

LETTER REPORT

**COLORADO DEPARTMENT OF PUBLIC
HEALTH AND ENVIRONMENT
SOURCE AREA DELINEATION AND
RISK-BASED CONSERVATIVE SCREEN
AND
ENVIRONMENTAL PROTECTION AGENCY
AREAS OF CONCERN DELINEATION**

**HUMAN HEALTH RISK ASSESSMENT
WOMAN CREEK PRIORITY DRAINAGE AREA
OPERABLE UNIT NO.5**

ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

**U.S. DEPARTMENT OF ENERGY
Rocky Flats Environmental Technology Site
Golden, Colorado**

**ENVIRONMENTAL RESTORATION PROGRAM
November 28, 1994**

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ACRONYMS

AOC	area of concern
ARAR	Applicable or Relevant and Appropriate Requirements
CDPHE	Colorado Department of Public Health and Environment
COC	chemical of concern
DOE	U.S Department of Energy
EPA	U.S. Environmental Protection Agency
FIDLER	Field Instrument for Detection of Low Energy Radiation
FS	feasibility study
ft	feet
HHRA	human health risk assessment
HPGe	High-purity Germanium
IAG	Interagency Agreement
IHSS	individual hazardous substance site
m	meter
OU5	Operable Unit No. 5
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyls
PCOC	potential chemical of concern
PPRG	Programmatic Preliminary Remediation Goal
QA/QC	quality assurance/quality control
RBC	risk-based concentration
RCRA	Resource Conservation and Recovery Act
RfD	reference dose
RFETS	Rocky Flats Environmental Technology Site
RFI/RI	RCRA Facility Investigation/Remedial Investigation
SF	slope factor
SID	South Interceptor Ditch
SVOC	semi-volatile organic compound
TAL	target analyte list
TCL	target compound list
TM	technical memorandum
TOC	total organic carbon
UTL _{99/99}	99 percent upper tolerance limit at the 99 percent upper confidence level
VOC	volatile organic compound

EXECUTIVE SUMMARY

This executive summary provides results of the Colorado Department of Public Health and Environment (CDPHE) Risk-Based Conservative Screen for the Woman Creek Priority Drainage, Operable Unit No. 5 (OU5), located at the Rocky Flats Environmental Technology Site (RFETS) in Golden, Colorado. Located primarily in the buffer zone on the southern side of the plant, the OU5 study area consists of approximately 292 hectares (720 acres) (Figure 1-1). Eleven individual hazardous substance sites (IHSSs) have been identified in OU5. They are the Original Landfill and Filter Backwash Pond (IHSSs 115 and 196), the Ash Pits (IHSSs 133.1, 133.2, 133.3, and 133.4), the Incinerator (IHSS 133.5), the Concrete Wash Pad (IHSSs 133.6), Detention Ponds C-1 and C-2 (IHSSs 142.10 and 142.11), and the Surface Disturbances (IHSS 209).

The CDPHE Risk-Based Conservative Screen was developed to support CDPHE's evaluation of contaminant source areas. The screen is used to support the identification of contaminant source areas, low-hazard areas that may warrant no further evaluation, high hazard areas that may warrant potential early action, and those areas which need to be evaluated in the HHRA. The CDPHE screen also provides a decision point as to whether a feasibility study (FS) is warranted. The source areas in the CDPHE screen will be used to define areas of concern (AOC) for evaluation in the Human Health Risk Assessment (HHRA) portion of the Phase I Resource Conservation and Recovery Act (RCRA) Facility Investigation/Remedial Investigation (RFI/RI) Report for OU5. The HHRA is performed as part of the RFI/RI conducted pursuant to the U.S. Department of Energy (DOE) Environmental Restoration Program; a Compliance Agreement between DOE, the U.S. Environmental Protection Agency (EPA), and CDPHE; and the Federal Facility Agreement and Consent Order (Interagency Agreement, referred to as the IAG) signed in 1991.

The CDPHE Risk-Based Conservative Screen for OU5 contains the following six steps:

- Step 1: Define potential chemicals of concern (PCOCs) in soil, groundwater, surface water, seep water, pond sediment, seep sediment, and stream sediment.
- Step 2: Identify contaminant source areas based on distribution of PCOCs.
- Step 3: Identify a health risk-based concentration (RBC) for each PCOC in each medium.

- Step 4: Calculate the ratio of the maximum concentrations of each PCOC to the corresponding RBC; sum the ratios for each medium and for each source area.
- Step 5: Apply CDPHE Risk-Based Conservative Screen decision criteria to the RBC ratio sums for each source area.
- Step 6: Define AOCs for the HHRA based on source areas.

In Step 1, PCOCs at OU5 are identified in soil, groundwater, surface water, seep water, pond sediment, seep sediment, and stream sediment. PCOCs are defined as (a) metals and radionuclides statistically significant levels above background as determined by application of statistical tests per the Gilbert methodology (Gilbert, 1993) and (b) organic target analytes that were detected above analytical detection limits.

The PCOCs in surface soil are radionuclides; metals; polycyclic aromatic hydrocarbons (PAHs); polychlorinated biphenyls (PCBs); and semi-volatile organics such as esters, pesticides, and miscellaneous aliphatics and aromatics. In subsurface soil, the PCOCs include similar analytes as found in the surface soil samples with additional volatile organic compounds (VOCs). Groundwater samples have PCOCs of radionuclides, metals, PAHs, PCBs, semi-volatile organics, and volatile organics. The PCOCs for surface water include all analytes listed previously (radionuclides, metals, and a few semi-volatile and volatile organic compounds) with the addition of water quality parameters such as chloride, fluoride, and sulfate. Concentrations of all chemicals in seep water are less than background arithmetic mean plus two standard deviations. Therefore, there are no PCOCs in seep water. The PCOCs for pond sediment samples include radionuclides, metals, semi-volatile organics, and one volatile organic (toluene). In the seep sediment samples, the PCOCs include radionuclides, metals, semi-volatile and volatile organics. The PCOCs in stream sediment samples are metals, radionuclides, and two water quality parameters (nitrate/nitrite and total organic carbon).

In Step 2, PCOC concentrations above the background arithmetic mean plus two standard deviations (inorganics) or detection limits (organics) are plotted on maps and contaminant source areas are identified based on the distribution of PCOCs. Source areas are defined as areas containing concentrations or radioactivities of inorganic PCOCs above the background arithmetic mean plus two standard deviations or areas where organic PCOCs are detected. Source areas include contaminated soil and associated groundwater, surface water, and sediment contaminant

plumes, if any. Six source areas are identified in OU5. These are illustrated in Figure 3-1 and listed as follows:

- IHSS 115 Source Area. This source area includes the area of IHSS 115 (the Original Landfill) as presented in Figure 1-1, with the additional area of a small margin around IHSS 115 to include associated data points.
- IHSS 133 Source Area. This source area includes the area encompassing all of the 133 IHSSs. This includes the Ash Pits (IHSSs 133.1, 133.2, 133.3, and 133.4), the Incinerator (IHSS 133.5), the Concrete Wash Pad (IHSS 133.6).
- Surface Disturbance south of IHSS 133 Source Area. This source area is located approximately 305 meters (m) [1000 feet (ft)] south of the ash pits (IHSS 133) and includes areas of former excavations and associated surface soil sampling locations.
- South Interceptor Ditch (SID) and Pond C-2 Source Area. This source area includes the SID up to the Original Landfill (IHSS 115) and the C-2 pond (IHSS 142.11). This SID terminates into Pond C-2.
- Surface Disturbance west of IHSS 209 Source Area. This source area includes the Surface Disturbance area located approximately 350 m (1150 ft) west of IHSS 209.
- Woman Creek and Pond C-1 Source Area. This source area includes Woman Creek to the west boundary of the OU5 study area and the C-1 pond (IHSS 142.10) located along the Woman Creek drainage.

IHSS 209 is not included as a source area because only calcium exceeded the mean plus two standard deviations. Also, there are no applicable or relevant and appropriate requirements (ARARs) for soil that would require IHSS 209 to be a source area.

In Step 3, RBCs are identified for each PCOC. For screening purposes, RBCs are defined as chemical concentrations associated with an excess cancer risk of 10^{-6} (one in one million) or a hazard index of one for noncarcinogenic effects, assuming residential exposure to the medium. Chemical-specific RBCs have been calculated specifically for RFETS and are presented in the Final Rocky Flats Programmatic Risk-Based Preliminary Remediation Goals (DOE, 1994b). These values, referred to as Programmatic Preliminary Remediation Goals (PPRGs) used in this

CDPHE Risk-Based Conservative Screen are based on a residential scenario for exposure to each medium.

In Step 4, maximum detected concentrations or radioactivities of PCOCs in each medium are compared to the RFETS PPRGs. The following ratio is calculated for each PCOC in each source area:

$$\text{Ratio} = \frac{\text{Maximum detected concentration/activity of PCOC}}{\text{PPRG for PCOC}}$$

In each source area, PCOC-specific ratios are summed to yield a ratio sum for each medium. Ratio sums above one indicate that cumulative effects of PCOCs at maximum detected concentrations exceed a conservative risk-based screening level and that the source area warrants further evaluation. A summary of the ratio sums by source area are shown in Table ES-1.

In Step 5, the following decision criteria are used to classify the source areas:

- If the ratio sum ≥ 100 , indicating a potential health hazard assuming long-term exposure to maximum detected concentrations, a voluntary corrective action (early action) or a baseline HHRA will be conducted.
- If $1 < \text{ratio sum} < 100$, a baseline HHRA must be conducted.
- If the ratio sum ≤ 1 , indicating a low-hazard source area, no further action may be required, pending evaluation of Applicable or Relevant and Appropriate Requirements (ARARs) and incremental risk from dermal exposure.

Only one of the source areas (disturbed area south of IHSS 133) had ratio sums less than one assuming residential exposure to maximum analyte concentrations in all media and/or carcinogenic and noncarcinogenic RBC ratio sums. This source area is, therefore, not identified as an AOC.

In Step 6, AOCs for OU5 are identified for the HHRA. AOCs are defined as one or several source areas grouped spatially in close proximity. Of the six source areas identified in OU5, the IHSS 115 area and the IHSS 133 area are generally physically separated and are treated individually as AOCs. The SID and Pond C-2 source area and the Woman Creek and C-1 source area are interrelated and are treated together as one AOC. The source area west of IHSS

Table ES-1
RFETS OU5
Summary of Total Ratio Sums by Source Area and Media

Source Area	Medium	Carcinogenic Ratio	Noncarcinogenic Ratio
IHSS 115 ⁽¹⁾	Soil to 12 feet	5.6E+03	3.4E+00
	Groundwater	1.9E+03	9.3E+01
	Surface water	1.4E-03	4.8E-04
	Seep sediment	<u>2.9E+01</u>	<u>1.1E+00</u>
	Source Area Total Ratio ⁽²⁾	7.5E+03	9.8E+01
IHSS 133 ⁽³⁾	Soil to 12 feet	2.6E+02	1.1E+01
	Groundwater	1.6E+03	3.1E+01
	Seep sediment	<u>2.9E+01</u>	<u>5.7E-01</u>
	Source Area Total Ratio ⁽²⁾	1.9E+03	4.3E+01
Surface disturbance south of IHSS 133 ⁽⁴⁾	Soil to 12 feet	8.2E-01	4.5E-01
	Source Area Total Ratio ⁽²⁾	8.2E-01	4.5E-01
SID and Pond C-2 ⁽⁵⁾	Soil to 12 feet	--	2.2E-07
	Surface water	5.3E-02	1.5E-03
	Pond sediment	2.7E+01	6.9E-01
	Stream sediment	<u>1.5E+01</u>	<u>6.5E-01</u>
	Source Area Total Ratio ⁽²⁾	4.2E+01	1.3E+00
Surface disturbance west of IHSS 209 ⁽⁶⁾	Soil to 12 feet	2.2E+00	4.2E-01
	Source Area Total Ratio ⁽²⁾	2.2E+00	4.2E-01
Woman Creek and Pond C-1 ⁽⁷⁾	Soil to 12 feet	4.7E-01	6.2E-07
	Groundwater	3.8E+02	2.6E+01
	Surface water	1.6E-01	3.9E-03
	Pond sediment	1.7E+01	1.1E+02
	Stream sediment	<u>1.8E+01</u>	<u>3.5E-01</u>
Source Area Total Ratio ⁽²⁾	4.2E+02	1.4E+02	

(1) No seep water, pond sediment, or stream sediment PCOCs in this source area.

(2) Total Carcinogenic Ratio > 1 equivalent to > 10⁻⁶ cancer risk level
Total Carcinogenic Ratio > 100 equivalent to < 10⁻⁴ cancer risk level
Total Noncarcinogenic Ratio > 1 equivalent to Hazard Index > 1.
(All assuming long-term residential exposure to maximum detected concentrations.)

(3) No surface water, seep water, pond sediment, or stream sediment PCOCs in this source area.

(4) Only soil PCOCs in this source area.

(5) No ground water, seep water, or seep sediment PCOCs in this source area.

(6) Only soil PCOCs in this source area.

(7) No seep water or seep sediment PCOCs in this source area.

209 slightly exceeded the CDPHE conservative screen criteria due to Plutonium (Pu)-239/240. Because the criteria was only slightly exceeded and due only to a single elevated sample of Pu-239/240 for the area, this source area is not identified as an AOC. Instead, it will be addressed in the uncertainty analysis of the OU5 HHRA along with the source area south of IHSS 133.

In summary, the OU5 AOCs are:

- AOC No. 1 is identical to the IHSS 115 Source Area
- AOC No. 2 is identical to the IHSS 133 Source Area
- AOC No. 3 contains the SID and Pond C-2 Source Area and the Women Creek and Pond C-1 Source Area.

The use of these exposure areas in the OU5 HHRA will be further addressed in the OU5 Exposure Assessment Technical Memorandum.

INTRODUCTION

The purpose of this report is to document the results of the Colorado Department of Public Health and Environment (CDPHE) Risk-Based Conservative Screen for Operable Unit No. 5 (OU5) at the Department of Energy (DOE) Rocky Flats Environmental Technology Site (RFETS) in Golden, Colorado. Located primarily in the buffer zone on the southern side of the plant, the OU5 study area consists of approximately 292 hectares (720 acres) (Figure 1-1). Eleven individual hazardous substance sites (IHSSs) have been identified in OU5. They are the Original Landfill and Filter Backwash Pond (IHSSs 115 and 196), the Ash Pits (IHSSs 133.1, 133.2, 133.3, and 133.4), the Incinerator (IHSS 133.5), the Concrete Wash Pad (IHSS 133.6), Detention Ponds C-1 and C-2 (IHSSs 142.10 and 142.11), and the Surface Disturbances (IHSS 209). The IHSS locations are shown on Figure 1-1.

The CDPHE Risk-Based Conservative Screen is used to support the identification of CDPHE's evaluation of contaminant source areas, low hazard areas that may warrant no further evaluation, high hazard areas that may warrant potential early action, and those areas which need to be evaluated in the baseline Human Health Risk Assessment (HHRA). The CDPHE screen also provides a decision point as to whether a feasibility study (FS) is warranted. In addition, the CDPHE screen supports the identification of the areas of concern (AOCs) that will be evaluated in the baseline HHRA portion of the Phase I Resource Conservation and Recovery Act (RCRA) Facility Investigation/Remedial Investigation (RFI/RI) report for OU5. An AOC may be comprised of one source area or of several source areas that can be grouped based on close proximity. In the RFI/RI report, a baseline HHRA will be conducted for each AOC.

Guidance for data aggregation for risk assessment and for the risk-based screen is provided in a memorandum from DOE (1994a) and in documents prepared jointly by CDPHE, U.S. Environmental Protection Agency (EPA), and DOE (CDPHE/EPA/DOE, 1994). The risk-based screen compares maximum detected concentrations of potential chemicals of concern (PCOCs) in each source area to health risk-based concentrations (RBCs) for chemicals in applicable media. If the sum of the ratios is less than one, the source area is a candidate for no further action. If the ratio sum exceeds one, the source area is subject to further evaluation, either in a baseline HHRA or as a candidate for early action. Therefore, the CDPHE Risk-Based Conservative Screen can be used to identify no further action source areas, potential early action source areas, and source areas that can be combined into AOCs for evaluation in the baseline HHRA.

The CDPHE Risk-Based Conservative Screen does not replace the selection of chemicals of concern (COCs), exposure pathway analysis, exposure assessment, toxicity assessment, risk characterization, and uncertainty analysis that are required in an EPA HHRA and are used to support risk management decisions. The relationship of the EPA HHRA to the CDPHE screen is illustrated in Figure 1-2.

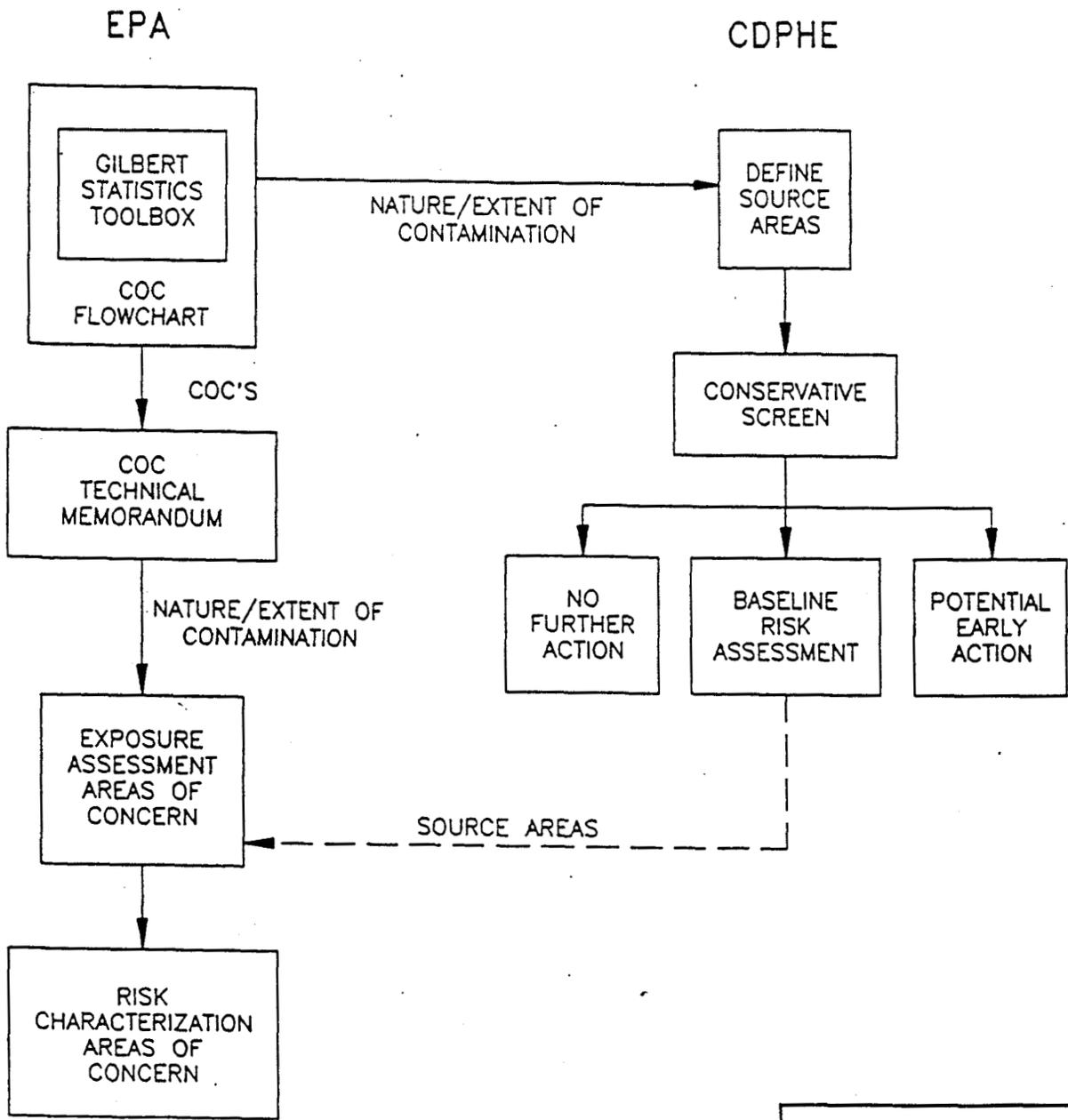
The process used to conduct the CDPHE Risk-Based Conservative Screen is illustrated in Figure 1-3. The steps in the screen are listed below:

Step 1 - Define Potential Chemicals of Concern (PCOCs). PCOCs are defined as (a) metals and radionuclides at significant levels above background based on statistical evaluation (Gilbert, 1993), and (b) organic target analytes detected above reporting limits in soil, groundwater, surface water, seep water, and pond sediment, seep sediment, and stream sediment samples in OU5. The background determination for metals and radionuclides is made on the basis of statistical comparison of OU5 data to background data.

