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RCRA Facility Investigation – Remedial Investigation/ Corrective Measures Study – Feasibility Study Report for the Rocky Flats Environmental Technology Site Appendix A – Comprehensive Risk Assessment

Volume 2 of 15

Comprehensive Risk Assessment Methodology and Data Description

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Volume 2 of 15

Comprehensive Risk Assessment Methodology and Data Description

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ACRONYMS AND ABBREVIATIONS

AEU	Aquatic Exposure Unit
AL	action level
AOC	Area of Concern
AT	alternative toxicity
AUF	area use factor
BAF	bioaccumulation factor
BGCR	Background Geochemical Characterization Report
bgs	below ground surface
BRA	Baseline Risk Assessment
BSCP	Background Soils Characterization Program
BZ	Buffer Zone
BZSAP	Buffer Zone Sampling and Analysis Plan
CAD/ROD	Corrective Action Decision/Record of Decision
CCP	Comprehensive Conservation Plan
CDD	polychlorinated dibenzodioxin
CDF	polychlorinated dibenzofurans
CDOW	Colorado Department of Wildlife
CDPHE	Colorado Department of Public Health and Environment
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
cm	centimeter
CMS	Corrective Measures Study
COC	contaminant of concern

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CRA	Comprehensive Risk Assessment
CSF	cancer slope factor
DAR	Data Adequacy Report
DCF	dos conversion factor
DOE	U.S. Department of Energy
DOI	U.S. Department of the Interior
DQA	Data Quality Assessment
DQO	data quality objective
ECOI	ecological contaminant of interest
ECOPC	ecological contaminant of potential concern
EcoSSL	ecological soil screening level
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
ERA	Ecological Risk Assessment
ESA	Endangered Species Act
ESL	ecological screening level
EU	Exposure Unit
FS	Feasibility Study
ft	foot
GMU	Game Management Unit
HHRA	Human Health Risk Assessment
HI	hazard index
HQ	hazard quotient
IA	Industrial Area
IABZSAP	Industrial Area and Buffer Zone Sampling and Analysis Plan

IAG	Interagency Agreement
IASAP	Industrial Area Sampling and Analysis Plan
ICA	Institutional Control Area
IHSS	Individual Hazardous Substance Site
IRIS	Integrated Risk Information System
LCS	laboratory control sample
LOAEL	lowest observed adverse effect level
LRA	Lead regulatory Agency
MDC	maximum detected concentration
mg/kg	milligrams per kilogram
mrem/yr	millirems per year
N/A	not applicable
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NOAEL	no observed adverse effect level
NOEC	no observed effect concentration
NPL	National Priorities List
OU	Operable Unit
P.L.	Public Law
PAC	Potential Area of Concern
PARCC	precision, accuracy, representativeness, completeness, and comparability
pCi/g	picocuries per gram
PCOC	potential contaminant of concern
PMJM	Preble's meadow jumping mouse
POC	Points of Compliance
PPRTV	Provisional Peer Reviewed Toxicity Values

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PRG	preliminary remediation goal
QC	quality control
RAWG	Risk Assessment Working Group
RCRA	Resource Conservation and Recovery Act
Refuge Act	Rocky Flats National Wildlife Refuge Act
RESRAD	RESidual RADioactivity Model
RFCA	Rocky Flats Cleanup Agreement
RfD	Reference Dose
RFETS	Rocky Flats Environmental Technology Site
RFI/RI	RCRA Facility Investigation/Remedial Investigation
RI	Remedial Investigation
RL	reporting limit
RSAL	radionuclide soil action level
SAP	Sampling and Analysis Plan
SCM	site conceptual model
SMDP	scientific management decision point
SWD	Soil Water Database
TCDD	tetrachlorordibenzodioxin
TEQ	toxicity equivalents
tESL	threshold ecological screening level
TRV	toxicity reference value
U.S.C.	U.S. Code
UBC	Under Building Contamination
UCL	upper confidence limit
USFWS	U.S. Fish and Wildlife Service

UTL	upper tolerance limit
WHO	World Health Organization
WRS	Wilcoxon Rank Sum
WRV	wildlife refuge visitor
WRW	wildlife refuge worker

1.0 INTRODUCTION AND PURPOSE

This Comprehensive Risk Assessment (CRA) for the Rocky Flats Environmental Technology Site (RFETS) has been prepared in accordance with Task 13 of the Final Work Plan for the Development of the Remedial Investigation and Feasibility Study Report (DOE 2002a), and in accordance with the Final CRA Work Plan and Methodology, Revision 1 (DOE 2005a), hereafter referred to as the CRA Methodology.

The purpose of the CRA is to assess human health and ecological risks[1] posed by chemicals, metals, and radionuclides remaining at RFETS following accelerated actions. The CRA is part of the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI)/Remedial Investigation (RI) for the site, and supports the Corrective Measures Study (CMS)/Feasibility Study (FS) as well as the Proposed Plan and Corrective Action Decision/Record of Decision (CAD/ROD).

The main features of Volume 2 include:

- A data adequacy and a Data Quality Assessment (DQA) for data used in the CRA;
- A summary of the methodology used to identify contaminants of concern (COCs) and ecological contaminants of potential concern (ECOPCs), and to estimate risks to human and ecological receptors on site;
- A summary of the previously prepared risk assessment for areas off site, and an evaluation of the potential for site impacts on the off-site areas since completion of the risk assessment;
- A sitewide trend analysis of the spatial distribution of metal concentrations in soil at RFETS as part of the COC/ECOPC selection process; and
- An estimation of background risks for the site.

2.0 COMPREHENSIVE RISK ASSESSMENT SCOPE

The CRA assesses, quantifies, and reports risks to human and ecological receptors posed by residual contamination remaining after accelerated actions for areas within the RFETS boundary, including former Operable Units (OUs) for which CAD/RODs have been issued (OU 1, OU 11, OU 15, and OU 16).[2] A discussion of data quality and adequacy for the CRA is first presented in Section 2.1, followed by summaries of the CRA Methodology for the Human Health Risk Assessment (HHRA) and Ecological Risk Assessment (ERA) in Sections 2.2 and 2.3, respectively.

2.1 Data Description

There are approximately 2 million data records for use in the CRA. The data used in the CRA are the result of implementation of regulatory agency-approved Sampling and

[1] The term "risk" for humans is used in this document to refer to the combined lifetime excess cancer risk and the noncarcinogenic health effects, the latter expressed as the hazard index (HI). "Risk" for ecological receptors is expressed as the hazard quotient (HQ).
[2] Under the Interagency Agreement (IAG) of 1991, the site was formerly divided into 16 OUs. See Section 1.0 of the RI/FS Report.

Analysis Plans (SAPs) that were prepared to characterize background and site conditions for soil, sediment, groundwater, and surface water. Consistent with the CRA Methodology, data quality was assessed using a standard precision, accuracy, representativeness, completeness, and comparability (PARCC) parameter analysis (EPA 2000a). The DQA presented in Attachment 2 is based on evaluation of field and laboratory control samples, and was performed on a sitewide basis. DQAs were also performed on an Exposure Unit (EU) and Aquatic Exposure Unit (AEU) basis, and are presented in each of the EU and AEU risk assessments. The DQA indicates data used in the CRA ("CRA-Ready" data) meet the data quality objectives (DQOs) for the CRA. The CRA-Ready data were extracted from the RFETS Soil Water Database (SWD) on September 1, 2005.

Sufficient samples must also be collected in each medium to adequately estimate the long-term average exposure of receptors to contaminants in an EU or AEU. The CRA Methodology requires that all decision criteria, sampling decisions, and supporting data be included in a data adequacy report (DAR) for the CRA. The DAR is provided in Attachment 3. Through the consultative process with the U.S. Environmental Protection Agency (EPA) and Colorado Department of Public Health and Environment (CDPHE), specific data adequacy guidelines were identified for use in the DAR. The guidelines address the number of samples, and the spatial and temporal representativeness of the data. The adequacy of the data was assessed on an EU and AEU basis. The DAR concludes that the data are considered adequate for the purposes of the CRA.

2.2 Overview of the Human Health Risk Assessment Methodology

The CRA Methodology was developed through the consultative process by the Rocky Flats Cleanup Agreement (RFCA) parties, and was approved on September 28, 2004. During the development of the draft CRA Methodology, the RFCA parties agreed to refinements of the methodology, and a revised CRA Methodology was issued in September 2005. The approach and methods used in the CRA are briefly summarized below.

2.2.1 Future Land Use

The reasonably anticipated future use of RFETS is a wildlife refuge as designated by the Rocky Flats National Wildlife Refuge Act of 2001 (Public Law [P.L.] 107-107, Subtitle F, 16 U.S. Code [U.S.C.] 668dd) (Refuge Act). RFETS will be transferred to the U.S. Department of the Interior (DOI) for refuge purposes; however, some portions of RFETS will remain under the jurisdiction of the U.S. Department of Energy (DOE). For the purposes of the CRA, all areas of RFETS were assessed assuming a wildlife refuge future land use.

2.2.2 Receptors

Two human receptors are evaluated consistent with the wildlife refuge future land use: a wildlife refuge worker (WRW) and a wildlife refuge visitor (WRV). A variety of representative terrestrial and aquatic receptors, as defined in the CRA Methodology, are evaluated in the ERA, including the Preble's meadow jumping mouse (PMJM), a federally listed threatened species (see Section 2.3).

2.2.3 Exposure Units

Risk assessments evaluate the long-term threats to human health and the environment. An EU or AEU is the area over which long-term risks to the receptors are assessed. There are 12 EUs for human and terrestrial ecological receptors, and seven AEUs for aquatic ecological receptors as defined in the CRA Methodology (Figures 2.1 and 2.2). Appendix A, Volumes 3 through 14 of Resource Conservation and Recovery Act (RCRA) Facility Investigation-Remedial Investigation (RI)/Corrective Measures Study (CMS)-Feasibility Study (FS) Report (hereafter referred to as the RI/FS Report) provide the HHRA and ERA for each of the EUs, and Volume 15B provides the ERA for the AEUs. A sitewide ERA for wide-ranging receptors (coyotes and mule deer) is provided in Volume 15A.

2.2.4 Exposure Pathways

An exposure pathway describes a specific environmental route by which an individual receptor could be exposed to contaminants present at or originating from a site. A complete exposure pathway includes five elements: source, mechanism of release, transport medium, exposure point, and intake route. If any of these elements are missing, the pathway is considered incomplete. Table 2.1 provides a summary of the potential exposure pathways for the WRW and WRV receptors, as presented in the human health SCM for RFETS in the CRA Methodology. The SCM classifies potential exposure pathways as follows:

- Complete and significant (S) – contributes the major portion of risk or dose;
- Complete and insignificant (I) – is not anticipated to contribute significantly to total risk or dose; and
- Incomplete (IC) – missing one or more of the five elements necessary for a complete exposure pathway.

Significant Exposure Pathways

The exposure pathways for the WRW that are considered complete and potentially significant are:

- Inhalation of surface soil/surface sediments and subsurface soil particulates;
- Ingestion of surface soil/surface sediments and subsurface soil;
- Dermal exposure to surface soil/sediments and subsurface soil (organic analytes only); and
- External irradiation exposure from surface soil/sediments and subsurface soil.

The exposure pathways for the WRV that are complete and potentially significant include:

- Inhalation of surface soil/surface sediment particulates;
- Ingestion of surface soil/surface sediments;
- Dermal exposure to surface soil/sediments (organic analytes only); and
- External irradiation exposure from surface soil/sediments.

Insignificant Exposure Pathways

As shown in Table 2.1, several complete exposure pathways are considered insignificant for the WRW and WRV. The insignificant pathways were determined using best professional judgment and the consultative process with the regulatory agencies. It was agreed, as documented in the CRA Methodology, that these exposure pathways are complete but do not contribute significantly to human risks. For those exposure pathways with the greatest uncertainty regarding their classification as insignificant, additional analysis has been conducted to verify their insignificance, or their insignificance has been verified through a data screening process (see Attachment 4). The insignificant pathways and the rationale for their classification are presented below.

<u>WRW Receptor</u>

- Ingestion of surface water - It was agreed through the consultative process that surface water exposures are likely to be insignificant. As a conservative measure in this CRA, data for surface water and for groundwater at likely points of emergence (seeps) were screened against the WRW surface water preliminary remediation goals (PRGs) presented in the CRA Methodology. These PRGs are based on a WRW's incidental exposure to surface water. The screening results and evaluation are provided in Attachment 4.
- Dermal exposure to surface water - EPA guidance for dermal risk assessment considers the pathway insignificant if the ratio of dermal dose to ingestion dose is less than 0.1 (EPA 2004a). According to EPA guidance, for organic contaminants, the ratio of dermal dose to ingestion dose from drinking water sources is highly variable, ranging from near 0 to more than 20 (EPA 2004). Dermal contact is assumed to occur infrequently or on an incidental basis for the WRW.
- Inhalation of volatiles from surface soil, surface water, or subsurface soil - Surface soil is not considered to be a source of volatiles because of the length of time since releases have occurred. Although surface water may receive volatile contaminants from groundwater in some locations, they would dissipate quickly in the air and not be a significant exposure. Subsurface soil data have been screened against subsurface soil volatilization PRGs, which are presented in the CRA Methodology. These PRGs are based on the indoor air pathway for the WRW. The screening results and evaluation are provided in Attachment 4.
- Inhalation of volatiles from groundwater - Groundwater data have been screened against the groundwater volatilization PRGs presented in the CRA Methodology, which are based on the indoor air pathway for the WRW. The screening results and evaluation are provided in Attachment 4.
- External irradiation exposure from subsurface soil and building rubble - Subsurface soil is defined as soil deeper than 6 inches below ground surface (bgs). Therefore, surface soil generally shields the receptor from external exposure to radiation originating in the subsurface soil. The WRW is considered to be exposed to subsurface soil for short periods of time each year. This exposure to external radiation is considered insignificant in relation to exposures from surface

soil. Building rubble will be buried greater than 3 feet bgs, so external irradiation is also insignificant.

WRV Receptor

- Ingestion of surface water - Under the preferred alternative presented in the U.S. Fish and Wildlife Service (USFWS) in the Rocky Flats National Wildlife Refuge, Final Comprehensive Conservation Plan and Environmental Impact Statement (USFWS 2004a), hereafter referred to as the CCP, visitors will not have prolonged access to surface water (USFWS 2004a). However, surface water data were screened against WRW surface water PRGs (see discussion above for the WRW and Attachment 4).
- Dermal exposure to surface water - See discussion above for the WRW.
- Ingestion of deer and/or grazing animals – The deer/grazing animal meat ingestion pathway for the WRV is not considered significant. This is confirmed by the additional analysis presented in Attachment 4.
- Inhalation of volatiles from surface soil, surface water, and groundwater - See discussion above for the WRW.
- External irradiation exposure from subsurface soil and building rubble - The WRV will not be participating in activities that significantly disturb the surface soil. See discussion above for the WRW.

Incomplete Exposure Pathways

As shown in Table 2.1, several exposure pathways are considered incomplete for the WRW and WRV. The incomplete pathways were determined using best professional judgment and the consultative process with the regulatory agencies. It was agreed, as documented in the CRA Methodology, that these exposure pathways are incomplete, lacking one of the five elements necessary for a complete pathway. The rationale for their classification is presented below.

WRW Receptor

- Ingestion of fish and/or deer/grazing animals – There are no WRW management activities that would result in the consumption of fish or animal tissue. The pathway is incomplete.
- Ingestion of groundwater – The RFCA Vision[3] states that on-site groundwater will not be used for any purposes unrelated to RFETS cleanup activities. Therefore, the pathway for direct ingestion of groundwater is incomplete.
- Ingestion of homegrown produce – The site will not be used for residential purposes in the future and, therefore, no production of produce for consumption

[3] Federal Facility Agreement and Consent Order Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) VIII-96-21, RCRA (3008(h)) VIII-96-01 and State of Colorado Docket number 96-07-19-01, referred to as RFCA.

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will occur. The pathway for direct ingestion of homegrown produce is incomplete.

- Ingestion of building rubble – The WRW will not contact building rubble because it will be buried more than 3 feet bgs. The pathway is incomplete.

WRV Receptor

- Inhalation of indoor air on site - This pathway will be incomplete if no visitor center is built on site. If a visitor center is built on site, this pathway will be complete. However, it is assumed that the WRV will not spend prolonged amounts of time indoors at a visitor center and exposures would be insignificant. See Attachment 4 for evaluation of the indoor air pathway for the WRW.
- Ingestion of fish - Fishing is not included in any of the proposed alternatives and, therefore, is not part of the comprehensive plan for the wildlife refuge. The pathway is incomplete because there will be no consumption of fish.
- Ingestion of groundwater - See discussion above for the WRW.
- Ingestion of building rubble - See discussion above for the WRW.

Based on the foregoing, risks to the WRW and WRV are evaluated based on exposure to site-related contaminants in surface soil/surface sediment and subsurface soil/subsurface sediment. Risks are evaluated by identifying the COCs; quantifying exposure to COCs for each significant pathway; and calculating risks from the exposure based on the toxicity characteristics of the COCs. This risk characterization process is performed for each EU, and is described in greater detail in the following sections.

2.2.5 Selection of Contaminants of Concern

COCs are used to streamline risk quantification by focusing on those contaminants that may contribute significantly to risk for the site. COCs are derived for both surface soil/surface sediment and subsurface soil/subsurface sediment in each EU. The following five-step process is used to select COCs for each of these media (Figure 2.3):

1) Compare the Potential Contaminant of Concern (PCOC)[4] maximum detected concentration (MDC) to the PRG;[5]
2) If the PCOC has a MDC that exceeds the PRG, based on the EU data distribution, calculate the exposure point concentration (EPC); [6]
3) Compare the EPC to the PRG;

[4] All detected analytes for which data meet the data quality objectives of the CRA Methodology are considered PCOCs.
[5] PRGs are risk-based concentrations that are protective of a WRW who is directly exposed to surface soil/surface sediment or subsurface soil/subsurface sediment. PRGs are based on a 1E-06 excess cancer risk or HQ equal to 0.1 for noncarcinogens (DOE 2005a). The WRW exposure scenario for development of the PRGs is consistent with the WRW scenario for development of RFETS radionuclide soil action levels (EPA et al. 2002).
[6] EPCs that are an upper-bound estimate of the average concentrations of contaminants in the medium to which the receptors are exposed in an EU (see Calculation of EPCs in this section).

4) For inorganic and radionuclide PCOCs, if the EPC exceeds the PRG, perform a statistical comparison of the EU and background data sets;[7] and

5) If the PCOC concentrations in the EU are statistically greater than background, or a background comparison could not be performed, conduct a professional judgment evaluation to assess whether the PCOC should be a COC or excluded from further consideration based on a weight-of-evidence approach.

The following sections provide additional information on the COC selection process, including a description of calculation of EPCs, RFETS background data, statistical comparisons of EU and background data sets, and professional judgment.

Calculation of EPCs

The EPC is the upper-bound estimate of the average concentration of a PCOC in the EU soil to which the human receptor is exposed. A two-tiered approach is used to calculate EPCs for the HHRA to reduce the uncertainty associated with nonrandom sampling data that may be biased toward historical source areas, i.e., Individual Hazardous Substance Sites (IHSSs).

In the first tier, the EPC is the upper confidence limit (UCL) estimated using ProUCL, or the MDC, whichever is less. ProUCL computes a parametric UCL based on normal, lognormal, or gamma distributions, and a nonparametric UCL using one of several nonparametric methods. ProUCL recommends the UCL for use as the EPC based on the data distribution and the associated skewness. For nondetects, one-half the reported detection limit is used as a proxy value.

If most samples in an EU are collected in or near historical IHSSs, and these areas present only a small portion of the exposure unit area, the UCL may overestimate the actual EPC. The second tier uses an area-weighted technique to account for this bias. A complete discussion of the calculation of Tier 2 EPCs is provided in Attachment 6. Tier 2 EPCs are calculated for surface soil/surface sediment COCs (and surface soil ECOPCs) only. The general method is:

- A 30-acre grid is randomly-placed over RFETS;
- The average concentration from samples within each 30-acre cell of the EU are calculated; and
- The UCL of the 30-acre cell averages is calculated and used for the Tier 2 EPC.

Site Background Data set

In step 3 of the COC selection process, the EU PCOC concentrations are compared to background concentrations. Background data for the site were originally collected under two programs, and the data are summarized in two separate reports. Surface soil background data are summarized in the Geochemical Characterization of Background Surface Soils: Background Soils Characterization Program (BSCP) (DOE 1995). Background data for all other environmental media are summarized in the Background

[7] Comparisons of EU and background data sets are performed using the S-Plus statistical program (see Background Comparison Testing in this section). Background data are summarized in Attachment 5.

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Geochemical Characterization Report (BGCR) (DOE 1993). As discussed below, through the consultative process, data have been added and some data removed from these data sets to arrive at the background data sets used for the CRA. All background data were extracted from the RFETS' SWD and processed to eliminate data that do not meet the CRA Methodology DQOs.[8]

The BSCP surface soil data fall into two categories: fallout radionuclides and naturally occurring radionuclides and metals. The BSCP sampling locations for the fallout radionuclides are along the Front Range and are depicted in Figure 2.4. The BSCP sampling locations for naturally occurring radionuclides and metals are just north of RFETS (Figure 2.5). The CRA uses only BSCP data that meet the CRA Methodology DQOs to develop the background data set.

The BGCR sampling locations are all within the RFETS property boundary, and accordingly, within some of the EUs and AEUs (those to the north, west, and south of the Industrial Area [IA]). The locations are shown on Figure 2.5. For subsurface soil, sediment, and surface water (total and dissolved concentrations), the CRA uses most of the BGCR sampling locations.[9] Background groundwater data and comparisons of site data to background concentrations are addressed in the Section 4.0 of the RI/FS Report. Background surface water and sediment sampling locations are for streams (not seeps). Only data meeting the CRA Methodology DQOs are used to develop the background data sets.

Background data summary tables are presented in Attachment 5. The tables provide fundamental background data statistics for PCOCs including the mean plus two standard deviations[10] and the UCL[11] for surface soil, subsurface soil, sediment (all depths), surface soil combined with surface sediment (end depth 6 inches or less), subsurface soil combined with subsurface sediment (end depth greater than 6 inches), surface water (total concentrations), and surface water (dissolved concentrations). The combined surface soil/surface sediment and the subsurface soil/subsurface sediment background data sets (Table 2.2) were developed because the data for these media are combined based on the significant exposure pathways to human receptors.

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[8] The data processing to arrive at data that meet the CRA Methodology DQOs is described in Attachment 2. As part of the processing, data are eliminated from use in the CRA if they were collected prior to June 28, 1991, the date of the first implementation of IAG Work Plans. Because BGCR data were collected prior to this date, and the data are critical to the establishment of a sound background data set for the site, this processing step was not applied to the BGCR data. However, all other processing steps were applied as described in Attachment 2.

[9] Through the consultative process, data for three downstream sampling locations were removed from the background data set: SW004/SED022 and SW108/SED021 in the Rock Creek drainage, and SW041/SED041/SED017 in the Woman Creek drainage. BGCR data for all remaining BGCR background sampling locations as well as data collected through 2004 at these locations (applicable to surface water and sediment sampling) are used to develop the background data sets (DOE 2005a).

[10] The mean plus two standard deviations is used in the RI as a screening measure of the background concentration for surface soil and subsurface soil inorganic analytes. This parameter is not used in the CRA for any medium.

[11] The UCL is the EPC for the EU (see Calculation of EPCs in this section).

Data Distribution Testing

Data distribution testing for EU and background data is conducted to identify the appropriate statistical methods and tests for the background comparisons and EPC calculations. Data distribution testing is conducted according to EPA guidance (EPA 2002) and EPA QA/G-9 methods (EPA 2000a) using the ProUCL (Version 3) computer program (Singh et al. 2004), as required by the CRA Methodology. ProUCL statistical software was developed for EPA's Technical Support Center to support risk assessment and cleanup decisions at contaminated sites.

ProUCL tests for normality, lognormality, gamma, and nonparametric distribution of the data using the following statistical tests:

- Shapiro-Wilk W-Test ($n < 50$);
- Lilliefors Test ($n > 50$; Note: can be used for $n < 50$ as well);
- Anderson-Darling Test for gamma distribution ($n < 2{,}500$); and
- Kolmogorov-Smirnov Test for gamma distribution ($n < 2{,}500$).

The ProUCL output provides a recommendation of the data distribution type for each tested data set.

Background Comparison Testing

As defined through the consultative process, before performing the statistical comparison, background data for locations within an EU/AEU are removed from the EU/AEU data set, as appropriate. Comparisons of EU and background data sets are performed using the S-Plus statistical program as discussed in the CRA Methodology. If the two data sets to be compared are both normally or lognormally distributed, the two-sample t-test is used. If the data sets have different distributions, or have gamma or nonparametric distributions, the Wilcoxon Rank Sum (WRS) test is used. As specified in the CRA Methodology, the level of significance to be used for the background comparisons in the CRA is 0.1 (i.e., 1-p is less than or equal to 0.1).

For chemicals that are not at concentrations statistically greater than background but are very similar to background, or for chemicals that are at concentrations greater than background but do not appear to be a result of historical site-related activities, additional evaluations may be performed under the professional judgment step of the COC screening process. These may include visual comparisons using graphics such as box plots, and comparison of descriptive statistics such as means, MDCs, and UCLs.

Professional Judgment

Based on the weight of evidence evaluated by professional judgment, the PCOC is either included for further evaluation as a COC, or excluded. The professional judgment evaluation takes into account the following factors (i.e., lines of evidence):

- ***Process Knowledge – Evaluation of historical RFETS-related operations that may have resulted in a release of the chemical.*** For Task 1 of the ChemRisk Dose Reconstruction Project, inventories of chemicals and radionuclides used at

RFETS were identified (CDH 1991). In addition, a White Paper (DOE 2005b) was prepared that identifies where metals were 1) used in buildings; 2) identified as constituents of wastes generated at buildings; 3) identified as constituents in Under Building Contamination (UBC) or in spills at buildings; and 4) identified as above a RFCA action level (AL) requiring an accelerated action

- ***Data Quality Assessment (DQA) – Evaluation of the data quality to determine if they are adequate for conducting a professional judgment evaluation.*** The DQA is presented in Attachment 2. As discussed therein, the data quality is adequate for the CRA and, therefore, for the professional judgment evaluation as well.

- ***Spatial Trends – Evaluation of sitewide concentration distributions to establish whether data are randomly distributed or depict a spatial trend suggesting a potential release from historical site-related activities.*** Figures are provided that show on a sitewide-basis where 1) an analyte is nondetected; 2) the concentration is greater than the PRG or ESL but less than the background MDC; 3) the concentration is greater than the background MDC but less than three times the background MDC; and 4) the concentration is greater than three times the background MDC. These concentration ranges are depicted on the figures to provide perspective on the magnitude of the concentrations relative to risk-based concentrations and background.

- ***Pattern Recognition – Evaluation of potential geochemical patterns in EU soil samples based on probability plots, and comparison of EU and background data descriptive statistics.*** The pattern recognition evaluation includes the use of probability plots. If two or more distinct populations are suggested in the probability plot, this may indicate that one or more local releases may have occurred. Conversely, if only one distinct low-concentration population is suggested, this may indicate the presence of a background population. Similar to all statistical methods, the probability plot has limitations in cases where there is inadequate sampling and the magnitude of the release is relatively small. Thus, absence of two clear populations in the probability plots is consistent with, but not definitive proof of, the hypothesis that no releases have occurred. However, if a release has occurred within the sampled area and has been included in the samples, then the elemental concentrations associated with that release are either within the background concentration range or the entire sampled population represents a release, a highly unlikely probability.

- ***Comparison to Regional Background –*** A regional background data set for Colorado and the bordering states was extracted from data for the western United States (Shacklette and Boerngen 1984), and is composed of data for Colorado as well as Arizona, Kansas, Nebraska, New Mexico, Oklahoma, Utah, and Wyoming. Although the background data set for Colorado and bordering states is not specific to Colorado's Front Range, it is useful for the professional judgment evaluation given the absence of a robust Front Range data set. Colorado's Front Range has highly variable terrain that changes elevation over short distances. Consequently, numerous soil types and geologic materials are present at Rocky

Flats, and the data set for Colorado and the bordering states may be more representative of these variable soil types.

- ***Risk Potential for Human Health – Evaluation of the magnitude of EU PCOC concentrations in relation to the WRW PRG.*** Because the PRG is based on an excess cancer risk of 10-6 or an HQ of 0.1, the magnitude of the EPC relative to the PRG provides an estimate of risks to human receptors.

For many metals in soil, elevated metal concentrations are seen in areas away from historical IHSSs, which should be indicative of naturally occurring levels even though concentrations for the entire EU are statistically greater than site-specific background concentrations. As discussed in Section 4.0, a sitewide spatial trend analysis has been conducted for metal PCOCs to assist in determining if the metal should be a COC.

Dixoins and Furans

Although not extensive, some site samples have been analyzed for polychlorinated dibenzodioxins (CDDs) and polychlorinated dibenzofurans (CDFs). MDC and EPC comparisons to the PRG, and risk characterization, require that the CDD and CDF concentrations be converted to 2,3,7,8-tetrachlorordibenzodioxin (TCDD) toxicity equivalents (TEQs). CDDs and CDFs include 75 and 135 individual compounds, respectively. These individual compounds are referred to as congeners. Only seven of the 75 congeners of CDDs are thought to have dioxin-like toxicity; these are ones with chlorine substitutions in at least the 2, 3, 7, and 8 positions. Only 10 of the 135 possible congeners of CDFs are thought to have dioxin-like toxicity; these also are ones with substitutions in the 2, 3, 7, and 8 positions. The TEQ procedure was developed by the World Health Organization (WHO) to describe the cumulative toxicity of these mixtures (WHO 1997). This procedure involves assigning individual toxicity equivalency factors (TEFs) to the CDD and CDF congeners (WHO 1997). 2,3,7,8-TCDD is assigned a TEF of 1.0. All other congeners have lower TEF values ranging from 0.5 to 0.00001. The TEF values for CDD/Fs are shown in Table 2.4. The TEQ of a mixture of congeners in a sample is calculated by multiplying the concentration of individual congeners by their respective TEFs. The sum of these TEQ concentrations for the individual congeners in the mixture is the TEQ concentration for the sample. The TEQ concentrations of the samples in each given medium are used in CRA.

2.2.6 Exposure Assessment

The purpose of the human health exposure assessment is to estimate COC intakes for the WRW and WRV. This section provides an overview of the methods and assumptions used in the exposure assessment. Additional information is presented in the CRA Methodology.

Exposures to COCs for the exposure pathways identified as potentially complete and significant in the SCM for the WRW and WRV are quantitatively estimated (see Section 2.2.4). The COC EPCs, and the exposure factors presented in the CRA Methodology, are used to quantify exposure from these pathways.

The WRW exposure scenario for the CRA is consistent with the WRW scenario for development of RFETS radionuclide soil action levels (RSALs) (EPA et al. 2002). The

CRA assumes that the WRW works 250 days per year for 18.7 years, and spends 50 percent of his or her work day outdoors on the site and the remaining 50 percent in an indoor office.

The WRV scenario is based on the open space scenario used in the RSAL Report (EPA 2002) and is consistent with the preferred alternative presented by the USFWS in the CPP (USFWS 2004a). The WRV includes both a child and adult who visit the site 100 days per year for 2.5 hours per day, for a total of 250 hours per year. The remaining time is spent off site. Outdoor recreational activities will primarily be on and near established hiking trails. Hunting may be allowed on a very limited basis (USFWS 2004a). It is assumed that the WRV will not participate in activities that result in significant exposures to subsurface soil or surface water. In general, the risks to the WRV are less than for the WRW primarily because the exposure time at the site for the WRV is shorter than for the WRW (250 hours per year versus 2000 hours annually).

2.2.7 Toxicity Assessment

The purpose of the human health toxicity assessment is to:

- Identify toxicity criteria for each noncarcinogen, chemical carcinogen, and radionuclide;
- Characterize and describe the toxicity of each COC; and
- Identify dose conversion factors for each radionuclide COC.

Toxicity criteria and dose conversion factors are used in the risk calculations. Additional documentation for the toxicity criteria and dose conversion factors are provided in the CRA Methodology (DOE 2005a).

The following EPA-recommended toxicity value hierarchy (EPA 2003), which is further discussed in the CRA Methodology, is used in the CRA:

- Tier 1 – EPA's Integrated Risk Information System (IRIS) (EPA 2004b);
- Tier 2 – EPA's Provisional Peer Reviewed Toxicity Values (PPRTVs); and
- Tier 3 – Other toxicity values including additional EPA and non-EPA sources of toxicity information.

In each of the EU risk assessments, cancer slope factors (CSFs) and reference doses (RfDs) for COCs are presented for the oral, inhalation, and dermal exposure pathways. The dermal exposure pathway is evaluated only for organics. In accordance with the EPA (2004a), Dermal Guidance, the oral values are used for evaluation of dermal exposure to organic COCs. Although organic chemicals are assumed to be 100 percent absorbed from the gastrointestinal tract, dermal absorption factors are applied to address the limited absorption of COCs through the skin.

2.2.8 Risk Characterization

In the risk characterization, health effects from exposure to carcinogens and non-carcinogens are estimated. The risk characterization methods are briefly described below and are discussed in detail in the CRA Methodology.

The chemical- or radionuclide-specific intakes for carcinogenic COCs are multiplied by the chemical-specific CSFs or radiological toxicity constants to estimate the cancer risk for an individual over a lifetime of exposure. Cancer risk estimates are calculated by receptor, medium, exposure pathway, and chemical. Cancer risk estimates are then summed across exposure media to obtain total cancer risk estimates for each receptor population (WRW and WRV).

Chemical intakes for noncarcinogenic COCs are compared with RfDs to estimate noncarcinogenic health effects. Noncarcinogenic health effect estimates are expressed as HQs for individual COCs and exposure pathways, and hazard indices (HIs) for COC and pathway combinations. The HI for a receptor is the sum of the HQs across pathways, and/or COCs. HQ and HI values are not statistical probabilities of a potential effect. If these values exceed 1, there is a concern for potential noncarcinogenic health effects and further analysis is conducted. HIs exceeding 1 are segregated and summed by mode of action or target organ to calculate total HIs by target organ.

2.2.9 Radiation Dose

Radiation dose for COCs are calculated using the methodology outlined in the Task 3 Report (EPA 2002). The Residual Radioactivity Computer Code (RESRAD) model (version 6.0) and point-estimate parameter values for exposure variables from the Task 3 Report is used in dose simulations for the WRW and WRV. The method for calculating radiation dose using the RESRAD program is documented in the Task 3 Report.

Radiation dose is calculated based on effective dose, an estimate of damage to the body from ionizing radiation. The dose-based calculations are performed using the equations and variables in the RESRAD computer model (DOE 2003). RESRAD calculates radiation dose based on an annual exposure. The amount of exposure is multiplied by a dose conversion factor (DCF) to determine a predicted dose.

2.3 Overview of the Ecological Risk Assessment Methodology

The ERA assesses ecological risks following the accelerated actions at the site. The CRA Methodology details a two-phase process. First, ECOIs are screened to identify ECOPCs for ecological receptors using conservative ecological screening levels (ESLs). Second, risks are characterized for the ECOPCs.

As part of the CRA Methodology, the Risk Assessment Working Group (RAWG) defined the absence of significant risk of adverse ecological effects to receptors from exposure to site-related residual contamination as the risk management goal for the ERA. The ERA was subsequently designed and implemented to assess ecological risks to determine if site conditions meet the defined goal.

2.3.1 Site Conceptual Model

Development of the SCM is the first step in the problem formulation, or planning phase of ERAs (EPA 1997). The purpose of the SCM is to help identify environmental stressors and the potential pathways by which ecological receptors may be exposed to them. This step allows investigators to identify the potentially complete pathways that will become the focus of the ERA.

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The SCM reflects the most appropriate ecological receptors for the site as a wildlife refuge (Figure 2.6). The purpose of the SCM is to help identify potential pathways by which ecological receptors may be exposed to ECOPCs. The identified pathways become the focus of the ERA. The SCM is used to identify measurement endpoints for use in evaluation of assessment endpoints.

Risk Assessment Endpoints

The CRA Methodology identifies endpoints to focus the ERA to provide the data necessary to determine if the overall risk management goal has been reached.

Assessment endpoints are the explicit description of the ecological values to be protected as a result of management actions at a site. Measurement endpoints are specific data collected to address the assessment endpoints in an attempt to answer the risk questions as they relate to the risk management goals for the site.

A significant risk of adverse ecological effects implies a toxicity condition that results in reductions in survivorship or reproductive capability that threaten populations or communities at RFETS. For species that are afforded additional regulatory protection due to their rare or threatened status, such as PMJM, significant adverse effects can occur even if individuals are affected. Therefore, the assessment for PMJM addresses the potential for individual mice to be adversely affected by contact with ECOPCs. For other species with stable or healthy populations, the assessment focuses on population-level effects where some individuals may suffer adverse effects, but the effects are not ecologically meaningful because the overall site population is not significantly affected.

For PMJM, the overall risk management goal and endpoints are:

- **Goal**: Prevent adverse effects on individual PMJM due to lethal, mutagenic, reproductive, systemic, or general toxic effects from contact with ECOPCs at the site.
- **Assessment Endpoints**: Survival, growth, and reproduction of individual PMJM at the site.
- **Measurement Endpoints**: Comparison of total intake measures, calculated from PMJM-specific ingestion models of ECOPCs from abiotic data (soil, sediments, and surface water) and food items, to toxicity reference values (TRVs).

For non-PMJM receptors, the risk management goal and endpoints are:

- **Goal**: Prevent adverse effects on populations due to lethal, mutagenic, reproductive, systemic, or general toxic effects from contact with ECOPCs at the Site.
- **Assessment Endpoints**: Survival, growth, and reproduction adequate to sustain populations at the Site.
- **Measurement Endpoints**: Comparison of total intake measures, calculated from receptor-specific ingestion models of ECOPCs from abiotic data (soil, sediments, and surface water) and food items, to TRVs.

Receptors of Concern

The receptors to be included as assessment endpoints for the site are shown in Table 2.3. These receptors are representative species of ecological functional groups at RFETS. The receptors were selected based on several criteria, including their potential to be found in the various habitats present within each EU, their potential to come into contact with ECOIs, and the amount of life history and behavioral information available.

Complete Exposure Pathways

Figure 2.6 identifies several potential pathways that describe how a receptor might contact an ECOPC. The figure identifies pathways that are potentially complete, as well as potentially significant for the receptor groups. The pathways designated as potentially complete but insignificant are not quantitatively evaluated.

Inhalation of ECOPCs in ambient air is generally thought to be insignificant compared to ingestion pathways (EPA 2000b) and is generally not evaluated quantitatively in ERAs. In addition, there is little information available to assess the potential toxicity of ECOPC concentrations in air. Therefore, while the pathway may not be significant, it is identified as a source of uncertainty that may result in an underestimate of exposure (see Attachment 7). Dermal exposure to surface water is also thought to be a minor pathway for most terrestrial species at RFETS. For metals, polar organic compounds, and radionuclides, skin, fur, and feathers are generally a significant barrier to absorption. Nonpolar organic ECOPCs are more likely to be transferred across external surfaces. However, the low concentrations at which such compounds are found in surface water and the low absorption rates for most terrestrial receptors limit the potential exposures. For terrestrial vertebrates at RFETS, oral ingestion is likely to be more significant than either inhalation or dermal contact.

2.3.2 Exposure Units

Two types of ecological receptors are evaluated as part of the ecological risk assessment (ERA): terrestrial and aquatic. The terrestrial ecological analysis is conducted for the same EUs as defined for the HHRA (Figure 2.1). A sitewide analysis is also conducted for wide-ranging receptors (coyote and mule deer). The aquatic ecological analysis is conducted on a watershed-specific basis using the AEUs shown on Figure 2.2.

2.3.3 ECOPC Identification Process

The ECOPC identification process detailed in the CRA Methodology is illustrated on Figure 2.7. ESLs have been identified for the receptors listed in Section 2.3.1 and are provided in Appendix B of the CRA Methodology.

In the first portion of the ECOPC identification process, two separate screens are performed: one for the PMJM, and one for non-PMJM receptors. The ECOPC identification process for the PMJM is more stringent than for other receptors because the PMJM is a federally listed threatened species under the ESA.

The first step in the screening for ECOPCs is a comparison of each ECOI MDC to an ESL (Figure 2.7).[12] For each ECOI, the surface soil MDC for an EU is compared to the minimum ESL for the terrestrial receptors, excluding the PMJM. The surface soil MDC for an EU in PMJM habitat is compared to the PMJM ESL. The subsurface soil MDC for an EU is compared to the prairie dog ESL, and the sediment or surface water MDC for an AEU is screened against the minimum ESL for aquatic receptors. If an ECOI MDC exceeds the appropriate ESL[13], the ECOPC identification process continues as follows for the non-PMJM receptors (Figure 2.7):

- A detection frequency screen is performed to identify ECOIs with less than 5 percent detection in an EU/AEU.
- A statistical comparison is performed for the EU (or AEU) data against the appropriate background data set (see Section 2.2.5 for further details).
- Calculated Tier 1 EPCs (see Section 2.3.4) are compared to threshold ESLs (tESLs)[14] or if a tESL cannot be calculated, to NOAEL ESLs. In the AEU assessments, EPCs are compared to ESLs since no tESLs were identified in the CRA Methodology.
- A professional judgment/weight-of-evidence approach is used to determine if the ECOI is present in the environmental medium as a result of historical site-related activities (see Section 2.2.5 for details).[15] If an ECOI is determined to be potentially site-related, then it is identified as an ECOPC for risk characterization.

If an ECOI MDC exceeds the PMJM ESL, the ECOPC identification process continues as follows for the PMJM receptor (Figure 2.7):

- A detection frequency screen is performed to identify ECOIs with less than 5 percent detection in PMJM habitat for the EU.
- A statistical comparison is performed for the PMJM habitat data for the EU against the surface soil background data set (see Section 2.2.5 for further details).
- A professional judgment/weight-of-evidence approach is used to determine if the ECOI is present in the PMJM habitat surface soil as a result of historical site-related activities (see Section 2.2.5 for details).

2.3.4 Exposure Assessment

The ECOPC identification process defined the steps necessary to identify those chemicals that could not reliably be removed from further consideration in the ERA process. The

[12] ESLs are generally no observed adverse effect levels (NOAELs). These are concentrations at which no effects to either individual receptors or populations of receptors are predicted. Surface water ESLs for aquatic receptors are water quality criteria.
[13] If an ESL is not available, the ECOI is identified as an ECOI of uncertain toxicity.
[14] The threshold ESL represent the hypothetical dose at which the response in a group of exposed organisms may first begin to be significantly greater than in unexposed receptors and is calculated as the geometric mean of the NOAEL and lowest observed adverse effect level LOAEL. Threshold ESLs were calculated based on specific data quality rules for use in the ECOPC identification process for a small subset of ECOIs in the CRA Methodology (DOE 2004a).
[15] As part of professional judgment in the ECOPC screening process, an ecological risk potential evaluation is performed in lieu of the human health risk potential.

characterization of risk examines a range of potential exposures to site receptors from the ECOPCs.

Exposure results from contact between a receptor and ECOPCs in an environmental medium. For exposure to occur, a release must have occurred and a receptor must have a point of potential contact with that medium. The potential for receptor contact and identification of exposure routes are shown on the SCM (Figure 2.6).

The exposure model describes the relationships and equations used to estimate how much of a given chemical in a given medium is taken up by the receptor via a given exposure route. These relationships may be simple or complex depending on the receptor involved and the number of exposure routes evaluated. Two basic exposure models are used in the CRA: the concentration-based model and the dosage-based model.

Concentration-Based Exposure Model

The exposure model for some ecological receptors is expressed as the concentration of each chemical in the medium to which the receptor is most likely exposed. This exposure model is used for aquatic receptors, terrestrial plants and terrestrial invertebrates.

Dosage-Based Exposure Model

The exposure model used for avian and mammalian receptors is based on exposure to contaminants through multiple pathways including the ingestion of soil, food items (plant, invertebrate, and bird/mammal tissue), and surface water. Other potential exposure pathways (e.g., inhalation and dermal exposures) are not evaluated due to a lack of available information necessary for their inclusion in the risk calculations. The total daily intake as a result of exposure via these pathways for terrestrial receptors is the sum of the intakes from the different pathways, with the total average daily intake ($Intake_{total}$) of a specific ECOPC calculated as:

$$\boxed{Intake_{total} = Intake_{food} + Intake_{water} + Intake_{soil}}$$

where:

$Intake_{food}$ = average daily intake from ingestion of food items (vegetation, invertebrate and animal tissues).

$Intake_{soil}$ = average daily intake from incidental ingestion of soil/residue or sediment.

$Intake_{water}$ = average daily intake from the ingestion of water.

The end product of the exposure estimate is an intake rate (milligrams per kilogram [mg/kg] of body weight per day [mg/kg/day]). Calculation of total intake assumes that receptors obtain 100 percent of exposure from within the EU (i.e., area use factor [AUF] = 100 percent). This likely overestimates the exposure of wide ranging receptors such as the coyote or mule deer that use the entire site in their feeding and resting activities. Sitewide exposure and risks are also evaluated for these receptors in Appendix A, Volume 15A of the RI/FS Report.

The following equation is used to calculate the amount of individual ECOPCs that a wildlife receptor could obtain from the ingestion of food, soil, and surface water within the EU.

$$\text{Exposure(Intake)} = \left[(C_{soil} * P_{soil} * FIR * RBA_{soil}) + \left(\sum_{i=1}^{n} ([C_{food}] * P_{food} * FIR * RBA_{food}) + (C_{water} * WIR) \right) \right] * AUF$$

where:

Exposure (Intake)	=	rate at which an ECOPC is ingested from all sources (mg/kg/bw/day)
C_{soil}	=	contaminant concentration for contaminant (j) in soil (mg/kg dry weight)
N	=	number of different biota food types in diet
C_{food}	=	contaminant concentration in food type (i) calculated by bioaccumulation factor (BAF) C_{soil} (mg/kg dry weight)
C_{water}	=	contaminant concentration in water (milligrams per liter [mg/L])
P_{food}	=	proportion of biota type (i) in diet
FIR	=	food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day)
RBA_{food}	=	relative bioavailability of contaminant (j) from biota type (i) ($RBA_{food} = 1$)
RBA_{soil}	=	relative bioavailability of contaminant (j) from soil ($RBA_{soil} = 1$)
P_{soil}	=	soil ingestion as proportion of diet
WIR	=	water ingestion rate (kg water/kg BW/day)
AUF	=	area use factor (AUF = 1)

Exposure Point Concentrations

Two types of EPCs are calculated for exposure assessment. The UCL is calculated using ProUCL for EU surface soil to address the wide-ranging receptors (coyote and mule deer), and the 95th UCL of the 90th percentile (upper tolerance limit [UTL]) is calculated using the S-Plus statistical program for EU surface soil and subsurface soil to address receptors with small home ranges (small mammals, birds, and terrestrial plants and invertebrates). The UTL is also calculated for AEU sediment and surface water to address aquatic receptors (Table 2.2). The PMJM habitat patch-specific UCL is calculated for the PMJM receptor (see Section 2.3.6 "PMJM Risk Characterization" for a description of habitat patches). If too few samples are available in a patch to calculate a UCL, the MDC is used as the EPC. Also, if a calculated UCL or UTL exceeds the MDC, the MDC is utilized as the EPC.

For the non-PMJM receptors, Tier 1 and Tier 2 UCLs and UTLs are calculated for use as EPCs as described in Section 2.2.5. These tiered geospatial statistics are only calculated for terrestrial EUs. Tier 2 statistics are not calculated for the AEUs because the linear nature of aquatic systems make this type of geospatial analysis irrelevant. Surface soil UCLs for PMJM habitat patches are calculated assuming that all samples are randomly located and weighted equally (Tier 1). Tier 2 EPCs are not calculated for PMJM habitat patches due to their limited size.

Surface water (total concentrations) EPCs are also calculated to estimate exposure via the surface water ingestion pathway for the dosage-based exposure model. The EPC statistic used for surface water is the same statistic used for soil. For example, if the relevant soil EPC statistic is the UCL (wide-ranging receptors), then the UCL concentration in surface water is used as the EPC.

Receptor-Specific Exposure Parameters

Receptor-specific exposure factors are needed to estimate exposure to ECOPCs for each representative species. These include body weight; food, water, and media ingestion rates; and diet composition and respective proportion of each dietary component. Daily rates for intake of forage, prey, water, and incidental ingestion of soils were developed in the CRA Methodology. Receptor-specific exposure parameters are not applicable to aquatic receptors since their exposure is not measured as intake, but as total exposure.

The measurement or estimation of concentrations of ECOPCs in wildlife food is necessary to estimate a receptor's exposure to ECOPCs in their food. Conservative bioaccumulation factors (BAFs) are identified in the CRA Methodology. These BAFs are either simple ratios between chemical concentrations in biota and soil, or are based on quantitative relationships such as linear, logarithmic, or exponential equations. The values reported in the CRA Methodology are used as the BAFs for purposes of risk estimation. Bioaccumulation factors are not used as part of the aquatic risk assessment since no intake estimates are calculated. Exposure of aquatic organisms to ECOPCs is measured via the concentration in the medium in which they may come into contact.

2.3.5 Toxicity Assessment

Exposure to wildlife receptors was estimated for representative species of functional groups based on taxonomy and feeding behavior in the form of a daily rate of intake for each ECOPC/receptor pair. To estimate risk, soil concentrations (plants and invertebrate exposure) and calculated intakes (birds and mammals) must then be compared to the laboratory-based toxicity benchmarks. These benchmarks are termed toxicity reference values (TRVs) and are of several basic types. The NOAEL and no observed effect concentration (NOEC) TRVs are intake rates or soil concentrations below which no ecologically significant effects are expected. The NOAEL and NOEC TRVs were used to calculate the NOAEL ESLs used in screening steps of the ECOPC identification process to eliminate chemicals that have no potential to cause risk to the representative receptors. The lowest observed adverse effect level (LOAEL) TRV is a concentration above which the potential for some ecologically significant adverse effect could be elevated. TRVs are presented in the CRA Methodology.

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For the AEU assessments, ESLs identified in the CRA Methodology represent media concentrations, above which risks cannot be ruled out. The CRA Methodology did not supply values analogous to the terrestrial LOAEL for the aquatic receptors. Alternative toxicity values (ATs) were derived and are presented in Appendix A, Volume 15B of the RI/FS Report for use as LOAEL equivalent values for aquatic receptors.

2.3.6 Risk Characterization

Characterization of risk focuses on the overall results for each assessment endpoint. This includes discussion of the potential for risk for each receptor group and level of biological organization (that is, individual or population level of protection), as appropriate for the assessment endpoints. Risk characterization typically has two main components: risk estimation and risk description. The risk estimation summarizes the results of the analysis, presents a range of potential risks for each ECOPC/receptor pair, and identifies the specific locations that may pose risk. The risk description provides the context for the analysis, including the interpretation of overall results.

ECOIs for which the potential for risk could not be considered *de minimus* using conservative approaches were identified as ECOPCs. Receptors of potential concern were also identified for each ECOPC based on screening against conservative NOAEL ESLs. These ECOPC/receptor pairs were carried forward through the exposure assessment and toxicity assessment to identify input parameters necessary to characterize potential risk. Therefore, risk characterization defines a range of potential risks to on-site receptors from the ECOPCs.

Chemical risk characterization utilizes quantitative methods to evaluate potential risks to ecological receptors. In the CRA, the quantitative method used to characterize chemical risk is the HQ approach. The HQ is a ratio of the estimated exposure concentration to the TRV where:

$$HQ = Intake/TRV$$

HQs are usually interpreted as follows:

HQ Values		Interpretation of HQ Results
NOAEL-based	LOAEL-based	
≤ 1	≤ 1	Minimal or no risk
> 1	≤ 1	Low level risk[a]
> 1	> 1	Potentially significant risk

[a] Assuming magnitude and severity of response at LOAEL are relatively small and based on endpoints appropriate for the assessment endpoint of the receptor considered.

One potential limitation of the HQ approach is that calculated HQ values may sometimes be uncertain due to simplifications and assumptions in the underlying exposure and toxicity data used to derive the HQs. Where possible, the CRA provides information on three potential sources of uncertainty, described below.

- **EPCs.** Because surface soil sampling programs in the EU sometimes tended to focus on areas of potential contamination (i.e., historical IHSSs), in addition to calculating Tier 1 EPCs, Tier 2 area-weighted EPCs are calculated to help compensate for this potential bias for non-PMJM receptors.
- **Bioaccumulation Factors (BAFs).** For wildlife receptors, concentrations of contaminants in dietary items are estimated from surface soil using uptake equations. When the uptake equation is based on a simple linear model (e.g., $C_{tissue} = BAF * C_{soil}$), the default exposure scenario uses a high-end estimate of the BAF (the 90th percentile BAF). However, the use of high-end BAFs may tend to overestimate tissue concentrations in some dietary items. In order to estimate more typical tissue concentrations, where necessary, an alternate exposure scenario total chemical intake using a 50th percentile (median) BAF is used to calculate the HQ. The use of the median BAF is consistent with the approach used in the ecological soil screening level (EcoSSL) guidance (EPA 2005).
- **Toxicity Reference Values (TRVs).** The CRA Methodology utilizes an established hierarchy to identify the most appropriate default TRVs for use in the ECOPC selection. However, in some instances, the default TRV selected may be overly conservative with regard to characterizing population-level risks. The determination of whether the default TRVs are thought to yield overly conservative estimates of risk is addressed in the uncertainty sections on a chemical-by-chemical basis in each ERA. When an alternate TRV is identified, the ERA provides a discussion of why the alternate TRV is thought to be appropriate to provide an alternative estimate of toxicity (e.g., endpoint relevance, species relevance, data quality, chemical form, etc.), and HQs are calculated using both default and alternate TRVs where necessary.

The influences of each of these uncertainties on the calculated HQs are evaluated both alone and in concert in the risk description for each chemical. Uncertainties related to the BAFs, TRVs and background risk are presented, and where uncertainties are deemed to be high, alternative BAFs and/or TRVs are provided as appropriate based on the results of the uncertainty assessment.

HQs calculated using the default BAFs and HQs with the Tier 1 and Tier 2 EPCs are provided for each ECOPC/Receptor pair. Where no LOAEL HQs exceed 1 using the default exposure and toxicity values, no further HQs are calculated regardless of the results of the uncertainty analysis. Since the default HQs are generally the most conservative risk estimations, if low risk is estimated using these values then further reductions of conservatism would only serve to reduce risk estimates further.

Where LOAEL HQs greater than 1 are calculated using default assumptions, and the uncertainty analysis indicates that alternative BAFs and/or TRVs would be beneficial to reduce uncertainty and conservatism, alternative HQs are presented as appropriate.

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The risk description incorporates results of the risk estimates along with the uncertainties associated with the risk estimations and other lines of evidence to evaluate potential chemical effects on ecological receptors for each EU. Information considered in the risk description includes receptor groups potentially affected, type of TRV exceeded (e.g., NOAEL versus LOAEL), relation of EU concentrations to other criteria such as EPA EcoSSLs, and incremental risk above background conditions. In addition, other site-specific and regional factors are considered such as the use of a given ECOPC within the EU as related to historical RFETS activities, comparison of ECOPC concentrations within the EU to concentrations in other EUs and site background, and/or comparison to regional background concentrations.

PMJM Risk Characterization

The risk characterization process for the PMJM includes the following analyses:

- Map locations in PMJM habitat patches with concentrations greater than the ESLs, greater than three times the ESLs, and greater than background; and
- Determine whether further assessment of habitat patches is necessary, and perform the assessment as necessary.
- Calculate HQs for the PMJM habitat patches based on default exposure and toxicity parameters as defined in the CRA Methodology.
- Review chemical-specific uncertainties as they relate to PMJM default HQ calculations.
- Review background risks for PMJM
- If deemed necessary in the risk description, calculate HQs based on alternative BAFs and/or TRVs as discussed in the chemical-specific uncertainty analysis.
- Incorporate ecosystem monitoring data for PMJM to provide a risk-based conclusion based on multiple lines of evidence.

Habitat patches are areas that can reasonably be expected to represent home ranges of individual PMJM or subpopulations. The rationale for creating site-wide PMJM habitat patches is outlined in the CRA Methodology. The intent of the patches is to aggregate data in order to estimate the average contaminant exposure that an individual PMJM could reasonably be expected to encounter throughout its home range.

To develop PMJM habitat patches, the following information was used:

- USFWS-approved PMJM Habitat Protection Areas (DOE 2000a).
- Past radio telemetry study results to create geospatial guidelines in identifying patches (K-H 1997).
- The RFETS vegetation map along with site knowledge to identify discontinuities in habitat and variations in habitat quality that may be useful in determining the extent of individual patches.

The PMJM Habitat Protection Area Map was originally developed in 1999 (K-H 2000) as a tool for project managers to assess whether specific projects may physically impact PMJM habitat. This map was based on the Site Vegetation Map (K-H 1997) and is comprised of a "Protection Area" where PMJM habitat is present, and "Supporting Wetlands" that are thought to be important in the long-term preservation of PMJM habitat, but are not actually habitat for PMJM.

Through consultation with the USFWS during the development of a programmatic biological assessment for Rocky Flats (USFWS 2004b), USFWS representatives adopted, with some revision, the Protection Area Map as PMJM habitat within RFETS (Nelson 2005). This map was then used in the Biological Opinion as a basis for determining impacts to PMJM habitat due to physical disturbances related to site closure activities. In developing habitat patches, the Protection Area Map (K-H 2000) was used as a base map and the patches were delineated within the bounds of the habitat.

PMJM habitat patches were developed for the three major drainages at RFETS using the following steps:

- Identify surface soil sample locations that fall within PMJM habitat.
- Aggregate soil sample locations using the PMJM range distance as a guideline.
- Further refine patch boundaries by reviewing vegetation patterns and observed PMJM movement patterns from past radio telemetry studies.

Soil samples were identified within the Rock Creek, Walnut Creek, and Woman Creek drainages that fell within PMJM habitat based on the established Habitat Protection Areas (K-H 2000). These samples represent the overall data set to be used in characterizing risk for PMJM. Using past studies for RFETS, PMJM home-range estimates and linear distance measures (K-H 1999, 2000) were reviewed. In general, PMJM is restricted to riparian habitats and a thin band of upland grasslands (Armstrong 1997). Additionally, PMJM ranges widely along riparian corridors in contrast to their movements perpendicular to the stream. Therefore, linear measures (i.e., extent of radio telemetry point distributions measuring the furthest distance between all locations) are useful as an indirect measure of home range given the long and narrow arrangement of PMJM habitat within RFETS. Linear measures represent the maximum extent of a stream reach that an individual PMJM uses over a minimum of 20 days (K-H 1999, 2000). These measures have been reported as averages for Rock Creek and Walnut Creek. Using these two values, an average length of stream used by a PMJM is estimated as 1,624 feet. Using a radius of 812 feet (1,624/2), surface soil samples in PMJM habitat were grouped together if the radii from each sample location overlapped. This step was conducted first because the purpose of creating the PMJM patches was to aggregate soil sample locations.

These groupings were then reviewed using the site vegetation map to determine if discontinuities in the vegetation represented a natural break in PMJM habitat. Examples include where contiguous willow shrubs changes to leadplant indicating a break due to moisture changes along a stream, or where vegetation is absent along a small reach of stream. These types of fluctuations make natural breaks between habitat patches.

Finally, PMJM movement patterns from past studies were used to help further refine PMJM patches. This was especially helpful in Rock Creek where habitat is complex and contiguous. For example, subpopulations of PMJM have been observed to be somewhat isolated from each other, including the upper and lower Rock Creek subpopulations (K-H 1999), and the A-Ponds, B-Ponds, and Lower Walnut Creek subpopulations (K-H 2000). Even within these subpopulations there are more subtle groupings that allow further refinement of patch boundaries. These smaller divisions exist within upper Rock Creek and upper Woman Creek.

Figure 2.8 shows the habitat patches for the Rock Creek, Walnut Creek, and Woman Creek drainages, each patch labeled with a unique number. A few patches comprise groupings of two or three polygons that are connected based on supporting wetland vegetation. These groups of polygons represent a patch of related areas of habitat on a creek tributary, including adjacent but disconnected habitat in upgradient seep areas.

Some PMJM patches cross EU boundaries. Estimated risks to the PMJM for these patches are discussed in only one of the adjoining EUs. For risk characterization purposes, the PMJM habitat patches are assigned to the EUs as shown in Table 2.5. If surface soil data is unavailable for a habitat patch, available surface soil data for sample locations near the patch are utilized for the ERA (see Attachment 3 of this volume for further discussion).

Non-PMJM Risk Characterization

The non-PMJM risk characterization process for EUs and AEUs is documented in the CRA Methodology and may include the following types of analyses:

- Document location and magnitude of concentrations above ESLs;
- Evaluate spatial variability of ECOPC concentrations;
- Consider alternative TRVs;
- Review ECOPC bioavailability;
- Evaluate site-specific tissue data;
- Review previous risk assessment data; and
- Perform tiered geospatial analysis.

2.3.7 Uncertainty Analysis

Quantitative evaluation of ecological risks is limited by uncertainties regarding the assumptions used to predict risk and the data available for quantifying risk. The general sources of uncertainty that apply to all EUs and AEUs are presented in Attachment 7. Chemical-specific uncertainties and uncertainties to each specific EU or AEU are discussed in the ERAs.

3.0 SUMMARY OF THE OU 3 RISK ASSESSMENT

While the scope of the CRA includes all areas within the RFETS boundary, this section provides a brief summary of the baseline risk assessment prepared for OU 3 (off-site areas immediately east of RFETS). In accordance with the CRA Methodology, summaries of data collected on RFETS after the CAD/ROD for OU 3 was finalized are also provided. These data indicate conditions do not exist to alter the conclusions of the earlier OU 3 assessment, and consequently, OU 3 has not been reassessed.

3.1 OU 3 Risk Assessment

A Baseline Risk Assessment (BRA), including an HHRA and an ERA, was conducted as part of the OU 3 RI/FS (DOE 1996). OU 3 consists of four historical IHSSs: IHSS 199 (Contamination of the Land's Surface), IHSS 200 (Great Western Reservoir), IHSS 201 (Standley Lake), and IHSS 202 (Mower Reservoir).

The first step of the HHRA consisted of an identification of Areas of Concern (AOCs) and COCs using the CDPHE Conservative Screen (CDPHE et al. 1994). As a result of this screening, three surface soil AOCs and a Great Western Reservoir AOC were identified. Americium-241 and plutonium-239/240 were identified as surface soil COCs for AOCs in IHSS 199, and plutonium-239/240 was identified as a surface sediment COC for the Great Western Reservoir AOC (IHSS 200) (DOE 1996).

Recreational and residential land use scenarios were evaluated for the HHRA. For residential exposure to surface soil (IHSS 199), direct contact exposure to COCs was assumed to occur as a result of ingestion and inhalation. It was assumed that indirect contact may occur through limited vegetable, beef, and milk consumption, and external radiation exposure. Using these exposure parameters, the highest identified activity in the soil (6.47 picocuries per gram [pCi/g] plutonium) corresponded to a potential excess lifetime cancer risk of 3×10^{-6}, a result at the lower end of EPA's acceptable risk range (that is, 1×10^{-6} to 1×10^{-4}).[16] The total effective dose equivalent was 0.026 millirem per year (mrem/yr).

For recreational exposure, the potential risks are lower than for residential exposure because the exposure area is larger, the exposure duration is shorter, and there is limited exposure to soil. The estimated excess lifetime cancer risk is 5×10^{-8} and the total effective dose equivalent is 0.003 mrem/year for the 50-acre recreational exposure area used in the OU 3 risk assessment calculations. The risk is well below EPA's acceptable risk range.

For the ERA, PCOCs were identified using the CDPHE Conservative Screen. Plutonium-239/240, and americium-241 were identified as PCOCs for soil within IHSS 199, and plutonium-239/240 was identified for sediment within IHSS 200. As a conservative measure, plutonium-239/240 and americium-241 were also retained as PCOCs for sediments within IHSS 200, IHSS 201, and IHSS 202. No PCOCs were selected for surface water.

[16] EPA's risk range from the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR 430[e][2][i][A][2]).

Effects for the terrestrial portion of the ERA were measured by an evaluation of PCOC occurrence and uptake within the OU 3 ecosystem. For the aquatic portion of the ERA, activities measured in sediments in each IHSS were compared to NOAELs.

Based on the results of the BRA, the June 1997 OU 3 CAD/ROD selected a remedy of no action (DOE 1997).

3.2 Review of Post-1997 Environmental Data

A 5-year review of the CAD/ROD for OU 3 was conducted to assess the continued protectiveness of the remedy (DOE 2002b). The OU 3 CAD/ROD concluded that transport by wind and water were the primary means by which plutonium-239/240 and americium-241 were carried to OU3. Therefore, available air and water monitoring data collected after the CAD/ROD was signed were reviewed to determine if environmental conditions at OU 3 have changed since the BRA was completed. The air monitoring data from the RFETS perimeter air monitoring network were analyzed and the conclusion was that the amounts of plutonium-239/240 and americium-241 that have been measured at the RFETS perimeter since 1997 have been environmentally insignificant (DOE 1999, 2000b, 2001, 2002c). These amounts of plutonium-239/240 and americium-241 would not have caused contaminant levels in OU 3 to change significantly since the CAD/ROD was signed. Water monitoring data from the RFCA Points of Compliance (POCs) on Woman Creek and Walnut Creek at Indiana Street, and data collected by the City of Broomfield for Great Western Reservoir, were analyzed. Samples of water leaving RFETS showed consistent compliance with RFCA surface water standards (K-H 2002), and water samples from Great Western Reservoir were consistently at or below detection limits for plutonium and americium (DOE 2002b).

