46977

August 1994

# Corrective Action Decision/ Record of Decision

## OU16: Low Priority Sites

*The Rocky Flats Environmental Technology Site*

ADMIN RECORD

OU16-A-000164

# CORRECTIVE ACTION DECISION/
# RECORD OF DECISION DECLARATION

Site Name and Location
Rocky Flats Plant Operable Unit 16 Low Priority Sites
Golden, Jefferson County, Colorado

Statement of Basis and Purpose
This decision document presents the selected remedial action for the Rocky Flats Plant Operable Unit (OU) 16 Low Priority Sites, located near Golden, Colorado The selected remedial action was chosen in accordance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986, the Colorado Hazardous Waste Act (CHWA) and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) OU16 was investigated and a final No Further Action Justification Document (NFAJD) was approved in compliance with the Federal Facility Agreement and Consent Order signed by the U S Department of Energy (DOE), the State of Colorado, and the U S Environmental Protection Agency (EPA) on January 22,1991

Description of the Selected Remedy. No Action
OU16 Low Priority Sites was originally composed of seven Individual Hazardous Substance Sites (IHSSs) The decision for a "No Action" remedy for five of the IHSSs (i e , 185, 192, 193, 194, and 195) was based upon the NCP which provides for the selection of a No Action alternative when a site or OU is already in a protective state The Risk Evaluation performed in the Final "No Further Action Justification" document determined that these IHSSs were in a protective state and presented no unacceptable risk to human health and the environment Further investigation has been recommended for IHSS 196 as part of OU5 and for IHSS 197 as part of OU13

Declaration Statement
DOE has determined that no remedial action is necessary to be protective of human health and the environment at *Rocky Flats Plant Operable Unit 16 Low Priority Sites* Because the remedy will not result in hazardous substances remaining onsite above health-based levels, a five-year review is not required

Mark N Silverman, Manager — Date: 9/27/94
U S Department of Energy, Rocky Flats Field Office

Jack W McGraw — Date: 9/29/94
Deputy Regional Administrator, Region VIII
U S Environmental Protection Agency

Thomas P Looby Director, Office Of Environment — Date: 9/23/94
Colorado Department of Public Health and Environment

# Section 1

## Decision Summary

A remedy of "No Action" was selected for the Rocky Flats Environmental Technology Site (RFETS) Operable Unit (OU) 16 Low Priority Sites Individual Hazardous Substance Sites (IHSSs) numbered 185, 192, 193, 194, and 195 The risks associated with these IHSSs were assessed using conceptual model analyses These conceptual model analyses demonstrated that exposure pathways were not completed for IHSSs 185, 192, 193, 194, and 195 because past response actions and/or natural attenuation processes eliminated the source or exposure pathways Therefore, these IHSSs present no unacceptable risk to human health and the environment

Site Name, Location, and Description

The Rocky Flats Environmental Technology Site is located north of the City of Golden in northern Jefferson County, Colorado A copy of a site location map is attached (See Figure 1) Most RFETS structures and OU16 IHSSs are located within the industrialized area of RFETS, which occupies approximately 400 acres RFETS is surrounded by a buffer zone of approximately 6,150 acres IHSS 195 is located within the buffer zone (See Fig 2)

RFETS is located along the eastern edge of the southern Rocky Mountain region, immediately east of the Colorado Front Range The site is located on a broad, eastward-sloping pediment that is capped by alluvial deposits of Quaternary age (i e , Rocky Flats Alluvium) The tops of alluvial-covered pediments are nearly flat but slope eastward at 50 to 200 feet per mile (EG&G, 1992) At RFETS, the alluvial-covered pediment surface is dissected by a series of east-northeast trending stream-cut valleys The bases of the valleys containing Rock Creek, North and South Walnut Creeks, and Woman Creek lie 50 to 200 feet below the elevation of the older pediment surface These valleys incise into the bedrock underlying alluvial deposits, but most bedrock is concealed beneath colluvial material accumulated along the gentle valley slopes

Rock Creek, North and South Walnut Creeks, and Woman Creek are intermittent streams that flow generally from west to east and drain excessive water collected at RFETS Retention ponds are located in each of the creeks downstream of the main site Rock Creek surface water flows northeast to the Rock Creek confluence with Coal Creek Surface water within North and South Walnut Creeks, which is not retained within retention ponds used for spill control, flows to Great Western Reservoir Surface water within Woman Creek, which is not diverted to Mower Reservoir, flows to Standley Lake

The population, economics, and land use of areas surrounding RFETS are described in a 1989 Rocky Flats vicinity demographics report prepared by the Department of Energy (DOE) (U S DOE, 1991b) Land use within 0 to 10 miles of RFETS has been divided within the demographics report into residential, commercial, industrial, parks and open space, agricultural and vacant, and institutional classifications Most residential use within five miles of RFETS is located immediately northeast, east, and southeast of RFETS Commercial development is concentrated near residential developments north and southwest of Standley Lake and around Jefferson County Airport, located approximately three miles northeast of RFETS Industrial land use within five miles of the site is limited to quarrying and mining operations Natural resources associated with the quarrying and mining activities include gravel and coal Open-space lands are located northeast of RFETS near the City of Broomfield and in small parcels adjoining major drainages and small neighborhood parks in the cities of Westminster and Arvada The west, north, and east sides of Standley Lake are surrounded by open space Irrigated and nonirrigated croplands, producing primarily wheat and barley, are located north and northeast of RFETS near the cities of Broomfield, Lafayette, Louisville, and Boulder and in scattered parcels adjacent to the east boundary of the site Several horse operations and small hay fields are located south of RFETS The demographic report characterizes much of the vacant land adjacent to RFETS as rangeland

<u>Site History and Enforcement Activities</u>
RFETS is a government-owned, contractor co-operated facility, which is part of the nationwide Nuclear Weapons Complex The site was operated for the U S Atomic Energy Commission (AEC) from its inception during 1951 until the AEC was dissolved during 1975 At that time, responsibility for RFETS was assigned to the Energy Research and Development Administration (ERDA), which was succeeded by DOE during 1977 Previous operations at RFETS consisted of fabrication of nuclear weapons components from plutonium, uranium, and nonradioactive metals (i e , stainless steel and beryllium)

Various studies were conducted at RFETS to characterize environmental media and to assess the extent of radiological and chemical contaminant releases to the environment The investigations performed before 1986 were summarized by Rockwell International (1986a) During 1986, two investigations were completed at the site The first was the DOE Comprehensive Environmental Assessment and Response Program (CEARP) Phase I Installation Assessment (U S DOE, 1986) A number of sites that could potentially have adverse impacts on the environment were identified and designated as Solid Waste Management Units (SWMUs) within the CEARP of RFETS The second investigation involved a hydrogeologic and hydrochemical characterization of RFETS (Rockwell International, 1986d)

On January 22, 1991, a Federal Facility Agreement and Consent Order (i e , the Interagency Agreement (IAG)) was signed by DOE, EPA Region VIII, and State of Colorado Within the IAG, the SWMUs were changed to IHSSs and seven IHSSs were assigned to OU16 In addition, the IAG provided guidance and direction for investigating OU16 IHSSs and preparation of the draft and final No Further Action Justification Documents (NFAJDs) The NFAJD for OU16 was defined by the scope of the IAG to fulfill the IAG requirements for submittal of documentation and data necessary to substantiate the cleanup of OU16 IHSSs and/or justify whether further action was required for OU16 IHSSs Based on the NFAJD prepared for OU16 in accordance with the IAG, "no action" is appropriate for five of the original seven OU16 IHSSs Based on the approved NFAJD for OU16, further investigation is necessary for IHSS 196 and 197 Subsequently, IHSS 196 was transferred into OU5 and 197 was transferred into OU13 for further investigation

The IAG scope of work was incorporated in its entirety within the Colorado Hazardous Waste Permit (CHWP) for RFETS Upon signature of the Record of Decision (ROD) by DOE, EPA, and the State of Colorado, the State shall modify the CHWP for RFETS to incorporate the signed ROD for OU16

<u>Highlights of Community Participation</u>
A public comment period was held concurrently for the *Proposed Plan and Draft Modification of CHWP for RFP OU16 Low Priority Sites* The public comment period was held from November 8, 1993, to January 7, 1994, and was extended to February 8, 1993, in response to written public request A public hearing was conducted on December 8, 1993, during which public comments

and questions regarding the *Proposed Plan and Draft Modification of CHWP for RFP OU16 Low Priority Sites* for OU16 were recorded and have subsequently been responded to within this ROD

Scope and Role of Operable Unit within Site Strategy

The five IHSSs comprising OU16 include IHSS 185 - Solvent Spill, IHSS 192 - Antifreeze Discharge, IHSS 193 - Steam Condensate Leak - 400 Area, IHSS 194 Steam Condensate Leak - 700 Area, and IHSS 195 - Nickel Carbonyl Disposal All of the IHSSs are located within the industrial area of RFETS, except for IHSS 195 which is located approximately 2,000 feet north of the industrialized area of RFETS (See Fig 2) OU16 IHSSs were grouped together as "low priority sites" within the IAG because of the likelihood that previous actions or natural environmental processes eliminated the need for remedial action The scope, defined for OU16 IHSSs within Table 5 of the IAG, included submittal of documentation and data required to justify whether further action was required for the IHSSs within OU16 The NFAJD was completed and submitted in accordance with the requirements specified within Table 5 and Table 6 of the IAG

Site Characteristics

The uppermost water bearing unit at RFETS is unconfined and consists of surficial deposits (i e , Rocky Flats Alluvium, colluvium, valley-fill alluvium, fill material, and disturbed ground), weathered bedrock units, and subcrops of the Arapahoe and Laramie Formations The bedrock underlying RFETS can be considered an aquitard The direction of ground-water flow within the surficial deposits is generally from west to east beneath OU16 IHSSs Recharge to the surficial water-bearing unit occurs primarily from precipitation Discharge from the surficial water-bearing unit occurs primarily at minor seeps Seeps occur in colluvial deposits that cover the contact between the alluvium and bedrock along the edges of the valleys Discharge also occurs through seepage into other geologic formations and through evapotranspiration

Based on the conceptual model presented within the NFAJD for OU16, no sources and/or pathways for contamination from OU16 IHSSs exists A more detailed discussion of each individual IHSS is included within the "Summary of Site Risks" presented below

Summary of Site Risks

The risks associated with the OU16 IHSSs and the need for further action were assessed using a conceptual model to evaluate the exposure pathways by which contaminants could reach humans The model is based on the physical setting, the operation, and the nature of hazardous substances The model describes the sources and types of contamination environmental media (i e , soil and ground water), contamination pathways, and the presence of humans (or other living organisms that may be affected) A detailed discussion of past cleanup actions and natural processes that have affected the hazardous substances are described in Section 3 of the Final "No Further Action Justification" document

An exposure pathway is defined as having four parts (1) A source of contamination, (2) A release of the contamination, (3) A route for the contamination to reach a human, and (4) A human (or other living organism) population that can be affected If the exposure pathway is not complete, there is no unacceptable risk to humans or the environment, and no further action is appropriate

A brief discussion of the conceptual model analysis performed for each IHSS is discussed in the following paragraphs

**IHSS 185, Solvent Spill.** Four gallons of 1 1,1 Trichloroethane (TCA) leaked from a 55-gallon drum onto the southeast loading dock of Building 707 and a paved area adjacent to the loading dock on November 10, 1985 A commercial absorbent was used to cleanup the spill The vapor pressure of TCA at 200C is 13 2kPa (99 mm Hg Mackav and Shui, 1981), and volatilization is rapid (U S EPA, 1979) Also, TCA was not detected in any of the eight ground-water samples collected between November 1989 and April 1992 from monitoring well P218089 The immediate cleanup action of the TCA minimized or potentially eliminated the source of TCA contamination Because the spill occurred on a paved area and the cleanup response action of the source was immediate, the wind dispersion and infiltration transport pathways are eliminated

**IHSS 192, Antifreeze Discharge.** During December, 1980, a release of 155 gallons of antifreeze containing 25 percent ethylene glycol was diverted into Pond B-1 The drainage system was subsequently flushed with 5, 000 gallons of water The concentration of ethylene glycol was diluted below the detection limits by the 5,000 gallons of water that was flushed through the system immediately after the release and by surface water runoff over the past 12 years Also, a degradation model of ethylene glycol showed less than 7 parts per million (ppm) (i e , 250,000 ppm in antifreeze) between twenty to forty days after the contamination occurrence Using this same reasoning, it was predicted that the ethylene glycol related to the 1980 spill has been completely degraded by this time