Step 2 - Identify Source Areas. Chemical source areas are defined as areas containing organic PCOCs above reporting limits and/or inorganic PCOCs at concentrations or radioactivities above the arithmetic mean plus two standard deviations of the background data.

Step 3 - Calculate Risk-Based Concentrations (RBCs). RBCs are calculated for each PCOC. RBCs are health-protective chemical concentrations in a media, calculated using conservative assumptions regarding exposure, toxicity, and acceptable risk. RBCs have been calculated specifically for RFETS and are presented in DOE (1994b). These values, referred to as Programmatic Preliminary Remediation Goals (PPRGs), are used as the RBCs in this CDPHE Risk-Based Conservative Screen. PPRGs for chemicals in soil were calculated for residential receptors assuming multiple pathway exposure (ingestion, inhalation of particulates, and external radiation exposure). PPRGs for chemicals in groundwater were calculated for residential use, assuming ingestion of water and inhalation of VOCs released during domestic use. PPRGs for chemicals in surface water were calculated for the residential receptor, assuming ingestion while swimming.

Step 4 - Calculate RBC Ratio Sums for Each Source Area. The ratio of the maximum detected concentration or radioactivity to the corresponding RBC is calculated for each PCOC that occurs in the source area at concentrations or radioactivity above background arithmetic mean plus two standard deviations (inorganics) or detection limits



AREA OF CONCERN IDENTIFICATION PROCESS	
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	Figure 1-2

Perform Background Analysis to Identify PCOCs

Delineate Source Areas - A Source Equals Any Area in Which Contaminant Levels Exceed:

- Detection limits for organic constituents
- Background mean plus two standard deviations for inorganic constituents.

Calculate the RBC Ratio Sum for Each Source Area

$$\text{RBC Ratio Sum} = \sum_{j=1}^m \left(\sum_{i=1}^n \left(\frac{\text{Maximum Concentration or Activity } ij}{\text{RBC}_{ij}} \right) \right)$$

i = PCOC
j = Medium

Apply CDPHE Risk-Based Conservative Screen Decision Criteria

Ratio Sum \leq 1

Assess Dermal Exposure

No Further Action

1 < Ratio Sum < 100

Continue HHRA Process

Ratio Sum \geq 100

Potential Early Action

Define AOCs:
One or More Source Areas Grouped Spatially in Close Proximity

Prepare the CDPHE Risk-Based Conservative Screen Letter Report

CDPHE CONSERVATIVE SCREEN PROCESS

CDPHE LETTER REPORT

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS, GOLDEN, COLORADO



Figure 1-3

(organics). Maximum detected concentrations or radioactivities in soil are identified from samples collected to a depth of 12 feet, which is the depth recommended for use by CDPHE. The chemical-specific ratios are then summed for each medium, resulting in a ratio sum for the medium. Ratio sums for each medium (if present) are also added to yield a total ratio sum for residential exposure. If any ratio or ratio sum exceeds one, the source area warrants further evaluation.

Step 5 - Apply CDPHE Risk-Based Conservative Screen Decision Criteria. The ratio sums determined in Step 4 are used to designate source areas as candidates for no further action or as candidates for further evaluation in the baseline HHRA or possible early action. For source areas with ratio sums less than one, DOE may pursue a no further action alternative. Source areas with ratio sums between one and 100 will be evaluated in the baseline HHRA. For source areas with ratio sums above 100, DOE may pursue a voluntary early action alternative or evaluate the source area further in the baseline HHRA.

Step 6 - Define AOCs for HHRA. As stated earlier, an AOC is a source area or group of source areas in close proximity. A baseline HHRA will be conducted for each AOC. AOC delineation is reviewed and approved by the agencies. The baseline HHRA will assess exposure to chemicals of concern (COCs) (a subset of PCOCs), that are identified following EPA- and CDPHE-approved procedures. The selection of COCs for the baseline HHRA is presented in the Draft Final Chemicals of Concern Technical Memorandum for OU5 (DOE, 1994c).

The following sections of this report describe the application and results of each step of the CDPHE Risk-Based Conservative Screen.

IDENTIFICATION OF POTENTIAL CHEMICALS OF CONCERN

Step 1 of the CDPHE Risk-Based Conservative Screen is to identify PCOCs for OU5. PCOCs are defined as (a) metals and radionuclides statistically significant levels above background and (b) organic target analytes detected above reporting limits in surface soil, groundwater, surface water, seep water, pond sediment, seep sediment, and stream sediment samples in OU5. The background determination is made on the basis of statistical comparison of OU5 data to background data. The data sets used in the evaluation, the background comparison process, and the identification of PCOCs for OU5 are summarized in this section. Greater detail is provided in the OU5 Draft Final Chemicals of Concern Technical Memorandum (DOE, 1994c).

2.1 DATA USED FOR EVALUATION

Analytical data from environmental samples collected during the OU5 field sampling program and the RFETS site-wide sampling programs were used to characterize contamination at OU5. The samples used in this evaluation were collected between October 1992 and November 1993. Sampling is ongoing as data gaps are identified. The number of samples, sampling locations, and other features of the sampling and analytical program are discussed in *Phase I RFI/RI Work Plan for Operable Unit No. 5* (DOE, 1993), and summarized in *Final Technical Memorandum No. 15* (DOE, 1994a). The following is a brief summary of the sampling and analytical programs separated by media. Samples were collected from the following media:

- surface soil
- subsurface soil
- groundwater
- surface water
- seep water
- pond sediment
- seep sediment
- stream sediment

- Surface Soil – The field procedures used to collect surface-soil samples were in accordance with the *RFETS, Section 5.0 of SOP GT.08 "Surface Soil Sampling"* (EG&G, 1991). The following list identifies the types of surface soil samples taken at each IHSS.
 - IHSS 115 (Original Landfill) and IHSS 196 (Filter Backwash Ponds) - Surface-soil samples were collected at 66 locations in IHSSs 115/196. Fifty-four of the samples were analyzed for target analyte list (TAL) metals, radionuclides, pesticides, polychlorinated biphenyls (PCBs), and target compound list (TCL)

semi-volatile organic compounds (SVOCs). The remaining 12 samples were collected at areas of relatively high radioactivity as identified by High-purity Germanium (HPGe) and/or Field Instrument for Detection of Low Energy Radiation (FIDLER) surveys and were analyzed only for radionuclides.

- IHSS 133 (Ash Pits, Incinerator, and Concrete Wash Pad) - A total of 20 surface-soil samples were collected in IHSS 133. Eighteen of the samples were analyzed for TOC, TAL metals, polyaromatic hydrocarbons, and radionuclides. Two profile samples were collected at HPGe survey stations and were analyzed only for radionuclides.
- IHSS 142.10 and IHSS 142.11 (Detention Ponds C-1 and C-2) - No surface soil samples were collected.
- IHSS 209 and Other Surface Disturbances - Surface-soil samples were collected at 19 locations and analyzed for TAL metals, radionuclides, pesticides, PCBs, TCL SVOCs, specific conductivity, pH, and TOC.
- Subsurface Soil - Subsurface-soil samples were collected with the use of hollow-stem auger drilling techniques and hydraulic-advancement drilling techniques. Soil samples were collected with split-barrel type samplers. Boreholes were typically cored continuously, with analytical samples being composited over six-foot intervals to a depth of five feet into claystone bedrock. Analytical parameters and depth intervals varied among the IHSSs as described below.
 - IHSS 115 (Original Landfill) and IHSS 196 (Filter Backwash Ponds) - Eight boreholes were advanced for subsurface characterization (six in the disturbed area east of the Original Landfill and two in the former Filter Backwash Ponds). Additionally, six boreholes were advanced into soil-gas anomalies (two were completed as mini-wells) at IHSS 115. Eight more boreholes were advanced for installation of monitoring wells (only five were completed as monitoring wells and one was completed as a small-diameter well). Discrete samples from all the boreholes were collected on two-foot intervals and were analyzed for TCL VOCs. In addition, six-foot composite samples from all the boreholes were analyzed for TCL SVOCs, TAL metals, and radionuclides.
 - IHSS 133 (Ash Pits, Incinerator, and Concrete Wash Pads) - Two boreholes were advanced in a hot spot detected during HPGe surface radiological surveys. Three boreholes (Kansas Sampler) were drilled in an anomaly identified by geophysical surveys on the west side of the IHSS 133 area. Nine boreholes were monitoring-well boreholes (due to the absence of groundwater, only three monitoring wells were installed). Seventeen boreholes were "offset" boreholes as described in TM15 (DOE, 1994a) (no soil samples were analyzed). Twenty-eight boreholes were drilled in the locations specified in TM15. Six-foot composite samples from all the boreholes were analyzed for TAL metals, and radionuclides.

- IHSS 142.10 and IHSS 142.11 (Detention Ponds C-1 and C-2) - Two monitoring-well boreholes were advanced below each of the two ponds. Discrete samples from all the boreholes were collected on two-foot intervals and were analyzed for TCL VOCs. In addition, six-foot composite samples from all the boreholes were analyzed for TCL SVOCs, TAL metals, and radionuclides.
- IHSS 209 and Other Surface Disturbances - One borehole was advanced in the Surface Disturbance west of IHSS 209 and three were advanced in the Surface Disturbance south of the Ash Pits. Discrete samples from all the boreholes were collected on two-foot intervals and were analyzed for TCL VOCs. In addition, six-foot composite samples from all the boreholes were analyzed for TCL SVOCs, TAL metals, and radionuclides.
- Groundwater — Groundwater samples were collected as Hydropunch® samples during drilling activities; from well points and small-diameter wells as one-time samples; and from monitoring wells on a quarterly basis under a site-wide groundwater sampling program. Many groundwater sampling points were found to be dry and therefore could not be sampled. The specifics of sampling varied among the IHSSs as described below.
 - IHSS 115 (Original Landfill) and IHSS 196 (Filter Backwash Ponds) - One groundwater sample was collected with the use of a Hydropunch® and was analyzed for TCL VOCs, SVOCs, TAL metals, and radionuclides. Two monitoring wells were sampled for three quarters (June, 1993 to November, 1993) and analyzed for TCL VOCs, SVOCs, TAL metals, and radionuclides. Six well points were sampled once (July, 1993) for TCL VOCs, three were sampled once (July, 1993) for radionuclides, and two were sampled once (July, 1993) for TAL metals.
 - IHSS 133 (Ash Pits, Incinerator, and Concrete Wash Pads) - Four Hydropunch® samples were analyzed for TAL metals and radionuclides. One well was sampled for three quarters (June, 1993 to November, 1993) and analyzed for TAL metals and radionuclides.
 - IHSS 142.10 and IHSS 142.11 (Detention Ponds C-1 and C-2) - One well was sampled for four quarters (March, 1993 to November, 1993) and analyzed for TCL VOCs, SVOCs, TAL metals, and radionuclides. One well was sampled for four quarters (March, 1993 to November, 1993) and analyzed for TCL VOCs. This well was also sampled for radionuclides three times (March, 1993, April, 1993, and November, 1993). Additionally, this well was sampled once for TAL metals (April, 1994).
 - IHSS 209 and Other Surface Disturbances - No monitoring wells were installed because groundwater was not encountered during drilling.

- Surface Water - Surface-water samples were collected as indicated in the following list.
 - IHSS 115 (Original Landfill) and IHSS 196 (Filter Backwash Ponds) - Surface-water samples were collected from various locations in the Woman Creek Drainage during two baseflow sampling events (March, 1993 and November, 1993) and two high-flow sampling events (March, 1993 and May, 1993). These samples were analyzed for TCL VOCs, SVOCs, pesticides, PCBs, TAL metals, and radionuclides.
 - IHSS 209 and Other Surface Disturbances - Two surface-water samples were collected in depressions at IHSS 209. Samples were analyzed for TCL VOCs, SVOCs, TAL metals, and radionuclides.
 - IHSS 142 (Detention Ponds C-1 and C-2) - Surface water samples were collected during a one-time sampling event at three locations in both Detention Ponds C-1 and C-2 with an Eckman dredge. These locations were located five feet from the inlet, at the mid-point, and at the deepest point in each pond. Samples were analyzed for TCL VOCs, TAL metals, and radionuclides.
- Seep Water - Seep-water samples were collected as indicated in the following list.
 - IHSS 115 (Original Landfill) and IHSS 196 (Filter Backwash Ponds) - Water samples were collected from two seeps in IHSS 115. Only enough water could be collected for analysis of TCL VOCs and some radionuclides.
 - IHSS 133 (Ash Pits, Incinerator, and Concrete Wash Pads) - Water samples were collected from two seeps in IHSS 133. Only enough water could be collected from one seep for analysis of TCL VOCs. The other was sampled for TCL VOCs and some radionuclides.
- Pond Sediment - Sediments were collected from the two ponds IHSS 142. Pond sediments were collected during a one-time sampling event at three locations in both Detention Ponds C-1 and C-2 with an Eckman dredge. These locations were located five feet from the inlet, at the mid-point, and at the deepest point in each pond. Samples were analyzed for TCL VOCs, TAL metals, and radionuclides.
- Seep Sediment - Seep-sediment samples were collected in both IHSSs 115 and 133. These samples were collected as grab samples.
 - IHSS 115 (Original Landfill) and IHSS 196 (Filter Backwash Ponds) - Two sediment samples were collected from seeps near IHSS 115 and analyzed for TAL metals, radionuclides, TCL VOCs, TCL SVOCs, pesticides, and PCBs.
 - IHSS 133 (Ash Pits, Incinerator, and Concrete Wash Pads) - Two sediment samples were collected from seeps near IHSS 133 and analyzed for TAL metals, radionuclides, TCL VOCs, TCL SVOCs, pesticides, and PCBs.

- Stream Sediment – Stream sediments were collected at nine monitoring sites along Woman Creek. One-time sediment sampling sites was conducted on November 5, 1992. These samples were analyzed for TAL metals, radionuclides, nitrate/nitrite, and TOC.

The process of developing a list of PCOCs is intended to identify the constituents in each medium that have detected concentrations statistically greater than background concentrations. The background data used for comparison were reported in the Background Geochemical Characterization Report (DOE, 1993), with the exception of the surface soil data, which were not available in the 1993 report. The background surface soil data were collected in the Rock Creek area during the 1991 OU1 Phase III investigation and the 1993 OU2 Phase II investigation (Rock Creek 18). Analytical results from each medium sampled were pooled, and the background comparison was performed on an OU-wide basis.

2.2 DATA REVIEW AND CLEANUP

The OU5 Phase 1 field program began in August 1992 and is on-going. A total of 641 samples have been analyzed. More than 42,000 analytical results (not including QA/QC samples) were reported for OU5 as of February 1994. Approximately 94 percent of these results have been validated by the validation contractor. Data review and cleanup were primarily conducted in accordance with "Practical Suggestions for Users of RFEDS Data" prepared by EG&G, dated April 5, 1994 (EG&G, 1994b). This Section describes the procedures used to review and edit the OU5 data.

Results for QA/QC samples, such as equipment rinsates, field and trip blanks, spikes, surrogates, and laboratory-generated samples were removed from the data set. Data were then checked for multiple reported records for the same sample. When multiple records were identified, Rocky Flats Environmental Data System (RFEDS) personnel were consulted to assist in selecting which records to retain. Records with blanks in the result field or those rejected by the validation contractor ("R" in the validation field) were also removed. Results of field duplicates were averaged with the associated real samples. The averaged result was used in the comparison with background.

Following DOE guidance given in DOE Order 5400.1, all results for radionuclides were considered detects, even if the reported result was qualified as being below the reported detection limit. Records for radionuclide analyses were used as reported, therefore, there were no non-detect results. Records for inorganic and organic analyses were modified based on the result qualifiers that were assigned by the analytical laboratory or the validation contractor. The

following is a summary of the qualifiers and how the data were modified prior to application of any statistical test.

- The B-qualifier for results of inorganic analyses indicates that the reported concentration is greater than the instrument detection limit but less than the contract required detection limit. These data were used as reported.
- The B-qualifier for results of organic analyses indicates the analyte was detected in both the method blank and the real sample. These data were used as reported if they were not qualified as non-detected on the basis of laboratory contamination (U-qualified) by the validation contractor.
- The E-qualifier indicates that the result exceeded the calibration range of the instrument. These data were replaced with the associated D-qualified data (diluted to within calibration range), if a D-qualified record was received. When only an E-qualified record was reported, it was used.
- The U-qualifier indicates that the constituent was not detected at the concentration reported in the "DETECTION LIMIT" field. When qualified as non-detected, the result was used when the result was greater than the reported detection limit. The result was replaced with the detection limit when the result was lower than the detection limit and qualified as a non-detect.

2.3 BACKGROUND COMPARISON

Organic compounds observed above detection limits are considered PCOCs. Background comparisons for radionuclides and inorganic analytes were performed according to the procedures given in the "Guidance Document, Statistical Comparisons of Site-To-Background Data in Support of RFI/RI Investigations" (EG&G, 1994a), which was primarily based on the methodology proposed by Gilbert (Gilbert, 1993). The formal statistical tests include the Gehan test, Slippage test, Quantile test, and t-test. Analytical results were also compared to the upper tolerance limit (UTL) of background. The conditions for applying each of the tests are briefly discussed in the following sections.

Each analyte was compared to the same analyte in the corresponding background medium. However, data for pond sediment in OU5 were compared to background data for both seep and stream sediments due to the lack of background pond data. Background data for samples collected from seep sediment sampling locations were used for comparison to OU5 pond sediment data because of the similarity of the flow conditions for ponds and seeps (both have relatively long resident time). Similarly, background data from stream sediment sampling

locations were used for comparison to OU5 pond data because of the similarity of the source areas. As a conservative measure, these separate PCOC lists were combined for the pond sediment comparison.

2.3.1 Upper Tolerance Limit Comparison

For each analyte in each medium evaluated in the BGCR (DOE, 1993), an upper tolerance limit with 99% confidence and 99% coverage ($UTL_{99/99}$) was calculated including outliers (EG&G, 1994). This was done once assuming the background data were normally distributed and once assuming the background data were lognormally distributed (EG&G, 1994c). Because all the radionuclide results were treated as detects, calculation of the lognormal $UTL_{99/99}$ required that all values be shifted (i.e., add positive number to all values) such that they were all positive results. After calculation of the lognormal $UTL_{99/99}$, the shift was reversed (i.e., subtracted) (EG&G, 1994).

The distribution of results for each analyte was evaluated by examining probability plots of the data. Each OU5 measurement was compared to the corresponding $UTL_{99/99}$ (normal or lognormal). If one or more OU5 measurements exceed the background $UTL_{99/99}$, the analyte was considered as a PCOC for further evaluation, even if the analyte did not exceed background levels according to the formal statistical evaluation.