Review of air monitoring data (DOE 2003, 2004) and water quality data at the POCs (K-H 2003a, 2003b, 2004) since the 5-year review also indicate there have not been significant amounts of plutonium-239/240 or americium-241 that have entered OU 3 through the air or water pathways. Therefore, environmental conditions at OU 3 have not changed significantly since the CAD/ROD was signed.

4.0 SITEWIDE ASSESSMENTS

In the professional judgment step of the soil COC/ECOPC selection process, a final determination is made as to whether PCOCs/ECOIs should be retained as COCs/ECOPCs for risk characterization. As presented in Appendix A, Volumes 3 through 14 of the RI/FS report, many metals have been carried through to the professional judgment step. Because metals are naturally occurring, the spatial trend analysis is an important element of professional judgment to ascertain if the presence of the metal is a result of historical site-related activities. This analysis is best performed on a sitewide level to gain perspective on trends, or the lack thereof, in specific EUs and across the site. Accordingly, the sitewide spatial trend analysis for metals carried through to professional judgment in each of the EUs is provided in Attachment 8. The process knowledge element of professional judgment is also a sitewide analysis where historical usage and releases to the environment are examined. Accordingly, this element of professional judgment for the metals is also presented in Attachment 8. Inclusion of both of these elements of professional judgment in Attachment 8 serves to streamline the presentation

of professional judgment because the information need not be repeated in each of the EU risk assessments.

5.0 BACKGROUND RISKS

As presented in Appendix A, Volumes 3 through 14 of the RI/FS Report, several metals have been identified as COCs and ECOPCs in many of the EUs. Because metals are also naturally occurring, risks posed to human and ecological receptors from exposure to metal COCs and ECOPCs are based on concentrations in the EUs that include a background component. Therefore, to put human health risks posed by any one metal PCOC into perspective, background risks, both carcinogenic and non-carcinogenic, have been computed for all metal PCOCs with cancer slope factors and/or reference doses (Attachment 9). The total risks for all the metals present at background levels also provides a measure of the risk posed to human receptors in EUs where COCs were not identified. With respect to ecological risks, background risks are computed for all ECOPC/receptor pairs identified in each of the EU. The background ecological risks also serve to put the EU ecological risks in perspective.

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Table 2.1
Human Health Site Conceptual Model

Primary Source	Primary Release Mechanism	Affected Media	Secondary Release Mechanism	Affected Media	WRW Exposure Pathway	WRV Exposure Pathway
Surface Soil, Subsurface Soil, Sediment, and Building Rubble	Stormwater Runoff	Surface Water Streams/Seeps	Direct Contact		Oral (I) Dermal (I)	Oral (I) Dermal (I)
			Biotic Uptake	Fish	Oral (IC)	Oral (IC)
			Ingestion	Deer/Grazing Animals	Oral (IC)	Oral (I)
	Infiltration Percolation	UHSU Groundwater	Percolation	LHSU Groundwater	Oral (IC) Dermal (IC)	Oral (IC) Dermal (IC)
			Domestic Use		Oral (IC) Dermal (IC)	Oral (IC) Dermal (IC)
			Surface Water		Oral (I) Dermal (I)	Oral (I) Dermal (I)
	Volatilization	Groundwater Subsurface Soil	Volatilization	Indoor Air	Inhalation (I)	Inhalation (IC)
				Outdoor Air	Inhalation (I)	Inhalation (I)
		Surface Water	Volatilization	Outdoor Air	Inhalation (I)	Inhalation (I)
	Resuspension	Airborne Particulates		Indoor Air	Inhalation (S)	Inhalation (IC)
				Outdoor Air	Inhalation (S)	Inhalation (S)
			Deposition	Deer/Grazing Animals	Oral (IC)	Oral (I)
	Plant Uptake	Vegetation	Ingestion	Deer/Grazing Animals	Oral (IC)	Oral (I)
	Direct Contact	Surface Soil (0 to 0.5 ft)			Oral (S) Dermal (S)	Oral (S) Dermal (S)

Table 2.1
Human Health Site Conceptual Model

Primary Source	Primary Release Mechanism	Affected Media	Secondary Release Mechanism	Affected Media	WRW Exposure Pathway	WRV Exposure Pathway
		Subsurface Soil (0.5 to 8 ft)			Oral (S) Dermal (S)	Oral (IC) Dermal (IC)
		Subsurface Soil (Below 8 ft)			Oral (IC) Dermal (IC)	Oral (IC) Dermal (IC)
		Sediment			Oral (S) Dermal (S)	Oral (S) Dermal (S)
		Building Rubble			Oral (IC) Dermal (IC)	Oral (IC) Dermal (IC)
	Radioactive Decay	Surface Soil			External Irradiation (S)	External Irradiation (S)
		Subsurface Soil			External Irradiation (I)	External Irradiation (I)
		Sediment			External Irradiation (S)	External Irradiation (I)
		Building Rubble			External Irradiation (I)	External Irradiation (I)

Key to Exposure Pathways: S - Significant, I - Insignificant, IC – Incomplete

Table 2.2
Statistical Background Comparisons and Exposure Point Concentration Calculations for the CRA

Medium	EU and AEU Background Comparisons[a]			EU EPC Requirements[a]	AEU EPC Requirements
	Background Data Set	EU Data Set	AEU Data Set		
Surface Soil (end depth equal to or less than 0.5 ft)	BSCP	EU surface soil data (for ERA)	N/A	Surface soil ECOPCs (for ERA)	N/A
Subsurface soil (start depth equal to or less than 8 ft and end depth > 0.5 ft)	BGCR	EU subsurface soil data not including data for background locations that are within the EU (for ERA)[b]	N/A	Subsurface soil ECOPCs (for ERA)	N/A
Sediment	BGCR as modified through the consultative process[b]	N/A	AEU sediment data not including data for background locations that are within the AEU (for ERA)[b]	N/A	Sediment ECOPCs (for ERA)
Surface Soil combined with Surface Sediment (end depth less than or equal to 0.5 ft)	BSCP (surface soil), and BGCR (surface sediment) as modified through the consultative process[b]	EU surface soil combined with surface sediment data not including data for background locations that are within the EU (for HHRA)[b]	N/A	Surface soil combined with surface sediment COCs (for HHRA)	N/A
Subsurface Soil combined with Subsurface Sediment (end depth greater than 0.5 ft)	BGCR (subsurface soil), and BGCR (subsurface sediment) as modified through the consultative process[b]	EU subsurface soil combined with subsurface sediment data not including data for background locations that are within the EU (for HHRA)[b]	N/A	Subsurface soil combined with subsurface sediment COCs (for HHRA)	N/A
Surface Water	BGCR as modified through the consultative process[b]; separate data sets for total and dissolved concentrations	N/A	AEU surface water data not including data for background locations that are within the AEU (for ERA)[b]; separate data sets for total and dissolved concentrations	N/A	Surface water ECOPCs; separate EPCs for total and dissolved concentrations

[a]For surface soil, sitewide data are also compared to BSCP data in the evaluation of risk to wide-ranging receptors. EPCs are also calculated for ECOPCs.

[b]See Section 2.2.5 for discussion.

Table 2.3
Ecological Receptors with Identified ESLs

Functional Group	Representative Species
Burrowing Small Mammal	Black-tailed Prairie Dog
Herbivorous or Omnivorous Small Mammal	Deer Mouse and PMJM
Insectivorous Small Mammal	Deer Mouse
Herbivorous or Omnivorous Bird	Mourning Dove
Insectivorous Bird	Mourning Dove
Ruminant Wildlife	Mule Deer
Mammalian Predator	Coyote
Avian Predator	American Kestrel
Plant	General
Terrestrial Invertebrate	General
Aquatic Life	General aquatic life, including amphibians and benthic macroinvertebrates (sediment exposure)

Table 2.4
Toxicity Equivalency Factors for Dioxins/Furans

Analyte	Human/Mammal TEF[b]	Bird TEF[b]	Aquatic TEF[b]
1234678-HpCDD	0.01	0.001	0.001
1234678-HpCDF	0.01	0.01	0.01
1234789-HpCDF	0.01	0.01	0.01
123478-HxCDD	0.1	0.05	0.5
123478-HxCDF	0.1	0.1	0.1
123678-HxCDD	0.1	0.01	0.01
123678-HxCDF	0.1	0.1	0.1
123789-HxCDD	0.1	0.1	0.01
123789-HxCDF	0.1	0.1	0.1
12378-PeCDD	1	1	1
12378-PeCDF	0.05	0.1	0.05
234678-HxCDF	0.1	0.1	0.1
23478-PeCDF	0.5	1	0.5
2378-TCDD	1	1	1
2378-TCDF	0.1	1	0.05
OCDD	0.0001	0.0001	0.0001
OCDF	0.0001	0.0001	0.0001
Heptachlorodibenzofuran[a]	0.01	0.01	0.01
Heptachlorodibenzo-p-dioxin [a]	0.01	0.001	0.001
Hexachlorodibenzofuran [a]	0.1	0.1	0.1
Hexachlorodibenzo-p-dioxin [a]	0.1	0.1	0.5
Pentachlorodibenzofuran [a]	0.5	1	0.5
Pentachlorodibenzo-p-dioxin [a]	1	1	1
Tetrachlorodibenzo-p-dioxin [a]	1	1	1

[a] For results listed as a group of congeners or as a generic dioxin/furan, the highest TEF within the series was assigned.

[b] TEFs from WHO 1997.

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Table 2.5
PMJM Habitat Patches within Exposure Units

Exposure Unit	PMJM Patches
Inter Drainage	9, 31
Lower Walnut Drainage	10, 13, 14
Lower Woman Drainage	22A, 23, 24A, 25, 26, 27, 28
No Name Gulch Drainage	11A, 11B
Rock CreekDrainage	1, 2, 3A, 3B, 4, 5, 6, 7, 8, 32, 33
Southwest Buffer Zone Area	29A, 29B, 30
Upper Walnut Drainage	12A, 12B, 15, 16, 17, 18
Upper Woman Drainage	19, 20A, 20B, 21A, 21B, 21C
Wind Blown Area	24B

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FIGURES

27

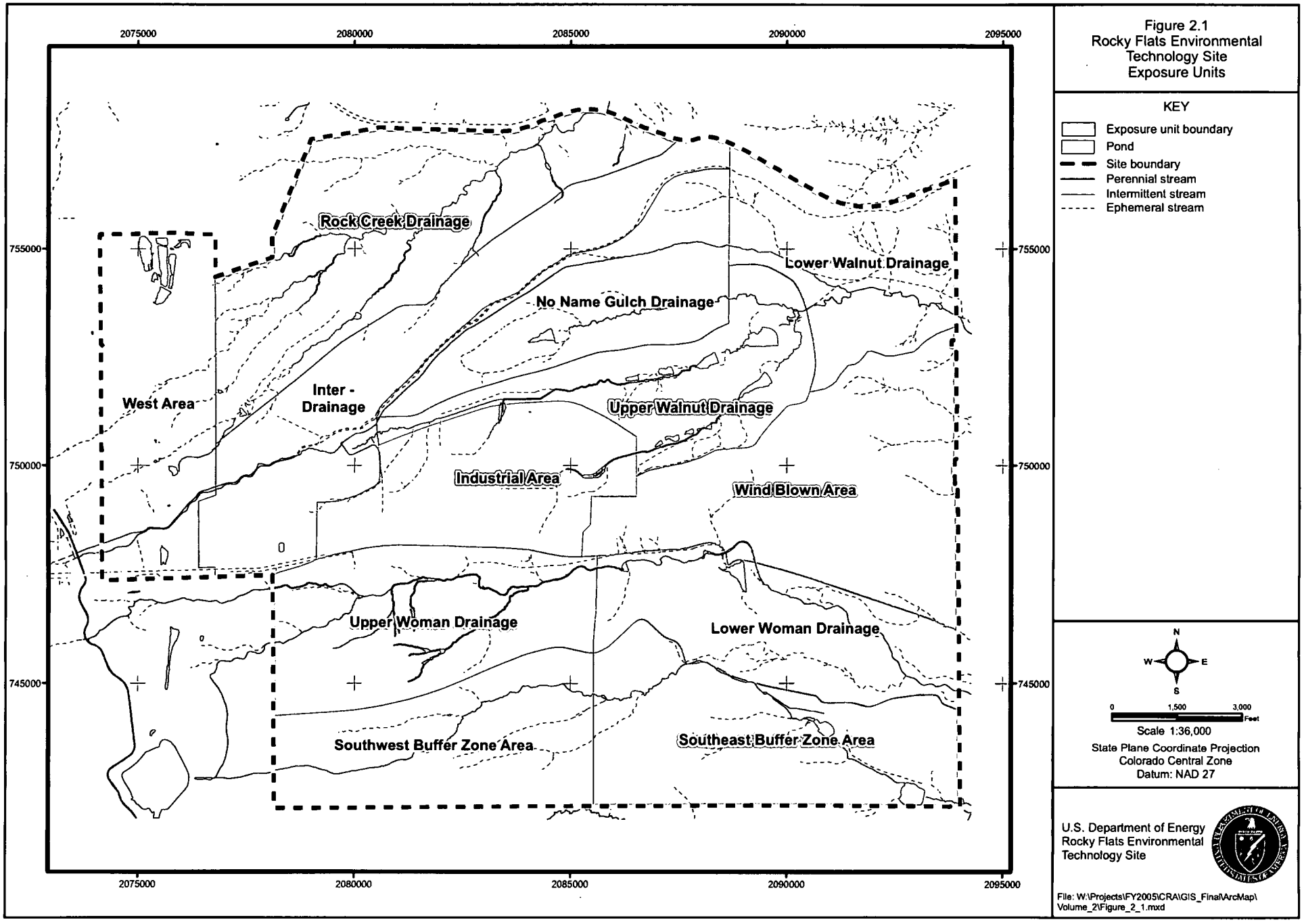


Figure 2.1
Rocky Flats Environmental
Technology Site
Exposure Units

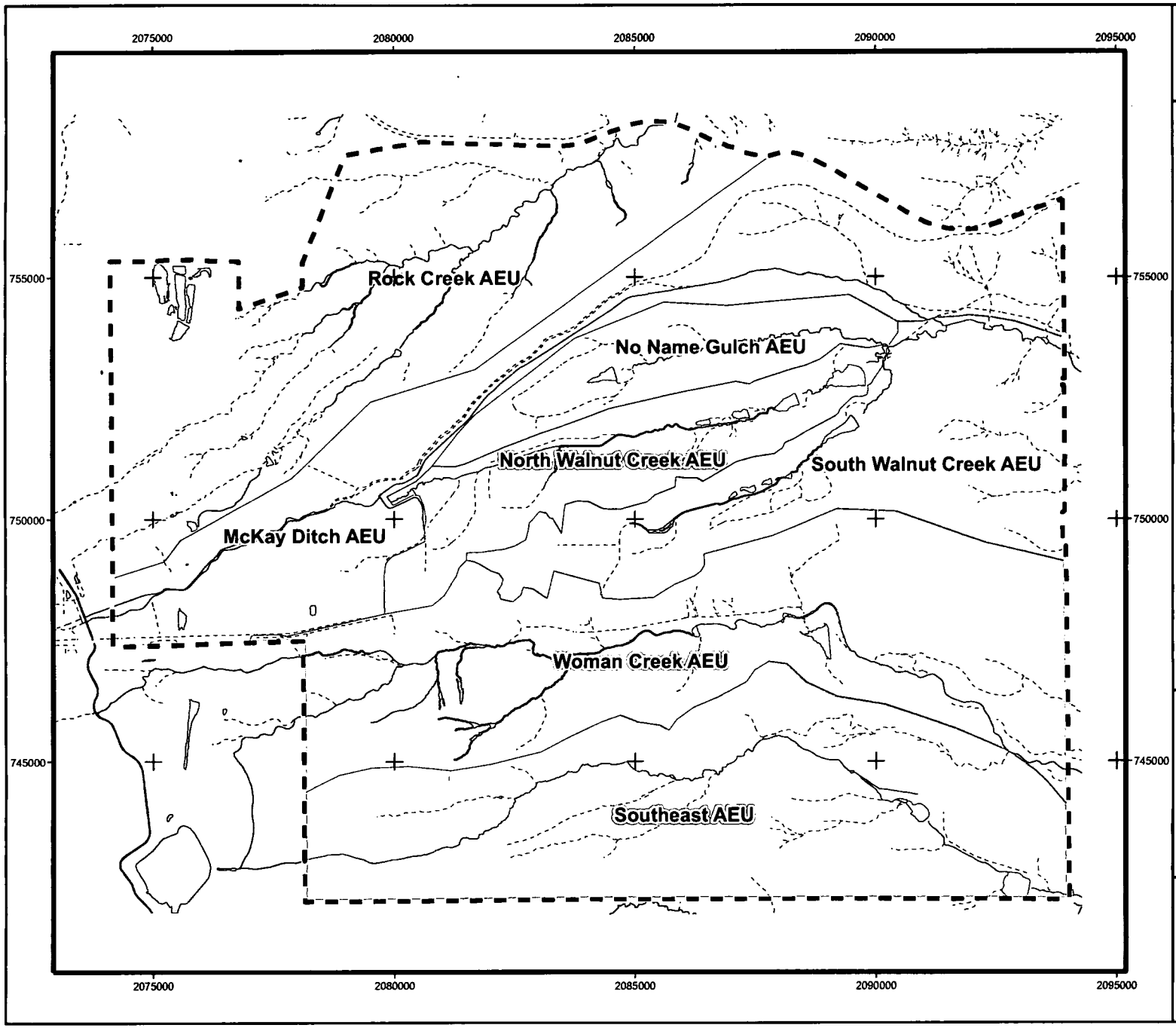


Figure 2.2
Rocky Flats Environmental Technology Site Aquatic Exposure Units

KEY

- Aquatic exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
W E
S

0 1,500 3,000 Feet

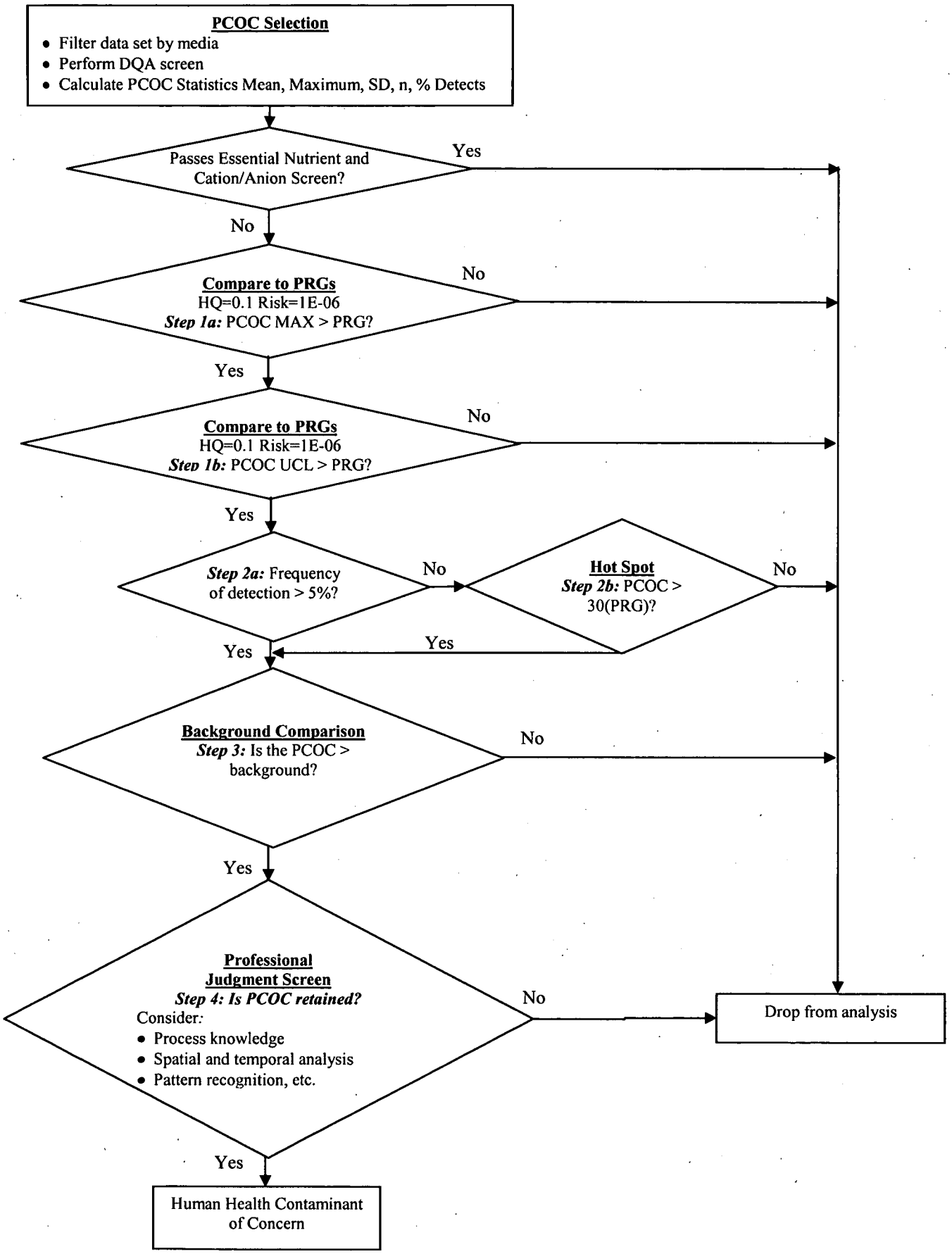
Scale 1:36,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

File: W:\Projects\FY2005\CRA\GIS_Final\ArcMap\Volume_2\Figure_2_2.mxd

Figure 2.3 Human Health COC Selection Process



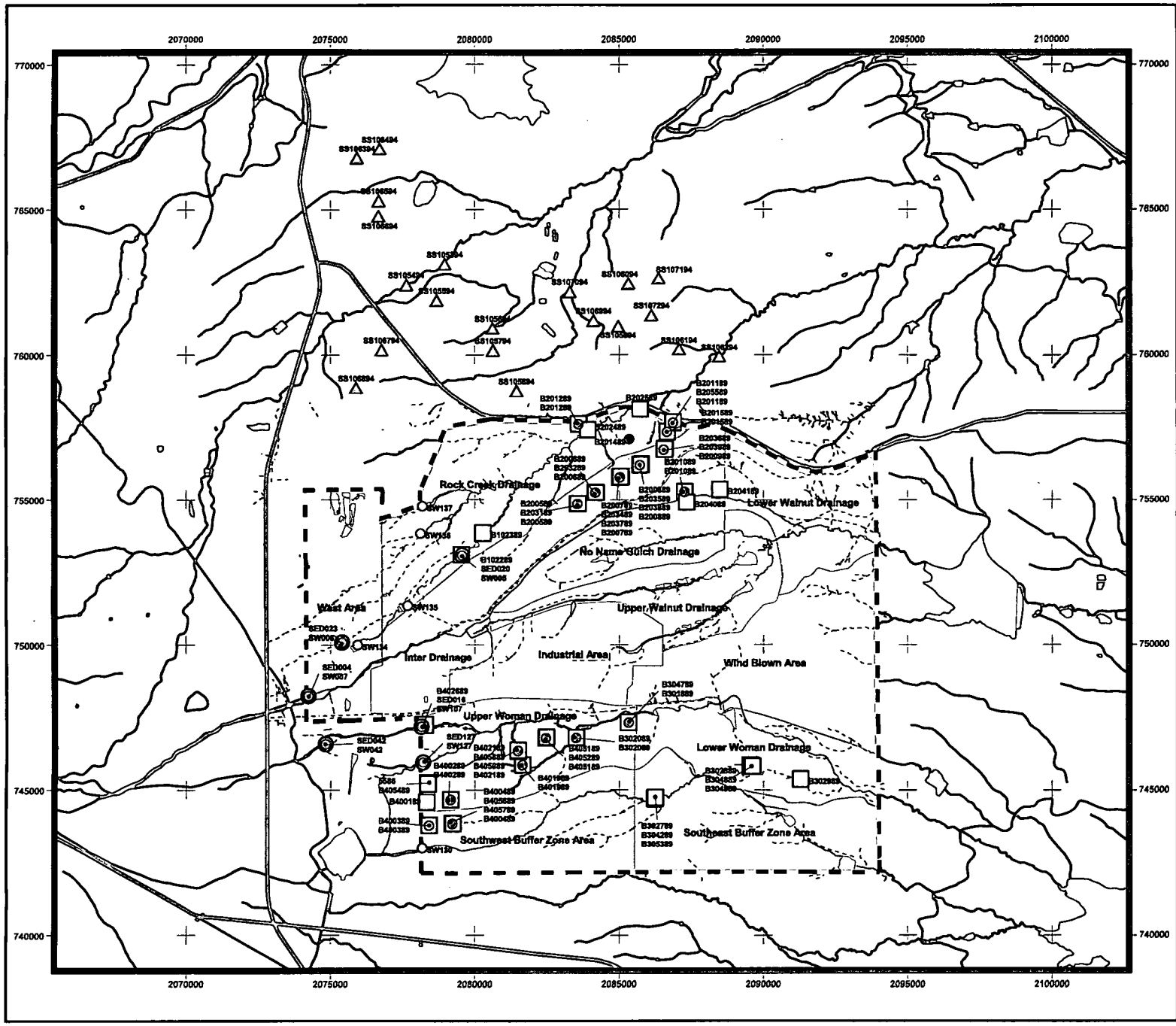


Figure 2.4
BSCP Sampling Locations for Metals and Naturally Occurring Radionuclides, and BGCR Sampling Locations

KEY

BGCR sample location

- Groundwater
- Sediment
- Subsurface soil
- Surface water

BSCP sample location

- Surface soil

Standard Map Features

- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
W E
S

0 2500 5000 Feet

Scale 1:15600

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

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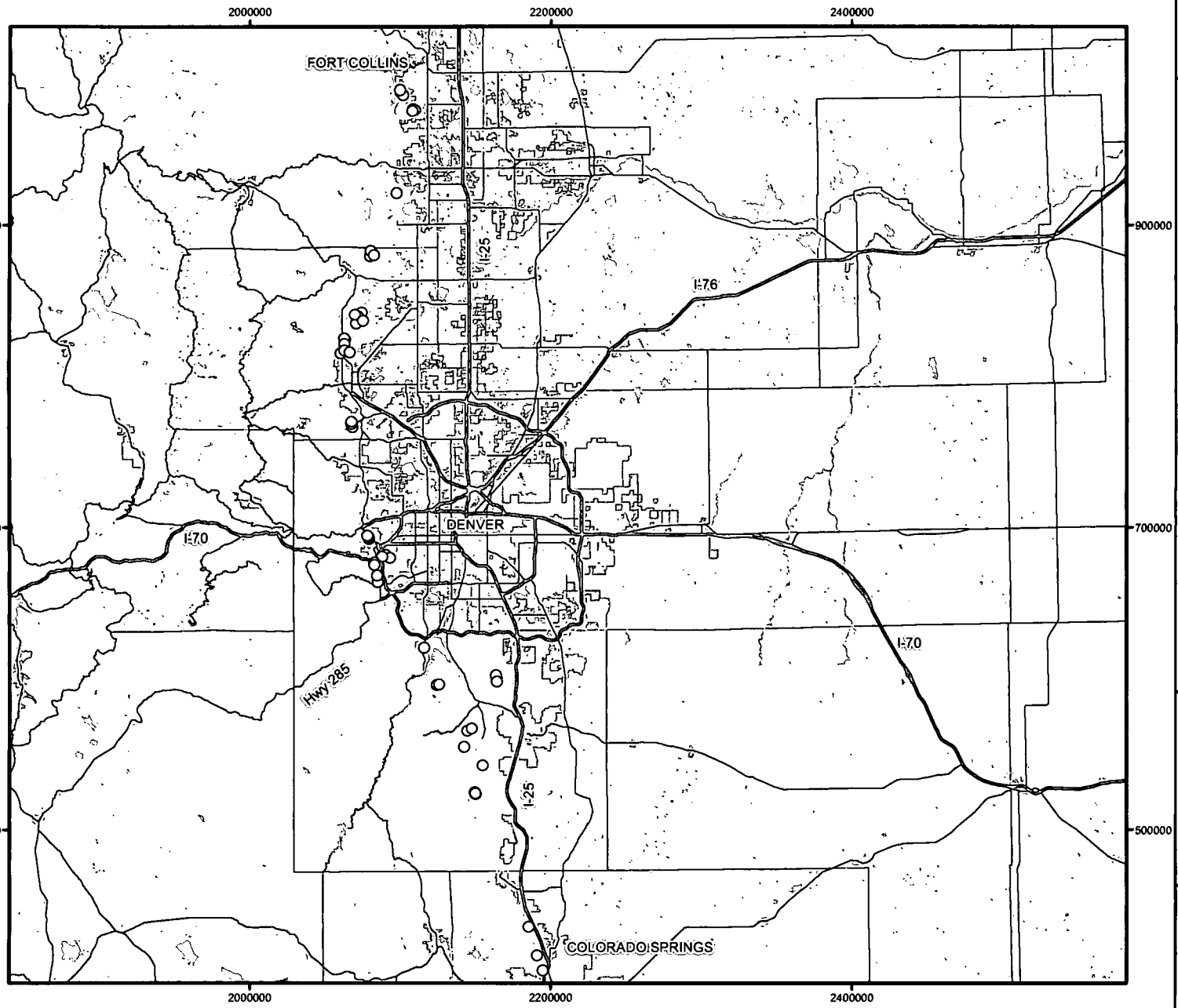

Figure 2.5

BCSP Sampling Locations for Fallout Radionuclides

Key

- BSCP location
- Surface roads
- Interstate
- Lakes and Ponds
- Site Boundary
- City Boundary
- County Boundary

Rocky Flats Environmental Technology Site (RFETS)

Colorado

N
W E
S

0 10 20 Miles

Scale 1:1,200,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

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Figure 2.6 Ecological Site Conceptual Model

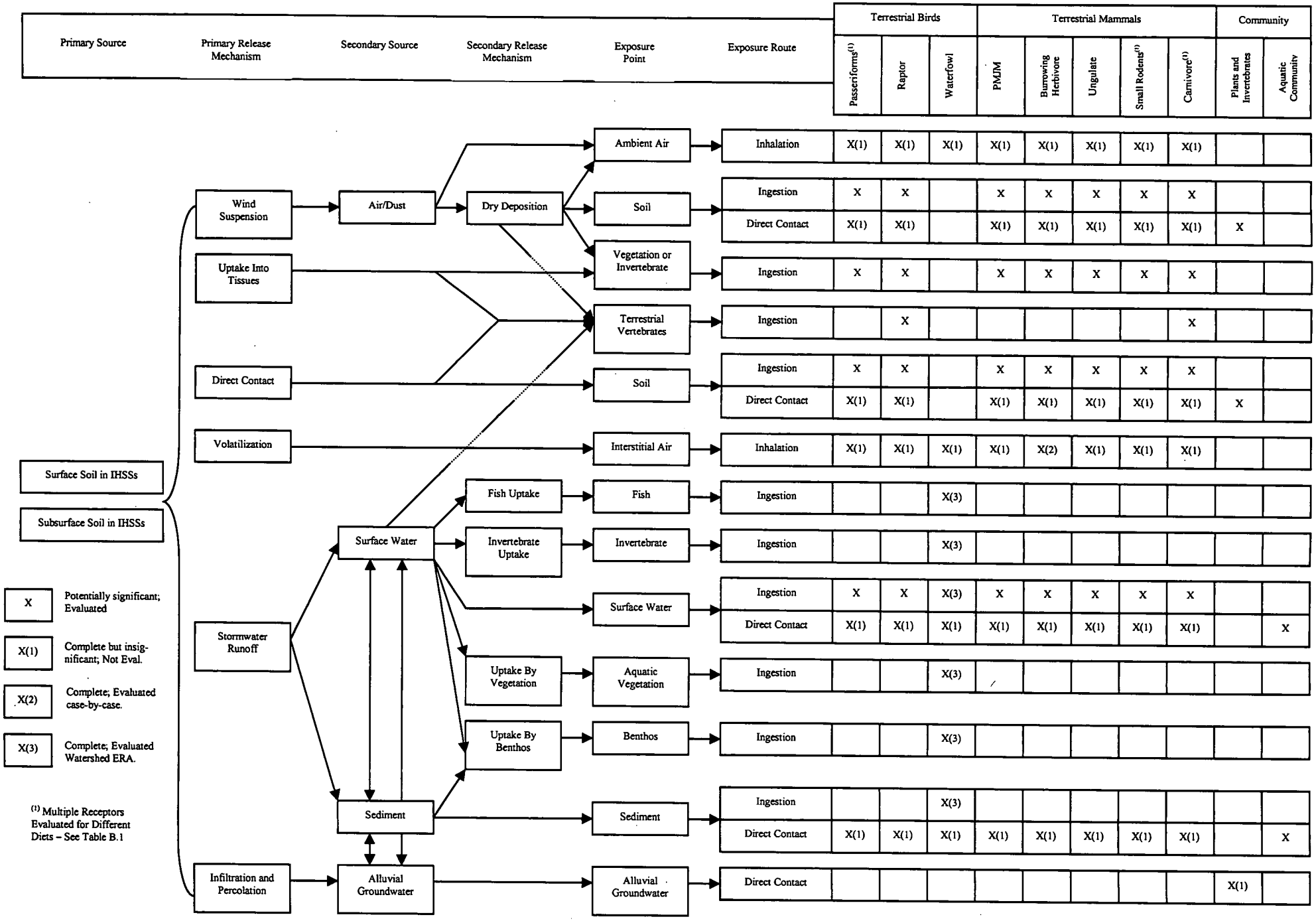
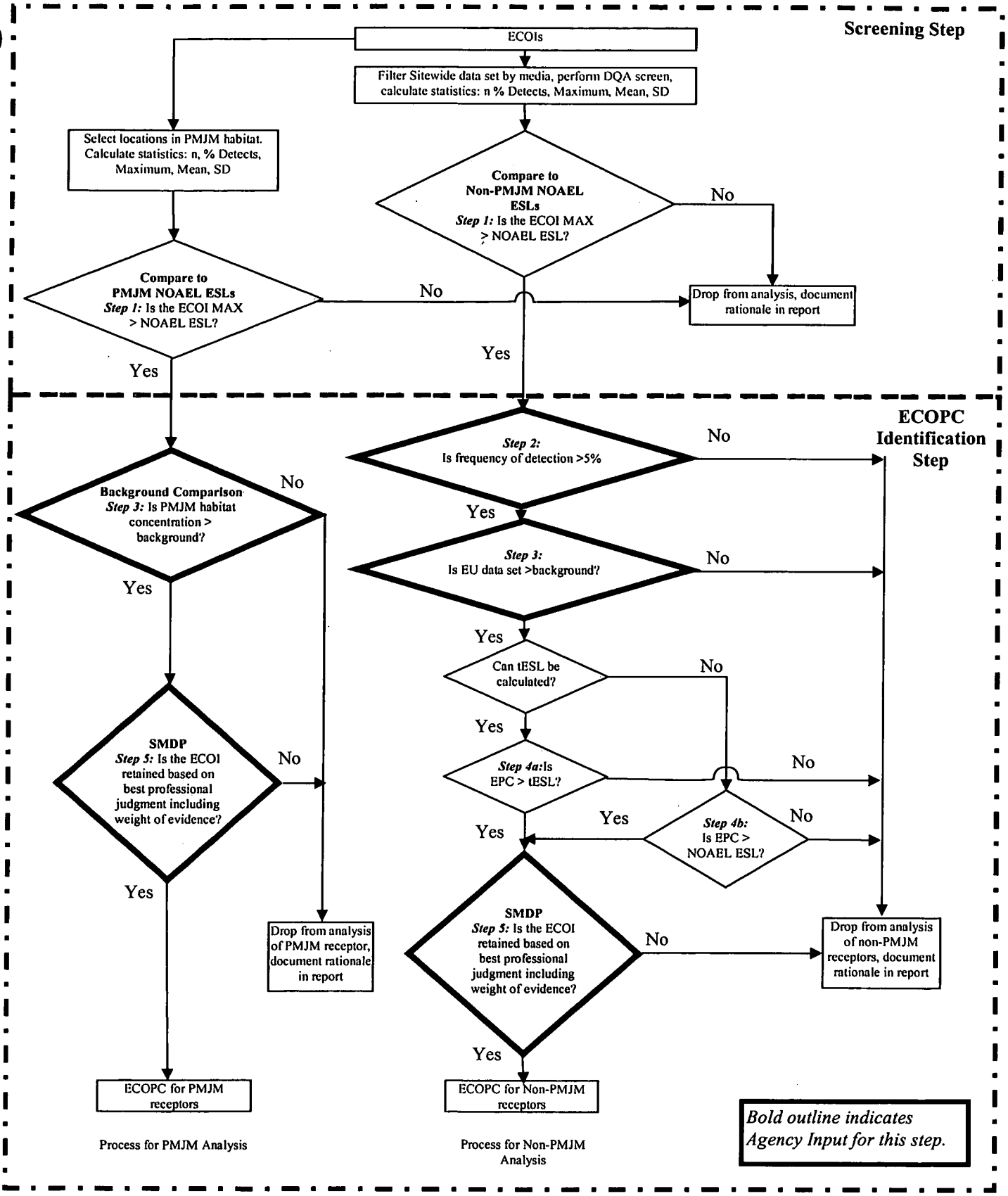


Figure 2.7 ECOPC Identification Process



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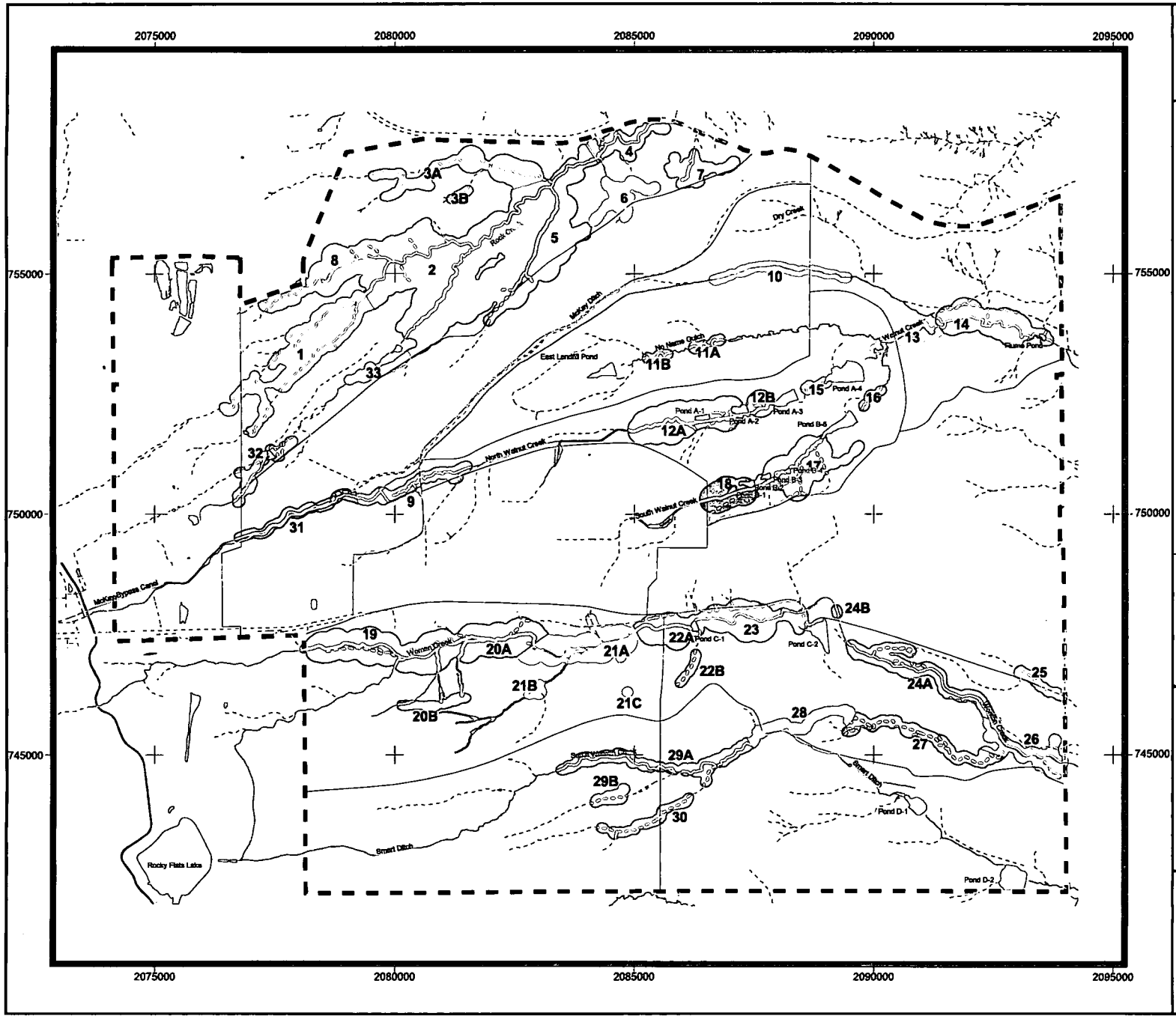

Figure 2.8

Preble's Meadow Jumping Mouse Functional Habitat Patches

KEY

PMJM habitat patch

1 PMJM habitat patch ID

Standard Map Features

Exposure unit boundary

Pond

Site boundary

Perennial stream

Intermittent stream

Ephemeral stream

N
W E
S

0 1000 2000 Feet

Scale 1:36000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental
Technology Site

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COMPREHENSIVE RISK ASSESSMENT

COMPREHENSIVE RISK ASSESSMENT METHODOLOGY AND DATA DESCRIPTION

VOLUME 2: ATTACHMENT 1

Reserved

COMPREHENSIVE RISK ASSESSMENT

COMPREHENSIVE RISK ASSESSMENT METHODOLOGY AND DATA DESCRIPTION

VOLUME 2: ATTACHMENT 2

Data Quality Assessment

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ACRONYMS AND ABBREVIATIONS

AA	atomic absorption
ASD	Analytical Services Division
COC	contaminant of concern
CRA	Comprehensive Risk Assessment
CRDL	contract required detection limit
DER	duplicate error ratio
DQA	Data Quality Assessment
DQO	data quality objective
DRC	data review checklist
EDD	electronic data deliverable
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
IAG	Interagency Agreement
ICP	inductively couple plasma
IDL	instrument detection limit
LCS	laboratory control sample
MDA	minimum detectable activity
MDL	method detection limit
MS	matrix spike
MSA	method of standard additions
MSD	matrix spike duplicate
PARCC	precision, accuracy, representativeness, completeness, and comparability
PPT	pipette

PCB	polychlorinated biphenyl
QC	quality control
RDL	required detection limit
RFETS	Rocky Flats Environmental Technology Site
RI/FS	Remedial Investigation/Feasibility Study
RL	reporting limit
RPD	relative percent difference
SDP	standard data package
SOW	Statement of Work
SVOC	semi-volatile organic compound
SWD	Soil Water Database
TCLP	Toxicity Characteristic Leaching Procedure
TIC	tentatively identified compound
V&V	verification and validation
VOC	volatile organic compound

EXECUTIVE SUMMARY

This document provides an assessment of the quality of the data used in the sitewide Comprehensive Risk Assessment (CRA). This Data Quality Assessment (DQA) focuses on all elements of quality control (QC) including both laboratory and sample-specific QC data.

Depending on the matrix and analyte group, anywhere from 58 to 100 percent of the sitewide data set has been verified and/or validated by a validator from the Analytical Services Division (ASD) at the Rocky Flats Environmental Technology Site (RFETS) (or from an outside subcontractor) using verification and validation (V&V) guidelines for each analytical method developed for RFETS. V&V data are identified in the RFETS Soil Water Database (SWD) by a data qualifier flag and reason code(s) that provide an explanation for the qualifier flag. All rejected data have been removed from the data set used in the CRA because the validator has determined the data are unusable. The remaining V&V data have associated qualifier flags indicating that the data are valid, estimated, or undetected, and are used in the CRA. Of the sitewide V&V data, approximately 13 percent was qualified as estimated and/or undetected. Less than 3 percent of the data reported as detected by the laboratory were qualified as undetected due to blank contamination. Data qualified as estimated or undetected are a result of various minor laboratory noncompliance issues that are insufficient to render the data unusable.

A review of the sitewide V&V data indicates that the data meet the data quality objectives (DQOs) outlined in the Final CRA Work Plan and Methodology (K-H 2004) (hereafter referred to as the CRA Methodology). A review of the most common observations found in the V&V data determined that a minimal amount, less than 1 percent, of the non-V&V data may have been qualified if a review had been performed. Based on this DQA, the data are of sufficient quality for use in the CRA.

1.0 INTRODUCTION

The sitewide Comprehensive Risk Assessment (CRA) for the Rocky Flats Environmental Technology Site (RFETS) has been prepared in accordance with the CRA Methodology. The CRA Methodology was developed jointly with the regulatory agencies using the consultative process, and was approved by the agencies on September 28, 2004. Consistent with the CRA Methodology, data quality was assessed using a standard precision, accuracy, representativeness, completeness, and comparability (PARCC) parameter analysis (EPA 2002). Both laboratory and field quality control (QC) parameters were evaluated for the data set.

Although many of the elements of QC that are reviewed in this document affect more than one PARCC parameter, their major impact on data quality is described below:

- Precision, as a measure of agreement among replicate measurements, is determined quantitatively based on the results of replicate laboratory measurements. Precision of the laboratory data was verified through review of:
  - Relative percent differences (RPDs) for laboratory control samples (LCSs) and LCS duplicates compared to the acceptable ranges (analytical precision);
  - RPDs (nonradionuclides) and duplicate error ratios (DERs) (radionuclides) for field sample and field duplicates compared to the acceptable ranges[1] (field precision);
  - RPDs for matrix spike (MS) and matrix spike duplicates (MSDs) compared to acceptable control ranges (matrix precision); and
  - RPDs for primary- and second-column analyses (analytical precision).
- Accuracy, as a measure of the distortion of a measurement process that causes error in measuring the true value, is determined quantitatively based on the analysis of samples with a known concentration. Accuracy of the laboratory data was verified through review of:
  - LCS data, calibration verification data, internal standard data, and instrument tune parameters (laboratory accuracy); and
  - Surrogate recoveries, MSs, and sample preparation (sample-specific accuracy).
- Representativeness of the data was verified through review of:

[1] The CRA Methodology states that the overall precision of the data is considered adequate if the RPD between the target and duplicate, at concentrations five times the reporting limit (RL), is less than 35 percent for solids and 20 percent for liquids. The precision adequacy requirement for radiological contaminants is a DER less than 1.96.

- Laboratory blank data;
- Sample preservation/storage;
- Adherence to sample holding times;
- Documentation issues;
- Contract noncompliance issues; and
- Laboratory activities affecting ability to properly identify compounds.

- Completeness is a data adequacy criterion and is addressed in Appendix A, Volume 2 of the Remedial Investigation/Feasibility Study (RI/FS) Report. It refers to the spatial and temporal distribution of the data, and their adequacy for estimating exposure point concentrations (EPCs) for the CRA.
- Comparability of the data was verified through evaluation of:
  - Analytical procedures, and whether they were standard U.S. Environmental Protection Agency (EPA)- and RFETS-approved procedures;
  - Instrument types and maintenance, sample preparation techniques, and standard units for reporting; and
  - MS and surrogate samples, ensuring accuracy within acceptable ranges.

2.0 ANALYTICAL DATA

Approximately 1,900,000 specific analytical records exist in the sitewide CRA data set, some 89 percent of which (1,663,535 records) have undergone V&V. The fraction of the data that was verified and/or validated is shown in Table A2.1 by analyte group and matrix. These data were reviewed by validators and their observations and comments are captured in the Soil Water Database (SWD). All of the data that have been flagged due to V&V findings (except "R"-flagged data) and data that have no flags as a result of V&V are used in the CRA. The small amount of data that has not undergone V&V is used as provided by the laboratories. The most common errors found during V&V such as transcription errors, calculation errors, and excluded records that were later added by the validator were reviewed to determine the possible effect on non-V&V data. Assuming that the percentage of data qualified as a result of these issues are representative of similar observations in the non-V&V data, less than one percent of the sitewide data set is at risk for such un-acknowledged and therefore un-corrected errors.

Data V&V involves an in-depth review of the data packages from the laboratory to assess compliance with contract requirements. In general, data validation includes all of the activities of verification, as well as additional QC checks and review of some raw laboratory instrument data and calculations. After V&V, a data qualifier flag and/or

reason code(s) are assigned to the data record (Tables A2.2 and A2.3). The reason codes provide an explanation for the qualifier flag, thereby making it possible to determine which of the PARCC parameters is affected by the observation (Table A2.4). Qualifier flags are discussed in this Data Quality Assessment (DQA) as those V&V flags that note issues in the data. V&V flags "V," "V1," and "1" represent data that were reviewed by validators, but no issues were observed. Eighty-five percent of the V&V data fall into this category. Additional qualifier flags such as "A," "E," and "Z" were also applied. These validation qualifiers are notations that do not indicate estimation or a change in the status of detection. The data are valid and useable as reported by the laboratory. Two percent of the V&V data are represented by these additional qualifier flags. The specific definitions of these additional V&V flags are presented in Table A2.2. Data with noted issues are presented in Table A2.5 and discussed in detail in Section 3.0.

V&V qualifier flags are not specifically addressed in this data assessment, but rather the reason codes associated with the qualifier flags for each analytical record are summarized and evaluated. This approach was chosen because the validator's specific observations (reason codes), and not the qualifier flags, provide the best descriptors of the data quality.

V&V data records contain a field with V&V reason codes (5, 18/52, 200, 99/101/701, and so forth), or the field is null. These reason codes represent observations related to assessment of precision, accuracy, and representativeness. For example, the reason code 110 definition (see Table A2.3) is "LCS recovery criteria were not met," which is an observation related to data accuracy.

Multiple reason codes were routinely applied to a specific sample method/matrix/analyte combination. Therefore, it was necessary to parse out the individual codes to create a table that included a unique record identifier and the associated parsed data V&V reason code (5, 18, 52, 200, 99, 101, 701, and so forth). With this information and the data V&V reason code definitions, the data validator's observations related to this data set can be re-created for each analytical record.

To summarize the reason codes in a logical manner for presentation, it was first necessary to group the reason codes that have slightly different definitions but convey the same meaning. A standardized definition was then applied to the individual reason codes within the group. The grouped reason codes were also assigned a QC category (for example, blanks, calibration, and holding time), and the affected PARCC parameter (Table A2.4). The reason codes were then summarized for each medium and analyte group within each QC category, applying the standardized definition to the summarized codes. The summary is presented in Table A2.5.

Rejected data (data qualifier flag "R"), consisting of approximately 2 percent of all V&V data, have been removed from the data used in the sitewide CRA because the validator has determined the data to be unusable. The fraction of the data that was rejected during validation and/or verification is shown in Table A2.6 by analyte group and matrix.

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Finally, evaluating the RPD (DER for radionuclides) between a target sample and the associated field duplicate is not a QC parameter performed during V&V, but is still an important analysis when determining data precision. Because this analysis was not performed during V&V, the target sample/field duplicate RPD and DER calculations were performed separately and are presented in Table A2.7 as the number of exceedances per analyte group/matrix combination. Only those analyte group/matrix combinations having records that met the criteria for calculating an RPD or DER are presented. RPDs and DERs for target sample/field duplicate analyte pairs where one or both of the results are less than five times the RL are not calculated as outlined in the CRA Methodology.

3.0 FINDINGS

V&V observations affecting the sitewide CRA data set are summarized by analyte group/matrix/QC category/V&V observation in Table A2.5. The detected and nondetected results are summarized separately to give the reader a better idea of the impact on data usability. Only those issues observed in notable percentages (generally greater than 5 percent) of the data are discussed below in further detail. RPDs (DERs for radionuclides) presented in Table A2.7 are only discussed below when RPD (DER for radionuclides) exceedances of control criteria are greater than 10 percent for any give analyte group/matrix combination. Instances of elevated rates (greater than 10 percent) of rejected data are also discussed below.

3.1 Dioxins and Furans – Soil

Blank, calibration, confirmation, documentation, and internal standard issues resulted in data V&V qualifications related to this analyte group/matrix combination. The percentage of observations is low with the exception of those records qualified due to blank contamination. While the importance of blank analyses should not be overlooked, it is also important to note that the associated data were qualified as usable, although estimated. Although 43 percent of the target sample/field duplicate analyte pairs exceeded RPD criteria, it is important to note that all exceedances were noted at only five locations. This is more indicative of matrix interference than an overall precision issue.

3.2 Dioxins and Furans – Water

Calibration, documentation, and internal standard issues resulted in data V&V qualifications related to this analyte group/matrix combination. The percentage of observations is low with the exception of those records qualified due to transcription errors. Transcription errors have no impact on data quality as all issues have previously been evaluated and corrected.

3.3 Herbicides – Soil

Calibration, documentation, holding time, internal standard, LCS, matrix, sample preparation, surrogate, and other issues resulted in data V&V qualifications related to this

analyte group/matrix combination. The percentage of all observations is low and within method expectations.

3.4 Herbicides – Water

Calculation error, calibration, documentation, holding time, internal standard, LCS, matrix, sample preparation, surrogate, and other issues resulted in data V&V qualifications related to this analyte group/matrix combination. The percentage of observations is low with the exception of those records qualified due to transcription errors. Transcription errors have no impact on data quality as all issues have previously been evaluated and corrected.

3.5 Metals – Soil

Blank, calculation error, calibration, documentation, holding time, instrument setup, LCS, matrix, sample preparations, sensitivity, and other observations resulted in data V&V qualifications related to this analyte group/matrix combination. The percentage of observations is low with the exception of those records qualified due to pre-digestion MS recoveries and expired instrument detection limit (IDL) studies. While the importance of these QC parameters should not be overlooked, it is also important to note that the associated data were qualified as usable, although estimated. Finally, although 12 percent of the target sample/field duplicate analyte pairs exceeded RPD criteria, it is important to note the majority of exceedances were noted in a limited number of locations within the sitewide data set. This is more indicative of matrix interference, than an overall precision issue.

3.6 Metals – Water

Blank, calculation error, calibration, documentation, holding time, instrument setup, LCS, matrix, sample preparation, sensitivity, and other observations resulted in V&V qualifications associated with this analyte group/matrix combination. The percentage of all observations is low and within method expectations.

3.7 Polychlorinated Biphenyls (PCBs) – Soil

Blank, calculation error, calibration, confirmation, documentation, holding time, matrix, sample preparation, surrogate, and other issues resulted in data V&V observations related to this analyte group/matrix combination. The percentage of all observations is low and within method expectations.

3.8 Polychlorinated Biphenyls – Water

Calibration, documentation, holding time, LCS, surrogate, and other issues resulted in data V&V observations related to this analyte group/matrix combination. The percentage of observations is low with the exception of those records qualified due to transcription

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errors and low surrogate recoveries. Transcription errors have no impact on data usability as all issues have previously been evaluated and corrected. While the importance of surrogate analyses should not be overlooked, it is also important to note that the associated data were qualified as usable, although estimated.

3.9 Pesticides – Soil

Blank, calculation error, calibration, confirmation, documentation, holding time, internal standard, LCS, matrix, sample preparation, surrogate, and other issues resulted in data V&V observations related to this analyte group/matrix combination. The percentage of all observations is low and within method expectations.

3.10 Pesticides – Water

Blank, calibration, confirmation, documentation, holding time, internal standard, matrix, sample preparation, surrogate, and other issues resulted in V&V qualification related to this analyte group/matrix combination. The percentage of observations is low with the exception of those records qualified due to low surrogate recoveries. While the importance of surrogate analyses should not be overlooked, it is also important to note that the data were qualified as usable, although estimated.

3.11 Radionuclides – Soil

Blank, calculation error, calibration, documentation, holding time, instrument setup, LCS, matrix, sample preparation, sensitivity, and other observations resulted in V&V qualifications related to this analyte group/matrix combination. The percentage of observations is low with few exceptions. Insufficient documentation indicates that a complete V&V evaluation may not have been performed, but it is important to note that the data were qualified as usable, although estimated. Transcription errors and validator-calculated minimum detectable activities (MDAs) have no effect on data quality as all issues have previously been evaluated and corrected. While the importance of QC parameters such as blank analyses and continuing calibration verifications should not be overlooked, it is also important to note that the data associated with these observations were qualified as usable, although estimated.

3.12 Radionuclides – Water

Blank, calculation error, calibration, documentation, holding time, instrument setup, LCS, matrix, sample preparation, sensitivity, and other observations resulted in V&V qualifications related to this analyte group/matrix combination. The percentage of observations is low with few exceptions. Insufficient documentation indicates that a complete V&V evaluation may not have been performed, but it is important to note that the data were qualified as usable, although estimated. Validator-calculated MDAs have no effect on data quality as all issues have previously been evaluated and corrected. While the importance of continuing calibration verifications should not be overlooked, it is also important to note that the data were qualified as usable, although estimated.

3.13 Semi-Volatile Organic Compounds (SVOCs) – Soil

Blank, calculation error, calibration, confirmation, documentation, holding time, instrument setup, internal standard, LCS, matrix, sample preparation, surrogate, and other observations resulted in V&V qualifications related to this analyte group/matrix combination. The percentage of all observations is low and within method expectations.

3.14 Semi-Volatile Organic Compounds – Water

Blank, calculation error, calibration, confirmation, documentation, holding time, instrument setup, internal standard, LCS, matrix, sample preparation, surrogate, and other issues resulted in V&V observations related to this analyte group/matrix combination. The percentage of observations is low with the exception of those records qualified due to omissions or errors in the data package. The noted omissions and/or errors do not impact data quality as the omitted data was not required for V&V.

3.15 Volatile Organic Compounds (VOCs) – Soil

Blank, calculation error, calibration, confirmation, documentation, holding time, instrument setup, internal standard, LCS, matrix, sample preparation, surrogate, and other issues resulted in V&V observations related to this analyte group/matrix combination. The percentage of all observations is low and within method expectations.

3.16 Volatile Organic Compounds – Water

Blank, calculation error, calibration, confirmation, documentation, holding time, instrument setup, internal standard, LCS, matrix, sample preparation, sensitivity, surrogate and other issues resulted in V&V observations related to this analyte group/matrix combination. The percentage of observations is low with few exceptions. The omissions or errors noted in the data package do not impact data quality as the omitted data was not required for V&V. Transcription errors also do not impact the usability of the data as all issues have previously been evaluated and corrected. While the importance of observing allowed sample holding times should not be overlooked, it is also important to note that the data were qualified as usable, although estimated.

3.17 Wet Chemistry Parameters – Soil

Blank, calculation error, calibration, documentation, holding time, LCS, matrix, sample preparations, and other issues resulted in V&V observations related to this analyte group/matrix combination. While the percentage of several of the observations is high, it is important to note that this analyte group contains numerous general chemistry parameters having little or no impact on site characterization.

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3.18 Wet Chemistry Parameters – Water

Blank, calculation error, calibration, documentation, holding time, LCS, matrix, sample preparation, and other issues resulted in V&V observations related to this analyte group/matrix combination. The percentage of all observations is low and within method expectations.

4.0 CONCLUSIONS

The quality of the laboratory results were evaluated for compliance with the CRA Methodology data quality objectives (DQOs) through an overall review of PARCC parameters.

Of the data used in the sitewide CRA, approximately 89 percent underwent the V&V process. Of that 89 percent, 85 percent was qualified as having no QC issues, and approximately 13 percent was qualified as estimated or undetected (Table A2.8). The remaining two percent of the V&V data are made up of records qualified with additional flags indicating acceptable data such as "A," "E," or "P." Less than 3 percent of the data reported as detected by the laboratory were flagged as undetected by the validators due to blank contamination (Table A2.9). Data qualified as estimated or undetected indicate some issues with PARCC parameters, but not to a degree sufficient to mark the data unusable. Approximately 2 percent of the entire data set was rejected during the V&V process (Table A2.6).

Although many of the elements of QC that are reviewed in this document affect more than one PARCC parameter, the general discussion below summarizes the data quality per the validation reason codes affecting each specific PARCC parameter. Several V&V reason codes have no real impact on data quality because they represent issues that were noted but corrected, or represent observations related to missing documentation that was not required for data assessment. Approximately 14 percent of the V&V data were flagged with these "Other" V&V observations.

- Precision, as a measure of agreement among replicate measurements, is determined quantitatively based on the results of replicate laboratory measurements.

  Of the V&V data, approximately 2 percent was noted for observations related to precision. Of that 2 percent, 99 percent was qualified for issues related to sample matrices. Result confirmation and instrument setup and sensitivity observations make up the other 1 percent. No LCS issues related to precision were noted.

  RPDs and DERs for target sample/field duplicate pairs were found to be acceptable for all analyte group/matrix combinations. Overall, the method precision was found to be generally acceptable.

- Accuracy is a measure of the distortion of a measurement process that causes error in the true value.

  Of the V&V data, 33 percent was noted for accuracy-related observations. Of that 33 percent, 76 percent was noted for laboratory practice-related observations, while sample-specific accuracy observations make up the other 24 percent. Although the percentage of data with noted accuracy issues is slightly elevated, it is important to note that most of the data flagged with these accuracy-related observations are also flagged as estimated and the CRA is performed with this uncertainty in mind.

  Accuracy was generally acceptable with infrequent performance outside QC limits.

- Representativeness of the data was verified.

  Of the V&V data, approximately 30 percent was noted for observations related to representativeness. Of that 30 percent, 63 percent was qualified for blank observations, 25 percent for failure to observe allowed holding times, 3 percent for documentation issues, 1 percent for instrument sensitivity issues, and approximately 6 percent for sample preparation observations. Instrument setup, LCS, matrix and other observations make up the other 2 percent of the data qualified for observations related to sample representativeness.

  Reportable levels of target analytes were not routinely detected in the laboratory blanks greater than the laboratory RLs except for relatively isolated incidences. Samples were generally stored and preserved properly. Overall, these elements of QC exceedances are indicative of normal laboratory operations and have little impact the sample data as reported.

  Sample data are representative of the site conditions at the time of sample collection.

- Comparability of the data was reviewed and no systematic errors were noted.

  - The use of standard EPA- and RFETS-approved analytical procedures;
  - Instrument types and maintenance, sample preparation techniques, and standard units for reporting; and
  - Evaluation of MS and surrogate samples, ensuring accuracy within acceptable ranges.

  Examination of these parameters did not show any systematic issues with comparability.

- Completeness, as defined in the CRA Methodology, is addressed in Appendix A, Volume 2 of the RI/FS Report.

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Another indication of completeness that is sometimes used is a measure of the number of valid measurements obtained in relation to the total number of measurements planned.

Because only approximately 2 percent of the overall data were rejected, the use of non-V&V data for the sitewide CRA does not contribute to any completeness issues.

This review concludes that the PARCC of the data are generally acceptable and the CRA objectives have been met.

5.0 REFERENCES

K-H, 2004. Final Comprehensive Risk Assessment Work Plan and Methodology, Environmental Restoration, Rocky Flats Environmental Technology Site, Golden, Colorado. September.

EPA, 2002. Guidance for Quality Assurance Project Plans. EPA QA/G-5, EPA/240/R-02/009. Office of Environmental Information, Washington, D.C. December.