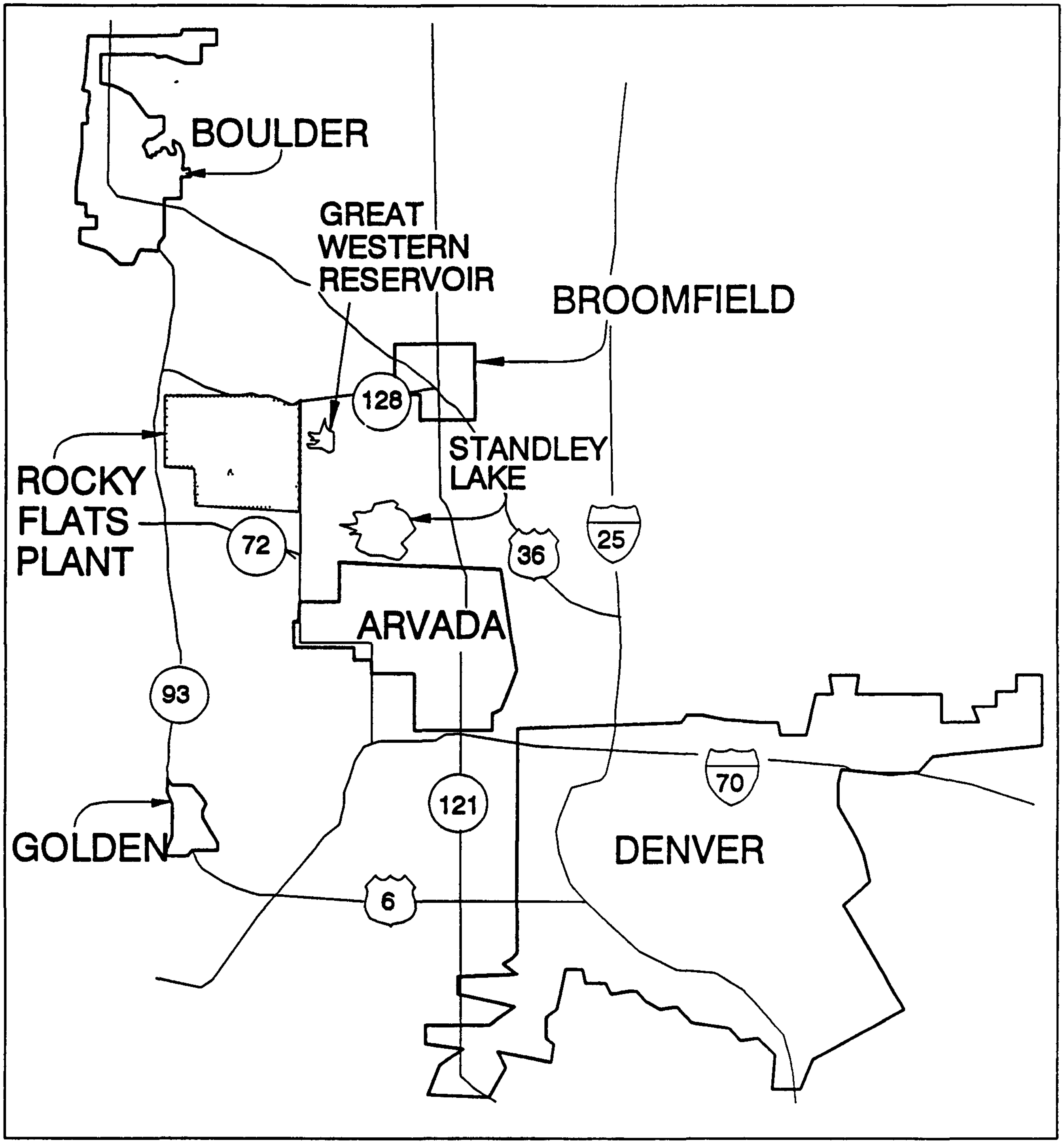
**IHSS 193, Steam Condensate Leak - 400 Area.** A steam condensate line containing water with low-level (0 135 milligrams per liter (mg/L)) amines was found to be leaking during November, 1979 The area where the leak occurred was paved at the time of the leak, eliminating the infiltration and wind dispersion pathways The concentration of amines in the steam condensate (0 135 mg/L) was approximately 1 1/2 percent of the permissible exposure limit (PEL) of 10 mg/L Also, the concentration of amines has been diluted by rainfall during the 15 year period since the spill occurred Amines could not be detected, no source of contamination is present

**IHSS 194, Steam Condensate Leak - 700 Area.** A break in a steam condensate line containing low-level of tritium occurred in the Building 707 area on September 26, 1979 The condensate had a tritium activity of approximately 1,000 pCi/L which was significantly lower than EPA's set public drinking water standard of 20,000 pCi/L (40 CFR Part 141 16) and the State of Colorado sitewide standard of 20,000 pCi/L (5 Colorado Code of Regulations 1002-8 § 3 11 5 (c)(2)) However, the State of Colorado site-specific standard for tritium activity at RFETS is 500 pCi/L (5 Colorado Code of Regulations 1002-8 § 3 12 0) The released tritium has undergone more than one half-life decay (i e , 12 26 years) since the occurrence of the release and significant dilution due to precipitation This results in a present-day tritium activity of much less than 500 pCi/L, which is within the range of background activities reported for tritium in surface waters at RFETS and less than any promulgated standard Therefore, tritium associated with this IHSS does not represent an existing source of contamination

**IHSS 195, Nickel Carbonyl Disposal.** From March through August 1972, cylinders of nickel carbonyl were disposed in a dry well located in the buffer zone The cylinders were opened inside the well and vented with small arms fire to allow decomposition in air Nickel carbonyl is highly volatile and readily decomposes in the presence of oxygen forming nickel oxide Nickel oxide is also highly insoluble in ground water For every gram (0 002 pound) of nickel oxide in contact with typical ground water, approximately $10^{-26}$ micrograms (ug) of nickel per liter of water is transferred to solution EPA's reference dose for nickel in drinking water is 100 ug/L (U S EPA, 1990) Wind dispersion disseminated nickel oxide particles, which would not be detected at concentrations exceeding background

These conceptual model analyses demonstrate that exposure pathways are not completed for IHSSs 185, 192, 193, 194, and 195 Past response actions and/or natural attenuation processes eliminated the source or exposure pathways  Future receptors were considered using the conceptual model analyses to ensure that risk was completely evaluated  Therefore, these hazardous sites do not presently, nor will they in the future, present unacceptable risk to human health and the environment

Explanation of Significant Changes
No changes in the selected remedy have been made since release of the *Proposed Plan and Draft Modification of Colorado Hazardous Waste Permit for Rocky Flats Plant Operable Unit 16  Low Priority Sites*

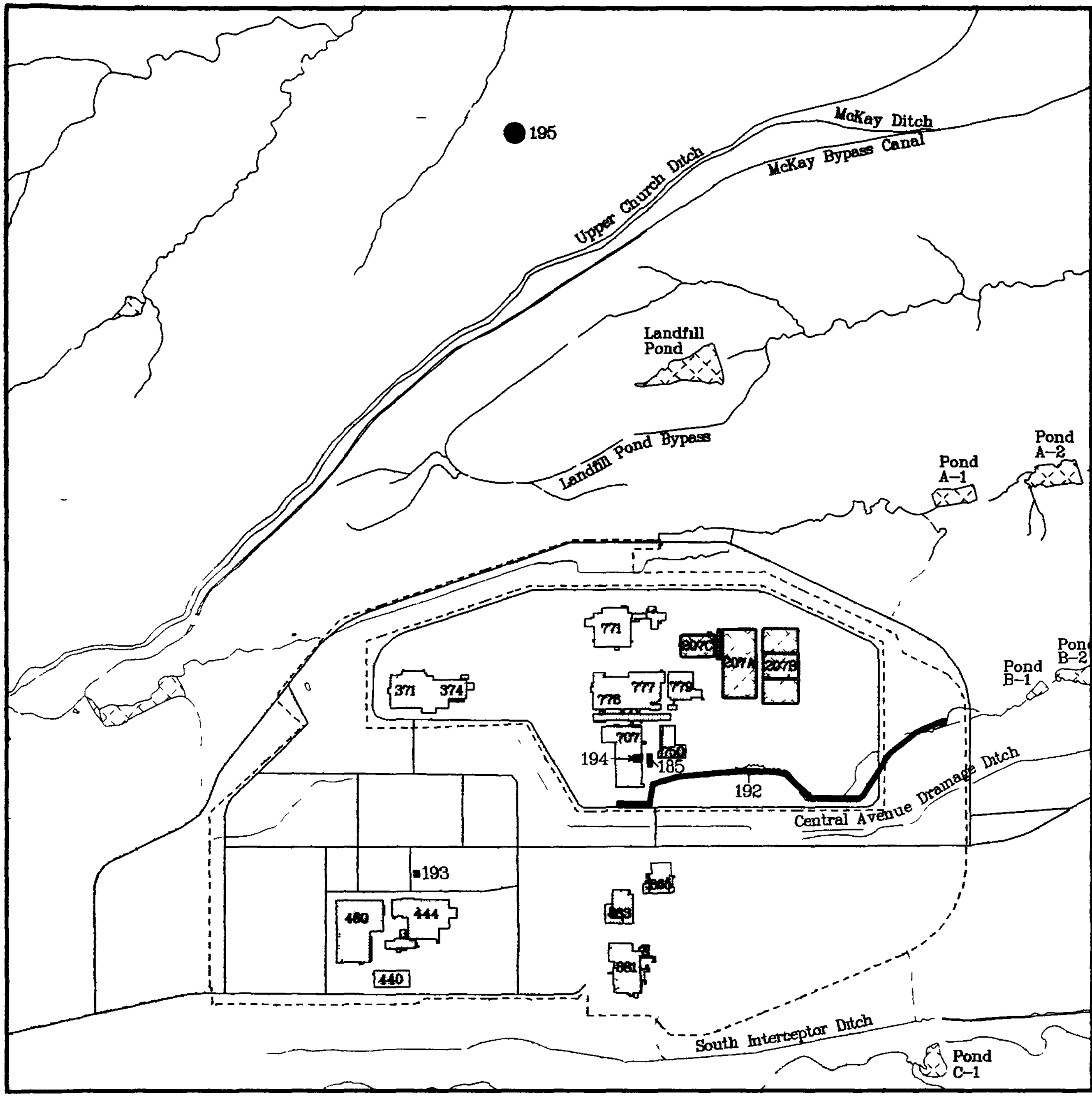



0 2.5 5

APPROXIMATE SCALE 1" = 5 MILES

N

FIGURE 1
**SITE LOCATION MAP**




U S Department of Energy
Rocky Flats Plant

Paved roads
Fences
Streams, ditches, and other drainage features
Ponds/lakes
Individual Hazardous Substance Sites (IHSS)
Buildings or structures

SOURCE OF DATA.