2.3.2 Formal Statistical Tests

Four formal statistical tests were performed to evaluate if there is a significant difference between background and site populations. If any of the four statistical tests was significant, the analyte was considered to be a PCOC. Significance was defined as a p-value less than or equal to 0.05, the Type I (false positive) error rate. Non-detects of metals were treated as described below for each test. All the radionuclide results were treated as detects.

1. Gehan Test

The Gehan test (Gehan, 1965, explained in Gilbert, 1993) is a nonparametric ranking test. It was performed for all the analytes in all media. For non-detects, the reporting limits were used for ranking purposes.

2. Slippage Test

The slippage test (Rosenbaum, 1954), a nonparametric test, was performed by comparing the OU5 measurements to the maximum background measurement (detect or non-detect). The p-value for the probability of the number of site measurements greater than the maximum background measurement was calculated. Reporting limits were used for non-detects.

3. Quantile Test

The Quantile test (Gilbert and Simpson, 1992), a nonparametric test, was performed by first ranking the combined background and OU5 measurements from largest to smallest. If there were no non-detects among the top 20% of the combined background and OU5 measurements, the probability of the number of site measurements within the top 20% of the data set was calculated. If there were any non-detects among the top 20% of the measurements, no Quantile test was performed.

4. t-Test

The t-test, a parametric statistical test, was performed under these conditions: (1) the non-detects in each of the data sets represent less than 20% of the measurements; and (2) each of the data sets contains at least 20 data points and both the data sets are normally distributed.

For simplicity, the t-test was only performed when condition (1) and the first option of condition (2) were met. Non-detect results for metals were replaced by one-half the reporting limits.

2.5 SUMMARY OF PCOCs

Table 2-1 presents the organic, inorganic, and radionuclide PCOCs in surface soil, subsurface soil, groundwater, surface water, seep water, pond sediment, seep sediment, and stream sediment. For the purpose of the next steps, both the surface and subsurface soil samples were combined in surface soil. Surface soil samples for this CDPHE Risk-Based Conservative Screen are those samples taken at surface and to 12 feet below surface.

Table 2-1
RFETS OU5
Summary of Chief PCOCs by Medium

Organic and Inorganic Compounds	Metals	Radionuclides
<u>Surface Soil:</u>		
4,4'-DDT	Aluminum	Americium-241
Acenaphthene	Antimony	Plutonium-239/240
Acenaphthylene	Arsenic	Uranium-233/234
Aldrin	Barium	Uranium-235
Anthracene	Beryllium	Uranium-238
Aroclor-1254	Cadmium	
Benzo(a)pyrene	Cobalt	
Benzo(b)fluoranthene	Iron	
Benzo(g,h,i)perylene	Lead	
Benzo(k)fluoranthene	Lithium	
Benzoic acid	Manganese	
Bis(2-ethylhexyl)phthalate	Mercury	
Di-n-butyl phthalate	Nickel	
Dibenzo(a,h)anthracene	Selenium	
Dibenzofuran	Silver	
Dieldrin	Thallium	
Endosulfan sulfate	Zinc	
Endrin ketone		
Fluorene		
Indeno(1,2,3-cd)pyrene		
Isophorone		
Methoxychlor		

Table 2-1
(continued)

Organic and Inorganic Compounds	Metals	Radionuclides
<u>Subsurface Soil:</u>		
1,1,1-Trichloroethane	Aluminum	Americium-241
2-Butanone	Antimony	Plutonium-239/240
2-Methylnaphthalene	Arsenic	Uranium-233/234
4-Methyl-2-pentanone	Barium	Uranium-235
Acetone	Beryllium	Uranium-238
alpha-BHC	Cadmium	
Aroclor-1260	Cesium	
Benzo(a)anthracene	Chromium	
Benzoic acid	Cobalt	
Bis(2-ethylhexyl)phthalate	Copper	
Butyl benzyl phthalate	Iron	
Chrysene	Lead	
Ethylbenzene	Lithium	
Fluoranthene	Manganese	
Heptachlor epoxide	Mercury	
Methylene chloride	Molybdenum	
Naphthalene	Nickel	
Pentachlorophenol	Selenium	
Phenanthrene	Silver	
Phenol	Strontium	
Pyrene	Thallium	
Tetrachloroethene	Tin	
Toluene	Vanadium	
Trichloroethene	Zinc	
Xylenes (total)		

Table 2-1
(continued)

Organic and Inorganic Compounds	Metals	Radionuclides
<u>Groundwater:</u>		
1,1-Dichloroethene	Aluminum	Americium-241
1,1,1-Trichloroethane	Antimony	Cesium-134
1,2-Dichloroethene	Arsenic	Cesium-137
Acenaphthene	Barium	Plutonium-238
Acetone	Beryllium	Plutonium-239/240
Bis(2-ethylhexyl)phthalate	Cadmium	Radium-226
Carbazole	Cesium	Radium-228
Chloride	Chromium	Strontium-89/90
Di-n-butyl phthalate	Cobalt	Tritium
Diethyl phthalate	Copper	Uranium-233/234
Fluoranthene	Iron	Uranium-235
Fluorene	Lead	Uranium-238
Fluoride	Lithium	
Methylene chloride	Manganese	
Naphthalene	Mercury	
Nitrate/Nitrite	Molybdenum	
Nitrate	Nickel	
Phenanthrene	Selenium	
Pyrene	Silicon	
Sulfate	Silver	
Tetrachloroethene	Strontium	
Trichloroethene	Tin	
	Vanadium	
	Zinc	

Table 2-1
(continued)

Organic and Inorganic Compounds	Metals	Radionuclides
<u>Surface Water:</u>		
Benzoic acid	Aluminum	Americium-241
Chloride	Arsenic	Cesium-137
Cyanide	Barium	Plutonium-239/240
Fluoride	Cesium	Radium-226
Methylene chloride	Cobalt	Strontium-89/90
Nitrate	Copper	Tritium
Pentachlorophenol	Iron	Uranium-233/234
Sulfate	Lead	Uranium-235
	Lithium	Uranium-238
	Manganese	
	Nickel	
	Selenium	
	Silicon	
	Strontium	
	Tin	
	Vanadium	
	Zinc	

Seep Water: There are no radionuclides statistically significant above background levels or organic target analytes that were detected above analytical detection limits in seep water samples.

<u>Pond Sediment:</u>		
Benzoic acid	Aluminum	Americium-241
Di-n-butyl phthalate	Arsenic	Plutonium-239/240
Fluoranthene	Barium	Tritium
Phenol	Beryllium	Uranium-233/234
Nitrate/Nitrite	Chromium	Uranium-235
Toluene	Cobalt	Uranium-238
	Copper	
	Iron	
	Lead	
	Lithium	
	Manganese	
	Mercury	
	Nickel	
	Selenium	
	Strontium	
	Vanadium	
	Zinc	

Table 2-1
(continued)

Organic and Inorganic Compounds	Metals	Radionuclides
<u>Seep Sediment:</u>		
Acetone	Aluminum	Americium-241
Benzo(a)anthracene	Antimony	Plutonium-239/240
Bis(2-ethylhexyl)phthalate	Arsenic	Uranium-233/234
Chrysene	Barium	Uranium-235
Fluoranthene	Beryllium	Uranium-238
Methylene chloride	Cadmium	
Nitrate/Nitrite	Chromium	
Phenanthrene	Cobalt	
Pyrene	Copper	
Tetrachloroethene	Iron	
	Lead	
	Lithium	
	Manganese	
	Mercury	
	Nickel	
	Silver	
	Strontium	
	Thallium	
	Tin	
	Vanadium	
	Zinc	

Table 2-1
(concluded)

Organic and Inorganic Compounds	Metals	Radionuclides
<u>Stream Sediment:</u>		
Nitrate/Nitrite	Aluminum Arsenic Barium Beryllium Cadmium Chromium Cobalt Copper Iron Lead Lithium Manganese Mercury Nickel Selenium Silver Strontium Vanadium Zinc	Americium-241 Plutonium-239/240 Tritium

DELINEATION OF CONTAMINANT SOURCE AREAS

A source area is defined as an IHSS or group of IHSSs where concentrations or activities of PCOCs in any medium exceed an upper-bound estimate of the background range. The upper-bound estimate of the background range for metals and radionuclides is defined as the background mean plus two standard deviations; detected organics are considered to be above background levels. The background comparison methodology and identification of PCOCs were described in Section 2.0.

Source areas in OU5 were delineated by evaluating the concentrations and distribution of PCOCs in all the media. Source areas include contaminated soil, ground- and surface water, and sediment contaminant plumes, if any. To assist in the delineation of contaminant source areas, concentrations and activities of inorganic PCOCs above background mean plus two standard deviations and detected concentrations of organic constituents were electronically presented by medium at the CDPHE/EPA/DOE meeting of October 26, 1994.

The six OU5 source areas that the agencies agreed to are listed below and illustrated in Figure 3-1. These source areas generally coincide with the IHSSs identified in Figure 1-1, with the exception of IHSS 209, which was not considered a source area because only calcium exceeded the mean plus two standard deviations and calcium is an essential nutrient with no ARAR available for this analyte. The physical areas are largely determined by the extent of the contamination. The six source areas are:

- (1) IHSS 115 Source Area. This source area includes the area of IHSS 115 (the Original Landfill) as presented in Figure 1-1, with the additional area of a small margin around IHSS 115 to include associated data points.
- (2) IHSS 133 Source Area. This source area includes the area encompassing all of the 133 IHSSs. This includes the Ash Pits (IHSS 133.1, 133.2, 133.3, and 133.4), the Incinerator (IHSS 133.5), the Concrete Wash Pad (IHSS 133.6).
- (3) Surface Disturbance south of IHSS 133 Source Area. This source area is located approximately 305 meters (m) (1000 ft) south of the ash pits (IHSS 133) and includes areas of former excavations and associated surface soil sampling locations.

- (4) South Interceptor Ditch (SID) and Pond C-2 Source Area. This source area includes the SID up to the Original Landfill (IHSS 115) boundary and the C-2 pond (IHSS 142.11). The SID terminates into Pond C-2.
- (5) Surface Disturbance west of IHSS 209 Source Area. This source area includes the Surface Disturbance area located approximately 350 m (1150 ft) west of IHSS 209.
- (6) Woman Creek and Pond C-1 Source Area. This source area includes Woman Creek to the west boundary of the OU5 study area and the C-1 pond (IHSS 142.10) located along the Woman Creek drainage.

Section 2.1 describes the analytical programs by media. Further detail of the number of samples, sampling locations, and other features of the sampling and analytical program are discussed in *Phase I RFI/RI Work Plan for Operable Unit No. 5* (DOE, 1993), and summarized in *Final Technical Memorandum No. 15* (DOE, 1994a).

CALCULATION OF RISK-BASED CONCENTRATIONS

RBCs are chemical concentrations in medium that are not expected to pose a health risk even under long-term exposure. They are calculated using conservative assumptions regarding exposure, toxicity, and acceptable risk. The purpose of developing chemical-specific RBCs and comparing them to concentrations of PCOCs at each source area is to provide preliminary screening-level information on the relative magnitude of chemical risk assuming long-term exposure to maximum detected concentrations. This information can be used in the preliminary selection of remedial alternatives prior to the completion of the HHRA and can also identify source areas where no further action is required. RBCs should not be used as a substitute for a complete HHRA, as a stand-alone decision making tool, or as site-specific cleanup levels.

For this CDPHE Risk-Based Conservative Screen, RBCs are calculated assuming long-term residential exposure to the medium. RBCs have been calculated specifically for RFETS and are presented in DOE (1994b). These values, referred to as Programmatic Preliminary Remediation Goals (PPRGs), are used in this CDPHE Risk-Based Conservative Screen. PPRGs for chemicals in soil were calculated for residential receptors assuming multiple pathway exposure (ingestion, inhalation of particulates, and external radiation exposure). PPRGs for chemicals in groundwater were calculated for residential use, assuming ingestion of water and inhalation of VOCs released during domestic use. PPRGs for chemicals in surface and seep water were calculated for the residential receptor, assuming ingestion while swimming. The PPRGs calculated for the soil residential receptor were used for the pond and seep sediment medium.

Separate PPRGs are calculated based on a one in 1,000,000 (10^{-6}) excess cancer risk level. PPRGs for noncarcinogenic effects of chemicals are calculated based on a hazard quotient of one (DOE, 1994b). General equations for calculated PPRGs are:

$$\text{Carcinogenic PPRG} = \frac{\text{Target Cancer Risk Level}}{\text{Intake Factor} \times \text{Cancer Slope Factor}}$$

$$\text{Noncarcinogenic PPRG} = \frac{\text{Target Hazard Index} \times \text{ReferenceDose}}{\text{Intake Factor}}$$

The reference doses (RfDs) and cancer slope factors (CSFs) are chemical-specific EPA-established toxicity factors; they are presented in DOE (1994b). Intake factors are an assumption of daily intake of the medium per kilogram body weight. The exposure parameters and other factors used to derive the intake factors for calculating PPRGs are discussed in detail in DOE (1994b). All exposure assumptions are EPA standard default values (EPA, 1991a) except where indicated in the PPRG document.

RISK-BASED SCREENING PROCESS

The first step in the risk-based screen is to divide the maximum concentration of each PCOC in each medium in each source area by the chemical-specific RBC for residential exposure to yield an RBC ratio, as shown in the following equation:

$$RBC \text{ Ratio} = \frac{\text{Maximum detected concentration}}{\text{Risk-based concentration (PPRG)}}$$

The chemical-specific ratios in that source area and medium are then summed to provide a ratio sum (multiple-chemical) for the medium. If a receptor is assumed to be exposed to more than one medium in a source area (for example, hypothetical residents are assumed to be exposed simultaneously to soil, groundwater, surface and seep water, and pond and seep sediments), the ratio sums for all relevant media are combined to provide a total ratio sum (multiple-chemical, multiple-media) for that exposure scenario. The residential scenario assumes that excavation has taken place prior to residential development and the resident may be exposed to soil to a depth of 12 feet. Therefore, maximum concentrations of PCOCs in soils were identified from samples collected to a depth of 12 feet.

The total ratio sums for carcinogenic or noncarcinogenic effects are an indication of potential risks to the receptors, assuming long-term exposure to maximum detected concentrations of PCOCs in the medium. For carcinogens, a total ratio sum of less than one indicates a total excess lifetime carcinogenic risk of less than 10^{-6} (one in 1,000,000) from long-term exposure to the maximum concentrations of PCOCs in that source area. A total ratio sum for carcinogens that is greater than one but less than 100 indicates a total excess lifetime cancer risk between 10^{-4} (one in 10,000) and 10^{-6} , which is the target cancer risk range that EPA has adopted to guide remedial decisions at hazardous waste sites (40 CFR 300). Where cancer risks estimated in a baseline HHRA do not exceed 10^{-4} , remediation is not generally warranted unless noncarcinogenic effects or ecological risks are significant (EPA, 1991b). A total ratio sum for carcinogens that is greater than 100 indicates a potentially unacceptable cancer risk from long-term exposure to maximum detected concentrations. For noncarcinogens, a ratio or ratio sum less than or equal to one indicates no toxic effects are expected. A noncarcinogenic total ratio greater than one indicates that there may be a potential for noncarcinogenic effects.

This CDPHE Risk-Based Conservative Screen is conservative because it assumes that a long-term resident will be routinely exposed to the maximum concentrations of chemicals found in the medium. The screen does not confirm that an actual risk exists. Ratio sums greater than one to 100 indicate that the area warrants further evaluation, but the ratios do not indicate that an actual health threat is present.

If either the carcinogenic or noncarcinogenic total ratio sum is greater than 100, that source area may be identified by DOE as a candidate for an early action. Source areas with ratio sums between one and 100 will be evaluated further in a baseline HHRA for OU5. If both the carcinogenic and noncarcinogenic total ratio sums are less than one, the source area is a candidate for no further action based on human health risk.

5.1 RATIO SUMS FOR SOURCE AREAS

The following subsections describe the ratio sums and are organized by each of the six source areas. For the ease of reading, Tables 5-1 through 5-19 are presented at the end of the section instead of being incorporated into the text.

5.1.1 IHSS 115 Source Area

In the IHSS 115 Source Area, 44 organic, 24 inorganic, and five radionuclide PCOCs are detected in soil up to 12 feet from the surface. The carcinogenic and noncarcinogenic ratio sums for soil based on residential exposure are 5600 and 3.4, respectively (Table 5-1). Uranium-235 and uranium-238 in surface soil are the greatest contributors to the carcinogenic ratio sum while manganese and copper in subsurface soil are the greatest contributors to the noncarcinogenic ratio sum. In groundwater 22 organic, 24 inorganic, and eight radionuclide PCOCs are identified. The carcinogenic ratio sum (1900) is above 100 and noncarcinogenic ratio sum (93) exceeds one (Table 5-2) based on long-term residential exposure to maximum detected concentrations. Beryllium and 1,1-dichloroethene are the major contributors to the carcinogenic ratio sum; manganese and antimony are the major contributors to the noncarcinogenic ratio sum in groundwater.

In surface water, five organic, five inorganic, and six radionuclide PCOCs are detected. The carcinogenic ratio sum for surface water is 1.4E-03 and the noncarcinogenic ratio sum is 4.8E-04 (Table 5-3). Cesium-137 and uranium-233/234 are the main contributors to the carcinogenic ratio sums in surface water. For noncarcinogenic ratio sums in surface water, fluoride and nitrate are the major contributors. In seep sediments, 10 organic, 18 inorganic, and five

radionuclide PCOCs are detected. The carcinogenic ratio sum is 29 and the noncarcinogenic ratio sum is 1.1 (Table 5-4) based on long-term residential exposure to seep sediment containing maximum detected concentrations. Arsenic and beryllium are the major contributors to the carcinogenic ratio sum; antimony and manganese are the major contributors to the noncarcinogenic ratio sum in seep sediments.

The total carcinogenic and noncarcinogenic ratio sums for the residential scenario are the sum of the ratios for all media (soil, groundwater, surface water, seep water, pond sediment, seep sediment, and stream sediment) for the source area. At the IHSS 115 Source Area, only soil, groundwater, surface water, and seep sediment had PCOCs detected. The carcinogenic and noncarcinogenic ratio sums for IHSS 115 Source Area are 7500 and 98, which exceeds 100 and 1, respectively, primarily due to soil carcinogenic and groundwater noncarcinogenic chemicals (see summary Table 5-19).

5.1.2 IHSS 133 Source Area

In the IHSS 133 Source Area, 24 inorganic and five radionuclide PCOCs are detected in soil up to 12 feet from the surface. The carcinogenic and noncarcinogenic ratio sums for soil based on residential exposure are 260 and 11, respectively (Table 5-6). Uranium-235 and uranium-238 in subsurface soil are the greatest contributors to the carcinogenic ratio sum; chromium VI and antimony in subsurface soil are the greatest contributors to the noncarcinogenic ratio sum. In groundwater four organic, 22 inorganic, and nine radionuclide PCOCs are identified. The carcinogenic ratio sum (1600) exceeds 100 and the noncarcinogenic ratio sum (31) exceeds one (Table 5-6) based on long-term residential exposure to maximum detected concentrations. Beryllium and arsenic are the major contributors to the carcinogenic ratio sum; manganese and aluminum are the major contributors to the noncarcinogenic ratio sum in groundwater.

In seep sediment, four organic, 20 inorganic, and five radionuclide PCOCs are detected. The carcinogenic ratio sum for seep sediment is 29 and the noncarcinogenic ratio sum is 0.57 (Table 5-7). Arsenic and beryllium are the main contributors to the carcinogenic ratio sums; antimony and arsenic are the main contributors to the noncarcinogenic ratio sums in seep sediment.

