REVIEW COPY - FINAL
PHSAE I RIF/RI WORK PLAN

ROCKY FLATS PLANT

OTHER OUTSIDE CLOSURES

(OPERABLE UNIT NO. 10)

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

ENVIRONMENTAL RESTORATION PROGRAM

APRIL 1992

1/360

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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 10 (OU10), Other Outside Closures, at the Rocky Flats Plant (RFP) in Jefferson County, Colorado. This investigation is part of a comprehensive, phased program of site characterization, remedial investigations (RIs), feasibility studies (FSs), and remedial/corrective actions currently in progress at RFP. These investigations are pursuant to an Interagency Agreement (IAG) among the U.S. Department of Energy (DOE), the U.S. Environmental Protection Agency (EPA), and the State of Colorado Department of Health (CDH) dated January 22, 1991 (DOE 1991). The IAG program developed by DOE, EPA, and CDH addresses RCRA and ~~Comprehensive Environmental Response, Compensation and Liability Act~~ (CERCLA) issues. Although the IAG requires general compliance with both RCRA and CERCLA, RCRA ~~regulations take precedence at OU10~~. 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" (RFI) 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).

OU10 is one of 16 OUs units listed for investigation by the IAG. Table 1-1 is a list of the OUs. OU10 contains 16 IHSSs which are also listed in Table 1-1. Figure 1.0-1 shows the locations of the RFP IHSSs. IHSSs were defined from Appendix I, 3004(u) Waste Management Units, of the RCRA Part B Permit Application, Rev. No. 1, USDOE - Rocky Flats Plant, dated December 15, 1987 (Table 2 was revised by the facility (Rev. No. 2), and is dated April 13,

Table 1-1 Operable Units and Individual Hazardous Substance Sites Included in the IAG

OU Number	OU Name	Individual Hazardous Substance Sites
1	881 Hillside	102, 103, 104, 105.1, 105.2, 106, 107, 119.1, 119.2, 130, 145
2	903 Pad, Mound, and East Trenches	108, 109, 110, 111.1, 111.2, 111.3, 111.4, 111.5, 111.6, 111.7, 111.8, 112, 113, 140, 153, 154, 155, 183, 216.2, 216.3
3	Off-Site Releases	199, 200, 201, 202
4	Solar Ponds	101
5	Woman Creek	115, 133.1, 133.2, 133.2, 133.4, 133.5, 133.6, 142.10, 142.11, 209
6	Walnut Creek	141, 142.1, 142.2, 142.2, 142.3, 142.4, 142.5, 142.6, 142.7, 142.8, 142.9, 142.12, 143, 165, 166.1, 166.2, 166.3, 167.1, 167.2, 167.3, 216.1
7	Present Landfill	114, 203
8	700 Area	118.1, 118.2, 123.1, 123.2, 125, 126.1, 126.2, 127, 132, 135, 137, 138, 139.1, 139.2, 144, 146.1, 150.1, 150.2, 150.3, 150.4, 150.5, 150.6, 150.7, 150.8, 151, 159, 163.1, 163.2, 172, 173, 184, 188
9	Original Process Waste Lines	121
10	Other Outside Closures	124, 124.1, 124.2, 124.3, 129, 170, 174, 175, 176, 177, 181, 182, 205, 206, 207, 208, 210, 213, 214
11	West Spray Field	168
12	400/800 Area	116.1, 116.2, 120.2, 136.1, 136.2, 136.3, 147.1, 147.2, 157.2, 187, 189
13	100 Area	117.1, 117.2, 117.3, 122, 128, 134, 148, 152, 157.1, 158, 169, 171, 186, 190, 191
14	Radioactive Sites	131, 156.1, 156.2, 160, 161, 162, 164.1, 164.2, 164.3
15	Inside Building Closures	178, 179, 180, 204, 211, 212, 215, 217
16	Low-Priority Sites	185, 192, 193, 194, 195, 196, 197

1988); Appendix I, 3004(u) Waste Management Units, of the Transuranic Mixed Wastes RCRA Part B Permit Application, dated July 1, 1988; and the Comprehensive Environmental Assessment and Response Program, Phase I (DOE 1991). The environmental impact from activities proposed under this plan will be very minor. Drilling and sampling is expected to release small amounts of fugitive dust and perhaps volatile organic compounds to the air. No impacts are expected on soil, groundwater, or surface water. Therefore, NEPA requirements for an environmental assessment or impact statement are not triggered.

As required by the IAG, this Phase I work plan addresses characterization of source materials and soils at OU10 IHSSs. A subsequent Phase II RFI/RI will investigate the nature and extent of surface water, groundwater sediment, biota, and air contamination and evaluate potential contaminant migration pathways.

This work plan was prepared in accordance with CERCLA, the National Oil and Hazardous Substance Pollution Contingency Plan (NCP), RCRA, and applicable Colorado state law. The presented work plan is prepared to be consistent with the IAG and the following guidance documents where applicable:

- EPA, Compendium of Superfund Field Operations Methods, September 1987
- EPA, Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA: OSWER Directive 9355.3-01, October 1988
- EPA, RCRA Facility Investigation Guidance, Interim Final, May 1989
- EPA, Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, SW-846, October 1986
- EPA, Guidance for Data Quality Objectives, 1987

- EPA, Interim Final Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual: OSWER Directive 9285.701A, July 1989

- EPA, Interim Final Risk Assessment Guidance for Superfund, Volume II: Environmental Evaluation Manual: EPA/540/1-89/001, March 1989

- EPA, Assessment of Errors in the Sampling of Soils; EPA/600/4-90/013, 1990

- EPA, Data Quality Objectives for Remedial Response Activities: Development Process. Office of Emergency and Remedial Response, EPA/540/G-87/003, 1987

- EPA, Data Quality Objectives for Remedial Response Activities, Example Scenario: RI/FS Activities at a Site with Contaminated Soil and Ground Water. Office of Emergency and Remedial Response, EPA/540/G-87/004, 1987

- EPA, Report on Minimum Criteria to Assure Data Quality. EPA/530-SW-90-021, 1989

- EPA, Guidance for Data Useability in Risk Assessment Interim Final. Office of Emergency and Remedial Response. EPA/540/G-90/008, 1990.

1.1 ENVIRONMENTAL RESTORATION PROGRAM

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 in Phase 2 as needing correction. Phase 4 (Remedial Design/Remedial Action) includes design and implementation of site-specific remedial actions selected on the basis of Phase 3 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. Phase 1 of the ER Program has been completed at RFP (DOE 1986), and Phase 2 is currently in progress for OU10.

1.2 WORK PLAN OVERVIEW

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 Plan (FSP) for the Phase I RFI/RI. Also included in the work plan are a Baseline Risk Assessment Plan (BRAP), Quality Assurance Addendum (QAA), and an Environmental Evaluation Work plan (EEW). The Health and Safety Plan for this work will be issued as a separate document. The RFP Site-Wide Quality Assurance Project Plan (QAPjP) provided guidance for the preparation of these plans. The RFP-wide Community Relations Plan (CRP), which is not a part of this document, was released in November 1991.

Section 2.0 (Site Characterization) presents a conceptual model of each IHSS, based on a comprehensive review and detailed analysis of all available historical information, previous site investigations, site geology and hydrology, and available data on the nature and extent of contamination in soils, groundwater, surface water, and sediments. 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 OU10. Section 4.0 discusses the DQOs and work plan rationale for the Phase I RFI/RI. Section 5.0 specifies tasks to be performed for the Phase I RFI/RI. Section 6.0 presents the schedule for performance of Phase I RFI/RI activities.

The FSP, presented in Section 7.0, describes the sampling program necessary to determine the nature and extent of contamination, evaluate remedial alternatives, provide data for the baseline risk assessment, and provide data for the environmental evaluation. The FSP also describes sampling objectives, sampling locations and frequencies, sample designation, sampling equipment and procedures, and sample handling and analysis.

The BRAP, presented in Section 8.0, specifies the techniques and methodology necessary to identify and characterize the toxicity of all hazardous and radioactive substances present, contaminant fate and transport, the potential for human and environmental exposure, and the risk of potential threats to human health and the environment. The baseline risk assessments will provide the justification for performing Corrective/Remedial Actions.

Section 9.0 presents the general EE approach employed at RFP. It describes the way in which this approach will be applied at OU10 and presents a detailed FSP for work plan implementation. Due to the disturbed and developed nature of OU10, many of the specified EE activities will be reduced in scope. Details of the environmental evaluation are presented in Section 9.0.

insert QAA

1.3 REGIONAL AND PLANT SITE BACKGROUND INFORMATION

1.3.1 Facility Background and Plant Operations

RFP is a government-owned, contractor-operated facility that is part of the nationwide nuclear weapons production 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 RFP was assigned to the Energy Research and Development Administration (ERDA), which was succeeded by DOE in 1977. Dow Chemical U.S.A., an operating unit of the Dow Chemical Company, was the prime operating contractor of the facility from 1951 until

June 30, 1975. Rockwell International was the prime operating contractor from July 1, 1975, until December 31, 1989. EG&G Rocky Flats, Inc., became the prime contractor on January 1, 1990.

The primary RFP mission is to produce components for nuclear weapons. Plutonium, uranium, beryllium, and stainless steel parts are fabricated at RFP and shipped off site for final assembly. Additional activities include chemical processing to recover plutonium from scrap material, metallurgical research and development, machining, assembly, nondestructive testing, coating remote engineering, chemistry, and physics. Waste handling operations at RFP include storage, transport, treatment, and packaging of waste materials generated on site. The waste forms that are handled include hazardous chemical waste, transuranic (TRU) waste, nonhazardous and nonradioactive waste, and combinations thereof. Current waste handling practices also involve on-site and off-site recycling of hazardous materials, on-site storage of hazardous and radioactive mixed wastes, and off-site disposal of solid radioactive materials at another DOE facility. However, both storage and disposal of hazardous and radioactive wastes occurred on site in the past. Preliminary assessments under the ER Program identified 16 past on-site storage and disposal locations as potential sources of environmental contamination within OU10.

1.3.2 Previous Investigations

Various 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, summarized by Rockwell International (1986a), include the following:

- 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. 1981a and 1981b)

- Several drilling programs initiated in 1960 that resulted in construction of approximately 60 monitoring wells by 1982

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

- Environmental, ecological, and public health studies that culminated in an environmental impact statement (EIS) (DOE 1980)

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

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

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

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

In 1986, two major investigations were completed at RFP. The first was the ER Program Phase 1 Installation Assessment (DOE 1986), which included analysis 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. 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. IHSSs were divided into three categories:

- Hazardous waste substance sites that will continue to operate and need a RCRA operating permit. These sites will need to have monitoring and maintenance programs developed which are based upon the evaluation of RFI/RI data.

- Hazardous waste substance sites that will be closed under RCRA interim status (OU10 IHSSs fall into this category). The RFI/RI for these sites will be designed to determine the impact of past activities. The data will be used to plan closure activities.

- Inactive waste substance sites that will be investigated and cleaned up under Section 3004(u) of RCRA or CERCLA. The RFI/RI for these sites will be designed to determine the impact of past activities. The data will be used to plan clean up activities which may be different from options considered for sites to be closed, due to difference in future use scenarios.

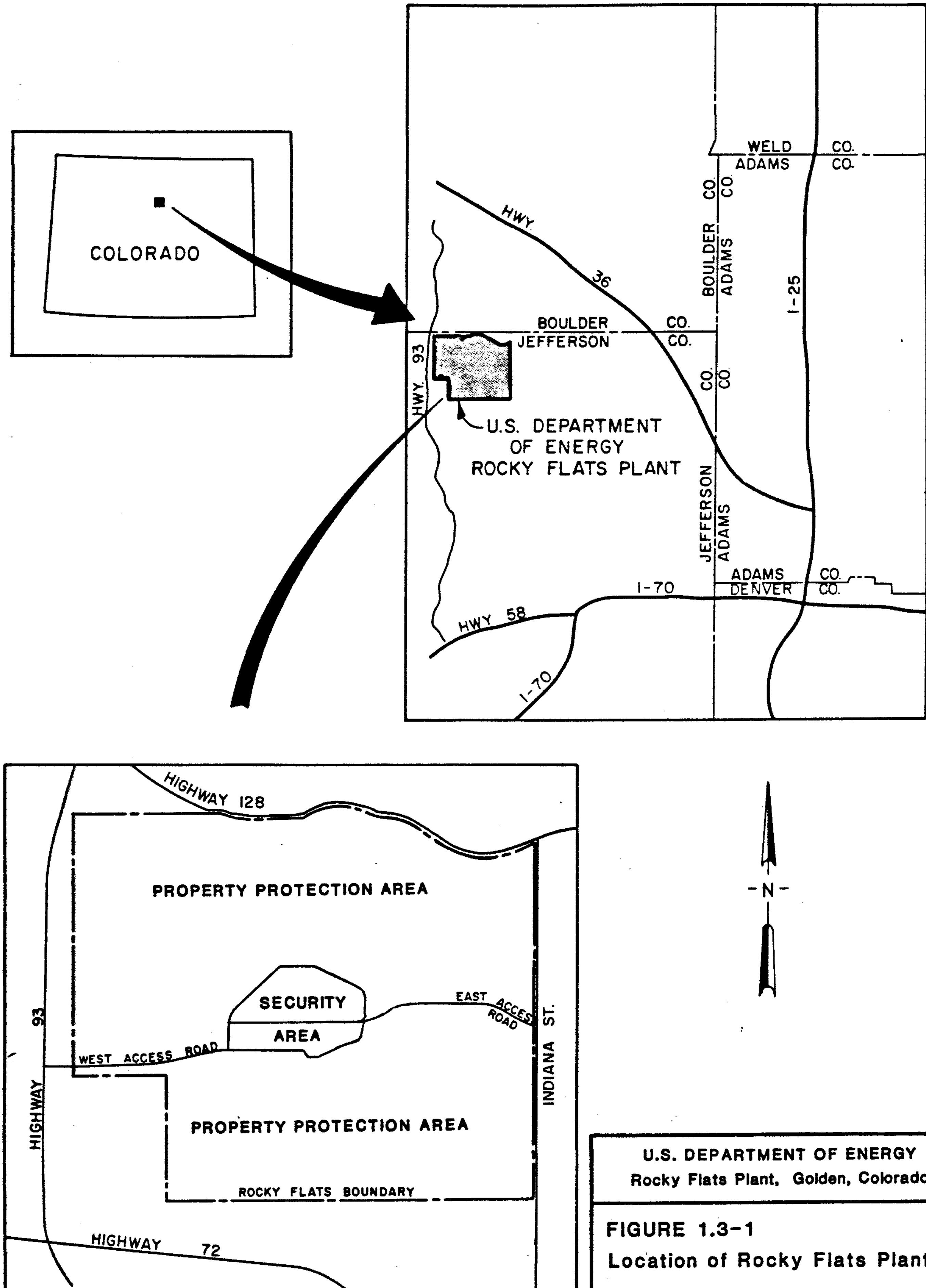
The second major investigation completed at RFP in 1986 involved a hydrogeologic and hydrochemical characterization of the entire site. Plans for this study were presented by Rockwell International (1986c and 1986d), and study results were reported by Rockwell International (1986e). Investigation results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

1.3.3 Physical Setting

1.3.3.1 Location

RFP is located in northern Jefferson County, Colorado, approximately 16 miles northwest of Denver (Figure 1.3-1). It encompasses approximately 6,550 acres of federally owned land in Sections 1 through 4 and 9 through 15 of T2S, R70W, 6th Principal Meridian. Major buildings are located within the RFP security area of approximately 400 acres. The security area is surrounded by a buffer zone of approximately 6,150 acres.

The approximately 140 on-site structures encompass approximately 256,400 square meters (2.76 million square feet [sq ft]) of floor space. Of this, major manufacturing, chemical processing, plutonium recovery, and waste treatment facilities occupy about 148,600 square meters (1.6 million sq ft). The remaining floor space is divided among laboratory, administrative,



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

FIGURE 1.3-1
Location of Rocky Flats Plant

utility, security, warehouse, storage, and construction contractor facilities (107,800 square meters [1.16 million sq ft]).

1.3.3.2 Topography

The natural environment in the vicinity of RFP and is influenced primarily by its proximity to the Front Range of the Rocky Mountains. Specifically, RFP is situated directly east of the north-south trending Rocky Mountains at an elevation of approximately 6,000 ft above mean sea level (msl), on a broad, eastward sloping plain of overlapping alluvial fans. The fans extend approximately 5 miles eastward from their origin in the abruptly rising Front Range, and terminate on low rolling hills at a break in slope. RFP is located approximately 25 miles east of the continental divide on a terrace between valleys cut by Walnut Creek and Woman Creek which are near the eastern edge of the fans.

1.3.3.3 Meteorology

RFP is located in a region of semiarid climate, characterized by warm summers and dry, cool winters, with some snow cover, as it is typical of much of the central Rocky Mountain Region. Clear skies, low average precipitation, and low relative humidity are also typical of this location. The elevation of RFP and the major topographical features in the area significantly influence the wind dispersion characteristics of the site. Winds, although variable, are predominantly northwesterly at RFP, with strongest winds occurring during the winter. The area occasionally experiences Chinook winds with gusts up to 100 miles per hour (DOE 1980). Studies of air flow and dispersion characteristics indicate that winds coming down off the mountains turn and move north and northeast along the South Platte River valley, to the west and north of Brighton, Colorado.

include wind rose

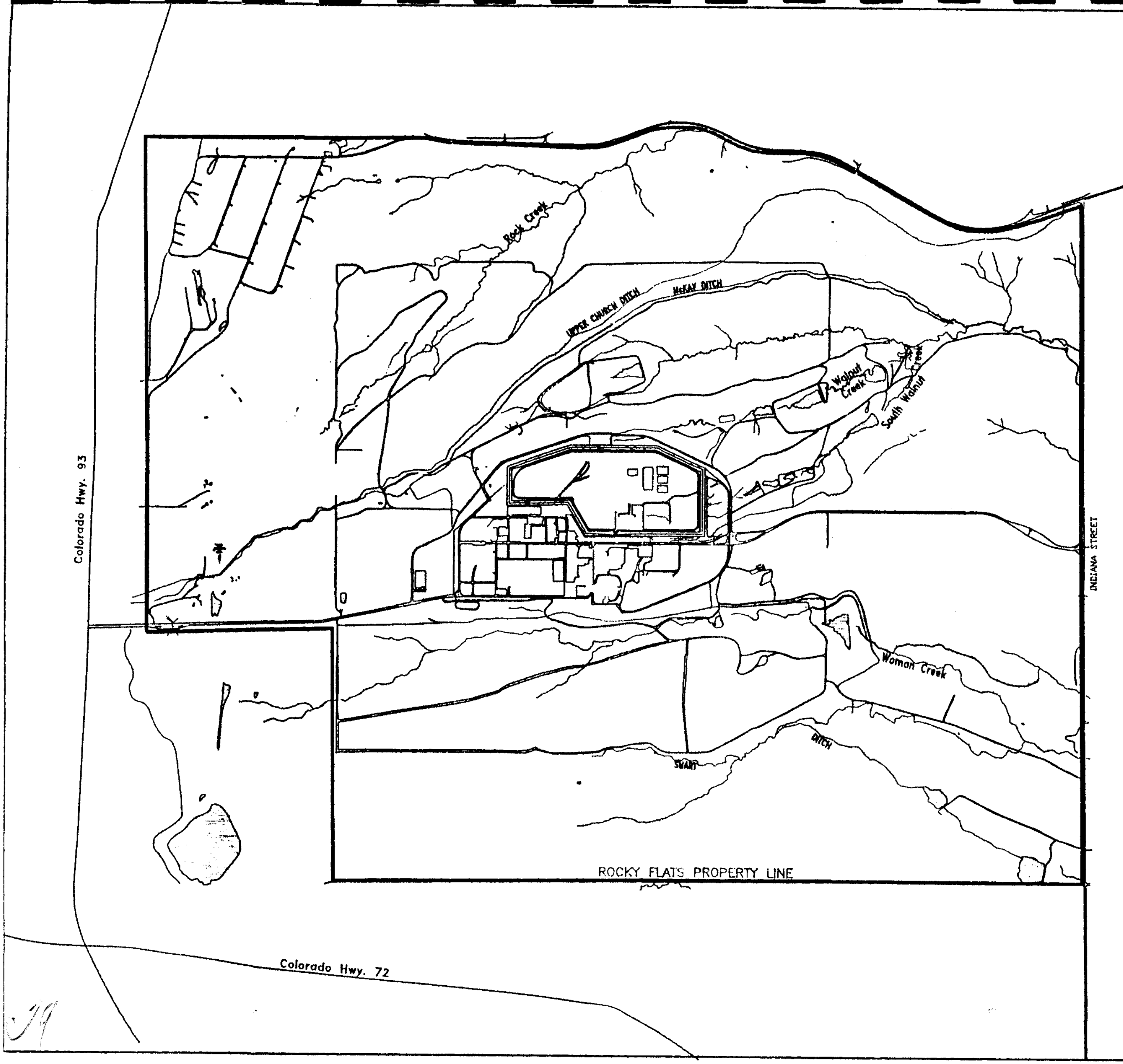
Temperatures are moderate; extremely warm or cold weather is usually of short duration. On the average, daily summer temperatures range from 55 to 85 degrees Fahrenheit (F) and winter temperatures range from 20 to 45 degrees F. Temperature extremes recorded at the Plant have ranged from 102 degrees F on July 12, 1971, to -26 degrees F on January 12, 1963. The 24-year average maximum temperature for the period 1952 to 1976 was 76 degrees F, the average minimum was 22 degrees F, and the average annual mean was 50 degrees F. Average relative humidity was 46 percent (DOE 1980).

Approximately 40 percent of the typical 15-inch annual precipitation falls during the spring season, predominantly as wet snow. Thunderstorms, occurring from June to August, account for an additional 30 percent of the annual precipitation. Drier autumn and winter seasons account for 19 and 11 percent of the annual precipitation, respectively. Snowfall, occurring from October through May, averages 85 inches per year. The maximum annual precipitation recorded over a 24-year period was 24.87 inches (63.17 centimeters) measured in 1969.

evaporation data paragraph insert

1.3.3.4 Surface Water Hydrology

Three intermittent streams drain RFP, flowing generally from west to east. These drainages are Rock Creek, Walnut Creek, and Woman Creek (Figure 1.3-2). Rock Creek drains the northwestern corner of RFP and flows northeast through the buffer zone to its off-site confluence with Coal Creek. North and South Walnut Creeks and an unnamed tributary drain the northern portion of RFP security area. These three forks of Walnut Creek join in the buffer zone and flow to Great Western Reservoir, which is approximately one mile east of the confluence. Woman Creek historically drained the southern RFP buffer zone flowing eastward to Standley Reservoir. A series of ponds designated Ponds A-1, A-2, A-3 and A-4 on Walnut Creek, Ponds B-1, B-2, B-3, B-4 and B-5 on South Walnut Creek and Ponds C-1 and C-2 on Woman Creek have been



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

FIGURE 1.3-2
Surface Water Drainage in Vicinity of Rocky Flats Plant

constructed to help control surface water flow and sediment transport. The South Interceptor Ditch lies between the RFP security area and Woman Creek and presently collects runoff from the southern RFP security area and diverts it to Pond C-2, where it is monitored in accordance with the RFP National Pollutant Discharge Elimination System (NPDES) permit prior to discharge to Woman Creek.

1.3.3.5 Ecology

The vegetation in the vicinity of RFP is representative of the plains grassland/lower montane ecotone. Grassland communities in this region are characterized by heavily grazed pastures with a mixture of herbs and relatively unpalatable grasses interspersed with isolated, undisturbed sites containing patches of big and little bluestem (*Andropogon gerardi* and *Andropogon scoparius*), needlegrass (*Stipa* sp.), blue grama (*Bouteloua gracilis*), and side-oats grama (*Bouteloua curtipendula*). Prickly pear cactus (*Opuntia* sp.) and yucca (*Yucca glauca*) are invaders where overgrazing has occurred; they are very common in the Property Protection Area (PPA), the approximately 6,150 acres surrounding the 400-acre RFP security area. Montane uplands contain ponderosa pine (*Pinus ponderosa*) and Douglas fir (*Pseudotsuga menziesii*), expressed in the foothills immediately adjacent to RFP as a savannah. Ravines contain wild plum (*Prunus americana*) and hawthorne (*Crataegus erythropoda*), with willows (*Salix* sp.), false indigo (*Amorpha fruticosa*) and cottonwood (*Populus* sp.) along drainages.

RFP includes species of flora representative of tall grass prairie, short grass plains, lower montane, and foothill ravine communities. The lands originally acquired for the site in 1951 have been generally undisturbed since that time. Most of the lands acquired in 1974 had been overgrazed. A plant inventory in 1973 reported 327 species of vascular plants, 25 lichens, 15 bryophytes, and one macroscopic green algae (Weber et al. 1974). The site's vegetation was mapped in 1974 (Clark 1977). At that time, the area within the 1951 boundary, especially east and south of the Security Area, was primarily bluegrass (*Poa* sp.) and wheatgrass (*Agropyron* sp.) meadow, with marsh and stream-bank vegetation along the drainages. Higher elevations were more dry and barren, vegetated primarily by cheatgrass (*Bromus tectorum*) and musk thistle (*Carduus nutans*). West of the site and in the PPA, the coarse and rocky substrate was primarily vegetated with junegrass (*Koeleria pyramidata*), Klamath weed (St. Johnswort, *Hypericum perforatum*), and cheatgrass or musk thistle. Musk thistle was particularly abundant throughout the site in fallow and disturbed areas. The local presence of big bluestem and side-oats grama indicated recovery from overgrazing. A few threatened or endangered species have been identified somewhere on RFP. None have been documented in OU10 IHSSs. Of the species identified, only the forktip three-awn (Aristida basiramea) is likely to occur as other than a transient at any of the OU10 IHSSs. A further discussion of threatened and endangered wildlife species is included in Section 9.0 Environmental Evaluation Work Plan.

Current studies (December 1990 through August 1991) indicate that plant succession has progressed significantly since studies conducted in the 1970s. Most areas formerly mapped as annual weed communities now qualify as perennial grassland. Indicator species for perennial grassland such as western wheatgrass (*Agropyron smithii*) and Canada bluegrass (*Poa compressa*) have clearly increased in abundance and now dominate much of the site.

RFP wildlife habitats are similar to other foothills habitats because of the absence of barriers between the site and the surrounding foothill terrain. In such habitats, the most common large mammals are mule deer (*Odocoileus hemionus*). Medium-sized herbivorous mammals are represented primarily by white-tailed jack rabbits (*Lepus townsendii*), prairie dogs (*Cynomus ludovicianus*), desert cottontails (*Sylvilagus audubonii*), and muskrats (*Ondatra zibethicus*).

Medium-sized carnivorous mammals are primarily coyotes (*Canis latrans*), red foxes (*Vulpes vulpes*), striped skunks (*Mephitis mephitis*), and long-tailed weasels (*Mustela frenata*), with occasional badgers (*Taxidea taxus*) and raccoons (*Procyon lotor*). Small mammals trapped in 1973 included deer mice (*Peromyscus maniculatus*), thirteen-lined ground squirrels (*Spermophilus tridecemlineatus*), northern pocket gophers (*Thomomys talpoides*), hispid pocket mice (*Perognathus hispidus*), silky pocket mice (*Perognathus flavus*), harvest mice (*Reithrodontomys sp.*), meadow voles (*Microtus pennsylvanicus*), and house mice (*Mus musculus*) (Winsor et al. 1975). Current studies (December 1990 to August 1991) have added several additional small mammal species, of which two are common: prairie voles (*Microtus ochrogaster*) and porcupines (*Erethizon dorsatum*).

Common small birds known to breed on RFP (based on current 1991 studies) are mourning doves (*Zenaidura macroura*), common nighthawks (*Chordeiles minor*), western kingbirds (*Tyrannus verticalis*), Say's phoebes (*Sayornis phoebe*), horned larks (*Eremophila alpestris*), barn swallows (*Hirundo rustica*), black-billed magpies (*Pica pica*), American robins (*Turdus migratorius*), European starlings (*Sturnus vulgaris*), yellow warblers (*Dendroica petechia*), blue grosbeaks (*Guiraca caerule*), green-tailed towhees (*Pipilo chlorurus*), rufous-sided towhees (*Pipilo erythrophthalmus*), vesper sparrows (*Pooecetes gramineus*), song sparrows (*Melospiza melodia*), western meadowlarks (*Sturnella neglecta*), red-winged blackbirds (*Agelaius phoeniceus*), Brewer's blackbirds (*Euphagus cyanocephalus*), brown-headed cowbirds (*Molothrus ater*), northern orioles (*Icterus galbula*), American goldfinches (*Carduelis tristis*), and house finches (*Carpodacus mexicanus*). Common birds-of-prey are turkey vultures (*Cathartes aura*), northern harriers (*Circus cyaneus*), red-tailed hawks (*Buteo jamaicensis*), Swainson's hawks (*Buteo swainsoni*), ferruginous hawks (*Buteo regalis*), rough-legged hawks (*Buteo lagopus*), American kestrels (*Falco sparverius*), and great horned owls (*Bubo virvinianus*). Mallards (*Anas platyrhynchos*) and, less commonly, Canada geese (*Branta canadensis*) and pintails (*Anas acuta*) breed on small ponds. Several species of diving ducks (*Aythya* sp.) are found in these ponds during migration. Great blue herons (*Ardea herodias*), and killdeer (*Charadrius vociferous*), spotted sandpipers (*Actitis macularia*), common snipe (*Calidris canulus*), and ring-billed gulls (*Larus delawarensis*) are also commonly found in the vicinity of the ponds.

Bullsnakes (*Pituophis melanoleucus*), prairie rattlesnakes (*Crotalus viridis*), and eastern yellow-bellied racers (*Coluber constrictor*) occur sitewide. Western painted turtles (*Chrysemys picta*) and western plains garter snakes (*Thamnophis radix*) appear in moist areas. Short-horned lizards (*Phrynosoma douglassi*) and red-sided garter snakes (*Thamnophis sirtalis*) occur, but are less common.

Aquatic life is not well developed in the streams, wastewater discharge system ponds, or other ponds. Aquatic and wetland vegetation, especially algae, is found in several of the wastewater and other ponds and reflects the nutrient supply. Black bass (probably largemouth bass, *Micropterus salmoides*), fathead minnows (*Pimephales promelas*), and bluegills (*Lepomis macrochirus*) were reported in one or more of the ponds (W-W Services 1976). Data from 1976 indicates that crayfish and benthic macroinvertebrates, including the relatively sensitive sideswimmers (Amphipoda), mayflies (Ephemeroptera), caddisflies (Trichoptera), and facultative organisms, were found primarily in Pond B4 and in Woman Creek (W-W Services 1976). Current studies (December 1990 to August 1991) in the PPA and OU1 and 2 have added golden shiner (*Notemigonus crysoleucas*), creek chub (*Semotilus atromaculatus*), stoneroller (*Campostoma anomalum*), white sucker (*Catostomus commersoni*), and green sunfish (*Lepomis cyanellus*) to the list and verified the presence of fathead minnows and largemouth bass. Current studies have also added six amphibians, three of which are common: tiger salamander

(*Ambystoma tigrinum*), boreal chorus frog (*Pseudacris triseriatus*), and northern leopard frog (*Rana pipiens*).

Within the vegetation communities and the habitats they provide on RFP, protected wildlife, vegetation, and habitats potentially occur. Of these species, only forktip three-awn (*Aristida basiramea*) is likely to occur as other than a transient at any of the OU10 IHSSs based on the habitats and substrates noted during the reconnaissance site visit. None of the small wetland areas within OU10 are eligible for jurisdictional status. Section 9.1.2.2 discusses these species and habitats in detail. refer to section 9 for T&E species.

1.3.3.6 Surrounding Land Use and Population Density

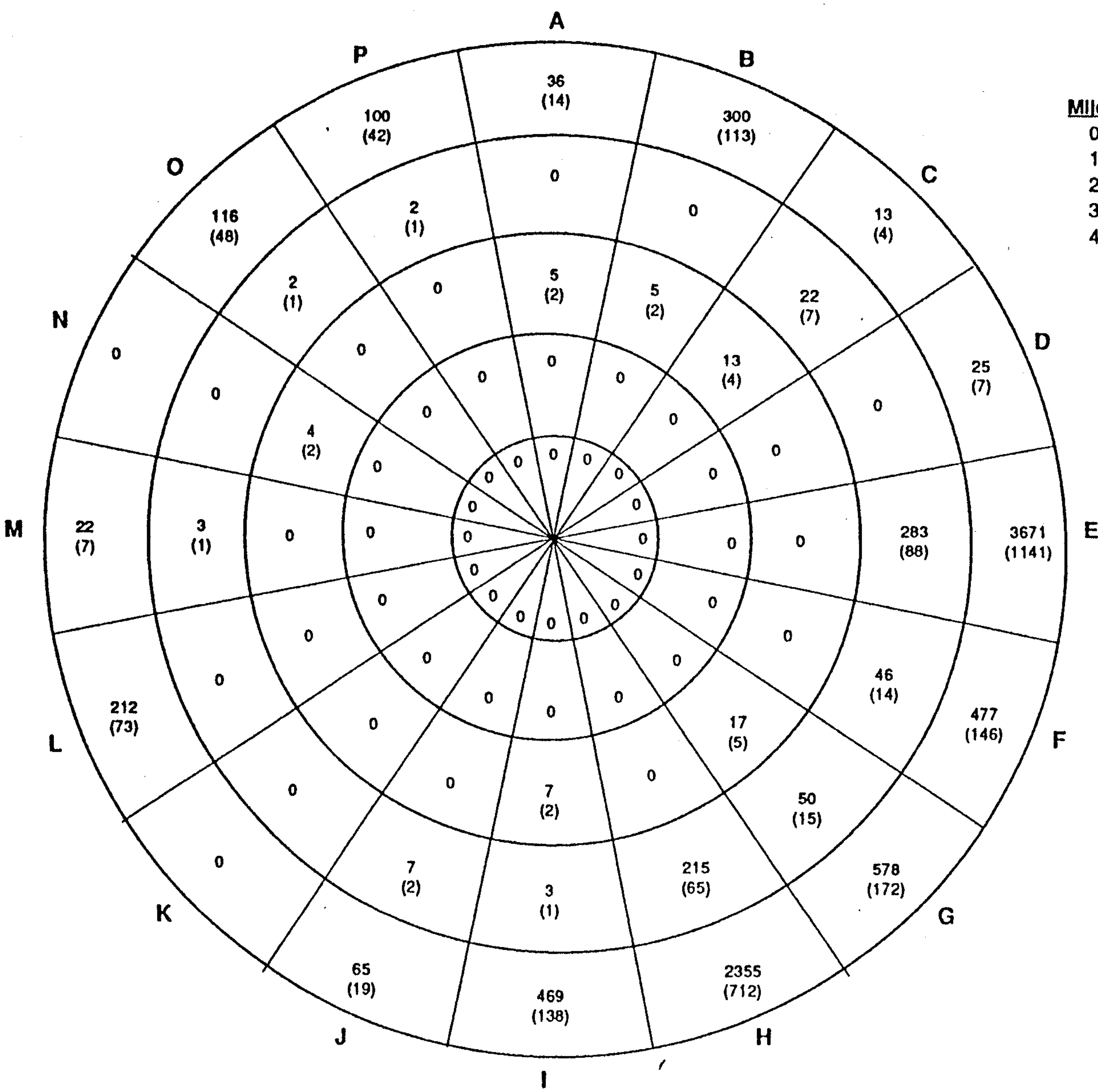
The population, economics, and land use of the areas surrounding the RFP are described in a 1989 Rocky Flats vicinity demographics report by DOE (DOE 1991d). This report divides general use of areas within zero to 10 miles (zero to 16 kilometers [km]) of the RFP into residential, commercial, industrial, parks and open spaces, agricultural and vacant, and institutional classifications, and considers current and future land use near the plant.

The majority of residential use within 5 miles (8 km) of the RFP is located immediately north and southwest of Standley Lake. Single-family dwellings are located in unincorporated areas immediately east and south of the RFP. Figure 1-4 shows the 1989 population distribution within areas up to 5 miles from the RFP. Commercial development is concentrated near the residential developments north and southwest of Standley Lake, and around the Jefferson County Airport approximately 3 miles (4.8 km) northeast of the RFP. Industrial land use within 5 miles (8 km) of the plant is limited to quarrying and mining operations. Open Space lands are located northeast of the 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 nonirrigated croplands, producing primarily wheat and barley, are located northeast of the RFP near the cities of Broomfield, Lafayette, and Louisville, north of the 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 the RFP. The demographics report characterizes much of the vacant land adjacent to the RFP and the reservoirs as rangeland (DOE 1991d).

Future land use in the vicinity of the RFP most likely involves continued suburban expansion, increasing the density of residential, commercial, and perhaps industrial land use in the areas. The expected trend in population growth in the vicinity of the RFP is addressed in the DOE demographics study (DOE 1991d). 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 the 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 the 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.

1.3.3.7 Regional Geology and Hydrogeology

Water-bearing units at RFP include alluvium and bedrock. The alluvium consists of fan deposits of the Rocky Flats Alluvium; terrace deposits of the Verdos, Slocum, and Louviers Alluvium, and valley-fill deposits of the Pre-Piney Creek, Piney Creek, and Post-Piney Creek Alluvium (Figure 1.3-3). The bedrock consists of sandstones and weathered and unweathered claystones



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

Figure 1-4
1989 POPULATIONS AND (HOUSEHOLDS), SECTORS 1-5

SOURCE: DOE, "1989 POPULATION, ECONOMIC AND LAND USE DATA BASE FOR ROCKY FLATS PLANT", (IN PRESS).

DRAWN BY	KRONER 3-21-91	CHECKED BY / APPROVED BY	CJR / TDK	3-22-91 / 3-22-91	DRAWING NUMBER	304923-A27

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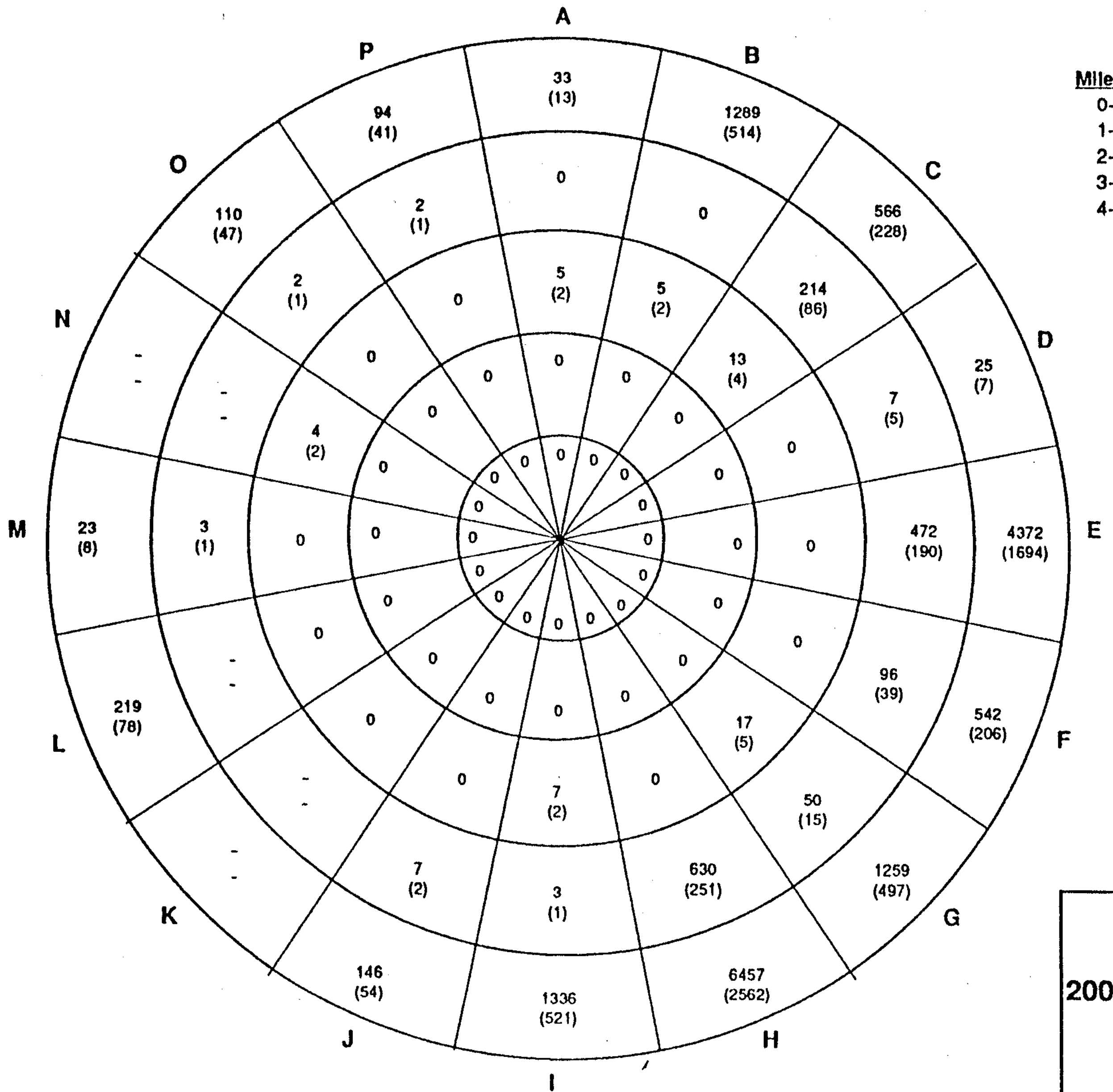
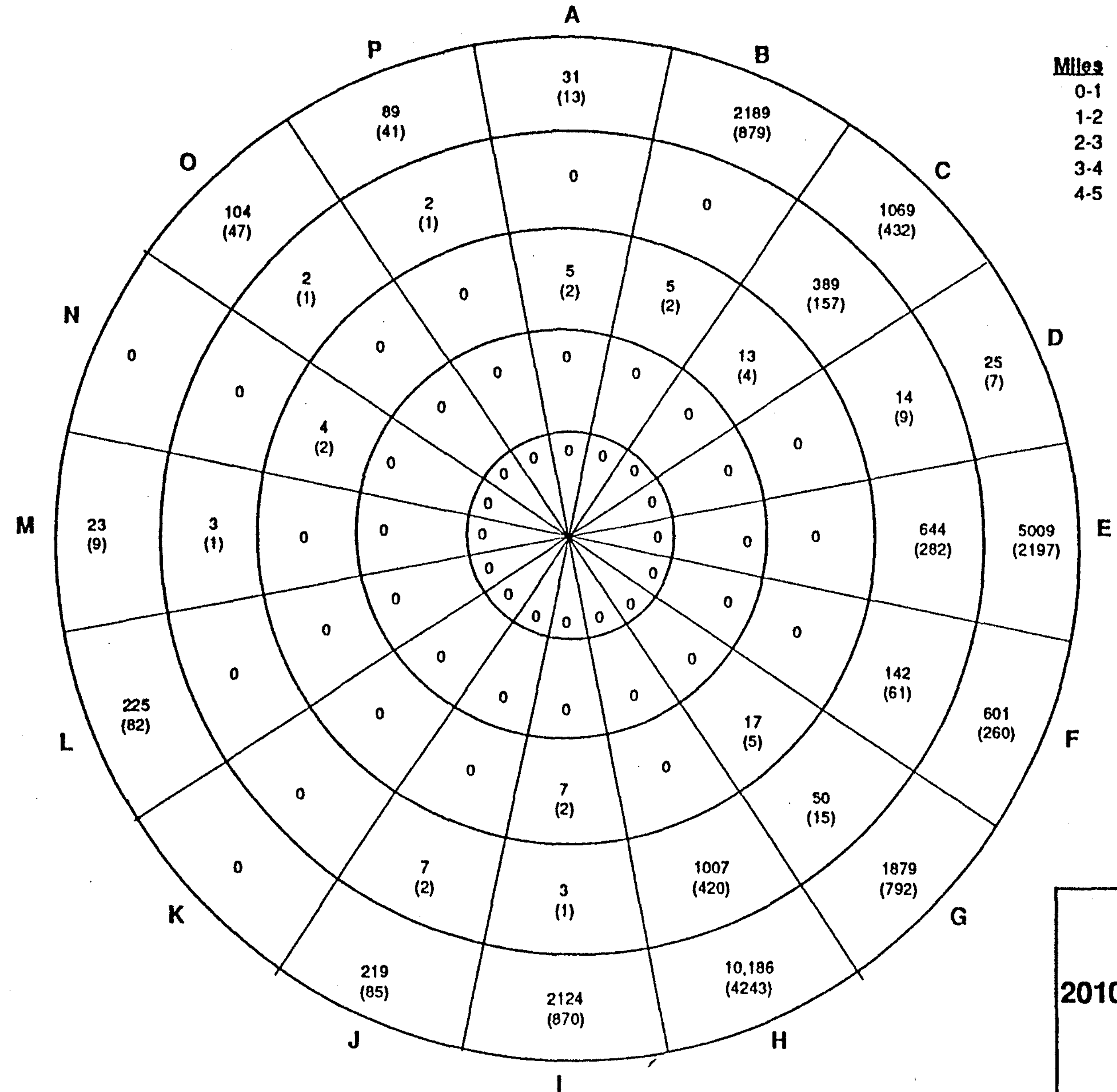


Miles	Sector Name
0-1	Sector 1
1-2	Sector 2
2-3	Sector 3
3-4	Sector 4
4-5	Sector 5

SOURCE: DOE, "1989 POPULATION, ECONOMIC AND LAND USE DATA BASE FOR ROCKY FLATS PLANT", (IN PRESS).

Figure 1-5
2000 POPULATIONS AND (HOUSEHOLDS), SECTORS 1-5

DRAWN BY	KRONER	CHECKED BY	CJR	3-22-91	DRAWING NUMBER 304923-A28
	3-21-91	APPROVED BY	TDK	3-22-91	



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

Figure 1-6
2010 POPULATIONS AND (HOUSEHOLDS), SECTORS 1-5

SOURCE: DOE, "1989 POPULATION, ECONOMIC AND LAND USE DATA BASE FOR ROCKY FLATS PLANT", (I[illegible]ESS).

DRAWN BY	KRONER 3-21-91	CHECKED BY CJR 3-22-91	APPROVED BY TDK 3-22-91	DRAWING NUMBER 304923-A29

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 (in press)

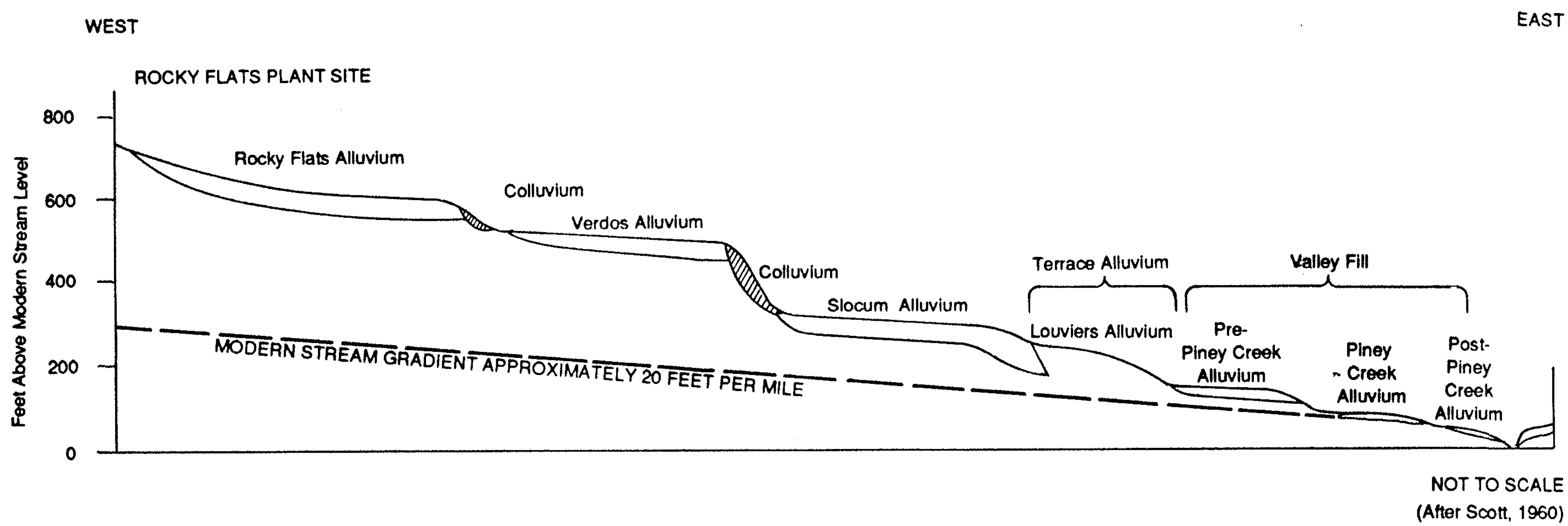


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FIGURE 1.3-3
Erosional Surfaces and Alluvial Deposits East of the Front Range, Colorado

of the Fox Hills Sandstone, Laramie Formation, and Arapahoe Formation (Figure 1.3-4). Alluvium, colluvium, and valley fill alluvium best fit the RCRA definition of "uppermost or unconfined aquifer" based on their proximity to the ground surface and higher hydraulic conductivities relative to bedrock units. Unweathered claystones are interpreted to be aquitards because of their low hydraulic conductivity (1 x 10^{-8} to 1 x 10^{-7} cm/sec). Bedrock sandstones beneath unweathered claystones are considered part of the confined aquifer. Bedrock sandstones and weathered claystones, which are hydraulically connected to the alluvial materials, may or may not be part of the "uppermost aquifer." In some locations at RFP, sandstones and weathered claystones have estimated hydraulic conductivities similar to those of unweathered claystones and are, therefore, not considered part of the uppermost aquifer. In other locations, sandstones and weathered claystones have estimated hydraulic conductivities more like those of alluvial units. Sandstones and weathered claystones will be considered part of the "uppermost aquifer" where:

- Weathered claystones and sandstones subcrop beneath an IHSS
- Saturated sandstones subcrop beneath saturated surficial material that has been contaminated by a regulated unit, regardless of the location with respect to the regulated unit.

Rocky Flats Alluvium

The Rocky Flats Alluvium is an alluvial fan deposit that occupies an extensive erosional surface beneath RFP. It ranges from 1 to 100 ft in thickness. The Rocky Flats Alluvium is thickest west of RFP near the apex of the fan and thinnest just east of RFP near the depositional limit of the fan. The Rocky Flats Alluvium has been removed by erosion along the Rock Creek, Walnut Creek, and Woman Creek drainages and tributaries. Because of the location of the erosional and depositional limits of the Rocky Flats Alluvium, wells downgradient of RFP are all screened in lithologic units beneath the Rocky Flats Alluvium. It is composed of poorly sorted, coarse, bouldery gravel in a sand matrix with lenses of clay, silt, and sand. Groundwater in the Rocky

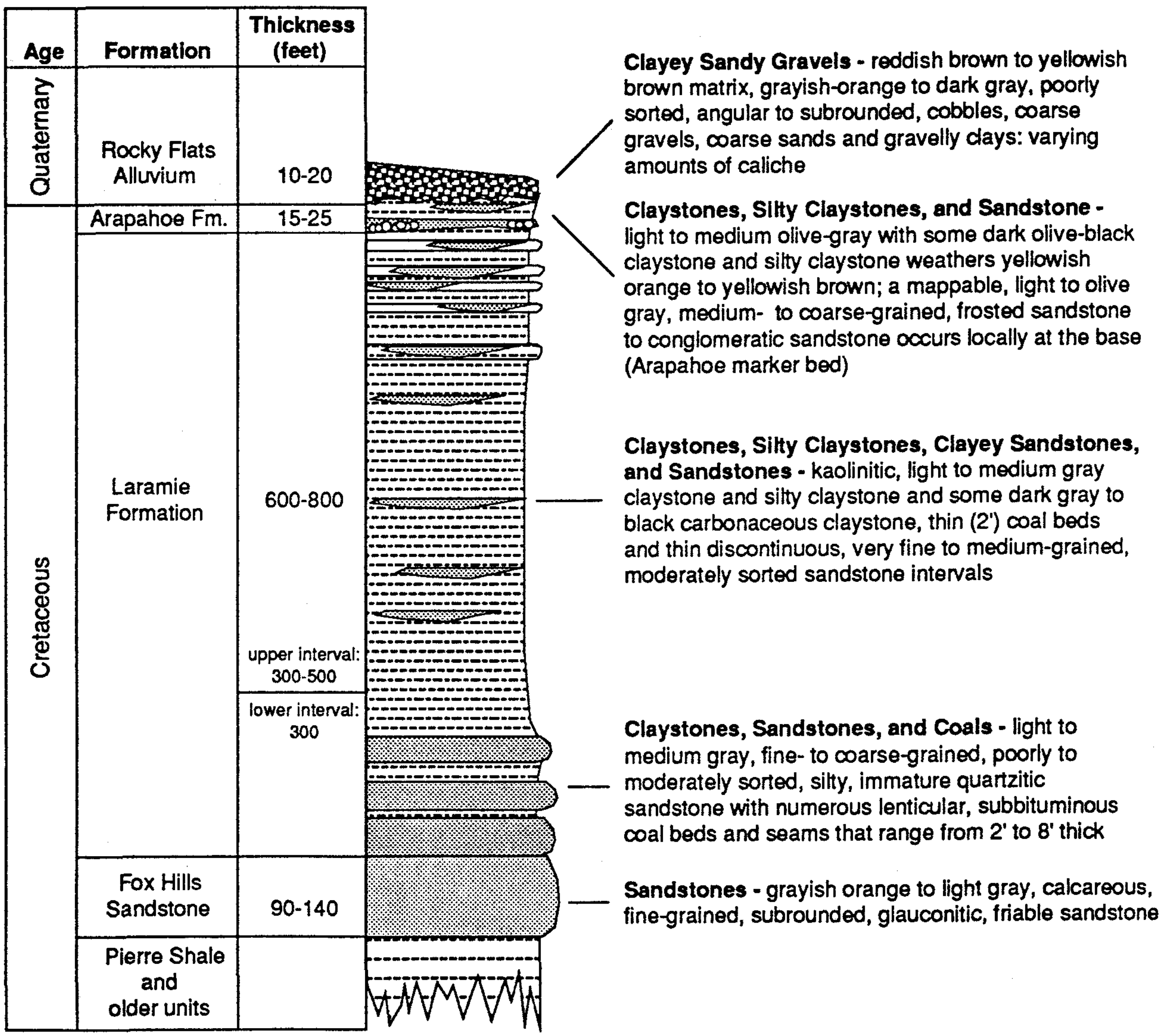

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Figure 1.3-4

Generalized Stratigraphic Section for the Central Portion of Rocky Flats Plant

After EG&G, 1992 — April 1992

Flats Alluvium is present under unconfined conditions. Hydraulic conductivities range from 1.6 x 10^{-5} to 1.3 x 10^{-3} cm/sec (Rockwell International 1989). Groundwater in the Rocky Flats Alluvium generally flows from west to east in the direction of surface water drainage. Paleochannels in the bedrock surface also control the direction of groundwater flow. The water table rises in response to recharge during the spring, and falls throughout the remainder of the year. Alluvial recharge occurs through precipitation, snowmelt, and water losses from ditches, streams, and ponds. Alluvial discharge occurs at minor seeps on hillslopes at the alluvial/bedrock contact.

Other Alluvial Deposits

Various other alluvial deposits occur downslope from the Rocky Flats Alluvium is deposited on in RFP drainages. Colluvium (slope wash) mantles the valley slopes between the pediment that the Rocky Flats Alluvium is deposited on and the valley bottoms. The range of hydraulic conductivity for the colluvium is 7.7 x 10^{-5} to 1.4 x 10^{-4} cm/s (EG&G 1991a). In addition, remnants of younger terrace deposits including the Verdos, Slocum, and Louviers Alluviums occur occasionally along the valley slopes. The hydraulic conductivity range for the Verdes, Slocum, and Louviers alluviums would be similar to the Rocky Flats Alluvium because they are similar in composition. Recent valley fill alluvial deposits occur in the active stream channels. The range of hydraulic conductivity for the valley fill alluvium is 3 x 10^{-4} to 3 x 10^{-3} cm/s (EG&G 1991a).

Unconfined groundwater flow occurs in these surficial units. Recharge is from precipitation, percolation from streams during periods of surface water runoff, and by seeps discharging from the Rocky Flats Alluvium. Discharge occurs by evapotranspiration and by seepage into other geologic formations and into surface streams. The direction of groundwater flow is generally downslope through colluvial materials and then along the course of the stream in valley fill materials. During periods of high surface water flow, water is lost to bank storage in the valley fill alluvium and returns to the stream after the runoff subsides.

Arapahoe Formation

The Arapahoe Formation underlies the Rocky Flats Alluvium. The Arapahoe Formation is 0 to 120 ft thick in the vicinity of RFP and is 15 to 25 ft thick under the central portion of the plant (EG&G 1992). It is composed of sandstones and claystones similar to those in the underlying Laramie Formation. The base of the Arapahoe Formation is marked by the presence of medium-grained to conglomeratic sandstones composed of well-rounded, frosted quartz sand grains with pebbles of chert, rock fragments, and ironstone (EG&G 1992). Dip of the sandstone beds is approximately 1 to 2 degrees east (EG&G 1992). Sandstone channels in the Arapahoe Formation were identified and mapped in OU2 using shallow, high-resolution seismic surveys (EG&G 1991b). Drill core data confirms that these channel sandstones are composed of medium-grained to conglomeratic sandstones of the basal Arapahoe Formation (EG&G 1992).

Recharge of the Arapahoe Formation occurs by leakage from the Rocky Flats Alluvium. Recharge is greatest during the spring and early summer when rainfall is at a maximum and water levels in the Rocky Flats Alluvium are high. Groundwater movement in the Arapahoe Formation is generally toward the east, although flow within individual sandstones is not fully characterized at this time. Regional groundwater flow in the Arapahoe Formation is east toward the South Platte River in the center of the Denver Basin. The hydraulic conductivity range for the Arapahoe Formation is 1.0×10^{-8} to 4.6×10^{-4} cm/s (Rockwell International 1989).

Laramie Formation and Fox Hills Sandstone

The Laramie Formation underlies the Arapahoe Formation and is informally subdivided into two members: an upper claystone member and a lower sandstone member. The upper claystone member is 300 to 500 ft thick and is composed of relatively impermeable claystones, silty claystones, and thin discontinuous sandstones. Hydraulic conductivities are very low. The lower sandstone member of the Laramie Formation is approximately 300 ft thick and is composed of sandstones with numerous lenticular claystone and coal beds. The Fox Hills Sandstone is 90 to 140 ft thick and is composed of massive, friable sandstones (EG&G 1992).

The lower sandstone member of the Laramie Formation and the underlying Fox Hills Sandstone comprise a regionally important aquifer in the Denver Basin known as the Laramie-Fox Hills aquifer. These units subcrop west of RFP and can be seen in clay pits excavated through the Rocky Flats Alluvium. Lower Laramie Formation sandstones dip 45 degrees east at the clay pits but the dip flattens abruptly to 1 to 2 degrees east under RFP (EG&G 1992). Recharge to the aquifer occurs along the limited outcrop/subcrop area along the Front Range that is exposed to surface water flow and leakage from the alluvium. The hydraulic conductivity range for the Laramie Formation is 1.0×10^{-8} to 5.5×10^{-7} cm/s (Rockwell International 1989). Because there is little, if any, hydraulic connection between the Laramie-Fox Hills aquifer and the overlying Arapahoe aquifer, and the recharge area for the Laramie-Fox Hills aquifer is west of RFP, plant operations should have little or no effect on the Laramie-Fox Hills aquifer (Hurr 1976).

2.0 SITE CHARACTERIZATION

A total of 16 Individual Hazardous Substance Sites (IHSSs) have been grouped into OU10, Other Outside Closures. Their locations are illustrated on Plate 1.

Section 2.1 discusses each IHSS in detail outlining the location and history, previous investigations, physical characteristics, and nature and extent of contamination. Most of the information is derived from the IHSS Closure Plans. Section 2.2, the site conceptual model, will discuss sources of contamination, types of contamination, release mechanisms, contaminant migration pathways, and receptors.

The soil data used in this report are 1988 soil data analyzed by Weston Analytics (Appendix A-1). The data are not known to be validated (Schoendaller 1990).

The groundwater data are from the RFP database (Appendix A-2). These data are presented in cases where wells exist in the IHSS's immediate location and can provide relevant data.

Many of the following discussions refer to the thickness of alluvium beneath the IHSSs and the direction of gorundwater flow. Figure 2.0-1 is an isopach map of alluvial thickness and Figure 2.0-2 is a water table elevation map.

2.1 BACKGROUND AND PHYSICAL SETTING OF OU10

2.1.1 Radioactive Liquid Waste Storage Tanks (IHSSs 124.1, 124.2, and 124.3)

IHSS 124 is composed of three underground concrete tanks designated T-66, T-67, and T-68. Each of the tanks has been given an individual IHSS number in the IAG: T-66 is IHSS 124.2, T-67 is IHSS 124.3, and T-68 is IHSS 124.1. The following site description and discussion of site history are from the Closure Plan for this site (Rockwell International 1989a) and the Draft Historical Release Report (U.S. DOE 1992).

IHSS 124.1 is a rectangular concrete tank located in-ground south of 124.2 and 124.3 with an actual capacity of 30,000 gallons and a nominal capacity of 28,000 gallons. IHSS 124.1 is 16 ft wide, 28 ft, 10 inches long, 10 ft, 3 inches deep, and the walls are 10 inches thick. IHSS 124.1 has two 2-ft-diameter manholes in its top.

IHSSs 124.2 and 124.3 are rectangular tanks with walls of concrete which are 10 inches thick. The two tanks share an inner wall and are capped by concrete. Both tanks are straddled by a dry chemical storage shed covering approximately two-thirds of the tank tops and using the tops as the shed floor. Inner dimensions of 124.2 and 124.3 are as follows: 20 ft long, 10 ft wide, and 10 ft, 2 inches deep. Each has an actual capacity of 14,000 gallons and a nominal capacity of 12,000 gallons, and may be accessed through individual 2-ft-diameter manhole openings at the tank tops. The tank floors are sloped to aid in draining.

2.1.1.1 Location and History

The following information is summarized from the closure plan for this IHSS (Rockwell International 1989a).

IHSSs 124.1, 124.2, and 124.3 are located in or are directly adjacent to Building 774, which is in the north-central portion of the Rocky Flats Facility (Plate 1 and Figure 2.1-1). IHSSs 124.1, 124.2, and 124.3 are located to the east of Room 241, outside and adjacent to the building (Figure 2.1-2). The three tanks remained in operation until September 30, 1989, when they were taken out of service in compliance with closure regulations.

The primary function of IHSSs 124.2 and 124.3 was to receive treated liquid decanted from the second-stage batch precipitation process in Building 774. IHSS 124.1 was used as a backup if IHSSs 124.2 and 124.3 were not available. Other uses for IHSS 124.1 included receipt, via tank truck, of aqueous waste from miscellaneous sources such as spills in Buildings 460, 483, and 484 and water overflows on the 904 Pad.

IHSS 124.1 was installed in 1959. According to available records, no coating was applied to this tank. Both IHSSs 124.2 and 124.3 were installed in 1953 and were cleaned, sandblasted, and coated with 8 tons of Amercoat No. 55 in 1956. The waste held in all the tanks was low in solids content and, therefore, not prone to compaction (Rockwell International 1989a).

Each of the three tanks has two 4-inch-diameter fill lines and one 4-inch drain line. Within each tank the drain line has a 90-degree drop leg ending 6 inches off the tank floor. All piping enters or exits on the west wall of each tank. Because of the design of the drains in the 60-series tanks, approximately 1,000 gallons will remain in the bottom of each tank. The tank bottoms will be a mixture of aqueous wastes and solids which have precipitated from the tank contents. None of the tanks in the 60 series are reported to have been cleaned since coatings were applied. The waste held in the tanks is low in solids content and, therefore, not prone to compaction.

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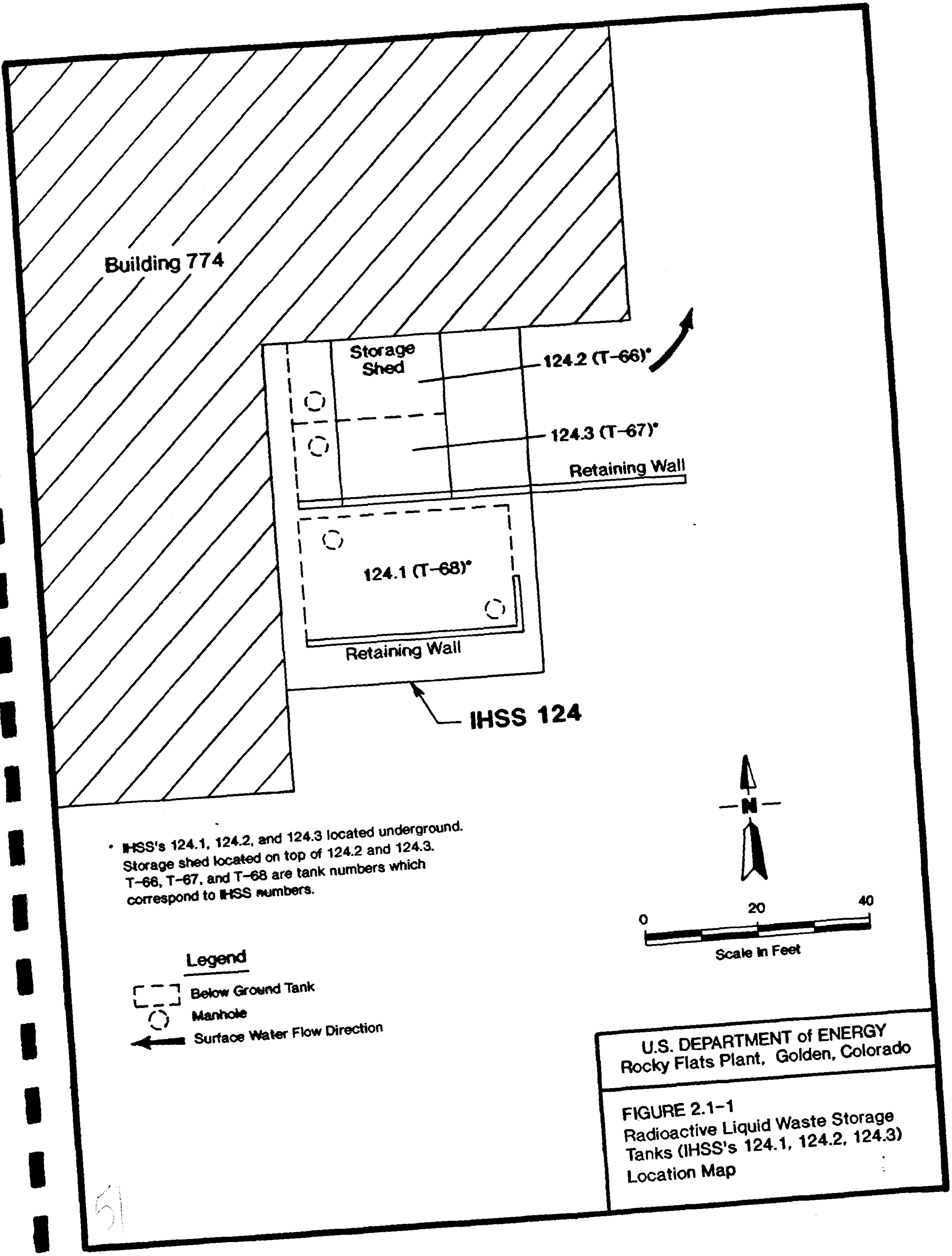

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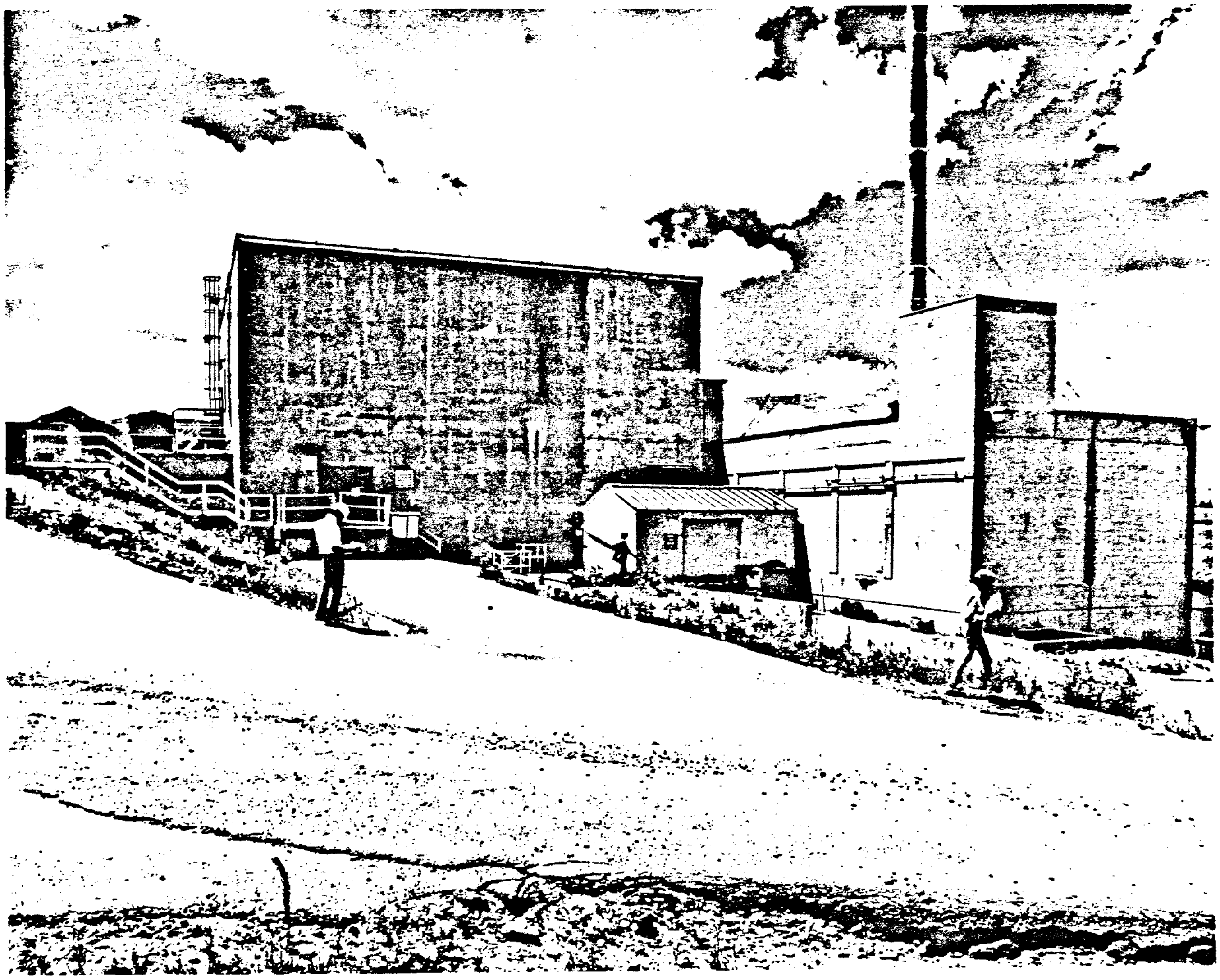
FIGURE 2.1-1
Radioactive Liquid Waste Storage Tanks (IHSS's 124.1, 124.2, 124.3) Location Map



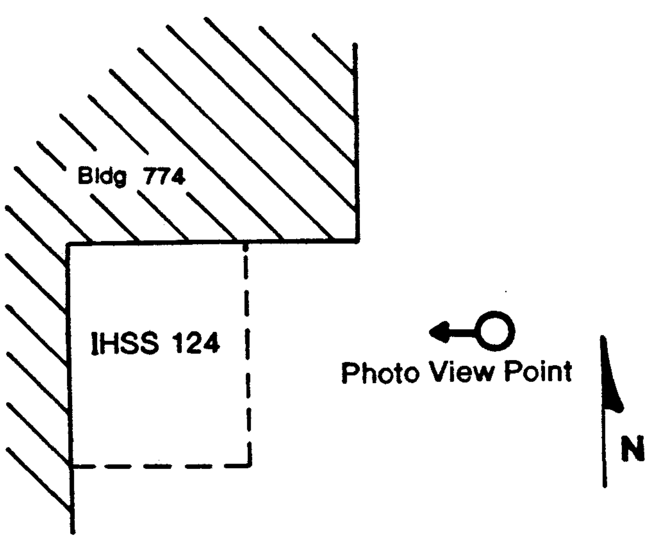


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FIGURE 2.1-2
Radioactive Liquid Waste Storage Tanks (IHSS 124.1, 124.2, 124.3)
Site Photo

The sludges and effluents which may be in IHSSs 124.1, 124.2, and 124.3 have resulted from treatment of hazardous wastes with the following Hazardous Waste Numbers and characteristics:

- D001 — Ignitability
- D002 — Corrosivity
- D004 — EP - Toxicity (Arsenic)
- D005 — EP - Toxicity (Barium)
- D006 — EP - Toxicity (Cadmium)
- D007 — EP - Toxicity (Chromium)
- D008 — EP - Toxicity (Lead)
- D009 — EP - Toxicity (Mercury)
- D010 — EP - Toxicity (Selenium)
- D011 — EP - Toxcity (Silver).

The intermittent aqueous spillage received in IHSS 124.1 may exhibit, in addition to the above list, the following Hazardous Waste Numbers and characteristics:

- D003 — Reactivity
- F009 — Spent stripping solutions from electroplating containing cyanide and exhibiting characteristics of reactivity and toxicity.

Additional wastes that the Closure Plan identifies as potentially present at IHSSs 124.1, 124.2, and 124.3 are listed below:

- F001 — Spent halogenated solvents used in degreasing
- F002 — Spent halogenated solvents
- F003 — Spent nonhalogenated solvents.

A large overflow occurred at IHSS 124. This overflow was most likely from a pipe break which occurred in the late 1970s. The liquid contained plutonium, americium and possibly uranium and flowed toward the front of Building 774. The overflow was immediately cleaned up. Documented information could not be found.

In July 1981, IHSS124.2 overflowed, spilling an estimated 500 gallons of liquid waste. A second source states that during the week ending July 17, 1981, about 3,300 gallons of process waste water overflowed a tank in Building 774 and about 50 gallons ran onto the asphalt driveway. Another source states that this spill involved between 50 to 100 gallons of liquid which contaminated the ground to the east of Building 774. The released process water was contaminated with nitrate, plutonium, and possibly uranium. The area east of Building 774 was paved in 1981 following the overflow. The contamination may not have been removed prior to paving (US DOE 1992).

2.1.1.2 Previous Investigations

IHSSs 124.1, 124.2, and 124.3 have not been previously investigated.

2.1.1.3 Physical Characteristics

The surficial materials existing at IHSSs 124.1, 124.2, and 124.3 consist of Rocky Flats Alluvium. The topography of the area gently slopes to the north, northeast (Plate 1). Approximately 10 ft of surficial materials overlie bedrock in the vicinity of IHSSs 124.1, 124.2, and 124.3. For a more detailed description of the geology, reference the bore log for Well 2086 found in Appendix B. Well 2086 is located approximately 120 ft to the northeast.

Groundwater is approximately 10 to 15 ft below the ground surface. The direction of flow in the unconfined flow system in the area of Building 774 is generally to the north into the Walnut Creek drainage. There is insufficient information to determine whether Wells 22-86 and 56-87, to the southeast of the tanks, or whether Well 19-86, to the west of Building 774, present the most relevant upgradient water quality data. Additional information is needed on the direction of flow of groundwater under Building 774 to accurately characterize the existing wells as being upgradient or downgradient of the tanks (RCRA Closure Plan 1989a).

The following information on physical characteristics is summarized from the Closure Plan for this IHSS (Rockwell International 1989a).