TABLES

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Table A2.1
CRA Data V&V Summary

Analyte Group	Matrix	Total No. of V&V Records	Total No. of CRA Records	Percent V&V (%)
Dioxins and Furans	SOIL	908	908	100.00
Dioxins and Furans	WATER	535	675	79.26
Explosive	SOIL	24	24	100.00
Herbicide	SOIL	2,832	3,008	94.15
Herbicide	WATER	1,427	2,475	57.66
Metal	SOIL	187,800	190,111	98.78
Metal	WATER	309,082	347,289	89.00
PCB	SOIL	14,276	15,136	94.32
PCB	WATER	4,779	6,118	78.11
Pesticide	SOIL	22,180	23,796	93.21
Pesticide	WATER	14,045	19,907	70.55
Radionuclide	SOIL	29,121	31,528	92.37
Radionuclide	WATER	71,021	101,963	69.65
SVOC	SOIL	166,283	176,315	94.31
SVOC	WATER	77,082	99,043	77.83
VOC	SOIL	265,381	274,552	96.66
VOC	WATER	453,061	523,174	86.60
Wet Chem	SOIL	5,598	6,012	93.11
Wet Chem	WATER	38,100	47,901	79.54
	Total	**1,663,535**	**1,869,935**	**88.96%**

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Table A2.2
V&V Qualifier Flag Definitions

Validation Qualifier Code	Description
1	QC data from a data package – Verification
A	Data acceptable with qualifications
B	Compound was found in BLK and sample
C	Calibration
E	Associated value exceeds calibration range; dilute and reanalyze
J	Estimated quantity – Validation
J1	Estimated quantity – Verification
JB	Organic method blank contamination – Validation
JB1	Organic method blank contamination – Verification
N	Historical – Validators asked not to validate this
NJ	Associated value is presumptively estimated
NJ1	Value presumptively estimated – Verification
P	Systematic error
R	Data unusable – Validation
R1	Data unusable – Verification
S	Matrix spike
U	Analyzed, not detected at/above method detection limit
U1	Analyzed, not detect at/above method detection limit – Verification
UJ	Associated value is considered estimated at an elevated detection
UJ1	Estimated at elevated level – Verification
V	No problems with the data – Validation
V1	No problems with the data – Verification
Y	Analytical results in validation process
Z	Validation was not requested or could not be performed

Table A2.3
V&V Reason Code Definitions

Validation Reason Code	Description
***	Unknown code from RFEDS
1	Holding times were exceeded
2	Holding times were grossly exceeded
3	Initial calibration correlation coefficient <0.995
4	Calibration verification criteria were not met
5	CRDL check sample recovery criteria were not met
6	Incorrect calibration of instrument
7	Analyte values > IDL were found in the blanks
8	Negative bias was indicated in the blanks
9	Interference indicated in the ICP interference check sample
10	Laboratory control sample recovery criteria were not met
11	Duplicate sample precision criteria were not met
12	Predigestion matrix spike criteria were not met (+/- 25 percent)
13	Predigestion matrix spike criteria were not met (<30 percent)
14	Post-digestion matrix spike recovery criteria were not met
15	MSA was required but not performed
16	MSA calibration correlation coefficient <0.995
17	Serial dilution criteria not met
18	Documentation was not provided
19	Calibration verification criteria not met
20	AA duplicate injection precision criteria were not met
21	Reagent blanks exceeded MDA
22	Tracer contamination
23	Improper aliquot size
24	Sample aliquot not taken quantitatively
25	Primary standard had exceeded expiration date
26	No raw data submitted by the laboratory
27	Recovery criteria were not met
28	Duplicate analysis was not performed
29	Verification criteria were not met
30	Replicate precision criteria were not met
31	Replicate analysis was not performed
32	Laboratory control samples >+/- 3 sigma
33	Laboratory control samples >+/- 2 sigma and <+/- 3 sigma
35	Transformed spectral index external ST criteria were not met
36	MDA exceeded the RDL
37	Sample exceeded efficiency curve weight limit
38	Excessive solids on planchet
39	Tune criteria not met
40	Organics initial calibration criteria were not met
41	Organics continuing calibration criteria were not met
42	Surrogates were outside criteria
43	Internal standards outside criteria
44	No mass spectra were provided
45	Results were not confirmed
47	Percent breakdown exceeded 20 percent
48	Linear range of instrument was exceeded
49	Method blank contamination
51	Nonverifiable laboratory results and/or unsubmitted data

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Table A2.3
V&V Reason Code Definitions

Validation Reason Code	Description
52	Transcription error
53	Calculation error
54	Incorrect reported activity or MDA
55	Result exceeds linear range; serial dilution value reported
56	IDL changed due to significant figure discrepancy
57	Percent solids < 30 percent
58	Percent solids < 10 percent
59	Blank activity exceeded RDL
60	Blank recovery criteria were not met
61	Replicate recovery criteria were not met
62	LCS relative percent error criteria not met
63	LCS expected value not submitted/verifiable
64	Nontraceable/noncertified standard was used
67	Sample results not submitted/verifiable
68	Frequency of quality control samples not met
69	Samples not distilled
70	Resolution criteria not met
71	Unit conversion of results
72	Calibration counting statistics not met
73	Daily instrument performance assessment not performed
74	LCS data not submitted
75	Blank data not submitted
76	Instrument gain and/or efficiency not submitted
77	Detector efficiency criteria not met
78	MDAs were calculated by reviewer
79	Result obtained through dilution
80	Spurious counts of unknown origin
81	Repeat count outside of 3 sigma counting error
82	Sample results were not corrected for decay
83	Sample results were not included on Data Summary Table
84	Key fields wrong
85	Record added by QLI
86	Results considered qualitative not quantitative
87	Laboratory did no analysis for this record
88	Blank corrected results
89	Sample analysis was not requested
90	Sample result was not validated due to reanalysis
91	Unit conversion; QC sample activity/uncertainty/MDA
99	See hard copy for further explanation
101	Holding times were exceeded (attributed to laboratory problem)
102	Holding times were grossly exceeded (attribute to laboratory problem)
103	Calibration correlation coefficient does not meet requirement
104	Calibration verification recovery criteria were not met
105	Low-level check sample recovery criteria were not met
106	Calibration did not contain minimum number of standards
107	Analyte detected but < RDL in calibration blank verification
109	Interference indicated in the ICP interference check sample
110	Laboratory control sample recovery criteria were not met
111	Laboratory duplicate sample precision criteria were not met

Table A2.3
V&V Reason Code Definitions

Validation Reason Code	Description
112	Predigestion matrix spike criteria were not met (+/- 25 percent)
113	Predigestion matrix spike recovery is <30 percent
114	Post-digestion matrix spike criteria were not met
115	MSA was required but not performed
116	MSA calibration correlation coefficient <0.995
117	Serial dilution percent D criteria not met
123	Improper aliquot size
128	Laboratory duplicate was not analyzed
129	Verification criteria for frequency or sequence were not met
130	Replicate precision criteria were not met
131	Confirmation percent difference criteria not met
132	Laboratory control samples >+/- 3 sigma
136	MDA exceeded the RDL
139	Tune criteria not met
140	Requirements for independent calibration verification were not met
141	Continuing calibration verification criteria were not met
142	Surrogates were outside criteria
143	Internal standards outside criteria
145	Results were not confirmed
147	Percent breakdown exceeded 20 percent
148	Linear range of measurement system was exceeded
149	Method, preparation, or reagent blank contamination > RDL
150	Unknown carrier volume
152	Reported data do not agree with raw data
153	Calculation error
155	Original result exceeds linear range; serial dilution value reported
159	Magnitude of calibration verification blank result exceeded the RDL
164	Standard traceability or certification requirements not met
166	Carrier aliquot nonverifiable
168	QC sample frequency does not meet requirements
170	Resolution criteria not met
172	Calibration counting statistics not met
174	LCS data not submitted
175	Blank data not submitted
177	Detector efficiency criteria not met
188	Blank corrected results
199	See hard copy for further explanation
201	Preservation requirements not met by the laboratory
205	Unobtainable omissions or errors on SDP (required for databases)
206	Analyses were not requested according to the SOW
207	Sample pretreatment or sample preparation method is incorrect
211	Poor cleanup recovery
212	Instrument detection limit was not provided
213	Instrument detection limit is > the associated RDL
214	IDL is older than 3 months from date of analysis
215	Blank results were not reported to the IDL/MDL
216	Post-digestion spike recoveries outside of 85-115 percent criteria
217	Post-digestion spike recoveries were < 10 percent
218	Sample COC was not verifiable (attributed to laboratory)

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Table A2.3
V&V Reason Code Definitions

Validation Reason Code	Description
219	Standards have expired or are not valid
220	TCLP sample percent solids < 0.5 percent
222	TCLP particle size was not performed
224	Incomplete TCLP extraction data
225	Insufficient TCLP extraction time
226	TIC misidentification
227	No documentation regarding deviations from methods or SOW
228	Calibration recoveries affecting data quality have not been met
229	Element not analyzed in ICP interference check sample
230	QC sample/analyte (e.g., spike, duplicate, LCS) not analyzed
231	MS/MSD criteria not met
232	Control limits not assigned correctly
233	Sample matrix QC does not represent samples analyzed
234	QC sample does not meet method requirement
235	Duplicate sample control limits do not pass
236	LCS control limits do not pass
237	Preparation blank control limits do not pass
238	Blank correction was not performed
239	Winsorized mean plus standard deviation of the same not calculated or calculated wrong
240	Sample preparations for soil/sludge/sediment were not homog/aliq properly
241	No micro PPT or electroplating data available
242	Tracer requirements were not met
243	Standard values were not calculated correctly (LCS, tracer, standards)
244	Standard or tracer is not NIST traceable
245	Energy calibration criteria not met
246	Background calibration criteria were not met
247	Sample or control analysis not chemically separated from each other
248	Single combined TCLP result was not repeated for sample with both mis+nonm
249	Result qualified due to blank contamination
250	Incorrect analysis sequence
251	Misidentified target compounds
252	Result is suspect DU
701	Holding times were exceeded (not attributed to laboratory)
702	Holding times were grossly exceeded (not attributed to laboratory)
703	Samples were not preserved properly in the field (not attributed to laboratory)
801	Missing deliverables (required for data assessment)
802	Missing deliverables (not required for data assessment)
803	Omissions or errors on SDP deliverables (required for data assessment)
804	Omissions or errors on SDP deliverables (not required for data assessment
805	Information missing from case narrative
806	Site samples not used for sample matrix QC
807	Original documentation not provided
808	Incorrect or incomplete DRC
809	Non-site samples reported with site samples
810	EDD does not match hard copy; EDD may be resubmitted

Table A2.4
Standardized V&V Reason Code Definitions, QC Categories, and Affected PARCC Parameters

Validation Reason Codes	Standardized Description	QC Category	Affected PARCC Parameter
188, 88	Blank corrected results	Blanks	Representativeness
238	Blank correction was not performed	Blanks	Representativeness
175, 75	Blank data not submitted	Blanks	Representativeness
60	Blank recovery criteria were not met	Blanks	Representativeness
215	Blank results were not reported to the IDL/MDL	Blanks	Representativeness
107, 159	Calibration verification blank contamination	Blanks	Representativeness
149, 21, 237, 249, 49, 59, 7	Method, preparation, or reagent blank contamination	Blanks	Representativeness
8	Negative bias indicated in the blanks	Blanks	Representativeness
153, 53	Calculation error	Calculation Errors	Other
232	Control limits not assigned correctly	Calculation Errors	Other
246	Background calibration criteria were not met	Calibration	Accuracy
103, 3	Calibration correlation coefficient did not meet requirements	Calibration	Accuracy
172, 72	Calibration counting statistics did not meet criteria	Calibration	Accuracy
106	Calibration did not contain minimum number of standards	Calibration	Accuracy
228	Calibration requirements affecting data quality have not been met	Calibration	Accuracy
104, 141, 19, 29, 4, 40, 41	Continuing calibration verification criteria were not met	Calibration	Accuracy
245	Energy calibration criteria not met	Calibration	Accuracy
6	Incorrect calibration of instrument	Calibration	Accuracy
148, 48	Result exceeded linear range of measurement system	Calibration	Accuracy
155, 55	Original result exceeded linear range, serial dilution value reported	Calibration	Accuracy
140	Requirements for independent calibration verification were not met	Calibration	Accuracy
129	Frequency or sequencing verification criteria not met	Calibration	Accuracy
131	Confirmation percent difference criteria not met	Confirmation	Precision
145, 45	Results were not confirmed	Confirmation	Precision
18	Sufficient documentation not provided by the laboratory	Documentation issues	Representativeness
705	Electronic qualifiers were applied from validation report by hand	Documentation issues	Other
805	Information missing from case narrative	Documentation issues	Other
84	Key data field incorrect	Documentation issues	Other
802	Missing deliverables (not required for validation)	Documentation issues	Other
801	Missing deliverables (required for validation)	Documentation issues	Representativeness
227	No documentation regarding deviations from methods or SOW	Documentation issues	Other
44	No mass spectra were provided	Documentation issues	Representativeness
241	No micro pipette or electroplating data available	Documentation issues	Other
26	No raw data submitted by the laboratory	Documentation issues	Representativeness
804	Omissions or errors in SDP (not required for validation)	Documentation issues	Other
803	Omissions or errors in SDP (required for validation)	Documentation issues	Representativeness
807	Original documentation not provided	Documentation issues	Other

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Table A2.4
Standardized V&V Reason Code Definitions, QC Categories, and Affected PARCC Parameters

Validation Reason Codes	Standardized Description	QC Category	Affected PARCC Parameter
85	Record added by the validator	Documentation issues	Other
152	Reported data do not agree with raw data	Documentation issues	Other
89	Sample analysis was not requested	Documentation issues	Other
218	Sample COC was not verifiable (attributed to laboratory)	Documentation issues	Representativeness
704	Sample COC was not verifiable (not attributed to laboratory)	Documentation issues	Representativeness
83	Sample results were not included on Data Summary Table	Documentation issues	Other
52	Transcription error	Documentation issues	Other
205	Unobtainable omissions or errors on SDP (required for data assessment)	Documentation issues	Representativeness
1, 101, 701	Holding times were exceeded	Holding times	Representativeness
2, 102, 702	Holding times were grossly exceeded	Holding times	Representativeness
251	Misidentified target compounds	Identification errors	Representativeness
70	Resolution criteria not met	Identification errors	Representativeness
226	TIC misidentification	Identification errors	Representativeness
143, 43	Internal standards did not meet criteria	Internal standards	Accuracy
5	CRDL check sample recovery criteria were not met	LCS	Accuracy
33	LCS > ± 2 sigma and < ± 3 sigma	LCS	Accuracy
10, 110, 236	LCS recovery criteria were not met	LCS	Accuracy
132, 32	Laboratory control samples > ± 3 sigma	LCS	Accuracy
174, 74	LCS data not submitted	LCS	Representativeness
63	Expected LCS value not submitted/verifiable	LCS	Representativeness
62	LCS relative percent error criteria not met	LCS	Accuracy
105	Low-level check sample recovery criteria were not met	LCS	Accuracy
230	QC sample/analyte (e.g., spike, duplicate, LCS) not analyzed	LCS	Representativeness
28	Duplicate analysis was not performed	Matrices	Precision
11, 235	Duplicate sample precision criteria were not met	Matrices	Precision
111	LCS/LCSD precision criteria were not met	Matrices	Precision
128	Laboratory duplicate was not analyzed	Matrices	Precision
231	MS/MSD criteria not met	Matrices	Precision
116, 16	MSA calibration correlation coefficient <0.995	Matrices	Accuracy
115, 15	MSA was required but not performed	Matrices	Representativeness
58	Sample contained < 10 percent solid material	Matrices	Representativeness
57	Sample contained < 30 percent solid material	Matrices	Representativeness
217	Post-digestion spike recoveries were < 10%	Matrices	Accuracy
14, 114, 216	Post-digestion matrix spike criteria were not met	Matrices	Accuracy
113, 13	Predigestion matrix spike recovery is <30%	Matrices	Accuracy
112, 12	Predigestion matrix spike recovery criteria were not met	Matrices	Accuracy
27	Recovery criteria were not met	Matrices	Accuracy
31	Replicate analysis was not performed	Matrices	Precision
130, 30	Replicate precision criteria were not met	Matrices	Precision
61	Replicate recovery criteria were not met	Matrices	Accuracy
233	Sample matrix QC does not represent samples analyzed	Matrices	Representativeness
117, 17	Serial dilution criteria not met	Matrices	Accuracy

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Table A2.4
Standardized V&V Reason Code Definitions, QC Categories, and Affected PARCC Parameters

Validation Reason Codes	Standardized Description	QC Category	Affected PARCC Parameter
806	Site samples not used for sample matrix QC	Matrices	Representativeness
810	EDD does not match hard copy; EDD may be resubmitted	Other	Other
214	IDL is older than 3 months from date of analysis	Other	Accuracy
250	Incorrect analysis sequence	Other	Representativeness
808	Incorrect or incomplete DRC	Other	Representativeness
212	Instrument detection limit was not provided	Other	Other
87	Laboratory did no analysis for this record	Other	Other
809	Nonsite samples reported with Site samples	Other	Other
64	Nontraceable/noncertified standard was used	Other	Accuracy
51	Nonverifiable laboratory results and/or unsubmitted data	Other	Representativeness
211	Poor cleanup recovery	Other	Accuracy
25	Primary standard had exceeded expiration date	Other	Accuracy
234	QC sample does not meet method requirement	Other	Representativeness
168, 68	QC sample frequency does not meet requirements	Other	Representativeness
252	Result is suspect due to dilution	Other	Other
79	Result obtained through dilution	Other	Other
37	Sample exceeded efficiency curve weight limit	Other	Accuracy
247	Sample or control analyses not chemically separated from each other	Other	Representativeness
90	Sample result was not validated due to re-analysis	Other	Other
67	Sample results not submitted/verifiable	Other	Representativeness
199, 99	See hard copy for further explanation	Other	Other
248	Single combined TCLP results was not reported for sample with both mis+nonm	Other	Accuracy
80	Spurious counts of unknown origin	Other	Representativeness
244	Standard or tracer is not NIST traceable	Other	Accuracy
164	Standard traceability or certification requirements not met	Other	Accuracy
219	Standards have expired or are not valid	Other	Accuracy
243	Standard values were not calculated correctly (LCS, tracer, standards)	Other	Other
22	Tracer contamination	Other	Accuracy
242	Tracer requirements were not met	Other	Accuracy
71	Unit conversion of results	Other	Other
239	Winsorized mean+standard deviation of the same not calculated or calculated wrong	Other	Other
38	Excessive solids on planchet	Sample preparation	Accuracy
123, 23	Improper aliquot size	Sample preparation	Accuracy
224	Incomplete TCLP extraction data	Sample preparation	Representativeness
225	Insufficient TCLP extraction time	Sample preparation	Representativeness
201	Preservation requirements not met by the laboratory	Sample preparation	Representativeness
24	Sample aliquot not taken quantitatively	Sample preparation	Accuracy
240	Sample preparation for soil/sludge/ sediment were not homog/aliq properly	Sample preparation	Representativeness
207	Sample pretreatment or preparation method is incorrect	Sample preparation	Representativeness
69	Samples not distilled	Sample preparation	Representativeness
703	Samples were not preserved properly in the field	Sample preparation	Representativeness

Table A2.4
Standardized V&V Reason Code Definitions, QC Categories, and Affected PARCC Parameters

Validation Reason Codes	Standardized Description	QC Category	Affected PARCC Parameter
222	TCLP particle size was not performed	Sample preparation	Representativeness
220	TCLP sample percent solids < 0.5 percent	Sample preparation	Representativeness
56	IDL changed due to significant figure discrepancy	Sensitivity	Representativeness
54	Incorrect reported activity or MDA	Sensitivity	Other
213	Instrument detection limit > the associated RDL	Sensitivity	Representativeness
136, 36	MDA exceeded the RDL	Sensitivity	Representativeness
78	MDA was calculated by reviewer	Sensitivity	Other
81	Repeat count outside of 3 sigma counting error	Sensitivity	Precision
86	Results considered qualitative not quantitative	Sensitivity	Accuracy
82	Sample results were not corrected for decay	Sensitivity	Other
91	Unit conversion, QC sample activity uncertainty/MDA	Sensitivity	Representativeness
142, 42	Surrogates were outside criteria	Surrogate	Accuracy
20	AA duplicate injection precision criteria were not met	Instrument Set-up	Precision
73	Daily instrument performance assessment not performed	Instrument Set-up	Accuracy
177, 77	Detector efficiency criteria not met	Instrument Set-up	Accuracy
229	Element not analyzed in ICP interference check sample	Instrument Set-up	Representativeness
76	Instrument gain and/or efficiency not submitted	Instrument Set-up	Representativeness
109, 9	Interference indicated in the ICP interference check sample	Instrument Set-up	Accuracy
147, 47	Percent breakdown exceeded 20 percent	Instrument Set-up	Representativeness
170	Resolution criteria not met	Instrument Set-up	Representativeness
35	Transformed spectral index external site criteria were not met	Instrument Set-up	Representativeness
139, 39	Tune criteria not met	Instrument Set-up	Accuracy
206	Analysis was not requested according to SOW	Unknown	Other
166	Carrier aliquot nonverifiable	Unknown	Representativeness
150	Unknown carrier volume	Unknown	Representativeness

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Table A2.5
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect ?	No. of Qualified Results	Total No. of V&V Records	Percent Qualified (%)
Dioxins and Furans	SOIL	Blanks	Calibration verification blank contamination	Yes	21	908	2.31
Dioxins and Furans	SOIL	Blanks	Method, preparation, or reagent blank contamination	Yes	131	908	14.43
Dioxins and Furans	SOIL	Calibration	Continuing calibration verification criteria were not met	No	7	908	0.77
Dioxins and Furans	SOIL	Calibration	Continuing calibration verification criteria were not met	Yes	6	908	0.66
Dioxins and Furans	SOIL	Confirmation	Confirmation percent difference criteria not met	Yes	26	908	2.86
Dioxins and Furans	SOIL	Documentation Issues	Transcription error	No	7	908	0.77
Dioxins and Furans	SOIL	Internal Standards	Internal standards did not meet criteria	No	2	908	0.22
Dioxins and Furans	SOIL	Internal Standards	Internal standards did not meet criteria	Yes	3	908	0.33
Dioxins and Furans	WATER	Calibration	Continuing calibration verification criteria were not met	No	14	535	2.62
Dioxins and Furans	WATER	Documentation Issues	Record added by the validator	No	9	535	1.68
Dioxins and Furans	WATER	Documentation Issues	Transcription error	No	51	535	9.53
Dioxins and Furans	WATER	Internal Standards	Internal standards did not meet criteria	No	22	535	4.11
Herbicide	SOIL	Calibration	Continuing calibration verification criteria were not met	No	100	2,832	3.53
Herbicide	SOIL	Documentation Issues	Missing deliverables (not required for validation)	No	5	2,832	0.18
Herbicide	SOIL	Documentation Issues	Missing deliverables (required for validation)	No	1	2,832	0.04
Herbicide	SOIL	Documentation Issues	Omissions or errors in data package (not required for validation)	No	57	2,832	2.01
Herbicide	SOIL	Documentation Issues	Record added by the validator	No	7	2,832	0.25
Herbicide	SOIL	Documentation Issues	Transcription error	No	27	2,832	0.95
Herbicide	SOIL	Holding Times	Holding times were exceeded	No	55	2,832	1.94
Herbicide	SOIL	Internal Standards	Internal standards did not meet criteria	No	7	2,832	0.25
Herbicide	SOIL	LCS	LCS recovery criteria were not met	No	2	2,832	0.07
Herbicide	SOIL	Matrices	MS/MSD precision criteria were not met	No	30	2,832	1.06
Herbicide	SOIL	Other	Sample results were not validated due to re-analysis	No	55	2,832	1.94
Herbicide	SOIL	Other	See hard copy for further explanation	No	9	2,832	0.32
Herbicide	SOIL	Sample Preparation	Samples were not properly preserved in the field	No	31	2,832	1.09
Herbicide	SOIL	Surrogates	Surrogate recovery criteria were not met	No	24	2,832	0.85
Herbicide	WATER	Calculation Errors	Calculation error	No	3	1,427	0.21
Herbicide	WATER	Calibration	Continuing calibration verification criteria were not met	No	37	1,427	2.59

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Table A2.5
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect ?	No. of Qualified Results	Total No. of V&V Records	Percent Qualified (%)
Herbicide	WATER	Calibration	Continuing calibration verification criteria were not met	Yes	1	1,427	0.07
Herbicide	WATER	Documentation Issues	Missing deliverables (not required for validation)	No	5	1,427	0.35
Herbicide	WATER	Documentation Issues	Omissions or errors in data package (not required for validation)	No	36	1,427	2.52
Herbicide	WATER	Documentation Issues	Omissions or errors in data package (required for validation)	No	1	1,427	0.07
Herbicide	WATER	Documentation Issues	Original documentation not provided	No	7	1,427	0.49
Herbicide	WATER	Documentation Issues	Record added by the validator	No	10	1,427	0.70
Herbicide	WATER	Documentation Issues	Transcription error	No	133	1,427	9.32
Herbicide	WATER	Documentation Issues	Transcription error	Yes	21	1,427	1.47
Herbicide	WATER	Holding Times	Holding times were exceeded	No	30	1,427	2.10
Herbicide	WATER	Internal Standards	Internal standards did not meet criteria	No	7	1,427	0.49
Herbicide	WATER	LCS	LCS recovery criteria were not met	No	2	1,427	0.14
Herbicide	WATER	Matrices	MS/MSD precision criteria were not met	No	3	1,427	0.21
Herbicide	WATER	Matrices	Site samples were not used for sample matrix QC	No	3	1,427	0.21
Herbicide	WATER	Other	Lab results not verified due to unsubmitted data	No	1	1,427	0.07
Herbicide	WATER	Other	Sample results were not validated due to re-analysis	No	15	1,427	1.05
Herbicide	WATER	Other	See hard copy for further explanation	No	53	1,427	3.71
Herbicide	WATER	Sample Preparation	Samples were not properly preserved in the field	No	13	1,427	0.91
Herbicide	WATER	Surrogates	Surrogate recovery criteria were not met	No	13	1,427	0.91
Metal	SOIL	Blanks	Calibration verification blank contamination	No	7,543	187,800	4.02
Metal	SOIL	Blanks	Calibration verification blank contamination	Yes	1,228	187,800	0.65
Metal	SOIL	Blanks	Method, preparation, or reagent blank contamination	No	3,689	187,800	1.96
Metal	SOIL	Blanks	Method, preparation, or reagent blank contamination	Yes	1,116	187,800	0.59
Metal	SOIL	Blanks	Negative bias indicated in the blanks	No	668	187,800	0.36
Metal	SOIL	Blanks	Negative bias indicated in the blanks	Yes	644	187,800	0.34
Metal	SOIL	Calculation Errors	Calculation error	Yes	18	187,800	0.01
Metal	SOIL	Calculation Errors	Control limits not assigned correctly	No	890	187,800	0.47
Metal	SOIL	Calculation Errors	Control limits not assigned correctly	Yes	2,850	187,800	1.52
Metal	SOIL	Calibration	Calibration correlation coefficient did not meet requirements	No	39	187,800	0.02
Metal	SOIL	Calibration	Calibration correlation coefficient did not meet requirements	Yes	80	187,800	0.04
Metal	SOIL	Calibration	Continuing calibration verification criteria were not met	No	29	187,800	0.02
Metal	SOIL	Calibration	Continuing calibration verification criteria were not met	Yes	34	187,800	0.02
Metal	SOIL	Calibration	Frequency or sequencing verification criteria not met	No	16	187,800	0.01
Metal	SOIL	Calibration	Frequency or sequencing verification criteria not met	Yes	35	187,800	0.02
Metal	SOIL	Calibration	Original result exceeded linear range, serial dilution value reported	Yes	1	187,800	0.00

Table A2.5
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect ?	No. of Qualified Results	Total No. of V&V Records	Percent Qualified (%)
Metal	SOIL	Documentation Issues	Information missing from case narrative	No	6	187,800	0.00
Metal	SOIL	Documentation Issues	Information missing from case narrative	Yes	21	187,800	0.01
Metal	SOIL	Documentation Issues	Key data fields incorrect	No	135	187,800	0.07
Metal	SOIL	Documentation Issues	Key data fields incorrect	Yes	257	187,800	0.14
Metal	SOIL	Documentation Issues	Missing deliverables (not required for validation)	No	54	187,800	0.03
Metal	SOIL	Documentation Issues	Missing deliverables (not required for validation)	Yes	260	187,800	0.14
Metal	SOIL	Documentation Issues	Missing deliverables (required for validation)	No	24	187,800	0.01
Metal	SOIL	Documentation Issues	Missing deliverables (required for validation)	Yes	88	187,800	0.05
Metal	SOIL	Documentation Issues	Omissions or errors in data package (not required for validation)	No	918	187,800	0.49
Metal	SOIL	Documentation Issues	Omissions or errors in data package (not required for validation)	Yes	3,116	187,800	1.66
Metal	SOIL	Documentation Issues	Omissions or errors in data package (required for validation)	Yes	3	187,800	0.00
Metal	SOIL	Documentation Issues	Record added by the validator	No	75	187,800	0.04
Metal	SOIL	Documentation Issues	Record added by the validator	Yes	191	187,800	0.10
Metal	SOIL	Documentation Issues	Transcription error	No	1,422	187,800	0.76
Metal	SOIL	Documentation Issues	Transcription error	Yes	6,142	187,800	3.27
Metal	SOIL	Holding Times	Holding times were exceeded	No	50	187,800	0.03
Metal	SOIL	Holding Times	Holding times were exceeded	Yes	103	187,800	0.05
Metal	SOIL	Holding Times	Holding times were grossly exceeded	No	1	187,800	0.00
Metal	SOIL	Holding Times	Holding times were grossly exceeded	Yes	21	187,800	0.01
Metal	SOIL	Instrument Set-up	AA duplicate injection precision criteria were not met	Yes	1	187,800	0.00
Metal	SOIL	Instrument Set-up	Interference was indicated in the interference check sample	No	470	187,800	0.25
Metal	SOIL	Instrument Set-up	Interference was indicated in the interference check sample	Yes	850	187,800	0.45
Metal	SOIL	LCS	CRDL check sample recovery criteria were not met	No	781	187,800	0.42
Metal	SOIL	LCS	CRDL check sample recovery criteria were not met	Yes	1,031	187,800	0.55
Metal	SOIL	LCS	LCS recovery criteria were not met	No	3,052	187,800	1.63
Metal	SOIL	LCS	LCS recovery criteria were not met	Yes	5,083	187,800	2.71
Metal	SOIL	LCS	Low level check sample recovery criteria were not met	No	4,525	187,800	2.41
Metal	SOIL	LCS	Low level check sample recovery criteria were not met	Yes	4,617	187,800	2.46
Metal	SOIL	LCS	QC sample/analyte (e.g. spike, duplicate, LCS) was not analyzed	No	119	187,800	0.06
Metal	SOIL	LCS	QC sample/analyte (e.g. spike, duplicate, LCS) was not analyzed	Yes	419	187,800	0.22
Metal	SOIL	Matrices	Duplicate sample precision criteria were not met	No	82	187,800	0.04
Metal	SOIL	Matrices	Duplicate sample precision criteria were not met	Yes	2,326	187,800	1.24
Metal	SOIL	Matrices	LCS/LCSD precision criteria were not met	No	93	187,800	0.05

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Table A2.5
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect ?	No. of Qualified Results	Total No. of V&V Records	Percent Qualified (%)
Metal	SOIL	Matrices	LCS/LCSD precision criteria were not met	Yes	1,809	187,800	0.96
Metal	SOIL	Matrices	MSA calibration correlation coefficient < 0.995	Yes	25	187,800	0.01
Metal	SOIL	Matrices	MSA was required, but not performed	Yes	4	187,800	0.00
Metal	SOIL	Matrices	Percent solids < 30 percent	No	20	187,800	0.01
Metal	SOIL	Matrices	Percent solids < 30 percent	Yes	200	187,800	0.11
Metal	SOIL	Matrices	Post-digestion MS did not meet control criteria	No	523	187,800	0.28
Metal	SOIL	Matrices	Post-digestion MS did not meet control criteria	Yes	472	187,800	0.25
Metal	SOIL	Matrices	Predigestion MS recovery criteria were not met	No	5,750	187,800	3.06
Metal	SOIL	Matrices	Predigestion MS recovery criteria were not met	Yes	14,802	187,800	7.88
Metal	SOIL	Matrices	Predigestion MS recovery was < 30 percent	No	45	187,800	0.02
Metal	SOIL	Matrices	Predigestion MS recovery was < 30 percent	Yes	813	187,800	0.43
Metal	SOIL	Matrices	Serial dilution criteria were not met	No	69	187,800	0.04
Metal	SOIL	Matrices	Serial dilution criteria were not met	Yes	4,161	187,800	2.22
Metal	SOIL	Other	IDL is older than 3 months from date of analysis	No	15,175	187,800	8.08
Metal	SOIL	Other	IDL is older than 3 months from date of analysis	Yes	48,509	187,800	25.83
Metal	SOIL	Other	Primary standard exceeded the expiration date	Yes	1	187,800	0.00
Metal	SOIL	Other	Result obtained through dilution	No	7	187,800	0.00
Metal	SOIL	Other	Result obtained through dilution	Yes	193	187,800	0.10
Metal	SOIL	Other	See hard copy for further explanation	No	318	187,800	0.17
Metal	SOIL	Other	See hard copy for further explanation	Yes	1,186	187,800	0.63
Metal	SOIL	Sample Preparation	Sample pretreatment or preparation method was incorrect	No	5	187,800	0.00
Metal	SOIL	Sample Preparation	Sample pretreatment or preparation method was incorrect	Yes	44	187,800	0.02
Metal	SOIL	Sample Preparation	Samples were not properly preserved in the field	No	36	187,800	0.02
Metal	SOIL	Sample Preparation	Samples were not properly preserved in the field	Yes	152	187,800	0.08
Metal	SOIL	Sensitivity	IDL changed due to a significant figure discrepancy	No	65	187,800	0.03
Metal	SOIL	Sensitivity	IDL changed due to a significant figure discrepancy	Yes	1	187,800	0.00
Metal	WATER	Blanks	Calibration verification blank contamination	No	10,426	309,082	3.37
Metal	WATER	Blanks	Calibration verification blank contamination	Yes	1,591	309,082	0.51
Metal	WATER	Blanks	Method, preparation, or reagent blank contamination	No	17,005	309,082	5.50
Metal	WATER	Blanks	Method, preparation, or reagent blank contamination	Yes	3,651	309,082	1.18
Metal	WATER	Blanks	Negative bias indicated in the blanks	No	3,396	309,082	1.10
Metal	WATER	Blanks	Negative bias indicated in the blanks	Yes	2,000	309,082	0.65
Metal	WATER	Calculation Errors	Calculation error	No	8	309,082	0.00
Metal	WATER	Calculation Errors	Calculation error	Yes	1	309,082	0.00
Metal	WATER	Calculation Errors	Control limits not assigned correctly	No	566	309,082	0.18
Metal	WATER	Calculation Errors	Control limits not assigned correctly	Yes	556	309,082	0.18
Metal	WATER	Calibration	Calibration correlation coefficient did not meet requirements	No	1,182	309,082	0.38
Metal	WATER	Calibration	Calibration correlation coefficient did not meet requirements	Yes	245	309,082	0.08

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Table A2.5
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect ?	No. of Qualified Results	Total No. of V&V Records	Percent Qualified (%)
Metal	WATER	Calibration	Continuing calibration verification criteria were not met	No	197	309,082	0.06
Metal	WATER	Calibration	Continuing calibration verification criteria were not met	Yes	219	309,082	0.07
Metal	WATER	Calibration	Frequency or sequencing verification criteria not met	No	116	309,082	0.04
Metal	WATER	Calibration	Frequency or sequencing verification criteria not met	Yes	275	309,082	0.09
Metal	WATER	Calibration	Result exceeded linear range of measurement system	Yes	4	309,082	0.00
Metal	WATER	Documentation Issues	Electronic qualifiers were applied from validation report by hand	No	93	309,082	0.03
Metal	WATER	Documentation Issues	Electronic qualifiers were applied from validation report by hand	Yes	52	309,082	0.02
Metal	WATER	Documentation Issues	Information missing from case narrative	No	94	309,082	0.03
Metal	WATER	Documentation Issues	Information missing from case narrative	Yes	93	309,082	0.03
Metal	WATER	Documentation Issues	Key data fields incorrect	No	474	309,082	0.15
Metal	WATER	Documentation Issues	Key data fields incorrect	Yes	1,713	309,082	0.55
Metal	WATER	Documentation Issues	Missing deliverables (not required for validation)	No	1,571	309,082	0.51
Metal	WATER	Documentation Issues	Missing deliverables (not required for validation)	Yes	1,310	309,082	0.42
Metal	WATER	Documentation Issues	Missing deliverables (required for validation)	No	1,460	309,082	0.47
Metal	WATER	Documentation Issues	Missing deliverables (required for validation)	Yes	1,587	309,082	0.51
Metal	WATER	Documentation Issues	No raw data submitted by the laboratory	No	2	309,082	0.00
Metal	WATER	Documentation Issues	No raw data submitted by the laboratory	Yes	1	309,082	0.00
Metal	WATER	Documentation Issues	Omissions or errors in data package (not required for validation)	No	6,605	309,082	2.14
Metal	WATER	Documentation Issues	Omissions or errors in data package (not required for validation)	Yes	9,780	309,082	3.16
Metal	WATER	Documentation Issues	Omissions or errors in data package (required for validation)	No	122	309,082	0.04
Metal	WATER	Documentation Issues	Omissions or errors in data package (required for validation)	Yes	79	309,082	0.03
Metal	WATER	Documentation Issues	Original documentation not provided	No	6	309,082	0.00
Metal	WATER	Documentation Issues	Original documentation not provided	Yes	6	309,082	0.00
Metal	WATER	Documentation Issues	Record added by the validator	No	485	309,082	0.16
Metal	WATER	Documentation Issues	Record added by the validator	Yes	536	309,082	0.17
Metal	WATER	Documentation Issues	Reported data does not agree with raw data	No	1	309,082	0.00
Metal	WATER	Documentation Issues	Transcription error	No	7,603	309,082	2.46
Metal	WATER	Documentation Issues	Transcription error	Yes	3,443	309,082	1.11
Metal	WATER	Holding Times	Holding times were exceeded	No	454	309,082	0.15
Metal	WATER	Holding Times	Holding times were exceeded	Yes	249	309,082	0.08
Metal	WATER	Holding Times	Holding times were grossly exceeded	No	2	309,082	0.00
Metal	WATER	Holding Times	Holding times were grossly exceeded	Yes	11	309,082	0.00
Metal	WATER	Instrument Set-up	AA duplicate injection precision criteria were not met	No	16	309,082	0.01
Metal	WATER	Instrument Set-up	AA duplicate injection precision criteria were not met	Yes	7	309,082	0.00

Table A2.5
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect ?	No. of Qualified Results	Total No. of V&V Records	Percent Qualified (%)
Metal	WATER	Instrument Set-up	Element not analyzed in the interference check sample	Yes	3	309,082	0.00
Metal	WATER	Instrument Set-up	Interference was indicated in the interference check sample	No	990	309,082	0.32
Metal	WATER	Instrument Set-up	Interference was indicated in the interference check sample	Yes	1,555	309,082	0.50
Metal	WATER	LCS	CRDL check sample recovery criteria were not met	No	1,418	309,082	0.46
Metal	WATER	LCS	CRDL check sample recovery criteria were not met	Yes	1,359	309,082	0.44
Metal	WATER	LCS	LCS data not submitted by the laboratory	No	6	309,082	0.00
Metal	WATER	LCS	LCS recovery criteria were not met	No	549	309,082	0.18
Metal	WATER	LCS	LCS recovery criteria were not met	Yes	1,108	309,082	0.36
Metal	WATER	LCS	Low level check sample recovery criteria were not met	No	2,757	309,082	0.89
Metal	WATER	LCS	Low level check sample recovery criteria were not met	Yes	2,345	309,082	0.76
Metal	WATER	LCS	QC sample/analyte (e.g. spike, duplicate, LCS) was not analyzed	No	452	309,082	0.15
Metal	WATER	LCS	QC sample/analyte (e.g. spike, duplicate, LCS) was not analyzed	Yes	384	309,082	0.12
Metal	WATER	Matrices	Duplicate analysis was not performed	No	167	309,082	0.05
Metal	WATER	Matrices	Duplicate analysis was not performed	Yes	69	309,082	0.02
Metal	WATER	Matrices	Duplicate sample precision criteria were not met	No	406	309,082	0.13
Metal	WATER	Matrices	Duplicate sample precision criteria were not met	Yes	1,622	309,082	0.52
Metal	WATER	Matrices	LCS/LCSD precision criteria were not met	No	446	309,082	0.14
Metal	WATER	Matrices	LCS/LCSD precision criteria were not met	Yes	601	309,082	0.19
Metal	WATER	Matrices	MS/MSD precision criteria were not met	No	21	309,082	0.01
Metal	WATER	Matrices	MS/MSD precision criteria were not met	Yes	3	309,082	0.00
Metal	WATER	Matrices	MSA calibration correlation coefficient < 0.995	No	10	309,082	0.00
Metal	WATER	Matrices	MSA calibration correlation coefficient < 0.995	Yes	54	309,082	0.02
Metal	WATER	Matrices	MSA was required, but not performed	Yes	8	309,082	0.00
Metal	WATER	Matrices	Post-digestion MS did not meet control criteria	No	2,871	309,082	0.93
Metal	WATER	Matrices	Post-digestion MS did not meet control criteria	Yes	711	309,082	0.23
Metal	WATER	Matrices	Predigestion MS recovery criteria were not met	No	3,783	309,082	1.22
Metal	WATER	Matrices	Predigestion MS recovery criteria were not met	Yes	4,347	309,082	1.41
Metal	WATER	Matrices	Predigestion MS recovery was < 30 percent	No	18	309,082	0.01
Metal	WATER	Matrices	Predigestion MS recovery was < 30 percent	Yes	150	309,082	0.05
Metal	WATER	Matrices	Recovery criteria were not met	Yes	12	309,082	0.00
Metal	WATER	Matrices	Serial dilution criteria were not met	No	273	309,082	0.09
Metal	WATER	Matrices	Serial dilution criteria were not met	Yes	5,529	309,082	1.79
Metal	WATER	Matrices	Site samples were not used for sample matrix QC	No	13	309,082	0.00
Metal	WATER	Matrices	Site samples were not used for sample matrix QC	Yes	43	309,082	0.01

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Table A2.5
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect ?	No. of Qualified Results	Total No. of V&V Records	Percent Qualified (%)
Metal	WATER	Other	Analysis was not requested according to the statement of work	No	10	309,082	0.00
Metal	WATER	Other	Analysis was not requested according to the statement of work	Yes	2	309,082	0.00
Metal	WATER	Other	IDL is older than 3 months from date of analysis	No	4,235	309,082	1.37
Metal	WATER	Other	IDL is older than 3 months from date of analysis	Yes	6,078	309,082	1.97
Metal	WATER	Other	Incorrect analysis sequence	No	31	309,082	0.01
Metal	WATER	Other	Incorrect analysis sequence	Yes	41	309,082	0.01
Metal	WATER	Other	Lab results not verified due to unsubmitted data	Yes	4	309,082	0.00
Metal	WATER	Other	QC sample frequency does not meet method requirements	No	193	309,082	0.06
Metal	WATER	Other	QC sample frequency does not meet method requirements	Yes	238	309,082	0.08
Metal	WATER	Other	Result obtained through dilution	No	49	309,082	0.02
Metal	WATER	Other	Result obtained through dilution	Yes	89	309,082	0.03
Metal	WATER	Other	See hard copy for further explanation	No	847	309,082	0.27
Metal	WATER	Other	See hard copy for further explanation	Yes	1,083	309,082	0.35
Metal	WATER	Sample Preparation	Preservation requirements were not met by the laboratory	No	1	309,082	0.00
Metal	WATER	Sample Preparation	Samples were not properly preserved in the field	No	3,135	309,082	1.01
Metal	WATER	Sample Preparation	Samples were not properly preserved in the field	Yes	5,533	309,082	1.79
Metal	WATER	Sensitivity	IDL changed due to a significant figure discrepancy	No	757	309,082	0.24
Metal	WATER	Sensitivity	Instrument detection limit > the associated RDL	Yes	2	309,082	0.00
PCB	SOIL	Blanks	Method, preparation, or reagent blank contamination	No	1	14,276	0.01
PCB	SOIL	Calculation Errors	Calculation error	Yes	3	14,276	0.02
PCB	SOIL	Calibration	Continuing calibration verification criteria were not met	No	170	14,276	1.19
PCB	SOIL	Calibration	Continuing calibration verification criteria were not met	Yes	11	14,276	0.08
PCB	SOIL	Calibration	Independent calibration verification criteria not met	Yes	3	14,276	0.02
PCB	SOIL	Confirmation	Confirmation percent difference criteria not met	No	1	14,276	0.01
PCB	SOIL	Confirmation	Confirmation percent difference criteria not met	Yes	47	14,276	0.33
PCB	SOIL	Documentation Issues	Missing deliverables (not required for validation)	No	76	14,276	0.53
PCB	SOIL	Documentation Issues	Missing deliverables (not required for validation)	Yes	1	14,276	0.01
PCB	SOIL	Documentation Issues	Omissions or errors in data package (not required for validation)	No	208	14,276	1.46
PCB	SOIL	Documentation Issues	Omissions or errors in data package (not required for validation)	Yes	2	14,276	0.01
PCB	SOIL	Documentation Issues	Record added by the validator	No	37	14,276	0.26
PCB	SOIL	Documentation Issues	Record added by the validator	Yes	6	14,276	0.04
PCB	SOIL	Documentation Issues	Transcription error	No	329	14,276	2.30
PCB	SOIL	Documentation Issues	Transcription error	Yes	12	14,276	0.08

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Table A2.5
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect ?	No. of Qualified Results	Total No. of V&V Records	Percent Qualified (%)
PCB	SOIL	Holding Times	Holding times were exceeded	No	400	14,276	2.80
PCB	SOIL	Holding Times	Holding times were exceeded	Yes	34	14,276	0.24
PCB	SOIL	Matrices	MS/MSD precision criteria were not met	No	40	14,276	0.28
PCB	SOIL	Matrices	MS/MSD precision criteria were not met	Yes	1	14,276	0.01
PCB	SOIL	Matrices	Percent solids < 30 percent	Yes	3	14,276	0.02
PCB	SOIL	Other	QC sample frequency does not meet method requirements	Yes	1	14,276	0.01
PCB	SOIL	Other	Sample results were not validated due to re-analysis	No	21	14,276	0.15
PCB	SOIL	Other	Sample results were not validated due to re-analysis	Yes	1	14,276	0.01
PCB	SOIL	Other	See hard copy for further explanation	No	18	14,276	0.13
PCB	SOIL	Other	See hard copy for further explanation	Yes	17	14,276	0.12
PCB	SOIL	Sample Preparation	Samples were not properly preserved in the field	No	258	14,276	1.81
PCB	SOIL	Sample Preparation	Samples were not properly preserved in the field	Yes	8	14,276	0.06
PCB	SOIL	Surrogates	Surrogate recovery criteria were not met	No	553	14,276	3.87
PCB	SOIL	Surrogates	Surrogate recovery criteria were not met	Yes	105	14,276	0.74
PCB	WATER	Calibration	Continuing calibration verification criteria were not met	No	38	4,779	0.80
PCB	WATER	Calibration	Continuing calibration verification criteria were not met	Yes	4	4,779	0.08
PCB	WATER	Documentation Issues	Key data fields incorrect	No	35	4,779	0.73
PCB	WATER	Documentation Issues	Missing deliverables (not required for validation)	No	14	4,779	0.29
PCB	WATER	Documentation Issues	Missing deliverables (required for validation)	No	28	4,779	0.59
PCB	WATER	Documentation Issues	Omissions or errors in data package (not required for validation)	No	70	4,779	1.46
PCB	WATER	Documentation Issues	Record added by the validator	No	42	4,779	0.88
PCB	WATER	Documentation Issues	Sample analysis was not requested	No	7	4,779	0.15
PCB	WATER	Documentation Issues	Transcription error	No	524	4,779	10.96
PCB	WATER	Documentation Issues	Transcription error	Yes	7	4,779	0.15
PCB	WATER	Holding Times	Holding times were exceeded	No	174	4,779	3.64
PCB	WATER	Holding Times	Holding times were exceeded	Yes	1	4,779	0.02
PCB	WATER	LCS	LCS recovery criteria were not met	No	12	4,779	0.25
PCB	WATER	LCS	LCS recovery criteria were not met	Yes	2	4,779	0.04
PCB	WATER	Other	Sample results were not validated due to re-analysis	No	5	4,779	0.10
PCB	WATER	Other	Sample results were not validated due to re-analysis	Yes	4	4,779	0.08
PCB	WATER	Other	See hard copy for further explanation	No	14	4,779	0.29
PCB	WATER	Surrogates	Surrogate recovery criteria were not met	No	465	4,779	9.73
PCB	WATER	Surrogates	Surrogate recovery criteria were not met	Yes	4	4,779	0.08
Pesticide	SOIL	Blanks	Method, preparation, or reagent blank contamination	No	4	22,180	0.02
Pesticide	SOIL	Blanks	Method, preparation, or reagent blank contamination	Yes	1	22,180	0.00
Pesticide	SOIL	Calculation Errors	Calculation error	No	8	22,180	0.04
Pesticide	SOIL	Calibration	Continuing calibration verification criteria were not met	No	270	22,180	1.22

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Table A2.5
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect.?	No. of Qualified Results	Total No. of V&V Records	Percent Qualified (%)
Pesticide	SOIL	Calibration	Continuing calibration verification criteria were not met	Yes	6	22,180	0.03
Pesticide	SOIL	Calibration	Independent calibration verification criteria not met	No	31	22,180	0.14
Pesticide	SOIL	Confirmation	Confirmation percent difference criteria not met	Yes	21	22,180	0.09
Pesticide	SOIL	Confirmation	Results were not confirmed	No	2	22,180	0.01
Pesticide	SOIL	Documentation Issues	Missing deliverables (not required for validation)	No	185	22,180	0.83
Pesticide	SOIL	Documentation Issues	Missing deliverables (required for validation)	No	1	22,180	0.00
Pesticide	SOIL	Documentation Issues	Omissions or errors in data package (not required for validation)	No	555	22,180	2.50
Pesticide	SOIL	Documentation Issues	Omissions or errors in data package (not required for validation)	Yes	2	22,180	0.01
Pesticide	SOIL	Documentation Issues	Record added by the validator	No	9	22,180	0.04
Pesticide	SOIL	Documentation Issues	Transcription error	No	278	22,180	1.25
Pesticide	SOIL	Documentation Issues	Transcription error	Yes	2	22,180	0.01
Pesticide	SOIL	Holding Times	Holding times were exceeded	No	568	22,180	2.56
Pesticide	SOIL	Internal Standards	Internal standards did not meet criteria	No	8	22,180	0.04
Pesticide	SOIL	LCS	LCS recovery criteria were not met	No	10	22,180	0.05
Pesticide	SOIL	Matrices	MS/MSD precision criteria were not met	No	101	22,180	0.46
Pesticide	SOIL	Other	Sample results were not validated due to re-analysis	No	92	22,180	0.41
Pesticide	SOIL	Other	Sample results were not validated due to re-analysis	Yes	9	22,180	0.04
Pesticide	SOIL	Other	See hard copy for further explanation	No	58	22,180	0.26
Pesticide	SOIL	Other	See hard copy for further explanation	Yes	2	22,180	0.01
Pesticide	SOIL	Sample Preparation	Samples were not properly preserved in the field	No	271	22,180	1.22
Pesticide	SOIL	Surrogates	Surrogate recovery criteria were not met	No	854	22,180	3.85
Pesticide	SOIL	Surrogates	Surrogate recovery criteria were not met	Yes	24	22,180	0.11
Pesticide	WATER	Blanks	Method, preparation, or reagent blank contamination	No	9	14,045	0.06
Pesticide	WATER	Calibration	Continuing calibration verification criteria were not met	No	260	14,045	1.85
Pesticide	WATER	Calibration	Continuing calibration verification criteria were not met	Yes	4	14,045	0.03
Pesticide	WATER	Calibration	Independent calibration verification criteria not met	No	6	14,045	0.04
Pesticide	WATER	Confirmation	Results were not confirmed	No	1	14,045	0.01
Pesticide	WATER	Documentation Issues	Key data fields incorrect	No	100	14,045	0.71
Pesticide	WATER	Documentation Issues	Missing deliverables (not required for validation)	No	5	14,045	0.04
Pesticide	WATER	Documentation Issues	Missing deliverables (required for validation)	No	38	14,045	0.27
Pesticide	WATER	Documentation Issues	Missing deliverables (required for validation)	Yes	2	14,045	0.01
Pesticide	WATER	Documentation Issues	Omissions or errors in data package (not required for validation)	No	153	14,045	1.09
Pesticide	WATER	Documentation Issues	Omissions or errors in data package (not required for validation)	Yes	2	14,045	0.01
Pesticide	WATER	Documentation Issues	Omissions or errors in data package (required for validation)	No	2	14,045	0.01

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Table A2.5
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect ?	No. of Qualified Results	Total No. of V&V Records	Percent Qualified (%)
Pesticide	WATER	Documentation Issues	Original documentation not provided	No	7	14,045	0.05
Pesticide	WATER	Documentation Issues	Record added by the validator	No	130	14,045	0.93
Pesticide	WATER	Documentation Issues	Transcription error	No	702	14,045	5.00
Pesticide	WATER	Documentation Issues	Transcription error	Yes	11	14,045	0.08
Pesticide	WATER	Holding Times	Holding times were exceeded	No	424	14,045	3.02
Pesticide	WATER	Internal Standards	Internal standards did not meet criteria	No	8	14,045	0.06
Pesticide	WATER	Matrices	MS/MSD precision criteria were not met	No	2	14,045	0.01
Pesticide	WATER	Matrices	Site samples were not used for sample matrix QC	No	6	14,045	0.04
Pesticide	WATER	Other	Lab results not verified due to unsubmitted data	No	1	14,045	0.01
Pesticide	WATER	Other	Sample results were not validated due to re-analysis	No	13	14,045	0.09
Pesticide	WATER	Other	Sample results were not validated due to re-analysis	Yes	6	14,045	0.04
Pesticide	WATER	Other	See hard copy for further explanation	No	49	14,045	0.35
Pesticide	WATER	Other	See hard copy for further explanation	Yes	13	14,045	0.09
Pesticide	WATER	Sample Preparation	Samples were not properly preserved in the field	No	15	14,045	0.11
Pesticide	WATER	Surrogates	Surrogate recovery criteria were not met	No	1,379	14,045	9.82
Pesticide	WATER	Surrogates	Surrogate recovery criteria were not met	Yes	5	14,045	0.04
Radionuclide	SOIL	Blanks	Blank recovery criteria were not met	No	6	29,121	0.02
Radionuclide	SOIL	Blanks	Blank recovery criteria were not met	Yes	343	29,121	1.18
Radionuclide	SOIL	Blanks	Method, preparation, or reagent blank contamination	No	54	29,121	0.19
Radionuclide	SOIL	Blanks	Method, preparation, or reagent blank contamination	Yes	1,890	29,121	6.49
Radionuclide	SOIL	Calculation Errors	Calculation error	No	45	29,121	0.15
Radionuclide	SOIL	Calculation Errors	Calculation error	Yes	117	29,121	0.40
Radionuclide	SOIL	Calibration	Background calibration criteria were not met	No	19	29,121	0.07
Radionuclide	SOIL	Calibration	Background calibration criteria were not met	Yes	16	29,121	0.05
Radionuclide	SOIL	Calibration	Continuing calibration verification criteria were not met	No	6	29,121	0.02
Radionuclide	SOIL	Calibration	Continuing calibration verification criteria were not met	Yes	2,193	29,121	7.53
Radionuclide	SOIL	Calibration	Frequency or sequencing verification criteria not met	Yes	4	29,121	0.01
Radionuclide	SOIL	Documentation Issues	Information missing from case narrative	No	64	29,121	0.22
Radionuclide	SOIL	Documentation Issues	Information missing from case narrative	Yes	52	29,121	0.18
Radionuclide	SOIL	Documentation Issues	Key data fields incorrect	Yes	195	29,121	0.67
Radionuclide	SOIL	Documentation Issues	Missing deliverables (required for validation)	No	12	29,121	0.04
Radionuclide	SOIL	Documentation Issues	Missing deliverables (required for validation)	Yes	41	29,121	0.14
Radionuclide	SOIL	Documentation Issues	Omissions or errors in data package (not required for validation)	No	192	29,121	0.66
Radionuclide	SOIL	Documentation Issues	Omissions or errors in data package (not required for validation)	Yes	407	29,121	1.40
Radionuclide	SOIL	Documentation Issues	Omissions or errors in data package (required for validation)	No	55	29,121	0.19
Radionuclide	SOIL	Documentation Issues	Omissions or errors in data package (required for validation)	Yes	122	29,121	0.42

Table A2.5
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect ?	No. of Qualified Results	Total No. of V&V Records	Percent Qualified (%)
Radionuclide	SOIL	Documentation Issues	Record added by the validator	Yes	266	29,121	0.91
Radionuclide	SOIL	Documentation Issues	Results were not included on Data Summary Table	No	35	29,121	0.12
Radionuclide	SOIL	Documentation Issues	Results were not included on Data Summary Table	Yes	16	29,121	0.05
Radionuclide	SOIL	Documentation Issues	Sample analysis was not requested	Yes	5	29,121	0.02
Radionuclide	SOIL	Documentation Issues	Sufficient documentation not provided by the laboratory	No	6	29,121	0.02
Radionuclide	SOIL	Documentation Issues	Sufficient documentation not provided by the laboratory	Yes	4,388	29,121	15.07
Radionuclide	SOIL	Documentation Issues	Transcription error	No	113	29,121	0.39
Radionuclide	SOIL	Documentation Issues	Transcription error	Yes	3,167	29,121	10.88
Radionuclide	SOIL	Holding Times	Holding times were grossly exceeded	Yes	42	29,121	0.14
Radionuclide	SOIL	Instrument Set-up	Detector efficiency did not meet requirements	No	1	29,121	0.00
Radionuclide	SOIL	Instrument Set-up	Detector efficiency did not meet requirements	Yes	136	29,121	0.47
Radionuclide	SOIL	Instrument Set-up	Instrument gain and/or efficiency not submitted	No	11	29,121	0.04
Radionuclide	SOIL	Instrument Set-up	Resolution criteria were not met	No	14	29,121	0.05
Radionuclide	SOIL	Instrument Set-up	Resolution criteria were not met	Yes	416	29,121	1.43
Radionuclide	SOIL	LCS	Lab control samples >+/- 2 sigma and <+/- 3 sigma	No	2	29,121	0.01
Radionuclide	SOIL	LCS	Lab control samples >+/- 2 sigma and <+/- 3 sigma	Yes	19	29,121	0.07
Radionuclide	SOIL	LCS	LCS data not submitted by the laboratory	Yes	94	29,121	0.32
Radionuclide	SOIL	LCS	LCS recovery > +/- 3 sigma	No	42	29,121	0.14
Radionuclide	SOIL	LCS	LCS recovery > +/- 3 sigma	Yes	1,420	29,121	4.88
Radionuclide	SOIL	LCS	LCS recovery criteria were not met	No	17	29,121	0.06
Radionuclide	SOIL	LCS	LCS recovery criteria were not met	Yes	259	29,121	0.89
Radionuclide	SOIL	LCS	LCS relative percent error criteria not met	No	38	29,121	0.13
Radionuclide	SOIL	LCS	LCS relative percent error criteria not met	Yes	1,568	29,121	5.38
Radionuclide	SOIL	LCS	QC sample/analyte (e.g. spike, duplicate, LCS) was not analyzed	Yes	1	29,121	0.00
Radionuclide	SOIL	Matrices	Duplicate sample precision criteria were not met	No	1	29,121	0.00
Radionuclide	SOIL	Matrices	Duplicate sample precision criteria were not met	Yes	6	29,121	0.02
Radionuclide	SOIL	Matrices	Recovery criteria were not met	No	15	29,121	0.05
Radionuclide	SOIL	Matrices	Recovery criteria were not met	Yes	264	29,121	0.91
Radionuclide	SOIL	Matrices	Replicate analysis was not performed	No	7	29,121	0.02
Radionuclide	SOIL	Matrices	Replicate analysis was not performed	Yes	37	29,121	0.13
Radionuclide	SOIL	Matrices	Replicate precision criteria were not met	No	34	29,121	0.12
Radionuclide	SOIL	Matrices	Replicate precision criteria were not met	Yes	1,548	29,121	5.32
Radionuclide	SOIL	Matrices	Replicate recovery criteria were not met	No	29	29,121	0.10
Radionuclide	SOIL	Matrices	Replicate recovery criteria were not met	Yes	292	29,121	1.00
Radionuclide	SOIL	Other	Lab results not verified due to unsubmitted data	No	12	29,121	0.04
Radionuclide	SOIL	Other	Lab results not verified due to unsubmitted data	Yes	245	29,121	0.84
Radionuclide	SOIL	Other	QC sample does not meet method requirements	No	391	29,121	1.34
Radionuclide	SOIL	Other	QC sample does not meet method requirements	Yes	528	29,121	1.81
Radionuclide	SOIL	Other	Sample exceeded efficiency curve weight limit	Yes	45	29,121	0.15

Table A2.5
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect ?	No. of Qualified Results	Total No. of V&V Records	Percent Qualified (%)
Radionuclide	SOIL	Other	Sample or control analyses not chemically separated	Yes	1	29,121	0.00
Radionuclide	SOIL	Other	Sample results were not validated due to re-analysis	Yes	1	29,121	0.00
Radionuclide	SOIL	Other	See hard copy for further explanation	No	48	29,121	0.16
Radionuclide	SOIL	Other	See hard copy for further explanation	Yes	1,055	29,121	3.62
Radionuclide	SOIL	Other	Standard values were not calculated correctly (LCS, tracer, standards)	No	1	29,121	0.00
Radionuclide	SOIL	Other	Standard values were not calculated correctly (LCS, tracer, standards)	Yes	2	29,121	0.01
Radionuclide	SOIL	Other	Tracer requirements were not met	No	134	29,121	0.46
Radionuclide	SOIL	Other	Tracer requirements were not met	Yes	231	29,121	0.79
Radionuclide	SOIL	Other	Unit conversion of results	Yes	2	29,121	0.01
Radionuclide	SOIL	Sample Preparation	Improper aliquot size	Yes	1	29,121	0.00
Radionuclide	SOIL	Sample Preparation	Samples were not properly preserved in the field	No	3	29,121	0.01
Radionuclide	SOIL	Sample Preparation	Samples were not properly preserved in the field	Yes	2	29,121	0.01
Radionuclide	SOIL	Sensitivity	Incorrect reported activity or MDA	No	69	29,121	0.24
Radionuclide	SOIL	Sensitivity	Incorrect reported activity or MDA	Yes	54	29,121	0.19
Radionuclide	SOIL	Sensitivity	MDA exceeded the RDL	No	42	29,121	0.14
Radionuclide	SOIL	Sensitivity	MDA exceeded the RDL	Yes	203	29,121	0.70
Radionuclide	SOIL	Sensitivity	MDA was calculated by reviewer	No	30	29,121	0.10
Radionuclide	SOIL	Sensitivity	MDA was calculated by reviewer	Yes	7,075	29,121	24.30
Radionuclide	SOIL	Sensitivity	Results considered qualitative not quantitative	No	17	29,121	0.06
Radionuclide	SOIL	Sensitivity	Results considered qualitative not quantitative	Yes	61	29,121	0.21
Radionuclide	WATER	Blanks	Blank correction was not performed	No	9	71,021	0.01
Radionuclide	WATER	Blanks	Blank correction was not performed	Yes	9	71,021	0.01
Radionuclide	WATER	Blanks	Blank data not submitted	Yes	12	71,021	0.02
Radionuclide	WATER	Blanks	Blank recovery criteria were not met	No	87	71,021	0.12
Radionuclide	WATER	Blanks	Blank recovery criteria were not met	Yes	431	71,021	0.61
Radionuclide	WATER	Blanks	Method, preparation, or reagent blank contamination	No	679	71,021	0.96
Radionuclide	WATER	Blanks	Method, preparation, or reagent blank contamination	Yes	3,627	71,021	5.11
Radionuclide	WATER	Calculation Errors	Calculation error	No	250	71,021	0.35
Radionuclide	WATER	Calculation Errors	Calculation error	Yes	237	71,021	0.33
Radionuclide	WATER	Calibration	Calibration counting statistics did not meet criteria	No	185	71,021	0.26
Radionuclide	WATER	Calibration	Calibration counting statistics did not meet criteria	Yes	33	71,021	0.05
Radionuclide	WATER	Calibration	Calibration requirements affecting data quality have not been met	No	1	71,021	0.00
Radionuclide	WATER	Calibration	Calibration requirements affecting data quality have not been met	Yes	1	71,021	0.00
Radionuclide	WATER	Calibration	Continuing calibration verification criteria were not met	No	739	71,021	1.04
Radionuclide	WATER	Calibration	Continuing calibration verification criteria were not met	Yes	5,285	71,021	7.44
Radionuclide	WATER	Documentation Issues	Information missing from case narrative	No	76	71,021	0.11

Table A2.5
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect ?	No. of Qualified Results	Total No. of V&V Records	Percent Qualified (%)
Radionuclide	WATER	Documentation Issues	Information missing from case narrative	Yes	144	71,021	0.20
Radionuclide	WATER	Documentation Issues	Key data fields incorrect	No	1	71,021	0.00
Radionuclide	WATER	Documentation Issues	Key data fields incorrect	Yes	4	71,021	0.01
Radionuclide	WATER	Documentation Issues	Missing deliverables (not required for validation)	No	24	71,021	0.03
Radionuclide	WATER	Documentation Issues	Missing deliverables (not required for validation)	Yes	57	71,021	0.08
Radionuclide	WATER	Documentation Issues	Missing deliverables (required for validation)	No	96	71,021	0.14
Radionuclide	WATER	Documentation Issues	Missing deliverables (required for validation)	Yes	124	71,021	0.17
Radionuclide	WATER	Documentation Issues	No raw data submitted by the laboratory	Yes	4	71,021	0.01
Radionuclide	WATER	Documentation Issues	Omissions or errors in data package (not required for validation)	No	550	71,021	0.77
Radionuclide	WATER	Documentation Issues	Omissions or errors in data package (not required for validation)	Yes	1,146	71,021	1.61
Radionuclide	WATER	Documentation Issues	Omissions or errors in data package (required for validation)	No	67	71,021	0.09
Radionuclide	WATER	Documentation Issues	Omissions or errors in data package (required for validation)	Yes	89	71,021	0.13
Radionuclide	WATER	Documentation Issues	Record added by the validator	No	4	71,021	0.01
Radionuclide	WATER	Documentation Issues	Record added by the validator	Yes	343	71,021	0.48
Radionuclide	WATER	Documentation Issues	Sample analysis was not requested	No	10	71,021	0.01
Radionuclide	WATER	Documentation Issues	Sample analysis was not requested	Yes	18	71,021	0.03
Radionuclide	WATER	Documentation Issues	Sufficient documentation not provided by the laboratory	No	130	71,021	0.18
Radionuclide	WATER	Documentation Issues	Sufficient documentation not provided by the laboratory	Yes	5,145	71,021	7.24
Radionuclide	WATER	Documentation Issues	Transcription error	No	2,547	71,021	3.59
Radionuclide	WATER	Documentation Issues	Transcription error	Yes	2,555	71,021	3.60
Radionuclide	WATER	Holding Times	Holding times were exceeded	No	190	71,021	0.27
Radionuclide	WATER	Holding Times	Holding times were exceeded	Yes	415	71,021	0.58
Radionuclide	WATER	Holding Times	Holding times were grossly exceeded	No	43	71,021	0.06
Radionuclide	WATER	Holding Times	Holding times were grossly exceeded	Yes	74	71,021	0.10
Radionuclide	WATER	Instrument Set-up	Resolution criteria were not met	No	45	71,021	0.06
Radionuclide	WATER	Instrument Set-up	Resolution criteria were not met	Yes	349	71,021	0.49
Radionuclide	WATER	Instrument Set-up	Transformed spectral index external site criteria were not met	No	81	71,021	0.11
Radionuclide	WATER	Instrument Set-up	Transformed spectral index external site criteria were not met	Yes	18	71,021	0.03
Radionuclide	WATER	LCS	Expected LCS value not submitted/verifiable	No	87	71,021	0.12
Radionuclide	WATER	LCS	Expected LCS value not submitted/verifiable	Yes	410	71,021	0.58
Radionuclide	WATER	LCS	LCS data not submitted by the laboratory	Yes	13	71,021	0.02
Radionuclide	WATER	LCS	LCS recovery > +/- 3 sigma	No	1,125	71,021	1.58
Radionuclide	WATER	LCS	LCS recovery > +/- 3 sigma	Yes	1,585	71,021	2.23
Radionuclide	WATER	LCS	LCS recovery criteria were not met	No	93	71,021	0.13

