	17-Jul-90	METHYLENE CHLORIDE	BJ	1	UG/L
SW102	17-Jul-90	TETRACHLOROETHENE	J	4	UG/L
SW102	17-Jul-90	TRICHLOROETHENE		20	UG/L
SW118	29-Oct-90	DI-n-BUTYL PHTHALATE	J	2	UG/L
SW118	29-Oct-90	METHYLENE CHLORIDE	B	6	UG/L
SW118	21-Mar-91	METHYLENE CHLORIDE	JB	3	UG/L
SW118	07-Aug-91	ACETONE	B	15	UG/L
SW118	07-Aug-91	METHYLENE CHLORIDE	B	12	UG/L
SW122	11-Oct-90	CHLOROBENZENE	J	1	UG/L
SW122	11-Oct-90	METHYLENE CHLORIDE	BJ	2	UG/L
SW122	11-Oct-90	METHYLENE CHLORIDE	BJ	3	UG/L
SW122	29-May-91	ACETONE	B	94	UG/L
SW122	29-May-91	METHYLENE CHLORIDE	B	33	UG/L
SW122	10-Sep-91	ACETONE	JB	3	UG/L
SW122	10-Sep-91	METHYLENE CHLORIDE	B	12	UG/L
SW122	07-Oct-91	alpha-BHC	J	0.01	UG/L
SW122	07-Oct-91	beta-BHC	J	0.02	UG/L
SW122	07-Oct-91	delta-BHC	J	0.01	UG/L
SW122	07-Oct-91	METHYLENE CHLORIDE	B	6	UG/L
SW122	07-Oct-91	TIC	J	7	UG/L
SW122	07-Oct-91	TIC	J	5	UG/L
SW122	07-Oct-91	TIC	JB	9	UG/L
SW122	07-Oct-91	TIC	JB	10	UG/L
SED011	13-Aug-86	2-BUTANONE		12	UG/KG
SED011	13-Aug-86	ACETONE		167	UG/KG
SED011	13-Aug-86	BIS(2-ETHYLHEXYL)PHTHALATE	J	40	UG/KG
SED011	13-Aug-86	DI-n-BUTYL PHTHALATE	J	40	UG/KG
SED011	13-Aug-86	ETHYLBENZENE	J	1	UG/KG
SED011	13-Aug-86	METHYLENE CHLORIDE	J	2	UG/KG
SED011	13-Aug-86	N-NITROSODIPHENYLAMINE	JB	170	UG/KG
SED011	13-Aug-86	TOLUENE	J	1	UG/KG
SED011	13-Aug-86	TOTAL XYLENES	J	7	UG/KG
SED011	13-Mar-89	CARBON TETRACHLORIDE		52	UG/G
SED011	13-Mar-89	CHLOROFORM		10	UG/G
SED011	13-Mar-89	METHYLENE CHLORIDE	JB	3	UG/G
SED011	13-Mar-89	TETRACHLOROETHENE		39	UG/G
SED011	26-Oct-89	ACETONE	B	33	UG/KG
SED011	26-Oct-89	METHYLENE CHLORIDE	B	15	UG/KG
SED011	01-Jun-90	ACETONE		190	UG/KG
SED011	01-Jun-90	ACETONE	JB	8	UG/L*
SED011	01-Jun-90	ACETONE		220	UG/KG
SED011	01-Jun-90	BENZO(a)ANTHRACENE	J	51	UG/KG

Table 2.33

Summary of Volatile Organic Compounds Detected in OU8 Surface Water and Sediment Samples

Location	Sample Date	Chemical	Qual	Result	Unit
SED011	01-Jun-90	BENZO(a)ANTHRACENE	J	46	UG/KG
SED011	01-Jun-90	BIS(2-ETHYLHEXYL)PHTHALATE	JB	32	UG/L*
SED011	01-Jun-90	BIS(2-ETHYLHEXYL)PHTHALATE	JB	390	UG/KG
SED011	01-Jun-90	BIS(2-ETHYLHEXYL)PHTHALATE	JB	420	UG/KG
SED011	01-Jun-90	BIS(2-ETHYLHEXYL)PHTHALATE	JB	420	UG/KG
SED011	01-Jun-90	CHLOROFORM	J	6	UG/KG
SED011	01-Jun-90	CHLOROFORM		9	UG/KG
SED011	01-Jun-90	CHLOROFORM	J	4	UG/KG
SED011	01-Jun-90	CHRYSENE	J	53	UG/KG
SED011	01-Jun-90	CHRYSENE	J	63	UG/KG
SED011	01-Jun-90	CHRYSENE	J	48	UG/KG
SED011	01-Jun-90	FLUORANTHENE	J	110	UG/KG
SED011	01-Jun-90	FLUORANTHENE	J	120	UG/KG
SED011	01-Jun-90	FLUORANTHENE	J	76	UG/KG
SED011	01-Jun-90	METHYLENE CHLORIDE	J	6	UG/KG
SED011	01-Jun-90	METHYLENE CHLORIDE		12	UG/KG
SED011	01-Jun-90	METHYLENE CHLORIDE		11	UG/L*
SED011	01-Jun-90	METHYLENE CHLORIDE		11	UG/KG
SED011	01-Jun-90	PHENANTHRENE	J	53	UG/KG
SED011	01-Jun-90	PHENANTHRENE	J	54	UG/KG
SED011	01-Jun-90	PHENANTHRENE	J	96	UG/KG
SED011	01-Jun-90	PYRENE	J	84	UG/KG
SED011	01-Jun-90	TETRACHLOROETHENE		17	UG/KG
SED011	01-Jun-90	TETRACHLOROETHENE		27	UG/KG
SED011	01-Jun-90	TETRACHLOROETHENE		16	UG/KG
SED011	01-Jun-90	TRICHLOROETHENE	J	5	UG/KG
SED011	05-Sep-90	ACETONE	BJ	12	UG/KG
SED011	05-Sep-90	ACETONE	BJ	8	UG/L*
SED011	05-Sep-90	ANTHRACENE	J	130	UG/KG
SED011	05-Sep-90	BENZOIC ACID	J	150	UG/KG
SED011	05-Sep-90	BENZO(a)ANTHRACENE	J	200	UG/KG
SED011	05-Sep-90	BENZO(a)PYRENE	J	190	UG/KG
SED011	05-Sep-90	BENZO(b)FLUORANTHENE	J	240	UG/KG
SED011	05-Sep-90	BIS(2-ETHYLHEXYL)PHTHALATE	J	140	UG/KG
SED011	05-Sep-90	BIS(2-ETHYLHEXYL)PHTHALATE	J	99	UG/KG
SED011	05-Sep-90	BIS(2-ETHYLHEXYL)PHTHALATE		41	UG/L*
SED011	05-Sep-90	CHRYSENE	J	200	UG/KG
SED011	05-Sep-90	FLUORANTHENE	J	580	UG/KG
SED011	05-Sep-90	METHYLENE CHLORIDE	B	8	UG/L*
SED011	05-Sep-90	PENTACHLOROPHENOL	J	270	UG/KG
SED011	05-Sep-90	PHENANTHRENE	BJ	530	UG/KG
SED011	05-Sep-90	PYRENE	J	640	UG/KG
SED011	03-Dec-90	BIS(2-ETHYLHEXYL)PHTHALATE	J	290	UG/KG
SED011	03-Dec-90	METHYLENE CHLORIDE	J	6	UG/KG
SED011	03-Dec-90	TOLUENE	J	2	UG/KG
SED011	21-Mar-91	ACETONE	JB	6	UG/KG
SED011	21-Mar-91	BIS(2-ETHYLHEXYL)PHTHALATE	J	160	UG/KG
SED011	21-Mar-91	FLUORANTHENE	J	91	UG/KG
SED011	21-Mar-91	METHYLENE CHLORIDE	J	4	UG/KG
SED011	21-Mar-91	PHENANTHRENE	J	71	UG/KG
SED011	21-Mar-91	PYRENE	J	81	UG/KG
SED011	14-May-91	2,4-DIMETHYLPHENOL	J	2	UG/L*

Table 2.33

Summary of Volatile Organic Compounds Detected in OU8 Surface Water and Sediment Samples

Location	Sample Date	Chemical	Qual	Result	Unit
SED011	14-May-91	ACETONE		24	UG/KG
SED011	14-May-91	ACETONE		17	UG/KG
SED011	14-May-91	BENZO(a)ANTHRACENE	J	77	UG/KG
SED011	14-May-91	BENZO(a)ANTHRACENE	J	57	UG/KG
SED011	14-May-91	BIS(2-ETHYLHEXYL)PHTHALATE	JB	4	UG/L*
SED011	14-May-91	BIS(2-ETHYLHEXYL)PHTHALATE	J	180	UG/KG
SED011	14-May-91	BIS(2-ETHYLHEXYL)PHTHALATE	J	150	UG/KG
SED011	14-May-91	CHRYSENE	J	53	UG/KG
SED011	14-May-91	CHRYSENE	J	80	UG/KG
SED011	14-May-91	FLUORANTHENE	J	140	UG/KG
SED011	14-May-91	FLUORANTHENE	J	97	UG/KG
SED011	14-May-91	METHYLENE CHLORIDE	B	40	UG/KG
SED011	14-May-91	METHYLENE CHLORIDE	B	33	UG/KG
SED011	14-May-91	PHENANTHRENE	J	58	UG/KG
SED011	14-May-91	PHENANTHRENE	J	100	UG/KG
SED011	14-May-91	PYRENE	J	140	UG/KG
SED011	14-May-91	PYRENE	J	99	UG/KG
SED011	14-May-91	TETRACHLOROETHENE	J	3	UG/KG
SED011	03-Sep-91	ACENAPHTHENE	J	56	UG/KG
SED011	03-Sep-91	ACETONE	B	49	UG/KG
SED011	03-Sep-91	AROCLOR-1254	J	91	UG/KG
SED011	03-Sep-91	BENZO(a)ANTHRACENE	J	92	UG/KG
SED011	03-Sep-91	BENZO(a)PYRENE	J	95	UG/KG
SED011	03-Sep-91	BENZO(b)FLUORANTHENE	J	110	UG/KG
SED011	03-Sep-91	BENZO(k)FLUORANTHENE	J	67	UG/KG
SED011	03-Sep-91	BIS(2-ETHYLHEXYL)PHTHALATE	J	88	UG/KG
SED011	03-Sep-91	CHRYSENE	J	94	UG/KG
SED011	03-Sep-91	FLUORANTHENE	J	220	UG/KG
SED011	03-Sep-91	INDENO(1,2,3-cd)PYRENE	J	74	UG/KG
SED011	03-Sep-91	METHYLENE CHLORIDE	B	94	UG/KG
SED011	03-Sep-91	NAPHTHALENE	J	59	UG/KG
SED011	03-Sep-91	PHENANTHRENE	J	240	UG/KG
SED011	03-Sep-91	PYRENE	J	240	UG/KG
SED011	03-Dec-91	ACETONE	B	28	UG/KG
SED011	03-Dec-91	AROCLOR-1254	J	78	UG/KG
SED011	03-Dec-91	BIS(2-ETHYLHEXYL)PHTHALATE	JB	310	UG/KG
SED011	03-Dec-91	METHYLENE CHLORIDE	B	15	UG/KG
SED011	03-Dec-91	TIC	JB	3000	UG/KG
SED011	03-Dec-91	TIC	J	300	UG/KG
SED011	03-Dec-91	TIC	J	200	UG/KG
SED011	03-Dec-91	TIC	J	400	UG/KG
SED011	03-Dec-91	TIC	J	800	UG/KG
SED011	03-Dec-91	TIC	J	10	UG/KG
SED011	03-Dec-91	TIC	JB	*******	UG/KG
SED011	03-Dec-91	TIC	JB	5000	UG/KG
SED118	18-Sep-90	2-BUTANONE	BJ	4	UG/KG
SED118	18-Sep-90	4-METHYL-2-PENTANONE	BJ	1	UG/KG
SED118	18-Sep-90	ACETONE	BJ	2	UG/KG
SED118	18-Sep-90	CARBON DISULFIDE	J	2	UG/KG
SED118	18-Sep-90	FLUORANTHENE	J	45	UG/KG
SED118	18-Sep-90	METHYLENE CHLORIDE	B	10	UG/KG
SED118	18-Sep-90	PYRENE	J	70	UG/KG

Table 2.33

Summary of Volatile Organic Compounds Detected in OU8 Surface Water and Sediment Samples

Location	Sample Date	Chemical	Qual	Result	Unit
SED118	18-Sep-90	TOLUENE	BJ	2	UG/KG
SED118	28-Nov-90	2-BUTANONE	B	59	UG/KG
SED118	28-Nov-90	METHYLENE CHLORIDE	BJ	9	UG/KG
SED118	27-Mar-91	BIS(2-ETHYLHEXYL)PHTHALATE	J	110	UG/KG
SED118	27-Mar-91	DI-n-BUTYL PHTHALATE	J	54	UG/KG
SED118	27-Mar-91	FLUORANTHENE	J	70	UG/KG
SED118	27-Mar-91	PYRENE	J	86	UG/KG
SED118	21-May-91	BENZO(a)ANTHRACENE	J	51	UG/KG
SED118	21-May-91	BENZO(b)FLUORANTHENE	J	62	UG/KG
SED118	21-May-91	CHRYSENE	J	53	UG/KG
SED118	21-May-91	FLUORANTHENE	J	99	UG/KG
SED118	21-May-91	METHYLENE CHLORIDE	B	110	UG/KG
SED118	21-May-91	PHENANTHRENE	J	71	UG/KG
SED118	21-May-91	PYRENE	J	92	UG/KG
SED118	13-Aug-91	ACETONE	B	21	UG/KG
SED118	13-Aug-91	BENZO(a)ANTHRACENE	J	49	UG/KG
SED118	13-Aug-91	BENZO(b)FLUORANTHENE	J	61	UG/KG
SED118	13-Aug-91	BIS(2-ETHYLHEXYL)PHTHALATE	JB	96	UG/KG
SED118	13-Aug-91	CHRYSENE	J	51	UG/KG
SED118	13-Aug-91	FLUORANTHENE	J	110	UG/KG
SED118	13-Aug-91	METHYLENE CHLORIDE	B	23	UG/KG
SED118	13-Aug-91	PHENANTHRENE	J	95	UG/KG
SED118	13-Aug-91	PYRENE	J	120	UG/KG
SED120	19-Sep-90	2-BUTANONE	BJ	3	UG/KG
SED120	19-Sep-90	ACETONE	BJ	2	UG/KG
SED120	19-Sep-90	BENZO(a)ANTHRACENE	J	200	UG/KG
SED120	19-Sep-90	BIS(2-ETHYLHEXYL)PHTHALATE	J	160	UG/KG
SED120	19-Sep-90	CARBON DISULFIDE	J	2	UG/KG
SED120	19-Sep-90	FLUORANTHENE	J	300	UG/KG
SED120	19-Sep-90	METHYLENE CHLORIDE	B	8	UG/KG
SED120	19-Sep-90	PHENANTHRENE	J	310	UG/KG
SED120	19-Sep-90	PYRENE	J	440	UG/KG
SED120	17-Dec-90	ACETONE	BJ	5	UG/KG
SED120	17-Dec-90	BENZO(a)ANTHRACENE	J	91	UG/KG
SED120	17-Dec-90	BENZO(a)PYRENE	J	100	UG/KG
SED120	17-Dec-90	BENZO(b)FLUORANTHENE	J	90	UG/KG
SED120	17-Dec-90	BENZO(k)FLUORANTHENE	J	74	UG/KG
SED120	17-Dec-90	BIS(2-ETHYLHEXYL)PHTHALATE	J	72	UG/KG
SED120	17-Dec-90	CHRYSENE	J	110	UG/KG
SED120	17-Dec-90	FLUORANTHENE	J	210	UG/KG
SED120	17-Dec-90	METHYLENE CHLORIDE	BJ	5	UG/KG
SED120	17-Dec-90	PHENANTHRENE	J	170	UG/KG
SED120	17-Dec-90	PYRENE	J	190	UG/KG
SED120	26-Mar-91	ACETONE	JB	9	UG/KG
SED120	26-Mar-91	BENZO(a)ANTHRACENE	J	64	UG/KG
SED120	26-Mar-91	BENZO(b)FLUORANTHENE	J	55	UG/KG
SED120	26-Mar-91	BENZO(k)FLUORANTHENE	J	37	UG/KG
SED120	26-Mar-91	BIS(2-ETHYLHEXYL)PHTHALATE	J	120	UG/KG
SED120	26-Mar-91	CHRYSENE	J	64	UG/KG
SED120	26-Mar-91	FLUORANTHENE	J	120	UG/KG

Table 2.33

Summary of Volatile Organic Compounds Detected in OU8 Surface Water and Sediment Samples

Location	Sample Date	Chemical	Qual	Result	Unit
SED120	26-Mar-91	METHYLENE CHLORIDE	B	5	UG/KG
SED120	26-Mar-91	PHENANTHRENE	J	84	UG/KG
SED120	26-Mar-91	PYRENE	J	110	UG/KG
SED120	29-May-91	ACETONE	B	24	UG/KG
SED120	29-May-91	BENZO(a)ANTHRACENE	J	77	UG/KG
SED120	29-May-91	BENZO(a)PYRENE	J	120	UG/KG
SED120	29-May-91	BENZO(b)FLUORANTHENE	J	120	UG/KG
SED120	29-May-91	BENZO(ghi)PERYLENE	J	64	UG/KG
SED120	29-May-91	BENZO(k)FLUORANTHENE	J	96	UG/KG
SED120	29-May-91	BIS(2-ETHYLHEXYL)PHTHALATE	JB	280	UG/KG
SED120	29-May-91	CHRYSENE	J	100	UG/KG
SED120	29-May-91	FLUORANTHENE	J	160	UG/KG
SED120	29-May-91	INDENO(1,2,3-cd)PYRENE	J	60	UG/KG
SED120	29-May-91	METHYLENE CHLORIDE	B	15	UG/KG
SED120	29-May-91	PHENANTHRENE	J	110	UG/KG
SED120	29-May-91	PYRENE	J	150	UG/KG
SED120	20-Aug-91	ACENAPHTHENE	J	56	UG/KG
SED120	20-Aug-91	ACETONE	B	12	UG/KG
SED120	20-Aug-91	ANTHRACENE	J	68	UG/KG
SED120	20-Aug-91	BENZO(a)ANTHRACENE	J	190	UG/KG
SED120	20-Aug-91	BENZO(a)PYRENE	J	210	UG/KG
SED120	20-Aug-91	BENZO(b)FLUORANTHENE	J	230	UG/KG
SED120	20-Aug-91	BENZO(k)FLUORANTHENE	J	250	UG/KG
SED120	20-Aug-91	BIS(2-ETHYLHEXYL)PHTHALATE	J	110	UG/KG
SED120	20-Aug-91	CHRYSENE	J	210	UG/KG
SED120	20-Aug-91	DI-n-BUTYL PHTHALATE	J	130	UG/KG
SED120	20-Aug-91	FLUORANTHENE		440	UG/KG
SED120	20-Aug-91	METHYLENE CHLORIDE	B	17	UG/KG
SED120	20-Aug-91	PHENANTHRENE	J	360	UG/KG
SED120	20-Aug-91	PYRENE		510	UG/KG

* The units indicated for this constituent in RFEDS appear to be incorrect. This apparent discrepancy was not resolved during the preparation of this Work Plan.

TABLE 2.34
SUMMARY STATISTICS – SELECTED TRACE METALS, OU13 AREA
SURFACE–WATER AND SEDIMENT SITES

A. Trace Metals, Surface–Water Sites

1 Aluminum, Dissolved

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	7	87.41	112.11	200.00	17.70
	SW043	0	N/A	N/A	N/A	N/A
	SW085	5	65.95	128.86	200.00	69.60
	SW086	13	234.14	167.16	910.00	32.90
	SW093	16	120.94	103.52	457.00	10.00
	SW102	5	65.95	128.86	200.00	69.60
	SW118	6	67.67	66.03	184.00	10.00
	SED118	0	N/A	N/A	N/A	N/A
	SED120	0	N/A	N/A	N/A	N/A

Aluminum, Total

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	5	66.35	97.40	196.00	32.00
	SW043	3	304.66	706.67	940.00	362.00
	SW085	4	6241.28	6449.00	12100.00	886.00
	SW086	13	3413.16	1680.59	12500.00	27.00
	SW093	23	26067.99	14347.16	110000.00	71.00
	SW102	5	21488.64	12767.80	51000.00	299.00
	SW118	9	43696.94	31291.20	120000.00	83.80
	SED118	4	3427.98	9452.50	14300.00	6250.00
	SED120	3	5057.75	8716.67	12400.00	2950.00

2 Antimony, Dissolved

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	7	11.26	19.40	42.20	11.00
	SW043	3	3.70	21.93	25.60	18.20
	SW085	5	15.21	53.20	60.00	26.00
	SW086	13	27.36	38.92	100.00	9.20
	SW093	15	21.14	27.49	60.00	7.00
	SW102	5	28.95	56.00	100.00	26.00
	SW118	6	8.04	18.62	25.60	7.00
	SED118	0	N/A	N/A	N/A	N/A
	SED120	0	N/A	N/A	N/A	N/A

Antimony, Total

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	5	6.14	15.96	25.60	11.00
	SW043	3	3.70	21.93	25.60	18.20
	SW085	5	15.21	53.20	60.00	26.00
	SW086	13	27.51	38.78	100.00	10.00
	SW093	23	15.83	28.71	60.00	11.00
	SW102	5	30.62	54.42	100.00	26.00
	SW118	9	27.14	30.18	92.60	7.00
	SED118	4	4.59	7.00	13.30	2.40
	SED120	3	3.26	5.63	9.40	3.70

TABLE 2.34
SUMMARY STATISTICS – SELECTED TRACE METALS, OU13 AREA
SURFACE–WATER AND SEDIMENT SITES

A. Trace Metals, Surface–Water Sites

3 Arsenic, Dissolved

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	7	0.61	1.36	2.00	0.70
	SW043	3	0.06	0.93	1.00	0.90
	SW085	5	3.58	8.40	10.00	2.00
	SW086	14	4.33	5.21	10.00	0.70
	SW093	15	3.95	3.72	10.00	0.90
	SW102	5	4.38	6.80	10.00	2.00
	SW118	6	0.60	1.45	2.00	0.90
	SED118	0	N/A	N/A	N/A	N/A
	SED120	0	N/A	N/A	N/A	N/A

Arsenic, Total

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	5	1.27	1.96	4.00	0.90
	SW043	3	0.06	0.93	1.00	0.90
	SW085	5	2.41	8.92	10.00	4.60
	SW086	14	7.13	6.54	27.00	0.70
	SW093	23	2.84	3.56	10.00	0.80
	SW102	5	3.71	7.40	10.00	2.00
	SW118	9	1.89	2.77	5.80	0.90
	SED118	4	2.46	6.53	10.20	5.00
	SED120	3	1.63	3.67	5.10	1.90

4 Barium, Dissolved

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	7	19.87	119.21	140.00	90.80
	SW043	3	7.09	134.33	142.00	128.00
	SW085	4	63.60	168.20	200.00	72.80
	SW086	13	49.69	132.10	200.00	68.60
	SW093	15	42.47	146.18	200.00	83.00
	SW102	5	51.07	162.38	224.00	96.90
	SW118	6	19.48	105.37	130.00	85.20
	SED118	0	N/A	N/A	N/A	N/A
	SED120	0	N/A	N/A	N/A	N/A

Barium, Total

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	5	15.72	129.00	140.00	102.00
	SW043	3	12.29	138.00	147.00	124.00
	SW085	4	28.24	198.25	231.00	162.00
	SW086	13	50.77	147.32	230.00	80.80
	SW093	23	203.49	225.52	1000.00	83.10
	SW102	5	178.00	272.80	590.00	167.00
	SW118	9	620.27	459.06	1980.00	91.50
	SED118	4	42.34	125.25	188.00	96.00
	SED120	3	41.51	87.80	124.00	42.50

TABLE 2.34
SUMMARY STATISTICS – SELECTED TRACE METALS, OU13 AREA
SURFACE–WATER AND SEDIMENT SITES

A. Trace Metals, Surface–Water Sites

5 Beryllium, Dissolved

	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
(ug/L, water)						
(mg/KG, sediments)	SW018	8	0.31	0.84	1.40	0.50
	SW043	3	0.23	0.73	1.00	0.60
	SW085	5	1.79	4.20	5.00	1.00
	SW086	14	26.21	9.17	100.00	0.60
	SW093	18	1.77	2.39	5.00	0.50
	SW102	5	43.43	22.40	100.00	1.00
	SW118	7	0.52	0.94	2.00	0.50
	SED118	0	N/A	N/A	N/A	N/A
	SED120	0	N/A	N/A	N/A	N/A

Beryllium, Total

	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
(ug/L, water)						
(mg/KG, sediments)	SW018	7	0.61	1.10	2.40	0.60
	SW043	3	0.23	0.73	1.00	0.60
	SW085	5	1.79	4.20	5.00	1.00
	SW086	14	26.17	9.30	100.00	0.60
	SW093	28	1.68	2.22	6.80	0.50
	SW102	5	42.98	23.18	100.00	1.00
	SW118	11	3.02	2.73	10.80	0.50
	SED118	5	0.30	0.80	1.20	0.44
	SED120	3	0.41	0.67	1.00	0.21

6 Cadmium, Dissolved

	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
(ug/L, water)						
(mg/KG, sediments)	SW018	4	0.97	3.25	4.60	2.40
	SW043	3	1.19	3.67	5.00	2.70
	SW085	5	1.34	4.40	5.00	2.00
	SW086	11	29.08	12.40	100.00	2.00
	SW093	12	1.40	3.18	5.00	2.00
	SW102	5	43.18	22.80	100.00	2.00
	SW118	5	0.54	2.78	3.30	2.00
	SED118	0	N/A	N/A	N/A	N/A
	SED120	0	N/A	N/A	N/A	N/A

Cadmium, Total

	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
(ug/L, water)						
(mg/KG, sediments)	SW018	2	0.42	3.00	3.30	2.70
	SW043	3	1.19	3.67	5.00	2.70
	SW085	5	1.34	4.40	5.00	2.00
	SW086	11	29.00	12.65	100.00	2.00
	SW093	18	1.41	3.59	5.80	2.00
	SW102	5	42.33	24.46	100.00	2.00
	SW118	7	2.74	4.00	9.80	2.00
	SED118	3	0.35	1.14	1.50	0.81
	SED120	3	0.72	1.08	1.90	0.56

TABLE 2.34
SUMMARY STATISTICS – SELECTED TRACE METALS, OU13 AREA
SURFACE–WATER AND SEDIMENT SITES

A. Trace Metals, Surface–Water Sites

7 Calcium, Dissolved

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	7	8748.85	77828.57	84000.00	59400.00
	SW043	3	6113.37	58366.67	64700.00	52500.00
	SW085	4	15786.60	59950.00	78000.00	40300.00
	SW086	13	18891.34	74946.15	106000.00	45100.00
	SW093	16	20798.75	82456.25	116000.00	41400.00
	SW102	5	27083.30	88500.00	128000.00	57500.00
	SW118	6	9453.34	57516.67	67200.00	46000.00
	SED118	0	N/A	N/A	N/A	N/A
	SED120	0	N/A	N/A	N/A	N/A

Calcium, Total

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	5	10962.12	79560.00	89000.00	60800.00
	SW043	3	1.19	3.67	5.00	2.70
	SW085	4	24904.27	71675.00	109000.00	57800.00
	SW086	13	17397.61	75000.00	94100.00	46200.00
	SW093	23	26448.16	63421.74	108000.00	24000.00
	SW102	5	29316.55	101700.00	137000.00	74400.00
	SW118	9	21121.89	56577.78	101000.00	25000.00
	SED118	4	2249.98	9082.50	12000.00	6800.00
	SED120	3	12839.70	11530.00	26300.00	3030.00

8 Cesium, Dissolved

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	7	238.78	308.57	500.00	50.00
	SW043	3	0.00	500.00	500.00	500.00
	SW085	4	1220.00	1890.00	2500.00	60.00
	SW086	13	1027.34	717.15	2500.00	50.00
	SW093	16	833.82	581.50	2500.00	50.00
	SW102	5	1074.20	579.40	2500.00	50.00
	SW118	6	214.49	321.00	500.00	50.00
	SED118	0	N/A	N/A	N/A	N/A
	SED120	0	N/A	N/A	N/A	N/A

Cesium, Total

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	5	244.68	232.00	500.00	50.00
	SW043	3	0.00	500.00	500.00	500.00
	SW085	4	1225.00	1887.50	2500.00	50.00
	SW086	13	1032.29	709.23	2500.00	50.00
	SW093	18	786.79	449.25	2500.00	0.50
	SW102	5	1074.20	579.40	2500.00	50.00
	SW118	9	216.47	233.22	500.00	1.00
	SED118	4	67.60	53.90	150.00	2.60
	SED120	3	56.42	68.20	103.00	3.10

TABLE 2.34
SUMMARY STATISTICS – SELECTED TRACE METALS, OU13 AREA
SURFACE–WATER AND SEDIMENT SITES

A. Trace Metals, Surface–Water Sites

9 Chromium, Dissolved

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	7	2.18	4.39	6.90	2.00
	SW043	3	1.67	5.93	6.90	4.00
	SW085	5	2.24	9.00	10.00	5.00
	SW086	13	25.86	14.63	100.00	2.20
	SW093	15	4.64	6.75	19.40	2.00
	SW102	5	41.32	26.20	100.00	5.00
	SW118	6	5.85	7.03	18.50	2.00
	SED118	0	N/A	N/A	N/A	N/A
	SED120	0	N/A	N/A	N/A	N/A

Chromium, Total

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	5	2.68	3.96	6.90	2.00
	SW043	3	1.67	5.93	6.90	4.00
	SW085	5	3.97	12.90	17.40	10.00
	SW086	13	29.41	19.36	100.00	2.00
	SW093	23	24.18	20.11	99.00	2.00
	SW102	5	40.53	35.40	100.00	6.00
	SW118	9	43.56	35.36	130.00	4.10
	SED118	4	1.73	9.03	11.30	7.40
	SED120	3	5.37	10.77	15.20	4.80

10 Cobalt, Dissolved

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	7	1.83	3.34	7.30	2.00
	SW043	3	0.50	3.53	4.00	3.00
	SW085	5	20.57	40.80	50.00	4.00
	SW086	13	31.16	25.57	100.00	2.00
	SW093	15	21.33	15.84	50.00	2.00
	SW102	5	39.93	41.60	100.00	4.00
	SW118	6	1.31	3.52	5.90	2.00
	SED118	0	N/A	N/A	N/A	N/A
	SED120	0	N/A	N/A	N/A	N/A

Cobalt, Total

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	5	0.74	2.52	3.60	2.00
	SW043	3	0.50	3.53	4.00	3.00
	SW085	5	20.57	40.80	50.00	4.00
	SW086	13	30.70	26.36	100.00	2.00
	SW093	23	17.66	15.99	53.00	2.00
	SW102	5	34.67	47.88	100.00	4.00
	SW118	9	27.68	18.96	87.10	3.00
	SED118	4	4.02	9.08	15.00	6.30
	SED120	3	3.72	5.70	9.60	2.20

TABLE 2.34
SUMMARY STATISTICS – SELECTED TRACE METALS, OU13 AREA
SURFACE–WATER AND SEDIMENT SITES

A. Trace Metals, Surface–Water Sites

11 Copper, Dissolved

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	7	4.07	4.83	13.60	2.00
	SW043	3	5.85	8.80	15.50	4.70
	SW085	5	8.94	21.00	25.00	5.00
	SW086	13	26.30	18.45	100.00	3.00
	SW093	15	9.88	9.26	25.00	2.00
	SW102	5	39.59	31.68	100.00	3.40
	SW118	6	4.28	5.33	13.80	2.00
	SED118	0	N/A	N/A	N/A	N/A
	SED120	0	N/A	N/A	N/A	N/A

Copper, Total

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	5	6.90	7.34	19.00	2.00
	SW043	3	0.74	5.27	6.10	4.70
	SW085	5	4.45	24.44	29.80	17.40
	SW086	13	26.64	23.14	100.00	3.00
	SW093	23	32.14	28.27	120.00	2.00
	SW102	5	44.29	51.96	100.00	9.80
	SW118	9	62.28	43.30	192.00	2.00
	SED118	4	11.54	18.70	35.90	11.10
	SED120	3	3.20	14.83	18.50	12.60

12 Iron, Dissolved

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	7	102.81	105.13	240.00	8.50
	SW043	3	90.27	146.00	204.00	42.00
	SW085	4	6.15	96.93	100.00	87.70
	SW086	13	308.95	186.37	1100.00	27.10
	SW093	16	223.46	192.89	750.00	6.00
	SW102	5	36.20	93.58	127.00	31.90
	SW118	6	27.53	65.17	97.00	20.60
	SED118	0	N/A	N/A	N/A	N/A
	SED120	0	N/A	N/A	N/A	N/A

Iron, Total

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	5	190.14	280.40	480.00	20.00
	SW043	3	455.75	924.33	1340.00	437.00
	SW085	5	6198.92	5656.00	13400.00	1030.00
	SW086	13	5962.58	3258.38	21800.00	27.00
	SW093	23	27358.87	16052.22	110000.00	488.00
	SW102	5	18393.56	11832.80	44400.00	344.00
	SW118	9	53371.81	35460.56	156000.00	149.00
	SED118	4	4925.44	14500.00	21700.00	10800.00
	SED120	3	5816.88	12306.67	16200.00	5620.00

TABLE 2.34
SUMMARY STATISTICS – SELECTED TRACE METALS, OU13 AREA
SURFACE–WATER AND SEDIMENT SITES

A. Trace Metals, Surface–Water Sites

13 Lead, Dissolved

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	7	0.52	1.37	2.40	0.90
	SW043	3	1.15	1.67	3.00	1.00
	SW085	5	17.15	10.16	40.80	1.00
	SW086	14	25.94	10.49	100.00	0.90
	SW093	15	25.41	8.23	100.00	0.40
	SW102	6	11.39	6.83	30.00	1.00
	SW118	6	0.26	1.23	1.50	1.00
	SED118	0	N/A	N/A	N/A	N/A
	SED120	0	N/A	N/A	N/A	N/A

Lead, Total

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	5	0.34	2.74	3.20	2.40
	SW043	3	0.78	2.20	2.70	1.30
	SW085	5	6.59	8.72	17.80	3.80
	SW086	14	13.36	9.74	50.00	0.80
	SW093	23	34.44	28.81	100.00	0.70
	SW102	6	34.46	20.17	90.20	3.00
	SW118	9	35.28	25.66	103.00	1.00
	SED118	4	3.29	16.68	21.60	14.90
	SED120	3	29.03	26.20	59.40	5.60

14 Lithium, Dissolved

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	7	1.21	6.36	8.10	4.30
	SW043	3	2.06	7.63	10.00	6.30
	SW085	4	43.30	78.35	100.00	13.40
	SW086	13	45.43	44.84	100.00	6.70
	SW093	16	41.22	42.24	100.00	3.70
	SW102	4	42.74	73.00	100.00	10.20
	SW118	6	5.17	11.85	20.00	7.40
	SED118	0	N/A	N/A	N/A	N/A
	SED120	0	N/A	N/A	N/A	N/A

Lithium, Total

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	5	1.67	7.22	8.40	4.30
	SW043	3	2.87	6.97	10.00	4.30
	SW085	4	36.10	81.95	100.00	27.80
	SW086	13	44.40	46.23	100.00	5.90
	SW093	18	34.65	33.02	100.00	0.50
	SW102	4	28.75	82.43	100.00	39.90
	SW118	9	24.58	26.76	84.50	7.40
	SED118	4	2.08	8.90	11.20	6.90
	SED120	3	6.47	8.77	15.70	2.90

TABLE 2.34
SUMMARY STATISTICS – SELECTED TRACE METALS, OU13 AREA
SURFACE–WATER AND SEDIMENT SITES

A. Trace Metals, Surface–Water Sites

15 Magnesium, Dissolved

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	7	1925.15	15257.14	17700.00	11500.00
	SW043	3	636.47	8910.00	9520.00	8250.00
	SW085	4	3729.09	10867.50	15600.00	6680.00
	SW086	13	2681.40	11168.46	15900.00	7310.00
	SW093	16	7269.39	18655.63	27100.00	10.00
	SW102	5	15813.76	24200.00	48000.00	10300.00
	SW118	6	2617.38	14633.33	17500.00	11000.00
	SED118	0	N/A	N/A	N/A	N/A
	SED120	0	N/A	N/A	N/A	N/A

Magnesium, Total

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	5	2413.92	15880.00	17700.00	11700.00
	SW043	3	594.05	9000.00	9550.00	8370.00
	SW085	4	3681.64	11527.50	17000.00	9090.00
	SW086	13	3735.44	12146.92	21300.00	7300.00
	SW093	23	6950.13	16176.96	31000.00	5770.00
	SW102	5	10055.94	25120.00	37900.00	14300.00
	SW118	9	11834.71	20255.56	50000.00	12000.00
	SED118	4	897.20	2935.00	4270.00	2400.00
	SED120	3	1023.13	2280.00	2920.00	1100.00

16 Manganese, Dissolved

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	7	37.43	147.86	204.00	100.00
	SW043	3	123.66	128.27	254.00	6.80
	SW085	5	98.97	59.06	236.00	9.80
	SW086	13	28.34	45.41	100.00	10.10
	SW093	16	414.43	555.66	1420.00	76.70
	SW102	5	41.32	26.96	100.00	1.10
	SW118	6	7.78	13.22	26.60	5.40
	SED118	0	N/A	N/A	N/A	N/A
	SED120	0	N/A	N/A	N/A	N/A

Manganese, Total

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	5	20.45	148.00	170.00	120.00
	SW043	3	192.72	188.73	408.00	46.20
	SW085	5	71.24	68.66	153.00	15.00
	SW086	13	75.20	75.73	281.00	14.20
	SW093	23	474.18	620.90	2100.00	87.80
	SW102	5	739.42	408.72	1730.00	38.70
	SW118	9	1195.51	721.74	3640.00	7.50
	SED118	4	111.63	315.00	457.00	210.00
	SED120	3	128.47	202.07	339.00	84.20

TABLE 2.34
SUMMARY STATISTICS – SELECTED TRACE METALS, OU13 AREA
SURFACE–WATER AND SEDIMENT SITES

A. Trace Metals, Surface–Water Sites

17 Mercury, Dissolved

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	7	0.00	0.20	0.20	0.20
	SW043	3	0.00	0.20	0.20	0.20
	SW085	5	0.08	0.26	0.34	0.20
	SW086	14	0.04	0.21	0.34	0.20
	SW093	14	0.11	0.20	0.54	0.10
	SW102	6	0.06	0.22	0.34	0.20
	SW118	6	0.00	0.20	0.20	0.20
	SED118	0	N/A	N/A	N/A	N/A
	SED120	0	N/A	N/A	N/A	N/A

Mercury, Total

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	5	0.00	0.20	0.20	0.20
	SW043	3	0.00	0.20	0.20	0.20
	SW085	5	0.07	0.26	0.34	0.20
	SW086	14	0.24	0.26	1.10	0.20
	SW093	21	0.08	0.21	0.40	0.10
	SW102	6	0.10	0.26	0.43	0.20
	SW118	9	0.07	0.22	0.41	0.20
	SED118	5	0.18	0.24	0.50	0.10
	SED120	3	0.04	0.12	0.16	0.08

18 Molybdenum, Dissolved

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	7	3.22	6.06	10.90	3.00
	SW043	3	2.36	8.70	10.90	6.20
	SW085	4	32.50	83.75	100.00	35.00
	SW086	13	45.84	45.81	100.00	2.20
	SW093	16	42.17	47.19	100.00	3.00
	SW102	4	47.10	60.45	100.00	6.80
	SW118	6	3.35	5.98	10.90	2.00
	SED118	0	N/A	N/A	N/A	N/A
	SED120	0	N/A	N/A	N/A	N/A

Molybdenum, Total

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	5	4.30	6.46	11.40	3.00
	SW043	3	2.63	8.53	10.90	5.70
	SW085	4	32.50	83.75	100.00	35.00
	SW086	13	46.64	44.22	100.00	2.00
	SW093	18	37.08	33.06	100.00	1.00
	SW102	4	47.10	60.45	100.00	6.80
	SW118	9	8.84	12.07	26.00	2.00
	SED118	4	2.75	3.42	7.20	0.66
	SED120	3	0.67	2.37	3.10	1.80

TABLE 2.34
SUMMARY STATISTICS – SELECTED TRACE METALS, OU13 AREA
SURFACE–WATER AND SEDIMENT SITES

A. Trace Metals, Surface–Water Sites

19 Nickel, Dissolved

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	7	4.37	8.03	14.70	3.90
	SW043	3	5.40	9.20	14.70	3.90
	SW085	5	15.21	33.20	40.00	6.00
	SW086	13	27.88	24.08	100.00	4.00
	SW093	15	15.36	15.93	40.00	4.00
	SW102	5	38.83	38.00	100.00	4.00
	SW118	6	5.27	8.42	14.70	3.90
	SED118	0	N/A	N/A	N/A	N/A
	SED120	0	N/A	N/A	N/A	N/A

Nickel, Total

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	5	4.73	7.52	14.70	3.90
	SW043	3	5.40	9.20	14.70	3.90
	SW085	5	11.45	34.88	40.00	14.40
	SW086	13	27.55	26.81	100.00	4.00
	SW093	23	24.58	25.63	100.00	4.00
	SW102	5	33.58	48.90	100.00	7.90
	SW118	9	58.06	42.27	183.00	3.90
	SED118	4	5.98	15.63	24.30	11.00
	SED120	3	8.55	11.10	19.70	2.60

20 Potassium, Dissolved

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	7	679.70	2792.86	4150.00	2100.00
	SW043	3	530.27	1537.00	2050.00	991.00
	SW085	4	953.50	17925.00	18900.00	16800.00
	SW086	13	489.90	5381.54	6200.00	4500.00
	SW093	15	790.00	3976.00	5000.00	2810.00
	SW102	5	3014.79	8560.00	11500.00	3720.00
	SW118	6	579.85	2215.00	3000.00	1460.00
	SED118	0	N/A	N/A	N/A	N/A
	SED120	0	N/A	N/A	N/A	N/A

Potassium, Total

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	5	1052.73	3280.00	4700.00	2000.00
	SW043	3	355.01	1693.33	2050.00	1340.00
	SW085	4	2575.53	17800.00	20700.00	15000.00
	SW086	13	998.22	5277.69	6710.00	2770.00
	SW093	23	3470.98	5552.17	18000.00	1620.00
	SW102	5	4902.88	10326.00	17000.00	4160.00
	SW118	9	5520.95	6022.22	17200.00	1700.00
	SED118	4	482.80	1425.00	2130.00	1050.00
	SED120	3	508.77	1373.67	1730.00	791.00

TABLE 2.34
SUMMARY STATISTICS – SELECTED TRACE METALS, OU13 AREA
SURFACE–WATER AND SEDIMENT SITES

A. Trace Metals, Surface–Water Sites

21 Selenium, Dissolved

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	7	1.49	2.41	4.00	1.10
	SW043	3	0.52	1.40	2.00	1.10
	SW085	5	0.89	4.60	5.00	3.00
	SW086	14	2.91	4.96	10.00	2.00
	SW093	16	4.95	4.89	18.40	1.00
	SW102	6	3.43	5.83	10.00	2.00
	SW118	6	1.18	1.72	4.00	1.00
	SED118	0	N/A	N/A	N/A	N/A
	SED120	0	N/A	N/A	N/A	N/A

Selenium, Total

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	5	1.59	2.84	4.00	1.10
	SW043	3	0.52	1.40	2.00	1.10
	SW085	5	0.89	4.60	5.00	3.00
	SW086	14	3.11	4.72	10.00	1.30
	SW093	23	4.83	3.97	20.00	1.00
	SW102	6	4.71	7.83	15.00	2.00
	SW118	9	4.50	3.26	15.00	1.00
	SED118	4	0.27	0.60	0.94	0.32
	SED120	3	0.17	0.43	0.61	0.28

22 Silicon, Dissolved

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	7	1056.28	6154.29	7480.00	4450.00
	SW043	2	417.19	7865.00	8160.00	7570.00
	SW085	1	N/A	3000.00	3000.00	3000.00
	SW086	5	818.15	5742.00	6640.00	4430.00
	SW093	8	1277.45	5930.00	7450.00	3720.00
	SW102	0	N/A	N/A	N/A	N/A
	SW118	6	1353.06	4861.67	6140.00	2590.00
	SED118	0	N/A	N/A	N/A	N/A
	SED120	0	N/A	N/A	N/A	N/A

Silicon, Total

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	3	595.34	5463.33	5920.00	4790.00
	SW043	2	940.45	8305.00	8970.00	7640.00
	SW085	1	N/A	4380.00	4380.00	4380.00
	SW086	3	591.02	5280.00	5960.00	4890.00
	SW093	5	1970.16	6132.00	9070.00	4110.00
	SW102	0	N/A	N/A	N/A	N/A
	SW118	0	N/A	N/A	N/A	N/A
	SED118	2	197.99	1180.00	1320.00	1040.00
	SED120	2	243.24	643.00	815.00	471.00

TABLE 2.34
SUMMARY STATISTICS – SELECTED TRACE METALS, OU13 AREA
SURFACE–WATER AND SEDIMENT SITES

A. Trace Metals, Surface–Water Sites

23 Silver, Dissolved

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	7	1.78	3.93	6.80	2.00
	SW043	3	1.01	3.93	5.00	3.00
	SW085	5	1.79	9.20	10.00	6.00
	SW086	13	26.21	13.36	100.00	2.00
	SW093	15	3.16	5.49	10.00	2.00
	SW102	5	41.72	25.60	100.00	2.00
	SW118	6	1.61	4.22	6.50	2.00
	SED118	0	N/A	N/A	N/A	N/A
	SED120	0	N/A	N/A	N/A	N/A

Silver, Total

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	5	1.51	3.56	5.00	2.00
	SW043	3	1.01	3.93	5.00	3.00
	SW085	5	45.65	29.40	111.00	6.00
	SW086	5	2.23	4.24	7.20	2.00
	SW093	23	2.56	4.84	10.00	2.00
	SW102	5	41.41	26.06	100.00	4.30
	SW118	9	1.30	3.76	5.00	2.00
	SED118	4	0.87	1.49	2.30	0.44
	SED120	3	1.40	1.49	3.10	0.59

24 Sodium, Dissolved

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	7	3831.01	30300.00	37100.00	26000.00
	SW043	3	1320.35	18833.33	20000.00	17400.00
	SW085	4	115788.77	160400.00	334000.00	97600.00
	SW086	13	7490.42	40484.62	53700.00	27000.00
	SW093	16	14029.54	44700.00	84800.00	22000.00
	SW102	5	63693.08	116660.00	219000.00	58300.00
	SW118	6	4941.93	34566.67	41400.00	30000.00
	SED118	0	N/A	N/A	N/A	N/A
	SED120	0	N/A	N/A	N/A	N/A

Sodium, Total

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	5	2941.43	32280.00	36800.00	29000.00
	SW043	3	896.29	18833.33	19400.00	17800.00
	SW085	4	100052.43	145075.00	295000.00	90000.00
	SW086	13	7305.66	40446.15	50600.00	28300.00
	SW093	23	18244.69	32330.43	87400.00	8800.00
	SW102	5	49691.87	107180.00	181000.00	60200.00
	SW118	9	11481.40	31800.00	51100.00	16000.00
	SED118	4	109.31	288.75	402.00	150.00
	SED120	3	317.67	401.67	742.00	113.00

TABLE 2.34
SUMMARY STATISTICS – SELECTED TRACE METALS, OU13 AREA
SURFACE–WATER AND SEDIMENT SITES

A. Trace Metals, Surface–Water Sites

25 Strontium, Dissolved

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	7	51.82	432.57	480.00	336.00
	SW043	3	3.46	236.00	238.00	232.00
	SW085	4	110.45	381.25	525.00	263.00
	SW086	13	82.67	342.92	492.00	211.00
	SW093	16	243.71	590.25	1000.00	243.00
	SW102	5	329.46	667.80	1070.00	343.00
	SW118	6	59.43	360.83	422.00	289.00
	SED118	0	N/A	N/A	N/A	N/A
	SED120	0	N/A	N/A	N/A	N/A

Strontium, Total

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	5	58.97	440.00	480.00	336.00
	SW043	3	1.53	237.67	239.00	236.00
	SW085	4	114.61	402.50	570.00	321.00
	SW086	13	91.65	356.38	531.00	211.00
	SW093	18	237.05	428.36	1000.00	0.50
	SW102	5	221.36	681.00	980.00	425.00
	SW118	9	149.59	389.00	739.00	190.00
	SED118	4	16.62	49.88	74.80	41.00
	SED120	3	23.29	40.17	64.80	18.50

26 Thallium, Dissolved

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	7	1.39	2.19	5.00	1.00
	SW043	3	0.35	1.60	2.00	1.40
	SW085	5	4.02	8.20	10.00	1.00
	SW086	14	3.90	5.86	10.00	1.00
	SW093	15	4.48	5.20	15.00	0.60
	SW102	5	4.44	6.80	10.00	1.00
	SW118	6	5.46	3.87	15.00	1.40
	SED118	0	N/A	N/A	N/A	N/A
	SED120	0	N/A	N/A	N/A	N/A

Thallium, Total

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	5	1.27	1.76	4.00	1.00
	SW043	3	0.35	1.60	2.00	1.40
	SW085	5	4.02	8.20	10.00	1.00
	SW086	14	4.23	5.34	10.00	1.00
	SW093	23	2.94	2.84	10.00	1.00
	SW102	5	4.44	6.80	10.00	1.00
	SW118	9	0.77	1.80	3.00	1.00
	SED118	4	0.48	0.69	1.40	0.41
	SED120	3	0.17	0.43	0.61	0.28

TABLE 2.34
SUMMARY STATISTICS – SELECTED TRACE METALS, OU13 AREA
SURFACE–WATER AND SEDIMENT SITES

A. Trace Metals, Surface–Water Sites

27 Tin, Dissolved

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	7	10.49	19.24	38.90	10.40
	SW043	3	3.35	26.13	30.00	24.20
	SW085	4	37.50	81.25	100.00	25.00
	SW086	13	40.61	51.39	100.00	11.00
	SW093	16	38.97	44.69	100.00	11.00
	SW102	4	40.89	64.73	100.00	25.00
	SW118	6	6.49	16.15	24.20	7.00
	SED118	0	N/A	N/A	N/A	N/A
	SED120	0	N/A	N/A	N/A	N/A

Tin, Total

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	5	6.55	17.08	24.20	11.00
	SW043	3	3.35	26.13	30.00	24.20
	SW085	4	37.50	81.25	100.00	25.00
	SW086	13	39.70	53.52	100.00	11.00
	SW093	18	31.81	33.65	100.00	2.00
	SW102	4	40.62	65.00	100.00	25.00
	SW118	9	27.14	31.09	94.60	12.00
	SED118	4	9.51	11.58	24.90	2.90
	SED120	3	3.13	3.66	5.90	0.08

28 Vanadium, Dissolved

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	7	1.99	3.21	6.50	2.00
	SW043	3	1.91	3.57	5.70	2.00
	SW085	5	19.68	41.20	50.00	6.00
	SW086	13	30.51	26.46	100.00	2.00
	SW093	15	20.61	17.13	50.00	2.00
	SW102	5	38.67	42.68	100.00	6.00
	SW118	6	2.50	4.43	8.20	2.00
	SED118	0	N/A	N/A	N/A	N/A
	SED120	0	N/A	N/A	N/A	N/A

Vanadium, Total

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	5	1.65	2.74	5.70	2.00
	SW043	3	2.03	4.33	5.70	2.00
	SW085	5	6.85	51.40	62.80	44.20
	SW086	13	30.03	29.20	100.00	2.10
	SW093	23	59.65	44.87	250.00	3.90
	SW102	5	49.65	70.58	140.00	12.90
	SW118	9	106.61	78.21	305.00	2.00
	SED118	4	9.78	27.93	42.40	21.20
	SED120	3	13.01	26.43	37.90	12.30

TABLE 2.34
SUMMARY STATISTICS – SELECTED TRACE METALS, OU13 AREA
SURFACE–WATER AND SEDIMENT SITES

A. Trace Metals, Surface–Water Sites

29 Zinc, Dissolved

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	7	8.15	13.89	27.00	4.30
	SW043	3	16.98	23.47	42.60	10.20
	SW085	5	30.25	29.58	82.50	5.40
	SW086	13	40.15	59.54	120.00	7.10
	SW093	16	70.13	42.77	297.00	3.00
	SW102	5	143.76	130.20	349.00	16.80
	SW118	6	101.76	50.38	258.00	3.30
	SED118	0	N/A	N/A	N/A	N/A
	SED120	0	N/A	N/A	N/A	N/A

Zinc, Total

(ug/L, water) (mg/KG, sediments)	Sampling Site	No. of Samples	Std Deviation	Mean	Maximum	Minimum
	SW018	5	8.31	16.42	24.60	5.00
	SW043	3	23.85	23.57	50.60	5.50
	SW085	5	39.11	130.14	169.00	71.70
	SW086	13	420.15	335.95	1540.00	7.20
	SW093	9	416.65	274.52	1260.00	4.30
	SW102	5	1734.35	1200.46	4240.00	41.30
	SW118	9	416.65	274.52	1260.00	4.30
	SED118	5	21.76	77.78	111.00	57.60
	SED120	3	29.71	81.47	102.00	47.40

TABLE 2.35
SUMMARY STATISTICS – SELECTED RADIONUCLIDES, OU8 AREA
SURFACE–WATER AND SEDIMENT SITES

GROSS ALPHA – DISSOLVED

	Sampling Site	No. of Samples	Std. Deviation	Mean	Maximum	Minimum
(pCi/l – Water)	SW018	2	2.67	4.81	6.70	2.92
(pCi/g – Sediment)	SW043	0	N/A	N/A	N/A	N/A
	SW056	12	4.31	5.24	16.12	0.14
	SW059	7	7.67	9.11	21.00	–0.30
	SW084	5	1.58	4.84	6.78	2.95
	SW085	1	N/A	2.89	2.89	2.89
	SW086	5	0.91	3.17	4.20	1.90
	SW093	6	5.68	8.00	18.86	3.81
	SW102	1	N/A	26.42	26.42	26.42
	SW118	8	26.74	14.83	79.00	–0.08
	SW122	4	2.79	3.48	7.52	1.18
	SW124	0	N/A	N/A	N/A	N/A
	SED011	7	13.81	12.09	36.00	0.06
	SED118	5	9.07	12.17	28.00	5.21
	SED120	3	3.55	5.94	9.55	2.46
	SED124	2	3.43	11.89	14.32	9.47

GROSS ALPHA – TOTAL

	Sampling Site	No. of Samples	Std. Deviation	Mean	Maximum	Minimum
(pCi/l – Water)	SW018	0	N/A	N/A	N/A	N/A
(pCi/g – Sediment)	SW043	0	N/A	N/A	N/A	N/A
	SW056	8	2.92	3.55	6.91	–0.02
	SW059	3	2.16	7.13	9.60	5.64
	SW084	3	2.16	4.65	6.50	2.27
	SW085	1	N/A	20.94	20.94	20.94
	SW086	5	2.85	5.09	8.91	1.92
	SW093	9	23.48	19.79	74.97	3.71
	SW102	2	53.08	48.76	86.29	11.23
	SW118	3	18.49	11.80	33.12	0.05
	SW122	1	N/A	2.43	2.43	2.43
	SW124	0	N/A	N/A	N/A	N/A
	SED011	0	N/A	N/A	N/A	N/A
	SED118	0	N/A	N/A	N/A	N/A
	SED120	0	N/A	N/A	N/A	N/A
	SED124	0	N/A	N/A	N/A	N/A

TABLE 2.35
SUMMARY STATISTICS – SELECTED RADIONUCLIDES, OU8 AREA
SURFACE–WATER AND SEDIMENT SITES

GROSS BETA – DISSOLVED

	Sampling Site	No. of Samples	Std. Deviation	Mean	Maximum	Minimum
(pCi/l – Water)	SW018	2	3.95	8.95	11.74	6.16
(pCi/g – Sediment)	SW043	0	N/A	N/A	N/A	N/A
	SW056	12	3.28	5.88	12.29	–0.63
	SW059	7	4.09	5.53	13.00	0.50
	SW084	5	2.40	6.36	10.58	4.78
	SW085	1	N/A	4.91	4.91	4.91
	SW086	5	1.54	5.33	7.10	3.87
	SW093	6	3.31	10.21	13.52	4.70
	SW102	1	N/A	24.70	24.70	24.70
	SW118	8	36.57	20.51	110.00	2.50
	SW122	4	3.70	5.65	9.94	1.83
	SW124	0	N/A	N/A	N/A	N/A
	SED011	7	12.49	18.54	32.00	–0.30
	SED118	5	6.20	27.40	37.00	19.79
	SED120	3	124.67	96.45	240.40	23.88
	SED124	2	4.90	29.48	32.94	26.01

GROSS BETA – TOTAL

	Sampling Site	No. of Samples	Std. Deviation	Mean	Maximum	Minimum
(pCi/l – Water)	SW018	0	N/A	N/A	N/A	N/A
(pCi/g – Sediment)	SW043	0	N/A	N/A	N/A	N/A
	SW056	7	3.19	4.24	8.18	–0.28
	SW059	3	2.42	9.10	11.88	7.44
	SW084	2	2.66	7.91	9.79	6.03
	SW085	1	N/A	7.18	7.18	7.18
	SW086	4	2.41	9.74	12.20	7.18
	SW093	6	31.26	24.89	87.83	8.83
	SW102	1	N/A	21.56	21.56	21.56
	SW118	3	15.16	14.04	30.99	1.79
	SW122	1	N/A	8.44	8.44	8.44
	SW124	0	N/A	N/A	N/A	N/A
	SED011	0	N/A	N/A	N/A	N/A
	SED118	0	N/A	N/A	N/A	N/A
	SED120	0	N/A	N/A	N/A	N/A
	SED124	0	N/A	N/A	N/A	N/A

TABLE 2.36
SUMMARY STATISTICS – SELECTED WATER QUALITY PARAMETERS, OU8
SURFACE–WATER AND SEDIMENT SITES

Nitrate/Nitrite

SW = mg/l SED = mg/kg	Sampling Site	No. of Samples	Std. Deviation	Mean	Maximum	Minimum
	SW018	8	0.48	1.60	2.10	0.89
	SW043	5	8.32	7.67	22.14	2.10
	SW085	15	71.31	71.82	247.91	15.00
	SW093	44	2.17	1.84	8.3	0.02
	SW102	9	19.15	18.61	68.62	4.80
	SW118	13	0.61	0.45	1.80	0.02
	SED118	5	1.89	3.46	6.30	1.40
	SED120	3	79.85	77.30	163.00	5.00

Orthophosphate

SW = mg/l SED = N/A	Sampling Site	No. of Samples	Std. Deviation	Mean	Maximum	Minimum
	SW018	7	0.01	0.05	0.05	0.02
	SW043	2	0.00	0.05	0.05	0.05
	SW085	0	N/A	N/A	N/A	N/A
	SW093	12	0.02	0.04	0.07	0.01
	SW102	1	N/A	0.04	0.04	0.04
	SW118	10	0.02	0.03	0.05	0.01
	SED118	0	N/A	N/A	N/A	N/A
	SED120	0	N/A	N/A	N/A	N/A

Phosphate

SW = mg/l SED = N/A	Sampling Site	No. of Samples	Std. Deviation	Mean	Maximum	Minimum
	SW018	0	N/A	N/A	N/A	N/A
	SW043	2	0.03	0.04	0.06	0.02
	SW085	0	N/A	N/A	N/A	N/A
	SW093	11	0.25	0.12	0.84	0.01
	SW102	1	N/A	0.18	0.18	0.18
	SW118	4	0.01	0.02	0.04	0.01
	SED118	0	N/A	N/A	N/A	N/A
	SED120	0	N/A	N/A	N/A	N/A

Phosphorus

SW = mg/l SED = N/A	Sampling Site	No. of Samples	Std. Deviation	Mean	Maximum	Minimum
	SW018	8	0.28	0.17	0.74	0.05
	SW043	2	0.01	0.06	0.07	0.05
	SW085	0	N/A	N/A	N/A	N/A
	SW093	10	0.33	0.18	1.1	0.01
	SW102	0	N/A	N/A	N/A	N/A
	SW118	7	0.01	0.05	0.06	0.04
	SED118	0	N/A	N/A	N/A	N/A
	SED120	0	N/A	N/A	N/A	N/A

CBOD5

SW = mg/l SED = N/A	Sampling Site	No. of Samples	Std. Deviation	Mean	Maximum	Minimum
	SW018	4	0.52	6.28	6.90	5.80
	SW043	4	14.50	16.65	29.50	3.80
	SW085	0	N/A	N/A	N/A	N/A
	SW093	2	0.07	7.55	7.6	7.5
	SW102	0	N/A	N/A	N/A	N/A
	SW118	3	0.57	5.37	6.00	4.90
	SED118	0	N/A	N/A	N/A	N/A
	SED120	0	N/A	N/A	N/A	N/A

TABLE 2.36
SUMMARY STATISTICS – SELECTED WATER QUALITY PARAMETERS, OU8
SURFACE–WATER AND SEDIMENT SITES

Total Organic Carbon

SW = mg/l SED = N/A	Sampling Site	No. of Samples	Std. Deviation	Mean	Maximum	Minimum
	SW018	7	0.91	3.70	4.60	2.00
	SW043	4	0.41	3.50	3.90	3.10
	SW085	0	N/A	N/A	N/A	N/A
	SW093	6	1.19	4.08	5.3	3
	SW102	0	N/A	N/A	N/A	N/A
	SW118	3	0.42	4.43	4.90	4.10
	SED118	0	N/A	N/A	N/A	N/A
	SED120	0	N/A	N/A	N/A	N/A

Oil and Grease

SW = mg/l SED = N/A	Sampling Site	No. of Samples	Std. Deviation	Mean	Maximum	Minimum
	SW018	6	2.62	7.30	12.20	5.30
	SW043	3	1.03	5.87	7.00	5.00
	SW085	11	96.40	30.36	321.00	1.00
	SW093	14	3.43	3.66	11.6	0.3
	SW102	8	154.48	56.74	439.00	1.00
	SW118	8	3.25	5.53	8.20	0.30
	SED118	0	N/A	N/A	N/A	N/A
	SED120	0	N/A	N/A	N/A	N/A

Bicarbonate as CaCO3

SW = mg/l SED = mg/kg	Sampling Site	No. of Samples	Std. Deviation	Mean	Maximum	Minimum
	SW018	6	54.28	227.33	288.00	145.00
	SW043	3	44.66	163.33	210.00	121.00
	SW085	11	226.32	342.73	1000.00	130.00
	SW093	16	107.76	171.88	310	50
	SW102	8	82.83	253.00	410.00	120.00
	SW118	13	74.85	154.00	250.00	57.00
	SED118	0	N/A	N/A	N/A	N/A
	SED120	1	N/A	270.00	270.00	270.00

Sulfate

SW = mg/l SED = N/A	Sampling Site	No. of Samples	Std. Deviation	Mean	Maximum	Minimum
	SW018	6	4.24	34.50	40.20	29.00
	SW043	4	15.80	40.75	54.00	18.00
	SW085	11	18.22	54.18	95.00	28.00
	SW093	26	24.26	34.96	120	8
	SW102	8	49.62	118.25	219.00	61.00
	SW118	13	6.39	17.88	29.00	9.00
	SED118	0	N/A	N/A	N/A	N/A
	SED120	0	N/A	N/A	N/A	N/A

Chloride

SW = mg/l SED = N/A	Sampling Site	No. of Samples	Std. Deviation	Mean	Maximum	Minimum
	SW018	5	10.79	54.24	67.00	40.30
	SW043	4	6.17	22.23	26.00	13.00
	SW085	11	22.78	43.09	85.00	10.00
	SW093	26	31.56	40.37	160	8
	SW102	8	38.37	74.41	142.00	22.00
	SW118	13	23.42	38.57	83.00	17.00
	SED118	0	N/A	N/A	N/A	N/A
	SED120	0	N/A	N/A	N/A	N/A

TABLE 2.36
SUMMARY STATISTICS – SELECTED WATER QUALITY PARAMETERS, OU8
SURFACE–WATER AND SEDIMENT SITES

Fluoride, Soluble

SW = mg/l SED = N/A	Sampling Site	No. of Samples	Std. Deviation	Mean	Maximum	Minimum
	SW018	6	0.06	0.54	0.64	0.48
	SW043	3	0.04	0.31	0.36	0.28
	SW085	0	N/A	N/A	N/A	N/A
	SW093	7	0.09	0.47	0.6	0.36
	SW102	2	0.04	0.77	0.80	0.74
	SW118	6	0.05	0.46	0.53	0.39
	SED118	0	N/A	N/A	N/A	N/A
	SED120	0	N/A	N/A	N/A	N/A

Total Dissolved Solids

SW = mg/l SED = N/A	Sampling Site	No. of Samples	Std. Deviation	Mean	Maximum	Minimum
	SW018	6	19.09	369.00	396.00	350.00
	SW043	4	85.09	339.50	450.00	258.00
	SW085	11	300.97	737.27	1500.00	440.00
	SW093	26	176.62	316.88	680	100
	SW102	7	191.17	574.14	910.00	290.00
	SW118	13	89.19	259.08	372.00	130.00
	SED118	0	N/A	N/A	N/A	N/A
	SED120	0	N/A	N/A	N/A	N/A

Specific Conductivity

SW = umho SED = N/A	Sampling Site	No. of Samples	Std. Deviation	Mean	Maximum	Minimum
	SW018	0	N/A	N/A	N/A	N/A
	SW043	0	N/A	N/A	N/A	N/A
	SW085	1	N/A	1630.00	1630.00	1630.00
	SW093	0	N/A	N/A	N/A	N/A
	SW102	1	N/A	1019.00	1019.00	1019.00
	SW118	0	N/A	N/A	N/A	N/A
	SED118	0	N/A	N/A	N/A	N/A
	SED120	0	N/A	N/A	N/A	N/A

TABLE 2.37
IHSS CLUSTERS AND CONSTITUENTS FOR SURFACE-WATER AND SEDIMENT ANALYSIS

Cluster No.	IHSSs	Constituents	Water Shed
I	135	A,B,C	North Walnut Creek
	150.2	A	North Walnut Creek
	150.7	A	North Walnut Creek
	151	D	North Walnut Creek
	188	C	North Walnut Creek
Total		A,B,C,&D	
II	118.1	D	North Walnut Creek
	137	B	North Walnut Creek
	138	A,B,C	North Walnut Creek
	139.1 (N)	B	North Walnut Creek
	139.1 (S)	B	North Walnut Creek
	139.2	C	North Walnut Creek
	144	A	North Walnut Creek
	150.1	A	North Walnut Creek
	150.3	A	North Walnut Creek
	150.6	A	North Walnut Creek
	150.7	A	North Walnut Creek
	150.8	A	North Walnut Creek
	163.1	A,C,D	North Walnut Creek
	163.2	A	North Walnut Creek
Total		A,B,C,&D	
III	118.2	D	South Walnut Creek
	123.1	A	South Walnut Creek
	150.4	A	South Walnut Creek
	150.7	A	South Walnut Creek
	172	A,D	South Walnut Creek
	173	A,D	South Walnut Creek
	184	A	South Walnut Creek
Total		A,D	

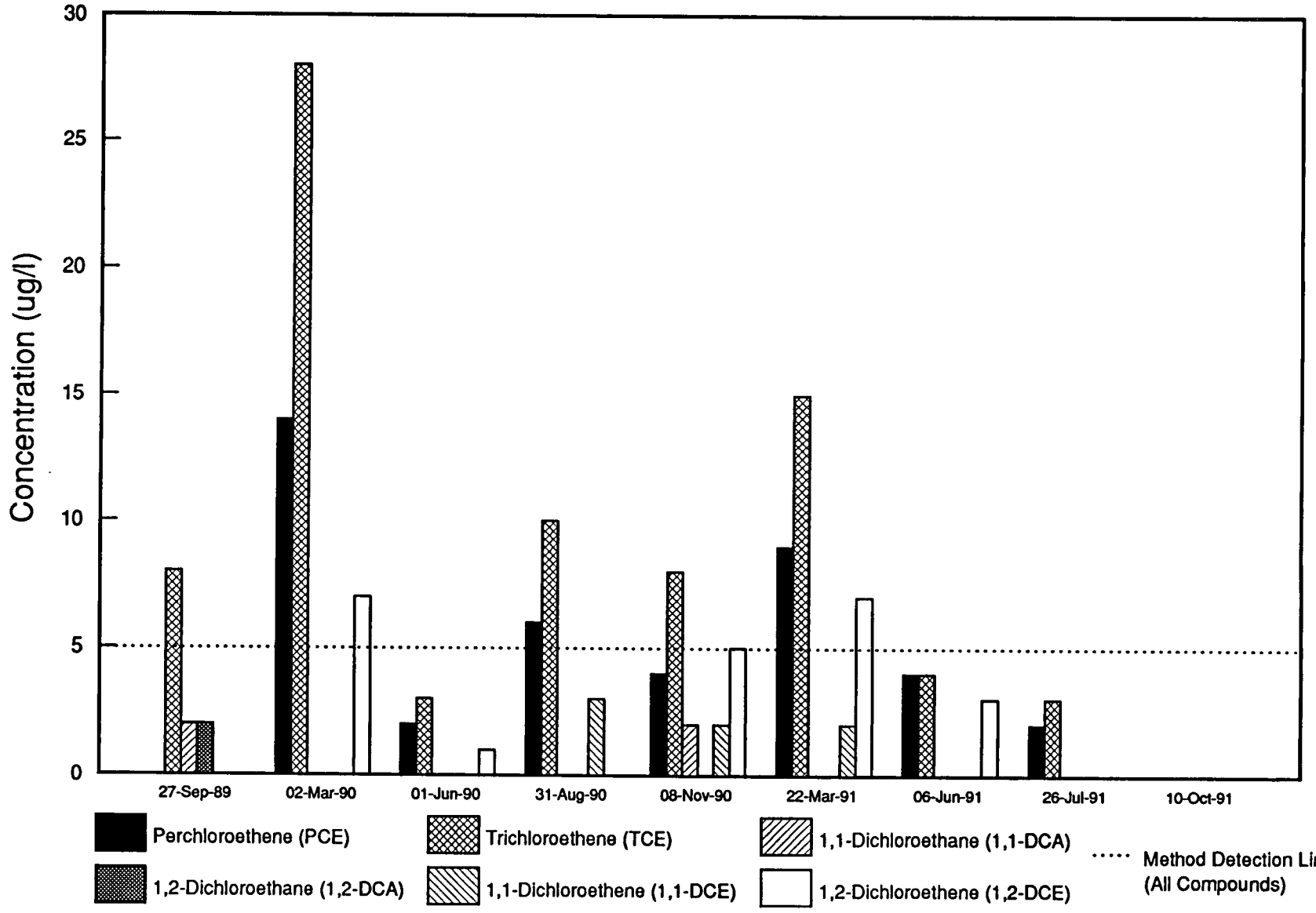


FIGURE 2-3

VOLATILE ORGANIC COMPOUNDS IN GROUNDWATER SAMPLES FROM WELL P209189

OPERABLE UNIT NO. 8
PHASE I RFI/RI WORK PLAN
U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant, Golden, Colorado

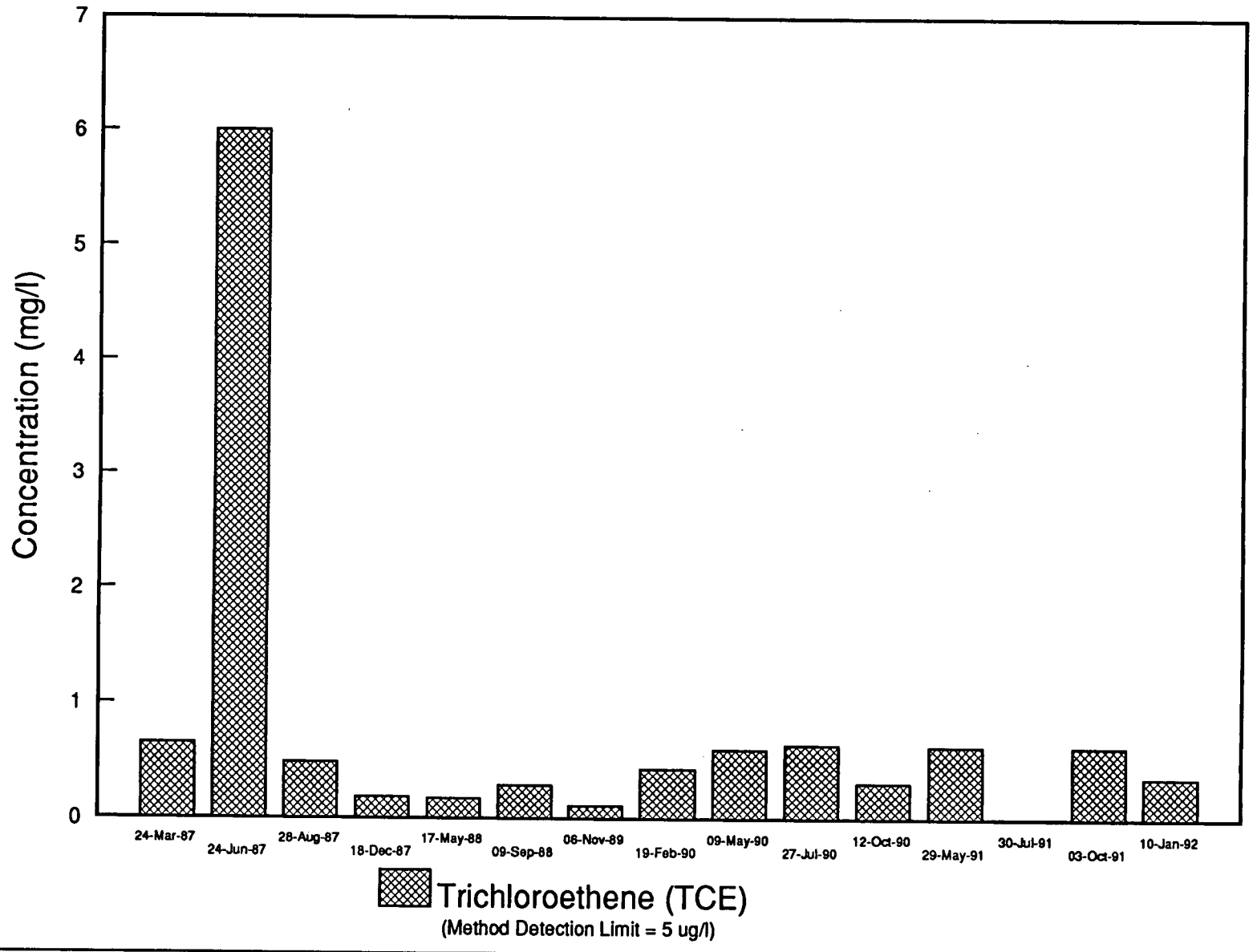


FIGURE 2-4

TRICHLOROETHENE CONCENTRATIONS IN GROUNDWATER SAMPLES FROM WELL 2286

OPERABLE UNIT NO. 8
PHASE I RFI/RI WORK PLAN
U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant, Golden, Colorado

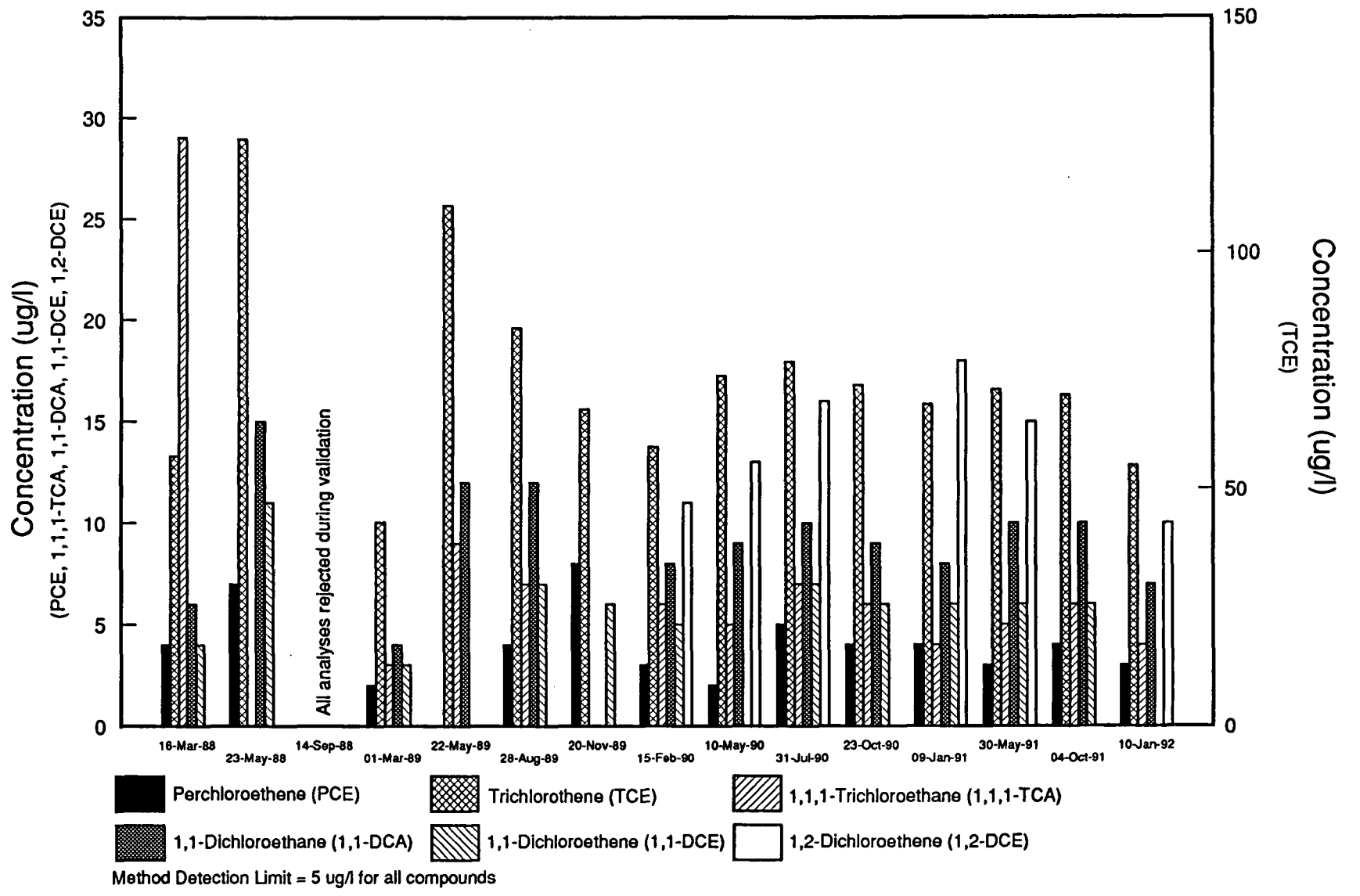


FIGURE 2-5

VOLATILE ORGANIC COMPOUNDS IN GROUNDWATER SAMPLES FROM WELL 5687

OPERABLE UNIT NO. 8
PHASE I RFI/RI WORK PLAN
U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant, Golden, Colorado

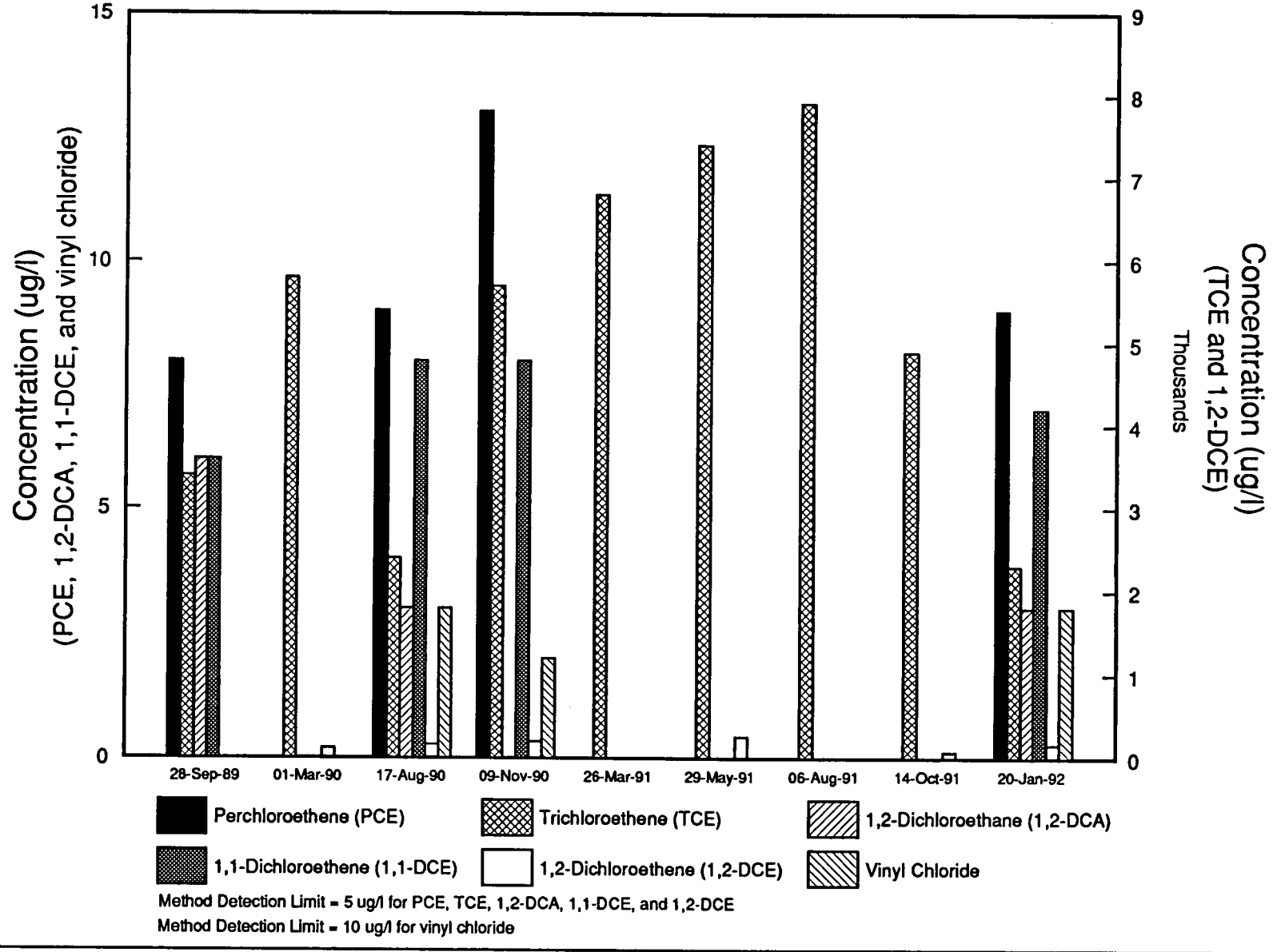


FIGURE 2-6

VOLATILE ORGANIC COMPOUNDS IN GROUNDWATER SAMPLES FROM WELL P210189

OPERABLE UNIT NO. 8
PHASE I RFI/RI WORK PLAN
U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant, Golden, Colorado

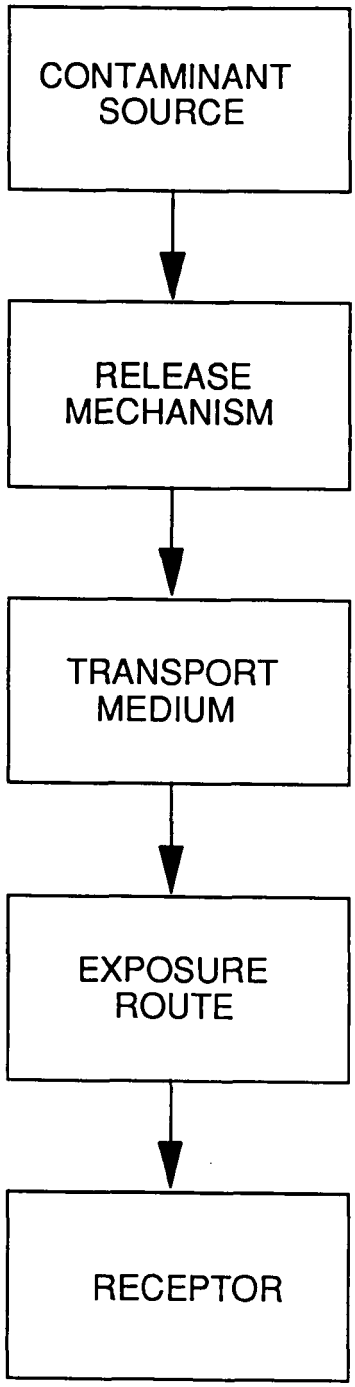


FIGURE 2.5 - 1
COMPONENTS OF A COMPLETED EXPOSURE PATHWAY

OPERABLE UNIT NO. 8
PHASE I RFI/RI WORK PLAN
U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant, Golden, Colorado