A french drain system has been installed north of IHSSs 124.1, 124.2, and 124.3 to intercept groundwater flowing towards North Walnut Creek. The system was installed in the hillside north of the Solar Evaporation Ponds and became operational in April 1981. This system of french drains north of the area strongly affects the surficial groundwater flow regime.

The depth of the drains range from approximately 1 to 27 ft below the ground surface, with a typical depth of 4 to 16 ft. The french drain system supplants a system of interceptor trenches which was installed in the period from 1971 to 1974. The seepage intercepted by the french drain system flows by gravity into the interceptor trench pump house. The amount of water drained through this system has been estimated at 4 million gallons per year. This amount, however, includes the water collected in the foundation drains of Building 774, which is also piped into the interceptor trench pump house.

It can be hypothesized from the groundwater table elevation data for 1988 that shallow soils around IHSSs 124.1, 124.2, and 124.3 remain unsaturated throughout the year except for June. If this hypothesis is correct, then it appears that the existing french drain system is effectively collecting the shallow groundwater from the area of these tanks, except perhaps during periods of heavy precipitation. However, this interpretation is based on a limited number of wells, none of which are close to the tank location.

Evidence indicates that the existing french drain system is not completely effective in containing the contaminated groundwater flow from the area of the Solar Evaporation Ponds because contaminated groundwater has been detected at Wells 17-86 and 15-86 downgradient of the system. These wells are located toward the northeast of the pond area, away from the tanks. Evaluations are being conducted to develop criteria for final design of the groundwater collection and treatment system for the Solar Evaporation Ponds, which will address deficiencies of the existing system.

2.1.1.4 Nature and Extent of Contamination

There is no existing soil sampling data for IHSSs 124.1, 124.2, and 124.3 available at this time. The possible contaminants are plutonium, americium, and uranium.

Well 56-87 is upgradient of the Solar Evaporation Ponds and IHSSs 124.1, 124.2, and 124.3. Prior to installation of this well, soil samples were collected within the screened interval. The soil samples contained high concentrations of thallium, cadmium, antimony, and beryllium. It appears that constituents from the original Solar Pond or the original process waste line system may have impacted these soils (Rockwell International 1989a).

Previous hydrogeologic investigations by Rockwell International and Weston have shown that groundwater in the surficial materials to the east of the tanks is contaminated. The Solar Evaporation Ponds are suspected as the sources for the contaminants which include nitrate, uranium, tritium, and trace metals. The groundwater in shallow bedrock also appears to have been impacted by the ponds. However, the extent of groundwater quality degradation in this zone is not adequately defined at this time. The report generated further states that the groundwater in deeper sandstone, which does not subcrop in the area, appears to have not been affected. None of the wells immediately adjacent to Building 774 are ~~finished~~ completed in the bedrock aquifer and, therefore, no information is presented here on water quality in this aquifer.

No upgradient or downgradient analytical groundwater data are available for this area, consequently further data are needed to assess the possibility of groundwater contamination from this site.

2.1.2 Oil Leak (IHSS 129)

The following discussion is summarized from the Closure Plan for the Building 443 No. 4 Fuel Oil Tank (Rockwell International et al. 1988a), the RCRA Part B Permit Application for the Rocky Flats Plant Hazardous and Radioactive Mixed Wastes (Rockwell International 1987), and the Draft Historical Release Report (U.S. DOE 1992).

2.1.2.1 Location and History

The Building 443 No. 4 Fuel Oil Tank (IHSS 129) is one of four fuel oil tanks located approximately 25 ft east of Building 443 (Figures 2.1-3 and 2.1-4). Since it is no longer in use, tank No. 4 is the only tank included in IHSS 129. The other three tanks are currently being used. The fuel oil tanks are oriented longitudinally east to west in a north-south line. Tank No. 4 is

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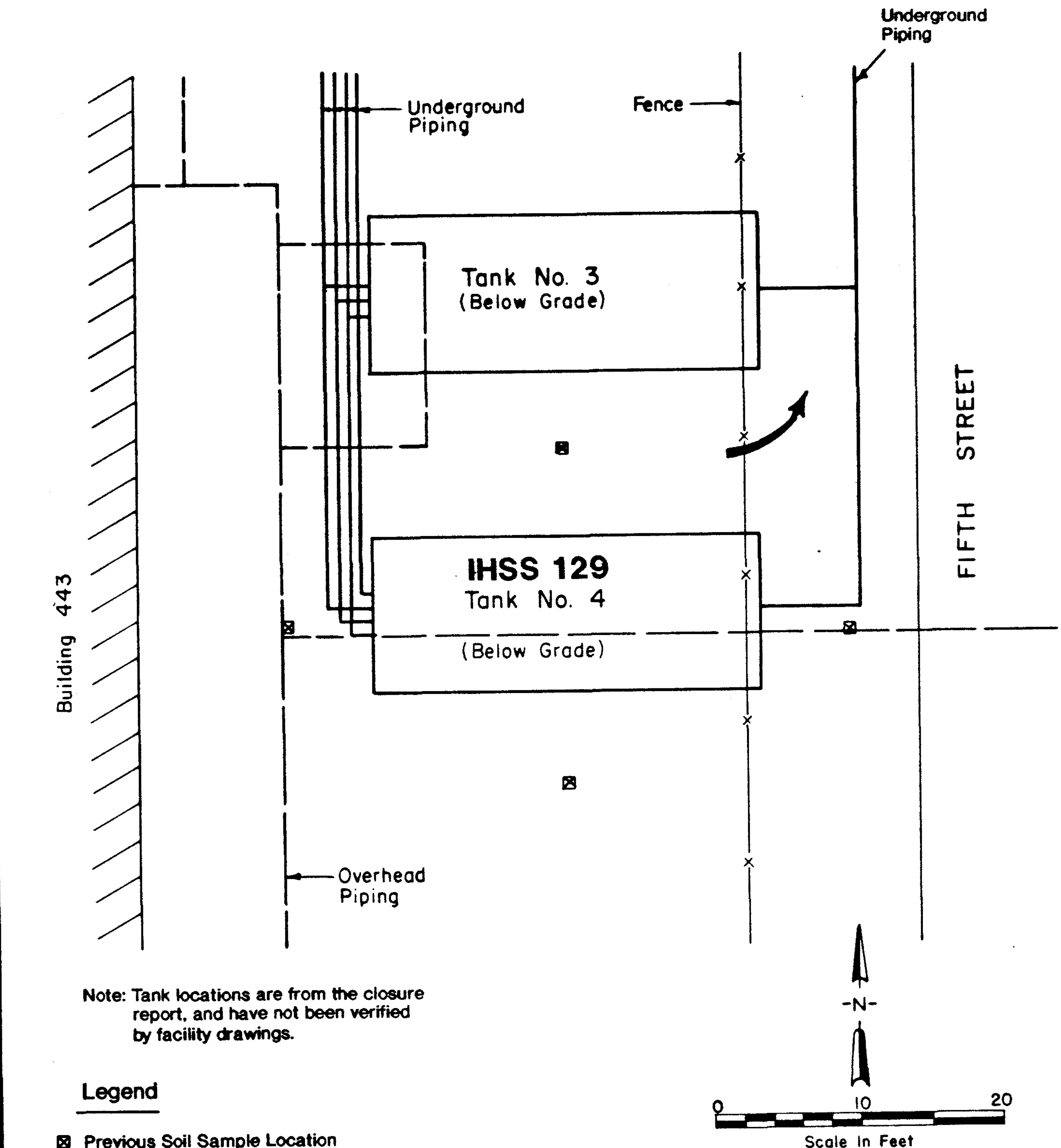

Note: Tank locations are from the closure report, and have not been verified by facility drawings.

Legend

⊠ Previous Soil Sample Location

← Surface Water Flow Direction

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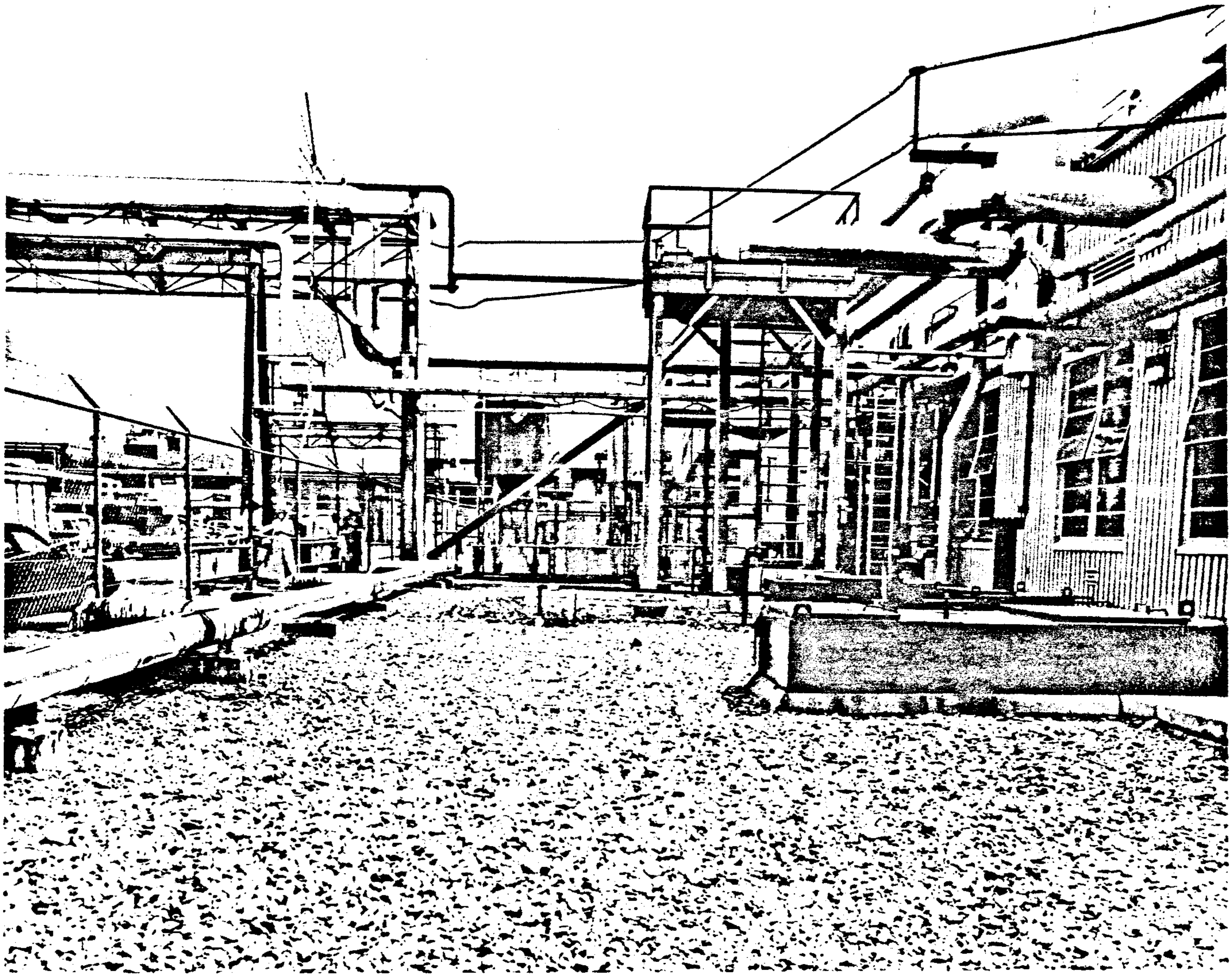
FIGURE 2.1-3
Oil Leak (IHSS 129)
Location Map



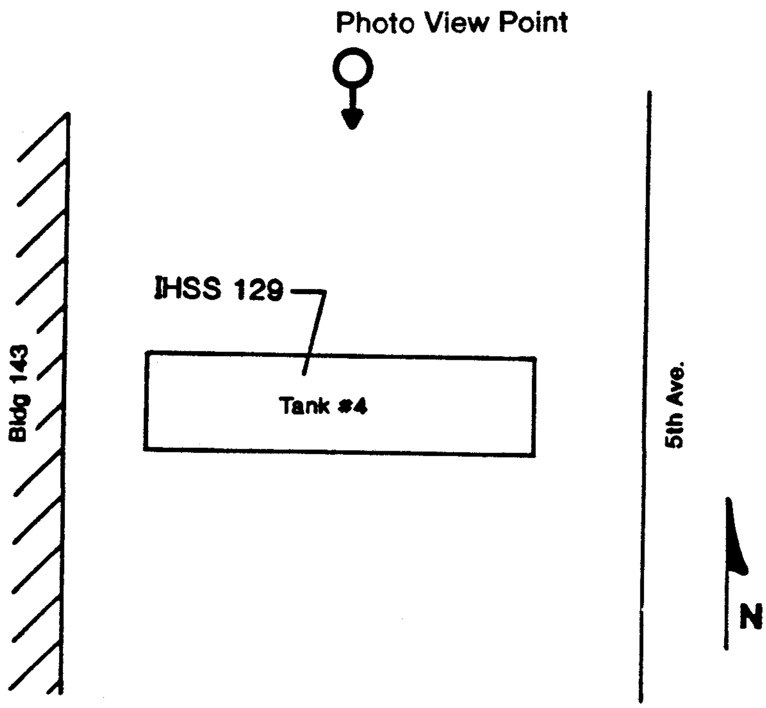


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FIGURE 2.1-4
Oil Leak (IHSS 129)
Site Photo

the southernmost of these tanks. The top of this carbon steel tank is located approximately 4 ft below grade without secondary containment. It is 11 ft in diameter by 27 ft in length and has a total storage capacity of approximately 19,000 gallons.

Five pipelines are connected with tank No. 4 (Figure 2.1-3). Four steel supply and return lines connect each of the four tanks to Building 443. These four lines consist of a steam line to supply the heaters located inside each tank, a return condensation line from the heaters, a pump line to pump fuel oil to Building 443, and a return line for oil being circulated from the Building 443 boilers. An additional aboveground line connects two supply tanks south of Building 551 to the four tanks. The portion of this line that is connected to tank No. 4 is an underground steel pipe.

The four fuel oil tanks historically supplied #6 fuel oil to the Building 443 steam plant. Two of the tanks were installed in 1952, while tank No. 4 and another tank were installed in 1967. Although tank No. 4 was primarily used from 1967 to 1984 to store #6 fuel oil, during the 1970s it was used to store #2 diesel oil. From 1984 to 1986, tank No. 4 was used to store a waste mixture of water and compressor oil prior to disposal. The compressor waste was a mixture of approximately 9 parts water to 1 part oil and was stored at a rate up to approximately 30 gallons per day. Solvents used to clean equipment and for cleaning up fuel oil spills have also been added to tank No. 4 from 1967 to 1986. Reportedly, solvents were not added to any of the other tanks. The solvents were added by pouring them through a vertical pipe located at the east end of the tank No. 4. Approximately 55 gallons of solvent were used every 2 years in Building 443. This amount corresponds to the approximate quantity of solvents added to tank No. 4. Use of tank No. 4 was discontinued in 1986 when a 4-ft-deep fence post hole excavation located approximately 6 inches east of the eastern edge of tank No. 4 partially filled with a material appeared to be compressor oil. Subsequently, the contents of tank No. 4, approximately

12,900 gallons of material, were removed and thermally destroyed by an off-site contractor in May 1986. Minor amounts of sludge may remain in tank No. 4 and associated lines.

There are no documented decreases in the level of material stored in tank No. 4 which would have indicated releases of material. Nevertheless, the source of the material in the fence post hole is believed to be spills associated with filling and possible leakage from tank No. 4. This theory is supported by documented increases in the level of material in tank No. 4 due to groundwater entering through a leak on the top of the tank. A summary of information pertaining to releases of fuel oil in the vicinity of the four #6 fuel oil tanks is presented below.

During 1967 and 1968, reported spills of #6 fuel oil were traced to overfilling the supply tanks because of inadequate instrumentation. The amount of fuel oil released is unknown.

In November 1977, approximately 600 gallons of #6 fuel oil were recovered from the sewage treatment plant. A cracked transfer pipe in an underground pipeline near tank No. 4 was determined to be the source of the oil. The oil had reportedly leaked out of the pipe, travelled through the pipe backfill and bedding materials, and seeped into a sump in Building 443 that was connected to the sewage treatment plant. The total amount of oil released is unknown. The pipe was repaired, and oil-contaminated soil encountered in the excavation was disposed of in the RFP sanitary landfill. Since 1983, aboveground transfer lines have been used.

Following the observation of oil in the fence post hole east of tank No. 4 in 1986, a trench approximately 3 ft wide, 4 ft deep, and 100 ft long was excavated east of the four Building 443 fuel oil tanks. The western edge of the trench was located approximately 3 to 4 ft east of the four fuel oil tanks. Dark fuel oil stains were observed in the southernmost 30 ft of the trench, immediately east of tank No. 4, and were believed to be related to previously mentioned spills and leakage events. No free product was present in the trench.

In February 1989, the level indicator in one of the tanks failed while the tank was being filled with #6 fuel oil causing 500 gallons of fuel to be released to the immediate area and to the street. The spill did not reach a water source. The oil was left on the ground until the next day to let it solidify in the cold. During the same month, 50 more gallons were spilled because the valves were left open. In July 1989, 1,700 gallons were released to the environment. The cause is unknown.

2.1.2.2 Previous Investigations

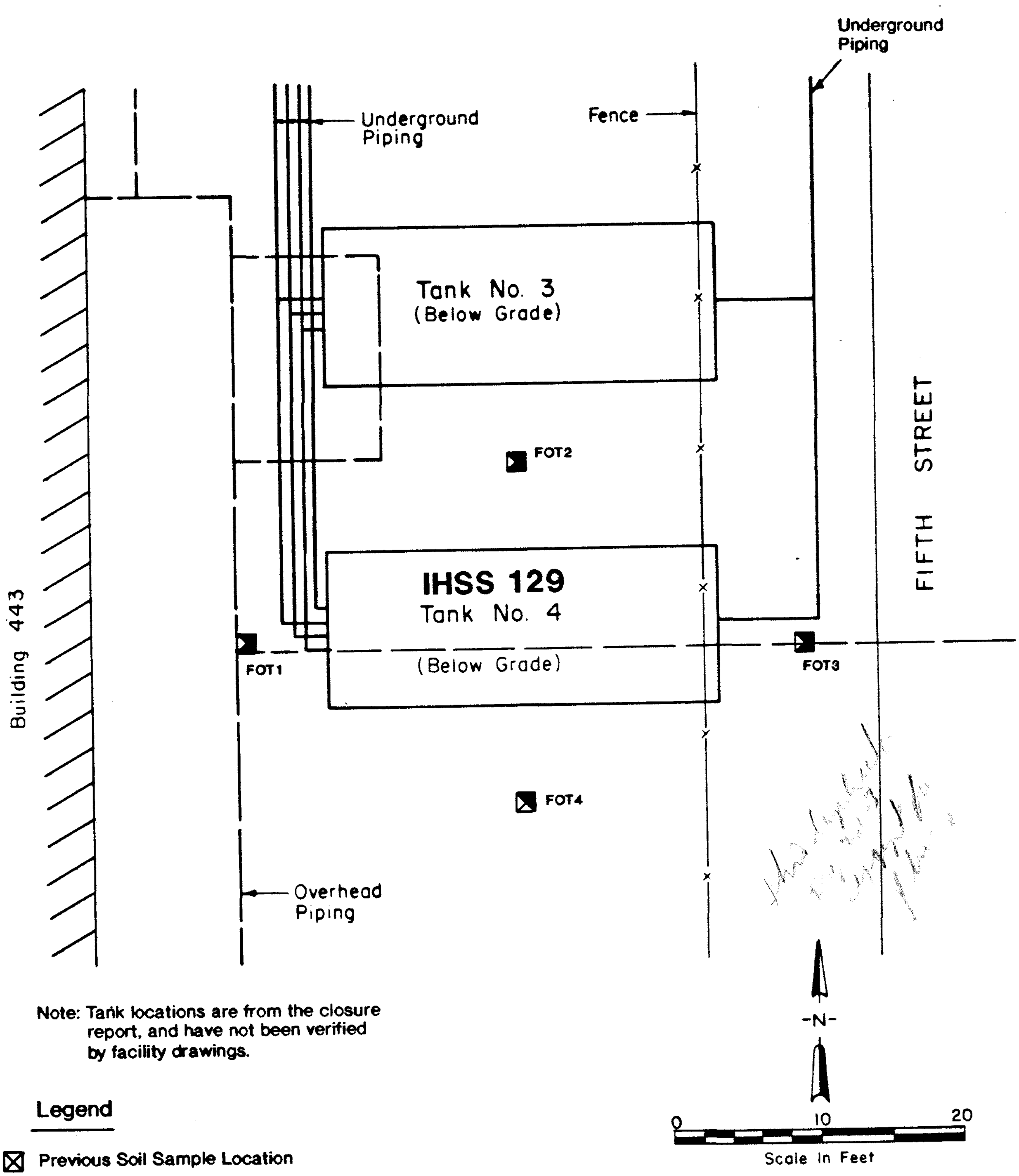
In 1986, samples were collected of the material stored in tank No. 4 and of the liquid that partially filled the excavated fence post hole east of tank No. 4. These samples were analyzed by both an on-site and an independent laboratory. The volatile organic compounds trichloroethylene, 1,1,1-trichloroethane, methylene chloride, and trichlorofluoromethane were detected in materials stored in tank No. 4. All of these compounds except trichloroethylene were also detected in the sample from the fence post hole. The Closure Plan for tank No. 4 (Rockwell International et al. 1988a) indicates that the No. 4 Fuel Oil Tank was the potential source of volatile organics in the material collected from the fence post hole.

The Closure Plan for the No. 4 Fuel Oil Tank (Rockwell International 1988a) presents results of groundwater analyses from five quarterly samplings of nearby alluvial Well 44-86 in 1986 and 1987. Well 44-86 is located approximately 150 ft northeast and cross-gradient of tank No. 4 and is not indicative of impacts to groundwater because of leakage or spills from tank No. 4. Trichloroethylene, 1,1,1-trichloroethane, and methylene chloride were the common analytes detected in tank No. 4 and the fence post hole, and were sampled for in Well 44-86. 1,1,1-Trichloroethane was found in two out of five sampling events; in one sampling event its concentration was less than one order of magnitude below the maximum contaminant level (mcl) of 0.20 milligram per liter (mg/l), and in the other sampling event the concentration was an estimated value below the analytical detection limit. Methylene chloride was detected in one out of two sampling events. The value for methylene chloride was actually an estimated value below the detection limit. Methylene chloride was also detected in a blank. Trichloroethylene was not detected in five out of five sampling events.

The Closure Plan for the Building 443 No. 4 Fuel Oil Tank (Rockwell International et al. 1988a) specifies an initial soil characterization program to determine the nature and extent of soil contamination. Subsequent to submittal of this Closure Plan, soil samples were obtained in 1988 from the four approximate locations shown in Figure 2.1-5 (Weston 1988). These borings were proposed to extend 10 ft below the water table or to a maximum depth of 30 ft. The actual depth of these borings is presently unknown. Analysis of soil samples included Hazardous Substance List (HSL) volatile organic analysis (VOAs), HSL base neutral acid extractable organics (BNAs), and HSL metals. Section 2.1.2.4 presents the results.

2.1.2.3 Physical Characteristics

The land surface at IHSS 129 gently slopes to the northeast (Plate 1). Approximately 25 ft of alluvium and fill overlie the bedrock in the vicinity of IHSS 129. The geologic materials in the vicinity of IHSS 129 consist of Rocky Flats Alluvium, fill, and Arapahoe Formation deposits. Unconfined groundwater flows to the east and probably intercepts the south Walnut Creek drainage. Depth to groundwater is estimated to be approximately 10 ft.



Note: Tank locations are from the closure report, and have not been verified by facility drawings.

Legend

- ☒ Previous Soil Sample Location
- ☒ Organics Detected
- ☒ Metals Detected
- ☒ Anions Detected
- ☒ Radionuclides Detected

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FIGURE 2.1-5
Previous Sampling Locations
Oil Leak (IHSS 129)

2.1.2.4 Nature and Extent of Contamination

Analytical results for soil samples taken in the area (Weston 1988) indicate the presence of organics above detection limit including 1,1,1-trichloroethane, methylene chloride, benzene, toluene, ethylbenzene, and total xylenes. The organic 1,1,1-trichloroethane was also detected by a portable gas chromatograph during field sampling. Table C-1 (Appendix C) lists the organics detected, present below detection limits, and present in blanks. Metals detected include aluminum, arsenic, beryllium, calcium, cadmium, chromium, copper, iron, mercury, magnesium, manganese, nickel, potassium, lead, vanadium, and zinc. Table C-1 also lists these metals. Radionuclides were not tested at this site. The sampling locations and concentrations of analytes detected are illustrated in Figure 2.1-5.

No upgradient or downgradient analytical groundwater data are available for this area.

2.1.3 <u>P.U.&D. Container Storage Yard - Waste Spills (IHSS 170)</u>

The following discussion is summarized from the Closure Plan for the Container Storage Facilities (Rockwell International et al. 1988b) and Draft Historical Release Report (U.S. DOE 1992).

2.1.3.1 Location and History

The P.U.&D. Storage Yard, approximately 260 ft by 1,000 ft in size is located southeast of the present landfill (Figures 2.1-6 and 2.1-7). The P.U.&D. Storage Yard began to be used in 1974 when operations were moved from the north end of the 551 Storage Yards. The P.U.&D. Storage Yard is presently active. It has been used to store containers such as barrels, drums, and cargo

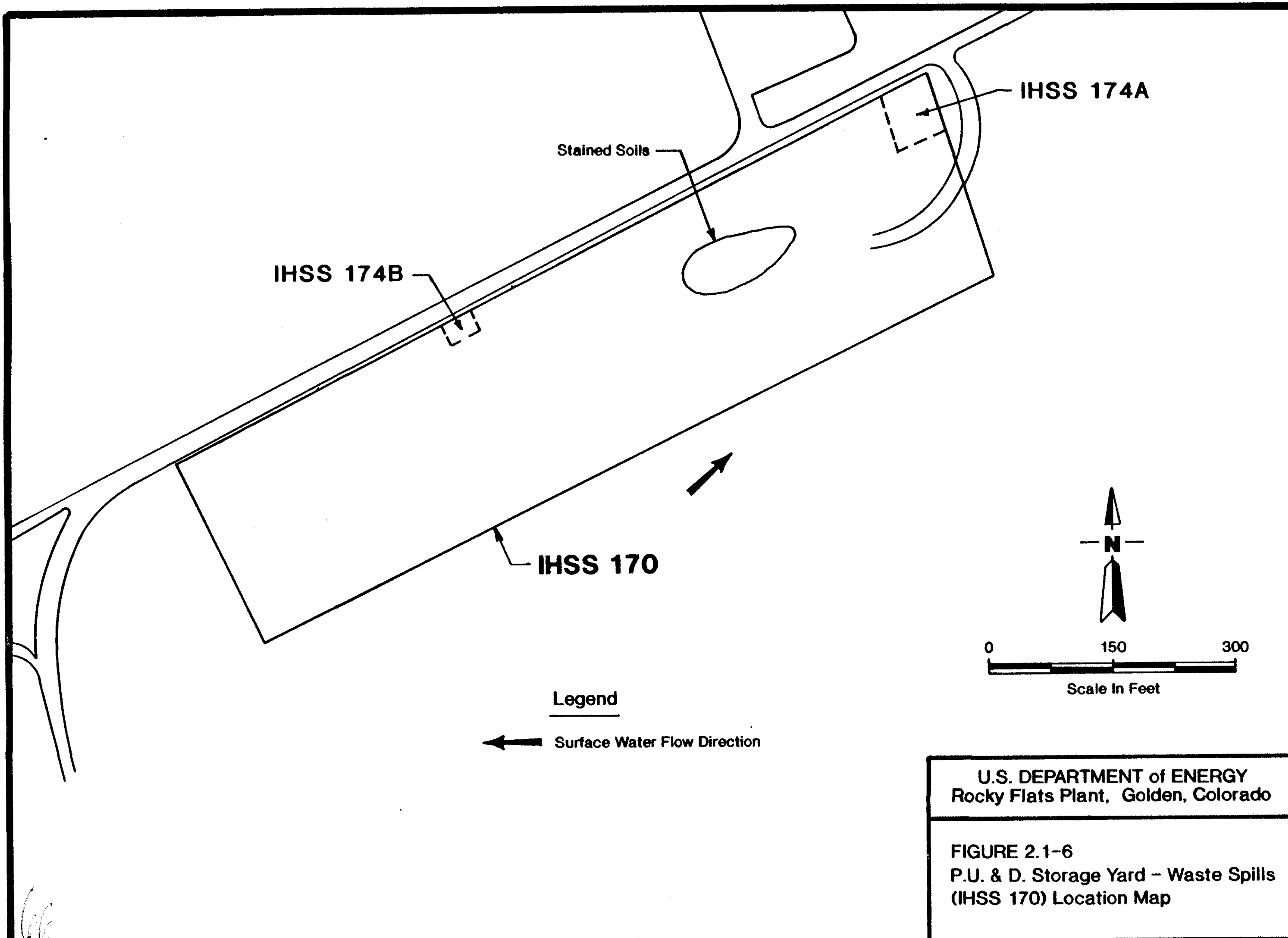

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FIGURE 2.1-6
P.U. & D. Storage Yard – Waste Spills
(IHSS 170) Location Map

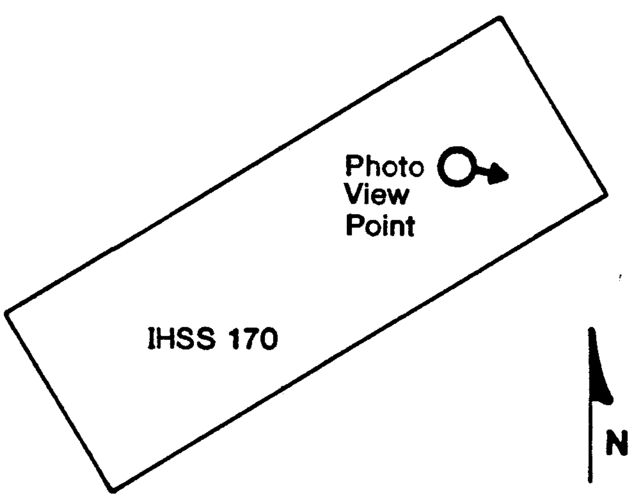

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FIGURE 2.1-7
P.U. & D. Storage Yard - Waste Spills
(IHSS 170) Site Photo

boxes, spent batteries, empty dumpsters, dumpsters filled with metal shavings coated with lathe coolant, and drums of spent solvents (paint thinners) and waste oils (Rockwell International 1988b).

The Storage Yard is divided into thirds with wire fences. The eastern third is used for the storage of scrap metal and contains the drum storage area. In this area, scrap metal may have been stored without prior decontamination. In addition, hazardous materials in drums were transferred within this area. The middle third is used for the storage of equipment (e.g., stainless steel tanks). Dumpsters containing hazardous materials were transferred in this area. The western third is used for the storage of excess property (U.S. DOE 1992).

Six tanks, containing approximately 1,800 gallons of liquid waste, have been generated from the cleanup of the RFP P.U.&D. Storage Yard. A 90-Day Accumulation Area has been established at the P.U.&D. Storage Yard for the storage of this material. EG&G Rocky Flats, Inc., is proposing to ship tanks numbered 1, 2, 4, 5, and 6 off site for disposal as nonradioactive waste. Tank No. 3 contains radioactive wastes.

Releases of battery acids have occurred in the past during removal of the batteries by recyclers. RFP personnel interviewed indicated that other releases have occurred from leaking dumpsters and drums of solvents and waste oils (Rockwell International 1988b).

In December 1987, a small amount of unknown radioactive powder spilled out of a drum in the yard (U.S. DOE 1992).

During a site visit in May 1990, EBASCO personnel observed that machined steel is currently stored near the middle of the P.U.&D. Storage Yard in a dumpster located several hundred feet from the reported location of the IHSS 174 Dumpster Storage Area (Rockwell International 1988b). Stained soil was also observed in the vicinity of this area. Inspection of air photos revealed a patch of stained soil near the center of the Storage Yard in 1985, which coincides with the current dumpster location. The dumpsters in current use reportedly do not contain hazardous constituents (Rockwell International 1988b).

In October 1990, rainwater had entered approximately 100 drums with unsecured bungs. Residual hazardous materials left in the drums contaminated the rainwater. The rainwater was not radioactively contaminated. An off-site contractor disposed of the liquid in the drums. A procedure is being implemented to ensure that the approximately 1,000 drums stored in the PU&D yard do not contain rainwater contaminated with hazardous materials (U.S. DOE 1992).

2.1.3.2 Previous Investigations

It is unknown if any previous soil or water sampling investigations have been performed at IHSS 170, but the six tanks containing liquid wastes have been sampled. The results from analytical report E90-2032, for sampling tanks 1 through 6 are listed below. These values represent ranges of concentrations for all six tanks and are expressed in ppm.

Acetone	0.20-0.30	Aluminum	100-300
Methylethyl ketone	0.30	Calcium	4.0-250
Ethylene dichloride	2.2-5.0	Iron	4.0-300
Freon 113	8.0	Potassium	4.0-300
Ethyl acetate	1.8	Sodium	4.0-300
Trichloroacetate	9.0-270	Gross Alpha	1.0±12-230±0.20
Perchloroethylene	0.50	Gross Beta	2.0±29-220±0.20
Toluene	0.50		

The tanks contain separate organic and aqueous phases. The organics above were sampled from the organic phase; there was no analysis of the organics in the aqueous phase. The organic layers all had VOCs. Samples of these tanks had a 6 to 23 volume percent organics, although Waste Guidance states that the layers of organic were approximately 1/4 to 1 inch thick. Therefore, the samples probably had a higher percentage organic than the tank (EG&G 1990a).

2.1.3.3 Physical Characteristics

The topography gently slopes to the northeast and east (Plate 1). Approximately 35 to 55 ft of Rocky Flats Alluvium and fill overlie the Arapahoe Formation in the vicinity of the P.U.&D. Storage Yard. The groundwater flows to the northeast, and probably intercepts the Present Landfill's groundwater extraction system on the north tributary of Walnut Creek. The depth to groundwater is approximately 10 ft. The closest well, Well 1086, is located 550 ft to the northeast of IHSS 170 (Plate 1).

2.1.3.4 Nature and Extent of Contamination

No previous investigations were performed so the nature and extent of contamination is unknown.

Acetone, methylene chloride, and nitrate/nitrite were detected in the groundwater of downgradient Well 1086 (Table C-2, Appendix C). Well 1086 is located 550 ft northeast of IHSS 170. Additional sampling is required to characterize the nature and extent of contamination.

2.1.4 <u>P.U.&D. Container Storage Yard - Waste Spills (IHSS 174)</u>

The following discussion is summarized from the Closure Plan for the Container Storage Facilities (Rockwell International et al. 1988b) and Draft Historical Release Report (U.S. DOE 1992).

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2.1.4.1 Location and History

Two separate areas are located within the P.U.&D. Container Storage Yard, the Drum Storage Area (IHSS 174A) and the Dumpster Storage Area (IHSS 174B) (Figures 2.1-8 and 2.1-9). IHSS 174A is a square area located within the northeast corner of the P.U.&D. Storage Yard and has dimensions of approximately 60 by 60 ft. The P.U.&D. Storage Yard was recently identified as IHSS 170 and is discussed in Section 2.1.3. IHSS 174B was reportedly located along the northern fence line, approximately 300 ft east of the western fence line of the P.U.&D. Storage Yard. There are discrepancies between the location of IHSS 174B as given by the IAG, the Closure Plan, the HRR description, and the HRR CAD drawing. The IAG and the Closure Plan give the location shown in Figure 2.1-8. The HRR description agrees with the IAG but states that the area is significantly larger. The HRR CAD drawing shows IHSS 174B to be over the stained soils area shown in Figure 2.1-6. This work plan will use the area defined by the IAG; between IHSS 170 and IHSS 174, the entire P.U.&D. Storage Yard will be addressed by the OU10 field sampling plan. Section 7.0 of this report will contain additional sampling of the stained soils area in IHSS 170.

Operations began in IHSS 174A sometime between 1974 and 1976 and ended in 1985. IHSS 174A was used for storage of 55-gallon steel drums that primarily contained waste oils from equipment and vehicle maintenance as well as waste paints and paint thinners from the RFP Paint Shop. These drums were placed directly on the ground surface without secondary containment. The drums and their contents were periodically sold for recycling until 1984, when the oil was determined to contain hazardous constituents. It has been estimated that a total of 460 drums were stored during the operation of the IHSS 174A, although the maximum number of drums stored at any one time may have been considerably less (Rockwell International 1988b). Assuming a total drum storage of 460 drums, this corresponds to a total storage capacity of

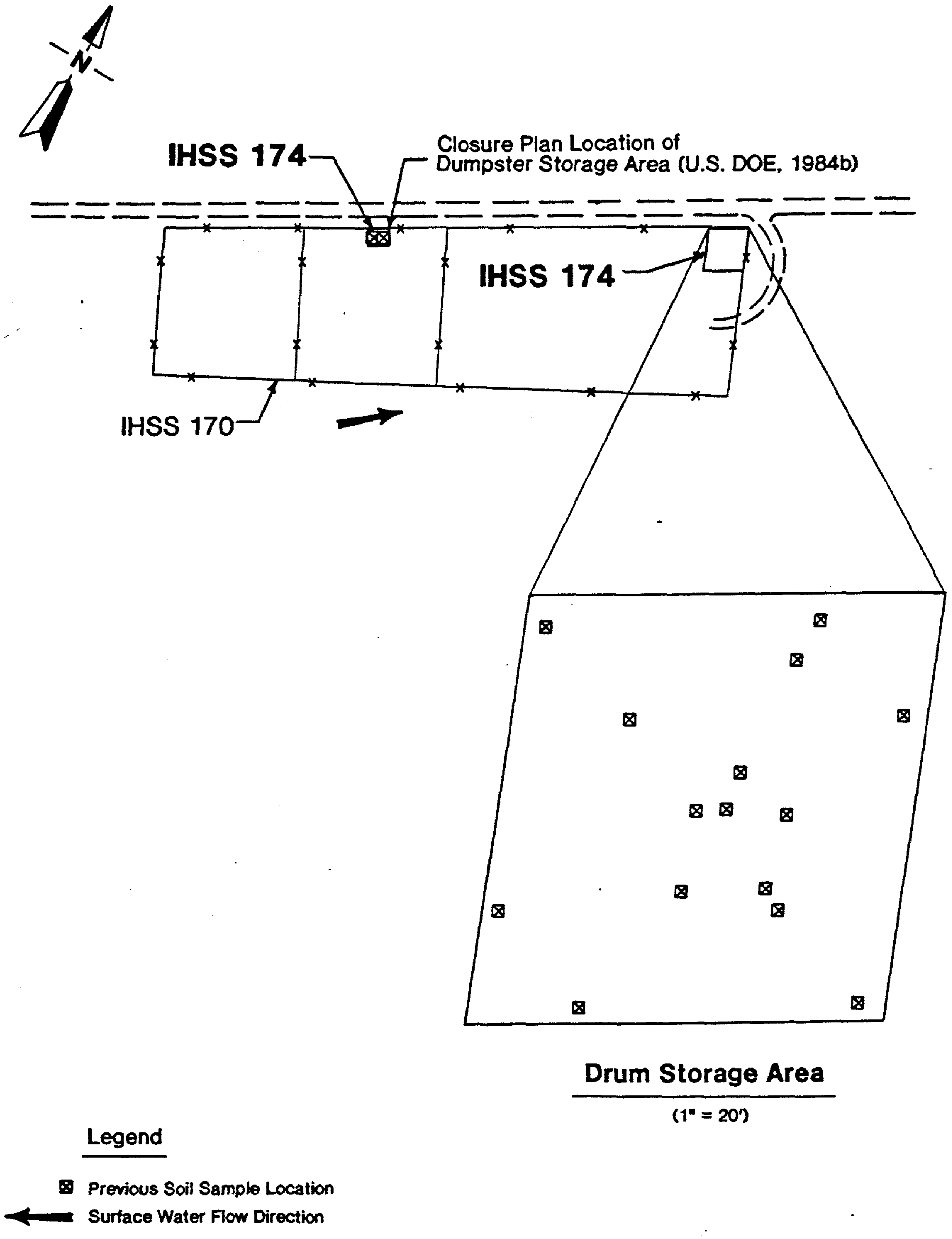

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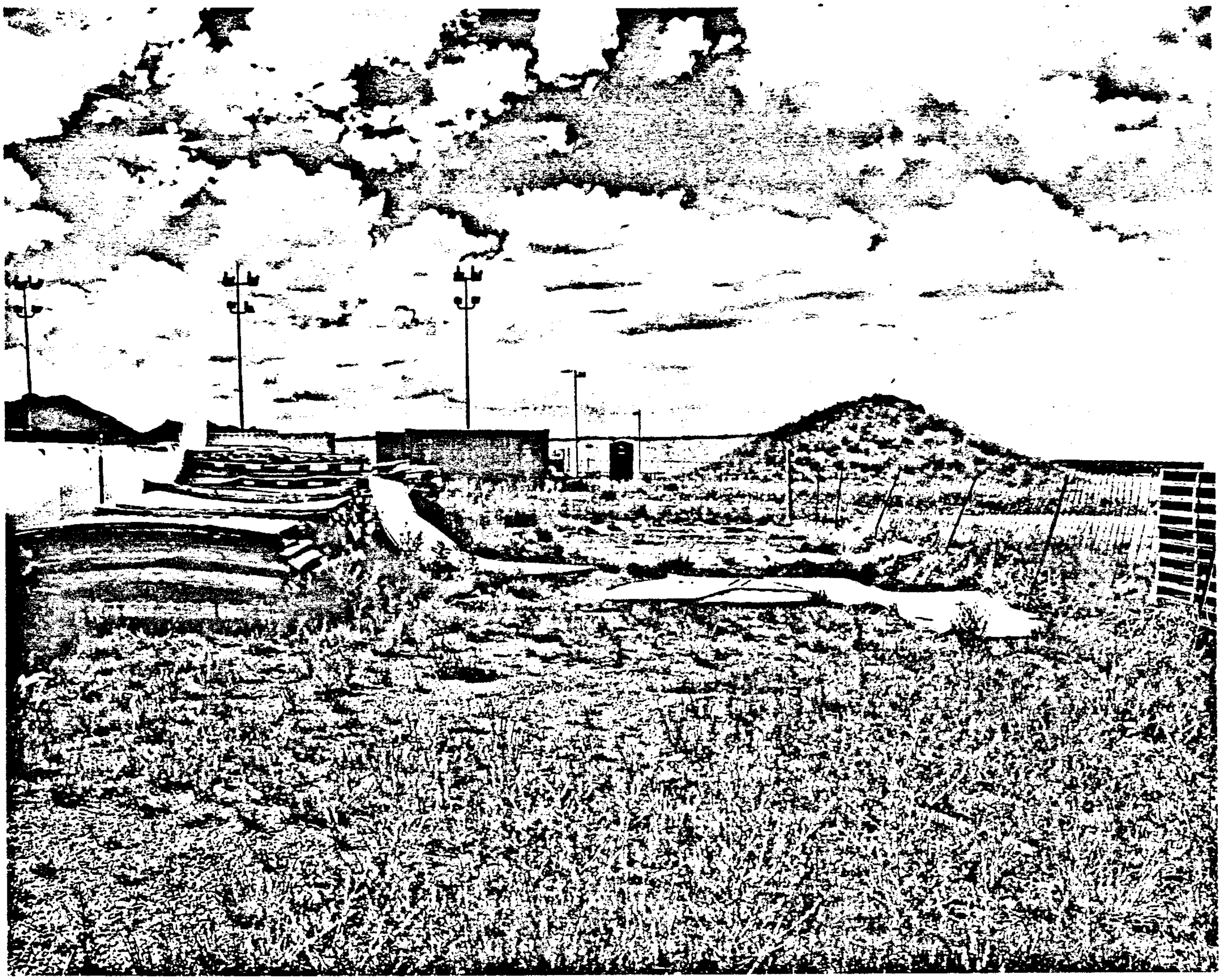
FIGURE 2.1-8
P.U. & D. Container Storage Facilities
(IHSS 174) Location Map



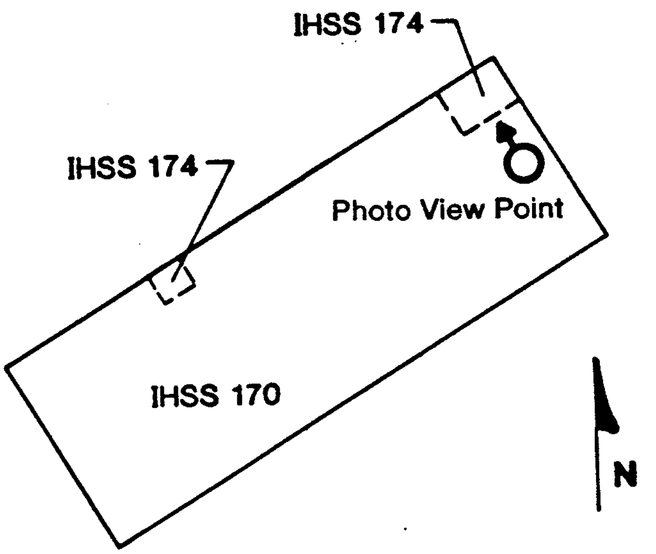


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FIGURE 2.1-9
P.U. & D. Container Storage Facilities
(IHSS 174) Site Photo

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25,300 gallons over the IHSS's operating life. Drums were generally stored for 1 to 2 years prior to removal and sale for recycling of their contents. In May 1982, a liquid drum exploded with the bottom blown out. Two other drums were found to have pressurized bulging tops. Documentation reporting a release to the environment was unavailable. These drums were subsequently transferred to the hazardous waste storage area west of the Present Landfill (IHSS 203) and the contents identified. In August 1985, all the drums were removed from the area for disposal by the Oil and Solvent Company. Since then, it has been used for the storage of empty drums.

IHSS 174B was used from 1974 to 1985 for storage of stainless steel machining chips that were coated with lathe coolant prior to off-site recycling. Two coolants were used. One was freon based and the other was composed of approximately 70 percent hydraulic oil and 30 percent carbon tetrachloride. Only one 12- by 16-ft dumpster with a total storage capacity of 860 cubic ft (ft^3) was used to contain the coated chips at any one time. The dumpster was located directly on the ground surface without secondary containment. Storage of these RCRA-regulated materials in the dumpster was discontinued in 1985, possibly due to elimination of solvents from the chip generating process. Visible staining is apparent on the soil in IHSS 174B from spills which occurred during transfer and from rainwater washing residual oil from metal shavings onto the ground.

Administrative controls were implemented to prevent radioactively contaminated material from being shipped to the yard. All drums were monitored externally for radiation prior to shipment to IHSS 174. Drums shipped from areas that handled radioactive materials were sampled and analyzed prior to shipment to IHSS 174.

2.1.4.2 Previous Investigations

In May 1985, samples were collected from 101 of the remaining 158 drums, composited into 12 samples, and analyzed. The oil fraction of the composited samples was analyzed quantitatively to determine which constituents composed the makeup of the oil. The remaining portions of the sample were analyzed by infrared spectroscopy. Components of the drummed waste were determined to include paraffinic base mineral oil, a volatile hydrocarbon solvent (e.g., mineral spirits such as aliphatic naphtha), carbon dioxide, methyl alcohol, silicone lubricant, freon, freon TF, water, and xylenes. Metals and other inorganics detected in the samples included aluminum, barium, beryllium, calcium, chromium, copper, iron, potassium, lithium, magnesium, molybdenum, sodium, nickel, lead, silicon, and zinc (Rockwell International 1988b).

An initial soil characterization program to determine the nature and extent of soil contamination was specified for IHSSs 174A and B in the Closure Plan for the Container Storage Facilities (Rockwell International 1988d). Subsequent to submittal of the Closure Plan, soil samples were obtained in 1988 from the approximate locations shown in Figure 2.1-9 (Weston 1988). These soil samples were collected from 1-ft-deep excavations and were composited over the 1 ft interval except for VOA samples, which were grab samples from a depth of 1 ft. Analysis of soil samples included HSL VOAs, HSL BNAs, HSL metals, inorganics, and radionuclides and results are presented in Section 2.1.4.4.

Prior to soil sampling, visual and direct radiation surveys were also conducted at IHSSs 174A and B to identify areas of potential contamination. The radiation surveys consisted of gamma surveys with a Field Instrument for Detection of Low Energy Radiation (FIDLER). In addition to the random systematic grid sampling program established in the Closure Plan, areas of stained soil or radiation detections were included.

During the visual surveys, several areas of stained soil and stressed vegetation were observed in the IHSS 174A. Staining was also observed in the northeast portion of this area where a dumpster of vanadium shavings was previously stored. Some shavings were still present on the ground surface. No areas were determined to have significant gamma radiation levels during the FIDLER survey.

2.1.4.3 Physical Characteristics

The topography of IHSS 174 gently slopes to the northeast and east (Plate 1). Approximately 30 to 50 ft of Rocky Flats Alluvium and fill overlie the Arapahoe Formation in the vicinity of IHSS 174, P.U.&D. Container Storage Facilities. The unconfined groundwater flows to the northeast and probably intercepts the groundwater extraction system of the Present Landfill on the north tributary of Walnut Creek. The depth to groundwater is approximately 10 ft below the ground surface. The closest well, Well 1086, is located 550 to 1,250 ft northeast of the IHSS 174 sites.

2.1.4.4 Nature and Extent of Contamination

The soil characterization program of IHSS 174B was conducted at the location along the northern fence line, approximately 300 ft east of the western fence line of the P.U.&D. Storage Yard.

There have been no documented spills at IHSSs 174A or B. An initial soil characterization program to determine the nature and extent of soil contamination in IHSSs 174A and B was initiated in 1988. Analysis of soil samples taken from borings in the area indicate the presence of organics above detection limit including acetone, 4-chloro-3-methylphenol, tetrachloroethene, 1,1,1-trichloroethane, and bis (2-ethylhexyl) phthalate.

Metals and inorganics detected include aluminum, arsenic, barium, beryllium, cadmium, calcium, chromium, magnesium, sodium, nickel, lead, iron, manganese, zinc, vanadium, copper, potassium, and nitrates. Radionuclides detected include gross alpha, gross beta, tritium, americium 241, uranium 233, 234, plutonium 239, 240, and uranium 238. Table C-3 (Appendix C) summarizes the organics, metals, inorganics, and radionuclides detected. The concentrations and sampling locations of these analytes detected above background are illustrated in Figure 2.1-10.

Analysis of groundwater samples taken from downgradient Well 1086 resulted in detections of acetone and methylene chloride (Plate 1). Inorganics detected include nitrate/nitrite. Table C-4 (Appendix C) lists the organics detected and the inorganics above background.

No upgradient well data are known to have been collected and Well 1086 is located approximately 500 ft from the east site and 1,250 ft form the west site of IHSS 174. Due to the distance of Well 1086 from the IHSS 174 locations, a groundwater plume may not be intercepted, so further data are needed to assess the possibility of groundwater contamination from IHSS 174 more accurately.

2.1.5 S&W Building 980 Container Storage Facility (IHSS 175)

The following discussion is summarized from the Closure Plan for the Container Storage Facilities (Rockwell International 1988b).

2.1.5.1 Location and History

The S&W Building 980 Container Storage Facility is reportedly located in the eastern third of a storage yard located south of Building 980 (Figure 2.1-11). The site has dimensions of approximately 25 by 25 ft. The precise location of IHSS 175 could not be determined during

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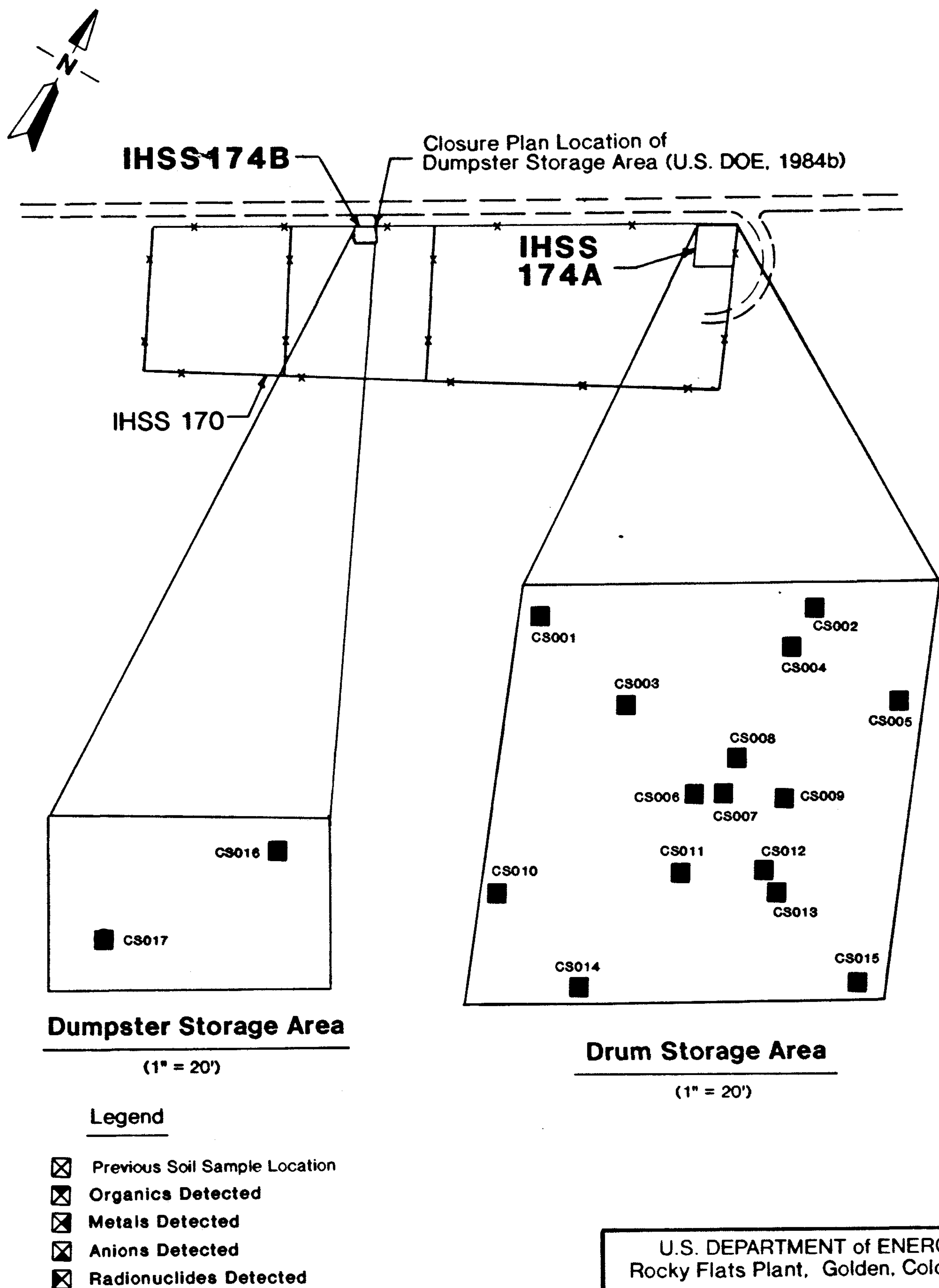

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FIGURE 2.1-10
Previous Sampling Locations
P.U. & D. Container Storage Facilities
(IHSS 174)

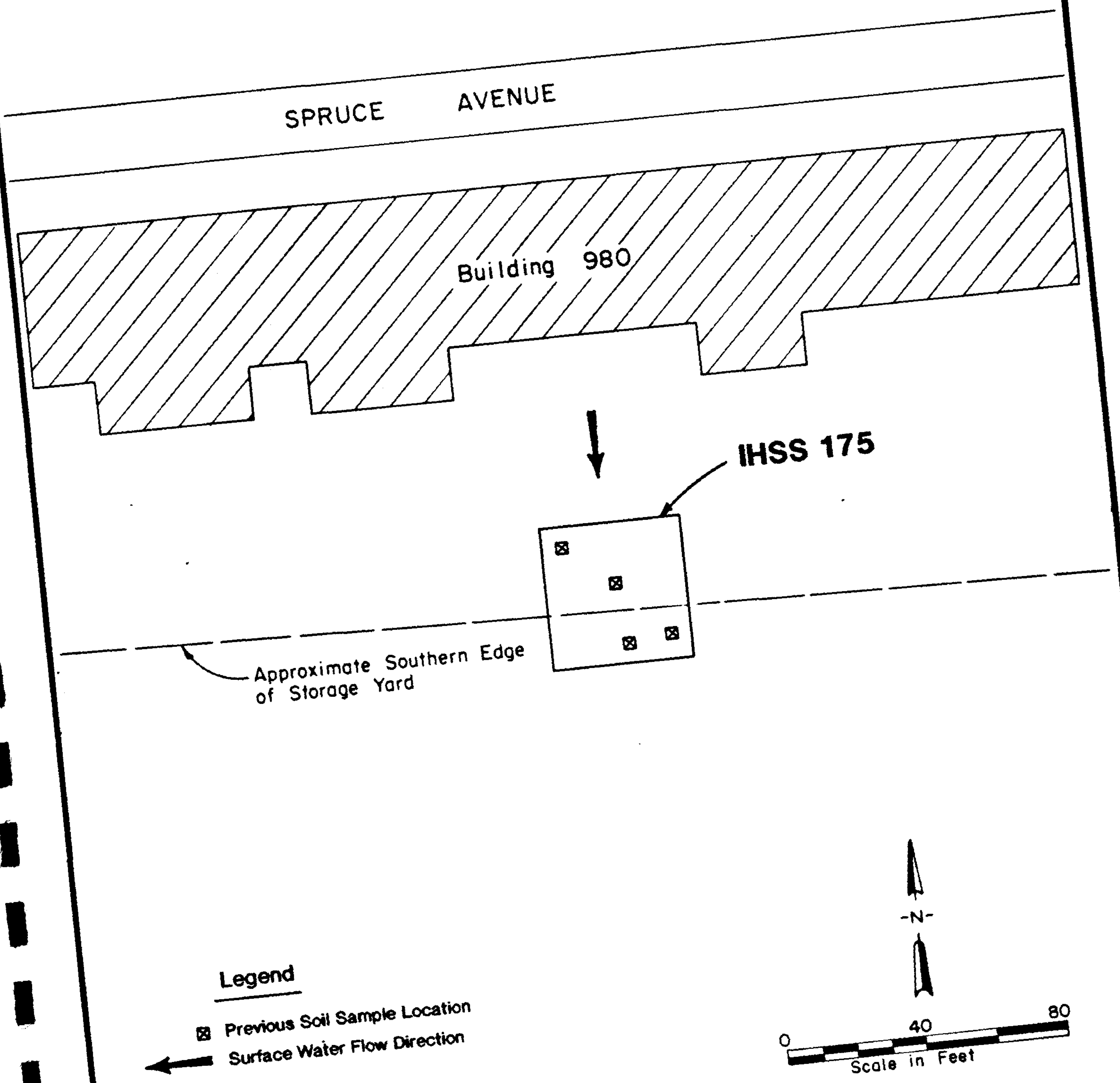

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FIGURE 2.1- 11
S & W Building 980 Container Storage Facility (IHSS 175) Location Map

a site visit in May 1990. The general area was reportedly regraded in spring 1988 (Rockwell International 1988b).

IHSS 175 was used from approximately 1980 to 1986 for storage of 55-gallon steel drums containing wastes generated by the S&W contractor's maintenance and fabrication shops. These wastes typically came from vehicle maintenance and painting activities and contained paraffinic-based mineral oil, a mixture of paraffinic- and naphthenic-based mineral oil, xylenes, freon TF, glycol ether/borate-based brake fluid, aluminum, barium, beryllium, calcium, sodium, lead, silicon, and zinc. A maximum of ten drums containing waste have been stored there at any one time. The drums were placed directly on the ground surface. A berm approximately 1 to 1.5 ft high was reportedly located on the west, south, and east sides of the overall storage yard. There have been no documented spills or leaks from this area; however, ground stains are visible. The area has been used from 1986 to the present as a 90-day accumulation area.

2.1.5.2 Previous Investigations

In May 1985, samples were collected from seven drums, composited into five samples and qualitatively analyzed. The oil layers of the composited samples were analyzed to determine their base materials and the remaining portions of the samples were analyzed by infrared spectroscopy. Components of the drummed waste were determined to include paraffinic-based mineral oil, a mixture of paraffinic- and naphthenic-based mineral oil, xylenes, freon TF, and glycol ether/borate-based brake fluid. Metals detected in the samples included aluminum, barium, beryllium, calcium, sodium, lead, silicon, and zinc.

An initial soil characterization program to determine the nature and extent of soil contamination was specified for the S&W Building 980 Container Storage Facility in the Closure Plan for the

Container Storage Facilities (Rockwell International 1988b). Subsequent to submittal of the Closure Plan, soil samples were obtained in 1988 from the approximate locations shown in Figure 2.1-11 (Weston 1988). One soil sample was collected from an area of stained soil and three samples were collected based on the random systematic grid sampling program. These soils samples were collected from 1-ft-deep excavations and were composited over the 1-ft-deep interval except for VOA samples, which were grab samples from a depth of 1 ft. Analysis of soil samples included HSL VOAs, HSL BNAs, HSL metals, inorganics, and radionuclides. (The results are presented in Section 2.1.5.4.)

Prior to soil sampling, a visual and a direct radiation survey were also conducted to identify areas of potential contamination. Several areas of ground staining were observed during the visual survey and it was noted that vegetation was sparse in the area. No areas were determined to have significant levels of gamma radiation during the FIDLER survey.

2.1.5.3 Physical Characteristics

The topography of IHSS 175 gently slopes to the northeast and more steeply to the east (Plate 1). Less than 10 ft of Rocky Flats alluvium and fill overlie the Arapahoe Formation in the vicinity of IHSS 175. The alluvium consists of clays, silts, sands, and gravel, and the bedrock is composed on claystone. The unconfined groundwater flows to the east, following the slope of the weathered bedrock surface and probably intercepts the south Walnut Creek drainage.

The depth to groundwater is approximately 15 ft below the ground surface. The closest well, Well 3386, is located 300 ft southeast of IHSS 175.

For a more detailed description of the geology, reference the bore log for Well 3386 found in Appendix B.

2.1.5.4 Nature and Extent of Contamination

Analysis of soil samples taken from borings in the area indicate detections of organics that include methylene chloride and acetone. Metals and other inorganics detected include arsenic, barium, beryllium, chromium, iron, manganese, nickel, strontium, vanadium, calcium, cadmium, copper, mercury, lead, magnesium, potassium, zinc, and nitrate/nitrites. Radionuclides detected include gross alpha; gross beta; tritium; uranium 233, 234; uranium 238; plutonium 239, 240; and americium 241. Table C-5 (Appendix C) summarizes the organics, metals, inorganics, and radionuclides detected. Figure 2.1-12 reports the sampling locations and the concentrations of analytes detected.

No upgradient or downgradient analytical groundwater data are known to have been collected.

2.1.6 <u>S&W Contractor Storage Yard (IHSS 176)</u>

The following discussion is summarized primarily from the Closure Plan for the Container Storage Facilities (Rockwell International 1988b).

2.1.6.1 Location and History

The S&W Contractor Storage Yard (IHSS 176) is located approximately 50 ft east of the Solar Evaporation ponds in the vicinity of Building 964 (Figures 2.1-13 and 2.1-14). This yard has been used for storage of contractor materials for use in various projects at the RFP. IHSS 176 is approximately 290 by 390 ft in size according to the IAG (1989). The actual area of

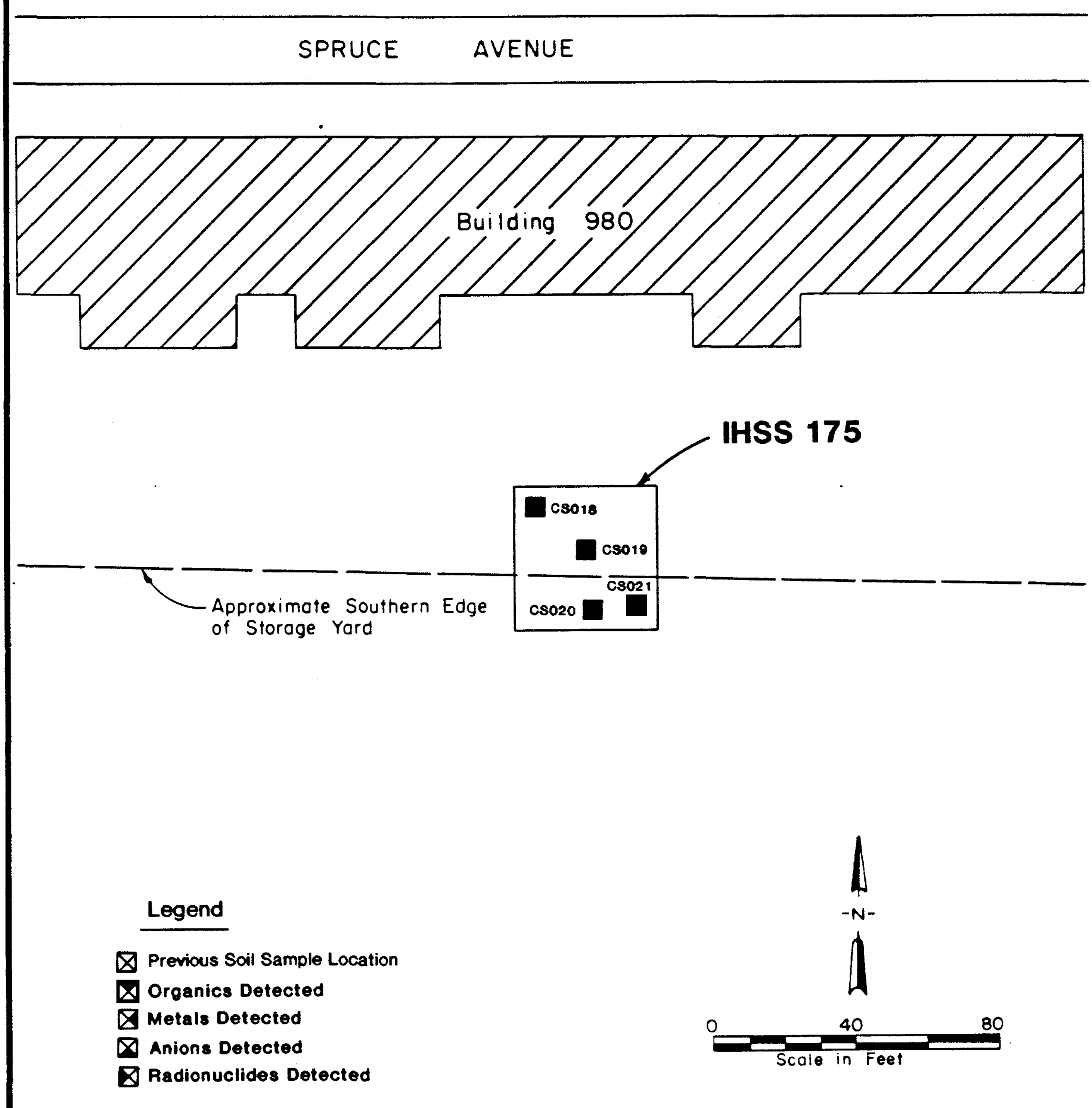

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FIGURE 2.1-12
Previous Sampling Locations
S & W Building 980 Container
Storage Facility (IHSS 175)

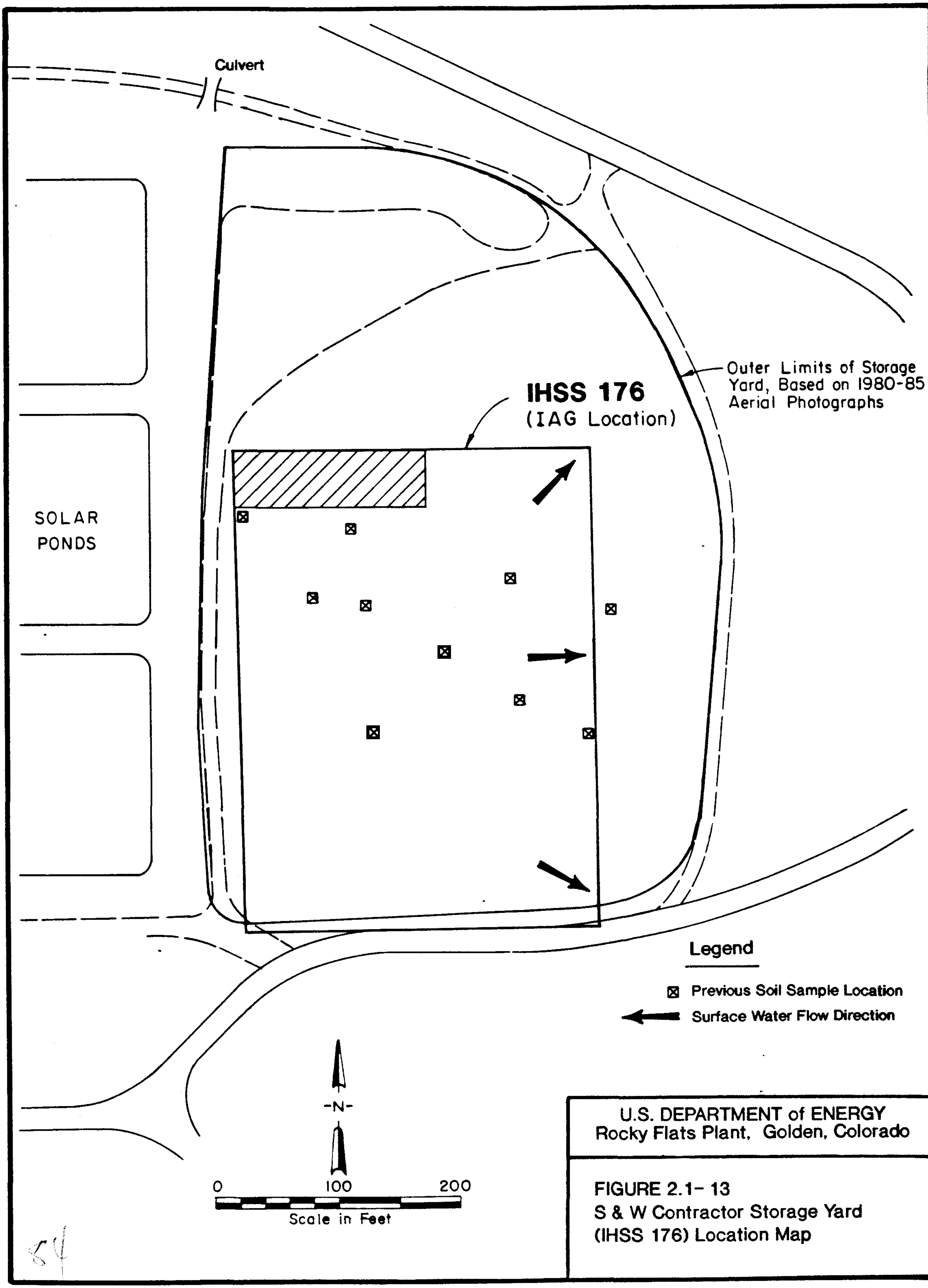

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FIGURE 2.1- 13
S & W Contractor Storage Yard
(IHSS 176) Location Map

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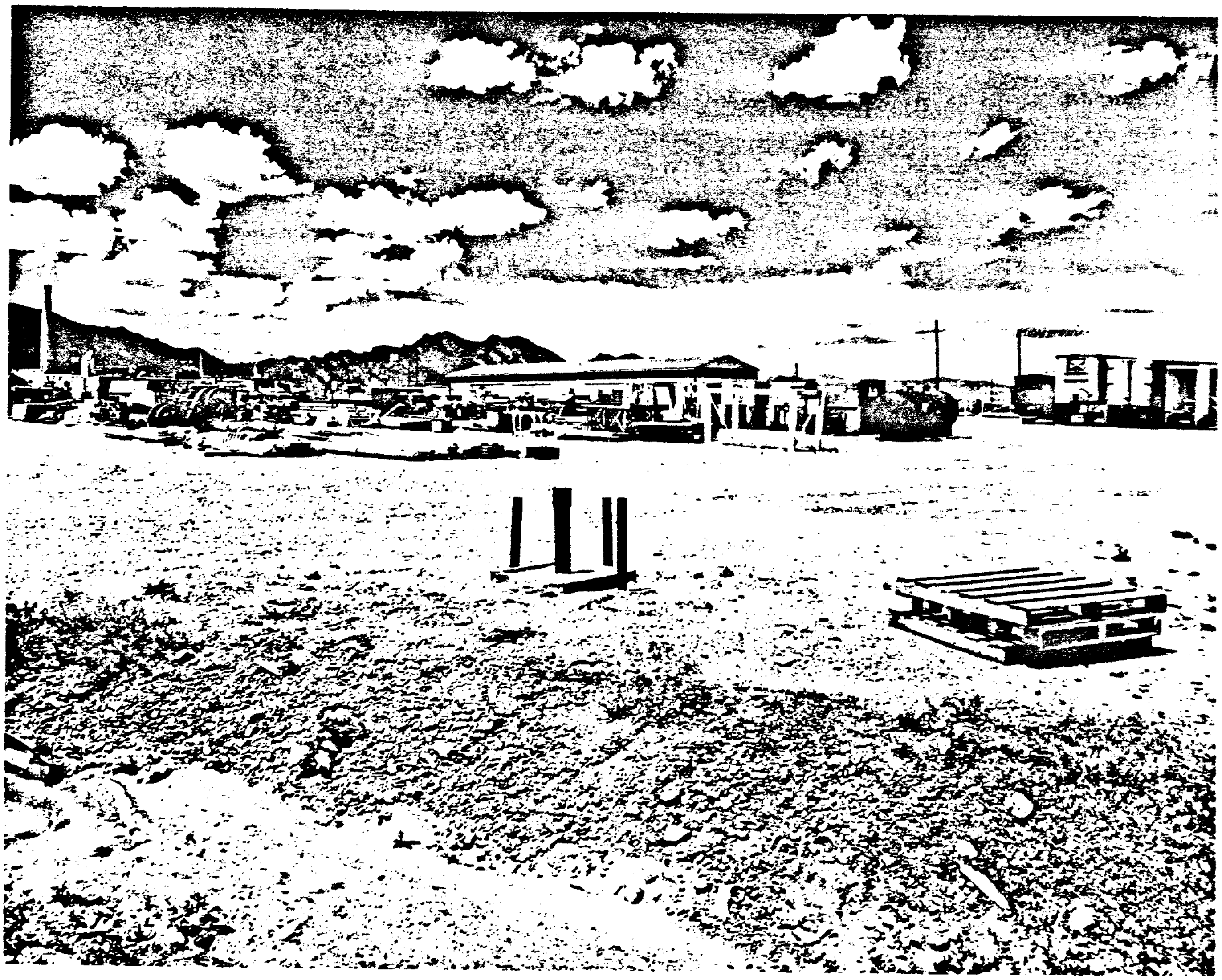

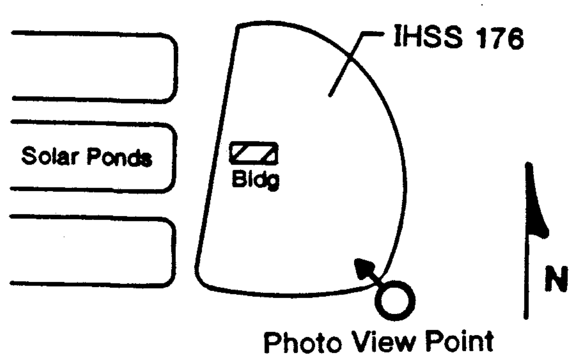

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FIGURE 2.1- 14
S & W Contractor Storage Yard
(IHSS 176) Site Photo

IHSS 176 used for storage appears to be considerably larger based on inspection of aerial photographs.