Table A2.5
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect ?	No. of Qualified Results	Total No. of V&V Records	Percent Qualified (%)
Radionuclide	WATER	LCS	LCS recovery criteria were not met	Yes	329	71,021	0.46
Radionuclide	WATER	LCS	LCS relative percent error criteria not met	No	337	71,021	0.47
Radionuclide	WATER	LCS	LCS relative percent error criteria not met	Yes	1,797	71,021	2.53
Radionuclide	WATER	LCS	QC sample/analyte (e.g. spike, duplicate, LCS) was not analyzed	No	1	71,021	0.00
Radionuclide	WATER	LCS	QC sample/analyte (e.g. spike, duplicate, LCS) was not analyzed	Yes	1	71,021	0.00
Radionuclide	WATER	Matrices	Duplicate analysis was not performed	No	18	71,021	0.03
Radionuclide	WATER	Matrices	Duplicate analysis was not performed	Yes	21	71,021	0.03
Radionuclide	WATER	Matrices	Duplicate sample precision criteria were not met	No	25	71,021	0.04
Radionuclide	WATER	Matrices	Duplicate sample precision criteria were not met	Yes	77	71,021	0.11
Radionuclide	WATER	Matrices	Laboratory duplicate was not analyzed	No	9	71,021	0.01
Radionuclide	WATER	Matrices	Laboratory duplicate was not analyzed	Yes	16	71,021	0.02
Radionuclide	WATER	Matrices	Recovery criteria were not met	No	99	71,021	0.14
Radionuclide	WATER	Matrices	Recovery criteria were not met	Yes	450	71,021	0.63
Radionuclide	WATER	Matrices	Replicate analysis was not performed	No	150	71,021	0.21
Radionuclide	WATER	Matrices	Replicate analysis was not performed	Yes	879	71,021	1.24
Radionuclide	WATER	Matrices	Replicate precision criteria were not met	No	496	71,021	0.70
Radionuclide	WATER	Matrices	Replicate precision criteria were not met	Yes	2,432	71,021	3.42
Radionuclide	WATER	Matrices	Replicate recovery criteria were not met	No	54	71,021	0.08
Radionuclide	WATER	Matrices	Replicate recovery criteria were not met	Yes	278	71,021	0.39
Radionuclide	WATER	Other	Lab results not verified due to unsubmitted data	No	13	71,021	0.02
Radionuclide	WATER	Other	Lab results not verified due to unsubmitted data	Yes	132	71,021	0.19
Radionuclide	WATER	Other	QC sample does not meet method requirements	No	359	71,021	0.51
Radionuclide	WATER	Other	QC sample does not meet method requirements	Yes	431	71,021	0.61
Radionuclide	WATER	Other	QC sample frequency does not meet method requirements	Yes	2	71,021	0.00
Radionuclide	WATER	Other	Sample exceeded efficiency curve weight limit	No	4	71,021	0.01
Radionuclide	WATER	Other	Sample exceeded efficiency curve weight limit	Yes	47	71,021	0.07
Radionuclide	WATER	Other	Sample or control analyses not chemically separated	No	1	71,021	0.00
Radionuclide	WATER	Other	Sample or control analyses not chemically separated	Yes	11	71,021	0.02
Radionuclide	WATER	Other	Sample results not submitted/verifiable	Yes	1	71,021	0.00
Radionuclide	WATER	Other	Sample results were not validated due to re-analysis	No	12	71,021	0.02
Radionuclide	WATER	Other	Sample results were not validated due to re-analysis	Yes	12	71,021	0.02
Radionuclide	WATER	Other	See hard copy for further explanation	No	497	71,021	0.70
Radionuclide	WATER	Other	See hard copy for further explanation	Yes	2,372	71,021	3.34
Radionuclide	WATER	Other	Tracer requirements were not met	No	295	71,021	0.42
Radionuclide	WATER	Other	Tracer requirements were not met	Yes	576	71,021	0.81
Radionuclide	WATER	Other	Unit conversion of results	Yes	10	71,021	0.01
Radionuclide	WATER	Sample Preparation	Excessive solids on planchet	Yes	2	71,021	0.00
Radionuclide	WATER	Sample Preparation	Improper aliquot size	No	3	71,021	0.00
Radionuclide	WATER	Sample Preparation	Improper aliquot size	Yes	36	71,021	0.05

Table A2.5
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect ?	No. of Qualified Results	Total No. of V&V Records	Percent Qualified (%)
Radionuclide	WATER	Sample Preparation	Preservation requirements were not met by the laboratory	No	1	71,021	0.00
Radionuclide	WATER	Sample Preparation	Preservation requirements were not met by the laboratory	Yes	2	71,021	0.00
Radionuclide	WATER	Sample Preparation	Samples were not properly preserved in the field	No	99	71,021	0.14
Radionuclide	WATER	Sample Preparation	Samples were not properly preserved in the field	Yes	132	71,021	0.19
Radionuclide	WATER	Sensitivity	Incorrect reported activity or MDA	No	38	71,021	0.05
Radionuclide	WATER	Sensitivity	Incorrect reported activity or MDA	Yes	151	71,021	0.21
Radionuclide	WATER	Sensitivity	MDA exceeded the RDL	No	321	71,021	0.45
Radionuclide	WATER	Sensitivity	MDA exceeded the RDL	Yes	1,860	71,021	2.62
Radionuclide	WATER	Sensitivity	MDA was calculated by reviewer	No	143	71,021	0.20
Radionuclide	WATER	Sensitivity	MDA was calculated by reviewer	Yes	10,561	71,021	14.87
Radionuclide	WATER	Sensitivity	Repeat count outside of 3 sigma counting error	Yes	1	71,021	0.00
SVOC	SOIL	Blanks	Method, preparation, or reagent blank contamination	No	422	166,283	0.25
SVOC	SOIL	Blanks	Method, preparation, or reagent blank contamination	Yes	279	166,283	0.17
SVOC	SOIL	Calculation Errors	Calculation error	Yes	48	166,283	0.03
SVOC	SOIL	Calibration	Continuing calibration verification criteria were not met	No	842	166,283	0.51
SVOC	SOIL	Calibration	Continuing calibration verification criteria were not met	Yes	223	166,283	0.13
SVOC	SOIL	Calibration	Independent calibration verification criteria not met	No	229	166,283	0.14
SVOC	SOIL	Calibration	Independent calibration verification criteria not met	Yes	2	166,283	0.00
SVOC	SOIL	Calibration	Original result exceeded linear range, serial dilution value reported	Yes	2	166,283	0.00
SVOC	SOIL	Confirmation	Confirmation percent difference criteria not met	Yes	3	166,283	0.00
SVOC	SOIL	Confirmation	Results were not confirmed	No	1	166,283	0.00
SVOC	SOIL	Documentation Issues	Missing deliverables (not required for validation)	No	349	166,283	0.21
SVOC	SOIL	Documentation Issues	Missing deliverables (not required for validation)	Yes	62	166,283	0.04
SVOC	SOIL	Documentation Issues	Missing deliverables (required for validation)	No	76	166,283	0.05
SVOC	SOIL	Documentation Issues	Missing deliverables (required for validation)	Yes	1	166,283	0.00
SVOC	SOIL	Documentation Issues	No mass spectra were provided	Yes	1	166,283	0.00
SVOC	SOIL	Documentation Issues	Omissions or errors in data package (not required for validation)	No	2,795	166,283	1.68
SVOC	SOIL	Documentation Issues	Omissions or errors in data package (not required for validation)	Yes	277	166,283	0.17
SVOC	SOIL	Documentation Issues	Omissions or errors in data package (required for validation)	No	27	166,283	0.02
SVOC	SOIL	Documentation Issues	Record added by the validator	No	408	166,283	0.25
SVOC	SOIL	Documentation Issues	Record added by the validator	Yes	6	166,283	0.00
SVOC	SOIL	Documentation Issues	Transcription error	No	979	166,283	0.59
SVOC	SOIL	Documentation Issues	Transcription error	Yes	449	166,283	0.27
SVOC	SOIL	Holding Times	Holding times were exceeded	No	2,102	166,283	1.26

Table A2.5
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect ?	No. of Qualified Results	Total No. of V&V Records	Percent Qualified (%)
SVOC	SOIL	Holding Times	Holding times were exceeded	Yes	128	166,283	0.08
SVOC	SOIL	Holding Times	Holding times were grossly exceeded	Yes	71	166,283	0.04
SVOC	SOIL	Instrument Set-up	Instrument tune criteria were not met	No	3	166,283	0.00
SVOC	SOIL	Internal Standards	Internal standards did not meet criteria	No	815	166,283	0.49
SVOC	SOIL	Internal Standards	Internal standards did not meet criteria	Yes	255	166,283	0.15
SVOC	SOIL	LCS	LCS recovery criteria were not met	No	17	166,283	0.01
SVOC	SOIL	LCS	QC sample/analyte (e.g. spike, duplicate, LCS) was not analyzed	No	2	166,283	0.00
SVOC	SOIL	LCS	QC sample/analyte (e.g. spike, duplicate, LCS) was not analyzed	Yes	1	166,283	0.00
SVOC	SOIL	Matrices	MS/MSD precision criteria were not met	No	1,459	166,283	0.88
SVOC	SOIL	Matrices	MS/MSD precision criteria were not met	Yes	95	166,283	0.06
SVOC	SOIL	Matrices	Percent solids < 30 percent	Yes	13	166,283	0.01
SVOC	SOIL	Other	QC sample frequency does not meet method requirements	No	6	166,283	0.00
SVOC	SOIL	Other	Sample results were not validated due to re-analysis	No	2,900	166,283	1.74
SVOC	SOIL	Other	Sample results were not validated due to re-analysis	Yes	603	166,283	0.36
SVOC	SOIL	Other	See hard copy for further explanation	No	485	166,283	0.29
SVOC	SOIL	Other	See hard copy for further explanation	Yes	148	166,283	0.09
SVOC	SOIL	Sample Preparation	Samples were not properly preserved in the field	No	1,860	166,283	1.12
SVOC	SOIL	Sample Preparation	Samples were not properly preserved in the field	Yes	48	166,283	0.03
SVOC	SOIL	Surrogates	Surrogate recovery criteria were not met	No	999	166,283	0.60
SVOC	SOIL	Surrogates	Surrogate recovery criteria were not met	Yes	175	166,283	0.11
SVOC	WATER	Blanks	Method, preparation, or reagent blank contamination	No	262	77,082	0.34
SVOC	WATER	Blanks	Method, preparation, or reagent blank contamination	Yes	74	77,082	0.10
SVOC	WATER	Calculation Errors	Calculation error	No	25	77,082	0.03
SVOC	WATER	Calibration	Continuing calibration verification criteria were not met	No	1,127	77,082	1.46
SVOC	WATER	Calibration	Continuing calibration verification criteria were not met	Yes	43	77,082	0.06
SVOC	WATER	Calibration	Independent calibration verification criteria not met	No	277	77,082	0.36
SVOC	WATER	Calibration	Independent calibration verification criteria not met	Yes	11	77,082	0.01
SVOC	WATER	Confirmation	Results were not confirmed	Yes	1	77,082	0.00
SVOC	WATER	Documentation Issues	Information missing from case narrative	No	46	77,082	0.06
SVOC	WATER	Documentation Issues	Key data fields incorrect	No	3	77,082	0.00
SVOC	WATER	Documentation Issues	Missing deliverables (not required for validation)	No	710	77,082	0.92
SVOC	WATER	Documentation Issues	Missing deliverables (not required for validation)	Yes	23	77,082	0.03
SVOC	WATER	Documentation Issues	Missing deliverables (required for validation)	No	55	77,082	0.07
SVOC	WATER	Documentation Issues	Missing deliverables (required for validation)	Yes	2	77,082	0.00
SVOC	WATER	Documentation Issues	No mass spectra were provided	No	2	77,082	0.00
SVOC	WATER	Documentation Issues	Omissions or errors in data package (not required for validation)	Nb	4,381	77,082	5.68

Table A2.5
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect ?	No. of Qualified Results	Total No. of V&V Records	Percent Qualified (%)
SVOC	WATER	Documentation Issues	Omissions or errors in data package (not required for validation)	Yes	168	77,082	0.22
SVOC	WATER	Documentation Issues	Omissions or errors in data package (required for validation)	No	99	77,082	0.13
SVOC	WATER	Documentation Issues	Omissions or errors in data package (required for validation)	Yes	1	77,082	0.00
SVOC	WATER	Documentation Issues	Original documentation not provided	No	425	77,082	0.55
SVOC	WATER	Documentation Issues	Original documentation not provided	Yes	17	77,082	0.02
SVOC	WATER	Documentation Issues	Record added by the validator	No	435	77,082	0.56
SVOC	WATER	Documentation Issues	Record added by the validator	Yes	2	77,082	0.00
SVOC	WATER	Documentation Issues	Transcription error	No	1,934	77,082	2.51
SVOC	WATER	Documentation Issues	Transcription error	Yes	57	77,082	0.07
SVOC	WATER	Holding Times	Holding times were exceeded	No	3,562	77,082	4.62
SVOC	WATER	Holding Times	Holding times were exceeded	Yes	63	77,082	0.08
SVOC	WATER	Instrument Set-up	Instrument tune criteria were not met	No	1,072	77,082	1.39
SVOC	WATER	Instrument Set-up	Instrument tune criteria were not met	Yes	22	77,082	0.03
SVOC	WATER	Internal Standards	Internal standards did not meet criteria	No	542	77,082	0.70
SVOC	WATER	Internal Standards	Internal standards did not meet criteria	Yes	7	77,082	0.01
SVOC	WATER	LCS	LCS recovery criteria were not met	No	532	77,082	0.69
SVOC	WATER	LCS	LCS recovery criteria were not met	Yes	11	77,082	0.01
SVOC	WATER	Matrices	MS/MSD precision criteria were not met	No	144	77,082	0.19
SVOC	WATER	Matrices	MS/MSD precision criteria were not met	Yes	5	77,082	0.01
SVOC	WATER	Matrices	Site samples were not used for sample matrix QC	No	287	77,082	0.37
SVOC	WATER	Matrices	Site samples were not used for sample matrix QC	Yes	1	77,082	0.00
SVOC	WATER	Other	Lab results not verified due to unsubmitted data	No	55	77,082	0.07
SVOC	WATER	Other	Lab results not verified due to unsubmitted data	Yes	1	77,082	0.00
SVOC	WATER	Other	QC sample frequency does not meet method requirements	No	5	77,082	0.01
SVOC	WATER	Other	QC sample frequency does not meet method requirements	Yes	1	77,082	0.00
SVOC	WATER	Other	Sample results were not validated due to re-analysis	No	369	77,082	0.48
SVOC	WATER	Other	Sample results were not validated due to re-analysis	Yes	30	77,082	0.04
SVOC	WATER	Other	See hard copy for further explanation	No	810	77,082	1.05
SVOC	WATER	Other	See hard copy for further explanation	Yes	20	77,082	0.03
SVOC	WATER	Sample Preparation	Preservation requirements were not met by the laboratory	No	15	77,082	0.02
SVOC	WATER	Sample Preparation	Samples were not properly preserved in the field	No	1,482	77,082	1.92
SVOC	WATER	Sample Preparation	Samples were not properly preserved in the field	Yes	28	77,082	0.04
SVOC	WATER	Surrogates	Surrogate recovery criteria were not met	No	576	77,082	0.75
SVOC	WATER	Surrogates	Surrogate recovery criteria were not met	Yes	48	77,082	0.06
VOC	SOIL	Blanks	Method, preparation, or reagent blank contamination	No	1,435	265,381	0.54
VOC	SOIL	Blanks	Method, preparation, or reagent blank contamination	Yes	910	265,381	0.34

Table A2.5
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect ?	No. of Qualified Results	Total No. of V&V Records	Percent Qualified (%)
VOC	SOIL	Calculation Errors	Calculation error	No	135	265,381	0.05
VOC	SOIL	Calculation Errors	Calculation error	Yes	8	265,381	0.00
VOC	SOIL	Calibration	Continuing calibration verification criteria were not met	No	6,069	265,381	2.29
VOC	SOIL	Calibration	Continuing calibration verification criteria were not met	Yes	495	265,381	0.19
VOC	SOIL	Calibration	Independent calibration verification criteria not met	No	1,177	265,381	0.44
VOC	SOIL	Calibration	Independent calibration verification criteria not met	Yes	82	265,381	0.03
VOC	SOIL	Calibration	Original result exceeded linear range, serial dilution value reported	Yes	11	265,381	0.00
VOC	SOIL	Calibration	Result exceeded linear range of measurement system	Yes	9	265,381	0.00
VOC	SOIL	Confirmation	Results were not confirmed	No	1	265,381	0.00
VOC	SOIL	Documentation Issues	Key data fields incorrect	No	30	265,381	0.01
VOC	SOIL	Documentation Issues	Key data fields incorrect	Yes	1	265,381	0.00
VOC	SOIL	Documentation Issues	Missing deliverables (not required for validation)	No	2,588	265,381	0.98
VOC	SOIL	Documentation Issues	Missing deliverables (not required for validation)	Yes	60	265,381	0.02
VOC	SOIL	Documentation Issues	Missing deliverables (required for validation)	No	421	265,381	0.16
VOC	SOIL	Documentation Issues	Missing deliverables (required for validation)	Yes	8	265,381	0.00
VOC	SOIL	Documentation Issues	Omissions or errors in data package (not required for validation)	No	6,735	265,381	2.54
VOC	SOIL	Documentation Issues	Omissions or errors in data package (not required for validation)	Yes	178	265,381	0.07
VOC	SOIL	Documentation Issues	Omissions or errors in data package (required for validation)	No	527	265,381	0.20
VOC	SOIL	Documentation Issues	Omissions or errors in data package (required for validation)	Yes	14	265,381	0.01
VOC	SOIL	Documentation Issues	Record added by the validator	No	190	265,381	0.07
VOC	SOIL	Documentation Issues	Record added by the validator	Yes	8	265,381	0.00
VOC	SOIL	Documentation Issues	Sample analysis was not requested	No	10	265,381	0.00
VOC	SOIL	Documentation Issues	Sample analysis was not requested	Yes	1	265,381	0.00
VOC	SOIL	Documentation Issues	Transcription error	No	2,541	265,381	0.96
VOC	SOIL	Documentation Issues	Transcription error	Yes	124	265,381	0.05
VOC	SOIL	Holding Times	Holding times were exceeded	No	2,337	265,381	0.88
VOC	SOIL	Holding Times	Holding times were exceeded	Yes	46	265,381	0.02
VOC	SOIL	Holding Times	Holding times were grossly exceeded	Yes	3	265,381	0.00
VOC	SOIL	Instrument Set-up	Instrument tune criteria were not met	No	60	265,381	0.02
VOC	SOIL	Instrument Set-up	Instrument tune criteria were not met	Yes	1	265,381	0.00
VOC	SOIL	Internal Standards	Internal standards did not meet criteria	No	1,987	265,381	0.75
VOC	SOIL	Internal Standards	Internal standards did not meet criteria	Yes	88	265,381	0.03
VOC	SOIL	LCS	LCS recovery criteria were not met	No	80	265,381	0.03
VOC	SOIL	LCS	LCS recovery criteria were not met	Yes	5	265,381	0.00

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Table A2.5
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect ?	No. of Qualified Results	Total No. of V&V Records	Percent Qualified (%)
VOC	SOIL	LCS	QC sample/analyte (e.g. spike, duplicate, LCS) was not analyzed	No	59	265,381	0.02
VOC	SOIL	LCS	QC sample/analyte (e.g. spike, duplicate, LCS) was not analyzed	Yes	2	265,381	0.00
VOC	SOIL	Matrices	MS/MSD precision criteria were not met	No	4,920	265,381	1.85
VOC	SOIL	Matrices	MS/MSD precision criteria were not met	Yes	100	265,381	0.04
VOC	SOIL	Matrices	Percent solids < 30 percent	No	2	265,381	0.00
VOC	SOIL	Matrices	Percent solids < 30 percent	Yes	25	265,381	0.01
VOC	SOIL	Other	Lab results not verified due to unsubmitted data	No	1	265,381	0.00
VOC	SOIL	Other	QC sample frequency does not meet method requirements	No	120	265,381	0.05
VOC	SOIL	Other	QC sample frequency does not meet method requirements	Yes	2	265,381	0.00
VOC	SOIL	Other	Sample results were not validated due to re-analysis	No	657	265,381	0.25
VOC	SOIL	Other	Sample results were not validated due to re-analysis	Yes	51	265,381	0.02
VOC	SOIL	Other	See hard copy for further explanation	No	157	265,381	0.06
VOC	SOIL	Other	See hard copy for further explanation	Yes	4	265,381	0.00
VOC	SOIL	Sample Preparation	Samples were not properly preserved in the field	No	2,319	265,381	0.87
VOC	SOIL	Sample Preparation	Samples were not properly preserved in the field	Yes	49	265,381	0.02
VOC	SOIL	Surrogates	Surrogate recovery criteria were not met	No	1,696	265,381	0.64
VOC	SOIL	Surrogates	Surrogate recovery criteria were not met	Yes	198	265,381	0.07
VOC	WATER	Blanks	Method, preparation, or reagent blank contamination	No	1,274	453,061	0.28
VOC	WATER	Blanks	Method, preparation, or reagent blank contamination	Yes	661	453,061	0.15
VOC	WATER	Calculation Errors	Calculation error	Yes	15	453,061	0.00
VOC	WATER	Calibration	Continuing calibration verification criteria were not met	No	7,404	453,061	1.63
VOC	WATER	Calibration	Continuing calibration verification criteria were not met	Yes	622	453,061	0.14
VOC	WATER	Calibration	Independent calibration verification criteria not met	No	696	453,061	0.15
VOC	WATER	Calibration	Independent calibration verification criteria not met	Yes	161	453,061	0.04
VOC	WATER	Calibration	Original result exceeded linear range, serial dilution value reported	No	4	453,061	0.00
VOC	WATER	Calibration	Original result exceeded linear range, serial dilution value reported	Yes	339	453,061	0.07
VOC	WATER	Calibration	Result exceeded linear range of measurement system	Yes	251	453,061	0.06
VOC	WATER	Confirmation	Results were not confirmed	No	72	453,061	0.02
VOC	WATER	Confirmation	Results were not confirmed	Yes	9	453,061	0.00
VOC	WATER	Documentation Issues	Information missing from case narrative	No	860	453,061	0.19
VOC	WATER	Documentation Issues	Information missing from case narrative	Yes	17	453,061	0.00
VOC	WATER	Documentation Issues	Key data fields incorrect	No	49	453,061	0.01
VOC	WATER	Documentation Issues	Key data fields incorrect	Yes	5	453,061	0.00
VOC	WATER	Documentation Issues	Missing deliverables (not required for validation)	No	7,894	453,061	1.74

Table A2.5
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect ?	No. of Qualified Results	Total No. of V&V Records	Percent Qualified (%)
VOC	WATER	Documentation Issues	Missing deliverables (not required for validation)	Yes	468	453,061	0.10
VOC	WATER	Documentation Issues	Missing deliverables (required for validation)	No	987	453,061	0.22
VOC	WATER	Documentation Issues	Missing deliverables (required for validation)	Yes	87	453,061	0.02
VOC	WATER	Documentation Issues	Omissions or errors in data package (not required for validation)	No	36,559	453,061	8.07
VOC	WATER	Documentation Issues	Omissions or errors in data package (not required for validation)	Yes	2,634	453,061	0.58
VOC	WATER	Documentation Issues	Omissions or errors in data package (required for validation)	No	713	453,061	0.16
VOC	WATER	Documentation Issues	Omissions or errors in data package (required for validation)	Yes	29	453,061	0.01
VOC	WATER	Documentation Issues	Original documentation not provided	No	1,082	453,061	0.24
VOC	WATER	Documentation Issues	Original documentation not provided	Yes	34	453,061	0.01
VOC	WATER	Documentation Issues	Record added by the validator	No	1,264	453,061	0.28
VOC	WATER	Documentation Issues	Record added by the validator	Yes	25	453,061	0.01
VOC	WATER	Documentation Issues	Reported data does not agree with raw data	No	1	453,061	0.00
VOC	WATER	Documentation Issues	Sample analysis was not requested	No	2	453,061	0.00
VOC	WATER	Documentation Issues	Sample analysis was not requested	Yes	1	453,061	0.00
VOC	WATER	Documentation Issues	Transcription error	No	25,911	453,061	5.72
VOC	WATER	Documentation Issues	Transcription error	Yes	3,250	453,061	0.72
VOC	WATER	Holding Times	Holding times were exceeded	No	27,819	453,061	6.14
VOC	WATER	Holding Times	Holding times were exceeded	Yes	512	453,061	0.11
VOC	WATER	Holding Times	Holding times were grossly exceeded	No	2	453,061	0.00
VOC	WATER	Holding Times	Holding times were grossly exceeded	Yes	58	453,061	0.01
VOC	WATER	Instrument Set-up	Instrument tune criteria were not met	No	18,678	453,061	4.12
VOC	WATER	Instrument Set-up	Instrument tune criteria were not met	Yes	1,225	453,061	0.27
VOC	WATER	Internal Standards	Internal standards did not meet criteria	No	1,041	453,061	0.23
VOC	WATER	Internal Standards	Internal standards did not meet criteria	Yes	74	453,061	0.02
VOC	WATER	LCS	CRDL check sample recovery criteria were not met	Yes	1	453,061	0.00
VOC	WATER	LCS	LCS recovery criteria were not met	No	6,106	453,061	1.35
VOC	WATER	LCS	LCS recovery criteria were not met	Yes	612	453,061	0.14
VOC	WATER	Matrices	MS/MSD precision criteria were not met	No	611	453,061	0.13
VOC	WATER	Matrices	MS/MSD precision criteria were not met	Yes	98	453,061	0.02
VOC	WATER	Matrices	Site samples were not used for sample matrix QC	No	4	453,061	0.00
VOC	WATER	Matrices	Site samples were not used for sample matrix QC	Yes	2	453,061	0.00
VOC	WATER	Other	Lab results not verified due to unsubmitted data	No	1	453,061	0.00
VOC	WATER	Other	Lab results not verified due to unsubmitted data	Yes	1	453,061	0.00
VOC	WATER	Other	QC sample frequency does not meet method requirements	No	103	453,061	0.02
VOC	WATER	Other	QC sample frequency does not meet method requirements	Yes	5	453,061	0.00
VOC	WATER	Other	Sample results were not validated due to re-analysis	No	1,469	453,061	0.32

Table A2.5
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect ?	No. of Qualified Results	Total No. of V&V Records	Percent Qualified (%)
VOC	WATER	Other	Sample results were not validated due to re-analysis	Yes	589	453,061	0.13
VOC	WATER	Other	See hard copy for further explanation	No	2,090	453,061	0.46
VOC	WATER	Other	See hard copy for further explanation	Yes	495	453,061	0.11
VOC	WATER	Sample Preparation	Preservation requirements were not met by the laboratory	No	241	453,061	0.05
VOC	WATER	Sample Preparation	Preservation requirements were not met by the laboratory	Yes	4	453,061	0.00
VOC	WATER	Sample Preparation	Samples were not properly preserved in the field	No	12,441	453,061	2.75
VOC	WATER	Sample Preparation	Samples were not properly preserved in the field	Yes	919	453,061	0.20
VOC	WATER	Sensitivity	Incorrect reported activity or MDA	Yes	1	453,061	0.00
VOC	WATER	Sensitivity	Instrument detection limit > the associated RDL	No	44	453,061	0.01
VOC	WATER	Surrogates	Surrogate recovery criteria were not met	No	4,066	453,061	0.90
VOC	WATER	Surrogates	Surrogate recovery criteria were not met	Yes	571	453,061	0.13
Wet Chem	SOIL	Blanks	Calibration verification blank contamination	No	71	5,598	1.27
Wet Chem	SOIL	Blanks	Calibration verification blank contamination	Yes	231	5,598	4.13
Wet Chem	SOIL	Blanks	Method, preparation, or reagent blank contamination	No	7	5,598	0.13
Wet Chem	SOIL	Blanks	Method, preparation, or reagent blank contamination	Yes	4	5,598	0.07
Wet Chem	SOIL	Calculation Errors	Control limits not assigned correctly	No	1	5,598	0.02
Wet Chem	SOIL	Calculation Errors	Control limits not assigned correctly	Yes	138	5,598	2.47
Wet Chem	SOIL	Calibration	Calibration did not contain minimum number of standards	No	1	5,598	0.02
Wet Chem	SOIL	Calibration	Calibration did not contain minimum number of standards	Yes	1	5,598	0.02
Wet Chem	SOIL	Documentation Issues	Key data fields incorrect	Yes	7	5,598	0.13
Wet Chem	SOIL	Documentation Issues	Missing deliverables (not required for validation)	No	1	5,598	0.02
Wet Chem	SOIL	Documentation Issues	Missing deliverables (not required for validation)	Yes	21	5,598	0.38
Wet Chem	SOIL	Documentation Issues	Missing deliverables (required for validation)	No	25	5,598	0.45
Wet Chem	SOIL	Documentation Issues	Missing deliverables (required for validation)	Yes	58	5,598	1.04
Wet Chem	SOIL	Documentation Issues	Omissions or errors in data package (not required for validation)	No	2	5,598	0.04
Wet Chem	SOIL	Documentation Issues	Omissions or errors in data package (not required for validation)	Yes	88	5,598	1.57
Wet Chem	SOIL	Documentation Issues	Record added by the validator	No	4	5,598	0.07
Wet Chem	SOIL	Documentation Issues	Record added by the validator	Yes	8	5,598	0.14
Wet Chem	SOIL	Documentation Issues	Transcription error	No	9	5,598	0.16
Wet Chem	SOIL	Documentation Issues	Transcription error	Yes	41	5,598	0.73
Wet Chem	SOIL	Holding Times	Holding times were exceeded	No	89	5,598	1.59
Wet Chem	SOIL	Holding Times	Holding times were exceeded	Yes	182	5,598	3.25
Wet Chem	SOIL	Holding Times	Holding times were grossly exceeded	No	46	5,598	0.82
Wet Chem	SOIL	Holding Times	Holding times were grossly exceeded	Yes	105	5,598	1.88
Wet Chem	SOIL	LCS	LCS recovery criteria were not met	No	13	5,598	0.23
Wet Chem	SOIL	LCS	LCS recovery criteria were not met	Yes	279	5,598	4.98

Table A2.5
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect ?	No. of Qualified Results	Total No. of V&V Records	Percent Qualified (%)
Wet Chem	SOIL	LCS	QC sample/analyte (e.g. spike, duplicate, LCS) was not analyzed	Yes	18	5,598	0.32
Wet Chem	SOIL	Matrices	Duplicate sample precision criteria were not met	No	5	5,598	0.09
Wet Chem	SOIL	Matrices	Duplicate sample precision criteria were not met	Yes	3	5,598	0.05
Wet Chem	SOIL	Matrices	LCS/LCSD precision criteria were not met	No	2	5,598	0.04
Wet Chem	SOIL	Matrices	LCS/LCSD precision criteria were not met	Yes	16	5,598	0.29
Wet Chem	SOIL	Matrices	Percent solids < 30 percent	Yes	9	5,598	0.16
Wet Chem	SOIL	Matrices	Predigestion MS recovery criteria were not met	No	65	5,598	1.16
Wet Chem	SOIL	Matrices	Predigestion MS recovery criteria were not met	Yes	960	5,598	17.15
Wet Chem	SOIL	Matrices	Predigestion MS recovery was < 30 percent	Yes	2,235	5,598	39.92
Wet Chem	SOIL	Matrices	Serial dilution criteria were not met	Yes	140	5,598	2.50
Wet Chem	SOIL	Other	IDL is older than 3 months from date of analysis	Yes	2,113	5,598	37.75
Wet Chem	SOIL	Other	Lab results not verified due to unsubmitted data	Yes	4	5,598	0.07
Wet Chem	SOIL	Other	Result obtained through dilution	Yes	4	5,598	0.07
Wet Chem	SOIL	Other	See hard copy for further explanation	No	11	5,598	0.20
Wet Chem	SOIL	Sample Preparation	Samples were not properly preserved in the field	No	1	5,598	0.02
Wet Chem	SOIL	Sample Preparation	Samples were not properly preserved in the field	Yes	8	5,598	0.14
Wet Chem	WATER	Blanks	Calibration verification blank contamination	No	34	38,100	0.09
Wet Chem	WATER	Blanks	Calibration verification blank contamination	Yes	10	38,100	0.03
Wet Chem	WATER	Blanks	Method, preparation, or reagent blank contamination	No	319	38,100	0.84
Wet Chem	WATER	Blanks	Method, preparation, or reagent blank contamination	Yes	9	38,100	0.02
Wet Chem	WATER	Blanks	Negative bias indicated in the blanks	No	151	38,100	0.40
Wet Chem	WATER	Blanks	Negative bias indicated in the blanks	Yes	92	38,100	0.24
Wet Chem	WATER	Calculation Errors	Calculation error	Yes	4	38,100	0.01
Wet Chem	WATER	Calculation Errors	Control limits not assigned correctly	No	3	38,100	0.01
Wet Chem	WATER	Calculation Errors	Control limits not assigned correctly	Yes	124	38,100	0.33
Wet Chem	WATER	Calibration	Calibration correlation coefficient did not meet requirements	No	2	38,100	0.01
Wet Chem	WATER	Calibration	Calibration correlation coefficient did not meet requirements	Yes	83	38,100	0.22
Wet Chem	WATER	Calibration	Continuing calibration verification criteria were not met	No	4	38,100	0.01
Wet Chem	WATER	Calibration	Continuing calibration verification criteria were not met	Yes	181	38,100	0.48
Wet Chem	WATER	Calibration	Original result exceeded linear range, serial dilution value reported	Yes	1	38,100	0.00
Wet Chem	WATER	Calibration	Result exceeded linear range of measurement system	Yes	26	38,100	0.07
Wet Chem	WATER	Documentation Issues	Key data fields incorrect	No	1	38,100	0.00
Wet Chem	WATER	Documentation Issues	Key data fields incorrect	Yes	1	38,100	0.00
Wet Chem	WATER	Documentation Issues	Missing deliverables (not required for validation)	No	3	38,100	0.01
Wet Chem	WATER	Documentation Issues	Missing deliverables (not required for validation)	Yes	59	38,100	0.15
Wet Chem	WATER	Documentation Issues	Missing deliverables (required for validation)	No	5	38,100	0.01

Table A2.5
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect ?	No. of Qualified Results	Total No. of V&V Records	Percent Qualified (%)
Wet Chem	WATER	Documentation Issues	Missing deliverables (required for validation)	Yes	66	38,100	0.17
Wet Chem	WATER	Documentation Issues	Omissions or errors in data package (not required for validation)	No	38	38,100	0.10
Wet Chem	WATER	Documentation Issues	Omissions or errors in data package (not required for validation)	Yes	564	38,100	1.48
Wet Chem	WATER	Documentation Issues	Omissions or errors in data package (required for validation)	No	5	38,100	0.01
Wet Chem	WATER	Documentation Issues	Omissions or errors in data package (required for validation)	Yes	23	38,100	0.06
Wet Chem	WATER	Documentation Issues	Record added by the validator	No	134	38,100	0.35
Wet Chem	WATER	Documentation Issues	Record added by the validator	Yes	150	38,100	0.39
Wet Chem	WATER	Documentation Issues	Reported data does not agree with raw data	Yes	1	38,100	0.00
Wet Chem	WATER	Documentation Issues	Transcription error	No	494	38,100	1.30
Wet Chem	WATER	Documentation Issues	Transcription error	Yes	1,417	38,100	3.72
Wet Chem	WATER	Holding Times	Holding times were exceeded	No	260	38,100	0.68
Wet Chem	WATER	Holding Times	Holding times were exceeded	Yes	418	38,100	1.10
Wet Chem	WATER	Holding Times	Holding times were grossly exceeded	No	205	38,100	0.54
Wet Chem	WATER	Holding Times	Holding times were grossly exceeded	Yes	172	38,100	0.45
Wet Chem	WATER	LCS	LCS recovery criteria were not met	No	17	38,100	0.04
Wet Chem	WATER	LCS	LCS recovery criteria were not met	Yes	18	38,100	0.05
Wet Chem	WATER	LCS	QC sample/analyte (e.g. spike, duplicate, LCS) was not analyzed	No	7	38,100	0.02
Wet Chem	WATER	LCS	QC sample/analyte (e.g. spike, duplicate, LCS) was not analyzed	Yes	10	38,100	0.03
Wet Chem	WATER	Matrices	Duplicate sample precision criteria were not met	No	10	38,100	0.03
Wet Chem	WATER	Matrices	Duplicate sample precision criteria were not met	Yes	40	38,100	0.10
Wet Chem	WATER	Matrices	LCS/LCSD precision criteria were not met	No	4	38,100	0.01
Wet Chem	WATER	Matrices	LCS/LCSD precision criteria were not met	Yes	18	38,100	0.05
Wet Chem	WATER	Matrices	Predigestion MS recovery criteria were not met	No	257	38,100	0.67
Wet Chem	WATER	Matrices	Predigestion MS recovery criteria were not met	Yes	1,015	38,100	2.66
Wet Chem	WATER	Matrices	Predigestion MS recovery was < 30 percent	Yes	36	38,100	0.09
Wet Chem	WATER	Matrices	Serial dilution criteria were not met	Yes	6	38,100	0.02
Wet Chem	WATER	Matrices	Site samples were not used for sample matrix QC	No	3	38,100	0.01
Wet Chem	WATER	Matrices	Site samples were not used for sample matrix QC	Yes	74	38,100	0.19
Wet Chem	WATER	Other	IDL is older than 3 months from date of analysis	Yes	10	38,100	0.03
Wet Chem	WATER	Other	Lab results not verified due to unsubmitted data	No	18	38,100	0.05
Wet Chem	WATER	Other	Lab results not verified due to unsubmitted data	Yes	232	38,100	0.61
Wet Chem	WATER	Other	QC sample frequency does not meet method requirements	Yes	2	38,100	0.01
Wet Chem	WATER	Other	Result obtained through dilution	Yes	50	38,100	0.13
Wet Chem	WATER	Other	See hard copy for further explanation	No	12	38,100	0.03
Wet Chem	WATER	Other	See hard copy for further explanation	Yes	50	38,100	0.13

Table A2.5
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect ?	No. of Qualified Results	Total No. of V&V Records	Percent Qualified (%)
Wet Chem	WATER	Sample Preparation	Preservation requirements were not met by the laboratory	No	6	38,100	0.02
Wet Chem	WATER	Sample Preparation	Preservation requirements were not met by the laboratory	Yes	163	38,100	0.43
Wet Chem	WATER	Sample Preparation	Sample pretreatment or preparation method was incorrect	Yes	10	38,100	0.03
Wet Chem	WATER	Sample Preparation	Samples were not properly preserved in the field	No	26	38,100	0.07
Wet Chem	WATER	Sample Preparation	Samples were not properly preserved in the field	Yes	429	38,100	1.13

Table A2.6
Summary of Data Rejected During V&V

Analyte Group	Matrix	Total No. of Rejected Records	Total No. of Records	Percent Rejected (%)
Dioxins and Furans	SOIL	0	1,055	0.00
Dioxins and Furans	WATER	4	595	0.67
Explosive	SOIL	0	24	0.00
Herbicide	SOIL	67	4,347	1.54
Herbicide	WATER	56	1,789	3.13
Metal	SOIL	2,511	271,703	0.92
Metal	WATER	7,587	399,677	1.90
PCB	SOIL	291	20,425	1.42
PCB	WATER	77	6,391	1.20
Pesticide	SOIL	610	34,018	1.79
Pesticide	WATER	186	19,066	0.98
Radionuclide	SOIL	4,313	227,125	1.90
Radionuclide	WATER	8,560	100,385	8.53
SVOC	SOIL	3,271	240,667	1.36
SVOC	WATER	2,409	94,596	2.55
VOC	SOIL	6,189	428,920	1.44
VOC	WATER	15,646	564,751	2.77
Wet Chem	SOIL	368	9,248	3.98
Wet Chem	WATER	1,054	51,694	2.04
	Total	**53,199**	**2,476,476**	**2.15%**

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Table A2.7
Summary of RPDs/DERs of Field Duplicate Analyte Pairs

Analyte Group	Matrix	No. of Duplicates Falling RPD/DER Criteria	Total No. of Duplicate Pairs	Percent Failure (%)	Field Duplicate Frequency (%)
Dioxins and Furans	SOIL	118	272	43.38	29.96
Explosive	SOIL	0	4	0.00	16.67
Herbicide	SOIL	1	311	0.32	10.34
Herbicide	WATER	0	93	0.00	3.76
Metal	SOIL	2,125	17,573	12.09	9.24
Metal	WATER	890	22,454	3.96	6.47
PCB	SOIL	37	1,529	2.42	10.10
PCB	WATER	0	378	0.00	6.18
Pesticide	SOIL	7	2,556	0.27	10.74
Pesticide	WATER	0	1,132	0.00	5.69
Radionuclide	SOIL	148	3,866	3.83	12.26
Radionuclide	WATER	62	6,104	1.02	5.99
SVOC	SOIL	190	17,735	1.07	10.06
SVOC	WATER	27	5,473	0.49	5.53
VOC	SOIL	70	25,891	0.27	9.43
VOC	WATER	820	34,135	2.40	6.52
Wet Chem	SOIL	21	522	4.02	8.68
Wet Chem	WATER	67	2,788	2.40	5.82

Table A2.8
Summary of Data Estimated or Undetected Due to V&V Determinations

Analyte Group	Matrix	No. of CRA Data Records Qualified	Total No. of V&V CRA Records	Detect?	Percent Qualified (%)
Dioxins and Furans	SOIL	9	908	No	0.99
Dioxins and Furans	SOIL	157	908	Yes	17.29
Dioxins and Furans	WATER	36	535	No	6.73
Herbicide	SOIL	179	2,832	No	6.32
Herbicide	WATER	138	1,427	No	9.67
Metal	SOIL	23,544	187,800	No	12.54
Metal	SOIL	34,737	187,800	Yes	18.50
Metal	WATER	42,692	309,082	No	13.81
Metal	WATER	25,181	309,082	Yes	8.15
PCB	SOIL	712	14,276	No	4.99
PCB	SOIL	77	14,276	Yes	0.54
PCB	WATER	666	4,779	No	13.94
PCB	WATER	6	4,779	Yes	0.13
Pesticide	SOIL	1,267	22,180	No	5.71
Pesticide	SOIL	39	22,180	Yes	0.18
Pesticide	WATER	2,005	14,045	No	14.28
Radionuclide	SOIL	119	29,121	No	0.41
Radionuclide	SOIL	287	29,121	Yes	0.99
Radionuclide	WATER	450	71,021	No	0.63
Radionuclide	WATER	1,024	71,021	Yes	1.44
SVOC	SOIL	5,146	166,283	No	3.09
SVOC	SOIL	632	166,283	Yes	0.38
SVOC	WATER	6,906	77,082	No	8.96
SVOC	WATER	171	77,082	Yes	0.22
VOC	SOIL	13,156	265,381	No	4.96
VOC	SOIL	1,439	265,381	Yes	0.54
VOC	WATER	45,343	453,061	No	10.01
VOC	WATER	2,667	453,061	Yes	0.59
Wet Chem	SOIL	241	5,598	No	4.31
Wet Chem	SOIL	3,602	5,598	Yes	64.34
Wet Chem	WATER	1,182	38,100	No	3.10
Wet Chem	WATER	2,366	38,100	Yes	6.21
	Total	**216,176**	**1,663,535**		**12.99%**

Table A2.9
Summary of Data Qualified as Undetected Due to Blank Contamination

Analyte Group	Matrix	No. of CRA Records Qualified as Undetected	Total No. of CRA Records with Detected Results[a]	Percent Qualified as Undetected
Dioxins and Furans	SOIL	2	478	0.42
Metal	SOIL	5,595	139,836	4.00
Metal	WATER	6,294	150,441	4.18
PCB	SOIL	1	641	0.16
Pesticide	WATER	1	47	2.13
Radionuclide	SOIL	7	24,485	0.03
Radionuclide	WATER	6	50,140	0.01
SVOC	SOIL	18	12,976	0.14
SVOC	WATER	5	1,051	0.48
VOC	SOIL	108	5,674	1.90
VOC	WATER	144	22,521	0.64
Wet Chem	SOIL	61	4,578	1.33
Wet Chem	WATER	24	30,471	0.08
	Total	**12,266**	**443,339**	**2.77%**

[a] As determined by the laboratory prior to V&V.

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COMPREHENSIVE RISK ASSESSMENT

COMPREHENSIVE RISK ASSESSMENT METHODOLOGY AND DATA DESCRIPTION

VOLUME 2: ATTACHMENT 3

Data Adequacy Report

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ACRONYMS AND ABBREVIATIONS

AEU	Aquatic Exposure Unit
BZ	Buffer Zone
CAD/ROD	Corrective Action Decision/Record of Decision
CDPHE	Colorado Department of Public Health and Environment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CHWA	Colorado Hazardous Waste Act
CRA	Comprehensive Risk Assessment
DAR	Data Adequacy Report
DOE	U.S. Department of Energy
DQO	data quality objectives
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
ESL	ecological screening level
EU	Exposure Unit
FS	Feasibility Study
ft	foot
HRR	Historical Release Report
IA	Industrial Area
IAG	Interagency Agreement
IHSS	Individual Hazardous Substance Site
IMP	Integrated Monitoring Plan
LRA	Lead Regulatory Agency
NFA	No Further Action

NPL	National Priorities List
OU	Operable Unit
PAC	Potential Area of Concern
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
PMJM	Preble's meadow jumping mouse
PRG	preliminary remediation goal
QA	quality assurance
QAPjP	Quality Assurance Project Plan
QC	quality control
RCRA	Resource Conservation and Recovery Act
RFCA	Rocky Flats Cleanup Agreement
RFETS	Rocky Flats Environmental Technology Site
RFI	RCRA Facility Investigation
RI	Remedial Investigations
SAP	Sampling and Analysis Plan
SEP	Solar Evaporation Ponds
SVOC	semivolatile organic compound
SWMU	Solid Waste Management Unit
UBC	Under Building Contamination
VOC	volatile organic compound
WSF	West Spray Field

1.0 PURPOSE

The Comprehensive Risk Assessment (CRA) has been prepared in accordance with the Final CRA Work Plan and Methodology (DOE 2004a), hereafter referred to as the CRA Methodology. This appendix is the Data Adequacy Report (DAR) for the CRA, and has been prepared to fulfill the CRA Methodology requirement for documenting the adequacy of the data used in the CRA.

In accordance with Step 5 of the data quality objectives (DQO) process in the CRA Methodology, the following decision rules were used to determine whether the analyte data are adequate to support statistical, exposure, and risk calculations for the CRA:

> **Decision Rule #1** - If one or more metal and radionuclide surface soil sample is available per 30-acre block outside of source areas, data will be considered sufficient. One composite sample will be collected in each 30-acre block where data are not available.
>
> **Decision Rule #2** - Data adequacy for all other analyte groups and media will be determined through the consultative process with the regulatory agencies. All decision criteria, sampling decisions, and supporting data will be included in the DAR for the CRA. Final sampling locations will be determined through the consultative process with the regulatory agencies.

The first data adequacy decision rule provides the minimum acceptable number of surface soil samples for metals and radionuclides in outlying EUs, while the second decision rule regarding the adequacy of data for other analyte groups and media represents a process. This DAR addresses both decision rules, and evaluates the adequacy of the data to support both the human health risk assessments (HHRAs) as well as the ecological risk assessments (ERAs) on an exposure unit (EU) and aquatic exposure unit (AEU) basis. The adequacy of the data to support the ERA for the Preble's meadow jumping mouse (PMJM) *(Zapus hudsonius preblei)* is also provided.

2.0 DATA ADEQUACY ASSESSMENT

This DAR presents a description of data collection activities at the Rocky Flats Environmental Technology Site (RFETS) and associated quality assurance/quality control (QA/QC) processes, as well as a summary of the types and quantities of data used in the CRA. The summaries are presented in both tabular and graphical format.

Tables A3.1 through A3.48 summarize the quantity of data available for the CRA by environmental medium and analyte group. Table 2.2 for the main text of this volume describes how the data for each medium are used in the HHRAs and ERAs. The tables presented in this attachment provide sample counts for each analyte group (radionuclides, metals, volatile organic compounds [VOCs], semivolatile organic compounds [SVOCs], polychlorinated biphenyls (PCBs), pesticides, herbicides, and dioxins) for each medium as follows:

- Surface soil (ERA); Tables A3.1 through A3.8.

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- Combined surface soil/surface sediment (HHRA); Tables A3.9 through A3.16.
- Sediment (ERA); Tables A3.17 through A3.24.
- Surface water (HHRA and ERA); Tables A3.25 through A3.32.
- Subsurface soil (ERA); Tables A3.33 though A3.40.
- Combined subsurface soil/subsurface sediment (HHRA); Tables A3.41 through A3.48.

Over 1,000 surface soil/surface sediment samples were collected for each of the analyte groups listed above, except dioxins, which were potential contaminants at only a few historical potential source areas at RFETS. There were also over 1,000 surface water samples collected for radionuclide, metal, VOC, and SVOC analysis.

Figures A3.1 through A3.74 provide a visual portrayal of the CRA data. These figures use color coding for the sampling locations to indicate whether constituents in the analyte group are at concentrations that exceed the appropriate lowest ecological screening level (ESL) [1] or preliminary remediation goal (PRG) based on human health-based toxicity criteria, as documented in the CRA Methodology. The data are portrayed graphically for each analyte group in the following figures:

- Surface soil - EU overlay and ESL comparison; Figures A3.1 through A3.8.
- Surface soil/surface sediment - EU overlay and PRG comparison; Figures A3.9 through A3.16.
- Surface soil - EU and PMJM habitat patch overlay and PMJM ESL comparison; Figures A3.17 through A3.24.
- Surface water - EU overlay and PRG comparison; Figures A3.25 through A3.32.
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- Surface soil sample locations within or near PMJM habitat patches; Figures A3.73 and A3.74

While groundwater data are not summarized in this DAR, data adequacy for groundwater is also addressed. A more detailed analysis of data adequacy for groundwater is not

[1] For the surface soil maps, the lowest ESL for terrestrial receptors is used, whereas the lowest ESL for aquatic receptors is used for the sediment maps. For the maps depicting sampling within the PMJM habitat, the PMJM ESLs are used, and for the subsurface soil maps, the prairie dog ESLs are used.

provided because a future wildlife refuge worker or ecological receptors are not expected to be directly exposed to groundwater.

2.1 CRA DQO Decision Rule #1

After review of the existing surface soil sampling locations, a CRA Sampling and Analysis Plan (SAP), Addendum 04-01, was prepared in February 2004 (DOE 2004b) to address the criteria of CRA DQO Decision Rule #1. The Addendum was approved by the U.S. Environmental Protection Agency (EPA) on February 26, 2004. The SAP was implemented in 2004, where for each 30-acre block across RFETS, five individual samples were collected and composited, one from each quadrant and one in the center. The compositing provided a more representative sample for the entire 30-acre block. The samples were analyzed for radionuclides and metals to complement the extensive data that had been collected in the Industrial Area and within IHSSs, and allow exposure point concentration (EPC) calculations in the outlying EUs to be performed. The surface soil radionuclide and metal data used in the CRA are summarized in Table A3.1 and on Figure A3.1 for radionuclides, and in Table A3.2 and on Figure A3.2 for metals. The 30-acre blocks are shown on these figures. These CRA data meet the criteria of the first CRA DQO data adequacy decision rule, and are not discussed further in this DAR for individual EUs/AEUs.

2.2 CRA DQO Decision Rule # 2

Data adequacy for analyte groups and media addressed by CRA DQO Decision Rule #2 was determined through a long-term consultative process with EPA and the Colorado Department of Public Health and Environment (CDPHE). The Department of Energy (DOE) has conducted Resource Conservation and Recovery Act (RCRA) Facility Investigations (RFIs)/Comprehensive Environmental Response, Conservation, Liability Act (CERCLA) Remedial Investigations (RIs) at RFETS beginning in the late 1980s and continuing through the mid-1990s. Since then, DOE has conducted accelerated action characterizations that encompass the known areas of releases or possible releases including Individual Hazardous Substance Sites (IHSSs), Potential Areas of Concern (PACs), and Under Building Contamination (UBC) Sites, collectively referred to as IHSSs.

Three regulatory agreements have controlled characterization and cleanup actions for all media. Regulatory agency-approved Work Plans, SAPs, and Quality Assurance Project Plans (QAPjPs) were prepared to meet DQOs and appropriate EPA and CDPHE guidance. The regulatory agreements are as follows:

1. **The 1986 Compliance Agreement (CERCLA VIII-86-08 and RCRA VIII 86-06)**

   Initial investigations were conducted in accordance with this agreement which identified 178 Solid Waste Management Units (SWMUs) and CERCLA areas, and over 2000 waste generation points.

2. **The 1991 Rocky Flats Interagency Agreement (IAG) (Federal Facility Agreement and Consent Order CERCLA VIII-91-03, RCRA (3008[h]) VIII-91-07 and State of Colorado Docket number 91-01-22-01).**

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The IAG replaced the Compliance Agreement in 1991. The IAG regulated DOE's investigations, response, and corrective actions at the Site, and established a comprehensive plan for integrating CERCLA and RCRA/Colorado Hazardous Waste Act (CHWA) requirements for these actions. EPA or CDPHE was identified in the IAG as the Lead Regulatory Agency (LRA) for each designated Operable Unit (OU). The identified LRA had approval authority over DOE's characterization and remediation activities for each OU. EPA and CDPHE established criteria reflecting priorities for addressing both human health and environmental issues. Based on the IAG, the on-Site investigations were required to:

- Submit SAPs to EPA and CDPHE for review, concurrence, and approval that are designed to define the nature and extent of contamination for the OUs; and
- Comply with a comprehensive laboratory review QA/QC program.

3. **The 1996 Rocky Flats Cleanup Agreement (RFCA) (Federal Facility Agreement and Consent Order CERCLA VIII-96-21, RCRA (3008[h]) VIII-96-01 and State of Colorado Docket number 96-07-19-01).**

   RFCA replaced the IAG and has served as the regulatory agreement to disposition all IHSSs and buildings through the accelerated action process, with characterization performed in accordance with EPA- and CDPHE-approved Industrial Area (IA) and Buffer Zone (BZ) SAPs, later consolidated into the IABZSAP (DOE 2004c), which specify DQOs and QA/QC process requirements. The SAPs targeted characterization of IHSSs with the intent of determining the need for accelerated action based on human health concerns.

A more detailed description of these regulatory agreements and the investigation and cleanup history under these agreements is contained in Section 1.0 of the RI/FS Report. Section 1.4.3 describes the accelerated action process, and the disposition of all IHSSs at RFETS is summarized in Table 1.4. The 2005 Annual Update to the HRR (DOE 2005a) provides for each IHSS; a description of the potential release and any interim responses to the release, identification of potential contaminants based on process knowledge and site data, data collection activities, accelerated action activities (if any), and the basis for recommending no further accelerated action.

2.2.1 Data Collection Overview

In accordance with these regulatory agreements, numerous RCRA/CERCLA investigations and accelerated action characterizations have been conducted to characterize the Site and IHSSs at RFETS, and to determine the extent to which contamination from IHSS sources has migrated. Additional data have been collected under various regulatory agency-approved programs not specifically associated with IHSS boundaries to augment these data (for example, surface water, sediment, and groundwater sampling conducted in accordance with the Integrated Monitoring Plan [IMP] [DOE 1997]). These programs have resulted in the collection of data for the following analyte groups:

- Radionuclides;

- Metals;
- VOCs;
- SVOCs;
- PCBs;
- Pesticides;
- Herbicides; and
- Dioxins.

The specific analytes within the analyte groups have varied over time based on changing EPA guidance and laboratory methods, results of previous investigations, and the DQOs for specific environmental monitoring and cleanup projects. They have also varied because both targeted (biased) and random sampling approaches were employed. A combination of these sampling approaches is typical at National Priorities List (NPL) sites based on consideration of priorities to identify and address significant risks, and to implement a cost- and resource-effective sampling and analysis program.

Targeted sampling is designed to focus on specific locations and chemicals based on historical and process knowledge information about known or reasonably suspected sources of released hazardous substances. Sampling at IHSSs represents this situation. Targeted sampling may also be designed to determine the extent of contamination from known or suspected migration processes, such as erosion from wind or groundwater movement. Targeted sampling is also used to determine compliance with regulatory standards.

Random sampling is usually designed to provide information for statistical analyses or aid in application of professional judgment in characterizing a site. Random sampling considers gaps in locations or analyte suites that may exist from targeted sampling results.

At RFETS, targeted sampling provides the greatest volume of data and thus provides a clear picture of the known or suspected sources of contamination and migration processes. This provides a good foundation for decision making regarding statistical sampling needs.

As shown by the data summary tables presented in this DAR, data have been collected for each of the analyte groups listed above for each environmental medium (soil, sediment, and surface water). The environmental medium classification for the samples used in the RI/FS report, including the CRA, is as documented during sample collection, i.e., no attempt has been made to alter the environmental medium classification based on future hydrologic conditions or future land configuration.[2] For example, confirmation samples collected from the floor of excavation areas are designated as surface soil

[2] Although not a change in hydrologic conditions, confirmation samples taken at the East Landfill Pond after removal of the sediment were classified in the data base as subsurface soil (beneath the sediment) but have been reclassified as surface sediment because they are at the current surface in contact with the pond water.

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samples. Although the samples are not at the surface after imported clean backfill has been placed in the excavation, the samples are still classified as surface soil samples in the database. Also, sample data that have become no longer representative because of an accelerated action soil and/or sediment removal have been excluded from the data set used for the CRA (and this DAR).

Only data that meet the CRA Methodology data quality criteria have been used for the CRA (see Attachment 2 for the Data Quality Assessment). However, all data are provided on a Compact Disk in the last attachment to each of the EU and AEU risk assessment volumes, and are delimited as to their "CRA-Ready" status. As outlined in Attachment 2, there are many data quality criteria that must be met for data to be included in the "CRA-Ready" data set. The one having a direct bearing on analysis presented in the DAR is the exclusion of data collected prior to June 1991. Only data from June 1991 to the present are used in the CRA because these data meet the approved analytical QA/QC programs established by the IAG and RFCA. For the CRA, analytical data for samples collected over this time frame constitute a reasonably representative data set for use in calculating EPCs for the CRA. At the request of the regulatory agencies, the DAR data summary tables also indicate the quantity of data collected from 2001 to the present. This shows the extent to which analytical data span the entire time interval from June 1991 to the present.

Review of the data summary tables in this DAR indicates that not all analyte groups are equally represented for each medium and location at RFETS. This is a result of the "fine tuning" of the analytical programs over time through the consultative process in order to focus on the collection of data for known or suspected contaminants in the various media. Therefore, the data that are most relevant to the potential contaminants released at the various sources within the RFETS boundary are the most plentiful.

2.2.2 Recent Sampling Activities

Four SAPs and the CRA Additional Data Collection Strategy (Data Collection Strategy) (DOE 2004d) were prepared with the goal of collecting additional data to meet CRA DQO Decision Rule #2. As discussed for Decision Rule #1, a SAP was prepared in February 2004 (DOE 2004b), and was implemented to ensure that one sample for metals and radionuclides was collected in each 30-acre block across the Site. The second SAP, entitled Calendar Year 2004 Well Installation and Sampling Project Work Plan, was prepared in October 2004. It was implemented, in part, to collect additional surface water data, particularly downgradient of identified historical potential contaminant sources (DOE 2004e).

Also in October 2004, the Data Collection Strategy (DOE 2004d) was prepared by DOE in consultation with the regulatory agencies to identify any additional data needs for the CRA. The Strategy indicated that additional data were necessary to assess:

- Stratification of contamination in sediments in Ponds A-1 and A-2;
- The possible presence of dioxins in Pond A-1 and C-1 sediments (these ponds were targeted as likely locations of dioxin deposition due to potential dioxin contaminated runoff from upstream historical IHSSs); and

- The spatial distribution of potential contamination in surface water and sediment in the Rock Creek, McKay Ditch, and Southeast Aquatic Exposure Units (AEUs).

To fill these data gaps, a third SAP entitled Phase 2 – Targeted Sampling (SAP Addendum 05-01) (DOE 2004f), was prepared and implemented.

Finally, in order enhance the adequacy of the retention pond sediment data (ponds not addressed through an accelerated action), a fourth SAP entitled Additional Sampling of RFETS Pond Sediment (SAP Addendum #BZ-05-06) was prepared and implemented. These data are representative of sediment conditions at the completion of accelerated action activities at RFETS. The ponds that were sampled are as follows:

- A-1 – IHSS-142.1;
- A-2 – IHSS-142.2;
- A-3 – IHSS-142.3;
- A-4 – IHSS-142.4;
- A-5 – IHSS-142.12;
- B-4 – IHSS-142.8;
- B-5 – IHSS-142.9;
- C-1 – IHSS-142.10; and
- C-2 – IHSS-142.11.

The additional data from these above noted sampling efforts are included in the database, and are reflected in this data adequacy assessment in order to render a determination regarding data adequacy in view of CRA DQO Decision Rule #2.

2.2.3 Refinement of Data Adequacy Guidelines

Through the consultative process with EPA and CDPHE regarding CRA DQO Decision Rule #2, specific data adequacy guidelines were identified for use in this DAR: 1) the data set should have a sufficient number of samples to calculate exposure point concentrations; 2) the data set should be composed of samples that are spatially representative; and 3) the data set should be composed of samples that are temporally representative.

- *Data Adequacy Guideline #1 - Sufficient Number of Samples:* The total number of samples recommended for a specified chemical, in a specified media, in a specified EU/AEU is not a fixed value. It is a function of the expected mean, variance, and proximity of the mean to the decision criterion (e.g., toxicity benchmark). Based on the general relationship between sample number and statistical uncertainty, 5 to 10 samples represent the minimum acceptable number of samples that are generally considered sufficient to calculate a reliable EPC, while greater sample numbers continue to reduce statistical uncertainty. With

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respect to Preble's meadow jumping mouse (PMJM) habitat patches,[3] 3 samples have been identified as a data adequacy guideline.

- *Data Adequacy Guideline #2 - Spatial Representativeness:* For an EU, a data set that consists of samples evenly distributed throughout the EU is considered spatially representative of the entire exposure area. For an AEU drainage, a data set that consists of samples that are located upstream, midstream, and downstream, and after confluences with other drainages is considered spatially representative.
- *Data Adequacy Guideline #3 - Temporal Representativeness:* A data set that is composed of measurements made in the current time frame (e.g., 2001 or later) is considered temporally representative; however, if there are no trends in concentrations over time, then data across all time periods is considered temporally representative. This guideline is only applicable to sediment and surface water because environmental forces are not expected to appreciably alter analyte concentrations in surface soil over the course of 10-15 years.

If a data set does not meet these guidelines, uncertainties may increase for the risk evaluation. In these cases, it may be possible to invoke knowledge of historical releases and fate and transport processes in order to support the adequacy of the existing data to render risk management decisions given these uncertainties. These additional lines of evidence and their association with the data adequacy guidelines are summarized below.

Data Adequacy Guideline	Lines of Evidence Used to Support Data Adequacy
Number of Samples in an EU/AEU or PMJM Habitat Patch*	• These types of contaminants are not expected based on process knowledge and/or data for IHSSs located within the EU/AEU. • These types of contaminants are not expected based on the potential for such contaminants to migrate via air or water to the EU/AEU from other RFETS' IHSSs. • These types of contaminants are not expected based on data for other media within the EU/AEU.
Spatial Representativeness for EU/AEU or PMJM Habitat Patch	• There are no transport processes operating on potential sources that would be expected to cause contaminants to become distributed

[3] Habitat patches are small areas within the EUs that can reasonably be expected to represent home ranges of individual PMJM or subpopulations. The rationale for creating site-wide PMJM habitat patches is outlined in the CRA Methodology. The intent of the patches is to aggregate data in order to estimate the average contaminant exposure that an individual PMJM could reasonably be expected to encounter throughout its home range.