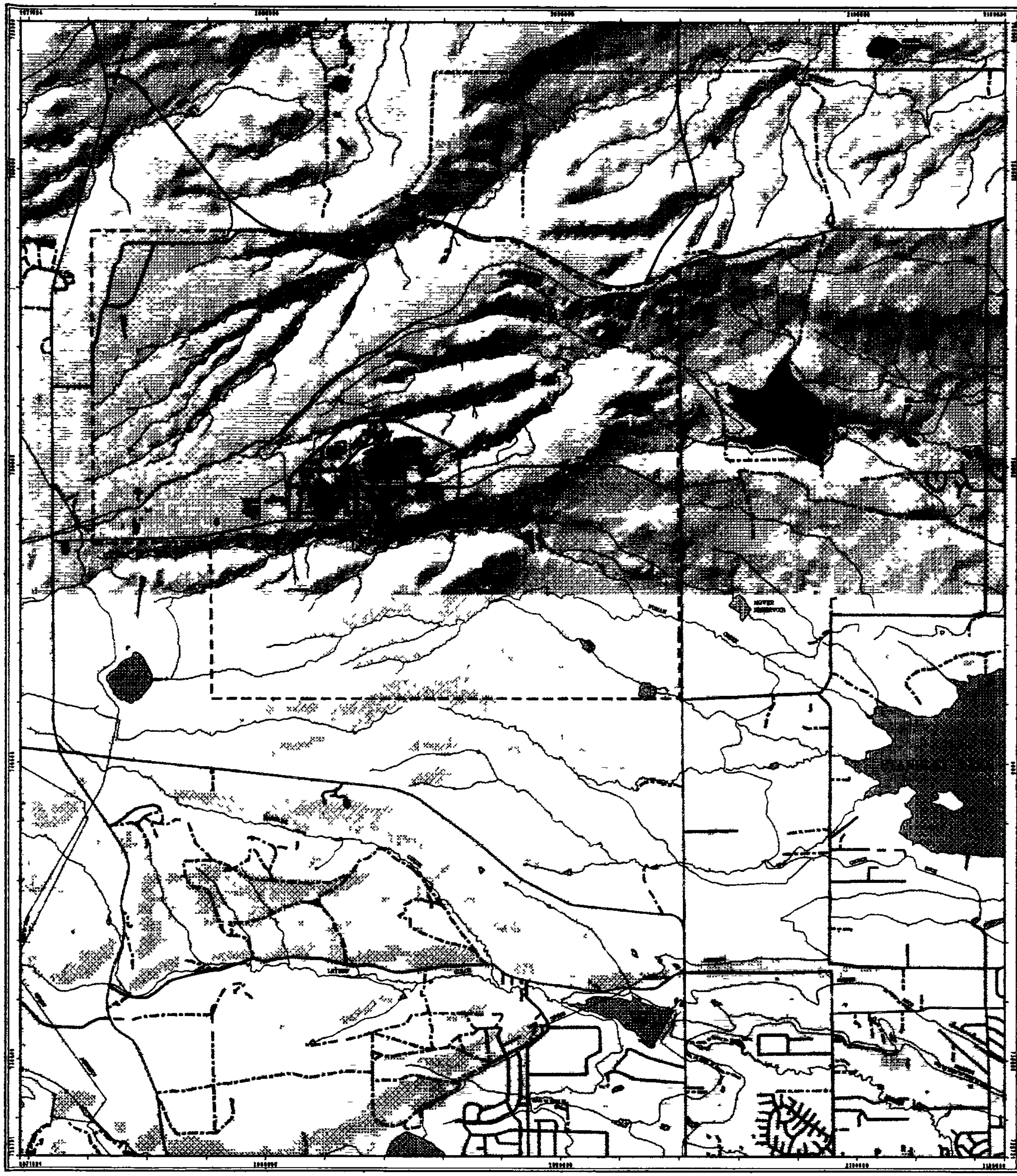
N

0 feet 750 1500

Environmental Restoration
Technical Support Document

Operable Unit 16
Low Priority Sites

Figure 2



U S Department of Energy
Rocky Flats Plant

# Figure 3

ROAD CLASSIFICATION

- Heavy-duty
- Medium-duty
- Light-duty
- Unimproved dirt

- Rocky Flats Plant boundary
- Streams, ditches, and other drainage features
- Ponds and lakes
- Buildings and other structures

Scale 1 : 60000
1 inch = 5000 feet

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

Prepared by
EG&G ROCKY FLATS

Rocky Flats Plant
P O Box 464
Golden Colorado 80402-0464

# Section 2

## Responsiveness Summary

*Proposed Plan/Draft Modification of Colorado Hazardous Waste Permit for the Rocky Flats Plant Operable Unit 16  Low Priority Sites*

## Ronald Harlan, Area Citizen:

### Question 1

How was the exposure pathway broken for each of the five sites?

### Response to Question 1

The exposure pathway was broken at the source for IHSS 185 since the spill (i e , four gallons of the solvent 1,1,1 Trichloroethane (TCA)) occurred onto a paved area, the volitization rate of TCA is inherently high, and a cleanup response action was initiated at the time of the release

The exposure pathway was broken at the source for IHSS 192 because the antifreeze discharged was diluted and evaluation of its degradation indicated that no ethylene glycol could be detected at this time

The exposure pathway was broken at the source for IHSS 193 because the steam condensate release occurred on a paved area, the concentration of amines was relatively low within the steam condensate, precipitation diluted the amines and amines could not be detected at IHSS 193

The exposure pathway was broken at the source for IHSS 194 because the tritium activity of 1000 picocuries per liter (pCi/L) within the steam condensate released was significantly lower than U S EPA set drinking water standard for tritium of 20,000 pCi/L  Also the activity of tritium was within the background range for surface water at RFP  In addition, based on the 12 26 year half-life of tritium, less than 500 pCi/l of tritium is estimated to be present today

The exposure pathway was broken at the pathway for IHSS 195 since nickel carbonyl is highly volatile and readily decomposes in the presence of oxygen to form nickel oxide  The concentration of nickel oxide on the ground surface if ejected from the dry well would not be detected above background  Nickel oxide is highly insoluble in ground water and a viable transport pathway does not exist for nickel oxide from the dry well

### Question 2

What metals, (within IHSS 197), were there that are of concern?

## Response to Question 2

Scrap metal components, primarily from the original plant construction program, were buried within IHSS 197 trenches In addition, unusable scrap metal such as aluminum and steel associated with the Property Utilization and Disposal yards was disposed of within the trenches There is a slight possibility that transformers containing polychlorinated biphenyls were disposed within the IHSS 197 trenches also Buried material was removed from the trenches during 1981 The unearthed material consisted of moist, but not oily, scrap metal such as machine turnings, rings, shapes, overlays, and other metal parts Transformers or related material were not present in the material excavated from the trenches Monitoring of materials using a Field Instrument for Detection of Low Energy Radiation (FIDLER) indicated no detectable radioactivity

## Question 3

So what needs investigating--you don't know what was put there, (within IHSS 197), so you?

## Response to Question 3

The response to this question provided during the Public Hearing conducted on December 8, 1993, was misstated Further investigation is warranted at IHSS 197 since the extent of excavation and removal of material from the trenches during 1981 is unknown Therefore, buried material may still be present within the trenches at IHSS 197 which could be a source of contamination Since contamination may still be present, exposure pathways may also exist Additional investigative work must be conducted at IHSS 197

## Question 4

Some day you'll get around to finding out what's there, (within IHSS 197)?

## Response to Question 4

Additional investigative work at IHSS 197 is being done as part of the Phase I Resource Conservation and Recovery Act (RCRA) Facility Investigation/Remedial Investigation (RFI/RI) for Operable Unit (OU) 13 Radiation surveys within IHSS 197 have already been completed as part of the RFI/RI IHSS 197 was transferred to OU 13 for two reasons 1) technically the RFI/RI for OU 13 is adequate for addressing potential contamination associated with IHSS 197, and 2) administratively the transfer of IHSS 197 from OU 16 to OU 13 allows the IHSSs remaining in OU 16 to be closed per the Interagency Agreement (IAG)

## Question 11

--I just question whether a thousand picocuries per liter, did you say, is a natural background There is tritium produced in nature, but this sounds a little high

That's roughly 2,200 disintegrations permitted per liter, and I'm kind of surprised at that

## Comment 4

Well, I think milligrams of tritium would be many curies

## Question 12

So five picocuries per liter, (of tritium is considered background)?

## Question 13

Okay  Of tritium, (500 pCi/l is considered background), in groundwater?

## Question 14

I kind of wonder how it, (1000 pCi/l tritium within the steam condensate), got to that high concentration

## Comment 5

In steam now--I don't know exactly how steam counts work  But let's say that water was being recirculated for many years  Tritium--well, water containing tritium is a little heavier than the average water molecule, and maybe over 20 years it would concentrate  I don't know

Of course, over 20 years, more than half of it should decay, too, so--

## General Response to IHSS 194 questions 11, 12, 13, and 14, and comments 4 and 5.

During the Public Hearing there was confusion regarding IHSS 194, the background activity of tritium, the units in which the activity of tritium is presented, etc  A general response approach to IHSS 194 questions and comments was agreed upon by EPA, DOE and CDH in order to ensure that the public's questions and comments regarding IHSS 194 are addressed clearly and that public hearing misstatements are corrected  A general response to IHSS 194 questions 11, 12, 13 and 14, and comments 4 and 5 is presented below

Within the Background Geochemical Characterization Report for Rocky Flats Plant (EG&G, 1990) a maximum background activity for tritium during 1989 is reported as 980 picocuries per liter (pCi/l) within Rocky Flats Plant (RFP) surface water  Other values of background tritium activity provided in response to Public comments and/or questions during the public hearing held on December 8, 1994, were misstated  The activity of tritium within samples of IHSS 194 steam condensate released during 1979 was approximately 1000 pCi/l which does not differ statistically from the reported range of background values (EG&G, 1990) measured during 1989  Additional information regarding background activities of tritium, and sampling that has been conducted, is stated in the No Further Action Justification Document (NFAJD) for OU 16  The NFAJD is available for the public at the various RFP information repositories located in the area

Tritium decays rapidly and has a half-life of 12 26 years  Based on the half-life of tritium, the present day activity of the tritium released during 1979 would be less than 500 pCi/l  The EPA has set a public drinking water standard of 20,000 pCi/l as a maximum for tritium  Therefore, the tritium activity present is at very low concentration and well below standards

Tritium is usually presented and discussed in units of picocuries (pCi) which is a measurement of activity  Picocuries per liter is an expression of activity concentration  An activity of 27 pCi is equivalent to one (1) disintegration per second (dps)  Therefore, steam condensate with an activity concentration of 1000 pCi/l is equivalent to approximately 37 dps per liter (dps/l)

Tritium is both a naturally occurring and man-made isotope of hydrogen and behaves identically to hydrogen when combining with oxygen to form water molecules  As stated above, tritium is usually discussed in terms of an activity versus a weight (i e , pCi versus milligrams, respectively)  One (1) milligram (mg) of steam condensate with an activity of 1000 pCi/l would have an activity equivalent to approximately $10^{-15}$ curies (Ci)  A conversion table for various units used within this general response is provided below

Tritium behaves identically to hydrogen when combining with oxygen to form water molecules  Tritium is not "dissolved" within water, but is part of the water molecule itself  As a result, tritium is readily transported and highly mobile as a component of surface water, ground water, body fluids, etc  Tritium will not concentrate within water (i e , steam condensate) because of its mobility as part of and the affinity that tritiated water molecules have for water

CONVERSION TABLE

1 dps = 27 pCi

1000 pCi/l = 37 dps/l

1 pCi = $10^{-12}$ Ci

1 mg $H_2O$ @ 1000 pCi/l = $10^{-15}$ Ci = 0 001 pCi

## Ken Korkia, Technical Assistant for the Rocky Flats Cleanup Commission:

**Question 5**

Does that mean that under the current situation they, (the four parts of the exposure pathway), have to be complete, or does this take in the hypothetical future uses that could lead to a population that may some day be exposed?

And specifically, I have a thought in mind that if you have an underground or groundwater contamination, and you know that there's definite levels of contamination, but you know that no one is currently using that source of groundwater, would that be a case, then, where you wouldn't have to clean up that source groundwater?

## Response to Question 5

Reasonable hypothetical future uses that could lead to a population that may some day be exposed were considered  Specifically, the future use of an aquifer would have to be considered and contamination addressed appropriately to protect the public and the environment  Per the EPA Risk Assessment Guidance for Superfund (RAGS) the exposure assessment included reasonable maximum estimates of exposure for both current and future land-use assumptions  Current exposure estimates were used to determine whether a threat exists based on existing exposure conditions at the site  Future exposure estimates are used to provide decision-makers with an understanding of the potential future exposures and threats and include a qualitative estimate of the likelihood of such exposure occurring

## Question 6

-- What's the source of tritium in that, (IHSS 194), steam condensate?

## Response to Question 6

The source of the tritium within the steam condensate is not known  However, the current maximum of 500 pCi/l within the steam condensate is within the reported range of background values (EG&G, 1990) for RFP and is significantly less than the EPA set public drinking water standard of 20,000 pCi/l for tritium  Please refer to the general response provided for questions 11, 12, 13 and 14, and comments 4 and 5 presented above

## Question 7

So, but is this, (1000 pCi/l tritium in steam condensate), higher than normal?

## Response to Question 7

Please refer to the general response provided for questions 11, 12, 13 and 14, and comments 4 and 5 presented above

## Question 8

--is this just naturally occurring in all the steam that's at Rocky Flats that you would find the tritium?

## Response to Question 8

Please refer to the general response provided for questions 11, 12, 13 and 14, and comments 4 and 5 presented above

## Question 9

Because my concern is, then, that every place--I'm sure you've had other steam leaks over the past with all the miles of pipe that you must have out there, and so that was this only one example that was pulled up, or why are other areas where there were leaks aren't being considered for this same contamination?

## Response to Question 9

When the IAG was negotiated the only steam condensate leak identified as a potential concern with regard to tritium was the IHSS 194 release However, it was agreed by EPA, CDH and DOE that a mechanism to address past and future releases needed to be in place within the IAG The mechanism that was agreed upon is the Historical Release Report (HRR) The HRR is updated every three months to include newly identified or suspected releases for which DOE has notified EPA and the State during the previous three months The HRR is available to the public at the public information repositories for Rocky Flats Plant

## Question 10

If a steam leak were to occur today, would it be standard procedure to do a radionuclide specific testing on that to see if there was tritium, plutonium, uranium in the steam?