The S&W Contractor Storage Yard has been used for storage since 1970. This area was not intended to be used for the storage of hazardous waste. Drum storage began at this site in 1970 and continued until 1985. Containers were stored in numerous areas of the S&W Contractor Storage Yard throughout time. The total amount of waste stored at the S&W Contractor Storage Yard is unknown. In 1985, materials were identified in several areas of the S&W Contractor Storage Yard that qualified as hazardous waste. These containers had been placed directly on the ground surface or on pallets. The contents of the containers were sampled in 1985 and qualitatively analyzed. Components of the drummed waste were determined to be primarily mineral spirits, water, waste oil, volatile organics, and metals. The containers were subsequently removed and disposed as hazardous waste. Most of the S&W Contractor Storage Yard area has been used for storage of surplus or raw materials for use by contractors in construction or maintenance projects rather than for drum storage or accumulation.

A site visit in May 1990 indicated that use of the S&W Contractor Storage Yard is diminishing. Air photos from 1967 to 1985 indicate that a larger area than the actual boundaries of IHSS 176 was used as a storage yard.

2.1.6.2 Previous Investigations

An initial soil characterization program to determine the nature and extent of soil contamination was specified for the S&W Contractor Storage Yard in the Closure Plan for the Container Storage Facilities (Rockwell International 1988b). Subsequent to submittal of the Closure Plan, soil samples were obtained in 1988 from the approximate ten locations shown in Figure 2.1-13

(Weston 1988). One sample location was based on ground staining, five sample locations were based on historical use of the area, and four sample locations were based on the presence of hazardous waste in 1985. The soil samples were collected from 1 ft deep excavations and were composited over the 1 ft deep interval except for VOA samples, which were grab samples from a depth of 1 ft. Analysis of soil samples included HSL VOAs, HSL BNAs, HSL metals, inorganics, and radionuclides. Prior to soil sampling, a visual and a direct radiation survey were also conducted to identify areas of potential contamination.

2.1.6.3 Physical Characteristics

The ground surface gently slopes to the northeast - east at IHSS 176 (Plate 1). Approximately 15 ft of alluvium and fill overlie the bedrock in the vicinity of IHSS 176. The alluvium observed in Well 2886 located 100 ft north of IHSS 176 consisted of a thin cobble layer resting atop claystone of the Arapahoe Formation which was overlain by approximately 8 ft of mixed gravel and clay (Appendix B). The groundwater flows to the northeast, and the depth to groundwater is estimated to be approximately 5 ft below the ground surface.

2.1.6.4 Nature and Extent of Contamination

Analysis of soil samples taken from borings in the area indicate levels above the detection limit for methylene chloride, and acetone. Table C-6 (Appendix C) lists the organics, metals, inorganics, and radionuclides detected. Metals and other inorganics detected include aluminum, arsenic, barium, beryllium, chromium, sodium, thallium, calcium, cadmium, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, vanadium, zinc, strontium, and nitrate/nitrite. Radionuclides detected include gross alpha; gross beta; tritium; americium 241; plutonium 239, 240; uranium 238; and uranium 233, 234. Figure 2.1-15 illustrates the concentrations and sampling locations of the analytes detected.

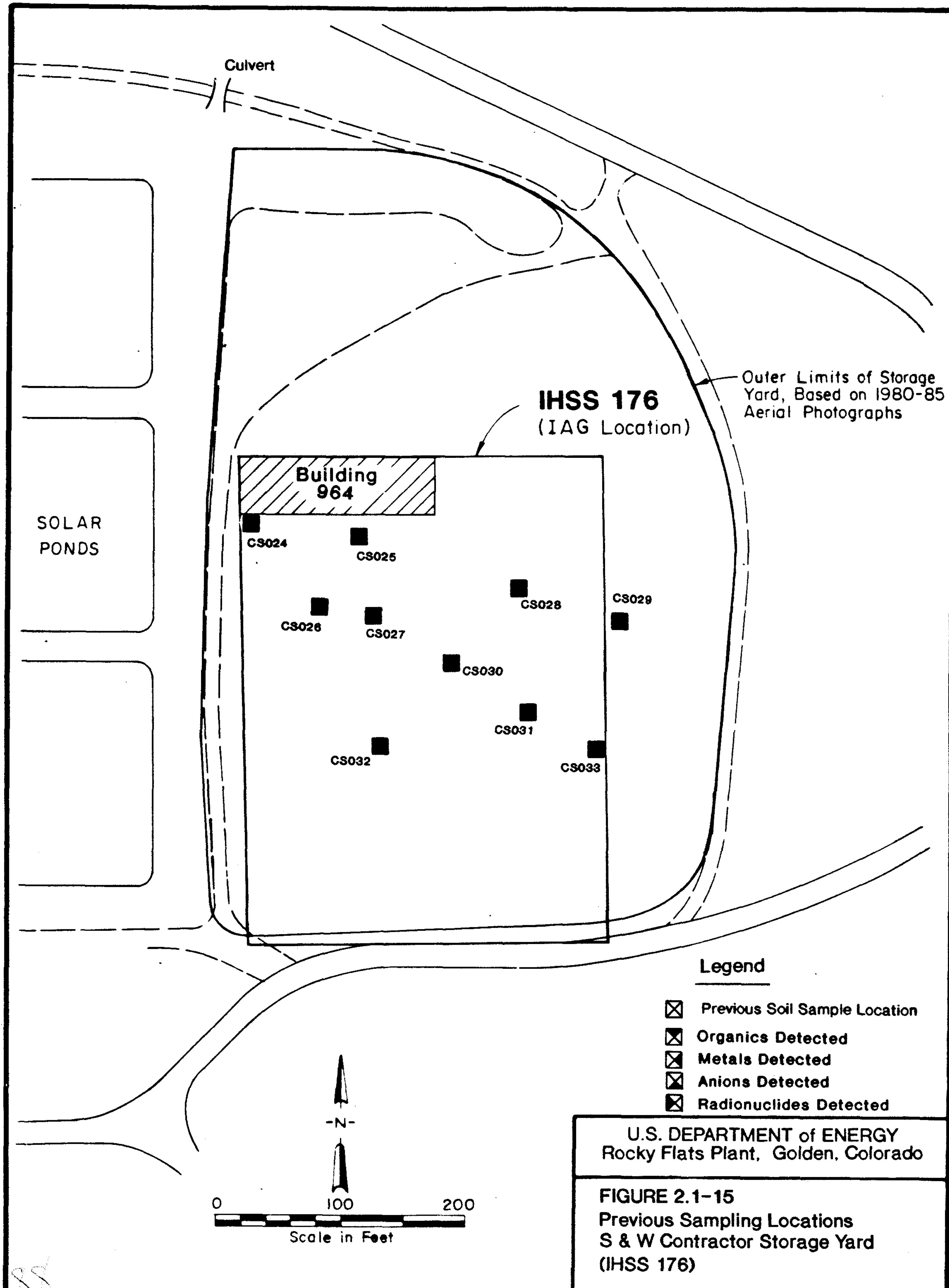

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FIGURE 2.1-15
Previous Sampling Locations
S & W Contractor Storage Yard
(IHSS 176)

Upgradient data from Well P207689 indicates detections for the metals and inorganics aluminum, beryllium, calcium, lead, magnesium, sodium, cyanide, and sulfate. Table C-7 (Appendix C) lists the metals and other inorganics detected. Radionuclides detected include americium 241; plutonium 239; tritium; and uranium 233, 234. Table C-7 lists the radionuclides detected.

Analysis of groundwater samples taken from Well 0460 within IHSS 176 indicates detections for the inorganics and metals calcium, cobalt, magnesium, mercury, potassium, sodium, zinc, carbonate, and sulfate. Table C-8 (Appendix C) lists the metals and other inorganics. Radionuclides detected include americium 241; gross alpha; plutonium 239; strontium 90; tritium; and uranium 233, 234. Table C-8 lists the radionuclides detected.

Metals and other inorganics located in the groundwater beneath IHSS 176 that were not detected in upgradient samples are cobalt, mercury, potassium, zinc, and carbonate. Radionuclides located beneath IHSS 176 that were not detected in upgradient samples include gross alpha and strontium 90. This may indicate that IHSS 176 is the source of these contaminants mentioned above but more information is needed from the proposed soil borings and wells at this site.

2.1.7 Building 885 Drum Storage Area (IHSS 177)

The following discussion is summarized from the Closure Plan for the Container Storage Facilities (Rockwell International 1988b) and the Draft Historical Release Report (U.S. DOE 1992).

2.1.7.1 Location and History

The Building 885 Drum Storage Area (IHSS 177) consists of the eastern and western sections of Building 885 (Figures 2.1-16 and 2.1-17). While the central section of Building 885 is completely enclosed, the eastern and western Drum Storage Areas are covered by a roof and are

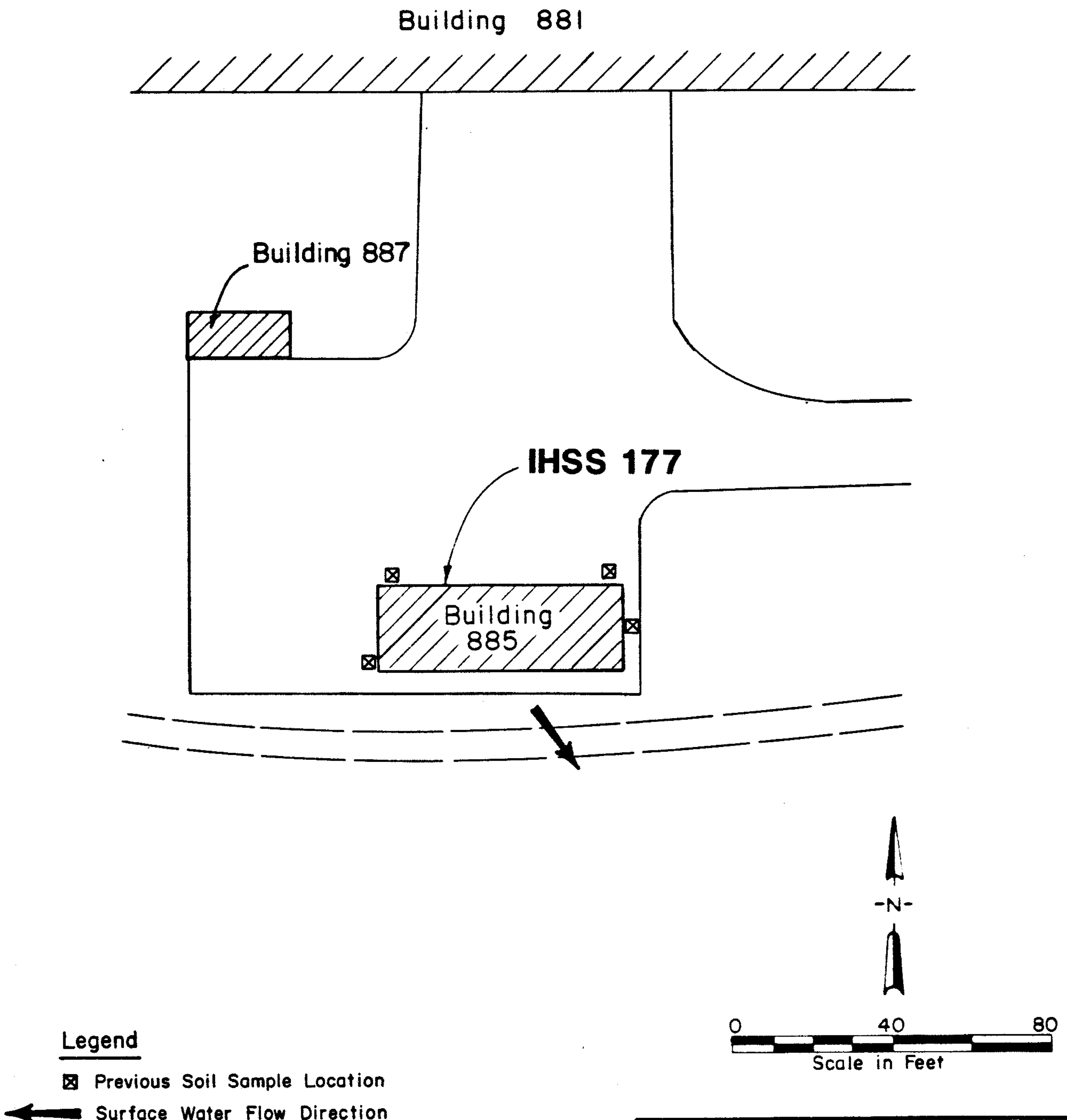

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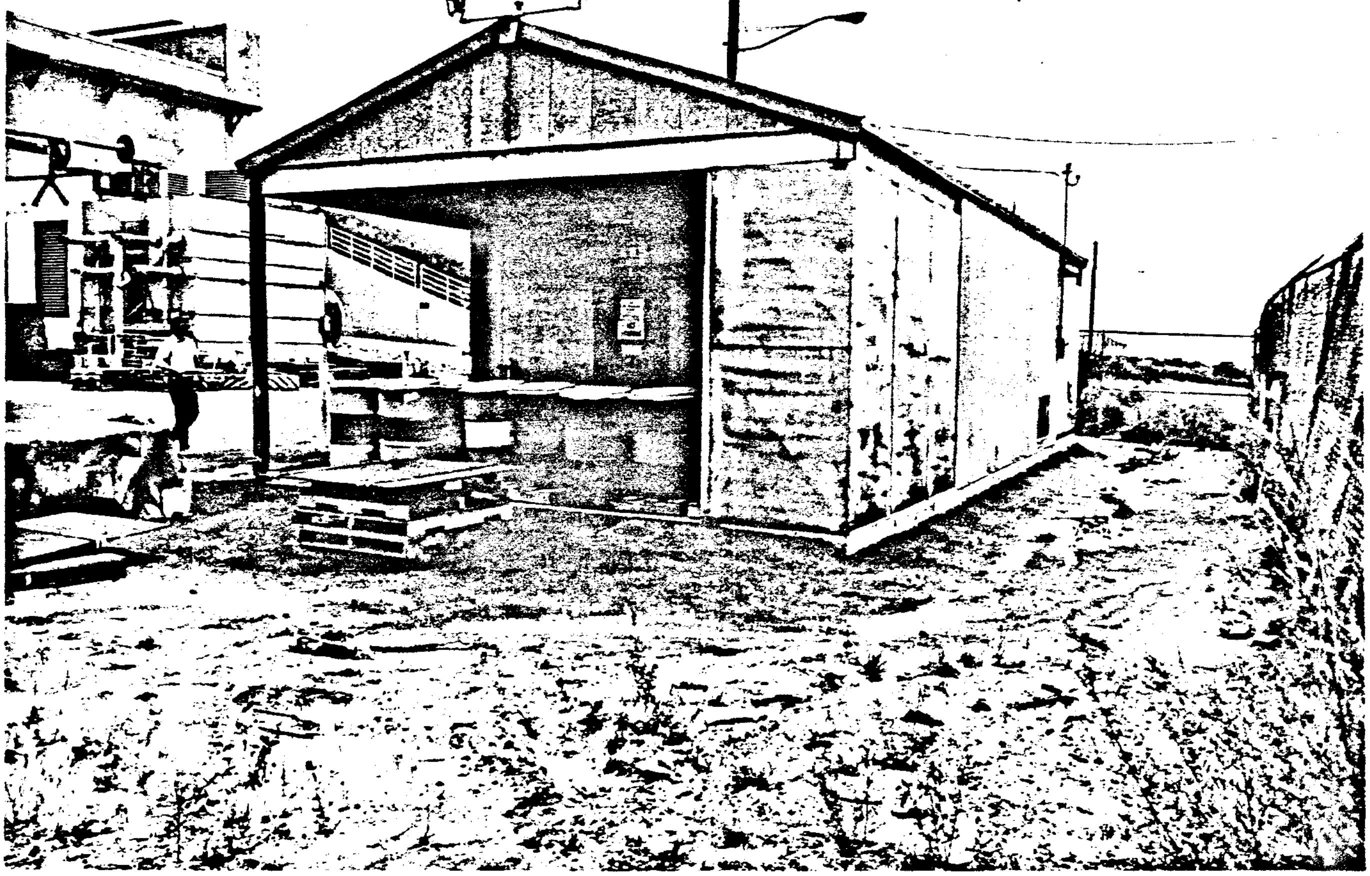
FIGURE 2.1-16
Building 885 Drum Storage Area
(IHSS 177) Location Map



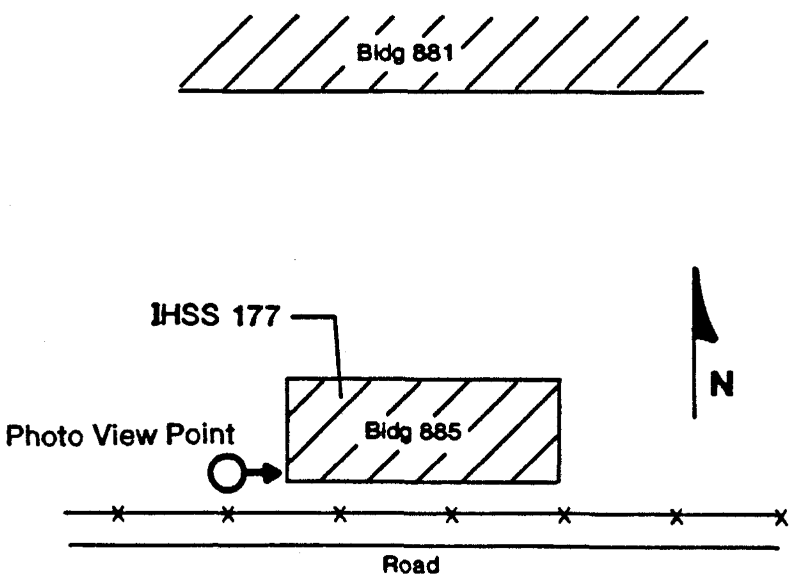


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FIGURE 2.1- 17
Building 885 Drum Storage Area
(IHSS 177) Site Photo

enclosed on two and three sides, respectively. The floors of the Drum Storage Areas are constructed of concrete. Each of the two Drum Storage Areas are approximately 10 by 20 ft in size.

IHSS 177 has been used for drum storage since 1953. The Drum Storage Areas have been used from 1986 to the present as a 90-day accumulation area and as a satellite collection station. The west section of Building 885 was used for storage of unused and waste oils, while the east section stored unused and waste paint and paint solvents. Waste material also contained low-level radioactive wastes. A maximum of ten to twenty 55-gallon drums were stored on pallets on the concrete floors in each area. There are no berms around the storage areas. Only one drum in each section was used for waste storage; the remaining drums contained unused oils and solvents. The total container storage capacity was 110 gallons, assuming only one drum in each of the two areas contained waste material. There have been no documented spills or leaks in this area.

2.1.7.2 Previous Investigations

An initial soil characterization program to determine the nature and extent of soil contamination was specified for IHSS 177 in the Closure Plan for the Container Storage Facilities (Rockwell International 1988b). Subsequent to submittal of the Closure Plan, four soil samples were collected from IHSS 177 and analyzed in 1988. The approximate sampling locations are shown in Figure 2.1-16 (Weston 1988). These samples were collected from 1 ft deep test pits located below a 6-inch-thick asphalt layer. Samples were composited over the test pit depth except for VOA samples, which were grab samples from a depth of 1 ft. Analysis of soil samples included HSL VOAs, HSL BNAs, HSL metals, inorganics, and radionuclides. Prior to soil sampling, visual and direct radiation surveys were conducted to identify areas of potential contamination.

A recent visual survey of IHSS 177 indicated that the area was still in use for drum storage; however, no ground staining was observed. However, ground staining was noted during an earlier visual survey in 1986. No areas were determined to have significant levels of gamma radiation during previous FIDLER surveys.

2.1.7.3 Physical Characteristics

The area around IHSS 177 gently slopes to the south and east (Plate 1). Approximately 12 ft of alluvium overlie the bedrock in the vicinity of IHSS 177. The alluvium, as described in Well 5187, located approximately 20 ft from the northwest corner of IHSS 177, consist of sandy, gravelly clay. The groundwater flows to the south and the depth to groundwater is estimated to be approximately 10 ft below the ground surface.

2.1.7.4 Nature and Extent of Contamination

Analysis of soil samples taken from borings surrounding IHSS 177 indicate detections of organics which include acetone, 2-butanone, and trans-1, 2-dichloroethene. Metals and inorganics detected include aluminum, arsenic, beryllium, chromium, strontium, manganese, barium, calcium, cadmium, copper, lead, iron, magnesium, mercury, vanadium, zinc, potassium, and nitrate/nitrite. Radionuclides detected include gross alpha; gross beta; tritium; uranium 238; uranium 233, 234; plutonium 239, 240; and americium 241. Table C-9 (Appendix C) lists the organics, metals, inorganics, and radionuclides detected. Figure 2.1-18 illustrates the concentrations and sampling locations of the analytes detected.

Analysis of groundwater samples taken from upgradient Well 5287 indicates detections for metals and other inorganics including aluminum, calcium, copper, magnesium, manganese, nickel, sodium, zinc, and sulfate. Table C-10 (Appendix C) lists metals and other inorganics detected.

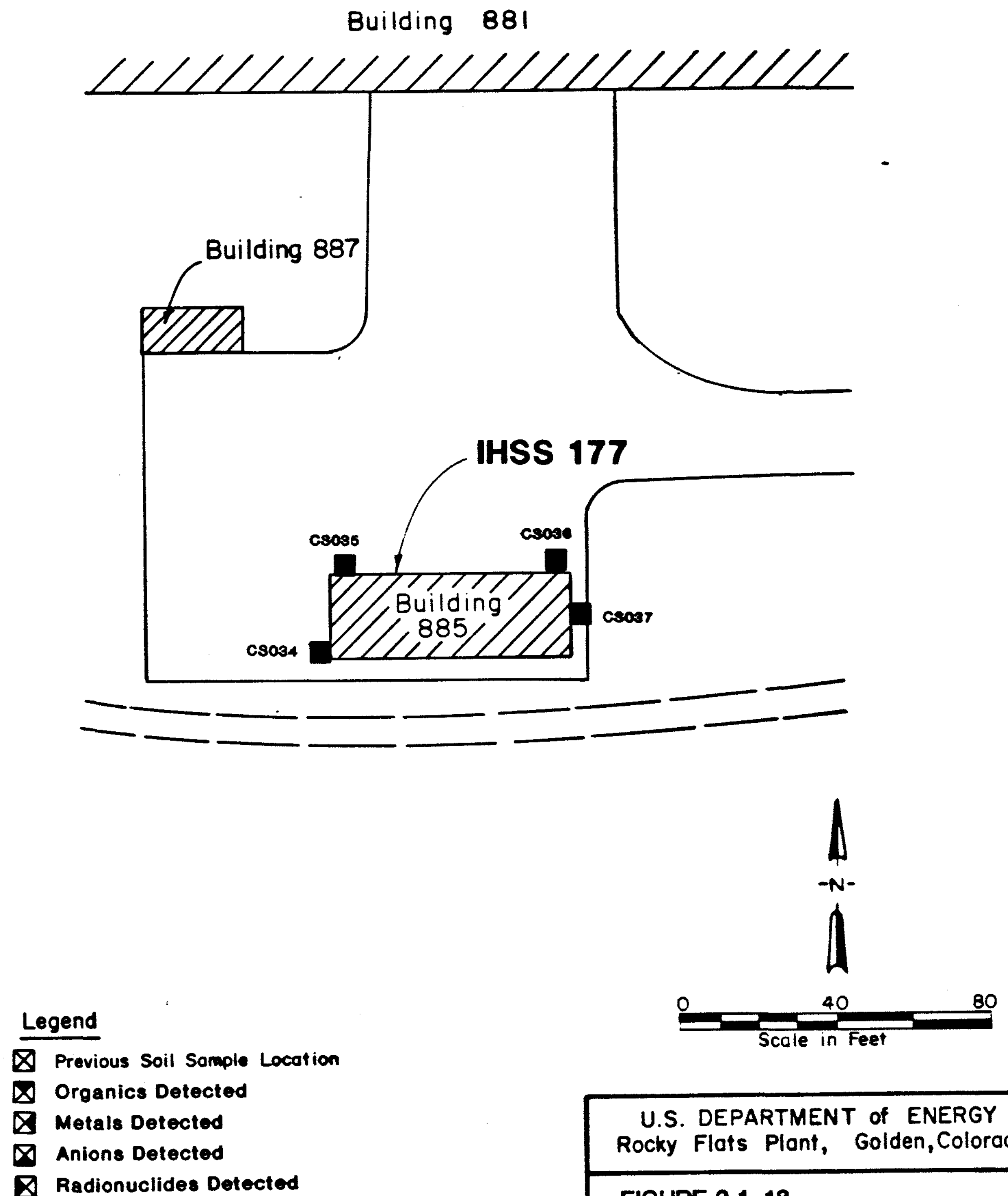

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FIGURE 2.1-18
Previous Sampling Locations
Building 885 Drum Storage Area
(IHSS 177)

Radionuclides detected include americium 241; gross alpha; plutonium 239; uranium 233, 234; uranium 238; and tritium. Table C-10 lists the radionuclides detected.

Downgradient data from Well 5387 indicates detections for the metals and other inorganics including calcium, copper, magnesium, nickel, sodium, zinc, and sulfate. Table C-11 (Appendix C) lists the metals and other inorganics detected. The radionuclides detected include uranium 233, 234. Table C-11 lists the radionuclide detected.

2.1.8 Building 334 Cargo Container Area (IHSS 181)

The following discussion is summarized from the Closure Plan for the Container Storage Facilities (Rockwell International 1988b).

2.1.8.1 Location and History

IHSS 181 is the site of a former cargo container area. The cargo container was 8 by 20 by 8 ft high steel and was used to store 55-gallon drums. The cargo container was located in the parking lot north of Building 334 (Figure 2.1-19). A maximum of eighteen 55-gallon drums could be stored in the cargo container; however, seven drums were the maximum stored there. The maximum storage capacity was, therefore, 385 gallons. The cargo container was located on an asphalt pad, and a collection pan was located in the bottom of the cargo container for secondary containment.

This area was used from the summer of 1984 to July 1986 for storage of drums containing waste machine oils, solvents, machine coolants and, possibly, low-level radioactive wastes. There is no documented or visual evidence of spills or leakage. The cargo container was moved to the Building 444/453 Drum Storage Area, IHSS 182 (Section 2.1.9).

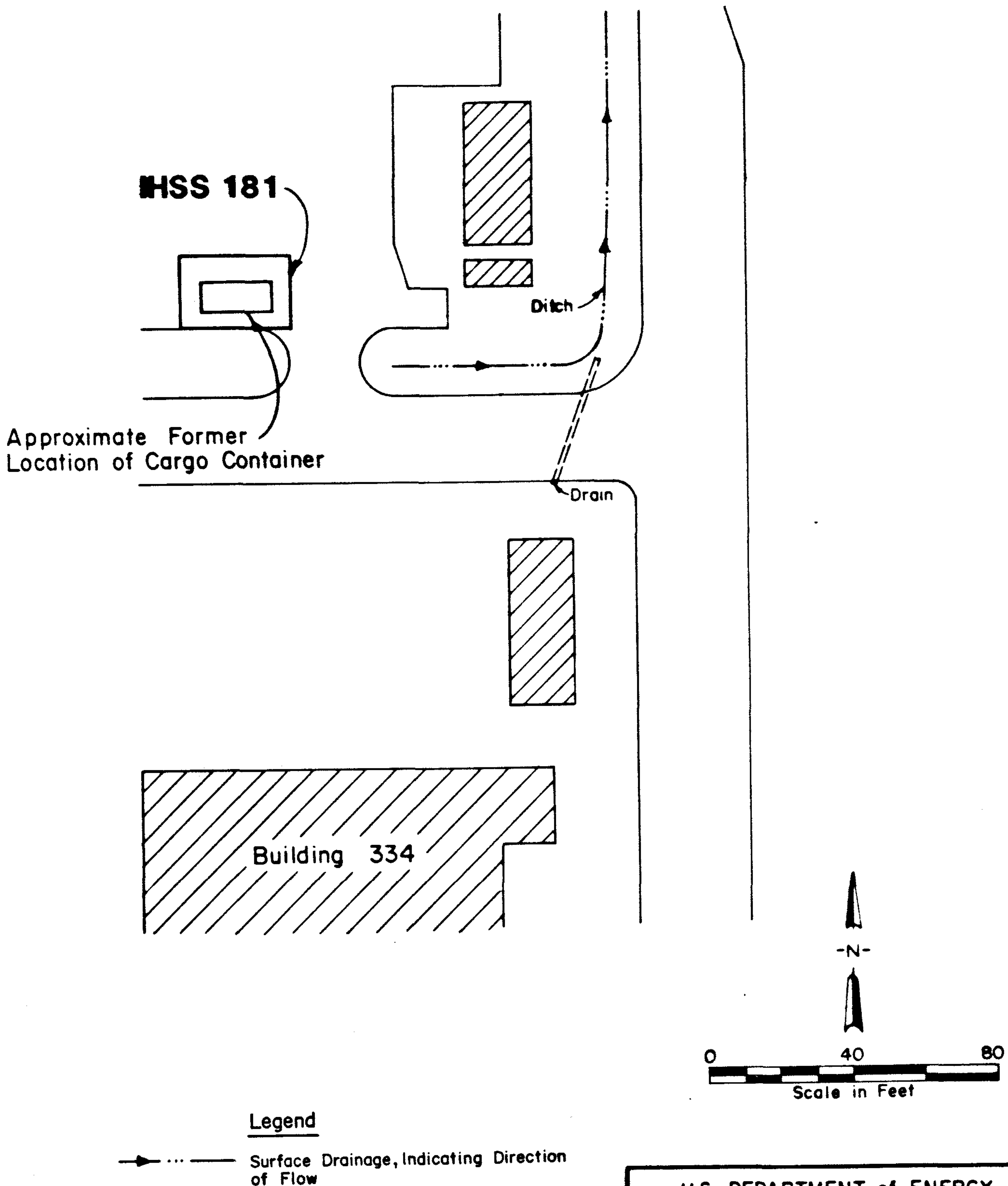

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FIGURE 2.1-19
Building 334 Cargo Container Area (IHSS 181) Location Map

2.1.8.2 Previous Investigations

No previous investigations of IHSS 181 have been conducted.

2.1.8.3 Physical Characteristics

The topography of IHSS 181 gently slopes to the east (Plate 1). The groundwater flows to the northeast and the depth to groundwater is approximately 10 ft below the ground surface. The closest well is located approximately 200 ft from the site; therefore, the data from well logs will not provide representative descriptions of geological materials at the IHSS. Approximately 20 ft of alluvium and fill overlie the bedrock in the vicinity of IHSS 181.

2.1.8.4 Nature and Extent of Contamination

No analytical data on soil or water are available, so the extent of contamination in this area is unknown.

No upgradient or downgradient analytical groundwater data are available for this area.

2.1.9 Building 444/453 Drum Storage Area (IHSS 182)

The following discussion is summarized from the Closure Plan for the Container Storage Facilities (Rockwell International 1988b) and the Draft Historical Release Report (U.S. DOE 1992).

2.1.9.1 Location and History

IHSS 182 is located between Buildings 444 and 453 and covers an area of approximately 1,700 square ft (ft^2) (Figures 2.1-20, 2.1-21, and 2.1-22). In the mid-1970s, the area was covered with 4 inches of asphalt. There are no berms around the area.

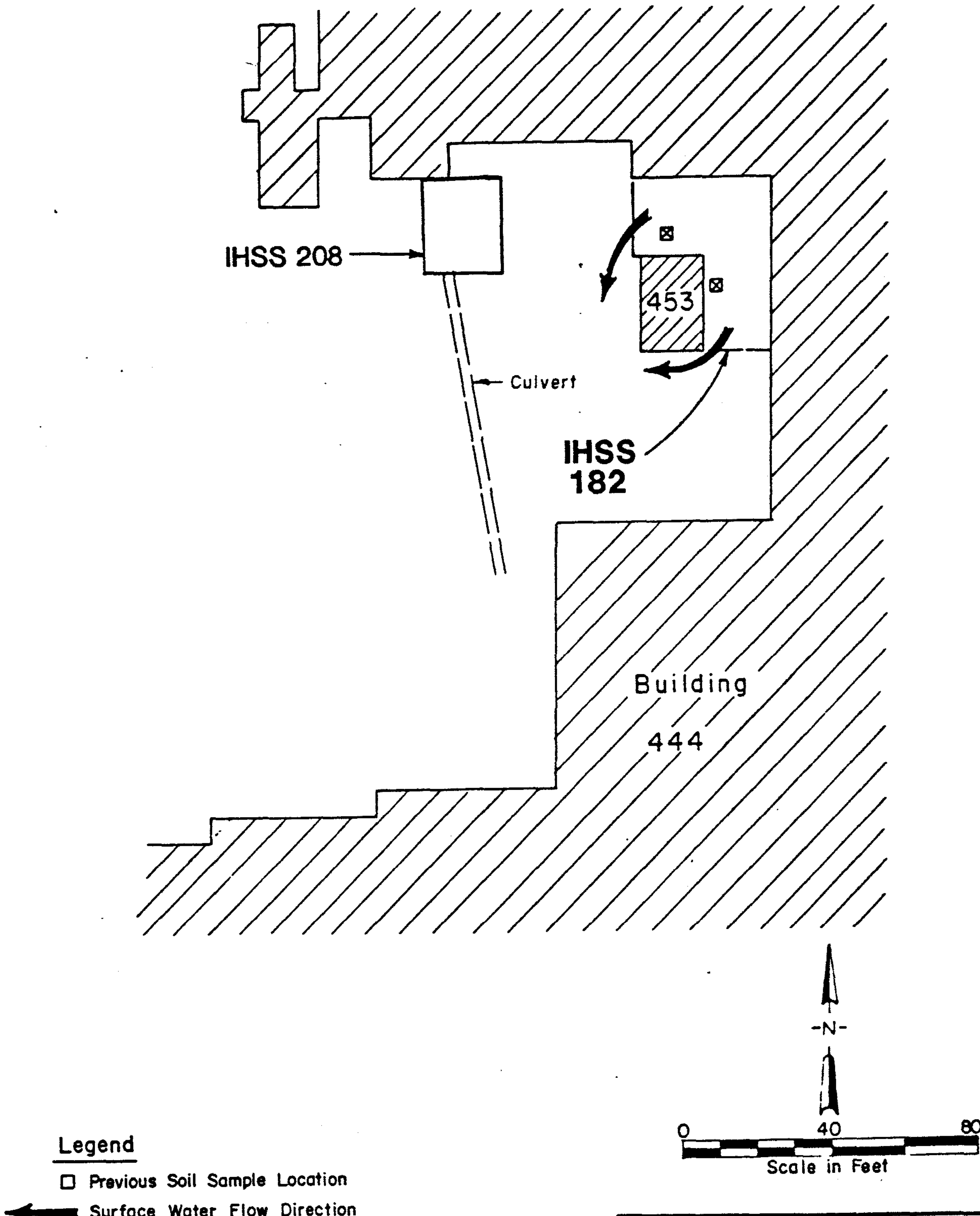

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FIGURE 2.1-20
Building 444/453 Drum Storage Area (IHSS 182) Location Map

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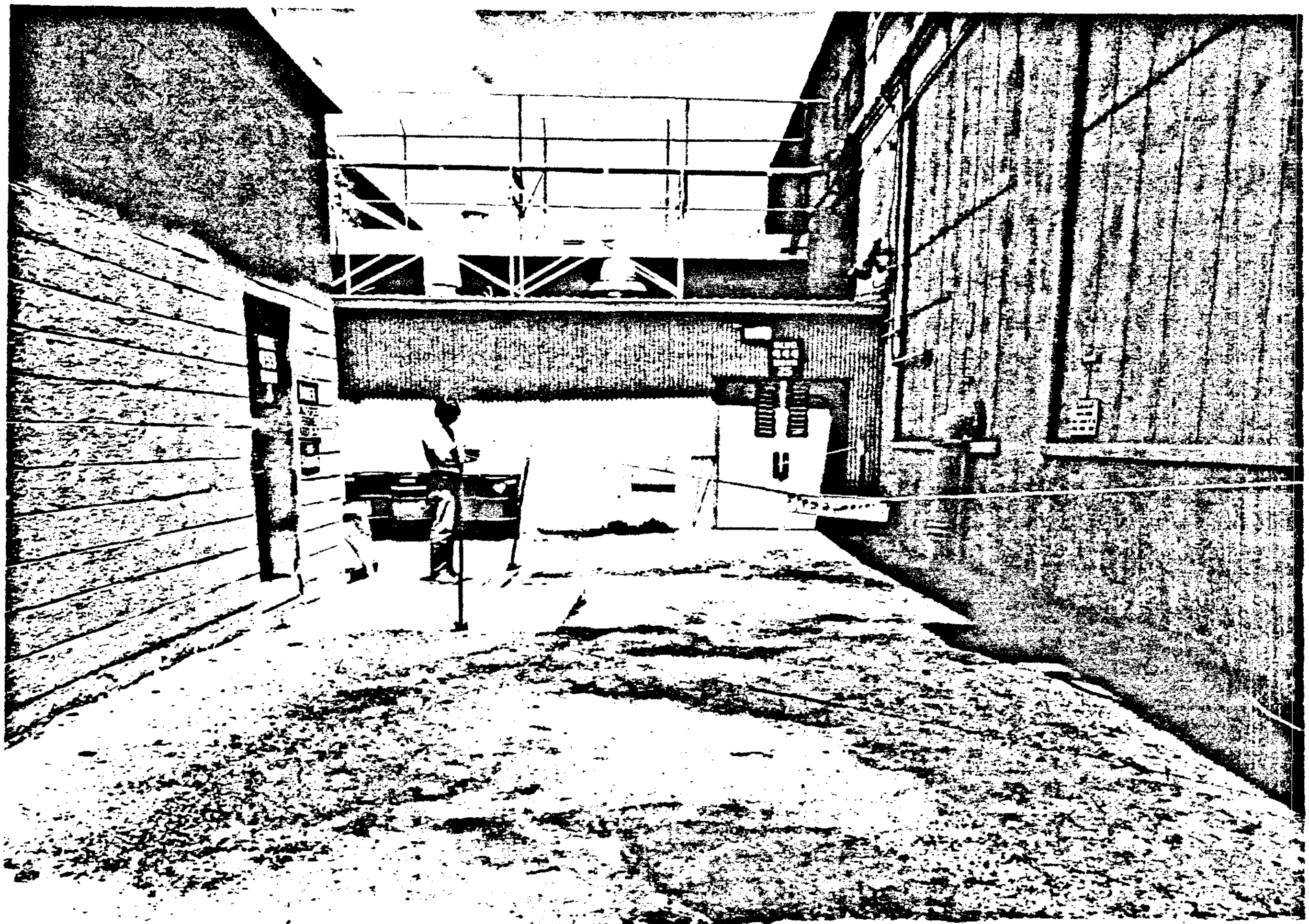

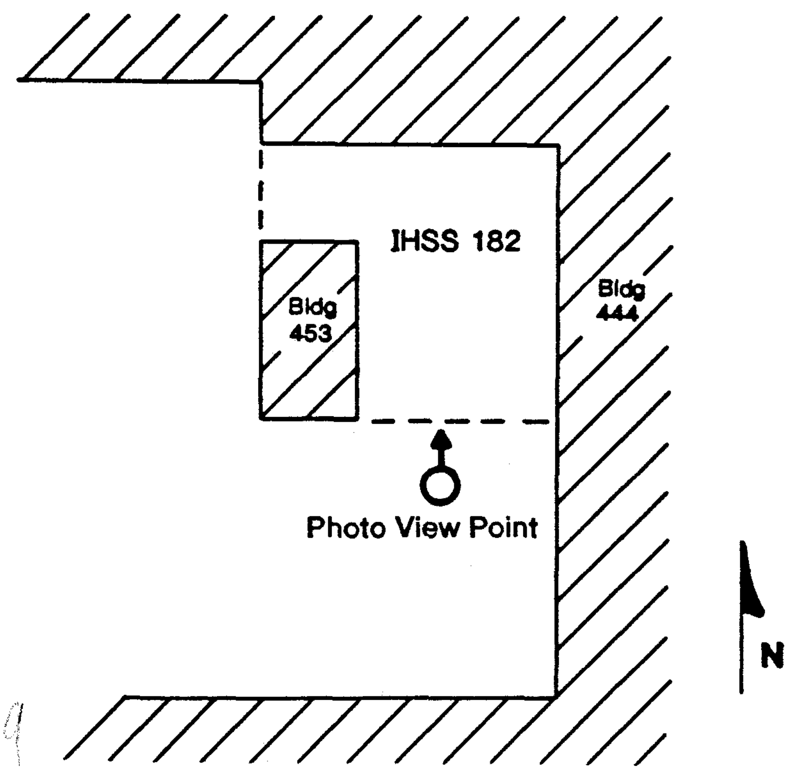

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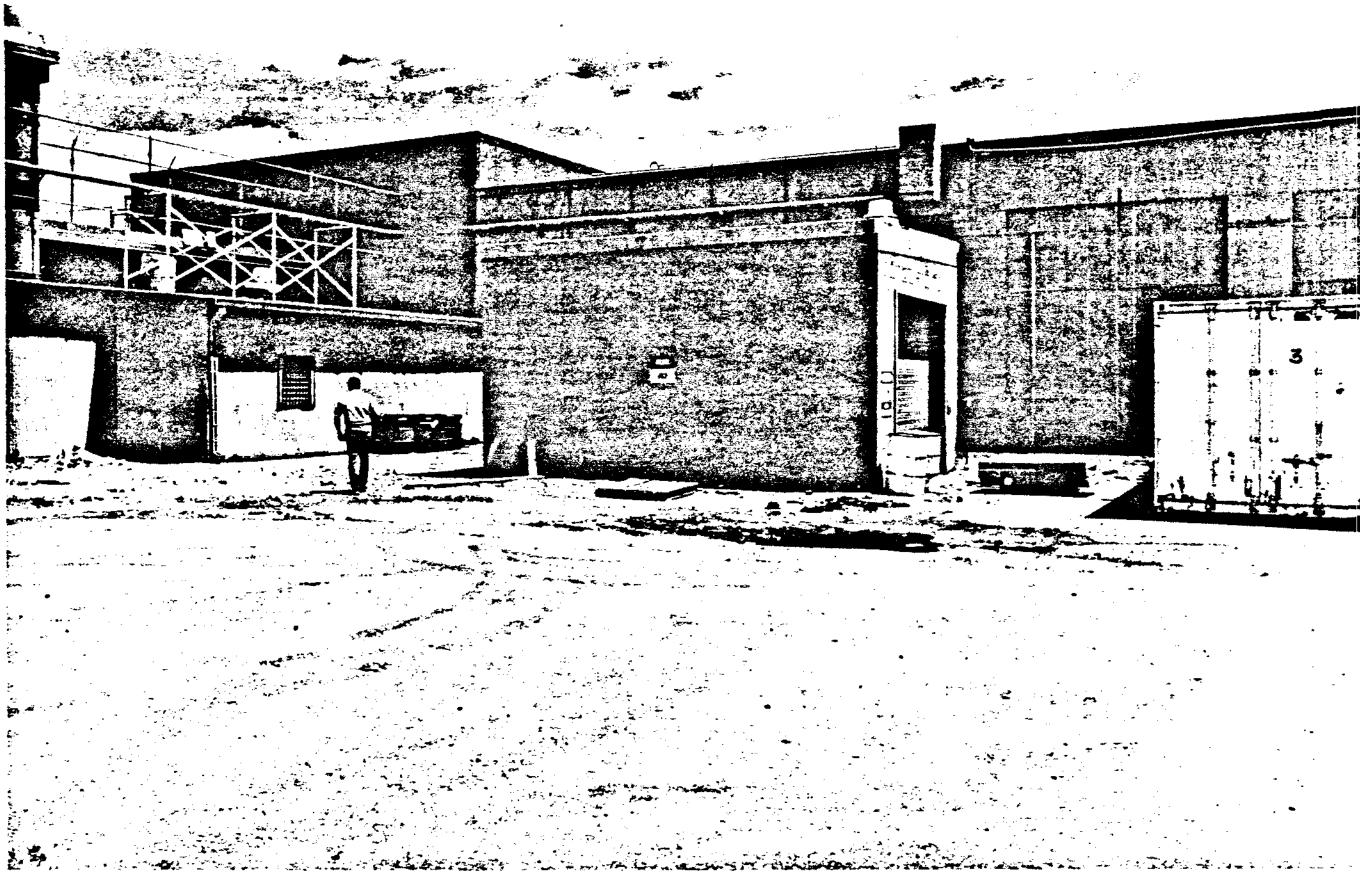
FIGURE 2.1-21
Building 444/453 Drum Storage Area (IHSS 182) Site Photo



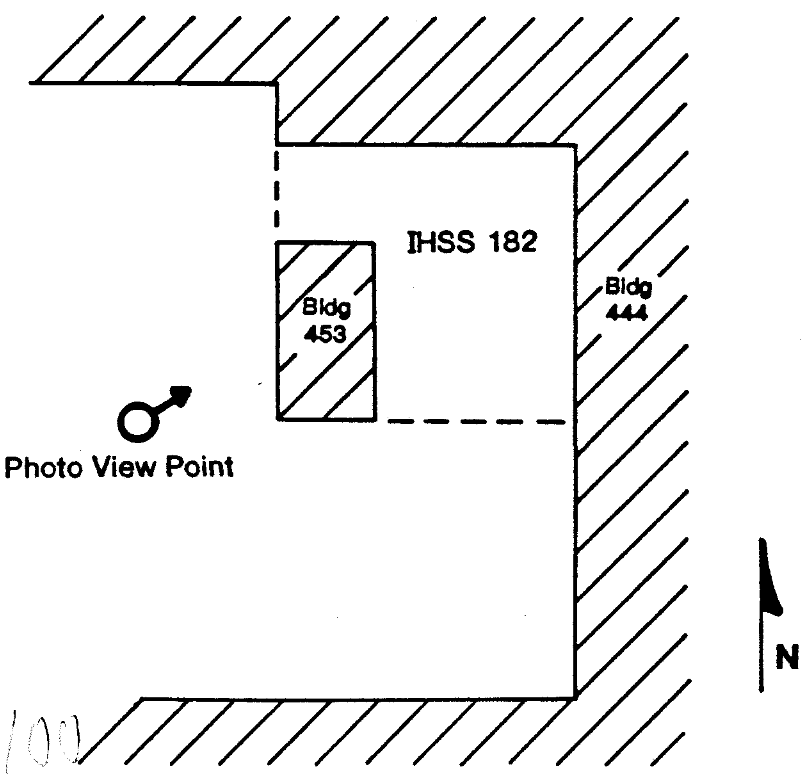


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FIGURE 2.1-22
Building 444/453 Drum Storage Area
(IHSS 182) Site Photo

IHSS 182 was first used as a storage area. In May 1957, it was noted that numerous drums of depleted uranium oxide were being stored in the "backyard" of Building 444. Originally, 55-gallon drums were placed directly on the ground surface. In the mid-1970s, the top 4 inches of soil in a portion of the Drum Storage Area was removed because it was believed to be contaminated. It was replaced with 4 inches of asphalt. However, drums were still stored on the soil in the remaining portion of the Drum Storage Area. It is unknown where the contaminated soil was moved or stored.

The maximum number of drums ever stored at one time was approximately 200; however, some of these drums contained unused oil. The exact number of drums containing contaminated waste oils or solvents is unknown. Based on storage of two hundred 55-gallon drums, the total container storage capacity at any given time was 11,000 gallons. Waste hydraulic oils and chlorinated solvents were stored in the 55-gallon drums. Beryllium and low-level uranium contamination were sometimes present in the waste. IHSS 182 is roped off and is generally empty, although trash, such as wood, is sometimes temporarily placed in the roped off area.

Building 453 was used as an oil storage area. In July 1983, high groundwater lifted oil that had been spilled over the years to the surface of the soil forming pools of oil near the building. At this time, 25 barrels of used oil were stored outside the building.

The Building 334 Cargo Container was moved and relocated adjacent to IHSS 182 in fall 1986. This Cargo Container was moved out of IHSS 182 to the main hazardous waste storage area identified as Unit #1 in the RCRA Part B permit application (Rockwell International 1988b).

During a site visit in May 1990, no drums of waste oil or solvents were observed in IHSS 182. Soil staining, apparently due to spillage of oils, was generally present throughout IHSS 182.

Aerial photographs taken in 1982 reveal dark stains around Building 453 and along the western side of Building 444.

2.1.9.2 Previous Investigations

An initial soil characterization program to determine the nature and extent of soil contamination was specified for IHSS 182 in the Closure Plan for the Container Storage Facilities (Rockwell International et al. 1988b). Subsequent to submittal of the Closure Plan, soil samples were obtained in 1988 from the approximate locations shown in Figure 2.1-20 (Weston 1988). These samples were collected from 1-ft-deep excavations below the concrete sidewalk and were composited over the 1-ft-deep interval except for VOA samples, which were grab samples from a depth of 1 ft.

Prior to soil sampling, visual and direct radiation surveys were also conducted to identify areas of potential contamination. The area north of Building 453 was identified in 1984 as being unable to be surveyed due to high-level background radioactivity. The soil samples were reportedly analyzed for HSL VOAs, BNAs, HSL metals, inorganics, and radionuclides. Section 2.1.9.4 presents the results of this sampling.

2.1.9.3 Physical Characteristics

The land surface at IHSS 182 is nearly flat. A small depression where surface water collects is located near the southwest corner of the site. The geologic materials in the vicinity of IHSS 182 consist of Rocky Flats Alluvium, fill, and Arapahoe Formation deposits.

The topography gently slopes to the east and south (Plate 1). Approximately 25 ft of alluvium and fill overlie the bedrock in the vicinity of IHSS 182. The groundwater flows to the east and the depth to groundwater is approximately 20 ft below the ground surface.

2.1.9.4 Nature and Extent of Contamination

Analysis of soil samples taken from borings in the area indicate detections of organics which include acetone, 1,1,1-trichloroethane, toluene, ethylbenzene, total xylenes, naphthalene, phenanthrene, fluoranthene, and pyrene. Table C-12 (Appendix C) lists the organics, metals, and radionuclides detected. Metals detected include aluminum, barium, beryllium, calcium, chromium, lead, cadmium, copper, iron, mercury, potassium, magnesium, manganese, nickel, vanadium, zinc, and nitrate/nitrite. Radionuclides detected include gross alpha; gross beta; tritium; uranium 233, 234; uranium 238; plutonium 239, 240; and americium 241. Figure 2.1-23 illustrates the concentrations and sampling locations of the analytes detected.

No representative upgradient or downgradient analytical groundwater data are available for this area.

2.1.10 <u>Building 460 Sump #3 Acid Side (IHSS 205)</u>

The following discussion is summarized from the Closure Plan for the Building 460 Acid and Solvent Dumpsters (Advanced Sciences, Inc. 1988).

2.1.10.1 Location and History

The dumpsters (portable cylindrical vessels) are located outside Building 460 along the southeast corner of the building (Figures 2.1-24 and 2.1-25). (Figure 2.1-24 varies slightly from the CAD drawing given in the HRR which incorrectly shows this IHSS completely inside Building 460.) These 460 dumpsters had been operated as interim status units in the 1986/1987 time frame, and were identified in the November 1986 RCRA Part A and Part B permit applications. The acid dumpsters are still in use, but as a 90-day accumulation area rather than an interim status unit. These changes away from interim status were reflected in the Revised RCRA Part A and Part B

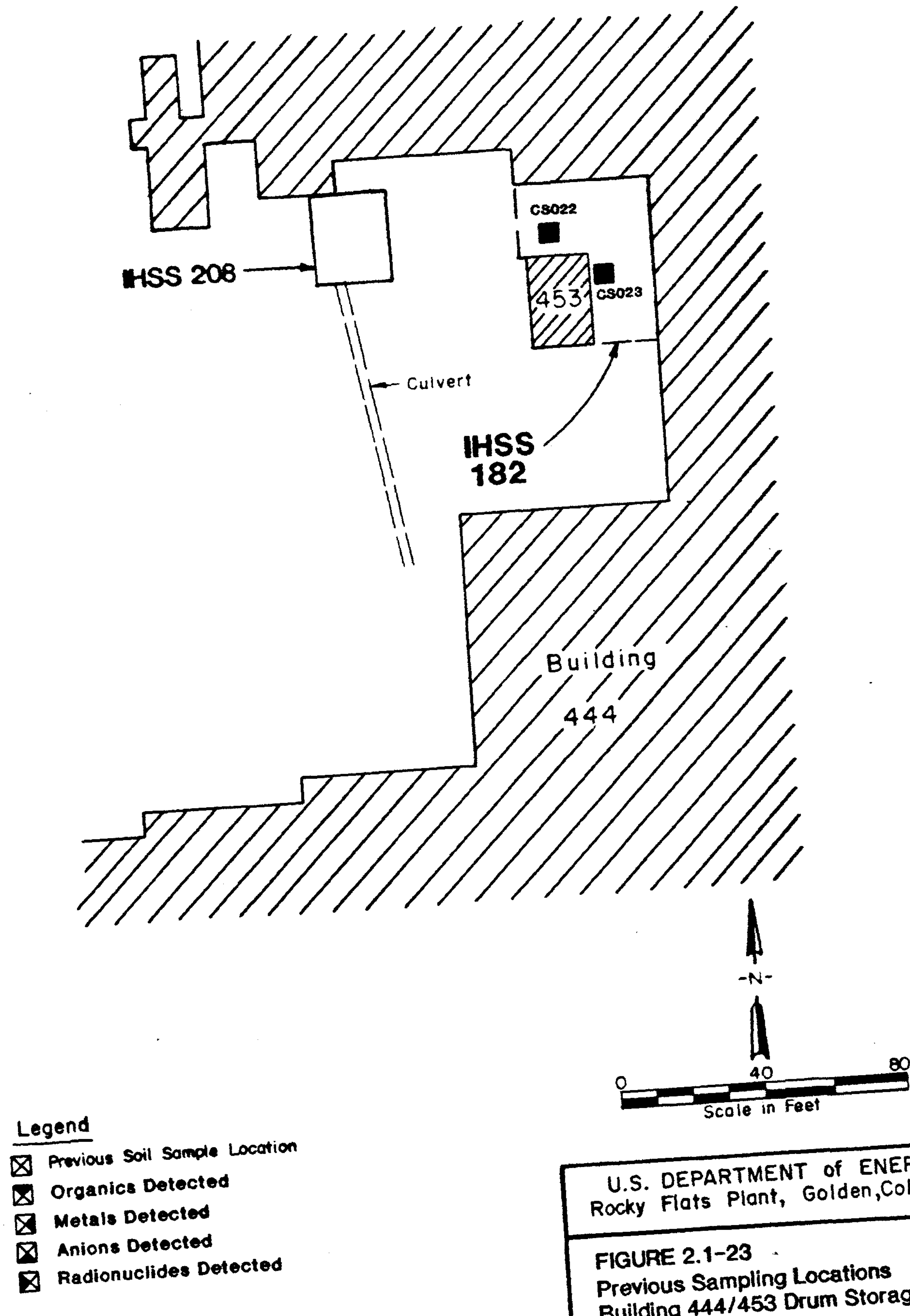

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FIGURE 2.1-23
Previous Sampling Locations
Building 444/453 Drum Storage Area
(IHSS 182)

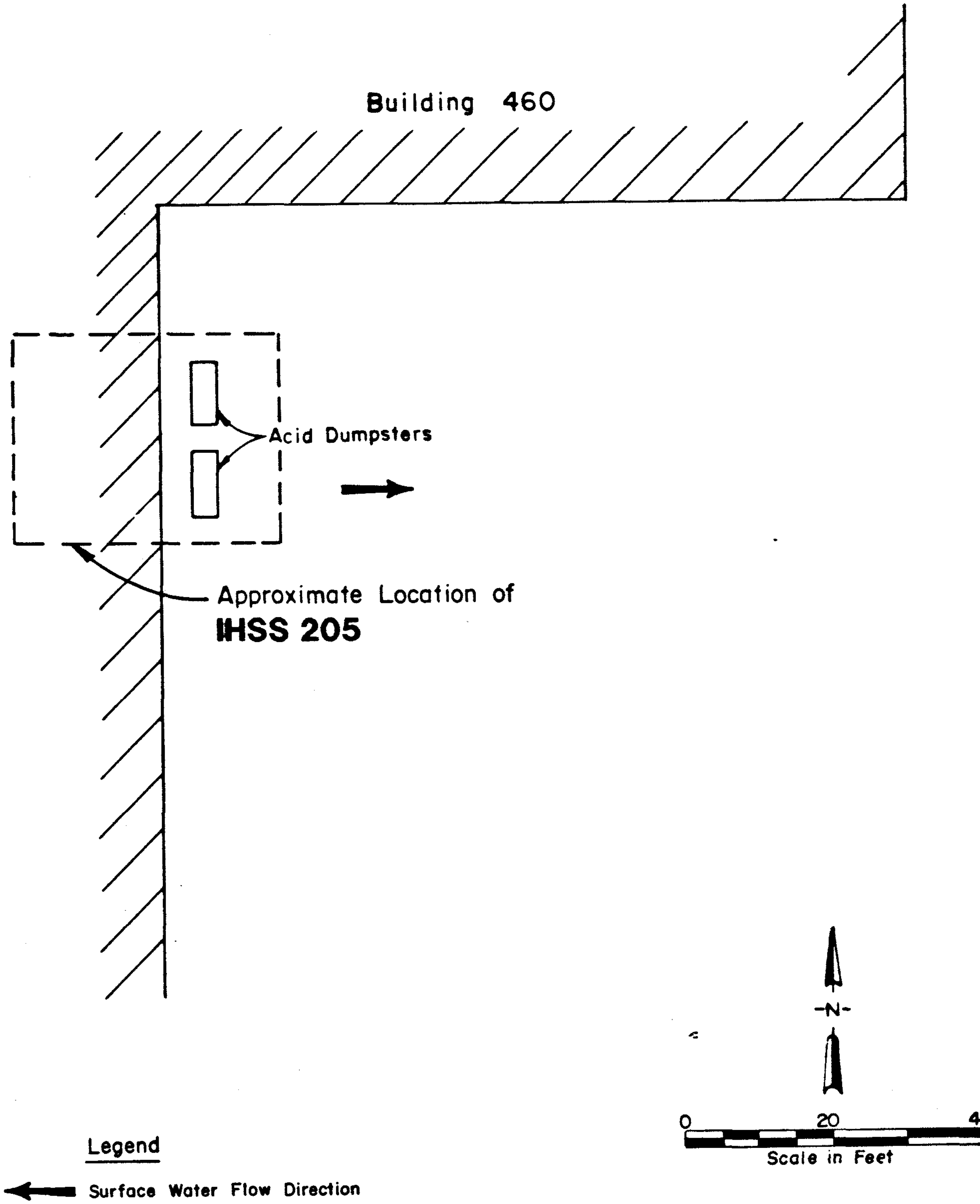

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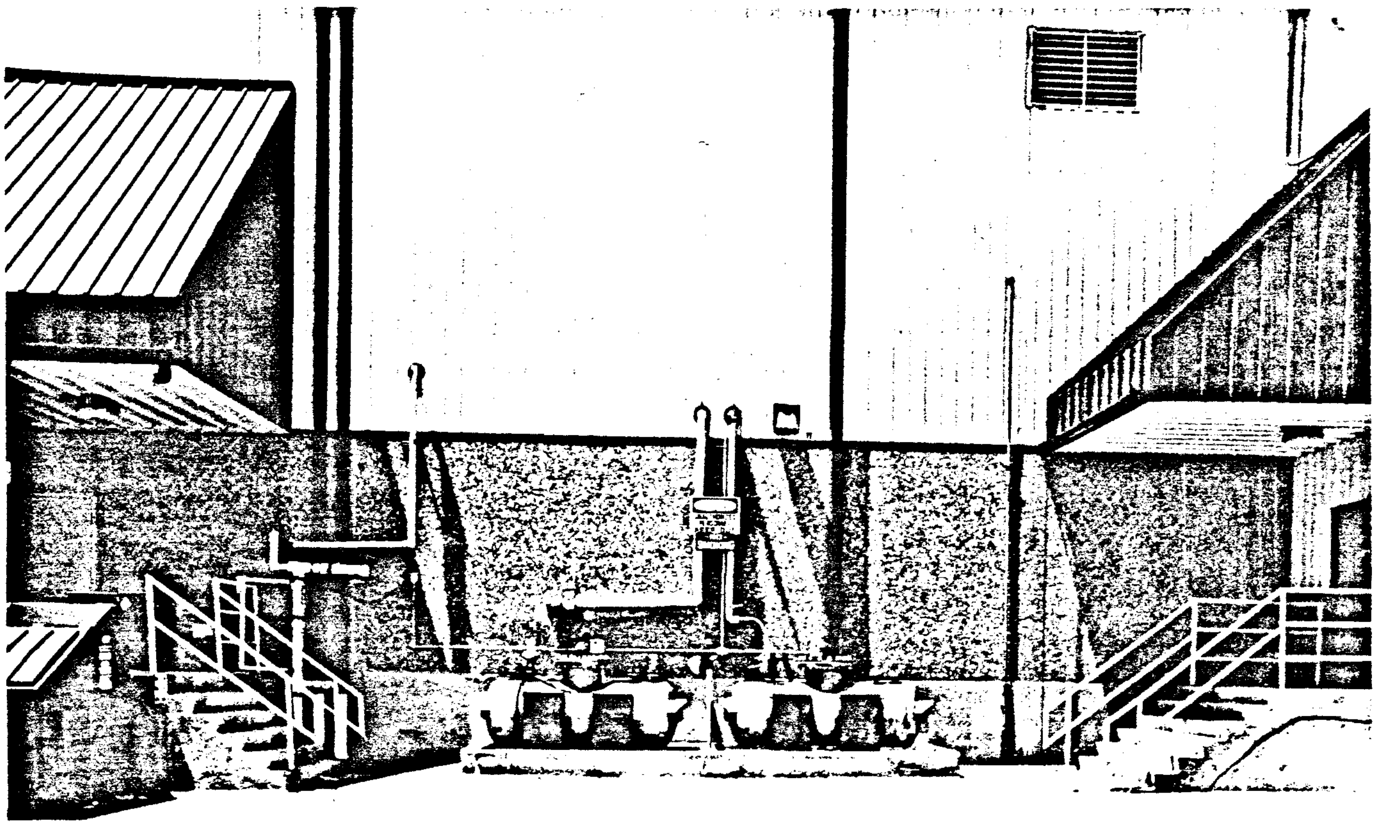
FIGURE 2.1-24
Building 460 Sump #3 Acid Side
(IHSS 205) Location Map



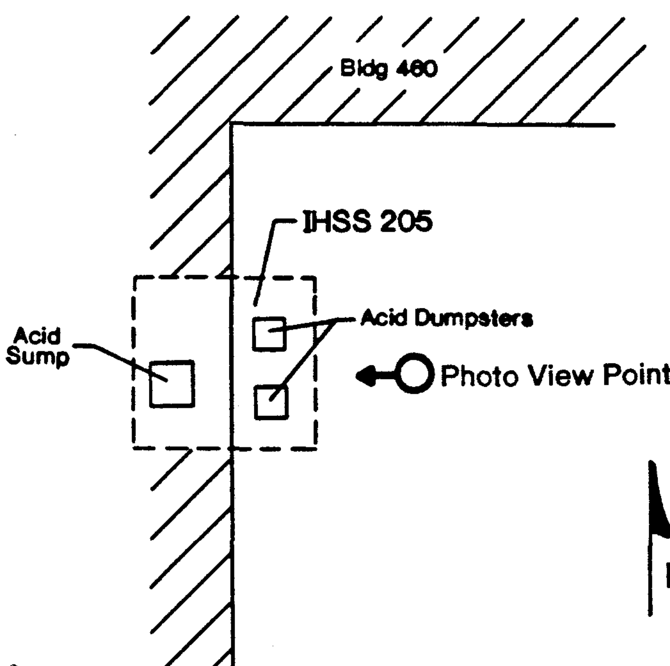


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FIGURE 2.1-25
Building 460 Sump #3 Acid Side (IHSS 205) Site Photo

Permits submitted to CDH and EPA on December 15, 1987. Interim status usage of the dumpsters ceased on March 24, 1988.

Lines run from the waste generators to a sump or holding tank (the acid sump is located in Room 156B), after which lines run from these holding tanks through the concrete wall to the dumpsters, where they are attached by quick connect couplings to the dumpsters.

The acid dumpsters are 3/16-inch thick, 394L stainless steel, 250-gallon cylinders, lined with Kynar polyvinyledine fluoride (as specified by SM-122, Section 6, ASME). Each dumpster contains an 18-inch-diameter manhole on the top and a 1-inch-diameter drain fitted with a ball-valve in the bottom. The paired dumpsters are used in a manner such that one dumpster of the pair can receive wastes while the other dumpster is being emptied.

The acid dumpsters have a storage capacity of 250 gallons each or a combined total of 500 gallons, however, they are used one at a time. Therefore, the capacity for storage is normally somewhat less than 250 gallons. An additional small amount of storage is available in an acid sump, a fiberglass tank located inside Building 460 (Room 156B) where acid wastes are transferred to the acid waste dumpsters through permanent piping.

A level sensor is mounted in a 2-1/2-inch-diameter, stainless steel pipe near the end of each dumpster. An up-to-the-minute log of the volume in the tank is maintained and visually checked with the sensor weekly to determine when dumpster changeover was necessary, generally when the liquid level reached about 1 ft from the top of the dumpster.

The dumpsters are contained within a concrete-bermed area, with a concrete divider separating each dumpster (Figure 2.1-25). Each bermed area measures 4 ft, 6-1/2 inches wide by 8 ft, 6 inches long, and 12 inches deep. Each bermed area has a 286-gallon capacity.

The containment areas cannot be drained into one another, e.g., each area represents a distinct basin separated by the dividing berm(s). Each basin, however, can be partially drained to the area outside of containment through a drain hole located 1-1/2 inches above the basin floor. It is unknown if these drain holes were ever opened, but they are currently plugged.

No cracks are present in the concrete containment pad under the acid dumpsters, and no spills from the dumpsters have ever escaped the secondary containment system. No stains from dumpster spillage are present. Stain from rainwater and snowmelt accumulation, however, is present.

The acid dumpsters are connected to an acid sump (a fiberglass tank in the wall of Building 460) with quick-disconnects to facilitate exchanging dumpsters. A pump transfers waste acids from the sump through a dedicated pipe system to the acid waste dumpster. The acid sump is connected to the Building 460 dedicated drainage system (exclusively acids).

When it is necessary to empty one of the dumpsters, it is either transported by the Trucking group directly to Building 374 or 774, or moved by forklift to an adjacent, bermed location for transfer to drums. Acid wastes are transferred from the dumpsters to steel drums with poly liners, using a 1/2 hp pump and 1-inch-diameter Tygon tubing. Filled acid drums are then stored in the Building 460 Drum Storage Area.

Waste materials handled by the Acid Dumpster were a mixture of approximately 80 percent water and 20 percent acid. The acids were primarily nitric acid and Nitradd, a combination of hydrofluoric acid and ammonium salts.

Building 460, the Consolidated Non-Nuclear Manufacturing Building, contains 25 major functions/operations:

Electric Discharge Machining	Copper Cleaning
Acid Cleaning - Automated line	Aqueous Cleaning
Acid Cleaning - Internal line	Inspection
Electro-Chemical Machining	R and D Lab
Final Step-Cleaning	Machinery
Nondestructive Testing	Assembly Machining
Hardware Machining	Assembly
R and D Shop	Maintenance Paint Shop (2)
Maintenance Machine Shop	Maintenance Pipe Shop
Crush Grinding Operation	Lube Oil Storage
Maintenance Sheet Metal Shop	Production Testing Cells
Maintenance Carpenter Shop	Metallography Lab

2.1.10.2 Previous Investigations

Previous soil sampling investigations have not been conducted at this site.

2.1.10.3 Physical Characteristics

The area around IHSS 205 is paved and flat lying. The geologic materials in the vicinity consist of Rocky Flats Alluvium, fill, and Arapahoe Formation deposits.

Approximately 25 ft of alluvium and fill overlie the bedrock in the vicinity of IHSS 205. The closest well is located approximately 500 ft from the site; therefore, detailed bore logs do not provide representative information on geologic materials in IHSS 205. The topography gently slopes to the east and south (Plate 1). The groundwater flows to the east and the depth to groundwater is approximately 20 ft below the ground surface.

2.1.10.4 Nature and Extent of Contamination

No samples were collected in this area for analysis, so the extent of contamination is unknown.

No upgradient or downgradient analytical groundwater data are available for this area.

2.1.11 Inactive D-836 Hazardous Waste Tank (IHSS 206)

The following discussion is summarized from the RCRA Part B Permit Application (Rockwell International 1987) and the Draft Historical Release Report (U.S. DOE 1992).

2.1.11.1 Location and History

IHSS 206 was previously identified in the RCRA Part B permit application (Rockwell International 1987) as Unit # 41.14, a portion of the Building 374 Waste Treatment Facility (Unit #42). Although the D-836 Hazardous Waste Tank was mobile, after consulting the Building Manager, the area considered for the scope of this Work Plan is the area outside Building 374 where this tank was connected to the building (Figures 2.1-26 and 2.1-27). The tank is constructed of carbon steel and is 8 ft in diameter and 49.5 ft in length, with a total storage capacity of 19,000 gallons.

The Inactive D-836 Hazardous Waste Tank was a 19,000-gallon, carbon steel tank constructed in 1962. Prior to 1975, it was probably used to store U.S. Air Force fuel at another location. From 1975 to 1987, the tank was used to store off-specification Building 374 product water (water too high in conductivity). In February 1980, a spill of condensate water containing low concentrations of tritium occurred when a line from the evaporator to the tank was disconnected.

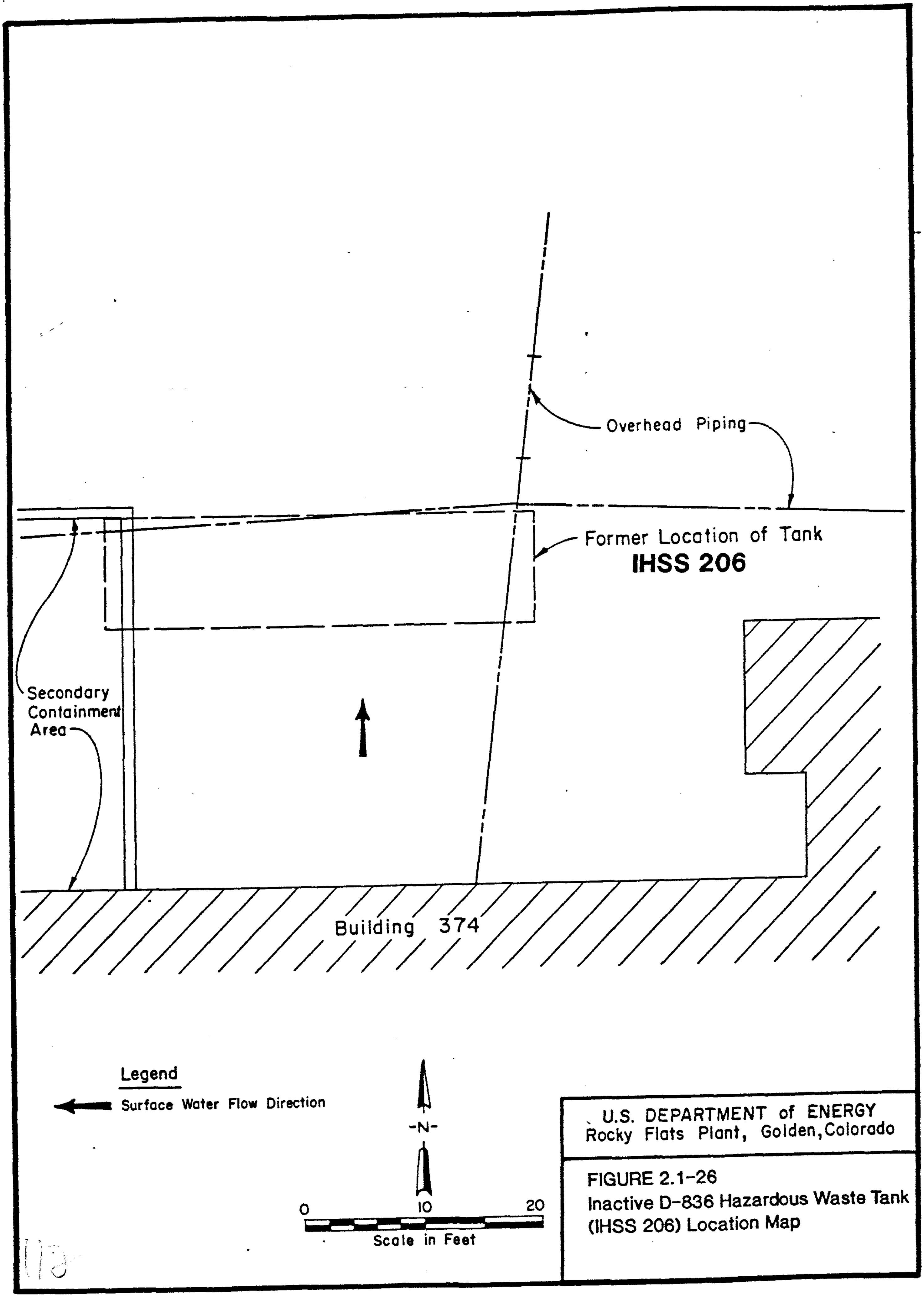

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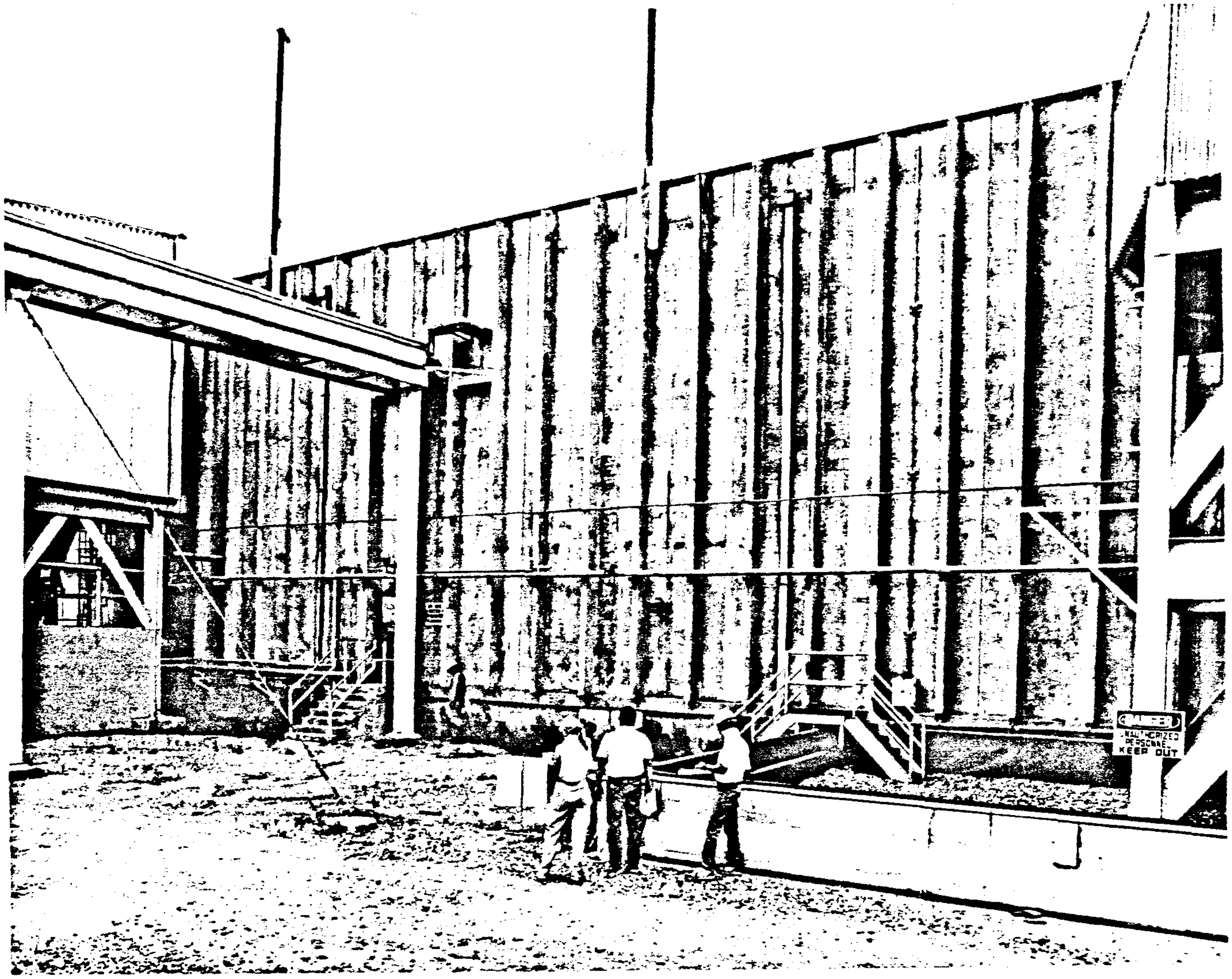
FIGURE 2.1-26
Inactive D-836 Hazardous Waste Tank (IHSS 206) Location Map



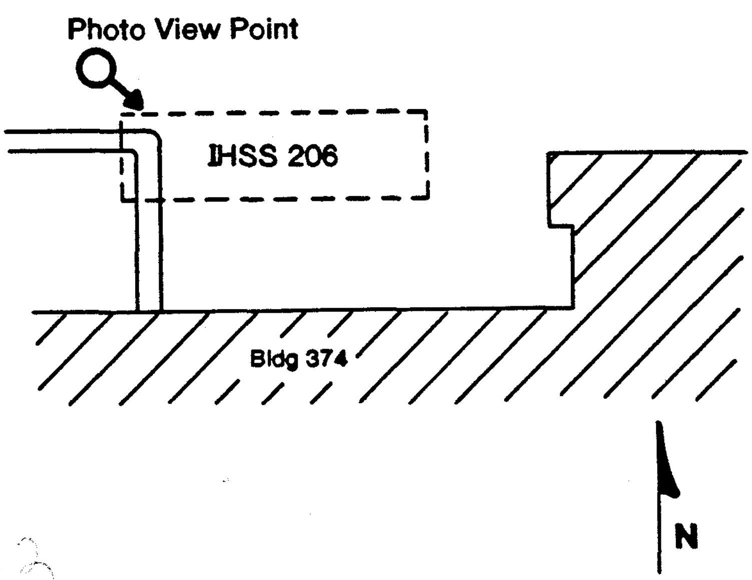


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FIGURE 2.1-27
Inactive D-836 Hazardous Waste Tank
(IHSS 206) Site Photo

The tank was located over compacted soil outside of Building 374 and was not secondarily contained.