The total carcinogenic and noncarcinogenic ratio sums for the residential scenario are the sum of the ratios for all media (soil, groundwater, surface water, seep water, pond sediment, seep sediment, and stream sediment) for the source area. At the IHSS 133 Source Area, only soil, groundwater, and seep sediment had PCOCs detected. The carcinogenic and noncarcinogenic

ratio sums for IHSS 133 Source Area are 1900 and 43, which exceeds 100 and 1, respectively, primarily due to groundwater contamination (see summary Table 5-19).

5.1.3 Surface Disturbance South of IHSS 133 Source Area

In the Surface Disturbance south of IHSS 133 Source Area, two organic (benzoic acid and methylene chloride), 21 inorganic, and five radionuclide PCOCs are detected in soil up to 12 feet from the surface. The carcinogenic and noncarcinogenic ratio sums for soil based on residential exposure are 0.82 and 0.45, respectively (Table 5-8).

The total carcinogenic and noncarcinogenic ratio sums for the residential scenario are the sum of the ratios for all media (soil, groundwater, surface water, seep water, pond sediment, seep sediment, and stream sediment) for the source area. At the Surface Disturbance south of IHSS 133 Source Area, only soil had PCOCs detected. The carcinogenic and noncarcinogenic ratio sums for Surface Disturbance south of IHSS 133 Source Area are 0.82 and 0.45, of which both do not exceed one (see summary Table 5-19).

5.1.4 South Interceptor Ditch and Pond C-2 Source Area

In the SID and Pond C-2 Source Area only one organic (toluene) PCOC is detected in soil up to 12 feet from the surface. The noncarcinogenic ratio sum for soil based on residential exposure is $2.2E-07$ (Table 5-9) due to toluene in subsurface soil. In surface water, eight organic, 13 inorganic, and eight radionuclide PCOCs are identified. Both the carcinogenic ratio sum ($5.3E-02$) and noncarcinogenic ratio sum ($1.5E-03$) do not exceed one (Table 5-10) based on long-term residential exposure to maximum detected concentrations. Arsenic and pentachlorophenol are the major contributors to carcinogenic ratio sum; manganese and fluoride are the major contributors to the noncarcinogenic ratio sum in surface water.

In pond sediment, five organic, 16 inorganic, and three radionuclide PCOCs are detected. The carcinogenic ratio sum for pond sediment is 27 and the noncarcinogenic ratio sum is 0.69 (Table 5-11). Arsenic and plutonium-239/240 are the main contributors to the carcinogenic ratio sums; manganese and arsenic are the main contributors to the noncarcinogenic ratio sums in pond sediment. In stream sediments, one organic (nitrate/nitrite), 19 inorganic, and three radionuclide PCOCs are detected. The carcinogenic ratio sum is 15 and the noncarcinogenic ratio sum is 0.65 (Table 5-12) based on long-term residential exposure to stream sediment containing maximum detected concentrations. Arsenic and beryllium are the major contributors to the

carcinogenic ratio sum; manganese and arsenic are the major contributors to the noncarcinogenic ratio sum in stream sediments.

The total carcinogenic and noncarcinogenic ratio sums for the residential scenario are the sum of the ratios for all media (soil, groundwater, surface water, seep water, pond sediment, seep sediment, and stream sediment) for the source area. At the SID and Pond C-2 Source Area, only soil, surface water, pond sediment, and stream sediment had PCOCs detected. The carcinogenic and noncarcinogenic ratio sums for the SID and Pond C-2 Source Area are 42 and 1.3, which exceed one, primarily due to stream sediment carcinogenic and pond sediment noncarcinogenic contamination (see summary Table 5-19).

5.1.5 Surface Disturbance West of IHSS 209 Source Area

In the Surface Disturbance west of IHSS 209 Source Area, three organic, 18 inorganic, and five radionuclide PCOCs are detected in soil up to 12 feet from the surface. The carcinogenic and noncarcinogenic ratio sums for soil based on residential exposure are 2.2 and 0.42, respectively (Table 5-13), mainly due to radionuclide contamination for carcinogens and manganese and arsenic for noncarcinogens.

The total carcinogenic and noncarcinogenic ratio sums for the residential scenario are the sum of the ratios for all media (soil, groundwater, surface water, seep water, pond sediment, seep sediment, and stream sediment) for the source area. At the Surface Disturbance west of IHSS 209 Source Area, only soil had PCOCs detected. The carcinogenic and noncarcinogenic ratio sums for Surface Disturbance west of IHSS 209 Source Area are 2.2 and 0.42, of which only the carcinogenic ratio sum exceeds one, primarily due to plutonium-239/240 contamination (see summary Table 5-19).

5.1.6 Woman Creek and Pond C-1 Source Area

In the Woman Creek and Pond C-1 Source Area two organic (methylene chloride and toluene) and five radionuclide PCOCs are detected in soil up to 12 feet from the surface. The carcinogenic and noncarcinogenic ratio sums for soil based on residential exposure are 0.47 and 6.2E-07, respectively (Table 5-14), both of which are below one. In groundwater, four organic, 18 inorganic, and 11 radionuclide PCOCs are identified. The carcinogenic ratio sum (380) exceeds 100, the noncarcinogenic ratio sum (26) exceeds one (Table 5-15) based on long-term residential exposure to maximum detected concentrations. Arsenic and beryllium are the major

contributors to carcinogenic ratio sum; manganese and silver are the major contributors to the noncarcinogenic ratio sum in groundwater.

In surface water, three organic, 17 inorganic, and seven radionuclide PCOCs are detected. The carcinogenic ratio sum for surface water is 0.16 and the noncarcinogenic ratio sum is 3.9E-03 (Table 5-16), both of which are below 1. Arsenic and radionuclides are the main contributors to the carcinogenic ratio sums; manganese and arsenic are the main contributors to the carcinogenic ratio sums in surface water. In pond sediment, four organic, 18 inorganic, and six radionuclide PCOCs are detected. The carcinogenic ratio sum for pond sediment is 17 and the noncarcinogenic ratio sum is 110 (Table 5-17). Arsenic and radionuclides are the main contributors to the carcinogenic ratio sums; cadmium and manganese are the main contributors to the noncarcinogenic ratio sums in pond sediment. In stream sediments, one organic (nitrate/nitrite), 17 inorganic, and three radionuclide PCOCs are detected. The carcinogenic ratio sum is 18 and the noncarcinogenic ratio sum is 0.35 (Table 5-18) based on long-term residential exposure to stream sediment containing maximum detected concentrations. Arsenic and beryllium are the major contributors to the carcinogenic ratio sum; manganese and arsenic are the major contributors to the noncarcinogenic ratio sum in stream sediments.

The total carcinogenic and noncarcinogenic ratio sums for the residential scenario are the sum of the ratios for all media (soil, groundwater, surface water, seep water, pond sediment, seep sediment, and stream sediment) for the source area. At the Woman Creek and Pond C-1 Source Area, soil, groundwater, surface water, pond sediment, and stream sediment had PCOCs detected. The carcinogenic and noncarcinogenic ratio sums for the Woman Creek and Pond C-1 Source Area are 420 and 140, which exceed 100, primarily due to groundwater carcinogenic and pond sediment noncarcinogenic contamination (see summary Table 5-19).

TABLE 5-1
RFETS OU5
RBC SCREEN FOR THE IHSS 115 SOURCE AREA
SOIL TO 12 FEET (RESIDENT)

Analyte	Maximum Concentration or Activity (mg/kg)	Location of Maximum Concentration	Depth of Maximum Concentration (ft.)	RBCs		Max Conc. / RBC	Max Conc. / RBC
				Carcinogenic (mg/kg)	Noncarcinogenic (mg/kg)	Carcinogen	Noncarcinogen
Organics and Inorganics							
Acenaphthene	4.40E+01	SS510593	0	-	1.65E+04	0.0E+00	2.7E-03
Acenaphthylene	6.00E-01	SS510593	0	-	-	0.0E+00	0.0E+00
Acetone	2.80E-01	58693	12	-	2.74E+04	0.0E+00	1.0E-05
Aldrin	1.70E-02	SS509793	0	3.77E-02	8.23E+00	4.5E-01	2.1E-03
Anthracene	4.70E+01	SS510593	0	-	8.23E+04	0.0E+00	5.7E-04
Aroclor-1254	3.90E+00	SS510093	0	8.32E-02	-	4.7E+01	0.0E+00
Aroclor-1260	9.10E-01	50992	6	8.32E-02	-	1.1E+01	0.0E+00
Benzo(a)anthracene	4.80E+01	58693	12	8.77E-01	-	5.5E+01	0.0E+00
Benzo(a)pyrene	4.30E+01	SS510593	0	8.77E-02	-	4.9E+02	0.0E+00
Benzo(b)fluoranthene	4.90E+01	SS510593	0	8.77E-01	-	5.6E+01	0.0E+00
Benzo(g,h,i)perylene	2.80E+01	SS510593	0	-	-	0.0E+00	0.0E+00
Benzo(k)fluoranthene	2.50E+01	SS510593	0	8.77E+00	-	2.9E+00	0.0E+00
Benzoic acid	9.74E-01	59593	6	-	1.10E+06	0.0E+00	8.9E-07
alpha-BHC	1.50E-02	50992	12	1.02E-01	-	1.5E-01	0.0E+00
Bis(2-ethylhexyl)phthalate	2.90E-01	58693	6	4.57E+01	5.49E+03	6.3E-03	5.3E-05
2-Butanone	2.00E-03	59793	9.3	-	1.65E+05	0.0E+00	1.2E-08
Butyl benzyl phthalate	3.60E-01	59593	12	-	5.49E+04	0.0E+00	6.6E-06
Di-n-butyl phthalate	4.25E-01	SS510993	0	-	2.74E+04	0.0E+00	1.5E-05
Chrysene	5.30E+01	58693	12	-	8.77E+01	0.0E+00	6.0E-01
4,4'-DDT	2.10E-02	SS509793	0	1.88E+00	1.37E+02	1.1E-02	1.5E-04
Dibenzo(a,h)anthracene	9.20E+00	SS510593	0	8.77E-02	-	1.0E+02	0.0E+00
Dibenzofuran	2.00E+01	SS510593	0	-	-	0.0E+00	0.0E+00
Dieldrin	3.40E-02	SS509793	0	4.00E-02	1.37E+01	8.5E-01	2.5E-03
Endosulfan sulfate	2.40E-02	SS509393	0	-	1.65E+03	0.0E+00	1.5E-05
Endrin ketone	3.60E-02	SS509793	0	-	-	0.0E+00	0.0E+00
Ethylbenzene	6.60E-02	58693	12	-	2.74E+04	0.0E+00	2.4E-06
Fluoranthene	1.60E+02	58693	12	-	1.10E+04	0.0E+00	1.5E-02
Fluorene	3.90E+01	SS510593	0	-	1.10E+04	0.0E+00	3.5E-03
Heptachlor epoxide	1.10E-02	58693	12	7.04E-02	3.57E+00	1.6E-01	3.1E-03
Indeno(1,2,3-cd)pyrene	3.20E+01	SS510593	0	8.77E-01	-	3.6E+01	0.0E+00
Methoxychlor	4.50E-01	SS509793	0	-	1.37E+03	0.0E+00	3.3E-04
4-Methyl-2-pentanone	2.00E-03	60993	8	-	2.20E+04	0.0E+00	9.1E-08
Methylene chloride	2.10E-02	58493	8	8.54E+01	1.65E+04	2.5E-04	1.3E-06
2-Methylnaphthalene	1.50E+01	58693	12	-	-	0.0E+00	0.0E+00
Naphthalene	6.10E+01	58693	12	-	1.10E+04	0.0E+00	5.5E-03
Pentachlorophenol	1.60E-01	50392	12	5.34E+00	8.23E+03	3.0E-02	1.9E-05
Phenanthrene	2.20E+02	58693	12	-	-	0.0E+00	0.0E+00
Phenol	1.40E-01	50992	6	-	1.65E+05	0.0E+00	8.5E-07
Pyrene	1.50E+02	58693	12	-	8.23E+03	0.0E+00	1.8E-02
Tetrachloroethene	9.20E-01	58493	8	1.23E+01	2.74E+03	7.5E-02	3.4E-04
Toluene	3.10E-01	59193	0.3	-	5.49E+04	0.0E+00	5.6E-06
Total xylenes	1.50E-01	58693	12	-	5.49E+05	0.0E+00	2.7E-07
1,1,1-Trichloroethane	2.00E-03	60993	8	-	-	0.0E+00	0.0E+00
Trichloroethene	4.40E-01	58493	8	5.82E+01	-	7.6E-03	0.0E+00
Metals							
Aluminum	2.00E+04	SS511293	0	-	7.96E+05	0.0E+00	2.5E-02
Antimony	4.98E+01	SS510293	0	-	1.10E+02	0.0E+00	4.5E-01
Arsenic	1.89E+01	58693	12	-	8.23E+01	0.0E+00	2.3E-01
Barium	2.67E+02	59593	2	-	1.91E+04	0.0E+00	1.4E-02
Beryllium	1.70E+00	59593	2	-	1.49E+03	0.0E+00	1.1E-03
Cadmium	4.10E+00	SS510093	0	-	1.37E+02	0.0E+00	3.0E-02
Cesium	3.10E+00	50792	10	-	-	0.0E+00	0.0E+00
Chromium III	1.11E+02	58493	12	-	2.74E+05	0.0E+00	4.1E-04
Chromium VI	1.11E+02	58493	12	9.39E+02	1.37E+03	1.2E-01	8.1E-02
Cobalt	2.71E+01	58493	12	-	1.65E+04	0.0E+00	1.6E-03
Copper	6.92E+03	59493	6.3	-	1.10E+04	0.0E+00	6.3E-01

TABLE 5-1 (Continued)
 RFETS OU5
 RBC SCREEN FOR THE IHSS 115 SOURCE AREA
 SOIL TO 12 FEET (RESIDENT)

Analyte	Maximum	Location of	Depth of	RBCs		Max Conc. / RBC	
	Concentration or Activity	Maximum Concentration	Maximum Concentration	Carcinogenic	Noncarcinogenic	Carcinogen	Noncarcinogen
Iron	7.89E+04	58493	12	-	-	0.0E+00	0.0E+00
Lead	3.04E+02	58493	12	-	-	0.0E+00	0.0E+00
Lithium	2.67E+01	50792	10	-	5.49E+03	0.0E+00	4.9E-03
Manganese	1.28E+03	59593	2	-	1.36E+03	0.0E+00	9.4E-01
Mercury	1.30E+00	59493	6.3	-	8.23E+01	0.0E+00	1.6E-02
Molybdenum	1.90E+02	58493	12	-	1.37E+03	0.0E+00	1.4E-01
Nickel	9.17E+01	59493	6.3	-	5.49E+03	0.0E+00	1.7E-02
Selenium	1.00E+00	SS510293	0	-	1.37E+03	0.0E+00	7.3E-04
Silver	9.43E+01	SS507893	0	-	1.37E+03	0.0E+00	6.9E-02
Strontium	1.48E+02	59193	8	-	1.65E+05	0.0E+00	9.0E-04
Thallium	4.60E-01	59293	6	-	-	0.0E+00	0.0E+00
Tin	5.72E+01	59493	6.3	-	1.65E+05	0.0E+00	3.5E-04
Vanadium	7.44E+01	58493	12	-	1.92E+03	0.0E+00	3.9E-02
Zinc	6.73E+02	59493	6.3	-	8.23E+04	0.0E+00	8.2E-03
Radionuclides	(pCi/g)			(pCi/g)	(pCi/g)		
Americium-241	4.60E-01	58493	12	2.37E+00	-	1.9E-01	0.0E+00
Plutonium-239/240	3.20E+00	58493	12	3.43E+00	-	9.3E-01	0.0E+00
Uranium-233/234	2.80E+03	SS505493	0	4.53E+01	-	6.2E+01	0.0E+00
Uranium-235	6.70E+02	SS505493	0	1.73E-01	-	3.9E+03	0.0E+00
Uranium-238	3.80E+04	SS505493	0	4.60E+01	-	8.3E+02	0.0E+00
					Ratio Sum	5.6E+03	3.4E+00

TABLE 5-2
RFETS OU5
RBC SCREEN FOR THE IHSS 115 SOURCE AREA
GROUNDWATER (RESIDENT)

Analyte	Maximum Concentration or Activity (mg/L)	Location of Maximum Concentration	RBCs		Max Conc. / RBC	
			Carcinogenic (mg/L)	Noncarcinogenic (mg/L)	Carcinogen	Noncarcinogen
Organics and Inorganics						
Acenaphthene	5.00E-03	59493	-	2.19E+00	0.0E+00	2.3E-03
Acetone	6.50E-02	62893	-	3.65E+00	0.0E+00	1.8E-02
Bis(2-ethylhexyl)phthalate	3.00E-03	59493	6.07E-03	7.30E-01	4.9E-01	4.1E-03
Di-n-butyl phthalate	2.00E-03	59493	-	3.65E+00	0.0E+00	5.5E-04
Carbazole	2.00E-04	59493	-	-	0.0E+00	0.0E+00
Chloride	1.14E+02	61093	-	-	0.0E+00	0.0E+00
1,1-Dichloroethene	3.25E-02	61093	6.77E-05	3.28E-01	4.8E+02	9.9E-02
1,2-Dichloroethene	4.00E-03	62893	-	3.28E-01	0.0E+00	1.2E-02
Diethyl phthalate	6.00E-03	59593	-	2.92E+01	0.0E+00	2.1E-04
Fluoranthene	4.00E-03	59493	-	1.46E+00	0.0E+00	2.7E-03
Fluorene	4.00E-03	59493	-	1.46E+00	0.0E+00	2.7E-03
Fluoride	8.42E-01	61093	-	2.19E+00	0.0E+00	3.8E-01
Methylene chloride	6.00E-03	59493	6.22E-03	1.73E+00	9.6E-01	3.5E-03
Naphthalene	1.30E-02	59493	-	1.46E+00	0.0E+00	8.9E-03
Nitrate	4.00E-01	59493	-	5.84E+01	0.0E+00	6.8E-03
Nitrate/Nitrite	6.65E+00	61093	-	3.65E+00	0.0E+00	1.8E+00
Benanthrene	6.00E-03	59493	-	-	0.0E+00	0.0E+00
Pyrene	3.00E-03	59493	-	1.09E+00	0.0E+00	2.8E-03
Sulfate	1.33E+03	61093	-	-	0.0E+00	0.0E+00
Tetrachloroethene	2.80E-02	62893	1.63E-03	3.65E-01	1.7E+01	7.7E-02
1,1,1-Trichloroethane	4.00E-02	61093	-	-	0.0E+00	0.0E+00
Trichloroethene	1.50E-01	61093	2.55E-03	-	5.9E+01	0.0E+00
Metals						
Aluminum	2.62E+02	59593	-	1.06E+02	0.0E+00	2.5E+00
Antimony	4.08E-02	59493	-	1.46E-02	0.0E+00	2.8E+00
Arsenic	1.33E-02	59593	4.86E-05	1.09E-02	2.7E+02	1.2E+00
Barium	3.04E+00	59593	-	2.56E+00	0.0E+00	1.2E+00
Beryllium	2.03E-02	59593	1.98E-05	1.82E-01	1.0E+03	1.1E-01
Cadmium	8.20E-03	59593	-	1.82E-02	0.0E+00	4.5E-01
Cesium	1.30E-02	59593	-	-	0.0E+00	0.0E+00
Chromium III	3.54E-01	59593	-	3.65E+01	0.0E+00	9.7E-03
Chromium VI	3.54E-01	59593	-	1.82E-01	0.0E+00	1.9E+00
Cobalt	1.20E-01	59593	-	2.19E+00	0.0E+00	5.5E-02
Copper	4.20E-01	59493	-	1.46E+00	0.0E+00	2.9E-01
Iron	2.94E+02	59593	-	-	0.0E+00	0.0E+00
Lead	2.40E-01	59593	-	-	0.0E+00	0.0E+00
Thium	2.75E-01	61093	-	7.30E-01	0.0E+00	3.8E-01
Manganese	1.37E+01	59493	-	1.82E-01	0.0E+00	7.5E+01