## Response to Question 10

All detected releases at RFP are investigated Steam condensate which is accidentally released within an IHSS is sampled, and the appropriate response is made Standard Operating Procedures (SOPs) for reporting and mitigating releases are in place at Rocky Flats Plant in compliance with RCRA and the Colorado Hazardous Waste Permit for RFP However, steam condensate is not considered a hazardous waste Tritium, plutonium and uranium are not automatically included with regard to steam condensate leak sampling unless a potential for tritium, plutonium and uranium contamination exists The steam system(s) at RFP where a potential for tritium, plutonium and uranium contamination exists are designed to maintain a "safety envelope" to prevent potentially contaminated steam from escaping A safety envelope is created by maintaining relatively greater steam pressures outside areas where a potential for tritium, plutonium and uranium contamination exists

## Comment 1

Well, I hope there's a little more information in the full document about tritium

## Response to Comment 1

Additional information regarding tritium is available within the No Further Action Justification Document for OU 16 which is available for the Public at the RFP Information Repositories

## Comment 2

And just a closing comment, I guess that I know this is our first operable unit where we've really gotten this far down where there actually have been decisions made, and I guess it's wishful on my part, but I hope that all the documents will be as easy to read and to comprehend, and that the decisions will be as easy to make But I seriously doubt that will be the case, but we can only hope

## Response to Comment 2

The DOE acknowledges the support for the format and content of the Proposed Plan/Draft Modification of the Colorado Hazardous Waste Permit for Rocky Flats Plant Operable Unit 16 Low Priority Sites

## Comment 3

I commend the authors of this, especially the inclusion of the glossary and just the explanation of everything was easy to comprehend Thanks

## Response to Comment 3

The DOE acknowledges the support for the format and content of the Proposed Plan/Draft Modification of the Colorado Hazardous Waste Permit for Rocky Flats Plant Operable Unit 16 Low Priority Sites

# Responsiveness Summary for U.S. Environmental Protection Agency Comments

## on the

# Draft Corrective Action Decision/Record of Decision (CAD/ROD) Declaration Rocky Flats Plant Operable Unit 16: Low Priority Sites

**Comment 1**

*Statement of Basis and Purpose, third sentence* Delete word "which "

**Response to Comment 1**

The appropriate response has been incorporated in CAD/ROD

**Comment 2**

*Description of the Selected Remedy No Action* The text needs to clarify the following (1) OU16 is composed of seven IHSSs, (2) no action was found necessary for five IHSSs (i e , 185, 192, 193 194, and 195), and (3) further investigation has been recommended for IHSSs 196 and 197 to be conducted as part of OU5 and OU13 The appropriate response has been incorporated in CAD/ROD

**Response to Comment 2**

The appropriate response has been incorporated in CAD/ROD

**Comment 3**

Second Sentence Replace Risk Assessment Analysis with "Risk Evaluation "

**Response to Comment 3**

The appropriate response has been incorporated in CAD/ROD

**Comment 4**

*Declaration Statement* Delete everything after first sentence

## Response to Question 4

The appropnate response has been incorporated in CAD/ROD

## Comment 5

*Signatures*   Replace EPA signature William P  Yellowtail with Jack W  McGraw

## Response to Question 5

The appropnate response has been incorporated in CAD/ROD

## Comment 6

*Site Name, Location, and Description, fourth paragraph, second to the last sentence*   Spelling Easter, should be east

## Response to Question 6

The appropnate response has been incorporated in CAD/ROD

## Comment 7

Site History and Enforcement Activities, third paragraph   First sentence, add comma (,) after 1991   Second sentence, add “to” OU16

## Response to Question 7

The appropnate response has been incorporated in CAD/ROD

## Comment 8

Fourth paragraph, spelling “preparation ”  Correction needed

## Response to Question 8

The appropnate response has been incorporated in CAD/ROD

## Comment 9

The text needs to explain what the NFAJD is

## Response to Question 9

The appropriate response has been incorporated in CAD/ROD

## Comment 10

*Highlights of Community Participation* There are several grammatical mistakes in this sentence These need to be corrected

## Response to Question 10

The appropriate response has been incorporated in CAD/ROD by adding commas after the dates

## Comment 11

*Summary of Site Risks, IHSS 185 through 195* The text needs to include more detailed information regarding the following (1) what was spilled, (2) when, (3) how much, and (4) what response action was conducted

## Response to Question 11

The appropriate response has been incorporated in CAD/ROD

## Comment 12

*IHSS 195, Steam Condensate Leak – 700 Area* Provide reference for the standard of 20,000 pCi/L

## Response to Question 12

The appropriate response has been incorporated in CAD/ROD

## Comment 13

*Responsiveness Summary, Question 5 Response* Correct response to specify if institutional controls are needed for this IHSS

# Responsiveness Summary for Colorado Department of Public Health and Environment, Hazardous Materials and Waste Management Division Comments

## on the

# Draft Corrective Action Decision/Record of Decision (CAD/ROD) Declaration Rocky Flats Plant Operable Unit 16: Low Priority Sites

### Comment 1

*Title of Decision Document* – This document is intended to record the selection of remedial action at OU16 under CHWA and CERCLA authority The title of this document should accurately reflect the scope of this decision Per Section XIII, page 42 of the IAG statement of work, the title of this decision document should be, "Corrective Action Decision/Record of Decision Declaration "

### Response to Comment 1

The title of the document has been changed

### Comment 2

*State of Colorado Signature* – The signature block for State concurrence on the CAD/ROD should be for signature by Tom Looby, Director, Office of Environment, Colorado Department of Public Health and Environment Please note the Colorado Department of Health's name was changed to the Colorado Department of Public Health and Environment on July 1, 1994

### Response to Comment 2

The appropriate response has been incorporated in CAD/ROD

### Comment 3

*Site Geology Description* – The Section Site Name, Location, and Description contains the sentence, "The pediment surface has a fan like form, with its apex and distal margins approximately two miles west of RFP " The term "apex" and "distal" generally apply to an alluvial fan such as the Rocky Flats Alluvium, not to the pediment surface the fan rests upon If the pediment surface has a fan-like form, it is because of the protection from erosion provided by the alluvial fan Furthermore, the term "distal" means the terminal edge of the fan which **does not** occur two miles west of RFP The alluvial fan and the pediment surface are dissected and portions of them terminate within RFP boundaries

## Response to Comment 3

The sentence, "The pediment surface has a fan like form, with its apex and distal margins approximately two miles west of RFP" has been deleted and the appropriate response has been incorporated in the CAD/ROD

## Comment 4

*Water Quality Standards at IHSS 194* – The 700 area groundwater is in the Rocky Flats Alluvium and possibly Quaternary colluvial deposits and, therefore, carries a surface water protection classification from the site specific classification (Classification and Water Quality Standards for Groundwater" 3 12 0 CCR 1002-6) The applicable standard for tritium is 500 pCi/L, not the 20,000 pCi/L EPA drinking water standard Since tritium associated with this release does not represent an existing source of contamination, this standard will not impact the no action decision However, the Division requests that the state water quality standard for tritium be added to the discussion of the summary of site risks for IHSS 194

## Response to Question 4

The appropriate response has been incorporated in CAD/ROD

## Comment 5

*Protectiveness of Future Receptors* – The Division requests that language be added to the summary of site risks clarifying that future receptors were considered in the conceptual model

## Response to Question 5

The appropriate response has been incorporated in CAD/ROD

## Comment 6

*Page Numbering* – The Division recommends that page numbers be added to the Final CAD/ROD

## Response to Question 6

The appropriate response has been incorporated in CAD/ROD

# Appendix A – Acronym List

| | |
|---|---|
| RFETS | The Rocky Flats Environmental Technology Site |
| OU | Operable Unit |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| SARA | Superfund Amendments and Reauthorization Act |
| CHWA | Colorado Hazardous Waste Act |
| NCP | National Oil and Hazardous Substances Pollution Contingency Plan (National Contingency Plan) |
| NFAJD | No Further Action Justification Document |
| DOE | Department of Energy |
| EPA | Environmental Protection Agency |
| IHSS | Individual Hazardous Substance Site |
| AEC | Atomic Energy Commission |
| ERDA | Energy Research and Development Administration |
| CEARP | Comprehensive Environmental Assessment and Response Program |
| SWMU | Solid Waste Management Unit |
| IAG | Interagency Agreement |
| CHWD | Colorado Hazardous Waste Permit |
| ROD | Record of Decision |
| TCA | Trichloroethane |
| PEL | Permissible Exposure Limit |
| ppm | part per million |
| pCi | picocuries |
| pCi/L | picocuries per liter |
| ug | micrograms |

| | |
|---|---|
| mg | milligrams |
| mg/L | milligrams per liter |
| PU&D | Property Utilization and Disposal |
| RCRA | Resource Conservation and Recovery Act |
| FIDLER | Field Instrument for Detection of Low Energy Radiation |
| RFI/RI | RCRA Facility Investigation/Remedial Investigation |
| dps | disintegrations per second |
| L | liter |
| CDPHE | Colorado Department of Public Health and Environment |
| dps/L | disintegrations per second per liter |
| Ci | curies |
| RAGS | Risk Assessment Guidance for Superfund |
| HRR | Historical Release Report |
| SOP | Standard Operating Procedure |

# Appendix B – References

**EG&G, 1992:** EG&G Rocky Flats, Inc , "Phase Iı Geologic Characterızatıon Data Acquısıtıon – Surface Geologic Mappıng of the Rocky Flats Plant and Vicınıty, Jefferson and Boulder Countıes, Fınal Report," Golden, Colorado, March 1992

**EG&G, 1991b:** EG&G Rocky Flats, Inc , "Phase II Geologıc Characterızatıon, Task 6 Surface Geologic Mappıng Draft Report," Golden, Colorado, May 1991

**Mackay, D., 1991:** *Multımedıa Envıronmental Models – The Fugacıty Approach*, Lewıs Publıshers, Chelsea, Mıchıgan

**Rockwell International, 1986a:** Rockwell Internatıonal, "Geologıc and Hydrologıcal Data Summary, U S Department of Energy, Rocky Flats Plant, Golden, Colorado," Golden, Colorado, July 21, 1986

**Rockwell International, 1986d:** Rockwell Internatıonal, "Resource Conservatıon and Recovery Act Part B – Post Closure Care Permıt Applıcatıon for U S Department of Energy, Rocky Flats Plant, Hazardous and Radıoactıve Mıxed Wastes," U S Department of Energy, unnumbered report, 1986

**U.S. EPA, 1990:** Health Effects Assessment Summary Tables, EPA Office of Research and Development/Office of Emergency and Remedıal Response, OSWER (OS-230)/OERR 9200/6-303/90-4, September 1990

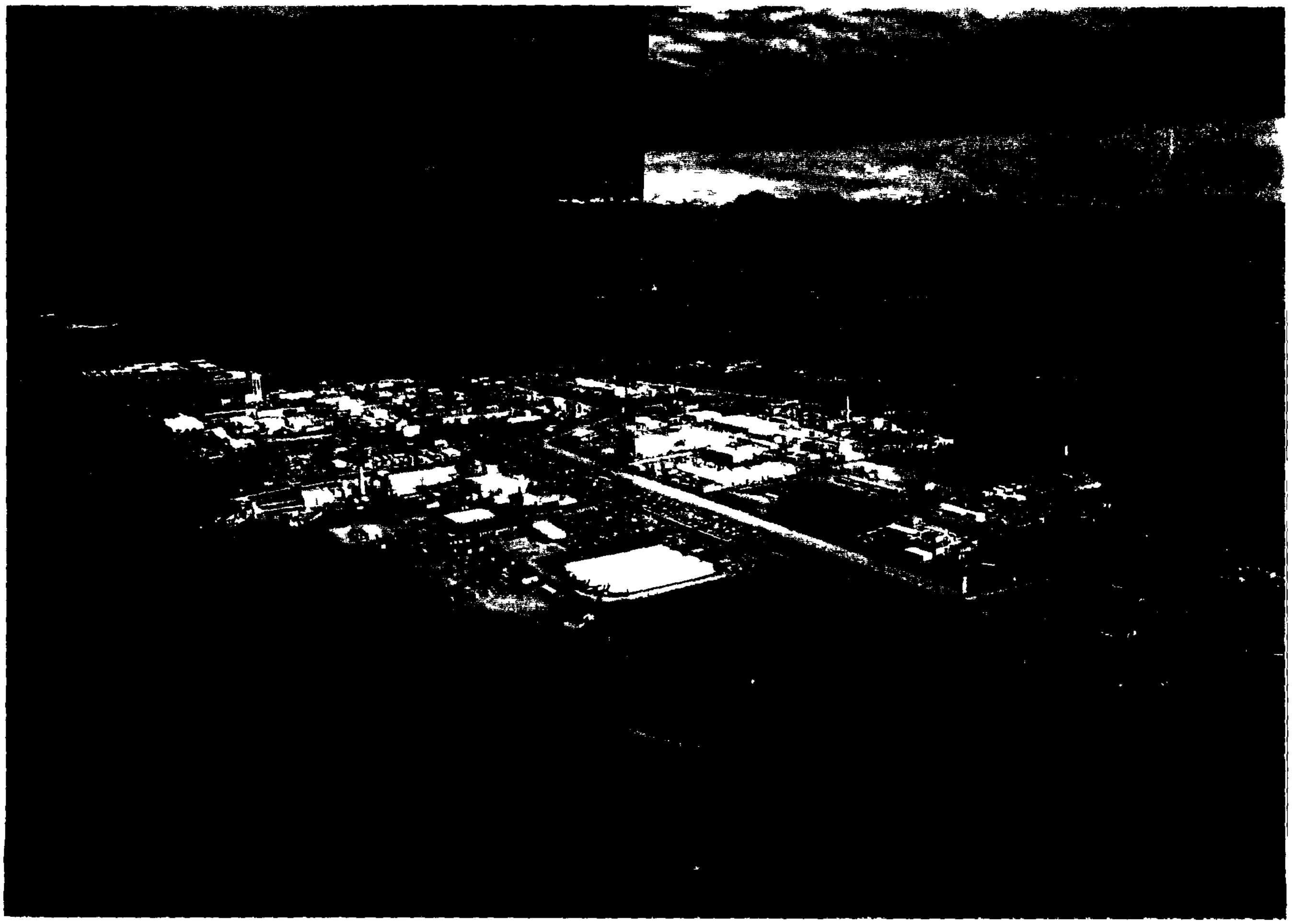
**U.S. EPA, 1979:** U S Envıronmental Protectıon Agency, Callahan, M A , et al , "Water Related Fate of 129 Prıorıty Pollutants," EPA-440/4-79-029b, December 1979