2.1.11.2 Previous Investigations

Previous soil sampling investigations have not been conducted at this site.

2.1.11.3 Physical Characteristics

The topography of IHSS 206 gently slopes to the north - northeast (Plate 1). The geologic materials in the vicinity consist of Rocky Flats Alluvium, fill, and Arapahoe Formation deposits.

Approximately 5 ft of alluvium and fill overlie the bedrock in the vicinity of IHSS 206. The closest well is located approximately 750 ft from the site; therefore, detailed bore logs will not be useful for detailed information on geologic materials at the IHSS. The groundwater flows to the northeast and the depth to groundwater is approximately 15 ft below the ground surface.

2.1.11.4 Nature and Extent of Contamination

No soil sampling investigations have been conducted at this site, so the nature and extent of contamination is not known.

No upgradient or downgradient analytical groundwater data are available for this area.

2.1.12 Inactive Building 444 Acid Dumpsters (IHSS 207)

The following discussion is summarized from the Closure Plan for Building 444 Acid Dumpsters (Rockwell International 1988c) and the Draft Historical Release Report (U.S. DOE 1992).

2.1.12.1 Location and History

IHSS 207 is the site of former Building 444 Acid Dumpsters which were located outside and to the east of Building 444 (Figures 2.1-28 and 2.1-29). (Figure 2.1-28 gives a more accurate depiction of IHSS 207 than the one given by the HRR CAD drawing which shows the IHSS in the street.) Each dumpster had the capacity to handle 500 gallons of waste. Only one dumpster was filled at a time. The dumpster receiving waste was placed within an asphalt bermed area with inner dimensions measuring 9.5 ft by 9 ft by 1 ft and a capacity to contain 640 gallons.

The acid dumpsters were used to store acidic wastes from Building 444 and operated from 1980 through 1987. When one dumpster was full it was transported to Building 374 or 774 for treatment and the other dumpster was subsequently used for waste storage. The waste consisted of acidic waste from the chemical milling of beryllium and electropolishing solution from chemical milling. The raw milling acid consisted of a mixture of 75 percent phosphoric acid, 3 percent sulfuric acid, and chromium trioxide. The electropolishing solution consisted of phosphoric acid. The spent acid was drained into a sump and then into the acid dumpsters. The bermed area was inspected frequently. In January 1981, radiation monitoring detected uranium-contaminated process waste that had leaked into the catch basin due to a missing gasket within the quick disconnect assembly. The spill was cleaned up. The acid dumpsters and associated piping were decontaminated and moved to another process area during 1987. During a site visit in May 1990, it was noted that although the bermed area was still intact, some concrete degradation had occurred.

Additional contaminants of concern found in the acid waste stream of Building 444 include the metals cadmium, chromium, lead, and silver and the radionuclides uranium 233, 234, uranium 238, americium 241, and tritium (Rockwell International 1988c). These contaminants

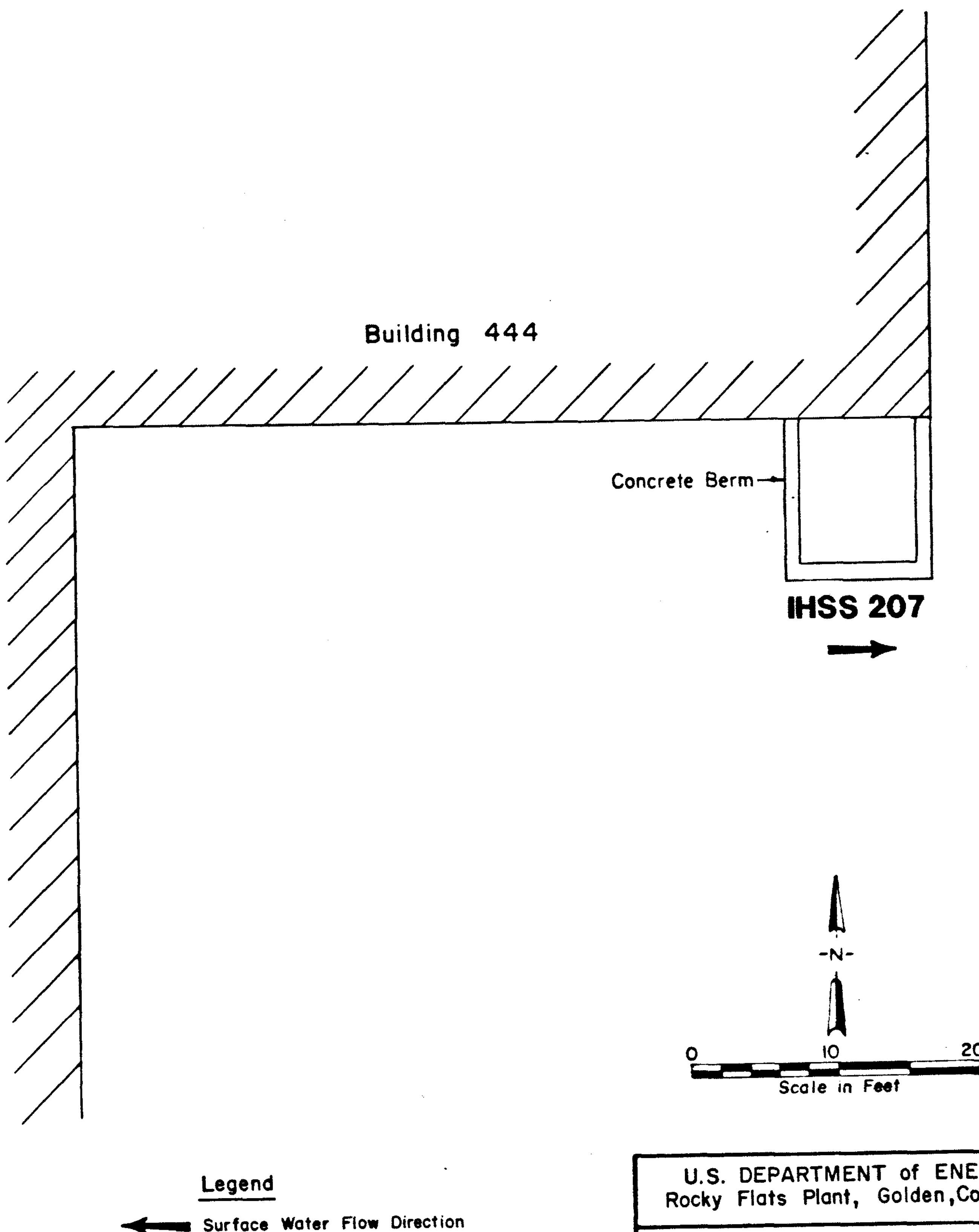

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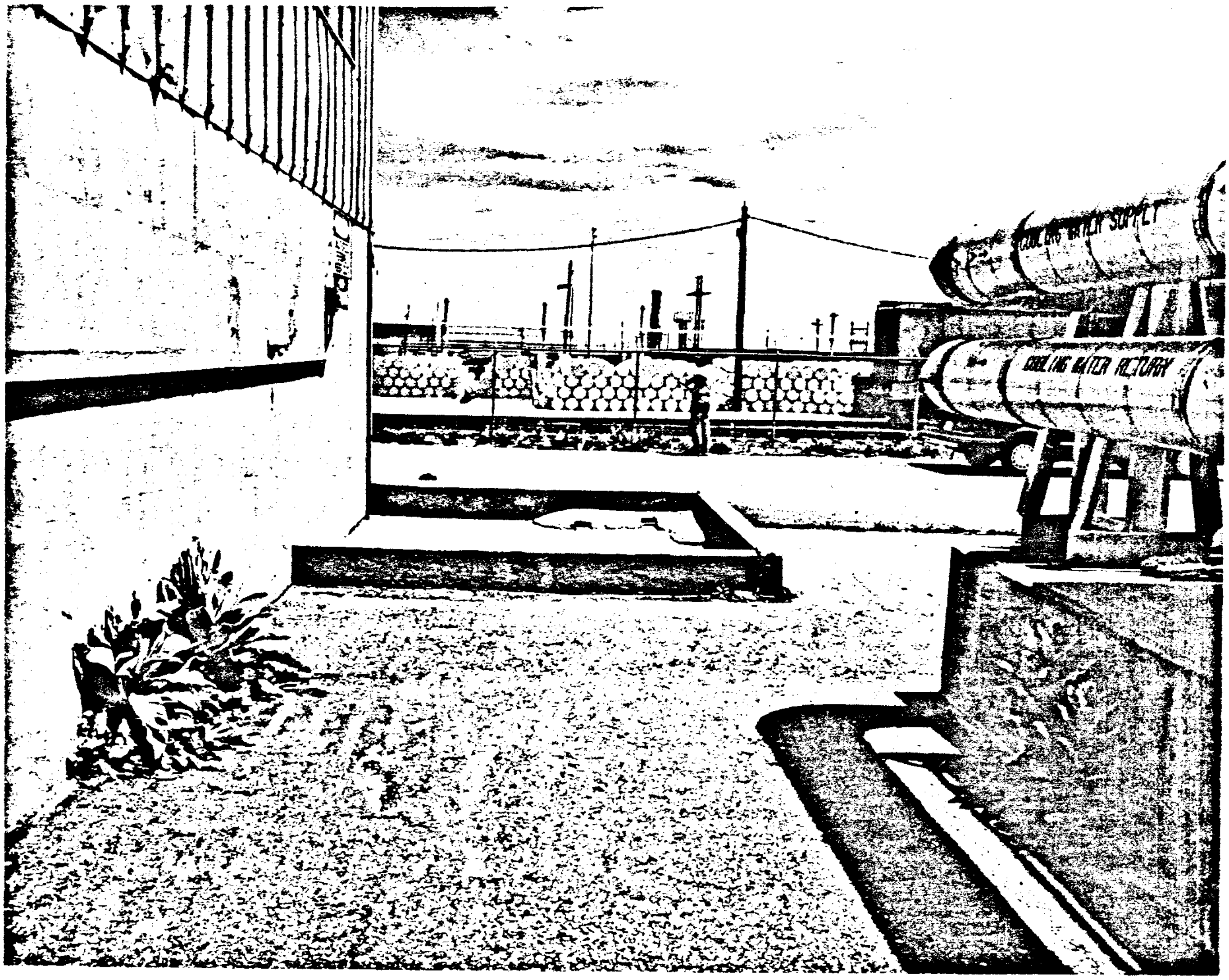
FIGURE 2.1-28
Inactive Building 444 Acid Dumpster (IHSS 207) Location Map



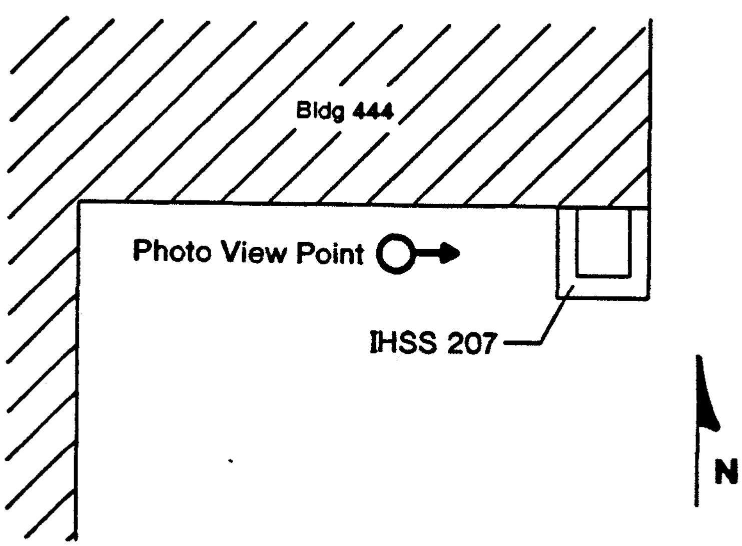


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FIGURE 2.1-29
Inactive Building 444 Acid Dumpster (IHSS 207) Site Photo

have no IHSS associated with actual storage. There is a possibility some of these waste acids could have been stored at IHSS 207.

2.1.12.2 Previous Investigations

No previous soil or water sampling investigations have been performed. The bermed area had been inspected on a frequent basis. No spills have been reported to date.

2.1.12.3 Physical Characteristics

The topography of IHSS 207 slopes to the east (Plate 1). The geologic materials in the vicinity consist of Rocky Flats Alluvium, fill, and Arapahoe Formation deposits.

Approximately 25 ft of alluvium and fill overlie the bedrock in the vicinity of IHSS 207. The closest well, in this case, is located approximately 200 ft south of the site. For a more detailed description of the geology, reference the bore log for Well P419689 found in Appendix B. The groundwater flows to the east and intercepts the Walnut Creek drainage. The depth of groundwater is approximately 25 ft below the ground surface.

2.1.12.4 Nature and Extent of Contamination

No analytical data are available, so extent of contamination is unknown.

No upgradient or downgradient analytical groundwater data are available for this area for this area.

2.1.13 <u>Inactive 444/447 Waste Storage Area (IHSS 208)</u>

The following discussion is summarized from the RCRA Part B permit application (Rockwell International et al. 1987).

2.1.13.1 Location and History

The Inactive 444/447 Waste Storage Area (IHSS 208) was previously identified in the RCRA Part B permit application (Rockwell International 1987) as Unit #3, and was located in the same area as IHSS 182 (Figures 2.1-30 and 2.1-31). This storage area consisted of a 20- by 8-ft cargo container with a maximum waste volume of 990 gallons. Similar to IHSS 206, this storage area was also mobile and is currently used to store hazardous waste at Unit #1 (Hazardous Storage Area) (Rockwell International 1987).

IHSS 208 was used from 1986 to 1987 at Unit #3, which was located at the same point as IHSS 182. This storage area was secondarily contained, and no leaks or spills were reported in this area. Typical stored wastes included a composite of nitric acid with silver, sodium fluoride, sodium fluoride solution, plating acids (hydrochloric acid, nitric acid, hydrofluoric acid) with concentrated chromium plating solution, concentrated cadmium cyanide solution, nickel sulfamate, and developer and fixer.

2.1.13.2 Previous Investigations

No previous soil sampling investigations have been performed at IHSS 208.

2.1.13.3 Physical Characteristics

The topography of IHSS 208 gently slopes to the east (Plate 1). The geologic materials in the vicinity consist of Rocky Flats Alluvium, fill, and Arapahoe Formation deposits.

Approximately 25 ft of alluvium and fill overlie the bedrock in the vicinity of IHSS 208. The closest well is located approximately 750 ft from the site; therefore, detailed bore logs will not be useful for descriptions of geologic materials. The groundwater flows to the east and

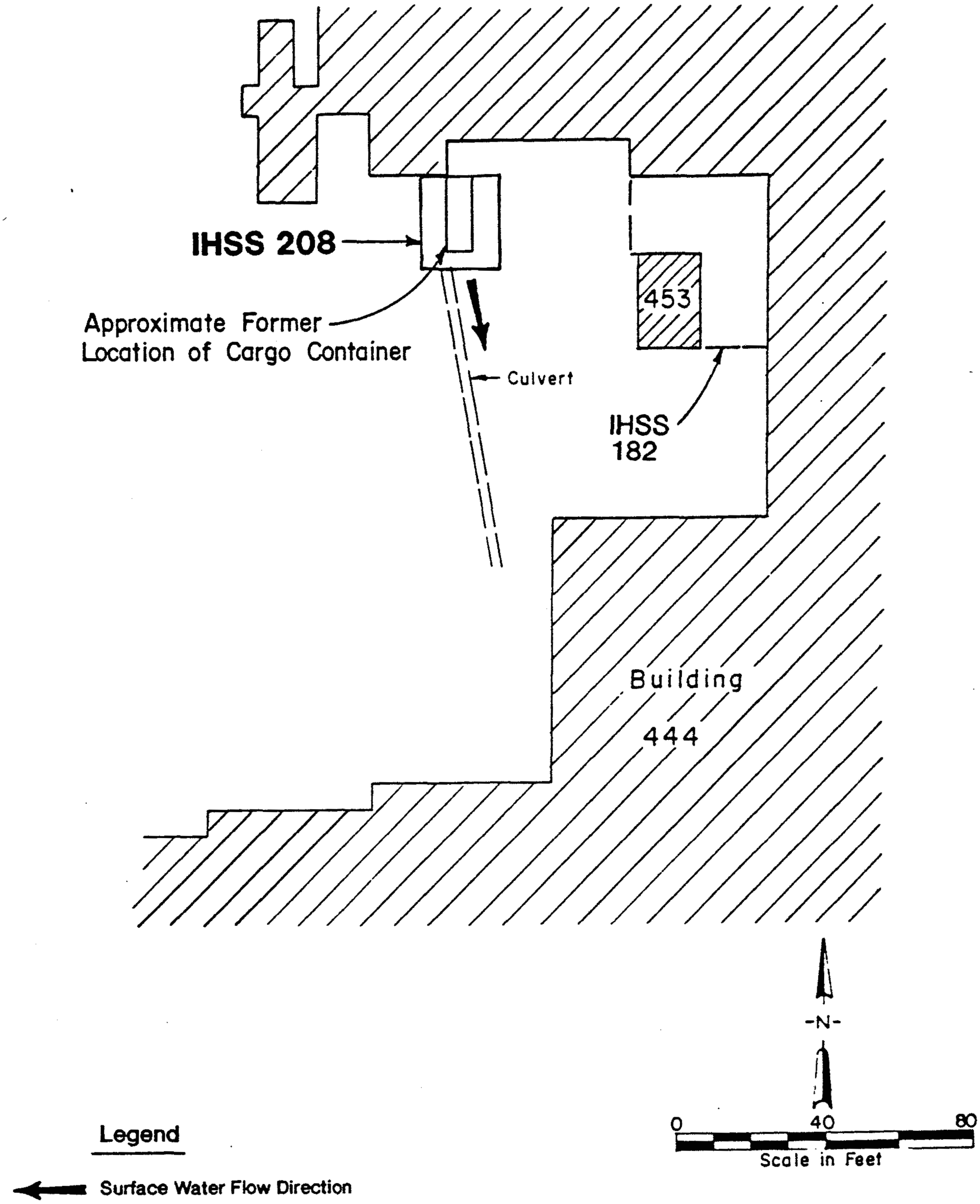

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FIGURE 2.1-30
Inactive 444/447 Waste Storage
Area (IHSS 208) Location Map

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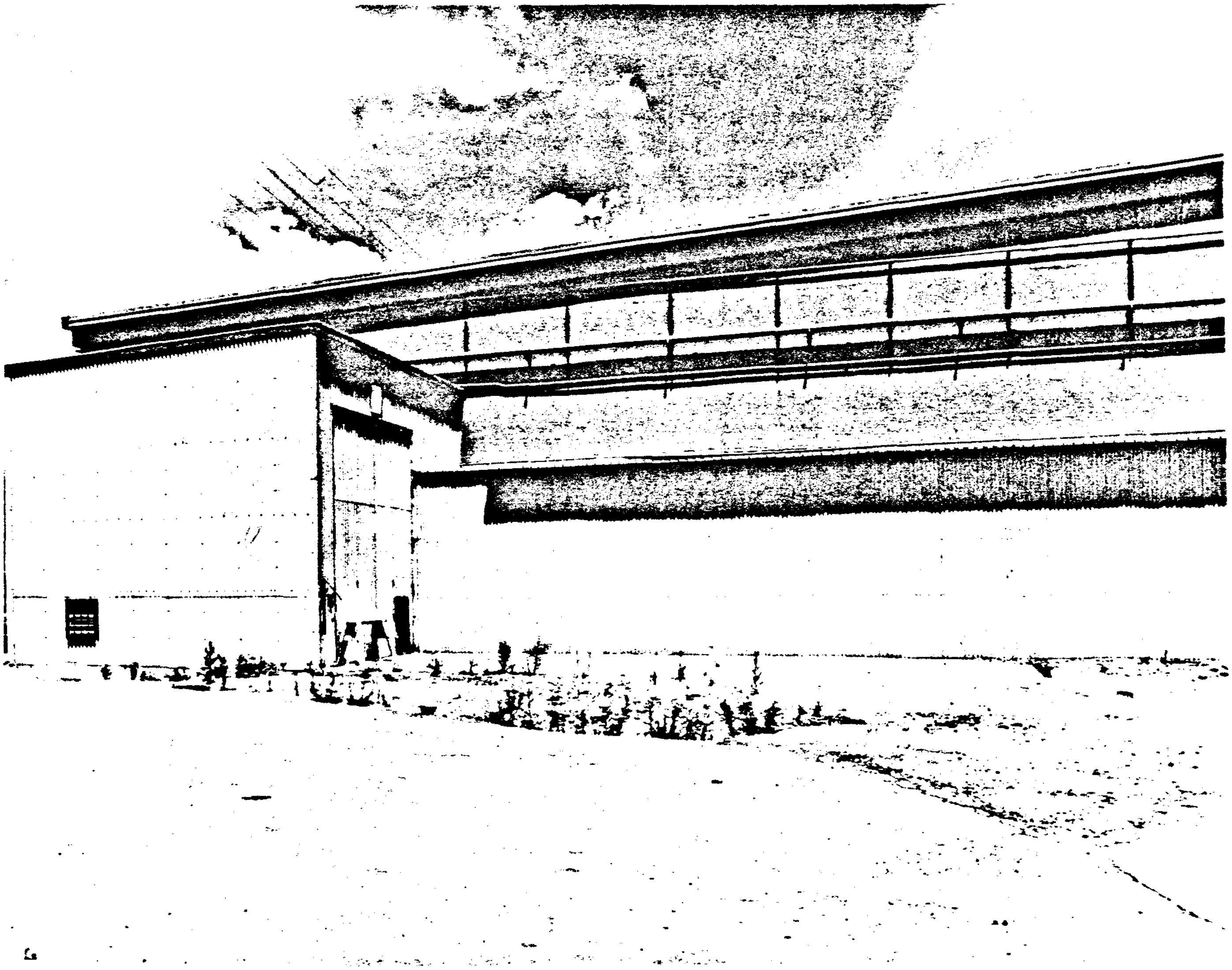

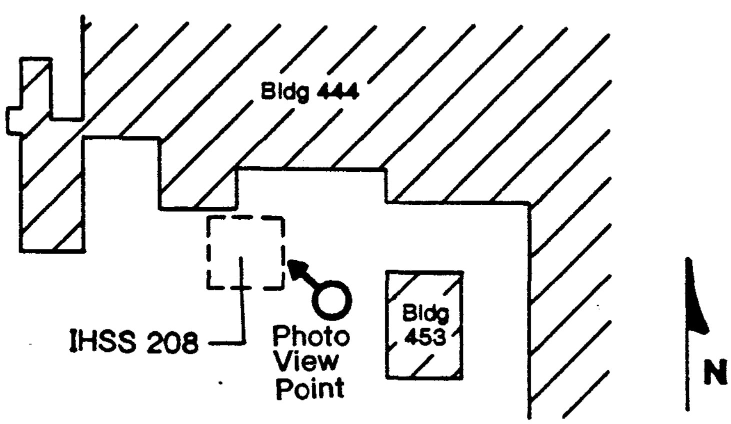

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FIGURE 2.1-31
Inactive 444/447 Waste Storage
Area (IHSS 208) Site Photo

intercepts the south Walnut Creek drainage. The depth of groundwater is approximately 20 ft below the ground surface.

2.1.13.4 Nature and Extent of Contamination

No soil sampling investigations have been conducted at this site, so the nature and extent of contamination is not known.

No upgradient or downgradient analytical groundwater data are available for this area for this area.

2.1.14 Unit 16, Building 980 Cargo Container (IHSS 210)

2.1.14.1 Location and History

IHSS 210 is located south of Spruce Avenue and east of 10th Street (Figure 2.1-32). Unit 16, an area located southeast of Building 980, provided solid and liquid waste drum storage for automotive oils, stoddard solvent, paints and paint thinner, paper and rags contaminated with oils, grease, gasoline, diesel fuel, solvents, metal scraps, and fiberglass resins and catalysts. IHSS 210 includes a steel cargo container and a roped area of ground adjacent and to the east of the container. The Cargo Container is approximately 20 ft long, 8 ft wide, and 8 ft high. The dimensions of the roped area are approximately 10 ft wide and 20 ft long.

IHSS 210 had been used for several years to store drummed hazardous waste generated from paint work, automotive work, and machine work performed in Building 980. On May 31, 1988, the IHSS 210 drum storage operation was terminated and the inventory removed. IHSS 210 is currently being used in a 90-day storage unit. As of May 31, 1988, all hazardous waste was removed from IHSS 210.

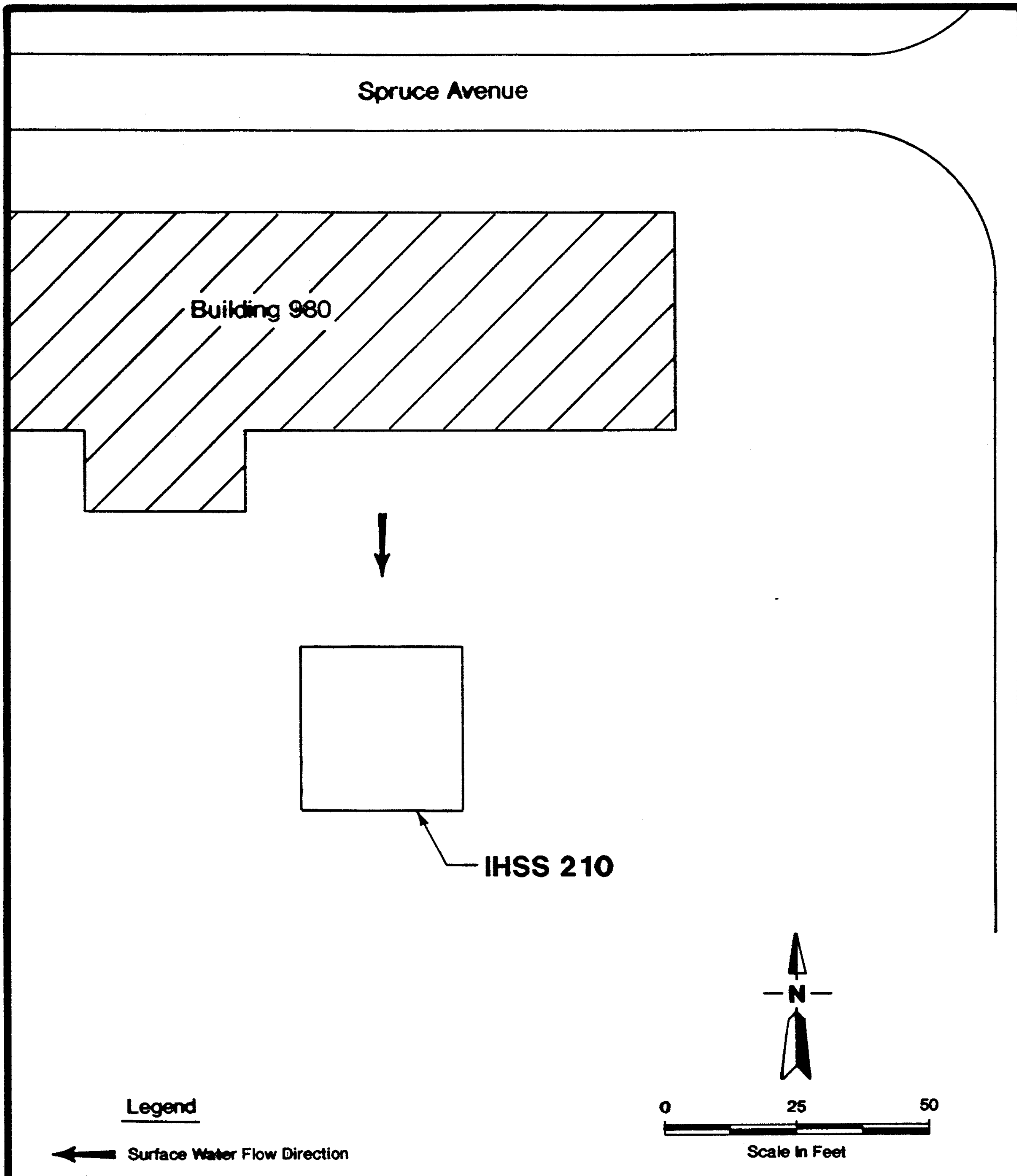

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FIGURE 2.1-32
Unit 16, Building 980 Cargo Container (IHSS 210) Location Map

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2.1.14.2 Previous Investigations

Periodic container inspections were performed by RFP personnel. These inspections consisted of visually assessing the structural integrity of the drums and checking for leaks and corrosion.

2.1.14.3 Physical Characteristics

The topography of IHSS 210 gently slopes to the northeast and east (Plate 1). The geologic materials in the vicinity of IHSS 210 consist of Rocky Flats Alluvium, fill, and Arapahoe Formation deposits.

Less than 10 ft of alluvium and fill overlie the bedrock in the vicinity of IHSS 210. The closest well is located approximately 200 ft northeast of the site. For a more detailed description of the geology, reference the bore log for Well 3887 found in Appendix B. The groundwater flows to the southeast intercepting the south Walnut Creek drainage. The depth of groundwater is approximately 10 ft below the ground surface.

2.1.14.4 Nature and Extent of Contamination

No analytical data are available, so the extent of contamination is unknown. No upgradient or downgradient analytical groundwater data are available for this area.

2.1.15 Unit 15, 904 Pad Pondcrete Storage (IHSS 213)

The following discussion is summarized from the Closure Plan for Unit 15, Storage Pad 904 (Rockwell International 1989c).

2.1.15.1 Location and History

The Unit 15, 904 Pad Pondcrete Storage is located in the southeastern portion of the RFP production area and occupies a 129,505-ft^2 rectangular area, measuring 439 ft north-south and 295 ft east-west (Figures 2.1-33 and 2.1-34).

The 904 Pad is used for the storage of pondcrete, a low-level mixed waste resulting from the solidification of Solar Evaporation Ponds sludge or sediment with Portland cement. The material is placed in polyethylene-lined 3/4-inch plywood boxes measuring 4 by 2-1/2 by 7 ft. Metal boxes measuring 4 by 4 by 7 ft are also used. Boxes are stacked three high on the 904 Pad. Saltcrete, a material similar in nature to pondcrete, is treated and stored in the same fashion as pondcrete. Saltcrete results from evaporation of liquid process water. Pondcrete and saltcrete are stored within the berm area of the 904 Pad.

The maximum pondcrete and saltcrete storage capacity of the 904 Pad is 6,136 wooden and 102 metal boxes of waste, accounting for approximately 103,464 ft^3 of waste (5,000 tons, assuming a density of 100 pounds per ft^3). Pad 904 is at maximum capacity.

The 904 Pad was constructed in August 1987 of 3-inch-thick hot bituminous pavement placed over 6 inches of Class 6 coarse aggregate. The aggregate had been placed on regraded native soil. The 904 Pad was located adjacent to the 903 Pad, a documented source of plutonium release to the environment at the RFP. Prior to construction, soil samples taken at a depth of approximately 2 inches were collected and analyzed. Plutonium 239 concentrations were generally above background levels, indicating some plutonium contamination was present at the 904 Pad location prior to construction. The area was resampled when the top 6 to 12 inches of soil was removed after grading for the 904 Pad construction. Plutonium 239 concentrations were found to be more than an order of magnitude higher than the previous shallow samples.

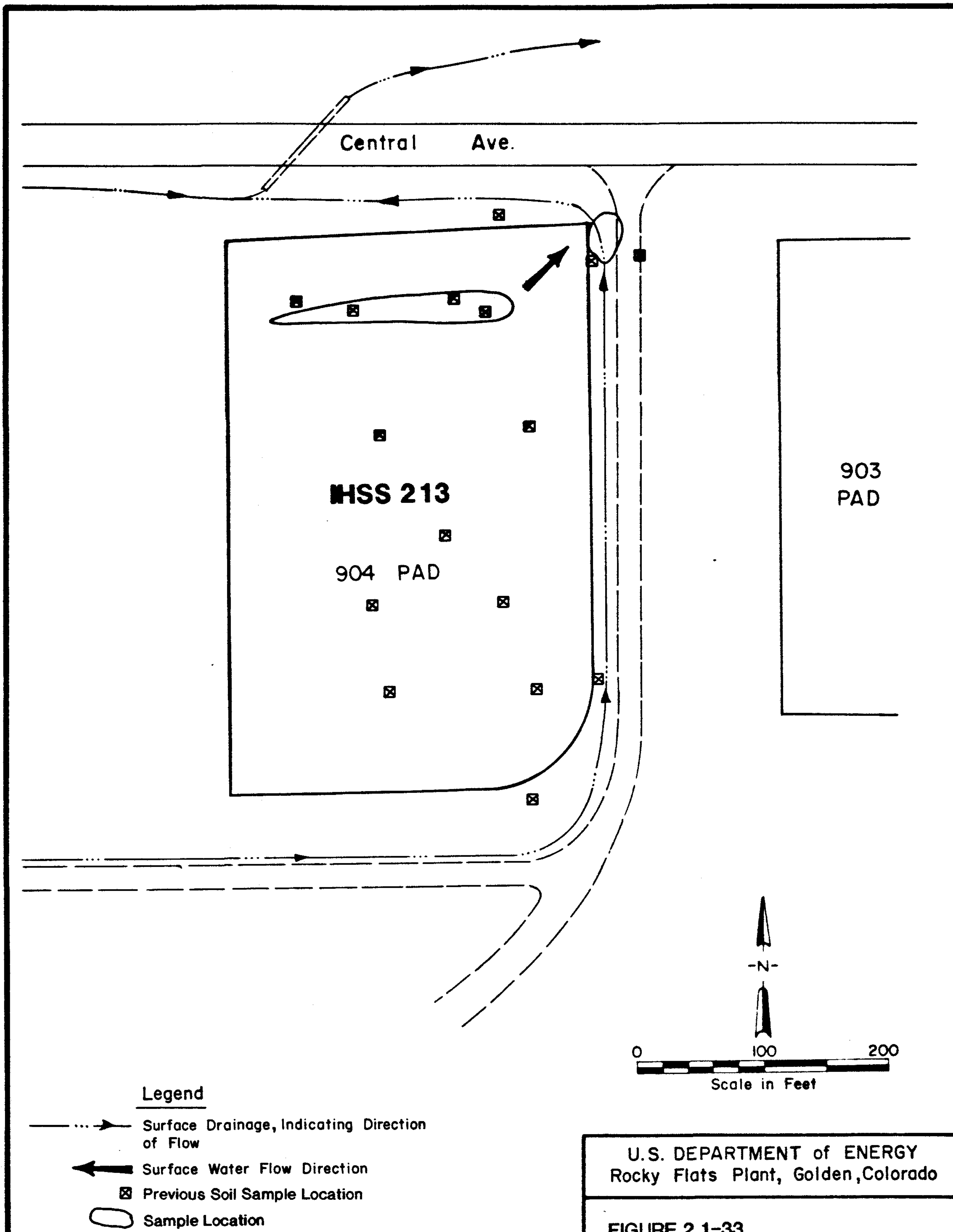

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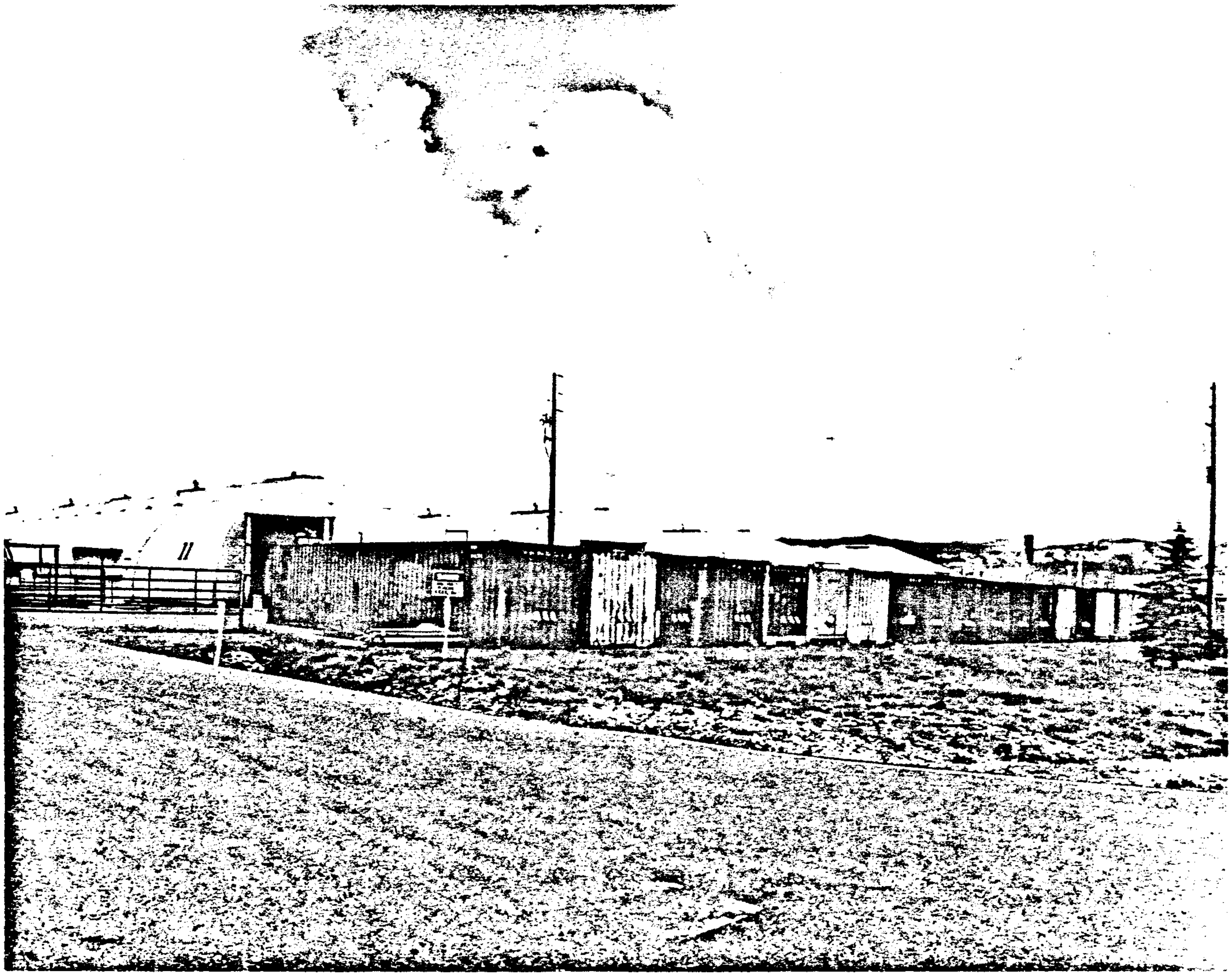
FIGURE 2.1-33
Unit 15, 904 Pad Pondcrete Storage (IHSS 213) Location Map



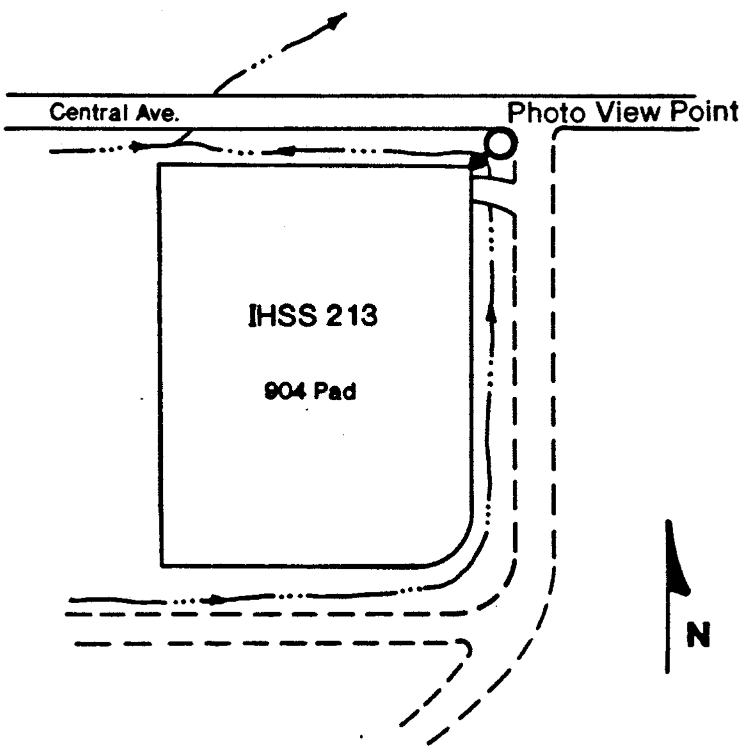


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FIGURE 2.1-34
Unit 15, 904 Pad Pondcrete Storage
(IHSS 213) Site Photo

These sampling results indicated that relatively clean soil material has been laid down over previously contaminated soil material in the area of the 904 Pad. Covering plutonium-contaminated soils with clean soils was a practice at the RFP during the late 1960s and early 1970s. Excavated contaminated material was stockpiled along the west border of the 904 Pad, covered with clean soil, and vegetated to prevent wind dispersal.

The 904 Pad began receiving waste during October 1987. The initial pad was not constructed with a containment berm. Pondcrete accumulation was temporarily halted in May 1988 as the result of a spill. On June 6, 1988, a 6-inch-high asphalt berm was constructed around the west, north, and east perimeter of the 904 Pad in an attempt to collect surface water runoff samples. Spills and leakage of both pondcrete and saltcrete have been a recurrent problem at the 904 Pad. A number of incidences are related to the incomplete solidification of the waste material which results in failure of the container and in releases to the pad surface. Spills of pondcrete are cleaned using water and brooms to scrub the pad surface. The brooms are used to remove contaminants from the crevices in the asphalt. Water is collected using a wet vacuum cleaner. The cleaning process is continued until radiation levels are below the detection limit for the monitoring instrument. Saltcrete spills tend to be composed of dry material which is cleaned by vacuuming the surface until radiation levels are below the detection limit for the monitoring instrument. Portable air monitors are moved to the pad shortly after spill incidence. Based on these monitors, there have been no releases that exceed the RFP Screening Guide for plutonium in air of 0.01 picocuries per cubic meter (pCi/m^3).

2.1.15.2 Previous Investigations

Soil sampling prior to and during grading activities associated with the 904 Pad construction have documented pre-existing radioactive contamination. Samples of runoff water from the 904 Pad taken after spills have detected gross alpha and beta concentrations above drinking water standards. Seepage of runoff water below the asphalt berm has been reported as very common by RFP employees. Analysis of runoff data indicates 41 percent of all runoff samples equal or exceed the gross alpha drinking water standard of 15 pCi/L and 37 percent of all runoff samples are equal to or exceed the gross beta drinking water standards of 50 pCi/L. The surface water background value for gross alpha is 177 pCi/l and for gross beta is 163 pCi/l. Analysis of existing data indicates that runoff from the 904 Pad may be contributing to the elevated analyte concentrations in the South Walnut Creek water. South Walnut Creek is diverted into Pond B-4 which intermittently discharges to Pond B-5, the last control point on the South Walnut Creek drainage (Plate 1). Pond B-5 discharges must meet the RFP NPDES permit.

A memo dated January 26, 1989, 89-RF-0332, addresses the possible impact of runoff from Pad 904 and Pad 750. The runoff may result in chronic low levels of contaminants being released into Pond B-5 that discharge from the pond would violate the NPDES permit. Therefore, the potential for contamination exists along the path from Pad 904 to Pond B-5.

2.1.15.3 Physical Characteristics

Approximately 10 to 20 ft of Rocky Flats Alluvium overlies the Arapahoe Formation in the vicinity of the 904 Pad. It appears to maintain a thickness of 10 to 20 ft east to west and is completely eroded approximately 150 and 900 ft north of the 904 Pad, where surface drainages exist. South of the 904 Pad, the Rocky Flats Alluvium attains a maximum thickness of approximately 25 ft, and then rapidly thins as it enters the north flank of the Woman Creek Valley (see EG&G 1992, Plate I). The Arapahoe Formation consists of subcropping claystones and discontinuous subcropping sandstones.

In Well 10-87, which is located in IHSS 213, the marker sandstone bed at the base of the Arapahoe Formation occurs at a depth of 27 ft. It is part of a 12-ft-thick, fining-upward sequence with medium-grained, well-rounded, frosted quartz sandstone at the base and very fine-grained quartz sandstone at the top. The Arapahoe Formation conformably overlies silty, fine-grained sandstones and claystones of the upper Laramie Formation, and is unconformably overlain by 15 ft of gravels of the Rocky Flats Alluvium. Sandstone beds in the Arapahoe and Laramie Formation dip approximately 1 to 2 degrees east (EG&G 1992). For more detail on the geology, see the bore log for Well 10-87 found in Appendix B.

The topography and drainage of the 904 Pad is approximately 0.7 percent to the northeast (Plate 1). Because of this slope, water tends to accumulate along the north berm, and in the northeast corner of the pad adjacent to the berm. Any runoff or berm overflow is intercepted by a ditch sloped to drain to the northeast to intercept the South Walnut Creek drainage. The ditch is located east of the 904 Pad. The west, north, and east perimeters of the 904 Pad are enclosed by a 6-inch-high berm, added approximately 1 year after storage operations began. The berm was designed to collect surface water runoff samples from the 904 Pad, and additionally to minimize runon. The bedrock aquifer potentiometric surface slopes away from the 904 Pad to the east, roughly consistent with the dip of the sandstone units of the Arapahoe Formation. This results in groundwater movement towards the north, east, and south.

Groundwater flow in the alluvial aquifer below the 904 Pad appears to be strongly influenced by the east-northeast sloping topography and the configuration of the base of weathering in the Arapahoe Formation. In addition, the alluvial aquifer potentiometric surface slopes away from the 904 Pad toward the north, east, and south, thus groundwater flows radially in those three directions. After examining data from logs of Well 10-87, which is an alluvial well on the site, the depth of groundwater was determined to be approximately 12 ft as of December 1988.

Analyses of potentiometric data for the alluvium indicates that water in the alluvial aquifer in the vicinity of the 904 Pad flows toward the south and southeast at a rate of about 5.26 x 10^{-3} ft/day (based on a saturated hydraulic conductivity of 1.36 x 10^{-2} ft/day, an assumed effective porosity of 0.1, and a gradient of 0.039 ft/ft) and toward the northeast at a rate of about 2.72 x 10^{-3} ft/day (based on a saturate hydraulic conductivity of 1.36 x 10^{-2} ft/day, an assumed effective porosity of 0.1, and a gradient of 0.020 ft/ft) (Rockwell International 1989c).

Analysis of bedrock aquifer potentiometric data indicates that groundwater in the bedrock aquifer, which is assumed to occur predominately in the fine-grained sandstone/siltstone units of the upper Laramie Formation in the vicinity of the 904 Pad, flows toward the south at a rate of 1.92 x 10^{-3} ft/day under a gradient of 0.170 ft/ft, toward the east at a rate of 1.15 x 10^{-3} ft/day under a gradient of 0.102 ft/ft, and toward the northeast at a rate of 1.38 x 10^{-3} ft/day under a gradient of 0.122 ft/ft. These groundwater flow rates assume an effective porosity of 0.1 and a sandstone-saturated hydraulic conductivity of 1.13 x 10^{-3} ft/day. The hydraulic conductivity values used are based on slug and packer test data (Rockwell International 1989c).

2.1.15.4 Nature and Extent of Contamination

Analysis of soil samples taken from borings in the area indicate the presence of gross alpha, gross beta, total plutonium, total uranium, uranium 234, unranium 238, americium 241, and plutonium 239. Table C-13 (Appendix C) presents the radionuclides detected.

In addition, analysis of surface water samples taken in the area of IHSS 213 the presence of gross alpha, gross beta, nitrate, cyanide, and cadmium. Table C-14 (Appendix C) presents the metals and other inorganics detected.

The sampling locations and concentrations of the analytes detected are illustrated in Figure 2.1-35.

Analysis of groundwater samples taken from upgradient Well 1087 indicates detections for the metals and other inorganics, barium, calcium, iron, magnesium, manganese, nickel, sodium, zinc, and sulfate. Radionuclides detected above background include americium 241 and uranium 233, 234. Table C-15 (Appendix C) presents the metals, inorganics, and radionuclides detected.

No downgradient groundwater analytical data are known to have been collected. In order to assess the possibility of groundwater contamination from IHSS 213, further data are needed.

2.1.16 Unit 25, 750 Pad Pondcrete and Saltcrete Storage (IHSS 214)

The following discussion is summarized primarily from the Closure Plan for Unit 25, Storage Pad 750 (Rockwell International 1989d).

2.1.16.1 Location and History

The Unit 25, 750 Pad Pondcrete and Saltcrete Storage (IHSS 214) was initially constructed as a parking lot for Building 750 (Figures 2.1-36 and 2.1-37). One hundred forty-two thousand ft^2 of the original 220,000 ft^2 surface are used for storage. The boundaries of the pad as depicted in Figure 2.1-36 are the latest boundaries of the present pad.

The 750 Pad is used for the storage of pondcrete, a low-level mixed waste resulting from the solidification of Solar Pond sludge or sediment with Portland cement. The material is placed in polyethylene-lined, 3/4-inch plywood boxes measuring 4 ft by 2.5 ft by 7 ft. Boxes are stacked three high on the Pad. Metal boxes measuring 4 ft by 4 ft by 7 ft are also used. Saltcrete, a

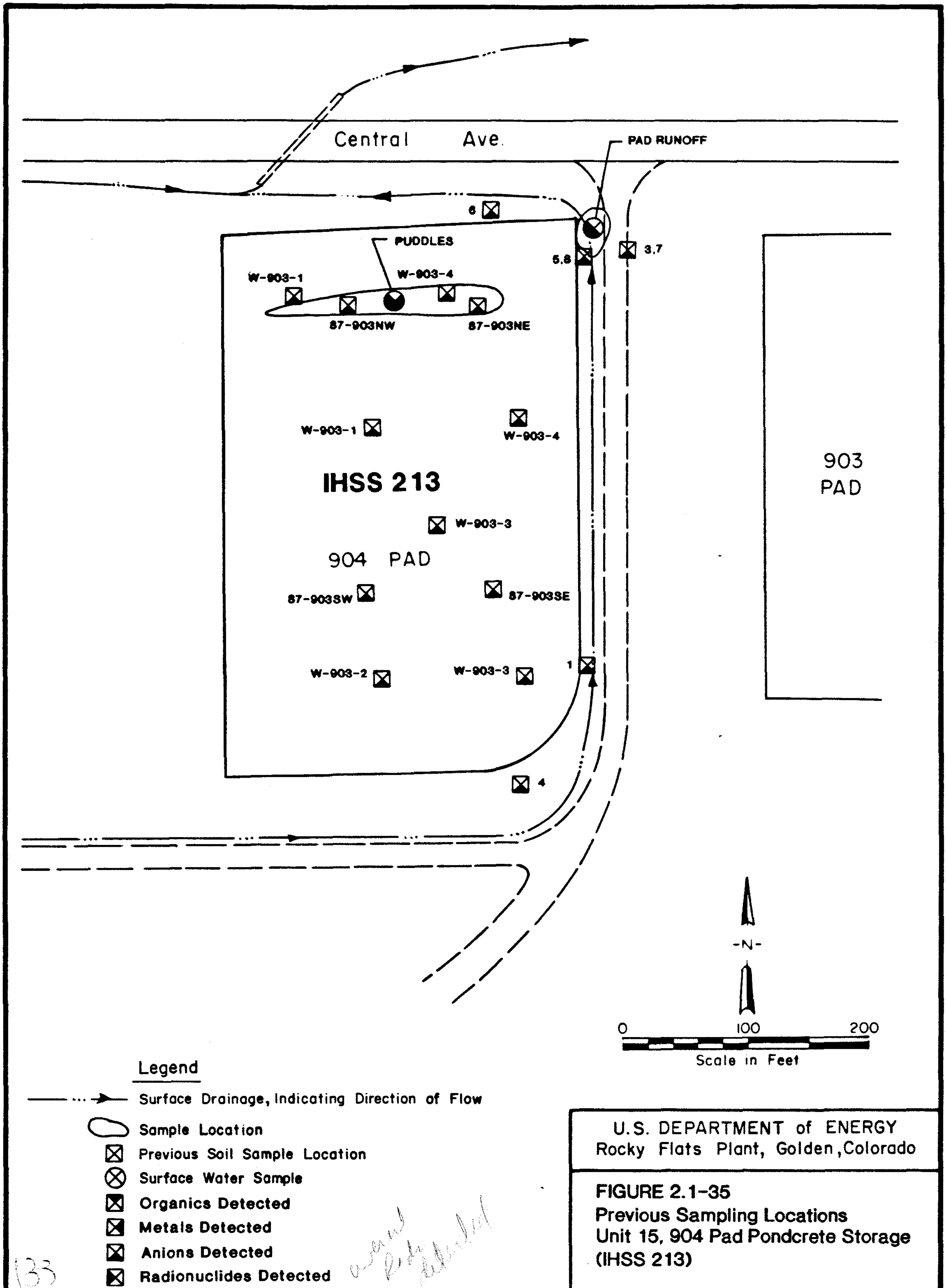

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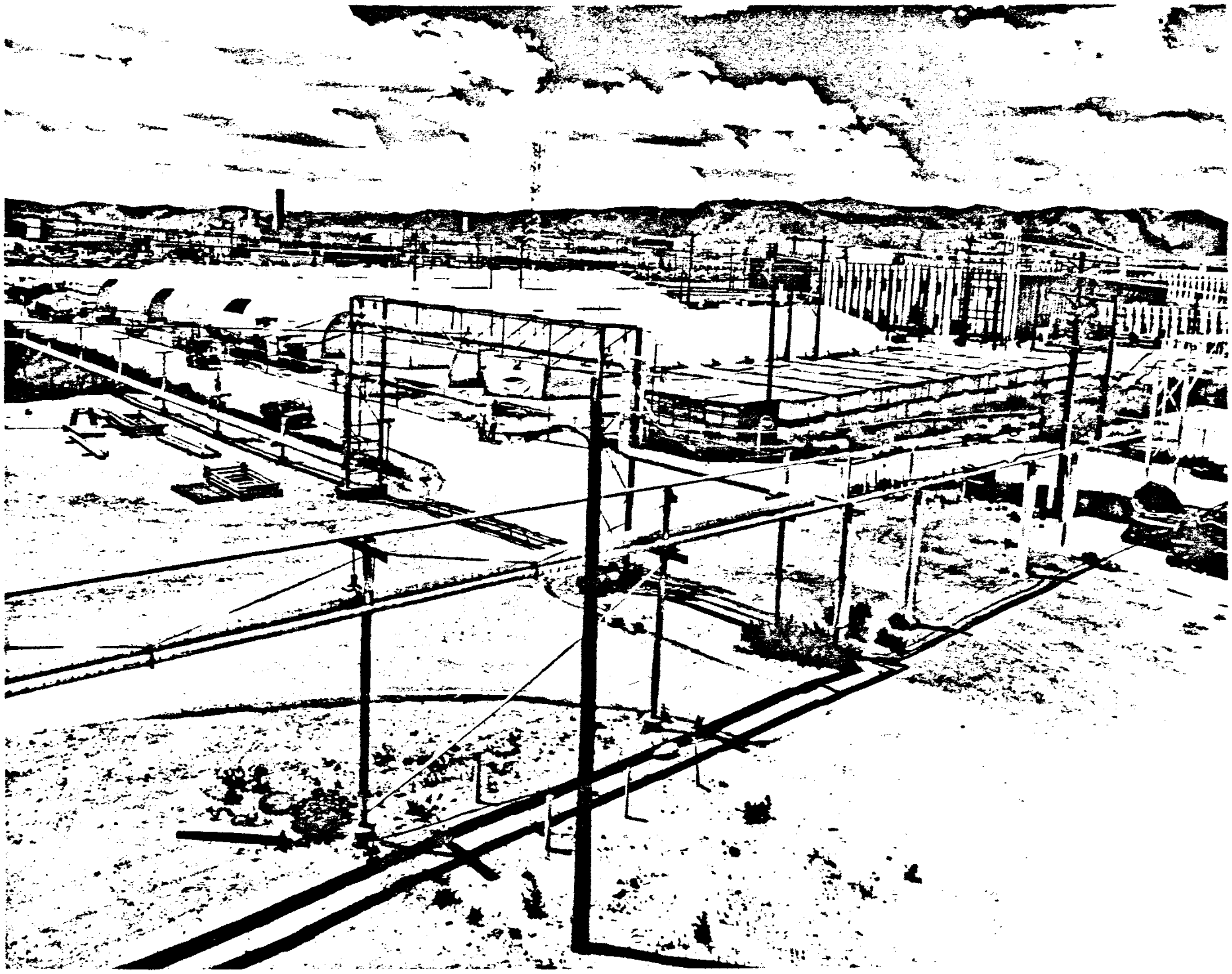
FIGURE 2.1-35
Previous Sampling Locations
Unit 15, 904 Pad Pondcrete Storage
(IHSS 213)



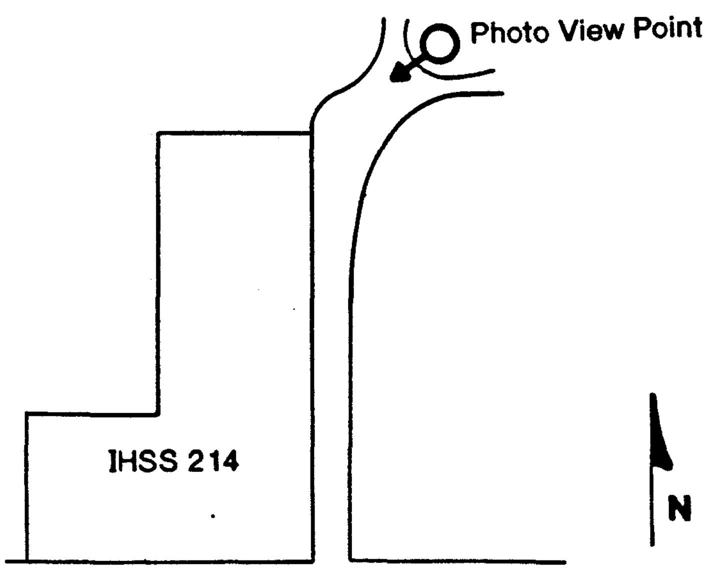


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FIGURE 2.1-37
Unit 25, 750 Pad Pondcrete and Saltcrete Storage (IHSS 214)
Site Photo

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material similar in nature to pondcrete resulting from evaporation of liquid process waste, is treated and stored in the same fashion as pondcrete on the pad. Pondcrete and saltcrete are stored within the berm area of the 750 Pad.

The maximum waste storage inventory of the 750 Pad is 12,168 boxes of waste, accounting for approximately 183,000 ft^3 of waste (9,000 tons, assuming a density of 100 pounds/ft^3). The inventory as of September 30, 1989, consisted of 8,881 wooden boxes of pondcrete, 157 metal boxes of pondcrete, and 855 wooden boxes of saltcrete.

The 750 Pad was initially constructed as a 220,000-ft^2 parking lot for Building 750 in 1969. The 750 Pad was constructed with a 6-inch-thick aggregate overlain by a 2-inch-thick asphaltic concrete. In 1986, prior to the storage of waste, 142,000 ft^2 of the 750 Pad was overlaid with Petromat and 3 inches of asphalt. Eight-inch-high asphalt berms were constructed along the east and portions of the north and south sides. Waste storage began on November 18, 1986. Production of pondcrete ceased on May 23, 1988, in response to spills on the 904 Pad. A detailed inspection of waste stored on the 750 Pad identified approximately 5 percent (440) of pondcrete boxes were of poor quality (i.e., containing unhardened pondcrete). Severely deformed boxes of waste were transferred to metal boxes or to Building 788 to await reprocessing. Storage of pondcrete resumed in November 1986 and continues to the present.

From November 18, 1986, to September 1, 1989, two spills of pondcrete occurred. The spills, totaling approximately 0.5 ft^3, were released to the asphalt pad. Both spills consisted of unhardened Solar Evaporation Pond sludge and cement. Following each incident, the entire contents of the failed container and spilled pondcrete were transferred to metal boxes. The spill locations were then cleaned by using water and brooms to scrub the 750 Pad surface. The brooms are used to remove pondcrete from the crevices in the asphalt. Water was collected using wet vacuums. Cleaning continued until radiation levels were below detection limits for the instruments being used.

Routine inspections of the 750 Pad on November 1, 1988, and April 7, 1989, identified deformed and leaking boxes of saltcrete. All saltcrete spills have consisted of a fine, dry, powder. From November 1, 1988, through July 25, 1989, a total of 64 leaking boxes were identified that had released approximately 113 pounds of saltcrete to the 750 Pad. The location of spills were cleaned by vacuuming until radiation levels were below detection limits of the instruments being used. Analytical results from samplers S-2 and S-17 located upwind from the 750 Pad identified no total long-lived alpha activity above plant standards. No soil monitoring has been conducted at the 750 Pad to confirm if precipitation migrated contaminants to the soil (Rockwell International 1989d). Berms 8 inches in height existed on the south, north, and east sides of the pad, so surface runoff would have been minimized. The quantity of saltcrete that was retrieved is unknown.

A site visit in May 1990 observed wet, severely deformed cardboard boxes being transported into storage tents. Torn boxes with exposed plastic inner liners were also observed. There is a high probability that leakage of material will continue until all materials are removed.

Portable air monitors were moved to the 750 Pad shortly after the spill incidences. Based on these air monitors, there have been no releases that exceed the RFP Screening Guide for plutonium (0.01 pCi/m^3).

2.1.16.2 Previous Investigations

Soil and surface water samples were taken at the 750 Pad puddle and the culvert outlet. Section 2.1.16.4 discusses the analytes detected.

2.1.16.3 Physical Characteristics

The asphalt pad at IHSS 214 is located approximately at grade, sloped 2 percent to the east. Prior to storage of waste material, an overlay was installed consisting of 3 inches of asphalt underlain by Petromat, a rubberized material intended to prevent permeation through the 750 Pad. An 8-inch-high asphalt berm was added to the east and portions of the north and south sides to minimize runon and provide runoff water samples from the 750 Pad. Runoff from the 750 Pad is collected in seven stormwater inlets between 10th Street and the 750 Pad. All runoff water storage behind the 8-inch berm occurs in the immediate vicinity of the stormwater inlets. Calculated storage potential behind the berm is approximately 500 ft^3. Any precipitation event that exceeds approximately 0.03 inch will cause overlapping of the berms. The stormwater inlets are directly piped to a culvert that drains to South Walnut Creek.

Approximately 5 to 10 ft of Rocky Flats Alluvium overlies the Arapahoe Formation in the vicinity of IHSS 214. The alluvium has been completely eroded approximately 250 ft east of Pad 750, in the South Walnut Creek drainage. The Arapahoe Formation consists of subcropping claystones and discontinuous subcropping siltstones and very fine grained sandstones.

The medium-grained to conglomeratic marker sandstone bed at the base of the Arapahoe Formation occurs at a depth of 25 to 35 ft, north of IHSS 214 in the Solar Ponds area, south of IHSS 214 in the vicinity of IHSS 213, and east of IHSS 214 in the Mound area (EG&G 1992). However, none of the wells adjacent to IHSS 214 intersected the marker sandstone bed. Isopach maps of the Arapahoe sandstone show a channel in the vicinity of IHSS 214 (EG&G 1991c, Figures 14 and 15), which suggests that the wells adjacent to IHSS 214 are in fine-grained channel margin sandstone or interchannel claystone deposits, or have not been drilled deep enough to reach the medium-grained to conglomeratic marker bed. The Arapahoe Formation conformably overlies silty, fine-grained sandstones and claystones of the upper Laramie Formation. Sandstone beds in the Arapahoe and Laramie Formations dip 1 to 2 degrees east (EG&G 1992). For a more detailed description of the geology, see the bore log for Well P207489 found in Appendix B. Well P207489 is located north of IHSS 214.

The alluvial aquifer potentiometric surface slopes away from IHSS 214 primarily to the east. Groundwater flow in the alluvial aquifer appears to be strongly influenced by the topography and the configuration of the base of weathering in the Arapahoe Formation (Rockwell International 1989d).

Depth of groundwater is approximately 5 ft below the ground surface. Groundwater elevation information for alluvial wells suggests that groundwater levels have remained relatively stable in Wells 4-87, 10-87, 15-87, 26-86, and 61-86 (with a variance between 1 and 6 ft), and have dropped below the lowest screened interval during most of the period of record in Wells 24-86 and 44-87 causing a variance of approximately 1 to 2 ft thus producing dry wells. Alluvial aquifer potentiometric maps for the first through fourth quarters of 1988 (Rockwell International 1989d) indicate that alluvial aquifer flow directions and gradients remain fairly constant throughout the year. Areas of unsaturated surficial materials are present north of IHSS 214 near Well 38-87, and east of Pad 750 near Well 33-86. These unsaturated surficial materials may represent areas where bedrock is very near the surface causing no flow boundaries or where building footing drains dewater the local alluvial aquifer. Groundwater flowing east from IHSS 214 will most likely be discharged to the headwaters of South Walnut Creek prior to being monitored by Well 33-86.

Analyses of potentiometric data for the alluvium indicate that water in the alluvial aquifer in the vicinity of the 750 Pad flows to the east at a rate of about 2.45 x 10^{-3} ft/day (based on a saturated hydraulic conductivity of 1.36 x 10^{-2} ft/day, an assumed effective porosity of 0.1, and a gradient of 0.018 ft/ft) and toward the northeast at a rate of about 2.72 x 10^{-3} ft/day (based on a saturated hydraulic conductivity of 1.36 x 10^{-2} ft/day, an assumed effective porosity of 0.1, and a gradient of 0.020 ft/ft). Hydraulic conductivity estimates for the alluvial aquifer are based on slug test data (Rockwell International 1989).

Groundwater elevation information for bedrock wells suggests that groundwater levels have remained relatively stable in Wells 5-87BR, 9-87BR, and 45-87BR (with a variance between 1 and 3 ft), moderately stable in Wells 16-87BR, and 23-86BR (with a variance between 15 and 30 ft), and relatively unstable in Well 25-86 (with a variance of approximately 60 ft). Bedrock aquifer potentiometric maps for the first through fourth quarters of 1988 (Rockwell International 1989d) indicate that bedrock aquifer flow directions and gradients remain fairly constant throughout the year. Groundwater flowing north from IHSS 214 may be monitored using information collected from Well 23-86BR; and groundwater flowing east from IHSS 214 may be monitored using information collected from Well 22-87BR.

Analysis of bedrock aquifer potentiometric data indicate that groundwater in the bedrock aquifer, which is assumed to occur predominately in the fine-grained sandstone/siltstone units of the upper Laramie Formation in the vicinity of IHSS 214, flow toward the northeast at a rate of 1.03 x 10^{-3} ft/day under a gradient of 0.091 ft/ft. This assumes an effective porosity of 0.10 and a sandstone saturated hydraulic conductivity of 1.13 x 10^{-3} ft/day. The hydraulic conductivity values used are based on slug and packer test data (Rockwell International 1989d).

2.1.16.4 Nature and Extent of Contamination

Radionuclide analysis of soil samples taken from borings in the area indicate the presence of gross alpha and gross beta. Table C-16 (Appendix C) lists the radionuclides detected. Analysis of surface water samples taken in the area of IHSS 214 indicate presence of gross alpha, gross beta, nitrate, cyanide, and cadmium. Table C-17 (Appendix C) lists the metals and other inorganics detected.

Figure 2.1-38 illustrates the sampling locations and concentrations of the analytes detected.

Analysis of groundwater samples taken from upgradient Well P207489 indicates detections of metals and other inorganics including calcium, magnesium, manganese, and sulfate. Table C-18 (Appendix C) presents the metals and other inorganics detected. Radionuclides detected include americium 241; tritium; uranium 233, 235; and uranium 235, 236. Table C-18 presents the metals, inorganics, and radionuclides detected.

No downgradient analytical data are available. In order to assess the possibility of groundwater contamination from IHSS 214, further data are needed.

2.2 SITE CONCEPTUAL MODEL

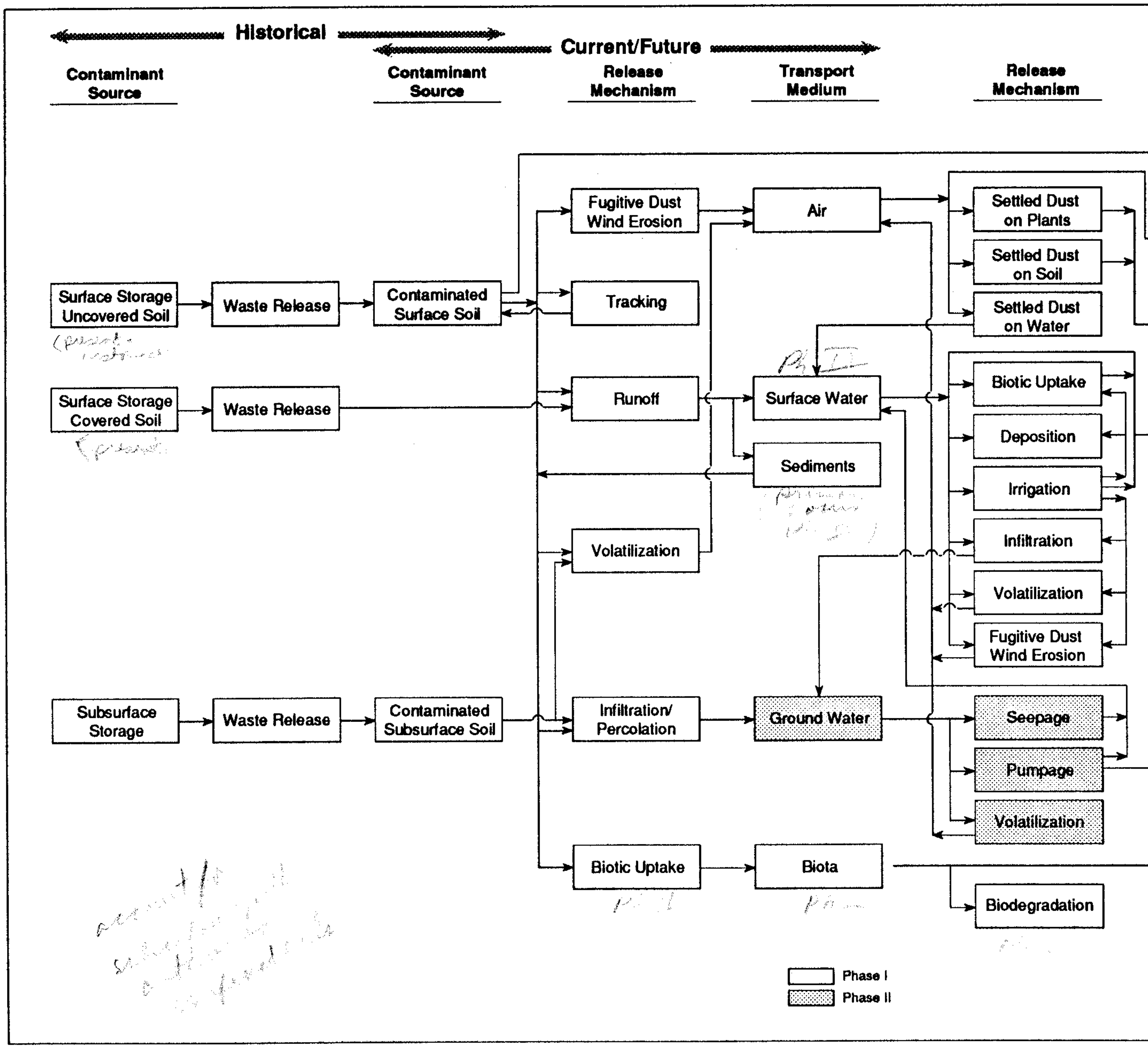
The primary purpose of the conceptual model is to aid in identifying exposure pathways by which human and biotic receptors may be exposed to contaminants. The conceptual model provides a contaminant source characterization and an overview of all the potential pathways that may from releases from and into each transport medium. The primary objective of the pathway screening process is to identify those exposure pathways which are or may be "complete" under current conditions or under reasonable assumptions about future conditions. An exposure pathway is considered to be complete if a linkage can be shown between one or more contaminant sources, through one or more environmental fate and transport processes, to an exposure point where human or ecological receptors are present. The identification of potentially complete pathways is a qualitative judgment, and the identification of a complete exposure pathway does not necessarily indicate that adverse effects will occur; it indicates that the effort to quantify exposures is worthwhile from the standpoint of protecting human health and the environment.

The following discussion contains a generalized discussion of contaminant sources, release mechanisms, contaminant migration, pathways and potential receptors, and is followed by a detailed discussion for each IHSS grouping. Figures 2.2-1 and 2.2-2 are idealized conceptual models for OU10.

In the OU10 conceptual model, the IHSSs have been grouped together into three groups based on similar characteristics. These groupings include subsurface storage (IHSSs 124, 124.1, 124.2, 124.3, and 129); surface storage with a covered surface (IHSSs 177, 181, 182, 205, 207, 208, 213, and 214); surface storage with an uncovered surface (IHSSs 170, 174, 175, 176, 206, and 210).

IHSSs 182 and 213 were covered at later dates after use, therefore, the surface storage with an uncovered surface model would apply before the addition of surface covering and the covered surface model would apply after surface covering was added. IHSSs 182 and 213 have been grouped into the covered storage site model since this model presently applies to these sites. Above ground tanks have been grouped into either the covered or uncovered storage yards, pads, cargo container areas since the models are similar (i.e., the point of release is on the surface).