Data Adequacy Guideline	Lines of Evidence Used to Support Data Adequacy
	so as to establish a significant concentration gradient within the EU/AEU.** • Samples were collected in IHSSs within the EU/AEU, where contamination that may be present would be expected to be at concentrations higher than for other EU/AEU areas (conservative estimation of the EPC).
Temporal Representativeness	• Absence of temporal trends.

*If the additional lines of evidence do not support rendering risk management decisions for the PMJM, surface soil data for sampling locations approximately 100 to 200 feet of the PMJM patch boundary may be included with the PMJM patch data set to meet the data adequacy guideline.
**For the purpose of conducting statistical comparisons to background, PMJM habitat patch data may be aggregated across the entire EU based on this line of evidence.

2.3 Overview of Contamination and Contaminant Migration Pathways at RFETS

The site data indicate historical contamination at RFETS can be characterized as:

- Radionuclides, metals, PCBs, SVOCs (polynuclear aromatic hydrocarbon [PAHs], and VOCs (chlorinated solvents)in surface and subsurface soil at IHSSs and in downgradient sediment due to runoff, but also widespread plutonium/americium contamination in surface soil from historical wind dissemination of these contaminants from the 903 Pad site (IHSS 112);
- PCBs in surface and subsurface soil at former transformer sites within the IA, and in downgradient sediment due to runoff;
- Chlorinated solvents, uranium, nitrate, nickel, and chromium contamination of groundwater from sources within and near the IA, and
- Plutonium and americium, and to a much lesser extent, chlorinated solvent and metal contamination of surface water within and immediately downgradient of the IA.

The contamination has been well characterized, and all associated historical IHSSs have been addressed through accelerated actions and interim measures/interim remedial actions (IM/IRAs), or otherwise determined to require no further accelerated action based on human health concerns. Accelerated actions for soil have been triggered by the presence of plutonium/americium, arsenic, chromium, lead, PAHs, and PCBs. Groundwater IM/IRAs have targeted chlorinated solvents and uranium.

Sampling and analysis of soil, sediment and surface water for pesticides, herbicides, and dioxins has been conducted at RFETS even though these classes of compounds are not expected to represent significant contamination. As expected, sampling results indicate

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pesticides, herbicides, and dioxins are detected infrequently at low concentrations. Accelerated actions or IM/IRAs have not been required for these analyte groups. Pesticides and herbicides were only used at RFETS for their intended purpose, i.e., pest and weed control. Although spills or other inadvertent disposal of these chemicals can occur at large facilities, the data do not support that such spills or disposal occurred at RFETS. There are only two historical IHSSs at RFETS where the burning of PCBs may have resulted in dioxin contamination: the Building 121 Security Incinerator (PAC 100-609) where no carbon required (NCR)-paper containing PCBs was burned; and the Oil Burn Pit (PAC 900-153) where oil containing PCBs may have been burned (a subsurface sample was analyzed for dioxins). A few other IHSSs have been sampled for dioxins although they were not expected contaminants. Accordingly, the sampling activities for these analyte groups have focused on IHSSs where these compounds are potential contaminants, and at locations generally within and downgradient of the IA, particularly in the sediment within the downgradient drainages where runoff may have transported these compounds. The data indicate that pesticide concentrations are infrequently above soil ESLs in surface soil (Figure A3.6), sediment (Figure A3.46), and subsurface soil (Figure A3.62), and are not above the PRGs in surface soil/surface sediment (Figure A3.14) and subsurface soil/subsurface sediment (Figure A3.70). With the exception of one dioxin surface sample location, herbicide and dioxin concentrations are not above the ESLs in surface soil (Figure A3.7 and A3.8), sediment[4] (Figures A3.47 and A3.48), and subsurface soil (Figures A3.63 and A3.64), or the PRGs in surface soil/surface sediment (Figure A3.15 and A3.16) and subsurface soil/subsurface sediment (Figures A3.71 an A3.72).The pesticide, herbicide, and dioxin concentrations in surface water show similar results with respect to the PRGs (Figures A3.30 through A3.32) and ESLs (Figures A3.54 through A3.56), i.e., with the exception of pesticides which are infrequently above the ESLs, these compounds are otherwise at concentrations below PRGs and ESLs.

As seen in the figures cited above, some EUs and AEUs do not have at least 5 samples for pesticides, herbicides, and dioxin, and in some cases, there are no samples. However, as discussed above, the available information on potential historical sources of contamination, migration pathways, and concentration levels, indicate these compound classes are not likely to be of concern in any EU or AEU, and the data are considered adequate for the purposes of the CRA. Accordingly, the data adequacy for these analyte groups is not discussed further for individual EUs/AEUs.

2.4 Exposure Unit-Specific Data Adequacy Assessment

The past sampling programs at RFETS have met the CRA DQO Decision Rule #1 for radionuclides and metals in surface soil and surface sediment for all EUs for the purposes of assessing human health and ecological receptor exposures. As discussed previously in Section 2.3, although the existing data sets for pesticides, herbicides and dioxins in surface soil are limited in some EUs, these analyte classes are not likely to be of concern in most EUs. Therefore, the CRA will be performed utilizing the available data, and data adequacy for these analyte classes is not addressed further.

[4] As shown in Figure A3.47, herbicides were rarely detected. There are no herbicide ESLs for sediment.

This section provides an evaluation of data adequacy for VOCs, SVOCs, and PCBs in surface soil and surface sediment for the purposes of assessing human health, non-PMJM, and PMJM ecological receptor exposures. In addition, data adequacy for radionuclides, metals, VOCs, SVOCs, and PCBs in surface soil is also evaluated within PMJM habitat areas, and in surface water for the purposes of human health exposures.[5] Surface water and sediment data adequacy for the purposes of aquatic receptor exposures is addressed in Section 2.5.

2.4.1 West Area EU

Surface Soil and Surface Soil/Surface Sediment

In the West Area EU (WAEU), surface soil was not sampled and analyzed for VOCs, SVOCs, and PCBs; however, ten sediment samples were analyzed for these classes of compounds (Tables A3.49 and A3.50, and Figure A3.3 through A3.8 and Figures A3.11 through A3.13).

Number of Samples

Data for at least 5 sediment samples exist for VOCs, SVOCs, and PCBs; however, surface soil data does not exist for these classes of compounds. The sediment data indicates these compounds are either not detected or detected at low concentrations below the PRGs (Figures A3.11 through A3.13). The WAEU contains no historical IHSSs, and is hydraulically upgradient and generally upwind of potential historical source areas in and near the IA. Therefore, available information on potential historical sources of contamination, contaminant migration pathways from potential sources in other EUs, and concentration levels in adjacent sediment show that the constituents in these analyte groups are not likely to be of concern in surface soil for this EU, and the data are considered adequate for the purposes of the CRA.

Spatial Representativeness

There are no surface soil sample locations analyzed for organic constituents within the WAEU, and the two sediment sample locations are on streams located in the southern half of the EU. Although the spatial distribution of sampling locations is limited, the WAEU contains no historical IHSSs, and is hydraulically upgradient and generally upwind of potential historical source areas in and near the IA. Thus, the absence of potential historical sources within the WAEU, or significant transport mechanisms for contaminants to migrate to the WAEU and establish a spatial concentration pattern indicates the data are representative of the entire EU. Therefore, the data are considered adequate for the purposes of the CRA.

Surface Soil in PMJM Habitat

There are 3 PMJM habitat patches in the WAEU: #1, #31, and #32. However, the data for these patches is evaluated in the risk assessments for the Rock Creek Drainage EU and

[5] It was agreed through the consultative process that human exposure to surface water is likely to be insignificant. As a conservative measure in the CRA, data for surface water are screened against the WRW surface water PRGs presented in the CRA Methodology (see Attachment 1).

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the Inter Drainage EU. Thus, data adequacy for surface soil in PMJM habitat is evaluated in the sections addressing these EUs.

Surface Water

One to 51 surface water samples were collected in the WAEU and analyzed for radionuclides, metals, VOCs, SVOCs, and PCBs (Table A3.52, and Figure A3.25 through A3.29).

Number of Samples

There are data for at least 5 surface water samples for radionuclides, metals, and VOCs, but only 1 sample for SVOCs and PCBs (Table A3.52). However, SVOCs and PCBs are relatively insoluble, and as expected, were not detected in surface water in the WAEU (Figures A3.28 and A3.29). Also, in sediment within this EU, SVOCs were detected at low levels below the PRGs, and PCBs were not detected (Figures A3.12 and A3.13). Furthermore, there are no historical sources for this type of contamination within the EU and no significant transport pathways for this contamination to have migrated to the WAEU. Therefore, although WAEU SVOC and PCB data are limited in number, available information on potential historical sources of contamination, contaminant migration pathways from potential sources in other EUs, contaminant chemical characteristics, and contaminant levels in other EU media show that the constituents in these analyte groups are not likely to be of concern for the EU surface water, and the data are considered adequate for the purposes of the CRA.

Spatial Representativeness

As shown on Figures A3.25 through A3.29, most of the streams in the WAEU are ephemeral which limits the collection of surface water samples. The existing sample locations are in the southern and central portions of the EU and were sampled based on the availability of water. Considering also the absence of historical sources of contamination within the EU or significant transport pathways for contaminants to have migrated to the EU, the data for these sample locations should be representative of surface water quality for the entire EU.

Temporal Representativeness

As shown in Table A3.52, although current data exist for metals, there are no surface water data from 2001 to the present for any of the organic analyte groups or radionuclides. As discussed above ("Number of Samples"), SVOCs and PCBs are not a concern in surface water for the WAEU. The pre-2001 data indicate that the radionuclides and VOCs are either less than the PRGs or non-detected (Figures A3.25 and A3.27). There is also an absence of historical sources of contamination within the EU or significant transport pathways for contaminants to have migrated to the EU. Therefore, although WAEU radionuclide and VOC data have not been collected since 2001, the existing data, and available information on potential historical sources of contamination and migration pathways indicate concentration trends for the constituents in these analyte groups are unlikely, and the data are considered adequate for the purposes of the CRA.

2.4.2 Inter Drainage EU

Surface Soil and Surface Soil/Surface Sediment

No sediment samples were collected in the Inter Drainage EU (IDEU) for organic analytes; however, three surface soil samples were collected and analyzed for VOCs and SVOCs, but no surface soil samples were collected for PCBs (Tables A3.49 and A3.50, and Figure A3.3 through A3.5 and Figures A3.11 through A3.13).

Number of Samples

For surface soil and surface soil/surface sediment, data for at least 5 samples does not exist for the organic analyte groups; there are 3 samples for VOCs and SVOCs and no samples for PCBs. The VOC and SVOC data for the 3 surface soil samples indicate non-detectable concentrations of these analytes (Figures A3.3 and A3.4). Although PCBs were not analyzed, these compounds are also not expected to be present in surface soil in this EU. Four historical IHSSs exist within the IDEU: the west spray field (IHSS 168), the nickel carbonyl disposal area (IHSS 195), roadway spray areas (PAC-000-501), and the tear gas powder release (PAC NE-1400). With the exception of roadway spray areas, these IHSSs are not expected to be historical sources of organic contamination, i.e. liquid low-level radioactive waste contaminated with high concentrations of nitrate from the Solar Evaporation Ponds (SEP) (IHSS 101) was periodically sprayed within IHSS 168; nickel carbonyl rapidly decomposes to nickel oxide; and tear gas powder rapidly volatilizes. The roadway spray areas are roads that were sprayed with waste oil for dust control, and accordingly, the oil could have contaminated the soil with polynuclear aromatic hydrocarbons (PAHs).[6] However, 2 of the 3 samples collected for SVOC analysis are near the road, and PAHs were not detected (Figure A3.4b). Also, data for a sample collected in the Upper Woman Drainage EU, and another sample collected in the Lower Woman Drainage EU, both of which are very close to PAC 000-501 (the latter sample is on the edge of the road), indicate that PAHs (and PCBs) are not detected (see Figure A3.4b). Furthermore, the IDEU is hydraulically upgradient and generally upwind of potential historical source areas in and near the IA. Therefore, although there are limited organic data in the IDEU, available information on potential historical sources of contamination in the EU, contaminant migration pathways from potential sources in other EUs, and concentration levels in surface soil show that organic constituents are not likely to be of concern in surface soil for this EU, and the data are considered adequate for the purposes of the CRA.

Spatial Representativeness

Surface soil sample locations for the VOCs and SVOCs are clustered in the central portion of the EU (Figures A3.3 through A3.4). As shown in these figures, the existing data indicate that concentrations of VOCs and SVOCs are non-detectable. Based on the knowledge of potential historical sources in the EU (see discussion for Sample Number), only SVOCs (PAHs) are expected organic contaminants in the EU because of the presence of the roadway spray area (PAC 000-501), yet PAHs were not detected near this

[6] There is no documentation that indicates the oil contained PCBs.

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PAC. Also, the IDEU is hydraulically upgradient and generally upwind of potential historical source areas in and near the IA. Thus, available information on potential historical sources within the IDEU, the absence of significant transport mechanisms for contaminants to migrate to the IDEU and establish a spatial concentration pattern indicates the data are representative of the entire EU. Therefore, the data are considered adequate for the purposes of the CRA.

Surface Soil in PMJM Habitat

There are 3 PMJM habitat patches in the IDEU: #5, #9, and #31. Two IDEU sampling locations are within PMJM habitat patch #5 (Figures A3.17 and A3.18). This habitat patch is mostly within the Rock Creek Drainage EU (RCEU), and the data for patch #5 are evaluated in RCEU risk assessment. No samples were collected in the IDEU for PMJM habitat patches #9 and #31.

Number of Samples

Because no samples were collected in the IDEU for PMJM habitat patches #9 and #31, in accordance with the data adequacy guideline, the availability of surface soil data near the PMJM habitat patch was reviewed for possible incorporation into the habitat patch data sets. As shown on Figure A3.73, 7 additional surface soil samples in the vicinity of the PMJM habitat patches were used to establish the PMJM data set for the patches; 4 for habitat patch #9 data set, and 3 for habitat patch #31 data set. For PMJM habitat patch # 9, the 4 samples are in, or very near to, the 100 foot buffer surrounding the patch. This additional data complements the data for the one sample located in PMJM habitat patch # 9, which is in the Upper Walnut Drainage EU, and will be used to evaluate risk to the PMJM in the IDEU risk assessment. For PMJM habitat patch #31, the 3 additional surface soil samples are in, or very near to, the 100 foot buffer surrounding the patch. (Figure A3.73). Inclusion of these samples provides additional radionuclides and metals data for the PMJM risk characterization, but organic data is absent. However, as discussed above ("surface soil/surface sediment"), organics are not expected to be contaminants in surface soil in this EU. Furthermore, historical IHSSs in the IDEU are to the north and south of the habitat patches, and runoff from these historical IHSSs is to the east following the gentle sloping grade to the east. Therefore, available information on potential historical sources of contamination, migration pathways, and concentration levels in surface soil elsewhere in the IDEU show that these compound classes are not likely to be of concern in PMJM habitat patch surface soil for this EU, and the data are considered adequate for the purposes of the CRA.

Spatial Representativeness

The PMJM habitat is located sidegradient of potential historical source areas in the IDEU. Because the dominant contaminant migration pathway from these potential sources is runoff and transport by water to the east and not into the PMJM habitat patches, concentration gradients should not be present in surface soil within the patches. Therefore, the surface soil data for the PMJM habitat can be aggregated for the purpose of conducting a statistical background comparison.

Surface Water

Seven to 11 surface water samples were collected in the IDEU and analyzed for radionuclides, metals, and VOCs. One sample was analyzed for SVOCs and PCBs (Table A3.52, and Figure A3.25 through A3.29).

Number of Samples

There are data for at least 5 surface water samples for radionuclides, metals and VOCs. Therefore, the data for these analyte groups are considered adequate for the purposes of the CRA.

SVOCs and PCBs are relatively insoluble, and as expected, were not detected in surface water in the IDEU (Figures A3.28 and A3.29). Also, SVOCs were not detected in sediment within this EU (Figures A3.12 and A3.13). The IDEU is hydraulically upgradient and generally upwind of potential historical source areas in and near the IA. Therefore, although there are limited organic data in the IDEU, available information on potential historical sources of contamination in the EU, contaminant migration pathways from potential sources in other EUs, and concentration levels in surface soil show that organic constituents are not likely to be of concern in surface soil for this EU, and the data are considered adequate for the purposes of the CRA.

Spatial Representativeness

As shown on Figures A3.25 through A3.29, surface water sampling locations, although limited in number for organic analyte groups, are well distributed along the short reach of McKay Ditch that passes through the IDEU. McKay Ditch is the only perennial stream in the IDEU.

Temporal Representativeness

As shown in Table A3.52, there are no surface water data from 2001 to the present for any of the analyte groups. However, the pre-2001 data indicate constituents in all analyte groups are either less than the PRGs or non-detected (Figures A3.25 through A3.29). The closest IHSS to McKay Ditch is the West Spray Field (IHSS 168). Runoff from this IHSS is to the east and would thus not impact McKay Ditch. Therefore, although IDEU surface water data have not been collected since 2001, the existing data, and available information on potential historical sources of contamination and migration pathways indicate concentration trends for the constituents in these analyte groups are unlikely, and the data are considered adequate for the purposes of the CRA.

2.4.3 Lower Walnut Drainage EU

Surface Soil and Surface Soil/Surface Sediment

Four to 12 surface soil samples and 7 to 15 surface soil/surface sediment samples were collected in the Lower Walnut Drainage EU (LWNEU) and analyzed for VOCs, SVOCs, and PCBs (Tables A3.49 and A3.50, and Figure A3.3 through A3.5 and Figures A3.11 through A3.13).

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Number of Samples

For surface soil, data for at least 5 samples exists for each organic analyte group, except PCBs (4 samples). For surface soil/surface sediment, data for at least 5 samples exist for each organic analyte group (Tables A3.49 and A3.50). Although there are only 4 surface soil samples for PCBs, these compounds are not expected to be contaminants in surface soil in this EU because the dominant contaminant migration pathway from historical sources in the IA (former transformer sites) is runoff and transport by water into Walnut Creek, i.e., PCBs are most likely to be present in the sediment of Walnut Creek if they are present at all.[7] The data indicate PCBs are present in the sediment of the A- and B-series ponds upgradient of the LWNEU, but are not present in the sediment of Walnut Creek within the LWNEU (Figures A3.13 and A3.45). Furthermore, PCBs are not detected in LWNEU surface soil. Therefore, although there are only four surface soil samples for PCBs in the LWNEU, available information on potential historical sources of contamination, migration pathways, and concentration levels in surface soil and adjacent sediment show that constituents in these analytes groups are not likely to be of concern in surface soil for this EU, and the data are considered adequate for the purposes of the CRA.

Spatial Representativeness

Surface soil sample locations for the VOCs, SVOCs, and PCBs tend to be clustered in the southern portion of the EU (Figures A3.3 through A3.5) with several samples located near the Flume Pond. With the addition of the sediment data (for the HHRA), the data are more evenly distributed throughout the EU with additional samples within and near the Flume Pond, although data are still lacking for the northern portion of the EU (Figures A3.11 through A3.13). As shown in the above cited figures, the existing data indicate that concentrations of VOCs, SVOCs, and PCBs, are either non-detected or less than the PRGs/ESLs. Although the surface soil sample locations are somewhat clustered, the absence of potential historical sources within the EU, and the remote location of LWNEU surface soil from potential historical sources in the IA indicate concentration gradients should not be present and the data should be representative of the entire EU. Therefore, the data are considered adequate for the purposes of the CRA.

Surface Soil in PMJM Habitat

There are 3 PMJM habitat patches in the LWNEU: #10, #13, and #14. Up to 8 surface soil samples were collected in the PMJM habitat patches and analyzed for particular analyte groups (Tables A3.51, and Figures A3.17 through A3.21).

Number of Samples

The number of samples within the PMJM habitat patches for each analyte group varies from zero to 8, with patch #14 having the greatest number of samples (Table A3.51 and Figures A3.17 through A3.21). Patch # 14 meets the data adequacy guideline of 3 or

[7] The Flume Pond (IHSS 142.12), otherwise known as Pond A-5, is the only historical IHSS in the EU. It was used for Walnut Creek flow measurements and is not expected to be a source of contamination for the LWNEU.

more samples, except for PCBs where there are no samples. However, as discussed for surface soil and surface soil/surface sediment, PCBs are not expected to be present in surface soil in the PMJM habitat. Patches #10 and #13 do not meet the data adequacy guideline for any analyte groups (except patch #13 has 3 samples for radionuclides), and there are no additional surface soils outside and near the patches that can be included in the PMJM habitat patch data. However, for the entire PMJM habitat within the LWNEU, radionuclides, VOCs, and SVOCs are either not detected or below ESLs (Figures A3.17, A3.19, and A3.20), which indicates these compound classes are not a concern in PMJM habitat surface soil. Metals are above the ESLs in patches #10 and #14 (Figure A3.18); however, patch #14 has adequate data relative to the data adequacy guideline. Because of the absence of potential historical sources within the EU for contamination, and the remote location of the LWNEU PMJM habitat from potential historical sources in the IA, concentration gradients should not be present and the data for habitat patch #14 should be representative of the other habitat patches. Therefore, the data are considered adequate for the purposes of the CRA.

Spatial Representativeness

Because of the absence of potential historical sources within the EU for contamination, and the remote location of the LWNEU PMJM habitat from potential historical sources in the IA, concentration gradients should not be present. Accordingly, surface soil data for the PMJM habitat patches can be aggregated for the purpose of conducting a statistical background comparison.

Surface Water

Four to 933 surface water samples were collected in the LWNEU and analyzed for radionuclides, metals, VOCs, SVOCs, and PCBs (Table A3.52, and Figure A3.25 through A3.29).

Number of Samples

There are data for at least 5 surface water samples for radionuclides, metals, VOCs, and SVOCs, but only 4 samples for PCBs (Table A3.52). However, PCBs were not detected in surface water in the LWNEU and have never been detected in surface water in the upgradient A- and B-series ponds (Figure A3.29). Therefore, although LWNEU PCB data are limited in number, the absence of detectable levels of these compounds in surface water within the EU and in the upgradient ponds suggest they are not of concern in surface water for the EU, and the data are considered adequate for the purposes of the CRA.

Spatial Representativeness

As shown on Figures A3.25 through A3.29, surface water sampling locations are well distributed throughout the LWNEU, particularly those for radionuclides.

Temporal Representativeness

As shown in Table A3.52, although current data exist for radionuclides and metals, there are no surface water data from 2001 to the present for any of the organic analyte groups.

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With respect to the organic analyte groups, the pre-2001 data indicate that the organics are either less than the PRGs or non-detected (Figures A3.27 through A3.29). This is observed for upstream surface water stations in the Upper Walnut Drainage EU at and below the terminal ponds (Ponds A-4 and B-5). There are also no sources for organic contamination within the LWNEU. Therefore, although LWNEU surface water data for organics have not been collected since 2001, the existing data, and available information on potential historical sources of contamination and migration pathways indicate concentration trends for the constituents in these analyte groups are unlikely, and the data are considered adequate for the purposes of the CRA.

2.4.4 Rock Creek Drainage EU

Surface Soil and Surface Soil/Surface Sediment

Seventeen surface soil samples and 26 to 31 surface soil/surface sediment samples were collected in the Rock Creek Drainage EU (RCEU) and analyzed for VOCs, SVOCs, and PCBs (Tables A3.49 and A3.50, and Figure A3.3 through A3.8 and Figures A3.11 through A3.13).

Number of Samples

Data for at least 5 samples exist for VOCs, SVOCs, and PCBs, and the data are considered adequate for the purposes of the CRA.

Spatial Representativeness

Surface soil sample locations for the organic analyte groups tend to be clustered in the northern portion of the EU (Figures A3.3 through A3.5). Many of these samples are associated with site background locations because the area was (and is) considered un-impacted from historical site-related activities. With the addition of the sediment data (for the HHRA), the data are more evenly distributed throughout the EU (Figures A3.11 through A3.13). The RCEU contains no historical IHSSs, and is hydraulically upgradient and generally upwind of potential historical source areas in and near the IA. Thus, the absence of potential historical sources within the RCEU, or significant transport mechanisms for contaminants to have migrated to the RCEU and establish a spatial concentration pattern indicates the data are representative of the entire EU. Therefore, the data are considered adequate for the purposes of the CRA.

Surface Soil in PMJM Habitat

There are 10 PMJM habitat patches in the RCEU: #1, #2, #3a/3b, #4, #5, #6, #7, #8, #32, and #33. Up to 13 surface soil samples were collected in the PMJM habitat patches and analyzed for particular analyte groups (Tables A3.51, and Figures A3.17 through A3.21).

Number of Samples

Data for at least 3 samples exists for radionuclides, metals, VOCs, SVOCs, and PCBs in patch # 2, for radionuclides in patch #5, and for radionuclides and metals in patch #8. The data adequacy guideline for 3 samples is not met for the other patches in the RCEU, organic data is absent for many of these patches, and no data exist for patches #4, #32,

and #33. However, the RCEU contains no historical IHSSs, and is hydraulically upgradient and generally upwind of potential historical source areas in and near the IA. Although not all PMJM habitat patches contain 3 samples, the absence of potential historical sources or significant transport mechanisms for contaminants to have migrated to the PMJM patch surface soil indicates concentration gradients should not be present and the data for habitat patch #2 should be representative of the other habitat patches. Therefore, the data are considered adequate for the purposes of the CRA.

Spatial Representativeness

Because of the absence of potential historical sources within the EU for contamination, and the upgradient and generally upwind location of the RCEU PMJM habitat from potential historical sources in the IA, concentration gradients should not be present. Accordingly, surface soil data for the PMJM habitat patches can be aggregated for the purpose of conducting a statistical background comparison.

Surface Water

Two to 65 surface water samples were collected in the RCEU and analyzed for radionuclides, metals, VOCs, SVOCs, and PCBs (Table A3.52, and Figure A3.25 through A3.29).

Number of Samples

There are data for at least 5 surface water samples for radionuclides, metals, VOCs, and SVOCs, but only 2 samples for PCBs (Table A3.52). However, PCBs were not detected in surface water in the RCEU (Figure A3.29). PCBs are also not detected in surface soil/surface sediment within the EU (Figure A3.13). Furthermore, there are no historical sources for this type of contamination within the EU and no likely pathways for this contamination to migrate to the RCEU. Therefore, although RCEU PCB data are limited in number, available information on potential historical sources of contamination, migration pathways, and contaminant levels in other EU media show that constituents in this analyte group are not likely to be of concern for the EU surface water, and the data are considered adequate for the purposes of the CRA.

Spatial Representativeness

As shown on Figures A3.25 through A3.29, surface water sampling locations are well distributed throughout the RCEU, particularly those for radionuclides and metals.

Temporal Representativeness

As shown in Table A3.52, although current data exist for radionuclides and metals, there are no surface water data from 2001 to the present for PCBs, and only one current sample for VOCs and SVOCs. With respect to the organic analyte groups, the pre-2001 data indicate that the organics are either less than the PRGs or non-detected (Figures A3.27 through A3.29). There is also an absence of sources of contamination within the EU or significant transport pathways for contaminants to migrate to the EU. Therefore, although RCEU organic data have not been collected since 2001, the existing data, and available information on potential historical sources of contamination and migration pathways

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indicate concentration trends for the constituents in these analyte groups are unlikely, and the data are considered adequate for the purposes of the CRA.

2.4.5 Southwest Buffer Zone Area EU

Surface Soil and Surface Soil/Surface Sediment

No surface soil or surface sediment samples from the Southwest Buffer Zone Area EU (SWEU) were analyzed for VOCs, SVOCs, or PCBs (see Tables A3.49 and A3.50 and Figure A3.3 through A3.5 and Figures A3.11 through A3.13).

Number of Samples

The number of samples for VOCs, SVOCs and PCBs do not meet the data adequacy guideline. A small portion of IHSS 000-501, roadway spray areas, is also located in the SWEU. The IHSS is a result of historical spraying of roads with waste oil for dust control, and accordingly, the oil could have contaminated the soil with PAHs (SVOCs). However, in other EUs, samples were collected near the road for PAH (and PCB) analysis, and PAHs (and PCBs) were not detected (see IDEU Surface Soil and Surface Soil/Surface Sediment, "Number of Samples"). PCBs are not known to be constituents in the oil that was used. Also, the SWEU is hydraulically isolated and is generally upwind from potential historical source areas in and near the IA. Thus, surface water and air do not provide pathways for migration of VOCs, SVOCs, and PCBs into the SWEU. Therefore, available information on potential historical sources of contamination and contaminant migration pathways from potential sources in other EUs show that the constituents in these analyte groups are not likely to be of concern in surface soil for this EU, and the data are considered adequate for the purposes of the CRA.

Spatial Representativeness

Surface soil and sediment samples were not collected for VOC, SVOC, and PCB analysis. Therefore, spatial representativeness is not applicable.

Surface Soil in PMJM Habitat

The SWEU contains three PMJM habitat patches: #29A, #29B, and #30. Portions of Patches #29A and #30 cross into the adjacent EU (Southeast Buffer Zone Area EU), but are evaluated as part of the SWEU risk assessment. For the PMJM patches in the SWEU, seven samples were analyzed for radionuclides and four samples were analyzed for metals. No surface soil samples from PMJM habitat in the SWEU were analyzed for VOCs, SVOCs, or PCBs.

Number of Samples

Data for at least 3 samples exists for radionuclides in patch # 29A, and two samples were analyzed for radionuclides in Patch #30. There are two samples that were analyzed for metals in Patch #29A, and two samples that were analyzed for metals in Patch #30. The data adequacy guideline for 3 samples is met only for radionuclides in Patch #29A. As discussed above for surface soil/surface sediment, there is an absence of potential historical sources within the SWEU or mechanisms for contaminants to migrate to the

SWEU. This indicates concentration gradients should not be present, and the radionuclide and metal data in aggregate are representative of both PMJM habitat patches.

There is no data for organic analyte groups for the PMJM habitat patches in the SWEU. However, as discussed for surface soil/ surface sediment, available information on potential historical sources of contamination and contaminant migration pathways from potential sources in other EUs show that the constituents in these analyte groups are not likely to be of concern for the PMJM habitat patches in this EU, and the data are considered adequate for the purposes of the CRA.

Spatial Representativeness

Because of the absence of potential historical sources within the EU for contamination, and the isolated location of the SWEU PMJM habitat from potential historical sources in the IA, concentration gradients should not be present. Accordingly, surface soil data for the PMJM habitat patches can be aggregated for the purpose of conducting a statistical background comparison.

Surface Water

Six surface water samples were collected in the SWEU and were analyzed for radionuclides, seven samples were analyzed for metals and six samples were analyzed for VOCs. No samples were analyzed for SVOCs or PCBs (see Table A3.52, and Figures, A3.25 through A3.29).

Number of Samples

At least five samples exist for radionuclides, metals, and VOCs. These sample numbers meet the data adequacy guideline. However no data exists for SVOCs and PCBs in surface water in the SWEU.

The one historical IHSS in the SWEU (PAC 000-501) is unlikely to be a source of SVOC and PCB contamination due to runoff from the segment of road near Smart Ditch (see discussion for Surface Soil and Surface Soil/Surface Sediment, Number of Samples). Also, the SWEU is hydraulically isolated from potential historical source areas in and near the IA, so migration of constituents in these analyte groups into the SWEU via surface or ground water is not expected. Therefore, available information on potential historical sources of contamination and contaminant migration pathways from potential sources in other EUs indicate that the constituents in these analyte groups are not likely to be of concern in surface water for this EU, and the data are considered adequate for the purposes of the CRA.

Spatial Representativeness

As shown on Figures A3.25 and A3.26, there are two surface water sampling locations for radionuclides and metals; one at the upstream boundary (western edge) of the EU and one near the downstream (east) end of the EU. VOCs were also sampled at the upstream station (see Figures A3.27). These locations provide representative data for Smart Ditch in the SWEU because of the absence of sources of contamination within the SWEU or transport pathways for contaminants to migrate into the EU.

Temporal Representativeness

As shown in Table A3.52, although current data exist for radionuclides and metals, there are no surface water data from 2001 to the present for the VOCs. As discussed above ("Number of Samples"), VOCs are not a concern for the SWEU. Therefore, although SWEU VOC data have not been collected since 2001, the existing data, and available information on potential historical sources of contamination and migration pathways indicate concentration trends for the constituents in these analyte groups is unlikely, and the data are considered adequate for the purposes of the CRA.

2.4.6 Southeast Buffer Zone Area EU

Surface Soil and Surface Soil/Surface Sediment

One surface soil sample from the Southeast Buffer Zone Area EU (SEEU) was analyzed for VOCs, SVOCs, and PCBs (see Table A3.49 and Figure A3.3 through A3.5). Because sediment samples were not taken in the SEEU, this is the same sample listed in the tables and figures for combined surface soil and surface sediment. (Table A3.50 and Figures A3.11 through A3.13).

Number of Samples

The single sample collected in the SEEU is one of a group of samples from five locations in and near IHSS 209, the other samples being located in the LWOEU. No VOCs, SVOCs, or PCBs were detected in any of the IHSS 209 samples, including the one located in the SEEU, indicating that IHSS 209 is not a potential source of organic contamination in the SEEU. A small portion of IHSS 000-501, roadway spray areas, is also located in the SEEU. The IHSS is a result of historical spraying of roads with waste oil for dust control, and accordingly, the oil could have contaminated the soil with PAHs (SVOCs). However, in other EUs, samples were collected near the road for PAH (and PCB) analysis, and PAHs (and PCBs) were not detected (see IDEU Surface Soil and Surface Soil/Surface Sediment, "Number of Samples"). Also, PCBs are not known to be constituents in the oil that was used. The SEEU is hydraulically isolated from potential historical source areas in and near the IA. Thus, surface water does not provide a contaminant pathway for migration of VOCs, SVOCs, and PCBs into the SEEU. Therefore, available information on potential historical sources of contamination, contaminant migration pathways from potential sources in other EUs, and concentration levels in surface soil show that the constituents in these analyte groups are not likely to be of concern in surface soil for this EU, and the data are considered adequate for the purposes of the CRA.

Spatial Representativeness

There is only one surface soil sample location in the SEEU. Although the spatial distribution of sampling locations is very limited, the SEEU contains no IHSSs that are potential sources of organic contamination, and the SEEU is hydraulically isolated from potential historical source areas in and near the IA (see discussion above - "Number of Samples"). Thus, the absence of potential historical sources for organics within the SEEU, or significant transport mechanisms for contaminants to have migrated to the

SEEU and establish a spatial concentration pattern indicates the data are representative of the entire EU. Therefore, the data are considered adequate for the purposes of the CRA.

Surface Soil in PMJM Habitat

The SEEU contains portions of three PMJM habitat patches: #28, #29A, and #30. However, these PMJM patches are evaluated in the risk assessments for the adjacent EUs. Patches #29A and #30 are evaluated as part of the Southwest Buffer Zone EU (SWEU) risk assessment, and Patch #28 is evaluated as part of the LWOEU risk assessment. Thus, data adequacy for surface soil in PMJM habitat is evaluated in the sections addressing these EUs.

Surface Water

Four surface water samples were collected in the SEEU and were analyzed for radionuclides and metals (see Table A3.52, and Figures, A3.25 and A3.26). One sample was analyzed for VOCs, SVOCs, and PCBs (see Table A3.52 and Figures A3.27 through A3.29).

Number of Samples

There are data for four surface water samples for radionuclides and metals, but only one sample for VOCs, SVOCs, and PCBs (Table A3.52). These sample numbers do not meet the data adequacy criterion.

Although there are only 4 radionuclide and metal samples, these constituents were detected below the PRG in all four samples. The one historical IHSS in the SEEU (000-501) is hydraulically downgradient of Smart Ditch, the water conveyance system where surface water samples were taken. Furthermore, as discussed above, the SEEU is hydraulically isolated from potential historical source areas in and near the IA, so migration of constituents in these analyte groups into the SEEU via surface or ground water is not possible. Therefore, available information on potential historical sources of contamination, contaminant migration pathways from potential sources in other EUs, and concentration levels in surface water show that the constituents in these analyte groups are not likely to be of concern in surface water for this EU, and the data are considered adequate for the purposes of the CRA.

VOCs, SVOCs, and PCBs were not detected in surface water in the SEEU (Figures A3.27 through A3.29). These organic analyte groups are also not detected in surface soil within the EU (Figures A3.3 through A3.5). Furthermore, there are no sources for organic contaminants within the EU (see discussion for Surface Soil and Surface Soil/Surface Sediment, Number of Samples), and no likely pathways for this contamination to have migrated into the SEEU. Therefore, although SEEU organic data are limited, available information on potential historical sources of contamination, migration pathways, and contaminant levels in other EU media show that constituents in these analyte groups are not likely to be of concern for the SEEU surface water, and the data are considered adequate for the purposes of the CRA.

Spatial Representativeness

As shown on Figures A3.25 and A3.26 surface water sampling locations for radionuclides and metals, while not abundant, are well distributed throughout the SEEU. The single sampling location for VOCs, SVOCs, and PCBs (see Figures A3.27 through A3.29) is located in Pond D-1 at about the center of the stream segment that passes through the SEEU. Therefore, the surface water data are representative of the surface water quality for the entire EU.

Temporal Representativeness

As shown in Table A3.52, although current data exist for radionuclides and metals, there are no surface water data from 2001 to the present for any of the organic analyte groups. Three of the four radionuclide and metal samples were taken after 2001 and thus the available data are temporally representative. As discussed above ("Number of Samples"), VOCs, SVOCs, and PCBs are not a concern for the SEEU based on the existing data, and available information on potential historical sources of contamination and migration pathways. Therefore, although SEEU surface water organic data have not been collected since 2001, the existing data, and available information on potential historical sources of contamination and migration pathways indicate concentration trends for the constituents in these analyte groups are unlikely, and the data are considered adequate for the purposes of the CRA.

2.4.7 Wind Blown Area

Surface Soil and Surface Soil/Surface Sediment

Eighty-one to 98 surface soil samples and 90 to 107 surface soil/surface sediment samples were collected in the Wind Blown Area EU (WBEU) and analyzed for VOCs, SVOCs, and PCBs (Tables A3.49 and A3.50, and Figure A3.3 through A3.5 and Figures A3.11 through A3.13).

Number of Samples

Data for at least 5 samples exist for VOCs, SVOCs, and PCBs, and the data are considered adequate for the purposes of the CRA.

Spatial Representativeness

As shown on Figure A3.3 through A3.5 and Figures A3.11 through A3.13, surface soil and surface soil/surface sediment sampling locations are well distributed throughout the WBEU.

Surface Soil in PMJM Habitat

There is one PMJM habitat patch in the WBEU: #24B. This habitat patch is part of #24A, which is in the Lower Woman Drainage EU. The data for this patch is evaluated in the risk assessment for the Lower Woman Drainage EU. Thus, data adequacy for surface soil in this PMJM habitat patch is evaluated in the section addressing the Lower Woman Drainage EU.

Surface Water

Two to 136 surface water samples were collected in the WBEU and analyzed for radionuclides, metals, VOCs, SVOCs, and PCBs (Table A3.52, and Figure A3.25 through A3.29).

Number of Samples

There are data for at least 5 surface water samples for radionuclides, metals, and VOCs, but only 4 samples for SVOCs and 2 samples for PCBs (Table A3.52). However, SVOCs and PCBs were not detected in surface water in the WBEU (Figures A3.28 and A3.29). Even though there are only 2 samples for PCBs, PCBs have never been detected in surface water anywhere within the southern half of RFETS (Figure A3.29). In particular, PCBs have never been detected in the South Interceptor Ditch which passes along the southern edge of the WBEU. Although SVOCs and PCBs are detected in surface soil and surface sediment in the WBEU and elsewhere at RFETS, occasionally above PRGs/ESLs (Figures A3.4 and A3.5 and Figures A3.12 and A3.13), they are present at low concentrations, often non-detected in surface water (Figures A3.28 and A3.29). Therefore, although WBEU SVOC and PCB surface water data are limited in number, available information on surface water concentrations in the WBEU and elsewhere at RFETS, and the low solubility of these classes of compounds indicate that SVOCs and PCBs not likely to be of concern for the EU surface water, and the data are considered adequate for the purposes of the CRA.

Spatial Representativeness

As shown on Figures A3.25 through A3.29, surface water sampling locations are on ephemeral streams in the western portion of the WBEU or on the South Interceptor Ditch. Ephemeral streams in the eastern portion of the WBEU rarely flow. Therefore, the sample locations are well distributed along the relevant surface water bodies in the WBEU.

Temporal Representativeness

As shown in Table A3.52, although current data exist for radionuclides and metals (to a much lesser extent), there are no surface water data from 2001 to the present for any of the organic analyte groups. However, the pre-2001 data indicate that the organics are either less than the PRGs or non-detected (Figures A3.27 through A3.29). Therefore, although WBEU surface water organic data is not current, the existing data and the chemical behavior of these classes of compounds (low solubility of SVOCs and PCBs, and volatility of VOCs) indicate concentration trends for the constituents in these analyte groups are unlikely, and the data are considered adequate for the purposes of the CRA.

2.4.8 No Name Gulch Drainage EU

Surface Soil and Surface Soil/Surface Sediment

Ninety-three to 116 surface soil samples and 106 to 121 surface soil/surface sediment samples were collected in the No Name Gulch Drainage EU (NNEU) and analyzed for

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VOCs, SVOCs, and PCBs (Tables A3.49 and A3.50, and Figure A3.3 through A3.5 and Figures A3.11 through A3.13).

Number of Samples

Data for at least 5 samples exist for VOCs, SVOCs, and PCBs, and the data are considered adequate for the purposes of the CRA.

Spatial Representativeness

Surface soil sample locations for the VOCs, SVOCs, and PCBs tend to be clustered in the NNEU historical IHSSs (Figures A3.3 through A3.5). With the addition of the sediment samples (for the HHRA), data exists downstream of the historical IHSSs, although data are still largely lacking in areas outside of the historical IHSSs (eastern portion of the NNEU) (Figures A3.11 through A3.13). Because the surface soil sample locations are clustered in IHSSs, which are historical potential sources of contamination, EPC calculations for the NNEU will be conservative. Therefore, the data are considered adequate for the purposes of the CRA.

Surface Soil in PMJM Habitat

There are 2 PMJM habitat patches in the NNEU: #10, and #11A/11B. PMJM habitat patch # 10 crosses into the LWNEU and is evaluated as part of the LWNEU risk assessment. Thus, data adequacy for surface soil in PMJM habitat patch #10 is evaluated in the section addressing this EU. Only 1 surface soil sample was collected in PMJM habitat patch #11A/11B (Tables A3.51, and Figures A3.17 through A3.21).

Number of Samples

There is only one sample within PMJM habitat patch #11A/11B, which was analyzed for radionuclides (Table A3.51 and Figures A3.17 through A3.21). In accordance with the data adequacy guideline, the availability of surface soil data near the PMJM habitat patch was ascertained for possible incorporation into the patch #11A/11B data set. As shown on Figure A3.74, 5 additional surface soil samples in the vicinity of the PMJM habitat were pulled into the PMJM data set to improve the data adequacy for risk evaluation. One sample is located to the north, near the edge of the 100 foot buffer, and the other 4 are clustered near the edge of the 200 foot buffer along the stream to the west (see Figure A3.74). Although somewhat removed from the habitat, these latter four samples were included because they are closest to both the stream feeding the habitat area as well as the habitat. Inclusion of these samples provides additional radionuclides and metals data for the PMJM risk characterization, but organic data is still absent. However, organics are not expected to be contaminants in surface soil in this EU because the habitat is located topographically above the No Name Gulch stream bed, and the dominant contaminant migration pathway from potential historical sources in the NNEU is runoff and transport by water into No Name Gulch where sediment may potentially become contaminated. Therefore, organics are not likely to be of concern in surface soil for this PMJM habitat patch, and the data are considered adequate for the purposes of the CRA.

Spatial Representativeness

The PMJM habitat is located downgradient of potential historical source areas in the NNEU. Because the dominant contaminant migration pathway from these potential sources is runoff and transport by water into No Name Gulch, concentration gradients should not be present in surface soil within the PMJM habitat patches, i.e., the habitat is located topographically above the stream bed. Therefore, the surface soil data for the PMJM habitat can be aggregated for the purpose of conducting a statistical background comparison.

Surface Water

Seven to 144 surface water samples were collected in the NNEU and analyzed for radionuclides, metals, VOCs, SVOCs, and PCBs (Table A3.52, and Figure A3.25 through A3.29).

Number of Samples

Data for at least 5 samples exist for radionuclides, metals, VOCs, SVOCs, and PCBs, and therefore, the data are considered adequate for the purposes of the CRA.

Spatial Representativeness

As shown on Figures A3.25 through A3.29, surface water sampling locations are mostly at or just downgradient of the East Landfill Pond. No Name Gulch is ephemeral and mostly dry throughout the year, which has limited the collection of samples further downgradient. Therefore, the data are considered adequate for the purposes of the CRA.

Temporal Representativeness

As shown in Table A3.52, current data exist for all analyte groups except PCBs. Although there are no surface water data from 2001 to the present for PCBs, the pre-2001 data indicate that PCBs are non-detected (Figure A3.29). In addition, these constituents are present at low concentrations, and often are non-detected in surface water site wide. Therefore, although NNEU surface water PCB data is not current, the existing data and the low solubility of this class of compound indicates concentration trends for PCBs are unlikely, and the data are considered adequate for the purposes of the CRA.

2.4.9 Lower Woman Drainage EU

Surface Soil and Surface Soil/Surface Sediment

Nine surface soil samples and 31 to 32 surface soil/surface sediment samples were collected in the Lower Woman Drainage EU (LWOEU) and analyzed for VOCs, SVOCs, and PCBs (Tables A3.49 and A3.50, and Figure A3.3 through A3.5 and Figures A3.11 through A3.13).

Number of Samples

Data for at least 5 samples exist for VOCs, SVOCs, and PCBs, and the data are considered adequate for the purposes of the CRA.

Spatial Representativeness

Surface soil sample locations for the VOCs, SVOCs, and PCBs tend to be clustered in the LWOEU historical IHSSs (Figures A3.3 through A3.5), although there are several samples to the east of the IHSSs out toward the eastern property boundary. With the addition of the sediment samples (for the HHRA), spatial representativeness improves somewhat, although data are still largely lacking in the southern portion of the EU outside of the historical IHSSs (Figures A3.11 through A3.13). Because the surface soil sample locations tend to be clustered in IHSSs, which are historical potential sources of contamination, EPC calculations for the LWOEU should be conservative. Therefore, the data are considered adequate for the purposes of the CRA

Surface Soil in PMJM Habitat

There are 7 PMJM habitat patches in the LWOEU: #22A, #23, #24A, #25, #26, #27, and #28. PMJM habitat patch # 24B, located in the WBEU, is part of patch #24A, and is also addressed in the LWOEU risk assessment. One to 39 surface soil samples were collected in the PMJM habitat patches and analyzed for radionuclides, metals, VOCs, SVOCs, and PCBs (Tables A3.51, and Figures A3.17 through A3.21).

Number of Samples

Except for radionuclide samples in PMJM habitat patches #22A, #23, #26, #27, and #28, and metal samples in patch #23, the data adequacy guideline for 3 samples is not met for the other analyte groups for the PMJM habitat patches in the LWOEU. Organic data is absent for many of these patches.

One sample was collected for organics in each of patches #23 and #25, and organics were not detected (Figures A3.19 through A3.21). Patch #23 has the greatest potential for organic contamination because historical IHSSs are located topographically upgradient to the north and south, and runoff from these historical IHSSs could have contaminated surface soil in the habitat patch. The absence of organics indicates the IHSSs are not significant sources of organic contamination and/or the runoff transport mechanism is not significant. Surface soil in the other patches would not be expected to have organic contamination because there are no historical IHSSs that are located topographically upgradient. Also, concentrations of organics in surface soil in the WBEU are largely not detected (Figures A3.3 through A3.5). Therefore, organics are not likely to be of concern in surface soil for this PMJM habitat patch, and the data are considered adequate for the purposes of the CRA.

Metal concentrations in surface soil are above the ESLs in patches#22, #23, #24, #25, and #27 (Figure A3.18. Patch #23 includes a portion of IHSS SE-1602 (East Firing Range), a historical potential source of metal contamination. Metal concentrations in surface soil for habitat patches #22, #24, #25, and #27 should be similar because of the absence of potential historical sources for metal contamination near these patches, i.e., concentration gradients should not be present and the data for habitat patches #22, #24, #25, and #27 should be representative of the other habitat patches. Although available data for each patch will be used to conduct patch-specific risk characterizations; the uncertainty analysis will document the greater reliability of patch #23 findings and their applicability

to the other patches in the EU. Therefore, the data are considered adequate for the purposes of the CRA.

Spatial Representativeness

Because of the absence of historical potential sources within the EU for radionuclide contamination, and the remote location of the LWOEU PMJM habitat from historical potential sources in and near the IA, concentration gradients should not be present. There is only one historical potential source for metal contamination (SE-1602), but this IHHS was addressed through a soil removal accelerated action. Accordingly, surface soil data for the PMJM habitat patches can be aggregated for the purpose of conducting a statistical background comparison.

Surface Water

Thirty-nine to 1719 surface water samples were collected in the LWOEU and analyzed for radionuclides, metals, VOCs, SVOCs, and PCBs (Table A3.52, and Figure A3.25 through A3.29).

Number of Samples

Data for at least 5 samples exist for radionuclides, metals, VOCs, SVOCs, and PCBs, and therefore, the data are considered adequate for the purposes of the CRA.

Spatial Representativeness

As shown on Figures A3.25 through A3.29, many surface water sampling stations are located on Woman Creek and the South Interceptor Ditch, and stations are located on Ponds C-1 and C-2. The stream stations provide coverage along the entire reach of the streams within the EU. Therefore, the data are considered adequate for the purposes of the CRA.

Temporal Representativeness

As shown in Table A3.52, current data exist for all analyte groups except PCBs. Although there are no surface water data from 2001 to the present for PCBs, the pre-2001 data indicate that PCBs are non-detected (Figure A3.29). In addition, these constituents are present at low concentrations, and are often non-detected in surface water site wide. Therefore, although LWOEU surface water PCB data is not current, the existing data and the low solubility of this class of compound indicates concentration trends for PCBs are unlikely, and the data are considered adequate for the purposes of the CRA.

2.4.10 Upper Woman Drainage EU

Surface Soil and Surface Soil/Surface Sediment

Numerous surface soil and surface sediment samples from the Upper Woman Creek Drainage EU (UWOEU) were analyzed for VOCs, SVOCs, and/or PCBs (see Tables A3.49 and A3.50 and Figure A3.3 through A3.5 and Figures A3.11 through A3.13). Ninety surface soil samples and 25 sediment samples were analyzed for PCBs; 113

surface soil samples and 24 sediment samples were analyzed for SVOCs; and 96 surface soil samples and 25 sediment samples were analyzed for VOCs.

Number of Samples

The number of samples for VOCs, SVOCs and PCBs meet the data adequacy guideline. Therefore, the data are considered adequate for the purposes of the CRA.

Spatial Representativeness

Figures A3.3 through A3.5 and A3.11 through A3.13 show the spatial distribution of locations where surface soil and surface sediment samples were collected and analyzed for VOCs, SVOCs, and PCBs. The sample locations for these media and analyte groups are distributed throughout the northern portion of the UWOEU, but there are not sample locations to the south. However, most of the sample locations in the north are in historical IHSSs, specifically IHSS 133 (Ash Pits) and IHSS 115 (the Original Landfill). Because these IHSSs are historical potential sources of contamination, EPC calculations for the UWOEU should be conservative. Therefore, the data are considered adequate for the purposes of the CRA.

Surface Soil in PMJM Habitat

There are 3 PMJM habitat patches in the UWOEU: #19, #20A/20B, and #21A/21B/21C, PMJM habitat patch # 22A, located in the both the UWOEU and LWOEU is addressed in the LWOEU risk assessment. Three to 22 surface soil samples were collected in the PMJM habitat patches and analyzed for radionuclides, metals, VOCs, SVOCs, and PCBs (Tables A3.51, and Figures A3.17 through A3.21).

Number of Samples

The data adequacy guideline of 3 samples is met for radionuclides and metals for all the habitat patches in the UWOEU, and is met for all organic analyte groups for patches #20 and #21. It is also met for SVOCs in patch #19. VOC and PCB data do not exist for patch #19. The Ash Pits (IHSS 133) is located in patch #19. Process knowledge and site data indicate that metals, radionuclides, and to a much lesser extent SVOCs are contaminants of the ash (see 2005 HRR Annual Update). Accordingly, the Ash Pits are not a source for VOC and PCB contamination. Therefore, constituents in these analyte groups are not likely to be of concern in surface soil for this PMJM habitat patch, and the data are considered adequate for the purposes of the CRA.

Spatial Representativeness

Sampling locations are well distributed throughout the habitat patches, and therefore, meet the guideline for spatial representativeness. Spatial concentration patterns may be present for metals because the Ash Pits in patch #19 are a potential source for metals (radionuclide results in all the patches are below the ESL so radionuclides are not a concern for the PMJM). However, data can be aggregated across all patches for the purpose of conducting a statistical background comparison because the large quantity of data near the Ash Pits will potentially result in a conservative bias, i.e. concluding that

more metals are statistically above background in patches # 20 and #21 than may actually be above background.

Surface Water

The surface water within the UWOEU has been extensively sampled for all analyte groups of interest for the CRA (see Table A3.52, and Figures, A3.25 through A3.29). Four hundred and eight samples were analyzed for radionuclides, 445 samples were analyzed for metals, 224 samples were analyzed for VOCs, 135 samples were analyzed for SVOCs, and 84 samples were analyzed for PCBs.

Number of Samples

At least five samples exist for all the analyte groups for surface water samples from the UWOEU. Therefore, the data are considered adequate for the purposes of the CRA.

Spatial Representativeness

Figures A3.25 through A3.29 show the spatial distribution of locations where surface water samples were collected and analyzed for radionuclides, metals, VOCs, SVOCs, and PCBs, respectively. The sample locations for all of these analyte groups are distributed throughout the UWOEU. Therefore, the data are considered adequate for the purposes of the CRA.

Temporal Representativeness

As shown in Table A3.52, current data exists for radionuclides, metals, VOCs, SVOCs, and PCBs for surface water samples from the UWOEU. Therefore, the data are considered adequate for the purposes of the CRA.

2.4.11 Upper Walnut Drainage EU

Surface Soil and Surface Soil/Surface Sediment

Many surface soil and surface sediment samples from the Upper Walnut Creek Drainage EU (UWNEU) were analyzed for VOCs, SVOCs, and/or PCBs (see Tables A3.49 and A3.50 and Figure A3.3 through A3.5 and Figures A3.11 through A3.13). Forty four surface soil samples and 79 sediment samples were analyzed for PCBs; 27 surface soil samples and 50 sediment samples were analyzed for SVOCs; and 29 surface soil samples and 52 sediment samples were analyzed for VOCs.

Number of Samples

The number of samples for VOCs, SVOCs and PCBs meet the data adequacy guideline. Therefore, the data are considered adequate for the purposes of the CRA.

Spatial Representativeness

Figures A3.3 through A3.5 and A3.11 through A3.13 show the spatial distribution of locations where surface soil and surface sediment samples were collected and analyzed for VOCs, SVOCs, and PCBs. For surface soil, many of the samples are clustered near historical IHSSs in the adjacent Industrial Area. With the addition of the sediment

samples, the sample locations are more distributed throughout the EU. Because the IHSSs in the IA are historical potential sources of contamination, EPC calculations for the UWNEU are expected to be conservative. Therefore, the data are considered adequate for the purposes of the CRA.

Surface Soil in PMJM Habitat

There are 5 PMJM habitat patches in the UWNEU: #12A/12B, #15, #16, #17, and #18. PMJM habitat patch # 13, located in the both the UWNEU and LWNEU is addressed in the LWNEU risk assessment. PMJM habitat patch # 9, located in the both the UWNEU and IDEU is addressed in the IDEU risk assessment. One to 41 surface soil samples were collected in the PMJM habitat patches and analyzed for radionuclides, metals, VOCs, SVOCs, and PCBs (Tables A3.51, and Figures A3.17 through A3.21).

Number of Samples

The data adequacy guideline of 3 samples is met for radionuclides, metals, VOCs, SVOCs, and PCBs for patches #12, is met for all analyte groups except SVOCs for patch #18, and is met for radionuclides and metals for patch #17. The data adequacy guideline is not met for patches #15 (1 radionuclide and 1 metal sample), #16 (1 radionuclide sample), and #17 (2 samples each VOCs, SVOCs, and PCBs). The data for radionuclides, VOCs, SVOCs, and PCBs for all patches in the UWNEU indicate that the ESLs are not exceeded. Therefore, organics are not likely to be of concern in surface soil for the PMJM habitat patches, and additional data collection is not required for the purposes of the CRA. Using the same rationale, radionuclides are not likely to be of concern in surface soil for the PMJM habitat patches, and additional data collection is not required for the purposes of the CRA. Only patches #15 and #16 do not meet the data adequacy guideline for metals. However, the more remote location of these patches from the historical IHSSs in and near the Industrial Area suggests that the metals data for the other patches in the EU (e.g. #12 and #18) are representative, if not biased high, for patches #15 and #16. Although available data for each patch will be used to conduct patch-specific risk characterizations, the uncertainty analysis will document the greater reliability of patches #12, #17, and #18 findings and their applicability to the other patches in the EU. Therefore, the data are considered adequate for the purposes of the CRA.

Spatial Representativeness

Sampling locations are generally well distributed throughout the habitat patches, and therefore, meet the guideline for spatial representativeness. Spatial concentration patterns may be present for metals because patches #12 and #18 are near historical IHSSs in the Industrial Area, potential sources for metals (radionuclide results in all the patches are below the ESL so radionuclides are not a concern for the PMJM). However, data can be aggregated across all patches for the purpose of conducting a statistical background comparison because the large quantity of data near the Industrial Area will potentially result in a conservative bias, i.e. concluding that more metals are statistically above background in patches # 15, #16, and #17 than may actually be above background.

Surface Water

The surface water within the UWNEU has been extensively sampled for all analyte groups of interest for the CRA (see Table A3.52, and Figures, A3.25 through A3.29). Three thousand eighty one samples were analyzed for radionuclides, 1263 samples were analyzed for metals, 430 samples were analyzed for VOCs, 284 samples were analyzed for SVOCs, and 119 samples were analyzed for PCBs.

Number of Samples

At least five samples exist for all the analyte groups for surface water samples from the UWNEU. Therefore, the data are considered adequate for the purposes of the CRA.

Spatial Representativeness

Figures A3.25 through A3.29 show the spatial distribution of locations where surface water samples were collected and analyzed for radionuclides, metals, VOCs, SVOCs, and PCBs, respectively. The sample locations for all of these analyte groups are distributed throughout the UWNEU. Therefore, the data are considered adequate for the purposes of the CRA.

Temporal Representativeness

As shown in Table A3.52, current data exist for all analyte groups except PCBs. Although there are no surface water data from 2001 to the present for PCBs, the pre-2001 data indicate that PCBs are non-detected (Figure A3.29). In addition, these constituents are present at low concentrations, and are often non-detected in surface water site wide. Therefore, although UWNEU surface water PCB data is not current, the existing data and the low solubility of this class of compound indicates concentration trends for PCBs are unlikely, and the data are considered adequate for the purposes of the CRA.

2.4.12 Industrial Area EU

Surface Soil and Surface Soil/Surface Sediment

Numerous surface soil and surface sediment samples from the Industrial Area EU (IAEU) were analyzed for VOCs, SVOCs, and/or PCBs (see Tables A3.49 and A3.50 and Figure A3.3 through A3.5 and Figures A3.11 through A3.13). Four hundred eighty four surface soil samples and 75 sediment samples were analyzed for PCBs; 1224 surface soil samples and 87 sediment samples were analyzed for SVOCs; and 1238 surface soil samples and 99 sediment samples were analyzed for VOCs.

Number of Samples

The number of samples for VOCs, SVOCs and PCBs meet the data adequacy guideline. Therefore, the data are considered adequate for the purposes of the CRA.

Spatial Representativeness

Figures A3.3 through A3.5 and A3.11 through A3.13 show the spatial distribution of locations where surface soil and surface sediment samples were collected and analyzed for VOCs, SVOCs, and PCBs. The sample locations for these media and analyte groups

are distributed throughout the IAEU. Therefore, the data are considered adequate for the purposes of the CRA.

Surface Soil in PMJM Habitat

There are no PMJM habitat patches in the IAEU.

Surface Water

The surface water within the IAEU has been extensively sampled for all analyte groups of interest for the CRA (see Table A3.52, and Figures, A3.25 through A3.29). Five thousand two hundred and three samples were analyzed for radionuclides, 2397 samples were analyzed for metals, 1321 samples were analyzed for VOCs, 806 samples were analyzed for SVOCs, and 70 samples were analyzed for PCBs.

Number of Samples

At least five samples exist for all the analyte groups for surface water samples from the IAEU. Therefore, the data are considered adequate for the purposes of the CRA.

Spatial Representativeness

Figures A3.25 through A3.29 show the spatial distribution of locations where surface water samples were collected and analyzed for radionuclides, metals, VOCs, SVOCs, and PCBs, respectively. The sample locations for all of these analyte groups are distributed throughout the IAEU. Therefore, the data are considered adequate for the purposes of the CRA.

Temporal Representativeness

As shown in Table A3.52, current data exist for radionuclides, metals, VOCs, SVOCs, and PCBs for surface water samples from the IAEU. Therefore, the data are considered adequate for the purposes of the CRA.

2.5 Sediment and Surface Water Data Adequacy Assessment

As previously mentioned, risk to ecological receptors from contaminants in sediment and surface water are evaluated on an AEU basis for the CRA. Accordingly, the data adequacy assessment for sediment and surface water has been conducted on an AEU basis.

2.5.1 North Walnut Creek AEU

Sediment

A large number of sediment samples from the North Walnut Creek AEU (NW AEU) were analyzed for radionuclides, metals, VOCs, SVOCs, and PCBs (see Table A3.53 and Figure A3.41 through A3.45). One hundred twenty seven sediment samples from the NW AEU were analyzed for radionuclides, 112 samples were analyzed for metals, 114 samples were analyzed for VOCs, 106 samples were analyzed for SVOCs, and 124 sediment samples were analyzed for PCBs.

Number of Samples

The sediment samples collected in the NW AEU meet the data adequacy guideline of at least five samples for all analyte groups noted above. Therefore, these data are considered adequate for the purposes of the CRA.

Spatial Representativeness

Figures A3.41 through A3.45 show the spatial distribution of locations where sediment samples were collected and analyzed for radionuclides, metals, VOCs, SVOCs, and PCBs. The sediment sample locations are distributed throughout the NW AEU wherever sediment occurs. The data are considered adequate for the purposes of the CRA.

Temporal Representativeness

As shown in Table A3.53, between 26 and 32 sediment samples were collected in the NW AEU from 2001 to the present for all analyte groups. Therefore, the existing data are considered adequate for the purposes of the CRA.

Surface Water

The surface water within the NW AEU has been extensively sampled for radionuclides, metals, VOCs, SVOCs, and PCBs (see Table A3.54, and Figures, A3.49 through A3.53). Two thousand seven hundred and sixty seven samples were analyzed for radionuclides, 1193 samples were analyzed for metals, 357 samples were analyzed for VOCs, 256 samples were analyzed for SVOCs, and 119 samples were analyzed for PCBs.

Number of Samples

The surface water samples collected in the NW AEU meet the data adequacy guideline of at least five samples for all analyte groups noted above. Therefore, these data are considered adequate for the purposes of the CRA.

Spatial Representativeness

Figures A3.49 through A3.53 show the spatial distribution of locations where surface water samples were collected and analyzed for radionuclides, metals, VOCs, SVOCs, and PCBs, respectively. The sample locations for all of these analyte groups are distributed throughout the NW AEU wherever surface water occurs. As shown in Figures A3.49 through A3.53, at least one sample for each analyte group was collected from a sampling station located in North Walnut Creek at the far western boundary of the AEU (upstream) as well as numerous samples collected in the A-series ponds and samples collected from a sampling station at the far eastern boundary of the AEU (downstream). Therefore, the data are representative of the surface water in the AEU and are considered adequate for the purposes of the CRA.

Temporal Representativeness

As shown in Table A3.54, current data exist for radionuclides, metals, VOCs, SVOCs, and PCBs for surface water samples from the NW AEU. Figures A3.33 through A3.37 show the frequency of sample collection from each sampling location in the NW AEU for

radionuclides, metals, VOCs, SVOCs, and PCBs, respectively. For radionuclides, metals, and VOCs, more than 4 samples were collected from numerous locations both upstream and downstream on the North Walnut Creek drainage. Both SVOCs and PCBs were sampled more than 4 times at several locations downstream within the NWAEU. At least one upstream location was sampled between 2 and 4 times for each of these analyte groups. For all analyte groups, multiple samples were collected from downstream locations that are more likely to be affected over time by runoff from the IA. Therefore, the data are considered adequate for the purposes of the CRA.

2.5.2 South Walnut Creek AEU

Sediment

A large number of sediment samples from the South Walnut Creek AEU (SW AEU) were analyzed for radionuclides, metals, VOCs, SVOCs, and/or PCBs (see Table A3.53 and Figure A3.41 through A3.45). One hundred seventy eight sediment samples were analyzed for radionuclides, 126 samples were analyzed for metals, 111 sediment samples were analyzed for VOCs; 103 sediment samples were analyzed for SVOCs; and 97 sediment samples were analyzed for PCBs.