TABLE 5-2 (Continued)
RFETS OU5
RBC SCREEN FOR THE IHSS 115 SOURCE AREA
GROUNDWATER (RESIDENT)

Analyte	Maximum	Location of	RBCs		Max Conc. / RBC	
	Concentration	Maximum	Carcinogenic	Noncarcinogenic	Carcinogen	Noncarcinogen
	or Activity	Concentration				
Mercury	3.00E-03	59493	-	1.09E-02	0.0E+00	2.8E-01
Molybdenum	1.80E-02	59593	-	1.82E-01	0.0E+00	9.9E-02
Nickel	2.88E-01	59593	-	7.30E-01	0.0E+00	3.9E-01
Selenium	1.26E-01	61093	-	1.82E-01	0.0E+00	6.9E-01
Silicon	3.54E+02	59593	-	-	0.0E+00	0.0E+00
Silver	5.32E-02	59493	-	1.82E-01	0.0E+00	2.9E-01
Strontium	2.58E+00	61093	-	2.19E+01	0.0E+00	1.2E-01
Vanadium	3.00E-01	59593	-	2.19E+01	0.0E+00	1.4E-02
Zinc	6.06E-01	59593	-	2.56E-01	0.0E+00	2.4E+00
Zinc	9.82E-01	59593	-	1.09E+01	0.0E+00	9.0E-02
Radionuclides	(pCi/L)		(pCi/L)	(pCi/L)		
Americium-241	2.00E-01	59493	1.98E-01	-	1.0E+00	0.0E+00
Plutonium-238	9.11E-03	59493	-	-	0.0E+00	0.0E+00
Plutonium-239/240	1.04E+00	59493	2.07E-01	-	5.0E+00	0.0E+00
Radium-226	4.40E+00	59493	3.97E-01	-	1.1E+01	0.0E+00
Strontium-89/90	1.50E+00	60293	1.44E+00	-	1.0E+00	0.0E+00
Uranium-233/234	4.90E+01	59993	2.98E+00	-	1.6E+01	0.0E+00
Uranium-235	4.00E+00	59993	2.98E+00	-	1.3E+00	0.0E+00
Uranium-238	4.40E+01	59993	2.98E+00	-	1.5E+01	0.0E+00
				Ratio Sum	1.9E+03	9.3E+01

TABLE 5-3
RFETS OU5
RBC SCREEN FOR THE IHSS 115 SOURCE AREA
SURFACE WATER (RESIDENT)

Analyte	Maximum Concentration or Activity (mg/L)	Location of Maximum Concentration	RBCs		Max Conc. / RBC	
			Carcinogenic (mg/L)	Noncarcinogenic (mg/L)	Carcinogen	Noncarcinogen
Organics and Inorganics						
Chloride	5.02E+01	SW500	-	-	0.0E+00	0.0E+00
Cyanide	5.50E-03	SW500	-	-	0.0E+00	0.0E+00
Fluoride	3.47E-01	SW500	-	1.68E+03	0.0E+00	2.1E-04
Nitrate	8.09E+00	SW500	-	4.49E+04	0.0E+00	1.8E-04
Sulfate	2.93E+01	SW500	-	-	0.0E+00	0.0E+00
Metals						
Barium	1.25E-01	SW500	-	1.97E+03	0.0E+00	6.3E-05
Lead	2.80E-03	SW500	-	-	0.0E+00	0.0E+00
Silicon	1.06E+01	SW500	-	-	0.0E+00	0.0E+00
Strontium	3.92E-01	SW500	-	1.68E+04	0.0E+00	2.3E-05
Zinc	8.59E-02	SW500	-	8.42E+03	0.0E+00	1.0E-05
Radionuclides						
Americium-241	9.54E-03	SW500	1.53E+02	-	6.2E-05	0.0E+00
Cesium-137	8.90E-01	SW500	1.31E+03	-	6.8E-04	0.0E+00
Plutonium-239/240	1.59E-03	SW500	1.59E+02	-	1.0E-05	0.0E+00
Uranium-233/234	7.75E-01	SW500	2.29E+03	-	3.4E-04	0.0E+00
Uranium-235	8.45E-02	SW500	2.29E+03	-	3.7E-05	0.0E+00
Uranium-238	6.97E-01	SW500	2.29E+03	-	3.0E-04	0.0E+00
Ratio Sum					1.4E-03	4.8E-04

TABLE 5-4
RFETS OU5
RBC SCREEN FOR THE IHSS 115 SOURCE AREA
SEEP SEDIMENT (RESIDENT)

Analyte	Maximum	Location of	RBCs		Max Conc. / RBC	Max Conc. / RBC
	Concentration or		Maximum	Carcinogenic	Noncarcinogenic	Carcinogen
Organics and Inorganics	Activity	Concentration	(mg/kg)	(mg/kg)		
Acetone	1.70E-02	SED51693	-	2.74E+04	0.0E+00	6.2E-07
Benzo(a)anthracene	3.80E-02	SED51693	8.77E-01	-	4.3E-02	0.0E+00
Bis(2-ethylhexyl)phthalate	6.80E-02	SED51693	4.57E+01	5.49E+03	1.5E-03	1.2E-05
Chrysene	4.10E-02	SED51693	-	8.77E+01	0.0E+00	4.7E-04
Fluoranthene	9.70E-02	SED51593	-	1.10E+04	0.0E+00	8.8E-06
Methylene chloride	5.00E-03	SED51693	8.54E+01	1.65E+04	5.9E-05	3.0E-07
Nitrate/Nitrite	2.43E+00	SED51593	-	2.74E+04	0.0E+00	8.9E-05
Phenanthrene	8.20E-02	SED51593	-	-	0.0E+00	0.0E+00
Pyrene	9.70E-02	SED51593	-	8.23E+03	0.0E+00	1.2E-05
Tetrachloroethene	1.00E-03	SED51593	1.23E+01	2.74E+03	8.1E-05	3.6E-07
Metals	(mg/kg)		(mg/kg)	(mg/kg)		
Aluminum	9.01E+03	SED51593	-	7.96E+05	0.0E+00	1.1E-02
Antimony	5.13E+01	SED51593	-	1.10E+02	0.0E+00	4.7E-01
Arsenic	6.10E+00	SED51693	3.66E-01	8.23E+01	1.7E+01	7.4E-02
Barium	1.26E+02	SED51593	-	1.91E+04	0.0E+00	6.6E-03
Beryllium	1.70E+00	SED51593	1.49E-01	1.37E+03	1.1E+01	1.2E-03
Cadmium	1.00E+00	SED51693	-	1.37E+02	0.0E+00	7.3E-03
Chromium III	1.15E+01	SED51593	-	2.74E+05	0.0E+00	4.2E-05
Chromium VI	1.15E+01	SED51593	9.39E+02	1.37E+03	1.2E-02	8.4E-03
Cobalt	1.09E+01	SED51693	-	1.65E+04	0.0E+00	6.6E-04
Copper	1.72E+01	SED51593	-	1.10E+04	0.0E+00	1.6E-03
Iron	2.21E+04	SED51593	-	-	0.0E+00	0.0E+00
Lead	4.12E+01	SED51693	-	-	0.0E+00	0.0E+00
Lithium	9.40E+00	SED51693	-	5.49E+03	0.0E+00	1.7E-03
Manganese	6.07E+02	SED51693	-	1.36E+03	0.0E+00	4.5E-01
Nickel	1.64E+01	SED51693	-	5.49E+03	0.0E+00	3.0E-03
Strontium	7.90E+01	SED51693	-	1.65E+05	0.0E+00	4.8E-04
Thallium	2.70E-01	SED51593	-	-	0.0E+00	0.0E+00
Vanadium	3.93E+01	SED51593	-	1.92E+03	0.0E+00	2.0E-02
Zinc	6.99E+01	SED51593	-	8.23E+04	0.0E+00	8.5E-04
Radionuclides	(pCi/g)		(pCi/g)	(pCi/g)		
Americium-241	1.10E-02	SED51593	2.37E+00	-	4.6E-03	0.0E+00
Plutonium-239/240	4.40E-02	SED51693	3.43E+00	-	1.3E-02	0.0E+00
Uranium-233/234	1.40E+00	SED51693	4.53E+01	-	3.1E-02	0.0E+00
Uranium-235	1.10E-01	SED51693	1.73E-01	-	6.4E-01	0.0E+00
Uranium-238	1.20E+00	SED51693	4.60E+01	-	2.6E-02	0.0E+00
				Ratio Sum	2.9E+01	1.1E+00

TABLE 5-5
RFETS OU5
RBC SCREEN FOR THE IHSS 133 SOURCE AREA
SOIL UP TO 12 FEET (RESIDENT)

Analyte	Maximum Concentration or Activity (mg/kg)	Location of Maximum Concentration	Depth of Maximum Concentration (ft.)	RBCs		Max Conc. / RBC	Max Conc. / RBC
				Carcinogenic (mg/kg)	Noncarcinogenic (mg/kg)	Carcinogen	Noncarcinogen
Organics and Inorganics							
Metals							
	(mg/kg)			(mg/kg)	(mg/kg)		
Aluminum	3.28E+04	55793	12	-	7.96E+05	0.0E+00	4.1E-02
Antimony	1.49E+02	56893	8.3	-	1.10E+02	0.0E+00	1.4E+00
Arsenic	1.36E+01	56393	8	-	8.23E+01	0.0E+00	1.7E-01
Barium	6.83E+02	54993	6	-	1.91E+04	0.0E+00	3.6E-02
Beryllium	1.31E+02	56893	8.3	-	1.49E+03	0.0E+00	8.8E-02
Cadmium	5.69E+01	56393	6	-	1.37E+02	0.0E+00	4.2E-01
Cesium	1.26E+01	56493	6	-	-	0.0E+00	0.0E+00
Chromium III	8.31E+03	56893	8.3	-	2.74E+05	0.0E+00	3.0E-02
Chromium VI	8.31E+03	56893	8.3	9.39E+02	1.37E+03	8.8E+00	6.1E+00
Cobalt	6.76E+01	56893	8.3	-	1.65E+04	0.0E+00	4.1E-03
Copper	2.92E+03	56393	6	-	1.10E+04	0.0E+00	2.7E-01
Iron	1.07E+05	55993	9.3	-	-	0.0E+00	0.0E+00
Lead	9.35E+02	55993	9.3	-	-	0.0E+00	0.0E+00
Lithium	2.90E+01	55793	12	-	5.49E+03	0.0E+00	5.3E-03
Manganese	1.26E+03	56893	8.3	-	1.36E+03	0.0E+00	9.3E-01
Mercury	1.20E+00	55993	6	-	8.23E+01	0.0E+00	1.5E-02
Molybdenum	1.29E+02	56893	8.3	-	1.37E+03	0.0E+00	9.4E-02
Nickel	4.75E+03	56893	8.3	-	5.49E+03	0.0E+00	8.7E-01
Selenium	4.50E-01	56393	2	-	1.37E+03	0.0E+00	3.3E-04
Silver	3.11E+02	55993	9.3	-	1.37E+03	0.0E+00	2.3E-01
Strontium	9.57E+01	56393	6	-	1.65E+05	0.0E+00	5.8E-04
Thallium	5.50E-01	56393	8	-	-	0.0E+00	0.0E+00
Tin	5.79E+02	55993	9.3	-	1.65E+05	0.0E+00	3.5E-03
Vanadium	6.78E+01	55793	12	-	1.92E+03	0.0E+00	3.5E-02
Zinc	2.39E+03	55993	6	-	8.23E+04	0.0E+00	2.9E-02
Radionuclides							
	(pCi/g)			(pCi/g)	(pCi/g)		
Americium-241	6.10E-01	56393	6	2.37E+00	-	2.6E-01	0.0E+00
Antonium-239/240	9.39E-01	56893	4	3.43E+00	-	2.7E-01	0.0E+00
Uranium-233/234	1.26E+02	58093	8	4.53E+01	-	2.8E+00	0.0E+00
Uranium-235	3.77E+01	56893	8.3	1.73E-01	-	2.2E+02	0.0E+00
Uranium-238	1.16E+03	56893	8.3	4.60E+01	-	2.5E+01	0.0E+00
						Ratio Sum	2.6E+02
							1.1E+01

TABLE 5-6
RFETS OU5
RBC SCREEN FOR THE IHSS 133 SOURCE AREA
GROUNDWATER (RESIDENT)

Analyte	Maximum	Location of	RBCs		Max Conc. / RBC	Max Conc. / RBC
	Concentration or Activity (mg/L)	Maximum Concentration	Carcinogenic (mg/L)	Noncarcinogenic (mg/L)	Carcinogen	Noncarcinogen
Organics and Inorganics						
Chloride	6.40E+01	58793	-	-	0.0E+00	0.0E+00
Fluoride	4.00E-01	58793	-	2.19E+00	0.0E+00	1.8E-01
Nitrate/Nitrite	1.04E+00	62693	-	3.65E+00	0.0E+00	2.8E-01
Sulfate	7.10E+01	58793	-	-	0.0E+00	0.0E+00
Metals						
	(mg/L)		(mg/L)	(mg/L)		
Aluminum	3.57E+02	58793	-	1.06E+02	0.0E+00	3.4E+00
Arsenic	4.80E-03	58793	4.86E-05	1.09E-02	9.9E+01	4.4E-01
Barium	2.65E+00	58793	-	2.56E+00	0.0E+00	1.0E+00
Beryllium	2.94E-02	58793	1.98E-05	1.82E-01	1.5E+03	1.6E-01
Cesium	4.00E-02	58793	-	-	0.0E+00	0.0E+00
Chromium III	4.42E-01	58793	-	3.65E+01	0.0E+00	1.2E-02
Chromium VI	4.42E-01	58793	-	1.82E-01	0.0E+00	2.4E+00
Cobalt	1.61E-01	58793	-	2.19E+00	0.0E+00	7.4E-02
Copper	3.01E-01	58793	-	1.46E+00	0.0E+00	2.1E-01
Iron	4.18E+02	58793	-	-	0.0E+00	0.0E+00
Lead	1.13E-01	58793	-	-	0.0E+00	0.0E+00
Lithium	3.06E-01	58793	-	7.30E-01	0.0E+00	4.2E-01
Manganese	3.52E+00	58793	-	1.82E-01	0.0E+00	1.9E+01
Mercury	6.90E-04	58793	-	1.09E-02	0.0E+00	6.3E-02
Nickel	3.13E-01	58793	-	7.30E-01	0.0E+00	4.3E-01
Selenium	7.40E-03	58793	-	1.82E-01	0.0E+00	4.1E-02
Silicon	2.05E+02	58793	-	-	0.0E+00	0.0E+00
Silver	3.80E-03	58793	-	1.82E-01	0.0E+00	2.1E-02
Strontium	1.08E+00	58793	-	2.19E+01	0.0E+00	4.9E-02
Thallium	1.30E-03	58793	-	-	0.0E+00	0.0E+00
Tin	1.03E-01	58793	-	2.19E+01	0.0E+00	4.7E-03
Vanadium	6.74E-01	58793	-	2.56E-01	0.0E+00	2.6E+00
Zinc	6.02E-01	58793	-	1.09E+01	0.0E+00	5.5E-02
Radionuclides						
	(pCi/L)		(pCi/L)	(pCi/L)		
Americium-241	5.80E-02	58793	1.98E-01	-	2.9E-01	0.0E+00
Actinium-228	5.24E-03	58793	-	-	0.0E+00	0.0E+00
Plutonium-239/240	3.30E-02	58793	2.07E-01	-	1.6E-01	0.0E+00
Radium-226	3.90E+00	58793	3.97E-01	-	9.8E+00	0.0E+00
Radium-228	8.40E+00	58793	4.76E-01	-	1.8E+01	0.0E+00
Strontium-89/90	9.10E-01	62693	1.44E+00	-	6.3E-01	0.0E+00
Uranium-233/234	7.60E+00	58793	2.98E+00	-	2.6E+00	0.0E+00
Uranium-235	4.70E-01	58793	2.98E+00	-	1.6E-01	0.0E+00
Uranium-238	1.10E+01	58793	2.98E+00	-	3.7E+00	0.0E+00
Ratio Sum					1.6E+03	3.1E+01

TABLE 5-7
RFETS OUS
RBC SCREEN FOR THE IHSS 133 SOURCE AREA
SEEP SEDIMENT (RESIDENT)

Analyte	Maximum	Location of	RBCs		Max Conc. / RBC	Max Conc. / RBC
	Concentration or Activity (mg/kg)	Maximum Concentration	Carcinogenic (mg/kg)	Noncarcinogenic (mg/kg)	Carcinogen	Noncarcinogen
Organics and Inorganics						
Acetone	1.20E-02	SED51793	-	2.74E+04	0.0E+00	4.4E-07
Bis(2-ethylhexyl)phthalate	8.00E-02	SED51893	4.57E+01	5.49E+03	1.8E-03	1.5E-05
Methylene chloride	4.00E-03	SED51793	8.54E+01	1.65E+04	4.7E-05	2.4E-07
Nitrate/Nitrite	6.90E-01	SED51893	-	2.74E+04	0.0E+00	2.5E-05
Metals						
Aluminum	1.14E+04	SED51793	-	7.96E+05	0.0E+00	1.4E-02
Antimony	4.36E+01	SED51793	-	1.10E+02	0.0E+00	4.0E-01
Arsenic	6.50E+00	SED51793	3.66E-01	8.23E+01	1.8E+01	7.9E-02
Barium	1.41E+02	SED51793	-	1.91E+04	0.0E+00	7.4E-03
Beryllium	1.50E+00	SED51793	1.49E-01	1.37E+03	1.0E+01	1.1E-03
Cadmium	2.30E+00	SED51893	-	1.37E+02	0.0E+00	1.7E-02
Chromium III	1.68E+01	SED51793	-	2.74E+05	0.0E+00	6.1E-05
Chromium VI	1.68E+01	SED51793	9.39E+02	1.37E+03	1.8E-02	1.2E-02
Cobalt	6.90E+00	SED51793	-	1.65E+04	0.0E+00	4.2E-04
Copper	1.56E+01	SED51793	-	1.10E+04	0.0E+00	1.4E-03
Iron	1.68E+04	SED51793	-	-	0.0E+00	0.0E+00
Lead	4.19E+01	SED51893	-	-	0.0E+00	0.0E+00
Lithium	9.70E+00	SED51793	-	5.49E+03	0.0E+00	1.8E-03
Mercury	6.00E-02	SED51893	-	8.23E+01	0.0E+00	7.3E-04
Nickel	2.50E+01	SED51893	-	5.49E+03	0.0E+00	4.6E-03
Silver	2.40E+00	SED51893	-	1.37E+03	0.0E+00	1.8E-03
Strontium	5.63E+01	SED51793	-	1.65E+05	0.0E+00	3.4E-04
Thallium	2.80E-01	SED51893	-	-	0.0E+00	0.0E+00
Tin	1.13E+01	SED51793	-	1.65E+05	0.0E+00	6.8E-05
Vanadium	3.18E+01	SED51793	-	1.92E+03	0.0E+00	1.7E-02
Zinc	1.05E+03	SED51893	-	8.23E+04	0.0E+00	1.3E-02
Radionuclides						
	(pCi/g)		(pCi/g)	(pCi/g)		
Americium-241	2.20E-02	SED51893	2.37E+00	-	9.3E-03	0.0E+00
Plutonium-239/240	3.80E-02	SED51793	3.43E+00	-	1.1E-02	0.0E+00
Radium-223/234	2.00E+00	SED51893	4.53E+01	-	4.4E-02	0.0E+00
Radium-226	1.30E-01	SED51793	1.73E-01	-	7.5E-01	0.0E+00
Uranium-238	3.70E+00	SED51893	4.60E+01	-	8.0E-02	0.0E+00
				Ratio Sum	2.9E+01	5.7E-01