2.2.1 Generalized Site Conceptual Model



U.S. Department of Energy
Rocky Flats Plant, Golden, Colorado

Figure 2.2-2
Risk Assessment Conceptual Model

2.2.1.1 Sources of Contamination

Historical sources include surface and subsurface storage, and the surface and subsurface soil and liquid contaminated as a result of waste releases from storage. Current sources include existing storage, and soils and liquid contaminated as a result of waste releases.

2.2.1.2 Types of Contamination

Types of contamination include organic compounds, inorganic compounds and radionuclides. The characteristics of RFP contaminants and movement through the environment vary depending on the waste composition and the environmental conditions.

2.2.1.3 Release Mechanisms

Release mechanisms are physical and/or chemical processes by which contaminants are released from the source. The conceptual model identifies historical mechanisms which released contaminants directly from the historical sources (in this case, leaks, spills, and overflows), and current release mechanisms which release contaminants from current contaminant sources or transport media. Release mechanisms include fugitive dust, wind erosion, runoff, volatilization, infiltration/percolation, biotic uptake, and tracking. Soil is the initial receiving medium for waste discharges except in the case of covered surface storage where waste either adsorbs to the cover material or is released by wind, volatilization, tracking, or runoff.

2.2.1.4 Contaminant Migration Pathways

Contaminant migration pathways include transport media and exposure routes. Transport media are the environmental media into which contaminants are released from the source and from which contaminants are in turn released to a receptor (or to another transport medium). Potential transport media from OU10 include air, ~~sediments~~, surface water, groundwater, and biota.

Exposure routes are avenues through which contaminants are physiologically incorporated by a receptor. Exposure routes for receptors are OU10 are inhalation, ingestion and dermal contact.

2.2.1.5 Receptors

Receptors are human or environmental populations which are affected by the contamination released from a site. Human receptors for OU10 may include RFP workers and visitors. Environmental receptors include the limited biota (both flora and fauna) indigenous to the OU10 environs.

2.2.2 Underground Storage

IHSSs 124, 124.1, 124.2, 124.3, and 129 are characterized by this conceptual model.

2.2.2.1 Sources of Contamination

Historical sources of contamination include overflows, spills from tanks, or leaks from association pipelines. Specifically, a large overflow occurred at the radioactive liquid waste storage tanks (IHSSs 124, 124.1, 124.2, and 124.3). Spills or leakage related to Tank No. 4 and its five associated pipelines are the historical sources of contamination at IHSS 129. The possible current sources of contamination include joints or corners of underground tanks and associated pipelines and the soils beneath these structures.

2.2.2.2 Types of Contamination

The type of contamination possibly existing at IHSSs 124, 124.1, 124.2, and 124.3 are radionuclides. IHSS 129 contains organic compounds, including free product, and inorganic compounds.

2.2.2.3 Release Mechanisms

Releases of contamination associated with tanks and pipes are most likely to occur at the following locations:

- Tank openings (e.g., overflows and spills)
- Tank/pipe connections
- The base of the tank where residual waste collects, and where underground tanks may be in contact with groundwater
- Cold joints along the walls of concrete tanks
- Structural seams which could be affected by differential settlement of the tank bedding or supports
- Sections of pipeline broken or corroded
- Elbows, joints, and intersection of piping.

Potential releases from contaminated soils could occur through leaching and infiltration. Soil contamination due to spills at the ground surface could result in other types of releases shown in Figure 2.2-2. However, fugitive dust is not expected to be released at IHSS 129 because the site has been covered with gravel.

2.2.2.4 Contaminant Migration Pathways

The contaminant migration pathways for underground tanks and associated pipes, which are illustrated in Figure 2.2-2, include air from volatilization and dust from possible surface spills. Surface water, sediments and biota are also transport media for possible surface spillage. Groundwater possibly transports contaminants that may have leached through the soil column or directly transports contaminants from tanks that are in contact with groundwater.

2.2.2.5 Receptors

Potential receptors may include humans and terrestrial biota through inhalation of windblown dust and through dermal contact with contaminated soils, surface water and sediment. Depending on future land use scenarios that will be developed in a separate technical memorandum, potential receptors of contaminated groundwater may include humans through dermal contact, ingestion, and inhalation of vapors volatilized from contaminated groundwater. Surface water and sediments contaminated by groundwater recharge could impact humans and terrestrial or aquatic biota through ingestion.

2.2.3 Surface Storage With A Covered Surface

As stated in Section 2.2.1, IHSSs 177, 181, 182, 205, 207, 208, 213, and 214 are characterized in this conceptual model.

2.2.3.1 Sources of Contamination

The historical sources of contamination include possible leaks or spills from drums or containers (IHSSs 177, 181, 182, and 208); spills from drums or containers (IHSSs 177, 181, 182, and 208); spills or leaks of acid waste from failing dumpsters or piping (IHSSs 205 and 207); spills or leaks from pondcrete or saltcrete storage (IHSSs 213 and 214). The current sources of contamination at these sites include the cover material on the site and the soils surrounding the site where runoff or wind has transported the contaminants. The soils underneath IHSSs 182 and 213 may be a source of possible contamination, since the sites were covered after a period of use.

2.2.3.2 Types of Contamination

The types of contamination include oils, coolants, solvents, and low level radioactive waste stored in drums (IHSSs 177, 181, and 182). Acid wastes are the types of contamination associated with

IHSSs 205, 207, and 208. Low-level mixed wastes (pondcrete and saltcrete) are associated with IHSSs 213 and 214.

2.2.3.3 Release Mechanisms

The most probable release mechanisms for sites with surface storage and a covered surface releasing contaminants from the surface cover and surrounding soils are runoff, wind erosion and volatilization. Wind dispersion of contaminants at IHSSs 213 and 214 may be particularly important because of pondcrete and saltcrete powders.

Other release mechanisms include tracking, and biotic uptake of materials on the surface cover and surrounding soils or water. Infiltration/percolation applies to the soils around the covered sites but a cover most likely prevents infiltration/percolation of contaminants directly under the cover. Infiltration/percolation directly under the cover may have occurred at IHSSs 182 and 213 where possible contamination of the soils occurred before installation of a surface cover.

2.2.3.4 Contaminant Migration Pathways

The primary migration pathways for wastes would be flow of liquid wastes off the cover or transport by wind or surface water off the cover. From this point, if the waste is carried by wind, the contaminants may settle on plants, soil or surface water. If the waste migrates in groundwater it may be pumped, recharge surface water, or volatilize. The waste possibly transported by surface water would eventually be deposited or reach humans or biota.

2.2.3.5 Receptors

Potential receptors may include humans and terrestrial biota through inhalation of windblown dust or volatilization and through dermal contact with contaminated surface cover, surrounding soils, surface water, and sediment. Potential receptors of contaminated groundwater may include

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humans through dermal contact and ingestion from pumpage and/or inhalation of vapors volatilized from contaminated groundwater. Surface water and sediments contaminated by groundwater recharge could impact humans, terrestrial or aquatic biota.

2.2.4 Surface Storage without a Covered Surface

As stated in Section 2.2.1, IHSSs 170, 174, 175, 176, 206, and 210 are characterized in this conceptual model.

2.2.4.1 Sources of Contamination

The historical sources of contaminants include possible leaks or spills from drums or containers (IHSSs 175, 176, and 210). Other sources include the above mentioned sources plus dumpsters, spent batteries, and miscellaneous wastes (IHSSs 170 and 174). Sources also include tanks and piping (IHSS 206). Current sources include soils on and around the site. Some of the low level radioactive wastes may have been transported by wind and did not originate from the actual sites where the radioactivity has been detected.

2.2.4.2 Types of Contamination

The types of contamination include oils, coolants, solvents, metals and low level radioactive wastes (IHSSs 170, 174, 175, 176, and 210). IHSS 206 may possibly have nitrates from off-specification water and, therefore, is much different than the other sites with respect to the types of contaminants existing at the sites.

2.2.4.3 Release Mechanisms

The most probable release mechanisms for sites with surface storage and uncovered surface are direct infiltration/percolation, volatilization, runoff, and fugitive dust wind erosion. Other release mechanisms include tracking and biotic uptake. The main difference between these uncovered sites and the covered sites is the possibility of direct infiltration/percolation due to contaminants leaking or spilling directly on the soil.

2.2.4.4 Contaminant Migration Pathways

The primary migration pathways would be infiltration of wastes, groundwater transport, or migration by wind or surface water. The possible wastes in groundwater could volatilize, migrate to surface water or be pumped out of the ground. The possible wastes transported by wind may settle on plants, soil, or surface water. The possible waste transported by surface water would eventually be deposited or reach humans or biota.

2.2.4.5 Receptors

Potential receptors include humans and terrestrial biota through inhalation of windblown dust or volatilization and through contact with contaminated soil, surface water, and sediment. Potential receptors of contaminated groundwater include humans through dermal contact and ingestion from pumpage and/or inhalation of vapors volatilized from contaminated groundwater. Surface water and sediments contaminated by groundwater recharge could impact humans, terrestrial or aquatic biota.

3.0 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

This section provides a preliminary identification of potential ARARs for OU10. The summary of potential sitewide ARARs presented is based on current federal and state health and environmental statutes and regulations. The chemical-specific ARARs presented are not specific to OU10 because insufficient validated data exist to justify inclusion or exclusion of specific constituents. The preliminary identification and examination of potential ARARs will provide for the use of appropriate analytical detection limits during the RFI/RI. As data become available during the Phase I RFI/RI, chemical-specific ARARs will be proposed for OU10. Location-specific ARARs will be addressed in the RFI/RI report. The CMS/FS report will further address chemical-specific ARARs as well as action- and location-specific ARARs in the development and evaluation of remedial alternatives.

A screening and analysis process will be used to determine which of the potential ARARs will be applied to OU10. The analysis will address compliance with chemical-, location-, and action-specific ARARs in accordance with the NCP. When more than one ARAR is identified dealing with a single subject, the more stringent of the applicable ARARs will be used. Potential ARARs are identified in this work plan. After the initial RFI/RI field investigation, chemicals present at the site and any location-specific characteristics at the site will be identified.

3.1 THE ARAR BASIS

Section 121(d) of CERCLA, as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), requires that Superfund-financed, enforcement, and federal facility remedial actions comply with federal ARARs or more stringent promulgated state requirements. CDH

Water Quality Control Commission (WQCC) groundwater standards became effective on April 30, 1991, and are therefore considered in the process for developing potential sitewide ARARs for RFP.

Potential ARARs are identified in this work plan.

3.2 ARAR DEFINITIONS

"Applicable requirements," as defined in 40 CFR 300.5, are "those standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstances found at a CERCLA site. Only those state standards that are identified by a state in a timely manner and that are more stringent than federal requirements may be applicable." "Relevant and appropriate requirements," also defined in 40 CFR 300.5 are "those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws, that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site. Only those state standards that are identified in a timely manner and are more stringent than federal requirements may be relevant and appropriate." The most stringent promulgated standards are applied as ARARs (Preamble to NCP, 55 FR 8741). According to the NCP [40 FR 300.400(g)(4)], the term "promulgated" means that standards are of general applicability and are legally enforceable. ARARs are mandatory and must be complied with, unless a waiver or variance is issued.

3.3 TBC DEFINITION

In addition to ARARs, advisories, criteria, or guidance may be identified as TBCs for a particular release. As defined in 40 CFR 300.400(g)(3), the TBC category consists of advisories, criteria, or guidance developed by EPA, other federal agencies, or states that may be useful in developing remedies. Use of the TBCs is discretionary rather than mandatory.

3.4 ARAR CATEGORIES

In general, there are three categories of ARARs:

- Contaminant or chemical-specific requirements
- Location-specific requirements
- Performance, design, or other action-specific requirements.

ARARs are generally considered to be dynamic in nature in that they evolve from general to very specific in the CERCLA site cleanup process. Initially, during the RFI/RI work plan stage, probable chemical-specific ARARs may be identified, usually on the basis of limited data. Chemical-specific ARARs at this point have meaning only in that they can be used to ensure that appropriate detection limits have been established so that data collected in the RFI/RI will be amenable for comparison to ARAR standards. It can also be appropriate to conduct a preliminary identification of location-specific ARARs early in the RFI/RI process so that information can be gathered to determine whether restrictions can be placed on the concentrations of hazardous substances or on the conduct of an activity solely because it occurs in a special location. As discussed in the introductory paragraph of this section, detailed, location-specific ARARs will be proposed in the RFI/RI report. Identification of action-specific ARARs and remediation goals is part of the feasibility study process and will be addressed in the CMS/FS report. Chemical-specific ARARs may be deleted if they are found to be inappropriate at any time in the RFI/RI process. Deletion of chemical-specified ARARs will be based on analytical information obtained from sampling at OU10.

Chemical-specific ARARs do not currently exist for soils; however, some chemical-related, action-specific requirements do exist, such as Colorado's construction standard for plutonium in soils. Relative to chemical-specific ARARs, a risk assessment will be performed to determine acceptable contaminant concentrations in soils to ensure environmental "protectiveness." At this time, with respect to establishing analytical detection limits for soil, use of method detection limits provided in GRRASP (EG&G 1991), which are Contract Laboratory Program (CLP) required quantitation limits, should enable meaningful interpretation of soil sample results.

For appropriate management of investigation-derived wastes, as required in the IAG (Attachment 2, Statement of Work, Section IV), DOE has developed standard operating procedures (SOPs) for field investigation activities. All waste generated by the various investigations conducted at RFP will follow SOPs approved by EPA and CDH. The SOPs satisfy the IAG requirement to comply with ARARs as they relate to investigation activities. This approach is consistent with EPA policy as provided in the Draft Guide to Management of Investigation-Derived Waste (EPA 1991).

3.5 CHEMICAL-SPECIFIC ARARs

The groundwater and surface water chemical-specific ARARs primarily apply to media that will be investigated in Phase II of the RFI/RI, however, they are presented here as well (Tables A-1 to A-4). After the chemicals have been identified, the presence or absence of chemical-specific ARARs will be determined. Chemical-specific ARARs will be derived primarily from federal and state health and environmental statutes and regulations including the following:

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- Safe Drinking Water Act (SDWA) Maximum Contaminant Levels (MCLs) and Maximum Contaminant Level Goals (MCLGs) applicable to both surface water and groundwater

- Clean Water Act (CWA) Ambient Water Quality Criteria (AWQC) potentially applicable to surface water and alluvial groundwater

- RCRA, Subpart F, Groundwater Concentration Limits (40 CFR 264.94) applicable to groundwater, and proposed Subpart S, the Corrective Action Rule (55 Fed. Reg. 30798, July 27, 1990).

- CDH surface water standards for Woman Creek and Walnut Creek (5 CCR 1002-8, Section 3.8.29, Final Rule Effective March 30, 1990) applicable to surface water

- CDH WQCC proposed statewide and classified groundwater area standards (5 CCR 1002-8, Section 3.11) effective April 30, 1991.

A summary of chemical-specific standards or potential ARARs (based on the above regulations and contaminants that may be found potentially sitewide) is presented in Table 3-1, Potential Chemical-Specific ARARs/TBCs Groundwater Quality Standards; Table 3-2, Potential Chemical-Specific ARARs/TBCs - Federal Surface Water Quality Standards; and Table 3-3, Potential Chemical-Specific ARARs/TBCs - State (CDH/WQCC) Surface Water Quality Standards. These potential chemical-specific ARARs and accompanying regulations will be screened to determine their jurisdictional requirements and applicability to OU10. If the requirements are not applicable, they will be further screened to determine whether they are relevant and appropriate to the particular site-specific conditions at OU10. Where ARARs do not exist for a particular chemical, or where existing ARARs are not protective of human health and the environment, to-be-considered criteria (TBC) (such as guidance, proposed standards, and advisories developed by EPA, other federal agencies, or states) will be evaluated for use. Where ARARs or TBC criteria are not available or are less than laboratory practical quantitation limits (PQLs), PQLs will be used. For any parameters to be analyzed in groundwater, surface water, or soil and for which no ARARs or TBCs were found, use of the methods that achieve the detection limits provided in the General Radiochemistry and Routine Analytical Services Protocol (GRRASP) (EG&G 1991), which are CLP contract-required quantitation limits, should enable meaningful interpretation of sample results. In addition, whenever a potential standard is below the GRRASP-derived detection limit, the detection limit will be used as the standard. Risk-based concentrations taken from the baseline risk assessment will be used in establishing the remediation goals for the parameters for which no potential ARARs could be identified, thus ensuring environmental protectiveness.

EPA's proposed Corrective Action Rule is not yet final and may be changed substantially before it is promulgated as a final regulation. The activities caused by this work plan consist only of sampling to determine the extent of the problem at OU10. When the results of this work at OU10 are available it will then be necessary to review all potential ARARs as revised at that time, to determine their applicability or relevance and appropriateness and to determine if any standards or criteria are exceeded.

3.6 LOCATION-SPECIFIC ARARs

Potential location-specific ARARs include the following:

- Endangered Species Act; 16 USC Sections 1531 et seq.
- Executive Orders and Regulations Pertaining to Floodplain Management [44 Fed. Reg. 43239; 40 CFR 6; 40 CFR 257.3.1(a)]
- Executive Order 11988, Floodplain Management
- Standards Pertaining to RCRA Regulated Waste Management Units [44 FR 43239, 40 CFR 6, 40 CFR 257.3.1(a)]
- State of Colorado Hazardous Waste Management Act Siting Standards

- Fish and Wildlife Coordination Act, including Protection of Aquatic Life During Stream Modification (16 USC 661 et seq.)
- Migratory Bird Treaty Act (16 USC 703 et seq.)
- Bald Eagle Protection Act (16 USC 688 et seq.)
- Requirement Pertaining to Protection of Wetlands (40 CFR 6)
- Executive Order 11990, Protection of Wetlands
- Army Corps of Engineers Permit Program Regulations (33 CFR 320-330)
- Proposed Fish and Wildlife Service List of Endangered and Threatened Wildlife and Plants (50 CFR 17.11, 17.12)
- National Historic Preservation Act and Regulations (40 CFR 800), including Colorado's delegated responsibilities.

No sites of historic interest will be affected. Sites of archaeological interest are not likely because most of the areas of concern have already been excavated and developed.

An environmental evaluation is already underway for species of concern which include all threatened and endangered species protected by the Endangered Species Act.

3.7 REMEDIAL ACTION

CERCLA Section 121 specifically requires attainment of all ARARs. Moreover, a remedial action that complies with the most stringent requirement is likely to ensure attainment of similar, but less stringent ARARs dealing with the same subject. Furthermore, CERCLA requires that the remedies selected attain ARARs and be protective of human health and the environment.

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Remediation goals will be based on the baseline risk assessment to be conducted for protection of human health and the environment.

4.0 DATA NEEDS AND DATA QUALITY OBJECTIVES

As required by the IAG and to meet CERCLA and RCRA requirements, data are necessary to characterize the sources/soils contamination, determine the nature and extent of contamination, and support a baseline risk assessment. As required by the results of the risk assessment, these data may also be used to support the development and evaluation of remedial alternatives. Data requirements for this work plan are presented below and derived from guidance documents previously cited.

In accordance with the IAG, the RFI/RI for OU10 has been divided into two phases. The objectives of Phase I of the RFI/RI are to characterize the sources/soils and determine the risk associated with this contamination at each OU10 IHSS. The objective of Phase II of the RFI/RI is to evaluate the impact of each OU10 IHSS on surface water, ground water, air, the environment, and biota. This work plan defines the DQOs, FSP, and BRAP for the Phase I program only.

DQOs are established to ensure that the data collected are sufficient and of adequate quality for their intended uses (EPA, 1987). DQOs were established for the OU10 Phase I RFI/RI in accordance with Appendix A of the Rocky Flats Plant Site-Wide Quality Assurance Project Plan (EG&G, 1991). The DQO process is divided into three steps: Step 1 identifies decision types, Step 2 identifies data uses and needs, and Step 3 is the design of a data collection program.

4.1 STEP 1 - IDENTIFY DECISION TYPES

The major elements of Step 1 include identifying and involving data users, evaluating available data, developing a conceptual model, and specifying objectives and decisions. The following sections address each of these elements.

4.1.1 Identify and Involve Data Users

Data users are divided into three groups: decision makers, program management staff, and technical personnel. The principal decision makers for OU10 are federal officials responsible for RFP operations and the federal and state regulatory officials responsible for environmental protection. These include the DOE Office of Environmental Restoration and Waste Management, DOE Rocky Flats Office, EPA Region VIII, and CDH. The program management staff are the prime EG&G contractor personnel responsible for ER Program activities, which includes the EG&G Rocky Flats Plant Environmental Management Department. Technical personnel include EG&G RFP technical specialists and subcontractors responsible for supervising, coordinating, and performing ER Program activities.

The data users are brought into the RFI/RI process during planning stages to help define data quality requirements. The work plan is reviewed by the data users and their comments are incorporated in the work plan structure.

4.1.2 Evaluate Available Data

The following three types of data are available to describe conditions at the OU10 IHSSs. Site features and conditions have been investigated using aerial photography and site visits so that current conditions can be incorporated in the conceptual models for each IHSS. Written historical data are available that document spills, overflows, or other types of releases that

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represent contaminant sources at the IHSSs. Finally, some chemical analytical data are available from previous soil and surface water sampling in this OU.

Section 2.0 describes current conditions and documented histories of the IHSSs. These data are used extensively to identify potential contaminant releases that are evaluated in the conceptual models, plan sampling at locations that are most likely to indicate the presence or absence of contamination, and develop the appropriate analyte list for laboratory analysis of samples.

Chemical analytical waste, soil, and surface water data were collected in 1988 at IHSSs 129, 174, 175, 176, 177, 182, 213, and 214 (Appendix A). These data cannot be considered quantitative because sampling locations are not fully documented and the analytical results cannot be validated. However, the data are discussed in the IHSS descriptions in Section 2.0 of this work plan and are used in developing quantitative DQOs for the Phase I investigation (see Section 4.2.4).

Section 2.0 and Appendix A also present validated groundwater data available for monitoring wells in the vicinity of OU10 IHSSs. The groundwater data are of sufficient quality to be used in a qualitative manner to design the Phase I field investigation program and for eventual use in the Phase II RFI/RI report and baseline risk assessment.

4.1.3 <u>Specify Phase I RFI/RI Objectives</u>

The primary objectives of the Phase I RFI/RI are to characterize the sources/soils and determine the risk associated with the source of contamination at each IHSS. A variety of data quality levels will be included in the investigation to meet these objectives. However, the investigation must be planned to obtain sufficient data at DQO level IV to support a baseline risk assessment.

The Phase I data will also be used to identify appropriate remedial responses at each IHSS that poses an unacceptable risk to human health and the environment. The DQOs established for this investigation will be met by implementation of and adherence to GRRASP protocols for sample analysis and RFP Environmental Management Department Operating Procedures (EMD OPS) for sample collection. Table 4-1 summarizes the specific data quality objectives and data needs.

4.2 STEP 2 - IDENTIFY DATA USES/NEEDS

The major objectives of Step 2 are the following:

- Identify data uses
- Identify data types
- Identify data quality needs
- Identify data quantity needs
- Evaluate sampling/analysis options
- Review precision, accuracy, representativeness, comparability, and completeness (PARCC) parameters.

The following sections discuss each of these elements.

4.2.1 Identify Data Uses

Data collected by the Phase I RFI/RI will be used to characterize the source/soils, and support the baseline risk assessment and environmental evaluation, and to evaluate remedial alternatives. To satisfy the objective of soil/source characterization, data must be collected on the physical characteristics of the soils and the nature and extent of soil or other vadose zone source of contamination. Therefore, chemical analytical data will be collected to identify contaminants and

Table 4-1 Phase I RFI/RI Data Quality Objectives

Specific Objective (Data Need)	Data Type	Sampling/Analysis Activity	Analytical Level	Data Use
Determine site-specific transport characteristics of the vadose zone materials	Soil physical parameters	Drill borings and collect samples for moisture content, sieve analysis, determination of porosity, permeameter tests, and analysis of total organic carbon content	I	• Source/Soil Characterization • Baseline Risk Assessment • Evaluation of Remedial Alternatives
Characterize subsurface stratigraphy and depth to groundwater	Geologic ~~parameters~~	Drill borings and log subsurface geology	I	• Source/Soil Characterization • Baseline Risk Assessment • Evaluation of Remedial Alternatives
Characterize groundwater flow regime around each Individual Hazardous Substance Site (IHSS)	Water level data	• Obtain quarterly water level measurements form existing monitoring wells around each IHSS	I	• Source/Soil Characterization
		• Install monitoring wells at each IHSS where wells are absent	I	• Baseline Risk Assessment • Evaluation of Remedial Alternatives
Characterize movement of water in the ~~unsaturated~~ zone	~~Soil moisture levels~~	• Install ~~tensiometers~~ at selected IHSSs	I	• Source/Soil Characterization • Baseline Risk Assessment • Evaluation of Remedial Alternatives

Table 4-1 Phase I RFI/RI Data Quality Objectives

Specific Objective (Data Need)	Data Type	Sampling/Analysis Activity	Analytical Level	Data Use
Characterize presence or absence of soil contamination at each IHSS	Soil chemical data	• Conduct radiological (FIDLER) surveys	II	• Source/Soil Characterization
		• Conduct soil gas surveys at appropriate IHSSs; analyze vapor samples for volatile organic compounds (VOCs)	II	• Baseline Risk Assessment
				• ~~Environmental Evaluation~~
		• Collect surficial soil samples; analyze for parameters appropriate for each IHSS	IV (V for radiological analysis)	• Evaluation of Remedial Alternatives
		• Collect soil core samples along depth profiles; analyze for parameters appropriate for each IHSS	IV (V for radiological analysis)	
Characterize presence or absence of sediment contamination at appropriate IHSSs	Sediment chemical data	Collect sediment samples from drainages downgradient of selected IHSSs	IV (V for radiological analysis)	• Source/Soil Characterization • Baseline Risk Assessment • Environmental Evaluation • Evaluation of Remedial Alternatives

quantify their concentrations. Supplemental chemical and physical data will be required to characterize contaminant migration pathways in support of the risk assessment. These data can include stratigraphy, porosity, total organic carbon content, and permeability of OU10 soils. Other environmental media and contaminant migration pathways, such as those related to air, surface water, and groundwater, are not fully evaluated until Phase II of the RFI/RI.

To meet the objectives of the baseline risk assessment, specific data need to be obtained to accomplish the five tasks of the assessment (contaminant identification, exposure assessment, toxicity assessment, risk characterization, and uncertainty analysis). Section 8.0 of this work plan describes how the first four steps of this process will be described in technical memoranda that will be developed as the investigation proceeds and Phase I data are evaluated. These memoranda will include the processes to identify potentially exposed populations, including assumptions about future land use at this OU.

Background or control data must also be collected at uncontaminated areas to establish baseline conditions to determine the degree to which contamination may affect receptors. Background data are available for subsurface soil but not for surficial soils that are expected to be the focus of the OU10 baseline risk assessment. Planning for data collection to establish background analyte concentrations in RFP surficial soils will be completed separately from this work plan. However, Phase I surficial soil sampling will include data collection outside of IHSS boundaries to evaluate lateral distribution of contaminants in the immediate surroundings.

Data requirements for the evaluation of remedial action alternatives include identification of the nature of contamination at sites of concern and the volumes and areas of contaminated media. This work plan addresses the sampling required to characterize the nature and extent of soil contamination at OU10. Other supporting studies that may be required for alternative selection include treatability studies and geological characterization. Alternatives for soil remediation at OU10 fall into one of four classes: removal and treatment, insitu treatment, containment, and no action.

Data collected for the OU10 Phase I RFI/RI will be used in the development of contaminant transport conceptual and computer models for the risk assessment. Conceptual and computer models that may be developed for the OU10 IHSSs include air and ~~vadose zone transport models~~. These models will be identified in technical memoranda during Phase I data evaluation. If needed, surface water and groundwater models may also be developed during the OU10 Phase II RFI/RI.

4.2.2 Identify Data Types

Data types will consist of field survey and laboratory analytical results of samples for each RFI/RI objective (Table 4-1). The media that will be sampled during the Phase I RFI/RI include terrestrial and aquatic biota and physical media. The terrestrial and aquatic media will include vegetation, invertebrates, and vertebrates. Section 9.0 describes the sampling of these media. The physical media include soil, sediment, soil gas, surface water, asphalt/concrete, and groundwater. Radiation surveys will also be performed at all IHSSs.

Exposure ~~Risk~~ assessment modeling requires additional data types. Data necessary for air dispersion modeling generally includes relative wind direction and frequency, atmospheric stability and wind speeds, ambient concentrations of airborne particulates, soil adsorption coefficients, solubility, particle size, and precipitation. Most of these parameters will be determined from RFP-wide atmospheric studies or from literature values. The OU10 Phase I field program will collect data pertaining to particle size of the surficial soils.

Risk assessment vadose zone modeling and alternatives analyses will generally need data to determine vadose zone physical characteristics as well as chemical characteristics. Data necessary for these analyses generally includes infiltration rates, soil porosity, unsaturated hydraulic conductivity, bulk density, soil moisture content, soil pH, and total organic carbon content (TOC).

4.2.3 Identify Data Quality Needs

Tables 4-1 and 4-2 list the analytical levels appropriate to intended data uses. The five levels of data quality as presented in EPA's Data Quality Objectives for Remedial Response Activities Development Process (EPA, 1987) are as follows:

- Screening (DQO Level I) provides the lowest data quality but the most rapid results, and is used for purposes of site health and safety monitoring, preliminary comparison to ARARs, and initial site characterization to define areas for further study. The data generated provides presence/absence of certain constituents and is generally qualitative rather than quantitative.

- Field Analysis (DQO Level II) provides less rapid results but better data quality. Analysis includes some mobile laboratory-generated data and data generated by use of field analytical instruments. The data may be qualitative or quantitative.

- Engineering (DQO Level III) provides an intermediate level of data quality and may be used for site characterization or risk assessment. Engineering analysis includes mobile laboratory-generated data and standard commercial laboratory analyses without full CLP documentation. These data are both qualitative and quantitative. If analysis are conducted in support of treatability models, it will be performed to Level III.

- Confirmational (DQO Level IV) provides the highest level of data quality and is used for purposes of risk assessment, engineering design, and cost recovery documentation.

Table 4-2 Appropriate Analytical Levels by Data Use

Analytical Level	Data Use			
	Site Characterization	Risk Assessment	Enviromental Evaluation	Evaluation of Alternatives
I	X			X
II	X			X
III	X	X		
IV	X	X	X	X
V	X	X	X	X
Other				

Confirmation analyses require full CLP analytical and data validation procedures.

- Nonstandard (DQO Level V) refers to analysis by nonstandard procedures, for example, exacting detection limits, or analyses of an unusual chemical compound. These analyses often require method development or adoption. The data validation procedures of Level IV can be applied to Level V, if required.

Data quality for the Phase I RFI/RI will be achieved by adhering to the data collection and analysis protocols provided in agency-approved EMD OPS (Volumes I through VI) and the General Radiochemistry and Routine Analytical Services Protocol (GRASPP). Level I and II data will be generated by the HPGe survey, soil gas survey, and physical testing of soil samples. All laboratory chemical analysis will be performed to meet DQO levels IV or V.

4.2.4 Identify Data Quantity Needs

Data quantity needs are based on an evaluation of available data for characterizing the source/soils of OU10 and for providing input to the risk assessment and assessment of remedial alternatives. This is consistent with guidance provided in Data Quality Objectives for Remedial Response Activities (EPA, 1987) and Guidance for Data Useability in Risk Assessment (EPA, 1990). Data presently available is insufficient to meet the objectives defined by the IAG; therefore, the collection of additional data is warranted.

To ensure that a sufficient amount of valid data are generated, the FSP was designed to include a rationale for all field activities and a phased approach using surficial soil sampling and screening-level techniques to identify critical sampling sites. Section 7.0 further discusses these components of the FSP and shows the number of samples planned in the first stage of Phase I sampling. The general approach to determining the number of chemical analytical samples that are need in this stage is outlined below. Phase I data adequacy will be reevaluated at the completion of each stage and during the planning of the next one.

Stage 1 data quantity needs were evaluated subjectively and statistically. The subjective evaluation of the data quantity needs included review of site features to ensure that data will be collected in each location where contamination is most likely to have been released. This evaluation also resulted in eliminating surficial soil samples at IHSSs where the conceptual model showed that such data would not be needed. In addition, a statistical approach was used to plan for collecting an adequate number of data to result in a mean contaminant concentration at the 95 percent confidence level that is required for the baseline risk assessment.

The statistical approach included a classical variability analysis of the existing nonvalidated data at certain IHSS. (Too few data were available for geostatistical analyses.) The variability analysis resulted in a preliminary estimate of the number of systematically located surficial soil samples that would be needed to characterize each IHSS. Data for IHSSs 174, 175, 176, and 177 were evaluated, resulting in a requirement for 25 or more surficial soil samples at each site. This estimate will be applied only to those samples that will be collected for nonradiological parameters since the results of the Stage 1 HPGe survey will be used to estimate the number of radiological samples required.

The limited existing database resulted in the following important limitations on the results of the variability analysis:

- Since the nonvalidated data included very few detections of organic analytes, metals concentrations were used in the variability analyses. The resulting preliminary estimates of numbers of Stage 1 samples required will be applied to all analyses. This approach may be modified in future stages where the variability of certain analytes may be significantly different from that of others.

- Since classical rather than geostatistical methods were used, the number of samples is not related to the size of the site. For Stage 1 planning, either the full number of 25 samples is proposed for larger sites, and approximately one-third that number is proposed for smaller sites. When Stage 1 sampling results are evaluated, geostatistical methods may be appropriate for determining whether the data are adequate.

The statistical estimation of number of samples needed was applied to a general case using assumptions about data variability at IHSSs with little or no data and was applied to specific IHSS where data were adequate. Both processes are described below.

The prescribed margin of error and the acceptable error of estimation of the mean were identified. The number of polygons to be sampled to estimate the population mean is a function of 1) the absolute margin of error, d, that can be tolerated; and 2) the acceptable confidence limits.

The basic equation for estimating the number of samples according to Gilbert (1987) is:

$$n = (t_{1-\alpha/2\,,\,n-1}\ \sigma/d)^2 \qquad (1)$$

Where n = number of samples requires
n-1 = degree of freedom
σ = sample standard deviation of the mean estimate

d = margin of error

$\alpha/2$ = one-sided confidence limit

Although a reliable value of σ is not available for determining n, an estimate of the relative standard deviation $\eta = \sigma/\mu$ (the coefficient of variation), may be roughly estimated. Because this quantity is usually less variable from one study site to another than μ is, the approach suggested by Gilbert is to specify the relative error $d_r = | x - \mu | / \mu$ such that:

$$\text{Prob}\ [| x - | > d_r\ \mu] = \alpha$$

Therefore, the equation becomes

$$n = (t_{1-\alpha/2,\, n-1}\ \eta / d_r)^2 \qquad (2)$$

where η must be prespecified.

For risk assessment, a reasonable bound on the error of estimation is 0.2 of mean, i.e., the 95% confidence interval for the mean is the mean plus or minus 20 percent of the mean. This level of uncertainty is small relative to the uncertainty associated with toxicological parameters used to estimate risk.

The η is first assumed as 0.59, which is common or relatively conservative in most soil sample data analysis. Since $t_{1-\alpha/2,\, n-1}$ depends on n, an iterative procedure should be used. Using this approach, a sample size of 25 polygons is estimated as follows:

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$$n = (1.708\ (0.59/0.2))^2$$

$$n = 25$$

where the Student T variate is 1.708 (confidence limit is 0.05 for one-sided and 24 degrees of freedom).

Since the number of samples is fully dependent on the estimated value of the coefficient of variation. The number 25 has the 95 percentage confidence limit only for the coefficient of variation less than 0.59. If the actual coefficient of variation is higher than 0.59, the number of sampling would have to be increased.

The chosen number of 25 is also based on the Central Limit Theorem. The value of n necessary for a normal curve to give a good approximation to mean's sampling distribution depends on how much the population distribution differs from a normal distribution. The closer the population distribution is to being normal , the smaller the value of n for which the central limit theorem approximation is accurate. A conservative rule recommended by many statisticians states that the central limit theorem can safely be applied if n exceeds 30.

Once the number of polygons is determined, the site is divided into 25 blocks of equal size (or segments) and one sample is taken at random location within each block. This sampling plans is called systematic and random sampling and this procedure allows for a more uniform coverage than simple random sampling does.

Variability analysis

Sampling variability affects the degree of confidence the risk assessor can expect. Large variation of a contaminant in a medium indicates that the number of samples should be increased or that the medium should be stratified to reduce variability. An estimate of the sampling variability that is a function of the spatial variation in the concentrations of chemicals of potential concern is obtained by calculating the coefficient of variation, η, for each chemical (EPA, 1990).

Only data of four sites (IHSS 174, 175, 176 and 177) are sufficient to perform variability analysis. The results are shown in following tables:

Table D-1 IHSS 174 Variability Analyses for Soil Sampling

Analyte	Coefficient of Variation
Bis(2-ethylhexyl) Phthalate	0.721
Aluminum	0.209
Arsenic	0.169
Barium	0.125
Cadmium	0.391
Chromium	0.409
Copper	0.259
Iron	0.202
Lead	0.176
Magnesium	0.105
Manganese	0.140

Nitrate/Nitrite	0.439
Potassium	0.106
Sodium	0.413
Vanadium	2.483
Zinc	0.270

Table D-2 IHSS 175 Variability Analyses for Soil Sampling

Analyte	Coefficient of Variation
Aluminum	0.119
Barium	0.113
Calcium	0.230
Cadmium	0.241
Chromium	0.462
Copper	0.239
Iron	0.152
Lead	0.427
Magnesium	0.061
Manganese	0.218
Mercury	0.836
Nitrate/Nitrite	0.639
Potassium	0.138
Vanadium	0.090
Zinc	0.488

Table D-3 IHSS 176 Variability Analyses for Soil Sampling

Analyte	Coefficient of Variation
Aluminum	0.193
Arsenic	0.855
Barium	0.168
Beryllium	0.070
Calcium	0.749
Cadmium	0.389
Chromium	0.283
Copper	0.211
Iron	0.171
Potassium	0.194
Magnesium	0.177
Manganese	0.248
Sodium	0.366
Nickel	0.367
Lead	0.887
Nitrate/Nitrite	1.119
Vanadium	0.192
Zinc	0.359

Table D-3 IHSS 177 Variability Analyses for Soil Sampling

Analyte	Coefficient of Variation
Aluminum	0.312
Arsenic	0.043
Barium	0.476
Calcium	0.344
Cadmium	1.138
Chromium	0.172
Copper	0.713
Iron	0.281
Potassium	0.534
Magnesium	0.439
Manganese	0.625
Mercury	0.573
Strontium	0.756
Lead	0.254
Nitrate/Nitrite	0.058
Vanadium	0.152
Zinc	0.318

For IHSS 174, the Coefficient of Variation η of most analytes, fourteen out of sixteen, are less than 5.9. Only Bis(2-ethylhexyl) Phthalate and Vanadium have very high values, which are

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caused by a few extremely large data and are easy to be identified as outlier or error. There are the sample size 25 is a good choice for IHSS 174.

For IHSS 175, the Coefficient of Variation η of most analytes, thirteen out of fifteen, are less than 5.9. Only Mercury with 0.836 and Nitrate/Nitrite with 0.639 are not satisfy the assumption, no obvious evidence that they are caused by outliers or errors. If the highest variability, η = 0.836, is concerned, sample sizes should be at least 48 according to Eg (2). Notice that only four data are available to calculate the Coefficient of Variation, the result are with high uncertainty. and because the size of area is very small, the practical choice of sample size may be eight, although five out of fifteen analytes may not satisfy Eg(2).

For IHSS 176, the Coefficient of Variation η of most analytes, fourteen out of eighteen, are less than 5.9. Arsenic, Calcium, Lead and Nitrate/Nitrite have relative high values, no obvious evidence that they are caused by outliers or errors. If the highest variability, η = 1.119, is concerned, sample sizes should be at least 86 according to Eg (2).

For IHSS 177, the Coefficient of Variation η of most analytes, thirteen out of seventeen, are less than 5.9. Cadmium, Copper, Manganese and Strontium have relative high values, no obvious evidence that they are caused by outliers or errors. If the highest variability, η = 1.138, is concerned, sample sizes should be at least 88 according to Eg (2). Notice that only four data are available to calculate the Coefficient of Variation, the result are with high uncertainty. and because the size of area is very small, the practical choice of sample size may be eight, although eleven out of seventeen analytes may not satisfy Eg(2).

<u>Balancing Issues For Decision-Making</u>

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The statistics approach enable the risk assessor to compare and evaluate sample design options and consequences and select the appropriate sample design for each analyte at each site. Practical tradeoffs between response time, analytical costs, number of samples, sample costs, and level of uncertainty should then be weighted. For example, perhaps more sample can be collected if less expensive analyses are used. Or, if the risk assessment is based on a point source, collection of additional samples to estimate chemical concentrations and distribution can be avoided.

4.2.5 Evaluate Sampling/Analysis Options

The Phase I RFI/RI for OU10 will consist of a phased approach in which field screening and surficial soil sampling techniques are used to direct subsurface data collection activities. This approach maximizes collection of useful data because surficial soil sampling and field screening techniques are used to properly locate and minimize borehole drilling. Additionally, this approach minimizes the volume of generated hazardous waste material that requires special management, the potential exposure of field personnel to hazardous waste material, and the overall time to perform the field activities.

Five types of activities will be performed during the Phase I field program: (1) installation and sampling of ~~monitoring wells~~; (2) surficial soil sampling and screening activities; (3) borehole drilling and subsurface soil sampling; (4) borehole drilling and groundwater grab sampling; and (5) installation of tensiometers ~~and lysimeters~~. Section 7.0 describes in detail the field activities.

Section 7.5 of this work plan discusses the analytical program requirements for OU10. Appendix B of the QAPjP (EG&G, 1991) provides a listing of the CLP analytes and detection/quantification limits for Target Compound List (TCL) volatile and semivolatile organics, Target Analyte List (TAL) metals, radionuclides, pesticides/PCBs, inorganic parameters, and other surficial soil sampling parameters. These analytical methods are appropriate for meeting the data quality requirements for analytical Levels I through V during the Phase I RFI/RI.

4.2.6 Review of PARCC Parameter Information

The PARCC parameters (precision, accuracy, representativeness, comparability, and completeness) are indicators of data quality. The end use of the measurement data should define the necessary objectives for the PARCC parameters. The PARCC goals are specified in the Quality Assurance Addendum (QAA) (Section 10.0) of this work plan. The PARCC parameters are discussed below. Analyte-specific precision and accuracy objectives are also listed in the QAPjP Appendix B.

Precision measures the reproducibility or degree of agreement among replicate measurements under a given set of conditions. The closer the numerical values of the measurements are to each other, the more precise the measurements. During the OU10 Phase I RFI/RI, collection of data using field instrumentation such as water level meters, pH meters, and conductivity meters will be checked by reporting at least three measurements taken at one location and comparing the results. Field analysis instruments such as a field gas chromatograph (GC) will be checked by the analysis of replicate samples. Sample collection precision will be measured in the laboratory with analysis of field replicates and laboratory duplicates.

Accuracy measures the bias in a measurement system. Sources of error include the sampling process, field contamination, preservation, handling, sample matrix, sample preparation, and sample analysis techniques. Sampling accuracy of the OU10 Phase I RFI/RI will be assessed by evaluating the results of field rinse and trip blanks. The accuracy of the laboratory analysis will be determined from the results of matrix spike recovery.

Representativeness 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. Representativeness is a qualitative parameter that is most concerned with the proper design of the sampling program. Given the lack of previous usable data from the OU10 IHSSs, designing a representative sampling program is difficult in Phase I. However, representativeness can be assured for the OU10 Phase I RFI/RI by the use of proper sampling techniques. Section 7.7 describes the sampling rationale and techniques. Representativeness will also be assessed by the collection and analysis of field duplicate samples.

Completeness is defined as the percentage of measurements made that are judged to be valid. The target completeness objective for the OU10 field and analytical data is 100 percent; 90 percent will be the minimum acceptable level. To ensure that a sufficient amount of valid data are generated, the FSP was designed to include a rationale for all field activities and a phased approach using screening level techniques to identify and locate critical sampling sites. Section 7.0 further discusses these components of the FSP.

Comparability is a qualitative measure defined by the confidence with which one data set can be compared to another. Differences in field and laboratory procedures greatly affect comparability. To optimize comparability, all OU10 Phase I RFI/RI sampling techniques and analytical methods will be in accordance with approved EMD OPS.

4.3 Step 3 - DESIGN DATA COLLECTION PROGRAM

The intent of Step 3 is to compile the information and DQOs developed for specific tasks in Step 2 into a comprehensive data collection program. The data collection program has been prepared for the OU10 Phase I RFI/RI and is presented in the FSP (Section 7.0). The FSP includes a detailed list of all samples to be collected including media, sample type, and number of samples. The FSP also includes sample location maps for each IHSS and lists of the number and type of QC samples to be collected.

The QAA (Section 10.0) and QAPjP describe the policy, organization, functional activities, and QA/QC protocols necessary to achieve the DQOs dictated by the intended use of the data.

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5.0 RCRA FACILITY INVESTIGATION/REMEDIAL INVESTIGATION TASKS

5.1 TASK 1 - PROJECT PLANNING

The project planning task involves all efforts required to initiate the Phase I RFI/RI of OU10 Other Outside Closures. Activities conducted for this project have included review of topographic maps and historical aerial photographs, a site visit, evaluation of existing data, and development of conceptual models. Results of these activities are presented in Section 2.0. Preliminary identification of ARARs and TBCs are presented in Section 3.0. Identification of data requirements and DQOs are presented in Section 4.0.

Several project planning documents were prepared which pertain to this Phase I RFI/RI as required by IAG (1991). The FSP identifies sampling locations and frequencies for each of OU10 Other Outside Closure sites and is included as Section 7.0 of the work plan. Other documents required by the IAG (1991) are a Sampling and Analysis Plan (SAP) and a Health and Safety Plan (HSP). Included in the SAP are a Quality Assurance Project Plan (QAPjP) and Environmental Management Department Operating Procedures (EMD OPS) for all field activities. The QAPjP and EMD OPS exist as separate stand-alone documents. A QAA has been prepared describing quality assurance/quality control (QA/QC) requirements specific to the OU10 investigation. The QAA is included as Section 10.0 of this work plan. The HSP is a separate stand-alone document.

The objective of the QAPjP is to identify the QA requirements and specific measures for implementing these requirements during investigations and remediation activities at RFP. The

QAA supplements the QAPjP and provides additional QA information specific to the OU10 Phase I RFI/RI.

5.2 TASK 2 - COMMUNITY RELATIONS

In accordance with the IAG, the RFP Communications Department is developing a sitewide community relations plan (CRP) to develop an interactive relationship with the public relating to environmental restoration activities. A draft CRP was issued for public comments in January 1991 and was revised to reflect public comment. Following EPA and CDH approval, a final CRP was released in December 1991. Accordingly, a site-specific CRP is not required for OU10. The ER Program community relations activities include participation by RFP representatives in informational workshops, Rocky Flats Environmental Monitoring Council meetings, public briefings on proposed remedial action plans, and public meetings held to solicit comment on various ER Program plans and actions.

The RFP Communications Department is continuing other public information efforts to keep the public informed of environmental restoration activities and other issues related to RFP operations. A Speakers Bureau Program sends speakers to civic groups and educational organizations, while a public tour program allows the public to visit RFP. In addition, an Outreach Program sends RFP officials to visit elected officials, the news media, and business and civic organizations to further discuss any issues related to RFP and environmental restoration activities. The RFP Communications Department responds to numerous public inquiries by telephone or by sending written informational materials to the requestor.

5.3 TASK 3 - FIELD INVESTIGATION

A field investigation will be conducted to delineate the vertical and horizontal extent of soil contamination associated with OU10 IHSSs and to provide data for evaluating the actual or potential risk posed by the site to human health and the environment. The field investigations program is designed to collect data to meet the DQOs for the Phase I RFI/RI described in Section 4.0. As this is a Phase I program, data collection will be primarily restricted to soil and asphalt/concrete sampling. However, field screening techniques such as soil gas sampling, radioactivity surveys, and groundwater grab sampling may be proposed in some cases. Surface water and sediment sampling may also be proposed in later stages of the investigation in support of Phase II planning. A limited number of piezometers may be installed to determine groundwater flow directions to aid in planning Phase II groundwater monitoring well locations. A detailed description of the field investigation program is presented in Section 7.0.

5.4 TASK 4 - SAMPLE ANALYSIS AND DATA VALIDATION

All analytical procedures will be in accordance with the ER Program QAPjP (EG&G 1991a). Also provided in the QAPjP are the analytical detection limits, sample container and volume requirements, preservation requirements, and sample holding times. Sample analysis will be conducted under a separate work order contract.

Data will be reviewed and validated by the ER Program staff or a designated contractor. Results of data review and validation activities will be documented in data validation reports. EPA data validation functional guidelines will be used for validating organic and inorganic (metals) data (EPA 1988a). Validation methods for radiochemistry and major ions data have not been published by the EPA; however, data and documentation requirements have been developed by the ER Program QA staff. Data validation methods for these data are derived from these requirements. Details of the data validation process are described in the QAPjP (EG&G 1991a) and the Data Validation Guidelines (EG&G 1990).

When the guidelines for validating radiochemistry analytical data are published, it should be noted that the validation criteria contained in the guidelines (both EPA CLP and EG&G Rocky Flats documents) will not strictly parallel EPA CLP or EG&G Rocky Flats scopes of work in all cases. These documents were created as guidelines rather than SOPs to allow data reviewers to exercise appropriate discretion and professional judgment in evaluating data.

5.5 TASK 5 - DATA EVALUATION

Data collected during Phase I will be incorporated with existing data describing contamination at OU10 IHSSs. The objectives of the data evaluation effort include analysis of actual and potential magnitude of releases from sources, horizontal and vertical spread of contamination, and mobility and persistence of contaminants. Analysis of the data will focus on the refinement of the conceptual models described in Section 2.0.

5.5.1 Site Characterization

The physical data collected during the Phase I RFI/RI will be used, along with previously collected site and historical information, to define the surface and subsurface characteristics of each IHSS. Geologic maps and cross sections will be prepared from the boring logs to identify the characteristics of the vadose zone. This information, along with geotechnical data from the physical soil samples, will be used to revise and quantify the conceptual models developed in this work plan. This information will be used in the baseline risk assessment ~~and environmental evaluation~~.

5.5.2 Source Characterization

Standard graphical and, where appropriate, statistical analysis methods will be employed to: (1) identify the major organic, inorganic, and radiogenic contaminants present in asphalt/cement, soils, surface water, and sediment; (2) determine the concentrations and spatial distribution of contaminants in soil and sediment; (3) evaluate contamination associated with the operation of IHSSs. Numerous types of work products, such as soil and sediment chemical tables, soil concentration isopleth maps, soil concentration versus depth profiles, and overlays of soil concentrations and IHSS boundary maps will be used in the characterization of the nature and extent of soil contamination.

5.6 TASK 6 - BASELINE RISK ASSESSMENT

A baseline risk assessment will be prepared for OU10 as part of the Phase I RFI/RI to evaluate the potential threat to human health and the environment from contaminated soil in the absence of remedial action. The baseline risk assessment will provide the basis for determining whether or not remedial action is necessary in the area and serve as the justification for performing remedial action (EPA 1988b). EPA's interim final Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual and Volume II: Environmental Evaluation Manual (EPA 1989) provide detailed guidance on evaluating potential human health impacts as part of this baseline risk assessment. The development of a baseline risk assessment is shown in Figure 5.6-1 and discussed fully in Section 8.0.

Several objectives will be accomplished under the baseline risk assessment task, including identification and characterization of the following (EPA 1988b):

- Toxicity and levels of hazardous and radioactive contaminants present in soils

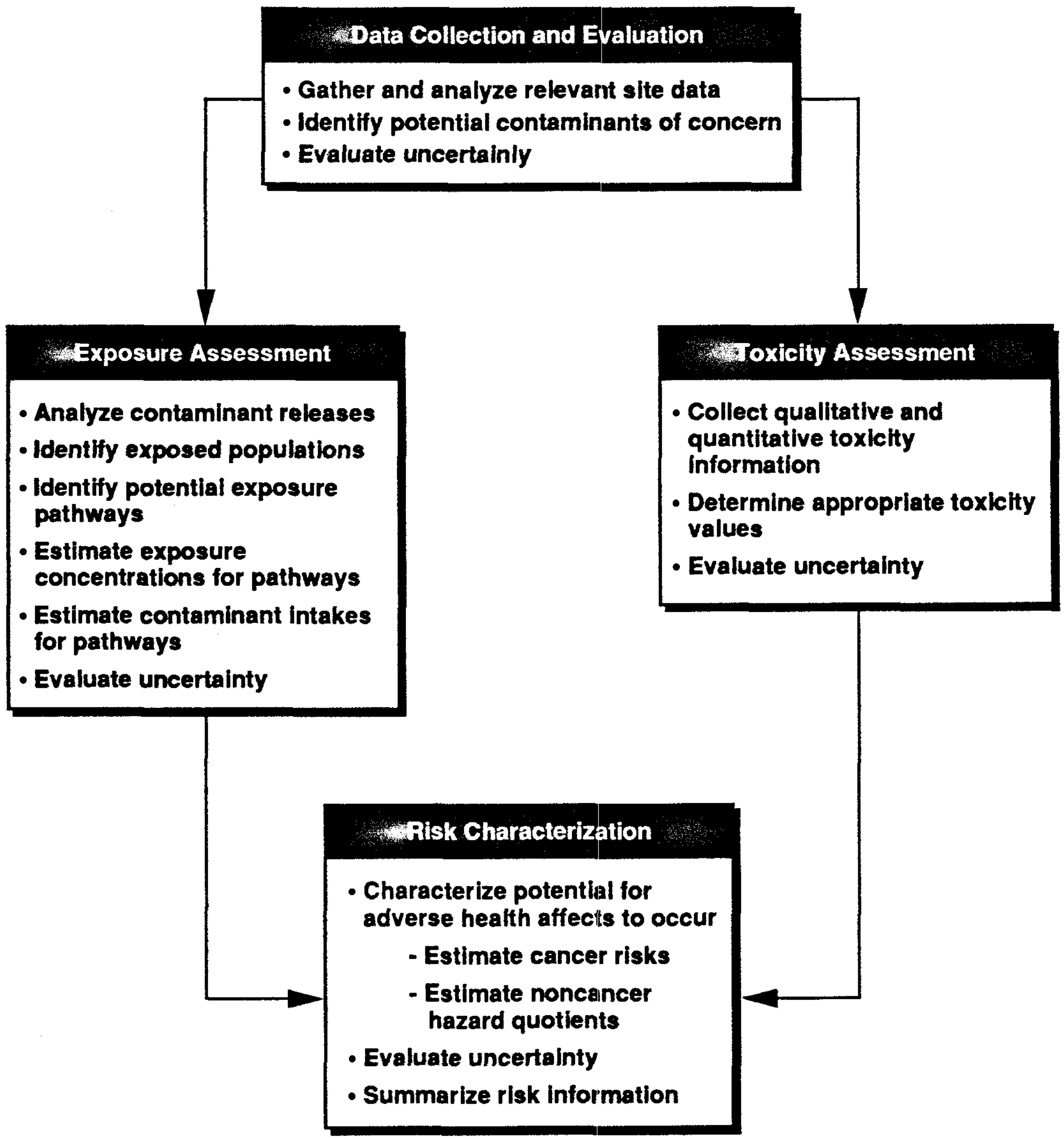

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Figure 5.6-1

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- Environmental fate and transport mechanisms within soils 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 an impact or threat occurring (i.e., risk characterization)
- Level(s) of uncertainty associated with any of the above.

The baseline risk assessment will address the potential human health associated with the site under the no-action alternative (no remedial action taken). This assessment will aid in the selection of site remedies based on the contaminants of concern and the environmental media associated with potential risks to human health.

The risk assessment process is divided into the following tasks:

- Contaminant identification
- Exposure assessment
- Toxicity assessment
- Risk characterization.

The objectives and description of work for the ~~baseline~~ risk assessment are described in detail in Section 8.0. The environmental evaluation work plan is presented in Section 9.0.

5.7 TASK 7 - DEVELOPMENT, SCREENING, AND DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

5.7.1 Remedial Alternatives Development and Screening

This section identifies potential technologies applicable to remediation of contaminated soils, wastes, surface water, sediments, and groundwater at OU10. The identified technologies are based on the preliminary site characterization developed in Section 2.0. Identification and screening of technologies, assembling an initial screening of alternatives, and identification of interim response actions will be conducted while the Phase I RFI/RI is being conducted. However, investigation of OU10 is in an early stage in which the presence or absence of contamination will be determined. Therefore, remedial alternatives are only briefly reviewed in this section. A more detailed evaluation of the remedial alternatives for OU10 will be performed as more data are collected and as IHSSs are identified that may require corrective action.

The process employed to develop and evaluate alternatives for OU10 will follow guidelines provided in the NCP. Although RCRA regulations will direct the RFI/RI at OU10 as stipulated in the IAG, CERCLA guidance will also be followed because it specifies in greater detail the steps that should be followed for selection of remedial alternatives. In addition, the IAG requires general compliance with both RCRA and CERCLA guidance.

The steps to be followed to develop remedial alternatives for the OU10 IHSSs are as follows:

1. Develop a list of general types of actions appropriate for the IHSS areas constituting OU10 (such as containment, treatment, and/or removal). These general types or classes of actions are generally referred to as "general response actions" in EPA guidance.

2. Identify and screen technology groups for each general response action. Screening will eliminate groups that are not technically feasible at the site.

3. 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 to represent a technology group for alternative development and evaluation, these processes are intended to represent the broader range of options within a general technology group.

4. Assemble the selected representative technologies into site closure and corrective action alternatives for the IHSS areas of OU10 that represent a range of treatment and containment combinations, as appropriate.

5. Screen the assembled alternatives in terms of the short- and long-term aspects of three broad criteria: effectiveness, implementability, and cost. Because the purpose of the screening evaluation is to reduce the number of alternatives that will undergo thorough and extensive analysis, alternatives will be evaluated in less detail than subsequent evaluations.

6. Develop preliminary risk-based remedial action goals for affected media. Preliminary remedial action goals will be applied as performance objectives for evaluating the effectiveness of specific technology processes identified as candidate components of viable remedial action alternatives. Consistent with the NCP, preliminary remediation goals will be established at a 1×10^{-6} excess cancer risk point of departure and at other intervals within the 1×10^{-4} to 1×10^{-6} decision range. As the CMS/FS evolves, preliminary remediation goals may be revised to a different risk level on the basis on consideration of appropriate factors that include, but are not limited to, exposure, uncertainty, and technical issues.

For the Phase I RFI/RI work plan, the appropriate level of alternatives analysis is the listing of general response actions most applicable to the type of site under investigation. General response actions are defined as those broad classes of actions that may satisfy the objectives for remediation defined for OU10. Table 5-1 provides a list, which is not all-inclusive, and description of general response actions and typical technologies associated with remediating soils, wastes, groundwater, sediments, asphalt/concrete, and surface water. Table 5-1 also includes a

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Table 5-1 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 on-site contact.
Access and use restrictions	Permanent prevention of entry into a contaminated area of site. Control of land use.	Site security; fencing; deed use restrictions; warning signs.	Could control on-site exposure and reduce potential for off-site 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; 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; 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.
Treatment	Application of technology to change the physical or chemical characteristics of the contaminated material. Applied to material that has been removed.	Solidification: biological, chemical, and physical treatment.	Applied to removed source material; could be used to control all pathways. Applied to removed transport media, could control air, surface water, groundwater, and sediment pathways.

for lines + pipelines

Table 5-1 General Response Actions, Typical Associated Remedial 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; 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 landfill; 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.

general statement regarding the applicability of the general response action to potential exposure pathways.

Table 5-1 does not list all possible actions nor may all of the alternative response actions and typical technologies listed be appropriate for the IHSS areas of OU10. Some will be discarded during the screening of alternatives.

The response actions outlined in Table 5-1 must be applied to the potential exposure pathways that will be identified for OU10. The response actions must be capable of providing control over all or some of the potential pathways. Partially effective response actions can be combined to form complementary sets of response actions that provide control over all pathways.

In general terms, potential human exposure can 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 exposure point where the contact could occur with the released contaminant.

The existing data do not adequately characterize the source, release mechanisms, and migration pathways for contamination at OU10. Therefore, the existing data are not sufficient for implementing the screening of alternatives. Phase I will generate data (Table 5-2) necessary to characterize the sources and soils. Phase II of the RFI/RI will evaluate the impact of OU10 on surface water, groundwater, air, sediments, and biota in addition to characterizing potential contaminant migration pathways. Data obtained from these investigations will:

- Characterize the nature, rate and extent of contamination

Table 5-2 Response Actions, Remedial Technologies, and Data Requirements

General Response Actions	Associated Remedial Technologies	Data Purpose	Data Need
Complete or Partial Removal and Treatment of Contaminated Soils	Disposal (off-site)	Evaluate RCRA Land Bank and Radioactivity Restrictions	- 40 CFR 268 Table CCWE and Appendix III Analyses - Full Suite of Radionuclide Analyses
		Cost Analysis	- Vertical and Horizontal Extent of Contamination
In Situ Contaminated Soils Treatment	Immobilization	Determine Viscosity of Grout Material	- Soil Grain Size Distribution (sieve analysis)
		Effectiveness	- Full Suite of Organic and Inorganic Analyses
	Soil Flushing	Effectiveness	- Full Suite of Organic and Inorganic Analyses - Soil Organic Matter Content - Soil Classification - Soil Permeability - Treatability Study
	Vapor Extraction	Effectiveness	- Full Suite or Organic and Inorganic Analyses - Subsurface Geological Characteristics - Depth to Groundwater - Soil Permeability - Treatability
	Vitrification	Cost Effectiveness	- Full Suite of Organic and Inorganic Analyses - Treatability Study
Groundwater Collection	Well Array/Subsurface Drains	Storativity (transient flow)	- Aquifer Tests

Table 5-2 Response Actions, Remedial Technologies, and Data Requirements

General Response Actions	Associated Remedial Technologies	Data Purpose	Data Need
Infiltration and Groundwater Containment Controls	Capping/Subsurface Barriers	Suitability of Off-Site Soil for Use	- Gradation (Sieve Analysis) - Atterberg Limits (Plasticity Tests) - Percent Moisture - Compaction (Proctor) - Permeability (Triaxial Permeability) - Strength (Triaxial or Direct Shear)
		Effectiveness	- Location of Subcroping Sandstones - Hydraulic Conductivity of Bedrock Materials
		Construction Feasibility	- Grade - Depth to Bedrock
In Situ Groundwater Treatment/Immobilization	Immobilization	Determine Viscosity of Grout Material	- Soil Grain Size Distribution (sieve analysis)
		Effectiveness	- Full Suite of Organic and Inorganic Analyses
	Aeration	Effectiveness	- Full Suite of Organic and Inorganic Analyses - Subsurface Geological Characteristics - Depth the Groundwater - Soil Permeability - Treatability Study
Groundwater/Surface Water Treatment	UV/Peroxide or UV/Ozone	Process Control	- Iron and Manganese
		Effectiveness	- Full Suite of Organic and Inorganic Analyses - Treatability Study

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Table 5-2 Response Actions, Remedial Technologies, and Data Requirements

General Response Actions	Associated Remedial Technologies	Data Purpose	Data Need
Groundwater/Surface Water Treatment (cont)	Air Stripping	Process Control	- Hardness
		Effectiveness	- Full Suite of Organic and Inorganic Analyses - Treatability Study
	Other Water Treatment Technologies (carbon adsorption, ion exchange, electrodialysis, and reverse osmosis)	Process Control	
		Effectiveness	

- Define pathways and methods of migration
- Identify areas threatened by releases from the facility
- Determine short and long-term threats to human health and the environment.

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 FSP (Section 7.0) describes the methodology that will be followed to obtain the required information for the Phase I RFI/RI characterization.

5.7.2 Detailed Analysis of Remedial Alternatives

Sufficient data may not be generated during the Phase I RFI/RI to allow for a detailed analysis of alternatives; however, this is not a requirement of the Phase I RFI/RI. The detailed analysis of each alternative will be performed when sufficient data are generated during Phase II. The detailed analysis and selection of alternatives is not a 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 in terms of eight evaluation criteria is necessary for the CMS/FS and the subsequent Corrective Action Decision (CAD)/Record of Decision (ROD). The nine specific evaluation criteria are as follows:

- Overall protection of human health and the environment
- ARARs

- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, or volume
- Short-term effectiveness
- Implementability
- Cost
- State acceptance
- Community acceptance.

These criteria are described in recently revised guidelines provided in the NCP. The first two criteria are considered threshold criteria because they must be evaluated before further consideration of the remaining criteria. The next five criteria are considered the balancing criteria on which the analysis is based. The final two criteria are addressed during the final decision-making process after completion of the CMS/FS.

5.8 TASK 8 - TREATABILITY STUDIES/PILOT TESTING

The primary objectives of a treatability study are to provide sufficient technology performance information and to reduce cost and performance uncertainties to acceptable levels so that treatment alternatives can be fully developed and evaluated during detailed analysis. The task includes efforts to evaluate whether treatability studies are necessary and, if so, to prepare for and conduct treatability studies. If remedial alternatives are developed, the data collected as part of the field investigation will be reviewed in terms of whether the alternatives can be evaluated. If additional data are required, treatability studies or additional field investigations will occur.

If it is determined that a treatability study is necessary, a treatability work plan will be prepared. The plan will identify treatability tests that need to be conducted as well as the test materials and equipment needed.

The treatability work plan will discuss the following:

- The scale of the treatability study
- Key parameters to be varied and evaluated and criteria to be used to evaluate the tests
- Specifications for test samples and the means for obtaining these samples
- Test equipment and materials and procedures to be used in the treatability test
- Identification of where and by whom the tests and any analytical services will be conducted, as well as any special procedures and permits required to transport samples and residues and conduct the test
- Methods required for residue management and disposal
- Any special QA/QC needed for the tests.

5.9 TASK 9 - PHASE I RFI/RI REPORT

5.9.1 Report Content

The Phase I RFI/RI report will summarize the findings of the Phase I soil contamination RFI/RI program for OU10 Other Outside Closures IHSSs. The report will be organized into sections that provide an overview of the RI program, describe the physical features of the site and individual IHSSs, and present the results of the Phase I RFI/RI. The report will also include sections describing soil, surface water, sediment, groundwater, and asphalt/concrete contamination related to activities of the IHSSs and the baseline risk assessment.

5.9.2 Report Reviews

The Phase I RFI/RI report will be issued as a draft final report that will undergo formal review by EPA and CDH. The final report will incorporate agency comments from EPA and CDH.

6.0 SCHEDULE

Figure 6.0-1 summarizes the schedule for conducting the Phase I RFI/RI. Dates from the IAG, dated January 22, 1991, were used where appropriate. The OU10 Phase I RFI/RI project began in January 1990 with the commencement of project planning and will continue until May 1995 when the treatability studes are completed.

U.S. Department of Energy
Rocky Flats Plant, Golden, Colorado
OPERABLE UNIT 10

Task	Activity	Start	Finish
1	Project Planning	1/25/90	6/2/92
2	Community Relations	1/25/90	5/18/95
3	Field Investigations	6/3/92	3/1/94
4	Sample Analysis & Data Validation	6/3/92	6/1/94
5	Data Evaluation	1/1/93	6/1/94
6	Baseline Risk Assessment	6/3/92	2/28/95
7	Development & Screening of Remedial Alternatives	6/3/92	5/18/95
8	Treatability Studies	8/26/94	5/18/95
9	Phase I RFI/RI Report	3/2/94	2/28/95

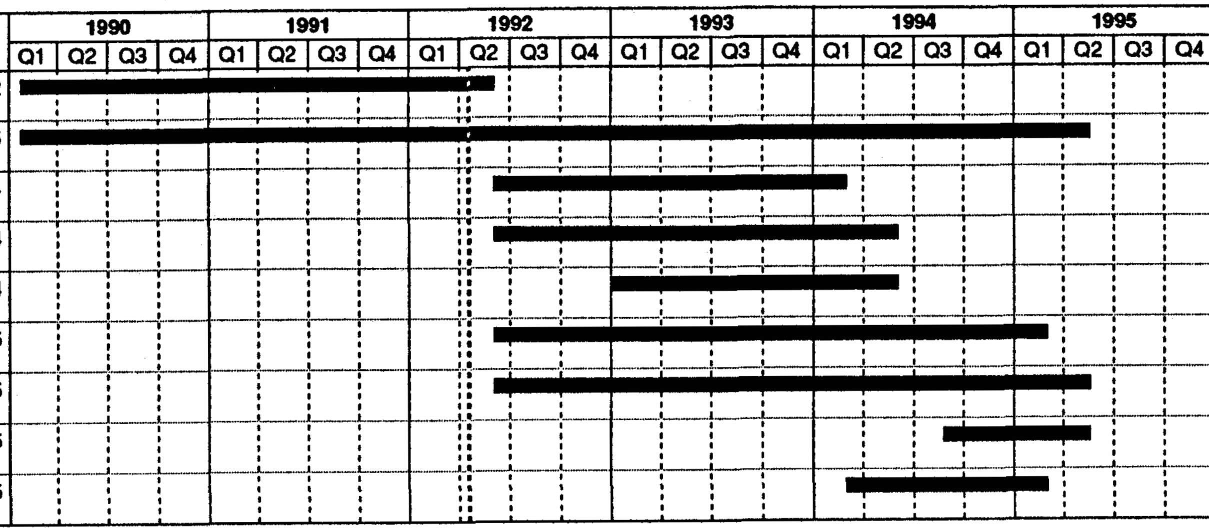

Figure 6.0-1 OU10 Phase I RFI/RI Schedule

7.0 FIELD SAMPLING PLAN

The purpose of this section of the work plan is to provide a field sampling program that will generate sufficient data to satisfy the Phase I RFI/RI objectives developed in Section 4.0. Section 7.1 presents how the investigation will be divided into stages and what types of sampling will be considered at each stage. Section 7.2 summarizes site background information and rationale for the sampling and analysis and other data collection activities needed to obtain necessary data to meet the Phase I RFI/RI objectives. Section 7.3 discusses the field data collection locations and frequencies for each site. Section 7.4 describes field sampling procedures and equipment and Section 7.5 describes the general analytical program including sample designation, analytical requirements, sample containers and preservation, and sample handling and documentation. Descriptions of data management procedures (Section 7.6) and QA/QC procedures (Section 7.7) complete the FSP for OU10.

7.1 OU10 PHASE I RFI/RI OBJECTIVES

The specific objectives of the Phase I RFI/RI field investigation for OU10 are as follows:

- completely Characterize contaminant sources ~~and extent~~
- Support a baseline risk assessment ~~and environmental evaluation~~
- Support selection of remedial action alternatives.

Source and soils characterization requires the determination of the ~~type~~ nature and extent of soils contamination at each IHSS as well the determination of as physical characteristics that are necessary for risk exposure assessment ~~modeling~~ and evaluation of any required remedial alternatives.

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This FSP will characterize contamination that may have resulted from historical spills at OU10 IHSSs. Some of these IHSSs will continue to be used after the investigation according to the terms of their RCRA operating or interim status permits.

7.2 BACKGROUND AND FSP RATIONALE

The design of a FSP for sources/soils characterization requires an understanding of both the physical characteristics of the IHSS and the nature of potential sources of contamination. OU10 consists of 16 IHSSs that can be categorized as follows:

- Four large surface storage areas greater than 100,000 ft^2 in area
- Four drum storage areas less than 5,000 ft^2 in area
- Three former locations of above ground tanks
- Two former locations of cargo containers containing drums
- One former location of a combined drum surface storage and cargo container area
- One consisting of three semi-submerged concrete tanks
- One underground storage tank.

Of the surface storage sites and surface tanks, six are located over uncovered soils and the rest are located on asphalt or cement, although two of these were formerly uncovered soils. These categories of sites are addressed in the FSP according to the conceptual models developed in Section 2.2 and data needs and uses outlined in Section 4.0. The general field sampling approach is described in Table 7-1.

Table 7-1. Phase I Investigation Stages for OU10

Activity	Purpose	Location	Sample Number
Stage 1			
Work Plan			
HPGe Radiation Survey	Identify areas of anomalous radiation readings.	Entire IHSS area.	IHSS dependent.
Soil Gas Survey	Locate plumes of volatile organics. Determine the integrity of UST and ancillary equipment (pipelines, valves, and fittings).	Entire IHSS area grid spacing IHSS dependent. Investigate surface and soil stains and confirm hits from previous sampling.	IHSS dependent.
Surficial Soil Samples	To assess variability.	Random areas, soil stains, and "hot spots" determined by either the soil gas or HPGe survey.	To be determined by statistical analysis. IHSS dependent two sample/hot spot.
Inspect Tanks and Ancillary Equipment (pipelines, valves, and fittings)	Establish tank and ancillary equipment integrity.	IHSS dependent (as needed).	IHSS dependent (as needed).
Sample Tank Residue	Determine what remains in tanks.	IHSS dependent. If tank is empty, a wipe sample will be taken at the bottom.	IHSS dependent.
Stage 2			
Technical Memorandum #1			
Surficial Soil Samples	Determine the presence or absence of contaminants.	IHSS dependent (defined in technical memorandum).	To be determined by statistical analysis.
Soil Borings	Determine the presence or absence of contaminants.	"Hot spots" from HPGe survey stained soil or surfaces, and high soil gas hits.	To be determined.

Table 7-1. Phase I Investigation Stages for OU10

Activity	Purpose	Location	Sample Number
Stage 3 Technical Memorandum #2			
Soil Borings	Determine the presence or absence of contaminants.	"Hot spots" from HPGe survey stained soil or surfaces, and high soil gas hits.	To be determined.
Stage 4 Technical Memorandum #3			
Soil Borings	Determine the presence or absence of contaminants.	"Hot spots" from HPGe survey stained soil or surfaces, and high soil gas hits.	To be determined.
Sediment and Surface Water Samples	Characterize surface water and runoff transport potential.	Drainage areas and depressions with water accumulation. (Soil borings in depressions and sediment samples in defined drainages.)	To be determined.
Piezometers, BAT Samples, and Tensiometer Nests	Introductory collection of information for Phase II planning.	To be determined.	To be determined.

Given the variable nature of the sites and their unknown histories, sampling programs have to be designed to be IHSS specific. In general, a four-stage sampling approach will be used for determining soils contamination at the surface storage sites where concrete or asphalt is not present or was not present when contamination could have occurred (IHSSs 124, 182, and 213).

Stage 1 will consist of screening techniques and surficial soil sampling to determine variability for statistical evaluation. Soil gas will be used as a screening technique at IHSSs where volatile organic compounds are suspected. A High Purity Geranium (HPGe) survey will be conducted at all IHSSs to determine radionuclide contamination. Surficial soil samples will be analyzed by an on-site laboratory for semivolatile organics, by a local off-site laboratory for metals, and an off-site laboratory for radionuclides. The screening techniques and on-site and local off-site laboratory analysis will allow a quick determination of horizontal contamination at the IHSSs. If asphalt or concrete is present, samples will be collected during the soil boring program.

Inspection of ancillary equipment (pipelines, fittings and valves) and inspection and residue sampling of tanks will be performed to assess their integrity and characterize the waste. The soil gas survey will be used to locate areas where tanks and ancillary equipment may have leaked.

Stage 2 will consist of soil cores and additional surficial soil samples to verify the presence or absence of contamination at each IHSS. The number and location of samples will be addressed in technical memorandum #1. Some of these samples will be used to verify hot spots detected by the screening techniques. Soil cores will be conducted for verification at those IHSSs with groundwater levels greater than 15 ft below land surface. Soil cores will be conducted at IHSSs 175, 182, and 206 only because the remaining IHSSs have shallow (10 ft or less) water tables and soil borings will be conducted instead.

Stage 3 will consist of soil borings to determine the vertical and horizonal extent of contamination at each IHSS. Borings will be placed in the hot spots identified by the screening and surficial soil sampling step. The borings, of variable depth, will be drilled 6 ft into bedrock or just above the water table, whichever is encountered first. If asphalt or concrete is present, samples will be collected during the soil boring program.