Number of Samples

The sediment samples collected in the SW AEU meet the data adequacy guideline of at least five samples for all analyte groups noted above. Therefore, these data are considered adequate for the purposes of the CRA.

Spatial Representativeness

Figures A3.41 through A3.45 show the spatial distribution of locations where sediment samples were collected and analyzed for radionuclides, metals, VOCs, SVOCs, and PCBs within the SW AEU. The sediment sample locations are distributed throughout the AEU along the South Walnut Creek and downgradient Walnut Creek streambed. Other sediment samples taken within the former IA are in ditches tributary to South Walnut Creek. Therefore, the data are considered adequate for the purposes of the CRA.

Temporal Representativeness

As shown in Table A3.53, between 23 and 47 sediment samples were taken in the SW AEU from 2001 to the present for all analyte groups. Therefore, the existing data are considered adequate for the purposes of the CRA.

Surface Water

The surface water within the SW AEU has been extensively sampled for radionuclides, metals, VOCs, SVOCs, and PCBs (see Table A3.54, and Figures, A3.49 through A3.56). Six thousand three hundred sixty eight samples were analyzed for radionuclides, 2488 samples were analyzed for metals, 1401 samples were analyzed for VOCs, 835 samples were analyzed for SVOCs, and 70 samples were analyzed for PCBs.

Number of Samples

The surface water samples collected in the SW AEU meet the data adequacy guideline of at least five samples for all analyte groups noted above. Therefore, these data are considered adequate for the purposes of the CRA.

Spatial Representativeness

Figures A3.49 through A3.54 show the spatial distribution of locations where surface water samples were collected and analyzed for radionuclides, metals, VOCs, SVOCs, and PCBs, respectively. The sample locations for all of these analyte groups are distributed throughout the SW AEU wherever surface water exists. Sampling locations are especially numerous in the western portion of the SW AEU, which overlaps the former IA. Numerous locations are directly downstream of the IA and there is one location at the far eastern edge of the SW AEU. Data were also collected at the extreme upstream and downstream ends of the SW AEU. Therefore, the data are considered adequate for the purposes of the CRA.

Temporal Representativeness

As shown in Table A3.54, current data exist for all analyte groups of concern except PCBs for surface water samples collected from the SW AEU. As shown in Figures A3.33 through A3.36 surface water samples, which were analyzed for radionuclides, metals, VOCs and SVOCs, were collected more than 4 times from numerous surface water locations throughout the SW AEU. Therefore, the data for these analytes are considered adequate for the purposes of the CRA.

Seventy surface water samples in the SW AEU were analyzed for PCBs (Table A3.54 and Figure A3.37). As discussed previously, the majority of these samples were taken from the western portion of the SW AEU within and directly downstream of the former IA. Several locations downstream of the former IA were sampled more than 4 times for PCBs, although no samples were collected after 2000. PCBs were detected in only one sample, which was taken in October 1991. In addition, these constituents are present at low concentrations, and often are non-detected in surface water site wide. Therefore, although SW AEU surface water PCB data is not current, the existing data and the low solubility of this class of compound indicates concentration trends for PCBs are unlikely, and the data are considered adequate for the purposes of the CRA.

2.5.3 No Name Gulch AEU

Sediment

At least six sediment samples from the No Name Gulch AEU (NN AEU) were analyzed for radionuclides, metals, VOCs, SVOCs, and PCBs (see Table A3.53 and Figure A3.41 through A3.48). Twenty three sediment samples were analyzed for radionuclides, 20 samples were analyzed for metals, 16 samples were analyzed for VOCs; 16 sediment samples were analyzed for SVOCs; and 6 sediment samples were analyzed for PCBs.

Number of Samples

The sediment samples collected in the NN AEU meet the data adequacy guideline of at least five samples for all analyte groups noted above. Therefore, these data are considered adequate for the purposes of the CRA.

Spatial Representativeness

Figures A3.41 through A3.45 show the spatial distribution of locations where sediment samples were collected and analyzed for radionuclides, metals, VOCs, SVOCs, and PCBs within the NNAEU. The sampling locations for radionuclides are clustered in and near the IHSSs at the western (upstream) end of the NN AEU and a small number of locations spread relatively uniformly along the drainage. The sampling locations for metals, VOCs, SVOCs, and PCBs are also clustered in and near the IHSSs at the western end of the NN AEU, with additional locations just downstream and at the eastern border of the NN AEU. Because the majority of the sampling locations are clustered in and near the IHSSs in the NN AEU, EPC calculations are expected to be conservative, and the data are considered adequate for the purposes of the CRA.

Temporal Representativeness

As shown in Table A3.53, 10 sediment samples were collected in the NN AEU after 2000 for all of the analyte groups except PCBs. PCBs were not detected in any of the six existing samples. Therefore, although NN AEU sediment PCB data is not current, the existing data and the low solubility of this class of compound indicates concentration trends for PCBs are unlikely, and the data are considered adequate for the purposes of the CRA.

Surface Water

The surface water within the NN AEU has been sampled for radionuclides, metals, VOCs, SVOCs, and PCBs (see Table A3.54, and Figures, A3.25 through A3.29). Eighty eight samples were analyzed for radionuclides, 78 samples were analyzed for metals, 144 samples were analyzed for VOCs, 121 samples were analyzed for SVOCs, and 7 samples were analyzed for PCBs.

Number of Samples

The surface water samples collected in the NN AEU meet the data adequacy guideline of at least five samples for all analyte groups noted above. Therefore, these data are considered adequate for the purposes of the CRA.

Spatial Representativeness

Figures A3.25 through A3.29 show the spatial distribution of locations where surface water samples were collected and analyzed for radionuclides, metals, VOCs, SVOCs, and PCBs, respectively. The sample locations for all of these analyte groups are primarily clustered in and just downstream (east) of the East Landfill Pond, which receives runoff from the upstream IHSSs. Therefore, the sampling locations for all analytes are in areas that are expected to contain the highest levels of contamination, and therefore, EPC

calculations are expected to be conservative, and the data are considered adequate for the purposes of the CRA.

Temporal Representativeness

As shown in Table A3.54, current data exist for radionuclides, metals, VOCs, and SVOCs for surface water samples from the NN AEU. As shown in Figures A3.33 through A3.36, these surface water samples were collected more than 4 times from most of the surface water locations in the NN AEU. Therefore, the data for these analytes are considered adequate for the purposes of the CRA.

Seven surface water samples in the NN AEU were analyzed for PCBs. The PCB samples were taken from the western portion of the NN AEU near the East Landfill Pond. PCBs were not detected in any of the samples. Because PCBs were not detected in any of the NN AEU samples, a concentration increase is unlikely, and the data for PCBs are considered adequate for the purposes of the CRA.

2.5.4 Woman Creek AEU

Sediment

A large number of sediment samples from the Woman Creek AEU (WC AEU) were analyzed for radionuclides, metals, VOCs, SVOCs, and/or PCBs (see Table A3.53 and Figure A3.41 through A3.45). One hundred seventeen sediment samples from the WCAEU were analyzed for radionuclides, 88 samples were analyzed for metals, 70 samples were analyzed for VOCs, 63 samples were analyzed for SVOCs, and 69 sediment samples were analyzed for PCBs.

Number of Samples

The sediment samples collected in the WC AEU meet the data adequacy guideline of at least five samples for all analyte groups noted above. Therefore, these data are considered adequate for the purposes of the CRA.

Spatial Representativeness

Figures A3.41 through A3.45 show the spatial distribution of locations where sediment samples were collected and analyzed for radionuclides, metals, VOCs, SVOCs, and PCBs. The sediment sample locations are distributed throughout the WC AEU wherever sediment occurs. Samples for all analytes were also collected at the western and eastern boundaries of the WC AEU, providing representative data for upstream and downstream conditions. Therefore, the data are considered adequate for the purposes of the CRA.

Temporal Representativeness

As shown in Table A3.53, between 7 and 15 sediment samples were collected in the WCAEU from 2001 to the present for all analyte groups. Therefore, the existing data are considered adequate for the purposes of the CRA.

Surface Water

The surface water within the WC AEU has been extensively sampled for radionuclides, metals, VOCs, SVOCs, and PCBs (see Table A3.54, and Figures, A3.49 through A3.53). Two thousand three hundred and nine samples were analyzed for radionuclides, 794 samples were analyzed for metals, 356 samples were analyzed for VOCs, 210 samples were analyzed for SVOCs, and 127 samples were analyzed for PCBs.

Number of Samples

The surface water samples collected in the WC AEU meet the data adequacy guideline of at least five samples for all analyte groups noted above. Therefore, these data are considered adequate for the purposes of the CRA.

Spatial Representativeness

Figures A3.49 through A3.53 show the spatial distribution of locations where surface water samples were collected and analyzed for radionuclides, metals, VOCs, SVOCs, and PCBs, respectively. The sample locations for all of these analyte groups are distributed throughout the WC AEU wherever surface water is regularly present. As shown in Figures A3.49 through A3.53, at least one sample for each analyte group was collected from sampling stations located in Woman Creek at the far western boundary of the AEU (upstream) as well as at the C-series ponds. Samples for radionuclides, metals, and VOCs were also collected from sampling stations at the far eastern boundary of the AEU (downstream). Therefore, the data are representative of the surface water in the WC AEU and are considered adequate for the purposes of the CRA.

Temporal Representativeness

As shown in Table A3.54, current data exist for radionuclides, metals, VOCs, SVOCs, and PCBs (one sample) for surface water samples from the WC AEU. Because of the extremely low frequency of detection for PCBs in samples collected over a number of years throughout the site, and the fact that PCBs were not detected in any of the WC AEU samples, the data for PCBs are considered adequate for the purposes of the CRA. Figures A3.33 through A3.37 show the frequency of sample collection from each sampling location in the WC AEU for radionuclides, metals, VOCs, SVOCs, and PCBs, respectively. For all analyte groups, more than four samples were collected from numerous locations along Woman Creek. Radionuclides and metals were also sampled four or more times at locations on the eastern border of the WC AEU and radionuclides, metals, and VOCs were sampled more than four times at locations on the western edge of the WC AEU. Therefore, the data are considered adequate for the purposes of the CRA.

2.5.5 Rock Creek AEU

Sediment

At least 13 sediment samples from the Rock Creek AEU (RC AEU) were analyzed for radionuclides, metals, VOCs, SVOCs, and PCBs (see Table A3.53 and Figure A3.41 through A3.48). Twenty sediment samples were analyzed for radionuclides, 22 samples

were analyzed for metals, 21 samples were analyzed for VOCs; 21 sediment samples were analyzed for SVOCs; and 13 sediment samples were analyzed for PCBs.

Number of Samples

The sediment samples collected in the RC AEU meet the data adequacy guideline of at least five samples for all analyte groups noted above. Therefore, these data are considered adequate for the purposes of the CRA.

Spatial Representativeness

Figures A3.41 through A3.45 show the spatial distribution of locations where sediment samples were collected and analyzed for radionuclides, metals, VOCs, SVOCs, and PCBs within the RC AEU. Sampling locations for all analytes are well distributed throughout the RC AEU. Therefore, the data are considered adequate for the purposes of the CRA.

Temporal Representativeness

As shown in Table A3.53, 5 sediment samples were collected in the RC AEU from 2001 to the present for all of the analyte groups except PCBs. PCBs were not detected in any of the 13 samples collected between 1991 and 2000. Although RC AEU sediment PCB data is not current, the absence of PCB detections in the existing data indicates concentration trends for PCBs are unlikely. Therefore, the data are considered adequate for the purposes of the CRA.

Surface Water

The surface water within the RC AEU has been sampled for radionuclides, metals, VOCs, SVOCs, and PCBs (see Table A3.54, and Figures, A3.25 through A3.29). Forty three samples were analyzed for radionuclides, 110 samples were analyzed for metals, 43 samples were analyzed for VOCs, 12 samples were analyzed for SVOCs, and 3 samples were analyzed for PCBs.

Number of Samples

At least five samples exist for all the analyte groups except PCBs for surface water samples from the RC AEU. Three samples exist for PCBs in RC AEU surface water. PCBs were not detected in any of these samples. Although the PCB data do not meet the data adequacy guideline, the absence of PCB detections in the existing data indicate concentration trends for PCBs are unlikely. Therefore, the data are considered adequate for the purposes of the CRA.

Spatial Representativeness

Figures A3.25 through A3.29 show the spatial distribution of locations where surface water samples were collected and analyzed for radionuclides, metals, VOCs, SVOCs, and PCBs, respectively. The sample locations for all of these analyte groups are well distributed throughout the RC AEU. Therefore, the data are considered adequate for the purposes of the CRA.

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Temporal Representativeness

As shown in Table A3.54, current data exist for all analyte groups of concern except PCBs for surface water samples from the RC AEU. There is only one sample for VOCs and SVOCs collected from 2001 to the present. As shown in Figures A3.33 through A3.36 surface water samples, which were analyzed for radionuclides, metals, and VOCs were collected more than four times from surface water locations that are distributed fairly uniformly along the east-west axis of the RC AEU. Fewer than 4 samples were analyzed for SVOCs, but these locations are also uniformly distributed along the east-west axis of the RC AEU. The data for these analytes are considered adequate for the purposes of the CRA.

Three surface water samples in the RC AEU were analyzed for PCBs. PCBs were not detected in any of the RC AEU samples. Although RC AEU sediment PCB data is not current, the absence of PCB detections in the existing data indicates concentration trends for PCBs are unlikely. Therefore, the data are considered adequate for the purposes of the CRA.

2.5.6 McKay Ditch AEU

Sediment

At least 8 sediment samples from the McKay Ditch AEU (MK AEU) were analyzed for radionuclides, metals, VOCs, SVOCs, and PCBs (see Table A3.53 and Figure A3.41 through A3.48). Thirteen sediment samples were analyzed for radionuclides, 12 samples were analyzed for metals, and 8 samples were analyzed for VOCs, SVOCs, and PCBs.

Number of Samples

The sediment samples collected in the MK AEU meet the data adequacy guideline of at least five samples for all analyte groups noted above. Therefore, these data are considered adequate for the purposes of the CRA.

Spatial Representativeness

Figures A3.41 through A3.45 show the spatial distribution of locations where sediment samples were collected and analyzed for radionuclides, metals, VOCs, SVOCs, and PCBs within the MK AEU. Four historical IHSSs exist within the MK AEU. As was discussed in the data adequacy description for the IDEU, the West Spray Field (IHSS 168) are not expected to be sources of organic contamination, but are potential sources of radionuclide and metals contamination. Two locations immediately downstream of the West Spray Field were sampled for radionuclides and metals. Other sampling locations, while not abundant, are well distributed throughout the MK AEU. In total, 6 locations were sampled for radionuclides, 5 locations were sampled for metals, and three locations were sampled for VOCs, SVOCs, and PCBs. Sediment samples were taken from three common locations for all analyte groups. These locations are at the upstream (western) and downstream (eastern) ends of the MK AEU as well as at intermediate locations. Therefore, the data are considered adequate for the purposes of the CRA.

Temporal Representativeness

As shown in Table A3.53, 4 sediment samples were collected in the MKAEU from 2001 to the present for radionuclides and metals. No current sediment sample data exist for VOCs, SVOCs or PCBs. As discussed previously in the IDEU data adequacy assessment, the IHSSs within the MK AEU are not expected to be sources of organic contaminants and the MK AEU is generally isolated from sources of contamination in the IA. The existing data, and available information on potential historical sources of contamination and migration pathways indicate concentration trends for the constituents in these analyte groups are unlikely. Therefore, although MK AEU VOC, SVOC, and PCB sediment data is not current, the existing data are considered adequate for the purposes of the CRA.

Surface Water

The surface water within the MKAEU has been sampled for radionuclides, metals, VOCs, SVOCs, and PCBs (see Table A3.54, and Figures, A3.25 through A3.29). Thirty eight samples were analyzed for radionuclides, 39 samples were analyzed for metals, 13 samples were analyzed for VOCs, 2 samples were analyzed for SVOCs, and 3 samples were analyzed for PCBs.

Number of Samples

At least five surface water samples from the MK AEU exist for all analyte groups except SVOCs and PCBs. Two samples exist for SVOCs and 3 samples exist for PCBs. The SVOC and PCB samples were taken at a location downstream from the West Spray Field IHSS. SVOCs and PCBs were not detected in any of these samples. Although RC AEU sediment SVOC and PCB data do not meet the data adequacy criterion, the absence of PCB detections indicates these analyte groups are not of concern. Therefore, the data are considered adequate for the purposes of the CRA.

Spatial Representativeness

Figures A3.25 through A3.29 show the spatial distribution of locations where surface water samples were collected and analyzed for radionuclides, metals, VOCs, SVOCs, and PCBs, respectively. The sample locations for radionuclides and metals are well distributed throughout the MK AEU. Surface water samples for VOCs, SVOCs and PCBs are clustered just downstream of the West Spray Field. EPC calculations based on these samples are expected to be conservative. Also, the entire MK AEU is hydraulically isolated from IHSSs in the IA, therefore, there are no external sources for contamination for the MK AEU. Therefore, although the spatial distribution of samples for VOCs, SVOCs and PCBs does not meet the data adequacy guideline, the data are considered adequate for the purposes of the CRA

Temporal Representativeness

As shown in Table A3.54, current surface water data exist in the MK AEU for radionuclides and metals. No samples that were analyzed for VOCs, SVOCs or PCBs were collected after 2000.

As shown in Figures A3.33 through A3.36 surface water samples which were analyzed for radionuclides, metals, and VOCs were collected more than four times from several surface water locations in the western portion of the MK AEU. No locations were sampled more than 4 times for SVOCs or PCBs.

Prior to 2001, thirteen samples were collected for VOC analysis, two samples were collected for SVOC analysis, and three samples were collected for PCB analysis. The data indicate constituents in these analyte groups are either less than the ESLs or not detected. This existing data, and available information on potential historical sources of contamination and migration pathways indicate concentration trends for the constituents in these analyte groups are unlikely. Therefore, data for VOCs, SVOCs, and PCBs are considered adequate for the purposes of the CRA.

2.5.7 Southeast AEU

Sediment

Very little data exists for sediment samples for the Southeast AEU (SE aEU) (see Table A3.53 and Figure A3.41 through A3.48). Nine sediment samples were analyzed for radionuclides, and 7 samples were analyzed for metals. No sediment samples collected in the SE AEU were analyzed for VOCs, SVOCs, or PCBs.

Number of Samples

The number of sediment samples in the SE AEU for radionuclides and metals meet the data adequacy guideline. Therefore, these data are considered adequate for the purposes of the CRA.

Data does not exist for VOCs, SVOCs, or PCBs in sediment in the SE AEU. No IHSSs except two small stretches of roadway (IHSS 000-501) are located in the SE AEU. The IHSS is a result of historical spraying of roads with waste oil for dust control, and accordingly, the oil could have contaminated the soil with PAHs (SVOCs). However, in other locations within this IHSS but outside the SE AEU, samples were collected near the road for PAH (and PCB) analysis, and PAHs (and PCBs) were not detected (see, for example, IDEU Surface Soil and Surface Soil/Surface Sediment, "Number of Samples"). Also, PCBs are not known to be constituents in the oil that was used. The SE AEU is also hydraulically isolated from potential historical source areas in and near the IA. Thus, surface water does not provide a contaminant pathway for migration of VOCs, SVOCs, and PCBs into the SE AEU. Therefore, available information on potential historical sources of contamination, and contaminant migration pathways from potential sources in other AEUs, show that the constituents in these analyte groups are not likely to be of concern in sediment for the SE AEU, and the existing data for other analyte groups for the SE AEU are adequate for the purposes of the CRA.

Spatial Representativeness

Sediment sampling locations in the SE AEU for both radionuclides and metals are distributed fairly uniformly from east to west along Smart Ditch. Sediment samples were also collected at the downstream ends of both of the ponds (D-1 and D-2) that are located in the AEU. The Pond D-2 sample location is at the extreme southeast corner of the AEU.

Therefore, the data for radionuclides and metals are adequate for the purpose of the CRA. As discussed above, there is no data for VOCs, SVOCs, and PCBs. However, constituents in these analyte groups are not of concern in the SE AEU.

Temporal Representativeness

As shown in Table A3.53, 7 sediment samples were collected in the SE AEU from 2001 to the present for radionuclides and metals. Therefore, the data for radionuclides and metals are considered adequate for the purposes of the CRA. As discussed above, there is no data for VOCs, SVOCs, and PCBs. However, constituents in these analyte groups are not of concern in the SE AEU.

Surface Water

The surface water within the SEAEU has been sampled for radionuclides, metals, VOCs, SVOCs, and PCBs (see Table A3.54, and Figures, A3.25 through A3.29), although only one sample was analyzed for SVOCs and PCBs. Eleven samples were analyzed for radionuclides, 12 samples were analyzed for metals, 7 samples were analyzed for VOCs, and 1 sample was analyzed for SVOCs, and PCBs.

Number of Samples

At least five samples exist for all analyte groups except SVOCs and PCBs for surface water samples from the SE AEU. The data for radionuclides, metals, and VOCs meet the data adequacy guideline of at least 5 samples, and therefore, are adequate for the purpose of the CRA.

As discussed for sediment samples from the SE AEU, although very little data exists for SVOCs, or PCBs in surface water in the SE AEU, historical information, data from locations outside the SE AEU, and the lack of migration pathways into the SEAEU for these analyte groups, indicate that the existing data are adequate for the purpose of the CRA

Spatial Representativeness

Figures A3.25 through A3.29 show the spatial distribution of locations where surface water samples were collected and analyzed for radionuclides, metals, VOCs, SVOCs, and PCBs, respectively. The sample locations for radionuclides and metals are well distributed throughout the SE AEU relatively uniformly from east to west along the South Woman Creek drainage. Surface water samples were also collected at the downstream ends of both of the ponds (D-1 and D-2) that are located in the AEU. The Pond D-2 sample location is at the extreme southeast corner of the AEU. Multiple radionuclide and metals samples were also collected from the extreme western edge of the SEAEU where Smart Ditch enters the site. In the absence of historical sources of contamination or migration pathways into the SE AEU, the data for radionuclides and metals are representative of the potential spatial distribution of contaminants and are adequate for the purpose of the CRA.

One of the VOC samples and the SVOC and PCB samples were taken from the terminal end of Pond D-1. Any organic contaminants contained in runoff, would be expected to be

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detectable in the Pond D-1 water. EPC calculations using data from this location are expected to be conservative. More than 4 VOC samples were also collected from the location where Smart Ditch enters the site from the west. Data from this location provide information about potential sources of contamination originating outside the site boundary. Although the number of sample locations for VOCs, SVOCs, and PCBs is very limited, surface water data for organic analyte groups is expected to be conservative and the data are considered adequate for the purposes of the CRA

Temporal Representativeness

As shown in Table A3.54, current surface water data exist in the SE AEU for radionuclides and metals. No samples that were analyzed for VOCs, SVOCs or PCBs were collected after 2000.

As shown in Figures A3.33 through A3.36 surface water samples, which were analyzed for radionuclides, metals, and VOCs were collected more than four times from the location where Smart Ditch enters the site at the western end of the SE AEU. No other locations were sampled more than once. Because samples were collected from 2001 to the present, the data are considered adequate for the purposes of the CRA.

Seven historical samples were analyzed for VOCs and one historical sample was analyzed for SVOCs and PCBs. SVOCs and PCBs were not detected, and VOCs were detected below the ESL at the western (upstream) property boundary. Although there are no current samples, the existing data and other information regarding sources for VOCs, SVOCs, and PCBs indicate the constituents in these analyte groups are not a concern for the SE AEU, and the data are considered adequate for the purposes of the CRA.

2.6 Subsurface Soil Data Adequacy Assessment

Site history and process knowledge indicate that subsurface soil contamination is largely confined to historical IHSSs (that is, areas of known or suspected historical releases). As discussed in this DAR, these areas have been characterized to understand the nature and extent of potential releases, and where necessary based on human health concerns, have been addressed through accelerated actions in accordance with regulatory agency-approved decision documents prepared in accordance with the IAG and RFCA.

2.6.1 Subsurface Soil to Depths of Eight Feet Below Ground Surface

Depending on the EU and analyte group, between zero to 3,196 subsurface soil samples and zero to 3,216 subsurface soil/subsurface sediment samples to depths of eight feet below ground surface (bgs) have been collected (Tables A3.55 and A3.56) for use in the CRA. The higher subsurface soil sampling densities in an EU reflect the higher numbers of IHSSs in the EU, with the IAEU having the greatest number of samples and IHSSs. For EUs where subsurface soil samples were not collected for an analyte group, the presence of this type of subsurface contamination was not expected.

Subsurface soil sampling and analysis has been tailored to characterize expected subsurface soil contamination based on process knowledge. Figures A3.57 through A3.64 show subsurface soil sampling locations for the eight analyte groups, and identify

concentrations relative to the prairie dog ESLs. Figures A3.55 through A3.72 show subsurface soil/subsurface sediment sampling locations for the eight analyte groups, and identify analyte concentrations relative to the PRGs.[8] The discussion below focuses on radionuclides, metals, VOCs, SVOCs, and PCBs. Sampling and analysis for pesticides, herbicides, and dioxins is addressed in Section 2.3, and the data have been determined to be adequate for the purposes of the CRA.

Examination of Figures A3.57 through A3.60 and Figures A3.65 through A3.68 show that subsurface sampling and analysis for radionuclides, metals, VOCs and SVOCs has been conducted at most IHSSs at RFETS. The IHSSs where subsurface soil sampling and analysis has not been conducted are discussed below.

NW-167.1 (Landfill North Area Spray Field) – Subsurface soil samples have not been collected for VOC and SVOC analysis. However, landfill leachate data collected since June 1991 indicate low concentrations of VOCs, and VOCs volatilize during spray operations. Landfill leachate data also indicate low concentrations of SVOCs, and in general, SVOCs do not migrate readily through the soil column and are expected to largely remain in surface soil.

NW-1505 (North Firing Range) - Subsurface soil samples have not been collected for radionuclide, VOC and SVOC analysis. However, metals are the principal contaminants at the North Firing Range, therefore, constituents in these analyte groups are not expected.

NW-170 (PU&D Storage Yard) - Subsurface soil samples have not been collected for radionuclide and metal analysis. Metals and radionuclides are expected contaminants in surface soil based on spills (radionuclides) and storage of scrap metal. However, radionuclides and metals do not migrate readily through the soil column and are expected to largely remain in surface soil.

300-134S (Lithium Metal Destruction Site) - Subsurface soil samples have not been collected for VOC and SVOC analysis. However, metals are the principal contaminants at the Lithium Metal Destruction Site, therefore, constituents in these analyte groups are not expected.

100-604 (T130 Complex Sewer Line Leaks) - Subsurface soil samples have not been collected for radionuclide, metal, VOC and SVOC analysis. This IHSS received a determination of NFAA based on process knowledge, i.e. hazardous constituents and substances were not expected to have been released from sewage leaks in an office complex.

SE-209 – Surface Disturbance Southeast of Building 881 - Subsurface soil samples have not been collected for SVOC analysis. However, this IHSS operational history is one of excavation activity, and not waste disposal activity. The IHSS received an NFAA designation based on data for other analyte groups

[8] Color coding on Figures A3.57 through A3.72 are based on the maximum analyte concentrations in subsurface soil at the borehole location.

SE-1602 (East Firing Range) - Subsurface soil samples have not been collected for radionuclide, VOC and SVOC analysis. However, metals are the principal contaminants at the East Firing Range, therefore, constituents in these analyte groups are not expected.

NE-216.1 and NE-216.2 (East Spray Field North and East Spray Field) - Subsurface soil samples have not been collected for radionuclide and metal analysis (NE-216.2) and SVOC analysis (NE-216.1). The IHSSs were used for spray evaporation of sewage treatment plant effluent and radionuclides, metals, and SVOCs are all potential constituents of the effluent. However, NE-216.3 is also part of the East Spray Field system and was sampled and analyzed for all of these analyte groups. It received a NFAA determination based on this data.

NE-156.2 (Soil Dump Area) - Subsurface soil samples have not been collected for SVOC analysis. The IHSS received soil and debris excavated during construction projects. SVOCs are not an expected contaminant in this material.

As shown in Figures A3.61 and A3.69, there are several IHSSs that have not been sampled for PCBs. However, all transformer site IHSSs and IHSSs where PCBs may have been disposed (e.g., the Original Landfill (IHSS 115) and the Present Landfill (IHSS 114)) have been sampled for PCB analysis. The IHSSs not sampled and analyzed for PCBs are not expected to have PCB contamination.

Based on the foregoing discussion, the existing subsurface soil data for RFETS are adequate for the purposes of the CRA.

2.6.2 Subsurface Soil at Depths Greater than Eight Feet Below Ground Surface – RI/FS Considerations

For subsurface soil data collected at depths greater than 8 feet, which is used in the RI, data quality and data adequacy was assessed for individual OUs[9] and IHSS group data sets prior to generating the RFCA decision documents. Soil data for RFETS were collected under agency-approved SAPs and standardized contract-required analytical procedures. Work Plans and SAPs specified the use of EPA-approved sampling procedures and analytical methods, data quality requirements including DQOs, data adequacy requirements, and data management processes.

2.7 Groundwater Data Adequacy – RI/FS Considerations

Groundwater monitoring has been conducted at RFETS throughout the site's history. Initially, groundwater monitoring was conducted under various individual programs, each designed to serve separate functions (for example, determining background values, measuring the concentration of hazardous constituents, estimating the rate and movement and extent of plumes, and/or measuring hydrologic parameters). Ultimately, after RFCA was implemented in 1996, groundwater monitoring was conducted as part of a comprehensive sitewide monitoring program designed to protect human health and the environment including impacts to surface water quality. Through years of investigations,

[9] Characterization data associated with individual OUs were included in data summary reports (DOE 2000, 2001).

RFETS has developed extensive knowledge and understanding of the site's hydrology, the nature and extent of groundwater contamination, and potential impacts to surface water quality.

Pursuant to the IAG and RFCA, groundwater data has been collected and evaluated to assess the need for accelerated actions, and groundwater collection and treatment systems have been installed to minimize impacts to surface water quality via groundwater discharge as seeps or stream interflow. Pursuant to RFCA and in consultation with the regulatory agencies, DOE established the Integrated Monitoring Plan (IMP) in 1997 that requires the collection and reporting of data required to ensure protection of human health and the environment. The IMP details the type of RFETS monitoring, monitoring locations, sampling frequencies and purpose of the monitoring in groundwater, surface water, air and ecological systems. The IMP is evaluated annually by DOE and the regulatory agencies to assess the adequacy of the monitoring based on previous monitoring results, changed conditions, planned remedial activities and public input. Changes are made to the IMP only upon the approval of the regulatory agencies.

In developing the IMP, consultation with the regulatory agencies and local stakeholder groups developed consensus on the types of data to be collected and their eventual uses, resulting in established DQOs. The program is designed to provide data that meet DQOs needed to support operational and regulatory decision making, and to address requirements in the following statutes, regulations, permits and agreements: RCRA; CERCLA; Clean Air Act (CAA); Clean Water Act (CWA); National Pollutant Discharge Elimination System (NPDES); CHWA; standards promulgated by the Colorado Water Quality Control Commission; RFCA; regulations governing natural resource (ecological) management; RFETS-specific monitoring and cleanup agreements; and DOE orders and technical guidance.

DQOs were developed to ensure that environmental monitoring data would satisfy the requirements of the regulations listed above and would aid in detection of conditions that could lead to unacceptable risks to public health and the environment. Historically, hydrogeologic interpretation of the sampled media and statistical analysis of existing data have determined the sampling frequency required to meet DQOs. The data have been used to: model contaminant movement and identify contaminant concentrations that exceed pre-established limits; support planning, implementation, and assessment of remedial, and decontamination and decommissioning activities; address regulatory requirements and commitments; and monitor various ecological systems at RFETS.

CDPHE guidance and regulations for determining impacts to groundwater, including compliance with surface water standards and RCRA groundwater monitoring, have been incorporated into the IMP and DQO process. Years of groundwater monitoring and hydrogeology studies have guided placement of wells. Wells identified in decision documents, to meet RCRA and CHWA requirements, the addition of new wells, and decisions to abandon existing wells, have all been approved by CDPHE and EPA.

Data collected under the IMP, meets or exceeds quality requirements to ensure accuracy in modeling, risk assessment, performance assessment and compliance. The data are of sufficient quality to withstand scientific and legal scrutiny, and are gathered using

appropriate procedures for their intended use in making decisions for RFETS activities. Each environmental monitoring program includes a set of data usability requirements and procedures to ensure quality data are produced (see IMP for specifics regarding data quality assurance (K-H 2004)).

These data have been adequate for making accelerated action decisions historically at RFETS and are adequate to support decision making for final remedy purposes. Accordingly, for the RI/FS and CRA, the existing groundwater data for RFETS are adequate to address the nature and extent of contamination in groundwater, and to evaluate the significance of the indoor air exposure pathway and the groundwater to surface water exposure pathway. In addition, the distribution of groundwater data, both spatially and temporally, has been assessed in the nature and extent sections to ensure that the nature and extent of contamination is well characterized. Groundwater data have been recently evaluated to delineate contaminant plumes and assess the need for any additional accelerated actions based on potential impacts to surface water (DOE 2005b).

2.8 Surface Water Data Adequacy – RI/FS Considerations

Surface waters at RFETS have been extensively monitored throughout the site's history. Initially, surface waters were analyzed to ensure that water quality standards were met, to characterize background water quality, and to evaluate potential contaminant releases from specific locations. Ultimately, after RFCA was implemented in 1996, surface water monitoring was also conducted as part of a comprehensive sitewide monitoring program designed to protect human health and the environment including impacts to surface water quality. Through years of investigations, RFETS has developed extensive knowledge and understanding of the site's hydrology, the nature and extent of surface water contamination, and potential impacts to surface water quality.

Pursuant to the IAG and RFCA, surface water data have been collected and evaluated to assess the need for accelerated actions, and groundwater collection and treatment systems have been installed to minimize impacts to surface water quality via groundwater discharge as seeps or stream interflow. Pursuant to RFCA and in consultation with the regulatory agencies, DOE established the Integrated Monitoring Plan (IMP) in 1997 that effectively collects and reports the data required to ensure protection of human health and the environment.

Data collected under the IMP have been adequate for making remedy decisions historically at RFETS and are adequate to support decision making for final remedy purposes. Accordingly, for the RI/FS, the existing surface water data for RFETS are adequate to address the nature and extent of contamination in surface water. In addition, the distribution of surface water data, both spatially and temporally, has been assessed in the nature and extent section for surface water to ensure that the nature and extent of contamination is well characterized.

The surface water nature and extent provides surface water data on a site wide basis, which is intended to present a representative picture of existing or "ambient" surface water quality. The Colorado Water Quality Control Commission (WQCC) and the Colorado Water Quality Control Division (WQCD) have published interpretive policy

and guidance in relation to determining ambient surface water quality. The criteria in this policy/guidance relates to surface water monitoring data collection (number of samples and sample frequency) and interpretation that the WQCC deems acceptable in rule making proceedings where ambient surface water quality is established. For example, data should be randomly or routinely collected over 1-2 years, but generally must be as recent as the last five years; and generally, at least 12-15 samples are required for evaluation. At RFETS, surface water monitoring has been on-going for over five years and in FY2004, 450 samples were collected, evaluated and reported in the IMP FY2004 (K-H 2004).

3.0 SUMMARY

This data adequacy assessment concludes that the data used for the CRA meet the CRA Methodology DQO Decision Rules. For metals and radionuclides, a SAP was prepared in February 2004 (DOE 2004b), and was implemented to ensure that one surface soil sample for metals and radionuclides was collected in each 30-acre block across the Site to meet the criteria of CRA DQO Decision Rule #1. For CRA DQO Decision Rule #2, which states that data adequacy for analyte groups and media not addressed by CRA DQO Decision Rule #1 will be determined through the consultative process with the agencies, the DAR provides a description of the regulatory agreements with DOE, and the regulatory agency-approved SAPs that have been implemented since 1991 to characterize the Site. Since 2004, four SAPs and the CRA Additional Data Collection Strategy (Data Collection Strategy) (DOE 2004d) were prepared and implemented with the goal of collecting additional data to meet CRA DQO Decision Rule #2. Through the consultative process with EPA and CDPHE, specific data adequacy guidelines were identified for use in this DAR that pertain to: 1) number of samples; 2) spatial representativeness; and 3) temporal representativeness. The DAR provides an evaluation of data adequacy on an EU and AEU basis with respect to these guidelines, and concludes the soil, sediment, and surface water data are adequate for the purposes of the CRA. Furthermore, groundwater (and surface water) data were collected under the IMP, and meet or exceed quality requirements to ensure accuracy in modeling, remedy performance assessment, regulatory compliance, depiction of the nature and extent of contamination, and the evaluation of human health and ecological risks.

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TABLES

Table A3.1a
Surface Soil Radionuclide Analyte List

Analyte	Number of Samples by Analyte[a]
Americium-241	2,024
Cesium-134	162
Cesium-137	360
Curium-242	1
Curium-244	1
Curium-245/246	1
Gross Alpha	1,202
Gross Beta	1,275
Neptunium-237	13
Plutonium-238	83
Plutonium-239/240	2,336
Radium-226	149
Radium-228	172
Strontium-89/90	289
Uranium-233/234	1,901
Uranium-235	1,900
Uranium-238	1,901

[a] July 1991 through 2005

Table A3.1b
Surface Soil Radionuclide Sampling Summary

ExposureUnit	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
Industrial Area	1,114	881	275	1,156
Inter Drainage	69	68	13	81
Lower Walnut Drainage	54	34	23	57
Lower Woman Drainage	53	94	4	98
No Name Gulch Drainage	282	277	10	287
Rock Creek Drainage	42	28	22	50
Southeast Buffer Zone Area	27	42	10	52
Southwest Buffer Zone Area	16	6	14	20
Upper Walnut Drainage	107	110	7	117
Upper Woman Drainage	142	158	19	177
West Area	10	0	10	10
Wind Blown Area	215	228	107	335

Table A3.2a
Surface Soil Metal Analyte List

Analyte	Number of Samples by Analyte[a]
Antimony	2,482
Arsenic	2,613
Barium	2,624
Beryllium	2,623
Boron	1,303
Cadmium	2,603
Calcium	2,622
Cesium	1,029
Chromium	2,624
Chromium VI	17
Cobalt	2,622
Copper	2,621
Iron	2,622
Lead	2,618
Lithium	2,433
Magnesium	2,633
Manganese	2,617
Mercury	2,541
Molybdenum	2,421
Nickel	2,620
Potassium	2,621
Selenium	2,590
Silicon	187
Silver	2,589
Sodium	2,622
Strontium	2,423
Tantalum	11
Thallium	2,597
Tin	2,423
Titanium	1,303
Uranium	1,296
Vanadium	2,622
Zinc	2,622

[a] July 1991 through 2005

Table A3.2b
Surface Soil Metal Sampling Summary

ExposureUnit	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
Industrial Area	1,670	626	1,054	1,680
Inter Drainage	64	50	14	64
Lower Walnut Drainage	22	4	18	22
Lower Woman Drainage	74	28	46	74
No Name Gulch Drainage	356	320	36	356
Rock Creek Drainage	34	19	17	36
Southeast Buffer Zone Area	19	5	14	19
Southwest Buffer Zone Area	14	0	14	14
Upper Walnut Drainage	90	77	13	90
Upper Woman Drainage	131	112	23	135
West Area	10	0	10	10
Wind Blown Area	139	75	76	151

Table A3.3a
Surface Soil VOC Analyte List

Analyte	Number of Samples by Analyte[a]
1,1,1-Trichloroethane	633
1,1,2,2-Tetrachloroethane	632
1,1,2-Trichloro-1,2,2-trifluoroethane	517
1,1,2-Trichloroethane	633
1,1-Dichloroethane	633
1,1-Dichloroethene	633
1,1-Dichloropropene	517
1,2,3-Trichlorobenzene	515
1,2,3-Trichloropropane	517
1,2,4-Trimethylbenzene	515
1,2-Dibromo-3-chloropropane	516
1,2-Dibromoethane	517
1,2-Dichlorobenzene	1,329
1,2-Dichloroethane	629
1,2-Dichloroethene	101
1,2-Dichloropropane	633
1,3,5-Trimethylbenzene	515
1,3-Dichlorobenzene	1,549
1,3-Dichloropropane	517
1,4-Dichlorobenzene	1,329
2,2-Dichloropropane	517
2-Butanone	631
2-Chloroethyl vinyl ether	15
2-Chlorotoluene	515
2-Hexanone	630
2-Nitrotoluene	5
4-Chlorotoluene	515
4-Isopropyltoluene	515
4-Methyl-2-pentanone	630
Acetone	632
Benzene	633
Bromobenzene	515
Bromochloromethane	517
Bromodichloromethane	633
Bromoform	633
Bromomethane	629
Carbon Disulfide	633
Carbon Tetrachloride	633
Chlorobenzene	633
Chloroethane	630
Chloroform	633
Chloromethane	633
cis-1,2-Dichloroethene	517
cis-1,3-Dichloropropene	633
Dibromochloromethane	633
Dibromomethane	517

Table A3.3a
Surface Soil VOC Analyte List

Analyte	Number of Samples by Analyte[a]
Dichlorodifluoromethane	499
Ethylbenzene	633
Gasoline	30
Hexachloroethane	1,227
Isopropylbenzene	515
Methylene Chloride	631
n-Butylbenzene	515
n-Propylbenzene	515
Pyridine	377
sec-Butylbenzene	515
Styrene	633
tert-Butylbenzene	515
Tetrachloroethene	633
Tetryl	5
Toluene	633
trans-1,2-Dichloroethene	532
trans-1,3-Dichloropropene	633
Trichloroethene	633
Trichlorofluoromethane	517
Vinyl acetate	78
Vinyl Chloride	633
Xylene	633

[a] July 1991 through 2005

Table A3.3b
Surface Soil VOC Sampling Summary

ExposureUnit	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
Industrial Area	1,181	358	880	1,238
Inter Drainage	3	0	3	3
Lower Walnut Drainage	12	4	8	12
Lower Woman Drainage	9	9	0	9
No Name Gulch Drainage	93	89	4	93
Rock Creek Drainage	17	17	0	17
Southeast Buffer Zone Area	1	1	0	1
Southwest Buffer Zone Area	0	0	0	0
Upper Walnut Drainage	29	24	5	29
Upper Woman Drainage	94	88	8	96
West Area	0	0	0	0
Wind Blown Area	96	36	62	98

Table A3.4a
Surface Soil SVOC Analyte List

Analyte	Number of Samples by Analyte[a]
1,3,5-Trinitrobenzene	5
1,3-Dinitrobenzene	5
2,4,5-Trichlorophenol	1,180
2,4,6-Trichlorophenol	1,180
2,4,6-Trinitrotoluene	8
2,4-Dichlorophenol	1,180
2,4-Dimethylphenol	1,180
2,4-Dinitrophenol	1,173
2,4-Dinitrotoluene	1,232
2,6-Dinitrotoluene	1,232
2-Amino-4,6-dinitrotoluene	5
2-Chloronaphthalene	1,227
2-Chlorophenol	1,180
2-Methylnaphthalene	1,223
2-Methylphenol	1,180
2-Nitroaniline	1,224
2-Nitrophenol	1,180
3,3'-Dichlorobenzidine	1,190
3-Nitroaniline	1,193
3-Nitrotoluene	5
4,6-Dinitro-2-methylphenol	1,176
4-Amino-2,6-dinitrotoluene	5
4-Bromophenyl-phenylether	1,227
4-Chloro-3-methylphenol	1,180
4-Chloroaniline	1,217
4-Chlorophenyl-phenyl ether	1,227
4-Methylphenol	1,180
4-Nitroaniline	1,218
4-Nitrotoluene	5
Acenaphthene	1,239
Acenaphthylene	1,241
Anthracene	1,245
Benzo(a)anthracene	1,226
Benzo(a)pyrene	1,235
Benzo(b)fluoranthene	1,231
Benzo(g,h,i)perylene	1,214
Benzo(k)fluoranthene	1,218
Benzoic Acid	1,135
Benzyl Alcohol	1,114
bis(2-Chloroethoxy) methane	1,227
bis(2-Chloroethyl) ether	1,222
bis(2-Chloroisopropyl) ether	1,207
bis(2-ethylhexyl)phthalate	1,227
Butylbenzylphthalate	1,226
Carbazole	39
Chrysene	1,240

Table A3.4a
Surface Soil SVOC Analyte List

Analyte	Number of Samples by Analyte[a]
Coumaphos	7
Di-n-butylphthalate	1,227
Di-n-octylphthalate	1,225
Dibenz(a,h)anthracene	1,217
Dibenzofuran	1,227
Dichlorovos	7
Diesel fuel	28
Diesel Range Organics	13
Diethylphthalate	1,224
Dimethoate	7
Dimethylphthalate	1,227
Disulfoton	7
Famphur	7
Fensulfothion	7
Fenthion	7
Fluoranthene	1,235
Fluorene	1,244
Hexachlorobenzene	1,224
Hexachlorobutadiene	1,550
Indeno(1,2,3-cd)pyrene	1,220
Isophorone	1,227
Malathion	7
Methyl parathion	7
Mevinphos	7
N-Nitroso-di-n-propylamine	1,222
N-nitrosodiphenylamine	1,227
Naled	7
Naphthalene	1,567
Nitrobenzene	1,218
O,O,O-Triethyl phosphorothioate	7
Parathion	7
Pentachlorophenol	1,180
Phenanthrene	1,246
Phenol	1,180
Phorate	7
Pyrene	1,242
Tetrachlorvinphos	7
Tetraethyl dithiopyrophosphate	7
Thionazine	7
Tributyl phosphate	1

[a] July 1991 through 2005

Table A3.4b
Surface Soil SVOC Sampling Summary

ExposureUnit	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
Industrial Area	1,164	333	891	1,224
Inter Drainage	3	0	3	3
Lower Walnut Drainage	12	4	8	12
Lower Woman Drainage	9	9	0	9
No Name Gulch Drainage	91	87	4	91
Rock Creek Drainage	17	17	0	17
Southeast Buffer Zone Area	1	1	0	1
Southwest Buffer Zone Area	0	0	0	0
Upper Walnut Drainage	27	22	5	27
Upper Woman Drainage	111	105	8	113
West Area	0	0	0	0
Wind Blown Area	96	36	62	98

Table A3.5a
Surface Soil PCB Analyte List

Analyte	Number of Samples by Analyte[a]
Aroclor-1221	845
Aroclor-1232	845
Aroclor-1242	845
Aroclor-1248	845
Aroclor-1254	842
Aroclor-1260	838

[a] July 1991 through 2005

Table A3.5b
Surface Soil PCB Sampling Summary

ExposureUnit	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
Industrial Area	483	240	244	484
Inter-Drainage	0	0	0	0
Lower Walnut Drainage	4	4	0	4
Lower Woman Drainage	9	9	0	9
No Name Gulch Drainage	116	116	0	116
Rock Creek Drainage	17	17	0	17
Southeast Buffer Zone Area	1	1	0	1
Southwest Buffer Zone Area	0	0	0	0
Upper Walnut Drainage	44	39	5	44
Upper Woman Drainage	88	89	1	90
West Area	0	0	0	0
Wind Blown Area	79	36	45	81

Table A3.6a
Surface Soil Pesticide Analyte List

Analyte	Number of Samples by Analyte[a]
4,4'-DDE	468
4,4'-DDT	468
Aldrin	468
alpha-BHC	468
alpha-Chlordane	433
beta-BHC	467
beta-Chlordane	411
Chlordane	34
Chlorpyriphos	7
delta-BHC	468
Demeton	7
Diazinon	7
Dieldrin	468
Endosulfan I	468
Endosulfan II	461
Endosulfan sulfate	468
Endrin	468
Endrin aldehyde	66
Endrin ketone	437
gamma-BHC (Lindane)	468
gamma-Chlordane	23
Heptachlor	468
Heptachlor epoxide	467
Hexachlorocyclopentadiene	1,208
Merphos	7
Methoxychlor	468
Toxaphene	468
Trichloronate	7

[a] July 1991 through 2005

Table A3.6b
Surface Soil Pesticide Sampling Summary

Exposure Unit	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
Industrial Area	953	339	617	956
Inter-Drainage	0	0	0	0
Lower Walnut Drainage	4	4	0	4
Lower Woman Drainage	9	9	0	9
No Name Gulch Drainage	82	82	0	82
Rock Creek Drainage	17	17	0	17
Southeast Buffer Zone Area	1	1	0	1
Southwest Buffer Zone Area	0	0	0	0
Upper Walnut Drainage	41	41	0	41
Upper Woman Drainage	89	89	2	91
West Area	0	0	0	0
Wind Blown Area	83	36	49	85

Table A3.7a
Surface Soil Herbicide Analyte List

Analyte	Number of Samples by Analyte[a]
2,4,5-TP (Silvex)	11
2,4-D	11
2,4-DB	9
4-Nitrophenol	1,169
Azinphos-methyl	7
Dalapon	9
Dicamba	9
Dichloroprop	9
Dinoseb	9
Ethoprop	7
MCPA	9
MCPP	9
Prothiophos	7
Ronnel	7
Sulprofos	7

[a] July 1991 through 2005

Table A3.7b
Surface Soil Herbicide Sampling Summary

ExposureUnit	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
Industrial Area	919	311	613	924
Inter-Drainage	0	0	0	0
Lower Walnut Drainage	4	4	0	4
Lower Woman Drainage	9	9	0	9
No Name Gulch Drainage	86	86	0	86
Rock Creek Drainage	11	11	0	11
Southeast Buffer Zone Area	1	1	0	1
Southwest Buffer Zone Area	0	0	0	0
Upper Walnut Drainage	17	17	0	17
Upper Woman Drainage	46	44	2	46
West Area	0	0	0	0
Wind Blown Area	78	31	49	80

Table A3.8a
Surface Soil Dioxin Analyte List

Analyte	Number of Samples by Analyte[a]
123478-HxCDD	22
123478-HxCDF	22
1234789-HpCDF	22
123678-HxCDD	22
123678-HxCDF	22
12378-PeCDF	22
123789-HxCDD	22
123789-HxCDF	22
234678-HxCDF	22
23478-PeCDF	22
2378-TCDD	22
2378-TCDF	22
Heptachlorodibenzo-p-dioxin	22
OCDD	22
OCDF	22
Pentachlorodibenzo-p-dioxin	22

[a] July 1991 through 2005

Table A3.8b
Surface Soil Dioxin Sampling Summary

ExposureUnit	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
Industrial Area	11	0	12	12
Inter-Drainage	0	0	0	0
Lower Walnut Drainage	0	0	0	0
Lower Woman Drainage	0	0	0	0
No Name Gulch Drainage	0	0	0	0
Rock Creek Drainage	0	0	0	0
Southeast Buffer Zone Area	0	0	0	0
Southwest Buffer Zone Area	0	0	0	0
Upper Walnut Drainage	0	0	0	0
Upper Woman Drainage	10	0	10	10
West Area	0	0	0	0
Wind Blown Area	0	0	0	0

Table A3.9a
Surface Soil/Surface Sediment Radionuclide Analyte List

Analyte	Number of Samples by Analyte[a]
Cesium-134	284
Cesium-137	538
Curium-242	1
Curium-244	1
Curium-245/246	1
Gross Alpha	1,405
Gross Beta	1,482
Neptunium-237	13
Plutonium-238	83
Plutonium-239/240	2,718
Radium-226	254
Radium-228	257
Strontium-89/90	462
Uranium-233/234	2,223
Uranium-235	2,222
Uranium-238	2,223

[a] July 1991 through 2005

Table 3.9b
Surface Soil/Surface Sediment Radionuclide Sampling Summary

ExposureUnit	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
Industrial Area	1,231	995	291	1,286
Inter-Drainage	70	70	13	83
Lower Walnut Drainage	76	55	26	81
Lower Woman Drainage	87	130	14	144
No Name Gulch Drainage	301	287	22	309
Rock Creek Drainage	49	39	25	64
Southeast Buffer Zone Area	30	42	13	55
Southwest Buffer Zone Area	18	6	16	22
Upper Walnut Drainage	177	168	31	199
Upper Woman Drainage	173	198	19	217
West Area	12	8	10	18
Wind Blown Area	224	240	107	347

Table A3.10a
Surface Soil/Surface Sediment Metal Analyte List

Analyte	Number of Samples by Analyte[a]
Antimony	2,758
Arsenic	2,901
Barium	2,913
Beryllium	2,907
Boron	1,370
Cadmium	2,885
Calcium	2,911
Cesium	1,214
Chromium	2,913
Chromium VI	59
Cobalt	2,909
Copper	2,910
Iron	2,911
Lead	2,907
Lithium	2,717
Magnesium	2,922
Manganese	2,906
Mercury	2,803
Molybdenum	2,705
Nickel	2,909
Potassium	2,909
Selenium	2,871
Silicon	303
Silver	2,865
Sodium	2,909
Strontium	2,710
Tantalum	11
Thallium	2,878
Tin	2,705
Titanium	1,370
Uranium	1,387
Vanadium	2,911
Zinc	2,911

[a] July 1991 through 2005

Table 3.10b
Surface Soil/Surface Sediment Metal Sampling Summary

ExposureUnit	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
Industrial Area	1,767	704	1,077	1,781
Inter-Drainage	64	50	14	64
Lower Walnut Drainage	28	7	21	28
Lower Woman Drainage	94	50	56	106
No Name Gulch Drainage	372	327	48	375
Rock Creek Drainage	41	31	20	51
Southeast Buffer Zone Area	22	5	17	22
Southwest Buffer Zone Area	16	0	16	16
Upper Walnut Drainage	145	116	36	152
Upper Woman Drainage	153	143	23	166
West Area	12	10	10	20
Wind Blown Area	145	84	76	160

Table A3.11a
Surface Soil/Surface Sediment VOC Analyte List

Analyte	Number of Samples by Analyte[a]
1,1,1-Trichloroethane	818
1,1,2,2-Tetrachloroethane	816
1,1,2-Trichloro-1,2,2-trifluoroethane	553
1,1,2-Trichloroethane	818
1,1-Dichloroethane	819
1,1-Dichloroethene	818
1,1-Dichloropropene	553
1,2,3-Trichlorobenzene	551
1,2,3-Trichloropropane	553
1,2,4-Trimethylbenzene	551
1,2-Dibromo-3-chloropropane	552
1,2-Dibromoethane	553
1,2-Dichlorobenzene	1,527
1,2-Dichloroethane	815
1,2-Dichloroethene	251
1,2-Dichloropropane	818
1,3,5-Trimethylbenzene	551
1,3-Dichlorobenzene	1,781
1,3-Dichloropropane	553
1,4-Dichlorobenzene	1,527
2,2-Dichloropropane	553
2-Butanone	815
2-Chloroethyl vinyl ether	15
2-Chlorotoluene	551
2-Hexanone	806
2-Nitrotoluene	5
4-Chlorotoluene	551
4-Isopropyltoluene	551
4-Methyl-2-pentanone	814
Acetone	818
Benzene	817
Bromobenzene	551
Bromochloromethane	553
Bromodichloromethane	818
Bromoform	818
Bromomethane	814
Carbon Disulfide	819
Carbon Tetrachloride	818
Chlorobenzene	816
Chloroethane	815
Chloroform	819
Chloromethane	814
cis-1,2-Dichloroethene	553
cis-1,3-Dichloropropene	818
Dibromochloromethane	818
Dibromomethane	553

Table A3.11a
Surface Soil/Surface Sediment VOC Analyte List

Analyte	Number of Samples by Analyte[a]
Dichlorodifluoromethane	535
Ethylbenzene	817
Gasoline	32
Hexachloroethane	1,440
Isopropylbenzene	551
Methylene Chloride	822
n-Butylbenzene	551
n-Propylbenzene	551
Pyridine	428
sec-Butylbenzene	551
Styrene	817
tert-Butylbenzene	551
Tetrachloroethene	817
Tetryl	5
Toluene	819
trans-1,2-Dichloroethene	568
trans-1,3-Dichloropropene	818
Trichloroethene	818
Trichlorofluoromethane	553
Vinyl acetate	183
Vinyl Chloride	819
Xylene	817

[a] July 1991 through 2005

Table 3.11b
Surface Soil/Surface Sediment VOC Sampling Summary

ExposureUnit	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
Industrial Area	1,276	425	912	1,337
Inter-Drainage	3	0	3	3
Lower Walnut Drainage	15	7	8	15
Lower Woman Drainage	23	28	4	32
No Name Gulch Drainage	105	94	14	108
Rock Creek Drainage	24	28	3	31
Southeast Buffer Zone Area	1	1	0	1
Southwest Buffer Zone Area	0	0	0	0
Upper Walnut Drainage	74	61	20	81
Upper Woman Drainage	112	113	8	121
West Area	2	10	0	10
Wind Blown Area	102	45	62	107

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Table A3.12a
Surface Soil/Surface Sediment SVOC Analyte List

Analyte	Number of Samples by Analyte[a]
1,3,5-Trinitrobenzene	5
1,3-Dinitrobenzene	5
2,4,5-Trichlorophenol	1,393
2,4,6-Trichlorophenol	1,393
2,4,6-Trinitrotoluene	8
2,4-Dichlorophenol	1,393
2,4-Dimethylphenol	1,393
2,4-Dinitrophenol	1,373
2,4-Dinitrotoluene	1,445
2,6-Dinitrotoluene	1,445
2-Amino-4,6-dinitrotoluene	5
2-Chloronaphthalene	1,440
2-Chlorophenol	1,393
2-Methylnaphthalene	1,436
2-Methylphenol	1,393
2-Nitroaniline	1,437
2-Nitrophenol	1,393
3,3'-Dichlorobenzidine	1,395
3-Nitroaniline	1,399
3-Nitrotoluene	5
4,6-Dinitro-2-methylphenol	1,380
4-Amino-2,6-dinitrotoluene	5
4-Bromophenyl-phenylether	1,440
4-Chloro-3-methylphenol	1,393
4-Chloroaniline	1,429
4-Chlorophenyl-phenyl ether	1,440
4-Methylphenol	1,394
4-Nitroaniline	1,423
4-Nitrotoluene	5
Acenaphthene	1,452
Acenaphthylene	1,454
Anthracene	1,458
Benzo(a)anthracene	1,439
Benzo(a)pyrene	1,447
Benzo(b)fluoranthene	1,443
Benzo(g,h,i)perylene	1,423
Benzo(k)fluoranthene	1,430
Benzoic Acid	1,298
Benzyl Alcohol	1,282
bis(2-Chloroethoxy) methane	1,440
bis(2-Chloroethyl) ether	1,435
bis(2-Chloroisopropyl) ether	1,417
bis(2-ethylhexyl)phthalate	1,440
Butylbenzylphthalate	1,439
Carbazole	84
Chrysene	1,454

Table A3.12a
Surface Soil/Surface Sediment SVOC Analyte List

Analyte	Number of Samples by Analyte[a]
Coumaphos	7
Di-n-butylphthalate	1,442
Di-n-octylphthalate	1,438
Dibenz(a,h)anthracene	1,429
Dibenzofuran	1,440
Dichlorovos	7
Diesel fuel	28
Diesel Range Organics	13
Diethylphthalate	1,438
Dimethoate	7
Dimethylphthalate	1,440
Disulfoton	7
Famphur	7
Fensulfothion	7
Fenthion	7
Fluoranthene	1,449
Fluorene	1,457
Hexachlorobenzene	1,437
Hexachlorobutadiene	1,782
Indeno(1,2,3-cd)pyrene	1,430
Isophorone	1,440
Malathion	7
Methyl parathion	7
Mevinphos	7
N-Nitroso-di-n-propylamine	1,435
N-nitrosodiphenylamine	1,440
Naled	7
Naphthalene	1,799
Nitrobenzene	1,431
O,O,O-Triethyl phosphorothioate	7
Parathion	7
Pentachlorophenol	1,393
Phenanthrene	1,460
Phenol	1,393
Phorate	7
Pyrene	1,456
Tetrachlorvinphos	7
Tetraethyl dithiopyrophosphate	7
Thionazine	7
Tributyl phosphate	1

[a] July 1991 through 2005

Table 3.12b
Surface Soil/Surface Sediment SVOC Sampling Summary

ExposureUnit	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
Industrial Area	1,247	388	923	1,311
Inter-Drainage	3	0	3	3
Lower Walnut Drainage	15	7	8	15
Lower Woman Drainage	22	27	4	31
No Name Gulch Drainage	103	92	14	106
Rock Creek Drainage	24	29	3	32
Southeast Buffer Zone Area	1	1	0	1
Southwest Buffer Zone Area	0	0	0	0
Upper Walnut Drainage	70	57	20	77
Upper Woman Drainage	128	129	8	137
West Area	2	10	0	10
Wind Blown Area	102	45	62	107

Table A3.13a
Surface Soil/Surface Sediment PCB Analyte List

Analyte	Number of Samples by Analyte[a]
Aroclor-1221	1,079
Aroclor-1232	1,079
Aroclor-1242	1,079
Aroclor-1248	1,079
Aroclor-1254	1,080
Aroclor-1260	1,070

[a] July 1991 through 2005

Table 3.13b
Surface Soil/Surface Sediment PCB Sampling Summary

ExposureUnit	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
Industrial Area	554	302	257	559
Inter-Drainage	0	0	0	0
Lower Walnut Drainage	7	7	0	7
Lower Woman Drainage	23	28	4	32
No Name Gulch Drainage	118	121	0	121
Rock Creek Drainage	21	26	0	26
Southeast Buffer Zone Area	1	1	0	1
Southwest Buffer Zone Area	0	0	0	0
Upper Walnut Drainage	109	103	20	123
Upper Woman Drainage	106	113	2	115
West Area	2	10	0	10
Wind Blown Area	85	45	45	90

Table A3.14a
Surface Soil/Surface Sediment Pesticide Analyte List

Analyte	Number of Samples by Analyte[a]
4,4'-DDE	642
4,4'-DDT	642
Aldrin	640
alpha-BHC	642
alpha-Chlordane	606
Atraton	1
Atrazine	1
beta-BHC	641
beta-Chlordane	521
Chlordane	35
Chlorpyriphos	7
delta-BHC	642
Demeton	7
Diazinon	7
Dieldrin	642
Endosulfan I	642
Endosulfan II	635
Endosulfan sulfate	642
Endrin	642
Endrin aldehyde	113
Endrin ketone	606
gamma-BHC (Lindane)	642
gamma-Chlordane	86
Heptachlor	642
Heptachlor epoxide	641
Hexachlorocyclopentadiene	1,413
Merphos	7
Methoxychlor	642
Prometon	1
Prometryn	1
Propazine	1
Simazine	1
Simetryn	1
Terbutryn	1
Terbutylazine	1
Toxaphene	642
Trichloronate	7

[a] July 1991 through 2005

Table 3.14b
Surface Soil/Surface Sediment Pesticide Sampling Summary

ExposureUnit	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
Industrial Area	1,032	408	631	1,039
Inter-Drainage	0	0	0	0
Lower Walnut Drainage	7	7	0	7
Lower Woman Drainage	23	28	4	32
No Name Gulch Drainage	94	87	10	97
Rock Creek Drainage	24	27	3	30
Southeast Buffer Zone Area	1	1	0	1
Southwest Buffer Zone Area	0	0	0	0
Upper Walnut Drainage	84	76	15	91
Upper Woman Drainage	106	113	2	115
West Area	2	10	0	10
Wind Blown Area	89	45	49	94

Table A3.15a
Surface Soil/Surface Sediment Herbicide Analyte List

Analyte	Number of Samples by Analyte[a]
2,4,5-TP (Silvex)	12
2,4-D	12
2,4-DB	10
4-Nitrophenol	1,380
Ametryne	1
Azinphos-methyl	7
Dalapon	10
Dicamba	10
Dichloroprop	10
Dinoseb	10
Ethoprop	7
MCPA	10
MCPP	10
Prothiophos	7
Ronnel	7
Sulprofos	7

[a] July 1991 through 2005

Table 3.15b
Surface Soil/Surface Sediment Herbicide Sampling Summary

ExposureUnit	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
Industrial Area	984	366	627	993
Inter-Drainage	0	0	0	0
Lower Walnut Drainage	7	7	0	7
Lower Woman Drainage	23	28	4	32
No Name Gulch Drainage	98	91	10	101
Rock Creek Drainage	18	20	3	23
Southeast Buffer Zone Area	1	1	0	1
Southwest Buffer Zone Area	0	0	0	0
Upper Walnut Drainage	59	51	15	66
Upper Woman Drainage	62	67	2	69
West Area	2	9	0	9
Wind Blown Area	84	40	49	89

Table A3.16a
Surface Soil/Surface Sediment Dioxin Analyte List

Analyte	Number of Samples by Analyte[a]
123478-HxCDD	24
123478-HxCDF	24
1234789-HpCDF	24
123678-HxCDD	24
123678-HxCDF	24
12378-PeCDF	24
123789-HxCDD	24
123789-HxCDF	24
234678-HxCDF	24
23478-PeCDF	24
2378-TCDD	24
2378-TCDF	24
Heptachlorodibenzo-p-dioxin	24
OCDD	24
OCDF	24
Pentachlorodibenzo-p-dioxin	24

[a] July 1991 through 2005

Table 3.16b
Surface Soil/Surface Sediment Dioxin Sampling Summary

ExposureUnit	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
Industrial Area	11	0	12	12
Inter-Drainage	0	0	0	0
Lower Walnut Drainage	0	0	0	0
Lower Woman Drainage	1	0	1	1
No Name Gulch Drainage	0	0	0	0
Rock Creek Drainage	0	0	0	0
Southeast Buffer Zone Area	0	0	0	0
Southwest Buffer Zone Area	0	0	0	0
Upper Walnut Drainage	1	0	1	1
Upper Woman Drainage	10	0	10	10
West Area	0	0	0	0
Wind Blown Area	0	0	0	0

Table A3.17a
Sediment Radionuclide Analyte List

Analyte	Number of Samples by Analyte[a]
Americium-241	462
Cesium-134	137
Cesium-137	226
Gross Alpha	259
Gross Beta	264
Plutonium-239/240	482
Radium-226	113
Radium-228	95
Strontium-89/90	200
Uranium-233/234	424
Uranium-235	424
Uranium-238	424

[a] July 1991 through 2005

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Table A3.17b
Sediment Radionuclide Sampling Summary

Aquatic Exposure Unit	Pond	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Sampling Depth Range (ft)	Total Number of Samples
North Walnut Creek AEU		93	95	32	0 - 4.50	127
	Bowmans Pond	0	0	0	N/A	0
	Pond A-1	9	8	7	0 - 3	15
	Pond A-2	7	6	7	0 - 4.50	13
	Pond A-3	8	4	4	0 - 2	8
	Pond A-4	9	4	8	0 - 2	12
South Walnut Creek AEU		148	138	40	0 - 8.50	178
	Flume Pond	11	8	4	0 - 2.50	12
	Pond B-1	0	0	0	N/A	0
	Pond B-2	0	0	0	N/A	0
	Pond B-3	0	0	0	N/A	0
	Pond B-4	12	8	15	0 - 8.50	23
	Pond B-5	10	5	7	0 - 4.50	12
No Name Gulch AEU		19	13	10	0 - 0.833	23
	East Landfill Pond	10	0	10	0 - 0.500	10
Woman Creek AEU		83	102	15	0 - 2.50	117
	Pond C-1	6	4	6	0 - 2	10
	Pond C-2	8	3	8	0 - 2.50	11
Rock Creek AEU		8	15	5	0 - 1.50	20
McKay Ditch AEU		6	9	4	0 - 2.25	13
Southeast AEU		7	2	7	0 - 1.75	9
	Pond D-1	1	0	2	0 - 1	2
	Pond D-2	1	0	1	0 - 0.500	1

N/A - Not applicable.