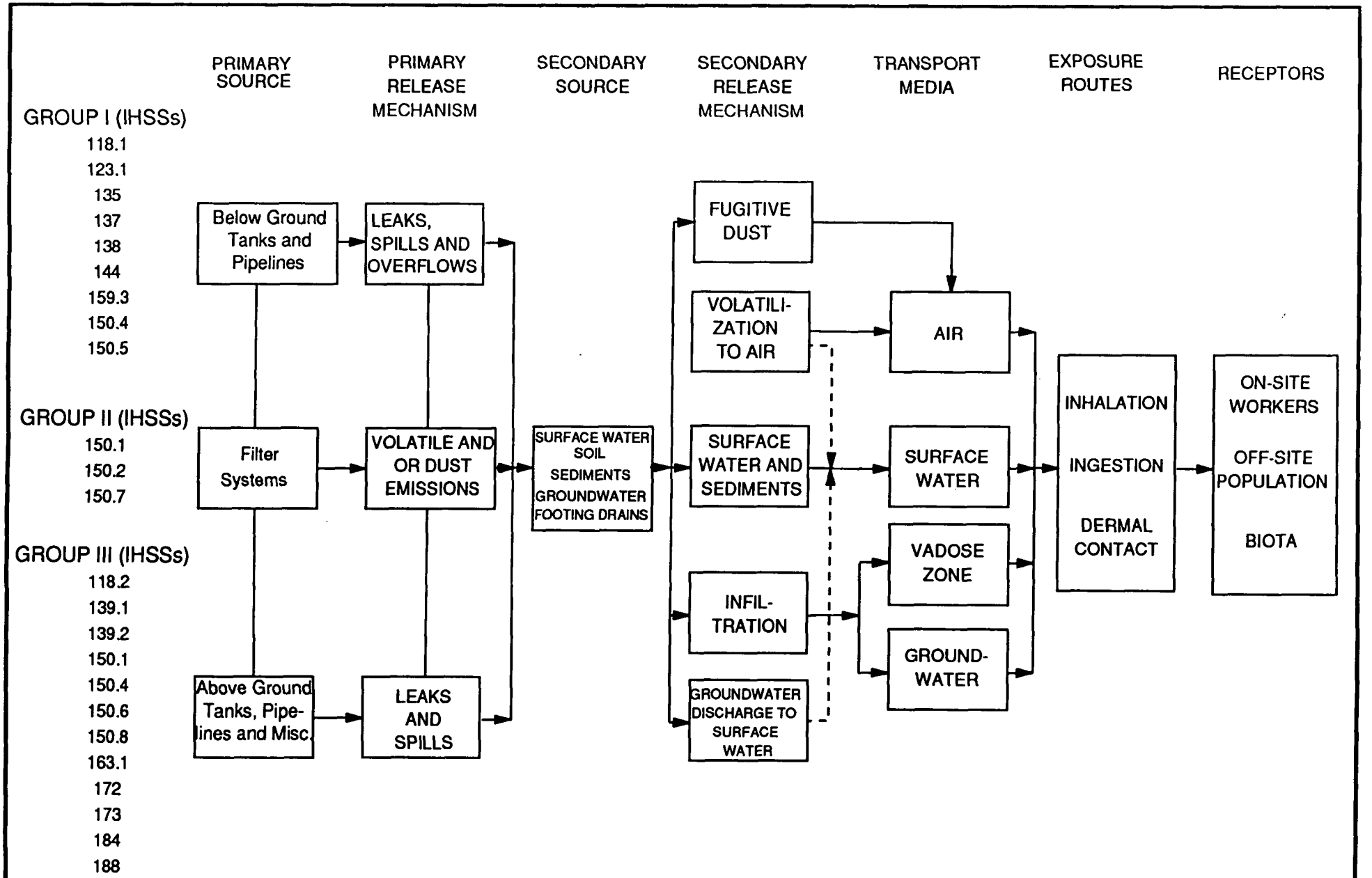


FIGURE 2.5-2

CONCEPTUAL MODEL FLOW CHART

OPERABLE UNIT NO. 8
PHASE I RFI/RI WORK PLAN
U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant, Golden, Colorado

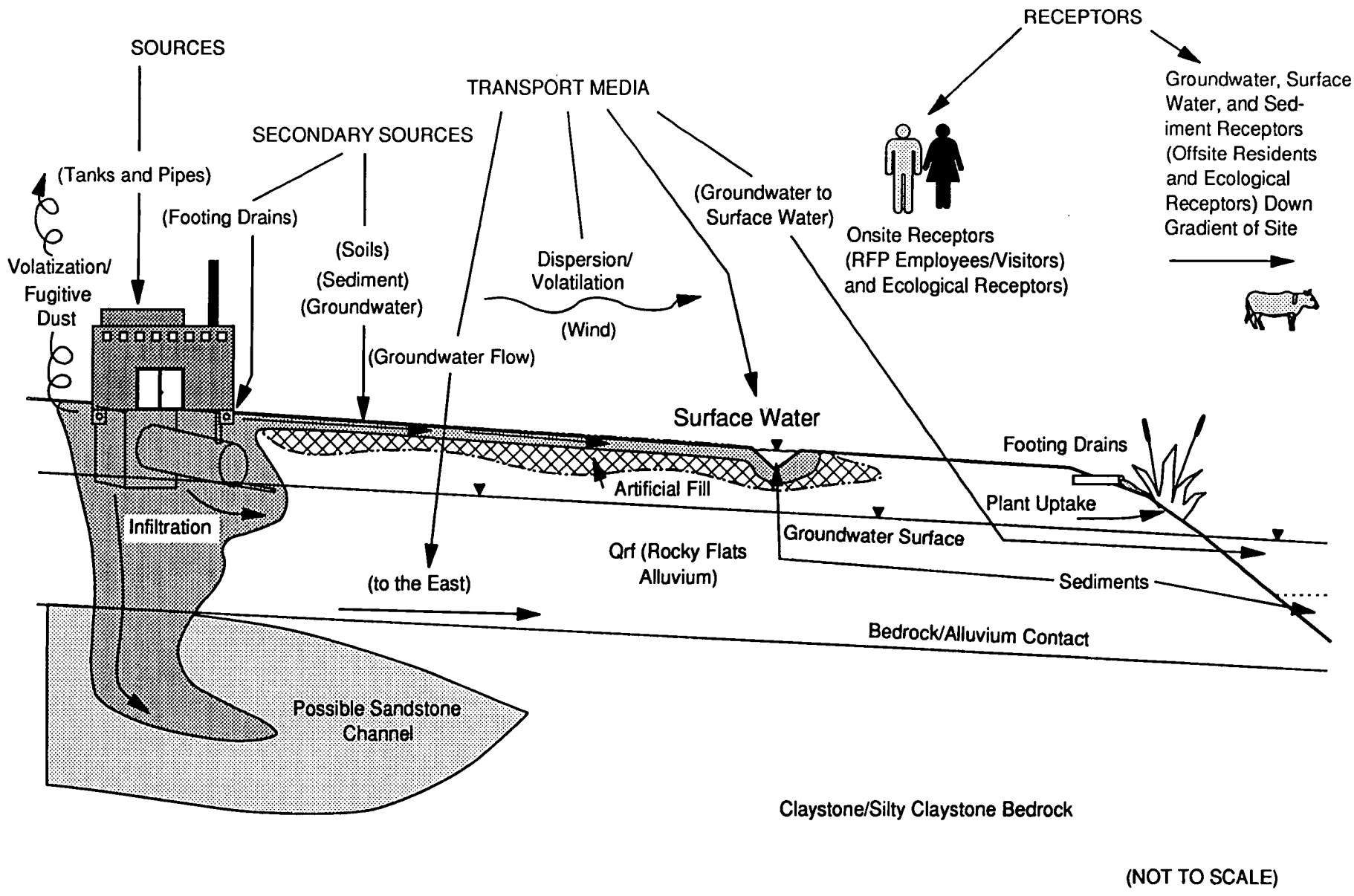


FIGURE 2.5-3

GROUP I - CONCEPTUAL MODEL

OPERABLE UNIT NO. 8
PHASE I RFI/RI WORK PLAN
U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant, Golden, Colorado

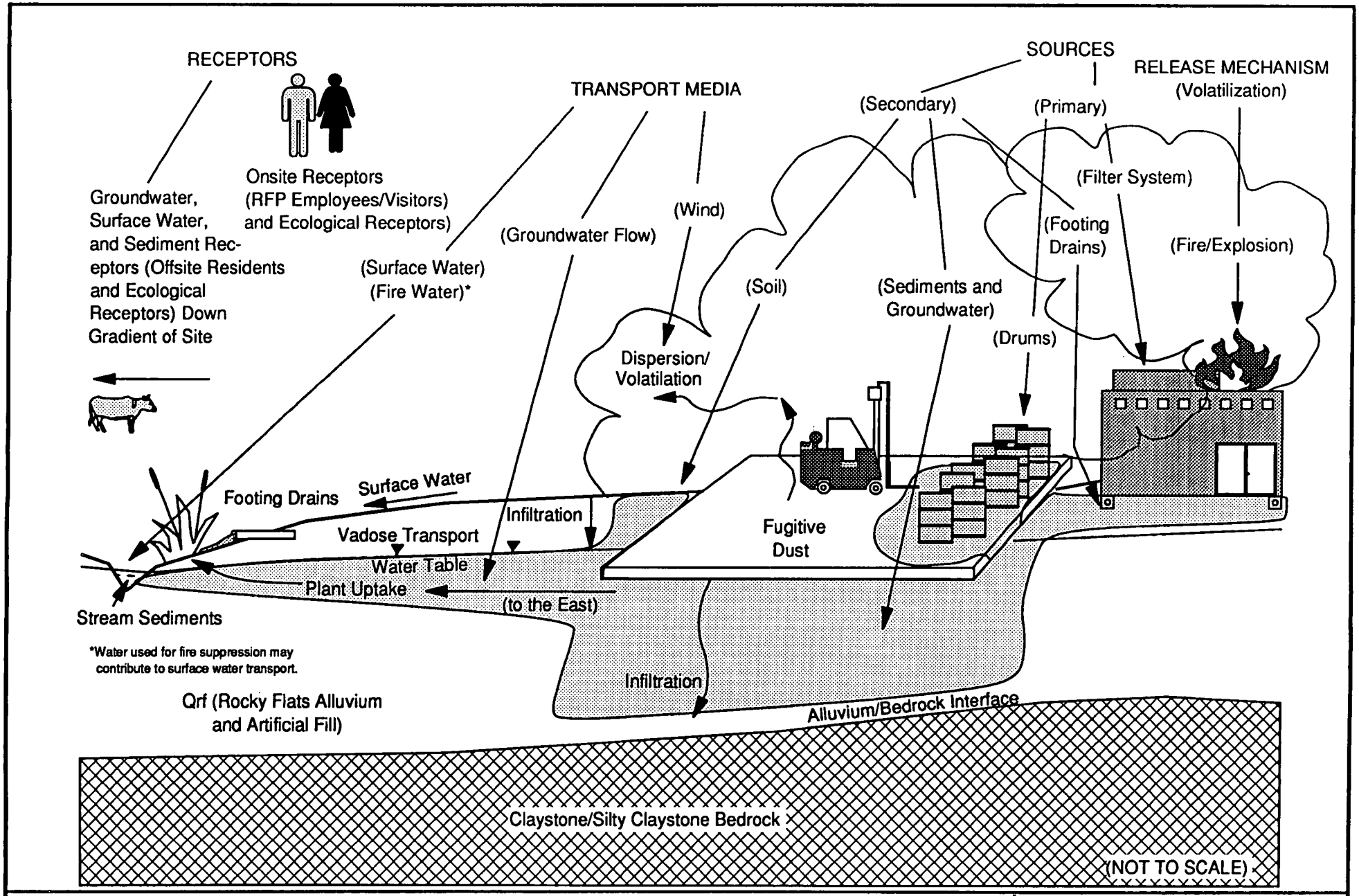


FIGURE 2.5-4
GROUP II - CONCEPTUAL MODEL

OPERABLE UNIT NO. 8
PHASE I RFI/RI WORK PLAN
U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant, Golden, Colorado

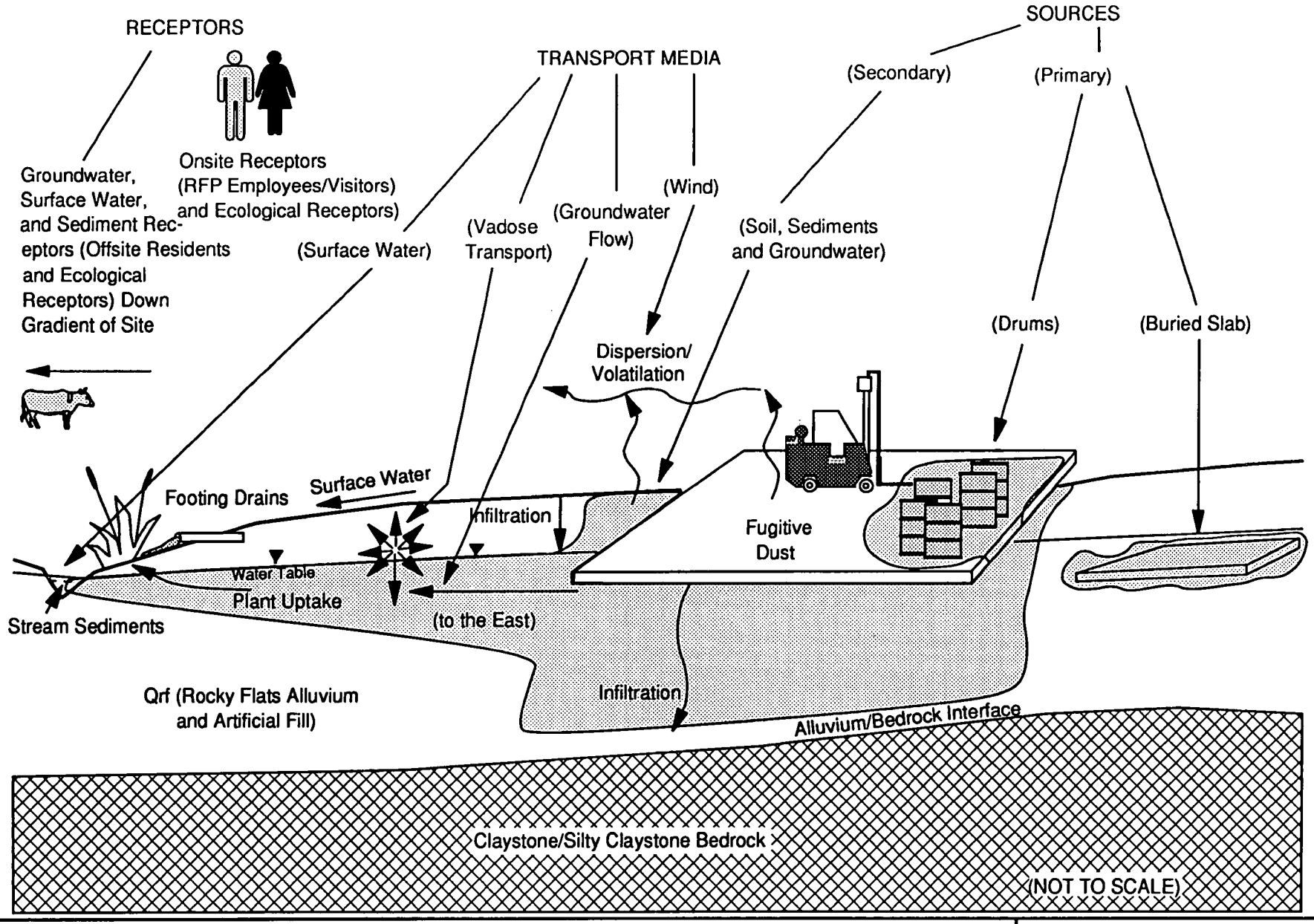


FIGURE 2.5-5

GROUP III - CONCEPTUAL MODEL

OPERABLE UNIT NO. 8
PHASE I RFI/RI WORK PLAN
U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant, Golden, Colorado

3.0 ROCKY FLATS PLANT CHEMICAL SPECIFIC BENCHMARKS

Rocky Flats Plant Chemical Specific Benchmarks (CSBs) (EG&G terminology) included in this section were provided by EG&G and are in lieu of Applicable or Relevant and Appropriate Requirements (ARARs). The CSBs were developed for the entire Rocky Flats Plant site and are not specific to OU8. Site-specific ARARs will be developed as the initial step of the Corrective Measures Study for OU8. Tables 3.1 through 3.4 provide a preliminary identification of potential CSBs for groundwater and surface water at the Rocky Flats Plant. CSBs for soil have not been developed at this time. EPA analytical methods and detection limits have been specified for soil analyses to obtain data of the highest quality with the lowest possible detection limits. As validated data become available from OU8 RFI/RI investigations, the CSBs will be reevaluated in accordance with Chapter Three, Part 15 of the IAG (DOE, 1991a). The site wide CSBs included in this work plan are not intended for use in establishing clean up goals, however, they will be used to establish RFI/RI analytical detection limits. Cleanup criteria for OU8 will be site specific and shall be based on results of an environmental and human-based Risk Assessment.

Sitewide CSBs represented in Tables 3.1 through 3.4 were developed from the following sources:

- Colorado Department of Health (CDH), Water Quality Control Commission (WQCC), groundwater standards (EG&G, 1991a);
- Safe Drinking Water Act (SWADA), Maximum Contaminant Levels (MCLs), surface water and groundwater (EG&G, 1991a);
- Clean Water Act (CWA), Ambient Water Quality Criteria (AWQC), potentially applicable to surface water and groundwater (EG&G, 1991a);
- RCRA, Subpart F, Groundwater Concentration Limits (40 CFR 264.94), groundwater standards (EG&G, 1991a); and
- CDH, WQCC proposed statewide and classified groundwater area standards (EG&G, 1991a).

In instances where CSBs have not been proposed for a particular chemical or for a particular type

of investigative method, EG&Gs General Radiochemistry and Routine Analytical Services Protocol (GRRASP) protocol or other appropriate laboratory procedures will be considered as the practical quantitation limits and will be applied (EG&G, 1991b).

TABLE 3.1. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992)
GROUND WATER QUALITY STANDARDS (ug/l)

					FEDERAL STANDARDS					STATE STANDARDS							
										CDH CWQCC Groundwater Quality Standards (d)							
										Statewide	Site-Specific (a)						
		PQL MDL			SDWA Maximum Contaminant Level (a)	SDWA Maximum Contaminant Level (b)	SDWA Maximum Contaminant Level Goals (a)	SDWA Maximum Contaminant Level Goals (b)	RCRA Subpart F Limit (c)	Table A (d) (7)	Table 1 Human Health	Table 2 Secondary Drinking	Table 3 Agriculture	Table 4 TDS	Table 5 Chronic	Table 6 Radionuclides	
Parameter	Type (5)	RFP	CDH	Method (6)												Woman Creek	Walnut Creek
Bicarbonate	A	10,000		E310.1													
Carbonate	A	10,000		E310.1													
Chloride	A	5,000		E325	250,000 *							250,000					
Chlorine	A	1,000		E4500													
Fluoride	A	5,000		E340	4,000; 2,000*		4,000				4,000		2,000				
N as Nitrate	A	5,000		E353.1	10,000			10,000			10,000						
N as Nitrate+Nitrite	A	5,000		E353.1		10,000		10,000					100,000				
N as Nitrite	A	5,000		E354.1		1,000		1,000			1,000		10,000				
Sulfate	A	5,000		E375.4	250,000*							250,000					
Sulfide	A																
Coliform (total)	B	1		SM9221C	1/100 ml						1/100 ml						
Ammonia as N	C	5,000		E350													
Dioxin	D		0.01(9)	d						0.00000022					0.000000013		
Sulfur	E	100,000		E600													
Dissolved Oxygen	FP	500		SM4500													
pH	FP	0.1		E150.1	6.5-8.5 *							6.5-8.5	6.5-8.5				
Specific Conductance	FP	1		E120.1													
Temperature	FP																
Boron	I	5,000		E6010									750				
Total Dissolved Solids	I	10,000		E160.1	500,000*									400,000 (1)			
Aluminum	M	200		CT		50 to 200*							5,000				
Antimony	M	60		CT													
Arsenic	M	10		CT	50				50		50		100				
Arsenic III	M																
Arsenic V	M																
Barium	M	200		CT	1,000	2,000 (e)		2,000 (e)	1,000		1,000						
Beryllium	M	5		CT									100				
Cadmium	M	5		CT	10	5		5	10		10		10				
Calcium	M	5,000		CT													
Cesium	M	1,000		NC													
Chromium	M	10		CT	50	100		100	50		50		100				
Chromium III	M	5		SW8467196													
Chromium VI	M	10		E218.5													
Cobalt	M	50		CT									50				
Copper	M	25		CT	1,000 *			1,300 (f)				1,000	200				
Cyanide	M	10		CT							200						
Iron	M	100		CT	300 *							300	5,000				
Lead	M	5		CT	50			0 (f)	50		50		100				
Lithium	M	100		NC									2,500				
Magnesium	M	5000		CT													

TABLE 3.1. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992)
GROUND WATER QUALITY STANDARDS (ug/l)

					FEDERAL STANDARDS					STATE STANDARDS							
										CDH CWQCC Groundwater Quality Standards (d)							
										Statewide	Site-Specific (g)						
Parameter	Type (5)	PQL MDL RFP	PQL MDL CDH	Method (6)	SDWA Maximum Contaminant Level (a)	SDWA Maximum Contaminant Level (b)	SDWA Maximum Contaminant Level Goals (a)	SDWA Maximum Contaminant Level Goals (b)	RCRA Subpart F Link (c)	Table A (d) (7)	Table 1 Human Health	Table 2 Secondary Drinking	Table 3 Agriculture	Table 4 TDS	Table 5 Chronic	Table 6 Radionuclides Woman Creek	Table 6 Radionuclides Walnut Creek
Manganese	M	15		CT	50 *							50	200				
Mercury	M	0.2		CT	2	2		2	2		2		10				
Molybdenum	M	200		NC													
Nickel	M	40		CT									200				
Potassium	M	5000		CT													
Selenium	M	5		CT	10	50		50	10		10		20				
Silver	M	10		CT	50	100 *			50		50						
Sodium	M	5000		CT													
Strontium	M	200		NC													
Thallium	M	10		CT													
Tin	M	200		NC													
Titanium	M	10		E6010													
Tungsten	M	10		E6010													
Vanadium	M	50		CT									100				
Zinc	M	20		CT	5,000 *							5,000	2,000				
2,4,5-TP Silvex	P		0.5	d	10	50		50	10	50							
2,4-Dichlorophenoxyacetic Acid (2,4-D)	P		1	d	100	70		70	100	70							
Acrolein	P		10														
Aldicarb	P		10			3 (e)		1 (e)		10							
Aldrin	P	0.05	0.1	CP						0.002					0.000074		
Bromacil	P																
Carbofuran	P			d		40		40		36							
Chloranil	P																
Chlordane (Alpha)	P	0.5	1	CP		2		0		0.03					0.00046		
Chlordane (Gamma)	P	0.5	1	CP		2		0		0.03					0.00046		
Chlorpyrifos	P			E619													
DDT	P	0.1	0.1	CP						0.1					0.000024		
DDT Metabolite (DDD)	P	0.1		CP													
DDT Metabolite (DDE)	P	0.1	0.1	CP						0.1							
Demeton	P																
Diazinon	P																
Dieldrin	P	0.1	0.1	CP						0.002					0.000071		
Endosulfan I	P	0.05		CP													
Endosulfan II	P	0.1		CP													
Endosulfan sulfate	P	0.1		CP													
Endrin	P	0.1	0.1	CP	0.2				0.2	0.2							
Endrin Aldehyde	P		0.1							0.2							
Endrin Ketone	P	0.1		CP													
Guthion	P																
Heptachlor	P	0.05	0.05	CP		0.4		0		0.008					0.00028		
Heptachlor Epoxide	P	0.05	0.05	CP		0.2		0		0.09							

TABLE 3.1. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992)
GROUND WATER QUALITY STANDARDS (ug/l)

					FEDERAL STANDARDS					STATE STANDARDS							
										CDH CWQCC Groundwater Quality Standards (d)							
		PQL MDL			SDWA Maximum Contaminant Level (a)	SDWA Maximum Contaminant Level (b)	SDWA Maximum Contaminant Level Goals (a)	SDWA Maximum Contaminant Level Goals (b)	RCRA Subpart F Limit (c)	Statewide	Site-Specific (g)						
Parameter	Type (5)	RFP	CDH	Method (6)						Table A (d) (7)	Table 1 Human Health	Table 2 Secondary Drinking	Table 3 Agriculture	Table 4 TDS	Table 5 Chronic	Table 6 Radionuclides Woman Creek	Walnut Creek
Hexachlorocyclohexane, Alpha	P	0.05	0.05	CP						0.006					0.0092		
Hexachlorocyclohexane, Beta	P	0.05	0.1(9)	CP											0.0163		
Hexachlorocyclohexane, BHC	P		0.05														
Hexachlorocyclohexane, Delta	P	0.05		CP													
Hexachlorocyclohexane, Tech	P		0.5(9)	f											0.0123		
Hexachlorocyclohexane, Lindane	P	0.05	0.05	CP	4	0.2		0.2	4.0	0.2					0.0186		
Malathion	P																
Methoxychlor	P	0.5	0.5	CP	100	40		40	100	40	100						
Mirex	P																
Parathion	P																
PCBs	P	0.5	1	CP		0.5		0		0.005					0.000079		
Simazine	P			e											4		
Toxaphene	P	1	5	CP		3		0	5.0	0.03	5						
Vaponite 2	P																
Aroclor 1016	PP	0.5		CP													
Aroclor 1221	PP	0.5		CP													
Aroclor 1232	PP	0.5		CP													
Aroclor 1242	PP	0.5		CP													
Aroclor 1248	PP	0.5		CP													
Aroclor 1254	PP	1		CP													
Aroclor 1260	PP	1		CP													
Atrazine	PP		1 (9)	e		3		3							3		
Americium (pCi/l)	R															0.05	0.05
Americium 241 (pCi/l)	R	0.01															
Cesium 134 (pCi/l)	R	1								80 (2)						80	80
Cesium 137 (pCi/l)	R	1															
Gross Alpha (pCi/l)	R	2			15 (8)						15(8)					7	11
Gross Beta (pCi/l)	R	4			50 (4 mrem/yr)						4 mrem/yr					5	19
Plutonium (pCi/l)	R															0.05	0.05
Plutonium 238+239+240 (pCi/l)	R	0.01								15 (2)							
Radium 226+228 (pCi/l)	R	0.5/1.0 (4)			5					5 (2)							
Strontium 89+90 (pCi/l)	R	1															
Strontium 90 (pCi/l)	R				8 (3)					8 (2)						8	8
Thorium 230+232 (pCi/l)	R									60 (2)							
Tritium (pCi/l)	R				20,000 (3)					20,000 (2)						500	500
Uranium 233+234 (pCi/l)	R																
Uranium 235 (pCi/l)	R	0.6															
Uranium 238 (pCi/l)	R	0.6															
Uranium (Total) (pCi/l)	R															5	10
1,2,4,5-Tetrachlorobenzene	SV		10	b						2							
1,2,4-Trichlorobenzene	SV	10		CS													

TABLE 3.1. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992)
GROUND WATER QUALITY STANDARDS (ug/l)

					FEDERAL STANDARDS					STATE STANDARDS							
										CDH CWQCC Groundwater Quality Standards (d)							
										Statewide	Site-Specific (g)						
		PQL MDL			SDWA Maximum Contaminant Level (a)	SDWA Maximum Contaminant Level (b)	SDWA Maximum Contaminant Level Goals (a)	SDWA Maximum Contaminant Level Goals (b)	RCRA Subpart F Limit (c)	Table A (d) (7)	Table 1 Human Health	Table 2 Secondary Drinking	Table 3 Agriculture	Table 4 TDS	Table 5 Chronic	Table 6 Radionuclides	
Parameter	Type (5)	RFP	CDH	Method (6)												Woman Creek	Walnut Creek
1,2-Dichlorobenzene (Ortho)	SV	10	1	CS		600		600		620							
1,2-Diphenylhydrazine	SV			b						0.05							
1,3-Dichlorobenzene (Meta)	SV	10	1	CS						620							
1,4-Dichlorobenzene (Para)	SV	10	1	CS	75		75			75							
2,4,5-Trichlorophenol	SV	50		CS						700							
2,4,6-Trichlorophenol	SV	10	50	CS						2					1.2		
2,4-Dichlorophenol	SV	10	50	CS						21							
2,4-Dimethylphenol	SV	10		CS													
2,4-Dinitrophenol	SV	50	50	CS						14							
2,4-Dinitrotoluene	SV	10		CS													
2,6-Dinitrotoluene	SV	10		CS													
2-Chloronaphthalene	SV	10		CS													
2-Chlorophenol	SV	10		CS													
2-Methylnaphthalene	SV	10		CS													
2-Methylphenol	SV	10		CS													
2-Nitroaniline	SV	50		CS													
2-Nitrophenol	SV	10		CS													
3,3-Dichlorobenzidine	SV	20		CS													
3-Nitroaniline	SV	50		CS													
4,6-Dinitro-2-methylphenol	SV	50		CS													
4-Bromophenyl Phenylether	SV	10		CS													
4-Chloroaniline	SV	10		CS													
4-Chlorophenyl Phenyl Ether	SV	10		CS													
4-Chloro-3-methylphenol	SV	10		CS													
4-Methylphenol	SV	10		CS													
4-Nitroaniline	SV	50		CS													
4-Nitrophenol	SV	50		CS													
Acenaphthene	SV	10		CS													
Anthracene	SV	10		CS													
Benzidine	SV		10	d						0.0002	0.1				0.00012		
Benzoic Acid	SV	50		CS													
Benzo(a)anthracene	SV	10		CS													
Benzo(a)pyrene	SV	10		CS													
Benzo(b)fluoranthene	SV	10		CS													
Benzo(g,h,i)perylene	SV	10		CS													
Benzo(k)fluoranthene	SV	10		CS													
Benzyl Alcohol	SV	10		CS													
bis(2-Chloroethoxy)methane	SV	10		CS													
bis(2-Chloroethyl)ether	SV	10		CS						0.03					0.0000037		
bis(2-Chloroisopropyl)ether	SV	10		CS													
bis(2-Ethylhexyl)phthalate	SV	10		CS													
Butadiene	SV																
Butylbenzylphthalate	SV	10		CS													

TABLE 3.1. POTENTIAL CHEMICAL–SPECIFIC BENCHMARKS (February 1, 1992)
GROUND WATER QUALITY STANDARDS (ug/l)

					FEDERAL STANDARDS					STATE STANDARDS							
										CDH CWQCC Groundwater Quality Standards (d)							
										Statewide	Site–Specific (g)						
Parameter	Type (5)	PQL MDL RFP	PQL MDL CDH	Method (6)	SDWA Maximum Contaminant Level (a)	SDWA Maximum Contaminant Level (b)	SDWA Maximum Contaminant Level Goals (a)	SDWA Maximum Contaminant Level Goals (b)	RCRA Subpart F Limit (c)	Table A (d) (7)	Table 1 Human Health	Table 2 Secondary Drinking	Table 3 Agriculture	Table 4 TDS	Table 5 Chronic	Table 6 Radionuclides Woman Creek	Table 6 Radionuclides Walnut Creek
Chlorinated Ethers	SV																
Chlorinated Napthalenes	SV																
Chloroalkylethers	SV	10		CS													
Chlorophenol	SV										1						
Chrysene	SV	10		CS													
Dibenzofuran	SV	10		CS													
Dibenz(a,h)anthracene	SV	10		CS													
Dichlorobenzenes	SV																
Dichlorobenzidine	SV	20	10(9)	CS											0.01		
Diethylphthalate	SV	10		CS													
Dimethylphthalate	SV	10		CS													
Di–n–butylphthalate	SV	10		CS													
Di–n–octylphthalate	SV	10		CS													
Ethylene Glycol	SV			d						7,000							
Fluoranthene	SV	10		CS													
Fluorene	SV	10		CS													
Formaldehyde	SV																
Haloethers	SV																
Hexachlorobenzene	SV	10	10	CS						6					0.00072		
Hexachlorobutadiene	SV	10	10	CS						1					0.45		
Hexachlorocyclopentadiene	SV	10		CS						49							
Hexachloroethane	SV	10		CS											1.9		
Hydrazine	SV																
Indeno(1,2,3–cd)pyrene	SV	10		CS													
Isophorone	SV	10	10	CS						1,050							
Naphthalene	SV	10		CS													
Nitrobenzene	SV	10	10	CS						3.5							
Nitrophenols	SV																
Nitrosamines	SV		10														
Nitrosodibutylamine	SV			b											0.0064		
Nitrosodiethylamine	SV		10	b											0.0008		
Nitrosodimethylamine	SV		10	b											0.0014		
Nitrosopyrrolidine	SV		10	b											0.016		
N–Nitrosodiphenylamine	SV	10	10(9)	CSb											4.9		
N–Nitroso–di–n–dipropylamine	SV	10		CSb													
Pentachlorinated Ethanes	SV			b													
Pentachlorobenzene	SV		10	b						6 (7)							
Pentachlorophenol	SV	50	50	CS		1 (e)		0 (e)		200							
Phenanthrene	SV	10		CS													
Phenol	SV	10		CS							1						
Phthalate Esters	SV																
Polynuclear Aromatic Hydrocarbons	SV		1 (9)	b											0.0028		
Vinyl Chloride	SV	10	2	CV	2		0			2							

TABLE 3.1. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992)
GROUND WATER QUALITY STANDARDS (ug/l)

					FEDERAL STANDARDS					STATE STANDARDS							
										CDH CWQCC Groundwater Quality Standards (d)							
										Statewide	Site-Specific (g)						
		PQL MDL			SDWA Maximum Contaminant Level (a)	SDWA Maximum Contaminant Level (b)	SDWA Maximum Contaminant Level Goals (a)	SDWA Maximum Contaminant Level Goals (b)	RCRA Subpart F Link (c)	Table A (d) (7)	Table 1 Human Health	Table 2 Secondary Drinking	Table 3 Agriculture	Table 4 TDS	Table 5 Chronic	Table 6 Radionuclides	
Parameter	Type (5)	RFP	CDH	Method (6)												Women Creek	Walnut Creek
1,1,1-Trichloroethane	V	5	1	CV	200		200			200							
1,1,2,2-Tetrachloroethane	V	5	1 (9)	CV											0.17		
1,1,2-Trichloroethane	V	5	1	CV						3					0.6		
1,1-Dichloroethane	V	5		CV													
1,1-Dichloroethene	V	5	1	CV	7		7			7							
1,2-Dichloroethane	V	5	1	CV	5		0			0.4							
1,2-Dichloroethene (cis)	V		1	a		70		70		70							
1,2-Dichloroethene (total)	V	5		CV													
1,2-Dichloroethene (trans)	V		1	a		100		100		100							
1,2-Dichloropropane	V	5	1	CV		5		0		0.56							
1,3-Dichloropropene (cis)	V	5		CV													
1,3-*Dichloropropene (trans)*	V	5		CV													
2-Butanone	V	10		CV													
2-Hexanone	V	10		CV													
4-Methyl-2-pentanone	V	10		CV													
Acetone	V	10		CV													
Acrylonitrile	V		15(9)	c											0.058		
Benzene	V	5	1	CV	5		0			1							
Bromodichloromethane	V	5	1	CV						0.3							
Bromoform	V	5	1	CV						4							
Bromomethane	V	10		CV													
Carbon Disulfide	V	5		CV													
Carbon Tetrachloride	V	5	1	CV	5		0			0.3							
Chlorinated Benzenes	V	10		CV/CS													
Chlorobenzene	V	5	1	CV/CS		100		100		100							
Chloroethane	V	10		CV													
Chloroform	V	5	1	CV	Tot THM <100**					6					0.19		
Chloromethane	V	10		CV													
Dibromochloromethane	V	5	1	CV						14							
Dichloroethenes	V																
Ethyl Benzene	V	5	1	CV		700		700		680							
Ethylene Dibromide	V			d		0.05		0		0.0004							
Ethylene Oxide	V																
Halomethanes	V		1 (9)		100					100					0.19		
Methylene Chloride	V	5		CV													
Pyrene	V	10		CS													
Styrene	V	5		CV		100		100									
Tetrachloroethanes	V	5		CV													
Tetrachloroethene	V	5	1	CV		5		0		5					0.8		
Toluene	V	5	1	CV		1,000		1,000		1,000							
Trichloroethanes	V	5		CV													

TABLE 3.1. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992)
GROUND WATER QUALITY STANDARDS (ug/l)

					FEDERAL STANDARDS					STATE STANDARDS							
										CDH CWQCC Groundwater Quality Standards (d)							
										Statewide	Site-Specific (g)						
Parameter	Type (5)	PQL MDL RFP	PQL MDL CDH	Method (6)	SDWA Maximum Contaminant Level (a)	SDWA Maximum Contaminant Level (b)	SDWA Maximum Contaminant Level Goals (a)	SDWA Maximum Contaminant Level Goals (b)	RCRA Subpart F Limit (c)	Table A (d) (7)	Table 1 Human Health	Table 2 Secondary Drinking	Table 3 Agriculture	Table 4 TDS	Table 5 Chronic	Table 6 Radionuclides Woman Creek	Table 6 Radionuclides Walnut Creek
Trichloroethene	V	5	1	CV	5		0			5							
Vinyl Acetate	V	10		CV													
Xylenes (total)	V	5		CV		10,000		10,000									

EXPLANATION OF TABLE

* = secondary maximum contaminant level

** = total trihalomethanes: chloroform, bromoform, bromodichloromethane, dibromochloromethane

CDH = Colorado Department of Health
CLP = Contract Laboratory Program
EPA = Environmental Protection Agency
pCi/l = picocuries per liter
PCB = polychlorinated biphenyl
PQL = Practical Quantitation Limit
RCRA = Resource Conservation and Recovery Act
RFP = Rocky Flats Plant
SDWA = Safe Drinking Water Act
TAL = Target Analyte List
THM = Total Trihalomethanes
TIC = Tentatively Identified Compound
MDL = Minimum Detection Limit for radionuclides (pCi/l)
ug/l = micrograms per liter
VOA = Volatile Organic Analysis
CWQCC = Colorado Water Quality Control Commission

TABLE 3.2. POTENTIAL CHEMICAL–SPECIFIC BENCHMARKS (February 1, 1992)
FEDERAL SURFACE WATER QUALITY STANDARDS (ug/l)

Parameter	Type (7)	PQL MDL RFP	PQL CDH	Method (8)	SDWA Maximum Contaminant Levels (a)	SDWA Maximum Contaminant Levels (b)	SDWA Maximum Contaminant Level Goals (a)	SDWA Maximum Contaminant Level Goals (b)	CWA AWQC for Protection of Aquatic Life (c) Acute Value	CWA AWQC for Protection of Aquatic Life (c) Chronic Value	CWA AWQC for Protection of Human Health (d) Water and Fish Ingestion	CWA AWQC for Protection of Human Health (d) Fish Consumption Only	NRC Effluent Standards Water pCi/L
Bicarbonate	A	10,000		E310.1									
Carbonate	A	10,000		E310.1									
Chloride	A	5,000		E325	250,000*				860,000(e)	230,000(e)			
Chlorine	A	1,000		E4500					19	11			
Flouride	A	5,000		E340	4,000; 2,000*		4,000					4,000	
N as Nitrate	A	5,000		E353.1	10,000			10,000			10,000		
N as Nitrate+Nitrite	A	5,000		E353.1		10,000		10,000					
N as Nitrite	A	5,000		E354.1		1,000		1,000					
Sulfate	A	5,000		E375.4	250,000*								
Sulfide	A												
Coliform (Fecal)	B	1		SM9221C	1/100 ml								
Ammonia as N	C	5,000		E350					Criteria are pH and temperature dependent – see criteria document				
Dioxin	D			d					0.01	0.00001	0.000000013	0.000000014	
Sulfur	E	100,000		E600									
Dissolved Oxygen	FP	500		SM4500					5,000				
pH	FP	0.1		E150.1	6.5–8.5 *					6.5–9			
Specific Conductance	FP	1		E120.1									
Temperature	FP								SS	SS			
Boron	I	5,000		E6010									
Total Dissolved Solids	I	10,000		E160.1	500,000*				SS	SS	250,000		
Aluminum	M	200		CT		50 to 200*			750	87			
Antimony	M	60		CT					9,000	1,600	146	45,000	
Arsenic	M	10		CT	50						0.0022	0.0175	
Arsenic III	M								360	190			
Arsenic V	M								850	48			
Barium	M	200		CT	1,000	2,000(f)		2,000(f)			1,000		
Beryllium	M	5		CT					130	5.3	.0068**	.117**	
Cadmium	M	5		CT	10	5		5	3.9(3)	1.1(3)	10		
Calcium	M	5,000		CT									
Cesium	M	1,000		NC									
Chromium	M	10		CT	50	100		100					
Chromium III	M	5		SW8467196					1,700	210	170,000	3,433,000	
Chromium VI	M	10		E218.5					16	11	50		
Cobalt	M	50		CT									
Copper	M	25		CT	1,000*			1,300(g)	18(3)	12(3)			
Cyanide	M	10		CT					22	5.2	200		
Iron	M	100		CT	300 *					1,000	300		
Lead	M	5		CT	50			0(g)	82(3)	3.2(3)	50		
Lithium	M	100		NC									
Magnesium	M	5000		CT									
Manganese	M	15		CT	50 *						50	100	
Mercury	M	0.2		CT	2	2		2	2.4	0.012	0.144	0.146	
Molybdenum	M	200		NC									
Nickel	M	40		CT					1,400(3)	160(3)	13.4	100	
Potassium	M	5000		CT									
Selenium	M	5		CT	10	50		50	20(d)	5(d)	10		
Silver	M	10		CT	50	100 *			4.1(3)	0.12	50		
Sodium	M	5000		CT									
Strontium	M	200		NC									
Thallium	M	10		CT					1,400(1)	40(1)	13	48	
Tin	M	200		NC									

TABLE 3.2. POTENTIAL CHEMICAL–SPECIFIC BENCHMARKS (February 1, 1992)
FEDERAL SURFACE WATER QUALITY STANDARDS (ug/l)

Parameter	Type (7)	PQL MDL RPP	PQL CDH	Method (8)	SDWA Maximum Contaminant Levels (a)	SDWA Maximum Contaminant Levels (b)	SDWA Maximum Contaminant Level Goals (a)	SDWA Maximum Contaminant Level Goals (b)	CWA AWQC for Protection of Aquatic Life (c) Acute Value	CWA AWQC for Protection of Aquatic Life (c) Chronic Value	CWA AWQC for Protection of Human Health (d) Water and Fish Ingestion	CWA AWQC for Protection of Human Health (d) Fish Consumption Only	NRC Effluent Standards Water pCi/L
Titanium	M	10		E6010									
Tungsten	M	10		E6010									
Vanadium	M	50		CT									
Zinc	M	20		CT	5,000 *				120 (3)	110 (3)			
2,4,5–TP Silvex	P		0.5	d	10	50		50					
2,4–Dichlorophenoxyacetic Acid (2,4–D)	P		1	d	100	70		70					
Acrolein	P		10						68(1)	21(1)	320	780	
Aldicarb	P		10			3 (f)		1 (f)					
Aldrin	P	0.05	0.1	CP					3.0		0.000074	0.000079	
Bromacil	P												
Carbofuran	P			d		40		40					
Chloranil													
Chlordane (Alpha)	P	0.5	1	CP		2		0	2.4	0.0043	0.00046	0.00048	
Chlordane (Gamma)	P	0.5	1	CP		2		0	2.4	0.0043	0.00046	0.00048	
Chlorpyrifos	P		0.1	E619					0.063	0.041			
DDT	P	0.1	0.1	CP					1.1	0.0011	0.000024	0.000024	
DDT metabolite (DDD)	P	0.1	0.1	CP					0.06				
DDT metabolite (DDE)	P	0.1	0.1	CP					1,050				
Demeton	P		1							0.1			
Diazinon	P												
Dieldrin	P	0.1	0.1	CP					2.5	0.0019	0.00007	0.000076	
Endosulfan I	P	0.05	0.1	CP					0.22	0.056	74	159	
Endosulfan II	P	0.1	0.1	CP									
Endosulfan Sulfate	P	0.1	0.1	CP									
Endrin	P	0.1	0.1	CP	0.2				0.18	0.0023	1		
Endrin Aldehyde	P		0.1										
Endrin Ketone	P	0.1		CP									
Guthion	P		1.5							0.01			
Heptachlor	P	0.05	0.05	CP		0.4		0	0.52	0.0038	0.00028	0.00029	
Heptachlor Epoxide	P	0.05	0.05	CP		0.2		0					
Hexachlorocyclohexane, Alpha	P	0.05	0.05	CP							0.0092	0.031	
Hexachlorocyclohexane, Beta	P	0.05	0.05	CP							0.0163	0.0547	
Hexachlorocyclohexane, BHC	P	0.05	0.05										
Hexachlorocyclohexane, Delta	P	0.05		CP									
Hexachlorocyclohexane, Technical	P		0.2	f							0.0123	0.0414	
Hexachlorocyclohexane, (Lindane) Gama	P	0.05	0.05	CP	4	0.2		0.2	2.0	0.08			
Malathion	P		0.2							0.01			
Methoxychlor	P	0.5	0.5	CP	100	40		40		0.03	100		
Mirex	P		0.1							0.001			
Parathion	P								0.065	0.013			
PCBs	P	0.5	1	CP		0.5		0	2.0	0.014	0.000079**	0.000079**	
Simazine	P			e									
Toxaphene	P	1	5	CP		3		0	0.73	0.0002	0.00071**	0.00073**	
Vaponite 2	P												
Aroclor 1016	PP	0.5		CP									
Aroclor 1221	PP	0.5		CP									
Aroclor 1232	PP	0.5		CP									
Aroclor 1242	PP	0.5		CP									
Aroclor 1248	PP	0.5		CP									
Aroclor 1254	PP	1		CP									
Aroclor 1260	PP	1		CP									
Atrazine	PP			e		3		3					

TABLE 3.2. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992)
FEDERAL SURFACE WATER QUALITY STANDARDS (ug/l)

Parameter	Type (7)	PQL MDL RPP	PQL CDH	Method (8)	SDWA Maximum Contaminant Levels (a)	SDWA Maximum Contaminant Levels (b)	SDWA Maximum Contaminant Level Goals (a)	SDWA Maximum Contaminant Level Goals (b)	CWA AWQC for Protection of Aquatic Life (c) Acute Value	CWA AWQC for Protection of Aquatic Life (c) Chronic Value	CWA AWQC for Protection of Human Health (c) Water and Fish Ingestion	CWA AWQC for Protection of Human Health (c) Fish Consumption Only	NRC Effluent Standards Water pCi/L
Americium (pCi/l)	R												
Americium 241 (pCi/l)	R	0.01											20
Cesium 134 (pCi/l)	R	1											900
Cesium 137 (pCi/l)	R	1											1000
Gross Alpha (pCi/l)	R	2			15 (10)							15	
Gross Beta (pCi/l)	R	4			50 (4 mrem/yr)								
Plutonium (pCi/l)	R												
Plutonium 238+239+240 (pCi/l)	R	0.01											20
Radium 226+228 (pCi/l)	R	0.5/0.1 (9)			5							5	60
Strontium 89+90 (pCi/l)	R	1											500
Strontium 90 (pCi/l)	R				8 (6)							8	500
Thorium 230+232 (pCi/l)	R												30
Tritium (pCi/l)	R				20,000 (6)								1000000
Uranium 233+234 (pCi/l)	R												300
Uranium 235 (pCi/l)	R	0.6											300
Uranium 238 (pCi/l)	R	0.6											300
Uranium (total) (pCi/l)	R												
1,2,4,5-Tetrachlorobenzene	SV		10	b							38	48	
1,2,4-Trichlorobenzene	SV	10		CS									
1,2-Dichlorobenzene (Ortho)	SV	10	10	CS		600		600					
1,2-Diphenylhydrazine	SV			b					270 (1)				
1,3-Dichlorobenzene (Meta)	SV	10	1	CS									
1,4-Dichlorobenzene (Para)	SV	10	1	CS	75		75						
2,4,5-Trichlorophenol	SV	50		CS							2,600		
2,4,6-Trichlorophenol	SV	10	50	CS						970 (1)	1.2 **	3.6 **	
2,4-Dichlorophenol	SV	10	50	CS					2,020 (1)	365 (1)	3,090		
2,4-Dimethylphenol	SV	10	50	CS					2,120 (1)				
2,4-Dinitrophenol	SV	50	50	CS									
2,4-Dinitrotoluene	SV	10	10	CS							0.11 **	9.1 **	
2,6-Dinitrotoluene	SV	10	10	CS					330 (1)	230 (1)	70	14,300	
2-Chloronaphthalene	SV	10		CS									
2-Chlorophenol	SV	10	50	CS					4,360 (1)	2,000 (1)			
2-Methylnaphthalene	SV	10		CS									
2-Methylphenol	SV	10		CS									
2-Nitroaniline	SV	50		CS									
2-Nitrophenol	SV	10		CS									
3,3-Dichlorobenzidine	SV	20	10	CS							0.01	0.02	
3-Nitroaniline	SV	50		CS									
4,6-Dinitro-2-methylphenol	SV	50	50	CS									
4-Bromophenyl Phenylether	SV	10		CS									
4-Chloroaniline	SV	10		CS									
4-Chlorophenyl Phenyl Ether	SV	10		CS									
4-Chloro-3-methylphenol	SV	10	50	CS					30 (1)				
4-Methylphenol	SV	10		CS									
4-Nitroaniline	SV	50		CS									
4-Nitrophenol	SV	50		CS					230 (1)	150 (1)			
Acenaphthene	SV	10	10	CS					1,700 (1)	520 (1)			
Anthracene	SV	10	1	CS									
Benzidine	SV		1	d					2,500		0.00012	0.00053	
Benzoic Acid	SV	50		CS									
Benzo(a)anthracene	SV	10	10	CS									

TABLE 3.2. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992)
FEDERAL SURFACE WATER QUALITY STANDARDS (ug/l)

Parameter	Type (7)	PQL MDL RFP	PQL CDH	Method (8)	SDWA Maximum Contaminant Levels (a)	SDWA Maximum Contaminant Levels (b)	SDWA Maximum Contaminant Level Goals (a)	SDWA Maximum Contaminant Level Goals (b)	CWA AWQC for Protection of Aquatic Life (c) Acute Value	CWA AWQC for Protection of Aquatic Life (c) Chronic Value	CWA AWQC for Protection of Human Health (c) Water and Fish Ingestion	CWA AWQC for Protection of Human Health (c) Fish Consumption Only	NRC Effluent Standards Water pCi/L
Benzo(a)pyrene	SV	10	10	CS									
Benzo(b)fluoranthene	SV	10	10	CS									
Benzo(g,h,i)perylene	SV	10	10	CS									
Benzo(k)fluoranthene	SV	10	10	CS									
Benzyl Alcohol	SV	10		CS									
bis(2-Chloroethoxy)methane	SV	10		CS									
bis(2-Chloroethyl)ether	SV	10	10	CS							0.03**	1.36**	
bis(2-Chloroisopropyl)ether	SV	10	10	CS							34.7	4,360	
bis(2-Ethylhexyl)phthalate	SV	10	10	CS							15,000	50,000	
Butadiene	SV												
Butylbenzylphthalate	SV	10	10	CS									
Chlorinated Ethers	SV												
Chlorinated Napthalenes	SV								1,600(1)				
Chloroalkylethers	SV	10		CS					238,000(1)				
Chlorophenol	SV		50										
Chrysene	SV	10	10	CS									
Dibenzofuran	SV	10		CS									
Dibenz(a,h)anthracene	SV	10	10	CS									
Dichlorobenzenes	SV		1						1,120(1)	763(1)	400	2,600	
Dichlorobenzidine	SV	20	10	CS							0.01	0.02	
Diethylphthalate	SV	10	10	CS							350,000	1,800,000	
Dimethylphthalate	SV	10	10	CS							313,000	2,900,000	
Di-n-butylphthalate	SV	10	10	CS									
Di-n-octylphthalate	SV	10		CS									
Ethylene Glycol	SV			d									
Fluoranthene	SV	10	10	CS					3,980(1)		42	54	
Fluorene	SV	10	10	CS									
Formaldehyde	SV												
Haloethers	SV								380(1)	122(1)			
Hexachlorobenzene	SV	10	10	CS							0.00072**	0.00074**	
Hexachlorobutadiene	SV	10	10	CS					90(1)	9.3(1)	0.45**	50**	
Hexachlorocyclopentadiene	SV	10	10	CS					7(1)	5.2(1)	206		
Hexachloroethane	SV	10	10	CS					980(1)	540(1)	1.9	8.74	
Hydrazine	SV												
Indeno(1,2,3-cd)pyrene	SV	10	10	CS									
Isophorone	SV	10	10	CS					117,000(1)		5,200	520,000	
Naphthalene	SV	10	10	CS					2,300(1)	620(1)			
Nitrobenzene	SV	10	10	CS					27,000(1)		19,800		
Nitrophenols	SV								230(1)	150(1)			
Nitrosamines	SV								5,850(1)				
Nitrosodibutylamine	SV		10	b							0.0064	0.587	
Nitrosodiethylamine	SV		10	b							0.0008	1.24	
Nitrosodimethylamine	SV		10	b							0.0014	16	
Nitrosopyrrolidine	SV		10	b							0.016	91.9	
N-Nitrosodiphenylamine	SV	10	10	b							4.9**	16.1**	
N-Nitroso-di-n-dipropylamine	SV	10	10	b									
Pentachlorinated Ethanes	SV			b					7,240(1)	1,100(1)			
Pentachlorobenzene	SV		10	b							74	85	
Pentachlorophenol	SV	50	50	CS		1(f)		0(f)	20(4)	13(4)	1,010		
Phenanthrene	SV	10	10	CS									
Phenol	SV	10	50	CS					10,200(1)	2,560(1)	3,500		
Phthalate Esters	SV			e					940(1)	3(1)			
Polynuclear Aromatic Hydrocarbons	SV		10	b							0.0028**	0.0311**	

TABLE 3.2. POTENTIAL CHEMICAL–SPECIFIC BENCHMARKS (February 1, 1992)
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Vinyl Chloride	SV	10	2	CV	2		0				2 **	525 **	
1,1,1–Trichloroethane	V	5	1	CV	200		200				18,400	1,030,000	
1,1,2,2–Tetrachloroethane	V	5	1	CV						2,400	0.17**	10.7 **	
1,1,2–Trichloroethane	V	5	1	CV						9,400	0.6**	41.8 **	
1,1–Dichloroethane	V	5		CV									
1,1–Dichloroethene	V	5	1	CV	7		7						
1,2–Dichloroethane	V	5	1	CV	5		0		118,000	20,000	0.94**	243 **	
1,2–Dichloroethene (cis)	V		1	a		70		70					
1,2–Dichloroethene (total)	V	5		CV									
1,2–Dichloroethene (trans)	V	5	1	a		100		100					
1,2–Dichloropropane	V	5	1	CV		5		0	23,000	5,700			
1,3–Dichloropropene (cis)	V	5	1	CV					6,060	244 (1)	87	14,100	
1,3–Dichloropropene (trans)	V	5	1	CV					6,060	244 (1)	87	14,100	
2–Butanone	V	10		CV									
2–Hexanone	V	10		CV									
4–Methyl–2–pentanone	V	10		CV									
Acetone	V	10		CV									
Acrylonitrile	V		5	c					7,500	2,600	0.058	0.65	
Benzene	V	5	1	CV	5		0		5,300		0.66**	40 **	
Bromodichloromethane	V	5	1	CV									
Bromoform	V	5	1	CV									
Bromomethane	V	10	1	CV									
Carbon Disulfide	V	5		CV									
Carbon Tetrachloride	V	5	1	CV	5		0		35,200 (1)		0.4**	6.94 **	
Chlorinated Benzenes	V	10		CV/CS					250 (1)	50 (1)			
Chlorobenzene	V	5	1	CV/CS		100		100					
Chloroethane	V	10		CV									
Chloroform	V	5	1	CV	Tot THM < 100 (2)				28,900 (1)	1,240 (1)	0.19 **	15.7 **	
Chloromethane	V	10	1	CV									
Dibromochloromethane	V	5	1	CV									
Dichloroethenes	V		1						11,600 (1)		0.033**	1.85 **	
Ethyl Benzene	V	5	1	CV		700		700	32,000 (1)		1,400	3,280	
Ethylene Dibromide	V			d		0.05		0					
Ethylene Oxide	V												
Halomethanes	V				100				11,000 (1)		0.19**	15.7 **	
Methylene Chloride	V	5	1	CV									
Pyrene	V	10	10	CS									
Styrene	V	5		CV		100		100					
Tetrachloroethanes	V	5	1	CV					9,320 (1)				
Tetrachloroethene	V	5	1	CV		5		0	5,280 (1)	840 (1)	0.80**	8.85 **	
Toluene	V	5	1	CV		1,000		1,000	17,500 (1)		14,300	424,000	
Trichloroethanes	V	5	1	CV					18,000 (1)				
Trichloroethene	V	5	1	CV	5		0		45,000 (1)	21,900 (1)	2.7 **	80.7 **	
Vinyl Acetate	V	10		CV									
Xylenes (total)	V	5		CV		10,000		10,000					

TABLE 3.2. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992)
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Parameter	Type (7)	PQL MDL RFP	PQL MDL CDH	Method (8)	SDWA Maximum Contaminant Levels (a)	SDWA Maximum Contaminant Levels (b)	SDWA Maximum Contaminant Level Goals (a)	SDWA Maximum Contaminant Level Goals (b)	CWA AWQC for Protection of Aquatic Life (c) Acute Value	CWA AWQC for Protection of Aquatic Life (c) Chronic Value	CWA AWQC for Protection of Human Health (c) Water and Fish Ingestion	CWA AWQC for Protection of Human Health (c) Fish Consumption Only	NRC Effluent Standards Water pCi/L
Acenaphthene	SV	10	10	CV					1700	520	20	90	
Acenaphthylene	SV	10	10	CV									
Acetone	V	10	10	CV									
Acrolein	V	50	50	CV					68	21	320	780	
Acrylonitrile	V	50	50	CV							0.059	0.66	
Aldrin	P	0.05	0.05	CV					3		0.00013	0.00014	
Ammonia	B	100	100	CV					1460	58			
Anthracene	SV	10	10	CV							9600	110000	
Antimony	M	60	60	CV	6	146	6	146	9000	1600	14	4300	
Arsenic	M	10	10	CV	50	50	50	50	360	190	0.0022	0.14	
Asbestos	M	10	10	CV	7 MFL	7 MFL	7 MFL	7 MFL					
Barium	M	200	200	CV	1000	1000	1000	1000					
Benzene	V	5	5	CV	5	5	0	0			0.58	14	
Benzidine	SV	50	50	CV							0.00012	0.00054	
Benzo(a)anthracene	SV	10	10	CV							0.0028	0.0311	
Benzo(a)pyrene	SV	10	10	CV	0.2	0.2	0	0			0.0028	0.0311	
Benzo(b)fluoranthene	SV	10	10	CV							0.0028	0.0311	
Benzo(ghi)perylene	SV	10	10	CV									
Benzo(k)fluoranthene	SV	10	10	CV							0.0028	0.0311	
Beryllium	M	5	5	CV	4	4	4	4			0.0068	0.117	
Bis(2-chloroethyl)ether	SV	10	10	CV							0.03	1.4	
Bis(2-chloroisopropyl)ether	SV	10	10	CV							1400	170000	
Bis(2-ethylhexyl)phthalate	SV	10	10	CV							1.2	5.9	
Bromodichloromethane	V	5	5	CV							0.27	17	
Bromoform	V	5	5	CV							4.3	140	
Bromomethane	V	10	10	CV							4.0	1500	
Butylbenzylphthalate	SV	10	10	CV							1500	1900	
Cadmium	M	5	5	CV	5	5	5	5	3.9	1.1	0.0093	0.0102	
Carbon tetrachloride	V	5	5	CV	5	5	0	0			0.25	1.6	
Chlordane	P	0.05	0.05	CV	2	2	0	0	2.4	0.0043	0.00057	0.00059	
Chloride	A	500	500	CV	250000*	250000*			860000	230000			
Chlorobenzene	V	5	5	CV	100	100	100	100			488	21000	
Chlorodibromomethane	V	5	5	CV							0.41	13	
Chloroethane	V	10	10	CV									
Chloroform	V	5	5	CV							5.7	470	
Chloromethane	V	10	10	CV									
Chlorophenol, 2-	SV	10	10	CV							150	400	
Chlorophenoxy Herbicide (2,4,5-TP)	P	1	1	CV	50	10	50	10					
Chlorophenoxy Herbicide (2,4-D)	P	1	1	CV	70	100	70	100					
Chromium (III)	M	10	10	CV	100	100	100	100	1700	210			
Chromium (VI)	M	10	10	CV	100	100	100	100	16	11	50	810	
Chrysene	SV	10	10	CV							0.0028	0.0311	
Cobalt	M	50	50	CV									
Copper	M	25	25	CV	1000*	1000*	1300	1300	18	12	1000	1300	
Cyanide	A	10	10	CV	200	200	200	200	22	5.2	140000	220000	
Dalapon	P	10	10	CV	200	200	200	200					
Dibenzo(a,h)anthracene	SV	10	10	CV							0.0028	0.0311	
Dibromochloromethane	V	5	5	CV							0.4	13	
Dibromochloropropane	P	0.05	0.05	CV	0.2	0.2	0	0					
Dibromomethane	V	10	10	CV									
Dichlorobenzene, 1,2-	V	5	5	CV	600	600	600	600			1300	17000	
Dichlorobenzene, 1,3-	V	5	5	CV							960	2600	
Dichlorobenzene, 1,4-	V	5	5	CV	75	75	75	75			190	2600	
Dichlorobenzidine, 3,3-	SV	50	50	CV							0.021	0.028	
Dichlorodifluoromethane	V	10	10	CV									
Dichloroethane, 1,1-	V	5	5	CV									
Dichloroethane, 1,2-	V	5	5	CV	5	5	0	0			0.94	37	
Dichloroethene, 1,1-	V	5	5	CV	7	7	7	7			0.057	3.2	
Dichloroethene, cis-1,2-	V	5	5	CV	70	70	70	70					
Dichloroethene, trans-1,2-	V	5	5	CV	100	100	100	100			140	4200	
Dichlorophenol, 2,4-	SV	10	10	CV							290	790	
Dichloropropane, 1,2-	V	5	5	CV	5	5	0	0			0.5	15	
Dichloropropene, 1,3-	V	5	5	CV							0.34	21	
Dieldrin	P	0.05	0.05	CV					0.24	0.056	0.00014	0.00014	
Diethylphthalate	SV	10	10	CV							17000	44000	
Dimethylphthalate	SV	10	10	CV							270000	1100000	
Dinitrophenol, 2,4-	SV	50	50	CV							5300	14000	
Dinitrotoluene, 2,4-	SV	10	10	CV							0.11	9.1	
Dinitrotoluene, 2,6-	SV	10	10	CV									
Dioxin (2,3,7,8-TCDD)	P	0.00001	0.00001	CV	0.00003	0.00003	0	0			5.1E-08	5.1E-08	
Diphenylhydrazine, 1,2-	SV	10	10	CV							0.2	2.1	
Endosulfan	P	0.05	0.05	CV					0.22	0.056	62	89	
Endrin	P	0.05	0.05	CV	2	2	2	2	0.18	0.0023	0.76	0.81	
Ethylbenzene	V	5	5	CV	700	700	700	700			1400	29000	
Fluoranthene	SV	10	10	CV							130	140	
Fluorene	SV	10	10	CV							1300	5300	
Fluoride	A	500	500	CV	4000	4000	4000	4000					
Gross Alpha	R	1 pCi/l	1 pCi/l	CV	15 pCi/l	15 pCi/l	0	0					
Heptachlor	P	0.05	0.05	CV	0.4	0.4	0	0	0.52	0.0038	0.00021	0.00021	
Heptachlor epoxide	P	0.05	0.05	CV	0.2	0.2	0	0	0.52	0.0038	0.00010	0.00011	
Hexachlorobenzene	P	0.05	0.05	CV	1	1	0	0			0.00028	0.00029	
Hexachlorobutadiene	V	5	5	CV					90	9.3	0.44	18	
Hexachlorocyclohexane, Alpha-	P	0.05	0.05	CV							0.0039	0.0123	
Hexachlorocyclohexane, Beta-	P	0.05	0.05	CV							0.0137	0.0431	
Hexachlorocyclohexane, Gamma- (Lindane)	P	0.05	0.05	CV	0.2	0.2	0.2	0.2	2	0.08	1.8	1.8	
Hexachlorocyclopentadiene	V	5	5	CV	50	50	50	50			206	1100	
Hexachloroethane	V	5	5	CV							0.8	3.3	
Indeno(1,2,3-cd)pyrene	SV	10	10	CV							0.0028	0.0311	
Isophorone	SV	10	10	CV							35	960	
Lead	M	5	5	CV	50	50	0	0	82	3.2			
Manganese	M	15	15	CV									
Mercury	M	0.2	0.2	CV	2	2	2	2	2.4	0.012	0.144	0.146	
Methoxychlor	P	0.05	0.05	CV	40	40	40	40		0.03			
Methylene chloride	V	5	5	CV	5	5	0	0			4.7	590	
Methylmercury	M	0.2	0.2	CV									
Naphthalene	SV	10	10	CV									
Nickel	M	40	40	CV					1400	160	100	610	
Nitrate	A	100	100	CV	10000	10000	10000	10000					
Nitrobenzene	SV	10	10	CV							17	1900	
Nitrosodibutylamine, N-	SV	10	10	CV							0.063	0.22	
Nitrosodiethylamine, N-	SV	10	10	CV							0.008	1.24	
Nitrosodimethylamine, N-	SV	10	10	CV							0.003	1.24	
Nitrosodiphenylamine, N-	SV	10	10	CV							5	16	
Nitrosodipropylamine, N-	SV	10	10	CV							0.005	0.38	
Nitrosopyrrolidine, N-	SV	10	10	CV							0.016	3.4	
Pentachlorophenol	P	0.05	0.05	CV	1	1	0	0	20	13	0.27	3.0	
Phenanthrene	SV	10	10	CV									
Phenol	SV	10	10	CV							10000	860000	
Pyrene	SV	10	10	CV							960	11000	
Radium 226 + 228	R	1 pCi/l	1 pCi/l	CV	5 pCi/l	5 pCi/l	0	0					
Selenium	M	5	5	CV	50	50	50	50	20	5	10	42	
Silver	M	10	10	CV	50*	50*			4.1		50		
Styrene	V	5	5	CV	100	100	100	100			2100	42000	
Sulfate	A	500	500	CV	250000*	250000*							
Tetrachloroethane, 1,1,2,2-	V	5	5	CV							0.17	4.0	
Tetrachloroethene	V	5	5	CV	5	5	0	0			0.8	8.85	
Thallium	M	10	10	CV	2	13	0.5	13	1400	40	0.24	0.47	
Toluene	V	5	5	CV	1000	1000	1000	1000			14300	424000	
Toxaphene	P	0.05	0.05	CV	3	3	0	0	0.73	0.0002	0.00073	0.00075	
Trichlorobenzene, 1,2,4-	V	5	5	CV	70	70	70	70			70	940	
Trichloroethane, 1,1,1-	V	5	5	CV	200	200	200	200			18400	1030000	
Trichloroethane, 1,1,2-	V	5	5	CV	5	5	3	5			0.6	16	
Trichloroethene	V	5	5	CV	5	5	0	0			2.7	81	
Trichlorofluoromethane	V	10	10	CV									
Trichlorophenol, 2,4,5-	SV	10	10	CV							1800	3600	
Trichlorophenol, 2,4,6-	SV	10	10	CV							2.1	2.4	
Trichlorophenoxy Herbicide (2,4,5-TP)	P	1	1	CV	50	10	50	10					
Vanadium	M	50	50	CV									
Vinyl chloride	V	5	5	CV	2	2	0	0			2	525	
Xylenes	V	5	5	CV	10000	10000	10000	10000					
Zinc	M	20	20	CV	5000*	5000*			120	110	5000	9400	

EXPLANATION OF TABLE

* = secondary maximum contaminant level

** = Human health criteria for carcinogens reported for three risk levels. Value presented is the 10-5 risk level.

AWQC	= Ambient Water Quality Criteria
CLP	= Contract Laboratory Program
CWA	= Clean Water Act
EPA	= Environmental Protection Agency
pCi/l	= picocuries per liter
PCB	= polychlorinated biphenyl
PQL	= Practical Quantitation Level
SDWA	= Safe Drinking Water Act
SS	= Species Specific
TAL	= Target Analyte List
THM	= Total Trihalomethanes
TIC	= Tentatively Identified Compound
MDL	= Minimum Detection Limit for radionuclides (pCi/l)
ug/l	= micrograms per liter
VOA	= Volatile Organic Analysis

(1) criteria not developed; value presented is lowest observed effects level (LOEL)
(2) total trihalomethanes: chloroform, bromoform, bromodichloromethane, dibromochloromethane
(3) hardness dependent criteria
(4) pH dependent criteria (7.8 pH used)
(5) standard is not adequately protective when chloride is associated with potassium, calcium, or magnesium, rather than sodium.
(6) if both strontium-90 and tritium are present, the sum of their annual dose equivalents to bone marrow shall not exceed 4 mrem/yr.
(7) type abbreviations are: A=anion; B=bacteria; C=cation; D=dioxin; E=element; I=indicator; FP=field parameter; M=metal; P=pesticide; PP=pesticide/PCB; R=radionuclide; SV=semi-volatile; V=volatile
(8) method abbreviations are: CT=CLP-TAL; NC=non-CLP; CV=CLP-VOA; CS=CLP-SEMI; EP=EPA-PEST; CP=CLP-PEST; E=EPA; a = detected as total in CV; b = detected as TIC in CS; c = detected as TIC in CV; d = not routinely monitored; e = monitored in discharge ponds; f = mixture-individual isomers detected.
(9) MDL for radium 226 is 0.5; MDL for radium 228 is 1.0
(10) Value for gross alpha excludes uranium

(a) EPA National Primary and Secondary Drinking Water Regulations, 40 CFR 141 and 40 CFR 143 (as of May 1990).
(b) EPA National Primary and Secondary Drinking Water Regulations, 40 CFR Parts 141, 142 and 143, Final Rule, effective July 30, 1992 (56 Federal Register 3526; 1/30/1991).
(c) EPA, Quality Criteria for Protection of Aquatic Life, 1986
(d) EPA, National Ambient Water Quality Criteria for Selenium - 1987
(e) EPA, National Ambient Water Quality Criteria for Chloride - 1988
(f) EPA National Primary and Secondary Drinking Water Regulations, 40 CFR Parts 141, 142, and 143, Final Rule (56 FR 30266; 7/1/1991) effective 1/1/1993.
(g) EPA Maximum Contaminant Level Goals and National Primary Drinking Water Regulations for Lead and Copper, 40 CFR 141 and 142 (56 FR 26460; 6/7/1991) effective 12/7/91.

TABLE 3.3. POTENTIAL CHEMICAL–SPECIFIC BENCHMARKS (February 1, 1992)
STATEWIDE AND BASINWIDE (CDH/CWQCC) SURFACE WATER QUALITY STANDARDS (ug/l)

					Statewide Standards (a)								Basin Standards (b)	
					Human Health Carcinogens/ Noncarcinogens (2) (6)		Aquatic Life (5)		Tables I,II,III (1) Aquatic Life				Organics (7)	
Parameter	Type (5)	PQL MDL RFP	PQL MDL CDH	Method (6)	Water Supply	Water and Fish	Acute Value	Chronic Value	Acute Value (2)	Chronic Value (2)	Agricultural Standard (3)	Domestic Water Supply (4)	Aquatic Life	Water Supply
Bicarbonate	A	10,000		E310.1										
Carbonate	A	10,000		E310.1										
Chloride	A	5,000		E325								250,000		
Chlorine	A	1,000		E4500					19	11				
Fluoride	A	5,000		E340								2,000		
N as Nitrate	A	5,000		E353.1							100,000	10,000		
N as Nitrate + Nitrite	A	5,000		E353.1							100,000	10,000		
N as Nitrite	A	5,000		E354.1					SS	SS	10,000	1,000		
Sulfate	A	5,000		E375.4								250,000		
Sulfide	A									2		50		
Coliform (Fecal)	B	1		SM9221C								2000/100 ml		
Ammonia as N	C	5,000		E350					620	60		500		
Dioxin	D			d	0.00000022	0.000000013	0.01	0.00001						
Sulfur	E	100,000		E600										
Dissolved Oxygen	FP	500		SM4500					5,000	5,000	3,000	3,000		
pH	FP	0.1		E150.1					6.5–9.0	6.5–9.0		5.0–9.0		
Specific Conductance	FP	1		E120.1										
Temperature	FP								30 degrees	30 degrees				
Boron	I	5,000		E6010							750			
Total Dissolved Solids	I	10,000		E160.1										
Aluminum	M	200		CT					750	87				
Antimony	M	60		CT								14		
Arsenic	M	10		CT					360	150	100	50		
Arsenic III	M													
Arsenic V	M													
Barium	M	200		CT								1,000		
Beryllium	M	5		CT							100	0.0076		
Cadmium	M	5		CT					TVS	TVS	10	10		
Calcium	M	5,000		CT										
Cesium	M	1,000		NC										
Chromium	M	10		CT										
Chromium III	M	5		SW8467196					TVS	TVS	100	50		
Chromium VI	M	10		E218.5					16	11	100	50		
Cobalt	M	50		CT										
Copper	M	25		CT					TVS	TVS	200	1,000		
Cyanide	M	10		CT					5	5	200	200		
Iron	M	100		CT						1,000		300 (dis)		
Lead	M	5		CT					TVS	TVS	100	50		
Lithium	M	100		NC										
Magnesium	M	5000		CT										
Manganese	M	15		CT						1,000	200	50 (dis)		
Mercury	M	0.2		CT					2.4	0.1		2.0		
Molybdenum	M	200		NC										
Nickel	M	40		CT					TVS	TVS	200			
Potassium	M	5000		CT										
Selenium	M	5		CT					135	17	20	10		
Silver	M	10		CT					TVS	TVS		50		
Sodium	M	5000		CT										
Strontium	M	200		NC										
Thallium	M	10		CT						15		0.012		
Tin	M	200		NC										

TABLE 3.3. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992)
STATEWIDE AND BASINWIDE (CDH/CWQCC) SURFACE WATER QUALITY STANDARDS (ug/l)

					Statewide Standards (a)								Basin Standards (b)	
					Human Health Carcinogens/ Noncarcinogens (2) (8)		Aquatic Life (8)		Tables I,II,III (1) Aquatic Life				Organics (7)	
Parameter	Type (5)	PQL MDL RFP	PQL MDL CDH	Method (6)	Water Supply	Water and Fish	Acute Value	Chronic Value	Acute Value (2)	Chronic Value (2)	Agricultural Standard (3)	Domestic Water Supply (4)	Aquatic Life	Water Supply
Titanium	M	10		E6010										
Tungsten	M	10		E6010										
Vanadium	M	50		CT										
Zinc	M	20		CT					TVS	TVS	2,000	5,000		
2,4,5-TP Silvex	P		0.5	d	50									
2,4-D	P		1	d	70									100
Acrolein			10			320	68	21						
Aldicarb	P		10		10									
Aldrin	P	0.05	0.1	CP	0.002(8)	0.00013	1.5						0.003	
Bromacil	P													
Carbofuran	P			d	36									
Chloranil	P			E619										
Chlordane (Alpha)	P	0.5	1	CP	0.03(8)		1.2	0.0043						
Chlordane (Gamma)	P	0.5	1	CP	0.03(8)	0.00058	1.2	0.0043						
Chlorpyrifos	P		0.1				0.083	0.041						
DDT	P	0.1	0.1	CP	0.1	0.00059	0.55	0.001					0.001	
DDT Metabolite (DDD)	P	0.1	0.1	CP		0.0008	0.6						0.001	
DDT Metabolite (DDE)	P	0.1	0.1	CP	0.1	0.00059	1,050						0.001	
Demeton	P		1					0.1					0.1	
Diazinon	P													
Dieldrin	P	0.1	0.1	CP	0.002	0.00014	1.3	0.0019					0.003	
Endosulfan I	P	0.05	0.1	CP		0.93	0.11	0.056					0.003	
Endosulfan II	P	0.1	0.1	CP										
Endosulfan Sulfate	P	0.1	0.1	CP		0.93								
Endrin	P	0.1	0.1	CP	0.2		0.09	0.0023					0.004	
Endrin Aldehyde	P		0.1		0.2	0.2								
Endrin Ketone	P	0.1		CP										
Guthion	P		1.5					0.01					0.01	
Heptachlor	P	0.05	0.05	CP	0.008	0.00021	0.26	0.0038					0.001	0.2
Heptachlor Epoxide	P	0.05	0.05	CP	0.09	0.0001	0.26	0.0038						
Hexachlorocyclohexane, Alpha	P	0.05	0.05	CP	0.006		0.0039							
Hexachlorocyclohexane, Beta	P	0.05	0.05	CP		0.014								
Hexachlorocyclohexane, BHC	P	0.05	0.05				100							
Hexachlorocyclohexane, Delta	P	0.05		CP										
Hexachlorocyclohexane, Tech.	P		0.2	f		0.012								
Hexachlorocyclohexane, Lindane	P	0.05	0.05	CP	0.2	0.019	1.0	0.08					0.01	4.0
Malathion	P		0.2					0.1					0.1	
Methoxychlor	P	0.5	0.5	CP	40			0.03					0.03	100
Mirex	P		0.1					0.001					0.001	
Parathion	P												0.04	
PCBs	P	0.5	1	CP	0.005	0.000044	2.0	0.014					0.001	
Simazine	P			e										
Toxaphene	P	1	5	CP	0.03	0.00073	0.73	0.0002					0.005	5.0
Vaponite 2	P													
Aroclor 1016	PP	0.5		CP										
Aroclor 1221	PP	0.5		CP										
Aroclor 1232	PP	0.5		CP										
Aroclor 1242	PP	0.5		CP										
Aroclor 1248	PP	0.5		CP										
Aroclor 1254	PP	1		CP										
Aroclor 1260	PP	1		CP										
Atrazine	PP			e										

TABLE 3.3. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992)
STATEWIDE AND BASINWIDE (CDH/CWQCC) SURFACE WATER QUALITY STANDARDS (ug/l)

					Statewide Standards (a)								Basin Standards (b)	
					Human Health Carcinogens/ Noncarcinogens (2) (8)		Aquatic Life (8)		Tables I,II,III (1) Aquatic Life				Organics (7)	
Parameter	Type (5)	PQL MDL RFP	PQL MDL CDH	Method (6)	Water Supply	Water and Fish	Acute Value	Chronic Value	Acute Value (2)	Chronic Value (2)	Agricultural Standard (3)	Domestic Water Supply (4)	Aquatic Life	Water Supply
Americium (pCi/l)	R													
Americium 241 (pCi/l)	R	0.01												
Cesium 134 (pCi/l)	R	1			80 (10)									
Cesium 137 (pCi/l)	R	1												
Gross Alpha (pCi/l)	R	2												
Gross Beta (pCi/l)	R	4												
Plutonium (pCi/l)	R													
Plutonium 238+239+240 (pCi/l)	R	0.01			15 (10)									
Radium 226+228 (pCi/l)	R	0.5/1 (9)			5 (10)									
Strontium 89+90 (pCi/l)	R	1												
Strontium 90 (pCi/l)	R				8 (10)									
Thorium 230+232 (pCi/l)	R				60 (10)									
Tritium (pCi/l)	R				20,000 (10)									
Uranium 233+234 (pCi/l)	R													
Uranium 235 (pCi/l)	R	0.6												
Uranium 238 (pCi/l)	R	0.6												
Uranium (Total) (pCi/l)	R								TVS	TVS				
1,2,4,5-Tetrachlorobenzene	SV		10	b	2 (8)									
1,2,4-Trichlorobenzene	SV	10		CS										
1,2-Dichlorobenzene (Ortho)	SV	10	1	CS	620	620								
1,2-Diphenylhydrazine	SV			b	0.05	0.04	270							
1,3-Dichlorobenzene (Meta)	SV	10	1	CS	620	400								
1,4-Dichlorobenzene (Para)	SV	10	1	CS	75	75								
2,4,5-Trichlorophenol	SV	50		CS										
2,4,6-Trichlorophenol	SV	10	50	CS	2	2		970						
2,4-Dichlorophenol	SV	10	50	CS	21	21	2,020	365						
2,4-Dimethylphenol	SV	10	50	CS			2,120							
2,4-Dinitrophenol	SV	50	50	CS	14	14								
2,4-Dinitrotoluene	SV	10	10	CS		0.11								
2,6-Dinitrotoluene	SV	10	10	CS			330	230						
2-Chloronaphthalene	SV	10		CS										
2-Chlorophenol	SV	10	50	CS			4,380	2,000						
2-Methylnaphthalene	SV	10		CS										
2-Methylphenol	SV	10		CS										
2-Nitroaniline	SV	50		CS										
2-Nitrophenol	SV	10		CS										
3,3-Dichlorobenzidine	SV	20	10	CS		0.039								
3-Nitroaniline	SV	50		CS										
4,6-Dinitro-2-methylphenol	SV	50	50	CS		13								
4-Bromophenyl Phenylether	SV	10		CS										
4-Chloroaniline	SV	10		CS										
4-Chlorophenyl Phenyl Ether	SV	10		CS										
4-Chloro-3-methylphenol	SV	10	50	CS			30							
4-Methylphenol	SV	10		CS										
4-Nitroaniline	SV	50		CS										
4-Nitrophenol	SV	50		CS										
Acenaphthene	SV	10	10	CS			1,700	520						
Anthracene	SV	10	1	CS		0.0028								
Benzidine	SV		10	d	0.0002	0.00012 (8)	2,500						0.1	0.01
Benzoic Acid	SV	50		CS										
Benzo(a)anthracene	SV	10	10	CS		0.0028								
Benzo(a)pyrene	SV	10	10	CS		0.0028								
Benzo(b)fluoranthene	SV	10	10	CS		0.0028								

TABLE 3.3. POTENTIAL CHEMICAL–SPECIFIC BENCHMARKS (February 1, 1992)
STATEWIDE AND BASINWIDE (CDH/CWQCC) SURFACE WATER QUALITY STANDARDS (ug/l)

					Statewide Standards (a)							Basin Standards (b)	
					Human Health Carcinogens/ Noncarcinogens (2) (8)	Aquatic Life (8)		Tables I,II,III (1)				Organics (7)	
								Aquatic Life					
Parameter	Type (5)	PQL RFP	PQL CDH	Method (6)	Water Supply	Water and Fish	Acute Value	Chronic Value	Acute Value (2)	Chronic Value (2)	Agricultural Standard (3)	Domestic Water Supply (4)	Aquatic Life	Water Supply
Benzo(g,h,i)perylene	SV	10	10	CS		0.0028								
Benzo(k)fluoranthene	SV	10	10	CS		0.0028								
Benzyl Alcohol	SV	10		CS										
bis(2–Chloroethoxy)methane	SV	10		CS										
bis(2–Chloroethyl)ether	SV	10	10	CS	0.03(8)	0.03(8)								
bis(2–Chloroisopropyl)ether	SV	10	10	CS		1,400								
bis(2–Ethylhexyl)phthalate	SV	10	10	CS		1.8(8)								
Butadiene	SV													
Butyl Benzylphthalate	SV	10	10	CS		3,000								
Chlorinated Ethers	SV													
Chlorinated Napthalenes	SV													
Chloroalkylethers	SV	10		CS										
Chlorophenol	SV		50										1.0	1.0
Chrysene	SV	10	10	CS		0.0028								
Dibenzofuran	SV	10		CS										
Dibenz(a,h)anthracene	SV	10	10	CS		0.0028								
Dichlorobenzenes	SV		1											
Dichlorobenzidine	SV	20	10	CS		0.039								
Diethylphthalate	SV	10	10	CS		23,000								
Dimethylphthalate	SV	10	10	CS		313,000								
Di–n–butylphthalate	SV	10	10	CS		2,700								
Di–n–octylphthalate	SV	10		CS										
Ethylene Glycol	SV			d										
Fluoranthene	SV	10	10	CS		42	3,980							
Fluorene	SV	10	10	CS		0.0028								
Formaldehyde	SV													
Haloethers	SV													
Hexachlorobenzene	SV	10	10	CS	6	0.00072								
Hexachlorobutadiene	SV	10	10	CS	1	0.45	90	9.3						
Hexachlorocyclopentadiene	SV	10	10	CS		240	7	5						
Hexachloroethane	SV	10	10	CS		1.9	980	540						
Hydrazine	SV													
Indeno(1,2,3–cd)pyrene	SV	10	10	CS		0.0028								
Isophorone	SV	10	10	CS	1,050	8.4	117,000							
Naphthalene	SV	10	10	CS		0.0028	2,300	620						
Nitrobenzene	SV	10	10	CS	3.5	3.5	27,000							
Nitrophenols	SV													
Nitrosamines	SV													
Nitrosodibutylamine	SV		10	b		0.0064								
Nitrosodiethylamine	SV		10	b		0.0008								
Nitrosodimethylamine	SV		10	b		0.00069								
Nitrosopyrrolidine	SV		10	b		0.016								
N–Nitrosodiphenylamine	SV	10	10	CSb		4.9								
N–Nitroso–di–n–dipropylamine	SV	10	10	CSb		0.005								
Pentachlorinated Ethanes	SV			b										
Pentachlorobenzene	SV		10	b	6(8)									
Pentachlorophenol	SV	50	50	CS	200		9	5.7						
Phenanthrene	SV	10	10	CS		0.0028								
Phenol	SV	10	50	CS		21,000	10,200	2,560					500	1.0
Phthalate Esters	SV			e										
Polynuclear Aromatic Hydrocarbons	SV		10	b		0.0028								
Vinyl Chloride	SV	10	2	CV	2	2								
1,1,1–Trichloroethane	V	5	1	CV	200	200								

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STATEWIDE AND BASINWIDE (CDH/CWQCC) SURFACE WATER QUALITY STANDARDS (ug/l)

					Statewide Standards (a)								Basin Standards (b)	
					Human Health Carcinogens/ Noncarcinogens (2) (8)		Aquatic Life (8)		Tables I,II,III (1) Aquatic Life				Organics (7)	
Parameter	Type (5)	PQL MDL RFP	PQL MDL CDH	Method (6)	Water Supply	Water and Fish	Acute Value	Chronic Value	Acute Value (2)	Chronic Value (2)	Agricultural Standard (3)	Domestic Water Supply (4)	Aquatic Life	Water Supply
1,1,2,2-Tetrachloroethane	V	5	1	CV		0.17		2,400						
1,1,2-Trichloroethane	V	5	1	CV	3	0.6	9,400							
1,1-Dichloroethane	V	5		CV										
1,1-Dichloroethene	V	5	1	CV	7	0.057								
1,2-Dichloroethane	V	5	1	CV	0.4	0.4	118,000	20,000						
1,2-Dichloroethene (cis)	V		1	a	70									
1,2-Dichloroethene (total)	V	5		CV										
1,2-Dichloroethene (trans)	V	5	1	a	100									
1,2-Dichloropropane	V	5	1	CV	0.56(8)	0.56	23,000	5,700						
1,3-Dichloropropene (cis)	V	5	1	CV		10	6,060	244						
1,3-Dichloropropene (trans)	V	5	1	CV		10	6,060	244						
2-Butanone	V	10		CV										
2-Hexanone	V	10		CV										
4-Methyl-2-pentanone	V	10		CV										
Acetone	V	10		CV										
Acrylonitrile	V		5	c		0.58	7,550	2,600						
Benzene	V	5	1	CV	1	1	5,300							
Bromodichloromethane	V	5	1	CV	0.3	0.3								
Bromoform	V	5	1	CV	4	4								
Bromomethane	V	10	1	CV		48								
Carbon Disulfide	V	5		CV										
Carbon Tetrachloride	V	5	1	CV	0.3	0.25	35,200							
Chlorinated Benzenes	V	10		CV/CS										
Chlorobenzene	V	5	1	CV/CVS	100	100								
Chloroethane	V	10		CV										
Chloroform	V	5	1	CV	6	6	28,900	1,240						
Chloromethane	V	10	1	CV		5.7								
Dibromochloromethane	V	5	1	CV	14	6								
Dichloroethenes	V		1											
Ethyl Benzene	V	5	1	CV	680	3,100	32,000							
Ethylene Dibromide	V			d										
Ethylene Oxide	V													
Halomethanes	V				100									
Methylene Chloride	V	5	1	CV		4.7								
Pyrene	V	10	10	CS		0.0028								
Styrene	V	5		CV										
Tetrachloroethanes	V	5	1	CV										
Tetrachloroethene	V	5	1	CV	5	0.8	5,280	840						
Toluene	V	5	1	CV	1,000	1,000	17,500							
Trichloroethanes	V	5	1	CV										
Trichloroethene	V	5	1	CV	5	2.7	45,000	21,900						
Vinyl Acetate	V	10		CV										
Xylenes (Total)	V	5		CV										

TABLE 3.3. POTENTIAL CHEMICAL–SPECIFIC BENCHMARKS (February 1, 1992)
STATEWIDE AND BASINWIDE (CDH/CWQCC) SURFACE WATER QUALITY STANDARDS (ug/l)

				Statewide Standards (a)							Basin Standards (b)	
				Human Health Carcinogens/ Noncarcinogens (2) (8)		Aquatic Life (8)		Tables I,II,III (1) Aquatic Life			Organics (7)	
Parameter	Type (5)	PQL MDL RFP	PQL MDL CDH	Method (6)	Water Supply	Water and Fish	Acute Value	Chronic Value	Acute Value (2)	Chronic Value (2)	Agricultural Standard (3)	Domestic Water Supply (4)	Aquatic Life	Water Supply

EXPLANATION OF TABLE

CLP	= Contract Laboratory Program
CDH	= Colorado Department of Health
dis	= dissolved
EPA	= Environmental Protection Agency
pCi/l	= *picocuries per liter*
PCB	= polychlorinated biphenyl
PQL	= Practical Quantitation Level
SS	= species specific
TAL	= Target Analyte List
THM	= Total Trihalomethanes
TIC	= Tentatively Identified Compound
TVS	= Table Value Standard (hardness dependent), see Table III in (a)
MDL	= Minimum Detection Limit for radionuclides (pCi/l)
ug/l	= micrograms per liter
VOA	= Volatile Organic Analysis
CWQCC	= Colorado Water Quality Control Commission

(1) Table I = physical and biological parameters
Table II = inorganic parameters
Table III = metal parameters
Values in Tables I, II, and III for recreational uses, cold water biota and domestic water supply are not included.
(2) In the absence of specific, numeric standards for non–naturally occurring organics, the narrative standard is interpreted as zero with enforcement based on practical quantification levels (PQLs) as defined by CDH/WQCC or EPA
(3) All are 30–day standards except for nitrate+nitrite
(4) Ammonia, sulfide, chloride, sulfate, copper, iron, manganese, and zinc are 30–day standards, all others are 1–day standards
(5) type abbreviations are: A=anion; B=bacteria; C=cation; I=indicator; FP=field parameter; M=metal; P= pesticide; PP=pesticide/PCB; R=radionuclide; SV=semi–volatile; V=volatile
(6) method abbreviations are: CT=CLP–TAL; NC=non–CLP; CV=CLP–VOA; CS=CLP–SEMI; EP=EPA–PEST; CP=CLP–PEST; E=EPA; *a = detected as total in CV; b = detected as TICs in CS; c = detected as TIC in CV; d = not routinely monitored; e = monitored in discharge ponds; f = mixture–individual isomers detected.*
(7) See Section 3.8.5 (2)(a) in (b)
(8) Where standard is below (more stringent than) PQL (CDH), PQL is standard.
(9) MDL for Radium 226 is 0.5; MDL for Radium 228 is 1.0
(10) See section 3.1.11 (f) (2) in (a)

(a) CDH/CWQCC, Colorado Water Quality Standards 3.1.0 (5 CCR 1002–8) 1/15/1974; amended 10/17/1991 (ARAR). (Environmental Reporter 726:1001–1020:6/1990)
(b) CDH/CWQCC, Classifications and Numeric Standards for S. Platte River Basin, Laramie River Basin, Republican River Basin, Smoky Hill River Basin 3.8.0 (5 CCR 1002–8) 4/6/1981; amended 2/15/1990 – Basin–wide standards are ARAR.