Stage 4 will consist of additional soil borings to collect groundwater grab samples from those IHSSs where contamination has been found in the subsurface soils. These samples will be collected using the BAT@ sampling system. At this time, samples of sediment and, if present, surface water will be collected from drainages immediately adjacent to those IHSSs where drainages or ditches exist. Piezometers will also be installed during this stage to determine groundwater gradients. This step will provide data for planning the location of groundwater monitoring wells in Phase II of the OU10 RFI/RI. At this time, tensiometers will be installed at IHSSs 170 and 176. These devices will provide information on infiltration of water and contaminants into the vadose zone at IHSSs located on natural soil and fill materials.

At the smaller sites (area less than 2,000 ft^2) where asphalt or concrete is present, except at IHSS 182 where asphalt was placed at a later date, additional surficial soil samples will not be necessary and the field program will consist of the steps that are appropriate. The following section describes the IHSS-specific sampling programs.

All of the procedures that are included in the four-stage program are presented in Table 7-2. These procedures are described further in Section 7.4.

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Table 7-2. Summary of Sampling Procedures Used in the OU10 Phase I RFI/RI Field Investigation Program

IHSS	Sample Type	Applicable Guidance Procedures
124	Surficial soil	EMD OPS GT.8 using the CDH method, GT.17
	Soil boring	EMD OPS GT.10, GT.02, GT.04, GT.03, GT.08, GT.01, GT.05, GT.17, FO.15, FO.06, FO.03, FO.04, FP.13, FO.07
	Sediment	EMD OPS SW.6, GT.01, GT.17
	Surface water	EMD OPS SW.2, SW.3
	Asphalt/concrete	
	Tank residue	
	Tank/pipeline inspection	
	Radiation survey	EMD OPS FO.16 and applicable EMD OPS referenced in Section 4.2
	Soil gas survey	EMD OPS GT.09 and applicable EMD OPS referenced in Section 4.2
129	Soil boring	EMD OPS GT.10, GT.02, GT.04, GT.03, GT.08, GT.01, GT.05, GT.17, FO.15, FO.06, FO.03, FO.04, FP.13, FO.07
	Radiation survey	EMD OPS FO.16 and applicable EMD OPS referenced in Section 4.2
	Tank residue	
	Tank/pipeline inspection	
	Soil gas survey	EMD OPS GT.09 and applicable EMD OPS referenced in Section 4.2
170	Surficial soil	EMD OPS GT.8 using the CDH method, GT.17
	Soil boring	EMD OPS GT.10, GT.02, GT.04, GT.03, GT.08, GT.01, GT.05, GT.17, FO.15, FO.06, FO.03, FO.04, FP.13, FO.07
	Radiation survey	EMD OPS FO.16 and applicable EMD OPS referenced in Section 4.2
	Soil gas survey	EMD OPS GT.09 and applicable EMD OPS referenced in Section 4.2
174	Surficial soil	EMD OPS GT.8 using the CDH method, GT.17
	Soil boring	EMD OPS GT.10, GT.02, GT.04, GT.03, GT.08, GT.01, GT.05, GT.17, FO.15, FO.06, FO.03, FO.04, FP.13, FO.07
	Radiation survey	EMD OPS FO.16 and applicable EMD OPS referenced in Section 4.2
	Soil gas survey	EMD OPS GT.09 and applicable EMD OPS referenced in Section 4.2
175	Surficial soil	EMD OPS GT.8 using the CDH method, GT.17
	Soil boring	EMD OPS GT.10, GT.02, GT.04, GT.03, GT.08, GT.01, GT.05, GT.17, FO.15, FO.06, FO.03, FO.04, FP.13, FO.07
	Radiation survey	EMD OPS FO.16 and applicable EMD OPS referenced in Section 4.2
	Soil gas survey	EMD OPS GT.09 and applicable EMD OPS referenced in Section 4.2
176	Surficial soil	EMD OPS GT.8 using the CDH method, GT.17
	Soil boring	EMD OPS GT.10, GT.02, GT.04, GT.03, GT.08, GT.01, GT.05, GT.17, FO.15, FO.06, FO.03, FO.04, FP.13, FO.07
	Sediment	EMD OPS SW.6, GT.01, GT.17
	Surface water	EMD OPS SW.2, SW.3
	Radiation survey	EMD OPS FO.16 and applicable EMD OPS referenced in Section 4.2
	Soil gas survey	EMD OPS GT.09 and applicable EMD OPS referenced in Section 4.2

Table 7-2. Summary of Sampling Procedures Used in the OU10 Phase I RFI/RI Field Investigation Program

IHSS	Sample Type	Applicable Guidance Procedures
177	Surficial soil	EMD OPS GT.8 using the CDH method, GT.17
	Soil boring	EMD OPS GT.10, GT.02, GT.04, GT.03, GT.08, GT.01, GT.05, GT.17, FO.15, FO.06, FO.03, FO.04, FP.13, FO.07
	Asphalt/concrete	EMD OPS FO.13
	Radiation survey	EMD OPS FO.16 and applicable EMD OPS referenced in Section 4.2
	Soil gas survey	EMD OPS GT.09 and applicable EMD OPS referenced in Section 4.2
181	Soil gas survey	EMD OPS GT.09 and applicable EMD OPS referenced in Section 4.2
	Soil boring	EMD OPS GT.10, GT.02, GT.04, GT.03, GT.08, GT.01, GT.05, GT.17, FO.15, FO.06, FO.03, FO.04, FP.13, FO.07
	Sediment	EMD OPS SW.6, GT.01, GT.17
	Asphalt/concrete	EMD OPS FO.13
	Radiation survey	EMD OPS FO.16 and applicable EMD OPS referenced in Section 4.2
182	Soil gas survey	EMD OPS GT.09 and applicable EMD OPS referenced in Section 4.2
	Soil boring	EMD OPS GT.10, GT.02, GT.04, GT.03, GT.08, GT.01, GT.05, GT.17, FO.15, FO.06, FO.03, FO.04, FP.13, FO.07
	Sediment	EMD OPS SW.6, GT.01, GT.17
	Surface water	EMD OPS SW.2, SW.3
	Asphalt/concrete	EMD OPS FO.13
	Radiation survey	EMD OPS FO.16 and applicable EMD OPS referenced in Section 4.2
205	Soil boring	EMD OPS GT.10, GT.02, GT.04, GT.03, GT.08, GT.01, GT.05, GT.17, FO.15, FO.06, FO.03, FO.04, FP.13, FO.07
	Tank inspection	
	Tank residue	
	Radiation survey	EMD OPS FO.16 and applicable EMD OPS referenced in Section 4.2
206	Surficial soil	EMD OPS GT.8 using the CDH method, GT.17
	Soil boring	EMD OPS GT.10, GT.02, GT.04, GT.03, GT.08, GT.01, GT.05, GT.17, FO.15, FO.06, FO.03, FO.04, FP.13, FO.07
	Radiation survey	EMD OPS FO.16 and applicable EMD OPS referenced in Section 4.2
207	Soil boring	EMD OPS GT.10, GT.02, GT.04, GT.03, GT.08, GT.01, GT.05, GT.17, FO.15, FO.06, FO.03, FO.04, FP.13, FO.07
	Sediment	EMD OPS SW.6, GT.01, GT.17
	Surface water	EMD OPS SW.2, SW.3
	Asphalt/concrete	
	Radiation survey	EMD OPS FO.16 and applicable EMD OPS referenced in Section 4.2
208	Surficial soil	EMD OPS GT.8 using the CDH method, GT.17
	Soil boring	EMD OPS GT.10, GT.02, GT.04, GT.03, GT.08, GT.01, GT.05, GT.17, FO.15, FO.06, FO.03, FO.04, FP.13, FO.07
	Sediment	EMD OPS SW.6, GT.01, GT.17
	Surface water	EMD OPS SW.2, SW.3
	Asphalt/concrete	EMD OPS FO.13
	Radiation survey	EMD OPS FO.16 and applicable EMD OPS referenced in Section 4.2

Table 7-2. Summary of Sampling Procedures Used in the OU10 Phase I RFI/RI Field Investigation Program

IHSS	Sample Type	Applicable Guidance Procedures
210	Soil gas survey	EMD OPS GT.09 and applicable EMD OPS referenced in Section 4.2
	Surficial soil	EMD OPS GT.8 using the CDH method, GT.17
	Soil boring	EMD OPS GT.10, GT.02, GT.04, GT.03, GT.08, GT.01, GT.05, GT.17, FO.15, FO.06, FO.03, FO.04, FP.13, FO.07
	Radiation survey	EMD OPS FO.16 and applicable EMD OPS referenced in Section 4.2
	Soil gas survey	EMD OPS GT.09 and applicable EMD OPS referenced in Section 4.2
213	Surficial soil	EMD OPS GT.8 using the CDH method, GT.17
	Soil boring	EMD OPS GT.10, GT.02, GT.04, GT.03, GT.08, GT.01, GT.05, GT.17, FO.15, FO.06, FO.03, FO.04, FP.13, FO.07
	Sediment	EMD OPS SW.6, GT.01, GT.17
	Surface water	EMD OPS SW.2, SW.3
	Asphalt/concrete	EMD OPS FO.13
	Radiation survey	EMD OPS FO.16 and applicable EMD OPS referenced in Section 4.2
214	Surficial soil	EMD OPS GT.8 using the CDH method, GT.17
	Soil boring	EMD OPS GT.10, GT.02, GT.04, GT.03, GT.08, GT.01, GT.05, GT.17, FO.15, FO.06, FO.03, FO.04, FP.13, FO.07
	Sediment	EMD OPS SW.6, GT.01, GT.17
	Surface water	EMD OPS SW.2, SW.3
	Asphalt/concrete	EMD OPS FO.13
	Radiation survey	EMD OPS FO.16 and applicable EMD OPS referenced in Section 4.2

7.3 SAMPLING LOCATION AND FREQUENCY

This section describes the field investigations proposed for each IHSS. Table 7-3 presents a summary of the proposed field investigation at each of these sites.

Following collection, a statistically based sampling program based on variability will be addressed in technical memorandum #1 of the Phase I RFI/RI. This program will also include the sampling of hot spots and areas of high contamination determined by the screening techniques. This methodology is appropriate for the objective of characterizing soils contamination at the OU10 IHSSs and is used for determining the sampling locations for stage 2 samples.

The approach used to determine the frequency at which surficial soils would be sampled at a particular IHSS is site specific. Where previous data was available, a variability was calculated by a technique developed by Richard O. Gilbert (Gilbert 1987). This method is discussed in detail in Section 4.

There were four IHSSs that had previous data available. These IHSSs include 174, 175, 176, and 177.

A 95 percent confidence interval was recommended for the calculation of a specific number of samples. The site was then divided into cells 100 x 50 ft to locate samples. The average lot size for Arvada is approximately 65 x 110 ft, but the 100 x 50 ft cell size was recommended by Gilbert. IHSS 176 was the only site that wasn't too small to use the 100 x 50 ft grid method. The samples were randomly placed for the remaining IHSSs.

IHSS	Type of Contamination: Acids	Solvents	Fuels/ Oils	Anions	Metals	Radionuclides	Soil Gas Analyses	Surface Soil Analyses: TCL VO	TCL BNAs	TCL PCBs	TAL Metals	CN	Radionuclides	Tank Liquid and Residue Analyses: VO	TCL BNAs	PCBs	TAL Metals	CN	Radionuclides	pH	HPGe
124		H			H	H	●		●	●	●	●	*	●	●	●	●	●	●	●	●
129		H,S	H, R, S		S		●						*	●	●		●				●
170	H, R	H,R	H,R	H	H	H, R	●		●	●	●	●	*								●
174		H,S	H, R, S	S	H, R, S	S	●		●	●	●	●	*								●
175		H,S	H	S	H, S	S	●		●	●	●		*								●
176		H,S	H, S	S	H, S	S	●		●	●	●		*								●
177		H,S	H, S	S	H, S	H, S	●		●	●	●		*								●
181		H	H		H	H	●	■	■	■	■		■								●
182		H,S	H, R, S		H, R, S	H, S	●	■	■	■	■		■								●
205	H	H	H		H			■	■	■	■		■	●	●	●	●			●	●
206				H	H	H, R, S					●	●	*								●
207	H			H	H	H, R, S		■	■	■	■		■								●
208	H			H	H						●	●	*								●
210		H	H		H		●		●	●	●		*								●
213				H, R		H, R, S			●		●		*								●
214				H, R		H, R, S			●		●		*								●

Table 7-3 • Phase I, Stage 1, Analytical Program.

Key

BNAs - Base/neutral and acid extractable organics
CN - Cyanide
H - Historical storage information
HPGe - Radiation field screening using high-purity germanium
PCBs - Polychlorinated biphenyls
R - Documented release information
S - Sample analysis information
VO - Volatile organics
* - According to the results of the HPGe survey
■ - Paved site with no surface soil

The calculations using the previous data resulted in unusually high sample numbers. IHSS 174 was the only site of the four that resulted in a realistic number. Ten samples are proposed for 175 and 177 and 25 samples are proposed for IHSS 176 to determine a new variability to determine the necessity for collecting the remaining number of samples.

The remaining IHSSs were grouped by size and coverage. Covered sites would have no surficial soil sampling unless soil was present where contaminant may have accumulated from runoff or wind (IHSS 177, 213, and 214). Ten samples are proposed for small uncovered sites and 27 samples are proposed for large uncovered sites (>2000 ft^2). The two screening techniques that will be used are the soil gas and HPGe survey programs. Soil gas sample locations are proposed on a 20 ft grid at small sites and a 40 ft grid at large sites where volatile organic compounds are suspected. The HPGe will be conducted at all sites. The grid size has yet to be determined.

The remaining stage 1 sampling requirement is tank residue sampling. If residue isn't present, a wipe sample will be taken at the base of each tank. Tank, pipe, valve and fitting inspection is also part of this stage of tank sampling. A test pit will be dug at each valve and fitting pertaining to IHSS 129.

This FSP assumes that materials stored on the IHSSs will be removed from the proposed sampling locations before the field investigation begins. Otherwise, sampling locations may have to be moved because of obstructions.

A minimum of two soil samples will be collected from each stratigraphic unit encountered while drilling at each IHSS for analysis of physical parameters. These samples will be tested to determine moisture content, grain size distribution, bulk density, specific density, porosity, and

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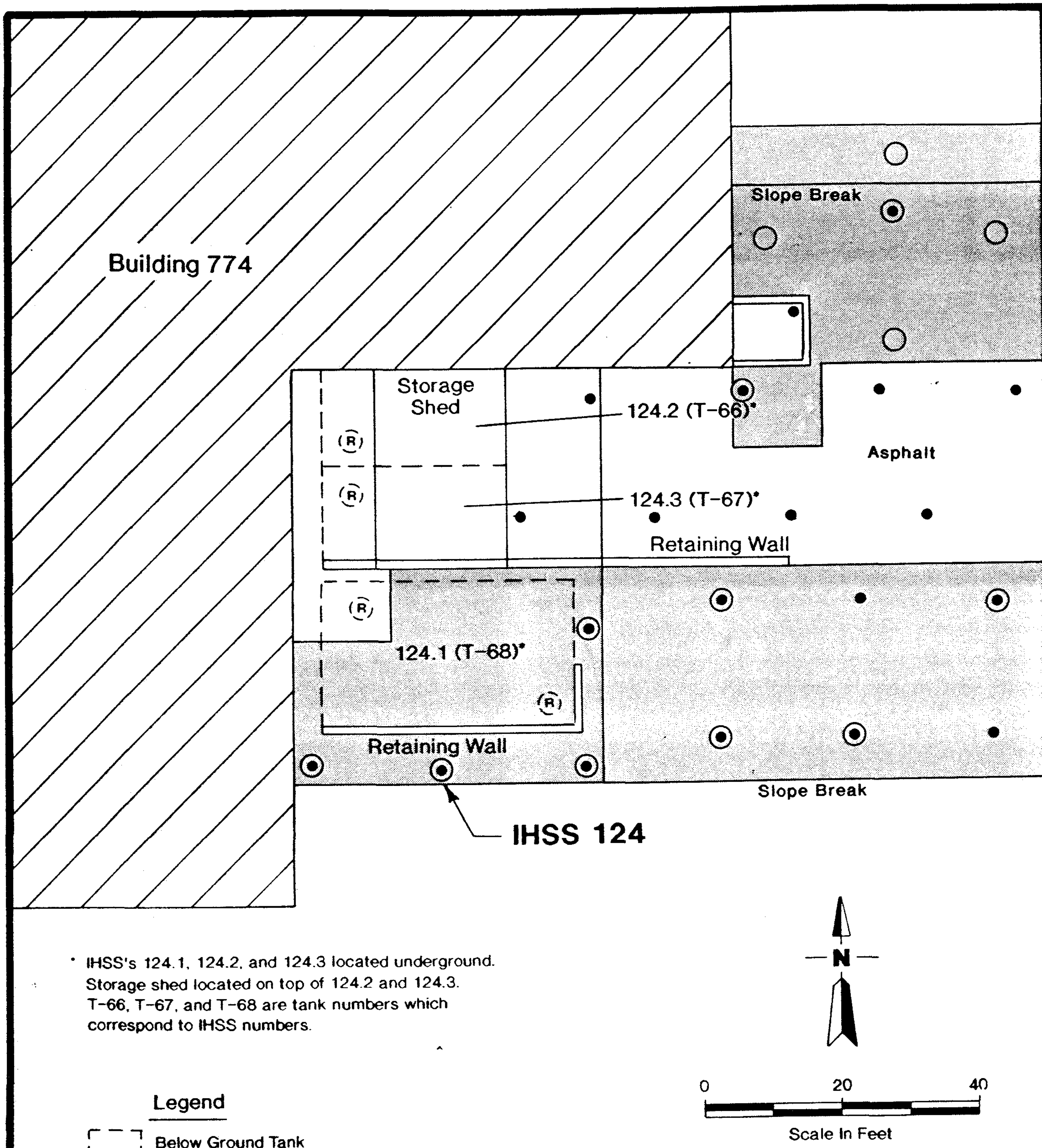
permeability. A minimum of two samples will also be collected for the determination of TOC content and soil pH.

7.3.1 Radioactive Liquid Waste Storage Tanks (IHSSs 124.1, 124.2, 124.3)

IHSS 124 has historical information indicating the potential presence of solvents, metals and radionuclides. This site is covered by concrete and has no known restrictions limiting sampling. Tanks and pipelines will be pressurized and soil gas techniques will be used to determine the horizontal extent of potential contamination from leaking tanks or ancillary equipment. Trenches will be excavated and soil sampled to verify high detections by the soil gas survey. Visual inspection of the tanks and ancillary equipment will be performed to determine their integrity. Four residue samples will be collected and analyzed for pH, volatiles, semivolatiles, metals and radionuclides. If sludge or liquid isn't present, wipe samples will be collected near the base of the tanks to be analyzed for the previously mentioned contaminants. One of the tanks was used to store unspecified miscellaneous wastes from many sources and the wastes stored in the remaining two tanks have not been fully characterized. If potentially spilled wastes included solvents or volatile hydrocarbons, soil gas techniques can quickly locate these constituents in shallow soils beneath the site. Soil gas data collection points will be located approximately on a 20 ft grid (Figure 7.3-1). Based on results of the initial sampling, additional soil gas points may be added to further define contamination. Soil gas samples will be analyzed for common solvents (trichloroethene, PCE, carbon tetrachloride 1,1,1-trichloroethane).

An HPGe survey on a 150 ft spacing, will be conducted to screen for areas of radioactive contamination. A total of 14 surficial soil samples (Figure 7.3-1) are planned to verify results from the soil gas and HPGe surveys and to establish a new variability for stage 2 sampling. Eight samples will be located in the soiled area associated with Tank T-68 to determine whether



* IHSS's 124.1, 124.2, and 124.3 located underground. Storage shed located on top of 124.2 and 124.3. T-66, T-67, and T-68 are tank numbers which correspond to IHSS numbers.

Legend

- Below Ground Tank
- Manhole
- Proposed Soil Gas Survey Locations (20 ft. Grid)
- Proposed Surficial Soil Sample Locations
- R Tank Residue Sample

Note: Shaded area is covered with soil.
HPGe survey location spacing is 150 ft.

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FIGURE 7.3-1
Proposed Sampling Locations for Radioactive Liquid Waste Storage Tanks (IHSS 124.1, 124.2, 124.3)

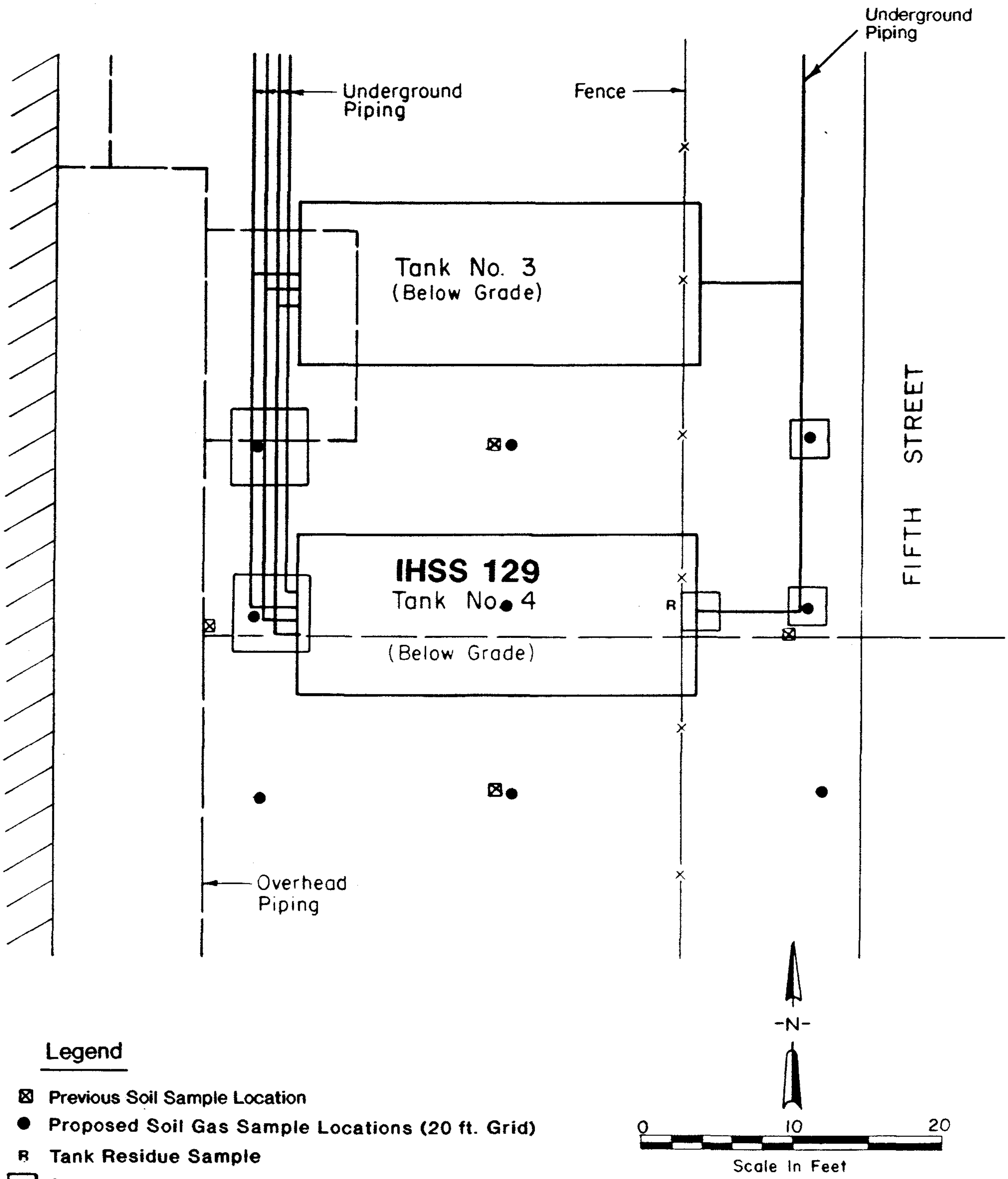
soils have been contaminated by spills or leaks. Six samples will be located to the east of Building 774 to determine whether possible contamination has migrated away from the tanks as surface flow. Surficial soil samples will be analyzed for BNAs, PCBs, metals, cyanide and radionuclides. Semivolatile compounds will be analyzed at an on-site mobile lab and metals and radionuclides will be analyzed at an off-site lab.

The number of deep borings will be determined and defined previous to stage 2 sampling in technical memorandum #2. In these deep borings, samples will be collected to 1 ft above the water table or 6 ft into bedrock, whichever comes first.

7.3.2 Oil Leak (IHSS 129)

IHSS 129 has sample analysis verifying the presence of solvents, fuels/oils, and metals. This sampling data has not been validated. This site has overhead pipelines, guy wires, above grade tanks and below grade pipelines limiting access for sampling borings.

Tanks and pipelines will be pressurized and soil gas techniques will be used to determine the horizontal extent of potential contamination from the leaking tanks or ancillary equipment. Trenches will be excavated and soil sampled to verify high detections by the soil gas survey. One residue sample from the tank will be analyzed for volatiles, BNAs, and metals. If liquid or sludge aren't present, wipe samples will be collected near the base of the tank. Soil gas is preferred to extensive soil sampling due to its ability to quickly delineate shallow occurrences of volatile hydrocarbons or solvents. Three lines of soil gas data collection points located above the subsurface piping and the tank (Figure 7.3-2) will be sampled on a 10 20-ft grid. Soil gas will also be analyzed for benzene, ethylbenzene, toluene, xylenes (fuel constituents) and trichloroethene, PCE, carbon tetrachloride, and 1,1,1-trichloroethane (solvents). An HPGe survey



Legend

- ⊠ Previous Soil Sample Location
- ● Proposed Soil Gas Sample Locations (20 ft. Grid)
- R Tank Residue Sample
- □ Inspection Pit Location

Note: Tank locations are from the closure report, and have not been verified by facility drawings.

Excavations for inspection will occur at pipe elbows, fittings and valves.

HPGe survey location spacing is 150 ft.

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FIGURE 7.3-2
Proposed Sampling Locations for Oil Leak (IHSS 129)

will be conducted on a 150 ft spacing to determine radionuclide contamination. No surficial soil samples will be collected at this site due to gravel coverage. The gravel would eliminate the exposure pathway.

The number of deep borings will be determined prior to stage 2 sampling and will be indicated in technical memorandum #2. Deep boring samples will be collected to 1 ft above the water table or 6 ft into bedrock, whichever is encountered first.

7.3.3 P.U.&D. Storage Yard - Waste Spills (IHSS 170)

IHSS 170 has historical information indicating the potential presence of acids, solvents, fuels/oils, anions, metals and radionuclides. This site has no known restrictions limiting sampling. HPGe and soil gas surveys will be used to locate areas of potential contamination. The soil gas survey will be initially conducted on a 40 ft grid and the HPGe will be conducted at 150 ft spacings. The soil gas survey will be used to locate possible occurrences of solvent spills. The sampling locations will be adjusted to define anomalous hot spots if necessary. Soil samples collected from these hot spot areas will be analyzed to further assess potential contamination at the site. Constituents that have either been historically stored or detected in soil samples include solvents, acids, metals, and radionuclides.

A total of 25 samples will be located on the basis of a 100 x 50 ft 10+ spacing based on the statistical method, outlined in Sections 4 and 5, will be placed on a smaller spacing interval due to an area of staining and two additional samples will be located outside the IHSS boundary (Figure 7.3-3). Surficial soil samples will be analyzed for BNAs, PCBs, metals, cyanide and radionuclides. Semivolatiles will be analyzed by an on-site mobil lab and metals, cyanide and

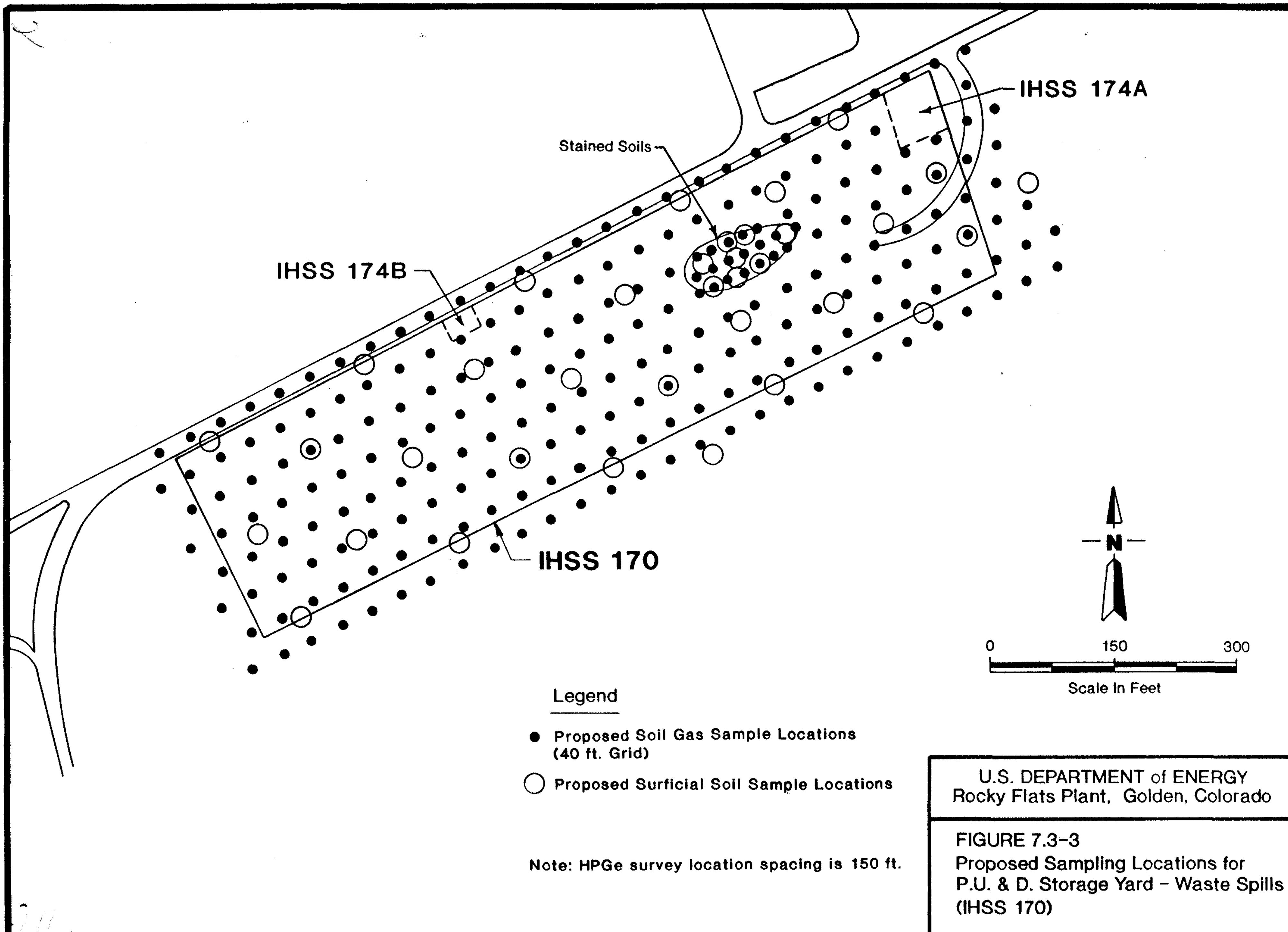

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FIGURE 7.3-3
Proposed Sampling Locations for P.U. & D. Storage Yard - Waste Spills (IHSS 170)

radionuclides will be analyzed by an off-site lab. Based on surficial soil analytical results and other screening techniques employed at the IHSS, deep borings will be drilled.

The number of deep borings will be determined prior to stage 2 sampling and indicated in technical memorandum #2. These deep boring samples will be collected to 1 ft above the water table or 6 ft into bedrock, whichever is encountered first.

7.3.4 P.U.&D. Container Storage Facilities (IHSS 174)

IHSS 174 has sample analysis verifying the presence of solvents, fuels/oils, anions, metals, and radionuclides. This sampling data has not been validated. This site has no known restrictions to limiting sampling. The soil gas survey will be conducted on a 20 ft grid and surficial soil samples will be collected at some of these locations to verify contamination. The soil gas samples will be analyzed for solvents and BTX. An HPGe survey will be conducted at a 150 ft spacing to determine radionuclide contamination. Twenty-five surficial soil samples are proposed for the drum storage area of IHSS 174 and will be located based on the lot method described in Section 4 (Figure 7.3-4). Eight samples are located in the reported perimeter of the dumpster storage area and two additional samples will be located outside of the IHSS boundary. Review of the site history and air photographs indicate that the dumpster storage area is actually located in IHSS 170. Surficial soil samples will be analyzed for BNAs, PCBs, metals, cyanide and radionuclides. The semivolatile compounds will be analyzed by an on-site mobile lab and the metals, cyanide and radionuclides will be analyzed by an off-site lab. Based on surficial soil analytical results and other screening techniques employed at the IHSS, deep borings will be drilled.

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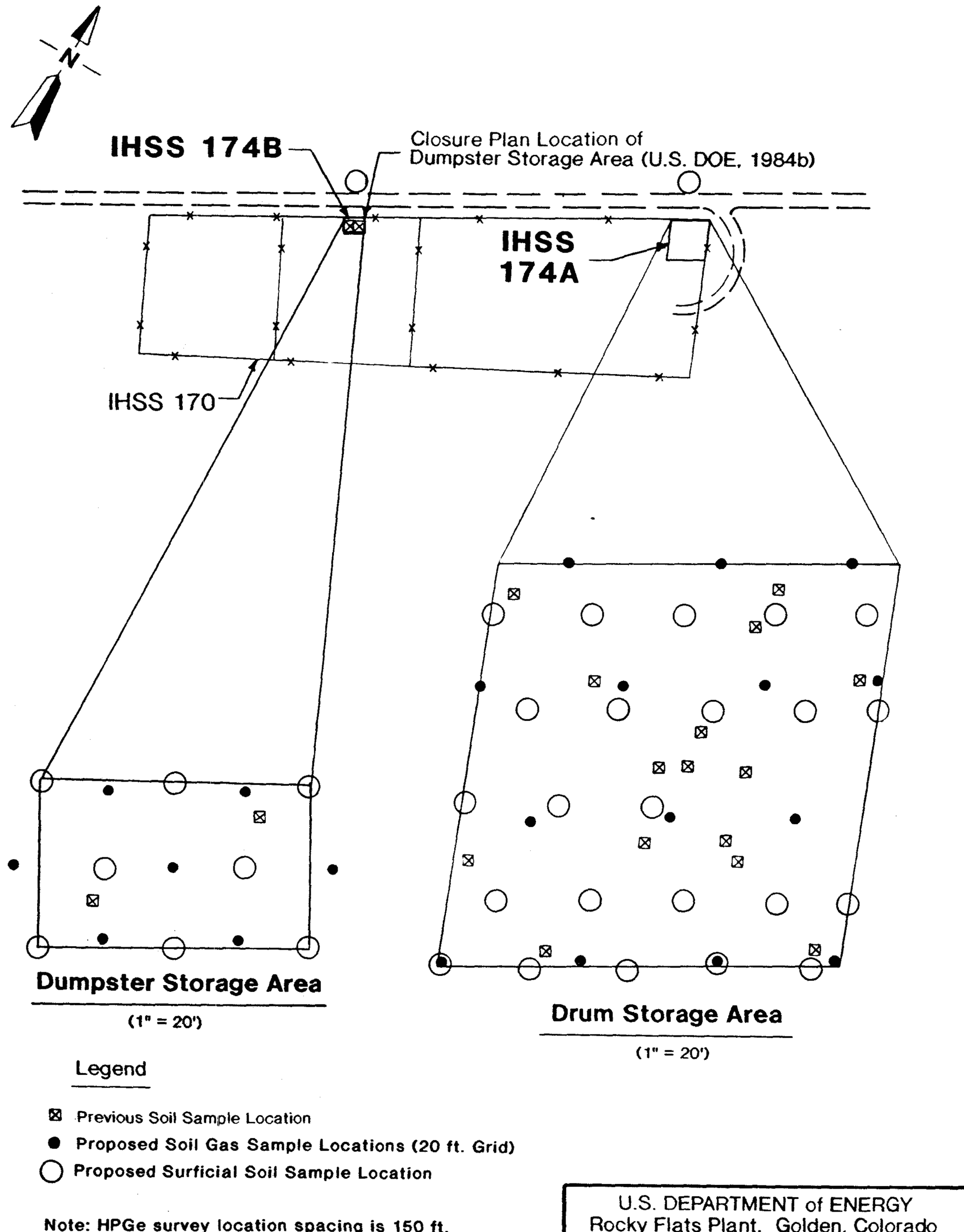

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FIGURE 7.3-4
Proposed Sampling Locations for
PU & D Container Storage Facilities
(IHSS 174)

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The number of deep borings will be determined prior to stage 2 sampling and indicated in technical memorandum #2. These deep boring, samples will be collected to ~~1 ft~~ above the water table or 6 ft into bedrock, whichever is encountered first.

7.3.5 S&W Building 980 Container Storage Facility (IHSS 175)

IHSS 175 has historical and sample analysis information indicating the potential presence of solvents, fuels/oils, anions, metals, and radionuclides. The sample data has not been validated. This IHSS has an overhead power line located near the site and an embankment to the south but they shouldn't pose a restriction to sampling. Soil gas techniques will be used to determine the horizontal extent of potential contamination from drums or containers stored in IHSS 175. If the potentially spilled waste included solvents or other volatile organics in vadose zone soil, soil gas techniques can quickly locate these constituents. Soil gas samples will be collected on a 20-ft grid and an HPGe survey will be conducted on a 150 ft spacing to screen areas for radioactive contamination (Figure 7.3-5).

Ten surficial soil samples, four around the perimeter, four within the site, and two outside the IHSS boundary will be sampled (Figure 7.3-5). Surficial soil samples will be analyzed for BNAs, PCBs, metals and radionuclides. BNAs and PCBs will be analyzed by an ~~on-site mobile~~ lab and metals and radionuclides will be analyzed by an off-site lab. Based on surficial soil analytical results and other screening techniques employed at the IHSS, deep borings will be drilled.

The number of deep borings will be determined prior to stage 2 sampling and indicated in technical memorandum #2. Deep boring samples will be collected to 1 ft above the water table or 6 ft into bedrock, whichever is encountered first.

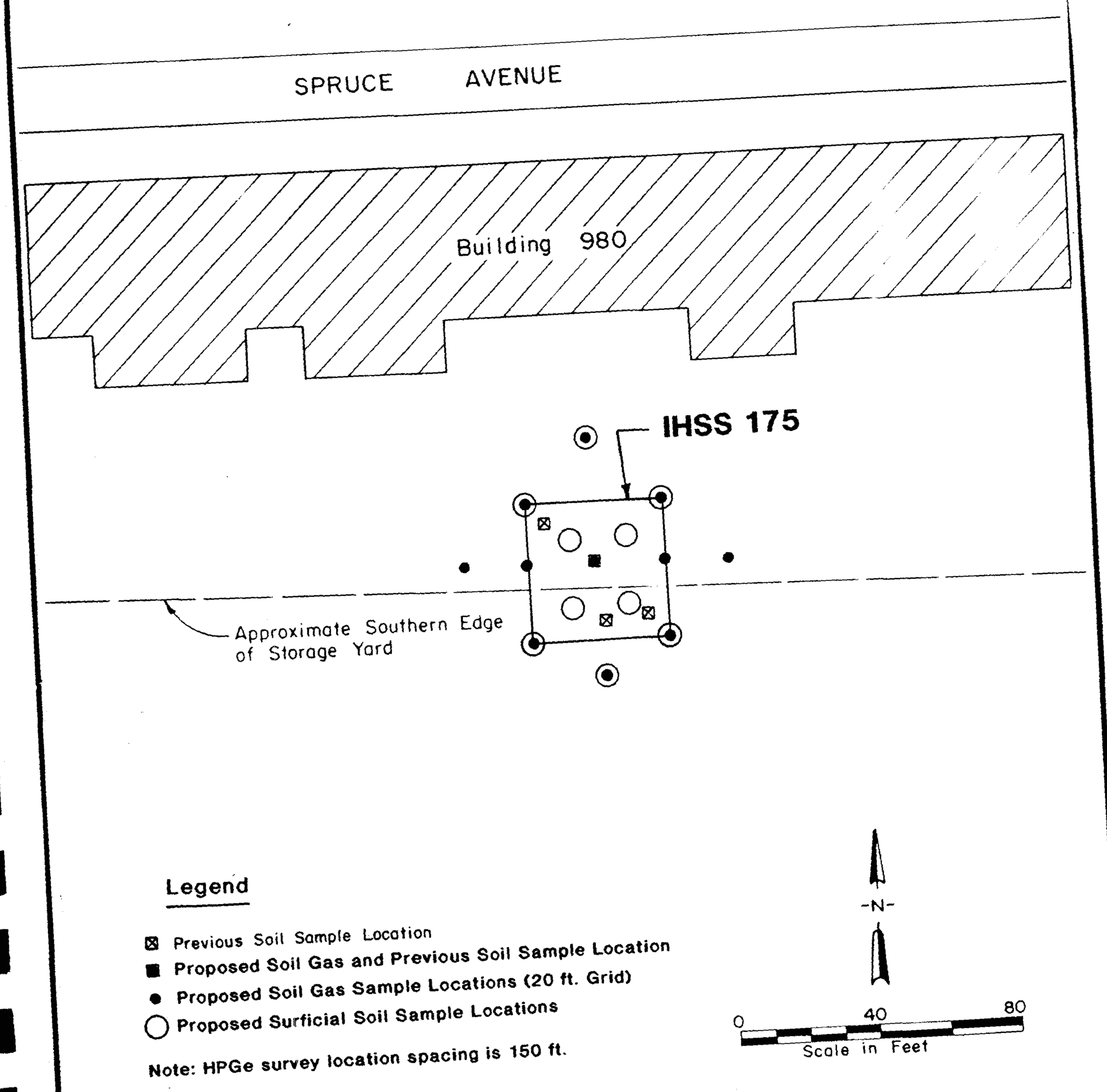

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FIGURE 7.3-5
Proposed Sampling Locations for S & W Building 980 Container Storage Facility (IHSS 175)

7.3.6 S&W Contractor Storage Yard (IHSS 176)

IHSS 176 has historical and sample analysis information indicating the potential presence of solvents, fuels/oils, anions, metals, and radionuclides. The sample data has not been validated. This IHSS has an overhead power line located near the site but poses no real restriction to soil boring sampling. Soil gas and HPGe surveys will be conducted to determine the horizontal extent of potential contamination from drums or containers stored in IHSS 176. Sampling points for the soil gas survey will be located on a 40 ft triangular grid and the HPGe survey will be conducted on a 150 ft spacing.

Twenty-five surficial soil samples will be located based on the lot method described in Section 4 and two samples will be located outside the IHSS boundary (Figure 7.3-6). Surficial soil samples will be analyzed for BNAs, PCBs, metals and radionuclides. BNAs and PCBs will be analyzed by an on-site mobile lab and analyzed for metals and radionuclides at an off-site lab. Based on surficial soil analytical results and other screening techniques employed at the IHSS, deep borings will be drilled.

The number of deep borings will be determined prior to stage 2 sampling and indicated in technical memorandum #2. In these deep borings, samples will be collected to 1 ft above the water table or 6 ft into bedrock, whichever is encountered first.

7.3.7 Building 885 Drum Storage Area (IHSS 177)

IHSS 177 has historical and sample analysis information indicating the potential presence of solvents, fuels/oils, anions, metals and radionuclides. The sample data has not been validated. This IHSS is covered with concrete and the perimeter is asphalted and has a narrow pathway

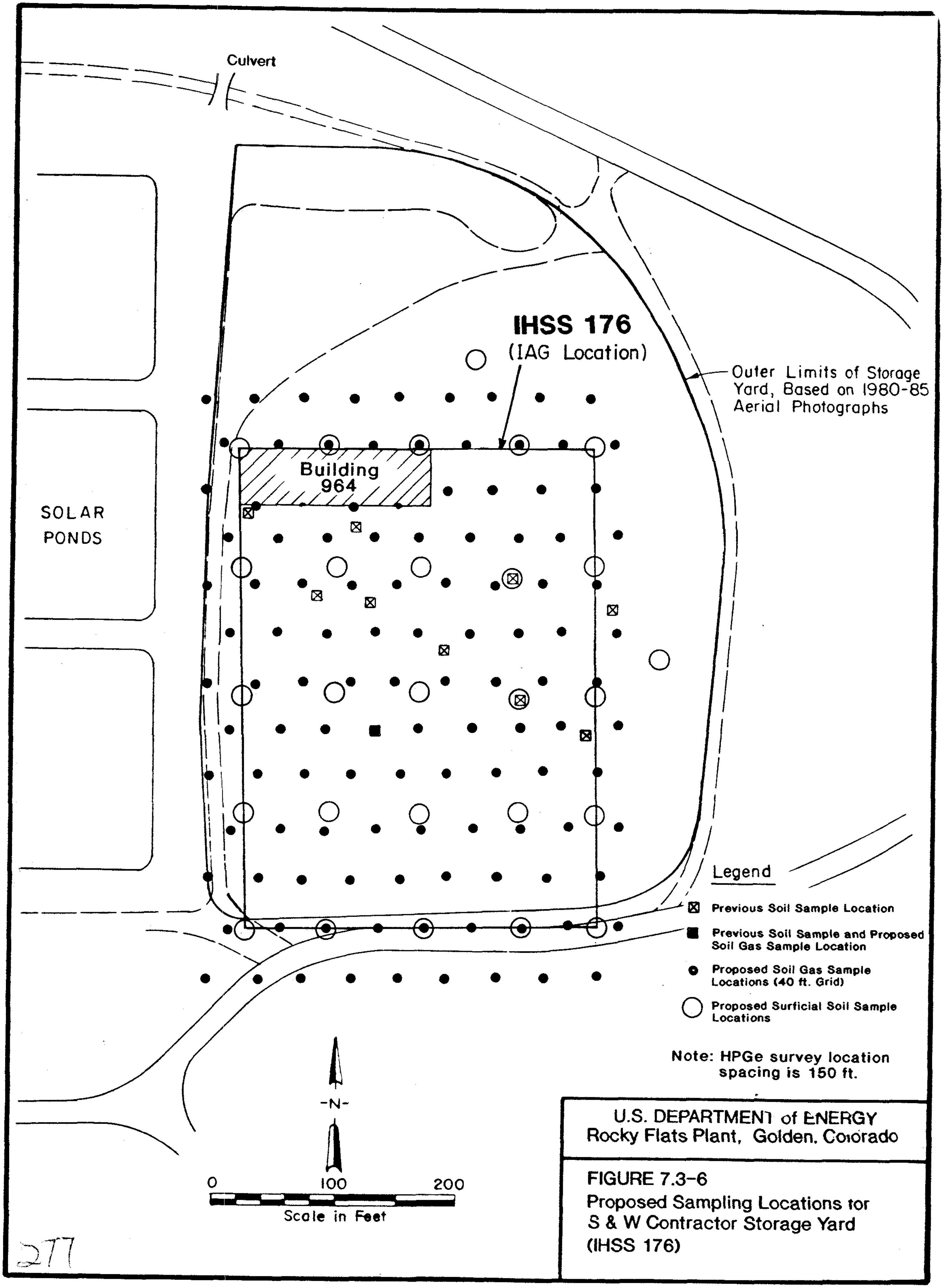

FIGURE 7.3-6
Proposed Sampling Locations for S & W Contractor Storage Yard (IHSS 176)

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between the building and fence on the south side and a power line to the east that may restrict soil boring sampling. Soil gas techniques will be used to determine the horizontal extent of potential contamination from drums or containers stored at IHSS 177. The soil gas survey will be performed to the south, east, and west of Building 885 on a 20-ft grid. There is no asphalt in these areas and dispersal of contaminants by surface runoff is likely.

An HPGe survey using a spacing of 150 ft will be conducted to screen areas for possible radioactive contamination. Ten surficial soil samples are proposed for the IHSS 177 investigation (Figure 7.3-7). Eight samples are located along the perimeter of Building 885 and surface water ponding areas to the south and southwest of Building 885. Two samples are located outside of the fence south of Building 885. Surficial soil samples will be analyzed for BNAs and PCBs by an onsite mobile lab and analyzed for metals and radionuclides at an offsite lab. Based on surficial soil analytical results and other screening techniques employed at the IHSS, deep borings will be drilled.

The exact number of deep borings will be determined prior to stage 2 sampling and indicated in technical memorandum #2. Deep boring samples will be collected to 1 ft above the water table or 6 ft into bedrock, whichever is encountered first.

7.3.8 Building 334 Cargo Container Area (IHSS 181)

IHSS 181 has historical information indicating the potential presence of solvents, fuels/oils, metals, and radionuclides. This site is covered with asphalt and has no known restrictions limiting sampling. This IHSS also has an asphalt drainage ditch associated with it. A soil gas survey will be performed at three sites located south of the IHSS at a 20 ft spacing. Samples will be analyzed for solvents and BTX (Figure 7.3-8). An HPGe survey will be performed on

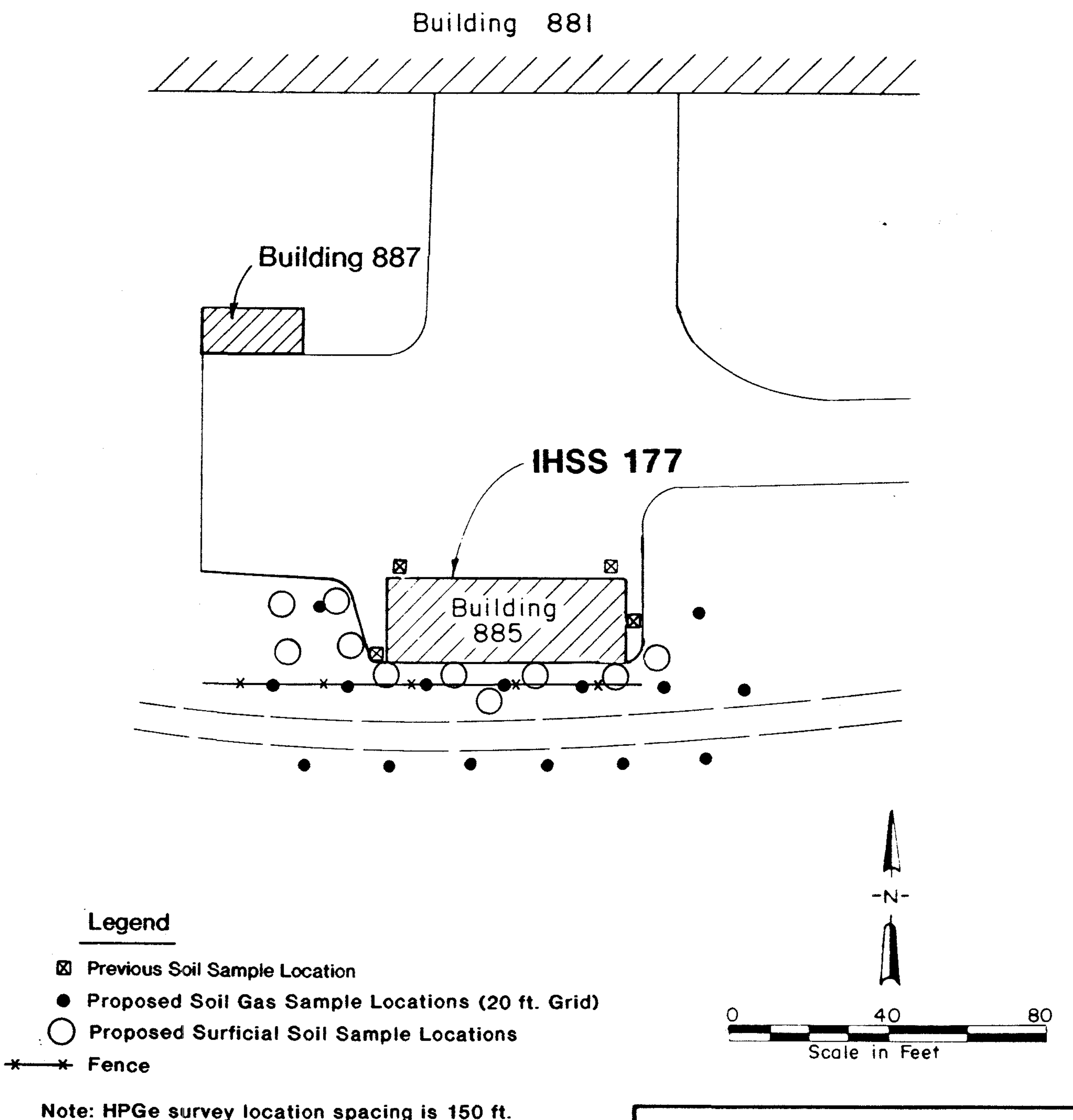

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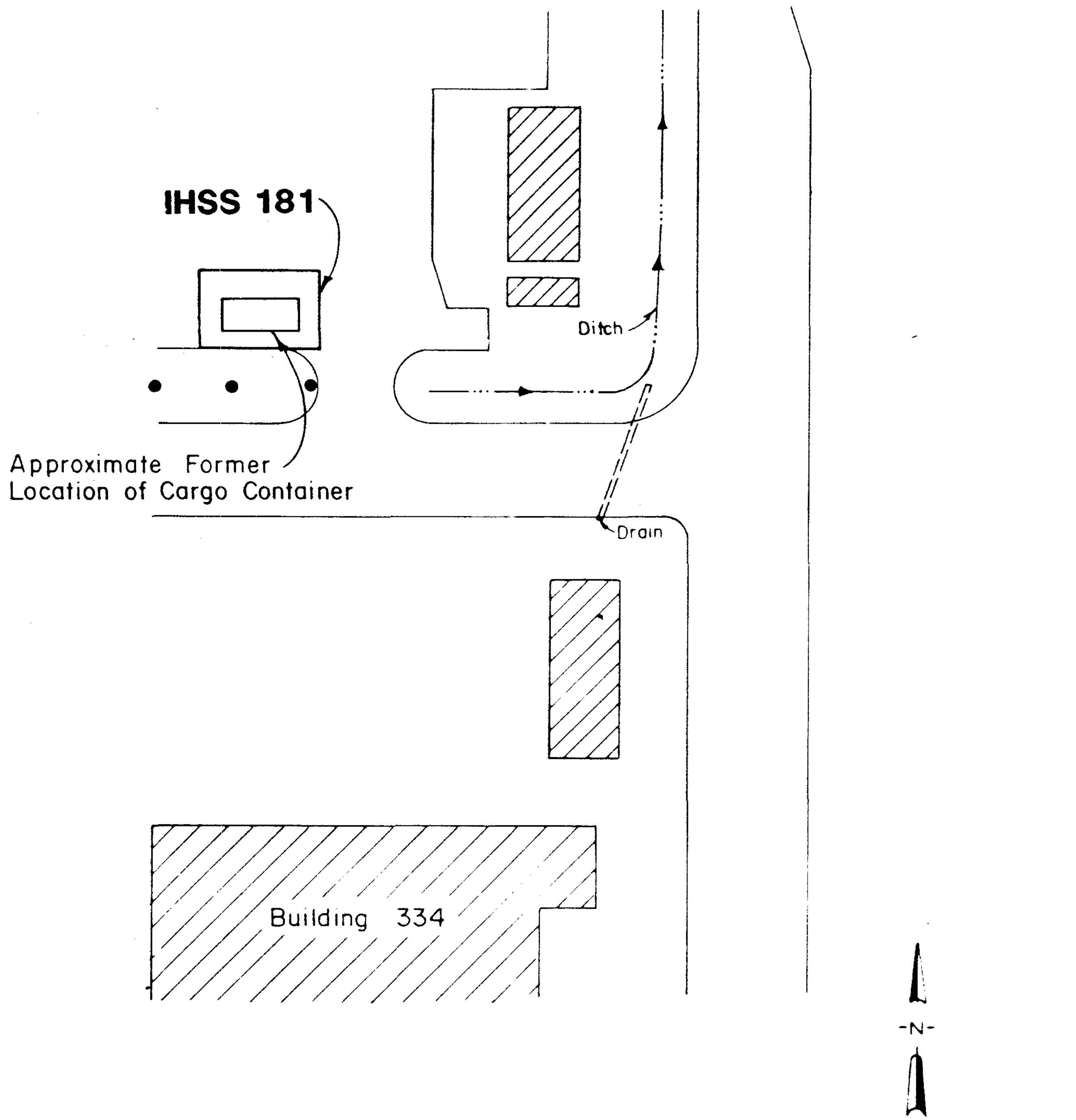
FIGURE 7.3-7
Proposed Sampling Locations for Building 885 Drum Storage Area (IHSS 177)



Legend

—··◄— Surface Drainage, Indicating Direction of Flow

● Proposed Soil Gas Sample Locations (20 ft. Grid)

Note: HPGe survey location spacing is 150 ft.

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FIGURE 7.3-8
Proposed Sampling Locations for Building 334 Cargo Container Area (IHSS 181)

a 150 ft spacing pattern and will be conducted to screen areas of possible radioactive contamination.

No surficial soil samples will be taken because this site has always been paved and contamination would have been removed by surface runoff. Based on the screening analytical results and other screening techniques employed at the IHSS, deep borings will be drilled.

The number of deep borings will be determined prior to stage 2 sampling and indicated in technical memorandum #2. Deep boring samples will be collected to 1 ft above the water table or 6 ft into bedrock, whichever is encountered first.

7.3.9 Building 444/453 Drum Storage Area (IHSS 182)

IHSS 182 has historical information indicating the potential presence of solvents, fuels/oils, metals and radionuclides. This site is covered with asphalt that was placed post storage and has a narrow pathway between buildings 453 and 444 which may restrict access for soil boring sampling. A soil gas survey will be conducted on a 20 ft grid and samples will be analyzed for solvents and BTX (Figure 7.3-9). An HPGe survey will be performed on a 150 ft spacing to screen areas of possible radioactive contamination.

No surficial soil samples will be collected since the site is paved and exposure pathway has been deleted. Based on the screening analytical results and other screening techniques employed at the IHSS, deep borings will be drilled.

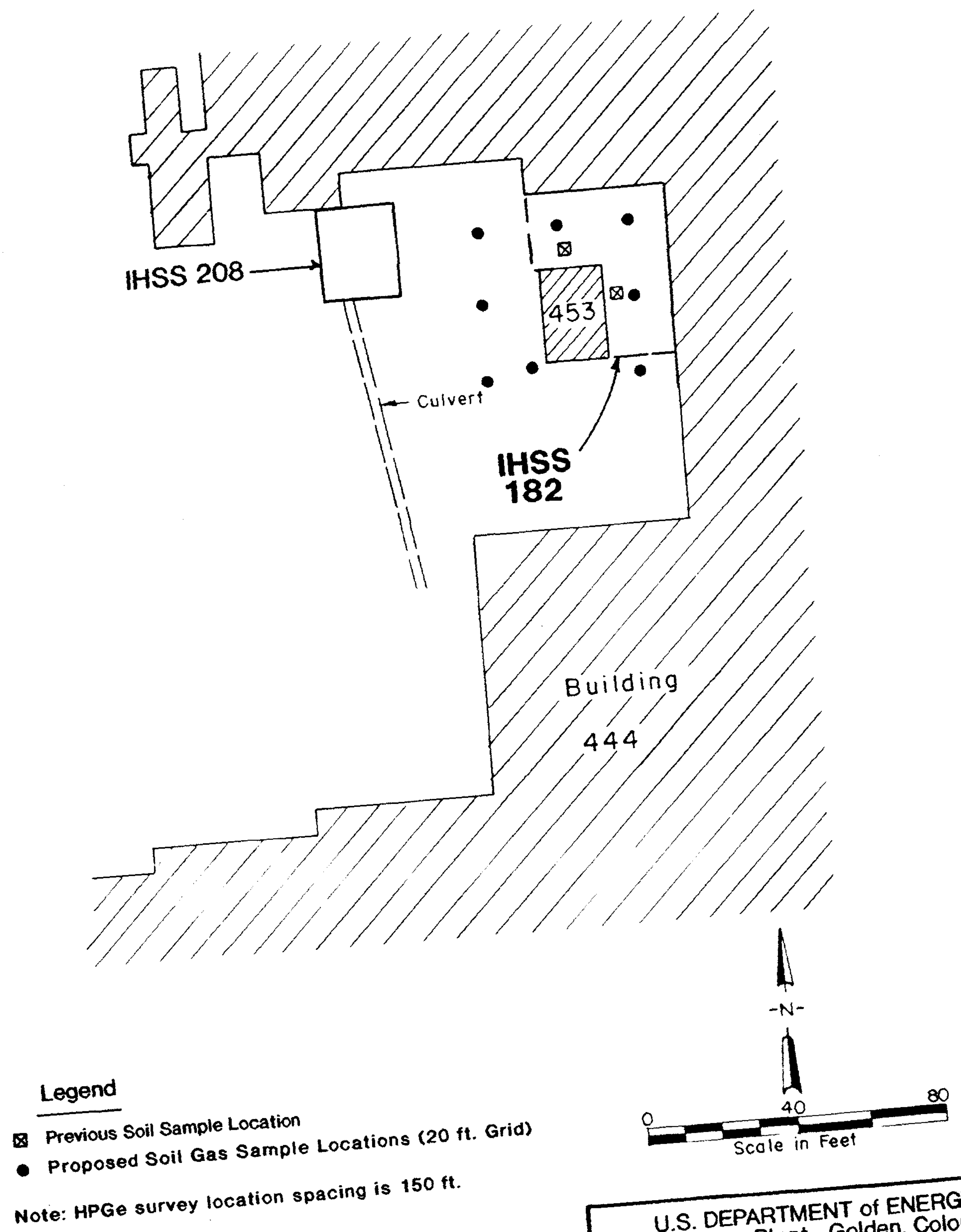

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FIGURE 7.3-9
Proposed Sampling Locations for Building 444/453 Drum Storage Area (IHSS 182)

The number of deep borings will be determined prior to stage 2 sampling and indicated in technical memorandum #2. Deep boring samples will be collected to 1 ft above the water table or 6 ft into bedrock, whichever is encountered first.

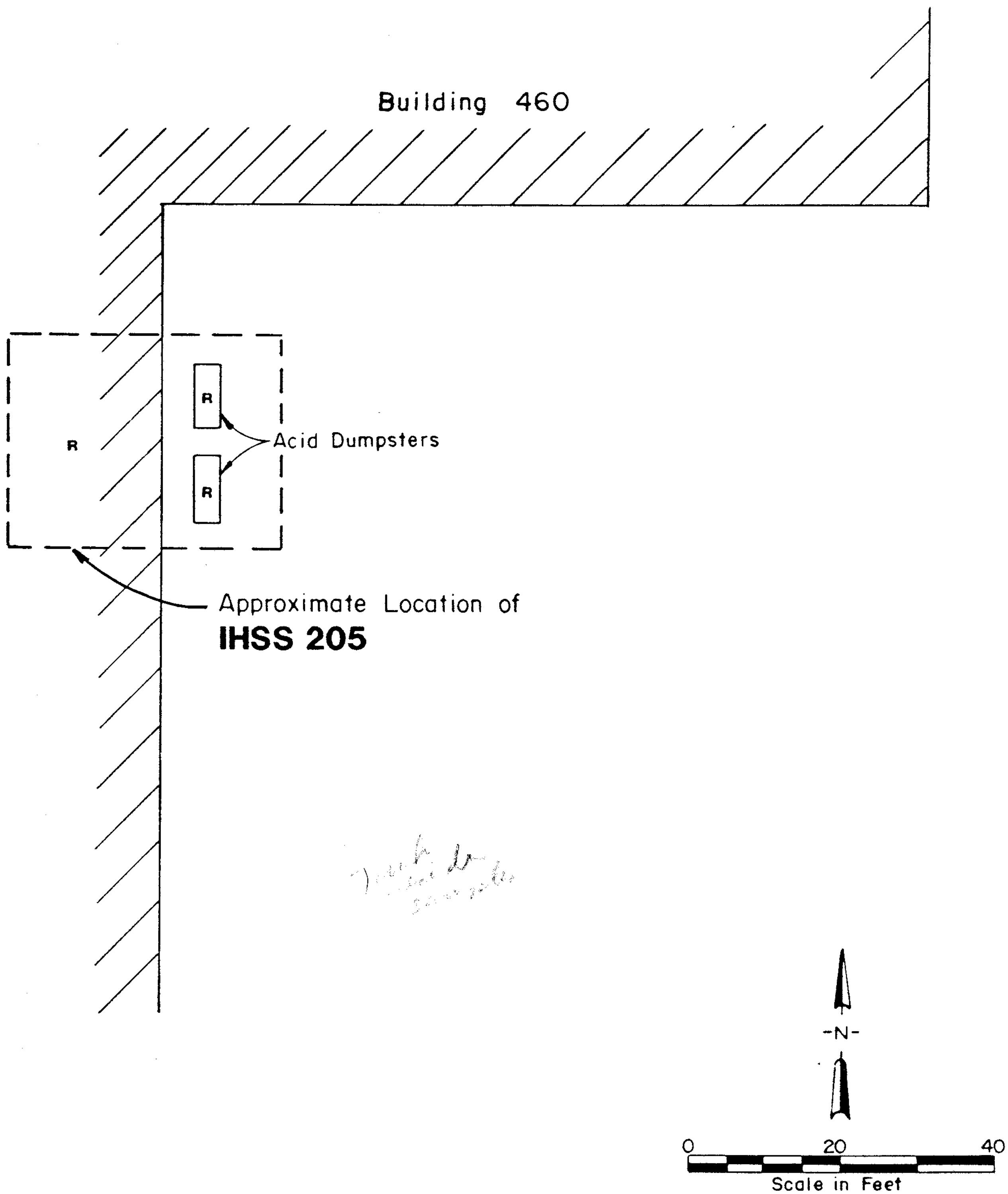
7.3.10 Building 460 Sump #3 Acid Side (IHSS 205)

IHSS 205 has historical information indicating the potential presence of acids. This site is covered by concrete and the presence of tanks limits access to sampling the concrete pad. No soil gas or surficial soil sampling are planned for IHSS 205 during the Phase I RFI/RI. The HPGe survey will be conducted on a 150 ft spacing to screen areas for radioactive contamination. If visual inspection reveals indication of tank leakage, such as deteriorated or stained concrete in the tank vicinity, then one scheduled soil sample will be located at the stained location. Two residue samples will be collected and analyzed for pH volatiles, BNAs, PCBs and metals. If liquid isn't present in the tanks, wipe samples will be performed at the base of the tanks (Figure 7.3-10). Based on HPGe survey results at the IHSS, deep borings will be drilled.

The number of deep borings will be determined prior to stage 2 sampling and indicated in technical memorandum #2. Deep boring samples will be collected to 1 ft above the water table or 6 ft into bedrock, whichever is encountered first.

7.3.11 Inactive D-836 Hazardous Waste Tank (IHSS 206)

IHSS 206 has historical information indicating the potential presence of metals and radionuclides. This site has guy wires and overhead structures restricting access for soil boring sampling. No soil gas sampling will be conducted at IHSS 206 during the Phase I RFI/RI. The HPGe survey will be conducted at 150 ft spacings to screen the area for radioactive contamination. Ten surficial soil samples are proposed at this location for Phase I (Figure 7.3-11). Eight samples



Legend

R Tank Residue Sample

Note: HPGe survey location spacing is 150 ft.

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FIGURE 7.3-10
Proposed Sampling Locations for Building 460 Sump #3 Acid Side (IHSS 205)

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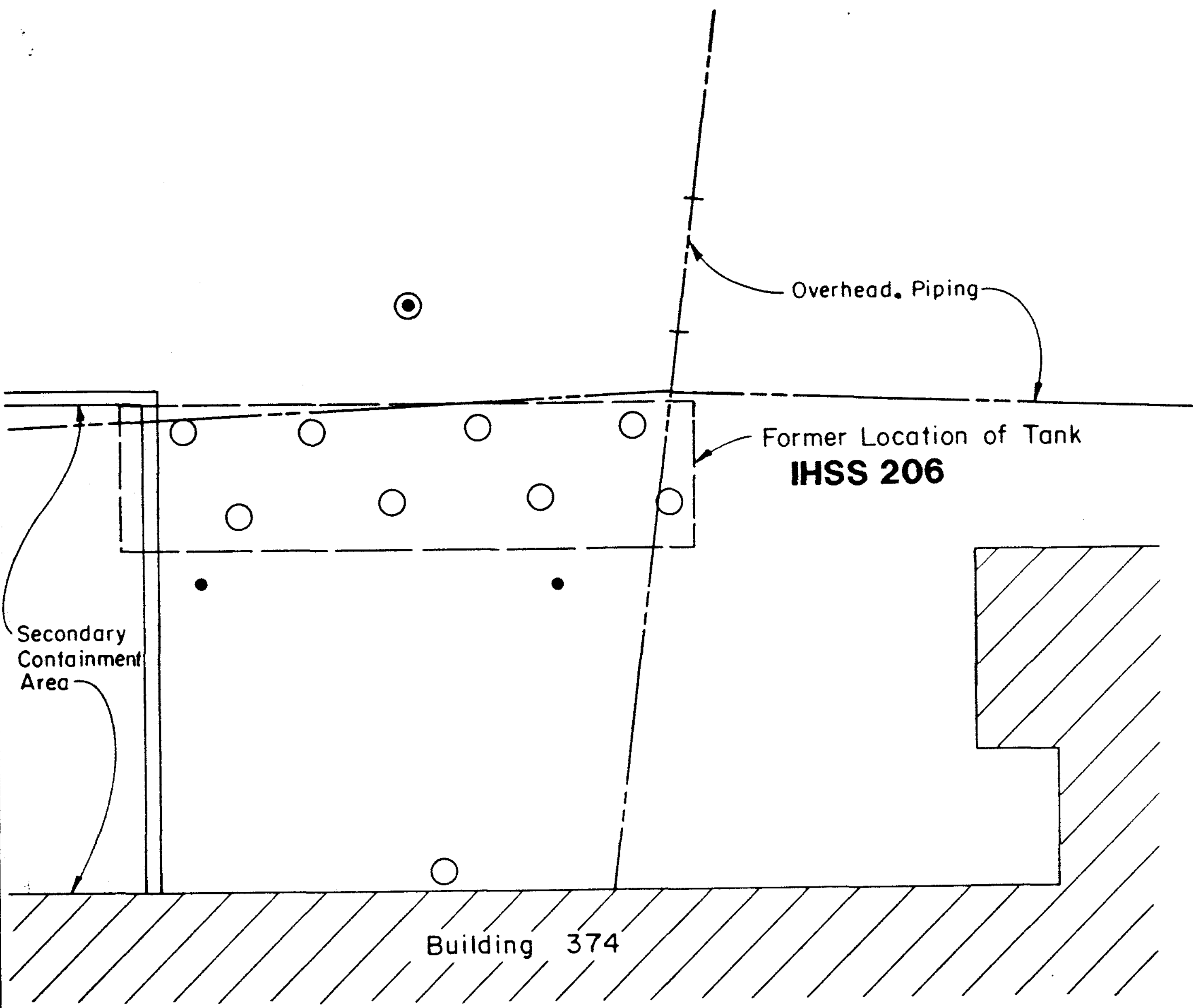

Legend

- ● Proposed Soil Gas Sample Locations (20 ft. Grid)
- ○ Proposed Surficial Soil Sample Locations

Note: HPGe survey location spacing is 150 ft.

-N-

0 10 20
Scale in Feet

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FIGURE 7.3-11
Proposed Sampling Locations for Inactive D-836 Hazardous Waste Tank (IHSS 206)

will be located where the tank was formerly located, one sample will be located where the piping exited the building and one will be located on the north side of former location of the tank. Surficial soil samples will be analyzed for metals, cyanide, and radionuclides at an offsite lab. Based on surficial soil analytical results and other screening techniques employed at the IHSS, deep borings will be drilled.

The number of deep borings will be determined prior to stage 2 sampling and indicated in technical memorandum #2. Deep boring samples will be collected to 1 ft above the water table or 6 ft into bedrock, whichever is encountered first.

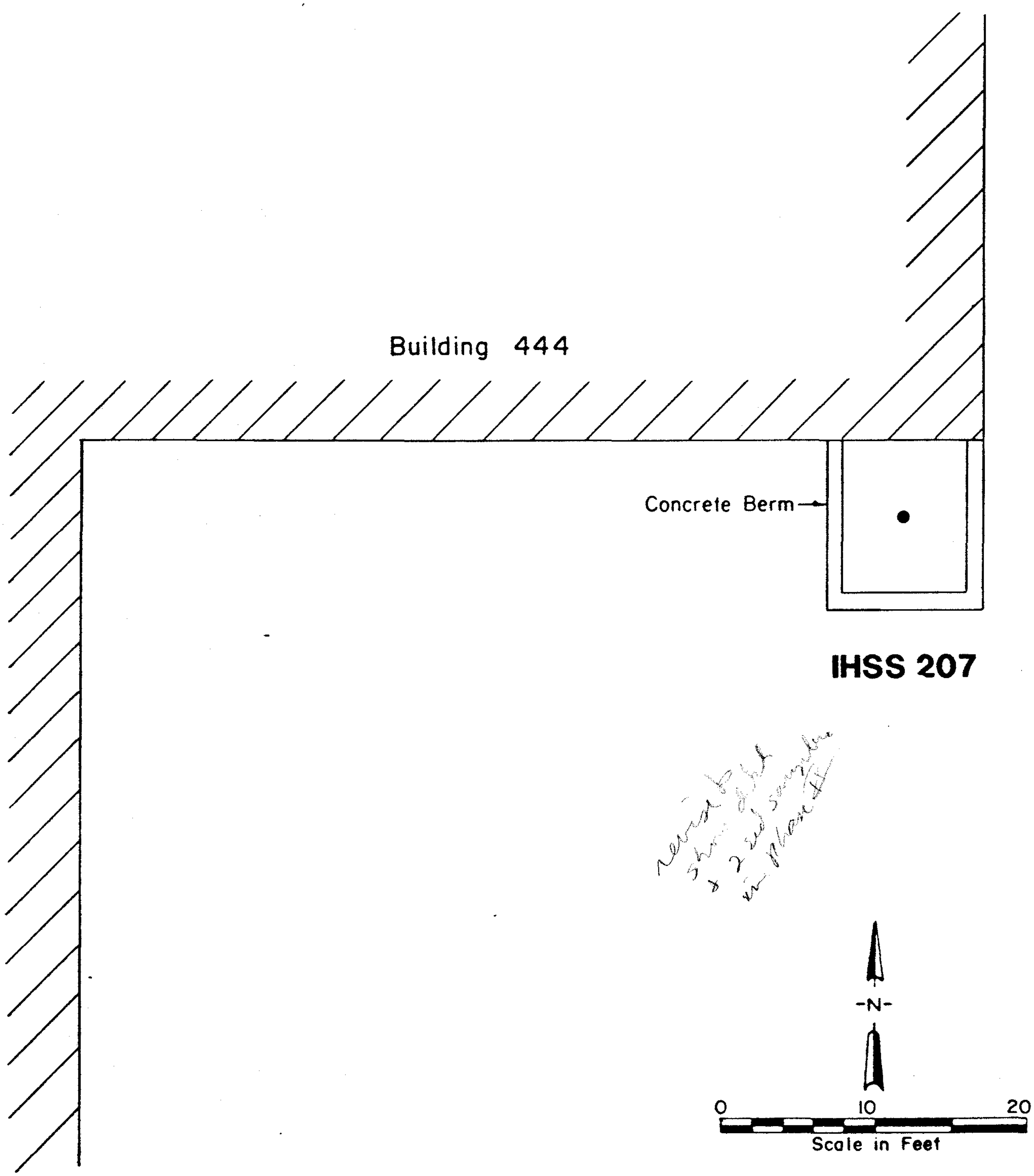
7.3.12 Inactive Building 444 Acid Dumpsters (IHSS 207)

IHSS 207 has historical information indicating the potential presence of acids, anions, metals, and radionuclides. This site is covered by concrete and has no known restrictions limiting sampling. No soil gas or surficial soil sampling will be conducted at IHSS 207. The HPGe survey will be conducted at one location in the center of the IHSS (Figure 7.3-12). Based on the HPGe survey results at the IHSS, deep borings will be drilled.