TABLE 5-8
RFETS OUS
RBC SCREEN FOR THE SURFACE DISTURBANCE S. OF IHSS 133 SOURCE AREA
SOIL UP TO 12 FEET (RESIDENT)

Analyte	Maximum Concentration or Activity (mg/kg)	Location of Maximum Concentration	Depth of Maximum Concentration (ft.)	RBCs		Max Conc. / RBC	Max Conc. / RBC
				Carcinogenic (mg/kg)	Noncarcinogenic (mg/kg)	Carcinogen	Noncarcinogen
Organics and Inorganics							
Benzoic acid	2.00E-01	57893	6	-	1.10E+06	0.0E+00	1.8E-07
Methylene chloride	1.10E-02	57893	6	8.54E+01	1.65E+04	1.3E-04	6.7E-07
Metals							
Aluminum	1.90E+04	57893	6	-	7.96E+05	0.0E+00	2.4E-02
Arsenic	6.30E+00	57993	6	-	8.23E+01	0.0E+00	7.7E-02
Barium	1.08E+02	SS513093	0	-	1.91E+04	0.0E+00	5.7E-03
Beryllium	1.50E+00	SS513393	0	-	1.49E+03	0.0E+00	1.0E-03
Cadmium	1.30E+00	SS513293	0	-	1.37E+02	0.0E+00	9.5E-03
Chromium III	1.08E+02	57993	8.1	-	2.74E+05	0.0E+00	4.0E-04
Chromium VI	1.08E+02	57993	8.1	9.39E+02	1.37E+03	1.2E-01	7.9E-02
Cobalt	1.09E+01	57993	8.1	-	1.65E+04	0.0E+00	6.6E-04
Copper	1.96E+01	57993	8.1	-	1.10E+04	0.0E+00	1.8E-03
Iron	1.97E+04	57893	6	-	-	0.0E+00	0.0E+00
Lead	4.70E+01	SS513093	0	-	-	0.0E+00	0.0E+00
Lithium	4.90E+00	57793	2	-	5.49E+03	0.0E+00	8.9E-04
Manganese	2.84E+02	SS513093	0	-	1.36E+03	0.0E+00	2.1E-01
Mercury	1.00E-01	SS513393	0	-	8.23E+01	0.0E+00	1.2E-03
Molybdenum	1.17E+01	57993	8.1	-	1.37E+03	0.0E+00	8.5E-03
Nickel	4.54E+01	57993	8.1	-	5.49E+03	0.0E+00	8.3E-03
Selenium	3.40E-01	SS512893	0	-	1.37E+03	0.0E+00	2.5E-04
Silver	8.05E-01	57993	8.1	-	1.37E+03	0.0E+00	5.9E-04
Strontium	2.63E+01	57893	6	-	1.65E+05	0.0E+00	1.6E-04
Vanadium	3.77E+01	57993	6	-	1.92E+03	0.0E+00	2.0E-02
Zinc	6.17E+01	SS513193	0	-	8.23E+04	0.0E+00	7.5E-04
Radionuclides							
Americium-241	2.49E-02	SS513093	0	2.37E+00	-	1.1E-02	0.0E+00
Plutonium-239/240	5.51E-01	SS513193	0	3.43E+00	-	1.6E-01	0.0E+00
Uranium-233/234	1.50E+00	57793	2	4.53E+01	-	3.3E-02	0.0E+00
Uranium-235	8.14E-02	57793	12	1.73E-01	-	4.7E-01	0.0E+00
Uranium-238	1.15E+00	57893	2	4.60E+01	-	2.5E-02	0.0E+00
Ratio Sum						8.2E-01	4.5E-01

TABLE 5-9
 RFETS OUS
 RBC SCREEN FOR THE SOUTH INTERCEPTOR DITCH & POND C-2 SOURCE AREA
 SOIL UP TO 12 FEET (RESIDENT)

Analyte	Maximum Concentration or Activity	Location of Maximum Concentration	Depth of Maximum Concentration (ft.)	RBCs		Max Conc. / RBC	Max Conc. / RBC
				Carcinogenic	Noncarcinogenic	Carcinogen	Noncarcinogen
Organics and Inorganics	(mg/kg)			(mg/kg)	(mg/kg)		
Toluene	1.20E-02	50192	9.9	-	5.49E+04	0.0E+00	2.2E-07
Metals	(mg/kg)			(mg/kg)	(mg/kg)		
Radionuclides	(pCi/g)			(pCi/g)	(pCi/g)		
					Ratio Sum	0.0E+00	2.2E-07

TABLE 5-10
RFETS OU5
RBC SCREEN FOR THE SOUTH INTERCEPTOR DITCH & POND C-2 SOURCE AREA
SURFACE WATER (RESIDENT)

Analyte	Maximum Concentration or Activity (mg/L)	Location of Maximum Concentration	RBCs		Max Conc. / RBC	Max Conc. / RBC
			Carcinogenic (mg/L)	Noncarcinogenic (mg/L)	Carcinogen	Noncarcinogen
Organics and Inorganics						
Benzoic acid	2.80E-02	SW027	-	1.46E+02	0.0E+00	1.9E-04
Chloride	6.30E+01	SW507	-	-	0.0E+00	0.0E+00
Cyanide	5.50E-03	SW500	-	-	0.0E+00	0.0E+00
Fluoride	7.00E-01	SW507	-	1.68E+03	0.0E+00	4.2E-04
Methylene chloride	3.50E-03	SW027	8.73E+00	1.68E+03	4.0E-04	2.1E-06
Nitrate	8.09E+00	SW500	-	-	0.0E+00	0.0E+00
Pentachlorophenol	5.00E-03	SW507	5.46E-01	8.42E+02	9.2E-03	5.9E-06
Sulfate	4.70E+01	SW507	-	-	0.0E+00	0.0E+00
Metals						
Aluminum	5.07E-01	SW027	-	8.14E+04	0.0E+00	6.2E-06
Arsenic	1.30E-03	SW507	3.74E-02	8.42E+00	3.5E-02	1.5E-04
Barium	1.65E-01	SW507	-	1.97E+03	0.0E+00	8.4E-05
Cesium	3.00E-02	SW507	-	-	0.0E+00	0.0E+00
Copper	8.40E-03	SW027	-	1.12E+03	0.0E+00	7.5E-06
Iron	6.00E-01	SW027	-	-	0.0E+00	0.0E+00
Lead	1.75E-03	SW027	-	-	0.0E+00	0.0E+00
Lithium	1.38E-02	SW027	-	5.62E+02	0.0E+00	2.5E-05
Manganese	7.14E-02	SW027	-	1.40E+02	0.0E+00	5.1E-04
Silicon	8.73E+00	SW500	-	-	0.0E+00	0.0E+00
Strontium	5.46E-01	SW507	-	1.68E+04	0.0E+00	3.3E-05
Vanadium	2.85E-03	SW027	-	1.97E+02	0.0E+00	1.4E-05
Zinc	8.59E-02	SW500	-	8.42E+03	0.0E+00	1.0E-05
Radionuclides						
	(pCi/L)		(pCi/L)	(pCi/L)		
Americium-241	1.80E-01	SW027	1.53E+02	-	1.2E-03	0.0E+00
Cesium-137	8.90E-01	SW500	1.31E+03	-	6.8E-04	0.0E+00
Plutonium-239/240	1.84E-02	SW027	1.59E+02	-	1.2E-04	0.0E+00
Radium-226	1.60E-01	SW507	3.05E+02	-	5.2E-04	0.0E+00
Strontium-89/90	8.30E-01	SW507	1.11E+03	-	7.5E-04	0.0E+00
Uranium-233/234	4.68E+00	SW507	2.29E+03	-	2.0E-03	0.0E+00
Uranium-235	2.80E-01	SW507	2.29E+03	-	1.2E-04	0.0E+00
Uranium-238	7.00E+00	SW507	2.29E+03	-	3.1E-03	0.0E+00
				Ratio Sum	5.3E-02	1.5E-03

TABLE 5-11
RFETS OU5
RBC SCREEN FOR THE SOUTH INTERCEPTOR DITCH & POND C-2 SOURCE AREA
POND SEDIMENT (RESIDENT)

Analyte	Maximum Concentration or Activity (mg/kg)	Location of Maximum Concentration	RBCs		Max Conc. / RBC	Max Conc. / RBC
			Carcinogenic (mg/kg)	Noncarcinogenic (mg/kg)	Carcinogen	Noncarcinogen
Organics and Inorganics						
Benzoic acid	2.40E-01	SED511	-	1.10E+06	0.0E+00	2.2E-07
Fluoranthene	1.40E-01	SED511	-	1.10E+04	0.0E+00	1.3E-05
Phenol	1.50E-01	SED511	-	1.65E+05	0.0E+00	9.1E-07
Nitrate/Nitrite	1.90E+00	SED513	-	3.84E+01	0.0E+00	4.9E-02
Toluene	4.10E-01	SED511	-	5.49E+04	0.0E+00	7.5E-06
Metals						
Aluminum	1.22E+04	SED513	-	7.96E+05	0.0E+00	1.5E-02
Arsenic	9.80E+00	SED513	3.66E-01	8.23E+01	2.7E+01	1.2E-01
Barium	2.26E+02	SED513	-	1.91E+04	0.0E+00	1.2E-02
Beryllium	6.70E-01	SED512	1.49E+03	1.37E+03	4.5E-04	4.9E-04
Chromium III	1.78E+01	SED513	-	2.74E+05	0.0E+00	6.5E-05
Chromium VI	1.78E+01	SED513	9.39E+02	1.37E+03	1.9E-02	1.3E-02
Cobalt	1.20E+01	SED513	-	1.65E+04	0.0E+00	7.3E-04
Copper	3.59E+01	SED513	-	1.10E+04	0.0E+00	3.3E-03
Iron	1.96E+04	SED513	-	-	0.0E+00	0.0E+00
Lead	3.46E+01	SED513	-	-	0.0E+00	0.0E+00
Lithium	9.70E+00	SED513	-	5.49E+03	0.0E+00	1.8E-03
Manganese	6.02E+02	SED513	-	1.36E+03	0.0E+00	4.4E-01
Mercury	6.80E-01	SED513	-	8.23E+01	0.0E+00	8.3E-03
Nickel	1.81E+01	SED512	-	5.49E+03	0.0E+00	3.3E-03
Strontium	1.67E+02	SED513	-	1.65E+05	0.0E+00	1.0E-03
Vanadium	4.09E+01	SED513	-	1.92E+03	0.0E+00	2.1E-02
Zinc	2.01E+02	SED513	-	8.23E+04	0.0E+00	2.4E-03
Radionuclides						
	(pCi/g)		(pCi/g)	(pCi/g)		
Americium-241	2.90E-01	SED025	2.37E+00	-	1.2E-01	0.0E+00
Plutonium-239/240	1.60E+00	SED025	3.43E+00	-	4.7E-01	0.0E+00
Tritium*	3.90E+03	SED507	-	-	0.0E+00	0.0E+00

Values are in pCi/L

Ratio Sum

2.7E+01

6.9E-01

TABLE 5-12
RFETS OU5
RBC SCREEN FOR THE SOUTH INTERCEPTOR DITCH & POND C-2 SOURCE AREA
STREAM SEDIMENT (RESIDENT)

Analyte	Maximum	Location of	RBCs		Max Conc. / RBC	Max Conc. / RBC
	Concentration or	Maximum	Carcinogenic	Noncarcinogenic	Carcinogen	Noncarcinogen
	Activity	Concentration	(mg/kg)	(mg/kg)		
Organics and Inorganics	(mg/kg)					
Nitrate/Nitrite	6.55E+00	SED507	-	2.74E+04	0.0E+00	2.4E-04
Metals	(mg/kg)		(mg/kg)	(mg/kg)		
Aluminum	1.25E+04	SED025	-	7.96E+05	0.0E+00	1.6E-02
Arsenic	4.30E+00	SED025	3.66E-01	8.23E+01	1.2E+01	5.2E-02
Barium	1.72E+02	SED025	-	1.91E+04	0.0E+00	9.0E-03
Beryllium	4.60E-01	SED025	1.49E-01	1.37E+03	3.1E+00	3.4E-04
Cadmium	2.80E+00	SED507	-	1.37E+02	0.0E+00	2.0E-02
Chromium III	1.87E+01	SED507	-	2.74E+05	0.0E+00	6.8E-05
Chromium VI	1.87E+01	SED507	9.39E+02	1.37E+03	2.0E-02	1.4E-02
Cobalt	7.30E+00	SED025	-	1.65E+04	0.0E+00	4.4E-04
Copper	1.36E+02	SED507	-	1.10E+04	0.0E+00	1.2E-02
Iron	1.79E+04	SED025	-	-	0.0E+00	0.0E+00
Lead	3.79E+01	SED507	-	-	0.0E+00	0.0E+00
Lithium	1.08E+01	SED025	-	5.49E+03	0.0E+00	2.0E-03
Manganese	6.09E+02	SED025	-	1.36E+03	0.0E+00	4.5E-01
Mercury	3.05E+00	SED507	-	8.23E+01	0.0E+00	3.7E-02
Nickel	1.73E+01	SED025	-	5.49E+03	0.0E+00	3.2E-03
Selenium	1.10E+00	SED025	-	1.37E+03	0.0E+00	8.0E-04
Silver	7.70E+00	SED507	-	1.37E+03	0.0E+00	5.6E-03
Strontium	7.09E+01	SED025	-	1.65E+05	0.0E+00	4.3E-04
Vanadium	3.51E+01	SED025	-	1.92E+03	0.0E+00	1.8E-02
Zinc	7.09E+02	SED507	-	8.23E+04	0.0E+00	8.6E-03
Radionuclides	(pCi/g)		(pCi/g)	(pCi/g)		
Americium-241	2.90E-01	SED025	2.37E+00	-	1.2E-01	0.0E+00
Plutonium-239/240	1.60E+00	SED025	3.43E+00	-	4.7E-01	0.0E+00
Protactinium*	3.90E+03	SED507	-	-	0.0E+00	0.0E+00
				Ratio Sum	1.5E+01	6.5E-01

*Values are in pCi/L

TABLE 5-13
RFETS OU5
RBC SCREEN FOR THE SURFACE DISTURBANCE W. OF IHSS 209 SOURCE AREA
SOIL UP TO 12 FEET (RESIDENT)

Analyte	Maximum Concentration or Activity (mg/kg)	Location of Maximum Concentration	Depth of Maximum Concentration (ft.)	RBCs		Max Conc. / RBC	Max Conc. / RBC
				Carcinogenic (mg/kg)	Noncarcinogenic (mg/kg)	Carcinogen	Noncarcinogen
Organics and Inorganics							
Benzoic acid	3.90E-01	SS511793	0	-	1.10E+06	0.0E+00	3.5E-07
Bis(2-ethylhexyl)phthalate	1.30E-01	SS511893	0	4.57E+01	5.49E+03	2.8E-03	2.4E-05
Isophorone	9.60E-02	SS511993	0	6.74E+02	5.49E+04	1.4E-04	1.7E-06
Metals							
Aluminum	1.16E+04	57693	6	-	7.96E+05	0.0E+00	1.5E-02
Arsenic	5.90E+00	SS511993	0	-	8.23E+01	0.0E+00	7.2E-02
Barium	1.99E+02	SS511593	0	-	1.91E+04	0.0E+00	1.0E-02
Beryllium	1.30E+00	57693	2	-	1.49E+03	0.0E+00	8.7E-04
Chromium III	1.30E+01	57693	6	-	2.74E+05	0.0E+00	4.7E-05
Chromium VI	1.30E+01	57693	6	9.39E+02	1.37E+03	1.4E-02	9.5E-03
Cobalt	1.37E+01	SS511993	0	-	1.65E+04	0.0E+00	8.3E-04
Copper	1.89E+01	57693	6	-	1.10E+04	0.0E+00	1.7E-03
Iron	2.04E+04	SS512093	0	-	-	0.0E+00	0.0E+00
Lead	2.69E+01	57693	6	-	-	0.0E+00	0.0E+00
Lithium	7.80E+00	SS512293	0	-	5.49E+03	0.0E+00	1.4E-03
Manganese	3.83E+02	SS512093	0	-	1.36E+03	0.0E+00	2.8E-01
Mercury	9.00E-02	SS512193	0	-	8.23E+01	0.0E+00	1.1E-03
Nickel	1.94E+01	SS511993	0	-	5.49E+03	0.0E+00	3.5E-03
Selenium	3.90E-01	SS511593	0	-	1.37E+03	0.0E+00	2.8E-04
Strontium	8.53E+01	57693	6	-	1.65E+05	0.0E+00	5.2E-04
Thallium	3.60E-01	SS511693	0	-	-	0.0E+00	0.0E+00
Vanadium	3.35E+01	SS511593	0	-	1.92E+03	0.0E+00	1.7E-02
Zinc	6.59E+01	SS512093	0	-	8.23E+04	0.0E+00	8.0E-04
Radionuclides							
	(pCi/g)			(pCi/g)	(pCi/g)		
Americium-241	8.02E-01	SS511693	0	2.37E+00	-	3.4E-01	0.0E+00
Plutonium-239/240	5.01E+00	SS511693	0	3.43E+00	-	1.5E+00	0.0E+00
Uranium-233/234	1.03E+00	57693	6	4.53E+01	-	2.3E-02	0.0E+00
Uranium-235	6.59E-02	57693	6	1.73E-01	-	3.8E-01	0.0E+00
Uranium-238	1.18E+00	57693	6	4.60E+01	-	2.6E-02	0.0E+00
					Ratio Sum	2.2E+00	4.2E-01

TABLE 5-14
RFETS OU5
RBC SCREEN FOR THE WOMAN CREEK & POND C-1 SOURCE AREA
SOIL UP TO 12 FEET (RESIDENT)

Analyte	Maximum Concentration or Activity	Location of Maximum Concentration	Depth of Maximum Concentration (ft.)	RBCs		Max Conc. / RBC	
				Carcinogenic (mg/kg)	Noncarcinogenic (mg/kg)	Carcinogen	Noncarcinogen
Organics and Inorganics	(mg/kg)			(mg/kg)	(mg/kg)		
Methylene chloride	4.00E-03	50092	5.15	8.54E+01	1.65E+04	4.7E-05	2.4E-07
Toluene	2.10E-02	50092	10.2	-	5.49E+04	0.0E+00	3.8E-07
Metals	(mg/kg)			(mg/kg)	(mg/kg)		
Radionuclides	(pCi/g)			(pCi/g)	(pCi/g)		
Americium-241	1.30E-02	51193	10	2.37E+00	-	5.5E-03	0.0E+00
Plutonium-239/240	1.60E-01	51193	10	3.43E+00	-	4.7E-02	0.0E+00
Uranium-233/234	1.00E+00	51193	10	4.53E+01	-	2.2E-02	0.0E+00
Uranium-235	6.50E-02	51193	10	1.73E-01	-	3.8E-01	0.0E+00
Uranium-238	1.10E+00	51193	10	4.60E+01	-	2.4E-02	0.0E+00
					Ratio Sum	4.7E-01	6.2E-07

TABLE 5-15
RFETS OU5
RBC SCREEN FOR THE WOMAN CREEK & POND C-1 SOURCE AREA
GROUNDWATER (RESIDENT)