TABLE 3.4. POTENTIAL CHEMICAL–SPECIFIC BENCHMARKS (February 1, 1992)
STREAM SEGMENT (CDH/CWQCC) SURFACE WATER QUALITY STANDARDS (ug/l)

					Segment 4 & 5 Stream Classification and Water Quality Standards (b)(4)						
		PQL MDL			Tables A,B (1)	Table C Fish & Water Ingestion	Table D Radio-nuclide	Stream Segment Table (5)		Table 2 Radionuclides	
Parameter	Type (5)	RFP	CDH	Method (6)				Acute Value	Chronic Value	Woman Creek	Walnut Creek
Bicarbonate	A	10,000		E310.1							
Carbonate	A	10,000		E310.1							
Chloride	A	5,000		E325				250,000	250,000		
Chlorine	A	1,000		E4500				3	3		
Fluoride	A	5,000		E340							
N as Nitrate	A	5,000		E353.1				10,000	10,000		
N as Nitrate+Nitrite	A	5,000		E353.1							
N as Nitrite	A	5,000		E354.1				1,000	1,000		
Sulfate	A	5,000		E375.4				250,000	250,000		
Sulfide	A										
Coliform (Fecal)	B	1		SM9221C							
Ammonia as N	C	5,000		E350				620	60		
Dioxin	D			d	0.00000022	0.000000013			0.000000013		
Sulfur	E	100,000		E600				2.0	2.0		
Dissolved Oxygen	FP	500		SM4500				5,000	5,000		
pH	FP	0.1		E150.1				6.5–9	6.5–9		
Specific Conductance	FP	1		E120.1							
Temperature	FP										
Boron	I	5,000		E6010				750	750		
Total Dissolved Solids	I	10,000		E160.1							
Aluminum	M	200		CT							
Antimony	M	60		CT							
Arsenic	M	10		CT				50			
Arsenic III	M										
Arsenic V	M										
Barium	M	200		CT							
Beryllium	M	5		CT							
Cadmium	M	5		CT				TVS	TVS		
Calcium	M	5,000		CT							
Cesium	M	1,000		NC							
Chromium	M	10		CT							
Chromium III	M	5		SW8467196				50			
Chromium VI	M	10		E218.5				TVS	TVS		
Cobalt	M	50		CT							
Copper	M	25		CT				TVS	TVS		
Cyanide	M	10		CT				5	5		
Iron	M	100		CT					300 (3)		
Lead	M	5		CT				TVS	TVS		
Lithium	M	100		NC							
Magnesium	M	5000		CT							
Manganese	M	15		CT					50 (3)		
Mercury	M	0.2		CT					0.01		
Molybdenum	M	200		NC							

TABLE 3.4. POTENTIAL CHEMICAL–SPECIFIC BENCHMARKS (February 1, 1992)
STREAM SEGMENT (CDH/CWQCC) SURFACE WATER QUALITY STANDARDS (ug/l)

					Segment 4 & 5 Stream Classification and Water Quality Standards (b)(4)						
		PQL MDL			Tables A,B (1)	Table C Fish & Water Ingestion	Table D Radio-nuclide	Stream Segment Table (5)		Table 2 Radionuclides	
Parameter	Type (5)	RFP	CDH	Method (6)				Acute Value	Chronic Value	Woman Creek	Walnut Creek
Nickel	M	40		CT				TVS	TVS		
Potassium	M	5000		CT							
Selenium	M	5		CT				10			
Silver	M	10		CT				TVS	TVS		
Sodium	M	5000		CT							
Strontium	M	200		NC							
Thallium	M	10		CT							
Tin	M	200		NC							
Titanium	M	10		E6010							
Tungsten	M	10		E6010							
Vanadium	M	50		CT							
Zinc	M	20		CT				TVS	TVS		
2,4,5–TP Silvex	P		0.5	d	10						
2,4–D	P		1	d	100						
Acrolein	P		10								
Aldicarb	P		10		10						
Aldrin	P	0.05	0.1	CP	0.002 (6)	0.000074			0.000074		
Bromacil	P										
Carbofuran	P			d	36						
Chloranil	P			E619							
Chlordane (Alpha)	P	0.5	1	CP	0.03 (6)	0.00046			0.00046		
Chlordane (Gamma)	P	0.5	1	CP	0.03 (6)	0.00046			0.00046		
Chlorpyrifos	P		0.1								
DDT	P	0.1	0.1	CP	0.1 (6)	0.000024			0.000024		
DDT Metabolite (DDD)	P	0.1	0.1	CP							
DDT Metabolite (DDE)	P	0.1	0.1	CP							
Demeton	P		1								
Diazinon	P										
Dieldrin	P	0.1	0.1	CP	0.002 (6)	0.000071			0.000071		
Endosulfan I	P	0.05	0.1	CP							
Endosulfan II	P	0.1	0.1	CP							
Endosulfan Sulfate	P	0.1	0.1	CP							
Endrin	P	0.1	0.1	CP	0.2						
Endrin Aldehyde	P		0.1								
Endrin Ketone	P	0.1		CP							
Guthion	P		1.5								
Heptachlor	P	0.05	0.05	CP	0.008 (6)	0.00028			0.00028		
Heptachlor Epoxide	P	0.05	0.05	CP	0.004 (6)						
Hexachlorocyclohexane, Alpha	P	0.05	0.05	CP		0.0092			0.0092		
Hexachlorocyclohexane, Beta	P	0.05	0.05	CP		0.0163			0.0163		
Hexachlorocyclohexane, BHC	P	0.05	0.05								
Hexachlorocyclohexane, Delta	P	0.05		CP							
Hexachlorocyclohexane, Tech.	P		0.2	f		0.0123			0.0123		
Hexachlorocyclohexane, Lindane	P	0.05	0.05	CP	4	0.0186			0.0186		
Malathion	P		0.2								

TABLE 3.4. POTENTIAL CHEMICAL–SPECIFIC BENCHMARKS (February 1, 1992)
STREAM SEGMENT (CDH/CWQCC) SURFACE WATER QUALITY STANDARDS (ug/l)

					Segment 4 & 5 Stream Classification and Water Quality Standards (b)(4)						
		PQL MDL			Tables A,B (1)	Table C Fish & Water Ingestion	Table D Radio-nuclide	Stream Segment Table (5)		Table 2 Radionuclides	
Parameter	Type (5)	RFP	CDH	Method (6)				Acute Value	Chronic Value	Woman Creek	Walnut Creek
Methoxychlor	P	0.5	0.5	CP	100						
Mirex	P		0.1								
Parathion	P										
PCBs	P	0.5	1	CP	0.005 (6)	0.000079			0.000079		
Simazine	P			e		4			4		
Toxaphene	P	1	5	CP	5						
Vaponite 2	P										
Aroclor 1016	PP	0.5		CP							
Aroclor 1221	PP	0.5		CP							
Aroclor 1232	PP	0.5		CP							
Aroclor 1242	PP	0.5		CP							
Aroclor 1248	PP	0.5		CP							
Aroclor 1254	PP	1		CP							
Aroclor 1260	PP	1		CP							
Atrazine	PP			e		3			3		
Americium (pCi/l)	R									0.05	0.05
Americium 241 (pCi/l)	R	0.01					30				
Cesium 134 (pCi/l)	R	1			80		80			80	80
Cesium 137 (pCi/l)	R	1									
Gross Alpha (pCi/l)	R	2								7	11
Gross Beta (pCi/l)	R	4								5	19
Plutonium (pCi/l)	R									0.05	0.05
Plutonium 238+239+240 (pCi/l)	R	0.01					15				
Radium 226+228 (pCi/l)	R	0.5/1.0 (7)					5				
Strontium 89+90 (pCi/l)	R	1									
Strontium 90 (pCi/l)	R						8			8	8
Thorium 230+232 (pCi/l)	R						60				
Tritium (pCi/l)	R						20,000			500	500
Uranium 233+234 (pCi/l)	R										
Uranium 235 (pCi/l)	R	0.6									
Uranium 238 (pCi/l)	R	0.6									
Uranium (Total) (pCi/l)	R						40			5	10
1,2,4,5–Tetrachlorobenzene	SV		10	b	2 (6)						
1,2,4–Trichlorobenzene	SV	10		CS							
1,2–Dichlorobenzene (Ortho)	SV	10	1	CS	620						
1,2–Diphenylhydrazine	SV			b	0.05 (6)						
1,3–Dichlorobenzene (Meta)	SV	10	1	CS	620						
1,4–Dichlorobenzene (Para)	SV	10	1	CS	75						
2,4,5–Trichlorophenol	SV	50		CS	700						
2,4,6–Trichlorophenol	SV	10	50	CS	2.0 (6)	1.2			1.2		
2,4–Dichlorophenol	SV	10	50	CS	21 (6)						
2,4–Dimethylphenol	SV	10	50	CS							
2,4–Dinitrophenol	SV	50	50	CS							
2,4–Dinitrotoluene	SV	10	10	CS							

TABLE 3.4. POTENTIAL CHEMICAL–SPECIFIC BENCHMARKS (February 1, 1992)
STREAM SEGMENT (CDH/CWQCC) SURFACE WATER QUALITY STANDARDS (ug/l)

					Segment 4 & 5 Stream Classification and Water Quality Standards (b)(4)						
		PQL MDL			Tables A,B (1)	Table C Fish & Water Ingestion	Table D Radio-nuclide	Stream Segment Table (5)		Table 2 Radionuclides	
Parameter	Type (5)	RFP	CDH	Method (6)				Acute Value	Chronic Value	Woman Creek	Walnut Creek
2,6-Dinitrotoluene	SV	10	10	CS							
2-Chloronaphthalene	SV	10		CS							
2-Chlorophenol	SV	10	50	CS							
2-Methylnaphthalene	SV	10		CS							
2-Methylphenol	SV	10		CS							
2-Nitroaniline	SV	50		CS							
2-Nitrophenol	SV	10		CS							
3,3-Dichlorobenzidine	SV	20	10	CS		0.01			0.01		
3-Nitroaniline	SV	50		CS							
4,6-Dinitro-2-methylphenol	SV	50	50	CS							
4-Bromophenyl Phenylether	SV	10		CS							
4-Chloroaniline	SV	10		CS							
4-Chlorophenyl Phenyl Ether	SV	10		CS							
4-Chloro-3-methylphenol	SV	10	50	CS							
4-Methylphenol	SV	10		CS							
4-Nitroaniline	SV	50		CS							
4-Nitrophenol	SV	50		CS							
Acenaphthene	SV	10	10	CS							
Anthracene	SV	10	1	CS							
Benzidine	SV		10	d	0.0002 (6)	0.00012			0.00012		
Benzoic Acid	SV	50		CS							
Benzo(a)anthracene	SV	10	10	CS							
Benzo(a)pyrene	SV	10	10	CS							
Benzo(b)fluoranthene	SV	10	10	CS							
Benzo(g,h,i)perylene	SV	10	10	CS							
Benzo(k)fluoranthene	SV	10	10	CS							
Benzyl Alcohol	SV	10		CS							
bis(2-Chloroethoxy)methane	SV	10		CS							
bis(2-Chloroethyl)ether	SV	10	10	CS	0.03 (6)	0.0000037			0.0000037		
bis(2-Chloroisopropyl)ether	SV	10	10	CS							
bis(2-Ethylhexyl)phthalate	SV	10	10	CS							
Butadiene	SV										
Butyl Benzylphthalate	SV	10		CS							
Chlorinated Ethers	SV										
Chlorinated Napthalenes	SV										
Chloroalkylethers	SV	10		CS							
Chlorophenol	SV		50								
Chrysene	SV	10	10	CS							
Dibenzofuran	SV	10		CS							
Dibenz(a,h)anthracene	SV	10	10	CS							
Dichlorobenzenes	SV		1								
Dichlorobenzidine	SV	20	10	CS		0.01			0.01		
Diethylphthalate	SV	10	10	CS							
Dimethylphthalate	SV	10	10	CS							
Di-n-butylphthalate	SV	10	10	CS							
Di-n-octylphthalate	SV	10		CS							

TABLE 3.4. POTENTIAL CHEMICAL–SPECIFIC BENCHMARKS (February 1, 1992)
STREAM SEGMENT (CDH/CWQCC) SURFACE WATER QUALITY STANDARDS (ug/l)

					Segment 4 & 5 Stream Classification and Water Quality Standards (b)(4)						
		PQL MDL			Tables A,B (1)	Table C Fish & Water Ingestion	Table D Radio-nuclide	Stream Segment Table (5)		Table 2 Radionuclides	
Parameter	Type (5)	RFP	CDH	Method (6)				Acute Value	Chronic Value	Woman Creek	Walnut Creek
Ethylene Glycol	SV			d							
Fluoranthene	SV	10	10	CS							
Fluorene	SV	10	10	CS							
Formaldehyde	SV										
Haloethers	SV										
Hexachlorobenzene	SV	10	10	CS	0.02 (6)	0.00072			0.00072		
Hexachlorobutadiene	SV	10	10	CS	14	0.45			0.45		
Hexachlorocyclopentadiene	SV	10	10	CS	49						
Hexachloroethane	SV	10	10	CS		1.9			1.9		
Hydrazine	SV										
Indeno(1,2,3-cd)pyrene	SV	10	10	CS							
Isophorone	SV	10	10	CS	1,050						
Naphthalene	SV	10	10	CS							
Nitrobenzene	SV	10	10	CS	3.5 (6)						
Nitrophenols	SV										
Nitrosamines	SV										
Nitrosodibutylamine	SV		10	b		0.0064			0.0064		
Nitrosodiethylamine	SV		10	b		0.0008			0.0008		
Nitrosodimethylamine	SV		10	b		0.0014			0.0014		
Nitrosopyrrolidine	SV		10	b		0.016			0.016		
N-Nitrosodiphenylamine	SV	10	10	CSb		4.9			4.9		
N-Nitroso-di-n-dipropylamine	SV	10	10	CSb							
Pentachlorinated Ethanes	SV			b							
Pentachlorobenzene	SV		10	b	6 (6)						
Pentachlorophenol	SV	50	50	CS	200						
Phenanthrene	SV	10	10	CS							
Phenol	SV	10	50	CS							
Phthalate Esters	SV			e							
Polynuclear Aromatic Hydrocarbons	SV		10	b		0.0028			0.0028		
Vinyl Chloride	SV	10	2	CV	2						
1,1,1-Trichloroethane	V	5	1	CV	200						
1,1,2,2-Tetrachloroethane	V	5	1	CV		0.17			0.17		
1,1,2-Trichloroethane	V	5	1	CV	28	0.60			0.60		
1,1-Dichloroethane	V	5		CV							
1,1-Dichloroethene	V	5	1	CV	7						
1,2-Dichloroethane	V	5	1	CV	5						
1,2-Dichloroethene (cis)	V		1	a	70						
1,2-Dichloroethene (total)	V	5		CV							
1,2-Dichloroethene (trans)	V	5	1	a	70						
1,2-Dichloropropane	V	5	1	CV	0.56 (6)						
1,3-Dichloropropene (cis)	V	5	1	CV							
1,3-Dichloropropene (trans)	V	5	1	CV							
2-Butanone	V	10		CV							
2-Hexanone	V	10		CV							
4-Methyl-2-pentanone	V	10		CV							

TABLE 3.4. POTENTIAL CHEMICAL–SPECIFIC BENCHMARKS (February 1, 1992)
STREAM SEGMENT (CDH/CWQCC) SURFACE WATER QUALITY STANDARDS (ug/l)

					Segment 4 & 5 Stream Classification and Water Quality Standards (b)(4)						
		PQL MDL			Tables A,B (1)	Table C Fish & Water Ingestion	Table D Radio-nuclide	Stream Segment Table (5)		Table 2 Radionuclides	
Parameter	Type (5)	RFP	CDH	Method (6)				Acute Value	Chronic Value	Woman Creek	Walnut Creek
Acetone	V	10		CV							
Acrylonitrile	V		5	c		0.058			0.058		
Benzene	V	5	1	CV	5						
Bromodichloromethane	V	5	1	CV							
Bromoform	V	5	1	CV							
Bromomethane	V	10	1	CV							
Carbon Disulfide	V	5		CV							
Carbon Tetrachloride	V	1		CV	5						
Chlorinated Benzenes	V	10		CV/CS							
Chlorobenzene	V	5	1	CV/CVS	300						
Chloroethane	V	10		CV							
Chloroform	V	5	1	CV	Tot THM <100*	0.19			0.19		
Chloromethane	V	10	1	CV							
Dibromochloromethane	V	5	1	CV							
Dichloroethenes	V		1								
Ethyl Benzene	V	5	1	CV	680						
Ethylene Dibromide	V			d							
Ethylene Oxide	V										
Halomethanes	V				100	0.19			0.19		
Methylene Chloride	V	5	1	CV							
Pyrene	V	10	10	CS							
Styrene	V	5		CV							
Tetrachloroethanes	V	5	1	CV		0.8			0.8		
Tetrachloroethene	V	5	1	CV	10						
Toluene	V	5	1	CV	2,420						
Trichloroethanes	V	5	1	CV							
Trichloroethene	V	5	1	CV	5						
Vinyl Acetate	V	10		CV							
Xylenes (Total)	V	5		CV							

TABLE 3.4. POTENTIAL CHEMICAL–SPECIFIC BENCHMARKS (February 1, 1992)
STREAM SEGMENT (CDH/CWQCC) SURFACE WATER QUALITY STANDARDS (ug/l)

				Segment 4 & 5 Stream Classification and Water Quality Standards (b)(4)						
		PQL MDL			Table C Fish & Water Ingestion	Table D Radio–nuclide	Stream Segment Table (5)		Table 2 Radionuclides	
Parameter	Type (5)	RFP	CDH	Method (6)	Tables A,B (1)			Acute Value	Chronic Value	Woman Creek	Walnut Creek

EXPLANATION OF TABLE

•	= Total trihalomethanes:chloroform, bromoform, bromodichloromethane, dibromochloromethane
CLP	= Contract Laboratory Program
CDH	= Colorado Department of Health
dis	= dissolved
EPA	= Environmental Protection Agency
pCi/l	= picocuries per liter
PCB	= polychlorinated biphenyl
PQL	= Practical Quantitation Level
RFP	= Rocky Flats Plant
SS	= species specific
TAL	= Target Analyte List
THM	= Total Trihalomethanes
TIC	= Tentatively Identified Compound
TVS	= Table Value Standard (hardness dependent), see Table III in (a)
MDL	= Minimum Detection Limit for radionudides (pCi/l)
ug/l	= micrograms per liter
VOA	= Volatile Organic Analysis
CWQCC	= Colorado Water Quality Control Commission

(1) In the absence of specific, numeric standards for non–naturally occurring organics, the narrative standard is interpreted as zero with enforcement based on practical quantification levels (PQLs) as defined by CDH/CWQCC or EPA
(2) Ammonia, sulfide, chloride, sulfate, copper, iron, manganese, and zinc are 30–day standards, all others are 1–day standards
(3) Lowest value given: dissolved or total recoverable
(4) Segment 5 standards are goals
(5) Includes Table 1: Additional Organic Chemical Standards (chronic only)
(6) Standard is below (more stringent than) PQL, therefore PQL is standard.
(7) MDL for Radium 226 is 0.5; MDL for Radium 228 is 1.0

(a) CDH/CWQCC, Colorado Water Quality Standards 3.1.0 (5 CCR 1002–8) 1/15/1974; amended 9/30/1989. (Envrionmental Reporter 726:1001–1020:6/1990)
(b) CDH/CWQCC, Classifications and Numeric Standards for S. Platte River Basin, Laramie River Basin, Republican River Basin, Smoky Hill River Basin 3.8.0 (5 CCR 1002–8) 4/6/1981; amended 2/15/1990.

4.0 RCRA FACILITY INVESTIGATION/REMEDIAL INVESTIGATION TASKS

4.1 PROJECT PLANNING

Project planning will consist of the activities necessary to initiate the Phase I RCRA Facility Investigation (RFI)/Remedial Investigation (RI) of the Individual Hazardous Substance Sites (IHSSs) in the 700 Area. Activities undertaken for this project have included a review of previous investigations, historical aerial photographs, and other historical information. Results of this review are presented in Section 2.0 of this work plan. Prior to field investigations, it is necessary to complete the review of the existing data, including plant records and plans, available aerial photographs, and new data which become available after preparation of this work plan. The Interagency Agreement (IAG) also requires the submittal of several existing reports to the regulatory agencies. These reports will be assembled and reviewed during the project planning task.

There are ongoing site studies at RFP of surface water and sediments, groundwater, geology, background geochemistry, and ambient air that may provide data that have bearing on the investigations in the 700 area. These data will be compiled and evaluated during the project planning activities. Data from investigations at overlapping OUs will also be reviewed. If available data from ongoing investigations meet the requirements of the Phase I sampling and analysis plan, the samples proposed in Section 6.0 need not be collected again.

Other project related documents are currently being prepared. The Sampling and Analysis Plan (SAP), which includes the site-wide Quality Assurance Project Plan (QAPJP) and Standard Operating Procedures (SOP) for field activities, is currently being completed by EG&G. The Health and Safety Plan (HSP) is also being completed by EG&G. The Field Sampling Plan (FSP) is included as Section 6.0 of this document.

4.2 COMMUNITY RELATIONS

In accordance with the IAG, dated January 22, 1991, the Communications Department at Rocky Flats is developing a plant-wide Community Relations Plan (CRP) to develop an interactive relationship with the public relating to environmental restoration activities. A Draft Community Relations Survey Plan has been completed and forwarded to the Environmental Protection Agency (EPA), the Colorado Department of Health (CDH), and the public for review. This plan specifies activities planned to complete the Environmental Restoration (ER) Program CRP, including plans for community interviews. The draft CRP was completed in September and the final CRP in November 1990, in accordance with the IAG schedules. Accordingly, a site-specific CRP is not required for Operable Unit Number 8 (OU8). The ER program community relations activities include participation by plant representatives in informational workshops, meetings of the Rocky Flats Environmental Monitoring Council, briefings of the public on proposed remedial action plans, and meetings to solicit public comment on various ER program plans and actions.

The Communications Department is continuing other public information efforts to keep the public informed on ER activities and other issues related to plant operations. A Speakers Bureau program sends speakers to civic groups and educational organizations, while a public tour program allows the public to visit Rocky Flats. An Outreach Program is also in place in which plant officials visit elected officials, the news media, and business and civic organizations to further discuss issues related to Rocky Flats and ER activities. The Communications Department receives numerous public inquiries which are answered through telephone conversations or by sending written informational materials to the requestor.

4.3 FIELD INVESTIGATION

Phase I field investigations will be conducted at the IHSSs in the 700 Area to collect samples and data concerning the nature and extent of contamination, if any, at each site. The data and sample results will be used to support the Phase I Environmental Evaluation and Phase I Human

Health Risk Assessment, as well as meet the objectives and data needs described in Section 5.0 of this work plan. Additional phase(s) of investigation and risk assessment may be required depending on the extent of contamination identified in Phase I.

Three types of activities will be performed during the Phase I field- investigation: screening activities and sampling activities. Screening activities include visual inspections, radiological surveys, organic vapor measurements using portable instruments, radiological screening of borehole samples, and soil gas surveys. Sampling activities include surface soil sampling, subsurface sampling using test borings, vadose water sampling, surface water sampling, and sediment sampling.

Twenty-four IHSSs have been included in OU8 in the 700 Area. These IHSSs have been grouped into three groups based on the contaminant source type and release mechanism of the sites. Because of the diverse nature of the IHSS groups, the Phase I field investigations for each group will be different. Specific field activities are described in the Phase I FSP in Section 6.0 of this work plan.

4.4 SAMPLE ANALYSIS AND DATA VALIDATION

Samples collected during the Phase I field investigation will be analyzed for the parameters specified in the IAG as described in Section 6.4. Analytical procedures will be completed in accordance with the ER Program QAPjP. Project-specific quality assurance (QA) requirements are included in the Quality Assurance Addendum (QAA), Section 10.0 of this work plan. Section 6.0 of this work plan specifies Phase I analytical requirements, as well as sample containers, preservation and holding times, and field quality control (QC) requirements. Samples collected for this work plan will be analyzed by a Rocky Flats Plant (RFP) contract laboratory.

Phase I data will be reviewed and validated according to the data validation guidelines in the QAPJP and the Data Validation Functional Guidelines. These documents state that the results of data review and validation activities will be documented in data validation reports.

4.5 DATA EVALUATION

Data collected during the Phase I 700 Area drainage RI will be incorporated into the existing database with data from investigations at other OUs. The data will be used to better define site characteristics, source characteristics, the nature and extent of contamination, to support the baseline risk assessment and environmental evaluation, and to evaluate potential remedial alternatives.

4.5.1 Site Characterization

Geologic and hydrogeologic data will be used to develop site maps and cross sections. Geologic data will be used to evaluate the stratigraphy of the alluvium and colluvium at each site and to determine the depth to bedrock and the bedrock type.

Hydrogeologic data will be used to characterize the unconfined aquifer at the sites. These data will include information about the following:

- Hydrostratigraphic characteristics of units present;
- Hydraulic gradients; and
- Water table depth and configuration.

To characterize the general groundwater flow regime within and adjacent to the IHSSs, groundwater flow modeling at an appropriate scale may be conducted. Prior to initiating any fate and transport modelling efforts a technical memorandum will be submitted as per Attachment 2,

Section VII.D.1.b., of the IAG. This technical memorandum will describe the models which will be utilized and include a summary of those data which will be modelled.

To characterize the general surface water system of OU8, a regional scale surface water flow and transport model may be developed. Where required, IHSS specific flow and transport models may be developed and integrated to the regional scale model. Details will be discussed in a technical memorandum prior to its implementation.

Air dispersion modeling may also be conducted and will be discussed in a technical memorandum prior to its implementation.

Data collected during surface water and sediment sampling, including background sampling, will be used to characterize the 700 Area.

4.5.2 Source Characterization

The data collected during the Phase I RI will be evaluated to identify potential sources of contamination at the IHSSs. Potential sources include wastes disposed at the sites and off-site sources located topographically and/or hydraulically upgradient of the sites. Analytical data from soil and sediment sampling at the sites will be used to characterize the nature, lateral and vertical extent, and volume of source materials, if present.

4.5.3 Nature and Extent of Contamination

Graphical and, where appropriate, statistical methods will be used to identify chemical and radioactive contaminants present in the soil, sediment, surface water, and groundwater and to estimate the concentrations and distributions of the contaminants. Results of sampling will be compared with results of the ongoing background geochemical characterization to assess the

chemical concentrations above background levels. Products of this analysis may include isopleth maps, cross sections and profiles, chemical tables, and statistical results.

4.6 PHASE I BASELINE RISK ASSESSMENT

Using existing data and data collected during the tasks described above, a Phase I baseline risk assessment will be prepared for OU8 to evaluate the potential risks to public health and the environment in the absence of remedial action. The Phase I baseline risk assessment will provide the basis for determining whether additional investigations are necessary at the IHSSs and whether remedial actions are necessary.

The risk assessment will be accomplished in four general steps:

- Identification of chemicals of concern;
- Exposure assessment;
- Toxicity assessment; and
- Risk characterization.

The Phase I risk assessment will address the potential public health and environmental impacts associated with the site under the no-action alternative (no remedial action taken) based on the data available. This assessment will aid in the preliminary screening site remedies based on the contaminants of concern and the environmental media associated with potential risks to public health and the environment.

The objectives and description of work for each risk assessment step are described in detail in the Human Health Risk Assessment Plan for OU8, Section 8.0 of this work plan. The Environmental Evaluation Work Plan for OU8 is Section 9.0 of this work plan.

4.7 PRELIMINARY REMEDIAL ACTION ALTERNATIVES

Remedial action alternatives reflect remedial action objectives aimed at protecting human health and the environment and should specify contaminants, exposure routes and receptors, and a preliminary remediation goal (e.g., an acceptable contaminant range).

4.7.1 Surficial Materials, Bedrock, Surface Water and Sediments, and Groundwater

4.7.1.1 Development and Screening of Remedial Alternatives

This section identifies potential technologies applicable to remediation of contaminated surficial materials (i.e., surficial soils, artificial fill, and alluvium), bedrock, surface water, sediments, and groundwater (including vadose water) at OU8. The identified technologies are based on the preliminary site characterization developed in Section 2.0. Identification and screening of technologies and assembling an initial screening of alternatives will be conducted simultaneously with the RFI/RI. However, investigation of this OU is in its early stages; thus, remedial alternatives are only briefly reviewed in this section. A more detailed evaluation of the remedial alternatives for OU8 will depend on the results obtained in Phase I investigation.

OU8 is a CERCLA unit and as such the processes employed to develop and evaluate alternatives for OU8 are outlined in Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (EPA, 1988). As stated in the IAG, general compliance with both RCRA and CERCLA is required for this OU. However, the outline presented in the CERCLA Guidelines provides the greatest detail and ensures compliance with RCRA.

The following steps were used to develop remedial alternatives for the OU8 area:

- Develop remedial action objectives of a general nature appropriate for site-specific, risk-related factors and based on chemical-specific and radionuclide-specific standards when available.

- Develop a list of actions appropriate for the bedrock, surface water, surficial materials, and groundwater at OU8 (such as containment, treatment, and/or removal) that may be implemented to satisfy the objectives defined in the previous step. These actions are generally referred to as "general response actions" in EPA guidelines.

- Identify and screen technology groups for each general response action. General response actions can each be further defined to include groups of technologies by which an action can be accomplished. Screening will eliminate those groups that are not technically feasible at the site.

- Identify and evaluate process options for each technology group to select a process option representing each technology group under consideration. Although specific process options are selected for alternative development and evaluation, these processes are intended to represent the broader range of options within a general technology group.

- Assemble the selected representative technologies into site closure and corrective action alternatives for the bedrock, surface water, surficial materials and groundwater of the IHSS areas of OU8 that represent a range of treatment and containment combinations, as appropriate.

- Screen the assembled alternatives against the short- and long-term aspects of three broad criteria: effectiveness, implementability, and cost. Because the screening evaluation reduces the number of alternatives that will undergo thorough and extensive analyses, alternatives will be evaluated in less detail than subsequent evaluations.

Determining the effectiveness of alternatives involves an evaluation of the protection of human health and the environment achieved by a remedial action during construction and implementation and after the response objectives have been met. Evaluation of short-term effectiveness is based on protection of the community and workers, impacts to the environment, and the time required to meet remedial response objectives. Long-term effectiveness addresses the risk remaining to human health and the environment. It is based on the percentage of permanent destruction, decreased mobility, and/or reduction in volume of toxic compounds achieved after response objectives have been met.

Implementability is a measure of both the technical and administrative feasibility of constructing, operating, and maintaining a remedial action alternative. It is used during screening to evaluate the combinations of process options with respect to the site-specific conditions. Technical feasibility refers to the ability to construct, reliably operate, and comply with action-specific (technology-specific) requirements in order to complete the remedial action. Administrative feasibility refers to the ability to obtain required permits and approvals; to obtain the necessary services and capacity for treatment, storage, and disposal of hazardous wastes; and to obtain essential equipment and technical expertise.

Cost estimates for screening will be derived from cost curves, generic unit costs, vendor information, conventional cost estimating guides, and prior estimates made for similar sites at RFP, with modifications made for current RFP conditions. Precise estimates are not necessary. However, the cost estimates for comparison and screening will have the same relative accuracy. The cost estimating procedures used during screening are similar to those that will be used during the later detailed alternatives analyses. However, the later detailed analysis will receive more in-depth and detailed estimates for the components of each alternative. The screening cost estimates will include capital, operating, and maintenance costs. The operating and maintenance costs will be calculated for the lifetime of the treatment operations at the site. Present worth cost analysis will be used to make the costs for the various alternatives for the various alternatives comparable.

Alternatives with the most favorable results from the composite evaluation will be retained for further scrutiny during the detailed analysis. Not more than ten alternatives will be retained for detailed analysis (including containment and no action). At that time, it may be determined that additional site-specific information or technology-specific treatability studies are necessary for an objective detailed analysis. It will also be necessary to identify and verify the action-specific applicable or relevant and appropriate requirements (ARARs) for each alternative.

The Phase I RFI/RI Work Plan identifies the appropriate level of alternatives analyses and involves listing general response actions most applicable to the type of site under investigation.

General response actions are broadly defined as those that may satisfy the objectives for remediation defined for OU8. Those objectives include the protection of human health and the environment from ingestion, dermal contact or inhalation of contaminants that may be present in the bedrock, wastes, surficial materials, surface water, or groundwater in the OU8 area through remediation. Table 4.1 provides a list and description of general response actions and typical technologies associated with remediating soils, wastes, groundwater, surficial materials, and surface water. Table 4.1 also includes a general statement regarding the applicability of the general response action to potential exposure pathways. Not all of the alternative response actions and typical technologies listed may be appropriate for the IHSS areas of OU8. Some will be discarded during the screening of alternatives.

The response actions outlined in Table 4.1 must be applied to the potential exposure pathways that will be identified for OU8. The response actions may provide control over all or some of the potential pathways. Partially effective response actions can be combined to form complementary sets of response actions that control all pathways.

In general terms, potential human exposure may be avoided by prevention of contaminant release, transport, and/or contact. Thus, application of the response actions may be considered at three different points in each potential exposure pathway: (1) at the point where the contaminant could be released from the source, (2) in the transport medium, and (3) at the point where contact with the released contaminant could be prevented.

While the identification of general response actions is discussed above, the selection of the most appropriate action or combination of actions is not warranted at this time. Site and contaminant data are not sufficient to initiate the screening process. Phase I will generate data necessary to characterize the nature and extent of contamination and will evaluate the impact of OU8 on surface water, groundwater, air, the environment, and biota in addition to characterizing potential contaminant migration pathways. Data obtained from these investigations will:

- Describe the physical characteristics of the site;

- Define sources of contamination;
- Determine the nature and extent of contamination in soil, groundwater, surface water, sediments, and air;
- Describe contaminant fate and transport; and
- Describe receptors.

These data will provide information for the preliminary screening of alternatives and a thorough, comparative evaluation of the technologies with respect to implementability, effectiveness, and cost. This information will allow for informed decisions to be made with respect to the selection of preferred technologies. The Field Sampling Plan (FSP) in Section 6.0 describes the methodology that will be followed to obtain the required information for the Phase I RFI/RI characterization.

Detailed Analysis of Remedial Alternatives

The detailed analysis of each alternative will be performed when sufficient data are generated. The detailed analysis and selection of alternatives is not a final decision-making process; rather, it is the process of analyzing and comparing relevant information in order to select a preferred remedial action. In accordance with the NCP, containment technologies will generally be appropriate remedies for wastes that pose a relatively low-level threat or where treatment is impracticable (EPA, 1991). Each appropriate alternative will be assessed in terms of nine evaluation criteria, and the assessments will be compared to identify the key attributes among the alternatives. Assessment based on the nine evaluation criteria is necessary for the Corrective Measure Study (CMS) and the subsequent Corrective Action Decision (CAD)/Record of Decision (ROD). The nine evaluation criteria are as follows:

1. Overall protection of human health and the environment;
2. ARARs;
3. Long-term effectiveness and permanence;

4. Reduction of toxicity, mobility, or volume;

5. Short-term effectiveness;

6. Implementability;

7. Cost;

8. State acceptance; and

9. Community acceptance.

These criteria are described in recently revised guidelines provided in the National Contingency Plan (NCP). The first two criteria are considered standards because they must be evaluated before further consideration of the remaining criteria. The next five criteria are considered the balancing items on which the analysis is based. The final two criteria are addressed during the final decision-making process after completion of the CMS/FS.

4.7.2 Air

Atmospheric transport is characterized by short migration times, relatively large areas of exposure, and an inability to mitigate the potential consequences of a contaminant release once it occurs. As such, effective air pathway contaminant control will emphasize source emissions reduction and containment prior to atmospheric release. Conventional technologies that may be employed during OU8 Work Plan implementation to suppress fugitive dust and volatile organic emissions include application of water sprays, surfactants, or dust suppressants and installation of wind-screens or membrane coverings. Such methods will be applied when personnel protection monitoring (as implemented according to the Site-Specific Health and Safety Plan) indicates the need for mitigative action during Work Plan implementation.

4.8 TREATABILITY STUDIES

This task includes efforts to provide technical support in the form of bench-scale treatability tests to the Rocky Flats Plant ER Program in the event that treatability studies are necessary or appropriate to support the OU8 RFI/RI. EG&G has prepared a site-wide Treatability Studies Plan which addresses this Task. The site-wide studies will be utilized as appropriate for OU8.

Treatability studies are conducted primarily to: (1) provide sufficient data to allow treatment alternatives to be fully developed and evaluated during the detailed analysis, and to support the design of a selected remedial alternative; and (2) reduce cost and performance uncertainties for treatment alternatives to acceptable levels so that a remedy can be selected. Treatability study requirements are developed during the development and screening of remedial alternatives and include all available data from the current study as well as prior studies.

Numerous technologies that appear to be potentially applicable for treating OU8 will be screened for treatability testing. The technologies selected for screening will be limited to those already commercially established or which have demonstrated potential for processing spent solvents, radionuclides, oils, and similar contaminants. Additionally, the technologies considered will be required to be readily implementable (i.e., standard design package units available) within a short time frame. Innovative and alternative technologies not meeting the above requirements will not be considered.

Depending on the hydraulic properties of the unconfined aquifer considered for remediation, it may be feasible to collect groundwater for treatment above ground. In that case, the following technologies have been identified for potential testing:

Chemical Oxidation of Organics - Chemical oxidation is used to degrade hazardous organic materials to less toxic compounds. Oxidation systems, particularly those using ultraviolet (UV) light, ozone, and hydrogen peroxide, are powerful tools for treating a

wide variety of common organic environmental contaminants. Disadvantages are similar to those for inorganic oxidation reduction: potential nontarget organics and inorganics can produce undesirable side products and increase oxidant requirements.

Granular Activated Carbon (GAC) Adsorption of Organics - GAC adsorption is the most fully developed and widely used technology for treating groundwater contaminated with organics. It is effective for the removal of a wide range of organics from aqueous waste streams. Bench-scale testing consists of running a series of descriptive tests to determine isotherms for the groundwater contaminants. GAC is typically regenerated with a thermal process, and the regeneration process can be performed at either off-site or on-site facilities.

Reverse Osmosis - Reverse osmosis processes involve the use of semipermeable membranes. By applying water pressure greater than the osmotic pressure to one side of the membrane, water is passed through the membrane while particulate, salts, and high molecular weight organics are retained. However, the retained, highly concentrated solution (retentate) contains dissolved salts as well as the target contaminants, and requires further treatment or disposal.

Air Stripping - Air stripping Is a proven technology for removal of volatile and semivolatile contaminants from water. This process involves the transfer of contaminants from a contaminated liquid phase to a vapor phase by passing the two countercurrent streams through a packed tower. Air emission treatment is generally required, with vapor phase activated-carbon systems being the most commonly used process for this purpose, though other alternatives, such as oxidation and incineration, exist. The vapor phase treatment unit is generally costly.

Distillation - Distillation is a process that involves separating compounds by means of their boiling point characteristics. The primary use of distillation is for reclaiming spent

solvents from industrial processes, and it is generally applicable only to rather concentrated solutions. The process can be used to separate various volatile compounds or to separate mixtures of organics into light and heavy fractions. The light fraction can usually be recycled or used as a boiler feed, while the heavy fraction requires further treatment.

Biological Reactors - Biological reactors utilize microorganisms to remove organic contaminants from the water. Most organic contaminants can be biologically degraded by introducing the appropriate microorganisms. High concentrations of some organics and the presence of metals may prove toxic to the organisms, however, and pretreatment may be required. Several types of aerobic reactors exist, including activated sludge systems, trickling filters, rotating biological contactors, and immobilized cell reactors. In general, these methods generate large amounts of sludge, requiring disposal.

Sorption of Radionuclides - Sorption of inorganics, metals, and radionuclides is a standard technique for removal and concentration of these contaminants from wastewater. Common and proven sorption processes include ion exchange and GAC, while less-proven techniques involve the use of activated alumina, bone char, and proprietary sorption media. The sorption media are generally chemically regenerated, which results in a concentrated side stream requiring further treatment or disposal. Ion exchange and GAC sorbents are addressed separately elsewhere in this subsection, while the use of activated alumina and bone char are discussed below.

Activated alumina is a porous form of aluminum oxide with a large surface area. For removal of aqueous contaminants, activated alumina is typically used in a column similar to that for ion exchange. It has been proven successful in the removal of arsenic and fluoride from groundwater. More recently, activated alumina has shown promise in absorbing plutonium from a low-level wastewater effluent at the Hanford Site. In the same study, plutonium adsorption on bone char was the most rapid and gave the highest

decontamination factors. Waste-stream specific laboratory testing would provide valuable information on the suitability of these sorbents for low-level radionuclide removal.

Ion Exchange of Radionuclides - Ion exchange processes are used for a wide range of water treatment application, including commonly recognized systems such as demineralizers and water softeners. The goal of an ion exchange system is to remove undesirable ions of a certain type(s) from a solution and replace them with more acceptable ions. Radionuclides are commonly removed from waste streams at nuclear facilities using ion exchange.

Ion exchange resins, particularly anion exchange resins, have been used to recover uranium from mine run-off water for many years. Extensive studies on the laboratory scale report removal of uranium from natural waters as high as 99 percent. A small full-scale ion exchange system was capable of removing uranium from drinking water supplies to as low as micrograms per liter. Ion exchange resins are typically rechargeable; however, the resins used in radioactive applications are generally only used once and are then disposed of as solid waste.

In cases where collection of groundwater is not feasible or practical, the following technologies have been identified for potential testing:

In Situ Biological Treatment - Depending on the effective porosity of the soils, in situ biological treatment may be feasible. In situ biological treatment of groundwater involves the stimulation of biological growth in the contaminated zone in order to reduce the contaminant concentrations. Microorganisms that can use some or all of the contaminants as substrates will normally exist in a contaminated environment. The microorganisms are stimulated to increase their biological growth and consumption of contaminants through addition of essential nutrients. Aerobic treatment systems also require the introduction

of oxygen. In situ treatment is dependent on geological and hydrological conditions. The process Is relatively inexpensive.

Vacuum Extraction - Volatile contaminants can be removed from soil using vacuum extraction, which is an in situ treatment technology that involves the air stripping of contaminants by inducing a vapor flow through the soil. Since this technology involves the transfer of contaminants to the vapor, air emission treatment Is generally required. The efficiency of the process is highly dependent on geologic conditions, and would tend to be ineffective in low-permeability materials.

In cases where contaminants are entrained in soils, the soil (such as surface soil) is accessible, and the contamination is of limited areal extent, the following technologies have been identified for potential testing:

Solidification/Stabilization - Solidification is a process in which contaminants are mechanically bound to solidification agents, reducing their mobility. This produces a solid matrix of waste with high structural integrity. Stabilization usually involves the addition of a chemical reagent to react with the contaminant, producing a less mobile or less toxic compound. Solidification and stabilization are frequently used together and are a well-established method for reducing the mobility and toxicity of hazardous wastes. This process generates large volumes of solidified materials requiring disposal.

Vitrification - The vitrification process involves heating the waste matrix to a very high temperature and either combining the matrix with molten glass or heating the matrix until it melts. Once cooled, the molten mass solidifies into a stable, noncrystalline solid resistant to leaching of Inorganic, metal, and radionuclide contaminants. Organic components are destroyed by pyrolysis. The process can be conducted either in situ or off site; however, the process is generally expensive.

Physical Separation - Soil contaminants are often found to be associated with a particular size fraction of soils, most often fine particles. In these cases, fractionation of the soil based on particle size can be an effective means of reducing the volume of the material that requires further treatment. The processes used for soil size fractionation include screening, classification, flotation, and gravity concentration.

Soil Washing - Soil washing is based on the principle of contaminant removal from soil by washing with two liquid solutions. Washing agents include water, acids, solvents, surfactants, and chelators. With the selection of appropriate washing solutions, soil washing technology can potentially be used to remove organics, inorganics, metals, and radionuclides. The wash solution containing the contaminants will require treatment and/or disposal.

4.9 REMEDIAL INVESTIGATION REPORT

An RFI/RI report will be prepared summarizing the data obtained during the Phase I field work and data collected from previous and ongoing investigations. This report will:

- Describe in detail the field activities that serve as a basis for the RFI/RI report. This will include any deviations from the Work Plan that occurred during implementation of the field investigation.
- Discuss site physical conditions. This discussion will include surface features, meteorology, surface water hydrology, surficial and subsurface geology, groundwater hydrology, demography and land use, and ecology.
- Present a Preliminary Site Characterization based on all RFI/RI activities at OU8 and characterize the nature and extent of contamination. The media to be addressed will include contaminant sources, soils, sediments, groundwater, surface water, air, and biota.
- Discuss contaminant fate and transport. This discussion will include potential migration routes, contaminant persistence, chemical attenuation processes and potential receptors.

- Present a baseline risk assessment. The risk assessment will include human health and environmental evaluations.

- Present a summary of the findings and conclusions.

- Identify potential data gaps and work that may be performed in a Phase II investigation, if such an investigation is determined to be necessary.

TABLE 4.1

General Response Actions
Typical Associated Remedial Technologies and Evaluation

General Response Action	Description	Typical General Response Technologies	Action to Potential Pathways
No Action.	No remedial action taken at site.	Some monitoring and analyses may be performed.	National Contingency Plan requires consideration of no action as an alternative. Would not address potential pathways, although existing access restriction would continue to control onsite contact.
Access and Use Restrictions.	Permanent prevention of entry into contaminated area of site. Control of land use.	Site security, fencing, deed use restrictions, and warning signs.	Could control onsite exposure and reduce potential for offsite exposure. Site security fence and some signs are in place. Additional short-term or long-term access restrictions would likely be part of most remedial actions.
Containment	In-place actions taken to prevent migration of contaminants.	Capping, groundwater containment barriers, soil stabilization, and enhanced vegetation.	If applied to source, could be used to control all pathways. If applied to transport media, could be used to mitigate past releases (except air).
Pumping	Transfer of accumulated subsurface or surface contaminated water, usually to treatment and disposal.	Groundwater pumping, leachate collection, and liquid removal from surface impoundments.	Applicable to leachate removal prior to in situ treatment or waste removal. Applicable removal of contaminated groundwater and bulk liquids (for example, from buried drums).
Removal	Excavation and transport of primarily nonaqueous contaminated material from area of concern to treatment or disposal area.	Excavation and transfer of drums, soils, sediments, wastes, and contaminated structures.	If applied to source, could be used to control all pathways. If applied to transport media, will control corresponding pathway. Must be used with treatment or disposal response actions to be effective.

TABLE 4.1 (Continued)

General Response Actions

Typical Associated Technologies and Evaluation

General Response Action	Description	Typical General Response Technologies	Action to Potential Pathways
In Situ Treatment	Application of technologies in situ to change the in-place physical or chemical characteristics of contaminated material.	In situ vitrification and bioremediation.	Applied to source, could be used to control all pathways. Applied to transport media, could be used to control corresponding pathways.
Storage	Temporary stockpiling of removed material in a storage area or facility prior to treatment or disposal.	Temporary storage structures.	May be useful as a means to implement removal actions, but definition would not be considered a final action for pathways.
Disposal	Final placement of removed contaminated material or treatment residue in a permanent storage facility.	Permitted landfills and repositories.	With source removal, could be used to control all pathways. With removal of contaminated transport media, could be used to control corresponding pathway (except air).
Monitoring	Short-and/or long-term monitoring is implemented to assess site conditions and contamination levels.	Sediment, soil, surface water, and groundwater sampling and analysis.	RCRA requires post-closure monitoring to assess performance of closure and corrective action implementation.

5.0 DATA NEEDS AND DATA QUALITY OBJECTIVES

5.1 SUMMARY OF IMPACTS, DATA GAPS, AND OTHER REQUIREMENTS

5.1.1 Surficial Material, Bedrock, and Groundwater

This subsection summarizes the information provided in previous subsections on possible impacts to surficial material (soil, artificial fill, and alluvium), bedrock, and groundwater resulting from activities or releases occurring at each OU8 IHSS. In addition, this subsection summarizes the data required to determine the nature and extent of contamination of these media attributable to each IHSS.

Subsection 5.1.1.1 summarizes the available information and data needs for surficial material and bedrock. The existing information is limited to borehole samples collected during the drilling of wells and boreholes. The data for these samples are described on an IHSS-specific basis in Subsection 2.4. Soils were not identified in the drill logs for any of the existing wells or boreholes discussed in Subsection 2.4. It is likely that any soils that may have developed in the area of OU8 have been disturbed by construction activities and are no longer present. In addition, artificial fill and alluvium are difficult to distinguish because most of the material used as fill is Rocky Flats Alluvium. For these reasons, soils, artificial fill, and alluvium are treated together under the category of surficial material in the following discussion.

Subsection 5.1.1.2 summarizes the available information and data needs for groundwater. The existing groundwater data for wells in the vicinity of OU8 IHSSs are described on an IHSS-specific basis in Subsection 2.4. None of the existing wells were installed for the purpose of monitoring the vadose zone. Therefore, information on vadose zone conditions in the vicinity of the IHSSs is limited to the analyses of borehole samples collected during drilling operations.

As discussed in Subsection 2.4, much of the available analytical data has not been validated and several discrepancies in the available data were identified during the preparation of this work plan. Therefore, the quality of much of the data discussed in Subsection 2.4 and summarized below is not currently known. As discussed in the following subsections, the existing sampling points were not installed to monitor releases from specific IHSSs addressed in this Work Plan and are not ideally located for such a purpose. The determination of impacts attributable to the IHSSs contained in OU8 is further complicated by the presence of IHSSs and PACs that are planned to be investigated under investigations of other operable units in close proximity to or contiguous with many of the OU8 IHSSs. RFI/RI activities at OU8 will be coordinated with RFI/RI activities at other operable units to the extent possible to obtain the information needed to assess other potential sources of contamination in the vicinity of the OU8 IHSSs.

5.1.1.1 Surficial Material and Bedrock

The existing data regarding potential impacts to surficial material and bedrock in the vicinity of the OU8 IHSSs are not of sufficient quantity and quality for defining the nature and extent of contamination associated with each IHSS. As discussed in Subsection 2.4 for individual IHSSs, the existing sampling locations are not located within or immediately adjacent to the IHSSs. In addition, in several instances the parameters that borehole samples were analyzed for are different than the contaminants that are potentially associated with the nearest IHSS. Therefore, it is difficult to attribute the contamination detected in samples of surficial material and bedrock from these wells and boreholes to releases from any OU8 IHSS.

Based on the evaluation of the existing data for borehole samples in the vicinity of the OU8 IHSSs, additional data is needed on surficial material and bedrock chemistry in proximity to these IHSSs. Surface scrapes, shallow soil samples, and borehole samples are needed from those IHSSs where the potential for contamination of these media is indicated. Because the release history of many of the IHSSs is not adequately understood and because contaminants not believed to have been released from many of the IHSSs have been detected in the nearest

existing sampling points, the analyses of the samples collected from these IHSSs for constituents not known to have been released are needed to determine whether the contamination detected is attributable to these IHSSs. These additional data will also assist in a determination of the reliability of the existing analytical data, particularly unvalidated data. The results of sampling and analysis of surficial material and bedrock in the immediate vicinity of each IHSS will serve to better define the nature of contamination associated with the IHSS and to allow scoping of additional investigations, such as additional borehole sampling and groundwater monitoring, that may be required to determine the extent of contamination.

5.1.1.2 Groundwater

The existing analytical data discussed in Subsection 2.4 indicate that groundwater within OU8 has been impacted by RFP operations. Some of the contamination detected may be attributable to releases from OU8 IHSSs. However, due to the locations of the existing wells in relation to the IHSSs, the presence of other potential sources of contamination, and the uncertainty regarding the release history of many IHSSs, it is difficult to make significant conclusions about the nature and extent of contamination associated with these IHSSs.

Data for groundwater chemistry immediately upgradient and downgradient of the OU8 IHSSs are needed. As indicated in Subsection 5.1.1.1, the need for groundwater monitoring and well locations will be contingent upon the results of sampling of surficial material and bedrock at each IHSS. With few exceptions, the existing monitoring wells are not located so as to be of use in defining contamination potentially associated with these IHSSs. In most instances, there currently are not wells both upgradient and downgradient of each IHSS, or group of IHSSs. The distances between the IHSSs and the existing wells are generally too great to allow the identification of the potential source of the contamination detected. In addition, the analytes for the samples that have been collected from many of the wells are different than the contaminants believed to have been released from an IHSS.

In addition to the need for groundwater chemistry data in the vicinity of each IHSS, additional data are needed regarding the hydrogeology of OU8. As noted in previous subsections, possible hydraulic interconnection between the upper most and lower most groundwater flow systems is indicated in several locations within OU8. This interconnection needs to be better defined, particularly where the nature of the contaminants released from an IHSS is such that a relatively high potential exists for these contaminants to migrate into the lower most flow system (e.g., DNAPLs such as carbon tetrachloride and TCE).

5.1.2 Surface-Water and Sediments

The existing data regarding potential impacts to surface water and sediments in the vicinity of the OU8 IHSSs are not of sufficient quantity and quality for defining the nature and extent of contamination associated with each IHSS. As discussed in Subsection 2.4 for individual IHSSs, the existing sampling locations are not located within or immediately adjacent to the IHSSs. Therefore, it is difficult to attribute the contamination detected in samples of surface water and sediments from these monitoring sites to releases from any individual IHSSs within OU8. Because the release history of many of the IHSSs is not adequately understood further characterization of the IHSSs is required to evaluate the need for additional surface water/sediment sampling (i.e., in addition to that performed by site-wide programs).

5.1.3 Summary of Air Monitoring Impacts and Other Requirements

5.1.3.1 Data Collection Systems

The air quality and meteorological monitoring programs currently in effect at RFP were designed to collect data on the entire facility; Air sampling stations have not been located or operated specifically in support of Operable Unit 8. Continuous ambient air monitoring programs have emphasized characterization of airborne particulate material concentrations and accompanying radionuclides, particularly plutonium. A systematic program for measurement of volatile organic

compound (VOC) concentrations in RFP ambient air has not been initiated; however, a dispersion model-derived ambient air concentration study was scheduled to be completed in late 1991 (EG&G, 1991j). Meteorological data is being collected at one location at RFP. Telemetered wind measurements are collected at the RFP 61-Meter Meteorological Tower (Figure 1-2) (EG&G, 1990c). These data are apparently not available in an annotated form directly suitable for atmospheric dispersion modeling.

Ambient air samplers are located in RFP site operations areas, at the plant perimeter (at distances of approximately 2 to 4 miles from the plant's center), and in surrounding communities (Figures 5-1 and 5-3). These RFP-designed air samplers operate at a volumetric flow rate of 25 ft^3/min. The units collect air particulates on 8- by 10-inch fiberglass filter media with a manufacturer's test specifications rating of 99.97% efficiency for particle sizes typically encountered during routine ambient air sampling (EG&G, 1990c).

Table 5.1 identifies the sampling equipment used for continuous measurement of airborne particulates. RFP samplers monitor ambient air for both Total Suspended Particulates (TSP) and Particulate Matter with aerodynamic diameters of 10 microns or less (PM-10). TSP and PM-10 samplers located near the east entrance to RFP are of particular importance because this location is unobscured by structures, is situated near a traffic zone, and is generally downwind from plant buildings and contaminated surfaces. Samplers are operated on a schedule of one day every sixth day. TSP is measured by the EPA-referenced, high-volume air sampling method (EPA, 1981).

5.1.3.2 Radionuclide Monitoring

The Radioactive Ambient Air Monitoring Program (RAAMP) collects particulate ambient air sampler information in order to track the dispersion of airborne radioactive materials from RFP into the surrounding environment as well as establish baseline concentrations. Samplers are assigned into one of three categories, depending upon their proximity to the main facilities area. Twenty-five onsite samplers are located within RFP and are concentrated near the main facilities

area. Fourteen perimeter samplers border RFP along major highways to the north, east, south, and west. Fourteen community samplers are located in the metropolitan areas adjacent to RFP (EG&G, 1990c).

RAAMP monitor locations within and adjacent to the RFP operations area are shown in Figure 5-1. During 1988, sample filters were collected biweekly from twenty-three locations and analyzed for total long-lived alpha (TLL-α) radiation. If the TLL-α activity for an ambient air sample exceeded the plant guide value of 10×10^{-15} Ci/ml (3.7×10^{-4} Bq/m^3), a specific plutonium analysis was performed on the collected sample. Filters from five of the twenty-three onsite samplers were routinely analyzed biweekly for plutonium (S-5 through S-9, Table 5.2). The mean concentrations of plutonium in ambient air at the five onsite stations during 1988 ranged from 0.149×10^{-15} to 0.710×10^{-15} Ci/m^3 (5.51×10^{6} to 2.63×10^{-5}Bq/m^3). These concentrations represented less than four percent of the offsite Derived Concentration Guide (DCG) for plutonium in air. These five onsite samplers have historically exhibited the highest TLL-α activities for the RAAMP network (Rockwell, 1988).

During 1990, filters were also collected biweekly from all RFP samplers. Each biweekly onsite sampler filter was analyzed separately every month except in December. Filters collected in December were composited by location into one onsite sample. Filters from perimeter and community samplers were collected biweekly, composited by location, and analyzed monthly for plutonium. Plutonium concentrations for onsite samplers during 1990 are provided in Table 5.3. Overall mean plutonium concentration for onsite samplers was 0.072×10^{-15} Ci/ml (2.7×10^{-6} Bq/m^3), or 0.36 percent of the offsite DCG for plutonium in air. By comparison, the overall mean plutonium concentration for perimeter samplers was 0.003×10^{-15} Ci/ml (1.1×10^{-7} Bq/m^3); The mean plutonium concentration for community samplers was 0.001×10^{-15} Ci/ml (3.7×10^{-8} Bq/m^3). These values are 0.013 percent and 0.005 percent, respectively, of the offsite DCG (EG&G, 1991).

Mean annual plutonium concentrations for 1986-1990 are shown in Figure 5-2 (onsite samplers) and Figure 5-4 (perimeter and community samplers). Onsite data were based on samplers S-5 through S-9; Isotope-specific analyses were not reported for other onsite locations until 1990 (EG&G, 1990).

5.1.3.3 Nonradiological Particulate Monitoring

Nonradiological particulate data collected by the RFP ambient air monitoring system are shown in Table 5.4 (EG&G, 1990). The highest TSP value recorded in 1990 (24-hour sample) was 134 micrograms per cubic meter (g/m^3) or 51 percent of the former TSP 24-hour primary standard. The annual geometric mean value was 31.4 g/m^3 or 12 percent of former TSP primary annual geometric mean standard. The observed 24-hour maximum for the PM-10 sampler was 26 g/m^3 or 17 percent of the primary 24-hour standard, and the annual arithmetic mean was 9.8 g/m^3 or 20 percent of the primary annual arithmetic mean standard. Mean annual concentrations of particulates for onsite ambient TSP samplers (1986-1990) and PM-10 samplers (1988-1990) are shown in Figure 5-5, (EG&G, 1990).

5.1.3.4 Air Data Usability

Air quality and meteorological monitoring programs at the RFP routinely emphasize meteorological parameters, total suspended particulates, and ambient air concentrations of particulate radionuclides. While a record of area radionuclide concentrations and trends is important, the specific identity of contaminant sources and the conditions of typical and maximum atmospheric input from OU8 IHSS sites cannot be ascertained. Although there are air monitoring stations operating at or near OU8, they measure aggregate airborne particulate concentrations regardless of source. Furthermore, their operational schedule of the monitoring stations are currently independent of OU8 activities.

However, existing ambient monitoring of existing sites can provide important records of historical trends, establish current baseline conditions, and characterize major deviations in concentrations that might result in IHSS site-specific actions. It must be remembered that this data is not provided on a real-time basis, and uncertainty will always exist with these monitors concerning to multiple contaminant sources. As such, additional IHSS site-specific ambient monitoring will be required during OU8 Work Plan implementation. This monitoring will be performed in conjunction with site worker safety monitoring.

The routine RFP ambient air quality monitoring network does not gather data relevant to outdoor-contaminated surface-area source releases of volatile organic compounds (VOCs). A complete human health risk assessment for IHSS site VOCs will require additional information on the identity, emissions rate, dispersion, and ambient concentrations of VOCs originating from OU8. However, source concentrations of airborne VOCs to the air pathway (particularly with regards to individual OU8 IHSS sites) appear limited and would probably exist below the minimum detection levels of ambient detectors at all locations except, possibly, the immediate vicinity of the source. As such, theoretical flux rates to the atmosphere can be derived from OU8 soil gas surveys. Coupled with dispersion models to support order-of-magnitude risk assessments, they can be used to determine VOCs should it be deemed necessary.

5.2 DATA QUALITY OBJECTIVES

Data Quality Objectives (DQOs) are established to define data needs for each of the RFI/RI tasks, coordinate data collection activities in support of those needs, and to ensure that the resultant data are of adequate quantity and quality to achieve the technical and regulatory objectives of the RFI/RI process. Collectively, the data are used to make decisions regarding the risks the site poses to human health and the environment and to make decisions regarding which remedial measures are appropriate to mitigate the risks. DQOs are developed interactively with ongoing RFI/RI activities. The DQO development process is flexible, iterative and dependant upon evaluation of existing data, and data that become available as a result of RFI/RI activities. Three

stages are used in the development of DQOs, and each of the stages is outlined below (EPA, 1987).

Stage 1 - Identify Decision Types

- Identify and involve data users;
- Evaluate available data;
- Develop a conceptual model of the study site; and
- Specify RFI/RI objectives and anticipate the decisions that may have to be made in order to achieve the objectives.

Stage 2 - Identify Data Uses and Needs

- Identify data uses
- Identify data types
- Identify data quality needs
- Identify data quantity needs
- Evaluate sampling and analysis options
- Review data precision, accuracy, representativeness, completeness and comparability (PARCC)

Stage 3 - Design Data Collection Program

- Assemble data collection components
- Develop data collection documentation

The DQO elements are continually revised and reevaluated on the basis of new data developed during each phase of the RFI/RI. As the environmental characteristics and the nature of contamination of the study area become clearer, additional data requirements will become apparent and both the DQOs and the Field Sampling Plan (FSP) may evolve in response to these requirements. The succeeding discussion addresses each of the DQO elements.

5.2.1 STAGE 1 Identification of Decision Types

5.2.1.1 Identification of Data Users

The following is a list of agencies and organizations that are the principal decision makers and end users of data that will be generated during the OU8 Phase I RFI/RI (EG&G, 1991i).

United States Department of Energy, Office of Environmental Restoration and Waste Management, Secretary of Energy, and the Acting Assistant Secretary for Environmental Restoration and Waste Management.

United States Department of Energy, Rocky Flats Office Manager, Assistant Manager for Environmental Management, and the Acting Environmental Restoration Division Director.

EG&G Rocky Flats Plant, Environmental Management Department, Associate General Manager for Environmental Restoration and Waste Management, Environmental Management Department Director, Environmental Management Department Division Managers, and matrix project personnel from other Rocky Flats Plant or external EG&G organizations.

EG&G Rocky Flats Plant technical specialists and subcontractors responsible for supervising, coordinating and performing Environmental Restoration activities (EG&G, 1991i).

United States Environmental Protection Agency, Region VIII, Waste Management Division Director, Federal Facilities Branch Chief and the Rocky Flats Remedial Project Manager.

State of Colorado Department of Health, Hazardous Materials and Waste Management Division Director, Hazardous Waste Section Leader, Hazardous Waste Facilities Unit Leader, and the Monitoring and Enforcement Unit Leader.

Natural Resource Trustees.

5.2.1.2 Evaluation of Available Data

Soils and geologic data collection activities in the vicinity of OU8 have been primarily directed towards defining the Rocky Flats Plant environmental setting; the data were developed as a result

of the Rocky Flats Plant Geological Characterization. Chemical data used to characterize the types and sources of contamination present in the soils and groundwater were collected as a result of the Rocky Flats Plant Geological Characterization. The soils and geologic data that are available were not developed for the specific purpose of characterizing OU8.

Existing ambient air monitoring programs characterize the Rocky Flats Plant site on an area-wide basis for total suspended particulates, PM_{10}, plutonium and americium. Rocky Flats Plant site air monitoring stations are shown in Figures 5-1 and 5-3. This data is not specific to any of the OU8 IHSS sources, but provides a baseline for the Rocky Flats Plant and is collected according to air sampling procedures specified in EMD Operating Procedures Manual No. 5-21000-OPS-AP, Volume VI, Air.

Surface water and sediment chemistry data (metals, water quality, and radiochemistry) for OU8 are available from 21 sampling stations located in two drainage basins (Figure 1-2).

Data for surface water, groundwater, soils and geology are in the process of being validated in accordance with sections 3.4 and 3.7 of the Rocky Flats Plant Site-Wide Quality Assurance Project Plan. Some of the data are validated and accepted, some are validated with qualifications, some have been rejected and some have yet to go through the validation process. The Rocky Flats Environmental Database lists the available analytical data and identifies which samples have been validated.

5.2.1.3 Site Conceptual Model

Conceptual models of IHSSs in OU8 have been developed and are presented in Section 2.5 of this document. The models include a description of potential sources of contamination, release mechanisms, media, transport, exposure routes, and potential receptors. The conceptual models were developed by organizing the IHSSs into three logical groups based primarily upon the type

of contaminant, release mechanism, and geographic location. The three groups, and the IHSSs that compose each group, are listed below.

- Leaks spills and overflows of tanks and pipelines originating below ground surface - IHSSs 118.1, 123.1, 135.0, 137.0, 138.0, 144.0, and 150.3.
- Releases associated with fires and explosions - IHSSs 150.1, 150.2, and 150.7.
- Leaks spills, and overflows of tanks, pipelines and/or drums originating above ground surface - IHSSs 118.2, 139.1, 139.2, 150.4, 150.6, 150.8, 151.0, 163.1, 163.2, 172.0, 173.0, 184.0, and 188.0

The conceptual models will be used as an aid in identifying exposure pathways, and to evaluate the potential risks to human health and the environment posed by the contamination present in OU8. These models are also used as an aid in developing the DQOs.

5.2.1.4 Data Objectives and Decisions

The DQO process requires identification of specific data objectives and the types of decisions that must be made regarding remediation; formulation of the objectives and decisions leads to the identification of data uses, needs and types. The data objectives and decisions for the OU8 RFI/RI Work Plan are summarized in Table 5.5. The objectives range from determination of the sites demographic setting to identification of applicable remedial alternatives. Table 5.5 lists RFI/RI activities that are related to each of the objectives. The decisions related to accomplishing the objectives range from deciding on the appropriate regulatory framework for each of the RFI/RI activities to deciding what resources can be shared between remedial actions at other operable units.

5.2.2 Stage 2 - Identify Data Uses and Needs

5.2.2.1 Identify Data Uses

The principal uses of RFI/RI data have been defined in Data Quality Objectives for Remedial Response Activities and are listed below (EPA, 1987).

- **Site Characterization** - data are used to determine the site physical characteristics and the nature and extent of contamination at a site;
- **Health and Safety** - data are used to establish the level of protection needed for on-site workers and to determine if there is imminent danger to the surrounding population;
- **Risk Assessment** - data are used to evaluate the threat posed by the site to public health and the environment;
- **Evaluation of Alternatives** - data are used to evaluate which remedial technologies may be appropriate;
- **Engineering Design of Alternatives** - data are used in the remedial design process to evaluate the performance of various remedial technologies; and
- **Monitoring During Remedial Action** - after remedial actions are implemented, data are used to assess their effectiveness.

Data uses specific to RFI/RI Phase I sampling and analysis activities for OU8 are listed in Table 5.6.

5.2.2.2 Identify Data Types

Data types required for the OU8 RFI/RI are: air quality, soil engineering/geotechnical, soil-gas, soil chemistry, surface water flow measurements, surface water/sediment chemistry, aquifer parameters, and groundwater chemistry. Table 5.6 provides additional information on the types of data that will be collected.

5.2.2.3 Identify Data Quality Needs

The level of data quality required for OU8 RFI/RI activities is based upon the following factors: appropriate analytical levels, contaminants of concern, level of concern, required detection limit, and critical samples. Each of these factors is discussed below.

Appropriate analytical levels for RFI/RI work are listed below (EPA, 1987).

- **Level I** Field portable instruments. Results are typically not compound specific and not quantitative. This analytical level is appropriate for providing real time health and safety data, and as a screening tool to indicate potentially contaminated areas.

- **Level II** Mobile laboratories and field gas chromatograph/mass spectrometer (GC/MS) units. Results may be compound specific and quantitative depending on instrument calibration, reference standards, equipment condition and operator capability. Real time data may be available, or results may be produced in several hours. This analytical level is appropriate during the site characterization, evaluation of remedial alternatives, engineering design, and during site monitoring.

- **Level III** Off-site analytical laboratory and for some analytes mobile laboratories. Results generally have a greater degree of analytical precision than Level II. Data may be available in 24 hours or in a period of several days to weeks. Level III is an appropriate level for some phases of site characterization, risk assessment, evaluation of remedial alternatives, engineering design, responsible party determination, and during site monitoring.

- **Level IV** EPA Contract Laboratory Program. The analytical precision is similar to that of Level III, but stringent quality assurance and quality control protocol are formally documented. Laboratory turn-around-times for reporting analytical results are similar to those described for Level III.

- **Level V** Off-site analytical laboratory using non-standard methods. Analytical method development or modification is required and analytical precision and reporting schedules may vary according to the method.

Analytical Level I through Level V will be used during implementation of the OU8 RFI/RI. The analytical methods that will be used are those specified in the EG&G Rocky Flats General Radiochemistry and Routine Analytical Services Protocol (GRRASP), Parts A and B (EG&G, 1991b).

Analytes of interest have been selected to assist in determining the extent of contamination and as an aid in developing a risk assessment. The criteria for selecting the analytes of interest are based upon IHSS historical data and indications of contamination based upon the Rocky Flats Environmental Database. The analytes of interest are listed in Table 5.7; as additional data become available, the list is expected to evolve.

Levels of concern are based upon available standards and are expressed as contaminant specific concentration ranges that serve as guidelines for selecting analytical methods and detection limits and in determining the limits of field investigations.

Detection limit requirements take into account the levels of concern, RFP chemical specific Benchmarks in lieu of Applicable or Relevant and Appropriate Requirements (ARARs), and Data Quality Objectives specified in the Rocky Flats Plant Site-Wide Quality Assistance Project Plan (EG&G, 1991a). Site-specific ARARs will be developed as the initial step in the corrective measures study. Detection limits are listed in Table 5.7 and in the Field Sampling Plan (FSP).

Critical samples may be collected in duplicate from areas that are considered vital to the RFI/RI decision making process. Selection of critical samples will occur after initial site scoping surveys have been completed.

5.2.2.4 Identify Data Quantity Needs

Data quantity needs are based primarily on a review of the available environmental data, and on an assessment of additional data required to adequately characterize the site and the nature of

contamination at OU8. The rationale for sampling quantities is described in the FSP presented in Section 6.0 of this Work Plan. The FSP recommends a staged approach to data collection to locate critical sampling sites. Field sampling density will be based upon methodologies and statistical guidance contained in Data Quality Objectives For Remedial Response Activities (EPA, 1987), sample density criteria specified in Attachment 2, Table 5 of the IAG (DOE, 1991), and site specific information available from the Historical Release Report and developed as a result of preparing this Work Plan.

Based upon the available data, and the site conceptual model, additional data described in Table 5.7 and the FSP will be collected for the OU8 Phase I RFI/RI. Additional data are needed to adequately characterize the site physical characteristics, sources of the contamination, the nature and extent of contamination, and to support a baseline risk assessment, and assessment of remediation alternatives.

5.2.2.5 Evaluate Sampling/Analysis Options

RFI/RI data collection and analysis for OU8 will utilize a graduated approach in which Analytical Level I and Level II field screening techniques will be used to focus subsequent data collection and analysis for Analytical Levels III through V. The sampling/analysis options selected are based upon their ability to obtain data that is consistent with known site conditions and that satisfy Attachment 2, Table 5, of the IAG.

Field screening techniques will be used whenever possible to reduce waste generated during sample collection, minimize delays that can result when more exacting analytical methods are used, and to minimize worker exposure. Analytical Level I and Level II field screening will be used to assess both radiochemical and organic chemical contamination. Radiological surveys using a High Purity Germanium detector (HPGe) will be conducted to identify areas of radiochemical contamination that may require further investigation. Field methods for use of the HPGe are presently being prepared and a standard operating procedure will incorporated in the

Environmental Management Radiological Guidelines Manual (EG&G, 1991e). A G-M shielded pancake detector and side shielded FIDDLER may used at locations deemed inappropriate for the HPGe depending site conditions. Soil-gas surveys utilizing a portable GC will be used to identify areas of organic chemical contamination and to direct further sampling efforts. Data collection procedures will be those specified in Environmental Management Division Manual 5-21000, Volume III, Geotechnical (EG&G, 1992c). Photoionization detectors will be employed as screening tools for volatile organic contamination and for health and safety purposes.

Surface scrape samples will be collected at IHSSs suspected or known to have heavy metal or radiological contamination. These samples will serve as an additional screening tool prior to more invasive sampling techniques such as drilling. Depending upon historical records for each IHSS, surface scrape samples may be analyzed for total plutonium, americium 241 total uranium, tritium, radium 226 &228, cesium 137, strontium 89/90, gross alpha and gross beta, beryllium, total chromium, lithium, nitrate, sodium, sulfate phosphate, and Target Analyte List (TAL) metals as specified in the IAG (DOE, 1991a) and as indicated by review of RFEDs data. Surface scrape samples may be analyzed for PCBs based upon the information contained in the Assessment of Known, Suspect and Potential Environmental Releases of PCBs Preliminary Assessment, Site Description (EG&G, 1991j). Analytical methods for each type of analysis will conform to a specific laboratory procedure referenced in the GRRASP (EG&G, 1991a), these methods meet the criteria for analytical Level III through V. Field data collection will be in accordance with Environmental Management Division Manual 5-21000, Volume III, Geotechnical, (EG&G, 1992c).

Soil samples will be collected from boreholes to assess the presence or absence of contaminants and to determine their distribution. Depending on historical records for each IHSS, samples will be analyzed for total plutonium, americium 241, cesium 137, strontium 89/90, radium 226 & 228, tritium, gross alpha, gross beta, total uranium, beryllium, phosphates, fluorides, nitrate, sodium, sulfate, TCL volatile compounds, TCL semi-volatile compounds, TAL metals. As per the FSP, the first two-foot interval will be composited and thereafter composite samples of six-foot

intervals will be collected over the entire depth of the borehole. One discrete sample will be collected from every four foot interval drilled in accordance with the SOPs identified in Table 5.7; these samples will be analyzed for TCL volatiles. Analytical Levels III, IV and V will be used for soil samples. Field data collection will be in accordance with Environmental Management Division Manual 5-21000, Volume III, Geotechnical, (EG&G, 1992d).

Alluvial groundwater samples will be collected using BAT samplers. In accordance with the FSP, additional groundwater monitoring will be deferred until phase two of the OU8 RFI/RI. BAT samples will be analyzed for TCL volatile compounds, chromium, and nitrate. Quarterly groundwater data collection activities will support characterization of contaminant distribution as well as ongoing monitoring activities. Analytical Level III and IV (CLP protocol) will be used to analyze groundwater samples. Groundwater sampling and measurement of field parameters will be conducted in accordance with Environmental Management Division Manual 521000, Volume II, Groundwater (EG&G, 1991).

Surface water and sediment monitoring efforts at existing surface water and sediment from sampling stations throughout the Rocky Flats Plant, especially the industrialized area, are managed by surface water sampling and sediment sampling programs at Rocky Flats. Results from sampling efforts of these programs with respect to OU8, will continuously be collected and evaluated. If elevated concentrations of analytes of interest are indicated from the results of sampling at existing surface water or sediment monitoring stations, then additional sampling programs may be proposed to further define contamination that may be part of OU8. If proposed changes or additional sampling is required, information collection and sampling will be coordinated with the surface water and sediment sampling programs to insure that efforts are not duplicated.

All data collection field records will be handled in accordance with the quality control procedures specified in Environmental Management Division Manual 521000, Volume I, Field Operations (EG&G, 1992c).

5.2.3 STAGE 3 - Design Data Collection Program

Stage three of the DQO process compiles the various elements of Stages one and two into a cohesive data collection program for the OU8 RFI/RI. To this end, a Quality Assurance/Quality Control Addendum (developed by EG&G) and a Field Sampling and Analysis Plan have been developed and are included as Sections 10.0 and 6.0, respectively, of this Work Plan. The results of the DQO process have been distilled into a detailed list (Table 5.10) of the number and type of samples to be collected, their location and analytical methods.

5.3 REVIEW OF PARCC PARAMETER INFORMATION

PARCC parameters (precision, accuracy, representativeness completeness, and comparability) for analytical Levels I through V are discussed below. Precision, accuracy and completeness goals are specified in the Quality Assurance addendum (section 10.0).