The number of deep borings will be determined prior to stage 2 sampling and indicate in technical memorandum #2. Deep boring samples will be collected to 1 ft above the water table or 6 ft into bedrock, whichever is encountered first.

7.3.13 Inactive 444/447 Hazardous Waste Storage Area (IHSS 208)

IHSS 208 has historical information indicating the potential presence of acids, anions, and metals. This IHSS is covered by asphalt and has no known restrictions limiting sampling. No soil gas survey is planned for this IHSS. An HPGe survey on a 150 ft spacing, will be conducted to



Legend

● Proposed HPGe Survey Location

Note: HPGe survey location spacing is 150 ft.

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FIGURE 7.3-12
Proposed Sampling Locations for Inactive Building 444 Acid Dumpsters (IHSS 207)

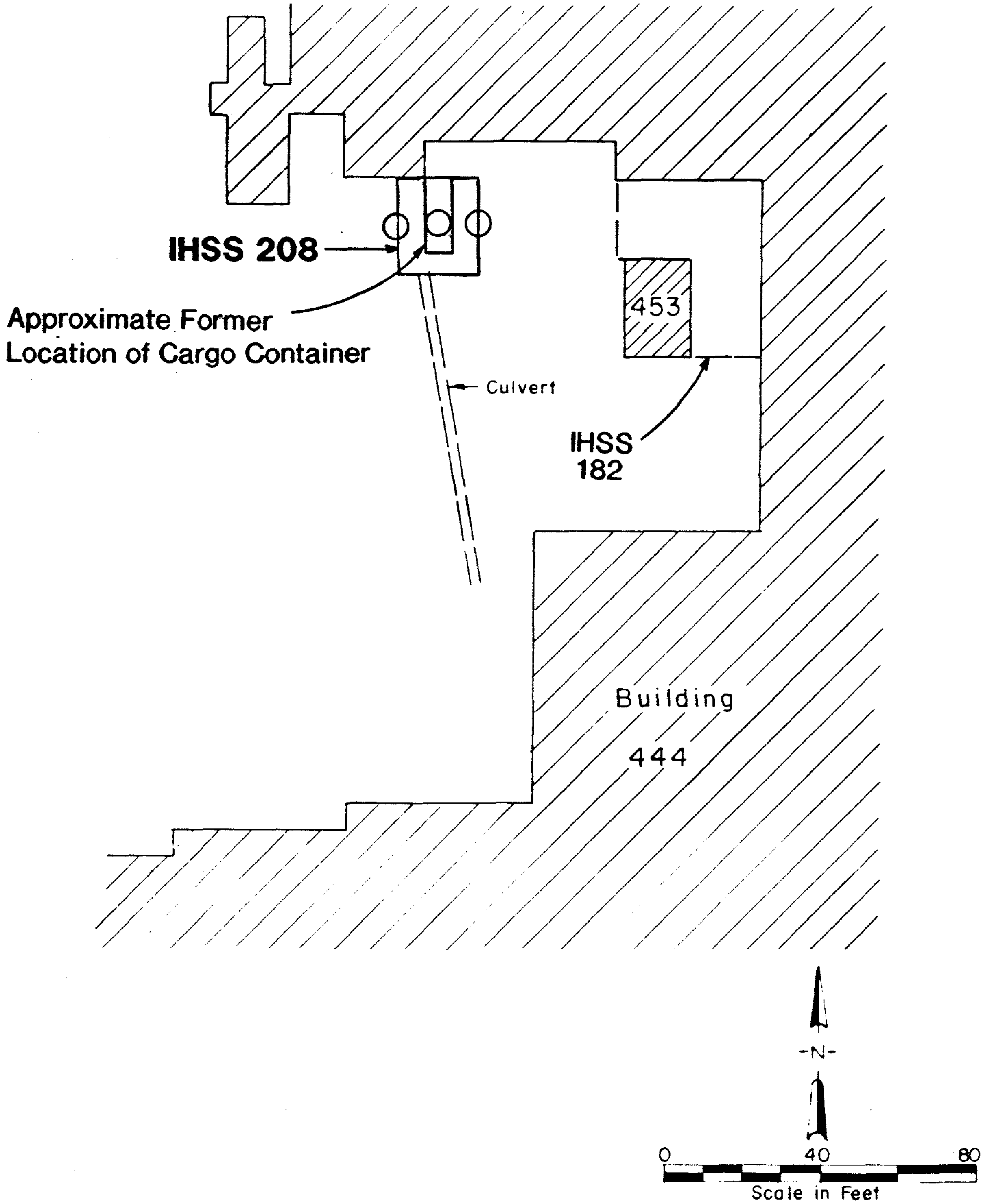
screen areas of possible radioactive contamination. Three surficial samples are proposed for IHSS 208 during Phase I (Figure 7.3-13). The three samples are located in the center of the IHSS on a soiled area. Surficial soil samples will be analyzed for metals, cyanide, and radionuclides at an offsite lab. Based on surficial soil analytical results at the IHSS, deep borings will be drilled.

The number of deep borings will be determined prior to stage 2 sampling and indicated in technical memorandum #2. Deep boring samples will be collected to 1 ft above the water table or 6 ft into bedrock, whichever is encountered first.

7.3.14 Unit 16 Building 980 Cargo Container (IHSS 210)

IHSS 210 has historical information indicating the potential presence of solvents, fuels/oils, and metals. This site has an embankment to the south but should not pose a restriction to sampling. A soil gas survey will be used to determine the horizontal extent of potential contamination from spills or leaks from drums or containers stored at IHSS 210. The soil gas sampling survey will be conducted on an approximate 20 ft grid. An HPGe survey, using 50 ft spacings, will be conducted to screen areas of possible radioactive contamination.

Six surficial soil samples are proposed along the perimeter of the maximum areal extent of the container area, two samples will be placed in the center of the IHSS. One sample will be located on the north and one sample on the south side of the site (Figure 7.3-14). Surficial soil samples will be analyzed for BNAs and PCBs onsite with a mobile lab and analyzed for metals at an offsite lab. Based on surficial soil analytical results and other screening techniques employed at the IHSS, deep borings will be drilled.



Legend

○ Proposed Surficial Soil Sample Locations

Note: HPGe survey location spacing is 150 ft.

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FIGURE 7.3-13
Proposed Sampling Locations for Inactive 444/447 Hazardous Waste Storage Area (IHSS 208)

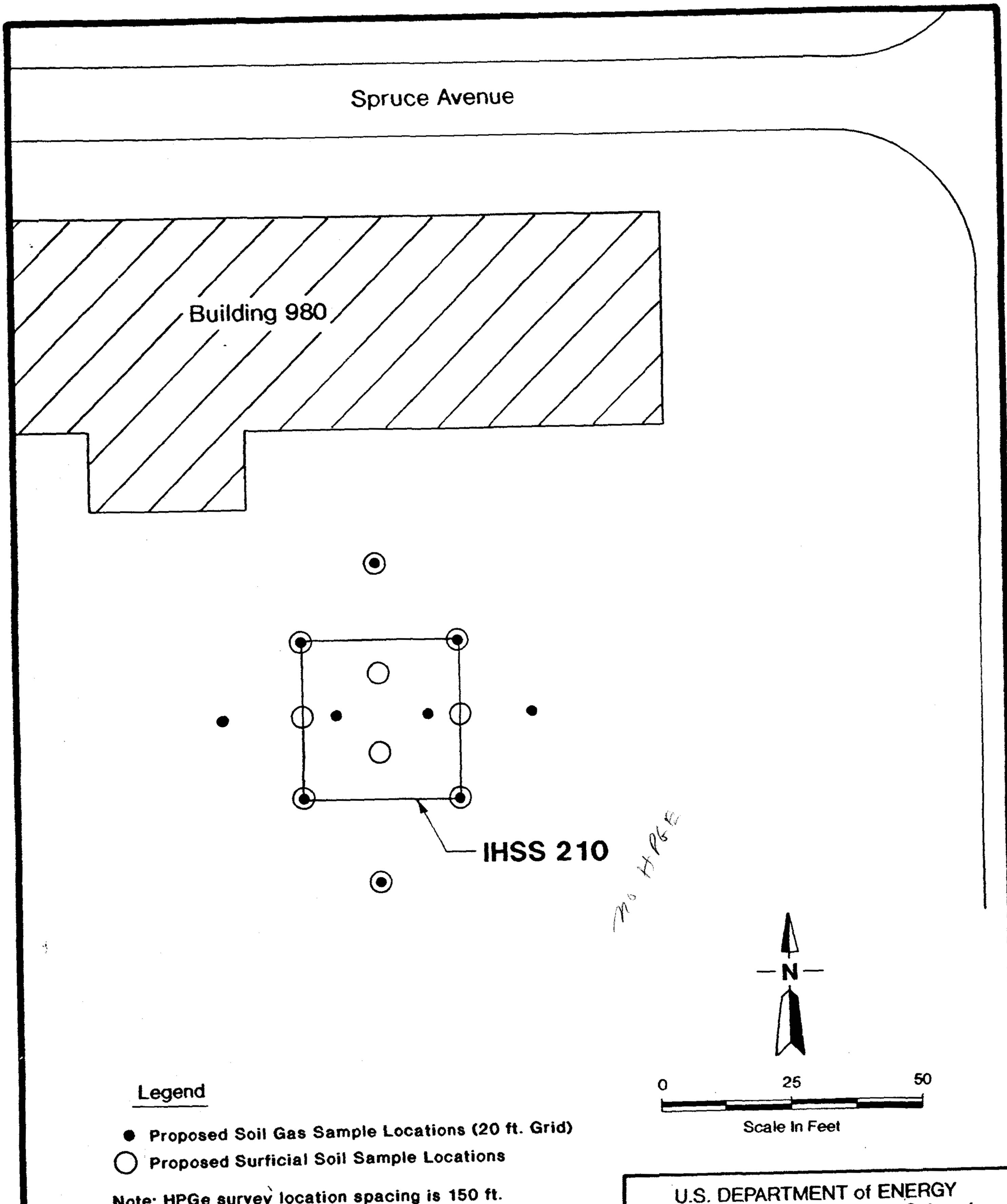

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FIGURE 7.3-14
Proposed Sampling Locations for Unit 16, Building 980 Cargo Container (IHSS 210)

The number of deep borings will be determined prior to stage 2 sampling and indicated in technical memorandum #2. Deep boring samples will be collected to 1 ft above the water table or 6 ft into bedrock, whichever is encountered first.

7.3.15 Unit 15, 904 Pad Pondcrete Storage (IHSS 213)

IHSS 213 has historical information indicating the potential presence of anions and radionuclides. This site was previously uncovered but is currently paved with asphalt. There are overhead power lines at this IHSS but they can be avoided during sampling. Spills involving poorly solidified pondcrete may involve volatile and semivolatile compounds. However, due to the small volume of liquid in these wastes, the prompt cleanup by RFP employees, and transport by wind or surface water of contaminants off of the pad, it is not expected that volatile compounds will be present in soils outside the pad. Therefore, a soil gas survey is not proposed for IHSS 213. Metals will most likely be concentrated within the ditches adjacent to the site. A HPGe survey will be conducted on a 150 ft spacing to define areas of potential radionuclide contamination.

Twenty-five surficial soil samples are proposed for IHSS 213 and are located around the outside of the IHSS boundary (Figure 7.3-15). The sampling grid was determined using the lot method outlined in Section 4. It is likely that contaminants washed off the pad will migrate to the drainage ditches. These samples will document potential dispersion of contaminants along the length of the ditch. Surficial soil samples will be analyzed for BNAs onsite with a mobile lab and analyzed for metals at an offsite lab. Based on surficial soil analytical results and other screening techniques employed at the IHSS, deep borings will be drilled.

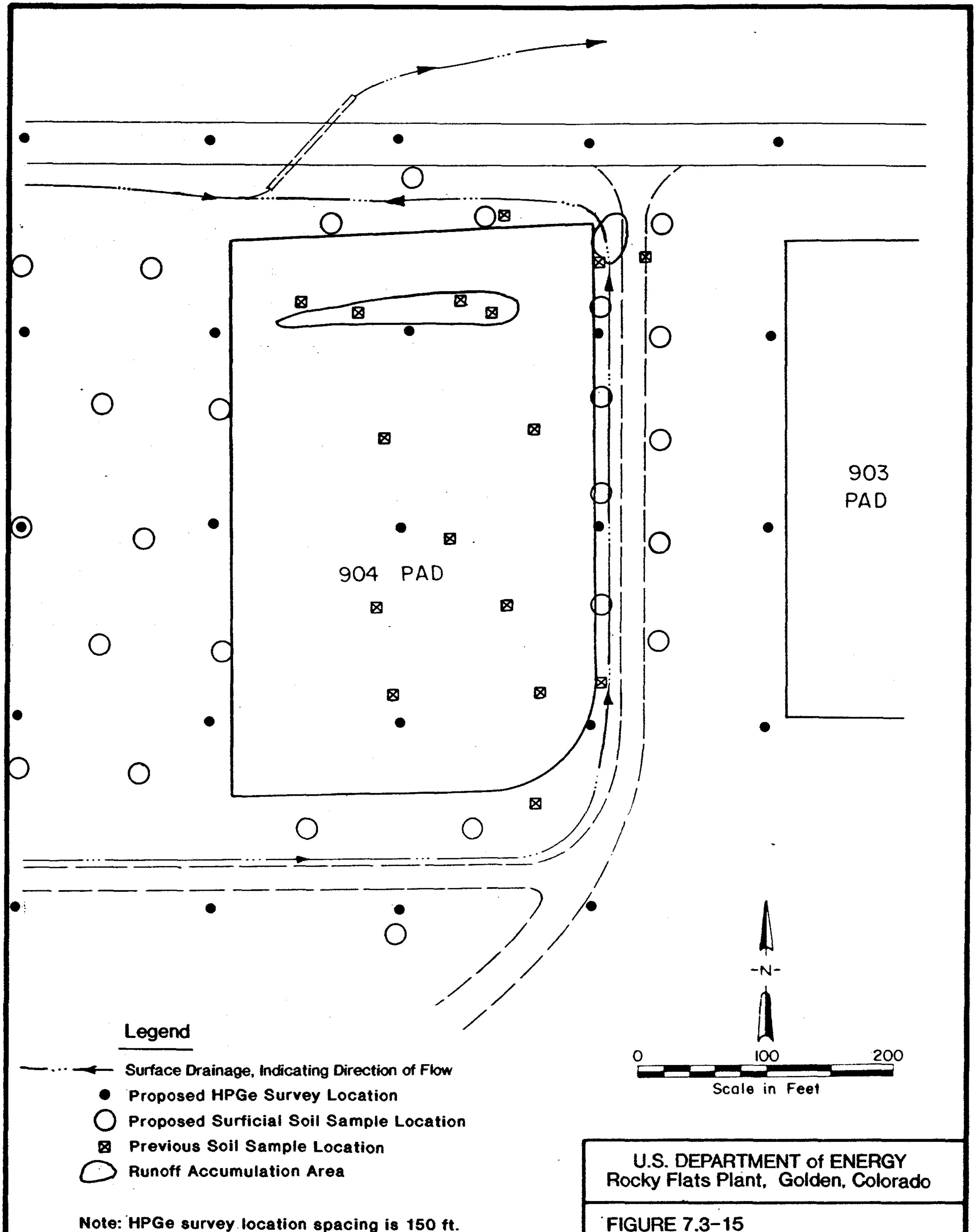

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FIGURE 7.3-15
Proposed Sampling Locations for Unit 15, 904 Pad Pondcrete Storage (IHSS 213)

The number of deep borings will be determined prior to stage 2 sampling and indicated in technical memorandum #2. Deep boring samples will be collected to 1 ft above the water table or 6 ft into bedrock, whichever is encountered first.

7.3.16 Unit 25, 750 Pad Pondcrete and Saltcrete Storage (IHSS 214)

IHSS 214 has historical information indicating the potential presence of anions and radionuclides. This site is covered by asphalt and has overhead pipelines and power lines associated with the IHSS but can be avoided during sampling. This site also has a concrete drainage associated with it. Because IHSS 214 is similar to IHSS 213, the sampling approach for IHSS 214 will generally follow that planned for IHSS 213 (Section 7.3.15). A HPGe survey will be conducted on a 150 ft grid prior to sampling. A soil gas survey will not be conducted due to no historical evidence of storage of volatile substances.

Twenty-five surficial soil samples are proposed for IHSS 214 and are located around the outside of the IHSS boundary (Figure 7.3-16). Surficial soil samples will be analyzed for BNAs onsite with a mobile lab and analyzed for metals at an offsite lab. Based on surficial soil analytical results at the IHSS, deep borings will be drilled.

The number of deep borings will be determined prior to stage 2 sampling and indicated in technical memorandum #2. Deep boring samples will be collected to 1 ft above the water table or 6 ft into bedrock, whichever is encountered first.

7.4 SAMPLING EQUIPMENT AND PROCEDURES

All field sampling and decontamination procedures will be in accordance with the most recent version of the RFP EMD OPS (EG&G, 1991). See Table 7-2 for procedures that will be used

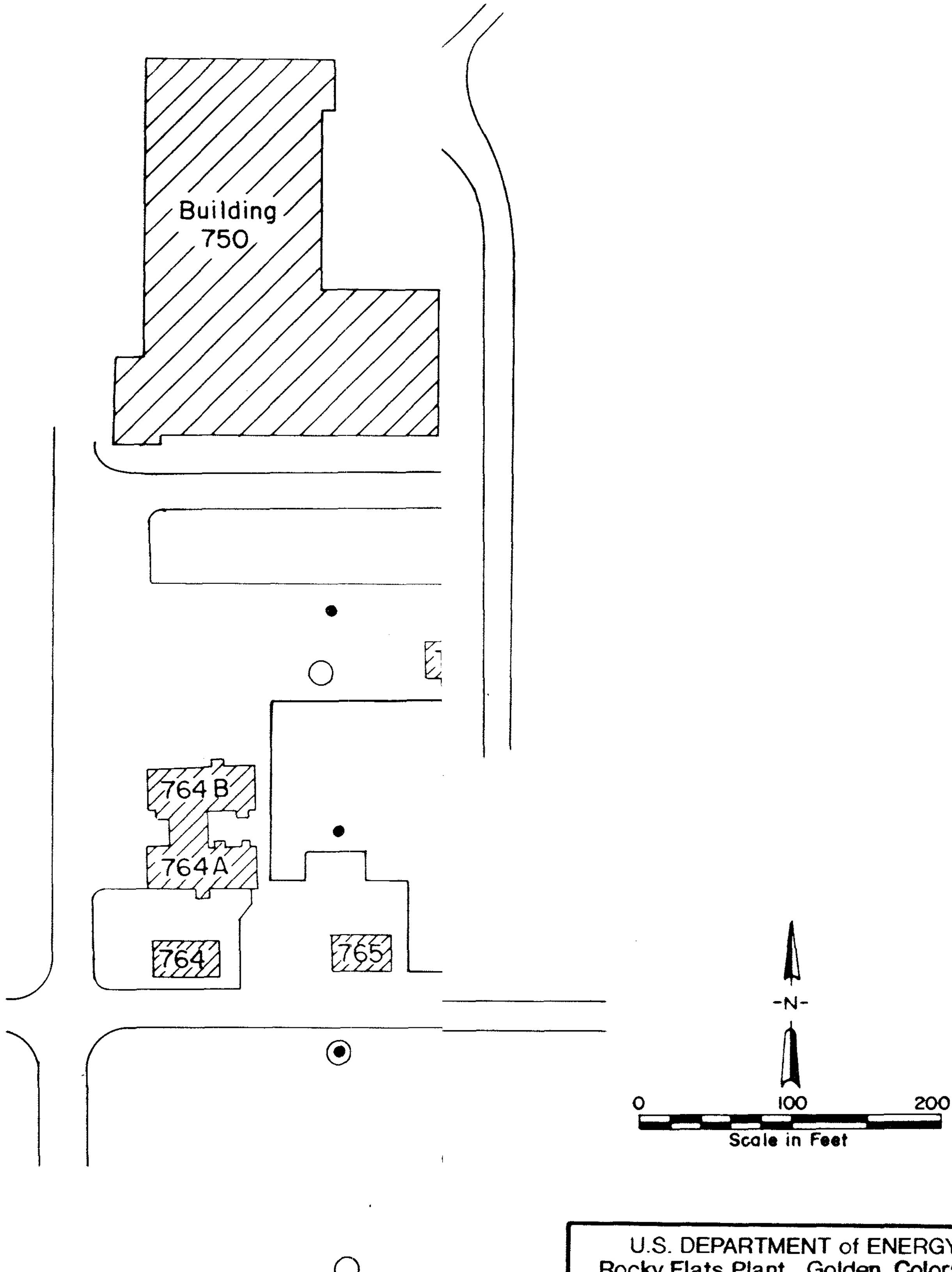

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FIGURE 7.3-16
Proposed Sampling Locations for Unit 25, 750 Pad Pondcrete and Saltcrete Storage (IHSS 214)

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50 ft.

2914

for each IHSS during Phase I. The version used to prepare this plan is dated February 1991. Sections of the EMD OPS are referenced where appropriate in the following sections. The EMD OPS are supplemented by EPA procedures (EPA 1987) and American Society of Testing Materials (ASTM) standards (ASTM 1991).

7.4.1 Surficial Soil Sampling Procedure

Surficial soil sampling will be conducted in accordance with EMD OPS GT.8 using the CDH method. A sample to be analyzed for radionuclides will be collected using a CDH sampler. A second sample from each grid node will be collected using a stainless steel scoop or trowel and stainless steel lab spoon as described in EMD OPS GT.8. This second sample will be divided into fractions for semivolatile organics and metals analysis. Semivolatiles analysis will be performed by an on-site mobile laboratory. Radionuclides and metals analysis will be conducted at a local off-site laboratory for quick turnaround.

7.4.2 Radiation Survey Procedure

Radiation surveys will be performed at many of the OU10 IHSSs. Sampling locations are IHSS dependent and are discussed in Section 7.3. The radiation readings will be taken on regular spaced grids according to the procedure described in EMD OPS FO.16 and the applicable EMD OPS cross-referenced in Section 4.2 of this EMD OPS. If readings above RFP background are detected, the size of the grid will be refined to 5 ft centers around the hot spot to further define the area of radioactive contamination. If readings above background are detected near the existing boundary of OU10 IHSSs, the grid will be expanded past the existing boundary. The results of the survey will be plotted and contoured on a map. The radiation survey will be conducted using a high purity germanium (HPGe) gamma ray detector developed for high resolution spectroscopy. The HPGe has a broad energy range, exhibits high resolution, excellent gain stability, moderate area averaging, and the ability to identify and quantify all gamma ray emitting radionuclides. The EMD OPS for the HPGe is presently under development and will be available prior to any OU10 Phase I field work. Other equipment requirements are listed in Section 5.2 of EMD OPS FO.16.

7.4.3 Soil Gas Sampling Procedure

Soil gas sampling will be conducted in accordance with EMD OPS GT.09. Soil gas samples will be collected from 2 to 4 ft below the ground surface. The samples will then be injected into a portable gas chromatograph (GC) for analysis. If soil gas samples are to be collected beneath asphalt or concrete, an electrical rotary hammer will be used to open a hole to the soil surface. Other related EMD OPS can be referenced in EMD OPS GT.09, Section 4.2; and equipment requirements are listed in Section 5.3.1.1 of this EMD OPS.

7.4.4 Pipeline Investigation

The sampling design and locations for pipeline investigation are discussed below. Pipeline sampling will be conducted using a three-stage approach. This section details activities to be conducted during each of the three stages of the pipeline investigations.

Tentative Stage 1 pipeline test pit locations are indicated in Figure 7.3-2. It must be emphasized that this represents only Stage 1 test pit locations at pipeline endpoints and known structural features. Information derived from additional data compilation activities, field observations, surface radiation surveys, and analytical results from previous stages of the investigation will dictate the specific sampling intervals required. The decision process for identification of sampling locations is discussed below.

7.4.4.1 Stage 1 Investigation

As discussed in Section 7.2, the investigation is designed to locate areas of contamination in OU10 vadose zone soils, based on conceptual model release scenarios (Section 2.2) and to provide an assessment of the nature of contamination at these locations. Pipelines will be investigated by excavating a series of tests pits along pipeline alignments. These test pits will provide the following:

- Confirmation of pipeline location and configuration
- Visual inspection of pipeline integrity
- Samples of surface soils
- Samples of pipeline trench backfill
- Samples of native soils beneath the pipeline trench
- Samples of any residue in pipelines.

The Stage 1 pipeline investigation will be conducted in accordance with all applicable EMD OPs. Activities will be governed by OPs as follows:

- Prework radiation survey of test pit locations will be conducted according to OP FO.16, Field Radiological Measurements

- Prior to excavation, test pit locations will be cleared according to OP GT.10, Borehole Clearing

- Surface soil samples will be collected using the grab sampling method per OP GT.8, Surface Soil Sampling

- Test pits will be excavated and sampled according to OP GT.7, Logging and Sampling of Test Pits and Trenches

- Water encountered in test pits will be sampled in accordance with OP SW.3, Surface Water Sampling

- Field parameters will be measured on test pit water samples in accordance with OP SW.2, Field Measurements of Surface Water Field Parameters

- Residue sampling in pipelines will be performed according to the OP revision presented in Section 11.0 of the Final Phase I RFI/RI Work Plan for Operable Unit 9.

- Wastes generated during the excavation of test pits and pipeline opening and sampling will be handled in accordance with OP FO.8, Handling of Drilling Fluids and Cuttings

- Test pit locations will be surveyed to achieve final location and elevation accuracies of ±0.1 ft per OP GT.17, Land Surveying.

Location of Test Pits

As discussed in the pipeline release conceptual model (Section 2.2), pipeline releases are most likely to occur at structural features in the pipeline. Structural features will be identified as primary test pit locations. Examples of structural features include:

- Valves, cleanouts, manholes, and other pipeline openings
- Elbows, tees, and reducers
- Pipe/tank connections
- Transitions in pipeline materials.

As described in Section 7.3, test pit construction will be performed at documented fittings, elbows, and valves. However, certain conditions may exist which mandate closer test pit spacing. Test pit spacing will be reduced under the following conditions:

- Poor pipeline integrity is observed in a test pit

- Poor pipeline integrity is observed in pipeline video inspection (see discussion below under Pipeline Video Inspection)

- Pipeline pressure testing results indicate pipeline leakage (see discussion below under Pipeline Pressure Testing).

The rationale for the reduction in test pit spacing is to double the sampling density in areas of uncertain conditions. This will increase the probability of identifying areas of contamination along the pipelines.

Surface Soil Sampling

A surface soil sample will be collected from each test pit location prior to excavation of the test pit. The sample location will be as close as possible to the center of the area to be excavated. Surface soil samples will be collected in accordance with the grab sample method described in OP GT.8, Surface Soil Sampling. The grab method is more applicable to collecting a discrete sample at a single location consisting of a small area. This is most appropriate for the OU10 investigation where one objective is to determine if contamination was deposited from an aqueous solution. Overlying pavement or other surface cover will be removed if necessary. Each surface soil sample will consist of a six inch square area sampled to a depth of six inches (i.e., a sample of dimensions six by six by six inches). This will provide sufficient sample volume to perform the analyses specified in Section 7.5.

Test Pit Excavation Procedures

Test pits will be excavated in accordance with the applicable provisions of OP GT.7, Logging and Sampling of Test Pits and Trenches. Test pit excavation will commence after collection of a surface soil sample at the test pit location, and after removal of any pavement or other surface cover as necessary. Pipelines must be exposed in their *in-situ* condition so that unbiased assessment of pipeline integrity can be made. Test pit construction will therefore be performed in a manner that does not damage the *in-situ* conditions of the pipelines. Mechanized digging equipment (e.g., backhoes) will be used to remove only the bulk of material covering the pipeline. Periodic manual probing may be necessary to measure the depth of the remaining cover. Once a depth of cover less than one foot remains, test pit excavation will be completed with shovels. Information gathered to complete excavation permitting procedures, described in OP GT.10, will help in planning the excavation by identifying potential interferences (e.g., nearby underground utilities).

Test Pit Logging and Sampling

Test pit logging and sampling will be conducted in accordance with OP GT.7, Logging and Sampling of Test Pits and Trenches. At each test pit, the condition of the exposed pipe material will be described and documented. Evidence of pipeline degradation (e.g., excessive corrosion, holes, cracks) will be described in detail. The pipeline and test pit will be photographed and sketched in accordance with OP GT.7. The location and invert elevation of the pipe will be surveyed. Soil exposed in the excavations will be described for visible contamination, extent of trench backfill, and the type of backfill material.

Nominal Stage 1 soil sample locations are illustrated in Figure 7.3-1. One discrete soil sample will be collected at each of the following locations:

- Ground surface (prior to excavation)
- In trench backfill directly beneath the pipeline
- In native soil directly below trench.

After collection of soil samples, one sample of pipeline residue will be collected at every test pit where feasible to characterize wastes. In instances where no residue is present, one wipe sample will be taken on the interior surface of pipeline components. Wipe samples will be collected and tested according to OP FO.16, Field Radiological Measurements. This will provide a qualitative measure of radionuclide contamination. In addition, inside surface radiological dose rate measurements will be obtained by inserting a low energy gamma probe radiation detector into the pipeline. These measurements will be useful in verifying process piping historical data and allow for future disposal criteria. Valves, cleanouts, manholes, and other pipeline openings will be the preferred locations for collection of residue samples. Where other access is in to available, the pipe will either be cut open or dismantled at test pit exposure. Pipe sections which are dismantled will be reassembled if possible. Pipe sections which are cut or which cannot be reassembled will be grouted closed with a plug of nonshrinking cement.

If groundwater is encountered in a test pit, a groundwater grab sample will be collected in accordance with OP SW.3, Surface Water Sampling, and submitted for analysis. field parameters will be measured on the groundwater sample as discussed in Section 7.5. No attempt will be made to open pipelines and collect residue samples. The trench backfill directly below the pipeline will be sampled if possible, but the native soil directly beneath the trench will not be samples. The depth at which groundwater is encountered will be recorded.

Pipeline Location and Tracing

In general, it is expected that pipeline structural features will allow pipeline alignments to be traced sufficiently to locate test pits along the alignment. Where structural features are absent or widely spaced, however, pipeline location devices may be utilized to trace the pipelines. The method used will depend upon the pipe construction material. Conductive pipes can be readily located by attaching a transmitter to the outer surface of the pipe. This produces a signal along the buried pipeline which can be traced by a detector at the surface. For nonconductive pipes, a flexible steel tape or similar conductive material must be inserted into an opening in the pipe and fed down the pipeline to carry the signal. Alternatively, a transmitting sonde can be inserted and moved down the pipeline with push rods or a steel tape. Pipeline video inspection (see discussion below) can also be utilized to trace pipeline alignments by providing azimuth and range data. Ground-penetrating radar (GPR) may provide another method of tracing pipelines, although its efficacy may be limited by the clayey, cobble-rich soil of the site and by congestion of pipelines and utility lines at many locations.

Pipeline location and tracing methods will be field-tested if it appears that pipeline tracing will be necessary to the Stage 1 pipeline investigation. Specific procedures for performing pipeline location and tracing will be provided by the contractor(s) selected to provide the service. These procedures will be modified as necessary to support the objectives of the OU10 RFI/RI and conform with project-specific health and safety or environmental protection requirements.

Pipeline Pressure Testing

Although the pipeline investigation has been designed to target both known release locations and locations most susceptible to releases, only a small percentage of the total pipeline system will be excavated and inspected. In order to more fully evaluate the current status of the pipeline system, pressure testing will be performed where possible on pipeline segments between available access points (test pits, manholes, valve vaults, etc.). Pressure testing will not be performed where potential access points are below the water table.

Pipeline pressure testing may aid in detecting release locations in unexcavated portions of pipelines, and in confirming the integrity of pipelines that appear sound in test pits. Where successfully performed, the testing will provide an additional measure of assurance that sections of pipeline which are not visually inspected have been evaluated. Pressure testing results together with historical data may provide sufficient justification to remove a particular pipeline section from further investigation and, more importantly, from having to be addressed by a final remedial action for OU10.

It should be noted that contamination may exist at locations where pipeline leaks were excavated and repaired. Contamination may also exist at locations where a replacement pipeline was installed in the same alignment where an older, leaking pipeline was removed. Pipelines which currently test "tight" may have ben repaired, or may be a replacement line for an older pipeline which leaked. Historical data may help identify locations of pipeline repair and replacement. However, it is expected that maintenance and construction records for the pipelines will be incomplete.

Techniques using tracer gas (typically helium) or sensors to detect air motion around leaks can be employed during pressure testing to identify specific leak locations along pipelines.

Pipeline Video Inspection

Video inspection of pipeline interior may be beneficial in evaluating the integrity of the pipeline and in tracing pipeline alignments. In particular, video inspection may aid in evaluating leaks detected through pipeline pressure testing, and aid in evaluating pipelines which are not conducive to pressure testing (e.g., vitrified clay pipelines). Video inspection can be performed on pipelines as small as three inches in diameter.

The potential applicability and benefits of pipeline video inspection depend upon the same factors that are identified above for pipeline pressure testing. Pipeline video inspection will be field-tested in order to evaluate its feasibility and potential benefits to the Stage 1 pipeline investigation. As with pipeline pressure testing, specific procedures for conducting video inspections will be provided by the contractor(s) selected to provide the service. These procedures will be modified as necessary to support the objectives of the OU10 RFI/RI and conform with project-specific health and safety or environmental protection requirements.

7.4.4.2 Stage 3 Investigation

As discussed in Section 7.3, the Stage 3 pipeline investigation will target contaminated sites identified during the Stage 1 investigation. The Stage 3 investigation is designed to provide a reasonable preliminary assessment of the extent of vadose zone soils contamination along pipeline alignments. The initial spread of contamination from pipeline releases is expected to be preferentially aligned along the pipeline. It is also expected that contaminant movement into native soils surrounding the pipeline trench will occur primarily from the bottom of the trench. Therefore, Stage 3 soil borings will be drilled along the pipeline alignments and will sample both trench fill material and native soil underlying the trench. The spacing of borings along the alignment is meant to help differentiate aerially restricted, lower-volume releases from potentially more significant higher-volume releases. The following discussion outlines the methods and procedures which will be employed during Stage 3.

Test pits (and borings for removed pipeline) identified as contaminated by Stage 1 analytical results will be sampled by soil borings drilled in a nominal pattern around the test pits as described in Technical Memorandum 2. Where a contaminated test pit occurs, additional soil borings will be drilled along the alignment in both directions from the contaminated pit. Where drilling rig access is restricted, the borings will be drilled as closely as possible to this nominal pattern. It may be possible in such instances to drill the borings with a hand auger, depending upon the depth required. Similarly, obstructions along the pipeline alignment (e.g., a building or security fence) may require modification of the nominal spacing.

Surface soil samples will be collected using the grab method described in OP GT.8, Surface Soil Sampling. Each surface soil sample will consist of a 6 inch square area sampled to a depth of 6 inches. Soil borings will be drilled and sampled in accordance with OP GT.2, Drilling and Sampling Using Hollow-Stem Auger Techniques, using the continuous core auger method. A three inch inside diameter sample barrel will be used to collect 2 ft long soil samples from the borings. A sample volume of 2,250 cubic centimeters (approximately 140 cubic inches) will be required to perform the analyses specified in Section 7.5.

Recent water level monitoring data, combined with information from alluvial isopach maps, will be used to predict depths to the water table and to bedrock at the various sampling locations. If the depth between the trench bottom and the water table or bedrock is less than 5 feet, the mid-depth soil sample will be omitted.

The Stage 2 pipeline investigation will be conducted in accordance with all applicable EMD OPs. Activities will be governed by OPs as follows:

- Prework radiation surveys of soil boring locations will be conducted according to OP FO.16, Field Radiological Measurements
- Prior to drilling, soil boring locations will be cleared according to OP GT.10, Borehole Clearing
- Surface soil samples will be collected using the grab method per OP GT.8, Surface Soil Sampling
- Soil borings will be drilled and sampled by continuous core auger methods according to OP GT.2, Drilling and Sampling Using Hollow-Stem Auger Techniques
- Soil boring samples will be logged according to OP GT.1, Logging of Alluvial and Bedrock Material

- Cuttings and fluid generated during drilling will be handled in accordance with OP FO.8, Handling of Drilling Fluids and Cuttings

- Soil borings will be plugged and abandoned per OP GT.5, Plugging and Abandonment of Boreholes

- Soil boring locations will be surveyed to achieve final location and elevation accuracies of ± 0.1 feet per OP GT.17, Land Surveying.

7.4.4.3 Stage 4 Investigation

The Stage 3 pipeline investigation may identify areas which warrant further characterization of vadose zone soils contamination. In particular, Stage 3 may indicate areas where contamination affects a significant length of pipeline alignment, suggesting a relatively large release from the pipeline. Following the completion of the Stage 3 pipeline investigation, the results of Stage 1 will be summarized in a technical memorandum, and the need for additional investigation will be resolved on a site-by-site basis for each contaminated area. Where additional investigation is determined to be appropriate, a Stage 4 pipeline investigation will be performed.

The Stage 3 investigation will utilize additional soil borings drilled along the pipeline alignment as necessary to fully determine the extent of contamination in vadose zone soils along the alignment, and in native soil adjacent to the alignment to evaluate any spread of contamination laterally from the pipeline trench into vadose zone soils.

Proposed Stage 4 boring locations will be documented through technical memoranda #3 which will be approved prior to implementation.

The Stage 3 pipeline investigation is designed to fully assess the lateral and vertical extent of contamination in vadose zone soils affected by pipeline releases. It is reasonable to expect that

Stage 3 will be implemented in stages in order to meet this objective, with borings located increasingly distant from the contaminant source until the lateral extent of vadose zone soils contamination is delineated. As discussed in Section 7.2, the extent of contamination will be determined through comparison of analytical results to values provided in the Final Background Geochemical Characterization Report (EG&G, 1991d), or to the most current background data available at the time the FSP is implemented, and to values specified in potential ARARs.

7.4.5 Tank Investigation

The sampling design and locations for the tank investigation are discussed below. This section details the activities to be conducted during the Stage 1 and Stage 2 tank investigations.

Tank locations targeted for investigation under the OU10 Phase I RFI/RI are identified in Figure 7.3-1, 7.3-2 and 7.3-10. Only tank locations identified in the Closure Plan are included in Figures 7.3-1, 7.3-2 and 7.3-10. The decision process used to identify tank investigation activities and sampling locations is discussed below.

7.4.5.1 Stage 1 Investigation

As discussed in Section 7.2, the Stage 1 tank investigation is designed to locate areas of contamination in OU10 vadose zone soils, based on conceptual model release scenarios (Section 2.2) and to provide an assessment of the nature of contamination at these locations. The following discussion outlines the methods and procedures which will be employed in the Stage 1 tank investigation.

The Stage 1 tank investigation will consist of the following activities:

- Visual inspections
- Residue sampling.

Tanks which are part of active waste management units will not be investigated. Residue samples will not be collected from tanks which have been cleaned and painted since being removed from service.

Stage 1 tank investigation activities will be conducted in accordance with all applicable EMD OPs. Activities will be governed by the OPs as follows:

- Tank residue sampling will be performed according to the OP revision presented in Section 11.0 of the Final Phase I RFI/RI Work Plan for Operable Unit 9
- Prework radiation survey of soil boring locations will be conducted according to OP FO.16, Field Radiological Measurements
- Prior to drilling, soil boring locations will be cleared according to OP GT.10, Borehole Clearing
- Surface soil samples will be collected using the grab method per OP GT.8, Surface Soil Sampling
- Soil borings will be drilled and sampled by continuous core auger methods according to OP GT.2, Drilling and Sampling Using Hollow-Stem Auger Techniques
- Soil boring locations will be surveyed to achieve final location and elevation accuracies of ±0.1 feet per OP GT.17, Land Surveying.

Tank Inspections

Tanks will be inspected to visually assess tank integrity. Both the interior and exterior of above-grade and on-grade tanks will be inspected. Detailed tank inspection work instructions and a form to document the inspection will be developed by the contractor that implements the OU10 Phase I RFI/RI. Observations of poor tank integrity (e.g., excessive corrosion, holes cracks and visual indication of contamination) will be documented and used to focus subsequent soil sampling efforts. Where possible, tank inspection will be conducted remotely to mitigate the need for entry into confined spaces. Access permits may be required to inspect some tank locations.

Residue Sampling

One residue sample will be collected from each tank which has not been cleaned since removal from process waste service to help characterize wastes. In instances where no residue is present, one wipe sample will be taken on the interior surfaces of the tank (preferably at the base of the tank or near pipeline connections). Wipe samples will be collected and tested according to OP FO.16, Field Radiological Measurements. This will provide a qualitative measure of radionuclide contamination. Where possible, residue or wipe samples will be collected remotely, to mitigate the need for entry into confines spaces. In addition, inside surface radiological dose rate measurements will be obtained by inserting a low energy gamma probe radiation detector into the tank. These measurements will be useful in verifying tank historical data and allow for future disposal criteria.

7.4.5.2 Stage 3 Investigation

Soil Boring Locations

Soil borings will be drilled and sampled during the Stage 3 tank investigation to identify areas of contamination immediately adjacent to the tank location. As discussed in the conceptual model release scenario (Section _____), contamination will most likely to exist at the following locations around tanks:

- Beneath or near external connections and openings
- Near joints or corners around underground tanks
- Beneath the base of the tank.

Areas beneath or near external connections and openings, and near joints or corners around underground tanks, will be targeted as primary soil boring locations. "Hot spots" identified through the surface radiation or soil gas surveys will also be targeted as primarily test pit locations. Soil borings will not be drilled for tanks inside or beneath production buildings that are not accessible from outside the building, as this would disrupt building operations.

Because tank locations vary widely in size and configuration, a nominal pattern for soil borings is not appropriate. As a general rule, it is proposed that one soil boring be drilled on each accessible side of the tank location. If field observations suggest that more or less soil borings are needed to adequately characterize the soils immediately surrounding a tank location (i.e., for very large or very small tank locations), proposed soil boring locations for the particular site will be documented in technical memoranda and approved prior to implementation. In all cases, soil borings will be drilled as close as possible to the tank structure.

Sampling of Soil Borings

Nominal soil boring sampling locations for the Stage 3 tank investigation will be addressed in Technical Memorandum #2. One discrete soil sample will be collected at each of the following locations:

- Ground surface (prior to drilling)
- One to 3 feet below the base of below-grade tanks unless base of tank is in bedrock; for above-grade or on-grade tanks, mid-depth between the ground surface and the water table or alluvium/bedrock interface, whichever is encountered first
- Directly above the water table or bedrock/alluvium interface, whichever is encountered first.

Regardless of whether the water table is encountered during drilling, a soil sample will be collected if possible from the interval one to three feet below the base of underground tanks. If the base of the tank extends into bedrock, however, a sample will be collected from the alluvium/bedrock interface and drilling will discontinue.

Surface soil samples will be collected using the grab method described in OP GT.8, Surface Soil Sampling. Each surface soil sample will consist of a 6-inch square area sampled to a depth of 6 inches. Soil borings will be drilled and sampled in accordance with OP GT.2, Drilling and Sampling Using Hollow-Stem Auger Techniques, using the continuous core auger method. A three-inch inside diameter sample barrel will be used to collect 2-foot long soil samples from the borings. A sample volume of 2,250 cubic centimeters (approximately 140 cubic inches) will be required to perform the analyses specified in Section 7.5.

Recent water level monitoring data, combined with information from alluvial isopach maps, will be used to predict depths to the water table and to bedrock at the various tank locations. If the depth between the ground surface and the water table or bedrock is less than 5 feet at above-grade or on-grade tank locations, the mid-depth soil sample will be omitted.

7.4.5.3 Stage 4 Investigation

The Stage 4 tank investigation is designed to determine the horizontal and vertical extent of contamination in vadose zone soils surrounding tank locations identified as contaminated during the Stage 3 tank investigation. These tank locations will be further investigated by drilling and sampling additional soil borings.

As with Stage 3 soil boring locations, the unique configuration of each tank location makes it impractical to establish a nominal sampling pattern for Stage 4 activities. As such, Stage 4 soil boring locations and subsurface sampling frequency will be developed on a case-by-case basis. The proposed Stage 4 investigation for each tank location will be documented in technical Memorandum #3 which will be approved prior to implementation.

The Stage 4 tank investigation is designed to fully assess the lateral and vertical extent of contamination in vadose zone soils affected by tank releases. It is reasonable to expect that Stage 4 will be implemented in tiers in order to meet this objective, with borings located increasingly distant from the contaminant source until the lateral extent of vadose soils contamination is delineated. The extent of contamination will be determined through comparison of analytical results to values provided in the Final Background Geochemical Characterization Report (EG&G, 1991d), or to the most current background data available at the time the FSP is implemented, and to values specified in potential ARARs.

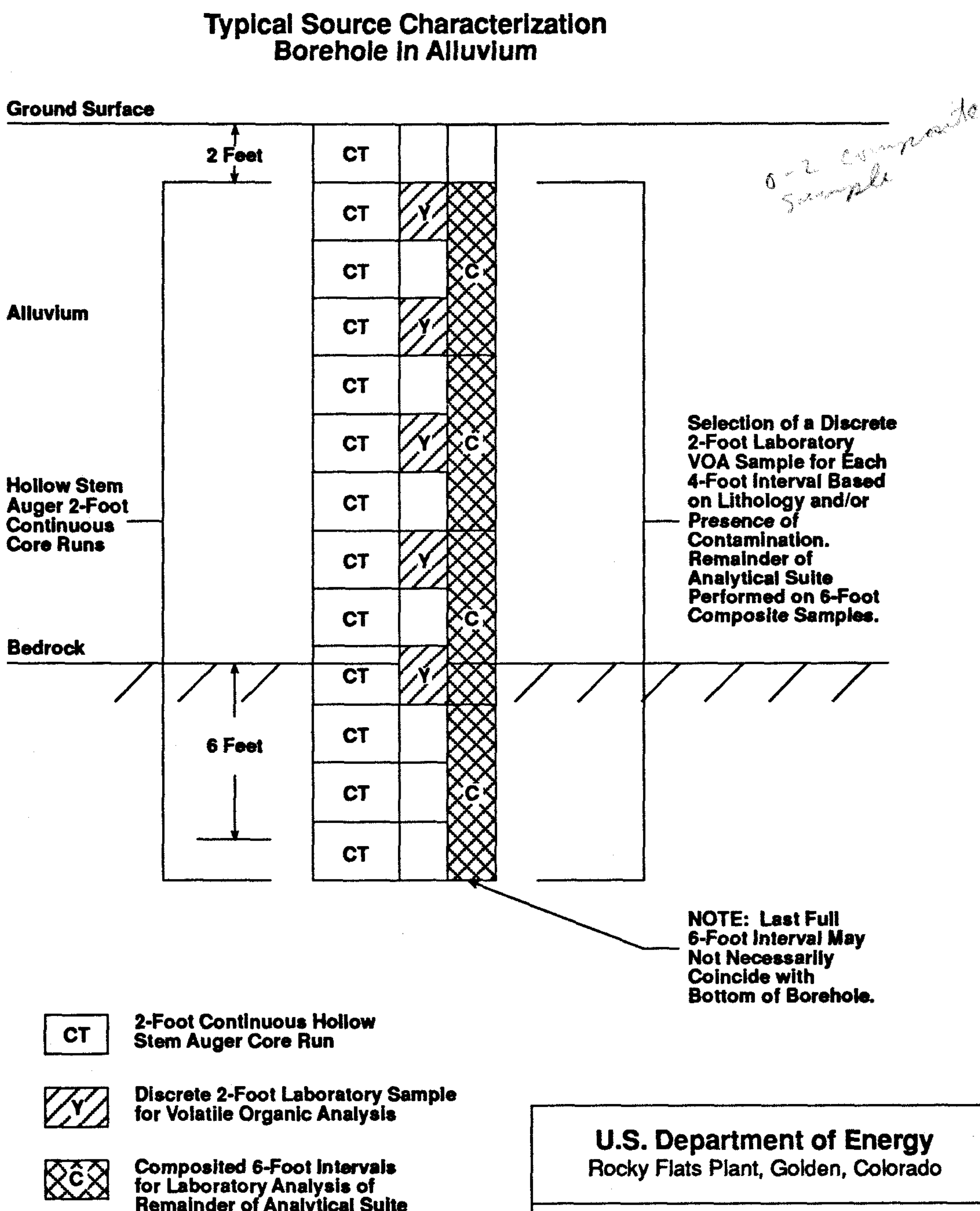
7.4.6 Borehole Drilling, Asphalt Sampling, Concrete Sampling, and Soil Sampling Procedures

Borings will be drilled to determine the geotechnical characteristics of the soil, collect samples for physical and chemical analysis and install piezometers to determine the elevation of the water table. Before any boreholes are drilled, the location will be cleared in accordance with EMD OPS GT.10.

Drilling will be in accordance with EMD OPS GT.02 except where material is impenetrable to this method. In the case where auguring is ineffective, rotary drilling will be used in accordance with EMD OPS GT.04. Rotary drilling will be used in situations where material is impenetrable, otherwise hollow-stem auguring will be the method of choice. The bedrock borings must be completed in accordance with EMD OPS GT.03. At locations with shallow borings where the drill rig cannot enter, hand augers will be used in accordance with guidelines in EMD OPS GT.02 and .08.

All boreholes will be drilled to groundwater or a depth penetrating bedrock by 6 feet (Figures 7.4-1 and 7.4-2).

All drill cuttings and soil samples will be monitored for radionuclides and organic vapors in accordance with EMD OPS FO.15, Use of Photoionizing and Flame Ionizing Detectors, and EMD OPS FO.06, Field Radiological Measurements. These procedures are described in the Health and Safety Plan. Investigation-derived wastes, such as drill cuttings and residual samples, will be handled according to guidelines in EMD OPS FO.08 and .09.



U.S. Department of Energy
Rocky Flats Plant, Golden, Colorado

Figure 7.4-1
Lithologic and Chemical Sampling for Source Characterization Boreholes in Alluvium

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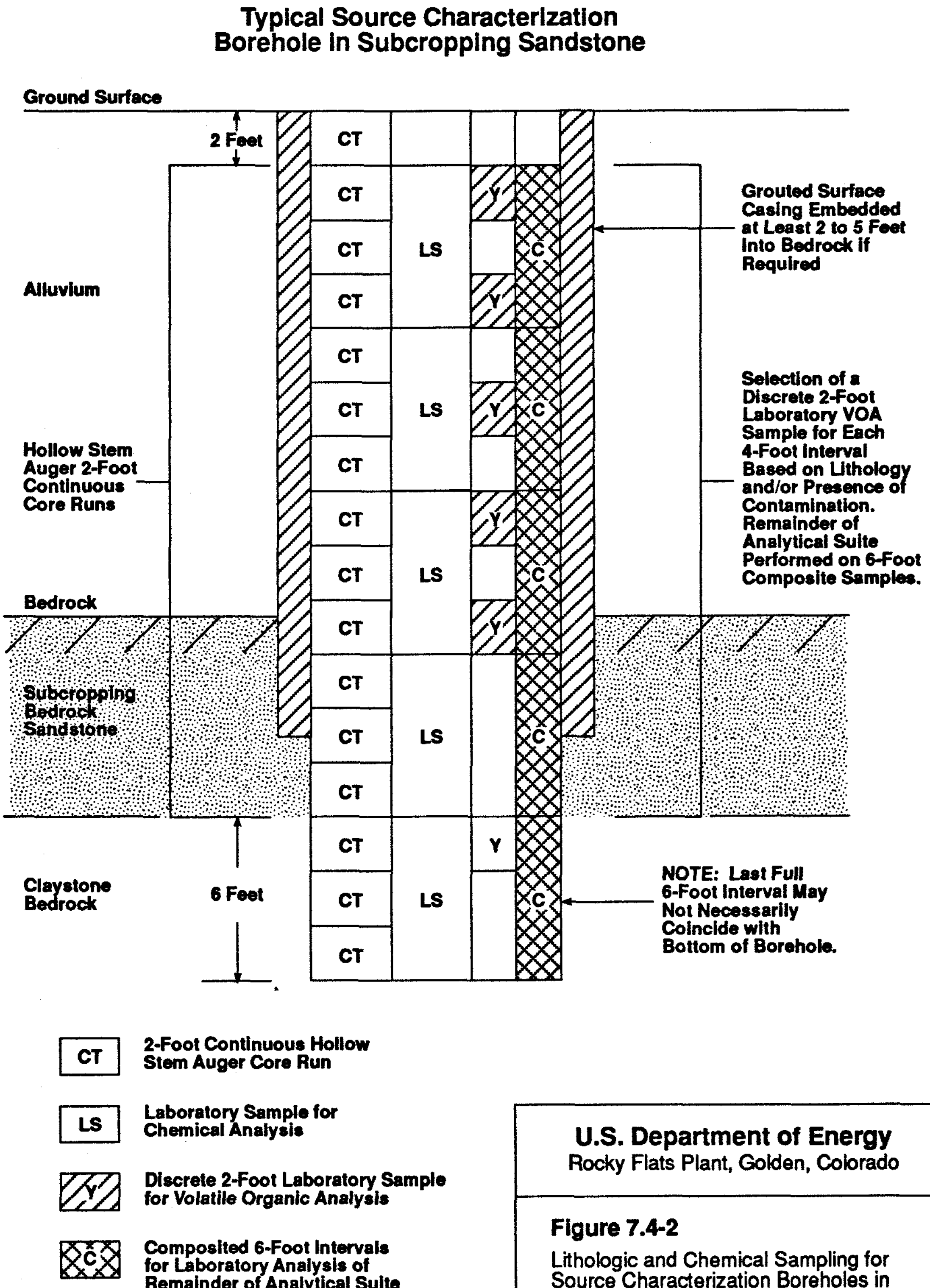

U.S. Department of Energy
Rocky Flats Plant, Golden, Colorado

Figure 7.4-2
Lithologic and Chemical Sampling for Source Characterization Boreholes in Subcropping Sandstone

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Before and after drilling and sampling takes place all equipment must be decontaminated in accordance with the procedures outlined in the EMD OPS FO.03 and .04. Decontamination water will be handled according to guidelines in EMD OPS FO.07.

All of the borings not completed as piezometers will be grouted and abandoned immediately after drilling in accordance with procedures outlined in EMD OPS GT.05. Procedures specified in this EMD OPS are designed to prevent vertical migration of contaminants after abandonment.

Equipment requirements are listed in EMD OPS GT.02, Section 5.1; and other applicable EMD OPS are listed in Section 4.2 of this EMD OPS.

Soil and bedrock samples will be collected during drilling for visual logging in accordance with EMD OPS GT.01 and for chemical and physical analysis in accordance with EMD OPS GT.02 and FO.13. The soil and bedrock samples will be collected using a hollow-stem auger with a continuous-core sampler. Continuous core will be collected for geologic descriptions for the entire borehole depth. From this core, discrete samples will be submitted for laboratory volatile organic analyses (VOA) beginning two ft from the ground surface, continuing every four ft to the water table. In addition, a discrete VOA sample will be submitted to the laboratory if staining, discoloration, odor or other anomaly is observed during drilling. VOA soil samples should be collected in ring samplers that are capped and sealed upon recovery. In addition to the VOA samples, linear composite samples from the core will be submitted to the laboratory for analysis of the remaining chemical parameters form every consecutive 6 ft interval to 1 ft above the water table.

Soil samples for geotechnical analysis require a minimum amount of disturbance and will be collected in thin-walled metal tubes. The thin-walled metal tube will be driven into the undisturbed soils in advance of the hollow-stem auger, removed, and the tube sealed for transport to the laboratory. An EMD SOPA for this procedure is currently under review. The EMD SOPA was prepared for the Geological Characterization Program.

Asphalt and concrete samples will also be collected at some IHSSs. These will consist of two small diameter (approximately 1 inch) core plugs. The core plugs will be collected using a core drill prior to the drilling of the borehole. The samples will be handled in accordance with EMD OPS FO.13. After the asphalt or concrete sample is collected, a rotary hammer will be used to open a hole to the soil surface for soil sampling.

7.4.7 Sediment Sampling Procedure

Sediment samples will be collected from locations identified in Section 7.3. At each of these locations, a core sampler with a core liner will be used to collect the top 2 inches of bed materials for VOC analysis. Samples for nonvolatile analysis will be collected with a stainless steel scoop. Sampling procedures will follow those outlined in EMD OPS SW.6. Sediment materials will be described according to EMD OPS GT.01.

7.4.8 Surface Water Sampling Procedure

If surface water is present, surface water samples will be collected at the same time that the sediment samples are collected. Field parameters will be measured following procedures outlined in EMD OPS SW.2. Samples will be collected according to procedures specified in EMD OPS SW.3.

7.4.9 Installing Piezometers

All piezometers will be constructed with new, flush threaded PVC (EMD OPS GW.6). An auger with an I.D. a minimum 4 inches larger than the well casing O.D. will be used to drill the monitoring wells to produce a minimum annular space of 2 inches. Well construction techniques will follow procedures outlined in EMD OPS GT.06. Investigation-derived wastes such as drilling fluids, cuttings, and residual samples will be handled in accordance with guidelines outlined in EMD OPS FO.08.

Well construction techniques for all piezometers will follow procedures contained in EMD OPS GT.06. Piezometer casings will be protected by the placement of steel posts around the piezometer, as described in EMD OPS GT.06. Pressure grouting procedures will follow guidelines outlined in EMD OPS GT.03. Additional equipment and materials that may be needed for piezometer installation are listed in EMD OPS GT.06, Section 5.1; other related EMD OPS are cross-referenced in Section 4.2 of this EMD OPS.

The wells will be developed no sooner than 48 hours and no longer than two weeks after completion. Water levels will be measured in all wells and recorded as outlined in EMD OPS GW.1 and the appropriately cross-referenced EMD OPS listed in Section 4.2 of the EMD OPS. After the water levels reach static conditions, the wells will be developed utilizing low-energy methods, such as an inertial pump or bottom discharging bailer. Well development will follow procedures outlined in EMD OPS GW.2.

All development and purge water will be handled in accordance with guidelines outlined in EMD OPS FO.08.

Water level measurements will be conducted in accordance with EMD OPS GW.1 and the appropriately cross-referenced EMD OPS listed in Section 4.2 of this EMD OPS.

7.4.10 Surveying of Sample Locations

The locations of all borings and surface sampling points will be paced and/or taped off prior to sampling or drilling. After sampling, drilling, or well installation, locations will be surveyed using standard land surveying techniques described in the EMD OPS GT.17. Horizontal accuracy will be ±0.5 ft for borings and ±0.1 ft for wells. Vertical accuracy will be ±0.1 ft for borings and ±0.01 ft for wells. Three elevations will be determined for each well: ground surface, top of well casing, and top of surface casing.

7.4.11 Tensiometer Installation and Monitoring Procedures

Tensiometers equipped with pressure transducers will be installed to measure metric potential of water in the unsaturated zone. The tensiometers will consist of a porous ceramic cup attached to a rigid plastic tube. The internal volume of the system will be completely filled with water. The pores in the cup form a continuum with the pores in the soil. Water will move either into or out of the tensiometer system, until equilibrium is attained across the ceramic cup. Multiple tensiometers allow for the determination of the direction and in some cases, the quantity of water flux from the ground surface to the water table.

Three tensiometer arrays each will be installed at IHSSs 170 and 176. Each array will consist of multiple tensiometers buried at 2 ft intervals from 1 ft above the water table to within 2 ft of the ground surface. The tensiometers will be installed by pushing them through the bottom of boreholes drilled with small diameter solid stem augers to minimize the soil disturbance. The boreholes will be backfilled with natural occurring soils to a compaction slightly greater than the bulk density of the undisturbed soils to reduce surface water infiltration, which results in abnormally low tensions in the backfill and the undisturbed soil.

Water used in the tensiometers must be deaerated and onsite purging may be necessary to prevent the formation of bubbles which can prevent accurate data collection. Purging time will be kept short to minimize wetting of soil adjacent to the porous tensiometer cup. When purging is complete, the system is closed and the soil draws water through the porous cup until equilibrium is established and the pressure is recorded by the pressure transducer and data logger.

The tensiometers will be monitored for at least one annual cycle from when the tensiometers are installed. The EMD OPS for the installation and monitoring of tensiometers is presently under development and will be available prior to any OU10 Phase I field work.

7.4.12 BAT@ Groundwater Sampling System

The BAT@ Groundwater Sampling System will be used to collect grab groundwater samples from the top of the water table. The BAT@ sampler consists of a filter tip connected to a hollow extender pipe. Inside the pipe, the filter tip is sealed from the rest of the pipe by a septum. A housing is lowered and raised in the extender pipe by wireline. The housing contains an evacuated vial in its upper end and a spring-loaded, double-ended needle on the lower end.

A sample is collected with the BAT when the housing is lowered to the filter tip. The spring-loaded, double-ended needle assemblage contracts and the needles piece the filter tip septum and the septum on the vial. The vial then fills with water. When the vial is filled, it is retrieved with the wireline.

The BAT sampler can be used with a hollow-stem auger. A borehole is drilled to within 1 to 2 ft of the water table and the BAT is driven through the end of the auger into the water table. The BAT sampling will be conducted outside the IHSS boundaries, down gradient from areas identified as contaminated during the surficial soil sampling.

An EMD OPS will be prepared for the BAT sampling prior to the OU10 field program.

7.5 SAMPLE ANALYSIS

This section describes the sample handling procedures and analytical program for samples collected during the Phase I RFI/RI investigation. It also includes discussions of sample designations, analytical requirements, sample containers and preservation, and sample handling and documentation.

7.5.1 Sample Designation

All sample designations generated for the Phase I RFI/RI will conform to the input requirements of the Rocky Flats Environmental Data System (RFEDS). Each sample designation will contain a nine-character sample number consisting of a two-letter prefix identifying the media sample (e.g., "SB" for soil borings, "SS" for surface soils), a unique five-digit number, and a two-letter suffix identifying the contractor. One sample number will be required for each sample generated, including QC samples. In this manner, 99,999 unique sample numbers are available for each sample media for each contractor that contributes sample data to the database. Boring numbers will be developed independently of the sample number for a given boring. These sample numbering procedures are consistent with the RFP QAPjP.

7.5.2 Analytical Requirements

Generally, samples from the Phase I RFI/RI will be analyzed for some or all of the following chemical and radionuclide parameters:

- Nitrate
- TAL analytes
- Uranium 233/234, 235, 236, and 238
- Transuranic elements (plutonium and americium)
- Gross alpha and gross beta
- Total dissolved solids
- TCL organics
- TCL PCBs
- Inorganics
- Anions (groundwater only)
- Field parameters (water only).

The analytical suites for each OU10 IHSS were developed according to the type of waste suspected to be present at each site. Table 7-4 lists the specific analytes in the above groups and their CLP detection/quantitation limits. These analytes and limits should address the bulk of detection of soil, sediment, surface water, and groundwater contamination, if present. Nitrates are included because low-level radioactive wastes with high nitrate concentrations may be present. Metals are suspected at many of the IHSSs in OU10; therefore, all of the TAL analytes have been selected for Phase I RFI/RI analysis. Both filtered and unfiltered samples of surface water and groundwater will be collected and analyzed at each location.

Table 7-4 Phase I Soil, Sediment, and Water Sampling Parameters and Detection/Quantitation Limits

Target Analyte List	Water (ug/l)	Soil/Sediment (mg/kg)
Metals and Cyamide		
Aluminum	200	40
Antimony	60	12
Arsenic	10	2
Barium	200	40
Beryllium	5	1.0
Cadmium	5	2.0
Calcium	5000	2000
Chromium	10	2.0
Cobalt	50	10
Copper	25	5.0
Cyanide	10	10
Iron	100	20
Lead	5	1.0
Magnesium	5000	2000
Manganese	15	3.0
Mercury	0.2	0.2
Nickel	40	8.0
Potassium	5000	2000
Selenium	5	1.0
Silver	10	2.0
Sodium	5000	2000
Thallium	10	2.0
Vanadium	50	10.0
Zinc	20	4.0

Table 7-4 Phase I Soil, Sediment, and Water Sampling Parameters and Detection/Quantitation Limits

Target Analyte List	Water (ug/l)	Soil/Sediment (mg/kg)
Other Metals		
Lithium	100	20
Molybdenum	200	40
Tin	200	40
Voltatile Organics		
Chloromethane	10	10
Bromomethane	10	10
Vinyl Chloride	10II	10
Chloroethane	10	10
Methylene Chloride	5	5
Acetone	10	10
Carbon Disulfide	5	5
1,1-Dichloroethene	5	5
1,1-Dichloroethane	5	5
1,2-Dichloroethene (total)	5	5
Chloroform	5	5
1,2-Dichloroethane	5	5
2-Butanone	10	10
1,1,1-Trichloroethane	5	5
Carbon Tetrachloride	5	5
Vinyl Acetate	10	10
Bromodichloromethane	5	5
1,2-Dichloropropane	5	5
cis-1,3-Dichloropropene	5	5

Table 7-4 Phase I Soil, Sediment, and Water Sampling Parameters and Detection/Quantitation Limits

Target Analyte List	Water (ug/l)	Soil/Sediment (mg/kg)
Trichloroethene	5	5
Dibromochloromethane	5	5
1,1,2-Trichloroethane	5	5
Benzene	5	5
trans-1,3-Dichloropropene	5	5
Bromoform	5	5
4-Methyl-2-pentanone	10	10
2-Hexanone	10	10
Tetrachloroethene	5	5
Toulene	5	5
Chlorobenzene	5	5
Ethyl Benzene	5	5
Styrene	5	5
Total Xylenes	5	5

Target Compound List	Water (ug/l)	Soil/Sediment (mg/kg)
BNAs		
Phenol	10**	330
bis(2-Chloroethyl)ether	10**	330
1,3-Dichlorobenzene	10	330
1,4-Dichlorobenzene	10	330
Benzyl alcohol	10	330
1,2-Dichlorobenzene	10	330
2-Methylphenol	10	330
bis(2-Chloroisopropyl)ether	10	330
4-Methylphenol	10	330
N-Nitroso-di-n-propylamine	10	330
Hexachloroethane	10	330
Nitrobenzene	10**	330
Isophorone	10	330
2-Nitrophenol	10	330
2,4-Dimethylphenol	10	330
Benzoic acid	50	1600
bis(2-Chloroethoxy)methane	10	330
2,4-Dichlorophenol	10	330
1,2,4-Trichlorobenzene	10	330
Naphthalene	10	330
4-Chloroaniline	10	330
Hexachlorobutadiene	10	330
4-Chloro-3-methylphenol (para-chloro-meta-cresol)	10	330
2-Methylnaphthalene	10	330
Hexachlorocyclopentadiene	10	330

Target Compound List	Water (ug/l)	Soil/Sediment (mg/kg)
2,4,6-Trichlorophenol	10	330
2,4,5-Trichlorophenol	50	1600
2-Chloronapthalene	10	330
2-Nitroaniline	50	1600
Dimethylphthalate	10	330
Acenaphthylene	10	330
2,6-Dinitrotoluene	10	330
3-Nitroaniline	50	1600
Acenaphthene	10	330
2,4-Dinitrophenol	50	1600
4-Nitrophenol	50	1600
Dibenzofuran	10	330
2,4-Dinitrotoluene	10	330
Diethylphthalate	10	330
4-Chlorophenyl-phenyl ether	10	330
Fluorene	10	330
4-Nitroaniline	50	1600
4,6-Dinitro-2-methylphenol	50	1600
N-nitrosodiphenylanmine	10	330
4,-Bromophenyl-phenylether	10	330
Hexachlorobenzene	10**	330
Pentachlorophenol	50	1600
Phenanthrene	10	330
Anthracene	10	330
Di-n-butylphthalate	10	330
Fluoranthene	10	330

Target Compound List	Water (ug/l)	Soil/Sediment (mg/kg)
Pyrene	10	330
Butylbenzylphthalate	10	330
3,3'-Dichlorobenzideine	20**	660
Benzo(a)anthracene	10	330
Chrysene	10	330
bis(2-Ethylhexyl)phthalate	10	330
Di-n-octylphthalate	10	330
Benzo(b)fluoranthene	10	330
Benzo(k)fluoranthene	10	330
Benzo(a)pyrene	10	330
Indeno(1,2,3-cd)pyrene	10	330
Dibenz(a,h)anthracene	10	330
Benzo(g,h,i)perylene	10	330
Pesticides		
alpha-BCH	0.05	8.0
beta-BCH	0.05	8.0
delta-BCH	0.05	8.0
gamma-BCH(Lindane)	0.05	8.0
Heptachlor	0.05**	8.0
Aldrin	0.05**	8.0
Heptachlor epoxide	0.05**	8.0
Endosulfan I	0.05	8.0
Dieldrin	0.10	16.0
4,4'-DDE	0.10	16.0
Endrin	0.10	16.0

Target Compound List	Water (ug/l)	Soil/Sediment (mg/kg)
Endosulfan II	0.10	16.0
4,4'-DDD	0.10	16.0
Methoxychlor	0.5	80.0
Endrin ketone	0.10	16.0
alpha-Chlordane	0.5**	80.0
gamma-Chlordane	0.5**	80.0
Toxaphene	1.0	160.0
PCBs		
Aroclor-1016	0.5**	80.0
Aroclor-1221	0.5**	80.0
Aroclor-1232	0.5**	80.0
Aroclor-1242	0.5**	80.0
Aroclor-1248	0.5**	80.0
Aroclor-1254	1.0**	160.0
Aroclor-1260	1.0**	160.0

Radionuclides	Water (ug/l)	Soil/Sediment (mg/kg)
Gross Alpha	2	4 dry
Gross Beta	4	10 dry
Uranium 233+234, 235, and 238 (each species)	0.6	0.3 dry
Americium 241	0.01	0.02 dry
Plutonium 239+240	0.01	0.03 dry
Tritium	400	400 (pCi/ml)
Cesium 137	1	0.1 dry
Strontium 89+90	1	1 dry

*Detection and quantitation limits are highly matrix dependent. The limits here are the minimum achievable under ideal conditions. Actual limits may be higher.

**The laboratory Practical Quantification Limits (PQLs) for these analytes exceed ARARs.

The following isotopes have been selected for analysis in Phase I: uranium 233/234, uranium 235, uranium 236, and uranium 238. Plutonium is the only transuranic element that is used on the site. However, americium is a daughter product of plutonium and has been detected in soil at OU10. Therefore, plutonium and americium have been selected as Phase I radionuclide parameters. Gross alpha and gross beta are included as screening parameters because they are useful indicators of radionuclides.

Volatile and semivolatile organics have been detected at concentrations above the detection limit in soil and have historically been stored at most of the OU10 IHSSs. Therefore, all of the TCL volatile and semivolatile organics will be included in the Phase I RFI/RI analyses.

The analytical parameters for the soil gas surveys at OU10 are TCE, 1,2-DCE, 1,1,1-TCA, methylene chloride, toluene, 2-butanone, acetone, ethylbenzene, PCE, carbon tetrachloride, and xylene (total). Table 7-5 lists the detection limits proposed for these parameters during the soil-gas survey.

7.5.3 Sample Containers and Preservation

Sample volume requirements, preservation techniques, holding times, and container material requirements are dictated by the media being sampled and by the analyses to be performed. The matrices to be analyzed include soils and sediments, and the water matrices for analysis will include surface water and groundwater. Tables 7-6 and 7-7 list the analytical parameters of interest in OU10 for water and soil matrices, along with the associated container size, preservatives (chemical and/or temperature), and holding times. Additional specific guidance on the appropriate use of containers and preservatives is provided in EMD OPS FO.13 (Containerizing, Preserving, Handling, and Shipping of Soil and Waste Samples).

Table 7-5 Phase I Investigation Soil Gas Parameters and Proposed Detection Limits

Sample Type	Detection Limit (µg/l)
Acetone	1
Carbon tetrachloride	1
Ethylbenzene	1
Hydrogen sulfide	1
Methylene chloride	1
Methane	1
PCE	1
TCE	1
Toluene	1
Xylenes (total)	1
1,1,1-TCA	1
1,2-DCE	1
2-Butanone	1

Note: Detection limits are a function of the detector type and injection volume. Thus, the detection limit may vary.

Table 7-6 Sample Containers, Sample Preservation, and Sample Holding Times for Water Samples

Parameter	Container	Preservative	Holding Time
<u>Liquid Samples - Low to Medium Concentration</u>			
Organic Compounds:			
Purgeable organics (VOCs)	2 x 40 mℓ VOA vials with teflon-lined septum lids	Cool, 4°C[a] with HCL to pH<2	7 days 14 days
Extractable organics (BNAs), pesticides, and PCBs	1 x 4 ℓ amber[b] glass bottle	Cool, 4°C	7 days until extraction, 40 days after extraction
Inorganic Compounds:			
Metals (TAL)	1 x 1 ℓ polyethylene bottle	Nitric acid pH<2; cool, 4°C	180 days[c]
Cyanide	1 x 1 ℓ polyethylene bottle	Sodium hydroxide[d] pH>12; cool, 4°C	14 days
Anions	1 x 1 ℓ polyethylene bottle	Cool, 4°C	14 days
Sulfide	1 x 1 ℓ polyethylene bottle	1 ml zinc acetate sodium hydroxide to pH>9; cool, 4°C	7 days
Nitrate	1 x 1 ℓ polyethylene bottle	Cool, 4°C	48 hours
Total dissolved solids (TDS)	1 x 1 ℓ polyethylene bottle	Cool, 4°C	48 hours
Radionuclides	1 x 1 ℓ polyethylene bottle	Nitric acid pH<2	180 days

a Add 0.008 percent sodium thiosulfate (Na2S203) in the presence of residual chlorine.
b Container requirement is for any or all of the parameters given.
c Holding time for mercury is 28 days.
d Use ascorbic acid only if the sample contains residual chlorine. Test a drip of sample with potassium iodine-starch test paper; a blue color indicates need for treatment. Add ascorbic acid, a few crystals at a time, until a drop of sample produces no color on the indicator paper. Then add an additional 0.6 g of ascorbic acid for each liter of sample volume.

Table 7-7 Sample Containers, Sample Preservation, and Sample Holding Times for Soil Samples

Parameter	Container	Preservative	Holding Time
Soil or Sediment Samples - Low to Medium Concentration			
Organic Compounds:			
Purgeable organics (VOCs)	1 x 4 oz wide-mouth teflon-lined glass vials	Cool, 4°C	7 days 14 days
Extractable organics (BNAs), pesticides, and PCBs	1 x 8 oz wide-mouth teflon-lined glass vials	Cool, 4°C	7 days until extraction, 40 days after extraction
Inorganic Compounds:			
Metals (TAL)	1 x 8 oz wide-mouth glass jar	Cool, 4°C	180 days[a]
Cyanide	1 x 8 oz wide-mouth glass jar	Cool, 4°C	14 days
Sulfide	1 x 8 oz wide-mouth glass jar	Cool, 4°C	28 days
Nitrate	1 x 8 oz wide-mouth glass jar	Cool, 4°C	48 hours
Radionuclides	1 x 8 oz wide-mouth glass jar	None	45 days

a Holding time for mercury is 28 days.

7.5.5 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 defining the necessary sample control, identification, and chain-of-custody documentation is discussed in EMD OPS FO.13.

7.6 DATA MANAGEMENT AND REPORTING PROCEDURES

Field data will be input to the RFEDS using a remote data entry module supplied by EG&G Rocky Flats. Data will be entered on a timely basis, and a 3.5-inch computer diskette will be delivered to EG&G Rocky Flats. A hard copy report will be generated from the module for contractor use. The data will undergo a prescribed QC process based on EMD OPS FO.14.

A sample tracking spreadsheet will be maintained by the contractor for use in tracking sample collection and shipment. EG&G Rocky Flats will supply the spreadsheet format and will stipulate timely reporting of information. These data will also be delivered to EG&G Rocky Flats on 3.5-inch computer diskettes. Computer hardware and software requirements for contractors using government-supplied equipment will be supplied by EG&G Rocky Flats. Computer and data security measures will also follow procedures outlined by EG&G Rocky Flats.