**U.S. DOE, 1986:** U S Department of Energy, "Comprehensıve Envıronmental Assessment and Response Program Phase I Draft Installatıon Assessment, Rocky Flats Plant," Washıngton, D C , DOE unnumbered draft report, 1986

August 1994

# Corrective Action Decision/ Record of Decision

## OU16: Low Priority Sites



*The Rocky Flats Environmental Technology Site*

# CORRECTIVE ACTION DECISION/ RECORD OF DECISION DECLARATION

Site Name and Location
Rocky Flats Plant Operable Unit 16 Low Priority Sites
Golden, Jefferson County, Colorado

Statement of Basis and Purpose
This decision document presents the selected remedial action for the Rocky Flats Plant Operable Unit (OU) 16 Low Priority Sites, located near Golden, Colorado The selected remedial action was chosen in accordance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986, the Colorado Hazardous Waste Act (CHWA) and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) OU16 was investigated and a final No Further Action Justification Document (NFAJD) was approved in compliance with the Federal Facility Agreement and Consent Order signed by the U S Department of Energy (DOE), the State of Colorado, and the U S Environmental Protection Agency (EPA) on January 22,1991

Description of the Selected Remedy. No Action
OU16 Low Priority Sites was originally composed of seven Individual Hazardous Substance Sites (IHSSs) The decision for a "No Action" remedy for five of the IHSSs (i e , 185, 192, 193, 194, and 195) was based upon the NCP which provides for the selection of a No Action alternative when a site or OU is already in a protective state The Risk Evaluation performed in the Final "No Further Action Justification" document determined that these IHSSs were in a protective state and presented no unacceptable risk to human health and the environment Further investigation has been recommended for IHSS 196 as part of OU5 and for IHSS 197 as part of OU13

Declaration Statement
DOE has determined that no remedial action is necessary to be protective of human health and the environment at *Rocky Flats Plant Operable Unit 16 Low Priority Sites* Because the remedy will not result in hazardous substances remaining onsite above health-based levels, a five-year review is not required

Mark N Silverman, Manager
U S Department of Energy, Rocky Flats Field Office

9/27/94
Date

Jack W McGraw
Deputy Regional Administrator, Region VIII
U S Environmental Protection Agency

9/29/94
Date

Thomas P Looby, Director, Office Of Environment,
Colorado Department of Public Health and Environment

10/23/94
Date

# Section 1

## Decision Summary

A remedy of "No Action" was selected for the Rocky Flats Environmental Technology Site (RFETS) Operable Unit (OU) 16 Low Priority Sites Individual Hazardous Substance Sites (IHSSs) numbered 185, 192, 193, 194, and 195 The risks associated with these IHSSs were assessed using conceptual model analyses These conceptual model analyses demonstrated that exposure pathways were not completed for IHSSs 185, 192, 193, 194, and 195 because past response actions and/or natural attenuation processes eliminated the source or exposure pathways Therefore, these IHSSs present no unacceptable risk to human health and the environment

Site Name, Location, and Description
The Rocky Flats Environmental Technology Site is located north of the City of Golden in northern Jefferson County, Colorado A copy of a site location map is attached (See Figure 1) Most RFETS structures and OU16 IHSSs are located within the industrialized area of RFETS, which occupies approximately 400 acres RFETS is surrounded by a buffer zone of approximately 6,150 acres IHSS 195 is located within the buffer zone (See Fig 2)

RFETS is located along the eastern edge of the southern Rocky Mountain region, immediately east of the Colorado Front Range The site is located on a broad, eastward-sloping pediment that is capped by alluvial deposits of Quaternary age (i e , Rocky Flats Alluvium) The tops of alluvial-covered pediments are nearly flat but slope eastward at 50 to 200 feet per mile (EG&G, 1992) At RFETS, the alluvial-covered pediment surface is dissected by a series of east-northeast trending stream-cut valleys The bases of the valleys containing Rock Creek, North and South Walnut Creeks, and Woman Creek lie 50 to 200 feet below the elevation of the older pediment surface These valleys incise into the bedrock underlying alluvial deposits, but most bedrock is concealed beneath colluvial material accumulated along the gentle valley slopes

Rock Creek, North and South Walnut Creeks, and Woman Creek are intermittent streams that flow generally from west to east and drain excessive water collected at RFETS Retention ponds are located in each of the creeks downstream of the main site Rock Creek surface water flows northeast to the Rock Creek confluence with Coal Creek Surface water within North and South Walnut Creeks, which is not retained within retention ponds used for spill control, flows to Great Western Reservoir Surface water within Woman Creek, which is not diverted to Mower Reservoir, flows to Standley Lake

The population, economics, and land use of areas surrounding RFETS are described in a 1989 Rocky Flats vicinity demographics report prepared by the Department of Energy (DOE) (U S DOE, 1991b) Land use within 0 to 10 miles of RFETS has been divided within the demographics report into residential, commercial, industrial, parks and open space, agricultural and vacant, and institutional classifications Most residential use within five miles of RFETS is located immediately northeast, east, and southeast of RFETS Commercial development is concentrated near residential developments north and southwest of Standley Lake and around Jefferson County Airport, located approximately three miles northeast of RFETS Industrial land use within five miles of the site is limited to quarrying and mining operations Natural resources associated with the quarrying and mining activities include gravel and coal Open-space lands are located northeast of RFETS near the City of Broomfield and in small parcels adjoining major drainages and small neighborhood parks in the cities of Westminster and Arvada The west, north, and east sides of Standley Lake are surrounded by open space Irrigated and nonirrigated croplands, producing primarily wheat and barley, are located north and northeast of RFETS near the cities of Broomfield, Lafayette, Louisville, and Boulder and in scattered parcels adjacent to the east boundary of the site Several horse operations and small hay fields are located south of RFETS The demographic report characterizes much of the vacant land adjacent to RFETS as rangeland

Site History and Enforcement Activities

RFETS is a government-owned, contractor co-operated facility, which is part of the nationwide Nuclear Weapons Complex The site was operated for the U S Atomic Energy Commission (AEC) from its inception during 1951 until the AEC was dissolved during 1975 At that time, responsibility for RFETS was assigned to the Energy Research and Development Administration (ERDA), which was succeeded by DOE during 1977 Previous operations at RFETS consisted of fabrication of nuclear weapons components from plutonium, uranium, and nonradioactive metals (i e , stainless steel and beryllium)

Various studies were conducted at RFETS to characterize environmental media and to assess the extent of radiological and chemical contaminant releases to the environment The investigations performed before 1986 were summarized by Rockwell International (1986a) During 1986, two investigations were completed at the site The first was the DOE Comprehensive Environmental Assessment and Response Program (CEARP) Phase I Installation Assessment (U S DOE, 1986) A number of sites that could potentially have adverse impacts on the environment were identified and designated as Solid Waste Management Units (SWMUs) within the CEARP of RFETS The second investigation involved a hydrogeologic and hydrochemical characterization of RFETS (Rockwell International, 1986d)

On January 22, 1991, a Federal Facility Agreement and Consent Order (i e , the Interagency Agreement (IAG)) was signed by DOE, EPA Region VIII, and State of Colorado Within the IAG, the SWMUs were changed to IHSSs and seven IHSSs were assigned to OU16 In addition, the IAG provided guidance and direction for investigating OU16 IHSSs and preparation of the draft and final No Further Action Justification Documents (NFAJDs) The NFAJD for OU16 was defined by the scope of the IAG to fulfill the IAG requirements for submittal of documentation and data necessary to substantiate the cleanup of OU16 IHSSs and/or justify whether further action was required for OU16 IHSSs Based on the NFAJD prepared for OU16 in accordance with the IAG, "no action" is appropriate for five of the original seven OU16 IHSSs Based on the approved NFAJD for OU16, further investigation is necessary for IHSS 196 and 197 Subsequently, IHSS 196 was transferred into OU5 and 197 was transferred into OU13 for further investigation

The IAG scope of work was incorporated in its entirety within the Colorado Hazardous Waste Permit (CHWP) for RFETS Upon signature of the Record of Decision (ROD) by DOE, EPA, and the State of Colorado, the State shall modify the CHWP for RFETS to incorporate the signed ROD for OU16.

Highlights of Community Participation

A public comment period was held concurrently for the *Proposed Plan and Draft Modification of CHWP for RFP OU16 Low Priority Sites* The public comment period was held from November 8, 1993, to January 7, 1994, and was extended to February 8, 1993, in response to written public request A public hearing was conducted on December 8, 1993, during which public comments and questions regarding the *Proposed Plan and Draft Modification of CHWP for RFP OU16 Low Priority Sites* for OU16 were recorded and have subsequently been responded to within this ROD

Scope and Role of Operable Unit within Site Strategy

The five IHSSs comprising OU16 include IHSS 185 - Solvent Spill, IHSS 192 - Antifreeze Discharge, IHSS 193 - Steam Condensate Leak - 400 Area, IHSS 194 Steam Condensate Leak - 700 Area, and IHSS 195 - Nickel Carbonyl Disposal All of the IHSSs are located within the industrial area of RFETS, except for IHSS 195 which is located approximately 2,000 feet north of the industrialized area of RFETS (See Fig 2) OU16 IHSSs were grouped together as "low priority sites" within the IAG because of the likelihood that previous actions or natural environmental processes eliminated the need for remedial action The scope, defined for OU16 IHSSs within Table 5 of the IAG, included submittal of documentation and data required to justify whether further action was required for the IHSSs within OU16 The NFAJD was completed and submitted in accordance with the requirements specified within Table 5 and Table 6 of the IAG

Site Characteristics

The uppermost water bearing unit at RFETS is unconfined and consists of surficial deposits (i e , Rocky Flats Alluvium, colluvium, valley-fill alluvium, fill material, and disturbed ground), weathered bedrock units, and subcrops of the Arapahoe and Laramie Formations The bedrock underlying RFETS can be considered an aquitard The direction of ground-water flow within the surficial deposits is generally from west to east beneath OU16 IHSSs Recharge to the surficial water-bearing unit occurs primarily from precipitation Discharge from the surficial water-bearing unit occurs primarily at minor seeps Seeps occur in colluvial deposits that cover the contact between the alluvium and bedrock along the edges of the valleys Discharge also occurs through seepage into other geologic formations and through evapotranspiration

Based on the conceptual model presented within the NFAJD for OU16, no sources and/or pathways for contamination from OU16 IHSSs exists A more detailed discussion of each individual IHSS is included within the "Summary of Site Risks" presented below

Summary of Site Risks

The risks associated with the OU16 IHSSs and the need for further action were assessed using a conceptual model to evaluate the exposure pathways by which contaminants could reach humans The model is based on the physical setting, the operation, and the nature of hazardous substances The model describes the sources and types of contamination, environmental media (i e , soil and ground water), contamination pathways, and the presence of humans (or other living organisms that may be affected) A detailed discussion of past cleanup actions and natural processes that have affected the hazardous substances are described in Section 3 of the Final "No Further Action Justification" document

An exposure pathway is defined as having four parts (1) A source of contamination, (2) A release of the contamination, (3) A route for the contamination to reach a human, and (4) A human (or other living organism) population that can be affected If the exposure pathway is not complete, there is no unacceptable risk to humans or the environment, and no further action is appropriate

A brief discussion of the conceptual model analysis performed for each IHSS is discussed in the following paragraphs