Table A3.18a
Sediment Metal Analyte List

Analyte	Number of Samples by Analyte[a]
Aluminum	386
Antimony	355
Arsenic	385
Barium	386
Beryllium	380
Boron	106
Cadmium	377
Calcium	386
Cesium	234
Chromium	386
Chromium VI	42
Cobalt	384
Copper	386
Iron	386
Lead	386
Lithium	379
Magnesium	386
Manganese	386
Mercury	353
Molybdenum	378
Nickel	385
Potassium	384
Selenium	375
Silicon	119
Silver	371
Sodium	384
Strontium	383
Thallium	376
Tin	377
Titanium	106
Uranium	135
Vanadium	386
Zinc	386

[a] July 1991 through 2005

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Table A3.18b
Sediment Metal Sampling Summary

Aquatic Exposure Unit	Pond	Total Number of Sampling Locations	Number of Samples, 1991-2000	Number of Samples 2001 to Present	Sampling Depth Range (ft)	Total Number of Samples
NorthWalnutCreekAEU		89	82	30	0 - 4.5	112
	Bowmans Pond	0	0	0	N/A	
	Pond A-1	9	4	7	0 - 3	11
	Pond A-2	7	3	7	0 - 4.5	10
	Pond A-3	8	4	4	0 - 2	8
	Pond A-4	9	4	8	0 - 2	12
SouthWalnutCreekAEU		108	79	47	0 - 8.5	126
	Flume Pond	8	5	4	0 - 2.5	9
	Pond B-1	0	0	0	N/A	0
	Pond B-2	0	0	0	N/A	0
	Pond B-3	0	0	0	N/A	0
	Pond B-4	11	8	14	0 - 8.5	22
	Pond B-5	12	7	7	0 - 4.5	14
NoNameGulchAEU		16	10	10	0 - 2	20
	East Landfill Pond	10	0	10	0 - 0.5	10
WomanCreekAEU		58	73	15	0 - 2.5	88
	Pond C-1	6	2	6	0 - 2	8
	Pond C-2	8	3	8	0 - 2.5	11
RockCreekAEU		8	17	5	0 - 1.5	22
McKayDitchAEU		5	8	4	0 - 2.25	12
SoutheastAEU		5	0	7	0 - 1.75	7
	Pond D-1	1	0	2	0 - 1	2
	Pond D-2	1	0	1	0 - 0.5	1

N/A = Not applicable.

Table A3-19a
Sediment VOC Analyte List

Analyte	Number of Samples by Analyte[a]
1,1,1,2-Tetrachloroethane	49
1,1,1-Trichloroethane	248
1,1,2,2-Tetrachloroethane	247
1,1,2-Trichloro-1,2,2-trifluoroethane	49
1,1,2-Trichloroethane	248
1,1-Dichloroethane	249
1,1-Dichloroethene	248
1,1-Dichloropropene	49
1,2,3-Trichlorobenzene	49
1,2,3-Trichloropropane	49
1,2,4-Trimethylbenzene	49
1,2-Dibromo-3-chloropropane	49
1,2-Dibromoethane	49
1,2-Dichlorobenzene	264
1,2-Dichloroethane	245
1,2-Dichloroethene	200
1,2-Dichloropropane	248
1,3,5-Trimethylbenzene	49
1,3-Dichlorobenzene	313
1,3-Dichloropropane	49
1,4-Dichlorobenzene	264
1,4-Dioxane	1
2,2-Dichloropropane	49
2-Butanone	246
2-Chlorotoluene	49
2-Hexanone	239
2-Methyl-1-propanol	1
4-Chlorotoluene	49
4-Isopropyltoluene	49
4-Methyl-2-pentanone	247
Acetone	250
Acetonitrile	1
Benzene	247
Bromobenzene	49
Bromochloromethane	49
Bromodichloromethane	248
Bromoform	248
Bromomethane	248
Carbon Disulfide	249
Carbon Tetrachloride	248
Chlorobenzene	246
Chloroethane	248
Chloroform	249
Chloromethane	244
cis-1,2-Dichloroethene	49
cis-1,3-Dichloropropene	248
Dibromochloromethane	248
Dibromomethane	49
Dichlorodifluoromethane	49

Table A3-19a
Sediment VOC Analyte List

Analyte	Number of Samples by Analyte[a]
Ether	1
ethyl acetate	1
Ethylbenzene	247
Gasoline	2
Hexachloroethane	292
Isopropylbenzene	49
Methylene Chloride	255
n-Butanol	1
n-Butylbenzene	49
n-Propylbenzene	49
Pyridine	76
sec-Butylbenzene	49
Styrene	247
tert-Butylbenzene	49
Tetrachloroethene	247
Toluene	250
trans-1,2-Dichloroethene	49
trans-1,3-Dichloropropene	248
Trichloroethene	248
Trichlorofluoromethane	49
Vinyl acetate	148
Vinyl Chloride	249
Xylene	247

[a] July 1991 through 2005

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Table A3.19b
Sediment VOC Sampling Summary

Aquatic Exposure Unit	Pond	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Sampling Depth Range (ft)	Total Number of Samples
North Walnut Creek AEU		84	87	27	0 - 4.50	114
	Bowmans Pond	0	0	0	N/A	0
	Pond A-1	9	4	7	0 - 3	11
	Pond A-2	7	3	7	0 - 4.50	10
	Pond A-3	4	4	0	0 - 2	4
	Pond A-4	4	4	0	0 - 0.667	4
South Walnut Creek AEU		96	69	42	0 - 8.50	111
	Flume Pond	5	5	0	0 - 1.92	5
	Pond B-1				N/A	0
	Pond B-2	1	0	1	0 - 1	1
	Pond B-3	0	0	0	N/A	0
	Pond B-4	11	8	14	0 - 8.50	22
	Pond B-5	7	7	0	0 - 1	7
No Name Gulch AEU		13	6	10	0 - 2	16
	East Landfill Pond	10	0	10	0 - 0.500	10
Woman Creek AEU		48	63	7	0 - 2	70
	Pond C-1	6	2	6	0 - 2	8
	Pond C-2	3	3	0	0 - 0.417	3
Rock Creek AEU		8	16	5	0 - 1.50	21
McKay Ditch AEU		3	8	0	0 - 0.300	8
Southeast AEU		0	0	0	N/A	
	Pond D-1	0	0	0	N/A	0
	Pond D-2	0	0	0	N/A	0

N/A - Not applicable.

Table A3.20a
Sediment SVOC Analyte List

Analyte	Number of Samples by Analyte[a]
1,2,4-Trichlorobenzene	313
2,4,5-Trichlorophenol	292
2,4,6-Trichlorophenol	292
2,4-Dichlorophenol	291
2,4-Dimethylphenol	291
2,4-Dinitrophenol	274
2,4-Dinitrotoluene	292
2,6-Dinitrotoluene	291
2-Chloronaphthalene	291
2-Chlorophenol	291
2-Methylnaphthalene	291
2-Methylphenol	292
2-Nitroaniline	291
2-Nitrophenol	291
3,3'-Dichlorobenzidine	283
3-Nitroaniline	274
4,6-Dinitro-2-methylphenol	280
4-Bromophenyl-phenylether	291
4-Chloro-3-methylphenol	291
4-Chloroaniline	284
4-Chlorophenyl-phenyl ether	291
4-Methylphenol	293
4-Nitroaniline	283
Acenaphthene	291
Acenaphthylene	291
Anthracene	291
Benzo(a)anthracene	291
Benzo(a)pyrene	290
Benzo(b)fluoranthene	290
Benzo(g,h,i)perylene	287
Benzo(k)fluoranthene	290
Benzoic Acid	237
Benzyl Alcohol	241
bis(2-Chloroethoxy) methane	291
bis(2-Chloroethyl) ether	291
bis(2-Chloroisopropyl) ether	288
bis(2-ethylhexyl)phthalate	291
Butylbenzylphthalate	291
Carbazole	50
Chrysene	292
Di-n-butylphthalate	292
Di-n-octylphthalate	291
Dibenz(a,h)anthracene	289
Dibenzofuran	291
Diethylphthalate	292
Dimethylphthalate	291
Fluoranthene	292
Fluorene	291

Table A3.20a
Sediment SVOC Analyte List

Analyte	Number of Samples by Analyte[a]
Hexachlorobenzene	292
Hexachlorobutadiene	313
Indeno(1,2,3-cd)pyrene	288
Isophorone	291
N-Nitroso-di-n-propylamine	291
N-nitrosodiphenylamine	291
Naphthalene	313
Nitrobenzene	292
Pentachlorophenol	292
Phenanthrene	292
Phenol	291
Pyrene	292

[a] July 1991 through 2005

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Table A3.20b
SVOC Sediment Sampling Summary

Aquatic Exposure Unit	Pond	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Sampling Depth Range (ft)	Total Number of Samples
North Walnut Creek AEU		82	79	27	0 - 4.50	106
	Bowmans Pond	0	0	0	N/A	0
	Pond A-1	9	4	7	0 - 3	11
	Pond A-2	7	3	7	0 - 4.50	10
	Pond A-3	4	4	0	0 - 2	4
	Pond A-4	4	4	0	0 - 0.667	4
South Walnut Creek AEU		88	61	42	0 - 8.50	103
	Flume Pond	5	5	0	0 - 1.92	5
	Pond B-1				N/A	
	Pond B-2	1	0	1	0 - 1	1
	Pond B-3	0	0	0	N/A	0
	Pond B-4	11	8	14	0 - 8.50	22
	Pond B-5	5	5	0	0 - 1	5
No Name Gulch AEU		13	6	10	0 - 2	16
	East Landfill Pond	10	0	10	0 - 0.500	10
Woman Creek AEU		41	56	7	0 - 2	63
	Pond C-1	6	2	6	0 - 2	8
	Pond C-2	2	2	0	0 - 0.417	2
Rock Creek AEU		8	16	5	0 - 1.50	21
McKay Ditch AEU		3	8	0	0 - 0.300	8
Southeast AEU		0	0	0	-	0
	Pond D-1	0	0	0	N/A	0
	Pond D-2	0	0	0	N/A	0

N/A - Not applicable.

Table A3.21a
Sediment PCB Analyte List

Analyte	Number of Samples by Analyte[a]
Aroclor-1016	313
Aroclor-1221	313
Aroclor-1232	313
Aroclor-1242	313
Aroclor-1248	313
Aroclor-1254	317
Aroclor-1260	311

[a] July 1991 through 2005

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Table A3.21b
Sediment PCB Sampling Summary

Aquatic Exposure Unit	Pond	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Sampling Depth Range (ft)	Total Number of Samples
North Walnut Creek AEU		81	98	26	0 - 4.50	124
	Bowmans Pond	0	0	0	N/A	0
	Pond A-1	9	8	7	0 - 3	15
	Pond A-2	7	5	7	0 - 4.50	12
	Pond A-3	4	8	0	0 - 2	8
	Pond A-4	5	9	0	0 - 1.67	9
South Walnut Creek AEU		72	74	23	0 - 8.50	97
	Flume Pond	5	5	0	0 - 1.92	5
	Pond B-1				N/A	0
	Pond B-2	1	0	1	0 - 1	1
	Pond B-3	0	0	0	N/A	0
	Pond B-4	11	13	14	0 - 8.50	27
	Pond B-5	6	11	0	0 - 1	11
No Name Gulch AEU		3	6	0	0 - 2	6
	East Landfill Pond	0	0	0	N/A	0
Woman Creek AEU		47	62	7	0 - 2	69
	Pond C-1	6	2	6	0 - 2	8
	Pond C-2	3	3	0	0 - 0.667	3
Rock Creek AEU		5	13	0	0 - 0.500	13
McKay Ditch AEU		3	8	0	0 - 0.300	8
Southeast AEU		0	0	0	N/A	0
	Pond D-1	0	0	0	N/A	0
	Pond D-2	0	0	0	N/A	0

N/A - Not applicable.

Table A3.22a
Sediment Pesticide Analyte List

Analyte	Number of Samples by Analyte[a]
4,4'-DDE	231
4,4'-DDT	231
Aldrin	229
alpha-BHC	231
alpha-Chlordane	229
Atraton	4
Atrazine	5
beta-BHC	231
beta-Chlordane	157
Chlordane	2
delta-BHC	231
Dieldrin	231
Endosulfan I	231
Endosulfan II	231
Endosulfan sulfate	231
Endrin	231
Endrin aldehyde	53
Endrin ketone	221
gamma-BHC (Lindane)	230
gamma-Chlordane	72
Heptachlor	231
Heptachlor epoxide	231
Hexachlorocyclopentadiene	283
Methoxychlor	231
Prometon	4
Prometryn	4
Propazine	4
Simazine	4
Simetryn	4
Terbutryn	4
Terbutylazine	4
Toxaphene	231

[a] July 1991 through 2005

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Table A3.22b
Sediment Pesticide Sampling Summary

Aquatic Exposure Unit	Pond	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Sampling Depth Range (ft)	Total Number of Samples
North Walnut Creek AEU		81	79	26	0 - 4.50	105
	Bowmans Pond	0	0	0	N/A	0
	Pond A-1	9	4	7	0 - 3	11
	Pond A-2	7	3	7	0 - 4.50	10
	Pond A-3	4	4	0	0 - 2	4
	Pond A-4	5	5	0	0 - 1.67	5
South Walnut Creek AEU		82	73	24	0 - 8.50	97
	Flume Pond	5	5	0	0 - 1.92	5
	Pond B-1	0	0	0	N/A	0
	Pond B-2	1	0	1	0 - 1	1
	Pond B-3	0	0	0	N/A	0
	Pond B-4	11	8	14	0 - 8.50	22
	Pond B-5	6	6	0	0 - 1	6
No Name Gulch AEU		13	6	10	0 - 2	16
	East Landfill Pond	10	0	10	0 - 0.500	10
Woman Creek AEU		45	60	7	0 - 2	67
	Pond C-1	6	2	6	0 - 2	8
	Pond C-2	3	3	0	0 - 0.667	3
Rock Creek AEU		8	14	5	0 - 1.50	19
McKay Ditch AEU		3	8	0	0 - 0.300	8
Southeast AEU		0	0	0	N/A	0
	Pond D-1	0	0	0	N/A	0
	Pond D-2	0	0	0	N/A	0

N/A - Not applicable.

Table A3.23a
Sediment Herbicide Analyte List

Analyte	Number of Samples by Analyte[a]
2,4,5-T	1
2,4,5-TP (Silvex)	1
2,4-D	1
2,4-DB	1
4-Nitrophenol	289
Ametryne	4
Dalapon	1
Dicamba	1
Dichloroprop	1
Dinoseb	1
MCPA	1
MCPP	1

[a] July 1991 through 2005

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Table A3.23b
Sediment Herbicide Sampling Summary

Aquatic Exposure Unit	Pond	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Sampling Depth Range	Total Number of Samples
North Walnut Creek AEU		81	79	26	0 - 4.50	105
	Bowmans Pond	0	0	0	N/A	0
	Pond A-1	9	4	7	0 - 3	11
	Pond A-2	7	3	7	0 - 4.50	10
	Pond A-3	4	4	0	0 - 2	4
	Pond A-4	5	5	0	0 - 1.67	5
South Walnut Creek AEU		69	61	23	0 - 8.50	84
	Flume Pond	5	5	0	0 - 1.92	5
	Pond B-1	0	0	0	N/A	0
	Pond B-2	0	0	0	N/A	0
	Pond B-3	0	0	0	N/A	0
	Pond B-4	11	8	14	0 - 8.50	22
	Pond B-5	6	6	0	0 - 1	6
No Name Gulch AEU		13	6	10	0 - 2	16
	East Landfill Pond	10	0	10	0 - 0.500	10
Woman Creek AEU		41	56	7	0 - 2	63
	Pond C-1	6	2	6	0 - 2	8
	Pond C-2	3	3	0	0 - 0.667	3
Rock Creek AEU		8	12	5	0 - 1.50	17
McKay Ditch AEU		3	8	0	0 - 0.300	8
Southeast AEU		0	0	0	N/A	0
	Pond D-1	0	0	0	N/A	0
	Pond D-2	0	0	0	N/A	0

N/A - Not applicable.

Table A3.24a
Sediment Dioxin Analyte List

Analyte	Number of Samples by Analyte[a]
1234678-HpCDF	6
123478-HxCDD	6
123478-HxCDF	6
1234789-HpCDF	6
123678-HxCDD	6
123678-HxCDF	6
12378-PeCDF	6
123789-HxCDD	6
123789-HxCDF	6
234678-HxCDF	6
23478-PeCDF	6
2378-TCDD	6
2378-TCDF	6
Heptachlorodibenzo-p-dioxin	6
OCDD	6
OCDF	6
Pentachlorodibenzo-p-dioxin	6

[a] July 1991 through 2005

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Table A3.24b
Sediment Dioxin Sampling Summary

Aquatic Exposure Unit	Pond	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Sampling Depth Range	Total Number of Samples
North Walnut Creek AEU		2	0	4	0 - 4.5	4
	Bowmans Pond	0	0	0	N/A	0
	Pond A-1	1	0	1	1.5 - 3	1
	Pond A-2	1	0	3	0 - 4.5	3
	Pond A-3	0	0	0	N/A	0
	Pond A-4	0	0	0	N/A	0
South Walnut Creek AEU		0	0	0	N/A	0
	Flume Pond	0	0	0	N/A	0
	Pond B-1	0	0	0	N/A	0
	Pond B-2	0	0	0	N/A	0
	Pond B-3	0	0	0	N/A	0
	Pond B-4	0	0	0	N/A	0
	Pond B-5	0	0	0	N/A	0
NoNameGulchAEU		0	0	0	N/A	0
	East Landfill Pond	0	0	0	N/A	0
Woman Creek AEU		1	0	2	0 - 2.5	2
	Pond C-1	1	0	2	0 - 2.5	2
	Pond C-2	0	0	0	N/A	0
Rock Creek AEU		0	0	0	N/A	0
McKay Ditch AEU		0	0	0	N/A	0
Southeast AEU		0	0	0	N/A	0
	Pond D-1	0	0	0	N/A	0
	Pond D-2	0	0	0	N/A	0

N/A - Not applicable.

Table A3-25a
Surface Water Radionuclide Analyte List

Analyte	Number of Samples by Analyte[a]
Americium-241	5191
Cesium-134	3
Cesium-137	690
Curium-244	67
Gross Alpha	6641
Gross Beta	6722
Neptunium-237	63
Plutonium-238	904
Plutonium-239/240	5424
Radium-226	91
Radium-228	3
Strontium-89/90	828
Strontium-90	1
Thorium-230	50
Thorium-232	50
Tritium	4808
Uranium-233/234	4904
Uranium-235	4845
Uranium-238	4904

[a] July 1991 through 2005

Table A3.25b
Surface Water Radionuclide Sampling Summary

Aquatic Exposure Unit	Pond	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
McKay Ditch AEU		10	36	2	**38**
No Name Gulch AEU		9	65	23	**88**
	East Landfill Pond	2	12	1	13
North Walnut Creek AEU		131	1,937	830	**2,767**
	Bowmans Pond	6	11	2	13
	Pond A-1	6	17	2	19
	Pond A-2	5	22	5	27
	Pond A-3	7	50	21	71
	Pond A-4	9	186	68	254
Rock Creek AEU		13	37	6	**43**
South Walnut Creek AEU		125	5,450	918	**6,368**
	Flume Pond	5	5	0	5
	Pond B-1	8	19	1	20
	Pond B-2	8	21	1	22
	Pond B-3	9	12	1	13
	Pond B-4	8	11	1	12
	Pond B-5	8	158	29	187
Southeast AEU		7	7	4	**11**
	Pond D-1	2	1	1	2
	Pond D-2	1	0	1	1
Woman Creek AEU		104	1,884	425	**2,309**
	Pond C-1	2	1,103	2	1,105
	Pond C-2	4	181	9	190
Exposure Unit	**Pond**	**Total Number of Sampling Locations**	**Number of Samples 1991-2000**	**Number of Samples 2001 to Present**	**Total Number of Samples**
Industrial Area		119	4286	917	**5203**
	Bowmans Pond	6	11	2	13
Inter-Drainage		4	10	0	**10**
Lower Walnut Drainage		15	803	130	**933**
	Flume Pond	5	5	0	5
Lower Woman Drainage		27	1569	150	**1719**
	Pond C-1	2	1103	2	1105
	Pond C-2	4	181	9	190
No Name Gulch Drainage		10	52	25	**77**
	East Landfill Pond	2	12	1	13
Rock Creek Drainage		11	26	6	**32**
Southeast Buffer Zone Area		4	1	3	**4**
	Pond D-1	2	1	1	2
	Pond D-2	1	0	1	1
Southwest Buffer Zone Area		2	5	1	**6**
Upper Walnut Drainage		129	2353	728	**3081**
	Pond A-1	6	17	2	19
	Pond A-2	5	22	5	27
	Pond A-3	7	50	21	71
	Pond A-4	9	186	68	254
	Pond B-1	8	19	1	20
	Pond B-2	8	21	1	22
	Pond B-3	9	12	1	13
	Pond B-4	8	11	1	12

Table A3.25b
Surface Water Radionuclide Sampling Summary

Aquatic Exposure Unit	Pond	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
	Pond B-5	8	158	29	187
Upper Woman Drainage		46	249	159	**408**
West Area		3	15	0	**15**
Wind Blown Area		29	47	89	**136**

Table A3.26a
Surface Water Metal Analyte List

Analyte	Number of Samples by Analyte[a]
Aluminum	3241
Antimony	3250
Arsenic	3236
Barium	3245
Beryllium	3836
Boron	11
Cadmium	3859
Calcium	3252
Cerium	18
Cesium	1276
Chromium	4518
Chromium VI	100
Cobalt	3244
Copper	3240
Iron	3246
Lead	3247
Lithium	2628
Magnesium	3252
Manganese	3250
Mercury	3087
Molybdenum	2878
Nickel	3243
Potassium	3244
Selenium	3244
Silicon	1372
Silver	4044
Sodium	3244
Strontium	2880
Thallium	3229
Tin	2537
Titanium	22
Uranium	867
Vanadium	3242
Zinc	3249

[a] July 1991 through 2005

Table A3.26b
Surface Water Metal Sampling Summary

Aquatic Exposure Unit	Pond Name	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
McKay Ditch AEU		10	37	2	**39**
No Name Gulch AEU		10	52	26	**78**
	East Landfill Pond	2	12	3	15
North Walnut Creek AEU		114	705	488	**1,193**
	Bowmans Pond	6	12	1	13
	Pond A-1	6	14	1	15
	Pond A-2	5	14	1	15
	Pond A-3	7	13	4	17
	Pond A-4	9	178	2	180
Rock Creek AEU		16	77	33	**110**
South Walnut Creek AEU		113	1,788	700	**2,488**
	Flume Pond	5	5	0	5
	Pond B-1	8	16	1	17
	Pond B-2	8	16	1	17
	Pond B-3	8	11	1	12
	Pond B-4	8	11	1	12
	Pond B-5	8	96	4	100
Southeast AEU		7	8	4	**12**
	Pond D-1	2	1	1	2
	Pond D-2	1	0	1	1
Woman Creek AEU		88	575	219	**794**
	Pond C-1	2	9	1	10
	Pond C-2	4	102	2	104
Exposure Unit	**Pond Name**	**Total Number of Sampling Locations**	**Number of Samples 1991-2000**	**Number of Samples 2001 to Present**	**Total Number of Samples**
Industrial Area		101	1524	873	**2397**
	Bowmans Pond	6	12	1	13
Inter-Drainage		4	11	0	**11**
Lower Walnut Drainage		11	48	11	**59**
	Flume Pond	5	5	0	5
Lower Woman Drainage		25	243	59	**302**
	Pond C-1	2	9	1	10
	Pond C-2	4	102	2	104
No Name Gulch Drainage		12	52	28	**80**
	East Landfill Pond	2	12	3	15
Rock Creek Drainage		14	46	19	**65**
Southeast Buffer Zone Area		4	1	3	**4**
	Pond D-1	2	1	1	2
	Pond D-2	1	0	1	1
Southwest Buffer Zone Area		2	6	1	**7**
Upper Walnut Drainage		121	959	304	**1263**
	Pond A-1	6	14	1	15

Table A3.26b
Surface Water Metal Sampling Summary

Aquatic Exposure Unit	Pond Name	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
	Pond A-2	5	14	1	15
	Pond A-3	7	13	4	17
	Pond A-4	9	178	2	180
	Pond B-1	8	16	1	17
	Pond B-2	8	16	1	17
	Pond B-3	8	11	1	12
	Pond B-4	8	11	1	12
	Pond B-5	8	96	4	100
Upper Woman Drainage		49	287	158	**445**
West Area		3	37	14	**51**
Wind Blown Area		12	28	2	**30**

Table A3.27a
Surface Water VOC Analyte List

Analyte	Number of Samples by Analyte[a]
1,1,1,2-Tetrachloroethane	1,094
1,1,1-Trichloroethane	2,263
1,1,2,2-Tetrachloroethane	2,264
1,1,2-Trichloro-1,2,2-trifluoroethane	241
1,1,2-Trichlorobenzene	3
1,1,2-Trichloroethane	2,263
1,1-Dichloroethane	2,265
1,1-Dichloroethene	2,262
1,1-Dichloropropene	1,107
1,2,3-Trichlorobenzene	1,106
1,2,3-Trichloropropane	1,040
1,2,4-Trimethylbenzene	1,106
1,2-Dibromo-3-chloropropane	592
1,2-Dibromoethane	1,108
1,2-Dichlorobenzene	1,534
1,2-Dichloroethane	2,221
1,2-Dichloroethene	1,120
1,2-Dichloropropane	2,265
1,3 & 1,4-xylene	2
1,3,5-Trimethylbenzene	1,106
1,3-Dichlorobenzene	1,534
1,3-Dichloropropane	1,105
1,4-Dichlorobenzene	1,534
2,2-Dichloropropane	1,097
2-Butanone	1,229
2-Chloroethyl vinyl ether	118
2-Chlorotoluene	1,107
2-Hexanone	1,335
2-Methyl-1-propanol	1
2-Picoline	4
4-Bromofluorobenzene	5
4-Chlorotoluene	1,107
4-Isopropyltoluene	1,105
4-Methyl-2-pentanone	1,335
Acetone	1,273
Acetonitrile	1
Acrolein	2
Acrylonitrile	47
Allyl Chloride	2
Benzene	2,266
Bromobenzene	1,107
Bromochloromethane	1,085
Bromodichloromethane	2,251
Bromoform	2,244
Bromomethane	2,243
Carbon Disulfide	1,363
Carbon Tetrachloride	2,254
Chlorobenzene	2,266

Table A3.27a
Surface Water VOC Analyte List

Analyte	Number of Samples by Analyte[a]
Chlorodifluoromethane	16
Chloroethane	2,250
Chloroform	2,266
Chloromethane	2,254
Chloroprene	1
cis-1,2-Dichloroethane	1
cis-1,2-Dichloroethene	1,106
cis-1,3-Dichloropropene	2,154
Dibromochloromethane	2,263
Dibromomethane	1,108
Dichlorodifluoromethane	1,211
Dichlorofluoromethane	1
Ethyl Methacrylate	2
Ethylbenzene	2,265
Gasoline	1
Hexachloroethane	596
Iodomethane	2
Isopropylbenzene	1,105
m,p-Xylene	625
m-Xylene	4
Methyl Acrylonitrile	2
methyl methacrylate	2
Methylene Chloride	2,257
n-Butylbenzene	1,107
n-Propylbenzene	1,106
o-Xylene	752
p-Xylene	2
Pentachloroethane	2
Propionitrile	1
Pyridine	9
sec-Butylbenzene	1,107
Styrene	2,161
tert-Butylbenzene	1,107
Tetrachloroethane	5
Tetrachloroethene	2,260
Toluene	2,266
trans-1,2-Dichloroethene	1,212
trans-1,3-Dichloropropene	2,151
trans-1,4-Dichlorobutene-2	2
Trichloroethene	2,264
Trichlorofluoromethane	1,213
Vinyl acetate	898
Vinyl Chloride	2,265
Xylene	1,589

[a] July 1991 through 2005

Table A3.27b
Surface Water VOC Sampling Summary

Aquatic Exposure Unit	Pond Name	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
McKay Ditch AEU		5	13	0	**13**
No Name Gulch AEU		11	113	31	**144**
	East Landfill Pond	4	63	26	89
North Walnut Creek AEU		98	298	59	**357**
	Bowmans Pond	6	12	2	14
	Pond A-1	6	18	1	19
	Pond A-2	5	18	1	19
	Pond A-3	7	11	5	16
	Pond A-4	9	70	15	85
Rock Creek AEU		11	42	1	**43**
South Walnut Creek AEU		111	1,259	142	**1,401**
	Flume Pond	5	5	0	5
	Pond B-1	11	25	2	27
	Pond B-2	12	31	5	36
	Pond B-3	9	11	3	14
	Pond B-4	8	11	3	14
	Pond B-5	9	49	29	78
Southeast AEU		2	7	0	**7**
	Pond D-1	1	1	0	1
	Pond D-2	0	0	0	0
Woman Creek AEU		79	324	32	**356**
	Pond C-1	2	6	2	8
	Pond C-2	3	37	6	43
Exposure Unit	**Pond Name**	**Total Number of Sampling Locations**	**Number of Samples 1991-2000**	**Number of Samples 2001 to Present**	**Total Number of Samples**
Industrial Area		79	1196	125	**1321**
	Bowmans Pond	6	12	2	14
Inter-Drainage		3	7	0	**7**
Lower Walnut Drainage		9	16	0	**16**
	Flume Pond	5	5	0	5
Lower Woman Drainage		23	93	15	**108**
	Pond C-1	2	6	2	8
	Pond C-2	3	37	6	43
No Name Gulch Drainage		11	113	31	**144**
	East Landfill Pond	4	63	26	89
Rock Creek Drainage		9	31	1	**32**
Southeast Buffer Zone Area		1	1	0	**1**
	Pond D-1	1	1	0	1
	Pond D-2	0	0	0	0
Southwest Buffer Zone Area		1	6	0	**6**
Upper Walnut Drainage		124	354	76	**430**
	Pond A-1	6	18	1	19
	Pond A-2	5	18	1	19
	Pond A-3	7	11	5	16
	Pond A-4	9	70	15	85

Table A3.27b
Surface Water VOC Sampling Summary

Aquatic Exposure Unit	Pond Name	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
	Pond B-1	11	25	2	27
	Pond B-2	12	31	5	36
	Pond B-3	9	11	3	14
	Pond B-4	8	11	3	14
	Pond B-5	9	49	29	78
Upper Woman Drainage		43	207	17	**224**
West Area		3	16	0	**16**
Wind Blown Area		11	16	0	**16**

Table A3.28a
Surface Water SVOC Analyte List

Analyte	Number of Samples by Analyte[a]
1,2,4,5-Tetrachlorobenzene	6
1,2,4-Trichlorobenzene	1,429
1,2-Diphenylhydrazine	2
1,3,5-Trinitrobenzene	4
1,3-Dinitrobenzene	4
1,4-Naphthoquinone	4
1,4-Phenylenediamine	4
1-Naphthylamine	4
2,3,4,6-Tetrachlorophenol	4
2,4,5-Trichlorophenol	591
2,4,6-Trichlorophenol	591
2,4-Dichlorophenol	591
2,4-Dimethylphenol	591
2,4-Dinitrophenol	569
2,4-Dinitrotoluene	592
2,6-Dichlorophenol	4
2,6-Dinitrotoluene	593
2-Acetylaminofluorene	4
2-Chloronaphthalene	596
2-Chlorophenol	591
2-Methylnaphthalene	593
2-Methylphenol	588
2-Naphthylamine	4
2-Nitroaniline	596
2-Nitrophenol	591
3 & 4-methyl phenol	32
3,3'-Dichlorobenzidine	582
3,3'-Dimethylbenzidine	4
3-Methylcholanthrene	4
3-Nitroaniline	587
4,6-Dinitro-2-methylphenol	584
4-Aminobiphenyl	4
4-Bromophenyl-phenylether	596
4-Chloro-3-methylphenol	591
4-Chloroaniline	589
4-Chlorophenyl-phenyl ether	596
4-Methylphenol	556
4-Nitroaniline	580
5-Nitro-o-toluidine	4
7,12-Dimethylbenz(a)-anthracene	4
a,a-Dimethylphenethylamine	4
Acenaphthene	598
Acenaphthylene	596
Acetophenone	3
Aniline	2
Anthracene	597
Aramite	3
Benzidine	15

Table A3.28a
Surface Water SVOC Analyte List

Analyte	Number of Samples by Analyte[6]
Benzo(a)anthracene	596
Benzo(a)pyrene	596
Benzo(b)fluoranthene	581
Benzo(b,k)fluoroanthene	15
Benzo(g,h,i)perylene	581
Benzo(k)fluoranthene	577
Benzoic Acid	515
Benzyl Alcohol	540
bis(2-Chloroethoxy) methane	593
bis(2-Chloroethyl) ether	593
bis(2-Chloroisopropyl) ether	580
bis(2-ethylhexyl)phthalate	594
Butylbenzylphthalate	596
Carbazole	56
Chlorobenzilate	4
Chrysene	596
Coumaphos	1
Di-n-butylphthalate	597
Di-n-octylphthalate	596
Dibenz(a,h)anthracene	586
Dibenzofuran	598
Dichlorovos	1
Diesel fuel	1
Diesel Range Organics	2
Diethylphthalate	597
Dimethoate	4
Dimethylaminoazobenzene	4
Dimethylphthalate	596
Diphenylamine	32
Disulfoton	5
Ethyl methanesulfonate	4
Famphur	4
Fensulfothion	1
Fenthion	1
Fluoranthene	596
Fluorene	598
Hexachlorobenzene	596
Hexachlorobutadiene	1,429
Hexachlorophene	4
Hexachloropropene	4
Indeno(1,2,3-cd)pyrene	585
Isophorone	596
Isosafrole	4
Kepone	4
Malathion	1
Methapyrilene	4
Methyl methanesulfonate	4
Methyl parathion	5

Table A3.28a
Surface Water SVOC Analyte List

Analyte	Number of Samples by Analyte[a]
Mevinphos	1
N-Nitroso-di-n-propylamine	596
N-Nitrosodi-n-butylamine	21
N-Nitrosodiethylamine	21
N-Nitrosodimethylamine	21
N-nitrosodiphenylamine	567
N-Nitrosomethylethylamine	4
N-Nitrosomorpholine	4
N-Nitrosopiperidine	4
N-Nitrosopyrrolidine	19
Naled	1
Naphthalene	1,430
Nitrobenzene	596
Nitroquinoline-1-oxide	4
O,O,O-Triethyl phosphorothioate	4
o-Toluidine	4
Parathion	4
Pentachlorobenzene	6
Pentachloronitrobenzene	2
Pentachlorophenol	591
Phenacetin	4
Phenanthrene	598
Phenol	595
Phorate	5
Pronamide	4
Pyrene	592
Safrole	4
Tetrachlorvinphos	1
Tetraethyl dithiopyrophosphate	4
Thionazine	4
Tributyl phosphate	29

[a] July 1991 through 2005

Table A3.28b
Surface Water SVOC Sampling Summary

Aquatic Exposure Unit	Pond Name	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
McKay Ditch AEU		2	2	0	**2**
No Name Gulch AEU		10	90	31	**121**
	East Landfill Pond	4	56	26	82
North Walnut Creek AEU		92	215	41	**256**
	Bowmans Pond	6	7	2	9
	Pond A-1	5	12	1	13
	Pond A-2	5	13	1	14
	Pond A-3	7	11	1	12
	Pond A-4	9	52	2	54
Rock Creek AEU		6	11	1	**12**
Southeast AEU		1	1	0	**1**
	Pond D-1	1	1	0	1
	Pond D-2	0	0	0	0
South Walnut Creek AEU		106	765	70	**835**
	Flume Pond	5	5	0	5
	Pond B-1	11	0,019	2	0,021
	Pond B-2	12	22	5	27
	Pond B-3	9	11	3	14
	Pond B-4	8	11	3	14
	Pond B-5	8	25	4	29
Woman Creek AEU		67	181	29	**210**
	Pond C-1	2	6	2	8
	Pond C-2	3	21	1	22
Exposure Unit	**Pond Name**	**Total Number of Sampling Locations**	**Number of Samples 1991-2000**	**Number of Samples 2001 to Present**	**Total Number of Samples**
Industrial Area		77	726	80	**806**
	Bowmans Pond	6	7	2	9
Inter-Drainage		1	1	0	**1**
Lower Walnut Drainage		9	11	0	**11**
	Flume Pond	5	5	0	5
Lower Woman Drainage		21	52	10	**62**
	Pond C-1	2	6	2	8
	Pond C-2	3	21	1	22
No Name Gulch Drainage		10	90	31	**121**
	East Landfill Pond	4	56	26	82
Rock Creek Drainage		5	10	1	**11**
Southeast Buffer Zone Area		1	1	0	**1**
	Pond D-1	1	1	0	1
	Pond D-2	0	0	0	0
Upper Walnut Drainage		117	251	33	**284**
	Pond A-1	5	12	1	13
	Pond A-2	5	13	1	14
	Pond A-3	7	11	1	12
	Pond A-4	9	52	2	54
	Pond B-1	11	19	2	21

Table A3.28b
Surface Water SVOC Sampling Summary

Aquatic Exposure Unit	Pond Name	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
	Pond B-2	12	22	5	27
	Pond B-3	9	11	3	14
	Pond B-4	8	11	3	14
	Pond B-5	8	25	4	29
Upper Woman Drainage		39	118	17	**135**
West Area		1	1	0	**1**
Wind Blown Area		3	4	0	**4**

Table A3.29a
Surface Water PCB Analyte List

Analyte	Number of Samples by Analyte[a]
Aroclor-1016	330
'Aroclor-1221	330
'Aroclor-1232	330
Aroclor-1242	330
'Aroclor-1248	330
'Aroclor-1254	330
'Aroclor-1260	330

[a] July 1991 through 2005

Table A3.29b
Surface Water PCB Sampling Summary

Aquatic Exposure Unit	Pond Name	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
McKay Ditch AEU		2	3	0	**3**
No Name Gulch AEU		4	7	0	**7**
	East Landfill Pond	0	0	0	0
North Walnut Creek AEU		43	110	9	**119**
	Bowmans Pond	5	7	0	7
	Pond A-1	1	5	0	5
	Pond A-2	1	8	0	8
	Pond A-3	2	6	0	6
	Pond A-4	3	30	0	30
Rock Creek AEU		3	3	0	**3**
Southeast AEU		1	1	0	**1**
	Pond D-1	1	1	0	1
	Pond D-2	0	0	0	0
South Walnut Creek AEU		32	70	0	**70**
	Flume Pond	0	0	0	0
	Pond B-1	2	6	0	6
	Pond B-2	2	6	0	6
	Pond B-3	2	6	0	6
	Pond B-4	2	6	0	6
	Pond B-5	1	12	0	12
Woman Creek AEU		44	126	1	**127**
	Pond C-1	1	6	0	6
	Pond C-2	2	13	0	13
Exposure Unit	**Pond Name**	**Total Number of Sampling Locations**	**Number of Samples 1991-2000**	**Number of Samples 2001 to Present**	**Total Number of Samples**
Industrial Area		45	61	9	**70**
	Bowmans Pond	5	7	0	7
Inter-Drainage		1	1	0	**1**
Lower Walnut Drainage		2	4	0	**4**
	Flume Pond	0	0	0	0
Lower Woman Drainage		12	39	0	**39**
	Pond C-1	1	6	0	6
	Pond C-2	2	13	0	13
No Name Gulch Drainage		4	7	0	**7**
Rock Creek Drainage		2	2	0	**2**
Southeast Buffer Zone Area		1	1	0	**1**
	Pond D-1	1	1	0	1
	Pond D-2	0	0	0	0
Upper Walnut Drainage		30	119	0	**119**
	Pond A-1	1	5	0	5
	Pond A-2	1	8	0	8
	Pond A-3	2	6	0	6
	Pond A-4	3	30	0	30
	Pond B-1	2	6	0	6

Table A3.29b
Surface Water PCB Sampling Summary

Aquatic Exposure Unit	Pond Name	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
	Pond B-2	2	6	0	6
	Pond B-3	2	6	0	6
	Pond B-4	2	6	0	6
	Pond B-5	1	12	0	12
Upper Woman Drainage		29	83	1	**84**
West Area		1	1	0	**1**
Wind Blown Area		2	2	0	**2**

Table A3.30a
Surface Water Pesticide Analyte List

Analyte	Number of Samples by Analyte[a]
4,4'-DDD	338
4,4'-DDE	338
4,4'-DDT	338
Aldrin	338
alpha-BHC	338
alpha-Chlordane	324
Atraton	118
Atrazine	187
beta-BHC	338
beta-Chlordane	194
Bladex	43
Chlordane (NOS)	14
Chlorpyriphos	1
delta-BHC	338
Demeton	1
Diallate (cis or trans)	3
Diazinon	1
Dieldrin	338
Endosulfan I	338
Endosulfan II	338
Endosulfan sulfate	338
Endrin	338
Endrin aldehyde	88
Endrin ketone	319
gamma-BHC (Lindane)	338
gamma-Chlordane	130
Heptachlor	338
Heptachlor epoxide	338
Hexachlorocyclopentadiene	585
Hexazinone	1
Isodrin	4
Merphos	1
Methoxychlor	325
Prometon	161
Prometryn	161
Propazine	161
Simazine	187
Simetryn	161
Terbutryn	109
Terbutylazine	161
Toxaphene	338
Trichloronate	1

[a] July 1991 through 2005

Table A3.30b
Surface Water Pesticide Sampling Summary

Aquatic Exposure Unit	Pond Name	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
McKay Ditch AEU		2	3	0	**3**
No Name Gulch AEU		8	71	2	**73**
	East Landfill Pond	4	49	1	50
North Walnut Creek AEU		84	236	6	**242**
	Bowmans Pond	5	7	0	7
	Pond A-1	5	11	1	12
	Pond A-2	5	15	1	16
	Pond A-3	7	11	1	12
	Pond A-4	9	68	1	69
Rock Creek AEU		3	3	0	**3**
Southeast AEU		1	1	0	**1**
	Pond D-1	1	1	0	1
	Pond D-2	0	0	0	0
South Walnut Creek AEU		81	159	12	**171**
	Flume Pond	5	5	0	5
	Pond B-1	8	14	1	15
	Pond B-2	8	15	1	16
	Pond B-3	8	11	1	12
	Pond B-4	8	11	1	12
	Pond B-5	3	31	2	33
Woman Creek AEU		55	161	11	**172**
	Pond C-1	2	6	1	7
	Pond C-2	3	29	1	30
Exposure Unit	**Pond Name**	**Total Number of Sampling Locations**	**Number of Samples 1991-2000**	**Number of Samples 2001 to Present**	**Total Number of Samples**
Industrial Area		62	135	2	**137**
	Bowmans Pond	5	7	0	7
Inter-Drainage		1	1	0	**1**
Lower Walnut Drainage		9	11	0	**11**
	Flume Pond	5	5	0	5
Lower Woman Drainage		18	58	6	**64**
	Pond C-1	2	6	1	7
	Pond C-2	3	29	1	30
No Name Gulch Drainage		8	71	2	**73**
	East Landfill Pond	4	49	1	50
Rock Creek Drainage		2	2	0	**2**
Southeast Buffer Zone Area		1	1	0	**1**
	Pond D-1	1	1	0	1
	Pond D-2	0	0	0	0
Upper Walnut Drainage		97	259	16	**275**
	Pond A-1	5	11	1	12
	Pond A-2	5	15	1	16
	Pond A-3	7	11	1	12

Table A3.30b
Surface Water Pesticide Sampling Summary

Aquatic Exposure Unit	Pond Name	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
	Pond A-4	9	68	1	69
	Pond B-1	8	14	1	15
	Pond B-2	8	15	1	16
	Pond B-3	8	11	1	12
	Pond B-4	8	11	1	12
	Pond B-5	3	31	2	33
Upper Woman Drainage		33	93	5	**98**
West Area		1	1	0	**1**
Wind Blown Area		2	2	0	**2**

Table A3.31a
Surface Water Herbicide Analyte List

Analyte	Number of Samples by Analyte[a]
2,4,5-T	51
2,4,5-TP (Silvex)	129
2,4-D	129
2,4-DB	46
4-Nitrophenol	585
Ametryne	161
Azinphos-methyl	1
Dalapon	46
Dicamba	46
Dichloroprop	46
Dinoseb	47
Ethoprop	1
MCPA	46
MCPP	46
Prothiophos	1
Ronnel	1
Sulprofos	1

[a] July 1991 through 2005

Table A3.31b
Surface Water Herbicide Sampling Summary

Aquatic Exposure Unit	Pond Name	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
McKay Ditch AEU		1	1	0	**1**
No Name Gulch AEU		8	70	2	**72**
	East Landfill Pond	4	49	1	50
North Walnut Creek AEU		82	225	4	**229**
	Bowmans Pond	5	7	0	7
	Pond A-1	4	11	0	11
	Pond A-2	5	13	1	14
	Pond A-3	6	11	0	11
	Pond A-4	9	67	1	68
Rock Creek AEU		3	3	0	**3**
Southeast AEU		1	1	0	**1**
	Pond D-1	1	1	0	1
	Pond D-2	0	0	0	0
South Walnut Creek AEU		82	157	12	**169**
	Flume Pond	4	4	0	4
	Pond B-1	8	14	1	15
	Pond B-2	8	15	1	16
	Pond B-3	8	11	1	12
	Pond B-4	8	11	1	12
	Pond B-5	7	36	2	38
Woman Creek AEU		53	153	10	**163**
	Pond C-1	2	6	1	7
	Pond C-2	3	30	1	31
Exposure Unit	**Pond Name**	**Total Number of Sampling Locations**	**Number of Samples 1991-2000**	**Number of Samples 2001 to Present**	**Total Number of Samples**
Industrial Area		60	125	2	**127**
	Bowmans Pond	5	7	0	7
Lower Walnut Drainage		8	10	0	**10**
	Flume Pond	4	4	0	4
Lower Woman Drainage		18	58	6	**64**
	Pond C-1	2	6	1	7
	Pond C-2	3	30	1	31
No Name Gulch Drainage		8	70	2	**72**
	East Landfill Pond	4	49	1	50
Rock Creek Drainage		2	2	0	**2**
Southeast Buffer Zone Area		1	1	0	**1**
	Pond D-1	1	1	0	1
	Pond D-2	0	0	0	0
Upper Walnut Drainage		99	255	14	**269**
	Pond A-1	4	11	0	11
	Pond A-2	5	13	1	14
	Pond A-3	6	11	0	11
	Pond A-4	9	67	1	68
	Pond B-1	8	14	1	15

Table A3.31b
Surface Water Herbicide Sampling Summary

Aquatic Exposure Unit	Pond Name	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
	Pond B-2	8	15	1	16
	Pond B-3	8	11	1	12
	Pond B-4	8	11	1	12
	Pond B-5	7	36	2	38
Upper Woman Drainage		32	87	4	**91**
West Area		1	1	0	**1**
Wind Blown Area		1	1	0	**1**

Table A3.32a
Surface Water Dioxin Analyte List

Analyte	Number of Samples by Analyte[a]
2378-TCDD	75
Hexachlorodibenzo-p-dioxin	2
Hexachlorodibenzofuran	2
Pentachlorodibenzo-p-dioxin	2
Pentachlorodibenzofuran	2
TCDF	2
Tetrachlorodibenzo-p-dioxin	2

[a] July 1991 through 2005

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Table A3.32b
Surface Water Dioxin Sampling Summary

Aquatic Exposure Unit	Pond Name	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
McKay Ditch AEU		0	0	0	**0**
No Name Gulch AEU		1	1	0	**1**
	East Landfill Pond	0	0	0	0
North Walnut Creek AEU		6	25	0	**25**
	Bowmans Pond	0	0	0	0
	Pond A-1	1	4	0	4
	Pond A-2	1	6	0	6
	Pond A-3	2	6	0	6
	Pond A-4	1	8	0	8
Rock Creek AEU		0	0	0	**0**
Southeast AEU		1	1	0	**1**
	Pond D-1	1	1	0	1
	Pond D-2	0	0	0	0
South Walnut Creek AEU		10	34	0	**34**
	Flume Pond				
	Pond B-1	2	6	0	6
	Pond B-2	2	5	0	5
	Pond B-3	2	6	0	6
	Pond B-4	2	6	0	6
	Pond B-5	1	8	0	8
Woman Creek AEU		3	14	0	**14**
	Pond C-1	1	6	0	6
	Pond C-2	2	8	0	8
Exposure Unit	**Pond Name**	**Total Number of Sampling Locations**	**Number of Samples 1991-2000**	**Number of Samples 2001 to Present**	**Total Number of Samples**
Industrial Area		0	0	0	**0**
	Bowmans Pond	0	0	0	0
Inter-Drainage		0	0	0	**0**
Lower Walnut Drainage		1	3	0	**3**
	Flume Pond	0	0	0	0
Lower Woman Drainage		3	14	0	**14**
	Pond C-1	1	6	0	6
	Pond C-2	2	8	0	8
No Name Gulch Drainage		1	1	0	**1**
	East Landfill Pond	0	0	0	0
Rock Creek Drainage		0	0	0	**0**
Southeast Buffer Zone Area		1	1	0	**1**
	Pond D-1	1	1	0	1
	Pond D-2	0	0	0	0
Southwest Buffer Zone Area		0	0	0	**0**
Upper Walnut Drainage		15	56	0	**56**
	Pond A-1	1	4	0	4

Table A3.32b
Surface Water Dioxin Sampling Summary

Aquatic Exposure Unit	Pond Name	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
	Pond A-2	1	6	0	6
	Pond A-3	2	6	0	6
	Pond A-4	1	8	0	8
	Pond B-1	2	6	0	6
	Pond B-2	2	5	0	5
	Pond B-3	2	6	0	6
	Pond B-4	2	6	0	6
	Pond B-5	1	8	0	8
Upper Woman Drainage		0	0	0	**0**
West Area		0	0	0	**0**
Wind Blown Area		0	0	0	**0**

Table A3.33a
Subsurface Soil Radionuclide Analyte List

Analyte	Number of Samples by Analyte[a]
Americium-241	1,997
Cesium-134	201
Cesium-137	392
Curium-244	16
Gross Alpha	1,016
Gross Beta	1,055
Iodine-129	7
Neptunium-237	2
Nickel-59	7
Plutonium-238	177
Plutonium-239/240	2,049
Plutonium-241	4
Plutonium-242	16
Radium-226	227
Radium-228	362
Strontium-89/90	462
Tritium	11
Uranium-232	16
Uranium-233/234	2,076
Uranium-234	1
Uranium-235	2,077
Uranium-238	2,077

[a] July 1991 through 2005

Table A3.33b
Subsurface Soil Radionuclide Sampling Summary

Exposure Unit	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
Industrial Area	723	394	610	1,004
Inter-Drainage	18	66	4	70
Lower Walnut Drainage	6	9	2	11
Lower Woman Drainage	11	20	0	20
No Name Gulch Drainage	167	260	0	260
Rock Creek Drainage	4	8	0	8
Southeast Buffer Zone Area	4	8	0	8
Southwest Buffer Zone Area				
Upper Walnut Drainage	70	84	27	111
Upper Woman Drainage	111	248	3	251
West Area	2	7	0	7
Wind Blown Area	283	277	137	414

Table A3.34a
Subsurface Soil Metal Analyte List

Analyte	Number of Samples by Analyte[a]
Antimony	3,399
Arsenic	3,576
Barium	3,576
Beryllium	3,559
Boron	2,252
Cadmium	3,514
Calcium	3,575
Cesium	1,087
Chromium	3,576
Chromium VI	1
Cobalt	3,576
Copper	3,575
Iron	3,575
Lead	3,586
Lithium	3,530
Magnesium	3,575
Manganese	3,575
Mercury	3,487
Molybdenum	3,561
Nickel	3,576
Potassium	3,572
Selenium	3,554
Silicon	339
Silver	3,544
Sodium	3,573
Strontium	3,574
Tantalum	2
Thallium	3,556
Tin	3,544
Titanium	2,261
Uranium	2,307
Vanadium	3,576
Zinc	3,573

[a] July 1991 through 2005

Table A3.34b
Subsurface Soil Metal Sampling Summary

Exposure Unit	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
Industrial Area	1,695	417	2,065	2,482
Inter-Drainage	19	66	6	72
Lower Walnut Drainage	12	6	8	14
Lower Woman Drainage	40	17	30	47
No Name Gulch Drainage	185	269	20	289
Rock Creek Drainage	4	8	0	8
Southeast Buffer Zone Area	3	6	0	6
Southwest Buffer Zone Area	1	0	2	2
Upper Walnut Drainage	52	81	14	95
Upper Woman Drainage	119	244	13	257
West Area	2	7	0	7
Wind Blown Area	160	147	162	309

Table A3.35a
Subsurface Soil VOC Analyte List

Analyte	Number of Samples by Analyte[a]
1,1,1-Trichloroethane	4,130
1,1,2,2-Tetrachloroethane	4,116
1,1,2-Trichloro-1,2,2-trifluoroethane	3,003
1,1,2-Trichloroethane	4,135
1,1-Dichloroethane	4,131
1,1-Dichloroethene	4,130
1,1-Dichloropropene	2,998
1,2,3-Trichlorobenzene	2,986
1,2,3-Trichloropropane	2,995
1,2,3-Trimethylbenzene	1
1,2,4-Trimethylbenzene	2,988
1,2-Dibromo-3-chloropropane	2,995
1,2-Dibromoethane	2,999
1,2-Dichlorobenzene	3,541
1,2-Dichloroethane	4,114
1,2-Dichloroethene	1,046
1,2-Dichloropropane	4,130
1,3,5-Trimethylbenzene	2,988
1,3-Dichlorobenzene	3,561
1,3-Dichloropropane	2,998
1,4-Dichlorobenzene	3,536
1,4-Dioxane	6
2,2-Dichloropropane	2,998
2,3-Dimethyl-1-butene	1
2,3-Dimethylhexane	1
2,3-Epoxy-2,3-dimethylbutane	2
2,6-Dimethylundecane	1
2,7,10-Trimethyldodecane	2
2-Butanone	3,926
2-Chloroethyl vinyl ether	63
2-Chlorotoluene	2,987
2-Hexanone	4,042
2-Methyl-1-propanol	5
2-Nitrotoluene	1
2-Picoline	1
4-Chlorotoluene	2,987
4-Isopropyltoluene	2,985
4-Methyl-2-pentanone	4,065
Acetone	4,035
Acetonitrile	5
Benzene	4,137
Bromobenzene	2,986
Bromochloromethane	2,998
Bromodichloromethane	4,129
Bromoform	4,116
Bromomethane	4,060
Carbon Disulfide	4,122

Table A3.35a
Subsurface Soil VOC Analyte List

Analyte	Number of Samples by Analyte[a]
Carbon Tetrachloride	4,127
Chlorobenzene	4,127
Chloroethane	4,072
Chloroform	4,133
Chloromethane	4,118
cis-1,2-Dichloroethene	2,990
cis-1,3-Dichloropropene	4,131
Decane	1
Dibromochloromethane	4,131
Dibromomethane	2,998
Dichlorodifluoromethane	2,935
Ether	3
ethyl acetate	6
Ethylbenzene	4,137
Fluoroacetamide	1
Gasoline	1
Gasoline Range Organics	22
Hexachloroethane	1,350
Hexamethylcyclotrisiloxane	1
Isopropylbenzene	2,990
m,p-Xylene	13
Methylene Chloride	4,133
n-Butanol	5
n-Butylbenzene	2,987
n-Propylbenzene	2,986
o-Xylene	31
Octamethylcyclotetrasiloxane	6
Propylcyclopentane	1
Pyridine	527
sec-Butylbenzene	2,987
Styrene	4,123
tert-Butylbenzene	2,987
Tetrachloroethene	4,137
Tetryl	1
Toluene	4,140
trans-1,2-Dichloroethene	3,087
trans-1,3-Dichloropropene	4,121
trans-2-pentenal	2
Trichloroethene	4,133
Trichlorofluoromethane	2,994
Vinyl acetate	989
Vinyl Chloride	4,131
Xylene	4,124

[a] July 1991 through 2005

Table A3.35b
Subsurface Soil VOC Sampling Summary

Exposure Unit	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
Industrial Area	2,088	584	2,612	3,196
Inter-Drainage	17	59	6	65
Lower Walnut Drainage	12	8	8	16
Lower Woman Drainage	12	26	0	26
No Name Gulch Drainage	66	176	4	180
Rock Creek Drainage	4	12	0	12
Southeast Buffer Zone Area	3	7	0	7
Southwest Buffer Zone Area	1	0	1	1
Upper Walnut Drainage	66	122	16	138
Upper Woman Drainage	79	289	8	297
West Area	1	5	0	5
Wind Blown Area	255	325	252	577

Table A3.36a
Subsurface Soil SVOC Analyte List

Analyte	Number of Samples by Analyte[a]
1,2,4-Trichlorobenzene	3,542
1,2-Diphenylhydrazine	57
1,3,5-Trinitrobenzene	2
1,3-Dinitrobenzene	2
1,4-Naphthoquinone	1
1,4-Phenylenediamine	1
1-Iodooctane	1
1-Naphthylamine	1
2,3,4,6-Tetrachlorophenol	1
2,4,5-Trichlorophenol	1,346
2,4,6-Trichlorophenol	1,346
2,4,6-Trinitrotoluene	10
2,4-Dichlorophenol	1,346
2,4-Dimethylphenol	1,346
2,4-Dinitrophenol	1,324
2,4-Dinitrotoluene	1,352
2,6-Dichlorophenol	1
2,6-Dinitrotoluene	1,351
2-Acetylaminofluorene	1
2-Amino-4,6-dinitrotoluene	1
2-Bromooctane	1
2-Chloronaphthalene	1,350
2-Chlorophenol	1,346
2-Methylnaphthalene	1,350
2-Methylphenol	1,349
2-Naphthylamine	1
2-Nitroaniline	1,350
2-Nitrophenol	1,345
3 & 4-methyl phenol	23
3,3'-Dichlorobenzidine	1,337
3,3'-Dimethylbenzidine	1
3-Methylcholanthrene	1
3-Methylphenol	1
3-Nitroaniline	1,302
3-Nitrotoluene	1
4,6-Dinitro-2-methylphenol	1,344
4-Amino-2,6-dinitrotoluene	1
4-Aminobiphenyl	1
4-Bromophenyl-phenylether	1,350
4-Chloro-3-methylphenol	1,346
4-Chloroaniline	1,326
4-Chlorophenyl-phenyl ether	1,350
4-Hydroxy-4-methyl-2-pentanone	7
4-Methylphenol	1,329
4-Nitroaniline	1,316
4-Nitrotoluene	1
5-Nitro-o-toluidine	1

Table A3.36a
Subsurface Soil SVOC Analyte List

Analyte	Number of Samples by Analyte[a]
7,12-Dimethylbenz(a)-anthracene	1
a,a-Dimethylphenethylamine	1
Acenaphthene	1,353
Acenaphthylene	1,350
Acetophenone	2
Aniline	1
Anthracene	1,353
Benzidine	1
Benzo(a)anthracene	1,349
Benzo(a)pyrene	1,348
Benzo(b)fluoranthene	1,347
Benzo(g,h,i)perylene	1,349
Benzo(k)fluoranthene	1,347
Benzoic Acid	1,283
Benzyl Alcohol	1,292
bis(2-Chloroethoxy) methane	1,349
bis(2-Chloroethyl) ether	1,349
bis(2-Chloroisopropyl) ether	1,342
bis(2-ethylhexyl)phthalate	1,350
bis(2-hydroxyethyl)lauramide	8
Butylbenzylphthalate	1,350
Carbazole	37
Chlorobenzilate	1
Chrysene	1,351
Coumaphos	1
Di-n-butylphthalate	1,349
Di-n-octylphthalate	1,349
Dibenz(a,h)anthracene	1,349
Dibenzofuran	1,346
Dichlorovos	1
Diesel fuel	1
Diesel Range Organics	25
Diethylphthalate	1,349
Dimethoate	1
Dimethylaminoazobenzene	1
Dimethylphthalate	1,349
Diphenylamine	18
Disulfoton	1
Dodecane	5
EPN	1
Ethyl methanesulfonate	1
Famphur	1
Fensulfothion	1
Fenthion	1
Fluoranthene	1,351
Fluorene	1,352
Hexachlorobenzene	1,350

Table A3.36a
Subsurface Soil SVOC Analyte List

Analyte	Number of Samples by Analyte[a]
Hexachlorobutadiene	3,550
Hexachloropropene	1
Hexadecane	2
Indeno(1,2,3-cd)pyrene	1,350
Isophorone	1,349
Isosafrole	1
Kepone	1
Malathion	1
Methapyrilene	1
Methyl methanesulfonate	1
Methyl parathion	1
Mevinphos	1
Monocrotophos	1
n-Hexyl Ether	1
N-Nitroso-di-n-propylamine	1,349
N-Nitrosodi-n-butylamine	58
N-Nitrosodiethylamine	58
N-Nitrosodimethylamine	58
N-nitrosodiphenylamine	1,332
N-Nitrosomethylethylamine	1
N-Nitrosomorpholine	1
N-Nitrosopiperidine	1
N-Nitrosopyrrolidine	1
n-Pentadecane	6
n-Tetradecane	4
n-Tetradecanoic Acid	1
n-Tridecane	1
Naled	1
Naphthalene	3,544
Nitrobenzene	1,356
O,O,O-Triethyl phosphorothioate	1
o-Toluidine	1
Octanol	1
Octylcyclohexane	1
Parathion	1
Pentachlorobenzene	58
Pentachloronitrobenzene	1
Pentachlorophenol	1,346
Phenacetin	1
Phenanthrene	1,351
Phenol	1,348
Phorate	1
Pronamide	1
Pyrene	1,350
Safrole	1
Tetrachlorvinphos	1
Tetraethyl dithiopyrophosphate	1

Table A3.36a
Subsurface Soil SVOC Analyte List

Analyte	Number of Samples by Analyte[a]
Thionazine	1
Tributyl phosphate	21
Undecane	3

[a] July 1991 through 2005

Table A3.36b
Subsurface Soil SVOC Sampling Summary

Exposure Unit	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
Industrial Area	1,972	254	2,610	2,864
Inter-Drainage	14	55	6	61
Lower Walnut Drainage	8	0	8	8
Lower Woman Drainage	6	8	0	8
No Name Gulch Drainage	32	58	4	62
Rock Creek Drainage	0	0	0	0
Southeast Buffer Zone Area	1	3	0	3
Southwest Buffer Zone Area	1	0	1	1
Upper Walnut Drainage	16	4	16	20
Upper Woman Drainage	62	103	8	111
West Area	1	5	0	5
Wind Blown Area	225	165	252	417

Table A3.37a
Subsurface Soil PCB Analyte List

Analyte	Number of Samples by Analyte[a]
Aroclor-1221	1,013
Aroclor-1232	1,010
Aroclor-1242	1,013
Aroclor-1248	1,013
Aroclor-1254	1,012
Aroclor-1260	1,014

[a] July 1991 through 2005

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Table A3.37b
Subsurface Soil PCB Sampling Summary