7.7 QUALITY ASSURANCE/QUALITY CONTROL 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 ER Program 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. Table 7-8 provides the frequency with which QC samples will be collected and analyzed.

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 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 preservation blanks of distilled water, preserved according to the preservation requirements (Section 7.5.3), will be prepared by the sampling team and will be used to provide an indication of any contamination introduced during field sample preparation. These QC samples are applicable only to samples requiring chemical preservation (Table 7-8).

Equipment (rinsate) blanks will be collected from final decontamination rinsate to evaluate the success of the field sampling team's decontamination efforts on nondedicated 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. Equipment rinsate blanks are applicable to all analyses for water and soil samples (Table 7-8).

Trip blanks consisting of distilled water will be prepared by the laboratory technician and will accompany each shipment of water samples for volatile organic 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 volatile organics or any problems associated with sample shipment,

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Table 7-8 Field QC Sample Frequency

		Media	
Sample Type	Type of Analysis	Solids	Liquids
Duplicates	Organics	1/10	1/10
	Inorganics	1/10	1/10
	Radionuclides	1/10	1/10
Field Preservation Blanks	Organics	NA	NA
	Inorganics	NA	1/20
	Radionuclides	NA	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	NR	NR
	Radionuclides	NR	NR

NA = Not Applicable
NR = Not Required
1/10 = one QC sampler per ten samples collected

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.

Procedures for monitoring field QC are provided in the RFP sitewide QAPjP.

Approved by:

_______________________ ___/___/___ _______________________ ___/___/___
Manager, Remediation Programs RFI Project Manager

QUALITY ASSURANCE ADDENDUM

This section consists of the Quality Assurance Addendum (QAA) for Phase I investigations at Operable Unit No. 10 (OU10), 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 OU10 Work Plan (OU10 WP).

OU10 is one of 16 operable units (OUs) identified for investigations under the Rocky Flats Plant (RFP) Interagency Agreement (IAG). OU10 contains 16 individual hazardous substance sites (IHSSs), which are described in Section 2 of the OU10 WP. The OU10 WP describes the Phase I characterization of source materials and soils at OU10 IHSSs. The OU10 WP was prepared in accordance with the Federal and State of Colorado regulations and guidance documents identified in the Introduction (Section 1.0).

10.1 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 OU10 WP. The specific EMD personnel who will interface with the Contractors and who will provide technical direction are shown in Figure 10-1.

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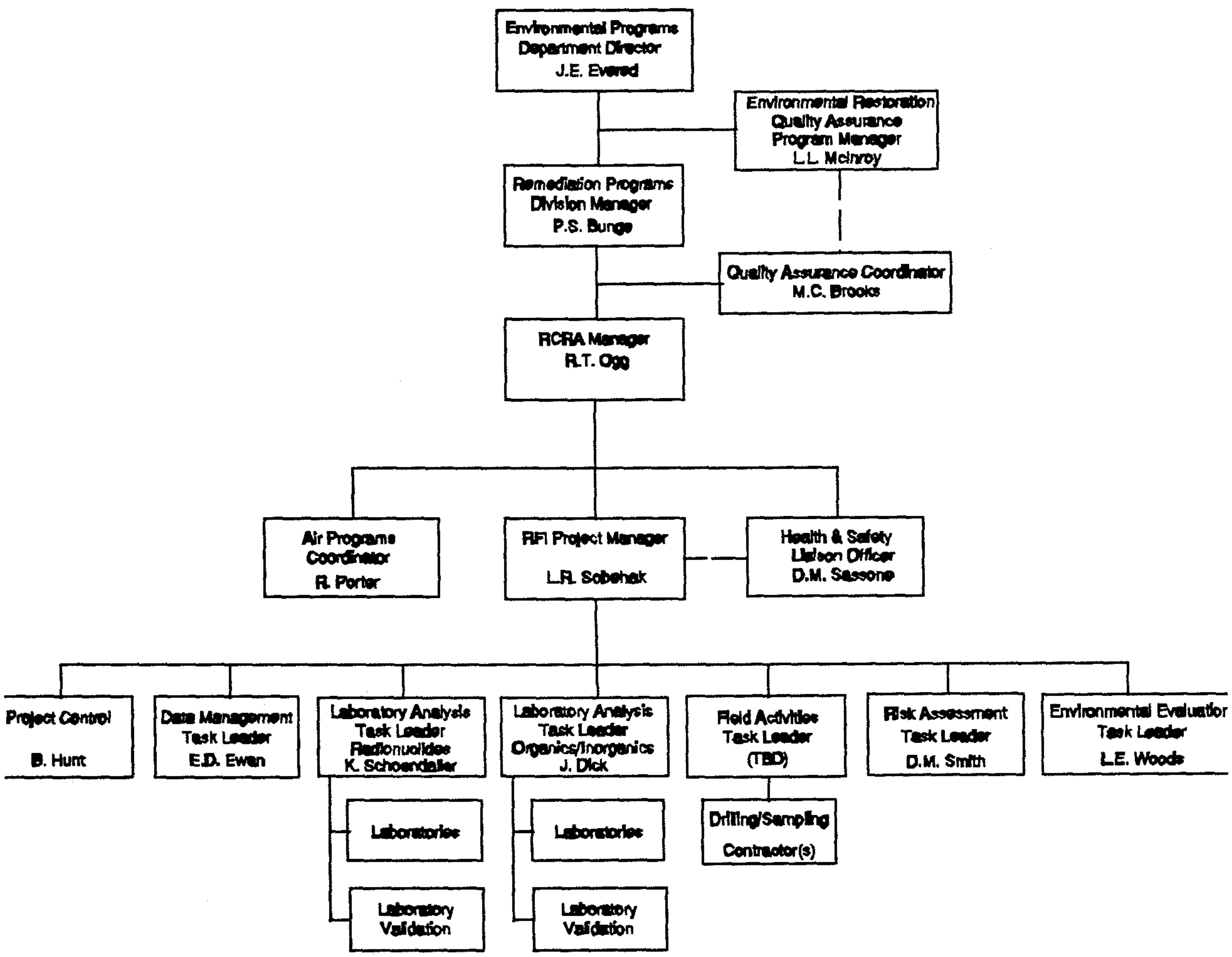
FIGURE 10-1. PROJECT MANAGEMENT FOR OPERABLE UNIT 10 OTHER OUTSIDE CLOSURES, PHASE I RFI/RI



10.2 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 the Environmental Protection Agency (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 OU10 Phase I activities, unless specified otherwise in this QAA. Where site-wide actions are applicable to OU10 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 OU10 Phase I activities that may not have been addressed on a site-wide basis in the QAPjP. Many of the QA requirements specific to OU10 are addressed in the OU10 WP and are referenced in this QAA.

10.2.1 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) that are applicable to OU10 investigations are specified within the respective procedures. The EMD OPs (which have been referred to as SOPs in the QAPjP and the OU10 WP) are identified in Table 10.1.

TABLE 10.1
EMD Operating Procedures and Field Activities for Which They are Applicable

Former SOP Reference Number	EMAD OPS Reference Number	Standard Operating Procedures	Biota Sampling	Asphalt & Concrete Sampling	Subsurface Soil/Mat Sampling	Surface Soil Sampling	Sediment Sampling	Surface-Water Sampling	Ground-Water Sampling	Well Drilling, Completion, Development	Field Screening Surveys
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	X	X	
1.16	FO.16	Field Radiological Measurements a) Walk-Over Surveys	X	X	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.04	Measurements for Groundwater Field Parameters							●		
2.6	GW.05	Groundwater Sampling							●		

X - As required by H&S plan.

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TABLE 10.1 (Continued)
EMD Operating Procedures and Field Activities for Which They are Applicable

Former SOP Reference Number	EMAD OPS Reference Number	Standard Operating Procedures	Biota Samples	Asphalt & Concrete Sampling	Subsurface Soil Sampling	Surface Soil Sampling	Sediment Sampling	Surface-Water Sampling	Ground-Water Sampling	Well Drilling, Completion, Development	Field Screening Surveys
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			●					●	
3.4	GT.04	Rotary Drilling and Rock Coring			●					●	
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			●						
3.11	GT.11	Plugging and Abandonment of Wells								●	
New	GT.17	Land Surveying			●					●	
4.1	SW.01	Surface Water Data Collection Activities						●			
4.2	SW.02	Field Measurement of Surface Water Parameters						●			
4.3	SW.03	Surface Water Sampling						●			
4.6	SW.06	Sediment Sampling					●				
5.1	EE.01	Sampling of Periphyton	●								
5.2	EE.02	Sampling of Benthic Macroinvertebrates	●								
5.3	EE.03	Sampling of Plankton	●								
5.4	EE.04	Sampling of Fishes	●								
5.5	EE.05	Sampling of Large Mammals	●								
5.6	EE.06	Sampling of Small Mammals	●								
5.7	EE.07	Sampling of Birds	●								
5.8	EE.08	Sampling of Reptiles and Amphibians	●								
5.9	EE.09	Sampling of Terrestrial Arthropods	●								
5.10	EE.10	Sampling of Terrestrial Vegetation	●								
5.11	EE.11	Identification of Habitat Types	●								
5.12	EE.12	Sampling of Soil for Soil Description	●								
5.13	EE.13	Development of Field Sampling Plans	●								

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10.2.2 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.

10.3 DESIGN CONTROL AND CONTROL OF SCIENTIFIC INVESTIGATIONS

10.3.1 Design Control

The OU10 WP describes the investigation activities that will be implemented during the Phase I characterization of the OU10 IHSSs. The OU10 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 OU10 WP is considered the investigation control plan for OU10 Phase I RFI/RI activities.

10.3.2 Data Quality Objectives

Data needs and data quality objectives (DQOs) for OU10 Phase 1 investigations are addressed in Section 4, and Section 9.2.1 for the Environmental Evaluation (EE) data. Identification of data needs and objectives assist decision makers in determining what the quality of the data should be, which in turn dictates the type of quality controls that are necessary to ensure that data of appropriate quality is generated. The DQOs for the OU10 Phase I investigations were established in accordance with Appendix A of the QAPjP. Data quality can be measured in terms of precision, accuracy, representativeness, comparability, and completeness (also referred to as PARCC parameters). These parameters are defined in Appendix A of the QAPjP.

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. Historical precision and accuracy measures for EPA Contract Laboratory Program (CLP) analytical methods have been determined. These historical measures have been selected as the goals for all Analytical IV and V data. (Analytical levels are defined and discussed in Appendix A of the QAPjP.) The precision and accuracy goals for Analytical Level IV and V data for EPA Target Analyte List, Target Compound List, and several indicator analytes are listed in Appendix B of the QAPjP. Precision and accuracy goals for Analytical Level I and II data, which consists of field screening and analysis measurements, have been established for several parameters and are also presented in Appendix B of the QAPjP. Table 4-1 of the OU10 WP identifies the analytical levels for each type of data to be generated during Phase I investigations. Goals for representativeness, comparability, and completeness for the RFP ER Program investigations, including OU10 Phase I investigations, are discussed in Appendix A of the QAPjP.

The ecological characterization activities described in Section 9 are considered screening activities that, typically, require Analytical Level I and II data. These characterization data will then be used, along with the OU10 RFI/RI characterization and source contamination data, to develop the conceptual model for the EE study. Data quality for these characterization activities will be controlled by adhering to the field sampling operating procedures in implementing the EE Field Sampling Plan (Section 9.3).

The conceptual model developed for the OU10 ecosystem will assist investigators in identifying site-specific target species, contaminants of concern, and potential exposure pathways. Additional DQOs for the contamination assessment tasks (Tasks 4 through 7 of Section 9) and the ecotoxicological studies (Task 8) will then be developed following steps recommended by the EPA in EPA/600/3-89/013, Ecological Assessments of Hazardous Waste Sites: A Field Guide and Laboratory Reference Document, and EPA/540/G-90/008, Guidance for Data Usability in Risk Assessment. The ecosystem characterization data and preliminary aquatic toxicity investigation data that will be obtained by implementing the EE Field Sampling Plan are needed to develop these additional DQOs.

10.3.3 Sampling Locations and Sampling Procedures

Sampling locations and frequencies for radiation, soil gas, asphalt/concrete, soil, sediment, surface water, and groundwater for each IHSS are addressed in Section 7.3 and summarized in Table 7-1. Sampling equipment and procedures for this sampling are identified in Section 7.4. Sampling locations and frequencies for the EE program, consisting of vegetation, periphyton, benthic macroinvertebrate, fish, and small mammals sampling, are addressed in Section 9.3. EE surveying and sampling procedures are identified in Section 9.4.

The operating procedures that are applicable to OU10 Phase I field activities and the particular activities to which they are applicable are summarized in Table 10.1.

10.3.4 Analytical Procedures

The analytical program for OU10 Phase I RFI/RI investigation is discussed in Section 7.5. The analytes of interest and the specified detection limits are identified in Table 7.2. 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 Section 7.5 are referenced in Appendix B of the QAPjP.

10.3.5 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, hydrogeologic/geologic testing, boring, sample collection, etc. shall also 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 OU10 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.

10.3.7 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 OU10 are addressed in Section 7.6 and identified in Table 7-6. 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.

10.3.7.1 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 7.2. 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 7-2. 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.

10.3.7.2 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.

10.3.8 Quality Assurance Monitoring

To assure the overall quality of the RFI/RI activities discussed in the OU10 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 6.0. At a minimum, each of the field sampling activities described in Sections 7.3 and 9.3 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 10.18.

10.3.9 Data Reduction, Validation, and Reporting

10.3.9.1 Analytical Reporting Turnaround Times

Analytical reporting turnaround times are as specified in Table 3-1 of Section 3.0 of the QAPjP.

10.3.9.2 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.

10.3.9.3 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.

10.3.9.4 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.

10.4 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.

10.5 INSTRUCTIONS, PROCEDURES, AND DRAWINGS

The OU10 WP describes the activities to be performed. The OU10 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 and the OU10 WP 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).

10.6 DOCUMENT CONTROL

The following documents will be controlled in accordance with Section 6.0 of the QAPjP:

- "Phase I RFI/RI Work Plan for Other Outside Closures, Operable Unit No. 10"
- "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. 10, Other Outside Closures, Phase I RFI/RI Activities
- EMD Operating Procedures (all operating procedures specified in the QAPjP, this QAA, and to-be-developed laboratory SOPs).

10.7 CONTROL OF PURCHASED ITEMS AND SERVICES

Contractors that provide services to support the OU10 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 OU10 investigations that have the ability to affect the quality of the data shall be inspected upon receipt.

10.8 IDENTIFICATION AND CONTROL OF ITEMS, SAMPLES, AND DATA

10.8.1 Sample Containers/Preservation

Appropriate volumes, containers, preservation requirements, and holding times for water and soil samples are presented in Tables 7-4 and 7-5. Requirements for EE samples are included here in Table 10.2.

10.8.2 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.

10.8.3 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.

10.9 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.

TABLE 10.2

HOLDING TIMES, PRESERVATION METHODS, AND SAMPLE CONTAINERS FOR BIOTA SAMPLES

	Holding Time From Date Collected	Preservation Method	Container	Approximate Sample Size*
SAMPLES FOR METALS ANALYSES				
TERRESTRIAL VEGETATION				
- Metals Determined by ICP**	6 mos.	Freeze & ship w/dry ice	Paper bag inserted into plastic bag and sealed	25 g
- Metals Determined by GFAA***	6 mos.	Freeze & ship w/dry ice	Paper bag inserted into plastic bag and sealed	25 g
- Hexavalent Chromium	24 hours	Freeze & ship w/dry ice	Paper bag inserted into plastic bag and sealed	25 g
- Mercury	28 days	Freeze & ship w/dry ice	Paper bag inserted into plastic bag and sealed	5 g
Periphyton and Benthic Macroinvertebrates				
- Metals Determined by ICP	6 mos.	Freeze & ship w/dry ice	Plastic	25 g
- Metals Determined by GFAA	6 mos.	Freeze & ship w/dry ice	Plastic	25 g
- Hexavalent Chromium	24 hours	Freeze & ship w/dry ice	Plastic	25 g
- Mercury	28 days	Freeze & ship w/dry ice	Plastic	5 g

TABLE 10.2

HOLDING TIMES, PRESERVATION METHODS, AND SAMPLE CONTAINERS FOR BIOTA SAMPLES

	Holding Time From Date Collected	Preservation Method	Container	Approximate Sample Size*
SAMPLES FOR RADIONUCLIDE ANALYSES				
Terrestrial Vegetation				
- Uranium 223, 234, 235, 238 Americium 241 Plutonium 239, 240	6 mos.	Freeze & ship w/dry ice	Paper bag inserted into plastic bag and sealed	1 kg
Periphyton and Benthic Macroinvertebrates				
- Uranium 233, 234, 235, 238 Americium 241 Plutonium 239, 240	6 mos.	Freeze & ship w/dry ice	Plastic	1 kg

* Sample size may vary with specific laboratory requirements.

**ICP = Inductively Coupled Argon Plasma Emission Spectroscopy. Metals to be determined include Ba, Cr, Cu, and Fe.

***GFAA = Graphite Furnace Atomic Absorption Spectroscopy. Metals to be determined include As, Cd, Li, Pb, Se, and Sr.

10.10 INSPECTION

Procured materials and construction activities (e.g., groundwater monitoring well installation) shall be inspected (as applicable) in accordance with the requirements specified in Section 10.0 of the QAPjP.

10.11 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 OU10 WP.

10.12 CONTROL OF MEASURING AND TEST EQUIPMENT (M&TE)

10.12.1 Field Equipment

Specific conductivity, temperature, pH, and dissolved oxygen content, chlorine, turbidity, and alkalinity of water samples shall be measured in the field. Field measurements will be taken and the instruments calibrated as specified in OPS-SW.02, Field Measurements of Surface Water Parameters. Measurements shall be made using the following equipment (or EG&G-approved alternates):

- 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
- Dissolved Oxygen: HACH or YSI Model 57 Dissolved Oxygen Meter
- pH: HACH One pH Meter (this meter may also be used for temperature measurements)
- Chlorine and Turbidity: HACH DR2000 spectrophotometer
- Alkalinity: HACH digital titrator

In addition to the field measurements for water quality, field measurements for radiation, soil gas, and VOCs in ground water will also be made. The following instruments will be used for these measurements.

- Radiological field readings for field survey grid locations and drill cuttings, core, and samples: A high purity germanium detector or equivalent. Use, calibration, and maintenance according to manufacturer's instructions. EMD OPS-F0-16, Field Radiological Measurements will be revised to include procedures for the use, calibration, and maintenance of the high purity germanium detector.
- Field readings for soil gas and VOCs in groundwater: 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.

10.12.2 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.

10.13 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.

10.14 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.

10.15 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.

10.16 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.

10.17 QUALITY ASSURANCE RECORDS

QA records will be controlled in accordance with OPS-FO.02, Field Document Control. QA records to be generated during OU10 RFI/RI activities include, but are not limited to:

- Field Logs and Data Record Forms (e.g., sample collection notebooks/logs for water, 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

10.18 QUALITY VERIFICATION

The requirements for the verification of quality shall be implemented as specified in Section No. 18 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 6.0.

Examples of some specific tasks that will be monitored by the surveillance program are as follows:

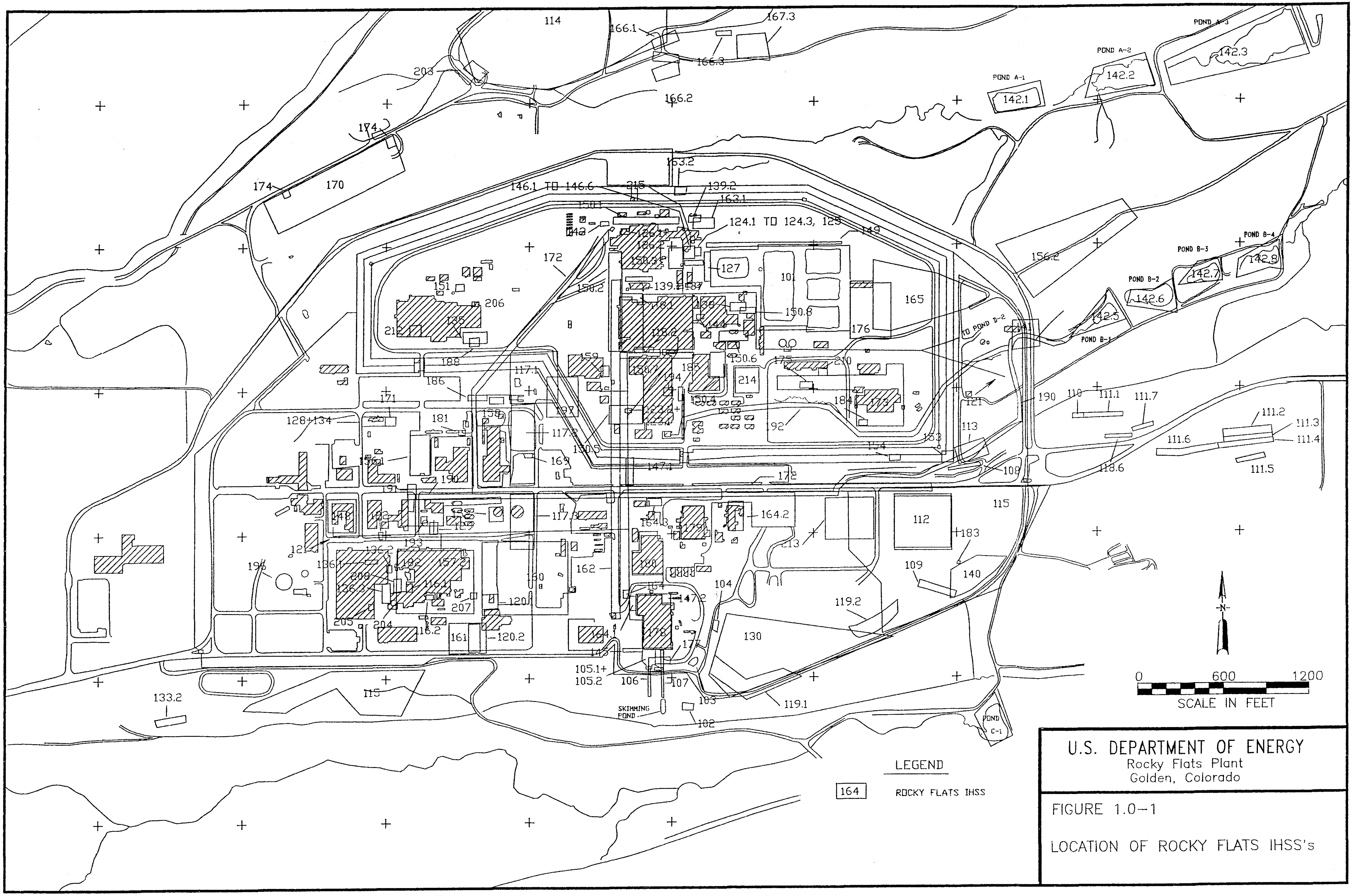
- Borings and well installations (approximately 10 percent of the holes)
- Field sampling (approximately 5 percent of each type of sample collected)
- Records management (a surveillance will be conducted once at the initiation of OU10 activities, and monthly thereafter)
- Data verification, validation, 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 OU10 field investigation activities. The readiness review will determine if all activity prerequisites have been met that are required to begin work. The applicable requirements of the QAPjP and this QAA will be addressed.

10.19 SOFTWARE CONTROL

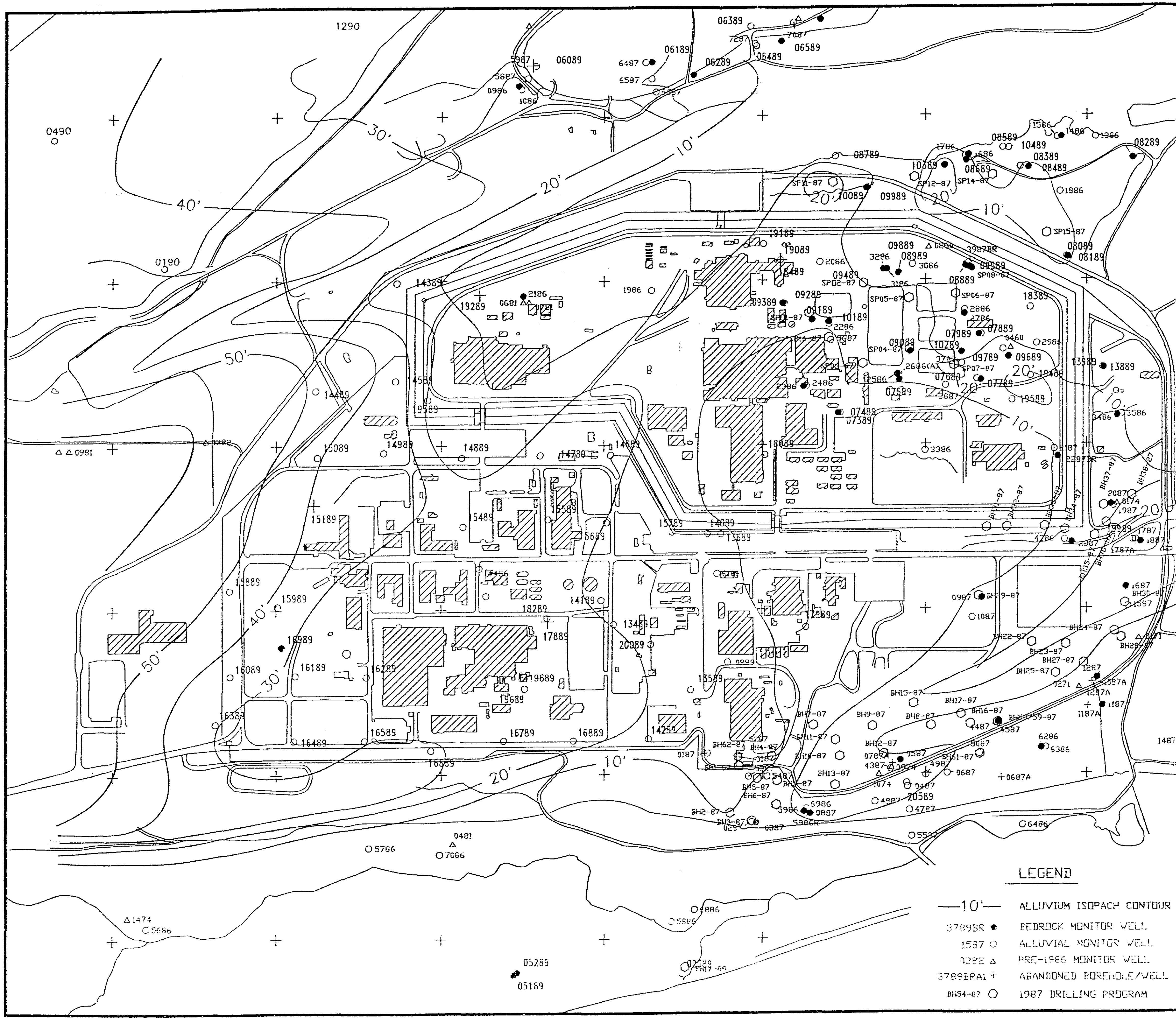
The requirements for the control of software shall be implemented as specified in Section 19.0 of the QAPjP. Only database software is anticipated to be used for the OU10 WP activities. Operating procedures applicable to the use of the database storing environmental data can be found in OPS-FO.14, Field Data Management.



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

FIGURE 1.0-1

LOCATION OF ROCKY FLATS IHSS's



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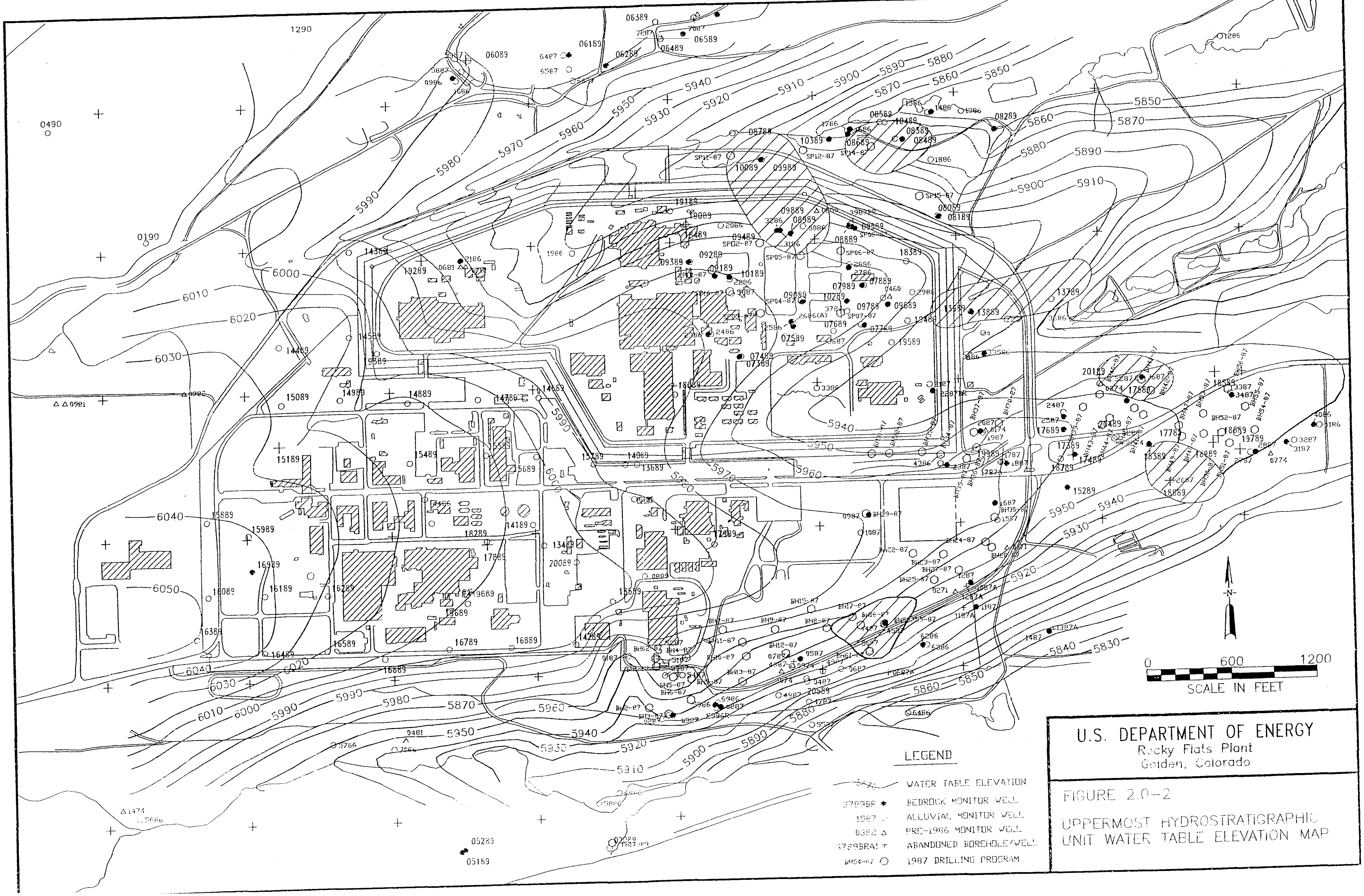
Rocky Flats Plant
Golden, Colorado

FIGURE 2.0-1

ROCKY FLATS PLANT
ALLUVIUM ISOPACH



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Rocky Flats Plant
Golden, Colorado

FIGURE 2.0-2

UPPERMOST HYDROSTRATIGRAPHIC UNIT WATER TABLE ELEVATION MAP

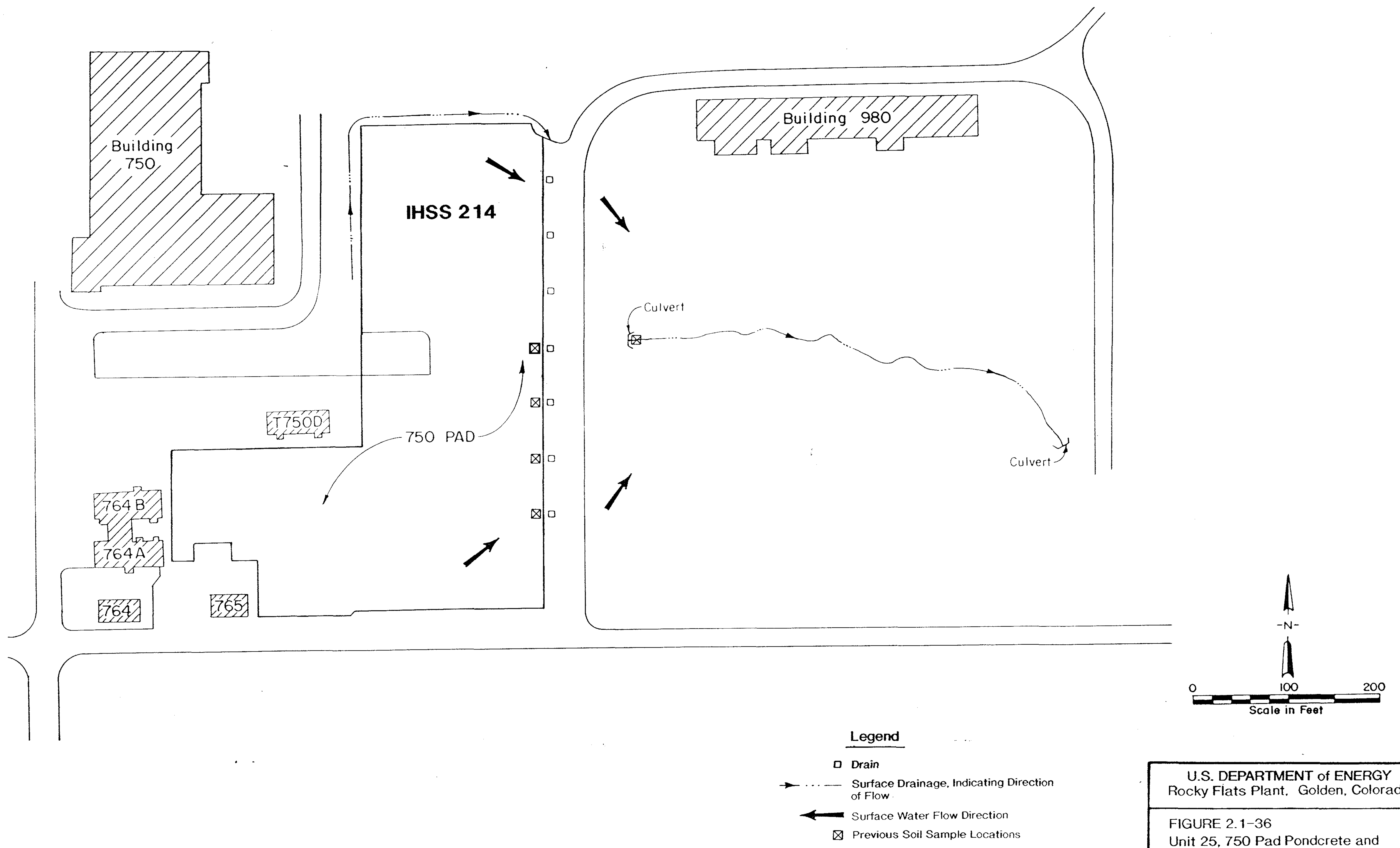

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FIGURE 2.1-36
Unit 25, 750 Pad Pondcrete and Saltcrete Storage (IHSS 214) Location Map

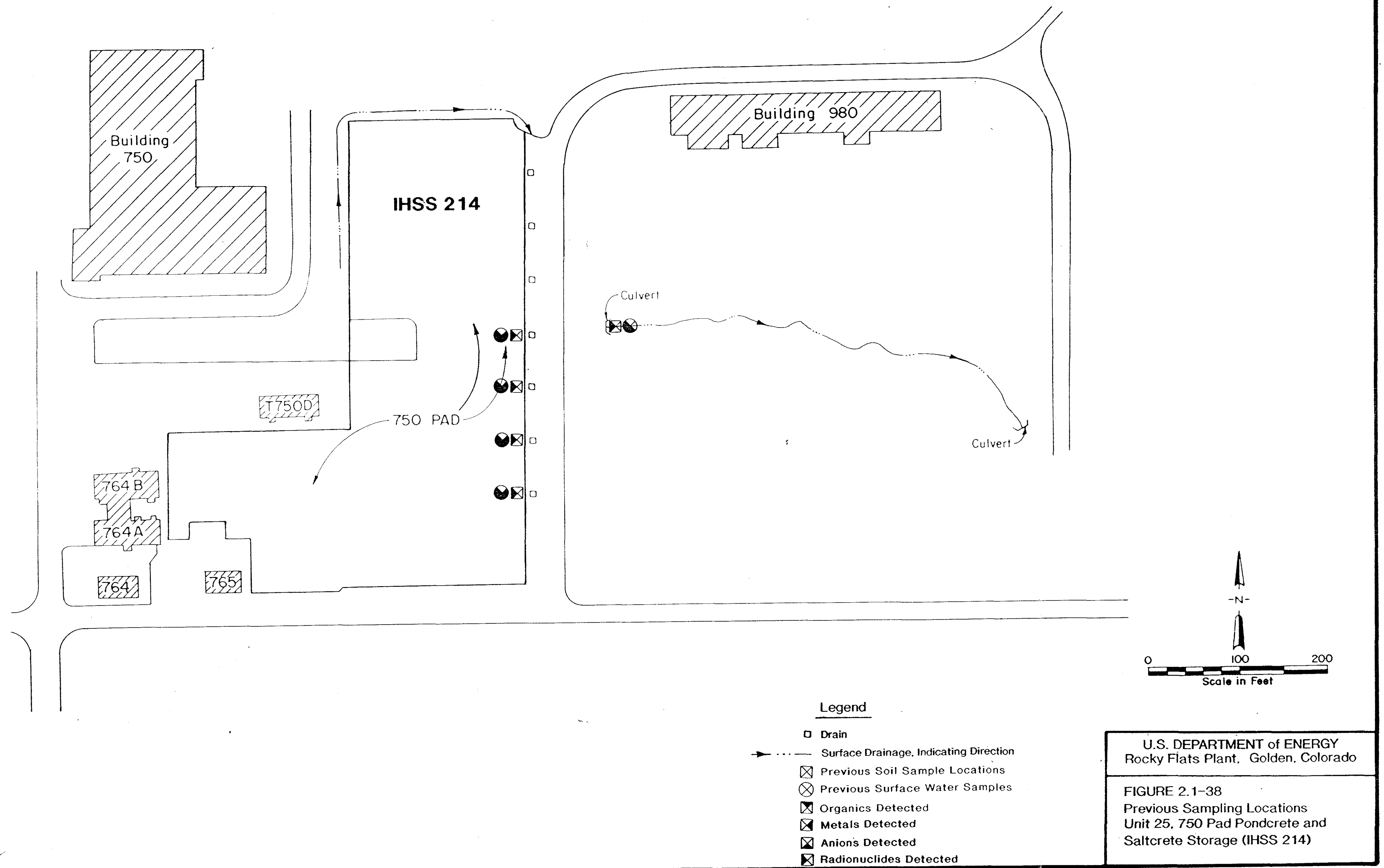

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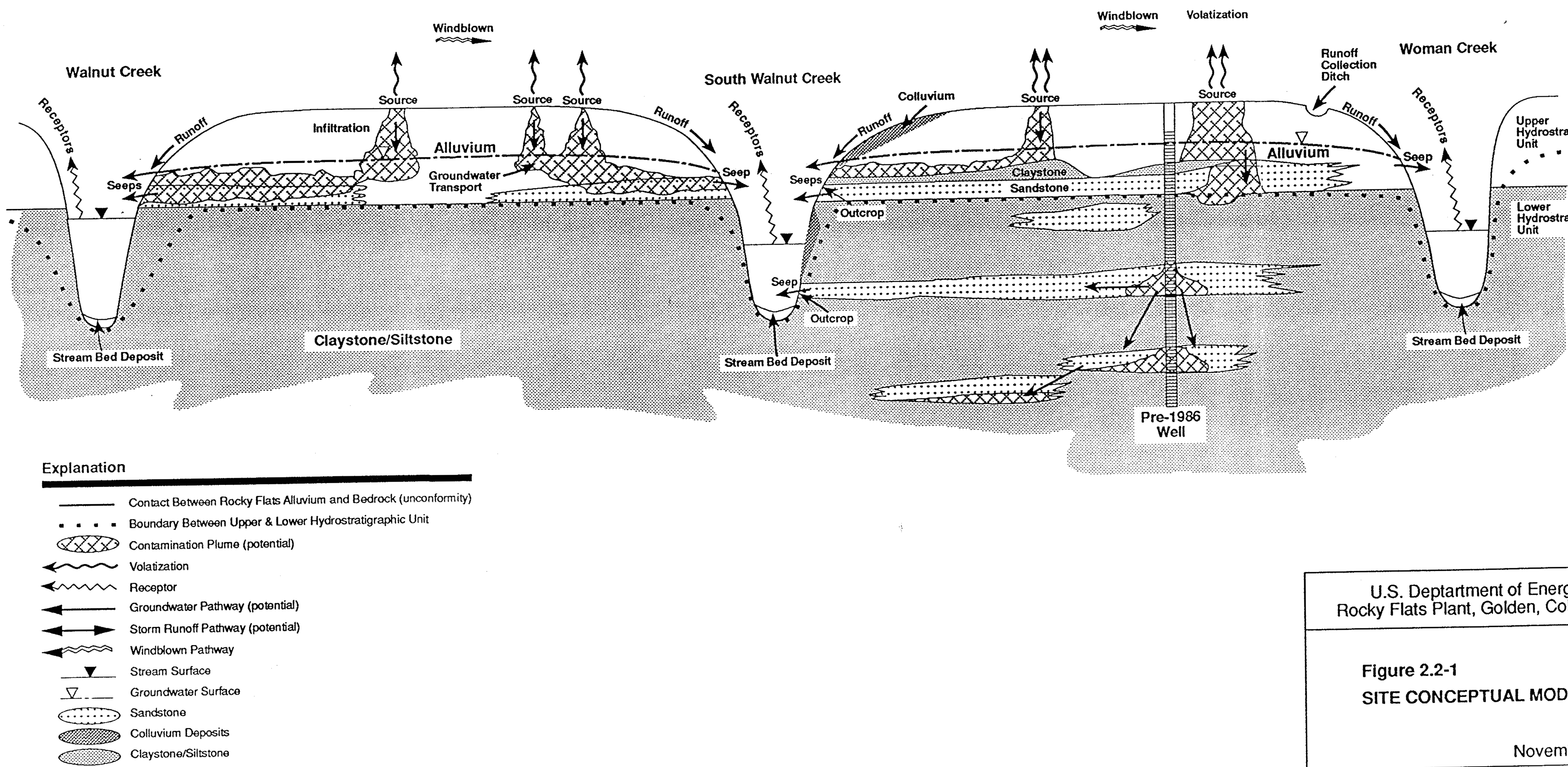
FIGURE 2.1-38
Previous Sampling Locations
Unit 25, 750 Pad Pondcrete and Saltcrete Storage (IHSS 214)



U.S. Deptartment of Energy
Rocky Flats Plant, Golden, Colorado

Figure 2.2-1
SITE CONCEPTUAL MODEL

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TABLE A-1. POTENTIAL CHEMICAL-SPECIFIC ARARs/TBCs (February 1, 1992)
GROUNDWATER QUALITY STANDARDS (ug/l)

Parameter	Type (5)	PQL MDL RFP	PQL MDL CDH	Method (6)	FEDERAL STANDARDS: SDWA Maximum Contaminant Level TBCs (a)	FEDERAL STANDARDS: SDWA Maximum Contaminant Level TBCs (b)	FEDERAL STANDARDS: SDWA Maximum Contaminant Level Goals TBCs (a)	FEDERAL STANDARDS: SDWA Maximum Contaminant Level Goal TBCs (b)	FEDERAL STANDARDS: RCRA Subpart F Limit (c)	STATE STANDARDS (TBCs): CDH WQCC Groundwater Quality Standards (d): Statewide Table A (d) (7)	Site-Specific (g): Table 1 Human Health	Site-Specific (g): Table 2 Secondary Drinking	Site-Specific (g): Table 3 Agriculture	Site-Specific (g): Table 4 TDS	Site-Specific (g): Table 5 Chronic	Site-Specific (g): Table 6 Radionuclides Woman Creek	Site-Specific (g): Table 6 Radionuclides 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																

TABLE A-1. POTENTIAL CHEMICAL-SPECIFIC ARARs/TBCs (February 1, 1992)
GROUNDWATER QUALITY STANDARDS (ug/l)

Parameter	Type (5)	PQL MDL RFP	PQL MDL CDH	Method (6)	FEDERAL STANDARDS: SDWA Maximum Contaminant Level TBCs (a)	FEDERAL STANDARDS: SDWA Maximum Contaminant Level TBCs (b)	FEDERAL STANDARDS: SDWA Maximum Contaminant Level Goals TBCs (a)	FEDERAL STANDARDS: SDWA Maximum Contaminant Level Goal TBCs (b)	FEDERAL STANDARDS: RCRA Subpart F Limit (c)	STATE STANDARDS (TBCs): CDH WQCC Groundwater Quality Standards (d): Statewide Table A (d) (7)	Site-Specific (g): Table 1 Human Health	Site-Specific (g): Table 2 Secondary Drinking	Site-Specific (g): Table 3 Agriculture	Site-Specific (g): Table 4 TDS	Site-Specific (g): Table 5 Chronic	Site-Specific (g): Table 6 Radionuclides Woman Creek	Site-Specific (g): Table 6 Radionuclides Walnut Creek
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													
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													

TABLE A-1. POTENTIAL CHEMICAL-SPECIFIC ARARs/TBCs (February 1, 1992)
GROUNDWATER QUALITY STANDARDS (ug/l)

					FEDERAL STANDARDS					STATE STANDARDS (TBCs)							
										CDH WQCC Groundwater Quality Standards (d)							
										Statewide	Site-Specific (g)						
		PQL MDL			SDWA Maximum Contaminant Level TBCs	SDWA Maximum Contaminant Level TBCs	SDWA Maximum Contaminant Level Goals TBCs	SDWA Maximum Contaminant Level Goal TBCs	RCRA Subpart F Limit	Table A	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)	(a)	(b)	(a)	(b)	(c)	(d) (7)						Woman Creek	Walnut Creek
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	P		1	d	100	70		70	100	70							
(2,4-D)	P																
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							

TABLE A-1. POTENTIAL CHEMICAL-SPECIFIC ARARs/TBCs (February 1, 1992) GROUNDWATER QUALITY STANDARDS (ug/l)

					FEDERAL STANDARDS					STATE STANDARDS (TBCs)							
										CDH WQCC Groundwater Quality Standards (d)							
										Statewide	Site-Specific (g)						
		PQL MDL			SDWA Maximum Contaminant Level TBCs (a)	SDWA Maximum Contaminant Level TBCs (b)	SDWA Maximum Contaminant Level Goals TBCs (a)	SDWA Maximum Contaminant Level Goal TBCs (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
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							
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		

TABLE A-1. POTENTIAL CHEMICAL-SPECIFIC ARARs/TBCs (February 1, 1992) GROUNDWATER QUALITY STANDARDS (ug/l)

Parameter	Type (5)	PQL MDL RFP	PQL MDL CDH	Method (6)	FEDERAL STANDARDS: SDWA Maximum Contaminant Level TBCs (a)	SDWA Maximum Contaminant Level TBCs (b)	SDWA Maximum Contaminant Level Goals TBCs (a)	SDWA Maximum Contaminant Level Goal TBCs (b)	RCRA Subpart F Limit (c)	STATE STANDARDS (TBCs): CDH WQCC Groundwater Quality Standards (d): Statewide Table A (d) (7)	Site-Specific (g): 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
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													
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		

TABLE A-1. POTENTIAL CHEMICAL-SPECIFIC ARARs/TBCs (February 1, 1992)
GROUNDWATER QUALITY STANDARDS (ug/l)

					FEDERAL STANDARDS					STATE STANDARDS (TBCs)							
										CDH WQCC Groundwater Quality Standards (d)							
										Statewide	Site-Specific (g)						
		PQL MDL			SDWA Maximum Contaminant Level TBCs (a)	SDWA Maximum Contaminant Level TBCs (b)	SDWA Maximum Contaminant Level Goals TBCs (a)	SDWA Maximum Contaminant Level Goal TBCs (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
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													

TABLE A-1. POTENTIAL CHEMICAL-SPECIFIC ARARs/TBCs (February 1, 1992)
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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													
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																

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GROUNDWATER QUALITY STANDARDS (ug/l)

					FEDERAL STANDARDS					STATE STANDARDS (TBCs)							
										CDH WQCC Groundwater Quality Standards (d)							
										Statewide	Site-Specific (g)						
Parameter	Type (5)	PQL MDL RFP	PQL MDL CDH	Method (6)	SDWA Maximum Contaminant Level TBCs (a)	SDWA Maximum Contaminant Level TBCs (b)	SDWA Maximum Contaminant Level Goals TBCs (a)	SDWA Maximum Contaminant Level Goal TBCs (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
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 Hydrocarb	SV		1 (9)	b											0.0028		
Vinyl Chloride	SV	10	2	CV	2		0			2							

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					FEDERAL STANDARDS					STATE STANDARDS (TBCs) CDH WQCC Groundwater Quality Standards (d)							
		PQL MDL								Statewide	Site-Specific (g)						
Parameter	Type (5)	RFP	CDH	Method (6)	SDWA Maximum Contaminant Level TBCs (a)	SDWA Maximum Contaminant Level TBCs (b)	SDWA Maximum Contaminant Level Goals TBCs (a)	SDWA Maximum Contaminant Level Goal TBCs (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
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					6					0.19		

TABLE A-1. POTENTIAL CHEMICAL-SPECIFIC ARARs/TBCs (February 1, 1992) GROUNDWATER QUALITY STANDARDS (ug/l)

					FEDERAL STANDARDS					STATE STANDARDS (TBCs)							
										CDH WQCC Groundwater Quality Standards (d)							
										Statewide	Site-Specific (g)						
		PQL MDL			SDWA Maximum Contaminant Level TBCs	SDWA Maximum Contaminant Level TBCs	SDWA Maximum Contaminant Level Goals TBCs	SDWA Maximum Contaminant Level Goal TBCs	RCRA Subpart F Limit	Table A	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)	(a)	(b)	(a)	(b)	(c)	(d) (7)						Woman Creek	Walnut Creek
Chloromethane	V	10		CV	<100**												
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													
Trichloroethene	V	5	1	CV	5		0			5							
Vinyl Acetate	V	10		CV													
Xylenes (total)	V	5		CV		10,000		10,000									

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TABLE A-1. POTENTIAL CHEMICAL-SPECIFIC ARARs/TBCs (February 1, 1992) GROUNDWATER QUALITY STANDARDS (ug/l)

EXPLANATION OF TABLE

* = secondary maximum contaminant level; TBCs

** = 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
WQCC	= Water Quality Control Commission

(1) TDS standard - see Table 4 in (d); standard is 400 mg/l or 1.25 times the background level, whichever is least restrictive

(2) radionuclide standards - see sec. 3.11.5(c)2 in (d)

(3) If both strontium-90 and tritium are present, the sum of their annual dose equivalents to bone marrow shall not exceed 4 mrem/yr.

(4) MDL for Radium 226 is 0.5; MDL for radium 228 is 1

(5) type abbreviations are: A=anion; B=bacteria; C=cation; D=dioxin; E=element; FP=field parameter; I=indicator; 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) Where standard is below (more stringent than) PQL (CDH), PQL is standard.

(8) Value for gross alpha excludes uranium.

(9) Value is CDH detection level (PQL not available)

(a) EPA National Primary and Secondary Drinking Water Regulations, 40 CFR 141 and 40 CFR 143 (as of 5/1990)

(b) EPA National Primary and Secondary Drinking Water Regulations, 40 CFR Parts 141, 142, 143, Final Rule, Effective July 30, 1992 (56 Federal Register 3526; 1/30/1991)

(c) NCP, 40 CFR 300; NCP Preamble 55 FR 8764; CERCLA Compliance with Other Laws Manual, EPA/540/G-89/006, August 1988, 40 CFR 264.94.

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TABLE A-1. POTENTIAL CHEMICAL-SPECIFIC ARARs/TBCs (February 1, 1992)
GROUNDWATER QUALITY STANDARDS (ug/l)

(d) CDH/Water Quality Control Commission, The Basic Standards for Ground Water, 3.11.0 (5 CCR 1002-8) 1/5/1987 amended 11/30/1991; statewide radioactive standards listed in 3.11.5(c)(2).
(e) EPA National Primary and Secondary Drinking Water Regulations, 40 CFR Parts 141, 142, 143, Final Rule, Effective January 1, 1993 (56 FR 30266; 7/1/1991)
(f) EPA Maximum Contaminant Level Goals and National Primary Drinking Water Regulations for Lead and Copper, 40 CFR 141 and 142 (56 FR 26460; 6/7/91) effective 12/7/92.
(g) CDH/Water Quality Control Commission, Classifications and Water Quality Standards for Ground Water, 3.12.0 (9/19/1991).

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TABLE A-2. POTENTIAL CHEMICAL-SPECIFIC ARARs/TBCs (February 1, 1992)
FEDERAL SURFACE WATER QUALITY STANDARDS (ug/l)

Parameter	Type (7)	PQL MDL RFP	PQL MDL CDH	Method (8)	SDWA Maximum Contaminant Level (a)	SDWA Maximum Contaminant Level TBCs (b)	SDWA Maximum Contaminant Level Goals (a)	SDWA Maximum Contaminant Level Goals TBCs (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
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**

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TABLE A-2. POTENTIAL CHEMICAL-SPECIFIC ARARs/TBCs (February 1, 1992)
FEDERAL SURFACE WATER QUALITY STANDARDS (ug/l)

Parameter	Type (7)	PQL MDL RFP	PQL MDL CDH	Method (8)	SDWA Maximum Contaminant Level (a)	SDWA Maximum Contaminant Level TBCs (b)	SDWA Maximum Contaminant Level Goals (a)	SDWA Maximum Contaminant Level Goals TBCs (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
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								
Titanium	M	10		E6010								
Tungsten	M	10		E6010								
Vanadium	M	50		CT								
Zinc	M	20		CT	5,000 *				120 (3)	110 (3)		

TABLE A-2. POTENTIAL CHEMICAL-SPECIFIC ARARs/TBCs (February 1, 1992)
FEDERAL SURFACE WATER QUALITY STANDARDS (ug/l)

Parameter	Type (7)	PQL MDL RFP	PQL MDL CDH	Method (8)	SDWA Maximum Contaminant Level (a)	SDWA Maximum Contaminant Level TBCs (b)	SDWA Maximum Contaminant Level Goals (a)	SDWA Maximum Contaminant Level Goals TBCs (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
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									

TABLE A-2. POTENTIAL CHEMICAL-SPECIFIC ARARs/TBCs (February 1, 1992)
FEDERAL SURFACE WATER QUALITY STANDARDS (ug/l)

Parameter	Type (7)	PQL MDL RFP	PQL MDL CDH	Method (8)	SDWA Maximum Contaminant Level (a)	SDWA Maximum Contaminant Level TBCs (b)	SDWA Maximum Contaminant Level Goals (a)	SDWA Maximum Contaminant Level Goals TBCs (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
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				
Americium (pCi/l)	R											
Americium 241 (pCi/l)	R	0.01										
Cesium 134 (pCi/l)	R	1										
Cesium 137 (pCi/l)	R	1										
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										
Radium 226+228 (pCi/l)	R	0.5/0.1 (9)			5							5

TABLE A-2. POTENTIAL CHEMICAL-SPECIFIC ARARs/TBCs (February 1, 1992)
FEDERAL SURFACE WATER QUALITY STANDARDS (ug/l)

Parameter	Type (7)	PQL MDL RFP	CDH	Method (8)	SDWA Maximum Contaminant Level (a)	SDWA Maximum Contaminant Level TBCs (b)	SDWA Maximum Contaminant Level Goals (a)	SDWA Maximum Contaminant Level Goals TBCs (b)	CWA AWQC for Protection of Aquatic Life (c) Acute Value	Chronic Value	CWA AWQC for Protection of Human Health (c) Water and Fish Ingestion	Fish Consumption Only
Strontium 89+90 (pCi/l)	R	1										
Strontium 90 (pCi/l)	R				8 (6)							8
Thorium 230+232 (pCi/l)	R											
Tritium (pCi/l)	R				20,000 (6)							
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											
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							2,800	
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

TABLE A-2. POTENTIAL CHEMICAL-SPECIFIC ARARs/TBCs (February 1, 1992)
FEDERAL SURFACE WATER QUALITY STANDARDS (ug/l)

Parameter	Type (7)	PQL MDL RFP	PQL MDL CDH	Method (8)	SDWA Maximum Contaminant Level (a)	SDWA Maximum Contaminant Level TBCs (b)	SDWA Maximum Contaminant Level Goals (a)	SDWA Maximum Contaminant Level Goals TBCs (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
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								
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									

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TABLE A-2. POTENTIAL CHEMICAL-SPECIFIC ARARs/TBCs (February 1, 1992) FEDERAL SURFACE WATER QUALITY STANDARDS (ug/l)

Parameter	Type (7)	PQL MDL RFP	PQL MDL CDH	Method (8)	SDWA Maximum Contaminant Level (a)	SDWA Maximum Contaminant Level TBCs (b)	SDWA Maximum Contaminant Level Goals (a)	SDWA Maximum Contaminant Level Goals TBCs (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
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

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TABLE A-2. POTENTIAL CHEMICAL-SPECIFIC ARARs/TBCs (February 1, 1992) FEDERAL SURFACE WATER QUALITY STANDARDS (ug/l)

Parameter	Type (7)	PQL MDL RFP	PQL MDL CDH	Method (8)	SDWA Maximum Contaminant Level (a)	SDWA Maximum Contaminant Level TBCs (b)	SDWA Maximum Contaminant Level Goals (a)	SDWA Maximum Contaminant Level Goals TBCs (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
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**
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 **

TABLE A-2. POTENTIAL CHEMICAL-SPECIFIC ARARs/TBCs (February 1, 1992)
FEDERAL SURFACE WATER QUALITY STANDARDS (ug/l)

		PQL MDL			SDWA Maximum Contaminant Level (a)	SDWA Maximum Contaminant Level TBCs (b)	SDWA Maximum Contaminant Level Goals (a)	SDWA Maximum Contaminant Level Goals TBCs (b)	CWA AWQC for Protection of Aquatic Life (c)		CWA AWQC for Protection of Human Health (c)	
Parameter	Type (7)	RFP	CDH	Method (8)					Acute Value	Chronic Value	Water and Fish Ingestion	Fish Consumption Only
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 A-2. POTENTIAL CHEMICAL-SPECIFIC ARARs/TBCs (February 1, 1992)
FEDERAL SURFACE WATER QUALITY STANDARDS (ug/l)

Parameter	Type (7)	PQL MDL RFP	PQL MDL CDH	Method (8)	SDWA Maximum Contaminant Level (a)	SDWA Maximum Contaminant Level TBCs (b)	SDWA Maximum Contaminant Level Goals (a)	SDWA Maximum Contaminant Level Goals TBCs (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

EXPLANATION OF TABLE

* = secondary maximum contaminant level, TBCs

** = 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;

TABLE A-2. POTENTIAL CHEMICAL-SPECIFIC ARARs/TBCs (February 1, 1992) FEDERAL SURFACE WATER QUALITY STANDARDS (ug/l)

Parameter	Type (7)	PQL MDL		Method (8)	SDWA Maximum Contaminant Level (a)	SDWA Maximum Contaminant Level TBCs (b)	SDWA Maximum Contaminant Level Goals (a)	SDWA Maximum Contaminant Level Goals TBCs (b)	CWA AWQC for Protection of Aquatic Life (c)		CWA AWQC for Protection of Human Health (c)	
		RFP	CDH						Acute Value	Chronic Value	Water and Fish Ingestion	Fish Consumption Only

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). Segment 4 MCLs are ARAR; Segment 5 MCLs are TBC; all MCLGs are TBC.

(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 A-3. POTENTIAL CHEMICAL-SPECIFIC ARARs/TBCs (February 1, 1992) STATEWIDE AND BASIN (CDH/WQCC) 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 MDL RFP	CDH	Method (6)	Water Supply	Water and Fish	Acute Value	Chronic Value	Acute Value (2)	Chronic Value (2)	Agricul-tural 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													

TABLE A-3. POTENTIAL CHEMICAL-SPECIFIC ARARs/TBCs (February 1, 1992)
STATEWIDE AND BASIN (CDH/WQCC) 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)	
		PQL MDL							Aquatic Life					
Parameter	Type (5)	RFP	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
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										
Titanium	M	10		E6010										
Tungsten	M	10		E6010										

TABLE A-3. POTENTIAL CHEMICAL-SPECIFIC ARARs/TBCs (February 1, 1992)
STATEWIDE AND BASIN (CDH/WQCC) 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)	
		PQL MDL							Aquatic Life					
Parameter	Type (5)	RFP	CDH	Method (6)	Water Supply	Water and Fish	Acute Value	Chronic Value	Acute Value (2)	Chronic Value (2)	Agricul-tural Standard (3)	Domestic Water Supply (4)	Aquatic Life	Water Supply
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

TABLE A-3. POTENTIAL CHEMICAL-SPECIFIC ARARs/TBCs (February 1, 1992)
STATEWIDE AND BASIN (CDH/WQCC) SURFACE WATER QUALITY STANDARDS (ug/l)

Parameter	Type (5)	PQL MDL RFP	PQL MDL CDH	Method (6)	Statewide Standards (a): Human Health Carcinogens/ Noncarcinogens (2) (8) Water Supply	Statewide Standards (a): Human Health Carcinogens/ Noncarcinogens (2) (8) Water and Fish	Statewide Standards (a): Aquatic Life (8) Acute Value	Statewide Standards (a): Aquatic Life (8) Chronic Value	Statewide Standards (a): Tables I,II,III (1) Aquatic Life Acute Value (2)	Statewide Standards (a): Tables I,II,III (1) Aquatic Life Chronic Value (2)	Statewide Standards (a): Tables I,II,III (1) Agricultural Standard (3)	Statewide Standards (a): Tables I,II,III (1) Domestic Water Supply (4)	Basin Standards (b): Organics (7) Aquatic Life	Basin Standards (b): Organics (7) Water Supply
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										
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												

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TABLE A-3. POTENTIAL CHEMICAL-SPECIFIC ARARs/TBCs (February 1, 1992)
STATEWIDE AND BASIN (CDH/WQCC) SURFACE WATER QUALITY STANDARDS (ug/l)

Parameter	Type (5)	PQL MDL RFP	PQL MDL CDH	Method (6)	Statewide Standards (a): Human Health Carcinogens/ Noncarcinogens (2) (8) Water Supply	Statewide Standards (a): Human Health Carcinogens/ Noncarcinogens (2) (8) Water and Fish	Statewide Standards (a): Aquatic Life (8) Acute Value	Statewide Standards (a): Aquatic Life (8) Chronic Value	Statewide Standards (a): Tables I,II,III (1) Aquatic Life Acute Value (2)	Statewide Standards (a): Tables I,II,III (1) Aquatic Life Chronic Value (2)	Statewide Standards (a): Tables I,II,III (1) Agricul-tural Standard (3)	Statewide Standards (a): Tables I,II,III (1) Domestic Water Supply (4)	Basin Standards (b): Organics (7) Aquatic Life	Basin Standards (b): Organics (7) Water Supply
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										

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TABLE A-3. POTENTIAL CHEMICAL-SPECIFIC ARARs/TBCs (February 1, 1992)
STATEWIDE AND BASIN (CDH/WQCC) SURFACE WATER QUALITY STANDARDS (ug/l)

					Statewide Standards (a)								Basin Standards (b)	
		PQL MDL			Human Health Carcinogens/ Noncarcinogens (2) (8)		Aquatic Life (8)		Tables I,II,III (1)				Organics (7)	
									Aquatic Life					
Parameter	Type (5)	RFP	CDH	Method (6)	Water Supply	Water and Fish	Acute Value	Chronic Value	Acute Value (2)	Chronic Value (2)	Agricul-tural Standard (3)	Domestic Water Supply (4)	Aquatic Life	Water Supply
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								
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								

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TABLE A-3. POTENTIAL CHEMICAL-SPECIFIC ARARs/TBCs (February 1, 1992)
STATEWIDE AND BASIN (CDH/WQCC) SURFACE WATER QUALITY STANDARDS (ug/l)

Parameter	Type (5)	PQL MDL RFP	PQL MDL CDH	Method (6)	Statewide Standards (a): Human Health Carcinogens/ Noncarcinogens (2) (8): Water Supply	Statewide Standards (a): Human Health Carcinogens/ Noncarcinogens (2) (8): Water and Fish	Statewide Standards (a): Aquatic Life (8): Acute Value	Statewide Standards (a): Aquatic Life (8): Chronic Value	Statewide Standards (a): Tables I,II,III (1): Aquatic Life: Acute Value (2)	Statewide Standards (a): Tables I,II,III (1): Aquatic Life: Chronic Value (2)	Statewide Standards (a): Tables I,II,III (1): Agricultural Standard (3)	Statewide Standards (a): Tables I,II,III (1): Domestic Water Supply (4)	Basin Standards (b): Organics (7): Aquatic Life	Basin Standards (b): Organics (7): Water Supply
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							

TABLE A-3. POTENTIAL CHEMICAL-SPECIFIC ARARs/TBCs (February 1, 1992)
STATEWIDE AND BASIN (CDH/WQCC) 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)	
		PQL MDL							Aquatic Life					
Parameter	Type (5)	RFP	CDH	Method (6)	Water Supply	Water and Fish	Acute Value	Chronic Value	Acute Value (2)	Chronic Value (2)	Agricul-tural Standard (3)	Domestic Water Supply (4)	Aquatic Life	Water Supply
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								
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									

TABLE A-3. POTENTIAL CHEMICAL-SPECIFIC ARARs/TBCs (February 1, 1992)
STATEWIDE AND BASIN (CDH/WQCC) 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 MDL RFP	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
1,2-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								

TABLE A-3. POTENTIAL CHEMICAL-SPECIFIC ARARs/TBCs (February 1, 1992)
STATEWIDE AND BASIN (CDH/WQCC) 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						
		PQL MDL					Acute Value	Chronic Value	Acute Value (2)	Chronic Value (2)	Agricultural Standard (3)	Domestic Water Supply (4)		Aquatic Life	Water Supply
Parameter	Type (5)	RFP	CDH	Method (6)	Water Supply	Water and Fish									
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 A-3. POTENTIAL CHEMICAL-SPECIFIC ARARs/TBCs (February 1, 1992)
STATEWIDE AND BASIN (CDH/WQCC) 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 MDL RFP	CDH	Method (6)	Water Supply	Water and Fish	Acute Value	Chronic Value	Acute Value (2)	Chronic Value (2)	Agricul-tural 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
WQCC = 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

TABLE A-3. POTENTIAL CHEMICAL-SPECIFIC ARARs/TBCs (February 1, 1992)
STATEWIDE AND BASIN (CDH/WQCC) 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					
		PQL MDL					Acute Value	Chronic Value	Acute Value (2)	Chronic Value (2)	Agricul-tural Standard (3)	Domestic Water Supply (4)	Aquatic Life	Water Supply
Parameter	Type (5)	RFP	CDH	Method (6)	Water Supply	Water and Fish								

(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/WQCC, Colorado Water Quality Standards 3.1.0 (5 CCR 1002-8) 1/15/1974; amended 10/17/1991 (ARAR).
(Envrionmental Reporter 726:1001-1020:6/1990)
(b) CDH/WQCC, 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 A-4. POTENTIAL CHEMICAL-SPECIFIC ARARs/TBCs (February 1, 1992)
STREAM SEGMENT (CDH/WQCC) 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										

TABLE A-4. POTENTIAL CHEMICAL-SPECIFIC ARARs/TBCs (February 1, 1992)
STREAM SEGMENT (CDH/WQCC) 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
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							
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							

TABLE A-4. POTENTIAL CHEMICAL-SPECIFIC ARARs/TBCs (February 1, 1992)
STREAM SEGMENT (CDH/WQCC) SURFACE WATER QUALITY STANDARDS (ug/l)

Parameter	Type (5)	PQL MDL RFP	PQL MDL CDH	Method (6)	Segment 4 & 5 Stream Classification and Water Quality Standards (b)(4): Tables A,B (1)	Table C Fish & Water Ingestion	Table D Radio-nuclide	Stream Segment Table (5) Acute Value	Stream Segment Table (5) Chronic Value	Table 2 Radionuclides Woman Creek	Table 2 Radionuclides Walnut Creek
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		

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TABLE A-4. POTENTIAL CHEMICAL-SPECIFIC ARARs/TBCs (February 1, 1992) STREAM SEGMENT (CDH/WQCC) 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
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								
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									

TABLE A-4. POTENTIAL CHEMICAL-SPECIFIC ARARs/TBCs (February 1, 1992)
STREAM SEGMENT (CDH/WQCC) 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
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							
2,6-Dinitrotoluene	SV	10	10	CS							
2-Chloronaphthalene	SV	10		CS							

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TABLE A-4. POTENTIAL CHEMICAL-SPECIFIC ARARs/TBCs (February 1, 1992)
STREAM SEGMENT (CDH/WQCC) SURFACE WATER QUALITY STANDARDS (ug/l)

					Segment 4 & 5 Stream Classification and Water Quality Standards (b)(4)						
					Tables	Table C	Table D	Stream Segment Table (5)		Table 2 Radionuclides	
	Type	PQL MDL		Method	A,B	Fish & Water	Radio-	Acute	Chronic	Woman	Walnut
Parameter	(5)	RFP	CDH	(6)	(1)	Ingestion	nuclide	Value	Value	Creek	Creek
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							

TABLE A-4. POTENTIAL CHEMICAL-SPECIFIC ARARs/TBCs (February 1, 1992)
STREAM SEGMENT (CDH/WQCC) 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
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							
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						

TABLE A-4. POTENTIAL CHEMICAL-SPECIFIC ARARs/TBCs (February 1, 1992)
STREAM SEGMENT (CDH/WQCC) SURFACE WATER QUALITY STANDARDS (ug/l)

					Segment 4 & 5 Stream Classification and Water Quality Standards (b)(4)						
		PQL MDL			Tables A,B	Table C Fish & Water	Table D Radio-	Stream Segment Table (5)		Table 2 Radionuclides	
Parameter	Type (5)	RFP	CDH	Method (6)	(1)	Ingestion	nuclide	Acute Value	Chronic Value	Woman Creek	Walnut Creek
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						

TABLE A-4. POTENTIAL CHEMICAL-SPECIFIC ARARs/TBCs (February 1, 1992)
STREAM SEGMENT (CDH/WQCC) 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
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							
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							

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TABLE A-4. POTENTIAL CHEMICAL-SPECIFIC ARARs/TBCs (February 1, 1992) STREAM SEGMENT (CDH/WQCC) 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
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 A-4. POTENTIAL CHEMICAL-SPECIFIC ARARs/TBCs (February 1, 1992)
STREAM SEGMENT (CDH/WQCC) SURFACE WATER QUALITY STANDARDS (ug/l)

					Segment 4 & 5 Stream Classification and Water Quality Standards (b)(4)						
		PQL MDL		Method (6)	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					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 radionuclides (pCi/l)
ug/l = micrograms per liter
VOA = Volatile Organic Analysis
WQCC = 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/WQCC 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)

TABLE A-4. POTENTIAL CHEMICAL-SPECIFIC ARARs/TBCs (February 1, 1992)
STREAM SEGMENT (CDH/WQCC) 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

(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/WQCC, Colorado Water Quality Standards 3.1.0 (5 CCR 1002-8) 1/15/1974; amended 9/30/1989 (ARAR).
(Envrionmental Reporter 726:1001-1020:6/1990)
(b) CDH/WQCC, 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; site-specific standards are TBC

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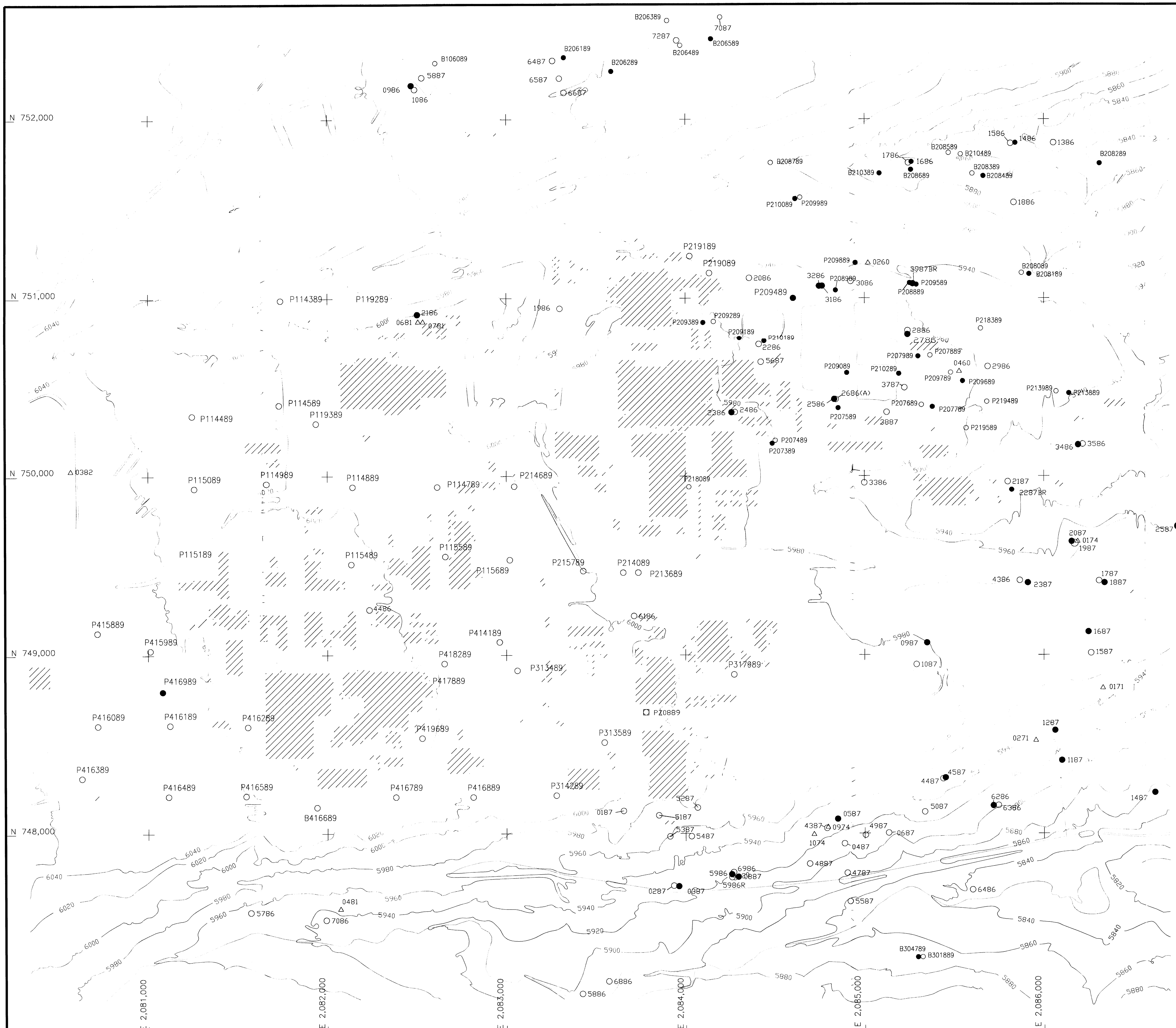

LEGEND

INDIVIDUAL HAZARDOUS SUBSTANCE SITE

3789BR ● BEDROCK MONITOR WELL

1587 ○ ALLUVIAL MONITOR WELL

0382 △ PRE-1986 MONITOR WELL

TOPOGRAPHIC CONTOUR
CONTOUR INTERVAL = 20'

STREAM

-N-

0 200 400 600 800 1000

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

PLATE 1

General Location Map of OU10 Individual Hazardous Substance Sites

SEPT. 30, 1991