**IHSS 185, Solvent Spill.** Four gallons of 1,1,1 Trichloroethane (TCA) leaked from a 55-gallon drum onto the southeast loading dock of Building 707 and a paved area adjacent to the loading dock on November 10, 1985 A commercial absorbent was used to cleanup the spill The vapor pressure of TCA at 200C is 13 2kPa (99 mm Hg Mackay and Shui, 1981), and volatilization is rapid (U S EPA, 1979) Also, TCA was not detected in any of the eight ground-water samples collected between November 1989 and April 1992 from monitoring well P218089 The immediate cleanup action of the TCA minimized or potentially eliminated the source of TCA contamination Because the spill occurred on a paved area and the cleanup response action of the source was immediate, the wind dispersion and infiltration transport pathways are eliminated

**IHSS 192, Antifreeze Discharge.** During December, 1980, a release of 155 gallons of antifreeze containing 25 percent ethylene glycol was diverted into Pond B-1 The drainage system was subsequently flushed with 5, 000 gallons of water The concentration of ethylene glycol was diluted below the detection limits by the 5,000 gallons of water that was flushed through the system immediately after the release and by surface water runoff over the past 12 years Also, a degradation model of ethylene glycol showed less than 7 parts per million (ppm) (i e , 250,000 ppm in antifreeze) between twenty to forty days after the contamination occurrence Using this same reasoning, it was predicted that the ethylene glycol related to the 1980 spill has been completely degraded by this time

**IHSS 193, Steam Condensate Leak - 400 Area.** A steam condensate line containing water with low-level (0 135 milligrams per liter (mg/L)) amines was found to be leaking during November, 1979 The area where the leak occurred was paved at the time of the leak, eliminating the infiltration and wind dispersion pathways The concentration of amines in the steam condensate (0 135 mg/L) was approximately 1 1/2 percent of the permissible exposure limit (PEL) of 10 mg/L Also, the concentration of amines has been diluted by rainfall during the 15 year period since the spill occurred Amines could not be detected, no source of contamination is present

**IHSS 194, Steam Condensate Leak - 700 Area.** A break in a steam condensate line containing low-level of tritium occurred in the Building 707 area on September 26, 1979 The condensate had a tritium activity of approximately 1,000 pCi/L which was significantly lower than EPA's set public drinking water standard of 20,000 pCi/L (40 CFR Part 141 16) and the State of Colorado sitewide standard of 20,000 pCi/L (5 Colorado Code of Regulations 1002-8 § 3 11 5 (c)(2)) However, the State of Colorado site-specific standard for tritium activity at RFETS is 500 pCi/L (5 Colorado Code of Regulations 1002-8 § 3 12 0) The released tritium has undergone more than one half-life decay (i e , 12 26 years) since the occurrence of the release and significant dilution due to precipitation This results in a present-day tritium activity of much less than 500 pCi/L, which is within the range of background activities reported for tritium in surface waters at RFETS and less than any promulgated standard Therefore, tritium associated with this IHSS does not represent an existing source of contamination

**IHSS 195, Nickel Carbonyl Disposal.** From March through August 1972, cylinders of nickel carbonyl were disposed in a dry well located in the buffer zone The cylinders were opened inside the well and vented with small arms fire to allow decomposition in air Nickel carbonyl is highly volatile and readily decomposes in the presence of oxygen forming nickel oxide Nickel oxide is also highly insoluble in ground water For every gram (0 002 pound) of nickel oxide in contact with typical ground water, approximately $10^{-26}$ micrograms (ug) of nickel per liter of water is transferred to solution EPA's reference dose for nickel in drinking water is 100 ug/L (U S EPA, 1990) Wind dispersion disseminated nickel oxide particles, which would not be detected at concentrations exceeding background

These conceptual model analyses demonstrate that exposure pathways are not completed for IHSSs 185, 192, 193, 194, and 195 Past response actions and/or natural attenuation processes eliminated the source or exposure pathways Future receptors were considered using the conceptual model analyses to ensure that risk was completely evaluated Therefore, these hazardous sites do not presently, nor will they in the future, present unacceptable risk to human health and the environment

Explanation of Significant Changes

No changes in the selected remedy have been made since release of the *Proposed Plan and Draft Modification of Colorado Hazardous Waste Permit for Rocky Flats Plant Operable Unit 16 Low Priority Sites*

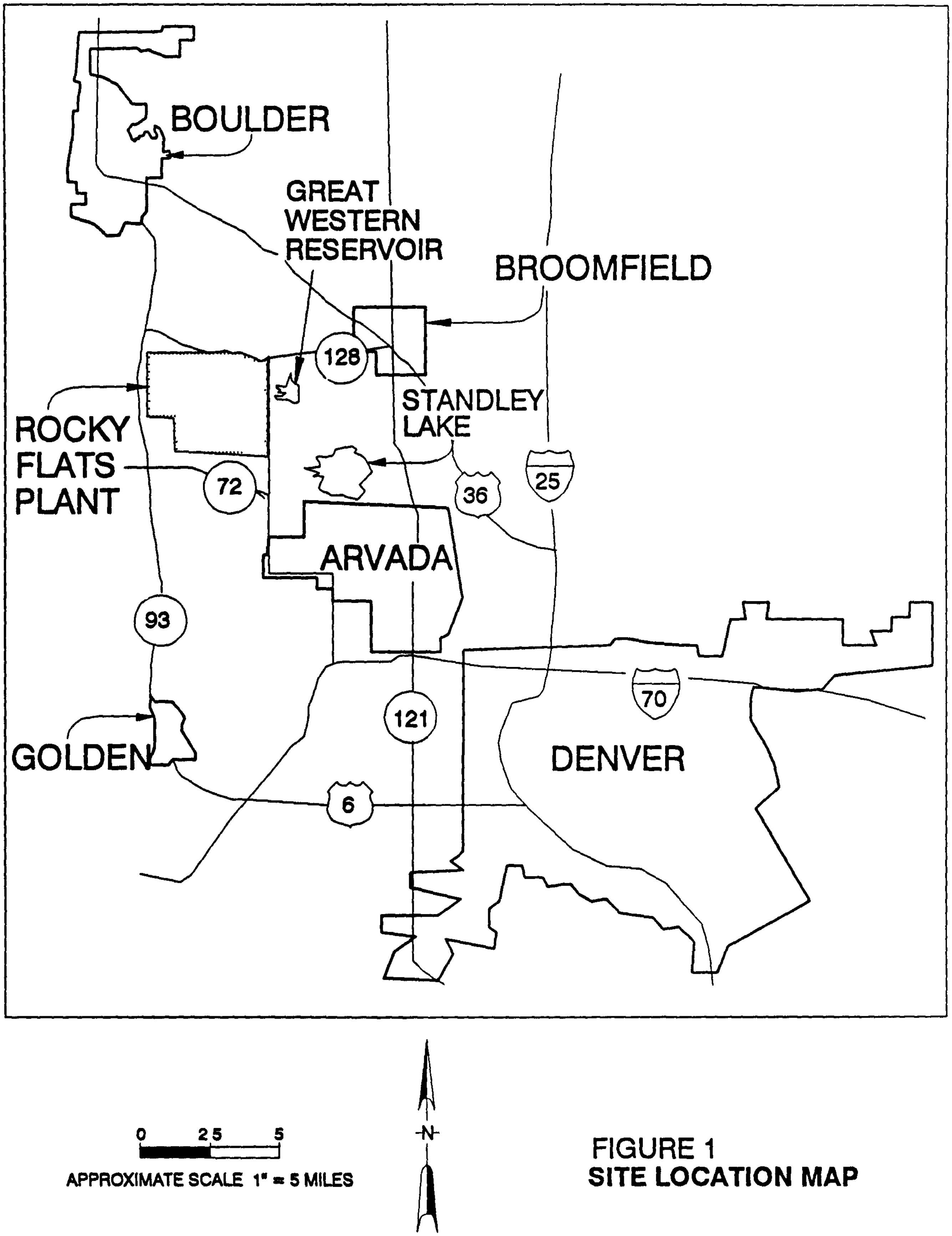
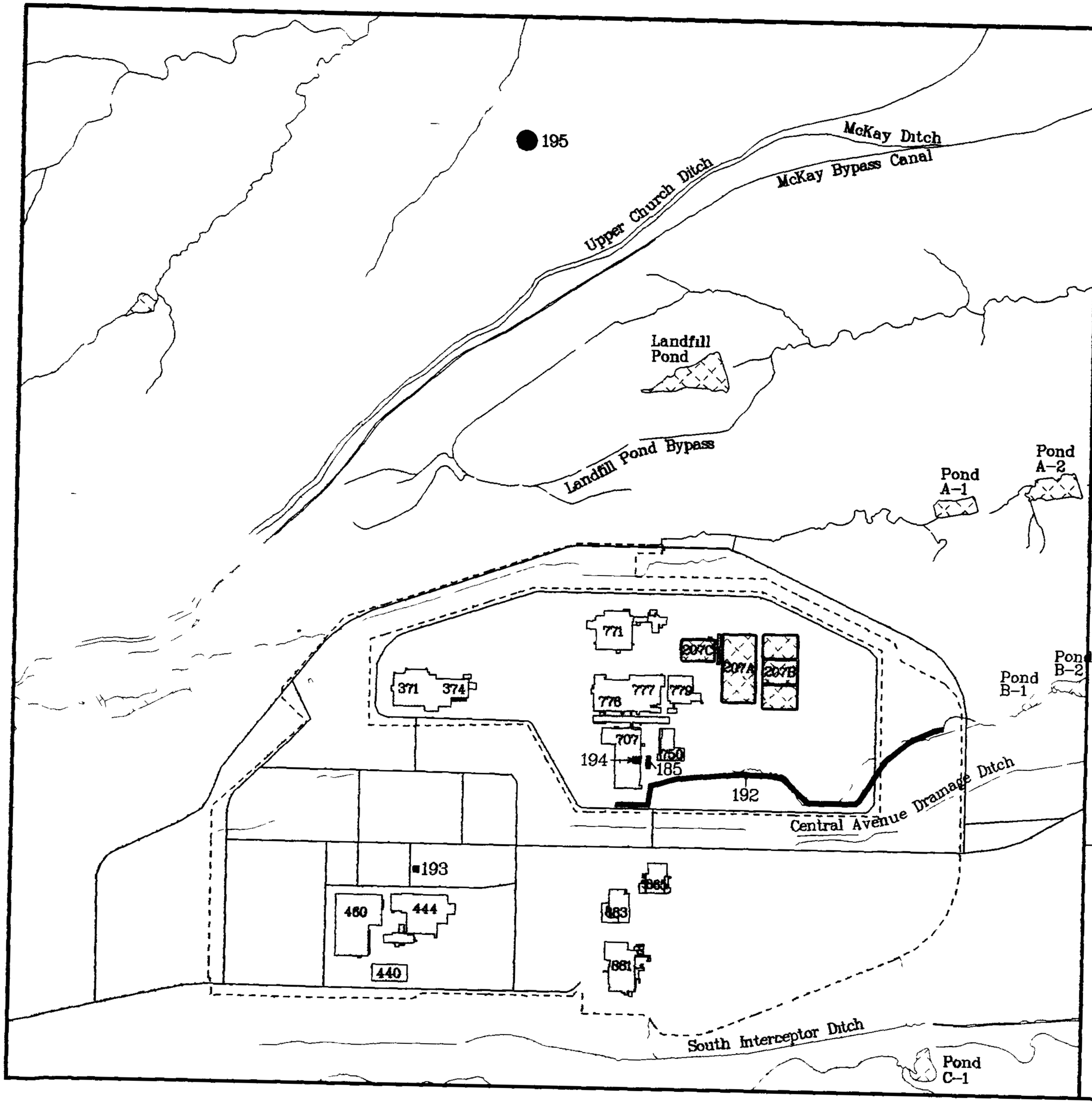



FIGURE 1
**SITE LOCATION MAP**




US Department of Energy
Rocky Flats Plant

Paved roads
Fences
Streams, ditches, and other drainage features
Ponds/lakes
Individual Hazardous Substance Sites (IHSS)
Buildings or structures