Precision is a quantitative measure of data quality that defines the reproducability or degree of agreement among replicate measurements of a single analyte. The closer the numerical values of the measurements are to each other, the more precise the measurements. One of methods used to estimate the precision of a method is the standard error of the estimates for the least square regression line of "measured" versus "target" concentrations (EG&G, 1991a). The primary role of this application is to characterize the precision of any analysis method under specified conditions, This allows comparison of different results produced by the same method. Analytical precision for a single analyte may be expressed as percentage of the difference between results of duplicate samples and matrix spike duplicates for a given analyte. Precision will be determined from the results of duplicate and matrix spike duplicate analyses (EG&G, 1991a).

During the collection of data using field methods or instrumentation, precision is checked by reporting several measurements taken at one location and comparing the results. Precision will

be reported as the relative percent difference for two results and as the standard deviation for three or more results. Sample collection precision shall be measured in the laboratory with the analysis of field replicates and laboratory duplicates (EG&G, 1991a). Analytical precision will be achieved by adhering to the analytical methods contained in the GRRASP (EG&G, 1991b). Sampling precision will be achieved by conforming to the procedures specified in the Environmental Management Division's Operating Procedure manuals referenced above.

Accuracy is a quantitative measure of data quality which refers to the degree of difference between measured or calculated values and the true value. The closer to the true value, the more accurate the measurement. One of the measures of analytical accuracy is expressed as a percent recovery of a spike or tracer which has been added to the environmental sample at a known concentration before analysis (EG&G, 1991a). While it is not feasible to totally eliminate sources of error that may reduce accuracy, the OU8 Work Plan attempts to minimize error by using standardized analytical methods and field procedures.

Representativeness is a qualitative parameter which expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition (EG&G, 1991a). Representative data will be obtained by using both biased and unbiased methods of selecting sample locations. Biased methods will employ existing data in areas known to be contaminated to determine the degree of contamination. Unbiased methods such as grid sampling will be used to determine both the nature and extent of contamination. Field work will be conducted according to standard operating procedures, further aiding the collection of representative data.

Completeness is a quantitative measure of data quality expressed as the percentage of valid or acceptable data obtained from a measurement system. The objectives of the field sampling program are to obtain samples for all analyses required at each individual site, to provide sufficient sample material to complete those analyses, and to produce QC samples that represent

all possible contamination situations; such as , potential contamination during sample collection, transportation or storage (EG&G, 1991a).

Comparability is a qualitative parameter describing the confidence with which one data set for similar samples and sample conditions may be compared to another (EPA, 1987). The standard laboratory methods of the GRRASP (EG&G, 1991b) and standard operating procedures for conducting field work will allow for one to one comparability of OU8 RFI/RI data to other work conducted in conformance with those same standards.

Table 5.1

AMBIENT AIR MONITORING DETECTION METHODS

Parameter	Detection Methods
Particulate Matter less than 10 micrometers in diameter (PM-10)	Wedding PM-10 Sampler
Total Suspended Particulates (TSP)	Reference Method (Hi-Volume) 24-Hour sampling (6th-day)

Table 5.2

PLUTONIUM-239 AND -240 ACTIVITY CONCENTRATIONS IN ONSITE AMBIENT AIR AT SELECTED LOCATIONS DURING 1988[a]

Station	Number of Analyses	Volume (X 1000m^3)[d]	Concentration[b] (x 10^{-15} µCi/ml)[c] C_{min}	C_{max}	Standard Deviation C_{mean}	Percent of DCG[e] (C_{mean})	(C_{mean})
S-5	25	331	0.054	1.389	0.389	0.357	1.95
S-6	26	344	0.027	0.460	0.149	0.111	0.75
S-7	26	328	0.045	1.171	0.515	0.369	2.58
S-8	26	418	0.114	1.246	0.710	0.366	3.55
S-9	26	376	0.205	1.179	0.641	0.286	3.21
S-6[f]	1	11	NA[g]	NA	0.059	NA	0.30
S-7	1	12	NA	NA	0.664	NA	3.32
S-8	1	17	NA	NA	2.129	NA	10.65
S-9	1	12	NA	NA	1.281	NA	6.41

a. Air-sampling stations S-5, S-6, S-7, S-8, and S-9 are located in areas where the potential for elevated airborne radioactivity is greatest.

b. Concentrations reflect monthly composites of biweekly station concentrations. C_{min} = minimum composited concentration; C_{max} = maximum composited concentration; C_{mean} = mean composited concentration.

c. To obtain the proper concentration, multiply the numbers listed in the table by 1 x 10^{-15} µCi/ml. For example, the mean concentration at S-5 was 0.389 x 10^{-15} µCi/ml.

d. To obtain the proper volume, multiply the numbers listed in the table by 1000 m^3. For example, the air volume sampled at S-5 was 331,000 m^3.

e. The interim standard calculated Derived Concentration Guide (DCG) for inhalation of class W plutonium by members of the public are applicable for offsite locations. All locations in this table are on Rocky Flats Plant property. The DCGs for the public are presented here for comparison purposes only.

f. Samples from stations S-6 (taken 8/9/88 to 8/23/88), S-7 (taken 4/19/88 to 5/3/88), S-8 (taken 11/29/88 to 12/13/88), and S-9 (taken 8/23/88 to 9/6/88) exceeded the screening guide to 10 x 10^{-15} µCi/ml total long-lived alpha activity. Specific plutonium analyses were performed on these samples. The results of these analyses are included for completeness.

g. NA = Not applicable.

Table 5.3

ONSITE AMBIENT AIR SAMPLER PLUTONIUM CONCENTRATIONS (1990[a,b])

Station	Number of Samples	Concentration ($\times 10^{-15}$ µCi/ml)[c] C minimum	C maximum	C mean	Standard Deviation (C standard)	Percent of DCG[d] (C mean)
S-1	21	0.000	3.057	0.948	0.892	4.740
S-2	13	0.003	0.024	0.007	0.007	0.037
S-3	16	0.000	0.010	0.003	0.001	0.014
S-4	17	0.001	0.181	0.022	0.050	0.110
S-5	24	0.004	0.453	0.099	0.123	0.496
S-6	24	0.013	0.482	0.127	0.144	0.637
S-7	24	0.010	0.670	0.118	0.180	0.588
S-8	25	0.024	0.108	0.061	0.033	0.305
S-9	24	0.033	0.328	0.107	0.094	0.535
S-10	17	0.002	0.016	0.006	0.004	0.028
S-11	17	0.000	0.008	0.005	0.003	0.024
S-12	17	0.002	0.023	0.013	0.007	0.063
S-13	17	0.001	0.008	0.004	0.003	0.018
S-14	17	0.000	0.006	0.002	0.002	0.011
S-15*	15	-0.001	0.028	0.004	0.008	0.021
S-16	17	-0.001	0.005	0.002	0.002	0.011
S-17	17	0.005	0.022	0.011	0.005	0.053
S-18*	16	0.011	0.069	0.035	0.020	0.177
S-19	17	0.010	0.092	0.028	0.023	0.142
S-20	17	0.004	0.033	0.016	0.008	0.080
S-21	17	0.004	0.018	0.009	0.005	0.045
S-22	17	0.001	0.009	0.004	0.002	0.020
S-23	16	0.001	0.006	0.003	0.002	0.015
S-24	17	-0.002	0.010	0.002	0.003	0.012
S-8B*	13	0.051	0.356	0.161	0.123	0.806
Overall	452	-0.002	3.057	0.072	0.070	0.360

a. Data provided in this table are based on various periods of sampling. The locations not marked with an asterisk are calculated on a 12-month basis. The other locations are calculated using less than 12 months of data due to mechanical malfunctions, incomplete laboratory analyses, or the installation of a new sampler (S-8B) that has not been in service for a complete year.

b. Isotope-specific analyses were reported only for locations S-5 through S-9 before 1990. These five samplers are the only onsite locations included in the 5-year trending portion of this report.

c. Concentrations reflect monthly composites of biweekly station concentrations; C minimum - minimum composited concentration; C maximum = maximum composited concentration; C mean = mean composited concentration.

d. The DOE Derived Concentration Guide (DCG) for inhalation of class W plutonium by members of the public is 20 x 10^{-15} µCi/ml. Protection standards for members of the public are applicable for offsite locations. All locations in this table are on RFP property. DCGs for the public are presented here for comparison purposes only.

Table 5.4

AMBIENT AIR QUALITY DATA FOR NONRADIOACTIVE PARTICULATES

Total Suspended Particulates	$\mu g/m^3$
Total Number of Samples[a]	56.0
Total Number of Samples[b]	59.0
Annual Geometric Mean[a]	31.4
Annual Geometric Mean[b]	27.7
Standard Deviation[a]	20.3
Standard Deviation[b]	18.2
Observed 24-Hour Maximum[a]	134.4
Observed 24-Hour Maximum[b]	119.0
Second Highest Maximum[a]	74.0
Second Highest Maximum[b]	69.0
Lowest Observed Value[a]	8.0
Lowest Observed Value[b]	2.9
Respirable Particulates (PM-10)	
Total Number of Samples[c]	45.0
Total Number of Samples[d]	49.0
Annual Arithmetic Mean[c]	9.8
Annual Arithmetic Mean[d]	11.2
Observed 24-Hour Maximum[c]	26.0
Observed 24-Hour Maximum[d]	29.7
Second Highest Maximum[c]	19.0
Second Highest Maximum[d]	26.0

a. Primary ambient air TSP particulate sampler; reporting unit.
b. Collocated duplicate TSP sampler.
c. Primary ambient air PM-10 sampler.
d. Collocated duplicate PM-10 sampler.

Table 5.5

DATA OBJECTIVES AND DECISIONS

OBJECTIVE	RFI/RI ACTIVITY	DECISIONS
Evaluate the potential presence or absence of contaminants in the site's air, surface water, sediments, soils, subsoils, and groundwater.	Review site historical records and available contaminant source and distribution data.	Determine the applicable regulatory framework in conformance with the IAG.
Determine the demographic setting of the site and establish the site's relationship with surrounding population centers.	Collect qualitative and quantitative information describing the demographic setting, community interest groups and their attitudes towards the site.	What level of community relations involvement is appropriate in the early stages of the RFI/RI process, and how will this involvement be incorporated into other ongoing or planned community relations efforts.
Characterize the environmental setting of the site and define the mechanisms for contaminant transport.	Collect environmental samples (surface water, sediments, soils, subsoils, and groundwater), perform analyses, and conduct field tests to quantify and describe the physical nature of the site and to define the mechanisms governing contaminant transport.	Adjust the level of detail necessary to adequately describe the site as investigative activities progress.
Define contaminant concentrations and the extent of contamination.	Analyze sample data to define concentration gradients.	Prioritize contamination sources and transport mechanisms for upcoming RFI/RI studies.
Assess the risks the site poses to human health and the environment.	Compare contamination data to existing health standards and perform a risk assessment.	Prioritize sources that may pose a threat to human health and the environment. Assess what level of community relations is appropriate.
Identify applicable remedial alternatives based upon the physical properties of the contaminants, the media in which they occur, and the migration and exposure pathways.	Review site wide treatability study and technical literature on available remedial technologies and their application. Use RFI/RI data to select technology that is compatible with the site and risk assessment requirements.	What resources can be shared between similar remedial actions at other operable units.

TABLE 5.6

DATA USES, DATA NEEDS AND ANALYTICAL/FIELD QUALITY (page 1)

DATA USE	DATA TYPE	ANALYTICAL LEVEL	QA/QC METHODS
Site Characterization Risk Assessment Evaluation of Remedial Alternatives Engineering Design Alternatives Monitoring During Remedial Action Correlation of Contamination to Responsible Party(s)	Groundwater samples are needed to determine concentrations of TCL volatiles and inorganic constituents.	Level III and Level IV, EPA CLP Protocol.	Field QA/QC will be in accordance with FSP. Duplicates, will be collected from wells that produce enough water to collect the required suites of analytes without dewatering. Laboratory QA/QC will be in accordance with CLP protocol.
Site Characterization Health and Safety Risk Assessment Evaluation of Remedial Alternatives Engineering Design Alternatives Monitoring During Remedial Action	Soil samples from boreholes are needed to determine the concentration and distribution of organic and inorganic chemicals, and radioisotopes in the alluvium.	Level I for field screening with organic vapor and radiation detectors. Level III and Level IV, offsite laboratory for analytes other than radiochemicals. Level V for radiochemical analysis.	Field QA/QC will be in accordance with FSP. Laboratory QA/QC will be in accordance with the GRRASP. Field screening instruments will be calibrated per manufacturers instructions.

TABLE 5.6

DATA USES, DATA NEEDS AND ANALYTICAL/FIELD QUALITY (page 2)

DATA USE	DATA TYPE	ANALYTICAL LEVEL	QA/QC METHODS
Site Characterization	Real time soil-gas surveys are needed to identify areas contaminated with organic chemicals. Surveys will be conducted using sampling grids.	Level II, field portable GC/MS or GC equipment.	GC field calibration after every 10 sample analyses. Field duplicates for every 10 samples. Method blanks for each operating day.
Site Characterization Health and Safety Risk Assessment	Surface scrape samples are needed to identify areas exhibiting heavy metal or radiological contamination. (Vertical soil profiles will be performed, as needed, in accordance with HPGe SOP).	Level III and Level IV, offsite laboratory for analytes other than radiochemicals. Level V for radiochemical analysis. Level II for HPGe detector.	Field QA/QC will be in accordance with FSP. Laboratory QA/QC will be in accordance with the GRRASP. Performance testing of HPGe as specified by EG&G Radiation Instrumentation.
Site Characterization Health and Safety	Radiological surveys are needed to identify areas with elevated activity levels in IHSSs that are suspected to be contaminated with radioisotopes.	Level I, GM and FIDLER detectors, and Level II, HPGe detector.	Performance testing as specified by EG&G Radiation Instrumentation.
Site Characterization Health and Safety Risk Assessment	Analysis of asphalt/concrete samples are needed to determine the concentration and distribution of radionuclides.	Level V for radiochemical analysis.	Field QA/QC will be in accordance with FSP. Laboratory QA/QC will be in accordance with the GRRASP.

TABLE 5.6

DATA USES, DATA NEEDS AND ANALYTICAL/FIELD QUALITY (page 3)

DATA USE	DATA TYPE	ANALYTICAL LEVEL	QA/QC METHODS
Site Characterization Risk Assessment Evaluation of Remedial Alternatives Engineering Design Alternatives	Leaching tests of soil samples are needed to characterize sources and evaluated potential mobility of contaminants.	Level III and Level IV, offsite laboratory for analytes other than radiochemicals. Level V for radiochemical analysis.	Leach test QA/QC will be in accordance with FSP to be provided in TM 1. Analytical laboratory QA/QC will be in accordance with the GRRASP.

TABLE 5.7
DATA QUALITY OBJECTIVES SUMMARY (page 1)

RADIATION SURVEY

IHSSs 118.1, 118.2, 123.1, 135, 137, 138, 139.1 (N & S), 139.2, 144 (N & S), 150.1 - 150.4, 150.6 - 150.8, 163.1, 163.2, 172, 173, 184, and 188

Analytes of Interest	Sampling Task	EG&G Operating Procedure	Analytical Method	Detection Limit
Alpha, Beta and Gamma radiation	Survey entire area on a grid[1]. Areas exhibiting elevated activity levels will be surveyed on a tighter grid spacing.	Operating Procedures for the HPGe will be developed prior to field use. OPS,EMRG.1.1* OPS,EMRG.1.2* OPS,EMRG.3.2*	HPGe or, alternatively, Geiger Mueller shielded pancake detector or side shielded FIDLER.	HPGe - 100 kev GM & FIDLER Beta/Gamma - 5,000 dpm/100cm^3 (removable plus fixed sources). Alpha - 300dpm/100cm^3 (removable plus fixed sources).

[1] Survey with HPGe will be performed on appropriate spacing to ensure full coverage of IHSS accounting for 45-foot diameter area of detection. Radiation Survey Grid Spacing for GM or FIDLER - IHSSs 118.1, 118.2, 123.1, 135, 137, 138, 139.1 (N & S), 139.2, 144, and 188 = 10 feet; IHSSs 150.1 - 150.4, 150.6 - 150.8, 163.1, 163.2, 173 and 184 = 25 feet; IHSS 172 = 50 feet.

* EG&G 1991b

TABLE 5.7
DATA QUALITY OBJECTIVES SUMMARY (page 2)

SURFACE SCRAPE SAMPLING

IHSSs 118.1, 118.2, 135, 137, 138, 144 (N & S), 150.1 - 150.4, 150.6 - 150.8, 163.1, 163.2, 172, 173, and 184.

Analytes of Interest	Sampling Task	EG&G Operating Procedure	Analytical Method	Detection Limit
Total plutonium[1,2,4,5,6,7,9] Total Uranium[1,2,4,5,6,7,9] Americium 241[1,2,4,5,6,7,9] Radium 226 and 228[1,4,5,6] Strontium 89/90[5,6,9] Cesium 137[5,9] Tritium[1,2,3,4,5,6] Gross alpha[1,2,4,5,6,7] Gross beta[1,2,4,5,6,7] Lithium[5] Nitrate[5,6,7] Sulfate[5,6] Phosphate[3,4] TAL metals[3,4,5,6,8,9]	Two inch surface scrapes will be collected at each borehole location.	OPS,GT.8.*	GRRASP methods.	Total Plutonium - 0.03 pCi/g Total Uranium - 0.03 pCi/g Americium 241 - 0.02 pCi/g Radium 226 & 228 - 0.5 pCi/g Strontium 89/90 - 1.0 pCi/g Cesium 137 - 0.1 pCi/g Tritium - 400 pCi/l Gross Beta - 10 pCi/g Gross Alpha - 4 pCi/g Lithium - 20 mg/kg Nitrate - 0.1 mg/kg Sulfate - 10.0 mg/kg Phosphate - 0.1 mg/kg TAL metals - EPA CLP Detection Limits.

[1] Analysis required for IHSS 118.1

[2] Analysis required for IHSS 118.2

[3] Analysis required for IHSS 135

[4] Analysis required for IHSSs 137 and 138

[5] Analysis required for IHSSs 144 N & S

[6] Analysis required for IHSSs 150.1 - 150.4 & 150.6 - 150.8

[7] Analysis required for IHSSs 163.1 & 163.2

[8] Analysis required for IHSS 173

[9] Analysis required for IHSS 184

* EG&G, 1992b

TABLE 5.7
DATA QUALITY OBJECTIVES SUMMARY (page 3)

SOIL - GAS SAMPLING

IHSSs 118.1, 118.2, 123.1, 135, 137, 138, 139.1 (N), 144 (N), 150.1 - 150.4, 150.6 - 150.8, 151, 163.1, 163.2, 173, 184, and 188

Analytes of Interest	Sampling Task	EG&G Operating Procedure	Analytical Method	Detection Limit
1,1,1-Trichloroethane[1,3] Carbon tetrachloride[1,3,4,5,6,7] Methylethylketone[1] Dichloromethane[1] Perchloroethene[1,2,3,4,5,6,9] Trichloroethene[1,2,3,4,5,6] Benzene[1,2,3,4,5,8] Toluene[2,3,4,5,8] Xylene[2,3,4,5,8] Acetone[7,9] trans-1,2-dichloroethene[3,6] 1,1-dichloroethene[3,6,7] 1,2-dichloroethane[5] Analytical peaks for compounds not calibrated for on the GC.	Sampling grid for IHSSs 118.1, 118.2 and 151 - 10 feet, IHSS 123.1 - 100 feet, IHSSs 135 and 137 - 40 feet, IHSSs 138, 139.1(N) and 144(N) - 20 feet, IHSS 150.1 - 75 feet, IHSSs 150.2 and 150.4 - 60 feet, IHSS 163.1 - 50 feet, IHSS 173 - 25 feet, and IHSS 188 - 30 feet. Soil gas sampling for IHSSs 150.6 - 150.8, 163.2, and 184 will be performed at borehole locations. Sample intervals may be compressed as field conditions indicate.	OPS,GT.9,* OPS,GT.19*	Field portable GC calibrated for sample parameters shown in column 1.	Perchloroethene - 5ug/l 1,1,1 Trichloroethane - 5ug/l Carbon tetrachloride - 5ug/l Methylethylketone - 10ug/l Dichloromethane - 5ug/l Trichloroethene - 5ug/l Benzene - 5ug/l Toluene - 5ug/l Xylenes - 5ug/l Acetone - 10ug/l trans-1,2-dichloroethene - 5 ug/l 1,1-dichloroethene - 5 ug/l 1,1-dichloroethane - 5 ug/l

[1] Analysis required for IHSS 118.1, 118.2, 137, and 144(N).
[2] Analysis required for IHSS 123.1 and 163.1.
[3] Analysis required for IHSS 135.
[4] Analysis required for IHSS 138, 139.1(N), 150.3, 150.6-150.8, 163.2, 184, and 188.
[5] Analysis required for IHSS 150.1.
[6] Analysis required for IHSS 150.2.
[7] Analysis required for IHSS 150.4.
[8] Analysis required for IHSS 151.
[9] Analysis required for IHSS 173.

* EG&G 1992b

TABLE 5.7
DATA QUALITY OBJECTIVES SUMMARY (page 4)

BOREHOLE SOIL SAMPLING
IHSSs - 118.1, 118.2, 123.1, 144 (N & S), 150.1 - 150.4, 150.6 - 150.8, 151, 163.1, 163.2, 173 and 184

Analytes of Interest	Sampling Task (For details see Table 5.8)	EG&G Operating Procedures	Analytical Method	Detection Limit
Total plutonium[3,4,5,7,9] Total Uranium[3,4,5,7,9] Americium-241[4,5,7,9] Radium-226 & 228[4,5] Cesium-137[4,9] Strontium-89/90[4,5,9] Gross alpha[3,4,5,7] Gross beta[3,4,5,7] Tritium[4,5] Lithium[4] Fluorides[3] Nitrate[3,4,5,7] Sulfate[4,5] TAL metals[1,3,4,5,8,9] TCL semi-volatiles[6] TCL volatiles[1,2,3,6] Total Recoverable Petroleum Hydrocarbons (TRPH)[6]	Borehole numbers, spacing, depth, composite intervals and special sample collection procedures are listed in Table 5.8.	OPS,GT.2*	Calibrated laboratory GC/MS, GRRASP methods. EPA 340.2, 353.2, 365.1 and 375.3 for fluorides, nitrate, phosphates and sulfate respectively.	Total Plutonium - 0.03 pCi/g Total Uranium - 0.03 pCi/g Americium 241 - 0.02 pCi/g Radium 226 & 228 - 0.5 pCi/g Cesium 137 - 0.1 pCi/g Strontium 89/90 - 1.0 pCi/g Tritium - 400 pCi/l Gross Beta - 10 pCi/g Gross Alpha - 4 pCi/g Lithium - 20 mg/kg Fluorides - 1.0 mg/kg Nitrate - 0.1 mg/kg Sulfate - 10.0 mg/kg TAL metals - EPA CLP Detection Limits. TCL semi-volatiles - EPA CLP Detection Limits. TCL volatiles - EPA CLP Detection Limits. TRPH - 10 mg/kg per EPA Method 418.1

TABLE 5.7
DATA QUALITY OBJECTIVES SUMMARY (page 5)

[1] Analysis required for IHSS 118.1.
[2] Analysis required for IHSS 118.2.
[3] Analysis required for IHSS 123.1.
[4] Analysis required for IHSS 144 (N & S)
[5] Analysis required for IHSSs 150.1 - 150.4 and 150.6 - 150.8
[6] Analysis required for IHSS 151
[7] Analysis required for IHSSs 163.1 and 163.2.
[8] Analysis required for IHSS 173.
[9] Analysis required for IHSS 184.

*EG&G, 1992b

TABLE 5.7
DATA QUALITY OBJECTIVES SUMMARY (page 6)

SHALLOW SOIL SAMPLING
IHSSs 135, 137, 138, 139.1 (N & S), 139.2, 172, and 173

Analytes of Interest	Sampling Task	EG&G Operating Procedure	Analytical Method	Detection Limit
Sodium[4] Potassium[4] Fluoride[4] Nitrate[4] pH[4] Chloride[4] Total plutonium[3,5,6] Total uranium[3,5,6] TCL Volatiles[1] TAL Metals[1,2,3,5] Tritium[1] Phosphate[1,2,3] Gross alpha[3,5,6] Gross beta[3,5,6] Americium-241[3,5,6] Beryllium[5,6] Cesium-137[6] Strontium-89,90[6]	Samples will be collected from soil borings 6 feet in depth (6 inches for IHSSs 139.1 (N & S) and 139.2).	OPS,GT.08*	GRRASP, CLP protocol and EPA 340.2 (Fluorides)	Sodium - 2,000 mg/kg Potassium - 2,000 mg/kg Fluoride - 0.1 mg/kg Nitrate - 0.1 mg/kg pH - 0.1 pH units Chloride - 0.1 mg/kg Total Uranium - 0.06 pCi/g Total Plutonium - 0.03 pCi/g TCL volatiles - EPA CLP Detection Limits TAL metals - EPA CLP Detection Limits Tritium - 400 pCi/l Phosphate - 0.1 mg/kg Gross alpha - 4 pCi/g Gross beta - 10 pCi/g Americium-241 - 0.2 pCi/g Beryllium - 1.0 mg/kg Cesium-137 - 0.1 pCi/g Strontium-89,90 - 1.0 pCi/g

TABLE 5.7
DATA QUALITY OBJECTIVES SUMMARY (page 7)

[1] Analysis required for IHSS 135.
[2] Analysis required for IHSS 137.
[3] Analysis required for IHSS 138.
[4] Analysis required for IHSSs 139.1 (N & S) and 139.2.
[5] Analysis required for IHSS 172.
[6] Analysis required for IHSS 173.

*EG&G, 1992b

TABLE 5.7
DATA QUALITY OBJECTIVES SUMMARY (page 8)

GROUNDWATER BAT SAMPLING
At Locations Specified in Technical Memoranda

Analytes of Interest	Sampling Task	EG&G Operating Procedure	Analytical Method	Detection Limit
Nitrate Total chromium TCL volatiles	To be determined.	To be developed as part of the Field Implementation Plan	GRRASP, CLP protocol.	Nitrate - 1 mg/l Chromium - 10.0 ug/l TCL volatiles - EPA CLP Detection Limits

TABLE 5.7
DATA QUALITY OBJECTIVES SUMMARY (page 9)

ASPHALT/CONCRETE SAMPLING
IHSS 172

Analytes of Interest	Sampling Task	EG&G Operating Procedure	Analytical Method	Detection Limit
Total plutonium Total americium Total uranium Beryllium Gross alpha Gross beta	Samples of asphalt/concrete will be collected if the results of the radiation survey to be conducted for this site indicate that contamination in excess of DOE limits for uncontrolled areas is present. Soil grab samples will be collected below asphalt/concrete where indications are that IHSS has been covered since historical release.	OPS,GT.08* to be modified by document change notice.	GRRASP, CLP protocol.	Total plutonium - 0.03 pCi/g Total americium - 0.01 pCi/g Total uranium - 0.06 pCi/g Gross alpha - 2 pCi/l Gross beta - 4 pCi/l Beryllium - 1.0 mg/kg

*EG&G, 1992b

TABLE 5.8

BOREHOLE SOIL SAMPLING DETAILS (page 1)

BOREHOLE SOIL SAMPLING TASKS

IHSS Number	Grid Spacing	Number of Boreholes	Borehole Depth	Sample Interval	Additional Sampling Criteria
118.1 & 118.2	Not applicable	4 boreholes transecting the IHSS 118.1 area with 1 additional random sample to be located after completing the soil-gas survey. 2 boreholes transecting IHSS 118.2 with 1 additional random borehole to be located after completion of the soil-gas survey.	Top of the saturated zone or 6 feet into weathered bedrock whichever is shallower.	1 discrete sample shall be collected from every 4 foot interval drilled and analyzed for TCL volatiles. Composite samples of first 2 feet and then 6-foot intervals shall be collected for remainder of analyses.	Geologic logs will be prepared over the entire depth of the boring. BAT samples (saturated zone) may be collected.
123.1	Approximately 30 foot spacing adjacent to the vault.	17 boreholes will be located immediately surrounding the vault with 1 additional random borehole to be located after completion of the soil-gas survey.	10 feet below the base of the vault or to tope of saturated zone or 6 feet into weathered bedrock whichever is shallower.	1 discrete sample shall be collected from every 4 foot interval drilled and analyzed for TCL volatiles. Composite samples of first 2 feet and then 6-foot intervals shall be collected for remainder of analyses.	Geologic logs will be prepared over the entire depth of the boring. BAT samples (saturated zone) may be collected.
135	25 foot spacing or as indicated by soil gas and radiation surveys.	30 shallow boreholes	6 feet	1 discrete sample shall be collected from every 2 foot interval drilled and analyzed for TCL volatiles. 2-foot composites shall be analyzed for other analytes.	Geologic logs will be prepared over the entire depth of the boring. BAT samples (saturated zone) may be collected.

TABLE 5.8

BOREHOLE SOIL SAMPLING DETAILS (page 2)

BOREHOLE SOIL SAMPLING TASKS

IHSS Number	Grid Spacing	Number of Boreholes	Borehole Depth	Sample Interval	Additional Sampling Criteria
137	20 foot spacing or as indicated by soil gas and radiation surveys.	15 shallow boreholes	6 feet	2-foot composites shall be analyzed for specified analytes.	Geologic logs will be prepared over the entire depth of the boring. BAT samples (saturated zone) may be collected.
138	25 foot spacing or as indicated by soil gas and radiation surveys.	9 shallow boreholes	6 feet	2-foot composites shall be analyzed for specified analytes.	Geologic logs will be prepared over the entire depth of the boring. BAT samples (saturated zone) may be collected.
139.1 N. 139.1 S. & 139.2	15 foot spacing	20 shallow boreholes (IHSS 139.1 N.), 9 shallow boreholes (IHSSs 139.1 S. and 139.2)	6 inches	Not applicable - full interval shall be analyzed for specified analytes.	Geologic logs will be prepared over the entire depth of the boring.

TABLE 5.8

BOREHOLE SOIL SAMPLING DETAILS (page 3)

BOREHOLE SOIL SAMPLING TASKS

IHSS Number	Grid Spacing	Number of Boreholes	Borehole Depth	Sample Interval	Additional Sampling Criteria
144 N. & 144 S.	Approximately 15 foot spacing (IHSS 144 N.), 20 foot spacing (IHSS 144 S.)	18 boreholes (IHSS 144 (N)), 9 boreholes (IHSS 144 (S)). 1 additional borehole to be located at random at IHSS 144 (N) after completion of soil-gas survey. 2 boreholes located adjacent the sewer line. 4 boreholes located on the affected hillside.	6 feet into weathered rock or to saturated zone whichever is shallower. 5 feet below the sewer pipe invert or 6 feet into weathered rock or to saturated zone whichever is shallower. 6 feet into weathered rock or to saturated zone whichever is shallower.	1 discrete sample shall be collected from every 4 foot interval drilled and analyzed for TCL volatiles. Composite samples of first 2 feet and then 6-foot intervals shall be collected for remainder of analyses.	Geologic logs will be prepared over the entire depth of the boring. BAT samples (saturated zone) may be collected.

TABLE 5.8

BOREHOLE SOIL SAMPLING DETAILS (page 4)

BOREHOLE SOIL SAMPLING TASKS

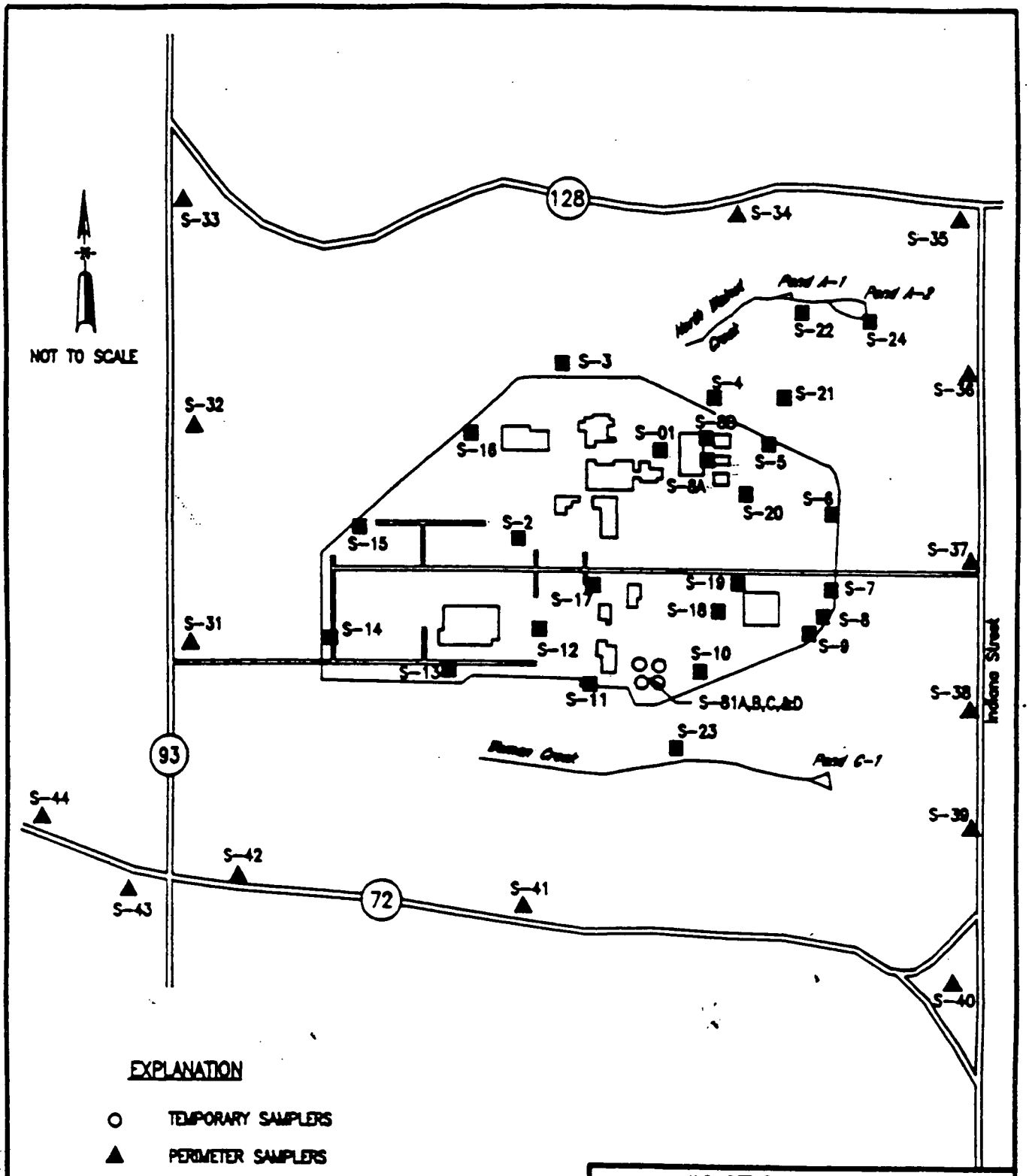
IHSS Number	Grid Spacing	Number of Boreholes	Borehole Depth	Sample Interval	Additional Sampling Criteria
150.1 - 150.4 & 150.6 - 150.8	150.1 - 50 foot spacing 150.2 - 50 foot spacing 150.3 - 2 rows of 3 boreholes 150.4 - 2 rows of 4 boreholes 150.6 - 2 rows of 4 boreholes 150.7 - 50 foot spacing 150.8 - 40 foot between boreholes on a linear transect	15 boreholes 15 boreholes 7 boreholes 11 boreholes 7 boreholes 8 boreholes 8 boreholes 1 additional borehole to be located at random at each IHSS after completion of soil-gas survey.	6 feet into weathered bedrock or to saturated zone whichever is shallower.	1 discrete sample shall be collected from every 4 foot interval drilled and analyzed for TCL volatiles. Composite samples of first 2 feet and then 6-foot intervals shall be collected for remainder of analyses.	Geologic logs will be prepared over the entire depth of the boring. BAT samples (saturated zone) may be collected.
151	Not applicable	4 boreholes spaced uniformly around the tank and immediately adjacent to it with 1 additional random borehole to be located after completion of the soil-gas survey.	5 feet below the bottom of the tank or 6 feet into weathered bedrock whichever is greater.	1 discrete sample shall be collected from every 4 foot interval drilled and analyzed for TCL volatiles and semi-volatiles and TRPH.	Geologic logs will be prepared over the entire depth of the boring. BAT samples (saturated zone) may be collected.

TABLE 5.8

BOREHOLE SOIL SAMPLING DETAILS (page 5)

BOREHOLE SOIL SAMPLING TASKS

IHSS Number	Grid Spacing	Number of Boreholes	Borehole Depth	Sample Interval	Additional Sampling Criteria
163.1 & 163.2	To be based upon the results of the radiation survey.	To be determined from the radiation survey.	10 feet or to saturated zone whichever is shallower.	1 discrete sample shall be collected from every 2-foot interval drilled and analyzed for radionuclides and nitrates.	Geologic logs will be prepared over the entire depth of the boring. BAT samples (saturated zone) may be collected.
172	Not applicable	To be determined from the radiation survey.	To be determined.	To be determined.	To be determined.
173	Not applicable	4 boreholes located at the corners of the IHSS with 1 additional random borehole to be located after completion of the soil-gas survey.	6 feet or to saturated zone whichever is shallower.	Composite samples of first 2 feet and then 6-foot intervals shall be collected for analysis of TAL metals.	Geologic logs will be prepared over the entire depth of the boring. BAT samples (saturated zone) may be collected.
184	Not applicable	5 boreholes - 4 located at the corners and 1 at the center of the IHSS.	Top of the saturated zone or 6 feet into weathered bedrock whichever is shallower.	Composite samples of first 2 feet and then 6-foot intervals shall be collected for analysis of radionuclides and TAL metals.	Geologic logs will be prepared over the entire depth of the boring. BAT samples (saturated zone) may be collected.
188	Not applicable	To be determined from soil gas and radiation surveys.	To be determined.	To be determined.	To be determined.



U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant, Golden, Colorado

OPERABLE UNIT NO. 2
PHASE II RFI/RI WORK PLAN (ALLUVIAL)

LOCATION OF ON-SITE AND PLANT PERIMETER AMBIENT AIR SAMPLERS

FIGURE 5-1

R3307LA0CH-071191

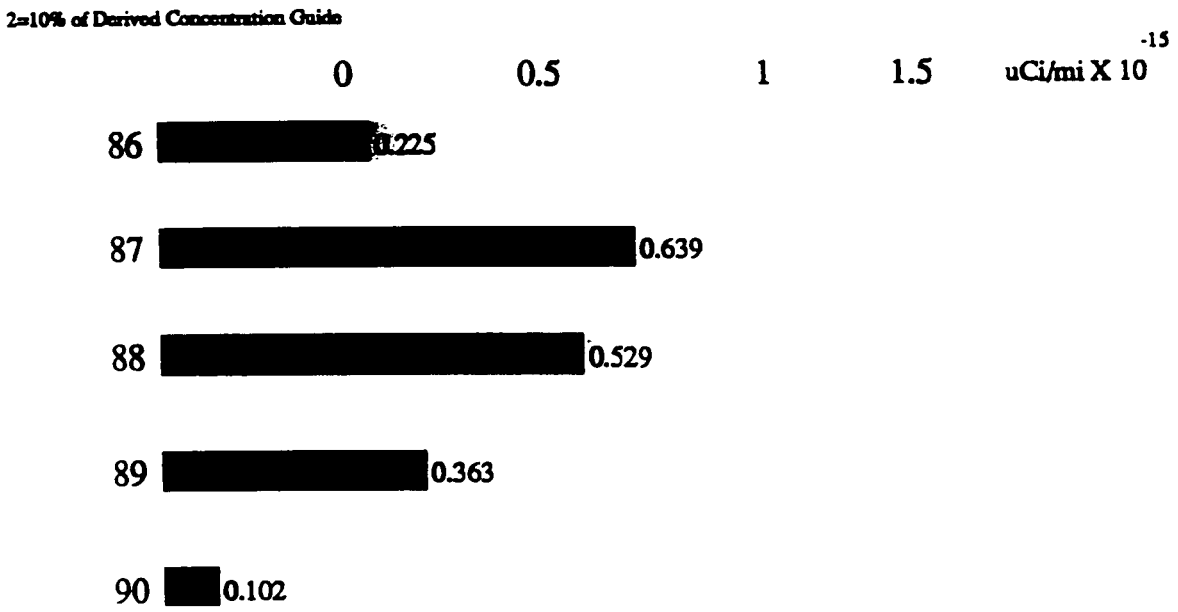


Figure 5-2. Plutonium-239,-240 Onsite Concentrations, 1986-1990

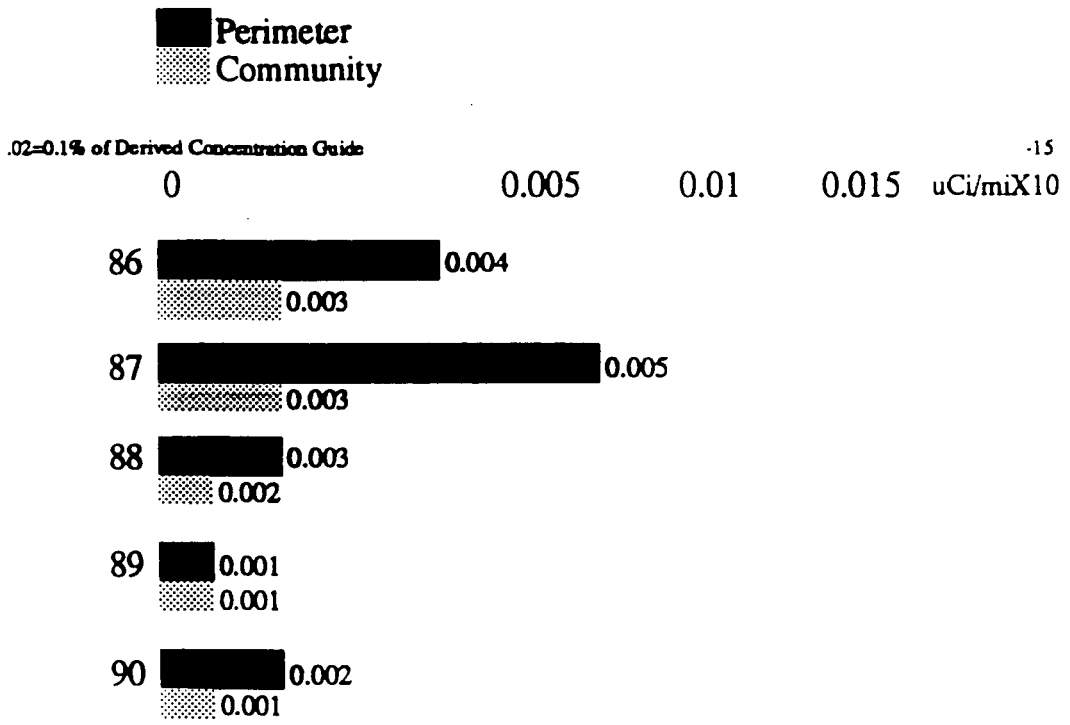
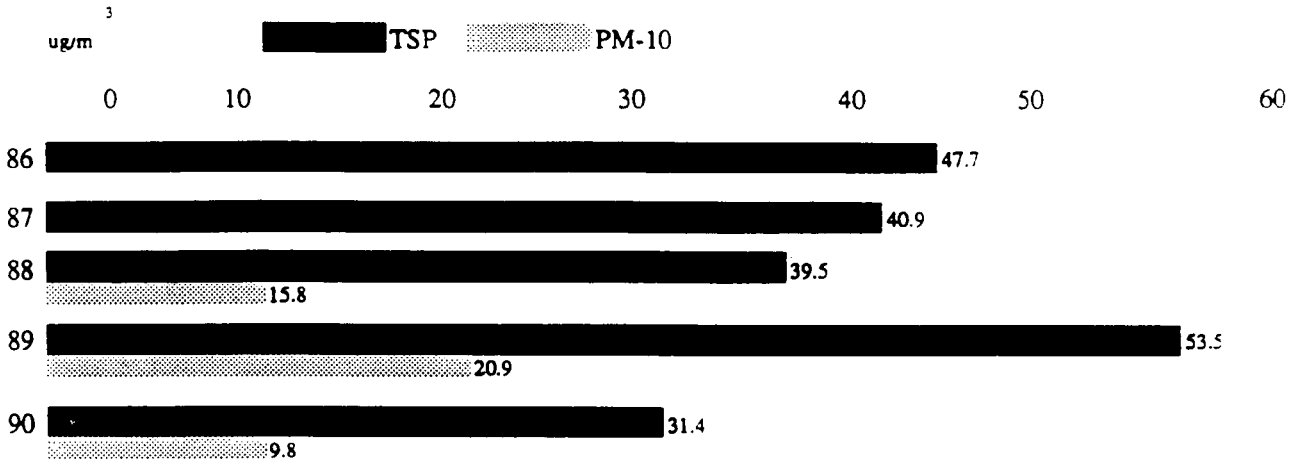


Figure 5-4. Plutonium-239, -240 Perimeter and Community Concentrations, 1986-1990



50=TSP (NAAQS) 60=PM-10 (NAAQS)

Figure 5-5. TSP and PM-10 Results, 1988-1990

6.0 FIELD SAMPLING PLAN

6.1 SAMPLING RATIONALE AND OBJECTIVES

Environmental samples will be collected to achieve the data objectives (Section 5.0) stated in this Work Plan. Sampling activities will be staged, allowing the initial stages to provide information that can be used to direct and refine the methods used in subsequent stages. At critical points in the Phase I RFI/RI investigation, Technical Memoranda will be prepared to summarize and interpret the information that was collected previously. Based upon an evaluation of the acquired data, the Technical Memoranda will outline approaches for continued investigations. Where warranted, the Memoranda will recommend changes in the investigation scope, variance in subsequent staged investigations, and will include any rationale and changes to the FSP regarding sample frequency, location, procedures and methodology, and analysis parameters.

The rationale used to select the analyses of concern specified in Section 5 of this Work Plan took into account the following considerations:

- The operating history of the IHSS suggests that there is a strong probability that the contaminant was released into the environment;
- The physical and chemical properties of the contaminant suggest that it is persistent once it has been released into the environment;
- The principal analyses of concern at each IHSS are identified in Attachment 2, Table 5 and attachment 4 of the IAG (Appendix A); and as are discussed in the draft HRR (DOE, 1992) including recent updates completed by Doty and Associates (Appendix B).
- Rocky Flats Environmental Database (RFEDs) analytical data that are applicable to OU8 indicate the presence of the contaminant in quantities above the maximum background concentration for RFP.

Coordination of field sampling activities between adjacent and contiguous Operable Units will be done to conserve resources and minimize field mobilization costs. Such coordination will

permit efficient and thorough evaluation of current conditions and the nature and extent of contamination for each IHSS in OU8.

6.1.1 Surficial Soil

The rational for surficial soils sampling is based on a lack of data which would indicate whether contamination of the soils and surficial materials from particular IHSSs has occurred, and/or would indicate the nature and extent of said contamination.

Within OU8 there are several IHSSs in which contamination of the surficial materials may have occurred. This assumption is based on the volume of the release, response to said release and the chemical character of the contaminant, including the potential for buffering or the likelihood that the contaminant would still be present in significant amounts. Insufficient data due to the lack of validating the current data and/or absence of analyses does not allow an adequate characterization of the individual IHSSs. In addition, variable geologic conditions and physical barriers (e.g. pavement over an IHSS that post-dates the IHSS use) exist at OU8 within the surficial materials and shallow bedrock which may complicate the expected flow paths of potential contaminants.

Surficial materials sampling can establish the presence and nature and extent of contaminants. It is likely that in most cases surficial materials sampling will also be able to determine the source areas, except in some areas with overlapping source areas. Additional data regarding the geochemical and physical characterization of the surficial materials at OU8 is needed and a preliminary step towards this goal can be accomplished by implementing the surface soils sampling plan as set forth in Section 6.

6.1.2 Surface Water and Sediment

The contaminants released to the environment from the IHSSs were often spilled or placed onto the uncovered ground or on parking lot surfaces which would allow infiltration and runoff of incident precipitation and the transport of the constituents into the drainageways downstream of the IHSSs. Also, water-transported contaminated soils or other surface materials into ditches and stream courses is expected to result in the occurrence and deposition of contaminated stream sediments. The location of the existing surface-water and sediment monitoring sites are in places that collect runoff from large, land areas of varied uses and development including from numerous IHSSs and other Operable Units within the RFP. Information continues to be collected by existing site-wide surface water and sediment collection programs at Rocky Flats. Analytical information from these programs will be continually updated for OU8, and if additional sampling is identified to isolate runoff from individual contamination sources, then close coordination with these programs will be performed to reduce redundant sampling efforts.

Many of the buildings within the OU8 boundary have perimeter footing underdrains. It is suspected that groundwater in the vicinity of these underdrains is being collected and discharged into the storm sewer (or sanitary sewer) systems and then being discharged into the open drainageways. The existence of underdrains and the location of the surface discharge points is necessary to determine the interaction between the groundwater and surface water within OU8.

A staged approach to surface-water and sediment monitoring is recommended in Section 6. This approach would analyze existing data, collect additional data where needed, and analyze that data before making decisions further regarding the continuation of field sampling.

6.1.3 Vadose Zone

Existing groundwater data for the wells in the vicinity of OU8 IHSSs are described on an IHSS-specific basis in section 2.4. None of the existing wells were installed for the purpose of

monitoring the vadose zone. Therefore conditions in the vadose zone in the vicinity of the IHSSs is lacking and indications of contamination are limited to analysis results (including leachability tests) of borehole samples (soil and groundwater) collected during drilling operations. Other methods to investigate the vadose zone would be based on information collected and summarized in technical memoranda No. 2. A Field Sampling Plan for vadose zone work would be provided in technical memoranda No.2 if required, based on results collected to date.

6.1.4 Groundwater

The rationale for groundwater sampling utilizing a BAT sampler or equivalent in soil borings drilled into the saturated zone, is based on a lack of downgradient groundwater monitoring well data which would indicate whether contamination of the groundwater exists or is sourced at a particular IHSS.

Within OU8 there are several IHSSs in which contamination of the groundwater may have occurred. This is based on the volume of the release, suspected pathway and the chemical character of the contaminant, including the potential for dilution or the likelihood that the contaminant would still be present in significant amounts. Insufficient data due to the absence of downgradient groundwater monitoring wells does not permit an adequate characterization for delineation of the nature and extent of contamination at individual IHSSs. In addition, variable geological conditions exist at OU8 within surficial materials and shallow bedrock which may complicate the expected flow paths of potential contaminants, most especially the presence of footings drains and outcropping and subcropping Arapahoe sandstones. The presence of surface drainages and footing drains in the vicinity and under various IHSSs could act as a pathway for contaminants to leave the groundwater system through infiltration along the walls of stream valleys and former excavations.

Groundwater sampling will establish the presence or absence, and to some degree the extent of a contaminant. However, it may have limited use to establish sources, especially in an area with

overlapping IHSS areas, unless the hydrogeological conditions are well understood, or are adequately represented in a conceptual model. Additional data regarding the geochemical and physical characterization of the groundwater system at OU8 is needed and a preliminary step towards this goal can be accomplished by implementing the sampling plan for groundwater as set described in Section 6.4.

6.1.5 Rationale for Specifying and Collecting Additional Air Quality Data

Whether defining baseline conditions or monitoring field operations, monitoring is the primary approach used to characterize and verify area air emissions. Air monitoring technologies can be organized into the following four generic categories:

1. Direct Emissions Measurement - This method is preferred for investigating an area's volatile soil gases. Area emissions measurement generally involves isolating a small section of soil surface with an airtight enclosure and measuring the concentration of vapor resulting in the headspace. Alternatively, soil gas plume boundaries and concentrations can be quickly defined by inserting an extraction probe into site soils and analyzing collected soil gases. These concentration measurements can be used to calculate an emission flux, which can then be related to an emissions rate for the area source. Although neither method considers local meteorological influences other than at the time of sampling, the acquired data can be used to develop estimates of volatile organic emissions to air. Neither technique allows evaluation of particulate emissions to air.

2. Indirect Emission Measurement - This method involves measuring the atmospheric concentration of the emitted species (volatile and/or particulate matter) and equating this data to an estimated emission rate. All techniques involve clusters of ambient air samplers positioned close to the emission source. Precise monitoring schemes require individual monitors be placed in a vertical array at

each monitoring station. Screening measurements can be made upwind, downwind, and/or directly above the site using real-time instruments. Downwind measurements can be corrected for instrument bias and upwind interferences. False negatives may occur if species concentrations are below instrument minimum detection levels. These methods are appropriate for assessment of airborne total suspended particulate/respiratory particulate concentrations.

3. Air Monitoring/Modeling - With this method of monitoring, technologies that measure ambient air concentration are combined with air dispersion algorithms to calculate the area source emission rate. These models usually provide air concentration information at a distance further downwind than indirect measurement data, and they do not distinguish between multiple units within a combined site.

4. Predictive Emissions Models - With this method, emission rates for a wide variety of waste types can be predicted provided fairly detailed information is available for model input. Assumptions concerning the theoretical and empirical relationships of individual contaminant mobility are applied to known site-specific factors to derive estimates of individual contaminant emissions rates. These rates are then added to determine the overall emission rate from the site.

Information currently available for OU8 does not support an air pathway assessment for individual IHSS sites at OU8. This limited data precludes the application of predictive emissions models in estimating individual site emissions rates. Similarly, dispersion modeling methodologies do not lend themselves to individual IHSS site air pathway analysis. However, the existing RAAMP monitoring can continue to be used in the acquisition of airborne particulate information on multiple RFP units, including OU8 IHSS sites.

Data from existing high-volume samplers will be evaluated for application at OU8 because they provide a high particulate loading on the filters. Heavily-loaded filters provide greater deductibility than lightly-loaded filters. Filters in the low-volume total suspended particulate samplers are often so lightly loaded that concentrations of many radionuclides fall below detection limits. The high-volume samplers sample almost twice as large a volume of air in 24 hours (2448 m^3). The high-volume filters, therefore, should have more contaminant mass and better deductibility than the low-volume filters. Additionally, EPA guidelines specify that total suspended particulate should be sampled with a high-volume sampler (EPA, 1985) for analysis of inorganic compounds.

6.2 PHASE I RFI/RI OBJECTIVE

This Field Sampling Plan (FSP) provides the rationale, and methodology for performing a Phase I RFI/RI at IHSSs located at the RFP. The RFI/RI will address 24 separate IHSSs which have been identified as potential or confirmed contaminant sources in the IAG.

The general purpose of the Phase I RFI/RI is to characterize the nature and extent of contamination, to provide the data needed to support a risk assessment and to aid in the selection of remedial alternatives. Specific objectives of the OU8 RFI/RI are to:

- Confirm or refute historical information to accurately locate and describe release mechanisms and contaminants at each of the IHSSs;
- Identify each of the chemical and radiochemical constituents that are present at each of the IHSSs;
- Define the lateral and vertical extent of contamination at each IHSS;
- Supplement and refine the existing body of knowledge regarding the environmental characteristics of the IHSSs including transport mechanisms;
- Evaluate potential risks posed to the public health and the environment;

- Develop sufficient data regarding the conditions at the IHSSs and nature and extent of contaminants present to enable evaluation and selection of remedial alternatives; and

- Provide information on the nature, extent, and level of contamination present at each IHSS to support development and evaluation of cleanup options and technologies in a Feasibility Study/Corrective Measures Study (FS/CMS).

The FSP was derived primarily from Attachment 2, Table 5 of the IAG and developed with the DQOs set forth in this Work Plan, and will be capable of providing quality data that are compatible with other RFP investigations that use the same standard methods specified in this Work Plan.

6.3 INTEGRATION WITH RFP STANDARD OPERATING PROCEDURES

EG&G Rocky Flats Plant Environmental Management has established Standard Operating Procedures (SOPs) for the performance of a wide variety of RFI/RI related tasks. To ensure quality and uniformity in the execution of the OU8 Work Plan, the Work Plan specifies SOPs that are to be employed for each sampling task. There are several SOPs that are currently being developed and are not yet finalized and approved. These SOPs are expected to be complete prior to implementation of OU8 field activities. Each IHSS may have unique conditions that require modification of an SOP; modifications will be requested by a Document Change Notice (DCN). Those activities that generate appreciable quantities of particulate will be conducted in accordance with the Rocky Flats Plan for Prevention of Contaminant Dispersion (PPCD).

6.4 SAMPLING METHODS, LOCATIONS, AND FREQUENCY

The primary goal of the OU8 Phase I FSP is to collect the data necessary to fulfill the Phase I Work Plan objectives outlined in Section 1.0.

The FSP is derived primarily from Attachment 2, Table 5 of the IAG (Appendix A, and U.S. DOE, 1991). This document spells out in detail the minimum Phase I sampling and field work requirements for each of the OU8 IHSSs. These requirements were based upon available information about the IHSSs at the time the IAG was finalized. In the course of researching this work plan, additional data have become available (Appendix B), which warrant modifying the scope and/or method of field investigation for a number of OU8 IHSSs. The most recent IHSS descriptions were the sources used to modify the required actions for each IHSS (Doty & Associates, "IAG Required Action Comments"). The field work proposed in this FSP for a particular IHSS may therefore vary from that stipulated in the IAG. Tables 6.1 and 6.2 summarize the IAG Phase I field work requirements for each OU8 IHSS, as well as any proposed modifications to these requirements.

It is recognized that the FSP must remain flexible in order to accommodate RFP operations and security requirements, utilities, interferences, and similar variables. Subsequent stages of the plan must also allow for adjustment to the data obtained in earlier stages; for instance, final borehole locations cannot reasonably be selected before the results of field detection instrument surveys are interpreted.

All FSP work will be conducted based on the DQOs and EG&G Rocky Flats Plant Standard Operating Procedures (SOPs). These documents will provide specifications for sample collection, handling and analytical protocol. The SOPs and Health and Safety (H&S) guidance documents will be of particular importance in implementing the Phase I RFI/RI activities.

6.4.1 Stage I - Soils and Groundwater Sampling and Investigations

Primary FSP sub-stages for sampling surficial materials have been identified. These sub-stages, are described in detail in the following sections:

- Sub-Stage 1 -- Facility Coordination and Mobilization

- Sub-Stage 2 -- Field Surveys
  - Sub-Stage 2a -- Portable GC Soil-Gas Surveys
  - Sub-Stage 2b -- Radiation Screening Surveys
  - Sub-Stage 2c -- Tank and Pipe Inspections and Sampling if required
  - Sub-stage 2d -- Informal Regulatory Meeting

- Sub-Stage 3 -- Surface Investigations
  - Sub-Stage 3a -- Surface Scrapings
  - Sub-Stage 3b -- Shallow Soil Samples
  - Sub-Stage 3c -- Technical Memorandum 1

- Sub-Stage 4 -- Subsurface Investigations
  - Sub-Stage 4a -- Soil Borings and Leach Testing
  - Sub-Stage 4b -- BAT (Saturated Zone) Sampling
  - Sub-Stage 4c -- Technical Memorandum 2

- Sub-Stage 5 -- Additional Sampling (contingent on above investigations)
  - Sub-Stage 5a -- Additional Soil Borings
  - Sub-Stage 5b -- Vadose Investigation

Table 6.2 provides the specific number and type of samples to be collected at each IHSS. These specifications however, may change based on preliminary surveys conducted for Sub-Stages 2 and 3. The sampling grid spacings used to determine the number and location of sampling points are those specified in the IAG, and those recommended by Doty & Associates after their review of the IHSSs and the IAG. Figure 6-1A provides a sequential flow chart for the proposed actions for OU8 investigations.

Sub-Stage-1 -- Facility Coordination and Mobilization

Sub-Stage 1 will address the logistics of FSP implementation prior to the commencement of field work. Detailed coordination with several RFP departments will be necessary. A Health and Safety Plan will be prepared with input from RFP health and safety personnel and from the EG&G Radiological Engineering Group. Because most of the OU8 IHSSs are within sensitive areas, coordination with RFP security will be of particular importance. Facility operations

personnel will be apprised of planned activities and schedules such that interference with RFP operations in minimized. Drilling permits, RFP excavations permits, and other required permits will be obtained. Qualified drilling and excavation subcontractors will be used.

Sub-Stage 2 -- Field Surveys

Site investigative work will commence with field detection instrument surveys specified by the IAG for a number of OU8 IHSSs. These include Portable Gas Chromatography (GC) soil-gas surveys, radiation screening surveys, and tank and pipe inspections.

Sub-Stage 2a -- Portable GC Soil Gas Surveys

Soil gas surveys, utilizing portable GC units, will be conducted at IHSSs with suspected volatile organic compound (VOC) contamination. In addition, a soil gas probe or portable GC unit will be utilized at other IHSSs to determine the presence or absence of volatile constituents. The primary reasons for performing soil gas surveys are 1) it is required by the IAG, and 2) the release that created the IHSS was one of a volatile nature. The secondary reasons for performing soil gas surveys are 1) the RFEDS data indicated volatile or semi-volatile constituents downgradient of an IHSS, and 2) the survey is to be used as a screening technique prior to further investigation as an attempt to optimize location and number of subsurface investigations e.g. soil borings (see figures 6-3 through 6-12 for soil gas sampling locations). The survey is designed to detect and quantify organic vapors in unsaturated (vadose zone) soils, and is most effective for volatile organic contaminants. The purpose of the soil gas surveys is merely to determine if contamination is present or absent.

Soil-gas samples will be collected by driving a small diameter stainless steel sampling probe approximately five feet below ground surface. A vacuum will be applied to the sampling probe to induce air flow (soil gas) from the soil pore spaces into the sampling probe. A sufficient volume of soil gas will be purged through the sampling probe to ensure that a representative

sample will be obtained. A sample of the soil gas will then be collected, using a gas-tight syringe inserted through fittings at the top of the sample probe.

Once the soil-gas sample has been collected, the sample will be analyzed using a portable field gas chromatograph (GC). The GC will be calibrated for the compounds of interest (Table 6.1), and the results will generally be available the same day the sample is collected. This methodology allows for modifications to the sampling program to be made as the sample results are obtained. In addition, once the sample has been run, the results will be analyzed to determine if other peaks occurred during the run. If other peaks do occur, the GC may be recalibrated to those peaks and the split of the original sample run within the holding time, to quantify what those peaks are. All sampling protocol will be in accordance with SOP GT.09, Soil Gas Sampling and Field Analysis and SOP.GT.19 Field Gas Chromatographies.

Grid spacings for some of the IHSSs have been determined in the IAG. However, Doty & Associates reviewed the IAG and current information pertaining to each IHSS and concluded in some cases that the recommended grid spacing was not appropriate. Due to IHSS size, tank size, nature of incident which created the IHSS, etc., Doty & Associates recommended alternative grid spacings for some of the IHSSs (see Table 6.1). For example, the proposed spacing for the soil gas surveys for IHSSs 118.1 and 118.2 was reduced from the IAG proposed 25- and 30-foot spacings, respectively, to 10-foot spacings. According to Doty & Associates' review, IHSS 118.1 was an 8-foot by 14-foot underground tank and IHSS 118.2 is an 8-foot by 14-foot aboveground tank. Because of the size of these tanks, a grid smaller than proposed in the IAG would permit better definition or indication of potential contamination from these tanks. Further, IHSS 118.2 is located in a courtyard approximately 40 feet wide between Buildings 776 and 707 which decreases the effectiveness of the IAG recommended grid size.

Grid spacing may also be modified from the recommendations in Table 6.1 based on field identification of "hot spots." Hot spots are defined for soil gas surveys as areas where relatively high concentrations of volatiles are noted during the proposed soil gas survey. Depending on the

results from the survey in the field, the grid spacing may be tightened and additional soil gas analyses performed to further investigate these areas.

Sub-Stage 2b -- Radiation Screening Surveys

Radiological surveys will be conducted to document the character of possible surficial radiological contamination (Table 6.1). A High Purity Germanium (HPGe) gamma ray detector will be used which is capable of high resolution gamma ray spectroscopy enabling the identification and quantification of gamma-emitting radionuclides. The HPGe detector will be mounted on a tripod and placed a set distance above the ground surface to measure gamma rays which originate from surface media. The detector system integrates gamma activity over the detector's "field of view." The "field of view" is defined as that volume where 90 percent of those gammas which are measured originate. It is assumed that radionuclide distribution is relatively homogeneous over the field of view, and that the distribution varies only with depth. HPGe results are typically reported as concentration per unit mass, picoCuries per gram (Pci/g). The HPGe detector provides radionuclide concentrations of gamma emitting radionuclides including, but no limited to, potassium-40, radium-226, thorium-232, cesium-137, americium-241, plutonium-239, -240, and -241, and uranium-233, -234, -235, and -238. Tritium and strontium-90 are not detected using this method.

Gamma rays originating in the soil or surface media are attenuated such that the number of gammas reaching the detector decrease exponentially with depth. The elemental composition of the soil or medium measured changes the attenuated properties of the gamma rays. The more dense the soils or surface media, the more gamma attenuation will occur. Where soils are covered by asphalt or concrete, HPGe measurements will reflect the activity of the pavement, rather than the underlying soil. The capabilities of the HPGe detector provide greater areal coverage and higher quality results than G-M shielded FIDLER instruments and pancake-type detectors outlined in the IAG. FIDLER instruments provide relative comparisons of radioactivity at discrete survey points whereas HPGe detectors provide radionuclide concentrations over the

entire area surveyed. HPGe radiological surveys conducted at OU8 IHSSs will be set up on a grid that provides total areal coverage, plus overlap (Figures 6-3 through 6-12).

EG&G currently has in-house capability to conduct HPGe field surveys using a tripod-mounted detector. The tripod-mounted detector has an approximate field of view of 14 meters, or approximately 45 feet. The EMD SOP for the HPGe is presently under development and should be available prior to any OU8 field work. Other equipment requirements are listed in Section 5.2 of EMD SOP FO.16.

Surficial samples and depth profile samples will be collected at a subset of the HPGe survey locations to determine the vertical extent of radionuclide contamination. This information is required in soil or gravel covered sites only to determine the vertical distribution of gamma emitting radionuclides contributing to the HPGe survey readings. Comparison of HPGe survey readings with surficial soil and depth profile samples will allow correlation of these remote and direct measurements. At selected soil covered survey points, surficial soil samples will be collected. Subsurface soil samples will also be collected from selected locations to provide profile information and allow correlation of radionuclide depth distributions with HPGe measurements. The surficial and subsurface samples will be measured onsite for radionuclide concentration using a laboratory HPGe. The availability of a laboratory HPGe for OU8 field samples is currently uncertain. In the event a laboratory HPGe is not available by the time OU8 field work commences, samples will be set to a radiochemistry laboratory for analysis.

At asphalt or concrete covered sites, tripod mounted HPGe measurements will provide only limited information on radionuclides potentially present in soils beneath the pavement. As a result, more extensive programs of surficial soil samples for radionuclides will be conducted in paved areas. Surficial soil samples will be collected at locations covered with asphalt or concrete. Depth profile samples, used to correlate the HPGe survey with direct radionuclide activities in exposed soils, will not be collected in the paved areas. Concrete or asphalt samples will be collected at survey points with anomalous surface activity.

Surficial and subsurface soil samples will be stored in containers for 30 days to allow radon gas to equilibrate with parent radionuclides present in the soil matrix. After 30 days, a shielded HPGe, set up at an onsite laboratory, will be used to detect concentrations of gamma-emitting offsite radionuclides in the samples. These data will be used to guide further investigation of anomalous radioactive areas. Additional soil samples will be collected and analyzed in a radiochemistry laboratory at a subset of HPGe survey points to determine the concentration of non-gamma emitting radionuclides and to confirm the HPGe detector measurements.

The 30-day lag time for HPGe analysis is not real time, per se, but is more advantageous than the six to nine month turn-around time currently experienced for laboratory radionuclide analysis. The availability of laboratory HPGe however, is key to implementation of this plan. An SOP for laboratory HPGe field screening is currently under development.

Radiation surveys will be conducted over the ground surface at selected IHSSs with suspected radioactive contamination (see figures 6-3 through 6-12 for radiation survey locations). The surveys are intended to help delineate the extent of near-surface radioactive contamination possibly related to releases from the IHSSs. They will be conducted with suitable instrumentation, in accordance with SOP FO.16 Field Radiological Measurements, and will employ field techniques established by RFP radiation monitoring personnel. It is suggested that the HPGe be used at all sites. Operation of the HPGe will be performed in accordance with the RFP SOP, which is currently being prepared. However, if the information provided by the HPGe does not appear to be location specific enough or physical barriers impede the HPGE "field of view," the FIDLER and/or the G-M shielded pancake will be used at locations specified in the IAG Attachment 2, Table 5 on an IHSS per IHSS basis and if not specified in the IAG per SOP FO.16.

Most of the IHSSs to be surveyed are adjacent to buildings within production areas of the RFP. Many of these buildings contain materials which may elevate local background radiation, making it difficult to interpret small fluctuations in nearby radiation readings (EG&G, 1990e). It is

likely, therefore, that the surveys will at best establish areas of gross contamination which could potentially impact field personnel health and safety practices. The results will provide a qualitative indication of near-surface radioactive contamination, and will help to focus the soil sampling efforts of subsequent tasks. The survey may also prove helpful in prescribing worker protection for sampling operations. As stipulated in the IAG, survey grids will be tightened if anomalous "hotspots" (areas in which radioactivity is detected above background as determined in EG&G's Background Geochemical Characterization Report, 1990b) are detected. Where pavement precludes radiation screening of potentially affected soils, surface soil grab samples will be collected from beneath the pavement and screened in the laboratory. Areas of concern will be given an identification number, logged, and marked.

A walkover radiation screening survey of RFP was conducted between 1975 - 1983 (Yoder, R.E., 1984). Radioactively-contaminated soil detected through this survey apparently was removed from several areas (EG&G, 1990c). Aerial radiometric surveys of RFP have also been conducted periodically by EG&G Energy Measurements Group. These large-scale surveys focused on areas surrounding RFP as well as RFP itself, and provide limited data on radiation levels within the OU8 area. Results from the aerial surveys form a basis for IAG sampling requirements for several OU8 IHSSs.

Sub-Stage 2c -- Tank and Pipe Inspections and Sampling, if required

Tanks, valve vaults, and underground pipes constitute the primary contamination source in numerous OU8 IHSSs. The physical condition of these structures, as well as the presence of residual product or waste materials, will bear upon site characterization and selection of remedial alternatives. Sub-Stage 2 will also include inspection (and sampling, where appropriate) of tanks, drain systems, and pipelines associated with OU8 IHSSs.

Sub-Stage 2d -- Informal Regulatory Meeting

Following the Sub-Stage 2 surveys, an informal meeting will be held including the subcontractor performing the RFI/RI, DOE personnel, EG&G personnel, and the involved regulatory agencies. As a minimum, this meeting will include a discussion of the results of the Sub-Stage 2 surveys, quantification of surface and soil boring locations, proposed methods for preceding with the following stages of work and any changes to the initially proposed methods as written in the OU8 work plan. In addition, an informal FSP for soil sampling will be established. It is possible that the level of effort may change for Sub-Stage 3 proposed actions, in that the sample types, numbers, and locations as proposed in the following Sub-Stages may change based on the Sub-Stage 2 results.

Sub-Stage 3 Surface Investigations

Sub-Stage 3a -- Surface Scrapings

Surface soil samples (including asphalt/concrete samples and grab samples below paved surfaces where applicable) will be collected for laboratory analysis from numerous OU8 IHSSs. The IAG establishes sampling grids across the IHSSs targeted for surface sampling, and also specifies the depth of collection and analytical parameters (Tables 6.1 and 6.2). In addition to the analytical parameters mandated by the IAG, some surface samples may be selected for analysis of radiological parameters based on previous radiological surveys. Prospective sampling locations are shown on Figures 6-3 through 6-12 (Figure 6-2 is provided as an index map for the locations of Figures 6-3 through 6-12). At many IHSSs, surface soil is proposed to be sampled at soil boring locations and analyzed for the same parameters as soil boring samples. These surface samples will be collected immediately prior to drilling at each boring location. Sub-Stage 3a also addresses surface samples from those IHSSs at which no soil borings will be drilled.

Sub-Stage 3a will be performed in accordance with SOP GT.08, Surface Soil Sampling. Additionally, surficial soil sampling for rads will be performed using the CDH method and for non-rads composites will be collected in accordance with OU1 Technical Memoranda No.5. At sampling sites that have been paved subsequent to the incident responsible for contaminating the area, individual grab samples will be collected from the soil beneath the pavement (SOPs for grab sampling below pavement are being developed). Typical RFI/RI surface and shallow soil sampling SOPs call for samples to be collected by trained personnel with a suitable instrument (e.g., a precleaned stainless steel trowel) and placed in an appropriately-labeled sample container. The sample will be described as completely as possible by field personnel. Sampling instruments will be completely cleaned and decontaminated between samples. Sample preservation will be achieved by cooling with ice. Transfer of the samples to a certified laboratory will be accomplished within the maximum time allowable for the applicable analyses. Detailed documentation of sample collection and chain-of-custody will be completed for each sample. The samples will be screened for gross radioactive contamination by EG&G radiation monitoring personnel prior to shipment to the analytical laboratory.

Sub-Stage 3b -- Shallow Soil Samples

Shallow soil samples will be collected for laboratory analysis from numerous OU8 IHSSs. Shallow soil samples are defined herein as those collected from a depth of less than six feet, or those able to be collected by hand auger. The IAG establishes sampling grids across most of the IHSSs targeted for shallow soil sampling, and also specifies the depth of collection and analytical parameters (Tables 6.1 and 6.2). Prospective sampling locations are shown on Figures 6-3 through 6-13. Figures 6-14 and 6-15 show the proposed sampling schemes for the shallow soil samples. In addition to meeting the IAG requirements, shallow soil samples that are to be collected at IHSSs where radiation surveys and/or soil gas surveys will be performed, are being collected to further define and/or confirm the presence or absence of suspected contaminants detected by the previous surveys. Shallow soil samples will also be utilized for vertical soil profiles using the HPGe as described in Sub-Stage 2b. At IHSSs where other surveys are not

proposed, the shallow soil samples will be collected to meet the IAG and to determine the presence or absence of the constituents suspected from the releases as stated in the HRR (Section 8.0).

Sub-Stage 3b will be performed in accordance with the EG&G SOPs presented in the discussion of Sub-Stage 4. Typical RFI/RI shallow soil sampling SOPs call for samples to be collected by trained personnel with a suitable instrument (e.g. a precleaned stainless steel hand auger and thin-walled sampler for shallow soil) and placed in an appropriately labeled sampler container. The sample is described as completely as possible by field personnel. Geologic and hydrologic data at each location, such as depth and nature of subcropping bedrock and depth to water table, will also be obtained and described. Sampling instruments are to be completely cleaned and decontaminated between samples. Sample preservation is achieved by cooling with ice. Transfer of the samples to a certified laboratory is accomplished within the maximum time allowable for the applicable analyses. Detailed documentation of sample collection and chain-of-custody will be completed for each sample. The samples will be screened for gross radioactive contamination by EG&G radiation monitoring personnel prior to shipment to the analytical laboratory.

Sub-Stage 3c -- Technical Memorandum 1

A Technical Memorandum (TM) will be issued to the leading agency(ies) detailing the results from the work completed for Sub-Stages 1 through 3b. In addition, the evaluation of results from site-wide surface water and sediment sampling programs will be compiled, evaluated and included within TM 1. This information will supplement the results of the surface and shallow soil sampling program and allow for a better evaluation of the nature and extent of contamination in addition to providing guidance to the following stages of work. Further, recommendations will be made with respect to how the following sub-stages will be completed for the Phase I investigation. Also as part of TM 1, a FSP will be provided for the implementation of Sub-Stage 4.

Sub-Stage 4 -- Subsurface Investigations

Sub-Stage 4a -- Soil Borings and Leach Testing

Continuously-sampled borings are to be drilled at selected OU8 IHSSs. Soil borings are defined herein as borings from which soil samples are collected from a depth of six feet or greater. The purpose and placement of the soil borings will be 1) to satisfy the IAG requirements, and 2) to support information obtained during previous surveys and sampling. The primary objective of these borings is to collect soil samples for laboratory analysis to determine the nature and extent of contamination. At each location geologic and hydrologic data, such as depth and nature of subcropping bedrock and depth to water table, will also be obtained. The borings will be drilled down to the water table or 6 feet into the bedrock, which ever is shallower (Figures 6-16 and 6-17). Table 6.1 provides IAG boring depth specifications and locations. Doty & Associates reviewed the IAG and current IHSS information. Based on this review Doty & Associates recommended that the borings in IHSS 163.1 and 163.2 should be 10 feet deep as opposed to the proposed 4-foot depth. Some of the grid spacings presented on Table 6.1 differ from the IAG specifications due to Doty & Associates review of the IAG and current IHSS data. Some of the boring locations may be moved or deleted based on information obtained from previous screening investigations. In most cases, surface soil scrapings will be collected at each boring location prior to drilling. Prospective boring locations are shown in Figures 6-3 through 6-12. Where portable GC soil-gas surveys and/or radiological surveys are required, final boring locations will be based upon survey results. Locations will be marked and surveyed prior to drilling. Soil borings will be completed in accordance to the following SOPs:

- SOP GT.17 Land Surveying
- SOP GT.10 Borehole Clearing
- SOP FO.03 General Equipment Decontamination
- SOP FO.04 Heavy Equipment Decontamination
- SOP GT.02 Drilling and Sampling Using Hollow Stem Auger Techniques

- SOP GT.01 Logging Alluvial and Bedrock Material
- SOP FO.08 Handling Drilling Fluids and Cuttings
- SOP GT.05 Plugging and Abandonment of Boreholes
- SOP FO.09 Handling of Residual Soil Samples
- SOP FO.18 Environmental Sample Radioactive Content Screening

Typical RFI/RI borehole soil sampling SOPs are similar to those for surface and shallow soil samples outlined in the previous section. Field personnel are also required to fully document the drilling operation and to record detailed geologic and hydrologic information as the hole progresses. Hollow stem auger drilling is the typical method used for soil borings at RFP. The SOPs probably will specify continuously-sampled borings, in which a thin-walled sampler attached in advance of the auger cutting head allows undisturbed samples to be taken continuously as drilling progresses. Continuously-sampled borings require detailed physical descriptions of the materials sampled. Also, results from field screening instruments will be recorded e.g. Hnu/OVA headspace readings. Samples for analysis will be taken from the continuously- sampled material. The intervals from which these are removed will be carefully marked and documented. Remaining samples will be placed into appropriately-labeled containers (typically core boxes) and logged into a designated storage facility.

In addition to collecting soil samples for chemical analyses, samples will also be collected for soil moisture. Samples for soil moisture will be collected at regular intervals throughout the length of each boring. Each of these samples will be properly sealed, labeled, and stored for future use. Once the sampling is completed for each IHSS, a number of samples will be selected for determination of soil moisture, as presented in the FSP in TM 1.

Predicting the mobility of suspected constituents will aid in developing a monitoring plan and remedial actions for subsequent Phases for OU8. The prediction may also be used to estimate the probable vertical or lateral extent of contamination. There are several means of investigating mobility, however, leaching tests have the advantage of being the only approach that integrates

soil and constituent properties in a single evaluation. Also, leaching tests may provide a conservative estimate of the concentration within leachate of waste constituents that may eventually impact groundwater. Therefore, soil samples will be collected within the vadose zone during the soil boring program, for leach test analysis. These samples will be collected at intervals specified by, and handled according to the FSP within TM 1. A soils/waste mixture leaching procedure, known as the Synthetic Precipitation Leach Test (Method 1312) has been developed by the EPA. This method is outlined in Appendix F, Volume II of the "Interim Final RCRA Facility Investigation (RFI) Guidance", 1989. It is suggested that this method be used for leaching tests. Results from the leachability tests, BAT sampling, soil moisture information, and subsurface investigations will be incorporated into Technical Memorandum No. 2. A FSP for additional borings (if required) and vadose zone investigation (if required) will be proposed. Methods for the vadose zone investigation are described in Sub-Stage 5b.

Personnel health and safety procedures for drill rig work will be set forth in the project-specific Health and Safety Plan, as well as in the EG&G guidance documents. These documents will address worker health and safety training requirements, personal protective clothing, personnel and equipment decontamination, health and safety monitoring, the establishment of site control zones around the drilling area, emergency procedures, and related health and safety issues.

Sub-Stage 4b -- BAT (Saturated Zone) Sampling

Once total depth has been reached at specified borings, a BAT sampler will be used to collect groundwater samples for presence/absence of contamination. Because the collected sample volume obtained by the BAT sampler is small, sample analysis will be limited to TCL volatiles and nitrates and chromium by colorimetric methods. The FSP within TM 1 will specify the number and location of groundwater samples to be collected by the BAT sampler (SOPs for use of BAT sampler are expected to be in place prior to field implementation). Following the collection of the groundwater sample, the boring will be plugged and abandoned according to SOP GT.05.

Groundwater samples will be collected by trained personnel with suitable instrumentation and placed in an appropriately-labeled sample container. The sample collection technique and surrounding circumstances will be described as completely as possible by field personnel. Sampling instruments will be completely cleaned and decontaminated between samples. Sample preservation will be achieved by cooling with ice. Transfer of the samples to a certified laboratory will be accomplished within the maximum time allowable for the applicable analyses. Detailed documentation of sample collection and chain-of-custody will be completed for each sample. The samples will be screened for gross radioactive contamination by EG&G radiation monitoring personnel prior to shipment to the analytical laboratory.

Sub-Stage 4c -- Technical Memorandum 2

A technical memorandum will be issued to the leading agency(ies) detailing the results of the work performed in sub-stages 4a and 4b and recapping the information provided in the TM 1. In addition, recommendations will be made with respect to how to proceed with the remaining sub-stages for the Phase I investigation. Also as part of TM 2, a FSP will be provided for the completion of Sub-Stage 5.

Sub-Stage 5 -- Additional Sampling

Sub-Stage 5a -- Additional Soil Borings

Additional soil borings may be required to fully assess the nature and extent of contamination at some of the OU8 IHSSs. Following evaluation of the work performed for Sub-Stages 1 through 4, as presented in Technical Memorandum 2, it may be evident that further investigations are warranted at certain IHSSs. Figure 6-1A shows a logical sequence of events that could lead to additional soil borings. In the event that additional soil borings are justified, the drilling and sample collection methods and techniques will be the same as outlined in Sub-Stage 4.

Sub-Stage 5b -- Vadose Investigation

Results of investigations evaluated in Technical Memorandum 2 may recommend vadose zone investigations at numerous OU8 IHSSs. If a vadose zone investigation is recommended, the FSP within TM 2 will provide the number, location, and methodology to be used for sample collection and/or insitu field measurements. These methods will be applied in areas that are determined via soil boring sampling leachability tests to contain contaminants and have potential for mobilization. A BAT sampler, or equivalent may be used to collect additional samples and soil tensiometer nests may be used for soil moisture profiling. TM2 will provide the information necessary to determine if vadose sampling and specific field instrumentation is both needed and physically possible.

Vadose zone water samples would be collected by trained personnel with suitable instrumentation and placed in an appropriately-labeled sample container. The sample collection technique and surrounding circumstances will be described as completely as possible by field personnel in a field log. Sampling instruments will be completely cleaned and decontaminated between samples. A mobile lab with GC or GC/MS instrumentation will be on site to provide real time results for organic analyses. For those constituents that a GC or GC/MS cannot detect, sample preservation will be achieved by cooling with ice. Transfer of the samples to a certified laboratory will be accomplished within the maximum time allowable for the applicable analyses. Detailed documentation of sample collection and chain-of-custody will be completed for each sample. The samples will be screened for gross radioactive contamination by EG&G radiation monitoring personnel prior to shipment to the analytical laboratory.

6.4.2 Stage II - Surface Water and Sediment Sampling

The objectives of the surface-water and sediment sampling plan is to define contamination boundaries and determine the likelihood of further contaminant migration via open drainageways and closed-conduit piping systems. This can be done by a multi-staged approach as outlined

below where each subsequent sub-stage is dependent on the results obtained from the previous sub-stage. Figure 6-1B is a flow chart of the implementation sequence for surface water and sediment sampling and shows how those activities will be integrated with Stage I sampling efforts.

The Sub-Stages are described in detail in the following sections:

- Sub-Stage 1A -- Underdrains
- Sub-Stage 1B -- Locate Underdrain Connections and Identify Additional Sampling Locations
- Sub-Stage 1c-- Technical Memorandum 1 (same as shown in fig. 6-1A)
- Sub-Stage 2 --Open Drainageway Sampling Activities

Sub-Stage 1a -- Underdrains

It is anticipated that groundwater is being collected and transported in underdrain systems located around the perimeter of foundation footings of some buildings. An analysis of this situation will require additional information regarding the existence of perimeter footing underdrains. It is unknown if each building within OU8 actually has a perimeter footing underdrain system in place, if it is connected with other drains, its constructed depth, and discharge point. Available plant plans will be reviewed for design and construction information. Following review of as-built drawings, a site walk of the facilities and buildings in OU8 will be conducted in an attempt to locate and determine the extent of the drains and determine optimum sampling locations.