Analyte	Maximum	Location of	RBCs		Max Conc. / RBC	Max Conc. / RBC
	Concentration or Activity (mg/L)	Maximum Concentration	Carcinogenic (mg/L)	Noncarcinogenic (mg/L)	Carcinogen	Noncarcinogen
Organics and Inorganics						
Chloride	4.27E+01	50092	-	-	0.0E+00	0.0E+00
Fluoride	1.00E+00	50092	-	2.19E+00	0.0E+00	4.6E-01
Nitrate/Nitrite	1.80E+00	50092	-	3.65E+00	0.0E+00	4.9E-01
Sulfate	1.60E+01	50092	-	-	0.0E+00	0.0E+00
Metals						
	(mg/L)		(mg/L)	(mg/L)		
Aluminum	3.51E+01	51193	-	1.06E+02	0.0E+00	3.3E-01
Arsenic	8.50E-03	51193	4.86E-05	1.09E-02	1.7E+02	7.8E-01
Barium	7.60E-01	51193	-	2.56E+00	0.0E+00	3.0E-01
Beryllium	3.40E-03	51193	1.98E-05	1.82E-01	1.7E+02	1.9E-02
Cesium	1.65E-02	51193	-	-	0.0E+00	0.0E+00
Chromium III	4.26E-02	51193	-	3.65E+01	0.0E+00	1.2E-03
Chromium VI	4.26E-02	51193	-	1.82E-01	0.0E+00	2.3E-01
Cobalt	4.47E-02	51193	-	2.19E+00	0.0E+00	2.0E-02
Copper	5.03E-02	51193	-	1.46E+00	0.0E+00	3.4E-02
Iron	7.18E+01	51193	-	-	0.0E+00	0.0E+00
Lead	3.94E-02	51193	-	-	0.0E+00	0.0E+00
Lithium	3.02E-02	51193	-	7.30E-01	0.0E+00	4.1E-02
Manganese	3.53E+00	51193	-	1.82E-01	0.0E+00	1.9E+01
Molybdenum	1.11E-02	51193	-	1.82E-01	0.0E+00	6.1E-02
Nickel	6.82E-02	51193	-	7.30E-01	0.0E+00	9.3E-02
Silicon	7.40E+01	51193	-	-	0.0E+00	0.0E+00
Silver	6.48E-01	51193	-	1.82E-01	0.0E+00	3.6E+00
Vanadium	8.96E-02	51193	-	2.56E-01	0.0E+00	3.5E-01
Zinc	2.13E-01	51193	-	1.09E+01	0.0E+00	2.0E-02
Radionuclides						
	(pCi/L)		(pCi/L)	(pCi/L)		
Americium-241	1.23E-02	51193	1.98E-01	-	6.2E-02	0.0E+00
Cesium-134	9.80E-01	51193	-	-	0.0E+00	0.0E+00
Cesium-137	3.80E-01	51193	1.70E+00	-	2.2E-01	0.0E+00
Plutonium-239/240	1.43E-02	51193	2.07E-01	-	6.9E-02	0.0E+00
Radium-226	1.55E+00	51193	3.97E-01	-	3.9E+00	0.0E+00
Radium-228	1.40E+00	51193	4.76E-01	-	2.9E+00	0.0E+00
Strontium-89/90	1.83E+00	51193	1.44E+00	-	1.3E+00	0.0E+00
Thorium	5.58E+02	51193	3.17E+01	-	1.8E+01	0.0E+00
Uranium-233/234	6.20E+00	50092	2.98E+00	-	2.1E+00	0.0E+00
Uranium-235	5.80E-01	50092	2.98E+00	-	1.9E-01	0.0E+00
Uranium-238	4.50E+00	50092	2.98E+00	-	1.5E+00	0.0E+00
				Ratio Sum	3.8E+02	2.6E+01

TABLE 5-16
RFETS OU5
RBC SCREEN FOR THE WOMAN CREEK & POND C-1 SOURCE AREA
SURFACE WATER (RESIDENT)

Analyte	Maximum Concentration or Activity (mg/L)	Location of Maximum Concentration	RBCs		Max Conc. / RBC	Max Conc. / RBC
			Carcinogenic (mg/L)	Noncarcinogenic (mg/L)	Carcinogen	Noncarcinogen
Organics and Inorganics						
Chloride	4.10E+01	SW026	-	-	0.0E+00	0.0E+00
Fluoride	6.00E-01	SW50293	-	1.68E+03	0.0E+00	3.6E-04
Sulfate	4.00E+01	SW026	-	-	0.0E+00	0.0E+00
Metals						
Aluminum	5.24E-01	SW029	-	8.14E+04	0.0E+00	6.4E-06
Arsenic	5.70E-03	SW55193	3.74E-02	8.42E+00	1.5E-01	6.8E-04
Barium	1.87E-01	SW55193	-	1.97E+03	0.0E+00	9.5E-05
Cesium	4.00E-02	SW026	-	-	0.0E+00	0.0E+00
Cobalt	5.70E-03	SW55193	-	1.68E+03	0.0E+00	3.4E-06
Copper	6.80E-03	SW041	-	1.12E+03	0.0E+00	6.1E-06
Iron	1.12E+01	SW55193	-	-	0.0E+00	0.0E+00
Lead	9.50E-03	SW55193	-	-	0.0E+00	0.0E+00
Lithium	1.14E-02	SW55193	-	5.62E+02	0.0E+00	2.0E-05
Manganese	3.63E-01	SW55193	-	1.40E+02	0.0E+00	2.6E-03
Nickel	2.00E-02	SW55193	-	5.62E+02	0.0E+00	3.6E-05
Selenium	3.20E-03	SW033	-	1.40E+02	0.0E+00	2.3E-05
Silicon	1.11E+01	SW034	-	-	0.0E+00	0.0E+00
Strontium	3.19E-01	SW026	-	1.68E+04	0.0E+00	1.9E-05
Tin	2.37E-02	SW55193	-	1.68E+04	0.0E+00	1.4E-06
Vanadium	6.40E-03	SW55193	-	1.97E+02	0.0E+00	3.2E-05
Zinc	3.83E-02	SW034	-	8.42E+03	0.0E+00	4.5E-06
Radionuclides						
Americium-241	3.80E-01	SW50293	1.53E+02	-	2.5E-03	0.0E+00
Plutonium-239/240	3.10E-02	SW029	1.59E+02	-	1.9E-04	0.0E+00
Rontium-89/90	8.20E-01	SW50193	1.11E+03	-	7.4E-04	0.0E+00
Strontium	-2.42E+01	IHSS209	2.44E+04	-	-9.9E-04	0.0E+00
Uranium-233/234	1.90E+00	SW026	2.29E+03	-	8.3E-04	0.0E+00
Uranium-235	1.99E-01	SW506	2.29E+03	-	8.7E-05	0.0E+00
Uranium-238	1.44E+00	SW026	2.29E+03	-	6.3E-04	0.0E+00
Ratio Sum					1.6E-01	3.9E-03

TABLE 5-17
RFETS OU5
RBC SCREEN FOR THE WOMAN CREEK & POND C-1 SOURCE AREA
POND SEDIMENT (RESIDENT)

Analyte	Maximum Concentration or Activity (mg/kg)	Location of Maximum Concentration	RBCs		Max Conc. / RBC	
			Carcinogenic (mg/kg)	Noncarcinogenic (mg/kg)	Carcinogen	Noncarcinogen
Organics and Inorganics						
Benzoic acid	4.10E-01	SED509	-	1.10E+06	0.0E+00	3.7E-07
Di-n-butyl phthalate	1.10E-01	SED510	-	2.74E+04	0.0E+00	4.0E-06
Nitrate/Nitrite	1.30E+00	SED509	-	2.74E+04	0.0E+00	4.7E-05
Toluene	5.63E-01	SED508	-	5.49E+04	0.0E+00	1.0E-05
Metals						
	(mg/kg)		(mg/kg)	(mg/kg)		
Aluminum	1.55E+04	SED509	-	7.96E+05	0.0E+00	1.9E-02
Arsenic	5.60E+00	SED509	3.66E-01	8.23E+01	1.5E+01	6.8E-02
Barium	2.62E+02	SED509	-	1.91E+04	0.0E+00	1.4E-02
Beryllium	1.00E+00	SED509	1.49E+03	1.37E+03	6.7E-04	7.3E-04
Cadmium	1.52E+04	SED509	-	1.37E+02	0.0E+00	1.1E+02
Chromium III	1.96E+01	SED509	-	2.74E+05	0.0E+00	7.2E-05
Chromium VI	1.96E+01	SED509	9.39E+02	1.37E+03	2.1E-02	1.4E-02
Cobalt	1.23E+01	SED509	-	1.65E+04	0.0E+00	7.5E-04
Copper	2.74E+01	SED509	-	1.10E+04	0.0E+00	2.5E-03
Iron	2.35E+04	SED509	-	-	0.0E+00	0.0E+00
Lead	3.05E+01	SED509	-	-	0.0E+00	0.0E+00
Lithium	1.57E+01	SED509	-	5.49E+03	0.0E+00	2.9E-03
Manganese	3.10E+02	SED509	-	1.36E+03	0.0E+00	2.3E-01
Mercury	1.60E+00	SED510	-	8.23E+01	0.0E+00	1.9E-02
Nickel	1.91E+01	SED510	-	5.49E+03	0.0E+00	3.5E-03
Selenium	1.50E+00	SED510	-	1.37E+03	0.0E+00	1.1E-03
Strontium	7.43E+01	SED509	-	1.65E+05	0.0E+00	4.5E-04
Vanadium	3.63E+01	SED509	-	1.92E+03	0.0E+00	1.9E-02
Zinc	1.06E+02	SED509	-	8.23E+04	0.0E+00	1.3E-03
Radionuclides						
	(pCi/g)		(pCi/g)	(pCi/g)		
Americium-241	2.20E-01	SED509	2.37E+00	-	9.3E-02	0.0E+00
Plutonium-239/240	1.40E+00	SED509	3.43E+00	-	4.1E-01	0.0E+00
Tritium ^a	4.90E+02	SED510	-	-	0.0E+00	0.0E+00
Radium-223/234	3.50E+00	SED509	4.53E+01	-	7.7E-02	0.0E+00
Radium-226	1.40E-01	SED509	1.73E-01	-	8.1E-01	0.0E+00
Uranium-238	3.00E+00	SED509	4.60E+01	-	6.5E-02	0.0E+00

Values are in pCi/L

Ratio Sum

1.7E+01

1.1E+02

TABLE 5-18
RFETS OU5
RBC SCREEN FOR THE WOMAN CREEK & POND C-1 SOURCE AREA
STREAM SEDIMENT (RESIDENT)

Analyte	Maximum	Location of	RBCs		Max Conc. / RBC	Max Conc. / RBC
	Concentration or	Maximum	Carcinogenic	Noncarcinogenic	Carcinogen	Noncarcinogen
	Activity	Concentration	(mg/kg)	(mg/kg)		
Organics and Inorganics	(mg/kg)					
Nitrate/Nitrite	9.00E-01	SED506	-	2.74E+04	0.0E+00	3.3E-05
Metals	(mg/kg)		(mg/kg)	(mg/kg)		
Aluminum	7.43E+03	SED501	-	7.96E+05	0.0E+00	9.3E-03
Arsenic	5.50E+00	SED024	3.66E-01	8.23E+01	1.5E+01	6.7E-02
Barium	1.31E+02	SED506	-	1.91E+04	0.0E+00	6.9E-03
Beryllium	4.70E-01	SED501	1.49E-01	1.37E+03	3.2E+00	3.4E-04
Cadmium	8.90E-01	SED501	-	1.37E+02	0.0E+00	6.5E-03
Chromium III	1.02E+01	SED501	-	2.74E+05	0.0E+00	3.7E-05
Chromium VI	1.02E+01	SED501	9.39E+02	1.37E+03	1.1E-02	7.4E-03
Cobalt	8.30E+00	SED501	-	1.65E+04	0.0E+00	5.0E-04
Copper	1.45E+01	SED501	-	1.10E+04	0.0E+00	1.3E-03
Iron	1.32E+04	SED501	-	-	0.0E+00	0.0E+00
Lead	1.53E+01	SED027	-	-	0.0E+00	0.0E+00
Lithium	6.50E+00	SED501	-	5.49E+03	0.0E+00	1.2E-03
Manganese	3.17E+02	SED027	-	1.36E+03	0.0E+00	2.3E-01
Nickel	1.17E+01	SED506	-	5.49E+03	0.0E+00	2.1E-03
Selenium	1.00E+00	SED501	-	1.37E+03	0.0E+00	7.3E-04
Strontium	5.21E+01	SED506	-	1.65E+05	0.0E+00	3.2E-04
Vanadium	2.43E+01	SED501	-	1.92E+03	0.0E+00	1.3E-02
Zinc	4.55E+01	SED024	-	8.23E+04	0.0E+00	5.5E-04
Radionuclides	(pCi/g)		(pCi/g)	(pCi/g)		
Americium-241	5.40E-02	SED027	2.37E+00	-	2.3E-02	0.0E+00
Plutonium-239/240	4.80E-01	SED027	3.43E+00	-	1.4E-01	0.0E+00
Tritium*	6.10E+02	SED506	-	-	0.0E+00	0.0E+00
Values are in pCi/L				Ratio Sum	1.8E+01	3.5E-01

Table 5-19
RFETS OUS
Summary of Total Ratio Sums by Source Area and Media

Source Area	Medium	Carcinogenic Ratio	Noncarcinogenic Ratio
IHSS 115 ⁽¹⁾	Soil to 12 feet	5.6E+03	3.4E+00
	Groundwater	1.9E+03	9.3E+01
	Surface water	1.4E-03	4.8E-04
	Seep sediment	<u>2.9E+01</u>	<u>1.1E+00</u>
	Source Area Total Ratio ⁽²⁾	7.5E+03	9.8E+01
IHSS 133 ⁽³⁾	Soil to 12 feet	2.6E+02	1.1E+01
	Groundwater	1.6E+03	3.1E+01
	Seep sediment	<u>2.9E+01</u>	<u>5.7E-01</u>
	Source Area Total Ratio ⁽²⁾	1.9E+03	4.3E+01
Surface disturbance south of IHSS 133 ⁽⁴⁾	Soil to 12 feet	8.2E-01	4.5E-01
	Source Area Total Ratio ⁽²⁾	<u>8.2E-01</u>	<u>4.5E-01</u>
SID and Pond C-2 ⁽⁵⁾	Soil to 12 feet	--	2.2E-07
	Surface water	5.3E-02	1.5E-03
	Pond sediment	2.7E+01	6.9E-01
	Stream sediment	<u>1.5E+01</u>	<u>6.5E-01</u>
	Source Area Total Ratio ⁽²⁾	4.2E+01	1.3E+00
Surface disturbance west of IHSS 209 ⁽⁶⁾	Soil to 12 feet	2.2E+00	4.2E-01
	Source Area Total Ratio ⁽²⁾	<u>2.2E+00</u>	<u>4.2E-01</u>
Woman Creek and Pond C-1 ⁽⁷⁾	Soil to 12 feet	4.7E-01	6.2E-07
	Groundwater	3.8E+02	2.6E+01
	Surface water	1.6E-01	3.9E-03
	Pond sediment	1.7E+01	1.1E+02
	Stream sediment	<u>1.8E+01</u>	<u>3.5E-01</u>
Source Area Total Ratio ⁽²⁾	4.2E+02	1.4E+02	

(1) No seep water, pond sediment, or stream sediment PCOCs in this source area.

(2) Total Carcinogenic Ratio > 1 equivalent to > 10⁻⁶ cancer risk level
 Total Carcinogenic Ratio > 100 equivalent to < 10⁻⁴ cancer risk level
 Total Noncarcinogenic Ratio > 1 equivalent to Hazard Index > 1.
 (All assuming long-term residential exposure to maximum detected concentrations.)

(3) No surface water, seep water, pond sediment, or stream sediment PCOCs in this source area.

(4) Only soil PCOCs in this source area.

(5) No ground water, seep water, or seep sediment PCOCs in this source area.

(6) Only soil PCOCs in this source area.

(7) No seep water or seep sediment PCOCs in this source area.

CDPHE CONSERVATIVE SCREENING DECISION CRITERIA

The results of the CDPHE Risk-Based Conservative Screen are compared to decision criteria to decide the appropriate course of action for each medium in each source area. The decision points are as follows:

- If the ratio sum ≥ 100 , a voluntary corrective action (or early action) or a baseline HHRA will be performed
- If $1 < \text{ratio sum} < 100$, a baseline HHRA in accordance with Risk Assessment Guidance for Superfund (RAGS) (EPA, 1989) will be conducted
- If ratio sum ≤ 1 , no further action may be required pending evaluation of ARARs and potential risk from dermal exposure.

The following tables (Tables 6-1 and 6-2) show the ratio sums for all media in each of the six source areas, assuming long-term residential exposure to maximum detected concentrations of PCOCs.

Table 6-1
RFETS OU5
Carcinogenic Ratio Sums by Source Area and Media

Source Area	IHSS 115	IHSS 133	S.IHSS133	SID & C-2	W.IHSS209	WC & C-1
Soil to 12 feet	5.6E+03	2.6E+02	8.2E-01	--	2.2E+00	4.7E-01
Groundwater	1.9E+03	1.6E+03	--	--	--	3.8E+02
Surface water	1.4E-03	--	--	5.3E-02	--	1.6E-01
Pond sediment	--	--	--	2.7E+01	--	1.7E+01
Seep sediment	2.9E+01	2.9E+01	--	--	--	--
Stream sediment	--	--	--	1.5E+01	--	1.8E+01
Total ratio sum	7.5E+03	1.9E+03	8.2E-01	4.2E+01	2.2E+00	4.2E+02

Table 6-2
RFETS OU5
Noncarcinogenic Ratio Sums by Source Area and Media

Source Area	IHSS 115	IHSS 133	S.IHSS133	SID & C-2	W.IHSS209	WC & C-1
Soil to 12 feet	3.4E+00	1.1E+01	4.5E-01	2.2E-07	4.2E-01	6.3E-07
Groundwater	9.3E+01	3.1E+01	--	--	--	2.6E+01
Surface water	4.8E-04	--	--	1.5E-03	--	3.9E-03
Pond sediment	--	--	--	6.9E-01	--	1.1E+02
Seep sediment	1.1E+00	5.7E-01	--	--	--	--
Stream sediment	--	--	--	6.5E-01	--	3.5E-01
Total Risk Sum	9.8E+01	4.3E+01	4.5E-01	1.3E+00	4.2E-01	1.4E+02

For residential exposure to soil (0 to 12 feet below ground surface), the IHSS 115, IHSS 133, and the soil disturbance area west of IHSS 209 source areas have RBC ratio sums greater than one. All of the source areas that include groundwater have RBC ratio sums greater than one for groundwater assuming residential use. For surface water residential exposure for the three source areas with surface water PCOCs (IHSS 115, the SID and Pond C-2, and Woman Creek and Pond C-1), RBC ratio sums are all less than one.

The two source areas with pond sediment PCOCs (the SID and Pond C-2 source area and Woman Creek and Pond C-1 source area) have either the carcinogenic or both the carcinogenic and noncarcinogenic RBC ratio sums greater than one assuming residential use. For residential exposure, the two source areas with seep sediment (the IHSS 115 and IHSS 133 source areas), either the carcinogenic or both the carcinogenic and noncarcinogenic RBC ratio sums are greater than one. The SID and Pond C-2 and Woman Creek and Pond C-1 source areas are the only source areas with stream sediment PCOCs, and RBC ratio sums are both above one for carcinogenic chemicals and below one for noncarcinogenic chemicals.

DETERMINATION OF AREAS OF CONCERN

AOCs are defined as one or several source areas that are in close proximity and can be evaluated as a unit in the HHRA. AOCs are identified in order to support the HHRA in the RFI/RI Report (DOE, 1993a).