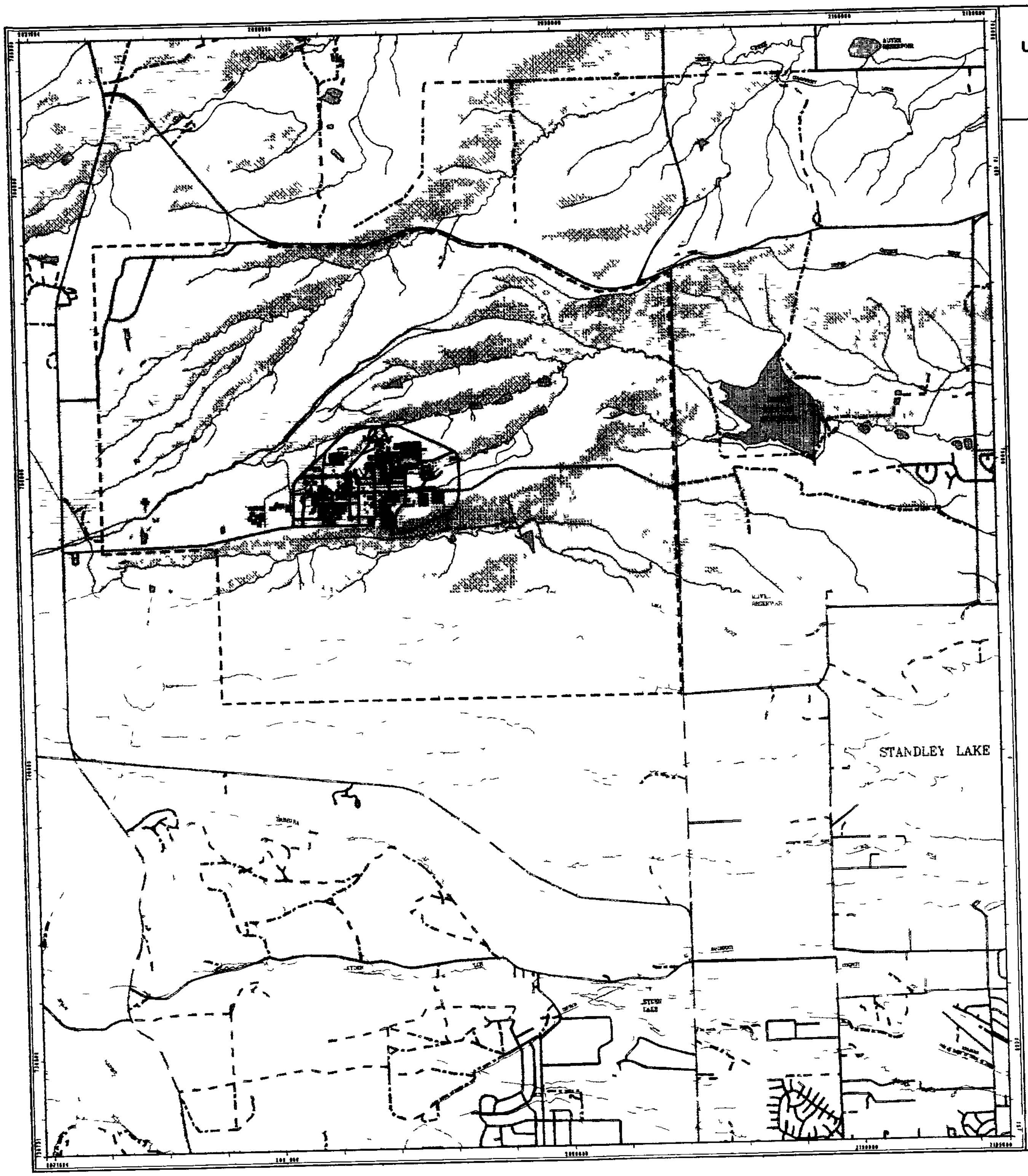
SOURCE OF DATA.
Individual Hazardous Substance Sites Historical Release Report.

Environmental Restoration
Technical Support Document

Operable Unit 16
Low Priority Sites

Figure 2

Dat 3-17-94




U S Department of Energy
Rocky Flats Plant

# Figure 3

ROAD CLASSIFICATION

- Heavy-duty
- Medium-duty
- Light-duty
- Unimproved dirt
- Rocky Flats Plant boundary
- Streams, ditches, and other drainage features
- Ponds and lakes
- Buildings and other structures

Scale = 1 : 60000
1 inch = 5000 feet

State Plane Coordinate Projection
Colorado Central Zone
Datum NAD27

Prepared by:
EG&G ROCKY FLATS

Rocky Flats Plant
P O Box 464
Golden Colorado 80402-0464

# Section 2

## Responsiveness Summary

*Proposed Plan/Draft Modification of Colorado Hazardous Waste Permit for the Rocky Flats Plant Operable Unit 16 Low Priority Sites*

## Ronald Harlan, Area Citizen:

### Question 1

How was the exposure pathway broken for each of the five sites?

### o Question 1

The exposure pathway was broken at the source for IHSS 185 since the spill (i e , four gallons of the solvent 1,1,1 Trichloroethane (TCA)) occurred onto a paved area, the volitization rate of TCA is inherently high, and a cleanup response action was initiated at the time of the release

The exposure pathway was broken at the source for IHSS 192 because the antifreeze discharged was diluted and evaluation of its degradation indicated that no ethylene glycol could be detected at this time

The exposure pathway was broken at the source for IHSS 193 because the steam condensate release occurred on a paved area, the concentration of amines was relatively low within the steam condensate, precipitation diluted the amines and amines could not be detected at IHSS 193

The exposure pathway was broken at the source for IHSS 194 because the tritium activity of 1000 picocuries per liter (pCi/L) within the steam condensate released was significantly lower than U S EPA set drinking water standard for tritium of 20,000 pCi/L Also the activity of tritium was within the background range for surface water at RFP In addition, based on the 12 26 year half-life of tritium, less than 500 pCi/l of tritium is estimated to be present today

The exposure pathway was broken at the pathway for IHSS 195 since nickel carbonyl is highly volatile and readily decomposes in the presence of oxygen to form nickel oxide The concentration of nickel oxide on the ground surface if ejected from the dry well would not be detected above background. Nickel oxide is highly insoluble in ground water and a viable transport pathway does not exist for nickel oxide from the dry well

### Question 2

What metals, (within IHSS 197), were there that are of concern?

## Response to Question 2

Scrap metal components, primarily from the original plant construction program, were buried within IHSS 197 trenches In addition, unusable scrap metal such as aluminum and steel associated with the Property Utilization and Disposal yards was disposed of within the trenches There is a slight possibility that transformers containing polychlorinated biphenyls were disposed within the IHSS 197 trenches also Buried material was removed from the trenches during 1981 The unearthed material consisted of moist, but not oily, scrap metal such as machine turnings, rings, shapes, overlays, and other metal parts Transformers or related material were not present in the material excavated from the trenches Monitoring of materials using a Field Instrument for Detection of Low Energy Radiation (FIDLER) indicated no detectable radioactivity

## Question 3

So what needs investigating--you don't know what was put there, (within IHSS 197), so you?

## Response to Question 3

The response to this question provided during the Public Hearing conducted on December 8, 1993, was misstated Further investigation is warranted at IHSS 197 since the extent of excavation and removal of material from the trenches during 1981 is unknown Therefore, buried material may still be present within the trenches at IHSS 197 which could be a source of contamination Since contamination may still be present, exposure pathways may also exist Additional investigative work must be conducted at IHSS 197

## Question 4

Some day you'll get around to finding out what's there, (within IHSS 197)?

## Response to Question 4

Additional investigative work at IHSS 197 is being done as part of the Phase I Resource Conservation and Recovery Act (RCRA) Facility Investigation/Remedial Investigation (RFI/RI) for Operable Unit (OU) 13 Radiation surveys within IHSS 197 have already been completed as part of the RFI/RI IHSS 197 was transferred to OU 13 for two reasons 1) technically the RFI/RI for OU 13 is adequate for addressing potential contamination associated with IHSS 197, and 2) administratively the transfer of IHSS 197 from OU 16 to OU 13 allows the IHSSs remaining in OU 16 to be closed per the Interagency Agreement (IAG)

## Question 11

--I just question whether a thousand picocuries per liter, did you say, is a natural background There is tritium produced in nature, but this sounds a little high

That's roughly 2,200 disintegrations permitted per liter, and I'm kind of surprised at that

## Comment 4

Well, I think milligrams of tritium would be many curies

## Question 12

So five picocuries per liter, (of tritium is considered background)?

## Question 13

Okay  Of tritium, (500 pCi/l is considered background), in groundwater?

## Question 14

I kind of wonder how it, (1000 pCi/l tritium within the steam condensate), got to that high concentration

## Comment 5

In steam now--I don't know exactly how steam counts work  But let's say that water was being recirculated for many years  Tritium--well, water containing tritium is a little heavier than the average water molecule, and maybe over 20 years it would concentrate  I don't know

Of course, over 20 years, more than half of it should decay, too, so--

## [illegible] 194 questions 11, 12, 13, and 14, [illegible]ments 4 and 5.

During the Public Hearing there was confusion regarding IHSS 194, the background activity of tritium, the units in which the activity of tritium is presented, etc  A general response approach to IHSS 194 questions and comments was agreed upon by EPA, DOE and CDH in order to ensure that the public's questions and comments regarding IHSS 194 are addressed clearly and that public hearing misstatements are corrected  A general response to IHSS 194 questions 11, 12, 13 and 14, and comments 4 and 5 is presented below

Within the Background Geochemical Characterization Report for Rocky Flats Plant (EG&G, 1990) a maximum background activity for tritium during 1989 is reported as 980 picocuries per liter (pCi/l) within Rocky Flats Plant (RFP) surface water  Other values of background tritium activity provided in response to Public comments and/or questions during the public hearing held on December 8, 1994, were misstated  The activity of tritium within samples of IHSS 194 steam condensate released during 1979 was approximately 1000 pCi/l which does not differ statistically from the reported range of background values (EG&G, 1990) measured during 1989  Additional information regarding background activities of tritium, and sampling that has been conducted, is stated in the No Further Action Justification Document (NFAJD) for OU 16  The NFAJD is available for the public at the various RFP information repositories located in the area

Tritium decays rapidly and has a half-life of 12.26 years. Based on the half-life of tritium, the present day activity of the tritium released during 1979 would be less than 500 pCi/l. The EPA has set a public drinking water standard of 20,000 pCi/l as a maximum for tritium. Therefore, the tritium activity present is at very low concentration and well below standards.

Tritium is usually presented and discussed in units of picocuries (pCi) which is a measurement of activity. Picocuries per liter is an expression of activity concentration. An activity of 27 pCi is equivalent to one (1) disintegration per second (dps). Therefore, steam condensate with an activity concentration of 1000 pCi/l is equivalent to approximately 37 dps per liter (dps/l).

Tritium is both a naturally occurring and man-made isotope of hydrogen and behaves identically to hydrogen when combining with oxygen to form water molecules. As stated above, tritium is usually discussed in terms of an activity versus a weight (i.e., pCi versus milligrams, respectively). One (1) milligram (mg) of steam condensate with an activity of 1000 pCi/l would have an activity equivalent to approximately $10^{-15}$ curies (Ci). A conversion table for various units used within this general response is provided below.

Tritium behaves identically to hydrogen when combining with oxygen to form water molecules. Tritium is not "dissolved" within water, but is part of the water molecule itself. As a result, tritium is readily transported and highly mobile as a component of surface water, ground water, body fluids, etc. Tritium will not concentrate within water (i.e., steam condensate) because of its mobility as part of and the affinity that tritiated water molecules have for water.

CONVERSION TABLE

1 dps = 27 pCi

1000 pCi/l = 37 dps/l

1 pCi = $10^{-12}$ Ci

1 mg $H_2O$ @ 1000 pCi/l = $10^{-15}$ Ci = 0.001 pCi

## Ken Korkia, Technical Assistant for the Rocky Flats Cleanup Commission:

**Question 5**

Does that mean that under the current situation they, (the four parts of the exposure pathway), have to be complete, or does this take in the hypothetical future uses that could lead to a population that may some day be exposed?

And specifically, I have a thought in mind that if you have an underground or groundwater contamination, and you know that there's definite levels of contamination, but you know that no one is currently using that source of groundwater, would that be a case, then, where you wouldn't have to clean up that source groundwater?

## Response to Question 5

Reasonable hypothetical future uses that could lead to a population that may some day be exposed were considered Specifically, the future use of an aquifer would have to be considered and contamination addressed appropriately to protect the public and the environment Per the EPA Risk Assessment Guidance for Superfund (RAGS) the exposure assessment included reasonable maximum estimates of exposure for both current and future land-use assumptions Current exposure estimates were used to determine whether a threat exists based on existing exposure conditions at the site Future exposure estimates are used to provide decision-makers with an understanding of the potential future exposures and threats and include a qualitative estimate of the likelihood of such exposure occurring

## Question 6

-- What's the source of tritium in that, (IHSS 194), steam condensate?

## Response to Question 6

The source of the tritium within the steam condensate is not known However, the current maximum of 500 pCi/l within the steam condensate is within the reported range of background values (EG&G, 1990) for RFP and is significantly less than the EPA set public drinking water standard of 20,000 pCi/l for tritium Please refer to the general response provided for questions 11, 12, 13 and 14, and comments 4 and 5 presented above

## Question 7

So, but is this, (1000 pCi/l tritium in steam condensate), higher than normal?