Another entry point for groundwater contaminants into the sanitary (ASI, 1991d) and storm sewer systems (ASI, 1991a) is via infiltration through joints, cracks, and other types of breaks in the closed conduit. In previous studies, infiltration and exfiltration of the storm and sanitary sewer systems was analyzed using mass-balance techniques by ASI (ASI, 1991a and 1991d). This information will be reviewed to determine which segments of pipe for OU8 are likely to have

additional water entering from the groundwater table. In conjunction with preparation of this work plan the currently known information regarding the presence or suspected location of footing drains was summarized by Doty and Associates (Appendix B, letter dated May 28, 1992). This information was taken into consideration in the developing the sampling program outlined below.

Sub-Stage 1b - Locate Underdrain Connections and Identify Additional Sampling Locations

It is anticipated that surface-water and sediment sampling may be required within the storm sewer and/or sanitary sewer systems in order to reliably isolate a given IHSS as the source of contaminants. This will require knowledge of the existence of perimeter footing underdrains and the location of the connection into sanitary or storm sewer systems or daylight points into drainageways.

It is currently unknown which buildings actually have a perimeter footing underdrain system in place. This will be determined as indicated in Stage II, Sub-Stage 1A above. If a system is in place, the location of the connection to an existing sanitary or storm sewer system will be determined. Plant plans will be reviewed and a video camera inspection of the pipe interior may be conducted to identify the location of connections which occur at points other than accessible manholes.

A copy of the plant utility plans showing the horizonal location of storm/sanitary sewer systems will then be updated to show the locations of each accessible manhole and the location of each known underdrain connection. This plan will be used to determine locations for supplemental surface-water and sediment sampling.

Sub-Stage 1c - Technical Memorandum

In conjunction with Technical Memorandum 1 of Stage I (i.e, Sub-Stage 3c) information and results from Sub-Stages 1A and 1B will be evaluated and reported.

As data from Sub-Stages 1A and 1B becomes available, this information will be processed and analyzed in an effort to identify expected contaminants from known IHSSs located upstream and to determine the source and areal extent of each contaminant. Based on the results of this data interpretation, a decision will be made regarding the need for and recommended locations of additional sampling sites. The Technical Memorandum will include locations, frequency, procedures, and methods and analysis parameters to supplement this FSP and outline efforts for Sub-Stage 2 - Open Drainageway Sampling Activities. Dependent on the timing an RFI schedule and extent of sampling or acquisition of other information the recommendation may be to defer further sampling to a possible Phase II RFI effort.

Data collected during the previous stages of the FSP, particularly soil gas survey, soil scrapings, soil borings, and groundwater samples from the saturated zone will be reviewed to assess the presence of contaminant and the level of contaminant impact on the groundwater system. Locations and elevations of the footings drains obtained in Sub-Stages 1A and 1B above will be evaluated in context of historic high water levels to determine whether the drains create an impact on the water table flow field. Based on the results, piezometers may be recommended to be installed at strategic locations near footings drains which are judged to have an effect on the groundwater flow regime and potential contaminant transport. These piezometers will be installed according to pertinent operating procedures set forth in SOP GT.06, Monitor Well and Piezometer Installation (EG&G, 1991). Hydrologic testing of the piezometers may also be proposed to evaluate aquifer characteristics. Groundwater samples may be recommended to be collected during piezometer installation using a BAT, or similar sampler, at the top and at the base of the uppermost hydrostratigraphic unit.

Water level and groundwater sample data collected from the footings drains piezometers will be analyzed to evaluate the effect of the drains on the surface water and groundwater flow regimes, the presence of contaminants, the possible source and fate of diverted contaminants.

Sub-Stage 2 - Open Drainageway Sampling Activities

Surface water and sediment will be sampled based on FSP presented in Technical Memorandum 1. Surface-water sampling points should be located at outfalls of storm sewer systems and underdrain trunk lines, upstream of confluence points between two open drainageways, and within open drainageways, where applicable. The sediment samples will be collected in areas of the drainageways that are exhibiting signs of channel-bottom aggradation, such as wide, flat areas, or immediately upstream of control structures. Table 6.2B lists the location of the surface water and sediment sites to be sampled in Sub-Stage 2.

6.4.3 Stage III - Air Sampling Program

6.4.3.1 Existing Resources

Characterization of ambient air quality at OU8 will require compilation of relevant existing data and collection of additional data to fill informational gaps. The relevant meteorological data collected from the RFP monitoring station include wind speed, wind direction, sigma theta, temperature, relative humidity, and precipitation. Hourly averages of these data are required for performance of air quality impact analysis. The wind data should be used to generate daily wind roses. Daily summaries of the other parameters will be required. A continual review of existing data that pertains to assessment of OU8 air quality should be conducted as part of the Work Plan. These reviews should include comparison of ambient air contaminant concentrations derived from previous modeling or monitoring programs.

Data use objectives require ambient air concentrations and distributions of the individual contaminants on and off the site. The existing ambient air monitoring program offers the spatial resolution necessary to meet these objectives for airborne plutonium, americium, and particulate material emitted from RFP as a whole. The existing monitoring stations located near individual IHSS sites will typically offer only limited support in definition of OU8 IHSS site air pathways. This IHSS site-specific support can be maximized by coordinating individual monitor operation schedules and correlating the collected data to IHSS site field activities and existing site conditions. Isopleth maps can then be developed as necessary to establish maximum and mean exposure levels on the site and quantify the off-site transport of contaminants.

Monitoring station locations should be selected on the basis of the dominant wind patterns at the site. Since the plumes from IHSS sites will be directed by the wind, locating monitors downwind will allow sampling of the plumes. The primary wind direction is northwesterly. Additional stations should be positioned to monitor concentrations when the winds are not from the primary direction.

There are six ambient air monitoring stations of interest to this investigation. These six samplers encircle the OU and should provide representative airborne particulate samples both upwind and downwind (according to prevailing area wind patterns). The specific ambient air monitoring sites suitable for data review when defining OU8 IHSS site air pathways include S-1, S-3, S-5, S-17, S-20, and S-21. With respect to prevailing wind patterns at RFP, S-3 and S-21 (or alternatively, S-4 and S-16) would generally represent upwind conditions while S-1, S-5, S-17, and S-20 represent downwind conditions relative to OU-8. Additional monitoring stations that might contribute to downwind IHSS site-specific air pathway definition include S-2, S-6, S-8B, and S-19. It should be noted that S-5 and S-6 have historically provided the highest area plutonium concentrations (Section 5.1, Table 5.6). It must also be remembered that all monitoring site measurements represent multiple RFP sources and may provide upwardly-biased information with regard to a specific OU8 IHSS site. Similarly, IHSS sites located closely to an operational downwind monitor would provide more reliable data than one situated a long distance upwind.

6.4.3.2 Additional Data Collection

Localized air monitoring may be performed during field activities to ensure that quality data are obtained during sampling. All sampling activities should be performed in compliance with the RFP PPCD and in accordance with OP FO.1, Air Monitoring and Dust Control.

Whenever implemented, area air quality monitoring requirements would be conducted during activities such as borehole drilling and soil-gas surveys are performed or when significant potential for production of appreciable quantities of airborne particulates or release of volatile organic materials is possible. These requirements include:

- Continued operation and monitoring of the Site Perimeter and Community Radiological Ambient Air Monitoring Program (RAAMP). Six of these samplers (S-1, S-3, S-5, S-17, S-20, S-21) are located within or immediately adjacent to OU-8 and will be relied upon to characterize the local area air pathway.

- Local monitoring of Respirable Suspended Particulates (RSP) at individual activity work sites using real-time respirable aerosol mass monitors. Local RSP measurements will be employed to guide the project manager's evaluation of the potential hazards associated with work activity-related emissions. The threshold RSP concentration for curtailing intrusive activities will be 6.0 mg/m^3.

- Additional worker health and safety monitoring as required by the Site-Specific Health and Safety Plan (SSH&SP). This includes initial area radiation surveys intended to identify possible radiation hazards that could be associated with airborne particulates and site monitoring for volatile organics using HNu or OVA.

Soil-gas surveys are planned for select IHSS sites believed containing VOCs. This data can: (1) Identify areas of higher than average soil-gas contaminant content and their movements, (2) Serve as model inputs (source terms) to estimate ambient air concentration under changing meteorological conditions, and (3) Estimate uncontrolled emissions levels during invasive site operations. These VOCs would have the potential to be released to the atmosphere during actual sample acquisition or as an emission from completed instrumentation (i.e., well headspace). This information can be coupled with indirect portable ambient air monitoring data collected in

accordance with the Site-Specific Health and Safety Plan to help understand the potential impacts attributable to individual IHSS sites.

6.4.4 Phase I RFI/RI Report

An internal draft RFI/FI report will be prepared after the evaluation of all field data is complete and all analytical data have been received and reviewed. The report will document the field activities, technical procedures and results of the investigation at OU8. For each IHSS, and to the extent possible, tabular summaries of analytical results and contaminant concentration contour camps will be included to define the nature and extent of any observed contamination. The report will provide recommendations for any additional field investigation that may be required.

Three versions of the RFI/RI report will be prepared. First, an Internal Draft RFI/RI report will be prepared and submitted. Following review and receipt of comments from DOE, a Draft RFI/RI Report will be prepared and submitted for review by the regulatory agencies. Following review of the document and incorporation of all comments provided by regulators, a Final RFI/RI report will be prepared and issued.

The RFI/RI report will include both a Human Health Risk Assessment (HHRA) and Environmental Evaluation (EE). The HHRA and EE will evaluate any no-action alternative based on current conditions at each IHSS within OU8 that was investigated during implementation of this Work Plan. Information about potential chemical releases, routes of exposure points, and the assessment of health risks developed for the non-action alternatives is used as a basis for determining the need and extent of any proposed remedial alternatives that may be required. Separate RAs will be prepared for each IHSS or group of IHSSs. The HHRA and EE will be conducted in accordance with HHRA and EE plan outlined in Section 8.0 and Section 9.0, respectively.

This HHRA and EE are integral parts of the RFI/RI report and will be submitted simultaneously. It will assist in evaluation of potential remedial alternatives including: no action; remediation that satisfies existing Applicable or Relevant and Appropriate Requirements (ARARS); remediation that does not meet existing ARARS but may nevertheless constitute a satisfactory approach to management of the site. Remedial objectives will be recommended that may be used to support a specific approach for each IHSS if an IHSS-specific approach is required. If more appropriate, a general approach addressing the entire OU or groups of IHSSs will be recommended. The remedial objectives recommended will be health-protective and cost-effective.

6.5 SAMPLE COLLECTION AND ANALYSIS

The purpose of this section is to develop field sample collection and analysis methods. These methods would then be applied to the sampling requirements presented in Section 11.4 by providing procedures for sampling tasks and identifying analytical levels and methodologies.

6.5.1 Sample Designations

All sample designations generated for this RFI/RI will conform to the input requirements of the RFEDS. Each sample designation will contain a nine-character sample number consisting of a two-letter prefix identifying the media sampled (e.g., "SB" for soil borings, "SS" for stream sediments), a unique five-digit number, and a two-letter suffix identifying the contractor (e.g., "AS" for Advanced Sciences). One sample number will be required for each sample generated, including QA/QC samples. In this manner, 99,999 unique sample numbers are available for each contractor that contributes sample data to the data base. A block of numbers will be reserved for the Phase I RFI/RI sampling of OU8. Boring numbers will be developed independently of the sample numbers for a boring.

6.5.2 Sample Handling and Documentation

Sample control and documentation is necessary to ensure the defensibility of data and to verify the quality and quantity of work performed in the field. Accountable documents include logbooks, data collection forms, sample labels or tags, chain-of-custody forms, photographs, and analytical records and reports. Specific guidance describing container labeling, decontamination, field packaging, chain of custody records, field data documentation, packaging, and shipping is provided in SOP FO.13, Containerization, Preserving, Handling, and Shipping of Soil and Water Samples (EG&G, 1992c).

The field data and reporting requirements are discussed in detail in the SOP FO.14 Field Data Management (EG&G, 1992c). In general the following procedures must be followed:

- Collection of data on pre-printed forms;
- Preliminary verification of the data;
- Technical verification by a qualified verifier;
- Data input into the RFEDS;
- Verification of input;
- Archiving and filing of data;
- Security of database and computers;
- Documentation of implementation of the referenced SOP; and
- Use of data management forms.

6.5.3 Sample Containers and Preservation

The type of analysis and media to be sampled dictates the sample container volume and material requirements, preservation techniques, and holding times. The parameters specific to OU8 with

the corresponding containers, preservative, and holding time are listed in Table 6.3. Additional specific information relating to sample containers and preservatives is provided in SOP FO.13, Containerization, Preserving, Handling, and Shipping of Soil and Water Samples (EG&G, 1992c).

6.5.4 Field QA/QC Procedures

Sample duplicates, field preservation blanks, and equipment rinsate blanks will be prepared. Trip blanks will be obtained from the laboratory. The analytical results obtained for these samples will be used by the EMD project manager to assess the quality of the field sampling effort. The types of field QC samples to be collected and their application are discussed below. The frequency with which QC samples will be collected and analyzed is provided in Table 6.4 and Section 10.0.

Duplicate samples will be collected by the sampling team for use as a relative measure of the precision of the sample collection process. These samples will be collected at the same time, using the same procedures and equipment, and placed in the same types of containers as required for the samples. They will also be preserved in the same manner and submitted for the same analyses as required for the samples.

Field blanks of distilled water will be prepared by the sampling team and will be used to provide any indication of any contamination introduced during field preparation.

Equipment (rinsate) blanks will be collected from final decontamination rinsate to evaluate the success of the field sampling team's decontamination efforts on non-dedicated sampling equipment. Equipment blanks are obtained by rinsing cleaned equipment with distilled water prior to sample collection. The rinsate is collected and placed in the appropriate sample containers.

Trip blanks consisting of distilled water will be prepared by the laboratory technician and will accompany each shipment of samples for VOC analysis. Trip blanks will be stored with the group of samples with which they are associated. Analysis of the trip blank will indicate migration of VOCs or any problems associated with sample shipment, handling, or storage. Information from the trip blanks will be used in conjunction with air monitoring data and other information to assess the influence of ongoing waste operations on the quality of data collected.

6.5.5 Prevention of Contaminant Dispersion

Contaminants may be dispersed as a result of soil disturbance and airborne/surface water transport, smearing of the soil profile, venting of volatile compounds from the subsurface, and cross connection of water-bearing zones.

The procedures for borehole soil sampling are outlined in:

- SOP GT.17 Land Surveying,
- SOP GT.10 Borehole Clearing,
- SOP FO.03 General Equipment Decontamination,
- SOP FO.04 Heavy Equipment Decontamination,
- SOP GT.02 Drilling and Sampling Using Hollow Stem Auger Techniques,
- SOP GT.01 Logging Alluvial and Bedrock Material,
- SOP FO.08 Handling Drilling Fluids and Cuttings,
- SOP GT.05 Plugging and Abandonment of Boreholes,
- SOP FO.09 Handling of Residual Soil Samples, and
- SOP FO.18 Environmental Sample Radioactive Content Screening (EG&G 1992c, EG&G, 1992d).

These methods reduce the likelihood of contaminant dispersion.

Localized air monitoring will be performed during field activities to ensure that quality data are obtained during sampling. All sampling activities will be performed in compliance with the RFP PPCD and in accordance with SOP FO.1, Air Monitoring and Dust Control (EG&G, 1992c).

In the case that contamination is being dispersed through air pathways in significant amounts as determined by monitoring outlined in Section 6, activities will be stopped until appropriate measures can be applied.

Soil-gas surveys will be performed as identified in Section 6.4. Soil gas data will be collected for select OU8 IHSS sites that appear to be potentially contaminated with volatile organic contaminants. These VOCs do have the potential to be released to the atmosphere during actual sample acquisition or as an emission from completed instrumentation (i.e., well headspace). Worker health and safety monitoring will be performed for these potential hazards as required by the Site-Specific Health and Safety Plan.

The procedures for installation of groundwater monitoring wells are previously outlined under borehole soil sampling procedures (EG&G 1992c; EG&G 1992d).

6.5.6 Analytical Requirements

As discussed in Section 6.4, analytical parameters are based on the rationale that the operational history and release history are not clearly defined. In general, initial soil and groundwater samples will be analyzed for the following chemical and radionuclide parameters:

- Target Analyte List (TAL) Metals,
- Total Organic Carbon (TOC),
- Total Petroleum Hydrocarbons (TPH),
- Target Compound List (TCL) Volatiles,
- Target Compound List (TCL) Semi-volatiles,
- Radionuclides,

- Anions,
- Ph, and
- Specific conductance.

Field measurement of temperature, Ph, and specific conductance will be taken on groundwater samples obtained in accordance with SOP GW.05 Field Measurement of Groundwater Field Parameters and SOP GW.06 Groundwater Sampling (EG&G 1991a).

The OU8 analytical parameter list may be modified for some IHSSs based on the results of additional data compilation activities in Section 6.4. Later stage analytical parameters will focus on only those contaminants identified in the earlier stages. Decisions regarding analytical parameter selection will be documented by submitting Technical Memoranda.

6.6 QUALITY ASSURANCE/QUALITY CONTROL PROCEDURES AND ADDENDUM

All work conducted in support of OU8 Phase I RFI/RI activities will be directed by the EG&G Environmental Management Department Quality Assurance Project Plan for CERCLA Remedial Investigation/Feasibility Studies and RCRA Facilities Investigation/Corrective Measures Study Activities (QAPjP). The QAPjP complies with the requirements of EPA QAMS-005/80 and DOE Order 5700.6B and 5700.6C.

The QAPjP will be supplemented by a Quality Assurance Addendum (QAA) specific to OU8. The QAA will be provided to ASI by EG&G for inclusion in the Work Plan after EG&G completes review of the Draft Work Plan. The QAA will establish the specific Quality Assurance controls applicable to the field investigation activities described in the OU8 Work Plan.

TABLE 6.1
OPERABLE UNIT NO. 8 SURFACE MATERIALS FIELD SAMPLING PLAN

IHSS NO.	PROPOSED ACTIONS					SUGGESTED MODIFICATIONS TO IAG PLAN
	Soil Gas[1)2)]	Surface/Shallow Soil	Soil Borings/Soil Surface Scrapes	Radiation Surveys	BAT Samples	
118.1	GC soil gas survey on 10 foot grid: analyze for carbon tetrachloride, 1,1,1-TCA, benzene, methylethylketone, dichloromethane, PCE, and TCE. Peaks for other compounds will be noted.	Surface soil samples may be collected and analyzed for radio-nuclides contingent upon results from radiation surveys. The core samples shall be composited to represent 2 foot intervals.	Four borings along longitudinal transect of site 118.1 or locate based on initial surveys. One random boring located at the same location as one of the eight GC soil gas survey locations to confirm the presence or absence of volatiles. Discrete samples taken at 4 foot intervals for TCL volatiles. The core samples shall also be composited to represent the first 2 feet and then 6 foot intervals and analyzed for TAL metals. Surface scraping will be collected from locations of each boring. Soil surface scrapes will be analyzed for total plutonium, americium-241, tritium, total uranium, gross alpha and gross beta and radium-226 and 228.	Conduct a radiation survey using the HPGe provided the performance specifications are met. Alternately, use the G-M shielded pancake and side-shielded FIDLER detectors on a ten foot grid. Cover all areas affected by releases. Tighten grid if hotspots are detected.	BAT samples may be collected at the water table and analyzed for chromium, nitrates and TCL volatiles.	Use 10 foot grid for soil gas survey due to size of tank. Soil gas detection limits will depend upon instrument used. Analytes of interest modified to include americium-241 and radium-226 and 228 based on RFEDS data. BAT sampling to characterize the groundwater. Surface/shallow soil sampling and a radiation survey has been added for preliminary screening and possible reduction of soil borings.

1) See section 6.4.1 for discussion of analytes.
2) See section 6.4.1 for explanation of grid spacing.

TABLE 6.1
OPERABLE UNIT NO. 8 FIELD SAMPLING PLAN
(continued)

IHSS NO.	PROPOSED ACTIONS					SUGGESTED MODIFICATIONS TO IAG PLAN
	Soil Gas[1)2)]	Surface/Shallow Soil	Soil Borings/Soil Surface Scrapes	Radiation Surveys	BAT Samples	
118.2	GC soil gas survey on 10 foot grid: analyze for carbon tetrachloride, 1,1,1-TCA, benzene, methylethylketone, dichloromethane, PCE, and TCE. Peaks for other compounds will be noted.	Surface soil samples may be collected and analyzed for radio-nuclides contingent upon results from radiation surveys. The core samples shall be composited to represent 2 foot intervals.	Two borings along longitudinal transect of site 118.2 or locate based on initial surveys. One random boring located at the same location as one of the twelve GC soil gas survey locations to confirm the presence or absence of volatiles. Discrete samples taken at 4 foot intervals and analyzed for TCL volatiles. Soil surface scraping taken from location of each boring. Soil surface scrapes will be analyzed for total plutonium, americium-241, tritium, total uranium, gross alpha and gross beta.	Conduct a radiation survey using the HPGe provided the performance specifications are met. Alternately, use the G-M shielded pancake and side-shielded FIDLER detectors on a ten foot grid. Cover all areas affected by releases. Tighten grid if hotspots are detected.	BAT samples may be collected at the water table and analyzed for chromium, nitrates and TCL volatiles.	Use 10 foot grid for soil gas survey due to size of tank. Soil gas detection limits will depend upon instrument used. Analytes of interest modified to include americium-241. BAT sampling to characterize the groundwater. Surface/shallow soil sampling and a radiation survey has been added for preliminary screening and possible reduction of soil borings.

1) See section 6.4.1 for discussion of analytes.
2) See section 6.4.1 for explanation of grid spacing.

TABLE 6.1
OPERABLE UNIT NO. 8 FIELD SAMPLING PLAN
(continued)

IHSS NO.	PROPOSED ACTIONS					SUGGESTED MODIFICATIONS TO IAG PLAN
	Soil Gas[1)2)]	Surface/Shallow Soil	Soil Borings/Soil Surface Scrapes	Radiation Surveys	BAT Samples	
123.1	GC soil gas survey on 100 foot grid: analyze for benzene, toluene, xylene, PCE and TCE. Peaks for other compounds will be noted.	Surface soil samples may be collected and analyzed for radio-nuclides contingent upon results from radiation surveys. The core samples shall be composited to represent 2 foot intervals.	Drill borings at locations affected by site 123.1 contingent on initial surveys or surrounding the vault (on 30-foot centers) and including surface ditches affected by releases. One random boring located at one of the seven GC soil gas survey locations to confirm the presence or absence of volatiles. Borings to be drilled to a depth of 10 feet below the bottom of each vault. Discrete samples shall be taken at 4 foot intervals and analyzed for TCL volatiles. The core samples shall also be composited to represent the first 2 feet and then 6 foot intervals and will be analyzed for total plutonium, nitrates, total uranium, gross alpha and gross beta, fluorides and TAL metals.	Conduct a radiation survey using the HPGe provided the performance specifications are met. Alternately, use the G-M shielded pancake and side-shielded FIDLER detectors on a ten foot grid. Cover all areas affected by releases. Tighten grid if hotspots are detected.	BAT samples may be collected at the water table and analyzed for chromium, nitrates and TCL volatiles.	Analytes of interest may be modified to include solvents and oils, although specific solvents are not yet known, americium-241, cesium-137, radium-226 and 228, tritium, and TAL metals based on existing RFEDS data and radiation survey results. BAT sampling to characterize the groundwater. Surface/shallow soil sampling has been added for preliminary screening and possible reduction of soil borings.

1) See section 6.4.1 for discussion of analytes.
2) See section 6.4.1 for explanation of grid spacing.

TABLE 6.1
OPERABLE UNIT NO. 8 FIELD SAMPLING PLAN
(continued)

IHSS NO.	PROPOSED ACTIONS					SUGGESTED MODIFICATIONS TO IAG PLAN
	Soil Gas[1)2)]	Surface/Shallow Soil	Soil Borings/Soil Surface Scrapes	Radiation Surveys	BAT Samples	
135	GC soil gas survey on 40 foot grid: analyze for PCE, TCE, 1,1,1-TCA, carbon tetrachloride, trans-1,2,-DCE, 1,1-DCE. Peaks for other compounds will be noted.	Drill borings from locations affected by site 135 contingent on initial surveys or at 25 foot centers to depths of 6 feet. Composite samples shall be taken at 2-foot intervals and analyzed for TCL volatiles, TAL metals, tritium, and phosphate. Soil surface scraping from location of each boring will be collected and analyzed for TAL metals, tritium, and phosphate.	To be determined based on preliminary screening survey results.	Conduct a radiation survey using the HPGe provided the performance specifications are met. Alternately, use the G-M shielded pancake and side-shielded FIDLER detectors on a ten foot grid. Cover all areas affected by releases. Tighten grid if hotspots are detected.	BAT samples may be collected at the water table and analyzed for chromium, nitrates and TCL volatiles.	Use 25-foot grid spacing to better characterize. Analytes include tritium and phosphate due to historical use in the cooling tower water. Other analytes of interest may include, based on existing RFEDS data and radiation survey results, include TCL volatiles, TAL metals, gross alpha, gross beta, americium-241, plutonium-239/240, radium-226 and 228, strontium-89/90 and total uranium. BAT sampling to characterize the groundwater. Soil gas and radiation survey have been added for preliminary screening.

1) See section 6.4.1 for discussion of analytes.
2) See section 6.4.1 for explanation of grid spacing.

TABLE 6.1
OPERABLE UNIT NO. 8 FIELD SAMPLING PLAN
(continued)

IHSS NO.	PROPOSED ACTIONS					SUGGESTED MODIFICATIONS TO IAG PLAN
	Soil Gas[1)2)]	Surface/Shallow Soil	Soil Borings/Soil Surface Scrapes	Radiation Surveys	BAT Samples	
137	GC soil gas survey on 40 foot grid: analyze for carbon tetrachloride, 1,1,1-TCA, benzene, methylethylketone, dichloromethane, PCE, and TCE. Peaks for other compounds will be noted.	Drill borings from locations affected by site 137 contingent on initial surveys or at 20 foot centers to depths of 6 feet. Composite samples shall be taken at 2-foot intervals and analyzed for TAL metals, and phosphate. Soil surface scraping from location of each boring will be collected and analyzed for TAL metals, gross alpha and gross beta, americium-241, plutonium-239/240, radium-226 and 228, total uranium, tritium and phosphate.	To be determined based on preliminary screening survey results.	Conduct a radiation survey using the HPGe provided the performance specifications are met. Alternately, use the G-M shielded pancake and side-shielded FIDLER detectors on a ten foot grid. Cover all areas affected by releases. Tighten grid if hotspots are detected.	BAT samples may be collected at the water table and analyzed for chromium, nitrates and TCL volatiles.	Analytes include phosphate due to historical use. Other analytes of interest may include TCL volatiles, TAL metals, gross alpha and gross beta, americium-241, plutonium-239/240, radium-226 and 228, total uranium and tritium based on existing RFEDS data and preliminary screening results. BAT sampling to characterize the groundwater. Soil gas and radiation survey have been added for preliminary screening and possible reduction of soil borings.

1) See section 6.4.1 for discussion of analytes.
2) See section 6.4.1 for explanation of grid spacing.

TABLE 6.1
OPERABLE UNIT NO. 8 FIELD SAMPLING PLAN
(continued)

IHSS NO.	PROPOSED ACTIONS					SUGGESTED MODIFICATIONS TO IAG PLAN
	Soil Gas[1)2)]	Surface/Shallow Soil	Soil Borings/Soil Surface Scrapes	Radiation Surveys	BAT Samples	
138	GC soil gas survey on 20 foot grid: analyze for PCE, TCE, carbon tetrachloride, benzene, toluene and xylene. Peaks for other compounds will be noted.	Drill borings from locations affected by site 138 contingent on initial surveys or at 25 foot centers to depths of 6 feet. Composite samples shall be taken at 2-foot intervals and analyzed for TAL metals, total plutonium, americium-241, total uranium, gross alpha and gross beta, and phosphate. Soil surface scraping from location of each boring will be collected and analyzed for the same constituents as the core samples.	To be determined based on preliminary screening survey results.	Conduct a radiation survey using the HPGe provided the performance specifications are met. Alternately, use the G-M shielded pancake and side-shielded FIDLER detectors on a ten foot grid. Cover all areas affected by releases. Tighten grid if hotspots are detected.	BAT samples may be collected at the water table and analyzed for chromium, nitrates and TCL volatiles.	Analytes of interest modified based on existing RFEDS data radionuclides and phosphates based on known chemistry of the blowdown water. Other analytes may include TCL volatiles, TAL metals, radium-226 and 228, strontium-89/90, and tritium based on preliminary screening results. BAT sampling to characterize the groundwater. Soil gas and radiation survey have been added for preliminary screening and possible reduction of soil borings.

1) See section 6.4.1 for discussion of analytes.
2) See section 6.4.1 for explanation of grid spacing.

TABLE 6.1
OPERABLE UNIT NO. 8 FIELD SAMPLING PLAN
(continued)

IHSS NO.	PROPOSED ACTIONS					SUGGESTED MODIFICATIONS TO IAG PLAN
	Soil Gas[1)2)]	Surface/Shallow Soil	Soil Borings/Soil Surface Scrapes	Radiation Surveys	BAT Samples	
139.1 (N),(S) 139.2	For site 139.1(N) perform a GC soil gas survey on 20 foot grid: analyze for PCE, TCE, carbon tetrachloride, benzene, toluene and xylene. Peaks for other compounds will be noted. For sites 139.1(S) and 139.2, perform a soil gas survey utilizing a soil gas probe at proposed soil boring locations and analyze for PCE, TCE, carbon tetrachloride, benzene, toluene and xylene.	Samples on 15 foot centers from top six inches of soils directly surrounding tanks and soils affected by releases from tanks. Locations will be contingent on initial surveys. Samples will be analyzed for pH, sodium, nitrates, potassium, fluoride, and chloride.	To be determined based on preliminary screening survey results.	Conduct a radiation survey using the HPGe provided the performance specifications are met. Alternately, use the G-M shielded pancake and side-shielded FIDLER detectors on a ten foot grid. Cover all areas affected by releases. Tighten grid if hotspots are detected.	To be determined based on preliminary screening survey results.	Reduce grid spacing to 15 foot centers since the tanks are small relative to the proposed 25 foot grid pattern. Analytes of interest modified based on existing RFEDS data include nitrates and chloride, total plutonium and total uranium may be analyzed for based on radiation survey results. Soil gas and radiation survey have been added for preliminary screening.

1) See section 6.4.1 for discussion of analytes.
2) See section 6.4.1 for explanation of grid spacing.

TABLE 6.1
OPERABLE UNIT NO. 8 FIELD SAMPLING PLAN
(continued)

IHSS NO.	PROPOSED ACTIONS					SUGGESTED MODIFICATIONS TO IAG PLAN
	Soil Gas[1)2)]	Surface/Shallow Soil	Soil Borings/Soil Surface Scrapes	Radiation Surveys	BAT Samples	
144(N), (S)	For site 144(N) perform a GC soil gas survey on 20 foot grid: analyze for carbon tetrachloride, 1,1,1-TCA, benzene, methylethylketone, dichloromethane, PCE, and TCE. Peaks for other compounds will be noted. For site 144(N), perform a soil gas survey utilizing a soil gas probe at proposed soil boring locations and analyze for PCE, TCE, carbon tetrachloride, benzene, toluene and xylene.	Surface soil samples may be collected and analyzed for radio-nuclides contingent upon results from radiation surveys. The core samples shall be composited to represent 2 foot intervals.	Drill borings in all areas affected by site 144. Site 144(N) drill on 15-foot centers, Site 144(S) drill 9 borings on longitudinal cross section on 20-foot centers. One random boring located at the same location as one of the eight GC soil gas survey locations to confirm the presence or absence of volatiles. Surface soil scrapings taken at hotspots and prior to borehole placement. Two boreholes shall be located adjacent to the sewer line and shall be drilled to 5 feet below the pipe invert or 6 feet into bedrock. Four boreholes shall be located on the affected hillside. Final locations will be contingent on initial surveys. The core samples shall be composited to represent the first 2 feet and then 6 foot intervals. Composite samples and soil scrapes will be analyzed for total plutonium, americium-241, cesium-137, strontium-89/90, radium-226 and 228, lithium, tritium, total nitrate, total uranium, gross alpha and gross beta, total sulfate and TAL metals.	Conduct a radiation survey using the HPGe provided the performance specifications are met. Alternately, use the G-M shielded pancake and side-shielded FIDLER detectors on a ten foot grid. Cover all areas affected by releases. Tighten grid if hotspots are detected.	BAT samples may be collected at the water table and analyzed for chromium, nitrates and TCL volatiles.	Analytes of interest modified based on existing RFEDS data and preliminary survey results, may include TCL volatiles, cesium-137, strontium-89/90, radium-226 and 228 and lithium. BAT sampling to characterize the groundwater. Soil gas and surface/shallow soil sampling have been added for preliminary screening and possible reduction of soil borings.

1) See section 6.4.1 for discussion of analytes.
2) See section 6.4.1 for explanation of grid spacing.

TABLE 6.1
OPERABLE UNIT NO. 8 FIELD SAMPLING PLAN
(continued)

IHSS NO.	PROPOSED ACTIONS					SUGGESTED MODIFICATIONS TO IAG PLAN
	Soil Gas[1)2)]	Surface/Shallow Soil	Soil Borings/Soil Surface Scrapes	Radiation Surveys	BAT Samples	
150.1, 150.2, 150.3, 150.4, 150.6, 150.7, 150.8	For sites 150.1, 150.2 and 150.4 perform GC soil gas surveys. Use a 75 foot grid at site 150.1 and analyze for 1,1-DCA, PCE, TCE, carbon tetrachloride, benzene, toluene and xylene. Use a 60 foot grid at site 150.2 and analyze for 1,1-DCE, PCE, TCE, carbon tetrachloride, 1,1,1-TCA and trans-1,2-DCE. Use a 60 foot grid at site 150.4 and analyze for acetone, 1,1-DCE and carbon tetrachloride. Peaks for other compounds will be noted at all sites. For all other 150 sites analyze for PCE, TCE, carbon tetrachloride, benzene, toluene and xylene utilizing a soil gas probe at proposed soil boring locations.	Surface soil samples may be collected and analyzed for radionuclides contingent upon results from radiation surveys. The core samples shall be composited to represent 2 foot intervals.	Drill borings at locations affected by the 150 sites. Discrete samples shall be taken at 4-foot intervals and analyzed for TCL volatiles. The samples shall also be composited to represent the first 2 feet and then 6 foot intervals. One random boring located at the same location as one of the GC soil gas survey locations to confirm the presence or absence of volatiles. Soil surface scraping from location of each boring will be collected. The 6 foot composite samples and surface scrapings will be analyzed for total plutonium, total americium, tritium, total nitrate, total uranium, radium-226 and 228, strontium-89/90, gross alpha, gross beta, total sulfate, and TAL metals. See Tables 5.8 and 6.2 for borehole spacing and frequency. Final locations will be contingent on initial surveys.	Conduct a radiation survey using the HPGe provided the performance specifications are met. Alternately, use the G-M shielded pancake and side-shielded FIDLER detectors on 25 foot grids. Cover all areas affected by releases. Tighten grid if hotspots are detected. If surface has been paved since releases, sample surface and top two inches of soil and analyze for radiation prior to drilling. For 150.6 an HPGe survey will be performed in the area between Building 779 and IHSS 150.6.	BAT samples may be collected at the water table and analyzed for chromium, nitrates and TCL volatiles.	Analytes of interest are modified to include radium-226 and 228 and strontium-89/90. BAT sampling to characterize the groundwater. Soil gas and surface/shallow soil sampling have been added for preliminary screening and possible reduction of soil borings.

1) See section 6.4.1 for discussion of analytes.
2) See section 6.4.1 for explanation of grid spacing.

TABLE 6.1
OPERABLE UNIT NO. 8 FIELD SAMPLING PLAN
(continued)

IHSS NO.	PROPOSED ACTIONS					SUGGESTED MODIFICATIONS TO IAG PLAN
	Soil Gas[1)2)]	Surface/Shallow Soil	Soil Borings/Soil Surface Scrapes	Radiation Surveys	BAT Samples	
151	GC soil gas survey on 10 foot grid: analyze for benzene, toluene, and xylene. Peaks for other compounds will be noted.	Surface soil samples may be collected and analyzed for radionuclides contingent upon results from radiation surveys. The core samples shall be composited to represent 2 foot intervals.	Four borings around tank, drilled to five feet below bottom of tank or six feet into bedrock, whichever is shallower. Final locations will be contingent on initial surveys. One random boring located at the same location as one of the 42 GC soil gas survey locations to confirm the presence or absence of volatiles. Discrete samples shall be taken from every 4-foot interval and analyzed for TPH, TCL volatiles and TCL semi-volatiles.	NA	BAT samples may be collected at the water table and analyzed for chromium, nitrates and TCL volatiles.	Analytes of interest are modified to include TCL semi-volatiles. BAT sampling to characterize the groundwater. Surface/shallow soil sampling has been added for preliminary screening and possible reduction of soil borings.

1) See section 6.4.1 for discussion of analytes.
2) See section 6.4.1 for explanation of grid spacing.

TABLE 6.1
OPERABLE UNIT NO. 8 FIELD SAMPLING PLAN
(continued)

IHSS NO.	PROPOSED ACTIONS					SUGGESTED MODIFICATIONS TO IAG PLAN
	Soil Gas[1)2)]	Surface/Shallow Soil	Soil Borings/Soil Surface Scrapes	Radiation Surveys	BAT Samples	
163.1	GC soil gas survey on 50 foot grid: analyze for TCE, PCE, benzene, toluene, and xylene. Peaks for other compounds will be noted.	Surface soil samples may be collected and analyzed for radionuclides contingent upon results from radiation surveys. The core samples shall be composited to represent 2 foot intervals. Additionally, investigate and determine the nature of the soil mounds north of 163.1 and east of 163.2 which are identified in the 1969 and 1971 aerial photographs.	Drill 10-foot deep borings at locations affected by site 163.1. Final locations will be contingent on initial surveys. Composite samples shall be taken at 2-foot intervals. One random boring located at the same location as one of the 18 GC soil gas survey locations to confirm the presence or absence of volatiles. Soil surface scraping from location of each boring will be collected. Surface samples and core samples will be analyzed for total plutonium, total americium, total nitrates, uranium 233/234, 235 & 238, gross alpha and gross beta.	Conduct a radiation survey using the HPGe provided the performance specifications are met. Alternately, use the G-M shielded pancake and side-shielded FIDLER detectors on 25 foot grids. Cover all areas affected by releases. Tighten grid if hotspots are detected. If surface has been paved since releases, sample top two inches of soil and analyze for radiation prior to drilling.	BAT samples may be collected at the water table and analyzed for chromium, nitrates and TCL volatiles.	Soil borings taken at a depth of 10 feet instead of proposed 4-foot depth. Added soil gas survey based on HRR description of possible contaminants. Analytes of interest are modified to include nitrates and TCL volatiles depending the soil gas survey results. BAT sampling to characterize the groundwater. Surface/shallow soil sampling has been added for preliminary screening and possible reduction of soil borings.

1) See section 6.4.1 for discussion of analytes.
2) See section 6.4.1 for explanation of grid spacing.

TABLE 6.1
OPERABLE UNIT NO. 8 FIELD SAMPLING PLAN
(continued)

IHSS NO.	PROPOSED ACTIONS					SUGGESTED MODIFICATIONS TO IAG PLAN
	Soil Gas[1)2)]	Surface/Shallow Soil	Soil Borings/Soil Surface Scrapes	Radiation Surveys	BAT Samples	
163.2	Perform a soil gas survey utilizing a soil gas probe at proposed soil boring locations and analyze for PCE, TCE, carbon tetrachloride, benzene, toluene and xylene.	Surface soil samples may be collected and analyzed for radionuclides contingent upon results from radiation surveys. The core samples shall be composited to represent 2 foot intervals.	Drill 10-foot deep borings at locations affected by site 163.2 based on radiation survey results. Composite samples shall be taken at 2-foot intervals. Soil surface scraping from location of each boring will be collected. Surface samples and core samples will be analyzed for total plutonium, total americium, total nitrates, total uranium, gross alpha and gross beta.	Conduct a radiation survey using the HPGe provided the performance specifications are met. Alternately, use the G-M shielded pancake and side-shielded FIDLER detectors on 25 foot grids. Cover all areas affected by releases. Tighten grid if hotspots are detected. If surface has been paved since releases, collect grab samples from the top two inches of soil beneath the pavement and analyze for radiation prior to drilling.	BAT samples may be collected at the water table and analyzed for chromium, nitrates and TCL volatiles.	Soil borings taken at a depth of 10 feet instead of proposed 4-foot depth. Analytes of interest are modified to include nitrates. BAT sampling to characterize the groundwater. Surface/shallow soil sampling and soil gas survey have been added for preliminary screening and possible reduction of soil borings.

1) See section 6.4.1 for discussion of analytes.
2) See section 6.4.1 for explanation of grid spacing.

TABLE 6.1
OPERABLE UNIT NO. 8 FIELD SAMPLING PLAN
(continued)

IHSS NO.	PROPOSED ACTIONS					SUGGESTED MODIFICATIONS TO IAG PLAN
	Soil Gas[1)2)]	Surface/Shallow Soil	Soil Borings/Soil Surface Scrapes	Radiation Surveys	BAT Samples	
172	NA	Soil and asphalt sampling shall be conducted at locations previously indicated as radioactive and at stopping and unloading points. Soil samples shall be analyzed for TAL metals, total plutonium, americium, total uranium, gross alpha and gross beta. Asphalt shall be analyzed for the same constituents as the soil with the exception of TAL metals.	To be determined based on preliminary screening survey results.	Conduct a radiation survey using the HPGe provided the performance specifications are met. Alternately, use the G-M shielded pancake and side-shielded FIDLER detectors on 50 foot grids along Central Avenue and 6th Street roadsides and all other roadsides utilized to transport the wastes, including northern and western roadside ditches, and on 5 foot grids within 50 feet of stopping and unloading points. Tighten grid if hotspots are detected.	NA	Analysis of carbon tetrachloride and bis(2-ethylhexyl) phthalate have been deleted from the soil sampling program due to high volatility and being a common lab contaminant, respectively. Analysis of TAL metals is deleted from the asphalt sampling program since the repaving history of the IHSS is unknown.

1) See section 6.4.1 for discussion of analytes.
2) See section 6.4.1 for explanation of grid spacing.

TABLE 6.1
OPERABLE UNIT NO. 8 FIELD SAMPLING PLAN
(continued)

IHSS NO.	PROPOSED ACTIONS					SUGGESTED MODIFICATIONS TO IAG PLAN
	Soil Gas[1)2)]	Surface/Shallow Soil	Soil Borings/Soil Surface Scrapes	Radiation Surveys	BAT Samples	
173	GC soil gas survey on 25 foot grid: analyze for PCE and acetone. Peaks for other compounds will be noted.	At radiation survey sites indicating radioactive contamination, soil and asphalt sampling shall be conducted to determine the radioactive constituents present. All samples shall be analyzed for total plutonium, total uranium, total americium, total cesium, total strontium, beryllium, tritium, gross alpha and gross beta.	Drill borings at the corners of the IHSS. One random boring located at the same location as one of the 11 GC soil gas survey locations to confirm the presence or absence of volatiles. Final locations will be contingent on initial surveys. The samples shall be composited to represent the first 2 feet and then 6 foot intervals. Soil surface scraping from location of each boring will be collected. The 6 foot composite samples and surface scrapings will be analyzed for TAL metals.	Conduct a radiation survey using the HPGe provided the performance specifications are met. Alternately, use the G-M shielded pancake and side-shielded FIDLER detectors on 25 foot grids.	BAT samples may be collected at the water table and analyzed for chromium, nitrates and TCL volatiles.	Soil borings and BAT sampling to characterize the groundwater have been added based on existing RFEDS data. Total plutonium, americium-241, beryllium, total uranium, strontium-89/90 and cesium-137 may be analyzed depending on the radiation survey results. TCL volatiles may be analyzed for based on the soil gas survey results. Surface wipe samples have been deleted in favor of soil/asphalt sampling.

1) See section 6.4.1 for discussion of analytes.
2) See section 6.4.1 for explanation of grid spacing.

TABLE 6.1
OPERABLE UNIT NO. 8 FIELD SAMPLING PLAN
(continued)

IHSS NO.	PROPOSED ACTIONS					SUGGESTED MODIFICATIONS TO IAG PLAN
	Soil Gas[1)2)]	Surface/Shallow Soil	Soil Borings/Soil Surface Scrapes	Radiation Surveys	BAT Samples	
184	Perform a soil gas survey utilizing a soil gas probe at proposed soil boring locations and analyze for PCE, TCE, carbon tetrachloride, benzene, toluene and xylene.	Surface soil samples may be collected and analyzed for radionuclides contingent upon results from radiation surveys. The core samples shall be composited to represent 2 foot intervals.	Drill 5 borings, one at each corner of the IHSS and one in the center. Final locations will be contingent on initial surveys. The samples shall be composited to represent the first two feet and then 6 foot intervals. Soil surface scraping from location of each boring will be collected. The composite samples and surface scrapings will be analyzed for total plutonium, americium-241, total uranium, strontium-89/90, cesium-137, and TAL metals.	Conduct a radiation survey using the HPGe provided the performance specifications are met. Alternately, use the G-M shielded pancake and side-shielded FIDLER detectors on 25 foot grids.	BAT samples may be collected at the water table and analyzed for chromium, nitrates and TCL volatiles.	Soil borings, BAT sampling to characterize the groundwater, and a radiological survey has been added based on existing RFEDS data and historical events. TCL volatiles may be analyzed for contingent upon the soil gas survey results. Surface/shallow soil sampling and soil gas survey have been added for preliminary screening and possible reduction of soil borings.

1) See section 6.4.1 for discussion of analytes.
2) See section 6.4.1 for explanation of grid spacing.

TABLE 6.1
OPERABLE UNIT NO. 8 FIELD SAMPLING PLAN
(continued)

IHSS NO.	PROPOSED ACTIONS					SUGGESTED MODIFICATIONS TO IAG PLAN
	Soil Gas[1)2)]	Surface/Shallow Soil	Soil Borings/Soil Surface Scrapes	Radiation Surveys	BAT Samples	
188	Perform a GC soil gas survey on 30 foot grid: analyze for PCE, TCE, carbon tetrachloride, benzene, toluene and xylene. Peaks for other compounds will be noted.	Surface soil samples may be collected and analyzed for radionuclides contingent upon results from radiation surveys. The core samples shall be composited to represent 2 foot intervals.	To be determined based on preliminary screening survey results.	Conduct a radiation survey using the HPGe provided the performance specifications are met. Alternately, use the G-M shielded pancake and side-shielded FIDLER detectors on a 10 foot grid.	NA	Preliminary screening surveys (i.e. soil gas survey, surface/shallow soil sampling and radiation survey) have been added to confirm absence/presence of contaminants.

1) See section 6.4.1 for discussion of analytes.
2) See section 6.4.1 for explanation of grid spacing.

TABLE 6.2

STAGE I SAMPLING METHODS & FREQUENCIES

IHSS Identification	Real Time Soil Gas Survey	Soil Borings	Soil Surface Scrapes	Radiation Survey	Shallow Soil Samples	BAT Samples
118.1	8	5	5	1	TBD*	TBD*
118.2	12	3	3	1	TBD*	TBD*
123.1	7	18	NA	1	TBD*	TBD*
135	15	TBD*	30	1	30	TBD*
137	7	TBD*	15	1	15	TBD*
138	9	TBD*	9	1	9	TBD*
139.1(N)	15	TBD*	NA	1	20	TBD*
139.1(S)	TBD*	TBD*	NA	1	9	TBD*
139.2	TBD*	TBD*	NA	1	9	TBD*
144(N)	8	19	TBD*	1	TBD*	TBD*
144(S)	TBD*	9	TBD*	1	TBD*	TBD*
150.1	12	16	16	1	TBD*	TBD*
150.2	24	16	16	1	TBD*	TBD*
150.3	TBD*	7	7	1	TBD*	TBD*
150.4	9	12	12	1	TBD*	TBD*
150.6	TBD*	7	7	1	TBD*	TBD*
150.7	TBD*	8	8	1	TBD*	TBD*
150.8	TBD*	8	8	1	TBD*	TBD*
151	42	5	NA	NA	TBD*	TBD*
163.1	18	TBD*	TBD*	1	TBD*	TBD*
163.2	TBD*	TBD*	TBD*	1	TBD*	TBD*
172	NA	TBD*	TBD*	1	TBD*	NA
173	11	5	5	1	TBD*	TBD*

TABLE 6.2

SURFICIAL MATERIAL SAMPLING METHODS & FREQUENCIES
(continued)

IHSS Identification	Real Time Soil Gas Survey	Soil Borings	Soil Surface Scrapes	Radiation Survey	Shallow Soil Samples	BAT Samples
184	TBD*	5	5	1	TBD*	TBD*
188	12	TBD*	TBD*	1	TBD*	NA

TBD* - To be determined.

TABLE 6.3

SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES FOR RESIDUE, SOIL, AND WATER SAMPLES

RESIDUE AND SOIL SAMPLES			
Parameter	Container	Preservative	Holding Time
TAL Metals	1 x 250ml wide-mouth glass jar	Cool, 4 degrees C	180 days
Cyanide	1 x250ml wide-mouth glass jar	Cool, 4 degress C	14 days
TCL Volatiles	2 x 125ml wide-mouth Teflon-lined jar	Cool, 4 degees C	7 days
TCL	1 x 250ml wide-mouth	Cool, 4 degrees ction	7 days until extraction
Semivolatiles	Teflon-lined jar		40 days after extraction
Radionuclides	1 x 1l Wide-mouth glass jar	None	180 days
TOC, Anions, pH, and specific conductance	1 x 250ml wide-mouth glass jar	Cool, 4 degrees C	28 days

WATER SAMPLES			
Parameter	Container	Preservative	Holding Time
TAL Metals	1 x 1l polyethylene bottle	Nitric acid pH<2; Cool, 4 degrees C	180 days
Cyanide	1 x 1l polyethylene bottle	Sodium hydroxide pH>12; Cool, 4 degrees C	14 days
TCL Volatiles	2 x 40ml VOA vials with teflon-lined septum lids	Cool, 4 degrees C	7 days
TCL Semivolatiles	1 x 4l amber glass bottle	Cool, 4 degrees C	7 days until extraction, 40 days after extraction
Radionuclides	12l polyethylene boules(s)	Nitric acid pH<2; Cool, 4 degrees C	180 days
TOC	1 x 250ml polytehylene bottle	Sulfuric acid pH<2; Cool, 4 degrees C	28 days
Anions	1 x 1l polyethylene bottle	Cool, 4 degrees C	28 days
Nitrate/Nitrite	1 x 250ml polyethylene bottle	Sulfuric acid pH<2; Cool, 4 degrees C	28 days
pH, temperature, and specific conductance	In-situ, beaker, or bucket	None	*Analyze immediatley*

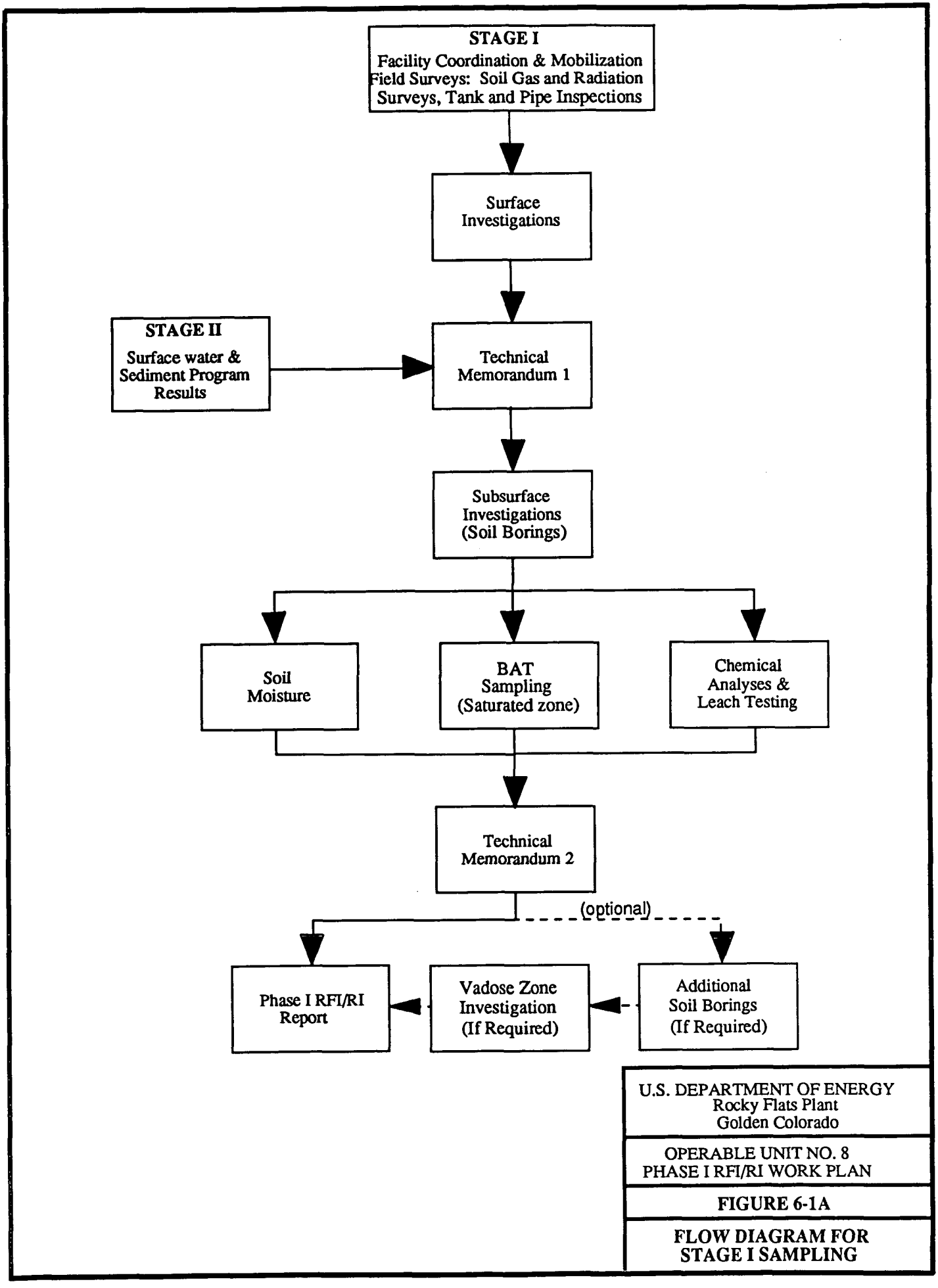
Holding time for mercury is 28 days.

TABLE 6.4

FIELD QC SAMPLE FREQUENCY

SAMPLE TYPE	TYPE OF ANALYSIS	SAMPLE FREQUENCY SOLIDS	LIQUIDS
Duplicates	Organics	1/10	1/10
	Inorganics	1/10	1/10
	Radionuclides	1/10	1/10
Field Banks	Organics	N/R	N/R
	Inorganics	1/20	1/20
	Radionuclides	1/20	1/20
Equipment Blanks	Organics	1/20	1/20
	Inorganics	1/20	1/20
	Radionuclides	1/20	1/20
Trip Blanks	Organics	1/20	1/20
	Inorganics	N/A	N/A
	Radionuclides	N/A	N/A

N/A = Not Applicable
N/R = Not Required
1/10 = one QC sample per ten samples collected

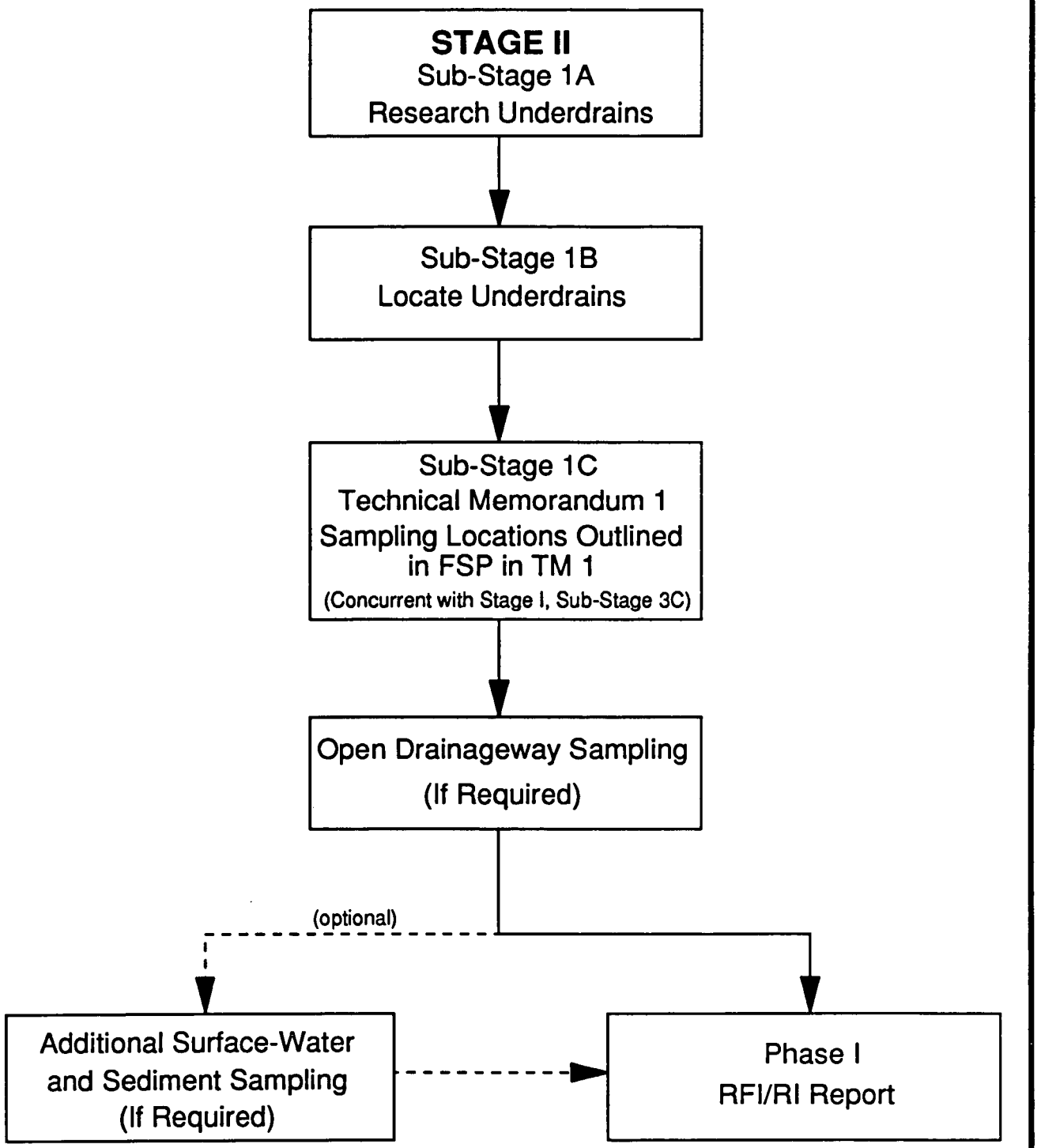


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FIGURE 6-1A

FLOW DIAGRAM FOR STAGE I SAMPLING



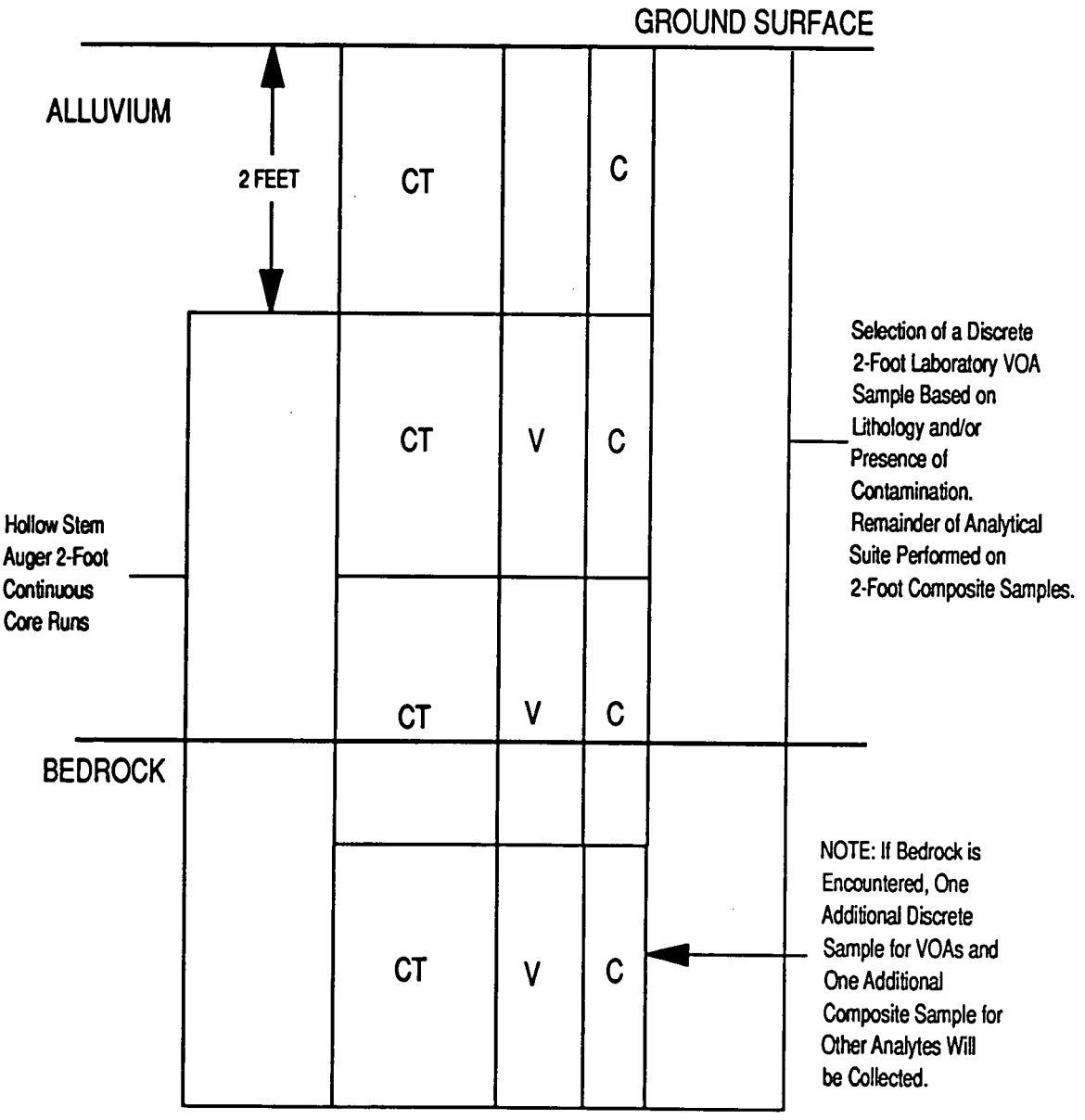
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FIGURE 6-1B

FLOW DIAGRAM FOR STAGE II SAMPLING

Typical Shallow Source Characterization
Borehole in Alluvium/Bedrock



CT — 2-FOOT CONTINUOUS HOLLOW STEM AUGER CORE RUN

V — DISCRETE 2-FOOT LABORATORY SAMPLE FOR TCL VOLATILE ANALYSIS

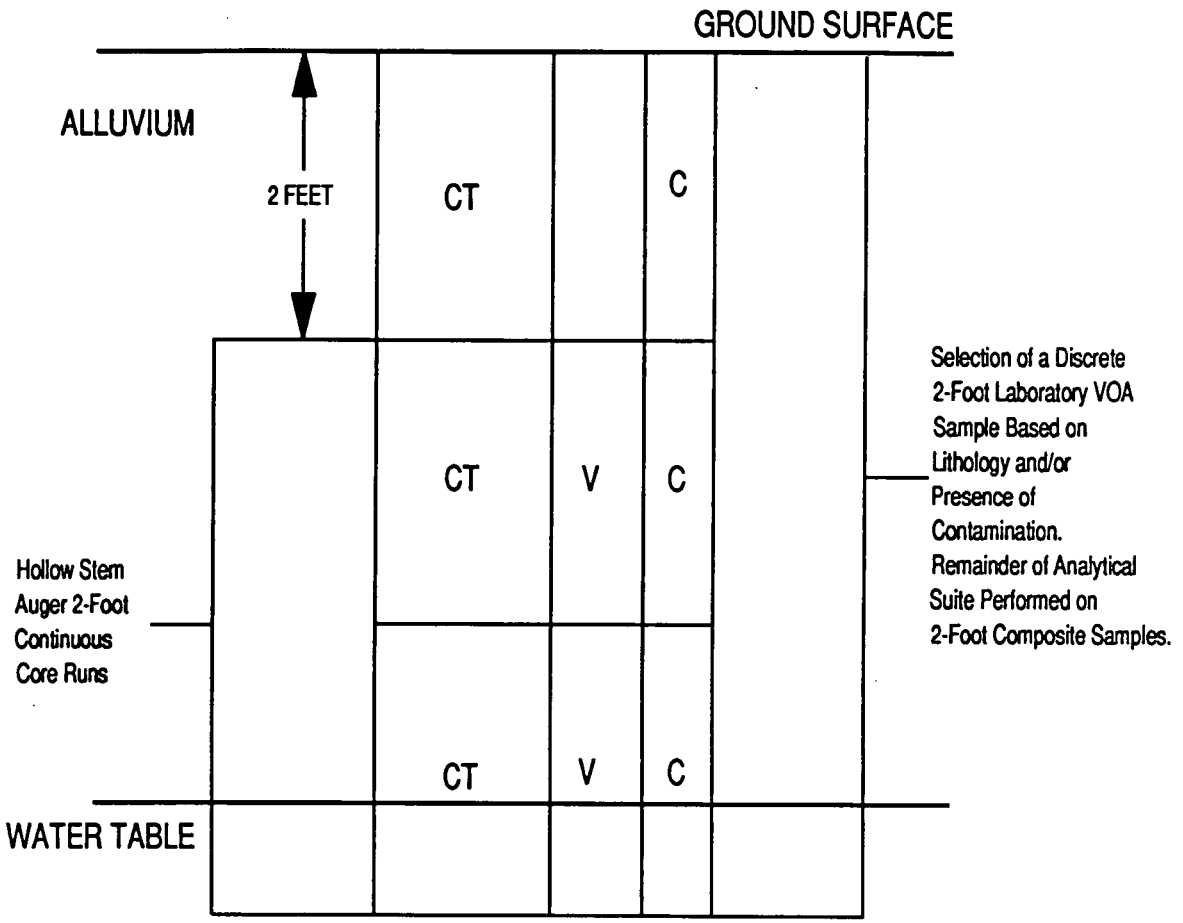
C — 2-FOOT COMPOSITE LABORATORY SAMPLE FOR ANALYSIS OF REMAINDER OF ANALYTICAL SUITE

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FIGURE 6-14
Lithologic and Chemical Sampling for Shallow Source Characterization Boreholes in Alluvium/Bedrock

Typical Shallow Source Characterization
Borehole Above Saturated Alluvium



CT — 2-FOOT CONTINUOUS HOLLOW STEM AUGER CORE RUN

V — DISCRETE 2-FOOT LABORATORY SAMPLE FOR TCL VOLATILE ANALYSIS

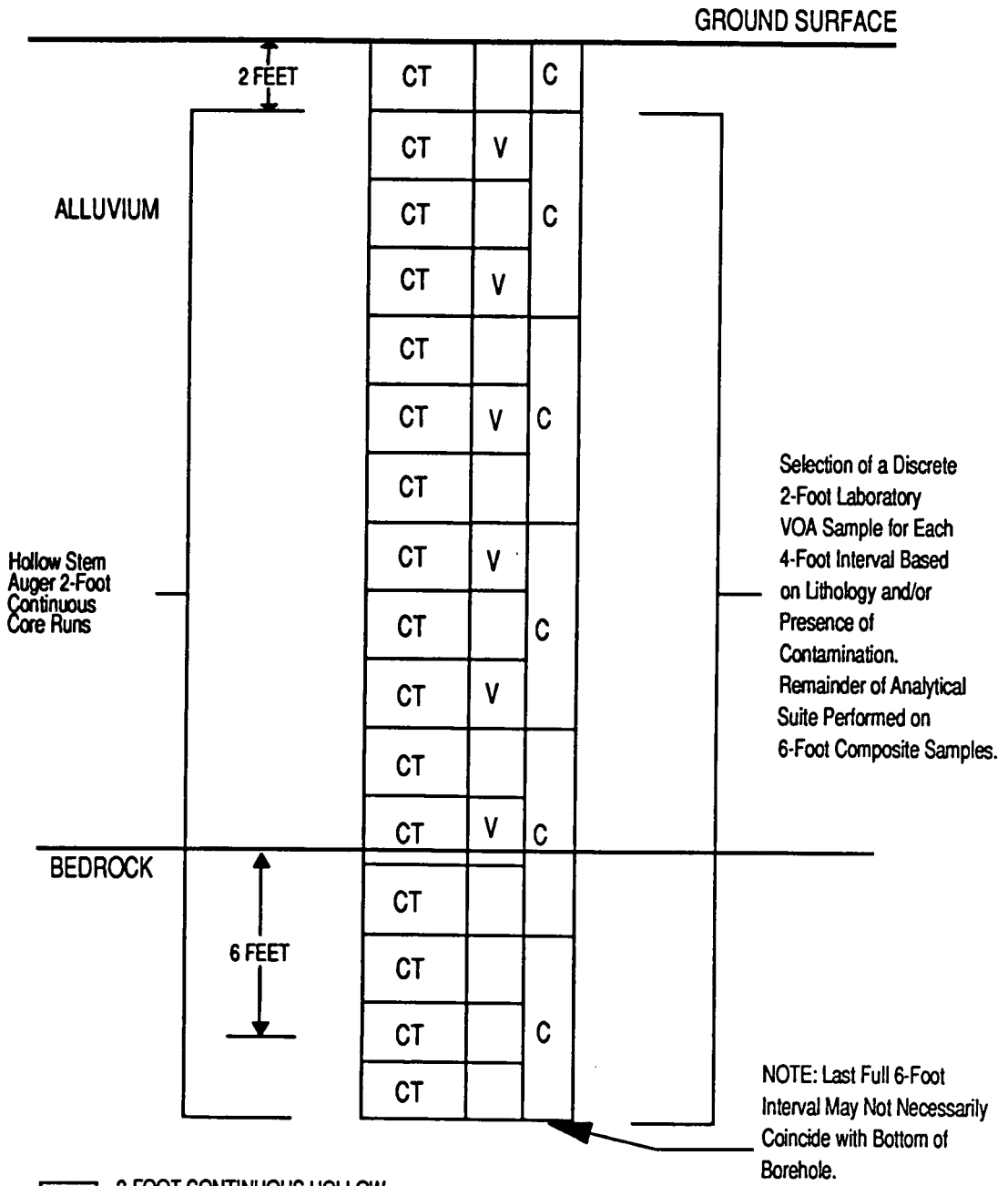
C — 2-FOOT COMPOSITE LABORATORY SAMPLE FOR ANALYSIS OF REMAINDER OF ANALYTICAL SUITE

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FIGURE 6-15
Lithologic and Chemical Sampling for Shallow Source Characterization Boreholes Above Saturated Alluvium

Typical Source Characterization Borehole in Alluvium/Bedrock



CT — 2-FOOT CONTINUOUS HOLLOW STEM AUGER CORE RUN

V — DISCRETE 2-FOOT LABORATORY SAMPLE FOR TCL VOLATILE ANALYSIS

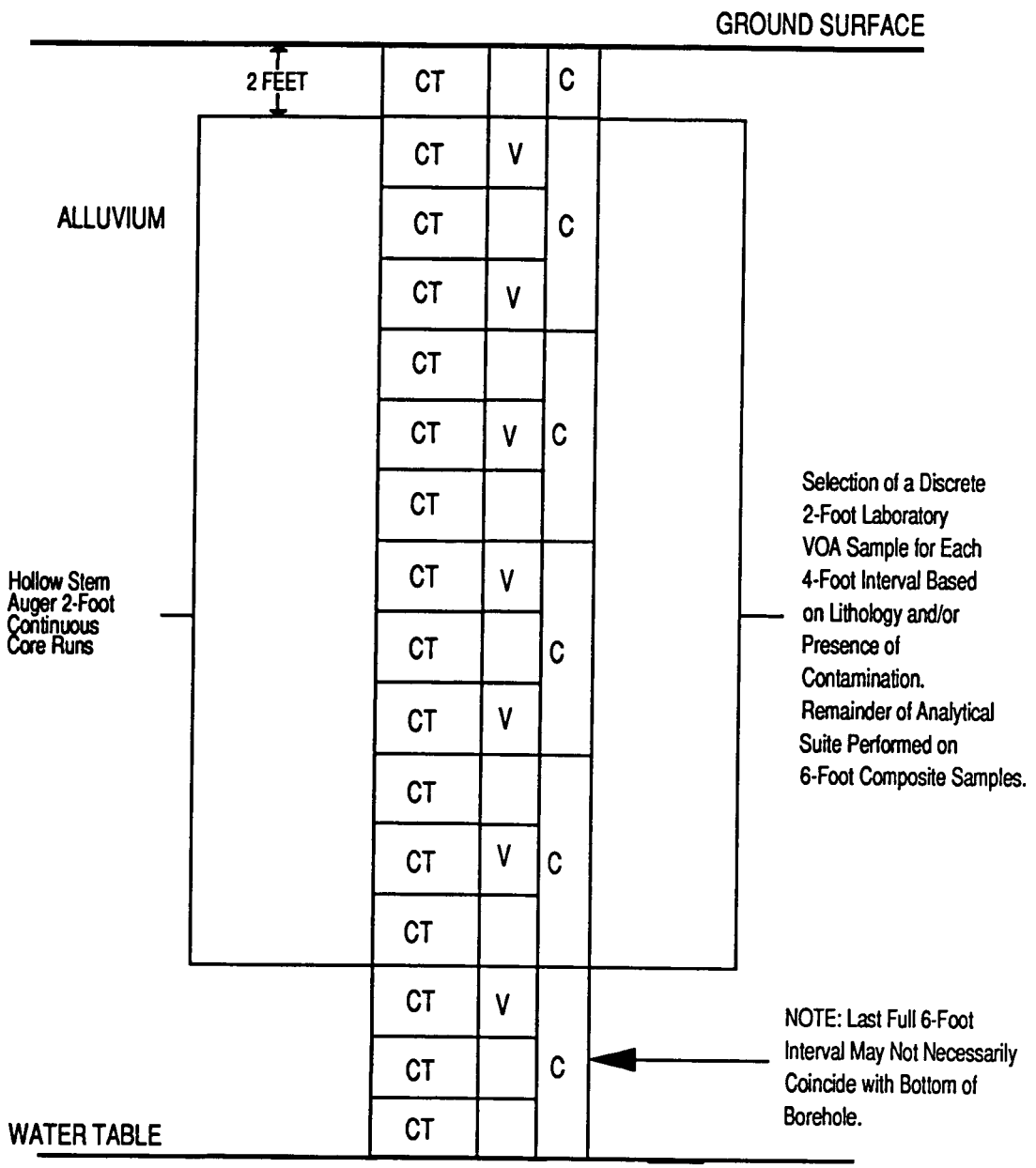
C — 6-FOOT COMPOSITE LABORATORY SAMPLE FOR ANALYSIS OF REMAINDER OF ANALYTICAL SUITE (2-FOOT AT THE 0-2 FOOT DEPTH INTERVAL)

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FIGURE 6-16
Lithologic and Chemical Sampling for Source Characterization Boreholes in Alluvium/Bedrock

Typical Source Characterization
Borehole Above Saturated Alluvium



CT — 2-FOOT CONTINUOUS HOLLOW STEM AUGER CORE RUN

V — DISCRETE 2-FOOT LABORATORY SAMPLE FOR TCL VOLATILE ANALYSIS

C — 6-FOOT COMPOSITE LABORATORY SAMPLE FOR ANALYSIS OF REMAINDER OF ANALYTICAL SUITE (2-FOOT AT THE 0-2 FOOT DEPTH INTERVAL)

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FIGURE 6-17
Lithologic and Chemical Sampling for Source Characterization Boreholes Above Saturated Alluvium

7.0 TASK SCHEDULE

The preliminary schedule for conducting the OU8 Phase I RFI/RI is summarized in Figure 7-1. The preliminary schedule includes the milestones established in Attachment 2, Table 6 of the IAG (Appendix A). An estimated one and one half years will elapse from the time the Work Plan is implemented until a final report of the RFI/RI Phase I investigation is issued. The schedule addresses contingencies related to regulatory review of Technical Memoranda between successive stages of the FSP, but it does not address scheduling issues related to obtaining contractual authorization to proceed.

Several key elements of the Work Plan overlap chronologically. This reflects both the flexibility designed into the Work Plan and the need to implement the Work Plan on an aggressive schedule.

Data validation will begin approximately one month after the site characterization task begins. Implementing data validation concurrent with site characterization will assist in the refinement of data collection procedures and in completing RFI/RI activities within the timeframe established in the IAG.

OU8 RFI/RI Schedule Includes Time for Regulatory Review of a Brief Technical Memoranda.

ID	Name
1	Submit Draft Phase I Workplan
2	EPA/CDH Review of Workplan
3	Prepare Final Phase I Workplan
4	Submit Final Phase I Workplan
5	EPA/CDH Approval of Final Workplan
6	Prepare Project Mgmt. Plans
7	EG&G/RFP/DOE Review & Approval
8	Field Mobilization
9	Implement Community Relations
10	Site Characterization/Workplan Implementation
11	Site Physical Characteristics
12	Data Validation
13	Conduct Risk Assessment
14	Develop and Screen Remedial Alternatives
15	Prepare Draft Phase I Report
16	Submit Draft RFI/RI Phase I Report
17	EPA, CDH, LRA Review
18	Prepare Final RFI/RI Phase I Report
19	Submit Final RFI/RI Phase I Report

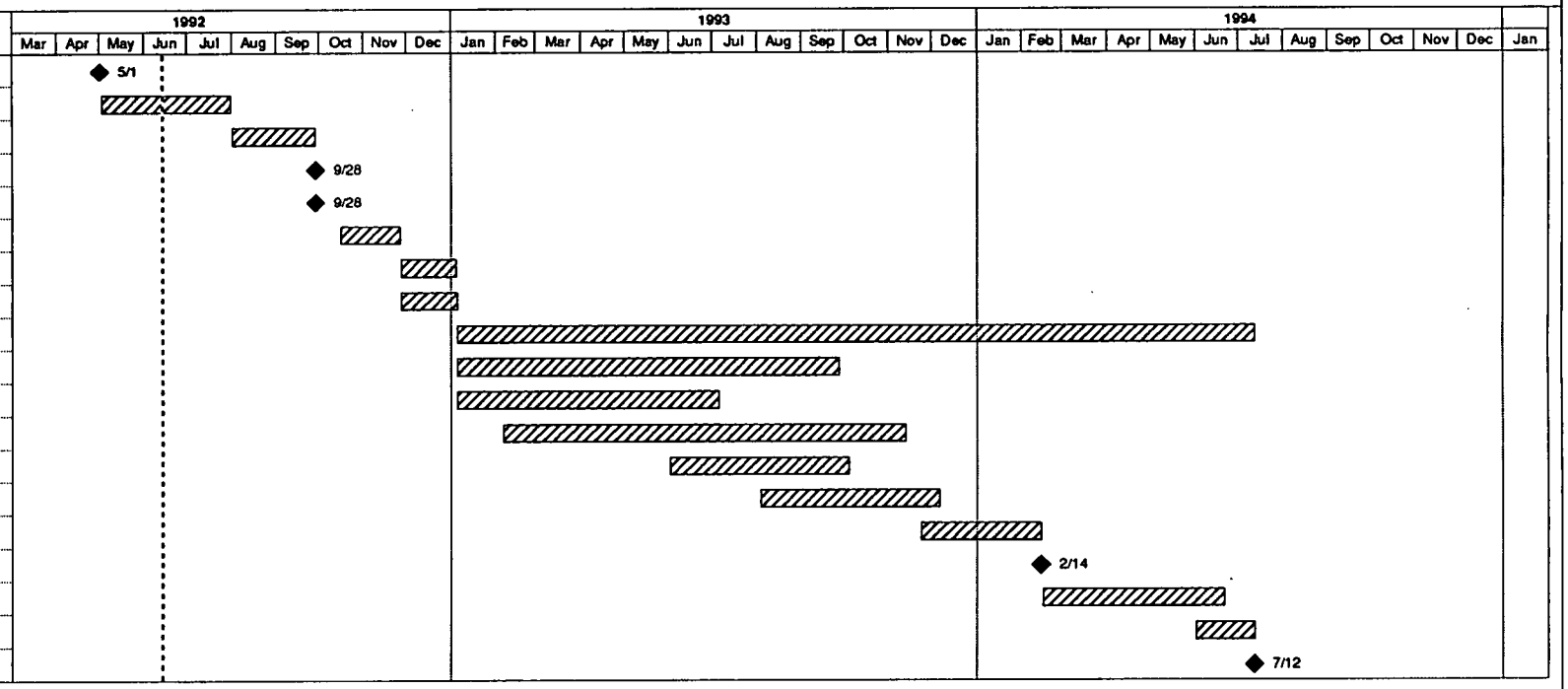


Figure 7-1

Project: OU8 RFI/RI Schedule
Date: 6/22/92

Critical Noncritical Progress Milestone Summary

Preliminary OU8 RFI/RI Draft Work Plan Schedule

8.0 HUMAN HEALTH RISK ASSESSMENT PLAN

8.1 OVERVIEW

Following implementation of the Work Plan and validation of all acquired data, a baseline risk assessment (BRA) will be conducted to evaluate potential threats to human health and the environment from constituents associated with the Rocky Flats OU8 and/or IHSSs contained within the unit boundary (Figure 8-1).

8.1.1 Regulatory Basis

Section 300.430(d) of the National Contingency Plan (Federal Register March 8, 1990, p. 8709) states that, as part of the remedial investigation, a Human Health Risk Assessment is to be conducted as part of a Baseline Risk Assessment (BRA) to determine whether contaminants of concern identified at the site pose a current or potential risk to human health and the environment in the absence of remedial action. This section describes the Human Health Risk Assessment components, which include:

- Data collection/evaluation which includes identification and description of contaminants of concern (COCs);
- Exposure assessment;
- Toxicity assessment; and
- Risk characterization.

These components correspond to the four components within the IAG required in Section VII.D.1. for contaminant identification and documentation, exposure assessment and documentation, toxicity assessment and documentation, and risk characterization. Uncertainty analysis will be an integral part of each of these four components.

Figure 8-2 illustrates the basic Human Health Risk Assessment process and components. The objective of this assessment is to identify and characterize the following:

- Toxicity and levels of hazardous and radioactive contaminants present in relevant media (e.g., air, ground water, soil, surface water, and sediment);
- Environmental fate and transport mechanisms within specific environmental media and cross-media fate and transport where appropriate;
- Potential human and environmental receptors;
- Potential exposure routes and extent of actual or expected exposure;
- Extent of expected impact or threat and the likelihood of such impact or threat occurring (i.e., risk characterization); and
- Levels of uncertainty associated with the above.

To ensure acceptance of the Human Health Risk Assessment, four technical memoranda will be prepared for review and approval. These memoranda will outline how the most crucial steps in the risk assessment will be performed and address the following:

- Contaminants of concern;
- Exposure scenarios;
- Fate and transport models; and
- Toxicity values.

The Human Health Risk Assessment considers risks from both radiological and nonradiological contaminants. The EPA and DOE require a two-phase evaluation for the radiological portion of the assessment. The Human Health Risk Assessment will incorporate the two-phase analysis, which includes:

- The implementation of procedures established by the International Commission on Radiological Protection (ICRP) and adopted by the EPA used to estimate the radiation dose equivalent to humans from potential exposure to radionuclides through all pertinent exposure pathways; and

- The computation of health risk, based on the age-averaged lifetime excess cancer incidence per unit intake (and per unit external exposure) for radionuclides of concern.

Human Health Risk Assessment results will be used to determine if remedial actions are warranted at OU8 and, if so, what associated cleanup levels will be necessary to protect human health. Cleanup levels are computed during the Feasibility Study.

A number of guidance and information documents will be used to provide direction for developing the Human Health Risk Assessment. These include:

Risk Assessment Guidance for Superfund, Human Health Evaluation Manual Volume 1. (Part A). Interim Final. 1989. EPA/540/1-89/002 (EPA, 1989d), including Office of Solid Waste and Emergency Response (OSWER) Directive 9285.6-03 Human Health Evaluation, Supplemental Guidance: "Standard Default Exposure Factors";

Guidance for Data Useability in Risk Assessment. Interim Final. 1990. EPA/540/G-90/008 (EPA, 1990);

Superfund Exposure Assessment Manual. 1988. EPA/540/1-88/001 (EPA, 1988c); Procedures established by the ICRP and adopted by EPA in Federal Guidance Report No. 11 (EPA, 1988b);

Radiation Protection of the Public and the Environment, DOE Order 5400.5;

Risk Assessment in the Federal Government: Managing the Process. 1983. National Academy Press, Washington, D.C.; and

Publications of the National Council of Radiation Protection, International Council on Radiological Protection, United National Scientific Committee on the Effects of Atomic Radiation, as appropriate.