Of the six source areas identified in OU5, the IHSS 115 area and the IHSS 133 area are generally physically separated and are treated individually as AOCs. The SID and Pond C-2 source area and the Woman Creek and C-1 source area are interrelated and are treated together as one AOC. The source area south of IHSS 133 did not exceed the CDPHE risk-based conservative screen criteria and, therefore, is not considered an AOC. The source area west of IHSS 209 slightly exceeded the CDPHE conservative screen criteria due to one sample of Pu-239/240. The remaining samples are significantly less than the RBC. Because the criteria was only slightly exceeded and due to a single sample of one PCOC, this source area is not identified as an AOC. Both the source area south of IHSS 133 and the source area west of IHSS 209 will be discussed in the OU5 HHRA uncertainty analysis and will also address dermal exposure at that time.

In summary, the OU5 AOCs are shown on Figure 7-1 and are identified as:

- AOC No. 1 is identical to the IHSS 115 Source Area
- AOC No. 2 is identical to the IHSS 133 Source Area
- AOC No. 3 contains the SID and Pond C-2 Source Area and the Women Creek and Pond C-1 Source Area.

The use of these exposure areas in the OU5 HHRA will be further addressed in the OU5 Exposure Assessment Technical Memorandum.

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-
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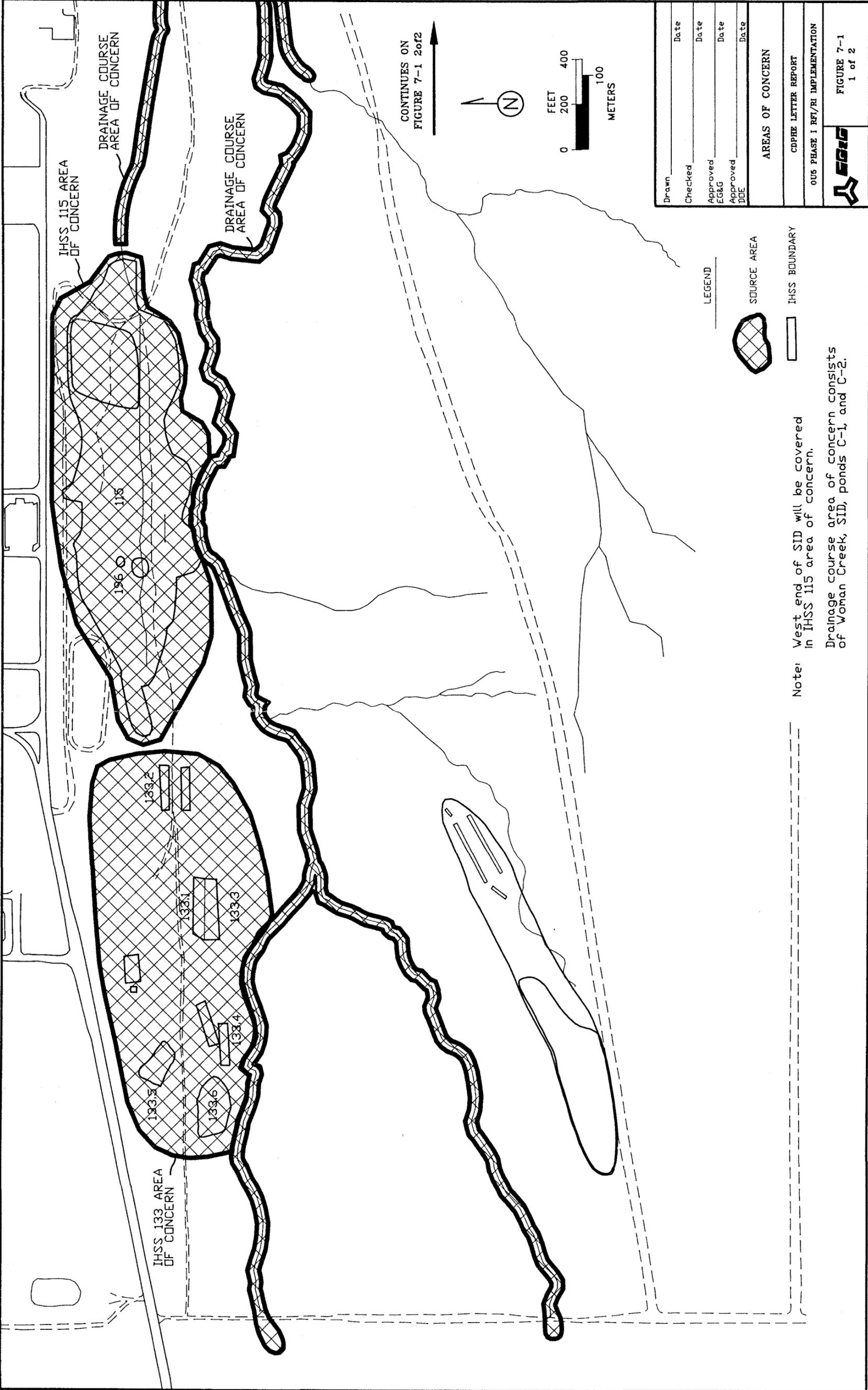
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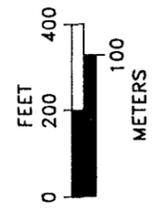
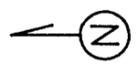
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CONTINUES ON
FIGURE 7-1 2 of 2



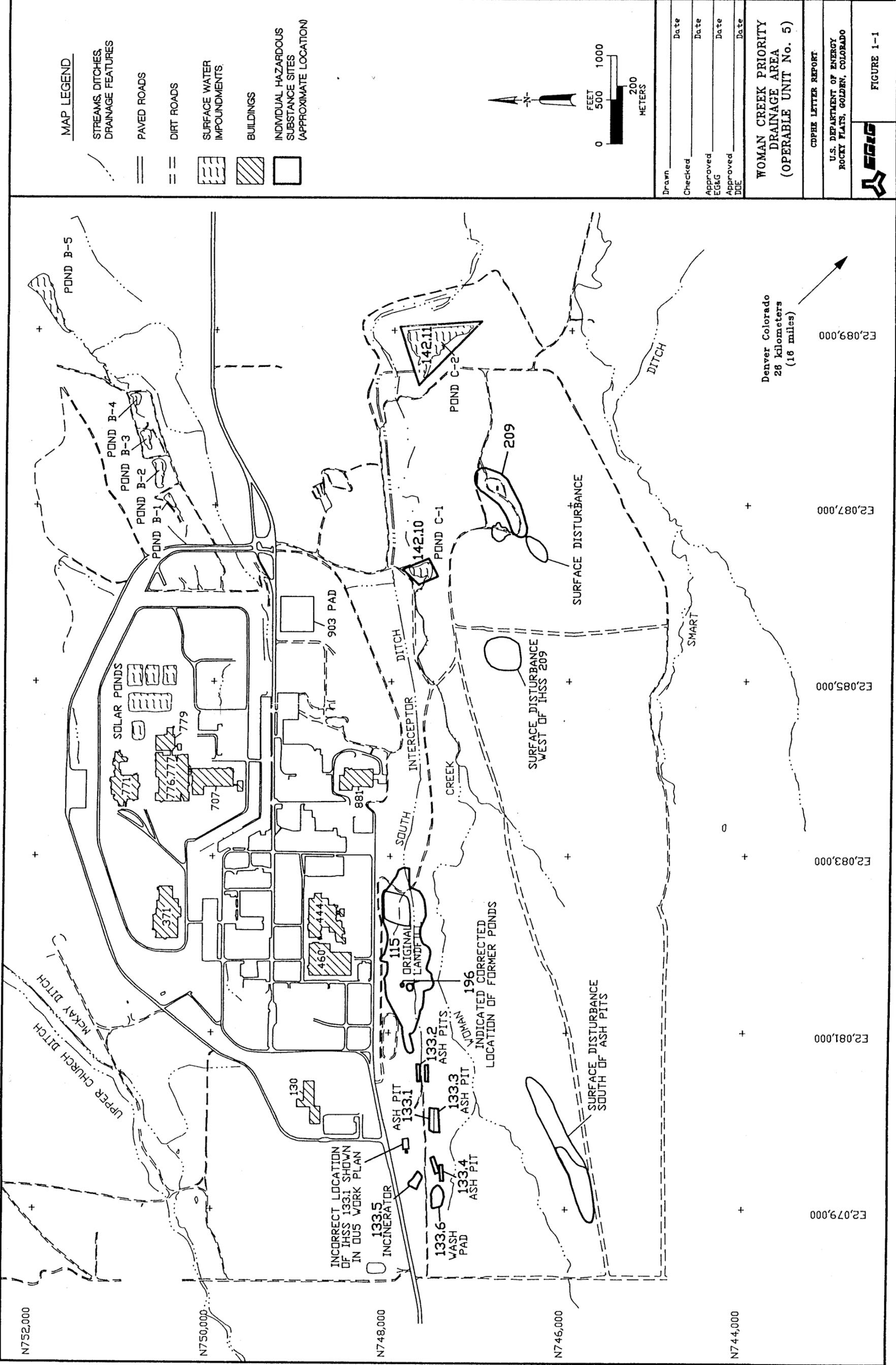
LEGEND

-  SOURCE AREA
-  IHSS BOUNDARY

Note: West end of SID will be covered in IHSS 115 area of concern.

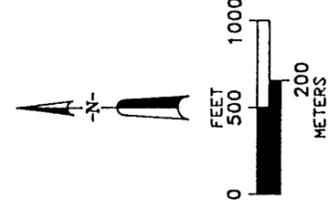
Drainage course area of concern consists of Woman Creek, SID, ponds C-1, and C-2.

Drawn	Date
Checked	Date
Approved EG&G	Date
Approved DDE	Date
AREAS OF CONCERN	
CDPHE LETTER REPORT	
005 PHASE I RFI/RI IMPLEMENTATION	
	
FIGURE 7-1 1 of 2	



MAP LEGEND

- STREAMS, DITCHES, DRAINAGE FEATURES
- PAVED ROADS
- DIRT ROADS
- SURFACE WATER IMPOUNDMENTS
- BUILDINGS
- INDIVIDUAL HAZARDOUS SUBSTANCE SITES (APPROXIMATE LOCATION)



Drawn	Date
Checked	Date
Approved EG&G	Date
Approved DOE	Date

WOMAN CREEK PRIORITY DRAINAGE AREA (OPERABLE UNIT No. 5)

CDPHE LETTER REPORT
U.S. DEPARTMENT OF ENERGY
ROCKY FLATS, GOLDEN, COLORADO



FIGURE 1-1

Denver Colorado
28 kilometers
(16 miles)

E2,089,000
E2,087,000
E2,085,000
E2,083,000
E2,081,000
E2,079,000

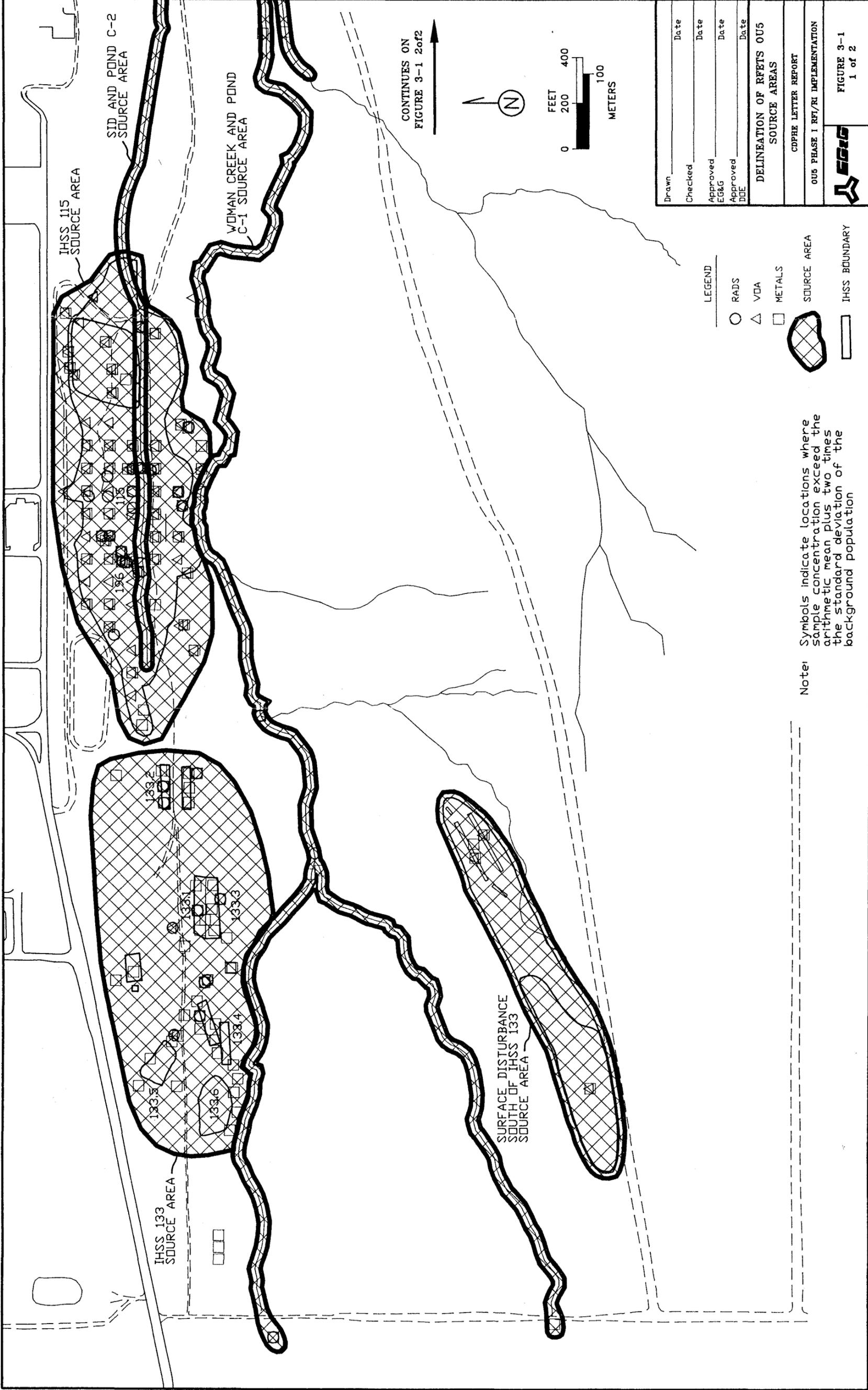
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N750,000

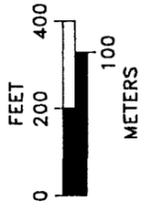
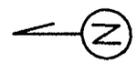
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N744,000



CONTINUES ON
 FIGURE 3-1 2of2

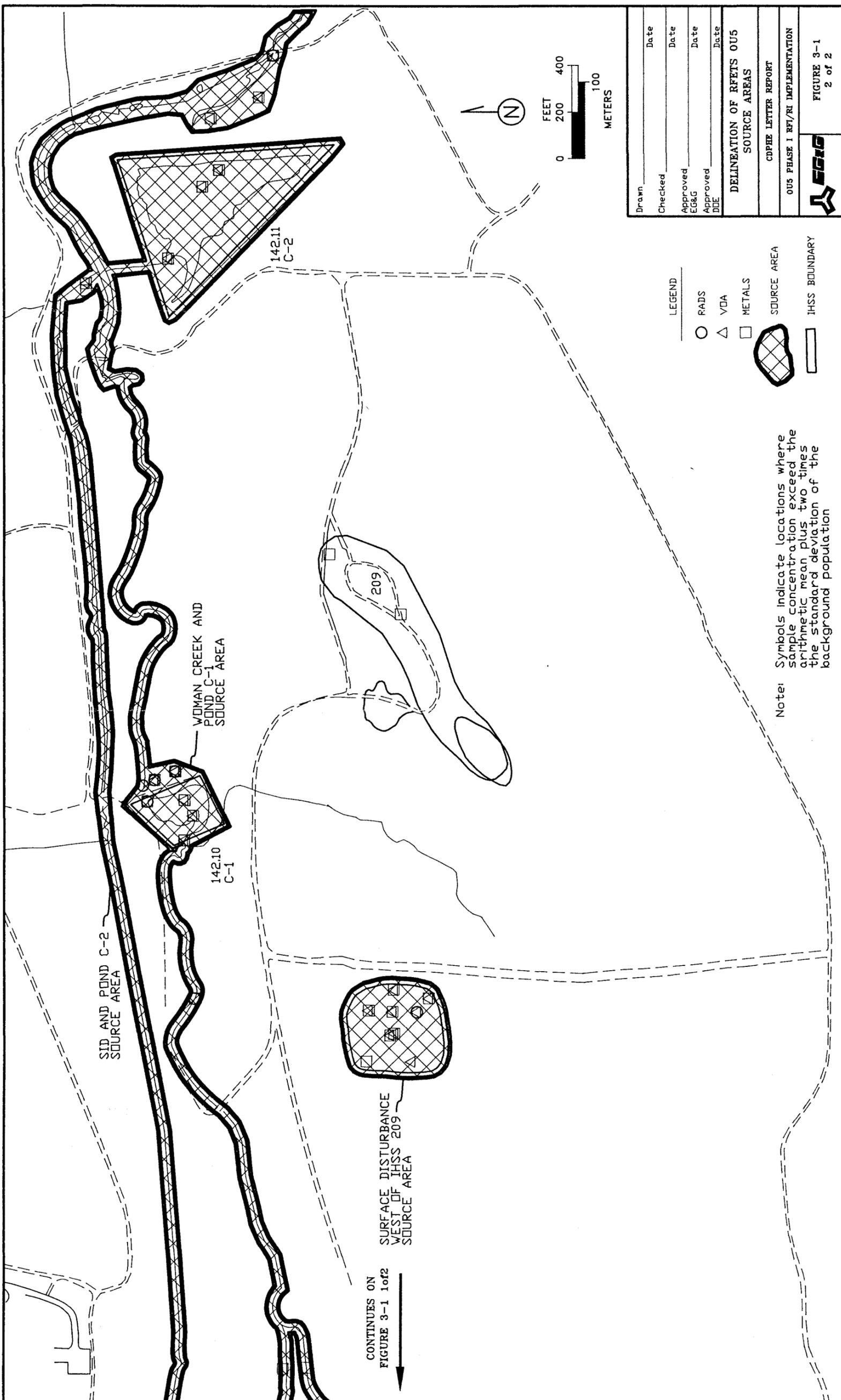


Drawn	Date
Checked	Date
Approved EG&G	Date
Approved DOE	Date
DELINEATION OF RFETS OUS5 SOURCE AREAS	
CDPHE LETTER REPORT	
OUS5 PHASE I RFI/RI IMPLEMENTATION	
FIG	
FIGURE 3-1 1 of 2	

LEGEND

- RADS
- △ VDA
- METALS
- SOURCE AREA
- IHSS BOUNDARY

Note: Symbols indicate locations where sample concentration exceed the arithmetic mean plus two times the standard deviation of the background population



Drawn	Date
Checked	Date
Approved EG&G	Date
Approved DDE	Date
DELINEATION OF RFETS OUS SOURCE AREAS	
CDPHE LETTER REPORT	
OUS PHASE I RF/RI IMPLEMENTATION	
FIGURE 3-1 2 of 2	

LEGEND

- RADS
- △ VDA
- METALS
- ▨ SOURCE AREA
- ▭ IHSS BOUNDARY

Note: Symbols indicate locations where sample concentration exceeded the arithmetic mean plus two times the standard deviation of the background population

CONTINUES ON
FIGURE 3-1 1 of 2

SURFACE DISTURBANCE
WEST OF IHSS 209
SOURCE AREA

SID AND POND C-2
SOURCE AREA

WOMAN CREEK AND
POND C-1
SOURCE AREA

142.10
C-1

142.11
C-2

209