## Response to Question 7

Please refer to the general response provided for questions 11, 12, 13 and 14, and comments 4 and 5 presented above

## Question 8

--is this just naturally occurring in all the steam that's at Rocky Flats that you would find the tritium?

## Response to Question 8

Please refer to the general response provided for questions 11, 12, 13 and 14, and comments 4 and 5 presented above

## Question 9

Because my concern is, then, that every place--I'm sure you've had other steam leaks over the past with all the miles of pipe that you must have out there, and so that was this only one example that was pulled up, or why are other areas where there were leaks aren't being considered for this same contamination?

## Response to Question 9

When the IAG was negotiated the only steam condensate leak identified as a potential concern with regard to tritium was the IHSS 194 release However, it was agreed by EPA, CDH and DOE that a mechanism to address past and future releases needed to be in place within the IAG The mechanism that was agreed upon is the Historical Release Report (HRR) The HRR is updated every three months to include newly identified or suspected releases for which DOE has notified EPA and the State during the previous three months The HRR is available to the public at the public information repositories for Rocky Flats Plant

## Question 10

If a steam leak were to occur today, would it be standard procedure to do a radionuclide specific testing on that to see if there was tritium, plutonium, uranium in the steam?

## Response to Question 10

All detected releases at RFP are investigated Steam condensate which is accidentally released within an IHSS is sampled, and the appropriate response is made Standard Operating Procedures (SOPs) for reporting and mitigating releases are in place at Rocky Flats Plant in compliance with RCRA and the Colorado Hazardous Waste Permit for RFP However, steam condensate is not considered a hazardous waste Tritium, plutonium and uranium are not automatically included with regard to steam condensate leak sampling unless a potential for tritium, plutonium and uranium contamination exists The steam system(s) at RFP where a potential for tritium, plutonium and uranium contamination exists are designed to maintain a "safety envelope" to prevent potentially contaminated steam from escaping A safety envelope is created by maintaining relatively greater steam pressures outside areas where a potential for tritium, plutonium and uranium contamination exists

## Comment 1

Well, I hope there's a little more information in the full document about tritium

## Response to Comment 1

Additional information regarding tritium is available within the No Further Action Justification Document for OU 16 which is available for the Public at the RFP Information Repositories

## Comment 2

And just a closing comment, I guess that I know this is our first operable unit where we've really gotten this far down where there actually have been decisions made, and I guess it's wishful on my part, but I hope that all the documents will be as easy to read and to comprehend, and that the decisions will be as easy to make But I seriously doubt that will be the case, but we can only hope

## Response to Comment 2

The DOE acknowledges the support for the format and content of the Proposed Plan/Draft Modification of the Colorado Hazardous Waste Permit for Rocky Flats Plant Operable Unit 16 Low Priority Sites

## Comment 3

I commend the authors of this, especially the inclusion of the glossary and just the explanation of everything was easy to comprehend Thanks

## Response to Comment 3

The DOE acknowledges the support for the format and content of the Proposed Plan/Draft Modification of the Colorado Hazardous Waste Permit for Rocky Flats Plant Operable Unit 16 Low Priority Sites

# Responsiveness Summary for U.S. Environmental Protection Agency Comments

## on the

## Draft Corrective Action Decision/Record of Decision (CAD/ROD) Declaration Rocky Flats Plant Operable Unit 16: Low Priority Sites

### Comment 1

*Statement of Basis and Purpose, third sentence* Delete word "which"

### Response to Comment 1

The appropriate response has been incorporated in CAD/ROD

### Comment 2

*Description of the Selected Remedy No Action* The text needs to clarify the following (1) OU16 is composed of seven IHSSs, (2) no action was found necessary for five IHSSs (i e , 185, 192, 193, 194, and 195), and (3) further investigation has been recommended for IHSSs 196 and 197 to be conducted as part of OU5 and OU13 The appropriate response has been incorporated in CAD/ROD

### Response to Comment 2

The appropriate response has been incorporated in CAD/ROD

### Comment 3

Second Sentence Replace Risk Assessment Analysis with "Risk Evaluation"

### Response to Comment 3

The appropriate response has been incorporated in CAD/ROD

### Comment 4

*Declaration Statement* Delete everything after first sentence

## Response to Question 4

The appropriate response has been incorporated in CAD/ROD

## Comment 5

*Signatures* Replace EPA signature William P Yellowtail with Jack W McGraw

## Response to Question 5

The appropriate response has been incorporated in CAD/ROD

## Comment 6

*Site Name, Location, and Description, fourth paragraph, second to the last sentence* Spelling Easter, should be east

## Response to Question 6

The appropriate response has been incorporated in CAD/ROD

## Comment 7

Site History and Enforcement Activities, third paragraph First sentence, add comma (,) after 1991 Second sentence, add “to” OU16

## Response to Question 7

The appropriate response has been incorporated in CAD/ROD

## Comment 8

Fourth paragraph, spelling “preparation ” Correction needed

## Response to Question 8

The appropriate response has been incorporated in CAD/ROD

## Comment 9

The text needs to explain what the NFAJD is

## Response to Question 9

The appropriate response has been incorporated in CAD/ROD

## Comment 10

*Highlights of Community Participation* There are several grammatical mistakes in this sentence These need to be corrected

## Response to Question 10

The appropriate response has been incorporated in CAD/ROD by adding commas after the dates

## Comment 11

*Summary of Site Risks, IHSS 185 through 195* The text needs to include more detailed information regarding the following (1) what was spilled, (2) when, (3) how much, and (4) what response action was conducted

## Response to Question 11

The appropriate response has been incorporated in CAD/ROD

## Comment 12

*IHSS 195, Steam Condensate Leak – 700 Area* Provide reference for the standard of 20,000 pCi/L

## Response to Question 12

The appropriate response has been incorporated in CAD/ROD

## Comment 13

*Responsiveness Summary, Question 5 Response* Correct response to specify if institutional controls are needed for this IHSS

## Response to Question 13

The Responsiveness Summary for the Proposed Plan for OU16 has been included in the Draft ROD as a "Final" document and should not be changed In addition, for the technical reasons discussed below, institution controls should **not** be specified as suggested by EPA

DOE prefers to address Question 5 using the explanation of the conceptual model and RAGS Institutional controls would be only one type of remedy which could be selected depending upon the scenario provided Specifying a remedy (i e , institutional controls) for a hypothetical scenario is inappropriate since the technical details of the hypothetical scenario are unknown In addition, the Public may confuse the hypothetical scenario with reality and confuse the hypothetical remedy (i e , institutional controls) with the no action remedy selected for OU16

# Responsiveness Summary for Colorado Department of Public Health and Environment, Hazardous Materials and Waste Management Division Comments

## on the

# Draft Corrective Action Decision/Record of Decision (CAD/ROD) Declaration Rocky Flats Plant Operable Unit 16: Low Priority Sites

### Comment 1

*Title of Decision Document* – This document is intended to record the selection of remedial action at OU16 under CHWA and CERCLA authority The title of this document should accurately reflect the scope of this decision Per Section XIII, page 42 of the IAG statement of work, the title of this decision document should be, "Corrective Action Decision/Record of Decision Declaration "

### Response to Comment 1

The title of the document has been changed

### Comment 2

*State of Colorado Signature* – The signature block for State concurrence on the CAD/ROD should be for signature by Tom Looby, Director, Office of Environment, Colorado Department of Public Health and Environment Please note the Colorado Department of Health's name was changed to the Colorado Department of Public Health and Environment on July 1, 1994

### Response to Comment 2

The appropriate response has been incorporated in CAD/ROD

### Comment 3

*Site Geology Description* – The Section Site Name, Location, and Description contains the sentence, "The pediment surface has a fan like form, with its apex and distal margins approximately two miles west of RFP " The term "apex" and "distal" generally apply to an alluvial fan such as the Rocky Flats Alluvium, not to the pediment surface the fan rests upon If the pediment surface has a fan-like form, it is because of the protection from erosion provided by the alluvial fan Furthermore, the term "distal" means the terminal edge of the fan which **does not** occur two miles west of RFP The alluvial fan and the pediment surface are dissected and portions of them terminate within RFP boundaries

## Response to Comment 3

The sentence, "The pediment surface has a fan like form, with its apex and distal margins approximately two miles west of RFP" has been deleted and the appropriate response has been incorporated in the CAD/ROD

## Comment 4

*Water Quality Standards at IHSS 194* – The 700 area groundwater is in the Rocky Flats Alluvium and possibly Quaternary colluvial deposits and, therefore, carries a surface water protection classification from the site specific classification (Classification and Water Quality Standards for Groundwater" 3 12 0 CCR 1002-6) The applicable standard for tritium is 500 pCi/L, not the 20,000 pCi/L EPA drinking water standard Since tritium associated with this release does not represent an existing source of contamination, this standard will not impact the no action decision However, the Division requests that the state water quality standard for tritium be added to the discussion of the summary of site risks for IHSS 194

## Response to Question 4

The appropriate response has been incorporated in CAD/ROD

## Comment 5

*Protectiveness of Future Receptors* – The Division requests that language be added to the summary of site risks clarifying that future receptors were considered in the conceptual model

## Response to Question 5

The appropriate response has been incorporated in CAD/ROD

## Comment 6

*Page Numbering* – The Division recommends that page numbers be added to the Final CAD/ROD

## Response to Question 6

The appropriate response has been incorporated in CAD/ROD

# Appendix A – Acronym List

| | |
|---|---|
| RFETS | The Rocky Flats Environmental Technology Site |
| OU | Operable Unit |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| SARA | Superfund Amendments and Reauthorization Act |
| CHWA | Colorado Hazardous Waste Act |
| NCP | National Oil and Hazardous Substances Pollution Contingency Plan (National Contingency Plan) |
| NFAJD | No Further Action Justification Document |
| DOE | Department of Energy |
| EPA | Environmental Protection Agency |
| IHSS | Individual Hazardous Substance Site |
| AEC | Atomic Energy Commission |
| ERDA | Energy Research and Development Administration |
| CEARP | Comprehensive Environmental Assessment and Response Program |
| SWMU | Solid Waste Management Unit |
| IAG | Interagency Agreement |
| CHWD | Colorado Hazardous Waste Permit |
| ROD | Record of Decision |
| TCA | Trichloroethane |
| PEL | Permissible Exposure Limit |
| ppm | part per million |
| pCi | picocuries |
| pCi/L | picocuries per liter |
| ug | micrograms |

| | |
|---|---|
| mg | milligrams |
| mg/L | milligrams per liter |
| PU&D | Property Utilization and Disposal |
| RCRA | Resource Conservation and Recovery Act |
| FIDLER | Field Instrument for Detection of Low Energy Radiation |
| RFI/RI | RCRA Facility Investigation/Remedial Investigation |
| dps | disintegrations per second |
| L | liter |
| CDPHE | Colorado Department of Public Health and Environment |
| dps/L | disintegrations per second per liter |
| Ci | curies |
| RAGS | Risk Assessment Guidance for Superfund |
| HRR | Historical Release Report |
| SOP | Standard Operating Procedure |

# Appendix B – References

**EG&G, 1992:** EG&G Rocky Flats, Inc , "Phase Iı Geologic Characterization Data Acquisition – Surface Geologic Mapping of the Rocky Flats Plant and Vicinity, Jefferson and Boulder Counties, Final Report," Golden, Colorado, March 1992

**EG&G, 1991b:** EG&G Rocky Flats, Inc , "Phase II Geologic Characterization, Task 6 Surface Geologic Mapping Draft Report," Golden, Colorado, May 1991

**Mackay, D., 1991:** *Multimedia Environmental Models – The Fugacity Approach*, Lewis Publishers, Chelsea, Michigan

**Rockwell International, 1986a:** Rockwell International, "Geologic and Hydrological Data Summary, U S Department of Energy, Rocky Flats Plant, Golden, Colorado," Golden, Colorado, July 21, 1986

**Rockwell International, 1986d:** Rockwell International, "Resource Conservation and Recovery Act Part B – Post Closure Care Permit Application for U S Department of Energy, Rocky Flats Plant, Hazardous and Radioactive Mixed Wastes," U S Department of Energy, unnumbered report, 1986

**U.S. EPA, 1990:** Health Effects Assessment Summary Tables, EPA Office of Research and Development/Office of Emergency and Remedial Response, OSWER (OS-230)/OERR 9200/6-303/90-4, September 1990

**U.S. EPA, 1979:** U S Environmental Protection Agency, Callahan, M A , et al , "Water Related Fate of 129 Priority Pollutants," EPA-440/4-79-029b, December 1979

**U.S. DOE, 1986:** U S Department of Energy, "Comprehensive Environmental Assessment and Response Program Phase I. Draft Installation Assessment, Rocky Flats Plant," Washington, D C , DOE unnumbered draft report, 1986