In addition to available national EPA guidance, supplemental Region VIII risk assessment guidance will be used, if applicable.

8.1.2 Background of Site Contamination

OU8 is comprised of 24 IHSSs throughout the 300, 500, 700, and 900 building areas as defined in the Draft Historical Release Report (HRR) (DOE, 1992). The HRR also identifies areas of under-building contamination (UBC) and several other previously unrecognized sites that are potential areas of contamination (PACs). Phase I RFI/RI investigations in this work Plan are confined to specific IHSSs. Although investigation of other sites are not part of OU8, the presence of those sites within the boundary of OU8 was recognized and considered and basic location information is incorporated into this plan. Historical quantitative data was addressed for those sites, however, only qualitative historical data available from the draft HRR as discussed in Section 2.2 of this work plan was considered.

Contaminants identified in the draft HRR at OU8 IHSSs and within the OU8 area include enriched and depleted uranium, plutonium, americium, beryllium, chlorinated solvents, chromates, hydrofluoric acid, potassium and sodium hydroxides, carbon tetrachloride, and petroleum hydrocarbons, among others. These compounds may occur in the groundwater, soils, ambient air, surface water, and sediments of OU8.

OU8 is encompassed entirely in the protected area at the RFP. Thus, the primary target population currently identified at OU8 is industrial site workers. Other target populations, including current offsite residents and future industrial and ecological site worker, will also be considered in the Human Health Risk Assessment. With DOE's future ecological land use plans for the OU8 industrial area, future onsite residents are not likely target populations. Potential exposure pathways to target populations considered may include:

- Ingestion of groundwater, surface water, sediments, and soil;
- Inhalation of airborne soil and sediment particles, vapors, and gases; and
- Dermal contact with soils, ground water, surface water, and airborne particulates.

Section 2.5 presents conceptual models of exposure pathways developed for each of three IHSS groups in OU8 using the known site physical conditions and potential contaminant sources described in Section 2.3 and 2.4. The conceptual models were developed for use in the evaluation of potential risks of OU8 contamination to human health and the environment. The IHSSs were organized into the three groups to simplify the conceptual models. The IHSSs are categorized based on contaminant source type and release mechanisms.

Data needs and Data Quality Objectives (DQOs) presented in Section 5.2 of this work plan. Section 6.0 describes how the data needs identified will be collected. The data needs and FSP address the objectives described in Subsections 5.1 and 6.1 and include characterizing the nature and extent of contamination and the data collection necessary to assess the complete potential exposure pathways. Data to be collected in the OU8 RFI/RI or obtained from other *programs* and used in the Human Health Risk Assessment includes sampling the following media.

- **Soils:** Data characterizing vertical depth contaminant concentrations in OU8 will be used to support discussions of contaminant fate and transport and, ultimately, the exposure assessment.

- **Surficial** Soils: Radiological and nonradiological surface soil data will be used to estimate exposure and risk through ingestion and, if necessary, estimate windborne particulate concentrations for subsequent inhalation exposures.

- **Surface Water and Sediments:** Data characterizing contaminants in surface water and sediments can be used to support discussions of contaminant fate and transport, in addition to estimating exposure and risk from ingestion or dermal contact with surface water and sediments, and inhalation of sediments.

- **Groundwater:** Data characterizing site-specific hydrogeology and potential contaminants in alluvial groundwater systems can be used to support discussions of contaminant fate and transport in addition to estimating exposure and risk from ingestion, inhalation, or dermal contact with groundwater.

- **Air:** Data characterizing the potential for dispersion of contaminated sediments can be used to support discussions of contaminant fate and transport in addition to estimating exposure and risk from inhalation. Air pathway analyses will be based on dispersion modeling.

A comprehensive quantitative assessment of all contaminants of concern and potential exposure pathways will be performed for surficial soils, surface water, and sediments as part of the RFI/RI. This RFI/RI includes a preliminary determination of the presence or absence of groundwater contamination at suspect OU8 IHSSs. This information may allow identification of preliminary contaminants of concern (COCs) and exposure pathways for groundwater. Further investigation of groundwater contamination may result in additional RFI/RI activities that may not be completed within the IAG schedule. The remainder of this section generally describes the individual Human Health Risk Assessment components as they relate to the overall risk assessment.

8.2 DATA COLLECTION/EVALUATION

The objective of this section is to describe the procedures to identify contaminants potentially present at OU8 IHSSs at concentrations that could be of concern to human health. The contaminant description and identification of COCs' component of the Human Health Risk Assessment provides a summary of historical and RFI/RI data collected at OU8, provides an evaluation of historical and RFI/RI data relative to performing the Human Health Risk Assessment and describes how to use this information to perform the hazard identification. The contaminant description section includes the following information:

- Data collection;
- Data evaluation; and Hazard identification.

8.2.1 Data Collection

The objective of the data collection task is to summarize all data available for use in the Human Health Risk Assessment in preparation of further data evaluation activities. This step then identifies the historical data relevant to performing the Human Health Risk Assessment,

assembles the RI data, and establishes data formats to facilitate data evaluation. The following data attributes are important to this step:

- Site description;
- Sample design with sample locations;
- Analytical method and detection limit;
- Results for each sample, including qualifiers;
- Sample quantification limits and/or detection limits for nondetects;
- Field conditions; and
- Sample documentation (for example, chain-of-custody and Standard Operating Procedures [SOPs]).

8.2.2 Data Evaluation

Historical and RFI/RI data will be evaluated using EPA's Guidance for Data Useability in Risk Assessment (EPA, 1990). The EPA identified the following data usability criteria:

- Assessment of data documentation for completeness;
- Assessment of data sources for appropriateness and completeness;
- Assessment of analytical methods and detection limits for appropriateness;
- Assessment of sampling data quality indicators (completeness, comparability, representativeness, precision, and accuracy); and
- Assessment of analytical data quality indicators (such as spike recoveries, duplicates, and blanks) for completeness, comparability, representativeness, precision, and accuracy.

The RFI/RI data that can be used to support a quantitative Human Health Risk Assessment will be identified. Part of this evaluation will include identification of the most appropriate summary

process and format. This will involve identifying statistical summary techniques that consider spatial and temporal data distributions, determining if arithmetic or geometric means are appropriate, and determining the appropriate method for dealing with nondetected values and qualified data. The data summary will include:

- The frequency of detection (number of positive detects/number of analyses) for each compound and sample location; and
- The minimum- and maximum-reported concentrations for each contaminant at each sample location.

Tentatively identified compounds (TICs) reported in the RFI/RI will be evaluated relative to their usefulness in the Human Health Risk Assessment. If only a few TICs are reported relative to other contaminants, or if they are unrelated to RFP, they will be excluded from the Human Health Risk Assessment. If numerous TICs are reported and they appear related to the RFP, they will be carried through the Human Health Risk Assessment only to the extent that they aid characterizing human health risk as needed for site decisions. It is anticipated that risks resulting from exposure to TICs will not be characterized because of the absence of specific contaminant identity and available toxicological information.

8.2.3 Hazard Identification

The objective of the hazard identification is to identify RFP-related contaminants present at OU8 in concentrations high enough that may be of concern relative to human health considerations. The HRR identified uranium, plutonium, beryllium, chlorinated solvents, chromates, acids, and hydraulic oil within OU8. In addition to these contaminants, others may be identified based on RFI/RI analytical results. Criteria for performing the hazard identification include, but may not be limited to:

- Frequency of detection;
- Environmental media concentrations which exceed background concentrations; and

- Comparison with Health/Environmental criteria.

8.2.4 Selection of Contaminants of Concern

Analytical results from OU8 field sampling will be screened to retain those contaminants which are most likely to contribute significantly to risks the public. These COCs represent the most toxic, persistent, or mobile contaminants identified at an OU. If COCs have to be selected, adequate documentation will be prepared to justify including or excluding specific contaminants. As required by the IAG Section VII.D.1.a, a technical memorandum which includes a listing of the hazardous substances present within OU8 will be prepared and submitted to the EPA and State of Colorado for review and approval. The COCs selected from this list will be included in the memorandum with the known corresponding ambient concentrations of these contaminants. The memorandum will be submitted prior to the required submittal of the HHR for OU8.

A flowchart to be used in screening COCs has been developed from the discussion in the Risk Assessment Guidance for Superfund (RAGS) Sections 5.8, 5.9, and 10.4 (EPA, 1989d) by the Rocky Flats Plant Risk Assessment Technical Working Group and is shown on Figure 8-3. In general, each box contains a screening criteria which may be answered "yes" or "no". Flow to the left indicates contaminants that will be deleted from quantitative risk assessment unless associated with an anomalous area, defined as 10 times the mean site concentration. Contaminants that the screening process moves to the right of the flowchart will be retained for quantitative risk assessment unless they are identified as essential human nutrients. Analytical results from the OU8 field sampling program will be screened in order to retain those contaminants which are most likely to contribute significantly to human health risks.

The screening process begins with analytical results from the site-specific chemical analysis list set forth in this work plan. The data will be evaluated according to RAGS section 5.9.3 to determine if the detection frequency is greater than 5 percent. The chemical will be considered for elimination from the quantitative risk assessment if:

- It is detected infrequently in one or perhaps two environmental media;
- It is not detected in any other sample media, or at high concentrations; and
- There is no reason to believe that the chemical may be present (EPA, 1989c).

Contaminants with a detection frequency less than or equal to 5 percent will be screened to determine if they were detected in anomalous areas. Contaminants with low detection frequency that were not detected in anomalous areas will be deleted from further consideration. Contaminants with a detection frequency greater than 5 percent will be retained for further screening.

As discussed in RAGS sections 5.8(3) and 10.4.7, remaining contaminants will be screened to determine if the concentration is statistically different from background. This second step in the screening process employs appropriate parametric and non-parametric statistical data evaluation methods (e.g., tolerance intervals, analysis of variance [ANOVA], etc.). Guidance on statistical methods includes RAGS (EPA, 1989d), Guidance for Data Useability in Risk Assessment (EPA, 1990), Methods for the Evaluation of Cleanup Standards (EPA, 1989c), and Statistical Methods for Environmental Pollution Monitoring (Gilbert, 1987). Those contaminants which are not detected at concentrations statistically elevated above background will be considered for elimination, but will be further screened to determine if they are associated with anomalous areas. If they are not statistically elevated above background or associated with anomalous areas, they will be eliminated.

The next step in the screening process is to determine if the chemical is considered a carcinogen. As indicated in Figure 8-3, EPA guidance will be employed to identify chemicals that are classified as Group A, B, or C carcinogens. This screening step does not eliminate a chemical from further consideration. Instead, it automatically identifies carcinogens for inclusion in the risk assessment, even if detected at low concentrations.

Non-carcinogens retained for further screening will be checked to determine if mean concentrations are greater than one-tenth the value of identified health protective criteria (e.g., reference dose-based criteria, drinking water standards, etc.). Contaminants with mean concentrations greater than one-tenth health/environmental criteria will be retained in the screening process. If the mean concentration is less than one-tenth health protective criteria, the contaminant is reviewed for mobility, persistence, or significant decay products. Mobility may be evaluated according to criteria such as high volatility, high solubility, and low organic carbon partition coefficient (K_{oc}) and persistence may be evaluated according to criteria such as half-life and bioaccumulation. For example, as K_{oc} increases, a contaminant is more likely to remain in water than to bind to sediment or soil. Contaminants that are not highly mobile, persistent or possess significant decay products and are not associated with hot spots will be eliminated. Contaminants determined to be highly mobile or persistent may be retained for further screening.

The final screening step is to determine if any of the contaminants retained in the screening process are essential human nutrients. As stated in RAGS section 5.9.4, "chemicals that are essential human nutrients, present at low concentrations (i.e., only slightly elevated above naturally occurring levels), and toxic only at very high doses (i.e., much higher than those associated with contact at the site) need not be considered further in the quantitative risk assessment. Examples of such chemicals are iron, magnesium, calcium, potassium, and sodium" (EPA, 1989d). Consequently, contaminants that meet the essential nutrient criteria will not be considered further.

Contaminants retained through the screening process represent the most prevalent, toxic, persistent or mobile contaminants. These will be added to the list of contaminants of concern, which will be used in the quantitative risk assessment.

There are inherent uncertainties that must be recognized in the data collection and evaluation component of the Human Health Risk Assessment. Uncertainties include those associated with field sampling laboratory analysis and laboratory quality assurance procedures, and with accuracy

of the RFEDS database or other databases compiled for use in the risk assessment. All of these sources of information are used to identify and describe COCs.

8.3 EXPOSURE ASSESSMENT

The objectives of the exposure assessment are to identify actual or potential chemical and radiological exposure pathways, characterize potentially exposed populations, and determine the concentration and duration of exposure. The exposure assessment includes several tasks:

- Characterization of the exposure setting relative to contaminant fate and transport and potentially exposed populations;
- Identification of exposure pathways which are comprised of a source and mechanism of release to the environment, an environmental transport medium, a point of potential contact for humans or biota, an exposure point, and an exposure route at the exposure point;
- Identification of exposure scenarios associated with pathways to current and potential future exposed populations; and
- Identification of uncertainties associated with the exposure assessment that impact the risk characterization.

Exposure is defined as the contact of an organism with a contaminant or physical agent. The magnitude of exposure is determined by measuring or estimating the amount of a contaminant available at the exchange boundaries. When contaminants migrate from the site to an exposure point, or when a receptor directly contacts contaminated media, exposure can occur.

8.3.1 Conceptual Site Model

The conceptual site model developed for OU8 discussed in Section 2.5 will be used to evaluate primary and secondary contaminant sources and releases, and potential receptors and associated exposures. The models help to characterize the exposure setting relative to contaminant fate and

transport mechanisms through exposed receptors. These models may be revised, based on RFI/RI data collected for the OU, to incorporate new information.

To assess the potential adverse health effects associated with access to the site, the potential level of potential receptor exposure to the selected contaminants must be determined. Both current and potential future receptors are considered in this determination. The primary current receptors identified at OU8 include occupational site workers, offsite residents, livestock, and aquatic and terrestrial wildlife. Offsite potential future receptors include light industrial and ecological site workers. Future onsite residential receptors will be considered, although it is highly unlikely the RFP will allow unrestricted, residential use in the future.

Intakes of potentially exposed receptors will be calculated separately for all appropriate pathways of exposure to contaminants. Then, the total chronic intake by each route of exposure will be calculated by adding the intakes from each pathway. Total oral, inhalation, and dermal chronic exposures as well as external exposure from radionuclides will be estimated separately. Exposure concentrations will be estimated as described in Section 8.3.4 for a variety of reasonable exposure conditions in order to evaluate the range of plausible exposure concentrations. At a minimum, the exposure assessment will consider the estimated minimum, expected, and reasonable maximum exposure (RME) concentrations. RME concentrations are represented by the 95th percent confidence limit on average concentration.

8.3.2 Contaminant Fate and Transport

The conceptual site model helps identify potential contaminant fate and transport mechanisms. These could include soil contents leaching to groundwater and subsequent transport, soil entrainment and downwind deposition, or surface runoff that transports surface soil and sediments downslope. Contaminant-specific characteristics affect fate and transport. Compound-specific factors affecting the probability a contaminant will migrate include, but are not limited to, the following:

- Solubility;
- Partition coefficients;
- Vapor pressure;
- Henry's Law constant;
- Bioconcentration or dilution factors; and
- Half-life or degradation in the environment.

The evaluation of these factors will help determine if contaminants can migrate from their sources to potential receptors. This includes not only those receptors identified under current use scenarios, but those identified under potential future exposure scenarios as well.

Models utilized for fate and transport evaluation will be described and submitted in a technical memorandum to the EPA and State of Colorado for review and approval as required by the IAG Section VII.D.1.b. The memorandum will include a summary of the data that will be utilized in these models. Representative data will be utilized and the stations, assumptions, and uncertainties associated with the models shall be documented. This memorandum will be submitted prior to the required submittal of the baseline risk assessment.

8.3.3 Exposure Pathways

By using the conceptual site model and information on contaminant fate and transport, exposure pathways can be identified. This information, combined with data on the physical site setting and potentially exposed site workers, will be used to identify and evaluate complete exposure pathways. The Human Health Risk Assessment will consider only complete exposure pathways, those for which data support the presence of a source, release mechanism, transport mechanism, exposure route, and affected receptor. Complete exposure pathways include the receptors and exposure route (ingestion, inhalation, dermal, and external irradiation).

As required by the IAG Section VII.D.1.b, a technical memorandum will be submitted to EPA and the State of Colorado for review and approval concerning the exposure scenarios. The memorandum will describe the present, future, potential, and reasonable-use scenarios. A description of the assumptions made and the data used will be included. This memorandum will be submitted prior to the required submittal of the baseline risk assessment.

8.3.4 Exposure Point Concentrations

By using the data set identified as part of Subsection 8.2.2, exposure point concentrations will be estimated. Some data will be collected at the point of exposure. Other data collected at the source may be used in conjunction with a transport model to estimate expected concentration at some exposure point. Because modeling may add uncertainty, the work plan emphasizes collecting data at exposure points where possible, even though these data provide only a snapshot of conditions in time and space.

A statistical approach will be taken to characterize a range of exposure point concentrations for representative exposure scenarios and conditions. The initial step will be to evaluate and characterize the underlying statistical distribution (e.g., normal, lognormal, etc.) through classical methods such as histograms and goodness of fit tests, and similar summary statistics. Based on this initial assessment, suitable measures of central tendency and dispersion such as the mean, variance, and similar summary statistics will be developed. These measures will be used to characterize exposure point concentrations for different cases of interest such as: the expected case; the 95 percent lower confidence limit case, and the 95 percent upper confidence limit the RME case.

8.3.5 Contaminant Intake Estimation

Contaminant intake or exposure is normalized for time and body weight and is expressed as milligrams of chemical per kilogram of body weight per day (mg/kg/day). Radionuclide intake

is expressed in picocuries (pCi). Six basic factors are used to estimate intake: exposure frequency, exposure duration, contact rate, chemical concentrations, body weight, and averaging time. These factors are based on the types of exposure (e.g., ingestion, inhalation, or dermal).

The lower confidence limit, upper confidence limit, and average exposure point concentrations are used in conjunction with receptor activity patterns to estimate contaminant intake for each exposure route as appropriate. EPA guidance such as Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual Supplemental Guidance, Standard Default Exposure Factors Interim Final, March 25, 1991 (EPA, 1989d) will be consulted in developing bounding case exposure parameters to support an unbiased exposure assessment. Also, the averaging time for carcinogens and noncarcinogens differ.

Other standard contaminant intake rates established by the EPA that will be used, if appropriate, include the following:

- Soil ingestion rates based on age; and
- Inhalation rates based on activity levels.

Contaminant intake rates can also be estimated for dermal exposures. Of the three routes of exposure (ingestion, inhalation, and dermal), the greatest uncertainty is associated with dermal exposures.

8.3.6 Uncertainly in the Exposure Assessment

The ability to construct exposure scenarios for a site depends on the amounts and kinds of environmental data collected for that purpose. Some uncertainty is inherent in environmental data collection. The numbers and kinds of uncertainties included in the exposure assessment directly impact the risk characterization; many professional judgements impact the identification and description of physical site attributes that affect exposure and activity patterns. One of the major

areas of uncertainty in the exposure assessment is the prediction of human activities that lead to contact with environmental media and exposures to site-related contaminants. This section of the Human Health Risk Assessment will identify and evaluate how site attributes related to environmental sampling and analysis, fate and transport modeling, and exposure parameter estimation and assumptions about them affect assessing risk. Uncertainty analysis will be performed to characterize and quantify, if possible, the sources and magnitudes of uncertainty in the data collection and evaluation component. Quantitative techniques may include sensitivity analysis, or numerical methods such as Monte Carlo analysis. A more detailed description of uncertain analyses considered for use in completing the overall Human Health Risk Assessment for OU8 is in Section 8.5.

8.4 TOXICITY ASSESSMENT

The objective of the toxicity assessment is to describe the contaminants considered in the Human Health Risk Assessment relative to their potential to cause harm. The toxicity assessment has two general steps. The first determines what adverse health impacts, if any, could result from exposure to a particular contaminant. These are typically classified as carcinogenic and noncarcinogenic health effects. The second step, the dose-response evaluation, quantitatively examines the relationship between the level of exposure and the incidence of adverse health effects.

Toxicity depends on the dose or concentration of the substance (dose-response relationship). Toxicity values are a quantitative expression of the dose-response relationship for a contaminant and take the form of reference doses (RfD) and cancer slope factors, both of which are specific to exposure via different routes.

Two sources of toxicity values are currently available for chemicals and radionuclides. The primary source is the EPA's Integrated Risk Information System (IRIS) database, which contains up-to-date health risk and regulatory information. IRIS contains only those RfDs and slope

factors that have been verified by EPA work groups, and is considered by EPA to be the preferred source of toxicity information for chemicals.

Following IRIS, the most recently available Health Effects Assessment Summary Tables (HEAST), issued by EPA's Office of Research and Development, will be consulted to identify interim RfDs and slope factors for chemicals and radionuclides. Other sources such as ICRP and National Commission on Radiological Protection (NCRP) will also be consulted.

Toxicity values for substances identified in OU8 which lack EPA toxicity values can be developed in consultation with EPA's Environmental Criteria Assessment Office (ECAO). It is not expected that toxicity values will be developed within the OU8 Human Health Risk Assessment.

A technical memorandum listing the toxicological and epidemiological studies utilized to perform the toxicity assessment as required by the IAG Section VII.D.1.c. will be submitted to EPA and the State of Colorado for their review and approval This memorandum will be submitted prior to the required submittal of the baseline risk assessment.

In addition to identifying appropriate toxicity values, this section of the Human Health Risk Assessment will provide brief toxicity profiles based on recent, published literature for each contaminant evaluated in the Human Health Risk Assessment. These profiles will describe the acute, chronic, and carcinogenic health effects associated with radioactive and nonradioactive contaminants identified in OU8. Acute and chronic exposure to site related radionuclides will be discussed, but most of the information presented will deal with the carcinogenic hazard posed by the site-specific radionuclides.

The toxicity assessment section will include an evaluation and discussion of uncertainties. The numbers and kinds of uncertainties identified for the toxicity assessment directly impact the risk assessment. Uncertainties for the toxicity assessment are associated with the toxicity values and

their derivation, or the lack of toxicity values for site-related contaminants. Uncertainties include, but may not be limited to, the following:

- Not all constituents at the site have critical toxicity values (such as cancer slope factors or reference doses). Therefore, potential risk cannot be quantified for these constituents and this may underestimate risk from the site.

- Using cancer slope factors derived from the upper 95th percent confidence limit is likely to lead to overestimation of risk. Carcinogen slope factors assume no threshold for effects; if thresholds do exist, the true risks could be zero at sufficiently low doses.

- Lacking toxicity data, synergistic or antagonistic effects cannot be accounted for quantitatively.

Critical toxicity values derivation include, but may not be limited to, the following:

- Extrapolating toxicity values from high experimental doses to low doses for environmental exposures;

- Extrapolating data from tests with experimental animals to humans; extrapolating test data collected over short durations to long-term exposure durations;

- Extrapolating data collected using homogeneous experimental animal populations to humans who individually can vary substantially in their dose-response reactions;

- Extrapolating from continuous experimental doses given to animals to intermittent human exposures; and

- Extrapolating absorption rates.

The methods used to derive slope factors and reference doses are intended to be conservative in recognizing these types of uncertainties. In addition to the numerical approaches used to incorporate uncertainty in deriving toxicity values, the overall quality of the toxicology data base for a compound is evaluated. This can include consideration of a number of studies, their consistency, the availability of information on multiple species and multiple routes of administration, the demonstration of a clear dose-response relationship, plausible biological mechanisms of action, and especially direct evidence of effects in humans. Such reviews are

performed by the EPA in developing toxicity parameter values and result in an overall evaluation of the confidence level in the toxicity values. Not all toxicity values represent the same degree of uncertainty; all are subject to change as new evidence becomes available.

8.5 RISK CHARACTERIZATION

This part of the Human Health Risk Assessment presents the evaluation of potential risks to public health associated with exposure to contaminants at the OU8 site. Potential carcinogenic and noncarcinogenic risks associated with complete exposure pathways will be estimated. Risk characterization involves integrating exposure assumptions and toxicity information to quantitatively estimate the risk of adverse health effects. Risk characterization will be performed in accordance with EPA guidance (EPA, 1989d).

Noncancerous health effects will be assessed by comparing the estimated daily intake or exposure to a contaminant to its reference dose (RfD). This comparison measures the potential for noncarcinogenic health effects given the chemical intake factors used to estimate exposure. To assess the potential for noncancerous effects posed by multiple contaminants, the EPA's hazard index approach will be used. The method assumes dose additivity. Hazard quotients (individual chemical intake divided by the chemical RfD) are summed based on identification of target-tissues and like impacts to provide a hazard index; if the index exceeds one, there is a potential for health effects.

The potential for carcinogenic effects for nonradiological contaminants will be estimated by calculating excess lifetime cancer risks from the lifetime average exposure and cancer slope factor. IRIS slope factors for radionuclides of concern will be used to estimate risks from exposure for up to four pathways: inhalation, ingestion, air immersion, and external irradiation. HEAST tables will also be used to identify interim RfDs and slope factors for any radionuclides of concern not included in the IRIS database, and radiological risks will be estimated according to guidance provided by the EPA (1989d).

For radiological contaminants, dose to the public will first be determined for the pathways in question for each radionuclide of concern. Based upon these doses, the risk of an effect will be determined using age- and sex-specific coefficients for individual organs receiving radiation doses. In accordance with EPA guidance, organ-specific dose conversion factors will be used to derive slope factors that represent the age-averaged lifetime excess cancer incidence per unit intake for the radionuclides of concern. The sum of the risks from all radionuclides and pathways yields the lifetime risk from the overall exposure. Risks will be combined as appropriate, taking into consideration the plausibility of multiple exposures.

The Human Health Risk Assessment will present the chemical and radiological risk estimates separately with discussion on the additivity potential for these risks. Both noncancerous and cancer risks will be estimated by using RME combined with exposure assumptions. This allows risk ranges to be considered rather than as a single value, and more closely considers the uncertainty associated with the estimates. Radiological risk will be presented in terms of the three common formats currently used in the radiologic and regulatory communities. These include: HEAST-type calculations as described in EPA's Risk Assessment Guidance for Superfund, Committed Effective Dose Equivalent (50 year commitment) also which is also suggested by EPA, and the more conventional accrued effective dose equivalent method used in the practice of health physics. In addition, risks may be added across exposure routes if conditions for doing so (i.e., biologically plausible and consistent with reasonably expected exposure scenarios) indicate that it is appropriate.

Not all contaminants identified at OU8 will have toxicity values, thereby limiting the ability to develop quantitative estimates of risk. Where adequate toxicity values cannot be identified, potential risks associated with exposure to those constituents will be dealt with qualitatively.

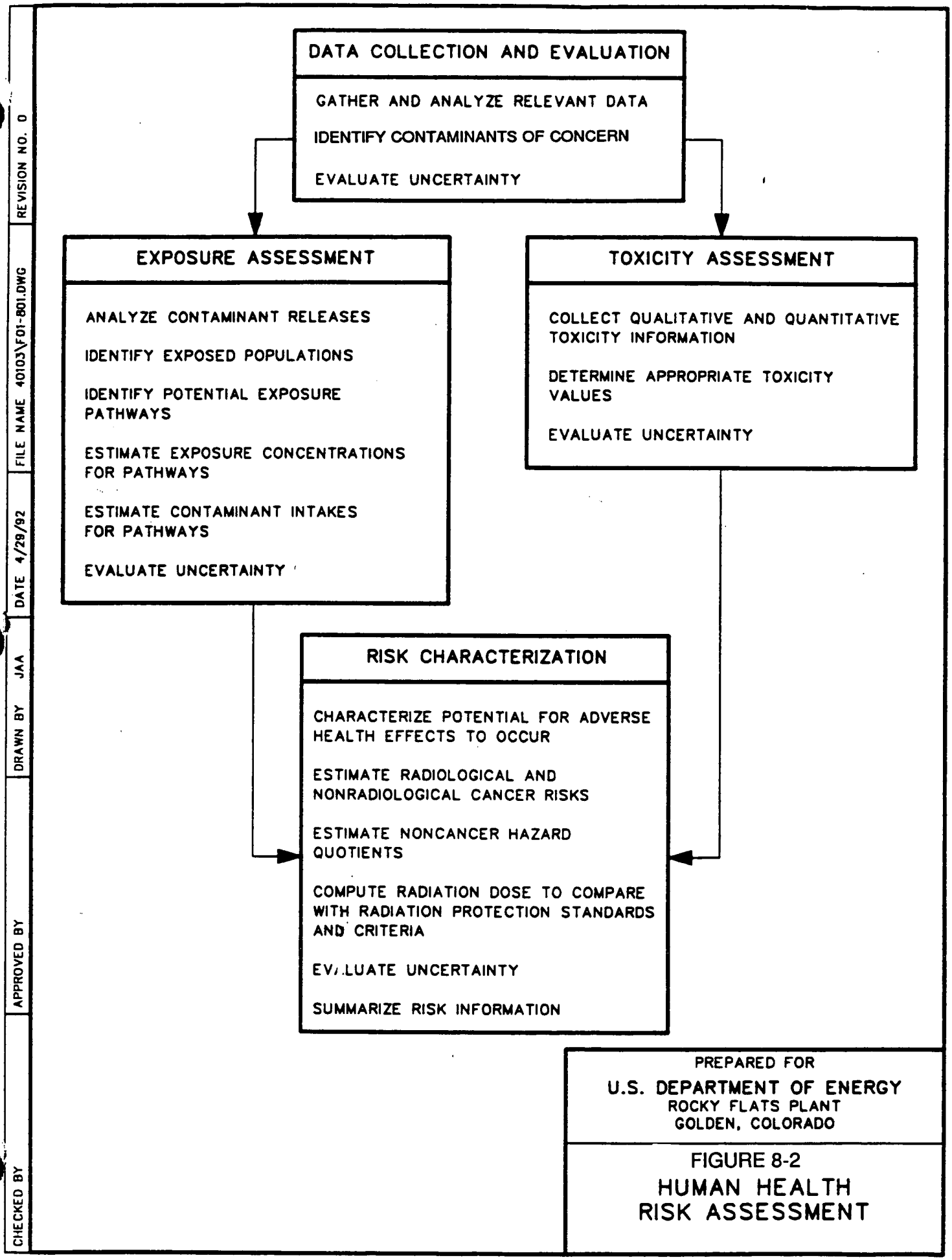
The numbers and kinds of uncertainties identified in the Human Health Risk Assessment directly impact the interpretation of estimated risks developed in this section. Quantitative risk estimates derived in risk assessments are conditional estimates that include numerous assumptions about

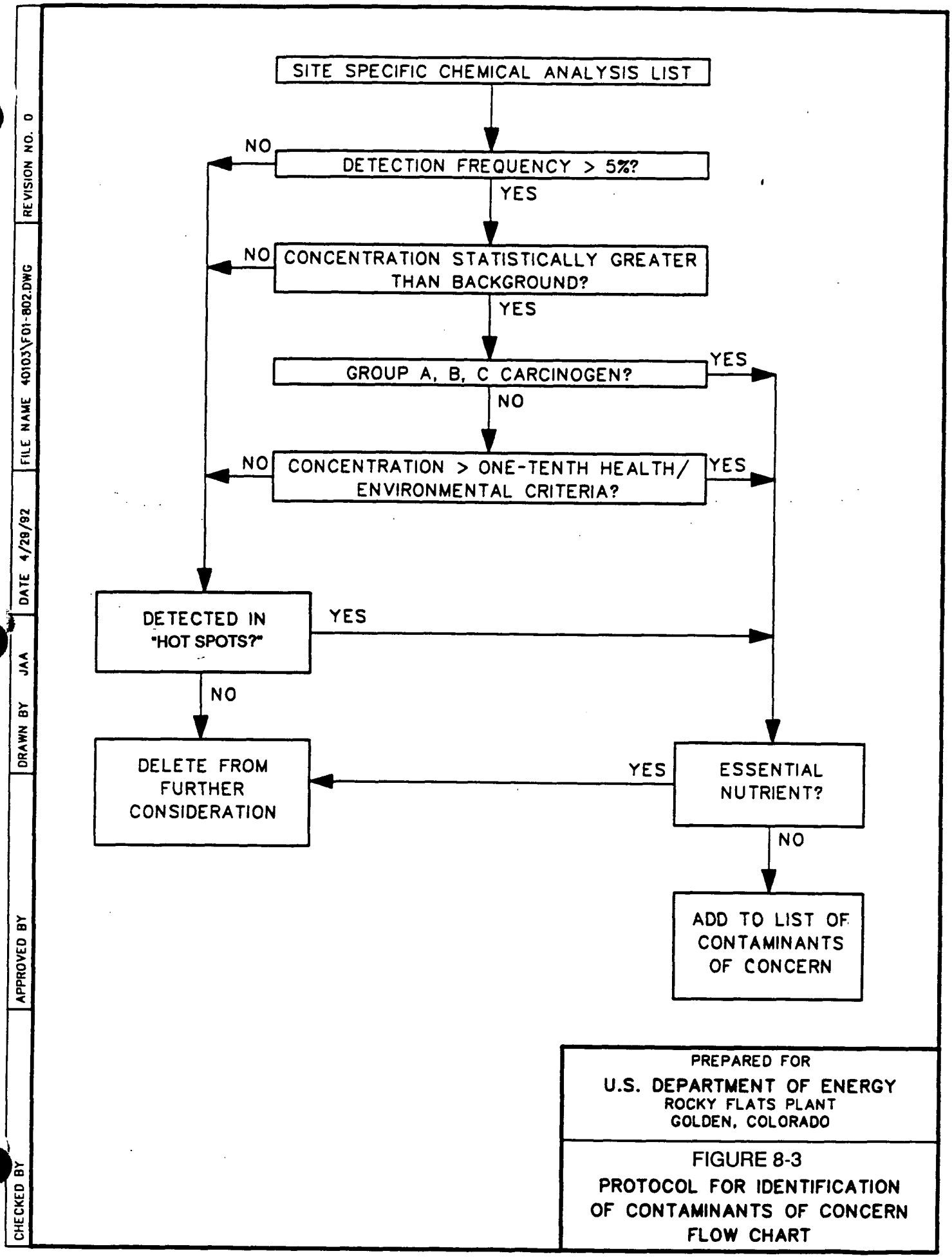
exposures and toxicity. Uncertainty is introduced from a variety of sources including, but not limited to, the following:

- Sampling and analysis;
- Exposure estimation;
- Exposure population dynamics; and
- Toxicological data.

Risk assessment involves extrapolation of often incomplete data and information obtained under one set of conditions to a likelihood or probability of events to be encountered under different circumstances. The objective of this task will be to evaluate the reliability of the Human Health Baseline Risk Assessment as a scientifically credible instrument upon which to base risk management decisions. An uncertainty analysis will be performed to characterize and quantify, to the extent practicable, the sources and magnitudes of uncertainty in the Human Health Risk Assessment.

The existing data bases may be inadequate for accurate analysis, and the complexity of the process requires the incorporation of expert or subjective judgments. Quantitative techniques may include sensitivity analysis of testable or untestable assumptions, first-order analysis to evaluate the propagation of errors, or numerical methods such as Monte Carlo analysis. To handle uncertainty, other methods of analysis of incomplete data sets may utilize Batesian theorems, expert systems that analyze the consequences of events relative to others, or other types of logic systems such as event or fault trees. The results of these analyses can be converted into quantitative terms to express probabilities.


DATA COLLECTION AND EVALUATION
GATHER AND ANALYZE RELEVANT DATA
IDENTIFY CONTAMINANTS OF CONCERN
EVALUATE UNCERTAINTY
EXPOSURE ASSESSMENT
ANALYZE CONTAMINANT RELEASES
IDENTIFY EXPOSED POPULATIONS
IDENTIFY POTENTIAL EXPOSURE PATHWAYS
ESTIMATE EXPOSURE CONCENTRATIONS FOR PATHWAYS
ESTIMATE CONTAMINANT INTAKES FOR PATHWAYS
EVALUATE UNCERTAINTY
TOXICITY ASSESSMENT
COLLECT QUALITATIVE AND QUANTITATIVE TOXICITY INFORMATION
DETERMINE APPROPRIATE TOXICITY VALUES
EVALUATE UNCERTAINTY
RISK CHARACTERIZATION
CHARACTERIZE POTENTIAL FOR ADVERSE HEALTH EFFECTS TO OCCUR
ESTIMATE RADIOLOGICAL AND NONRADIOLOGICAL CANCER RISKS
ESTIMATE NONCANCER HAZARD QUOTIENTS
COMPUTE RADIATION DOSE TO COMPARE WITH RADIATION PROTECTION STANDARDS AND CRITERIA
EVALUATE UNCERTAINTY
SUMMARIZE RISK INFORMATION
REVISION NO. 0
FILE NAME 40103\F01-801.DWG
DATE 4/29/92
DRAWN BY JAA
APPROVED BY
CHECKED BY
PREPARED FOR
U.S. DEPARTMENT OF ENERGY
ROCKY FLATS PLANT
GOLDEN, COLORADO
FIGURE 8-2
HUMAN HEALTH RISK ASSESSMENT


SITE SPECIFIC CHEMICAL ANALYSIS LIST
NO
DETECTION FREQUENCY > 5%?
YES
NO
CONCENTRATION STATISTICALLY GREATER THAN BACKGROUND?
YES
GROUP A, B, C CARCINOGEN?
YES
NO
NO
CONCENTRATION > ONE-TENTH HEALTH/ ENVIRONMENTAL CRITERIA?
YES
DETECTED IN "HOT SPOTS?"
YES
NO
DELETE FROM FURTHER CONSIDERATION
YES
ESSENTIAL NUTRIENT?
NO
ADD TO LIST OF CONTAMINANTS OF CONCERN
REVISION NO. 0
FILE NAME 40103\F01-802.DWG
DATE 4/28/92
DRAWN BY JAA
APPROVED BY
CHECKED BY
PREPARED FOR
U.S. DEPARTMENT OF ENERGY
ROCKY FLATS PLANT
GOLDEN, COLORADO
FIGURE 8-3
PROTOCOL FOR IDENTIFICATION OF CONTAMINANTS OF CONCERN FLOW CHART

9.0 ENVIRONMENTAL EVALUATION WORK PLAN

9.1 INTRODUCTION

OU8 lies entirely within the production area at RFP in areas surrounding the building complexes 300 and 700. This area has been developed to such an extent that there are no viable ecosystems or natural habitats. There are insufficient ecosystems, components, or functions existing on OU8 to require or allow a comprehensive ecological risk assessment. OU8 overlaps with several other plant site OUs and is largely included within the OU9 ecological study area, which extends throughout most of the production area. The OU9 Environmental Evaluation (EE) Work Plan provides for an ecological risk evaluation of the production area focused on requirements appropriate for the depauperate ecosystems that exist there. The objective of the OU8 EE is to address and characterize any potential for adverse impacts to ecosystems or ecological resources present or at other locations and then to determine if there is a risk of contamination via abiotic or biotic transport.

Coordination of OU8 EE requirements with the OU9 EE is required due to the overlapping study areas. Habitat and biological surveys proposed for OU9 will cover the entire industrial area, and as a result will apply to OU8. Following is a brief description of the study components proposed for OU9 and how these studies relate to the OU8 EE. This description is based on the final EE technical memorandum for OU9 dated June 1992 that has been submitted for agency review. Due to the extensive overlap of OU9 and OU8, all work related to the EE for OU8 is expected will be conducted as part of the OU9 Work Plan. However, should the OU8 Work Plan be implemented prior to OU9, the EE described in OU9 will then be implemented as part of the OU8 activities.

9.2 BIOLOGICAL AND HABITAT SITE CHARACTERIZATION

Biota and habitat surveys proposed for OU9 will be adequate for the biological and habitat characterization of OU8 and will not be duplicated or repeated. Based on OU9, potential target taxa including migratory birds are listed in Table 9.1. These surveys will provide the following information applicable to OU8:

- Comprehensive survey and mapping of types and extent of habitats, particularly habitats that could support migratory birds;
- Presence and/or use of habitats by raptors and migratory birds, including waterfowl and passerine species;
- Presence or absence of threatened and endangered species, or species of special concern; and
- Data on small and large mammal or bird population dynamics, if present.

This characterization will include a literature review, expert consultation, and field surveys for 1) vegetation, 2) species of special concern, 3) small and large mammals, and 4) birds. Soil series will not be mapped because of the heavily disturbed nature of the soil surface within OU8. This information will be included in the following three reports:

- Habitat survey report for compliance with acts for protection of migratory birds;
- Biological survey report for compliance with acts and regulations protecting threatened and endangered species; and
- Reporting of results of small and large mammals and bird surveys.

9.3 ECOTOXICOLOGICAL INVESTIGATIONS

Details of the Ecotoxicological Investigation approach and its schedule to initiate and complete it within an entire EE for a one-phase RFI/RI are described in the final technical memoranda

for OU9 dated June, 1992. The ecotoxicological work will be completed after surficial soils, sediments, and surface water samples are collected and the analytical data evaluated. Ecotoxicological investigations will be conducted if the following conditions are present on OU8:

- If target taxa are present on the study area and could accumulate or concentrate target analytes; and either
- The contaminated target taxa are capable of migration outside the OU8 study boundaries; or
- The contaminated target taxa are highly mobile and actually move outside the study or industrial area boundaries.

If the above conditions are not met, then it is presumed that there is no risk of contamination of offsite biota from OU8.

If an ecotoxicological investigation is necessary, it would consist of the following procedures:

- Developing a site-specific Conceptual Exposure Model to identify potential pathways for exposure of onsite biota;
- Developing a Conceptual Biota Transport model to identify potential pathways for offsite transport;
- Selection of target taxa and target analytes (biologically active COCs); and
- Direct measurement of target analytes within target taxa.

A Technical Memorandum will be prepared and submitted for EPA and CDH review and approval and U.S. Fish and Wildlife Surface and Colorado Department of Wildlife review prior to initiating any work.

The procedures for conducting this type of investigation for the industrial area are presently under development for OU9 and would be adapted, if needed, for the highly disturbed study area in OU8.

This information would be used to assess the ecological risk posed by contaminant migration by biological pathways. Information on contaminant migration by target taxa to other OUs will be provided to those OU managers for use in conducting their EEs for identifying ecological risks. This would be a quantitative estimate with the appropriate uncertainty analysis for model assumptions and estimates of parameters. This information would also be coordinated with contaminant migration by physical or abiotic media developed during the site characterization and transport models.

9.4 ENVIRONMENTAL EVALUATION REPORT

The EE portion of the BRA in the Phase I RFI/RI report will consist of the habitat survey, biological survey and small mammal and bird survey reports discussed in Section 9.2. If an ecotoxicological investigation is conducted in Phase I, the results could be included in the EE portion of the BRA in the Phase I RFI/RI report.

TABLE 9.1

POTENTIAL TARGET TAXA FOR ASSESSMENT OF ECOLOGICAL IMPACTS AT OU9

Category	Taxon
Mammals	Deer mouse
	House mouse
	Cottontail
Terrestrial invertebrates	Earthworms
	Arthropods
Grasses/forbs	Smooth brome
	Crested wheatgrass
	Cheatgrass
	Weeds species
Microbial Populations	Entire population

10.0 QUALITY ASSURANCE/QUALITY CONTROL PROCEDURES AND ADDENDUM

All work conducted in support of OU8 Phase I RFI/RI activities will be directed by the EG&G Environmental Management Department Quality Assurance Project Plan for CERCLA Remedial Investigation/Feasibility Studies and RCRA Facilities Investigation/Corrective Measures Study Activities (QAPjP). The QAPjP complies with the requirements of EPA QAMS-005/80 and DOE Order 5700.6B which addresses NQA-1.

The QAPjP will be supplemented by a Quality Assurance Addendum (QAA) specific to OU8 and provided to ASI by EG&G for inclusion in the Work Plan after EG&G completes its review of a draft iteration of this Work Plan. The QAA will establish the specific Quality Assurance (QA) controls applicable to the field investigation activities described in the Plan.

The QAA provided by EG&G that will guide the activities presented in this Work Plan are presented on the following pages in this section.

Approved by:

	/ /		/ /
Manager, Remediation Programs		RFI Project Manager	

10.1 QUALITY ASSURANCE ADDENDUM

This section consists of the Quality Assurance Addendum (QAA) for Phase I investigations at Operable Unit No. 8 (OU8), which supplements the "Rocky Flats Plant Site-Wide Quality Assurance Project Plan for CERCLA Remedial Investigation/Feasibility Studies and RCRA Facility Investigations/Corrective Measures Studies Activities" (QAPjP). This QAA establishes the site-specific Quality Assurance (QA) controls applicable to the investigation activities described in the OU8 Work Plan (OU8 WP).

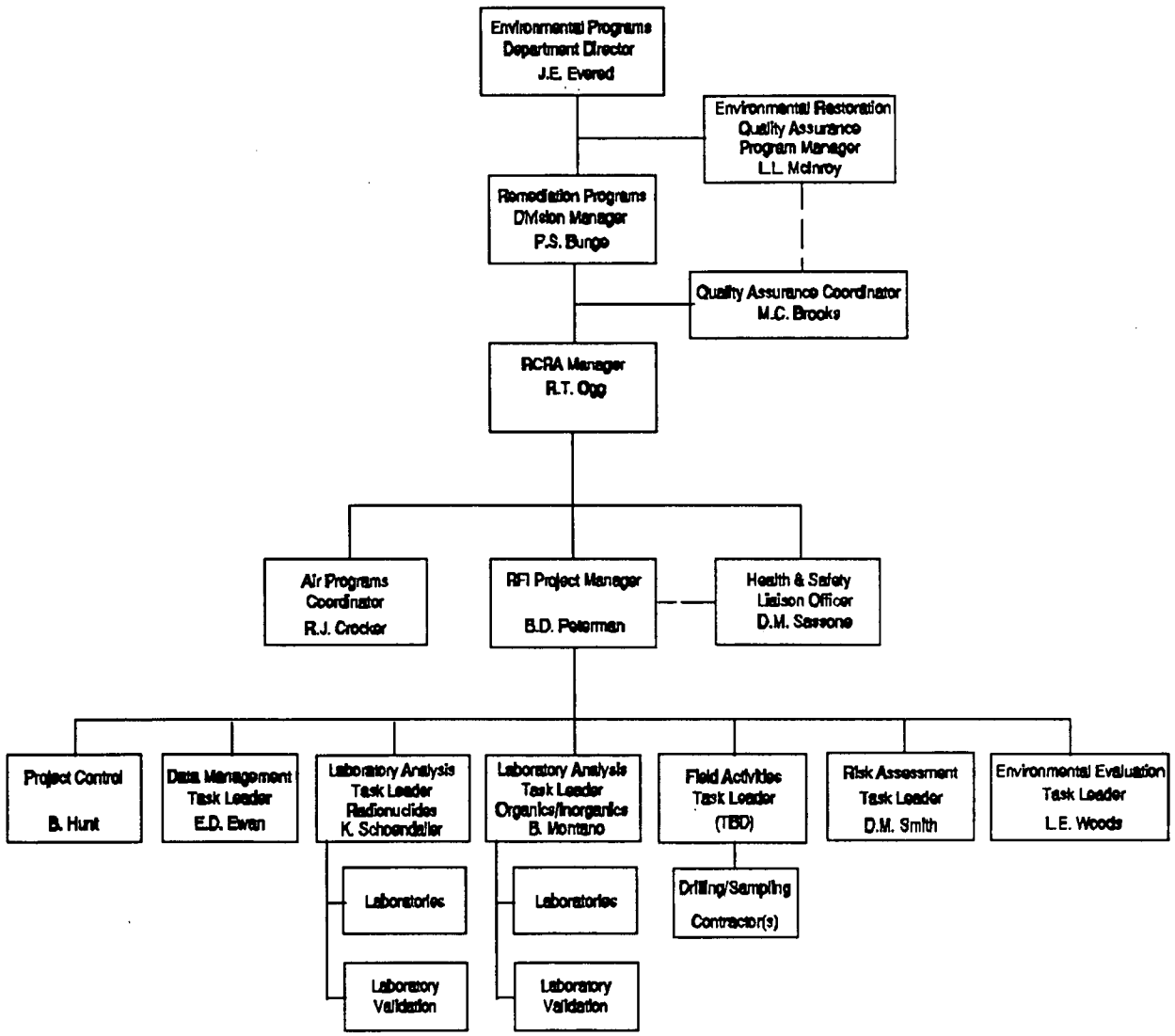
OU8 is one of 16 operable units (OUs) identified for investigations under the Rocky Flats Plant (RFP) Interagency Agreement (IAG). OU8 contains 38 individual hazardous substance sites (IHSSs), which are described in Section 2.4 of the OU8 WP. Section 2.5 describes the nature and extent of contamination at the IHSSs within OU8. The OU8 WP was prepared in accordance with EPA/530/SW-89-031, RCRA Facility Investigation (RFI) Guidance (May 1989), EPA/540/8-89/004, Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (October 1988), and the IAG.

10.1.1 ORGANIZATION AND RESPONSIBILITIES

The overall organization of EG&G Rocky Flats and the Environmental Management Department (EMD) and divisions involved in Environmental Restoration (ER) Program activities is shown in Figures 1-1, 1-2, and 1-3 of Section 1.0 of the QAPjP. Individual responsibilities are also described in Section 1.0 of the (QAPjP).

Contractors will be tasked by EG&G Rocky Flats to implement the field activities outlined in the OU8 WP. The specific EMD personnel who will interface with the Contractors and who will provide technical direction are shown in Figure 10-1.

FIGURE 10-1. PROJECT MANAGEMENT FOR OPERABLE UNIT 8 700 AREA, PHASE I RFI/RI



10.1.2 QUALITY ASSURANCE PROGRAM

The QAPjP was written to address QA controls and requirements for implementing IAG-related activities. The content of the QAPjP was driven by Department of Energy (DOE) RFP Standard Operating Procedure (SOP) 5700.6B, which requires a QA program to be implemented for all RFP activities based on American Society of Mechanical Engineers (ASME) NQA-1, "Quality Assurance Requirements for Nuclear Facilities," as wall as the IAG, which specifies that a QAPjP for IAG-related activities be developed in accordance with EPA/QAMS-005/80, "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans." The 18-element format of NQA-1 was selected as the basis for both the QAPjP and subsequent QAAs with the applicable elements of QAMS-005/80 incorporated where appropriate. Figure 2-1 of the QAPjP illustrates where the 16 QA elements of QAMS-005/80 are integrated into the QAPjP and also into this QAA. Section 2.0 of the QAPjP also identifies other DOE Orders and QA requirements documents to which the QAPjP and this QAA are responsive.

The controls and requirements addressed in the QAPjP are applicable to OU8 Phase I activities, unless specified otherwise in this QAA. Where site-wide actions are applicable to OU8 activities, the applicable section of the QAPjP is referenced in this QAA. This QAA addresses additional and site-specific QA controls and requirements that are applicable to OU8 Phase I activities that may not have been addressed on a site-wide basis in the QAPjP. Many of the QA requirements specific to OU8 are addressed within other section of the OU8 WP and are referenced in this QAA.

10.1.2.1 Training

Personnel qualification and training requirements for RFP ER Program activities are addressed in Section 2.0 of the QAPjP. Personnel qualifications and training required to perform the EMD Operating Procedures (OPS) and Environmental Management Radiological Guidelines (EMRGs)

that are applicable to OU8 investigations are specified within the respective procedures. The EMD OPS (which may also be referred to as EM Standard Operating Procedures [SOPs] in the QAPjP and the OU8 WP) and EMRGs that are applicable to Phase I activities at OU8 are identified in Table 10.1.

TABLE 10.1

EMD Operating Procedures and Field Activities for Which they are Applicable

Former SOP Reference Numbers	EMAD OPS Reference Numbers	Standard Operating Procedures	Field Radiation Surveys	Well Drilling	Completion, Development	Ground-Water Sampling	Soil Gas Surveys	Surface Soil and Soil Scrape Sampling	Subsurface Soil Sampling
1.1	FO.01	Wind Blown Contaminant Dispersion Control						●	
1.2	FO.02	Field Document Control	●	●	●	●	●	●	●
1.3	FO.03	General Equipment Decontamination	●	●	●	●	●	●	●
1.4	FO.04	Heavy Equipment Decontamination		●	●	●		●	●
1.5	FO.05	Handling of Purge and Development Water		●	●	●			
1.6	FO.06	Handling of Personal Protective Equipment	●	●	●	●	●	●	●
1.7	FO.07	Handling of Decontamination Water & Wash Water	●	●	●	●	●	●	●
1.8	FO.08	Handling of Drilling Fluids & Cuttings		●					●
1.9	FO.09	Handling of Residual Samples						●	●
1.10	FO.10	Receiving, Labeling, and Handling Waste Containers		●	●	●			●
1.11	FO.11	Field Communications	●	●	●	●	●	●	●
1.12	FO.12	Decontamination Facility Operations	●	●	●	●	●	●	●
1.13	FO.13	Containerizing, Preserving, Handling, and Shipping of Soil and Water Samples			●	●	●	●	●
1.14	FO.14	Field Data Management	●	●	●	●	●	●	●
1.15	FO.15	Use of PIDs and FIDs		X	X	X	X	X	X
1.16	FO.16	Field Radiological Measurements a) Walk-Over Surveys	●	X	X	X	X	X	X
New	FO.18	Environmental Sample Radioactivity Content Screening			●	●		●	●
2.1	GW.01	Water Level Measurements in Wells and Piezometers		●	●	●			
2.2	GW.02	Well Development		●					
2.5	GW.03	Measurements for Groundwater Field Parameters				●			
2.6	GW.04	Groundwater Sampling				●			

X-As required by H&S plan.

TABLE 10.1 - (Continued)
EMD Operating Procedures and Field Activities
for Which they are Applicable

Former SOP Reference Numbers	EMAD OPS Reference Numbers	Standard Operating Procedures	Field Radiation Surveys	Well Drilling	Completion, Development	Ground-Water Sampling	Soil Gas Surveys	Surface Soil and Soil Scrape Sampling	Subsurface Soil Sampling
3.1	GT.01	Logging Alluvial and Bedrock Material		●					●
3.2	GT.02	Drilling and Sampling Using Hollow-Stem Auger Techniques		●					●
3.3	GT.03	Isolating Bedrock from the Alluvium with Surface Casing		●					●
3.5	GT.05	Plugging and Abandonment of Boreholes		●					●
3.6	GT.06	Monitoring Well and Piezometer Installation		●					
3.8	GT.08	Surface Soil Sampling						●	
3.9	GT.09	Soil Gas Sampling and Field Analysis							
3.10	GT.10	Borehole Clearing		●					●
New	GT.15	Geophysical Borehole Logging		●					●
New	GT.17	Land Surveying		●					●
New	GT.19	Field Gas Chromatographs					●		
New	GT.22	BAT In-Situ Sampler (Proposed)				●			
EMRG OPS Reference No.									
1.1		Gamma Radiation Surveys	●						
1.2		Beta Radiation Surveys	●						
3.2		Survey Requirements for Conditional and Unrestricted Use	●						

10.1.2.2 Quality Assurance Reports to Management

A QA summary report will be prepared annually or at the conclusion of these activities (whichever is more frequent) by the EMD Quality Assurance Project Manager (QAPM) or designee. This report will include a summary of field operation and laboratory inspections, surveillance, and audits and a report on data verification/validation results.

10.1.3 DESIGN CONTROL AND CONTROL OF SCIENTIFIC INVESTIGATIONS

10.1.3.1 Design Control

The OU8 WP describes the investigation activities that will be implemented during the Phase I characterization of the OU8 IHSSs. The OU8 WP identifies the objectives of the investigations; specifies the sampling, analysis, and data generation requirements; and identifies applicable operating procedures that will provide controls for the investigations. As such, the OU8 WP is considered the investigation control plan for OU8 Phase I RFI/RI activities.

10.1.3.2 Data Quality Objectives

The development of Data Quality Objectives (DQOs) for the OU8 Phase I investigations is presented in Section 5.2 of the OU8 WP. The DQOs for OU8 were established in accordance with 3-stage process described in EPA/540/G-87/003 (OSWER Directive 9355.0-7B), Data Quality Objectives for Remedial Response Activities, and Appendix A of the QAPjP.

Identifying data quality needs begins with defining investigation objectives and identifying data uses and the types of data to be collected. Phase 1 investigation objectives, data uses and data quality objectives (DQOs) for OU8 are defined in Section 5.2. Other factors that are necessary

in identifying data quality needs include selecting appropriate analytical levels, contaminants of concern, levels of concern, required detection limits, and critical samples. The analytical levels, contaminants of concern, levels of concern, and required detection limits are presented in Section 5 of the OU8 WP.

Data quality can be measured in terms of precision, accuracy, representativeness, comparability, and completeness (also referred to as PARCC parameters). Precision, accuracy, and completeness are quantitative measures of data quality, while representativeness and comparability are qualitative statements that express the degree to which sample data represent actual conditions and describe the confidence of one data set to another. These parameters are defined in Appendix A of the QAPjP. PARCC parameters will be determined for OU8 Phase I investigations as described previously in Section 5. PARCC parameter goals are established prior to initiating investigations in order to assist decision makers in determining if DQOs for measurement data have been met. The goals for precision and accuracy for the contaminants of concern identified in Table 5.2-4 are presented in Table 10.2. The goal for completeness is 100 percent with a minimum acceptable completeness of 90 percent for laboratory measurement data and 80 percent for field measurements.

Based on the data quality needs identified for OU8 Phase I investigations, the sampling and analytical options were evaluated. The sampling and analytical methods selected for OU8 Phase I investigations are listed in Table 5.2-4. The specific field analytical methods and the Standard EPA and EPA CLP laboratory methods are identified in Table 10.2.

10.1.3.3 Sampling Locations and Sampling Procedures

The sampling plan for OU8 is described in Section 6 of the OU8 WP. Sampling activities will be staged, with the initial stages providing information that will be used to direct and refine

sampling methods and location in subsequent stages. The field sampling plan for OU8 is summarized in Table 6.1.

The operating procedures that are applicable to OU8 Phase I field activities and the particular activities to which they are applicable are summarized in Table 10.1.

10.1.3.4 Analytical Procedures

The analytical program for OU8 Phase I RFI/RI investigation is discussed in Section 6.5.6. The analytes of interest and the specified detection limits for radiation surveys, surface scrape radiochemistry, soil gas sampling, subsurface (borehole) soil sampling, shallow soil sampling, alluvial groundwater sampling, asphalt sampling, and surface wipe sampling for each IHSS are identified in Table 6.3. The analytical methods that shall be adhered to are those that are specified in the EG&G Rocky Flats General Radiochemistry and Routine Analytical Services Protocol (GRRASP), Parts A and B. These methods are referenced in Section 3.0 of the QAPjP. Specific analytical methods for each analyte identified in Table 6.3 are referenced in Table 10.2.

10.1.3.5 Equipment Decontamination

Non-dedicated sampling equipment (i.e., sampling equipment that is used at more than one location) shall be decontaminated between sampling locations in accordance with OPS-FO.03, General Equipment Decontamination. Other equipment (e.g., heavy equipment) potentially contaminated during drilling, boring, well installation, sample collection, etc. shall be decontaminated as specified in OPS-FO.04, Heavy Equipment Decontamination.

10.3.6 Air Quality

Air monitoring will be conducted during implementation of field activities that have the potential to create windblown dispersion of contaminants, including drilling, coring, and installation of boreholes and monitoring wells. Air monitoring will ensure that OU8 RFI/RI activities comply with the RFP Interim Plan for Prevention of Contaminant Dispersion. Air monitoring will be conducted according to OPS-FO.01, Wind Blown Contaminant Dispersion Control.

10.1.3.7 Quality Control

To ensure the quality of the field sampling techniques, collection and/or preparation of field quality control (QC) samples are incorporated into the sampling scheme. Field QC samples and collection frequencies for OU8 are addressed in Section 6.5.4 and are identified in Table 6.4. A specific sampling schedule will be prepared by the sampling subcontractor for approval by the EG&G Laboratory Analysis Task Leader (Figure 10-1) prior to sampling.

Objectives for Field QC Samples:

Equipment rinsate blanks are considered acceptable (with no need for data qualification) if the concentration of analytes of interest is less than three times the required detection limit for each analyte as specified in Table 5.3. Equipment rinsate blanks may only be analyzed if contaminants of concern are detected above background in samples. Field duplicate samples shall agree within 30 percent relative percent difference for aqueous samples and 40 percent for homogenous, non-aqueous samples.

Trip blanks and field preservation blanks (for organics and inorganics, respectively) indicate possible field contamination when analytes are detected above the minimum detection limits presented in Table 5.3. The Laboratory Analysis Task Leader (Figure 10-1) is responsible for

verifying these criteria and shall be responsible for checking to see if they are met and for qualifying data.

Laboratory QC

Laboratory QC procedures are used to provide measures of internal consistency of analytical and storage procedures. The laboratory contractor will submit written SOPs to the Laboratory Analysis Task Leader for approval. The interlaboratory SOPs shall be consistent with or equivalent to EPA-CLP QC procedures. The laboratory SOPs must cover the following areas in sufficient detail and reflect actual operating conditions in effect during analysis of EG&G RFP samples:

- Sample receipt and log-in
- Sample storage and security
- Facility security
- Sample tracking (from receipt to sample disposition)
- Sample analysis method references
- Data reduction, verification, and reporting
- Document control (including submitting documents to EG&G)
- Data package assembly (see Section III.A of the GRRASP)
- Qualifications of personnel
- Preparation of standards
- Equipment maintenance and calibration
- List of instrumentation and equipment (including date purchased, date installed, model number, manufacturer, and service contracts, if any)
- Instrument detection limits
- Acceptance criteria for non-CLP analyses
- Laboratory QC checks applicable to each analytical method

Laboratory QC techniques to ensure consistency and validity of analytical results (including detecting potential laboratory contamination of samples) include using reagent blanks, field blanks, internal standard reference materials, laboratory replicate analysis, and field duplicates. The laboratory contractor will follow the standard evaluation guidelines and QC procedures, including frequency of QC checks, that are applicable to the particular type of analytical method being used as specified in Parts A and B of the GRRASP and Section 3.0 of the QAPjP. All data packages will be forwarded to the Laboratory Analysis Task Leader or validation contractor (Figure 10-1) for review and verification.

10.1.3.8 Quality Assurance Monitoring

To assure the overall quality of the RFI/RI activities discussed in the OU8 WP, field inspections will be conducted daily and audits and surveillance will be conducted at various intervals. The intervals will be determined by the importance and complexity of each activity. Intervals will also be based on the schedule contained in Section 7.0. At a minimum, each of the field sampling activities described in Sections 6.4 will be monitored by an independent surveillance team at least once during the sampling process. EG&G will conduct audits of the laboratory contractor(s) as specified in the GRRASP, Parts A and B. The audits and surveillance, and activity Readiness Reviews are discussed further in Section 6.6.18.

10.1.3.9 Data Reduction, Validation, and Reporting

Analytical Reporting Turnaround Times

Analytical reporting turnaround times are as specified in Table 3-1 of Section 3.0 of the QAPjP.

Data Reduction

Reduction of laboratory measurements shall be in accordance with the methods specified for each analytical method. Laboratory data will be compiled into sample data packages by the laboratory contractor. A sample data package shall be developed for each sample delivery group or sample batch, with separate data packages for each type of analysis (e.g., a data package for organics, one for inorganics, one for water quality parameters, and one for radionuclides). The sample data package shall consist of a cover sheet/transmittal letter, a case narrative, data summary forms, and copies of the data checklists found in Attachments I in Parts A and B of the GRRASP. The reduced data will be used in the data validation process to verify that the laboratory control and the overall system DQOs have been met.

Data Validation

Validation activities consist of reviewing and verifying field and laboratory data and evaluating these verified data for data quality (i.e., comparison of reduced data to DQOs, where appropriate). The field and laboratory data validation activities and guidelines are described and referenced in Section 3.0 of the QAPjP. The process for validating the quality of the data is illustrated graphically in Figure 3-1 of Section 3.0 of the QAPjP, and is also included as part of the sample collection, chain-of-custody, and analysis process illustrated in Figure 8-1 of Section 8.0 of the QAPjP. The criteria for determining the validity of ER data at Rocky Flats are described in subsection 3.3.7 of Section 3.0 of the QAPjP.

Data Reporting

Depending on the data validation process, data are flagged as either "valid," "acceptable with qualifications," or "rejected." The results of the data validation shall be reported in ER Department Data Assessment Summary reports. The usability of data (the criteria of which is

also described in subsection 3.3.7 of Section 3.0 of the QAPjP) shall also be addressed by the RFI Project Manager.

10.1.4 PROCUREMENT DOCUMENT CONTROL

Procurement documents for items and services, including services for conducting field investigations and analytical laboratories, shall be prepared, handled, and controlled in accordance with the requirements and methods specified in Section 4.0 of the QAPjP.

10.1.5 INSTRUCTIONS, PROCEDURES, AND DRAWINGS

The OU8 WP describes the activities to be performed. The OU8 WP will be reviewed and approved in accordance with the requirements for instructions, procedures, and drawings outlined in Section 5.0 of the QAPjP.

EMD OPS approved for use are identified in Table 10.1, which also indicates their applicability. Any additional quality-affecting procedures proposed for use but not identified in Table 10.1 will be developed and approved as required by Section 5.0 of the QAPjP prior to performing the affected activity.

Changes and variances to approved operating procedures shall be documented through preparation of Document Change Notices (DCNs), which will be prepared, reviewed, and approved in accordance with requirements specified in Section 5.0 of the QAPjP. (Note: DCNs were referred to as Procedure Change Notices in Revision 0 of the QAPjP). Any changes, revisions, additions, or deletions to the OU8 WP will be presented in either DCNs or Technical Memoranda. DCNs and Technical Memoranda will be reviewed and approved by the same organizations that reviewed and approved the original OU8 WP.

10.1.6 DOCUMENT CONTROL

The following documents will be controlled in accordance with Section 6.0 of the QAPjP:

- "Phase I RFI/RI Work Plan for the 700 Area, Operable Unit No. 8"
- "Rocky Flats Plant Site-Wide Quality Assurance Project Plan for CERCLA Remedial Investigation/Feasibility Studies and RCRA Facility Investigations/Corrective Measures Studies Activities" (QAPjP)
- Quality Assurance Addendum (QAA) to the Rocky Flats Site-Wide QAPjP for Operable Unit No. 8, 700 Area, Phase I RFI/RI Activities
- EMD Operating Procedures and EM Radiological Guidelines (all operating procedures specified in this QAA and to-be-developed laboratory SOPs).

10.1.7 CONTROL OF PURCHASED ITEMS AND SERVICES

Contractors that provide services to support the OU8 WP activities will be selected and evaluated as outlined in Section 7.0 of the QAPjP. This includes preaward evaluation/audit of proposed contractors as well as periodic audit of the acceptability of contractor performance during the life of the contract. Any items or materials that are purchased for use during the OU8 investigations that have the ability to affect the quality of the data shall be inspected upon receipt.

10.1.8 IDENTIFICATION AND CONTROL OF ITEMS, SAMPLES, AND DATA

10.1.8.1 Sample Containers/Preservation

Appropriate volumes, containers, preservation requirements, and holding times for water and soil samples are presented in Table 6.3.

10.1.8.2 Sample Identification

RFI/RI samples shall be labeled and identified in accordance with Section 8.0 of the QAPjP and OPS-FO.13, Containerizing, Preserving, Handling, and Shipping of Soil and Water Samples. Samples shall have unique identification that traces the sample to the source(s) and indicates the method(s), date, the sampler(s), and conditions prevailing at the time of sampling.

10.1.8.3 Chain-of-Custody

Sample chain-of-custody will be maintained through the application of OPS-FO.13, Containerizing, Preserving, Handling, and Shipping of Soil and Water Samples, and as illustrated in Figure 8-1 of the QAPjP for all environmental samples collected during field investigations.

10.1.9 CONTROL OF PROCESSES

The overall process of collecting samples, performing analysis, and inputting the data into a database is considered a process that requires control. The process is controlled through a series of written procedures that govern and document the work activities. A process diagram is shown in Section 8.0 of the QAPjP.

10.1.10 INSPECTION

Procured materials and construction activities (e.g., groundwater monitoring well installation) shall be inspected in accordance with the requirements specified in Section 10.0 of the QAPjP.

10.1.11 TEST CONTROL

Test control requirements specified in Section 11.0 of the QAPjP are not applicable to any of the RFI/RI investigations described in the OU8 WP.

10.1.12 CONTROL OF MEASURING AND TEST EQUIPMENT (M&TE)

10.1.12.1 Field Equipment

Specific conductivity, temperature, and pH of groundwater samples shall be measured in the field. Field measurements will be taken and the instruments calibrated as specified in OPS-GW.05, Field Measurements for Groundwater Field Parameters. Measurements shall be made using the following equipment (or EG&G-approved alternatives):

- Temperature: mercury-filled, teflon-coated, safety-type thermometer (VWR catalogue No. 6107-832 or equivalent), or digital readout thermistor (VWR Catalogue No. 61017-562 or equivalent)
- Specific Conductivity: HACH 44600 Conductivity/TDS Meter
- pH: HACH One pH Meter (this meter may also be used for temperature measurements)

In addition to the field measurements for water quality, field measurements for radiation and soil gas will also be made. The following instruments will be used for these measurements.

- Radiological field readings for field survey grid locations. Beta/Gamma radiation will be measured with a Geiger-Muller shielded pancake detector, and Alpha radiation will be measured by a side shielded FIDLER. Use, calibration, and maintenance shall be according to EMRG OPS-1.1, 1.2 and 3.2. Walk-over radiation screenings shall also be performed for worker health and safety using a side shielded FIDLER according to OPS-FO.16, Field Radiological Measurements.

- Field readings for soil gas will be taken using a portable photoionization detector (PID), HNU Systems P1-101 or equivalent. Use, calibration, and maintenance according to OPS-FO.15, Photoionization Detectors (PIDs) and Flame Ionization Detectors (FIDs).

Each piece of field equipment shall have a file that contains:

- Specific model and instrument serial number
- Operating instructions
- Routine preventative maintenance procedures, including a list of critical spare parts to be provided or available in the field
- Calibration methods, frequency, and description of the calibration solutions
- Standardization procedures (traceability to nationally recognized standards).

The above information shall, in general, conform to the manufacturer's recommended operating instructions or shall explain the deviation from said instructions.

10.1.12.2 Laboratory Equipment

Laboratory analyses will be performed by contracted laboratories. The equipment used to analyze environmental samples shall be calibrated, maintained, and controlled in accordance with the

requirements contained in the specific analytical protocols used as specified in the GRRASP. This information will be supplied to EG&G as a laboratory SOP.

10.1.13 HANDLING, STORAGE, AND SHIPPING

Samples shall be packaged, transported, and stored in accordance with OPS-FO.13, Containerizing, Preserving, Handling, and Shipping of Soil and Water Samples. Maximum sample holding times, sample preservative, sample volumes, and sample containers are specified in Table 8-1 of Section 8.0 of the QAPjP. Sample handling and storage controls at the laboratory shall be provided as a laboratory SOP.

10.1.14 STATUS OF INSPECTION, TEST, AND OPERATIONS

The requirements for the identification of inspection, test, and operating status shall be implemented as specified in Section 14.0 of the QAPjP. A log specifying the status of all boreholes and groundwater monitoring wells shall be maintained by the Field Activities Task Leader, which will include well/borehole identification number, ground elevation, casing depth of hole, depth to bedrock, static water level (as applicable), depth to top and bottom of screen (as applicable), diameter of hole, diameter of casing, and top/bottom of casing.

10.1.15 CONTROL OF NONCONFORMANCES

The requirements for the identification, control, evaluation, and disposition of nonconforming items, samples, and data will be implemented as specified in Section 15.0 of the QAPjP. Nonconformances identified by the implementing contractor shall be submitted to EG&G for processing as outlined in the QAPjP.

10.1.16 CORRECTIVE ACTION

The requirements for the identification, documentation, and verification of corrective actions for conditions adverse to quality will be implemented as outlined in Section 16.0 of the QAPjP. Conditions adverse to quality identified by the implementing contractor shall be documented and submitted to EG&G for processing as outlined in the QAPjP.

10.1.17 QUALITY ASSURANCE RECORDS

QA records will be controlled in accordance with OPS-FO.02, Field Document Control. QA records to be generated during OU8 RFI/RI activities include, but are not limited to:

- Field Logs and Data Record Forms (e.g., sample collection notebooks/logs for groundwater, sediment, and air)
- Calibration Records
- Sample Collection and Chain-of-Custody Records
- Laboratory Sample Data Packages
- Drilling Logs
- Work Plan/Field Sampling Plan
- QAPjP/QAA
- Audit/Surveillance/Inspection Reports
- Nonconformance Reports
- Corrective Action Documentation
- Data Validation Results
- Data Reports
- Procurement/Contracting Documentation
- Training/Qualification Records
- Inspection Records

10.1.18 QUALITY VERIFICATION

The requirements for the verification of quality shall be implemented as specified in Section 18.0 of the QAPjP. EG&G will conduct audits of the laboratory contractor as specified in the GRRASP, Parts A and B. The EMD QAPM shall develop a surveillance schedule with the surveillance intervals based on the importance and complexity of each sampling/analytical activity. Intervals will also be based on the schedule contained in Section 7.0.

Examples of some specific tasks that will be monitored by the surveillance program are as follows:

- Borings and well installations (approximately 10 percent of the holes)
- Field sampling (approximately 5 percent of each type of sample collected)
- Records management (a surveillance will be conducted once at the initiation of OU8 activities, and monthly thereafter)
- Data verification, validation, and reporting

Audits of contractors providing field investigation, construction, and analytical support services shall be performed at least annually or once during the life of the project, whichever is more frequent.

A Readiness Review shall be conducted by the EMD QAPM prior to the implementation of OU8 field investigation activities. The readiness review will determine if all activity prerequisites that are required to begin work have been met. The applicable requirements of the QAPjP and this QAA will be addressed during the readiness review.

10.1.19 SOFTWARE CONTROL

The requirements for the control of software shall be implemented as specified in Section 19.0 of the QAPjP. Only database software is anticipated to be used for the OU8 WP activities. Operating procedures applicable to the use of the database storing environmental data can be found in OPS-FO.14, Field Data Management.

TABLE 10.2
ANALYTICAL METHODS, DETECTION LIMITS, AND DATA QUALITY OBJECTIVES

Analyte	Method	GW	SOIL	Required Detection Limits Water	Required Detection Limits Soil	Precision Objective	Accuracy Objective
INDICATORS							
Total Organic Carbon	EPA 415[d] ASTM D4129-82	X[b]	X	5 mg/L		20%RPD[f]	80-120% LCS Recovery
INORGANICS							
Target Analyte List - Metals		X[f]	X			WATER/SOIL	WATER/SOIL
Aluminum	EPA CLP SOW[a]			200 ug/L[d]	40 mg/Kg[d]	**	***
Antimony	EPA CLP SOW[a]			60	12		
Arsenic (GFAA)	EPA CLP SOW[a]			10	2		
Barium	EPA CLP SOW[a]			200	40		
Beryllium	EPA CLP SOW[a]			5	1.0		
Cadmium	EPA CLP SOW[a]			5	1.0		
Calcium	EPA CLP SOW[a]			5000	2000		
Chromium	EPA CLP SOW[a]			10	2.0		
Cobalt	EPA CLP SOW[a]			50	10		
Copper	EPA CLP SOW[a]			25	5.0		
Cyanide	EPA 335.3 (modified for CLP)[a,d]			5	10		
Iron	EPA CLP SOW[a]			100	20		
Lead (GFAA)	EPA CLP SOW[a]			3	1.0		
Magnesium	EPA CLP SOW[a]			5000	2000		
Manganese	EPA CLP SOW[a]			15	3.0		
Mercury (CVAA)	EPA CLP SOW[a]			0.2	0.2		
Nickel	EPA CLP SOW[a]			40	8.0		
Potassium	EPA CLP SOW[a]			5000	2000		
Selenium (GFAA)	EPA CLP SOW[a]			5	1.0		
Silver	EPA CLP SOW[a]			10	2.0		
Sodium	EPA CLP SOW[a]			5000	2000		
Thallium (GFAA)	EPA CLP SOW[a]			10	2.0		
Vanadium	EPA CLP SOW[a]			50	10		
Zinc	EPA CLP SOW[a]			20	4.0		

TABLE 10.2
ANALYTICAL METHODS, DETECTION LIMITS, AND DATA QUALITY OBJECTIVES

Analyte	Method	GW	SOIL	Required Detection Limits Water	Required Detection Limits Soil	Precision Objective	Accuracy Objective
ANIONS						Water/Soil	Water/Soil
Sulfate	EPA 375.4[d]		X				
Nitrate as N	EPA 353.2[d] or 353.3[d]	X[o]	X	1 mg/L		Same as Metals	Same as Metals
Fluoride	(TBD)		X				
Target Compound List - Volatiles		X[o]	X			WATER/SOIL	WATER/SOIL
Chloromethane	EPA CLP SOW[c]			10 ug/L	10 ug/Kg (low)[3]	**	***
Bromomethane	EPA CLP SOW[c]			10	10		
Vinyl Chloride	EPA CLP SOW[c]			10	10		
Chloroethane	EPA CLP SOW[c]			10	10		
Methylene Chloride	EPA CLP SOW[c]			5	5		
Acetone	EPA CLP SOW[c]			10	10		
Carbon Disulfide	EPA CLP SOW[c]			5	5		
1,1-Dichloroethene	EPA CLP SOW[c]			5	5		
1,1-Dichororethane	EPA CLP SOW[c]			5	5		
total 1,2-Dichloroethene	EPA CLP SOW[c]			5	5		
Chloroform	EPA CLP SOW[c]			5	5		
1,2-Dichloroethane	EPA CLP SOW[c]			1	5		
2-Butanone	EPA CLP SOW[c]			10	10		
1,1,1-Trichoroethane	EPA CLP SOW[c]			5	5		
Carbon Tetrachloride	EPA CLP SOW[c]			5	5		
Vinyl Acetate	EPA CLP SOW[c]			10	10		
Bromodichloromethane	EPA CLP SOW[c]			5	5		
1,2-Dichloropropane	EPA CLP SOW[c]			5	5		
cis-1,3-Dichloropropene	EPA CLP SOW[c]			5	5		
Trichloroethene	EPA CLP SOW[c]			5	5		
Dibromochloromethane	EPA CLP SOW[c]			5	5		
1,1,2-Trichloroethane	EPA CLP SOW[c]			5	5		
Benzene	EPA CLP SOW[c]			5	5		
trans-1,2-Dichloropropene	EPA CLP SOW[c]			5	5		
Bromoform	EPA CLP SOW[c]			5	5		
4-Methyl-2-pentanone	EPA CLP SOW[c]			10	10		
2-Hexanone	EPA CLP SOW[c]			10	10		
Tetrachloroethene	EPA CLP SOW[c]			5	5		
Toluene	EPA CLP SOW[c]			5 ug/L	5 ug/KG	**	***
1,1,2,2-Tetrachoroethane	EPA CLP SOW[c]			5	5		
Chlorobenzene	EPA CLP SOW[c]			5	5		
Ethyl Benzene	EPA CLP SOW[c]			5	5		
Styrene	EPA CLP SOW[c]			5	5		
Total Xylenes	EPA CLP SOW[c]			5	5		
Target Compound List - Semi-Volatiles			X			SOIL	SOIL
Phenol	EPA CLP SOW[c]				330 ug/Kg[3]	**	***
bis(2-Chloroethyl)ether	EPA CLP SOW[c]				330		
2-Chlorophenol	EPA CLP SOW[c]				330		
1,3-Dichlorobenzene	EPA CLP SOW[c]				330		
1,4-Dichlorobenzene	EPA CLP SOW[c]				330		
Benzyl Alcohol	EPA CLP SOW[c]				330		

TABLE 10.2
ANALYTICAL METHODS, DETECTION LIMITS, AND DATA QUALITY OBJECTIVES

Analyte	Method	GW	SOIL	Required Detection Limits Water	Required Detection Limits Soil	Precision Objective	Accuracy Objective
1,2-Dichlorobenzene	EPA CLP SOW[c]				330		
2-Methylphenol	EPA CLP SOW[c]				330		
bis(2-Chloroisopropyl)ether	EPA CLP SOW[c]				330		
4-Methylphenol	EPA CLP SOW[c]				330		
N-Nitroso-Dipropylamine	EPA CLP SOW[c]				330		
Hexachloroethane	EPA CLP SOW[c]				330		
Nitrobenzene	EPA CLP SOW[c]				330		
Isophorone	EPA CLP SOW[c]				330		
2-Nitrophenol	EPA CLP SOW[c]				330		
2,4-Dimethylphenol	EPA CLP SOW[c]				330		
Benzoic Acid	EPA CLP SOW[c]				1600		
bis(2-Choroethoxy)methane	EPA CLP SOW[c]				330		
2,4-Dichlorophenol	EPA CLP SOW[c]				330		
1,2,4-Trichlorobenzene	EPA CLP SOW[c]				330		
Naphthalene	EPA CLP SOW[c]				330		
4-Chloroanaline	EPA CLP SOW[c]				330		
Hexachlorobutadiene	EPA CLP SOW[c]				330		
4-Chloro-3-methylphenol	EPA CLP SOW[c]				330		
2-Methylnaphthalene	EPA CLP SOW[c]				330		
Hexachlorocyclopentadiene	EPA CLP SOW[c]				330		
2,4,6-Trichlorophenol	EPA CLP SOW[c]				330		
2,4,5-Trichlorophenol	EPA CLP SOW[c]				1600 ug/Kg[3]	**	***
2-Chloronaphthalene	EPA CLP SOW[c]				330		
2-Nitroanaline	EPA CLP SOW[c]				1600		
Dimethylphthalate	EPA CLP SOW[c]				330		
Acenaphthylene	EPA CLP SOW[c]				330		
2,6-Dinitrotoluene	EPA CLP SOW[c]				330		
3-Nitroaniline	EPA CLP SOW[c]				1600		
Acenaphthene	EPA CLP SOW[c]				330		
2,4-Dinitrophenol	EPA CLP SOW[c]				1600		
4-Nitrophenol	EPA CLP SOW[c]				1600		
Dibenzofuran	EPA CLP SOW[c]				330		
2,4-Dinitrotoluene	EPA CLP SOW[c]				330		
Diethylphthalate	EPA CLP SOW[c]				330		
4-Chlorophenol Phenyl ether	EPA CLP SOW[c]				330		
Fluorene	EPA CLP SOW[c]				330		
Target Compound List - Semi-Volatiles (continued)			X				
4-Nitroanaline	EPA CLP SOW[c]				1600 ug/Kg[3]	**	***
4,6-Dinitro-2-methylphenol	EPA CLP SOW[c]				1600		
N-nitrosodiphenylamine	EPA CLP SOW[c]				330		
4-Bromophenyl Phenyl ether	EPA CLP SOW[c]				330		
Hexachlorobenzene	EPA CLP SOW[c]				330		
Pentachlorophenol	EPA CLP SOW[c]				1600		
Phenanthrene	EPA CLP SOW[c]				330		
Anthracene	EPA CLP SOW[c]				330		
Di-n-butylphthalate	EPA CLP SOW[c]				330		
Fluoranthene	EPA CLP SOW[c]				330		
Pyrene	EPA CLP SOW[c]				330		
Butyl Benzylphthalate	EPA CLP SOW[c]				330		
3,3'-Dichlorobenzidine	EPA CLP SOW[c]				660		

TABLE 10.2
ANALYTICAL METHODS, DETECTION LIMITS, AND DATA QUALITY OBJECTIVES

Analyte	Method	GW	SOIL	Required Detection Limits Water	Required Detection Limits Soil	Precision Objective	Accuracy Objective
Benzo(a)anthracene	EPA CLP SOW[c]				330		
Chrysene	EPA CLP SOW[c]				330		
bis(2-ethylhexyl)phthalate	EPA CLP SOW[c]				330		
Di-n-octyl Phthalate	EPA CLP SOW[c]				330		
Benzo(b)fluoranthene	EPA CLP SOW[c]				330		
Benzo(k)fluoranthene	EPA CLP SOW[c]				330		
Benzo(a)pyrene	EPA CLP SOW[c]				330		
Indeno(1,2,3-cd)pyrene	EPA CLP SOW[c]				330		
Dibenz(a,h)anthracene	EPA CLP SOW[c]				330		
Benzo(g,h,i)perylene	EPA CLP SOW[c]				330		
RADIONUCLIDES						(Replicate Analyses) **	(Laboratory Control Sample) ***
Gross Alpha	s,f,g,h,i,k,l,m,n		X	NA	4 pCi/g		
Gross Beta	s,f,g,h,i,k,l,m,n		X	NA	10 pCi/g		
Uranium 233+234	f,h,i,m,n,s,l	X[r]	X	0.6 pCi/L	0.3 pCi/g		
Uranium 235,238	f,h,i,m,n,s,l		X	NA	0.3 pCi/g		
Americium 241	p,q,s,l,i		X	NA	0.02 pCi/g		
Plutonium 239+240	o,p,s,l,i	X[r]	X	0.01 pCi/L	0.03 pCi/g		
Tritium	f,g,h,m,s,i,l	X[o]	X	400 pCi/L	400 pCi/L		
Strontium 89,90	f,h,i,m,s,l		X	NA	1 pCi/g		
FIELD MEASUREMENTS							
1,1,1 Trichloroethane	EPA 502.2		X	5 ug/L	35% RPD		
Carbon tetrachloride	EPA 502.2		X	5 ug/L	35% RPD		
Methylethylketone	EPA 502.2		X	10 ug/L	35% RPD		
Dichloromethane	EPA 502.2		X	5 ug/L	35% RPD		
Perchloroethene	EPA 502.2		X	5 ug/L	35% RPD		
Trichloroethene	EPA 502.2		X	5 ug/L	35% RPD		
Benzene	EPA 502.2		X	5 ug/L			
Toluene	EPA 502.2		X	5 ug/L			
Xylene	EPA 502.2		X	5 ug/L			

TABLE 10.2
ANALYTICAL METHODS, DETECTION LIMITS, AND DATA QUALITY OBJECTIVES

Analyte	Method	GW	SOIL	Required Detection Limits Water	Required Detection Limits Soil	Precision Objective	Accuracy Objective
				Detection Limit	**Precision**	**Accuracy**	
FIELD PARAMETERS							
pH	1	X		0.1 pH unit	NA	0.2 pH units	
Specific Conductance	1	X		2.5 umho/cm[7]	NA	2.5% max. error at 500, 5000,	
				25 umho/cm[8]	NA	50000 umhos/cm plus probe;	
				250 umho/cm[9]	NA	3.0% max error at 250, 2500, and	
						25000 plus probe accuracy of 2.0%.	
Temperature	1	X		0.1 C	NA	1.0 C	
Beta/Gamma	Geiger Muller Detector		X	5,000 dpm/100cm²	± 20% Error	NA	
Alpha Radiation	FIDLER		X	300 dpm/100cm²	± 20% Error	NA	

TABLE 11.6
ANALYTICAL METHODS, DETECTION LIMITS, AND DATA QUALITY OBJECTIVES

** Precision objective = control limits specified in referenced method and/or Data Validation Guidelines.
*** Accuracy objective = control limits specified in referenced method (in GRRASP for radionuclides).
F = Filtered
U = Unfiltered

1. Measured in the field in accordance with instrument manufacturer's instructions. The instruments to be used are specified in Section 12.
2. Medium soil/sediment required detection limits for pesticide/PCB TCL compounds are 15 times the individual low soil/sediment required detection limit.
3. Detection limits listed for soil/sediment are based on wet weight. The detection limits calculated by the laboratory for soil/sediment, calculated on dry weight basis as required by the contract, will be higher.
4. Higher detection limits may only be used in the following circumstance: If the sample concentration exceeds five times the detection limit of the instrument or method in use, the value may be reported even though the instrument or method detection limit may not equal the required detection limit. This is illustrated in the example below:

   For lead:

   Method in use - ICP
   Instrument Detection Limit (IDL) - 40
   Sample Concentration - 220
   Required Detection Limit (RDL) - 3

   The value of 220 may be reported even though the instrument detection limit is greater than the RDL.

   Note: The specified detection limits are based on a pure water matrix. The detection limits for samples may be considerably higher depending on the sample matrix.
5. If gross alpha > 5 pCi/L, analyze for Radium 226; if Radium 226 > 3 pCi/L, analyze for Radium 228.
6. The detection limits presented were calculated using the formula in N.R.C. Regulatory Guide 4.14, Appendix Lower Limit of Detection, pg. 21, and follow:

$$LLD = \frac{4.66\ (BKG/BKG\ DUR)^{1/2}}{(2.22)\ (Eff)\ (CR)\ (SR)\ (e^{-\lambda t})\ (Aliq)}$$

$$MDA = \frac{4.66\ (BKG/Sample\ DUR)^{1/2}}{(2.22)\ (Eff)\ (CR)\ (SR)\ e^{-\lambda t}\ (Aliq)}$$

Where:

LLD = Lower Limit of Detection in pCi per sample unit.
BKG = Instrument Background in counts per minute (CPM).
Eff = Counting efficiency in cpm/disintegration per minute (dpm).
CR = Fractional radiochemical yield.
SR = Fractional radiochemical yield of a known solution.
λ = The radioactive decay constant for the particular radionuclide.
t = The elapsed time between sample collection and counting
Aliq = Sample volume.
BKG DUR = Background count duration in minutes.

MDA = Minimum Detectable Activity in pCi per sample unit
BKG = same as for LLD
EFF = same as for LLD
CR = same as for LLD
SR = same as for LLD
λ = same as for LLD
t = same as for LLD
Aliq = same as for LLD
Sample DUR = sample count duration in minutes

7. On 500 umho/cm range.
8. On 5000 umho/cm range.
9. On 50000 umho/cm range.

a. U.S. Environmental Protection Agency Contract Laboratory Program Statement of Work for Inorganics Analysis, Multi-Media, Multi-Concentration, 7/88 (or latest version).
b. U.S. Environmental Protection Agency Contract Laboratory Program Statement of Work for Inorganics Analysis, Multi-Media, Multi-Concentration, 7/88 (or latest version). The specific method to be utilized is at the laboratory's discretion provided it meets the specified detection limit.
c. U.S. Environmental Protection Agency Contract Laboratory Program Statement of Work for Organic Analysis, Multi-Media, Multi-Concentration, 2/88 (or latest version).
d. Methods are from "Methods for Chemical Analysis of Water and Wastes," U.S. Environmental Protection Agency, 1983, unless otherwise indicated.
e. Methods are from "Test Methods for Evaluation of Solid Waste, Physical/Chemical Methods," (SW-846, 3rd Ed.), U.S. Environmental Protection Agency.
f. U.S. Environmental Protection Agency, 1979, Radiochemical Analytical Procedures for Analysis of Environmental Samples, Report No. EMSL-LY-0539-1, Las Vegas, NV, U.S. Environmental Protection Agency.
g. American Public Health Association, American Water Works Association, Water Pollution Control Federation, 1985. Standard Methods for the Examination of Water and Wastewater, 16th ed., Washington, D.C., Am. Public Health Association.

TABLE 11.6
ANALYTICAL METHODS, DETECTION LIMITS, AND DATA QUALITY OBJECTIVES

h. U.S. Environmental Protection Agency, 1976. Interim Radiochemical Methodology for Drinking Water, Report No. EPA-600/4-75-008. Cincinnati U.S. Environmental Protection Agency.
i. Harley, J.H., ed., 1975, ASL Procedures Manual, HASL-300; Washington, D.C., U.S. Energy Research and Development Administration.
j. U.S. EPA, 1982. "Methods for Organic Analysis of Municipal and Industrial Waste Water," US EPA-600/4-82-057.
k. "Handbook of Analytical Procedures," USAEC, Grand Junction Lab. 1970, page 196.
l. "Prescribed Procedures for Measurement of Radioactivity in Drinking Water," EPA-600/4-80-032, August 1980, Environmental Monitoring and Support Laboratory, Office of Research and Development, U.S. Environmental Protection Agency, Cincinnati, Ohio 45268.
m. "Methods for Determination of Radioactive Substances in Water and Fluvial Sediments," U.S.G.S. Book 5, Chapter A5, 1977.
n. "Acid Dissolution Method for the Analysis of Plutonium in Soil," EPA-600/7-79-081, March 1979, U.S. EPA Environmental Monitoring and Support Laboratory, Las Vegas, Nevada, 1979.
o. "Procedures for the Isolation of Alpha Spectrometrically Pure Plutonium, Uranium, and Americium," by E.H. Essington and B.J. Drennon, Los Alamos National Laboratory, a private communication.
p. "Isolation of Americium from Urine Samples," Rocky Flats Plant, Health, Safety, and Environmental Laboratories.
q. "Radioactivity in Drinking Water," EPA 570/9-81-002.
r. If the sample or duplicate result is <5 x IDL, then the control limit is IDL.
s. U.S. EPA, 1987. "Eastern Environmental Radiation Facility Radiochemistry Procedures Manual," EPA-520/5-84-006.

11.0 REFERENCES

ASI, 1991: Advanced Sciences, Inc., "Non-Tributary Ground-Water Study," Rocky Flats Plant: Zero-Offsite Water-Discharge Study, May 21, 1991.

ASI, 1991a: Advanced Sciences, Inc., "Non-Point Source Assessment and Storm-Sewer Infiltration/Inflow and Exfiltration Study," Rocky Flats Plant Site: Prepared for EG&G Rocky Flats, Inc., Tasks 2 and 3 of the Zero-Offsite Water-Discharge Study, Appendices A through G, 66 p., 15 figures, 10 tables, September 30, 1991.

ASI, 1991b: Advanced Sciences, Inc., "Storm-Runoff Quantity for Various Storm Events," Rocky Flats Plant Site, Task 6 of the Zero-Offsite Water Discharge Study: Prepared for EG&G, Rocky Flats, Inc.

ASI, 1991c: Advanced Sciences, Inc., "Temporary Water-Storage Capabilities Study," Rocky Flats Plant Site, Task 21 of the Zero-Offsite Water Discharge Study, 116 p., 12 figures, 45 tables, and 3 appendices, March 19, 1991.

ASI, 1991d: Advanced Sciences, Inc., "Sanitary Sewer Infiltration/Inflow and Exfiltration Study," Rocky Flats Plant Site, Task 1 of the Zero-Offsite Water-Discharge Study: Prepared for EG&G Rock Flats, Inc., September 30, 48p., 10 tables, 24 figures, and 3 appredices (A through C).

Baker, 1973: V. R. Baker, "Paleosol Development in Quaternary Alluvium Near Golden, Colorado," The Mountain Geologist, Volume 10, No. 4, pp. 127-133, 1973.

Dames and Moore, 1981: Dames and Moore, "Geologic and Seismologic Investigations for Rocky Flats Plant," Contract DE-AC04-80A110890, 1981.

Delnay, R.L., 1959: "The Composition of Pond 2A," 1959.

DOE, 1980: United States Department of Energy, United States Department of Energy, "Final Environmental Impact Statement: Rocky Flats Plant Site, Golden, Jefferson County, Colorado," Volumes 1, 2, and 3, Washington, D.C., DOE/EIS-0064, 1980.

DOE, 1986: United States Department of Energy, "Comprehensive Environmental Assessment and Response Program Phase I: Draft Installation Assessment Rocky Flats Plant." Washington: U.S. Department of Energy. Unnumbered draft report, 1986.

DOE, 1986a: RI, United States Department of Energy, "Geological and Hydrological Data Summary," Rocky Flats Plant, Golden, Colorado, RI, 58 pp., July 21, 1986.

DOE, 1991: United States Department of Energy, "Federal Facility Agreement and Consent Order (Interagency Agreement [IAG]: DOE, EPA, and CDH)," Washington, D.C., January 22, 1991.

DOE, 1991a: United States Department of Energy, "1989 Population, Economic and Land Use Data Base for Rocky Flats Plant, Golden, Colorado," 1991.

DOE, 1991b: United States Department of Energy, "Federal Facility Agreement and Consent Order (IAG), DOE, EPA, and CDH," Washington, D.C., January 22, 1991.

DOE, 1991c: United States Department of Energy, Technical Memorandum 1, Final Phase II RCRA Facility Investigation, Work Plan (Alluvial), Rocky Flats Plant, 902 Pad, Mound, and East Trenches Area (Operable Unit No. 2), Environmental Restoration Program, Rocky Flats Office, Golden, Colorado, 1991.

DOE, 1991d: United States Department of Energy, "Federal Facility Agreement and consent Order (Interagency Agreement (IAG): DOE, EPA, and CDH), "Washington D.C., January 22, 1991.

DOE, 1992: United States Department of Energy, "Historical Release Report for the Rocky Flats Plant," Environmental Restoration Program, January 1992.

Doty & Associates, 1992: Doty & Associates, Inc., Evaluation of 0-3 Pump Test, Woman Creek Alluvium, Rocky Flats Plant, January 13, 1992.

Doty & Associates, 1992a: Doty & Associates, Inc., "OU8 IHSS Descriptions": Prepared for Advanced Sciences, Inc., 15 sections, 1992.

Doty & Associates, 1992b: Doty & Associates, Inc., "Evaluation of 0-3 Pump Test, Woman Creek Alluvium, Rocky Flats Plant, January 13, 1992.

EG&G, 1990: EG&G Rocky Flats, Inc., "Wetlands Assessment, Rocky Flats Site Revision C," 1990.

EG&G, 1990a: EG&G Rocky Flats, Inc., "Sediment Characterization Plan," Environmental Restoration Program: Prepared by Stoller and Associates, Inc., 41 p., 4 figures, 6 tables, and 1 plate, October 9, 1990.

EG&G, 1990b: EG&G Rocky Flats, Inc., "Background Geochemical Characterization Report, Rocky Flats Plant for 1989": Prepared for the U.S. Department of Energy, Rocky Flats Plant, Golden, Colorado, 6 sections, 34 figures, 81 tables, 3 plates, and Appendices A through D, December 21, 1990.

EG&G, 1991: EG&G Rocky Flats, Inc., "Groundwater Protection and Monitoring Program Plan," 1991.

EG&G, 1991a: EG&G Rocky Flats, Inc., "Quality Assurance Project Plan for CERCLA Remedial Investigations and Feasibility Studies and RCRA Facility Investigations and Corrective Measures Studies Activities," Environmental Restoration Program, 1991.

EG&G, 1991b: EG&G Rocky Flats, Inc., "EG&G Rocky Flats General Radiochemistry and Routine Analytical Services Protocol, Parts A & B (GRRASP)," Environmental Management Department, 1991.

EG&G, 1991c: EG&G Rocky Flats, Inc., "Draft Final Geologic Characterization Report," with Appendices, July 31, 1991.

EG&G, 1991d: EG&G Rocky Flats, Inc., "Surface Water and Sediment Monitoring Plan," Environmental Restoration Program, 81 p., 5 figures, 10 tables, and 2 plates, February 15, 1991.

EG&G, 1991e: EG&G Rocky Flats, Inc., "Radiological Guidelines Manual," No. 3-21000-SOPS-EMRG, Environmental Management Department, 1991.

EG&G, 1991f: EG&G Rocky Flats, Inc., "Draft, Rocky Flats Surface Water Management Plan," Prepared for U.S. Department of Energy, Rocky Flats Area Office, Volumes I and II, March 1991.

EG&G, 1991g: EG&G Rocky Flats, Inc., "Final Groundwater Protection and Monitoring Program Plan for Rocky Flats Plant," in compliance with DOE Order 5400.1, 9 sections, 1 plate, 31 figures, 20 tables, and Appendices A through E, November 27, 1991.

EG&G, 1991h: Rocky Flats Plant Geologic Characterization, EG&G Rocky Flats, Inc., Golden, Colorado, July 31, 1991.

EG&G, 1991i: EG&G Rocky Flats, Inc., "Phase II RFI/RI Work Plan (Bedrock), 903 Pad, Mound, and East Trenches Areas (Operable Unit No. 2)," U.S. Department of Energy, Rocky Flats Plant, Golden, Colorado, June 27, 1991.

EG&G, 1991j: EG&G Rocky Flats Plant, Inc., "Assessment of Known Suspect and Potential Environmental Releases of PCBs, Preliminary Assessment, Site Description, 1991.

EG&G, 1992: EG&G Rocky Flats, Inc., "Hazardous Release Report," 1992.

EG&G, 1992a: EG&G Rocky Flats, Inc., RFEDS - Selected Data Retrieval for OU 13; Received March 23, 1992, 11 sections, March 19, 1992.

EG&G, 1992b: EG&G Rocky Flats, Inc., "Final Phase I RFI/RI Work Plan for Original Process Waste Lines (Operable Unit 9)," Volumes 1 and 2, Environmental Restoration Program, February 19, 1992.

EG&G, 1992c: EG&G Rocky Flats, Inc., "Operating Procedures, Volume I, Field Operations," No. 521000, SOPS-FO, Environmental Management Department, 1992.

EG&G, 1992d: EG&G Rocky Flats, Inc., "Operating Procedures, Volume III, Geotechnical," No. 521000, SOPS-GT, Environmental Management Department, 1992.

EG&G, 1992e: EG&G Rocky Flats, Inc., "Operating Procedures, Volume I, Surface Water," No. 521000, SOPS-SW, Environmental Management Department, 1992.

EPA, 1981: United States Environmental Protection Agency, "National Primary and Secondary Ambient Air Quality Standards." 40 CFR Part 50, Subchapter C - Air Programs, Washington, D.C., 1981.

EPA, 1985: United States Environmental Protection Agency, "Development of Statistical Distribution or Ranges of Standard Factors Used in Exposure Assessments," Office of Research and Development, Washington, D.C.

EPA, 1987: United States Environmental Protection Agency, "Data Quality Objectives for Remedial Response Actions," CDM Federal Programs Corporation, 1987.

EPA, 1988a: United States Environmental Protection Agency, United States Environmental Protection Agency, Interim Final, "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA," Washington, D.C., EPA/540/8-89/004, OSWER Directive 9355.3.01, October 1988.

EPA, 1989: United States Environmental Protection Agency, "Data Quality Objectives for Remedial Response Actions," CDM Federal Programs Corporation, 1987.

EPA, 1989a: United States Environmental Protection Agency, United States Environmental Protection Agency, Interim Final, "RCRA Facility Investigation (RFI) Guidance," Washington, D.C., EPA/530/SW-89-031, May 1989.

EPA, 1989b: United States Environmental Protection Agency, Interim Final, "RCRA Facility Investigation (RFI) Guidance," Washington D.C., EPA/530/SW-89-031, May 1989.

EPA, 1989c: United States Environmental Protection Agency, "Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A), 1989.

EPA, 1989d: United States Environmental Protection Agency, "Superfund Exposure Assessment

Manual," 1989.

EPA, 1991: United States Environmental Protection Agency, "Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites," Washington, D.C., EPA, 540/P-91/001, 1991.

Hurr, 1976: R.T. Hurr, "Hydrology of Nuclear-Processing Plant Site, Rocky Flats, Jefferson County, Colorado," Open File Report 76-268. USGS, Denver, Colorado, March, 1976.

Hydro-Search, 1985: Hydro-Search, Inc., "Hydrogeologic Characterization of the Rocky Flats Plant, Golden, Colorado," Project No. 1520, 55 pp., 1985.

Hydro-Search, 1986: Hydro-Search, Inc., "Electromagnetic Survey, Rocky Flats Plant, Golden, Colorado," 1986.

Illsley, 1980: "Report of Investigation on a Recent Process Waste Pipeline Leak," 1990.

Johnson, L.P., 1981: "774 Spill-Tank 66 Analytical," EG&G Internal Report.

Kissell, D.O., and F.P. McMenus, 1987: Fire - Building 771," September 11, 1957.

LWA, 1987: Lee Wan and Associates, "Instruction Manual for Site Drainage Computer Model," Rocky Flats Plant Site: 24 p., February 1987.

Malde, 1955: H.E. Malde, "Surficial Geology of Louisville Quadrangle, Colorado," U.S. Geological Survey Bulletin 996-E, pp. 217-259, 1955.

Owen, J.B., 1964: "Decontamination of Building 76 and Environs Following Incident of June 12, 1964," 1964.

Paricio, 1986: "Oil Spill Documentation," 1986.

Robson, et al., 1981: S.G. Robson, J.C. Romero, and S. Zawistowski, "Geologic Structure, Hydrology, and Water Quality of the Arapahoe Aquifer in the Denver Basin, Colorado," U.S. Geological Survey Atlas HA-647, 1981.

Robson, et al., 1981a: S.G. Robson, A. Wacinski, S. Zawistowski, and J.C. Romero, "Geologic Structure, Hydrology, and Water Quality of the Laramie-Fox Hills Aquifer in the Denver Basin, Colorado," U.S. Geological Survey Hydrologic Atlas HA-650, 1981.

Rockwell, 1975: Rockwell International, "Annual Environmental Monitoring Report, January-December 1974," Golden, Colorado: Rockwell International, Rocky Flats Plant, Report RFP-ENV-74, 1975.

Rockwell, 1976: Rockwell International, "Annual Environmental Monitoring Report, January-December 1975," Golden, Colorado: Rockwell International, Rocky Flats Plant, Report RFP-ENV-75, 1976.

Rockwell, 1977: Rockwell International, "Annual Environmental Monitoring Report, January-December 1976," Golden, Colorado: Rockwell International, Rocky Flats Plant, Report RFP-ENV-76, 197.

Rockwell, 1978: Rockwell International, "Annual Environmental Monitoring Report, January-December 1977," Golden, Colorado: Rockwell International, Rocky Flats Plant, Report RFP-ENV-77, 1978.

Rockwell, 1979: Rockwell International, "Annual Environmental Monitoring Report, January-December 1978," Golden, Colorado: Rockwell International, Rocky Flats Plant, Report RFP-ENV-78, 1979.

Rockwell, 1980: Rockwell International, "Annual Environmental Monitoring Report, January-December 1979," Golden, Colorado: Rockwell International, Rocky Flats Plant, Report RFP-ENV-79, 1980.

Rockwell, 1981: Rockwell International, "Annual Environmental Monitoring Report, January-December 1980," Golden, Colorado: Rockwell International, Rocky Flats Plant, Report RFP-ENV-80, 1981.

Rockwell, 1982: Rockwell International, "Annual Environmental Monitoring Report, January-December 1981," Golden, Colorado: Rockwell International, Rocky Flats Plant, Report RFP-ENV-81, 1982.

Rockwell, 1983: Rockwell International, "Annual Environmental Monitoring Report, January-December 1982," Golden, Colorado: Rockwell International, Rocky Flats Plant, Report RFP-ENV-82, 1983.

Rockwell, 1984: Rockwell International, "Annual Environmental Monitoring Report, January-December 1983," Golden, Colorado: Rockwell International, Rocky Flats Plant, Report RFP-ENV-83, 1984.

Rockwell, 1985: Rockwell International, "Annual Environmental Monitoring Report, January-December 1984," Golden, Colorado: Rockwell International, Rocky Flats Plant, Report RFP-ENV-84, 1985.

Rockwell, 1986: Rockwell International, "Geological and Hydrological Data Summary, U.S. Department of Energy, Rocky Flats Plant, Golden, Colorado," Golden, Colorado:

Rockwell International, 58 pp., July 21, 1986.

Rockwell, 1986a: Rockwell International, "Annual Environmental Monitoring Report, January-December 1985," Golden, Colorado: Rockwell International, Rocky Flats Plant, Report RFP-ENV-85, 1986.

Rockwell, 1986b: Rockwell International, "Draft Work Plan, Geological and Hydrological Site Characterization, U.S. Department of Energy, Rocky Flats Plant, Golden, Colorado." Golden, Colorado: Rockwell International, Rocky Flats Plant, 1986.

Rockwell, 1986c: Rockwell International, "Draft Project Operations Plan, Geological and Hydrological Site Characterization, U.S. Department of Energy, Rocky Flats Plant, Golden, Colorado," Golden, Colorado: Rocky Flats Plant, 1986.

Rockwell, 1986d: Rockwell International, "Resource Conservation and Recovery Act Part B - Post-Closure Care Permit Application for U.S. Department of Energy Rocky Flats Plant, Hazardous and Radioactive Mixed Wastes." U.S. Department of Energy. Unnumbered report, 1986.

Rockwell, 1987: Rockwell International, "Resource Conservation and Recovery Act Part B - Operating Permit Application for the U.S. DOE Rocky Flats Plant, Hazardous and Radioactive Mixed Wastes, Revision 1," U.S. Department of Energy. Unnumbered Report.

Rockwell, 1988: Rockwell International," RCRA Post-Closure Permit Care, U.S. Department of Energy, Hazardous and Radioactive and Mixed Waste," Volume 2, Plate E-6, October 5, 1988.

Rockwell, 1988a: Rockwell International," RCRA Post-Closure Permit Care, U.S. Department of Energy, Hazardous and Radioactive and Mixed Waste," Volume 2, Plate E-6, October 5, 1988.

Rockwell, 1989: Rockwell International, "1988 Annual RCRA Ground-Water Monitoring Report for Regulated Units at Rocky Flats Plant," 2 Volumes, 1989.

Rockwell, 1989a: Rockwell International, "RCRA Closure Plan Tanks T-40, T-66, T-67, T-68, Hazardous Waste Management Unit," 1989.

Rockwell, 1989b: Rockwell International, "Rocky Flats Plant Site Environmental Report for 1988, May 1989.

Ryan, E.S., 1962: Disposition of South Section of Clay Lined Pond in Relation to Proposed Building 79," 1962.

Schleicher and Schuell, 1982: Schleicher and Schuell, Publication No. 500, Innovative Products for Separation Science, March 1982.

Scott, 1960: G.R. Scott, "Quaternary Sequence East of the Front Range Near Denver, Colorado," U.S. Geological Survey Professional Paper 700-C, pp. C11-C18, 1970.

Scott, 1963: G.R. Scott "Quaternary Geology and Geomorphic History of the Kassler Quadrangle, Colorado," U.S. Geological Survey Professional Paper 421-A, 1963.

Scott, 1970: G.R. Scott, "Quaternary Faulting and Potential Earthquakes in East-Central Colorado," U.S. Geological Survey Miscellaneous Geologic Inventory Map I-790-A, 1972.

Scott, 1972: G.R. Scott, "Geologic Map of the Morrison Quadrangle, Jefferson County, Colorado," U.S. Geological Survey Miscellaneous Geologic Inventory Map I-790-A, 1972.

Scott, 1975: G.R. Scott, "Cenozoic Surfaces and Deposits in the Southern Rocky Mountains" in Cenozoic History of the Southern Rocky Mountains, B.F. Curtis, ed., Geological Society of America Memoir 144, pp. 227-248, 1975.

SCS, 1983: Soil Conservation Service, "Soil Survey of Golden Area, Colorado," U.S. Department of Agriculture, Jefferson County, Colorado, 167-S/304, 1983.

Smith, R.E., 1986: 776 Utilities Compressor House Oil Spills," EG&G Internal Report.

Spencer, 1961: F.D. Spencer, "Bedrock Geology of the Louisville Quadrangle, Colorado," U.S. Geological Survey Geologic Quadrangle Map GQ-151, 1961.

Teel, Ron, 1992: Personal Communication, RFP Employee, April 10, 1992, (See Doty & Associates, 1992a).

Tracer, 1986: Tracer Research, Inc., "Shallow Soil Gas Investigation of the Rocky Flats Plant, Golden, Colorado," 1986.

Van Horn, 1972: R. Van Horn, "Surficial and Bedrock Geologic Map of the Golden Quadrangle, Jefferson County, Colorado," U.S. Geological Survey Miscellaneous Geological Field Inventory Map 1-781-A, 1972.

Van Horn, 1976: R. Van Horn, "Surficial and Bedrock Geologic Map of the Golden Quadrangle, Jefferson County, Colorado," U.S. Geological Survey Miscellaneous Geological Field Inventory Map 1-781-A, 1972.

Van Horn, 1976a: R. Van Horn, "Geology of the Golden Quadrangle, Colorado," U.S. Geological Survey Professional Paper 872, 116 pp., 1976.

Voight, 1971: A.H.Voight, "Evaporation Ponds," 1971.

Weimer, 1973: R.J. Weimer, "A Guide to Uppermost Cretaceous Stratigraphy, Central Front Range, Colorado: Del Taic Sedimentation, Growth Faulting, and Early Laramide Crustal Movement," The Mountain Geologist, Volume 10, No.3, pp. 53-97, July 1973.

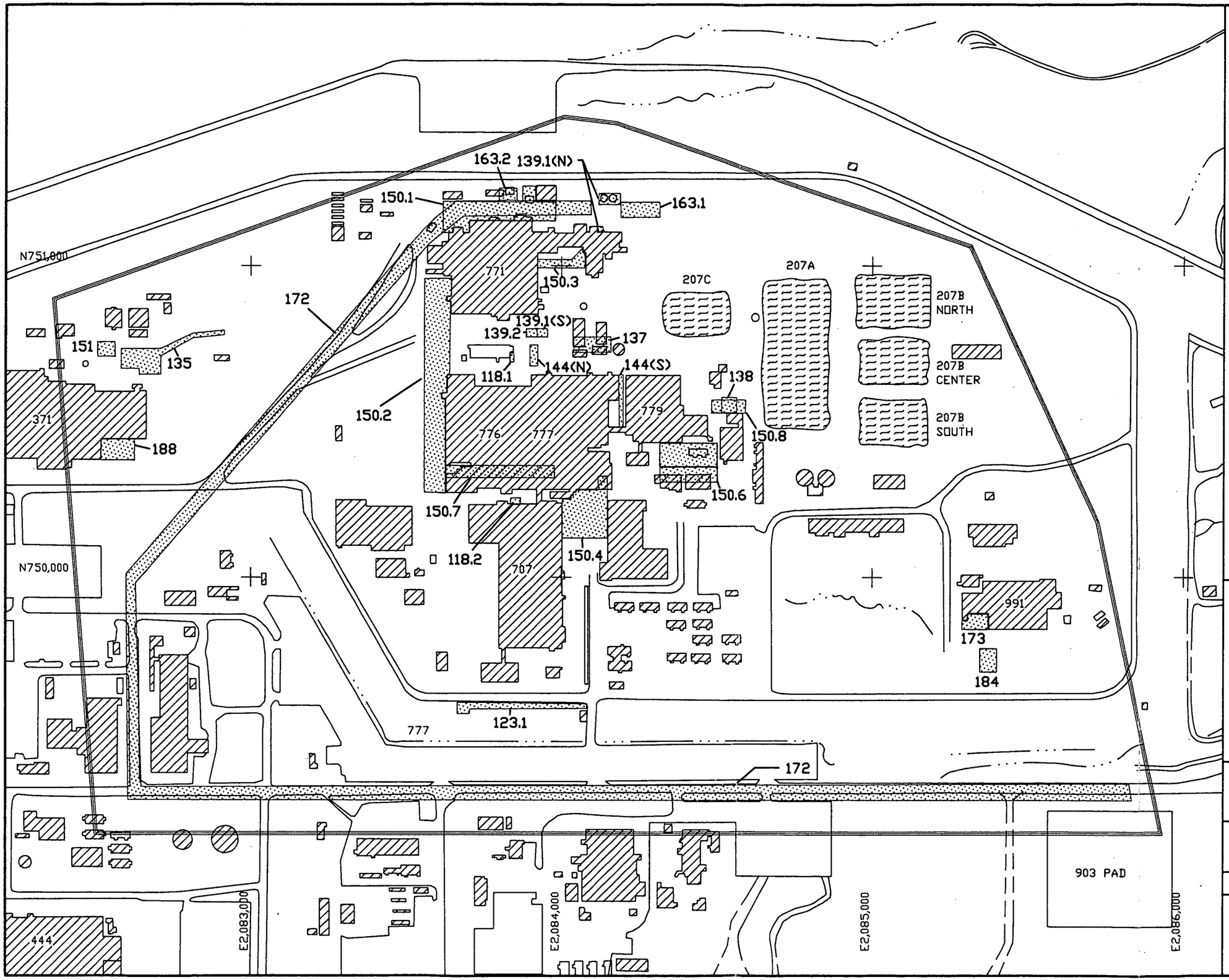
Werkema, 1972: Investigation of Radioactivity Found in 701 Building Sanitary Sewer Backflow and in 995 Building Outfall," June 7-13, 1972, (See Doty & Associates, 1992a).

Werkema, 1977: "Building 559 Groundwater Contamination," EG&G Internal Report, 1977.

Woodward-Clevenger, 1970: Woodward-Clevenger & Associates, "Engineering and Ceologic Investigation for Two Additions to Building No. 774, AEC Rocky Flats Facility," 1970 (See Doty & Associates, 1992a).

WWE, 1991: Wright Water Engineers, Inc., "Rocky Flats Master Drainage Plan: Prepared for EG&G Rocky Flats, Inc.," Rocky Flats Plant, Sections I through IX, December 1991.

Yoder, R.D.: "Radiometric Soil Survey Completion," September 18, 1984.



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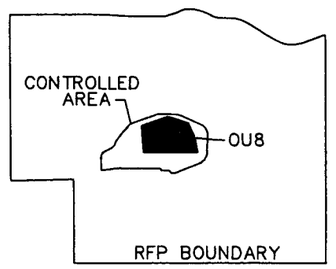
- OPERABLE UNIT 8
- STREAMS DITCHES DRAINAGE FEATURES
- PAVED ROADS
- DIRT ROADS
- SURFACE WATER IMPOUNDMENTS
- BUILDINGS
- INDIVIDUAL HAZARDOUS SUBSTANCE SITES

-N-

SCALE

0 300 600

Source: Groundwater Protection and Monitoring Program Plan. ASI Nov. 1991

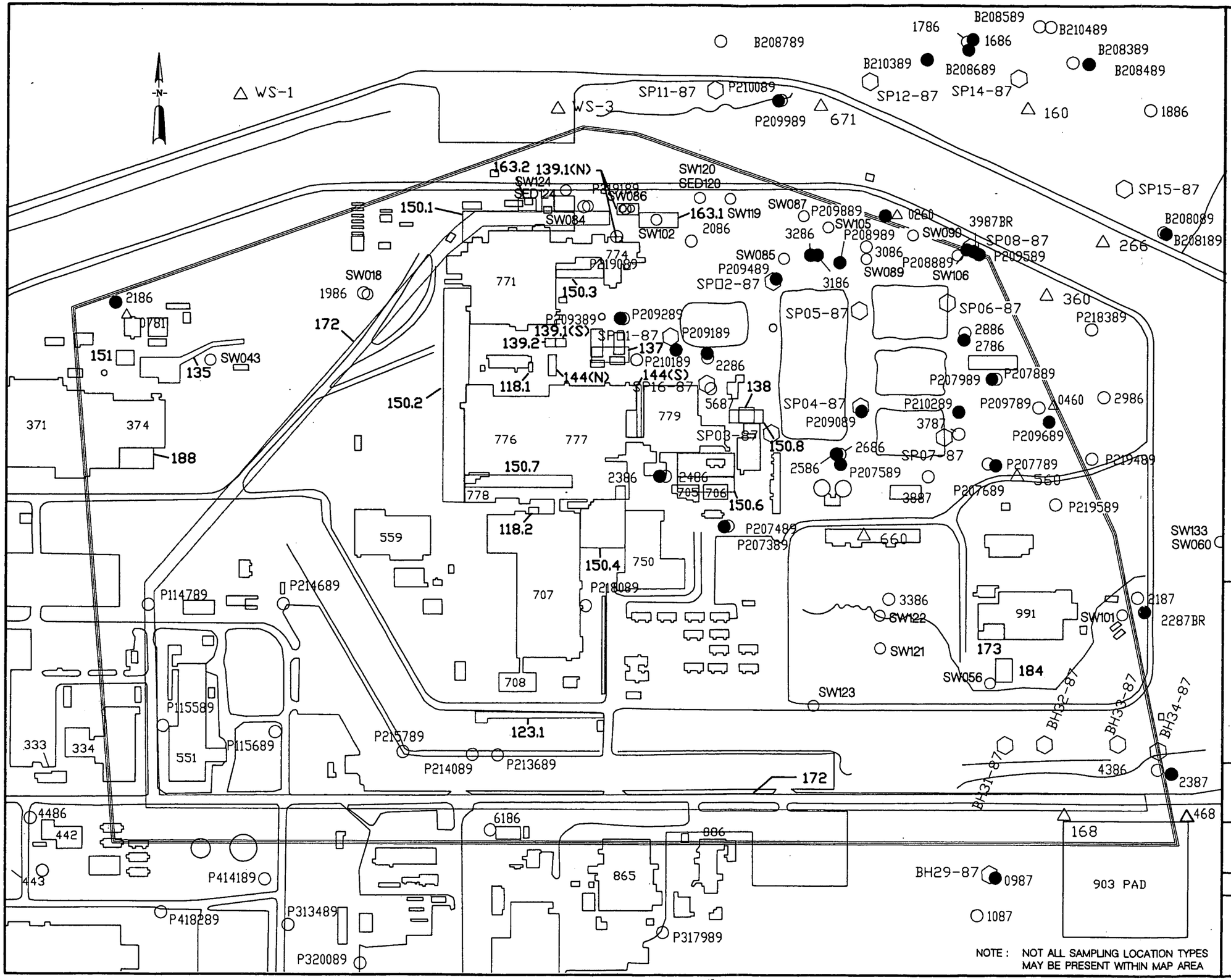


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Golden Colorado

OPERABLE UNIT NO. 8
PHASE I RFI/RI WORK PLAN

FIGURE 8-1

LOCATION OF INDIVIDUAL HAZARDOUS SUBSTANCE SITES OPERABLE UNIT 8 700 AREA



MAP LEGEND

- ROADWAYS
- SURFACE WATER FEATURES
- BUILDINGS AND NUMBERS
- 137 — INDIVIDUAL HAZARDOUS SUBSTANCE SITES AND NUMBERS

EXISTING SAMPLING LOCATION

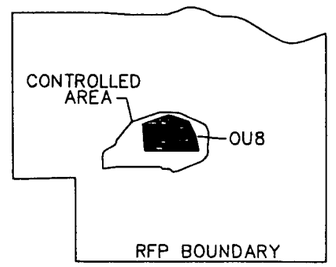
- SW121 ○ — SURFACE WATER SAMPLING
- SED124 ○ — SURFACE WATER SEDIMENT
- P207589 ● — BEDROCK WELL
- P219589 ○ — ALLUVIAL WELL
- BH33-87 ⬡ — BOREHOLE
- 560 — PRE-1986 MONITOR WELL

PROPOSED SAMPLING LOCATION

- SOIL GAS SURVEY
- × SOIL BORING
- △ SHALLOW SOIL SAMPLE

SCALE

0 300 600

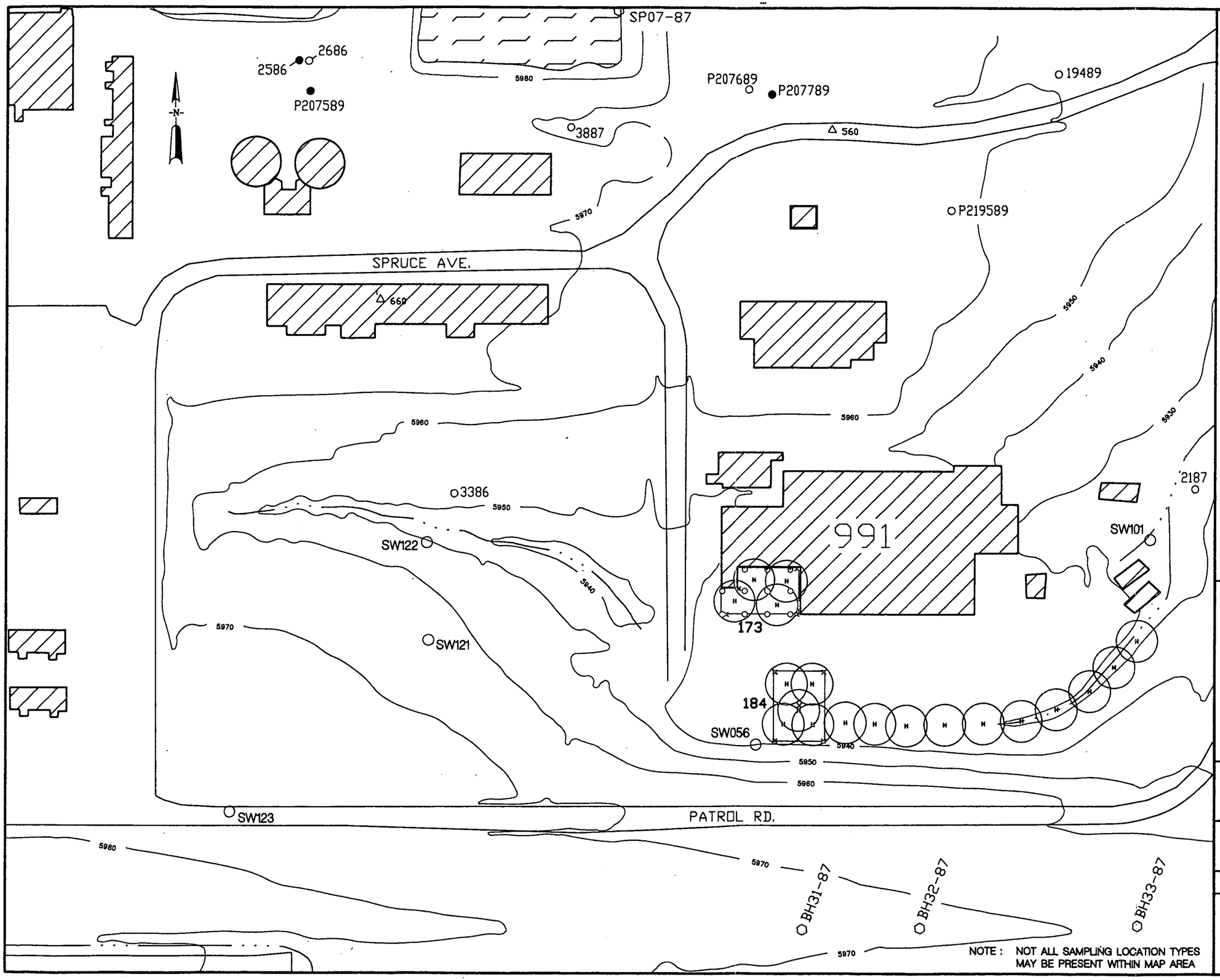


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P219989Rocky Flats Plant
Golden Colorado

OPERABLE UNIT NO. 8
PHASE I RFI/RI WORK PLAN

FIGURE 6-13

PROPOSED SAMPLING LOCATIONS:
IHSS Nos.: 172



MAP LEGEND

- ROADWAYS
- SURFACE WATER FEATURES
- BUILDINGS AND NUMBERS
- 137 INDIVIDUAL HAZARDOUS SUBSTANCE SITES AND NUMBERS

EXISTING SAMPLING LOCATION

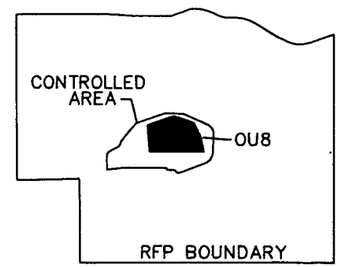
- SW121 ○ SURFACE WATER SAMPLING
- SED124 ○ SURFACE WATER SEDIMENT
- P207589 ● BEDROCK WELL
- P219589 ○ ALLUVIAL WELL
- BH33-87 ⬡ BOREHOLE
- 560 △ PRE-1986 MONITOR WELL

PROPOSED SAMPLING LOCATION

- ∘ SOIL GAS SURVEY
- ▪ SOIL BORING
- △ SHALLOW SOIL SAMPLE
- H HPGe SET UP LOCATION
- ◯ DIAMETER OF DETECTION

SCALE

0 100 200



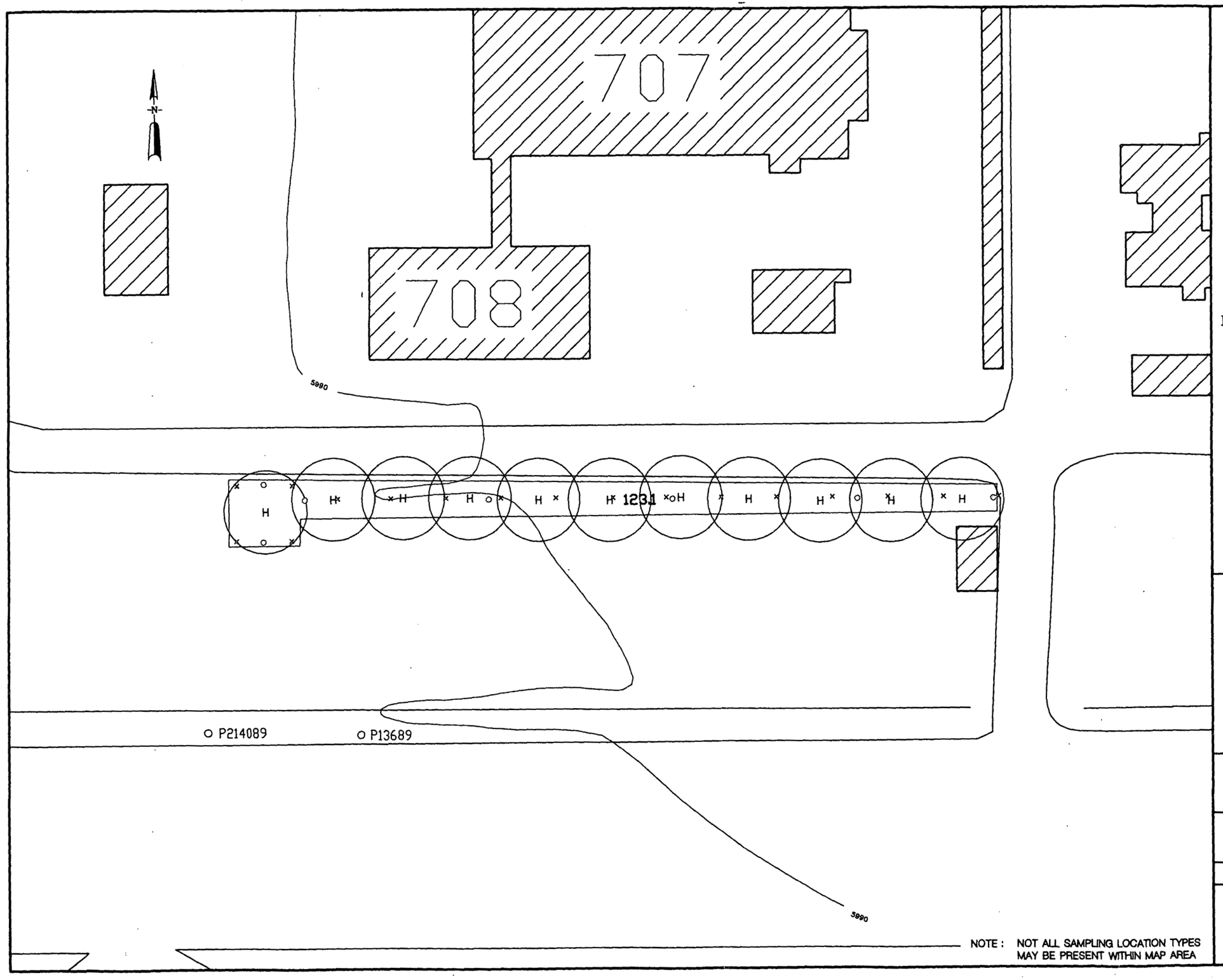
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Rocky Flats Plant
Golden Colorado

OPERABLE UNIT NO. 8
PHASE I RFI/RI WORK PLAN

FIGURE 6-12

PROPOSED SAMPLING LOCATIONS:
IHSS Nos.: 173 & 184

IHSS10



MAP LEGEND

- ROADWAYS
- SURFACE WATER FEATURES
- BUILDINGS AND NUMBERS
- 137 — INDIVIDUAL HAZARDOUS SUBSTANCE SITES AND NUMBERS

EXISTING SAMPLING LOCATION

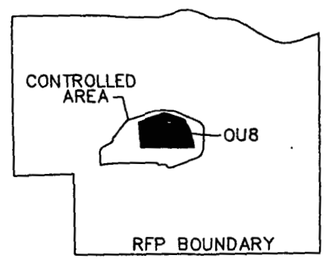
- SW121 ○ — SURFACE WATER SAMPLING
- SED124 ○ — SURFACE WATER SEDIMENT
- P207589 ● — BEDROCK WELL
- P219589 ○ — ALLUVIAL WELL
- BH33-87 ⬡ — BOREHOLE
- 560 △ — PRE-1986 MONITOR WELL

PROPOSED SAMPLING LOCATION

- ○ — SOIL GAS SURVEY
- × — SOIL BORING
- △ — SHALLOW SOIL SAMPLE
- H — HPGe SET UP LOCATION
- ○ — DIAMETER OF DETECTION

SCALE

0 50 100



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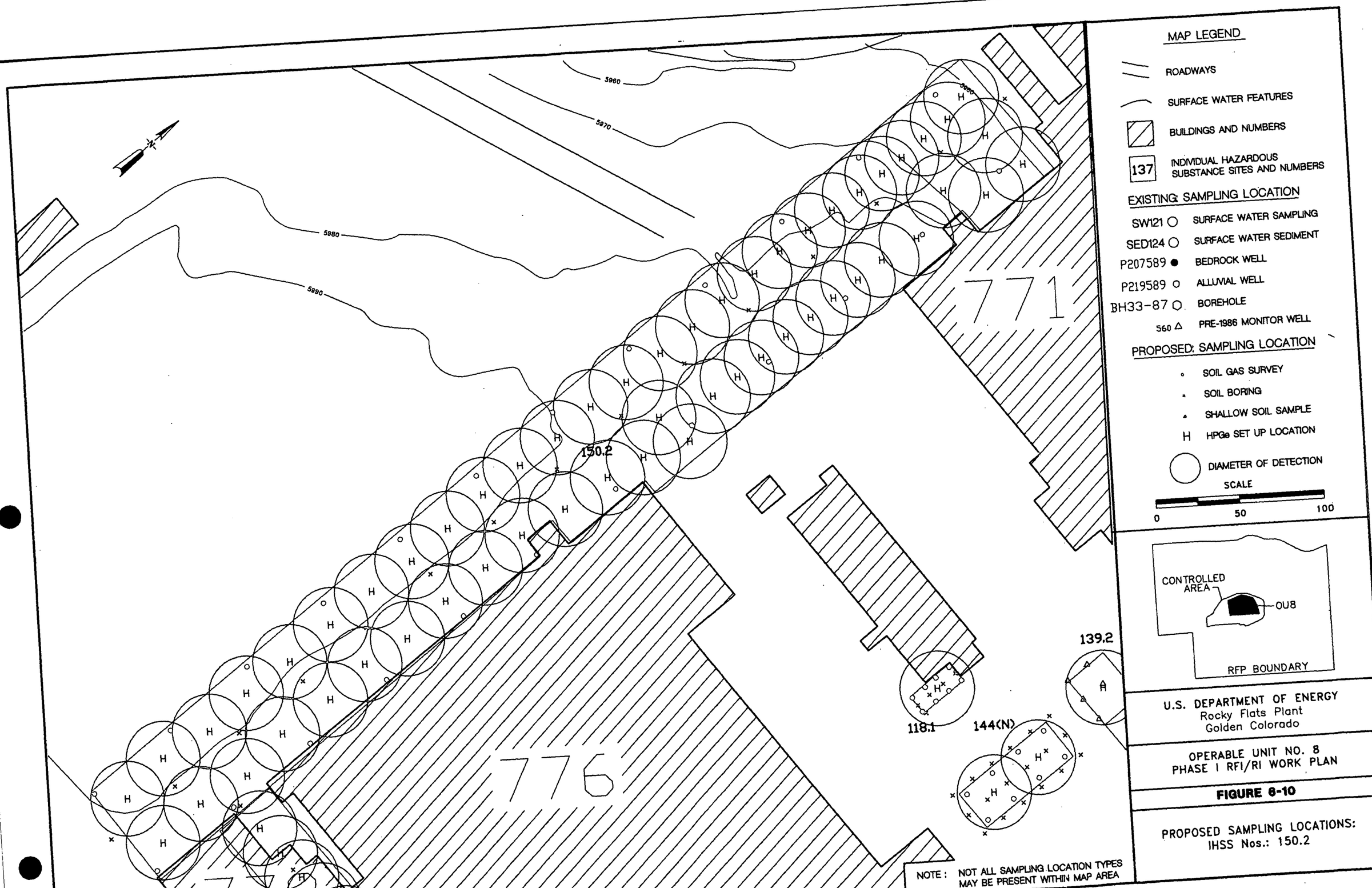
OPERABLE UNIT NO. 8
PHASE I RFI/RI WORK PLAN

FIGURE 6-11

PROPOSED SAMPLING LOCATIONS:
IHSS Nos.: 123.1

NOTE : NOT ALL SAMPLING LOCATION TYPES MAY BE PRESENT WITHIN MAP AREA

IHSS7



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PHASE I RFI/RI WORK PLAN

FIGURE 6-10

PROPOSED SAMPLING LOCATIONS:
IHSS Nos.: 150.2

776

777

778

707

150.2

150.7

118.2

150.4

IHSS5

MAP LEGEND

ROADWAYS

SURFACE WATER FEATURES

BUILDINGS AND NUMBERS

137 INDIVIDUAL HAZARDOUS SUBSTANCE SITES AND NUMBERS

EXISTING SAMPLING LOCATION

SW121 ○ SURFACE WATER SAMPLING

SED124 ○ SURFACE WATER SEDIMENT

P207589 ● BEDROCK WELL

P219589 ○ ALLUVIAL WELL

BH33-87 ○ BOREHOLE

560 △ PRE-1986 MONITOR WELL

PROPOSED SAMPLING LOCATION

o SOIL GAS SURVEY

× SOIL BORING

△ SHALLOW SOIL SAMPLE

H HPGe SET UP LOCATION

DIAMETER OF DETECTION

SCALE

0 50 100

CONTROLLED AREA — OU8

RFP BOUNDARY

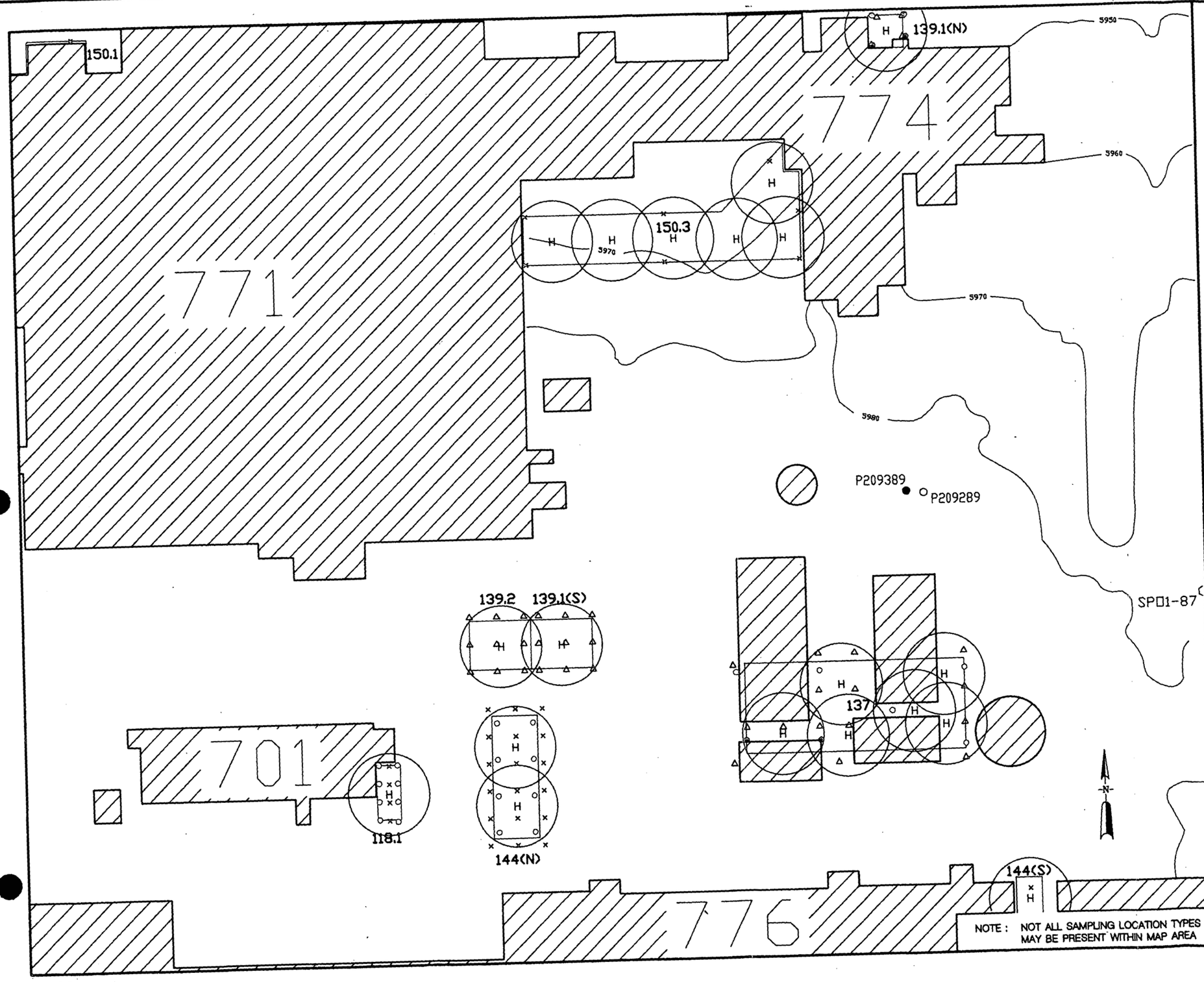
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Golden Colorado

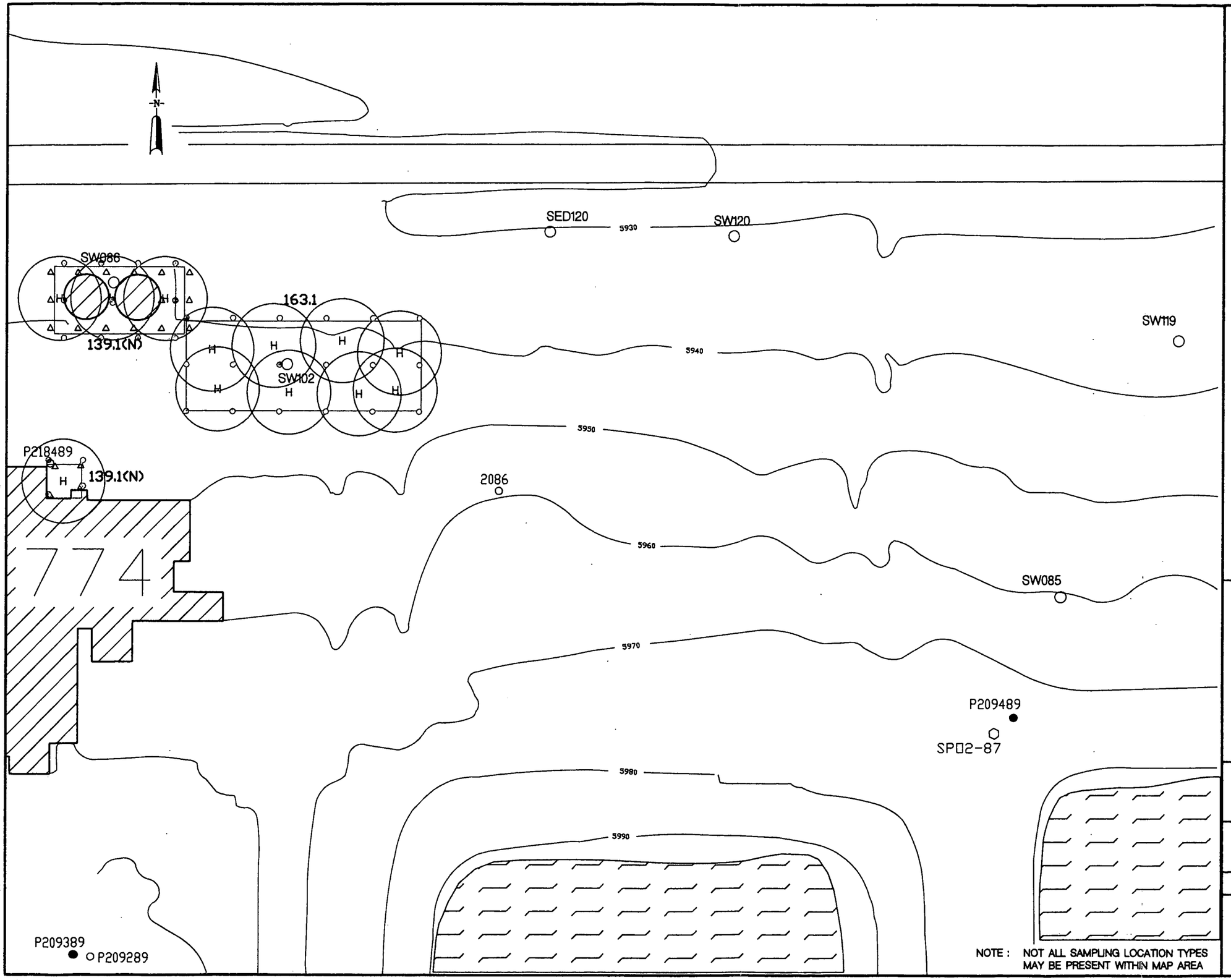
OPERABLE UNIT NO. 8
PHASE I RFI/RI WORK PLAN

FIGURE 6-9

PROPOSED SAMPLING LOCATIONS:
IHSS Nos.: 118.2 & 150.7

NOTE: NOT ALL SAMPLING LOCATION TYPES MAY BE PRESENT WITHIN MAP AREA


150.1
771
774
139.1(N)
5950
5960
5970
5980
150.3
H
5970
P209389
P209289
SP01-87
139.2
139.1(S)
137
701
118.1
144(N)
144(S)
776
IHSS4
NOTE : NOT ALL SAMPLING LOCATION TYPES MAY BE PRESENT WITHIN MAP AREA
MAP LEGEND
ROADWAYS
SURFACE WATER FEATURES
BUILDINGS AND NUMBERS
137 INDIVIDUAL HAZARDOUS SUBSTANCE SITES AND NUMBERS
EXISTING SAMPLING LOCATION
SW121 SURFACE WATER SAMPLING
SED124 SURFACE WATER SEDIMENT
P207589 BEDROCK WELL
P219589 ALLUVIAL WELL
BH33-87 BOREHOLE
560 PRE-1986 MONITOR WELL
PROPOSED SAMPLING LOCATION
SOIL GAS SURVEY
SOIL BORING
SHALLOW SOIL SAMPLE
H HPGe SET UP LOCATION
DIAMETER OF DETECTION
SCALE
0 50 100
CONTROLLED AREA
OU8
RFP BOUNDARY
N
U.S. DEPARTMENT OF ENERGY
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Golden Colorado
OPERABLE UNIT NO. 8
PHASE I RFI/RI WORK PLAN
FIGURE 6-8
PROPOSED SAMPLING LOCATIONS:
IHSS Nos.: 118.1, 137, 139.1(S), 139.2, 144, & 150.3



MAP LEGEND

ROADWAYS

SURFACE WATER FEATURES

BUILDINGS AND NUMBERS

137 INDIVIDUAL HAZARDOUS SUBSTANCE SITES AND NUMBERS

EXISTING: SAMPLING LOCATION

SW121 ○ SURFACE WATER SAMPLING

SED124 ○ SURFACE WATER SEDIMENT

P207589 ● BEDROCK WELL

P219589 ○ ALLUVIAL WELL

BH33-87 ⬡ BOREHOLE

560 △ PRE-1986 MONITOR WELL

PROPOSED: SAMPLING LOCATION

○ SOIL GAS SURVEY

× SOIL BORING

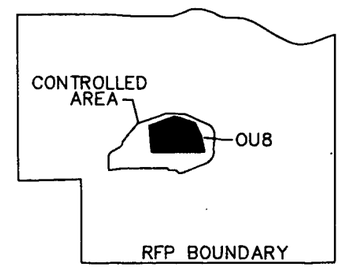
△ SHALLOW SOIL SAMPLE

H HPGe SET UP LOCATION

DIAMETER OF DETECTION

SCALE

0 50 100



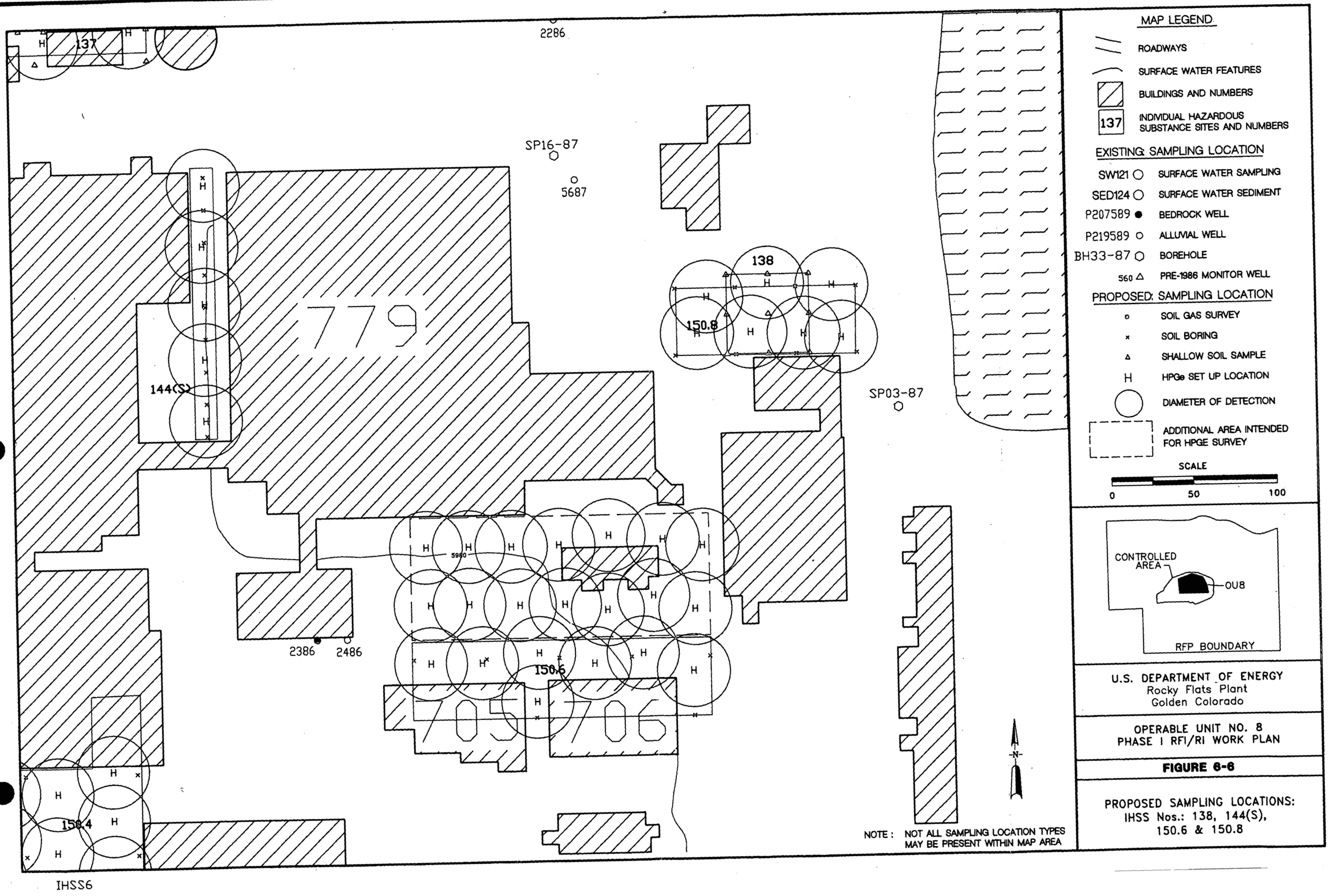
NOTE : NOT ALL SAMPLING LOCATION TYPES MAY BE PRESENT WITHIN MAP AREA

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PHASE I RFI/RI WORK PLAN

FIGURE 6-7

PROPOSED SAMPLING LOCATIONS:
IHSS Nos.: 139.1(N) & 163.1

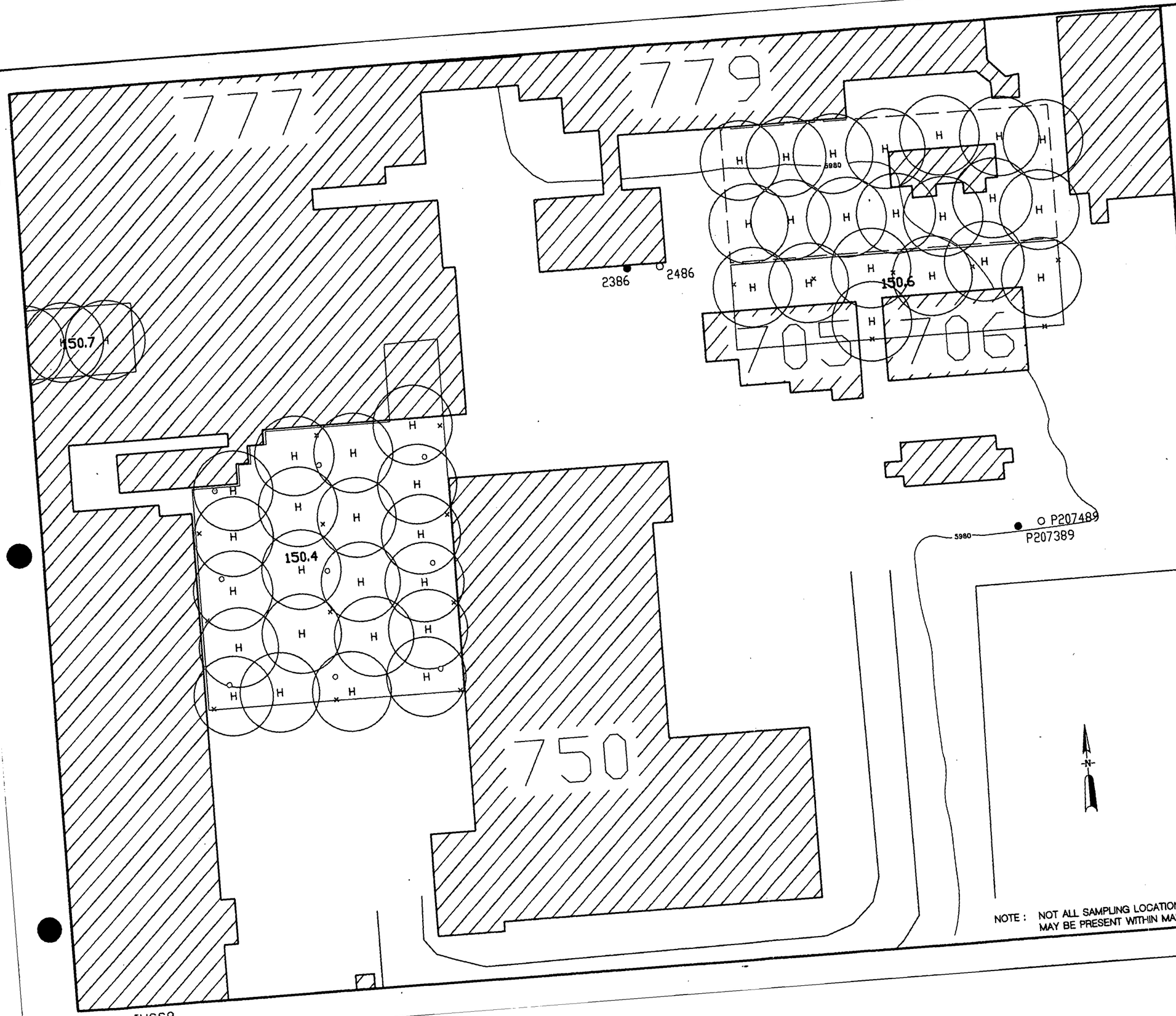


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FIGURE 6-6

PROPOSED SAMPLING LOCATIONS:
IHSS Nos.: 138, 144(S),
150.6 & 150.8

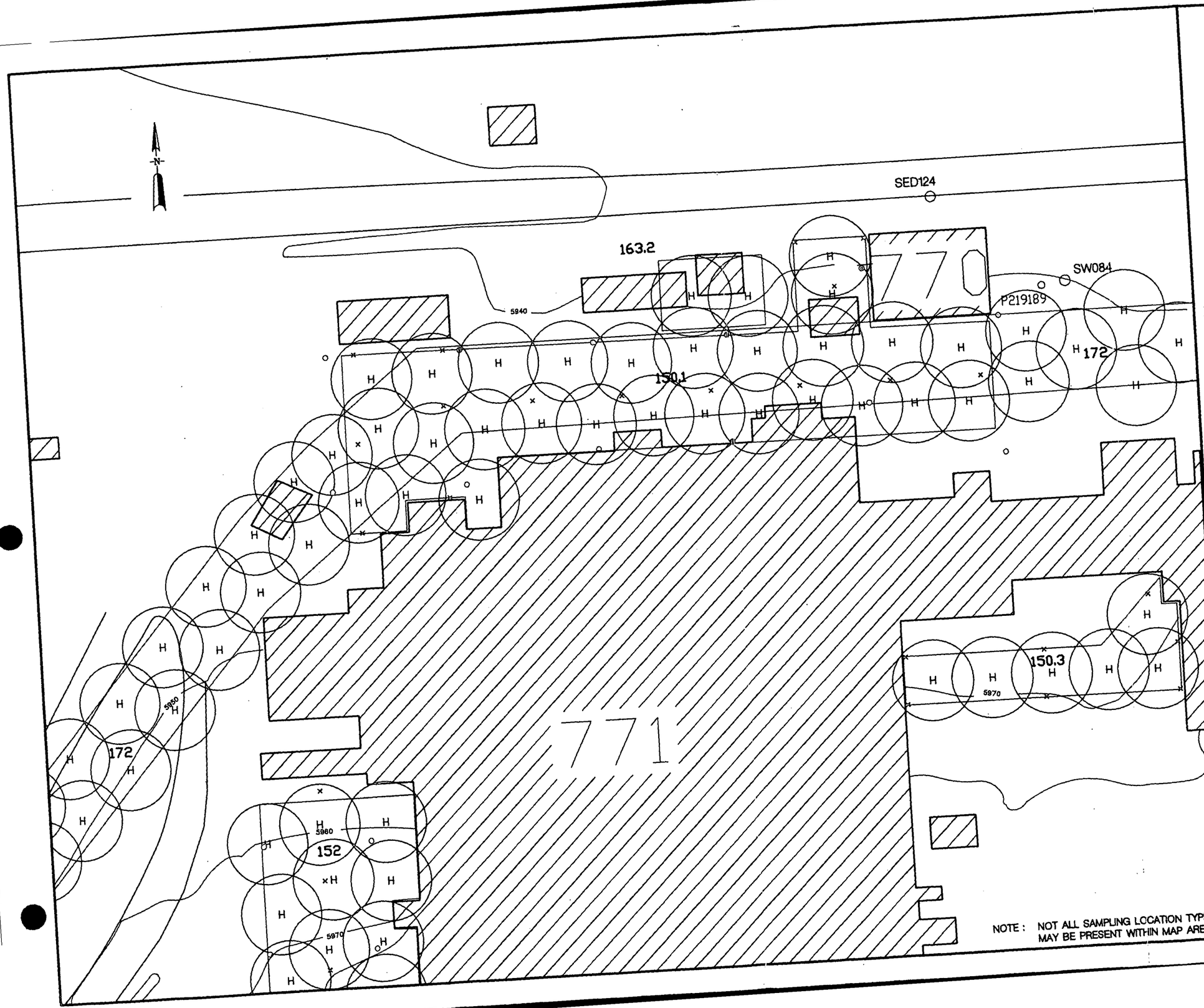


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PHASE I RFI/RI WORK PLAN

FIGURE 6-5

PROPOSED SAMPLING LOCATIONS:
IHSS Nos.: 150.4



MAP LEGEND

ROADWAYS

SURFACE WATER FEATURES

BUILDINGS AND NUMBERS

137 INDIVIDUAL HAZARDOUS SUBSTANCE SITES AND NUMBERS

EXISTING SAMPLING LOCATION

SW121 ○ SURFACE WATER SAMPLING

SED124 ○ SURFACE WATER SEDIMENT

P207589 ● BEDROCK WELL

P219589 ○ ALLUVIAL WELL

BH33-87 ○ BOREHOLE

560 △ PRE-1986 MONITOR WELL

PROPOSED SAMPLING LOCATION

○ SOIL GAS SURVEY

× SOIL BORING

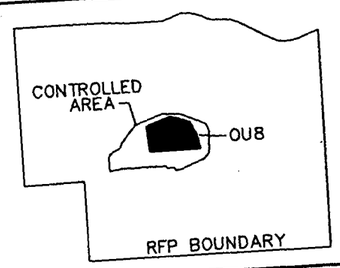
△ SHALLOW SOIL SAMPLE

H HPGe SET UP LOCATION

DIAMETER OF DETECTION

SCALE

0 50 100



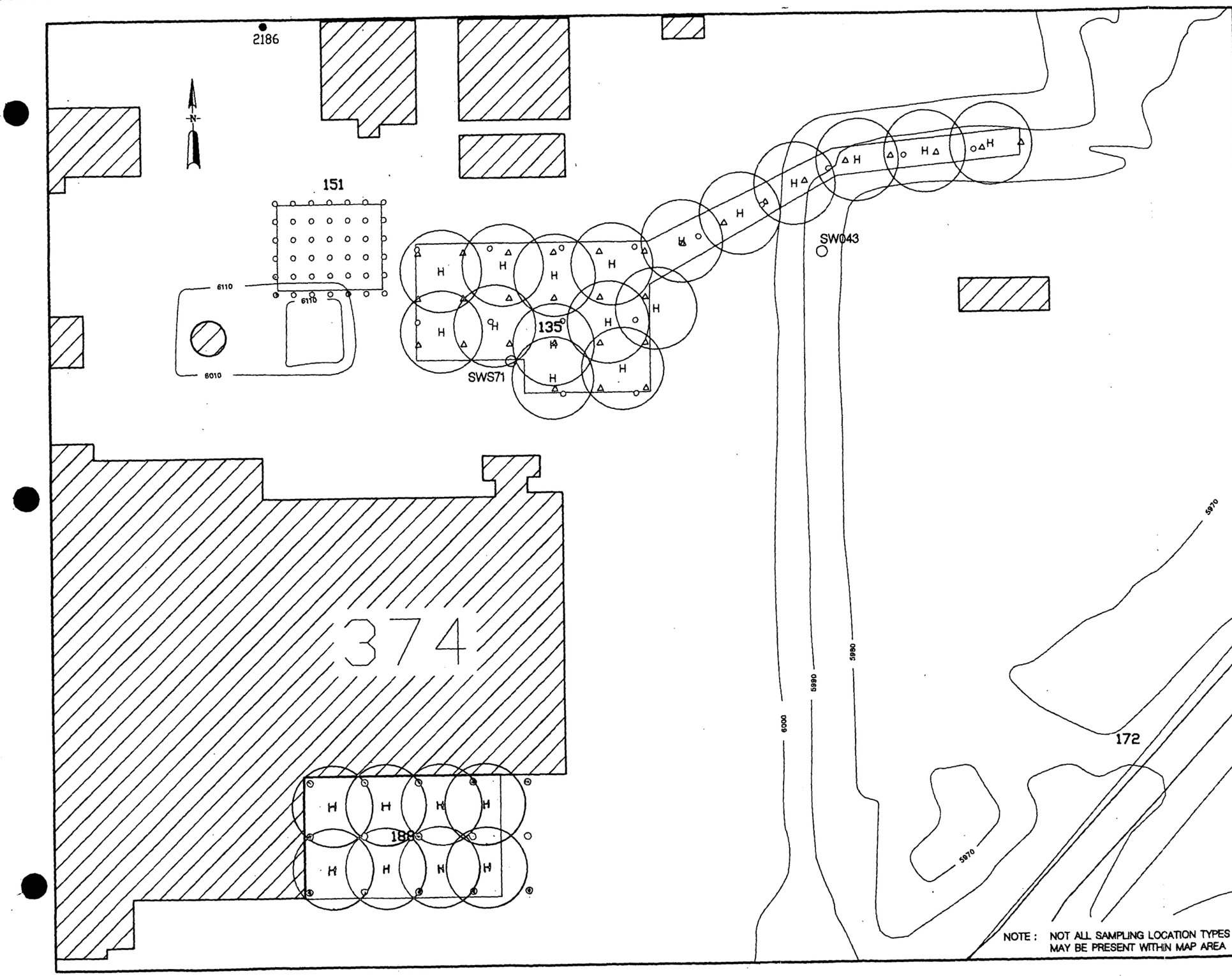
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Golden Colorado

OPERABLE UNIT NO. 8
PHASE I RFI/RI WORK PLAN

FIGURE 6-4

PROPOSED SAMPLING LOCATIONS:
IHSS Nos.: 150.1, 150.3 & 163.2

NOTE : NOT ALL SAMPLING LOCATION TYPES MAY BE PRESENT WITHIN MAP AREA



MAP LEGEND

ROADWAYS

SURFACE WATER FEATURES

BUILDINGS AND NUMBERS

137 INDIVIDUAL HAZARDOUS SUBSTANCE SITES AND NUMBERS

EXISTING: SAMPLING LOCATION

SW121 ○ SURFACE WATER SAMPLING

SED124 ○ SURFACE WATER SEDIMENT

P207589 ● BEDROCK WELL

P219589 ○ ALLUVIAL WELL

BH33-87 ⬡ BOREHOLE

560 △ PRE-1986 MONITOR WELL

PROPOSED: SAMPLING LOCATION

○ SOIL GAS SURVEY

× SOIL BORING

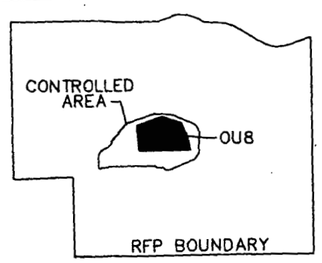
△ SHALLOW SOIL SAMPLE

H HPGe SET UP LOCATION

DIAMETER OF DETECTION

SCALE

0 50 100



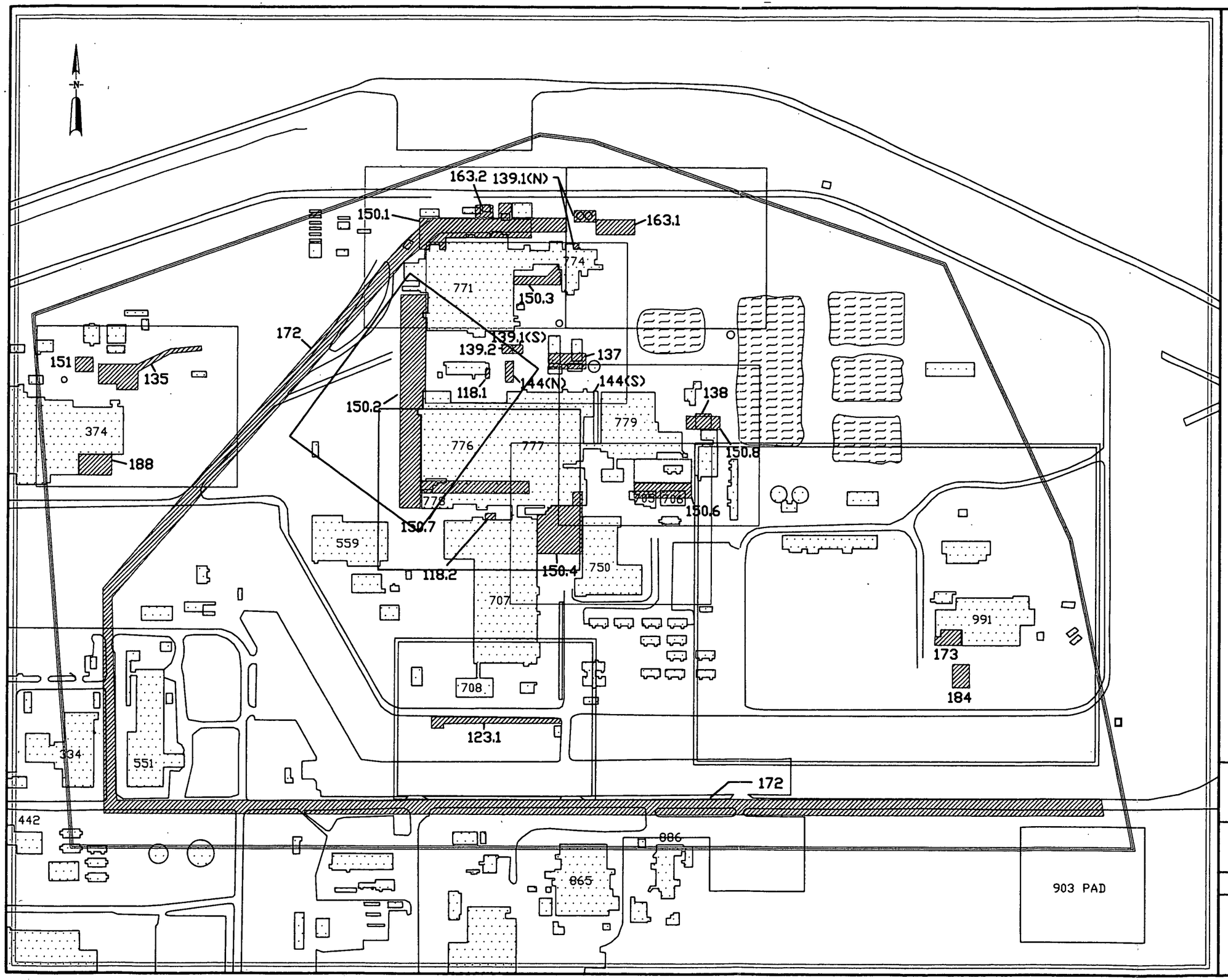
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Golden Colorado

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PHASE I RFI/RI WORK PLAN

FIGURE 6-3

PROPOSED SAMPLING LOCATIONS:
IHSS Nos.: 135, 151 & 188

NOTE : NOT ALL SAMPLING LOCATION TYPES MAY BE PRESENT WITHIN MAP AREA



MAP LEGEND

- ROADWAYS
- 991 BUILDINGS AND NUMBERS
- 137 INDIVIDUAL HAZARDOUS SUBSTANCE SITES (IHSS) AND NUMBERS
- EVAPORATION PONDS
- OU8 BOUNDARY

INDEX TO IHSS LOCATION MAPS

- FIGURE 6-3
- FIGURE 6-4
- FIGURE 6-5
- FIGURE 6-6
- FIGURE 6-7
- FIGURE 6-8
- FIGURE 6-9
- FIGURE 6-10
- FIGURE 6-11
- FIGURE 6-12
- FIGURE 6-13

SCALE

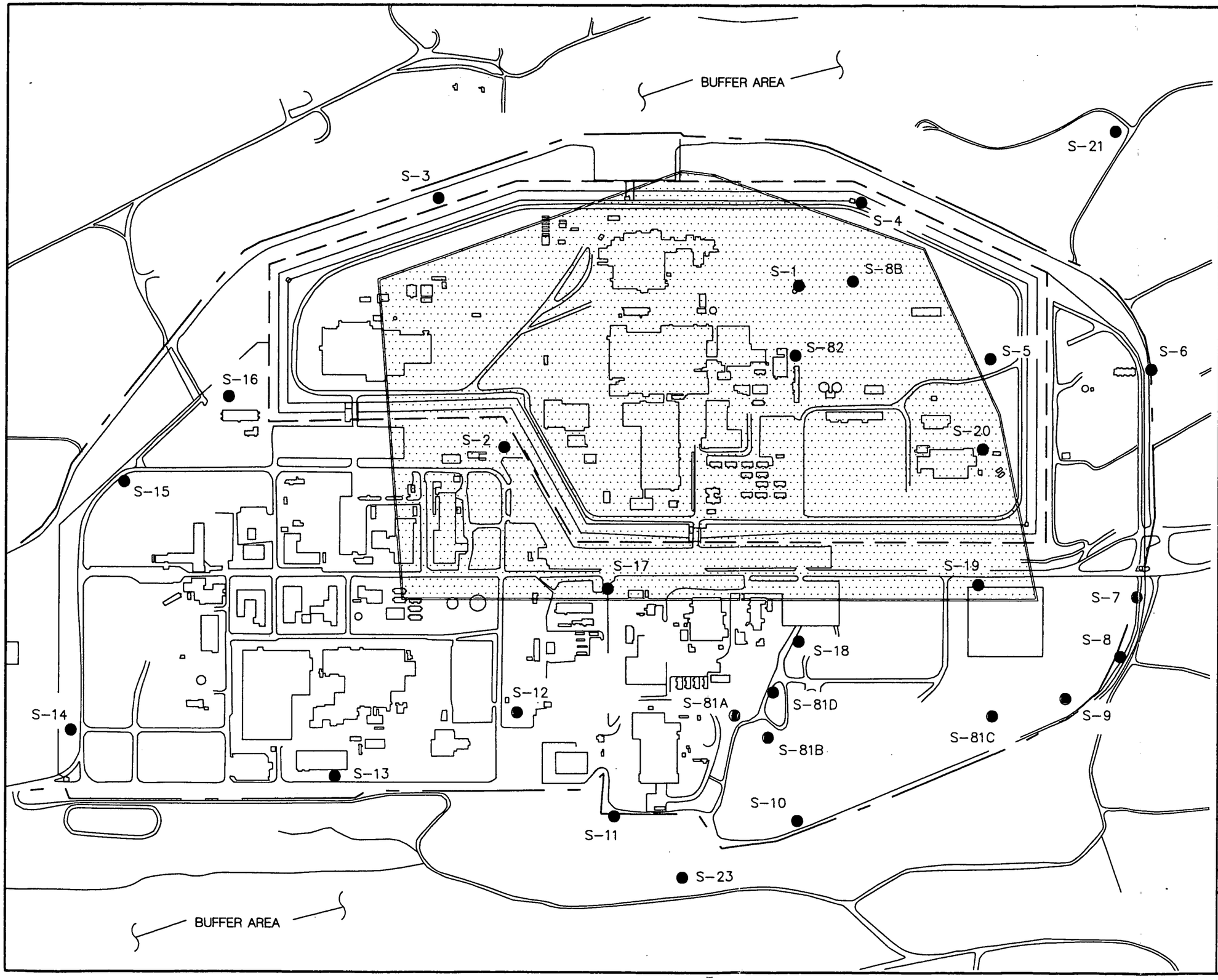
0 300 600

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Golden Colorado

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FIGURE 6-2

INDEX MAP TO FIGURES 6-3 TO 6-13



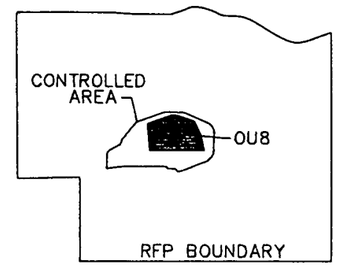
LEGEND

- S-21 — AIR SAMPLING SITE
- OPERABLE UNIT 8
- CONTROLLED AREA
- PROTECTED AREA

-N-

SCALE

0 500 1000

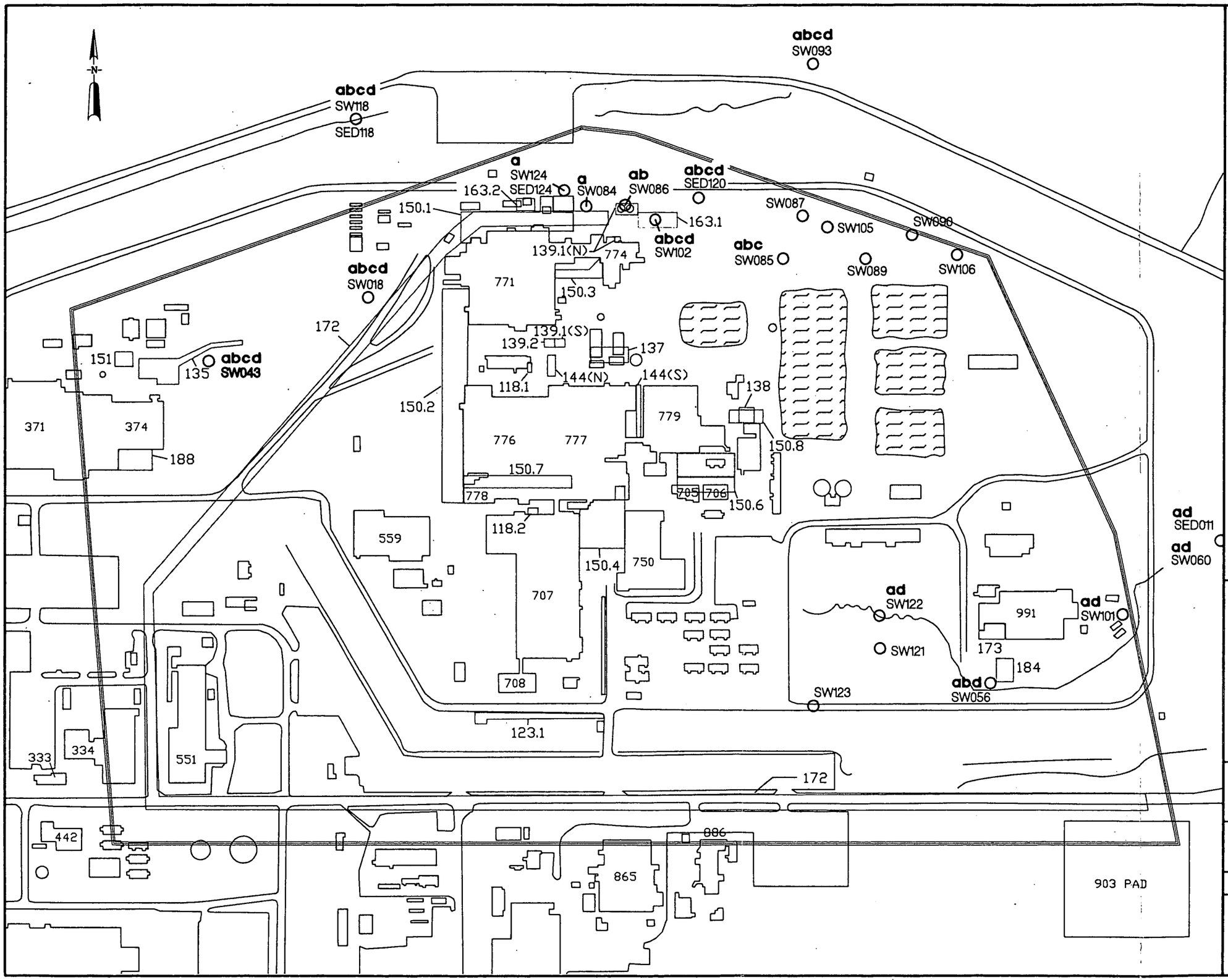


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Rocky Flats Plant
Golden Colorado

OPERABLE UNIT NO. 8
PHASE I RFI/RI WORK PLAN

FIGURE 5-3

LOCATION OF ONSITE AIR SAMPLERS



MAP LEGEND

- ROADWAYS
- SURFACE WATER FEATURES
- 991 — BUILDINGS AND NUMBERS
- 137 — INDIVIDUAL HAZARDOUS SUBSTANCE SITES AND NUMBERS

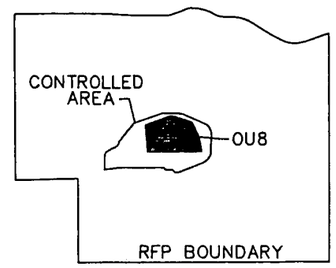
EXISTING SAMPLING LOCATION

- SW121 — SURFACE WATER SAMPLING
- SED124 — SURFACE WATER SEDIMENT

- **a** — RADIONUCLIDE DATA
- **b** — TRACE METAL DATA
- **c** — INORGANICS DATA
- **d** — VOC DATA

SCALE

0 300 600

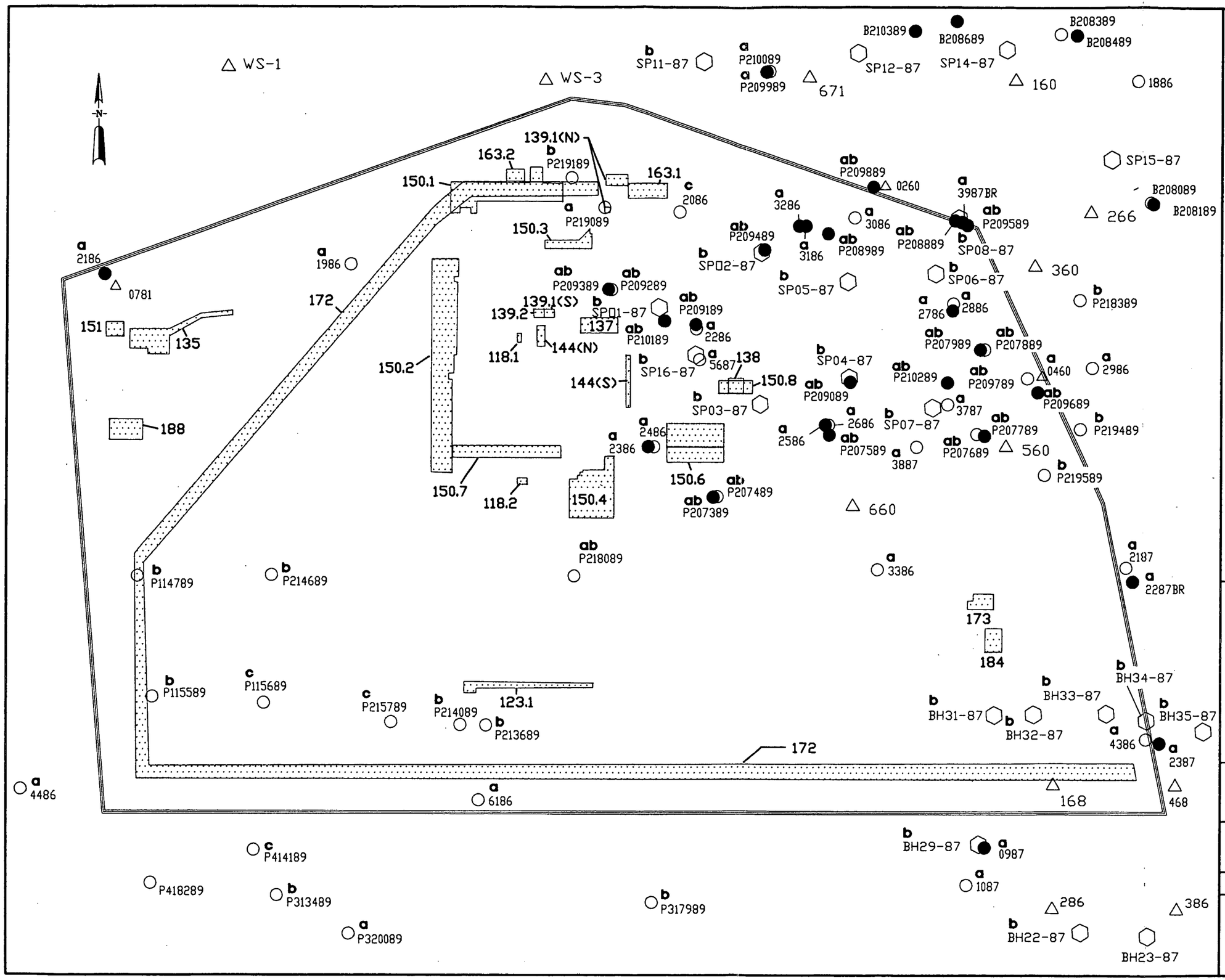


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FIGURE 2-7

TYPES OF ANALYTICAL DATA AVAILABLE FOR SURFACE WATER AND SEDIMENT MONITORING SITES



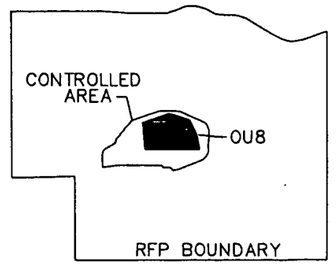
MAP LEGEND

- OU8 BOUNDARY
- 137 — INDIVIDUAL HAZARDOUS SUBSTANCE SITES AND NUMBERS
- a — GROUNDWATER CHEMISTRY DATA
- b — BOREHOLE SAMPLE CHEMISTRY DATA
- c — NO DATA AVAILABLE

NOTE: THE ABSENCE OF ONE OF THE ABOVE IDENTIFIERS SIGNIFIES THAT NO DATA WAS REQUESTED FOR THIS WELL

P207589 ● BEDROCK WELL
P219589 ○ ALLUVIAL WELL
BH33-87 ⬡ BOREHOLE
560 △ ABANDONED WELL

SCALE
0 300 600

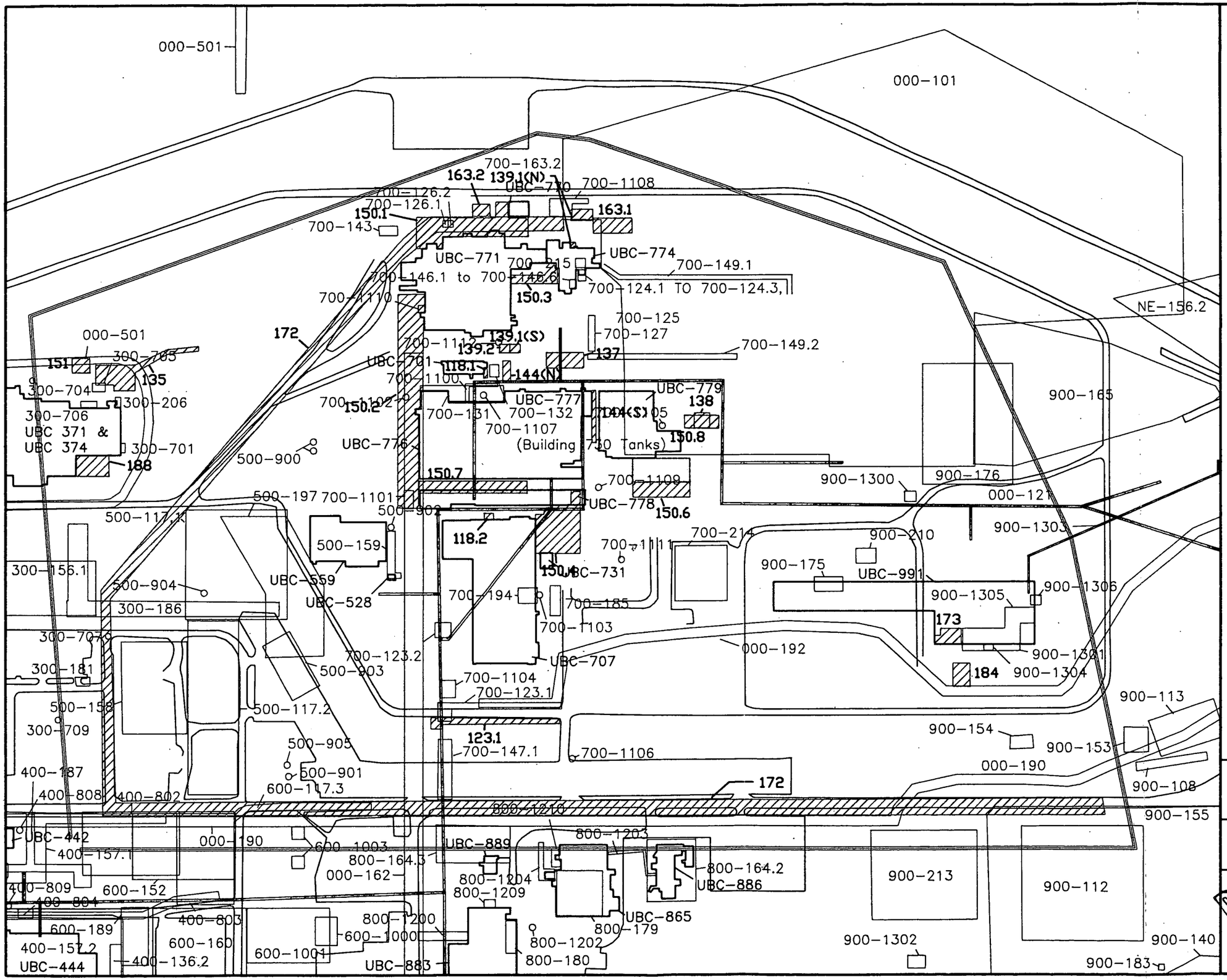


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PHASE I RFI/RI WORK PLAN

FIGURE 2-2

TYPES OF ANALYTICAL DATA AVAILABLE FOR WELLS, PIEZOMETERS AND BOREHOLES



MAP LEGEND

ROADWAYS

OU8 BOUNDARY

137 — INDIVIDUAL HAZARDOUS SUBSTANCE SITES CONTAINED WITHIN THE OU8 WORK PLAN

165 — INDIVIDUAL HAZARDOUS SUBSTANCE SITES/POTENTIAL AREAS OF CONCERN NOT CONTAINED IN THE OU8 WORK PLAN

UBC-731 — UNDERBUILDING CONTAMINATION IN PROXIMITY TO OU8

DRAFT

N

SCALE

0 300 600

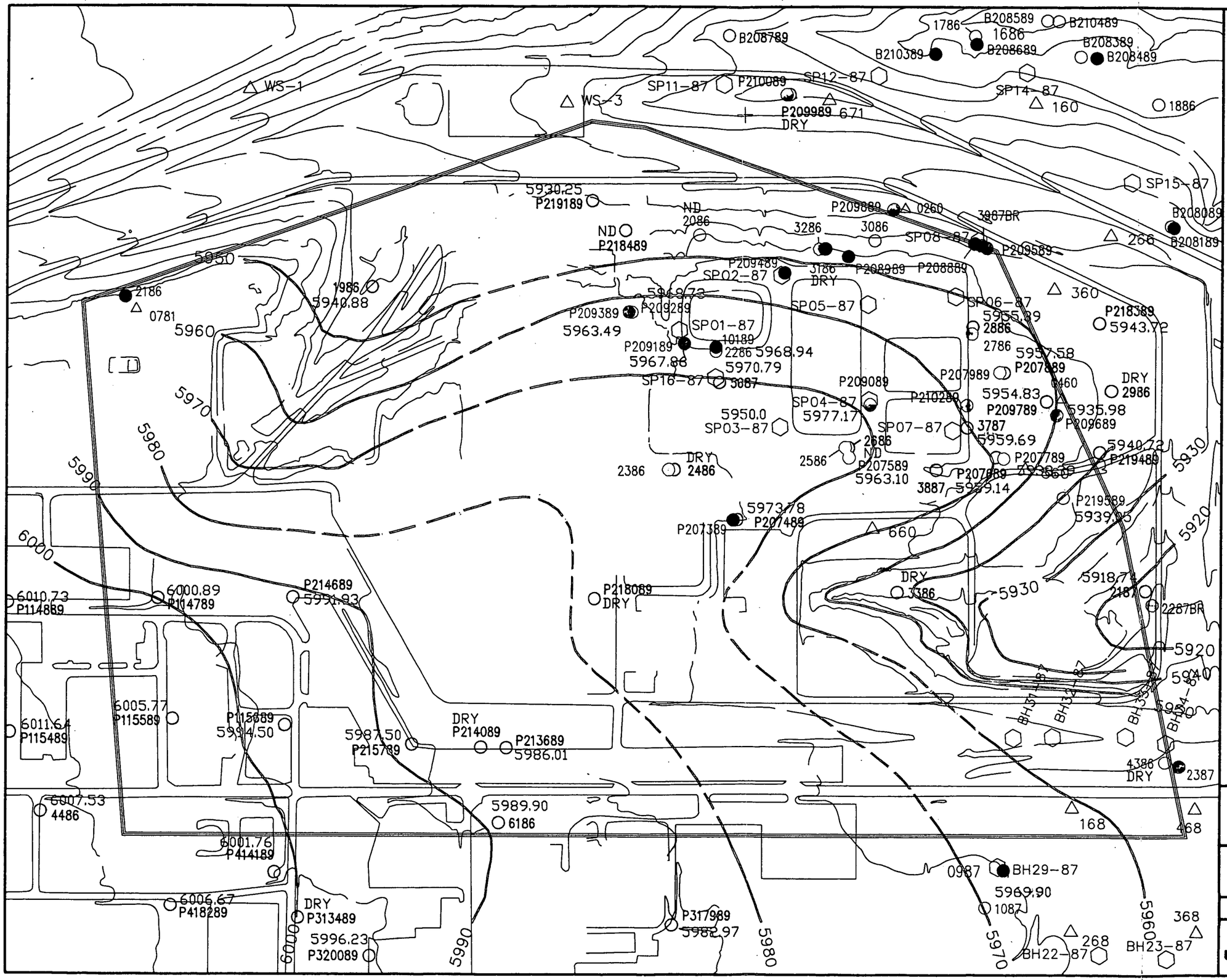
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OPERABLE UNIT NO. 8
PHASE I RFI/RI WORK PLAN

FIGURE 2-1

LOCATION OF ALL IHSSs WITHIN OU8 BOUNDARY

DRAFT



LEGEND

CONTOURS REFLECT DATA POINTS FROM WELLS OPEN TO THE UPPERMOST HYDROSTRATIGRAPHIC UNIT (HSU1)

6042.2 — WATER LEVEL ELEVATION ABOVE SEA LEVEL

6012 — WATER LEVEL CONTOURS

5996 — SURFACE CONTOURS

171 — INDIVIDUAL HAZARDOUS SUBSTANCE SITES

OU 8 BOUNDARY

- ALLUVIAL MONITORING WELL
- BEDROCK MONITORING WELL

HYDROSTRATIGRAPHIC UNIT

4089	SURFICIAL MATERIALS (HSU1)
9189	SURFICIAL MATERIALS / UPPERMOST SANDSTONE IN HYDRAULIC CONNECTION (HSU1)
9489	UPPERMOST SANDSTONE
0289	CLAYSTONE
8889	DEEPER SANDSTONE

ALL WATER LEVEL ELEVATION DATA COLLECTED JANUARY, 1991

CONTOUR INTERVAL: 10'

N

SCALE

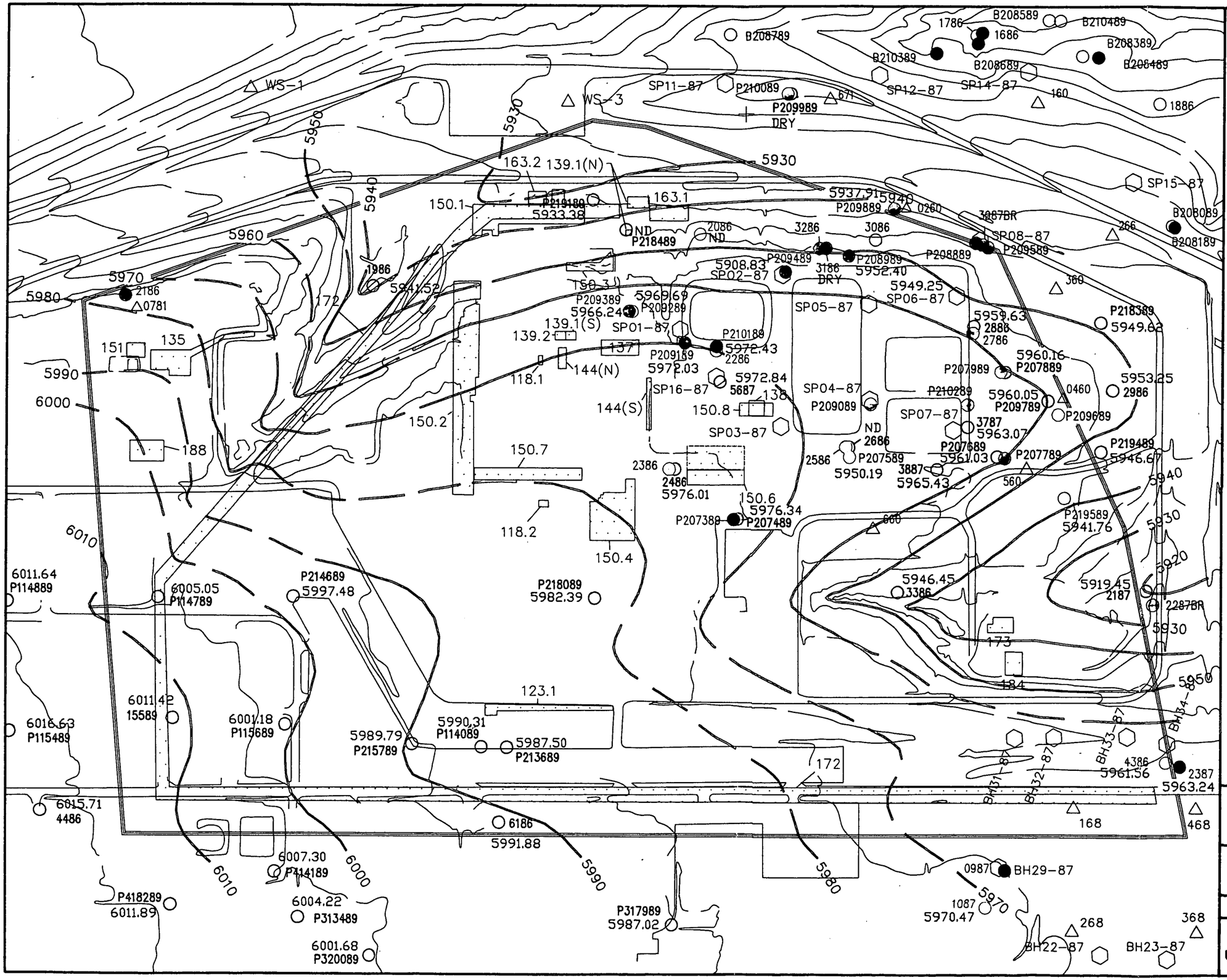
0 300 600

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PHASE I RFI/RI WORK PLAN

FIGURE 1-28

LOW WATER LEVEL MAP
UPPERMOST HYDROSTRATIGRAPHIC UNIT



LEGEND

CONTOURS REFLECT DATA POINTS FROM WELLS OPEN TO THE UPPERMOST HYDROSTRATIGRAPHIC UNIT (HSU1)

6042.2 — WATER LEVEL ELEVATION ABOVE SEA LEVEL

6012 — WATER LEVEL CONTOURS

5996 — SURFACE CONTOURS

171 — INDIVIDUAL HAZARDOUS SUBSTANCE SITES

OU 8 BOUNDARY

○ ALLUVIAL MONITORING WELL

● BEDROCK MONITORING WELL

HYDROSTRATIGRAPHIC UNIT

4089	SURFICIAL MATERIALS (HSU1)
9189	SURFICIAL MATERIALS / UPPERMOST SANDSTONE IN HYDRAULIC CONNECTION (HSU1)
9489	UPPERMOST SANDSTONE
0289	CLAYSTONE
8889	DEEPER SANDSTONE

ALL WATER LEVEL ELEVATION DATA COLLECTED APRIL, 1992

CONTOUR INTERVAL: 10'

-N-

SCALE

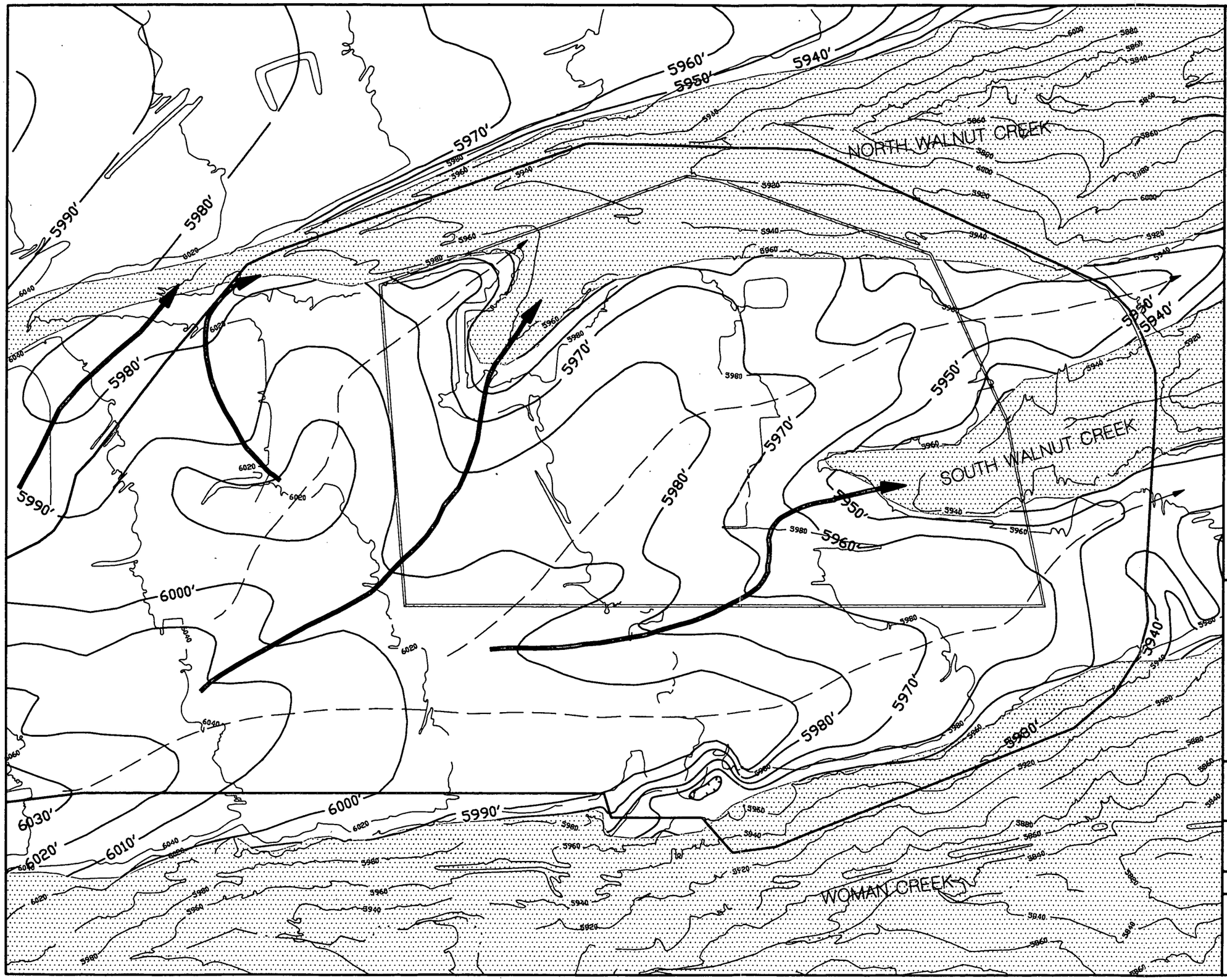
0 300 600

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OPERABLE UNIT NO. 8
PHASE I RFI/RI WORK PLAN

FIGURE 1-27

**HIGH WATER LEVEL MAP
UPPERMOST HYDROSTRATIGRAPHIC UNIT**



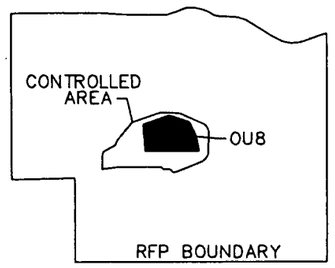
LEGEND

- 5940' — PEDIMENT ELEVATION
- 5880 — GROUND SURFACE ELEVATION
- PALEO RIDGE
- PALEO DRAINAGE
- CREEKS
- OU 8 BOUNDARY
- AREA SUBJECT TO EROSION AT PEDIMENT DUE TO LOSS OF ROCKY FLATS ALLUVIUM
- AREA OF PEDIMENT PRESERVED BY ROCKY FLATS ALLUVIUM

N

SCALE

0 500 1000



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PHASE I RFI/RI WORK PLAN

FIGURE 1-26

MAP OF PRESENT-DAY TOPOGRAPHY AND SUBSURFACE, PRESERVED PRE-ROCKY FLATS ALLUVIUM PEDIMENT SURFACE

E P210089 NORTH

P209489

IHSS 138, 150.8

P207589 2586

3386 Ties to B-B'

IHSS 173

IHSS 184

SOUTH BH31-87 E'

5980
5970
5960
5950
5940
5930
5920
5910
5900
5890

Elevation in Feet MSL

INTERPRETATION 1
No. 1 Sandstone

INTERPRETATION 2
No. 1 Sandstone

11.2- to 22.9 ft.

573' 600' 461' 602'

34'

10'
VERT. EXAG. X 20
0 200'

NOTE: BEDROCK GEOLOGY IS BASED ON THE GEOLOGICAL CHARACTERIZATION REPORT (EG&G, 1991h) AND IS A CONCEPTUAL INTERPRETIVE MODEL.

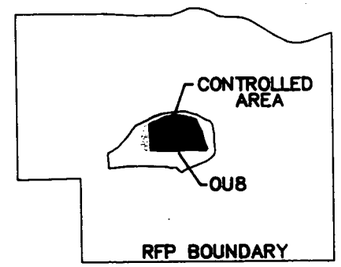
LEGEND

P110189 WELL NO.
QUADRANT SEQUENCE YEAR DRILLED

GEOLOGICAL LITHOLOGIES

GROUND SURFACE
ARTIFICIAL FILL
CALICHE
COLLUVIUM
CLAY
SILT
SAND
GRAVEL
COBBLES
ROCKY FLATS ALLUVIUM
WELL SCREEN
HSU 1 WATER LEVEL- 4/92
TOP OF BEDROCK
INTERBEDDED CLAYSTONES
HSU 1 WATER LEVEL-1/91
SILTSTONES
SANDSTONES
ARAPAHOE FORMATION
OTHER WATER LEVELS
No. 1 SANDSTONE (Dashed where Inferred)
1/91
4/92
BOTTOM OF WELL

0 200' 400'
SCALE IN FEET



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PHASE I RFI/RI WORK PLAN

FIGURE 1-25

GEOLOGICAL CROSS SECTION

E-E'

NORTH

D

SOUTH

D'

P219189 | P209389 | P209189 | 2386 | P218089 | P213689 | 6186

Ties to A–A' | Ties to B–B'

IHSS 123.1 | IHSS 172 | IHSS 150.4 | IHSS 150.3 | IHSS 150.6 | IHSS 144 | IHSS 150.1

Elevation in Feet MSL

6000 | 5990 | 5980 | 5970 | 5960 | 5950 | 5940 | 5930 | 5920

INTERPRETATION 2
No. 1 SANDSTONE

INTERPRETATION 1
No. 1 SANDSTONE

INTERPRETATION 2
No. 1 SANDSTONE

113.0 ft

117.3 ft

BOTTOM OF WELL
130.5 FEET BELOW
SURFACE

359' | 211' | 411' | 479' | 567' | 239'

10'
VERT.
EXAG. X 20
0 200'

NOTE: BEDROCK GEOLOGY IS BASED ON THE GEOLOGICAL CHARACTERIZATION REPORT (EG&G, 1991h) AND IS A CONCEPTUAL INTERPRETIVE MODEL.

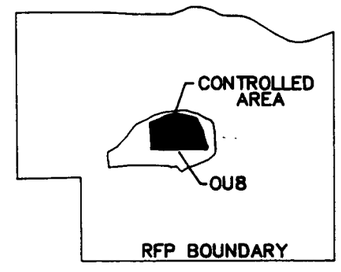
LEGEND

P110189 — WELL NO.
QUADRANT | SEQUENCE | YEAR DRILLED

GEOLOGICAL LITHOLOGIES

GROUND SURFACE
ARTIFICIAL FILL
CALICHE
COLLUVIUM
CLAY
SILT
SAND
GRAVEL
COBBLES
ROCKY FLATS ALLUVIUM
WELL SCREEN
HSU 1 WATER LEVEL– 4/92
TOP OF BEDROCK
INTERBEDDED CLAYSTONES
HSU 1 WATER LEVEL–1/91
SILTSTONES
SANDSTONES
ARAPAHOE FORMATION
No. 1 SANDSTONE (Dashed where inferred)
OTHER WATER LEVELS 4/92 1/91
BOTTOM OF WELL

0 200' 400'
SCALE IN FEET



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Golden Colorado

OPERABLE UNIT NO. 8
PHASE I RFI/RI WORK PLAN

FIGURE 1-24

GEOLOGICAL CROSS SECTION
D-D'

NORTH

C

SOUTH

C'

1986

P214689

P115689

P414189

IHSS 172

Ties to B–B'

IHSS 172

Elevation in Feet MSL

6010
6000
5990
5980
5970
5960
5950
5940
5930

10'
VERT.
EXAG. X 20
0
200'

984'
411'
472'

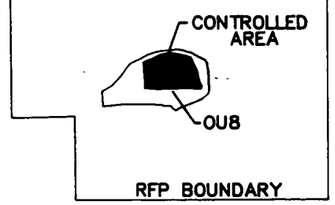
NOTE: BEDROCK GEOLOGY IS BASED ON THE GEOLOGICAL CHARACTERIZATION REPORT (EG&G, 1991h) AND IS A CONCEPTUAL INTERPRETIVE MODEL.

LEGEND

P110189 — WELL NO.
QUADRANT · SEQUENCE · YEAR DRILLED

GEOLOGICAL LITHOLOGIES

GROUND SURFACE
ARTIFICIAL FILL
CALICHE
COLLUVIUM
CLAY
SILT
SAND
GRAVEL
COBBLES
ROCKY FLATS ALLUVIUM
WELL SCREEN
HSU 1 WATER LEVEL– 4/92
TOP OF BEDROCK
INTERBEDDED CLAYSTONES
HSU 1 WATER LEVEL–1/91
SILTSTONES
SANDSTONES
ARAPAHOE FORMATION
No. 1 SANDSTONE (Dashed where inferred)
OTHER WATER LEVELS
4/92
1/91
BOTTOM OF WELL
0
200'
400'
SCALE IN FEET



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FIGURE 1-23

GEOLOGICAL CROSS SECTION
C-C'

WEST

B

EAST

B'

P114889 | P114789 | P214689 | P218089 | 3386 | 2287BR

IHSS 172

Ties to C-C'

Ties to D-D'

Ties to E-E'

IHSS 173

Elevation in Feet MSL

6020
6010
6000
5990
5980
5970
5960
5950
5940
5930
5920

INTERPRETATION 2 No. 1 SANDSTONE

INTERPRETATION 1 No. 1 SANDSTONE

INTERPRETATION 1 No. 1 SANDSTONE

INTERPRETATION 2 No. 1 SANDSTONE

10′
VERT.
EXAG. X 53.3
0 400′

483′ | 440′ | 985′ | 986′ | 843′

NOTE: BEDROCK GEOLOGY IS BASED ON THE GEOLOGICAL CHARACTERIZATION REPORT (EG&G, 1991h) AND IS A CONCEPTUAL INTERPRETIVE MODEL.

INTERPRETATION 1 No. 1 SANDSTONE

SCREEN BELOW GROUND SURFACE 81.41-88.46

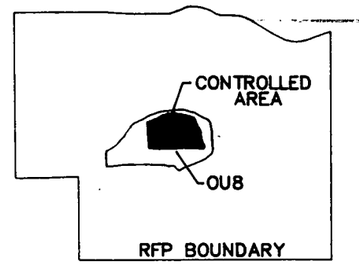
INTERPRETATION 2 No. 1 SANDSTONE

LEGEND

P110189 ← WELL NO.
QUADRANT | SEQUENCE | YEAR DRILLED

GEOLOGICAL LITHOLOGIES

GROUND SURFACE
ARTIFICIAL FILL
CALICHE
COLLUVIUM
CLAY
SILT
SAND
GRAVEL
COBBLES
ROCKY FLATS ALLUVIUM
WELL SCREEN
HSU 1 WATER LEVEL- 4/92
TOP OF BEDROCK
INTERBEDDED CLAYSTONES
HSU 1 WATER LEVEL-1/91
SILTSTONES
SANDSTONES
ARAPAHOE FORMATION
OTHER WATER 4/92 LEVELS
No. 1 SANDSTONE (Dashed where inferred)
1/91
BOTTOM OF WELL
0 400′ 800′
SCALE IN FEET



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FIGURE 1-22

GEOLOGICAL CROSS SECTION B-B'

WEST

A

EAST

A'

2186

P209189

P210189

P209089

P210289

P209689

Ties to D–D'

IHSS 172

IHSS 150.2

IHSS 139.1 (5) 139.2

IHSS 137

Elevation in Feet MSL

5990

5980

5970

5960

5950

5940

5930

5920

5910

INTERPRETATION 2
No. 1 SANDSTONE

INTERPRETATION 1
No. 1 SANDSTONE

INTERPRETATION 1
No. 1 SANDSTONE

10'

VERT.
EXAG. X 30

0

300'

99'

1838'

535'

320'

294'

NOTE: BEDROCK GEOLOGY IS BASED ON THE GEOLOGICAL CHARACTERIZATION REPORT (EG&G, 1991h) AND IS A CONCEPTUAL INTERPRETIVE MODEL.

LEGEND

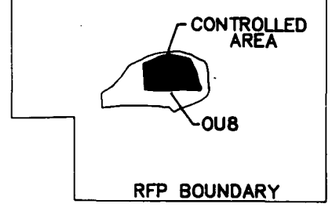
P110189 — WELL NO.
QUADRANT · SEQUENCE · YEAR DRILLED

GEOLOGICAL LITHOLOGIES

GROUND SURFACE
ARTIFICIAL FILL
CALICHE
COLLUVIUM
CLAY
SILT
SAND
GRAVEL
COBBLES
ROCKY FLATS ALLUVIUM
WELL SCREEN
HSU 1 WATER LEVEL– 4/92
TOP OF BEDROCK
INTERBEDDED CLAYSTONES
HSU 1 WATER LEVEL–1/91
SILTSTONES
SANDSTONES
ARAPAHOE FORMATION
No. 1 SANDSTONE
(Dashed where inferred
OTHER WATER LEVELS
4/92
1/91
BOTTOM OF WELL

0 300' 600'

SCALE IN FEET

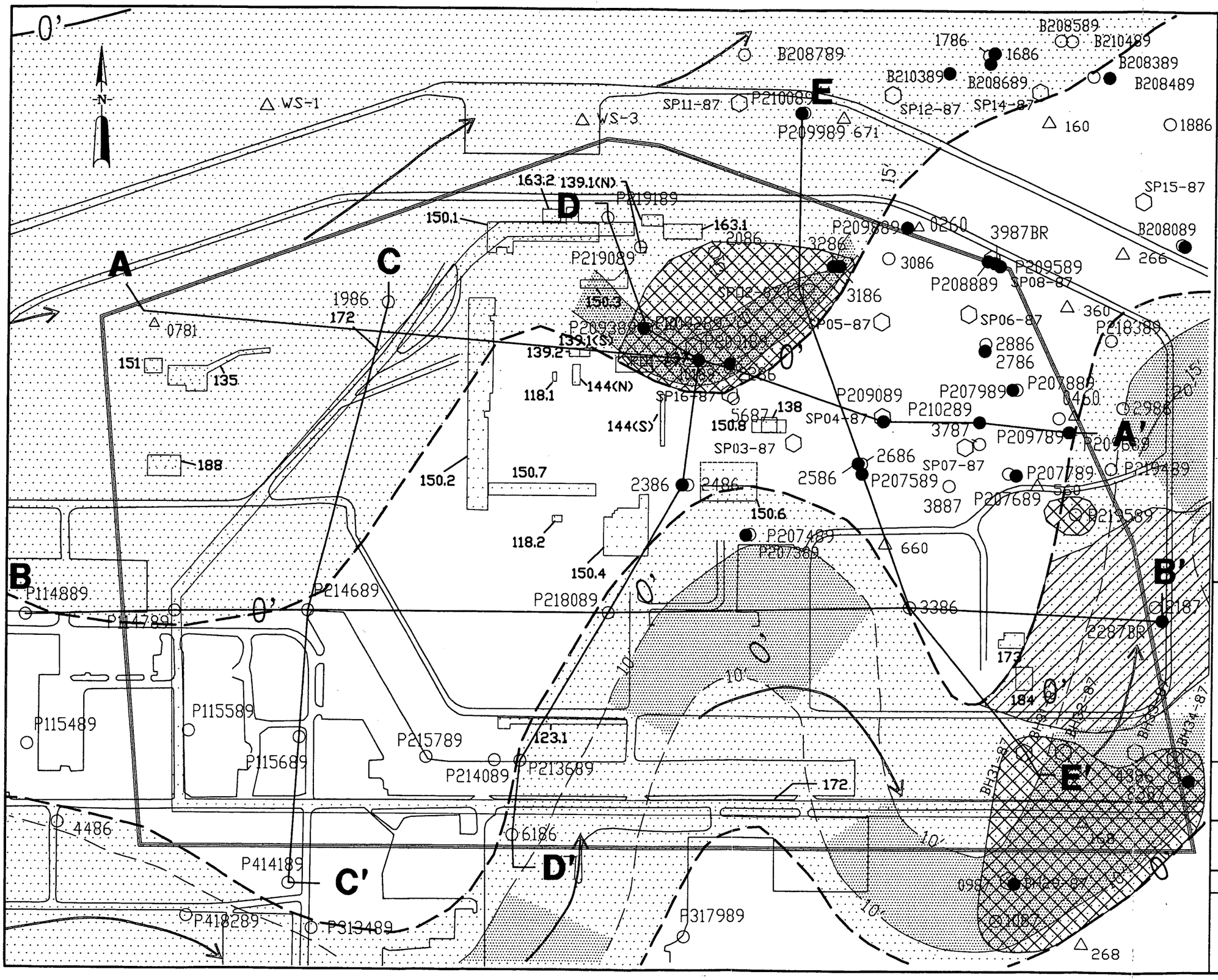


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FIGURE 1-21

GEOLOGICAL CROSS SECTION A-A'

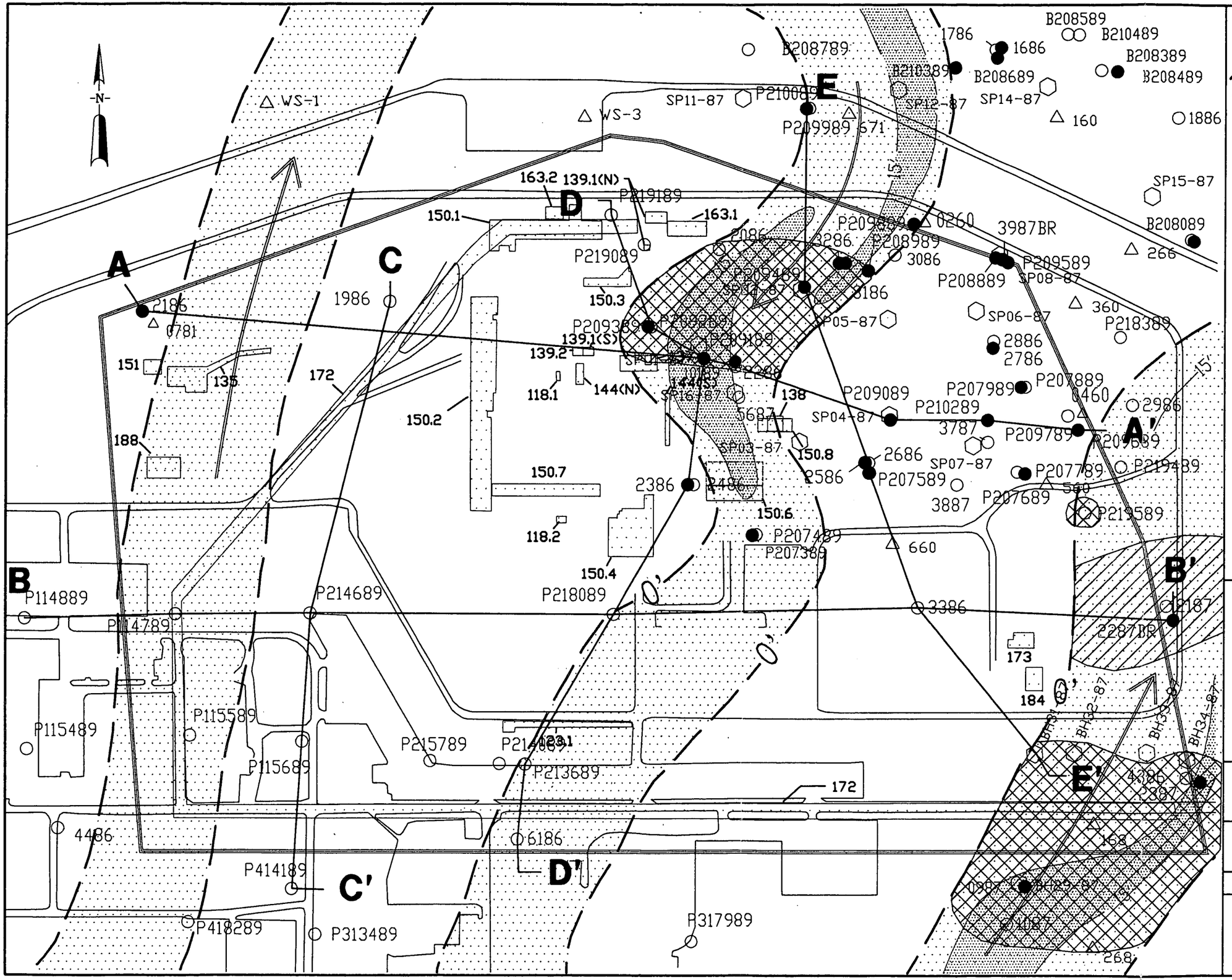


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PHASE I RFI/RI WORK PLAN

FIGURE 1-20

ISOPACH OF NO. 1 SANDSTONE INTERPRETATION 2

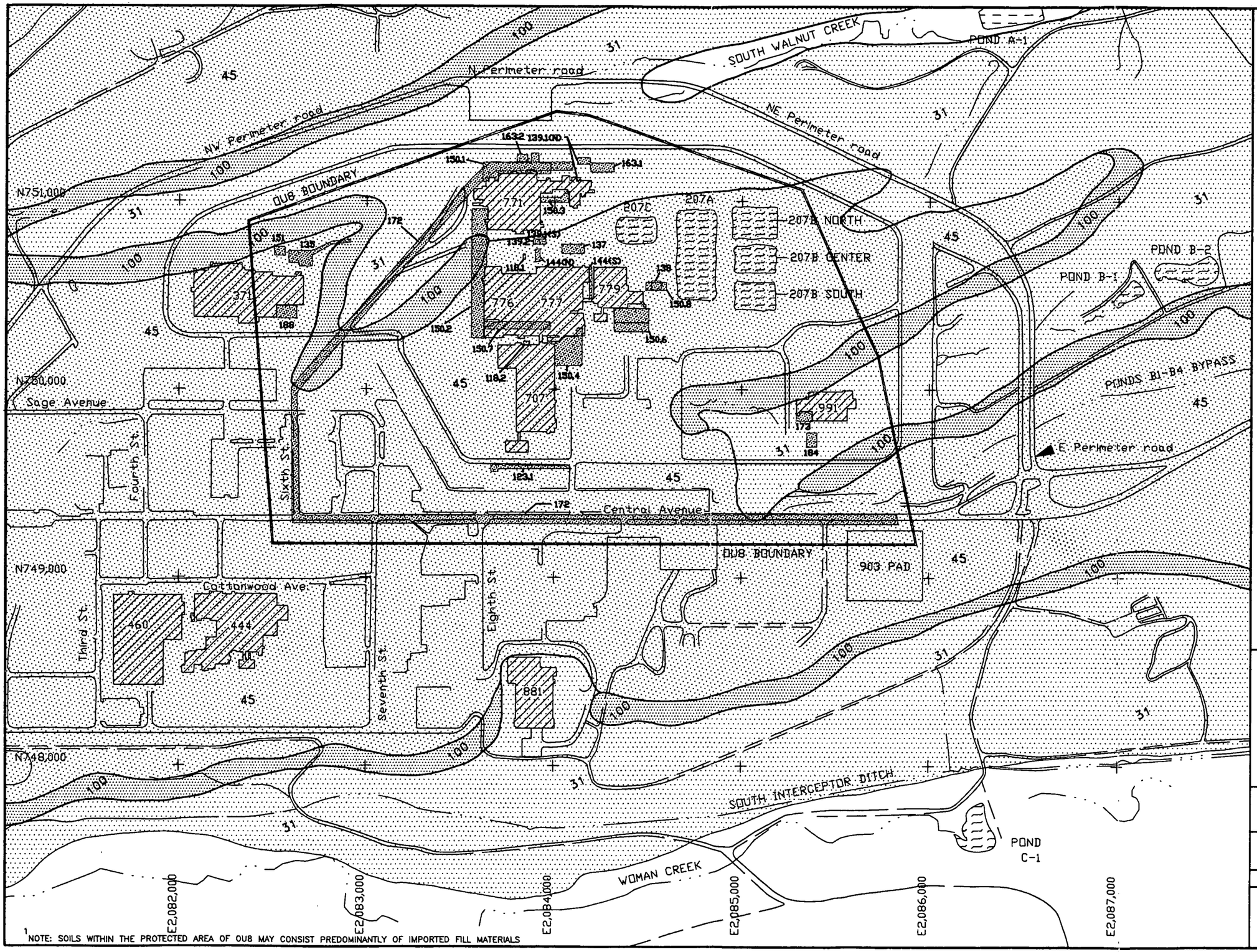


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PHASE I RFI/RI WORK PLAN

FIGURE 1-19

ISOPACH OF NO. 1 SANDSTONE INTERPRETATION 1



MAP LEGEND

- OPERABLE UNIT 8 BOUNDARY
- STREAMS DITCHES DRAINAGE FEATURES
- PAVED ROADS
- DIRT ROADS
- SURFACE WATER IMPOUNDMENTS
- BUILDINGS
- INDIVIDUAL HAZARDOUS SUBSTANCE SITES

SOIL SERIES

- 100 NEDERLAND
- 45 FLATIRONS[1]
- 31 DENVER-KUTCH-MIDWAY

FEET

0 500 1000

CONTROLLED AREA — OU8 — RFP BOUNDARY

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Golden Colorado

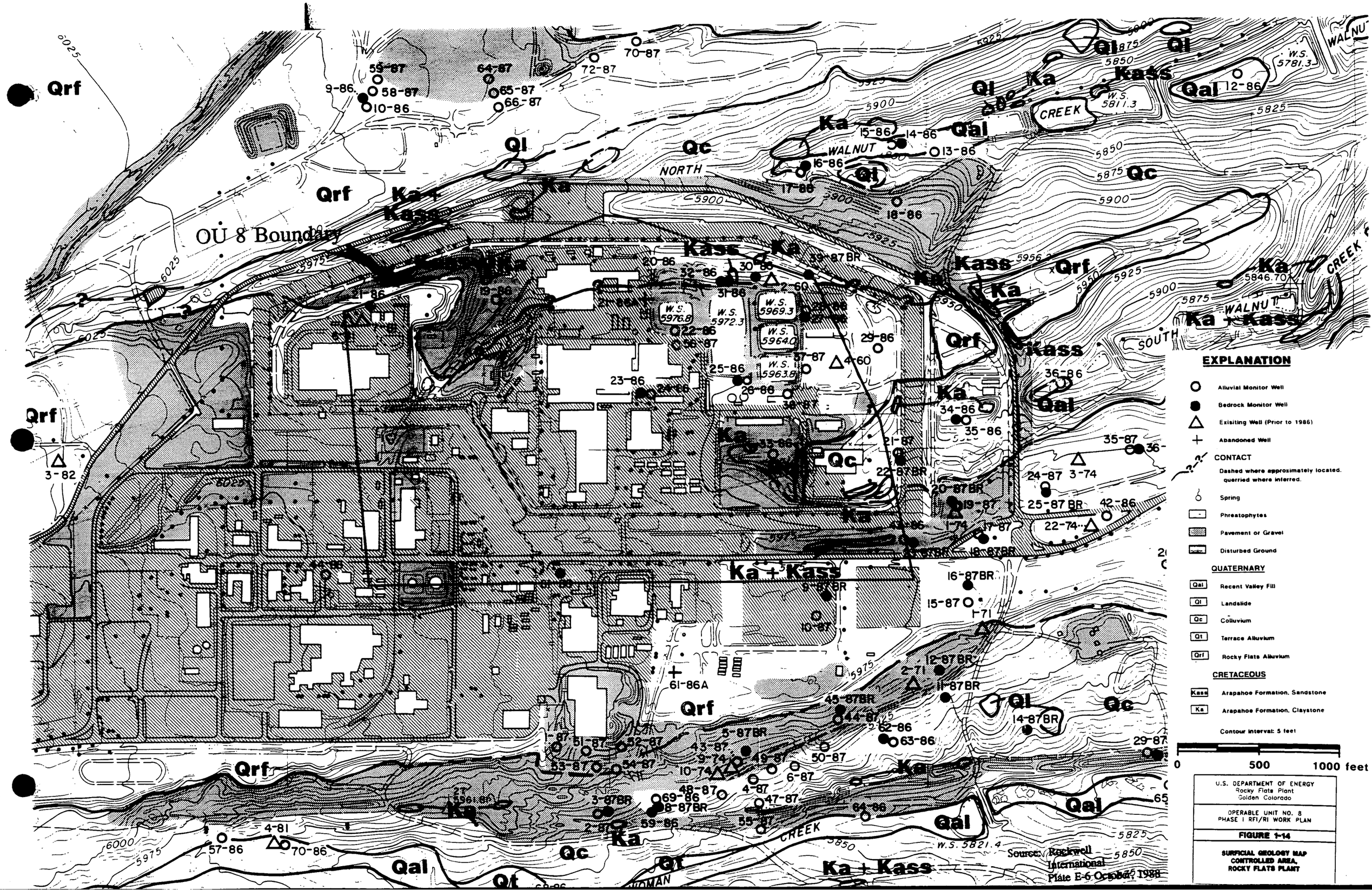
OPERABLE UNIT NO. 8
PHASE I RFI/RI WORK PLAN

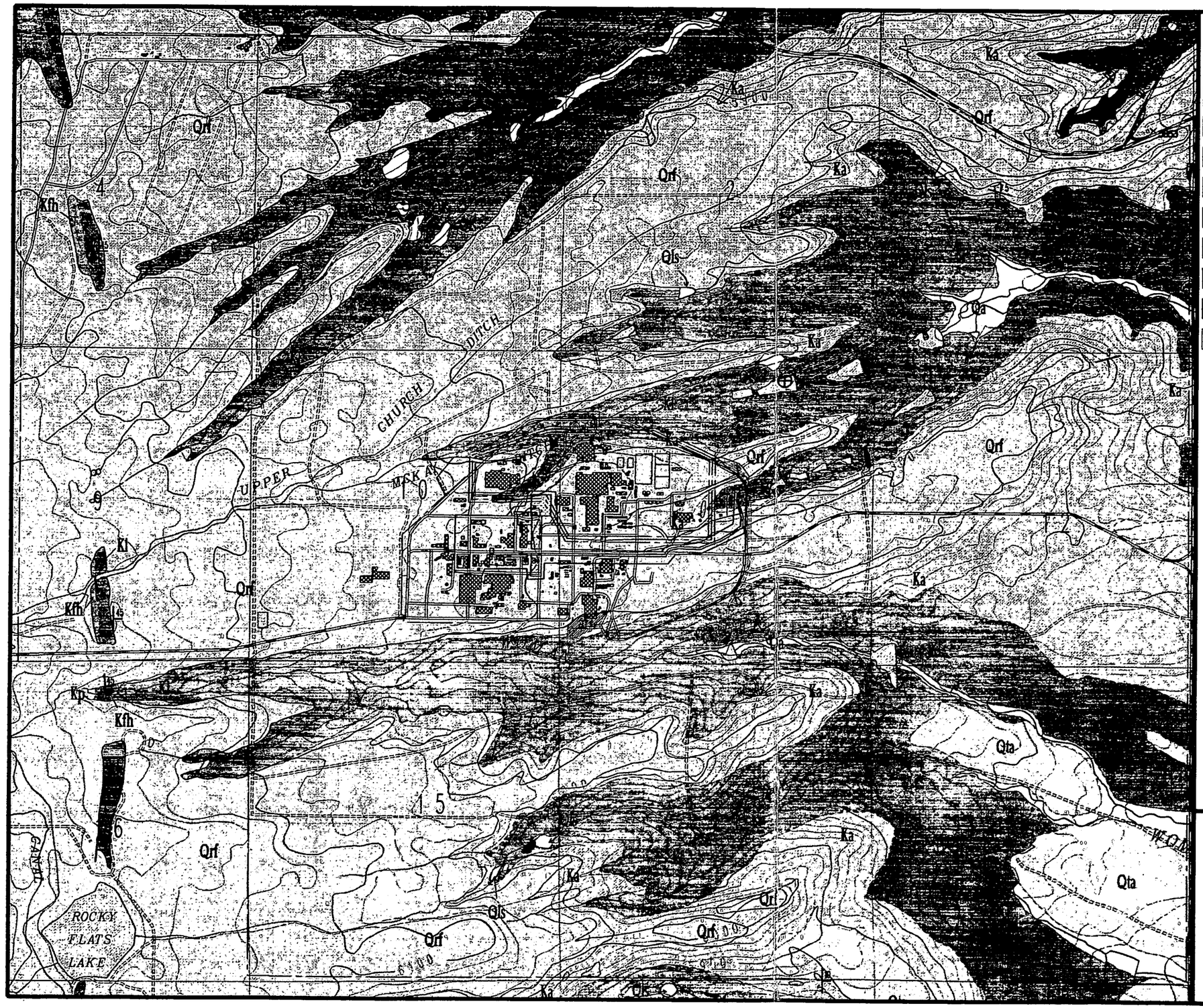
FIGURE 1-15

SOILS IN THE VICINITY OF ROCKY FLATS PLANT

SOURCE:
SOIL CONSERVATION SERVICE, 1980.

[1] NOTE: SOILS WITHIN THE PROTECTED AREA OF OU8 MAY CONSIST PREDOMINANTLY OF IMPORTED FILL MATERIALS


OU 8 Boundary
Qrf
Ql
Qc
Qal
Ka
Kass
Ka + Kass
Qt
NORTH
SOUTH
WALNUT
CREEK
W.S. 5976.8
W.S. 5972.3
W.S. 5969.3
W.S. 5964.0
W.S. 5963.8
W.S. 5781.3
W.S. 5811.3
W.S. 5821.4
Ka 5846.70
EXPLANATION
Alluvial Monitor Well
Bedrock Monitor Well
Exisiting Well (Prior to 1986)
Abandoned Well
CONTACT
Dashed where approximately located. queried where inferred.
Spring
Phreatophytes
Pavement or Gravel
Disturbed Ground
QUATERNARY
Recent Valley Fill
Landslide
Colluvium
Terrace Alluvium
Rocky Flats Alluvium
CRETACEOUS
Arapahoe Formation, Sandstone
Arapahoe Formation, Claystone
Contour interval: 5 feet
0
500
1000 feet
U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant
Golden Colorado
OPERABLE UNIT NO. 8
PHASE I RFI/RI WORK PLAN
FIGURE 1-14
SURFICIAL GEOLOGY MAP
CONTROLLED AREA,
ROCKY FLATS PLANT
Source: Rockwell International Plate E-6 October, 1988



EXPLANATION

- Artificial Fill (RECENT)
- Valley Fill Alluvium (RECENT)
- Landslide Slump (RECENT)
- Undiff. Terrace Alluvium (PLEISTOCENE)
- Rocky Flats Alluvium (PLEISTOCENE)
- Arapahoe Formation (CRETACEOUS)
- Laramie Formation (CRETACEOUS)
- Fox Hills Sandstone (CRETACEOUS)
- Pierre Shale (CRETACEOUS)

Strike and dip of bedding planes in bedrock

inclined | vertical | overturned | horizontal

Gravel, sand, or clay pit BM Benchmark

Area of bedrock exposure

Contact
dashed where approx. located;
dotted where concealed

From EG.& G., 1992

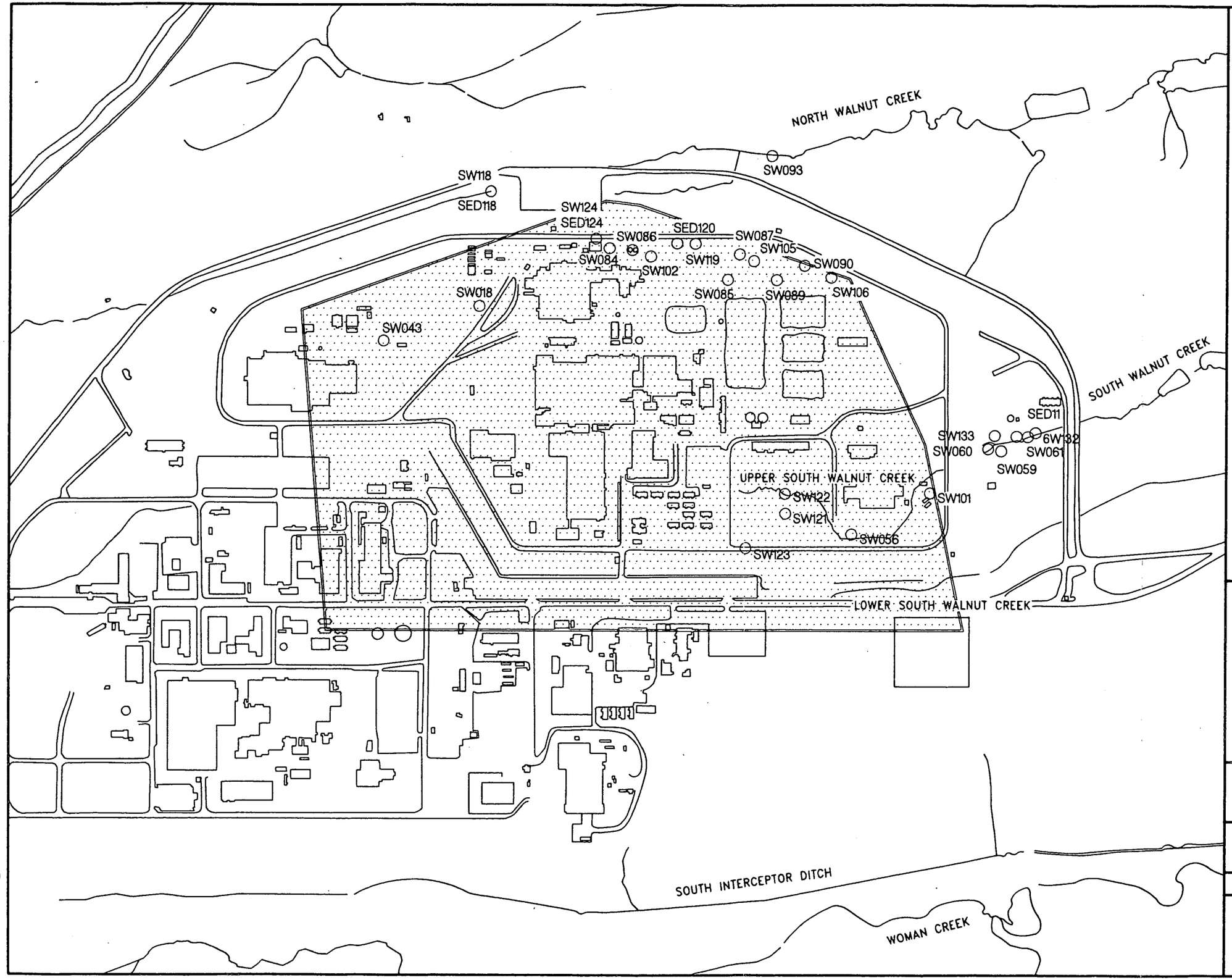
SCALE 1" = 1700'

1700' 0 1700'

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Rocky Flats Plant, Golden, Colorado

FIGURE 1-13

SURFICIAL GEOLOGY
FOR THE
ROCKY FLATS PLANT



LEGEND

PAVED ROADS

WATER

SW123 SITE LOCATIONS

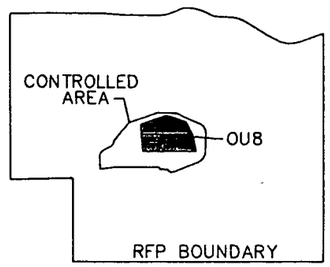
SED120 SITE LOCATIONS

OU8 BOUNDARY

-N-

SCALE

0 500 1000

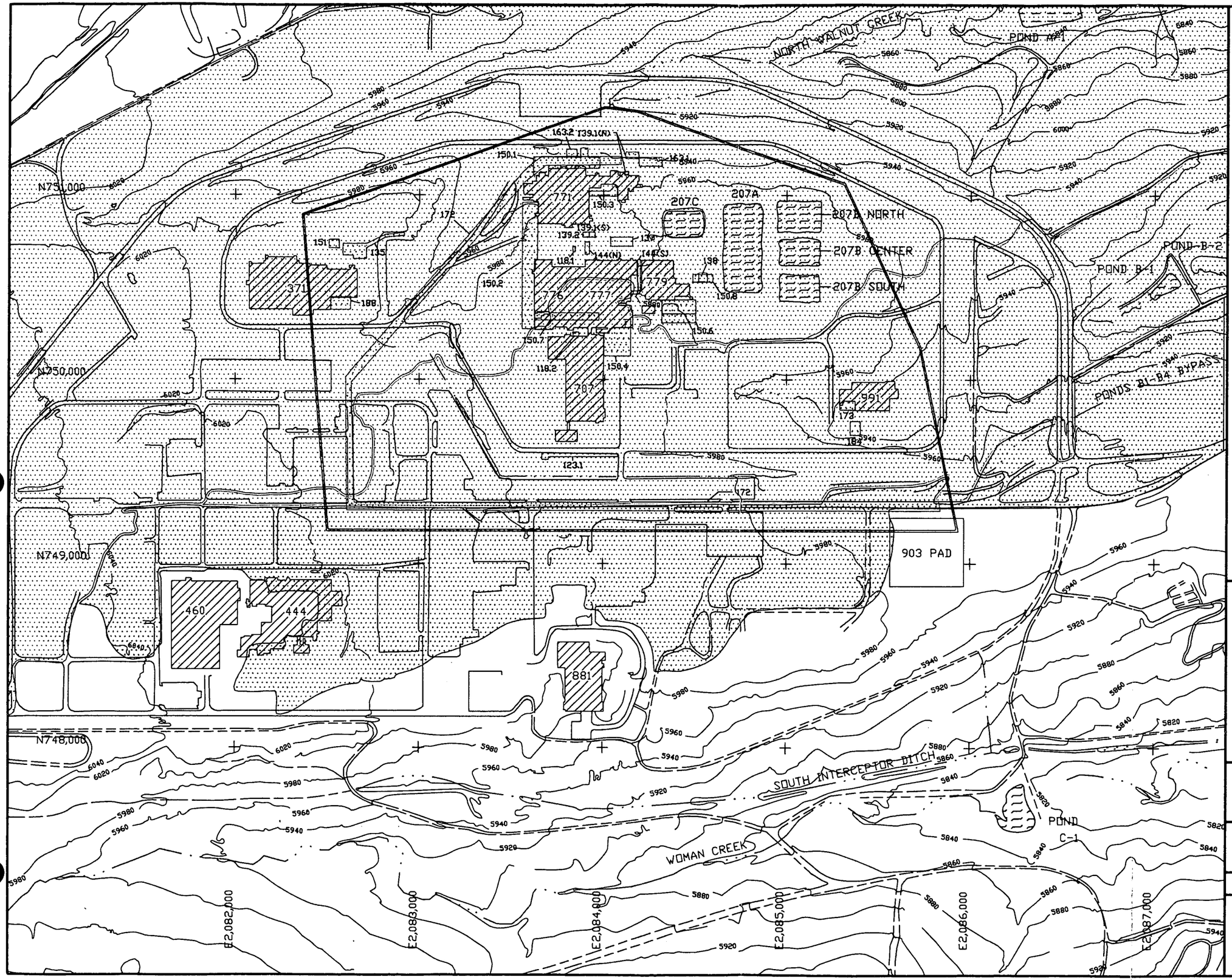


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Golden Colorado

OPERABLE UNIT NO. 8
PHASE I RFI/RI WORK PLAN

FIGURE 1-12

SURFACE WATER MONITORING SITE LOCATION MAP



MAP LEGEND

- OPERABLE UNIT
- 163.2 INDIVIDUAL HAZARDOUS SUBSTANCE SITES
- STREAMS DITCHES DRAINAGE FEATURES
- PAVED ROADS
- DIRT ROADS

DRAINAGE BASINS

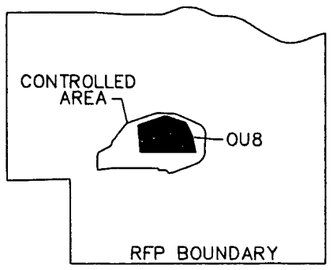
- NORTH WALNUT CREEK DRAINAGE BASIN
- UPPER S. WALNUT CREEK DRAINAGE BASIN
- LOWER S. WALNUT CREEK DRAINAGE BASIN

N

SCALE

0 500 1000

SCALE: 1" = 500'

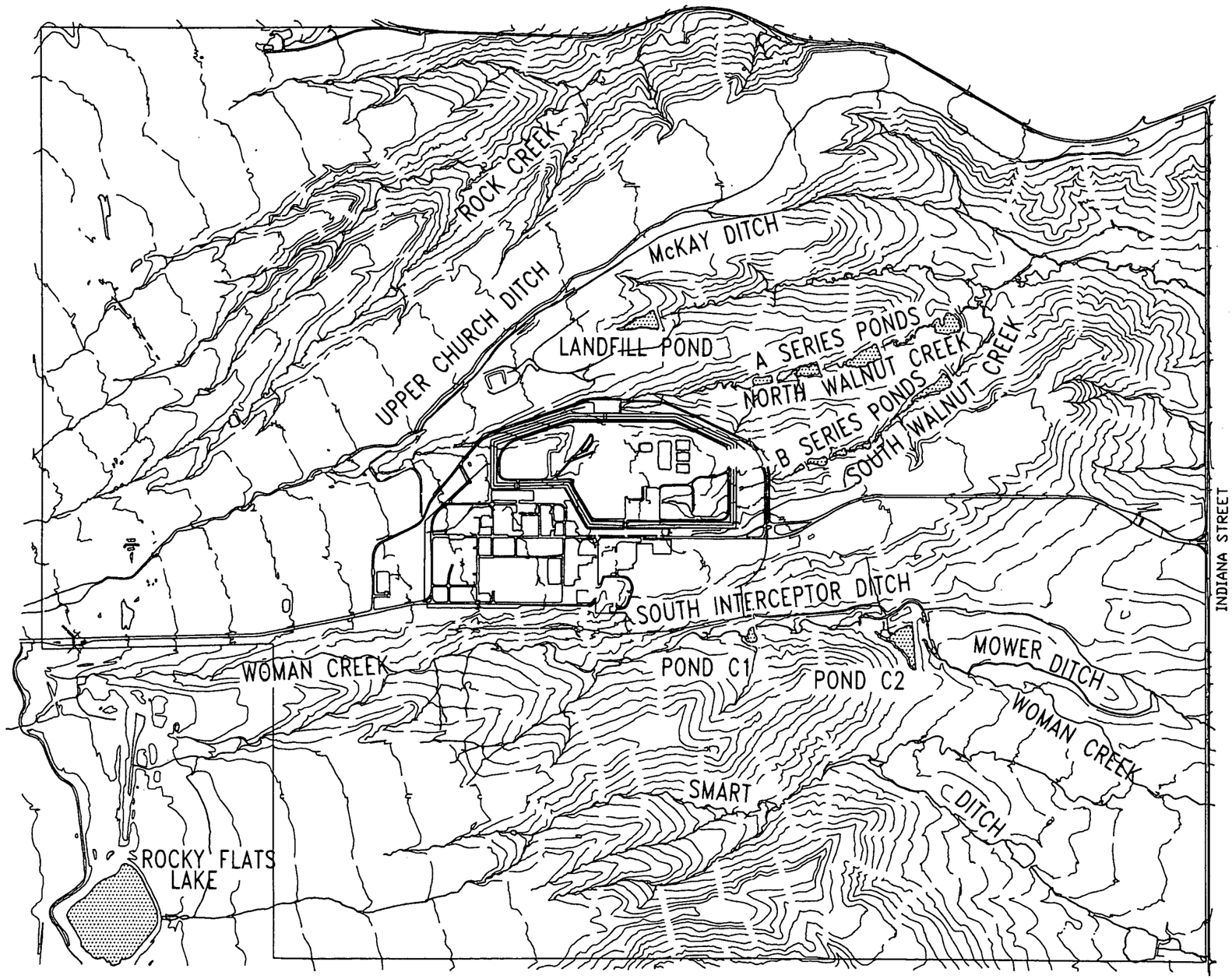


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FIGURE 1-9

SURFACE-WATER DRAINAGE BASINS



EXPLANATION

GROUND SURFACE CONTOURS

CURRENT RFP WATER STORAGE FACILITIES

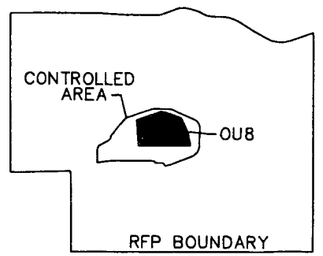
PAVED ROADS
GROUND WATER (mg/l)

STREAMS DITCHES
DRAINAGE FEATURES

-N-

FEET

0 2000 4000

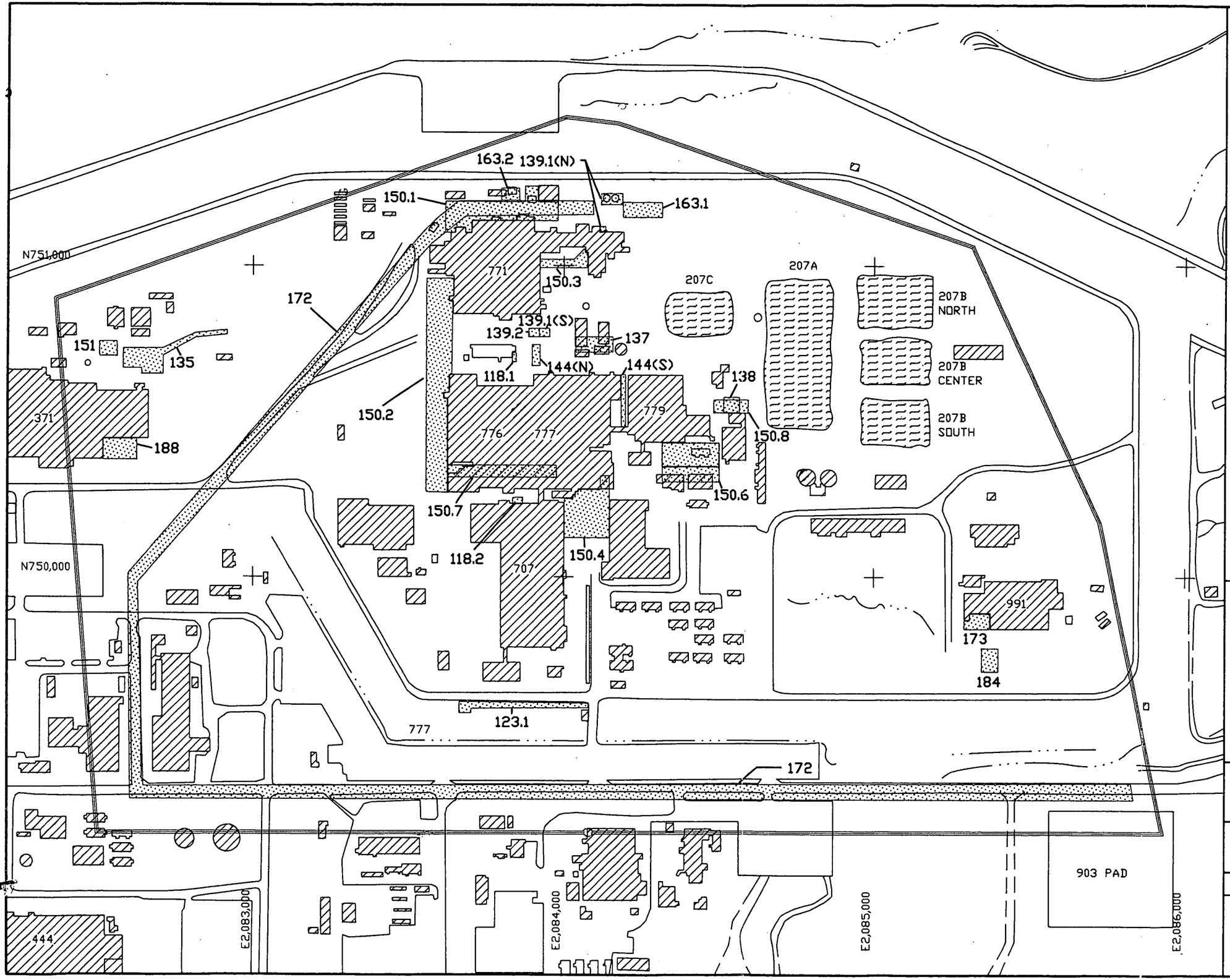


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FIGURE 1-8

LOCATION OF SURFACE WATER FEATURES



MAP LEGEND

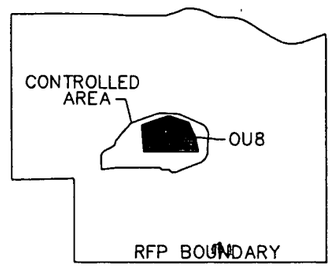
- OPERABLE UNIT 8
- STREAMS DITCHES DRAINAGE FEATURES
- PAVED ROADS
- DIRT ROADS
- SURFACE WATER IMPOUNDMENTS
- BUILDINGS
- INDIVIDUAL HAZARDOUS SUBSTANCE SITES

-N-

SCALE

0 300 600

Source: Groundwater Protection and Monitoring Program Plan. ASI Nov. 1991



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Golden Colorado

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FIGURE 1-3

LOCATION OF INDIVIDUAL HAZARDOUS SUBSTANCE SITES OPERABLE UNIT 8 700 AREA