Exposure Unit	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
Industrial Area	466	143	518	661
Inter-Drainage	0	0	0	0
Lower Walnut Drainage	0	0	0	0
Lower Woman Drainage	4	4	0	4
No Name Gulch Drainage	26	51	0	51
Rock Creek Drainage	0	0	0	0
Southeast Buffer Zone Area	0	0	0	0
Southwest Buffer Zone Area	0	0	0	0
Upper Walnut Drainage	7	0	10	10
Upper Woman Drainage	53	99	0	99
West Area	0	0	0	0
Wind Blown Area	73	76	113	189

Table A3.38a
Subsurface Soil Pesticide Analyte List

Analyte	Number of Samples by Analyte[a]
4,4'-DDE	344
4,4'-DDT	347
Aldrin	347
alpha-BHC	347
alpha-Chlordane	279
beta-BHC	347
beta-Chlordane	252
Chlordane	68
Chlorpyriphos	1
delta-BHC	347
Demeton-S	1
Diallate (cis or trans)	1
Diazinon	1
Dieldrin	343
Endosulfan I	346
Endosulfan II	343
Endosulfan sulfate	343
Endrin	343
Endrin aldehyde	99
Endrin ketone	278
gamma-BHC (Lindane)	347
gamma-Chlordane	27
Heptachlor	347
Heptachlor epoxide	347
Hexachlorocyclopentadiene	1,335
Isodrin	1
Merphos	1
Methoxychlor	347
Toxaphene	347
Trichloronate	1

[a] July 1991 through 2005

Table A3.38b
Subsurface Soil Pesticide Sampling Summary

Exposure Unit	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
Industrial Area	712	177	705	882
Inter-Drainage	9	45	0	45
Lower Walnut Drainage	0	0	0	0
Lower Woman Drainage	5	6	0	6
No Name Gulch Drainage	12	38	0	38
Rock Creek Drainage	0	0	0	0
Southeast Buffer Zone Area	1	3	0	3
Southwest Buffer Zone Area	0	0	0	0
Upper Walnut Drainage	7	0	10	10
Upper Woman Drainage	58	103	4	107
West Area	1	5	0	5
Wind Blown Area	117	125	131	256

Table A3.39a
Subsurface Soil Herbicide Analyte List

Analyte	Number of Samples by Analyte[a]
2,4,5-TP (Silvex)	9
2,4-D	9
2,4-DB	5
4-Nitrophenol	1,342
Azinphos-methyl	1
Dalapon	5
Dicamba	5
Dichloroprop	5
Dinoseb	6
Ethoprop	1
MCPA	5
MCPP	5
Prothiophos	1
Ronnel	1
Sulprofos	1

[a] July 1991 through 2005

Table A3.39b
Subsurface Soil Herbicide Sampling Summary

Exposure Unit	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
Industrial Area	705	176	696	872
Inter-Drainage	11	55	0	55
Lower Walnut Drainage	0	0	0	0
Lower Woman Drainage	5	6	0	6
No Name Gulch Drainage	12	39	0	39
Rock Creek Drainage	0	0	0	0
Southeast Buffer Zone Area	1	3	0	3
Southwest Buffer Zone Area	0	0	0	0
Upper Walnut Drainage	6	0	9	9
Upper Woman Drainage	56	100	4	104
West Area	1	5	0	5
Wind Blown Area	116	123	131	254

Table A3.40a
Subsurface Soil Dioxin Analyte List

Analyte	Number of Samples by Analyte[a]
123478-HxCDD	25
123478-HxCDF	25
1234789-HpCDF	25
123678-HxCDD	25
123678-HxCDF	25
12378-PeCDF	25
123789-HxCDD	25
123789-HxCDF	25
234678-HxCDF	25
23478-PeCDF	25
2378-TCDD	26
2378-TCDF	25
Heptachlorodibenzo-p-dioxin	25
Hexachlorodibenzo-p-dioxin	1
Hexachlorodibenzofuran	1
OCDD	25
OCDF	25
Pentachlorodibenzo-p-dioxin	26
Pentachlorodibenzofuran	1
TCDF	1
Tetrachlorodibenzo-p-dioxin	1

[a] July 1991 through 2005

Table A3.40b
Subsurface Soil Dioxin Sampling Summary

Exposure Unit	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
Industrial Area	9	0	17	17
Inter-Drainage	0	0	0	0
Lower Walnut Drainage	0	0	0	0
Lower Woman Drainage	1	0	2	2
No Name Gulch Drainage	1	1	0	1
Rock Creek Drainage	0	0	0	0
Southeast Buffer Zone Area	0	0	0	0
Southwest Buffer Zone Area	0	0	0	0
Upper Walnut Drainage	2	0	5	5
Upper Woman Drainage	1	0	1	1
West Area	0	0	0	0
Wind Blown Area	0	0	0	0

Table A3.41a

Subsurface Soil/Subsurface Sediment Radionuclide Analyte List

Analyte	Number of Samples by Analyte[a]
Cesium-134	216
Cesium-137	440
Curium-244	16
Gross Alpha	1,072
Gross Beta	1,112
Iodine-129	7
Neptunium-237	2
Nickel-59	7
Plutonium-238	177
Plutonium-239/240	2,149
Plutonium-241	4
Plutonium-242	16
Radium-226	235
Radium-228	372
Strontium-89/90	489
Tritium	11
Uranium-232	16
Uranium-233/234	2,178
Uranium-234	1
Uranium-235	2,179
Uranium-238	2,179

[a] July 1991 through 2005

Table A3.41b
Subsurface Soil/Subsurface Sediment Radionuclide Sampling Summary

Exposure Unit	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
Industrial Area	731	401	612	1,013
Inter-Drainage	18	66	4	70
Lower Walnut Drainage	12	14	3	17
Lower Woman Drainage	19	26	5	31
No Name Gulch Drainage	171	262	2	264
Rock Creek Drainage	7	9	2	11
Southeast Buffer Zone Area	5	8	1	9
Southwest Buffer Zone Area	1	0	1	1
Upper Walnut Drainage	121	121	53	174
Upper Woman Drainage	112	249	3	252
West Area	2	7	0	7
Wind Blown Area	286	280	137	417

Table A3.42a
Subsurface Soil/Subsurface Sediment Metal Analyte List

Analyte	Number of Samples by Analyte[a]
Antimony	3,478
Arsenic	3,673
Barium	3,673
Beryllium	3,655
Boron	2,291
Cadmium	3,609
Calcium	3,672
Cesium	1,136
Chromium	3,673
Chromium VI	1
Cobalt	3,673
Copper	3,672
Iron	3,672
Lead	3,683
Lithium	3,625
Magnesium	3,672
Manganese	3,672
Mercury	3,578
Molybdenum	3,655
Nickel	3,672
Potassium	3,668
Selenium	3,648
Silicon	342
Silver	3,639
Sodium	3,670
Strontium	3,670
Tantalum	2
Thallium	3,651
Tin	3,639
Titanium	2,300
Uranium	2,351
Vanadium	3,673
Zinc	3,670

[a] July 1991 through 2005

Table A3.42b
Subsurface Soil/Subsurface Sediment Metal Sampling Summary

Exposure Unit	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
Industrial Area	1,703	424	2,067	2,491
Inter-Drainage	19	66	6	72
Lower Walnut Drainage	18	11	9	20
Lower Woman Drainage	48	20	35	55
No Name Gulch Drainage	189	271	22	293
Rock Creek Drainage	7	9	2	11
Southeast Buffer Zone Area	4	6	1	7
Southwest Buffer Zone Area	2	0	3	3
Upper Walnut Drainage	103	119	39	158
Upper Woman Drainage	120	245	13	258
West Area	2	7	0	7
Wind Blown Area	161	148	162	310

Table A3.43a
Subsurface Soil/Subsurface Sediment VOC Analyte List

Analyte	Number of Samples by Analyte[a]
1,1,1-Trichloroethane	4,193
1,1,2,2-Tetrachloroethane	4,179
1,1,2-Trichloro-1,2,2-trifluoroethane	3,016
1,1,2-Trichloroethane	4,198
1,1-Dichloroethane	4,194
1,1-Dichloroethene	4,193
1,1-Dichloropropene	3,011
1,2,3-Trichlorobenzene	2,999
1,2,3-Trichloropropane	3,008
1,2,3-Trimethylbenzene	1
1,2,4-Trimethylbenzene	3,001
1,2-Dibromo-3-chloropropane	3,008
1,2-Dibromoethane	3,012
1,2-Dichlorobenzene	3,607
1,2-Dichloroethane	4,173
1,2-Dichloroethene	1,096
1,2-Dichloropropane	4,193
1,3,5-Trimethylbenzene	3,001
1,3-Dichlorobenzene	3,642
1,3-Dichloropropane	3,011
1,4-Dichlorobenzene	3,602
1,4-Dioxane	7
2,2-Dichloropropane	3,011
2,3-Dimethyl-1-butene	1
2,3-Dimethylhexane	1
2,3-Epoxy-2,3-dimethylbutane	2
2,6-Dimethylundecane	1
2,7,10-Trimethyldodecane	2
2-Butanone	3,988
2-Chloroethyl vinyl ether	63
2-Chlorotoluene	3,000
2-Hexanone	4,105
2-Methyl-1-propanol	6
2-Nitrotoluene	1
2-Picoline	1
4-Chlorotoluene	3,000
4-Isopropyltoluene	2,998
4-Methyl-2-pentanone	4,128
Acetone	4,099
Acetonitrile	6
Benzene	4,200
Bromobenzene	2,999
Bromochloromethane	3,011
Bromodichloromethane	4,192
Bromoform	4,179
Bromomethane	4,123
Carbon Disulfide	4,185
Carbon Tetrachloride	4,190

Table A3.43a
Subsurface Soil/Subsurface Sediment VOC Analyte List

Analyte	Number of Samples by Analyte[a]
Chlorobenzene	4,190
Chloroethane	4,135
Chloroform	4,196
Chloromethane	4,181
cis-1,2-Dichloroethene	3,003
cis-1,3-Dichloropropene	4,194
Decane	1
Dibromochloromethane	4,194
Dibromomethane	3,011
Dichlorodifluoromethane	2,948
Ether	4
ethyl acetate	7
Ethylbenzene	4,200
Fluoroacetamide	1
Gasoline	1
Gasoline Range Organics	22
Hexachloroethane	1,429
Hexamethylcyclotrisiloxane	1
Isopropylbenzene	3,003
m,p-Xylene	13
Methylene Chloride	4,197
n-Butanol	6
n-Butylbenzene	3,000
n-Propylbenzene	2,999
o-Xylene	31
Octamethylcyclotetrasiloxane	6
Propylcyclopentane	1
Pyridine	552
sec-Butylbenzene	3,000
Styrene	4,186
tert-Butylbenzene	3,000
Tetrachloroethene	4,200
Tetryl	1
Toluene	4,204
trans-1,2-Dichloroethene	3,100
trans-1,3-Dichloropropene	4,184
trans-2-pentenal	2
Trichloroethene	4,196
Trichlorofluoromethane	3,007
Vinyl acetate	1,032
Vinyl Chloride	4,194
Xylene	4,187

[a] July 1991 through 2005

Table A3.43b
Subsurface Soil/Subsurface Sediment VOC Sampling Summary

Exposure Unit	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
Industrial Area	2,101	597	2,619	3,216
Inter-Drainage	17	59	6	65
Lower Walnut Drainage	17	13	8	21
Lower Woman Drainage	18	29	3	32
No Name Gulch Drainage	66	176	4	180
Rock Creek Drainage	7	13	2	15
Southeast Buffer Zone Area	3	7	0	7
Southwest Buffer Zone Area	1	0	1	1
Upper Walnut Drainage	108	161	31	192
Upper Woman Drainage	80	290	8	298
West Area	1	5	0	5
Wind Blown Area	256	326	252	578

Table A3.44a
Subsurface Soil/Subsurface Sediment SVOC Analyte List

Analyte	Number of Samples by Analyte[a]
1,2,4-Trichlorobenzene	3,623
1,2-Diphenylhydrazine	57
1,3,5-Trinitrobenzene	2
1,3-Dinitrobenzene	2
1,4-Naphthoquinone	1
1,4-Phenylenediamine	1
1-Iodooctane	1
1-Naphthylamine	1
2,3,4,6-Tetrachlorophenol	1
2,4,5-Trichlorophenol	1,425
2,4,6-Trichlorophenol	1,425
2,4,6-Trinitrotoluene	10
2,4-Dichlorophenol	1,424
2,4-Dimethylphenol	1,424
2,4-Dinitrophenol	1,398
2,4-Dinitrotoluene	1,431
2,6-Dichlorophenol	1
2,6-Dinitrotoluene	1,429
2-Acetylaminofluorene	1
2-Amino-4,6-dinitrotoluene	1
2-Bromooctane	1
2-Chloronaphthalene	1,428
2-Chlorophenol	1,424
2-Methylnaphthalene	1,428
2-Methylphenol	1,428
2-Naphthylamine	1
2-Nitroaniline	1,428
2-Nitrophenol	1,423
3 & 4-methyl phenol	23
3,3'-Dichlorobenzidine	1,415
3,3'-Dimethylbenzidine	1
3-Methylcholanthrene	1
3-Methylphenol	1
3-Nitroaniline	1,370
3-Nitrotoluene	1
4,6-Dinitro-2-methylphenol	1,420
4-Amino-2,6-dinitrotoluene	1
4-Aminobiphenyl	1
4-Bromophenyl-phenylether	1,428
4-Chloro-3-methylphenol	1,424
4-Chloroaniline	1,398
4-Chlorophenyl-phenyl ether	1,428
4-Hydroxy-4-methyl-2-pentanone	7
4-Methylphenol	1,408
4-Nitroaniline	1,394
4-Nitrotoluene	1
5-Nitro-o-toluidine	1

Table A3.44a
Subsurface Soil/Subsurface Sediment SVOC Analyte List

Analyte	Number of Samples by Analyte[a]
7,12-Dimethylbenz(a)-anthracene	1
a,a-Dimethylphenethylamine	1
Acenaphthene	1,431
Acenaphthylene	1,428
Acetophenone	2
Aniline	1
Anthracene	1,431
Benzidine	1
Benzo(a)anthracene	1,427
Benzo(a)pyrene	1,426
Benzo(b)fluoranthene	1,425
Benzo(g,h,i)perylene	1,427
Benzo(k)fluoranthene	1,425
Benzoic Acid	1,357
Benzyl Alcohol	1,365
bis(2-Chloroethoxy) methane	1,427
bis(2-Chloroethyl) ether	1,427
bis(2-Chloroisopropyl) ether	1,420
bis(2-ethylhexyl)phthalate	1,428
bis(2-hydroxyethyl)lauramide	8
Butylbenzylphthalate	1,428
Carbazole	42
Chlorobenzilate	1
Chrysene	1,429
Coumaphos	1
Di-n-butylphthalate	1,426
Di-n-octylphthalate	1,427
Dibenz(a,h)anthracene	1,426
Dibenzofuran	1,424
Dichlorovos	1
Diesel fuel	1
Diesel Range Organics	25
Diethylphthalate	1,427
Dimethoate	1
Dimethylaminoazobenzene	1
Dimethylphthalate	1,427
Diphenylamine	18
Disulfoton	1
Dodecane	5
EPN	1
Ethyl methanesulfonate	1
Famphur	1
Fensulfothion	1
Fenthion	1
Fluoranthene	1,429
Fluorene	1,430
Hexachlorobenzene	1,429

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Table A3.44a
Subsurface Soil/Subsurface Sediment SVOC Analyte List

Analyte	Number of Samples by Analyte[a]
Hexachlorobutadiene	3,631
Hexachloropropene	1
Hexadecane	2
Indeno(1,2,3-cd)pyrene	1,428
Isophorone	1,427
Isosafrole	1
Kepone	1
Malathion	1
Methapyrilene	1
Methyl methanesulfonate	1
Methyl parathion	1
Mevinphos	1
Monocrotophos	1
n-Hexyl Ether	1
N-Nitroso-di-n-propylamine	1,427
N-Nitrosodi-n-butylamine	58
N-Nitrosodiethylamine	58
N-Nitrosodimethylamine	58
N-nitrosodiphenylamine	1,410
N-Nitrosomethylethylamine	1
N-Nitrosomorpholine	1
N-Nitrosopiperidine	1
N-Nitrosopyrrolidine	1
n-Pentadecane	6
n-Tetradecane	4
n-Tetradecanoic Acid	1
n-Tridecane	1
Naled	1
Naphthalene	3,625
Nitrobenzene	1,435
O,O,O-Triethyl phosphorothioate	1
o-Toluidine	1
Octanol	1
Octylcyclohexane	1
Parathion	1
Pentachlorobenzene	58
Pentachloronitrobenzene	1
Pentachlorophenol	1,425
Phenacetin	1
Phenanthrene	1,429
Phenol	1,426
Phorate	1
Pronamide	1
Pyrene	1,428
Safrole	1
Tetrachlorvinphos	1
Tetraethyl dithiopyrophosphate	1

Table A3.44a
Subsurface Soil/Subsurface Sediment SVOC Analyte List

Analyte	Number of Samples by Analyte[a]
Thionazine	1
Tributyl phosphate	21
Undecane	3

[a] July 1991 through 2005

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Table A3.44b
Subsurface Soil/Subsurface Sediment SVOC Sampling Summary

Exposure Unit	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
Industrial Area	1,985	261	2,617	2,878
Inter-Drainage	14	55	6	61
Lower Walnut Drainage	13	5	8	13
Lower Woman Drainage	12	11	3	14
No Name Gulch Drainage	32	58	4	62
Rock Creek Drainage	2	0	2	2
Southeast Buffer Zone Area	1	3	0	3
Southwest Buffer Zone Area	1	0	1	1
Upper Walnut Drainage	58	43	31	74
Upper Woman Drainage	63	104	8	112
West Area	1	5	0	5
Wind Blown Area	225	165	252	417

Table A3.45a
Subsurface Soil/Subsurface Sediment PCB Analyte List

Analyte	Number of Samples by Analyte[a]
Aroclor-1016	1092
Aroclor-1221	1092
Aroclor-1232	1089
Aroclor-1242	1092
Aroclor-1248	1092
Aroclor-1254	1091
Aroclor-1260	1093

[a] July 1991 through 2005

Table A3.45b
Subsurface Soil/Subsurface Sediment PCB Sampling Summary

Exposure Unit	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
Industrial Area	478	150	524	674
Inter-Drainage	0	0	0	0
Lower Walnut Drainage	5	5	0	5
Lower Woman Drainage	9	7	2	9
No Name Gulch Drainage	26	51	0	51
Rock Creek Drainage	0	0	0	0
Southeast Buffer Zone Area	0	0	0	0
Southwest Buffer Zone Area	0	0	0	0
Upper Walnut Drainage	51	40	25	65
Upper Woman Drainage	54	100	0	100
West Area	0	0	0	0
Wind Blown Area	73	76	113	189

Table A3.46a
Subsurface Soil/Subsurface Sediment Pesticide Analyte List

Analyte	Number of Samples by Analyte[a]
4,4'-DDE	401
4,4'-DDT	404
Aldrin	404
alpha-BHC	404
alpha-Chlordane	335
Atraton	3
Atrazine	4
beta-BHC	404
beta-Chlordane	299
Chlordane	69
Chlorpyriphos	1
delta-BHC	404
Demeton-S	1
Diallate (cis or trans)	1
Diazinon	1
Dieldrin	400
Endosulfan I	403
Endosulfan II	400
Endosulfan sulfate	400
Endrin	400
Endrin aldehyde	105
Endrin ketone	330
gamma-BHC (Lindane)	403
gamma-Chlordane	36
Heptachlor	404
Heptachlor epoxide	404
Hexachlorocyclopentadiene	1,413
Isodrin	1
Merphos	1
Methoxychlor	404
Prometon	3
Prometryn	3
Propazine	3
Simazine	3
Simetryn	3
Terbutryn	3
Terbutylazine	3
Toxaphene	404
Trichloronate	1

[a] July 1991 through 2005

Table A3.46b
Subsurface Soil/Subsurface Sediment Pesticide Sampling Summary

Exposure Unit	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
Industrial Area	724	184	711	895
Inter-Drainage	9	45	0	45
Lower Walnut Drainage	5	5	0	5
Lower Woman Drainage	11	9	3	12
No Name Gulch Drainage	12	38	0	38
Rock Creek Drainage	2	0	2	2
Southeast Buffer Zone Area	1	3	0	3
Southwest Buffer Zone Area	0	0	0	0
Upper Walnut Drainage	51	40	25	65
Upper Woman Drainage	59	104	4	108
West Area	1	5	0	5
Wind Blown Area	117	125	131	256

Table A3.47a
Subsurface Soil/Subsurface Sediment Herbicide Analyte List

Analyte	Number of Samples by Analyte[a]
2,4,5-TP (Silvex)	9
2,4-D	9
2,4-DB	5
4-Nitrophenol	1,420
Ametryne	3
Azinphos-methyl	1
Dalapon	5
Dicamba	5
Dichloroprop	5
Dinoseb	6
Ethoprop	1
MCPA	5
MCPP	5
Prothiophos	1
Ronnel	1
Sulprofos	1

[a] July 1991 through 2005

Table A3.47b
Subsurface Soil/Subsurface Sediment Herbicide Sampling Summary

Exposure Unit	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
Industrial Area	717	183	702	885
Inter-Drainage	11	55	0	55
Lower Walnut Drainage	5	5	0	5
Lower Woman Drainage	11	9	3	12
No Name Gulch Drainage	12	39	0	39
Rock Creek Drainage	2	0	2	2
Southeast Buffer Zone Area	1	3	0	3
Southwest Buffer Zone Area	0	0	0	0
Upper Walnut Drainage	49	40	23	63
Upper Woman Drainage	57	101	4	105
West Area	1	5	0	5
Wind Blown Area	116	123	131	254

Table A3.48a
Subsurface Soil/Subsurface Sediment Dioxin Analyte List

Analyte	Number of Samples by Analyte[a]
123478-HxCDD	29
123478-HxCDF	29
1234789-HpCDF	29
123678-HxCDD	29
123678-HxCDF	29
12378-PeCDF	29
123789-HxCDD	29
123789-HxCDF	29
234678-HxCDF	29
23478-PeCDF	29
2378-TCDD	30
2378-TCDF	29
Heptachlorodibenzo-p-dioxin	29
Hexachlorodibenzo-p-dioxin	1
Hexachlorodibenzofuran	1
OCDD	29
OCDF	29
Pentachlorodibenzo-p-dioxin	30
Pentachlorodibenzofuran	1
TCDF	1
Tetrachlorodibenzo-p-dioxin	1

[a] July 1991 through 2005

Table A3.48b
Subsurface Soil/Subsurface Sediment Dioxin Sampling Summary

Exposure Unit	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
Industrial Area	9	0	17	17
Inter-Drainage	0	0	0	0
Lower Walnut Drainage	0	0	0	0
Lower Woman Drainage	1	0	3	3
No Name Gulch Drainage	1	1	0	1
Rock Creek Drainage	0	0	0	0
Southeast Buffer Zone Area	0	0	0	0
Southwest Buffer Zone Area	0	0	0	0
Upper Walnut Drainage	2	0	8	8
Upper Woman Drainage	1	0	1	1
West Area	0	0	0	0
Wind Blown Area	0	0	0	0

Table A3.49
EU Surface Soil Data Summary

Exposure Unit	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
West Area EU				
Radionuclide	10	0	10	10
Metal	10	0	10	10
VOC	0	0	0	0
SVOC	0	0	0	0
PCB	0	0	0	0
Pesticide	0	0	0	0
Herbicide	0	0	0	0
Dioxins and Furans	0	0	0	0
Inter-Drainage EU				
Radionuclide	69	68	13	81
Metal	64	50	14	64
VOC	3	0	3	3
SVOC	3	0	3	3
PCB	0	0	0	0
Pesticide	0	0	0	0
Herbicide	0	0	0	0
Dioxins and Furans	0	0	0	0
Lower Walnut Drainage EU				
Radionuclide	54	34	23	57
Metal	22	4	18	22
VOC	12	4	8	12
SVOC	12	4	8	12
PCB	4	4	0	4
Pesticide	4	4	0	4
Herbicide	4	4	0	4
Dioxins and Furans	0	0	0	0
Rock Creek Drainage EU				
Radionuclide	42	28	22	50
Metal	34	19	17	36
VOC	17	17	0	17
SVOC	17	17	0	17
PCB	17	17	0	17
Pesticide	17	17	0	17
Herbicide	11	11	0	11
Dioxins and Furans				
Southwest Buffer Zone Area EU				
Radionuclide	16	6	14	20
Metal	14	0	14	14
VOC	0	0	0	0
SVOC	0	0	0	0
PCB	0	0	0	0
Pesticide	0	0	0	0
Herbicide	0	0	0	0
Dioxins and Furans	0	0	0	0
Southeast Buffer Zone Area EU				

Table A3.49
EU Surface Soil Data Summary

Exposure Unit	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
Radionuclide	27	42	10	52
Metal	19	5	14	19
VOC	1	1	0	1
SVOC	1	1	0	1
PCB	1	1	0	1
Pesticide	1	1	0	1
Herbicide	1	1	0	1
Dioxins and Furans	0	0	0	0
Wind Blown Area EU				
Radionuclide	215	228	107	335
Metal	139	75	76	151
VOC	96	36	62	98
SVOC	96	36	62	98
PCB	79	36	45	81
Pesticide	83	36	49	85
Herbicide	78	31	49	80
Dioxins and Furans	0	0	0	0
No Name Gulch Drainage EU				
Radionuclide	282	277	10	287
Metal	356	320	36	356
VOC	93	89	4	93
SVOC	91	87	4	91
PCB	116	116	0	116
Pesticide	82	82	0	82
Herbicide	86	86	0	86
Dioxins and Furans	0	0	0	0
Lower Woman Drainage EU				
Radionuclide	53	94	4	98
Metal	74	28	46	74
VOC	9	9	0	9
SVOC	9	9	0	9
PCB	9	9	0	9
Pesticide	9	9	0	9
Herbicide	9	9	0	9
Dioxins and Furans	0	0	0	0
Upper Woman Drainage EU				
Radionuclide	142	158	19	177
Metal	131	112	23	135
VOC	94	88	8	96
SVOC	111	105	8	113
PCB	88	89	1	90
Pesticide	89	89	2	91
Herbicide	46	44	2	46
Dioxins and Furans	10	0	10	10
Upper Walnut Drainage EU				
Radionuclide	107	110	7	117

Table A3.49
EU Surface Soil Data Summary

Exposure Unit	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
Metal	90	77	13	90
VOC	29	24	5	29
SVOC	27	22	5	27
PCB	44	39	5	44
Pesticide	41	41	0	41
Herbicide	17	17	0	17
Dioxins and Furans	0	0	0	0
Industrial Area EU				
Radionuclide	1,114	881	275	1,156
Metal	1,670	626	1,054	1,680
VOC	1,181	358	880	1,238
SVOC	1,164	333	891	1,224
PCB	483	240	244	484
Pesticide	953	339	617	956
Herbicide	919	311	613	924
Dioxins and Furans	11	0	12	12

Table A3.50
EU Surface Soil/Surface Sediment Data Summary

ExposureUnit	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
West Area EU				
Radionuclide	12	8	10	18
Metal	12	10	10	20
VOC	2	10	0	10
SVOC	2	10	0	10
PCB	2	10	0	10
Pesticide	2	10	0	10
Herbicide	2	9	0	9
Dioxins and Furans	0	0	0	0
Inter-Drainage EU				
Radionuclide	70	70	13	83
Metal	64	50	14	64
VOC	3	0	3	3
SVOC	3	0	3	3
PCB	0	0	0	0
Pesticide	0	0	0	0
Herbicide	0	0	0	0
Dioxins and Furans	0	0	0	0
Lower Walnut Drainage EU				
Radionuclide	76	55	26	81
Metal	28	7	21	28
VOC	15	7	8	15
SVOC	15	7	8	15
PCB	7	7	0	7
Pesticide	7	7	0	7
Herbicide	7	7	0	7
Dioxins and Furans	0	0	0	0
Rock Creek Drainage EU				
Radionuclide	49	39	25	64
Metal	41	31	20	51
VOC	24	28	3	31
SVOC	24	29	3	32
PCB	21	26	0	26
Pesticide	24	27	3	30
Herbicide	18	20	3	23
Dioxins and Furans	0	0	0	0
Southwest Buffer Zone Area EU				
Radionuclide	18	6	16	22
Metal	16	0	16	16
VOC	0	0	0	0
SVOC	0	0	0	0
PCB	0	0	0	0
Pesticide	0	0	0	0
Herbicide	0	0	0	0

Table A3.50
EU Surface Soil/Surface Sediment Data Summary

ExposureUnit	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
Dioxins and Furans	0	0	0	0
Southeast Buffer Zone Area EU				
Radionuclide	30	42	13	55
Metal	22	5	17	22
VOC	1	1	0	1
SVOC	1	1	0	1
PCB	1	1	0	1
Pesticide	1	1	0	1
Herbicide	1	1	0	1
Dioxins and Furans	0	0	0	0
Wind Blown Area EU				
Radionuclide	224	240	107	347
Metal	145	84	76	160
VOC	102	45	62	107
SVOC	102	45	62	107
PCB	85	45	45	90
Pesticide	89	45	49	94
Herbicide	84	40	49	89
Dioxins and Furans	0	0	0	0
No Name Gulch Drainage EU				
Radionuclide	301	287	22	309
Metal	372	327	48	375
VOC	105	94	14	108
SVOC	103	92	14	106
PCB	118	121	0	121
Pesticide	94	87	10	97
Herbicide	98	91	10	101
Dioxins and Furans	0	0	0	0
Lower Woman Drainage EU				
Radionuclide	87	130	14	144
Metal	94	50	56	106
VOC	23	28	4	32
SVOC	22	27	4	31
PCB	23	28	4	32
Pesticide	23	28	4	32
Herbicide	23	28	4	32
Dioxins and Furans	1	0	1	1
Upper Woman Drainage EU				
Radionuclide	173	198	19	217
Metal	153	143	23	166
VOC	112	113	8	121
SVOC	128	129	8	137
PCB	106	113	2	115
Pesticide	106	113	2	115

Table A3.50
EU Surface Soil/Surface Sediment Data Summary

ExposureUnit	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
Herbicide	62	67	2	69
Dioxins and Furans	10	0	10	10
Upper Walnut Drainage EU				
Radionuclide	177	168	31	199
Metal	145	116	36	152
VOC	74	61	20	81
SVOC	70	57	20	77
PCB	109	103	20	123
Pesticide	84	76	15	91
Herbicide	59	51	15	66
Dioxins and Furans	1	0	1	1
Industrial Area EU				
Radionuclide	1,231	995	291	1,286
Metal	1,767	704	1,077	1,781
VOC	1,276	425	912	1,337
SVOC	1,247	388	923	1,311
PCB	554	302	257	559
Pesticide	1,032	408	631	1,039
Herbicide	984	366	627	993
Dioxins and Furans	11	0	12	12

Table A3.51
PMJM Habitat Patch Sample Summary

Exposure Unit	PMJM Habitat Patch ID	Number of Samples							
		Radionuclides	Metals	VOCs	SVOCs	PCBs	Pesticides	Herbicides	Dioxins
Inter-Drainage									
	9	1	4	1	1	1	1	1	0
	31	3	3	0	0	0	0	0	0
Lower Walnut Drainage									
	10	2	1	0	0	0	0	0	0
	13	3	0	0	0	0	0	0	0
	14	7	8	8	8	0	0	0	0
Lower Woman Drainage									
	22A	4	2	0	0	0	0	0	0
	23	10	39	1	1	1	1	1	0
	24A	1	1	0	0	0	0	0	0
	25	1	1	1	1	1	1	1	0
	26	3	0	0	0	0	0	0	0
	27	16	2	0	0	0	0	0	0
	28	5	0	0	0	0	0	0	0
No Name Gulch Drainage									
	11A	2	1	0	0	0	0	0	0
	11B	4	4	0	0	0	0	0	0
Rock Creek Drainage									
	1	2	2	0	0	0	0	0	0
	2	13	7	4	4	4	4	3	0
	3A	2	2	1	1	1	1	1	0
	3B	1	1	1	1	1	1	1	0
	4	0	0	0	0	0	0	0	0
	5	5	2	0	0	0	0	0	0
	6	2	1	0	0	0	0	0	0
	7	1	1	0	0	0	0	0	0
	8	3	3	1	1	1	1	1	0
	32	0	0	0	0	0	0	0	0
	33	0	0	0	0	0	0	0	0
Southwest Buffer Zone Area									
	29A	5	2	0	0	0	0	0	0
	29B	0	0	0	0	0	0	0	0
	30	2	2	0	0	0	0	0	0
Upper Walnut Drainage									
	12A	12	8	12	11	8	6	6	0
	12B	0	0	0	0	0	0	0	0
	15	1	1	0	0	0	0	0	0
	16	1	0	0	0	0	0	0	0
	17	20	13	2	2	2	2	2	0
	18	41	40	3	2	39	39	2	0
Upper Woman Drainage									
	19	12	11	0	7	0	0	0	0
	20A	22	17	13	15	16	15	7	0
	20B	0	0	0	0	0	0	0	0
	21A	11	7	3	3	3	3	3	0
	21B	0	0	0	0	0	0	0	0
	21C	0	0	0	0	0	0	0	0
Wind Blown Area									
	24B	0	0	0	0	0	0	0	0

Table A3.52
EU Surface Water Data Summary

Exposure Unit or Pond		Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
West Area EU					
	Radionuclide - Total	3	15	0	**15**
	Metal - Total	3	37	14	**51**
	VOC - Total	3	16	0	**16**
	SVOC - Total	1	1	0	**1**
	PCB - Total	1	1	0	**1**
	Pesticide - Total	1	1	0	**1**
	Herbicide - Total	1	1	0	**1**
	Dioxins and Furans - Total	0	0	0	**0**
Inter Drainage EU					
	Radionuclide - Total	4	10	0	**10**
	Metal - Total	4	11	0	**11**
	VOC - Total	3	7	0	**7**
	SVOC - Total	1	1	0	**1**
	PCB - Total	1	1	0	**1**
	Pesticide - Total	1	1	0	**1**
	Herbicide - Total	0	0	0	**0**
	Dioxins and Furans - Total	0	0	0	**0**
Lower Walnut Drainage EU					
	Radionuclide - Total	15	803	130	**933**
	Flume Pond	5	5	0	5
	Metal - Total	11	48	11	**59**
	Flume Pond	5	5	0	5
	VOC - Total	9	16	0	**16**
	Flume Pond	5	5	0	5
	SVOC - Total	9	11	0	**11**
	Flume Pond	5	5	0	5
	PCB - Total	2	4	0	**4**
	Flume Pond	0	0	0	0
	Pesticide - Total	9	11	0	**11**
	Flume Pond	5	5	0	5
	Herbicide - Total	8	10	0	**10**
	Flume Pond	4	4	0	4
	Dioxins and Furans - Total	1	3	0	**3**
	Flume Pond	0	0	0	0
Rock Creek Drainage EU					
	Radionuclide - Total	11	26	6	**32**
	Metal - Total	14	46	19	**65**
	VOC - Total	9	31	1	**32**
	SVOC - Total	5	10	1	**11**
	PCB - Total	2	2	0	**2**
	Pesticide - Total	2	2	0	**2**
	Herbicide - Total	2	2	0	**2**
	Dioxins and Furans - Total	0	0	0	**0**
Southwest Buffer Zone Area EU					
	Radionuclide - Total	2	5	1	**6**
	Metal - Total	2	6	1	**7**
	VOC - Total	1	6	0	**6**
	SVOC - Total	0	0	0	**0**

Table A3.52
EU Surface Water Data Summary

Exposure Unit or Pond		Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
	PCB - Total	0	0	0	**0**
	Pesticide - Total	0	0	0	**0**
	Herbicide - Total	0	0	0	**0**
Dioxins and Furans - Total		0	0	0	**0**
Southeast Buffer Zone Area EU					
Radionuclide - Total		4	1	3	**4**
	Pond D-1	2	1	1	2
	Pond D-2	1	0	1	1
	Metal - Total	4	1	3	**4**
	Pond D-1	2	1	1	2
	Pond D-2	1	0	1	1
	VOC - Total	1	1	0	**1**
	Pond D-1	1	1	0	1
	Pond D-2	0	0	0	0
	SVOC - Total	1	1	0	**1**
	Pond D-1	1	1	0	1
	Pond D-2	0	0	0	0
	PCB - Total	1	1	0	**1**
	Pond D-1	1	1	0	1
	Pond D-2	0	0	0	0
	Pesticide - Total	1	1	0	**1**
	Pond D-1	1	1	0	1
	Pond D-2	0	0	0	0
	Herbicide - Total	1	1	0	**1**
	Pond D-1	1	1	0	1
	Pond D-2	0	0	0	0
Dioxins and Furans - Total		1	1	0	**1**
	Pond D-1	1	1	0	1
	Pond D-2	0	0	0	0
Wind Blown Area EU					
Radionuclide - Total		29	47	89	**136**
	Metal - Total	12	28	2	**30**
	VOC - Total	11	16	0	**16**
	SVOC - Total	3	4	0	**4**
	PCB - Total	2	2	0	**2**
	Pesticide - Total	2	2	0	**2**
	Herbicide - Total	1	1	0	**1**
Dioxins and Furans - Total		0	0	0	**0**
No Name Gulch Drainage EU					
Radionuclide - Total		10	52	25	**77**
	East Landfill Pond	2	12	1	13
	Metal - Total	12	52	28	**80**
	East Landfill Pond	2	12	3	15
	VOC - Total	11	113	31	**144**
	East Landfill Pond	4	63	26	89
	SVOC - Total	10	90	31	**121**
	East Landfill Pond	4	56	26	82
	PCB - Total	4	7	0	**7**
	East Landfill Pond	0	0	0	0

Table A3.52
EU Surface Water Data Summary

Exposure Unit or Pond		Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
	Pesticide - Total	8	71	2	**73**
	East Landfill Pond	4	49	1	50
	Herbicide - Total	8	70	2	**72**
	East Landfill Pond	4	49	1	50
Dioxins and Furans - Total		1	1	0	**1**
	East Landfill Pond	0	0	0	0
Lower Woman Drainage EU					
Radionuclide - Total		27	1569	150	**1719**
	Pond C-1	2	1103	2	1105
	Pond C-2	4	181	9	190
	Metal - Total	25	243	59	**302**
	Pond C-1	2	9	1	10
	Pond C-2	4	102	2	104
	VOC - Total	23	93	15	**108**
	Pond C-1	2	6	2	8
	Pond C-2	3	37	6	43
	SVOC - Total	21	52	10	**62**
	Pond C-1	2	6	2	8
	Pond C-2	3	21	1	22
	PCB - Total	12	39	0	**39**
	Pond C-1	1	6	0	6
	Pond C-2	2	13	0	13
	Pesticide - Total	18	58	6	**64**
	Pond C-1	2	6	1	7
	Pond C-2	3	29	1	30
	Herbicide - Total	18	58	6	**64**
	Pond C-1	2	6	1	7
	Pond C-2	3	30	1	31
Dioxins and Furans - Total		3	14	0	**14**
	Pond C-1	1	6	0	6
	Pond C-2	2	8	0	8
Upper Woman Drainage EU					
Radionuclide - Total		46	249	159	**408**
	Metal - Total	49	287	158	**445**
	VOC - Total	43	207	17	**224**
	SVOC - Total	39	118	17	**135**
	PCB - Total	29	83	1	**84**
	Pesticide - Total	33	93	5	**98**
	Herbicide - Total	32	87	4	**91**
Dioxins and Furans - Total		0	0	0	**0**
Upper Walnut Drainage EU					
Radionuclide - Total		129	2353	728	**3081**
	Pond A-1	6	17	2	19
	Pond A-2	5	22	5	27
	Pond A-3	7	50	21	71
	Pond A-4	9	186	68	254
	Pond B-1	8	19	1	20
	Pond B-2	8	21	1	22
	Pond B-3	9	12	1	13

Table A3.52
EU Surface Water Data Summary

Exposure Unit or Pond		Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
	Pond B-4	8	11	1	12
	Pond B-5	8	158	29	187
	Metal - Total	121	959	304	**1263**
	Pond A-1	6	14	1	15
	Pond A-2	5	14	1	15
	Pond A-3	7	13	4	17
	Pond A-4	9	178	2	180
	Pond B-1	8	16	1	17
	Pond B-2	8	16	1	17
	Pond B-3	8	11	1	12
	Pond B-4	8	11	1	12
	Pond B-5	8	96	4	100
	VOC - Total	124	354	76	**430**
	Pond A-1	6	18	1	19
	Pond A-2	5	18	1	19
	Pond A-3	7	11	5	16
	Pond A-4	9	70	15	85
	Pond B-1	11	25	2	27
	Pond B-2	12	31	5	36
	Pond B-3	9	11	3	14
	Pond B-4	8	11	3	14
	Pond B-5	9	49	29	78
	SVOC - Total	117	251	33	**284**
	Pond A-1	5	12	1	13
	Pond A-2	5	13	1	14
	Pond A-3	7	11	1	12
	Pond A-4	9	52	2	54
	Pond B-1	11	19	2	21
	Pond B-2	12	22	5	27
	Pond B-3	9	11	3	14
	Pond B-4	8	11	3	14
	Pond B-5	8	25	4	29
	PCB - Total	30	119	0	**119**
	Pond A-1	1	5	0	5
	Pond A-2	1	8	0	8
	Pond A-3	2	6	0	6
	Pond A-4	3	30	0	30
	Pond B-1	2	6	0	6
	Pond B-2	2	6	0	6
	Pond B-3	2	6	0	6
	Pond B-4	2	6	0	6
	Pond B-5	1	12	0	12
	Pesticide - Total	97	259	16	**275**
	Pond A-1	5	11	1	12
	Pond A-2	5	15	1	16
	Pond A-3	7	11	1	12
	Pond A-4	9	68	1	69
	Pond B-1	8	14	1	15
	Pond B-2	8	15	1	16

Table A3.52
EU Surface Water Data Summary

Exposure Unit or Pond		Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
	Pond B-3	8	11	1	12
	Pond B-4	8	11	1	12
	Pond B-5	3	31	2	33
	Herbicide - Total	99	255	14	**269**
	Pond A-1	4	11	0	11
	Pond A-2	5	13	1	14
	Pond A-3	6	11	0	11
	Pond A-4	9	67	1	68
	Pond B-1	8	14	1	15
	Pond B-2	8	15	1	16
	Pond B-3	8	11	1	12
	Pond B-4	8	11	1	12
	Pond B-5	7	36	2	38
Dioxins and Furans - Total		15	56	0	**56**
	Pond A-1	1	4	0	4
	Pond A-2	1	6	0	6
	Pond A-3	2	6	0	6
	Pond A-4	1	8	0	8
	Pond B-1	2	6	0	6
	Pond B-2	2	5	0	5
	Pond B-3	2	6	0	6
	Pond B-4	2	6	0	6
	Pond B-5	1	8	0	8
Industrial Area EU					
	Radionuclide - Total	119	4286	917	**5203**
	Bowman's Pond	6	11	2	13
	Metal - Total	101	1524	873	**2397**
	Bowman's Pond	6	12	1	13
	VOC - Total	79	1196	125	**1321**
	Bowman's Pond	6	12	2	14
	SVOC - Total	77	726	80	**806**
	Bowman's Pond	6	7	2	9
	PCB - Total	45	61	9	**70**
	Bowman's Pond	5	7	0	7
	Pesticide - Total	62	135	2	**137**
	Bowman's Pond	5	7	0	7
	Herbicide - Total	60	125	2	**127**
	Bowman's Pond	5	7	0	7
Dioxins and Furans - Total		0	0	0	**0**
	Bowman's Pond	0	0	0	0

Table A3.53
AEU Sediment Data Summary

Aquatic Exposure Unit or Pond	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Sampling Depth Range (ft)	Total Number of Samples
North Walnut Creek AEU					
Radionuclide - Total	93	95	32	0 - 4.50	**127**
Bowman's Pond	0	0	0	N/A	0
Pond A-1	9	8	7	0 - 3	15
Pond A-2	7	6	7	0 - 4.50	13
Pond A-3	8	4	4	0 - 2	8
Pond A-4	9	4	8	0 - 2	12
Metal - Total	89	82	30	0 - 4.50	**112**
Bowman's Pond	0	0	0	N/A	0
Pond A-1	9	4	7	0 - 3	11
Pond A-2	7	3	7	0 - 4.50	10
Pond A-3	8	4	4	0 - 2	8
Pond A-4	9	4	8	0 - 2	12
VOC - Total	84	87	27	0 - 4.50	**114**
Bowman's Pond	0	0	0	N/A	0
Pond A-1	9	4	7	0 - 3	11
Pond A-2	7	3	7	0 - 4.50	10
Pond A-3	4	4	0	0 - 2	4
Pond A-4	4	4	0	0 - 0.667	4
SVOC - Total	82	79	27	0 - 4.50	**106**
Bowman's Pond	0	0	0	N/A	0
Pond A-1	9	4	7	0 - 3	11
Pond A-2	7	3	7	0 - 4.50	10
Pond A-3	4	4	0	0 - 2	4
Pond A-4	4	4	0	0 - 0.667	4
PCB - Total	81	98	26	0 - 4.50	**124**
Bowman's Pond	0	0	0	N/A	0
Pond A-1	9	8	7	0 - 3	15
Pond A-2	7	5	7	0 - 4.50	12
Pond A-3	4	8	0	0 - 2	8
Pond A-4	5	9	0	0 - 1.67	9
Pesticide - Total	81	79	26	0 - 4.50	**105**
Bowman's Pond	0	0	0	N/A	0
Pond A-1	9	4	7	0 - 3	11
Pond A-2	7	3	7	0 - 4.50	10
Pond A-3	4	4	0	0 - 2	4
Pond A-4	5	5	0	0 - 1.67	5
Herbicide - Total	81	79	26	0 - 4.50	**105**
Bowman's Pond	0	0	0	N/A	0
Pond A-1	9	4	7	0 - 3	11
Pond A-2	7	3	7	0 - 4.50	10
Pond A-3	4	4	0	0 - 2	4
Pond A-4	5	5	0	0 - 1.67	5
Dioxins and Furans - Total	2	0	4	0 - 4.50	**4**
Bowman's Pond	0	0	0	N/A	0
Pond A-1	1	0	1	1.50 - 3	1
Pond A-2	1	0	3	0 - 4.50	3
Pond A-3	0	0	0	N/A	0

Table A3.53
AEU Sediment Data Summary

Aquatic Exposure Unit or Pond	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Sampling Depth Range (ft)	Total Number of Samples
Pond A-4	0	0	0	N/A	0
SouthWalnutCreekAEU					
Radionuclide - Total	148	138	40	0 - 8.50	**178**
Flume Pond	11	8	4	0 - 2.50	12
Pond B-1	0	0	0	N/A	0
Pond B-2	0	0	0	N/A	0
Pond B-3	0	0	0	N/A	0
Pond B-4	12	8	15	0 - 8.50	23
Pond B-5	10	5	7	0 - 4.50	12
Metal - Total	108	79	47	0 - 8.50	**126**
Flume Pond	8	5	4	0 - 2.50	9
Pond B-1	0	0	0	N/A	0
Pond B-2	0	0	0	N/A	0
Pond B-3	0	0	0	N/A	0
Pond B-4	11	8	14	0 - 8.50	22
Pond B-5	12	7	7	0 - 4.50	14
VOC - Total	96	69	42	0 - 8.50	**111**
Flume Pond	5	5	0	0 - 1.92	5
Pond B-1	0	0	0	N/A	0
Pond B-2	1	0	1	0 - 1	1
Pond B-3	0	0	0	N/A	0
Pond B-4	11	8	14	0 - 8.50	22
Pond B-5	7	7	0	0 - 1	7
SVOC - Total	88	61	42	0 - 8.50	**103**
Flume Pond	5	5	0	0 - 1.92	5
Pond B-1	0	0	0	N/A	0
Pond B-2	1	0	1	0 - 1	1
Pond B-3	0	0	0	N/A	0
Pond B-4	11	8	14	0 - 8.50	22
Pond B-5	5	5	0	0 - 1	5
PCB - Total	72	74	23	0 - 8.50	**97**
Flume Pond	5	5	0	0 - 1.92	5
Pond B-1	0	0	0	N/A	0
Pond B-2	1	0	1	0 - 1	1
Pond B-3				-	
Pond B-4	11	13	14	0 - 8.50	27
Pond B-5	6	11	0	0 - 1	11
Pesticide - Total	82	73	24	0 - 8.50	**97**
Flume Pond	5	5	0	0 - 1.92	5
Pond B-1	0	0	0	N/A	0
Pond B-2	1	0	1	0 - 1	1
Pond B-3	0	0	0	N/A	0
Pond B-4	11	8	14	0 - 8.50	22
Pond B-5	6	6	0	0 - 1	6
Herbicide - Total	69	61	23	0 - 8.50	**84**

Table A3.53
AEU Sediment Data Summary

Aquatic Exposure Unit or Pond	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Sampling Depth Range (ft)	Total Number of Samples
Flume Pond	5	5	0	0 - 1.92	5
Pond B-1	0	0	0	N/A	0
Pond B-2	0	0	0	N/A	0
Pond B-3	0	0	0	N/A	0
Pond B-4	11	8	14	0 - 8.50	22
Pond B-5	6	6	0	0 - 1	6
Dioxins and Furans - Total	0	0	0	N/A	**0**
Flume Pond	0	0	0	N/A	0
Pond B-1	0	0	0	N/A	0
Pond B-2	0	0	0	N/A	0
Pond B-3	0	0	0	N/A	0
Pond B-4	0	0	0	N/A	0
Pond B-5	0	0	0	N/A	0
NoNameGulchAEU					
Radionuclide - Total	19	13	10	0 - 0.833	**23**
East Landfill Pond	10	0	10	0 - 0.500	10
Metal - Total	16	10	10	0 - 2	**20**
East Landfill Pond	10	0	10	0 - 0.500	10
VOC - Total	13	6	10	0 - 2	**16**
East Landfill Pond	10	0	10	0 - 0.500	10
SVOC - Total	13	6	10	0 - 2	**16**
East Landfill Pond	10	0	10	0 - 0.500	10
PCB - Total	3	6	0	0 - 2	**6**
East Landfill Pond	0	0	0	N/A	0
Pesticide - Total	13	6	10	0 - 2	**16**
East Landfill Pond	10	0	10	0 - 0.500	10
Herbicide - Total	13	6	10	0 - 2	**16**
East Landfill Pond	10	0	10	0 - 0.500	10
Dioxins and Furans - Total	0	0	0	N/A	**0**
East Landfill Pond	0	0	0	N/A	0
WomanCreekAEU					
Radionuclide - Total	83	102	15	0 - 2.50	**117**
Pond C-1	6	4	6	0 - 2	10
Pond C-2	8	3	8	0 - 2.50	11
Metal - Total	58	73	15	0 - 2.50	**88**
Pond C-1	6	2	6	0 - 2	8
Pond C-2	8	3	8	0 - 2.50	11
VOC - Total	48	63	7	0 - 2	**70**
Pond C-1	6	2	6	0 - 2	8
Pond C-2	3	3	0	0 - 0.417	3
SVOC - Total	41	56	7	0 - 2	**63**
Pond C-1	6	2	6	0 - 2	8
Pond C-2	2	2	0	0 - 0.417	2
PCB - Total	47	62	7	0 - 2	**69**
Pond C-1	6	2	6	0 - 2	8
Pond C-2	3	3	0	0 - 0.667	3
Pesticide - Total	45	60	7	0 - 2	**67**

Table A3.53
AEU Sediment Data Summary

Aquatic Exposure Unit or Pond	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Sampling Depth Range (ft)	Total Number of Samples
Pond C-1	6	2	6	0 - 2	8
Pond C-2	3	3	0	0 - 0.667	3
Herbicide - Total	41	56	7	0 - 2	**63**
Pond C-1	6	2	6	0 - 2	8
Pond C-2	3	3	0	0 - 0.667	3
Dioxins and Furans - Total	1	0	2	0 - 2.50	**2**
Pond C-1	1	0	2	0 - 2.50	2
Pond C-2	0	0	0	N/A	0
RockCreekAEU					
Radionuclide - Total	8	15	5	0 - 1.50	**20**
Metal - Total	8	17	5	0 - 1.50	**22**
VOC - Total	8	16	5	0 - 1.50	**21**
SVOC - Total	8	16	5	0 - 1.50	**21**
PCB - Total	5	13	0	0 - 0.500	**13**
Pesticide - Total	8	14	5	0 - 1.50	**19**
Herbicide - Total	8	12	5	0 - 1.50	**17**
Dioxins and Furans - Total	0	0	0	N/A	**0**
McKayDitchAEU					
Radionuclide - Total	6	9	4	0 - 2.25	**13**
Metal - Total	5	8	4	0 - 2.25	**12**
VOC - Total	3	8	0	0 - 0.300	**8**
SVOC - Total	3	8	0	0 - 0.300	**8**
PCB - Total	3	8	0	0 - 0.300	**8**
Pesticide - Total	3	8	0	0 - 0.300	**8**
Herbicide - Total	3	8	0	0 - 0.300	**8**
Dioxins and Furans	0	0	0	N/A	**0**
SoutheastAEU					
Radionuclide - Total	7	2	7	0 - 1.75	**9**
Pond D-1	1	0	2	0 - 1	2
Pond D-2	1	0	1	0 - 0.500	1
Metal - Total	5	0	7	0 - 1.75	**7**
Pond D-1	1	0	2	0 - 1	2
Pond D-2	1	0	1	0 - 0.500	1
VOC - Total	0	0	0	N/A	**0**
Pond D-1	0	0	0	N/A	0
Pond D-2	0	0	0	N/A	0
SVOC - Total	0	0	0	N/A	**0**
Pond D-1	0	0	0	N/A	0
Pond D-2	0	0	0	N/A	0
PCB - Total	0	0	0	N/A	**0**
Pond D-1	0	0	0	N/A	0
Pond D-2	0	0	0	N/A	0
Pesticide - Total	0	0	0	N/A	**0**
Pond D-1	0	0	0	N/A	0
Pond D-2	0	0	0	N/A	0
Herbicide - Total	0	0	0	N/A	**0**
Pond D-1	0	0	0	N/A	0
Pond D-2	0	0	0	N/A	0

Table A3.53
AEU Sediment Data Summary

Aquatic Exposure Unit or Pond	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Sampling Depth Range (ft)	Total Number of Samples
Dioxins and Furans - Total	0	0	0	N/A	0
Pond D-1	0	0	0	N/A	0
Pond D-2	0	0	0	N/A	0

Table A3.54
AEU Surface Water Data Summary

AEU or Pond	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
North Walnut Creek AEU				
Radionuclide - Total	131	1,937	830	**2,767**
Bowman's Pond	6	11	2	13
Pond A-1	6	17	2	19
Pond A-2	5	22	5	27
Pond A-3	7	50	21	71
Pond A-4	9	186	68	254
Metal - Total	114	705	488	**1,193**
Bowman's Pond	6	12	1	13
Pond A-1	6	14	1	15
Pond A-2	5	14	1	15
Pond A-3	7	13	4	17
Pond A-4	9	178	2	180
VOC - Total	98	298	59	**357**
Bowman's Pond	6	12	2	14
Pond A-1	6	18	1	19
Pond A-2	5	18	1	19
Pond A-3	7	11	5	16
Pond A-4	9	70	15	85
SVOC - Total	92	215	41	**256**
Bowman's Pond	6	7	2	9
Pond A-1	5	12	1	13
Pond A-2	5	13	1	14
Pond A-3	7	11	1	12
Pond A-4	9	52	2	54
PCB - Total	43	110	9	**119**
Bowman's Pond	5	7	0	7
Pond A-1	1	5	0	5
Pond A-2	1	8	0	8
Pond A-3	2	6	0	6
Pond A-4	3	30	0	30
Pesticide - Total	84	236	6	**242**
Bowman's Pond	5	7	0	7
Pond A-1	5	11	1	12
Pond A-2	5	15	1	16
Pond A-3	7	11	1	12
Pond A-4	9	68	1	69
Herbicide - Total	82	225	4	**229**
Bowman's Pond	5	7	0	7
Pond A-1	4	11	0	11
Pond A-2	5	13	1	14
Pond A-3	6	11	0	11
Pond A-4	9	67	1	68
Dioxins and Furans - Total	6	25	0	**25**
Bowman's Pond	0	0	0	0
Pond A-1	1	4	0	4

Table A3.54
AEU Surface Water Data Summary

AEU or Pond	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
Pond A-2	1	6	0	6
Pond A-3	2	6	0	6
Pond A-4	1	8	0	8
South Walnut Creek AEU				
Radionuclide - Total	125	5,450	918	**6,368**
Flume Pond	5	5	0	5
Pond B-1	8	19	1	20
Pond B-2	8	21	1	22
Pond B-3	9	12	1	13
Pond B-4	8	11	1	12
Pond B-5	8	158	29	187
Metal - Total	113	1,788	700	**2,488**
Flume Pond	5	5	0	5
Pond B-1	8	16	1	17
Pond B-2	8	16	1	17
Pond B-3	8	11	1	12
Pond B-4	8	11	1	12
Pond B-5	8	96	4	100
VOC - Total	111	1,259	142	**1,401**
Flume Pond	5	5	0	5
Pond B-1	11	25	2	27
Pond B-2	12	31	5	36
Pond B-3	9	11	3	14
Pond B-4	8	11	3	14
Pond B-5	9	49	29	78
SVOC - Total	106	765	70	**835**
Flume Pond	5	5	0	5
Pond B-1	11	19	2	21
Pond B-2	12	22	5	27
Pond B-3	9	11	3	14
Pond B-4	8	11	3	14
Pond B-5	8	25	4	29
PCB - Total	32	70	0	**70**
Flume Pond	0	0	0	0
Pond B-1	2	6	0	6
Pond B-2	2	6	0	6
Pond B-3	2	6	0	6
Pond B-4	2	6	0	6
Pond B-5	1	12	0	12
Pesticide - Total	81	159	12	**171**
Flume Pond	5	5	0	5
Pond B-1	8	14	1	15
Pond B-2	8	15	1	16
Pond B-3	8	11	1	12
Pond B-4	8	11	1	12
Pond B-5	3	31	2	33

Table A3.54
AEU Surface Water Data Summary

AEU or Pond	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
Herbicide - Total	82	157	12	**169**
Flume Pond	4	4	0	4
Pond B-1	8	14	1	15
Pond B-2	8	15	1	16
Pond B-3	8	11	1	12
Pond B-4	8	11	1	12
Pond B-5	7	36	2	38
Dioxins and Furans - Total	10	34	0	**34**
Flume Pond	0	0	0	0
Pond B-1	2	6	0	6
Pond B-2	2	5	0	5
Pond B-3	2	6	0	6
Pond B-4	2	6	0	6
Pond B-5	1	8	0	8
No Name Gulch AEU				
Radionuclide - Total	9	65	23	**88**
East Landfill Pond	2	12	1	13
Metal - Total	10	52	26	**78**
East Landfill Pond	2	12	3	15
VOC - Total	11	113	31	**144**
East Landfill Pond	4	63	26	89
SVOC - Total	10	90	31	**121**
East Landfill Pond	4	56	26	82
PCB - Total	4	7	0	**7**
East Landfill Pond	0	0	0	0
Pesticide - Total	8	71	2	**73**
East Landfill Pond	4	49	1	50
Herbicide - Total	8	70	2	**72**
East Landfill Pond	4	49	1	50
Dioxins and Furans - Total	1	1	0	**1**
East Landfill Pond	0	0	0	0
Woman Creek AEU				
Radionuclide - Total	104	1,884	425	**2,309**
Pond C-1	2	1,103	2	1,105
Pond C-2	4	181	9	190
Metal - Total	88	575	219	**794**
Pond C-1	2	9	1	10
Pond C-2	4	102	2	104
VOC - Total	79	324	32	**356**
Pond C-1	2	6	2	8
Pond C-2	3	37	6	43
SVOC - Total	67	181	29	**210**
Pond C-1	2	6	2	8
Pond C-2	3	21	1	22
PCB - Total	44	126	1	**127**
Pond C-1	1	6	0	6

Table A3.54
AEU Surface Water Data Summary

AEU or Pond	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
Pond C-2	2	13	0	13
Pesticide - Total	55	161	11	**172**
Pond C-1	2	6	1	7
Pond C-2	3	29	1	30
Herbicide - Total	53	153	10	**163**
Pond C-1	2	6	1	7
Pond C-2	3	30	1	31
Dioxins and Furans - Total	3	14	0	**14**
Pond C-1	1	6	0	6
Pond C-2	2	8	0	8
Rock Creek AEU				
Radionuclide - Total	13	37	6	**43**
Metal - Total	16	77	33	**110**
VOC - Total	11	42	1	**43**
SVOC - Total	6	11	1	**12**
PCB - Total	3	3	0	**3**
Pesticide - Total	3	3	0	**3**
Herbicide - Total	3	3	0	**3**
Dioxins and Furans	0	0	0	**0**
McKay Ditch AEU				
Radionuclide - Total	10	36	2	**38**
Metal - Total	10	37	2	**39**
VOC - Total	5	13	0	**13**
SVOC - Total	2	2	0	**2**
PCB - Total	2	3	0	**3**
Pesticide - Total	2	3	0	**3**
Herbicide - Total	1	1	0	**1**
Dioxins and Furans	0	0	0	**0**
Southeast AEU				
Radionuclide - Total	7	7	4	**11**
Pond D-1	2	1	1	2
Pond D-2	1	0	1	1
Metal - Total	7	8	4	**12**
Pond D-1	2	1	1	2
Pond D-2	1	0	1	1
VOC - Total	2	7	0	**7**
Pond D-1	1	1	0	1
Pond D-2	0	0	0	0
SVOC - Total	1	1	0	**1**
Pond D-1	1	1	0	1
Pond D-2	0	0	0	0
PCB - Total	1	1	0	**1**
Pond D-1	1	1	0	1
Pond D-2	0	0	0	0
Pesticide - Total	1	1	0	**1**
Pond D-1	1	1	0	1

Table A3.54
AEU Surface Water Data Summary

AEU or Pond	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
Pond D-2	0	0	0	0
Herbicide - Total	1	1	0	**1**
Pond D-1	1	1	0	1
Pond D-2	0	0	0	0
Dioxins and Furans - Total	1	1	0	**1**
Pond D-1	1	1	0	1
Pond D-2	0	0	0	0

Table A3.55
EU Subsurface Soil Data Summary

Exposure Unit	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
West Area EU				
Radionuclide	2	7	0	7
Metal	2	7	0	7
VOC	1	5	0	5
SVOC	1	5	0	5
PCB	0	0	0	0
Pesticide	1	5	0	5
Herbicide	1	5	0	5
Dioxins and Furans	0	0	0	0
Inter-Drainage EU				
Radionuclide	18	66	4	70
Metal	19	66	6	72
VOC	17	59	6	65
SVOC	14	55	6	61
PCB	0	0	0	0
Pesticide	9	45	0	45
Herbicide	11	55	0	55
Dioxins and Furans	0	0	0	0
Lower Walnut Drainage EU				
Radionuclide	6	9	2	11
Metal	12	6	8	14
VOC	12	8	8	16
SVOC	8	0	8	8
PCB	0	0	0	0
Pesticide	0	0	0	0
Herbicide	0	0	0	0
Dioxins and Furans	0	0	0	0
Rock Creek Drainage EU				
Radionuclide	4	8	0	8
Metal	4	8	0	8
VOC	4	12	0	12
SVOC	0	0	0	0
PCB	0	0	0	0
Pesticide	0	0	0	0
Herbicide	0	0	0	0
Dioxins and Furans	0	0	0	0
Southwest Buffer Zone Area EU				
Radionuclide	0	0	0	0
Metal	1	0	2	2
VOC	1	0	1	1
SVOC	1	0	1	1
PCB	0	0	0	0
Pesticide	0	0	0	0
Herbicide	0	0	0	0
Dioxins and Furans	0	0	0	0
Southeast Buffer Zone Area EU				

Table A3.55
EU Subsurface Soil Data Summary

Exposure Unit	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
Radionuclide	4	8	0	8
Metal	3	6	0	6
VOC	3	7	0	7
SVOC	1	3	0	3
PCB	0	0	0	0
Pesticide	1	3	0	3
Herbicide	1	3	0	3
Dioxins and Furans	0	0	0	0
Wind Blown Area EU				
Radionuclide	283	277	137	414
Metal	160	147	162	309
VOC	255	325	252	577
SVOC	225	165	252	417
PCB	73	76	113	189
Pesticide	117	125	131	256
Herbicide	116	123	131	254
Dioxins and Furans	0	0	0	0
No Name Gulch Drainage EU				
Radionuclide	167	260	0	260
Metal	185	269	20	289
VOC	66	176	4	180
SVOC	32	58	4	62
PCB	26	51	0	51
Pesticide	12	38	0	38
Herbicide	12	39	0	39
Dioxins and Furans	1	1	0	1
Lower Woman Drainage EU				
Radionuclide	11	20	0	20
Metal	40	17	30	47
VOC	12	26	0	26
SVOC	6	8	0	8
PCB	4	4	0	4
Pesticide	5	6	0	6
Herbicide	5	6	0	6
Dioxins and Furans	1	0	2	2
Upper Woman Drainage EU				
Radionuclide	111	248	3	251
Metal	119	244	13	257
VOC	79	289	8	297
SVOC	62	103	8	111
PCB	53	99	0	99
Pesticide	58	103	4	107
Herbicide	56	100	4	104
Dioxins and Furans	1	0	1	1
Upper Walnut Drainage EU				
Radionuclide	70	84	27	111

Table A3.55
EU Subsurface Soil Data Summary

Exposure Unit	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
Metal	52	81	14	95
VOC	66	122	16	138
SVOC	16	4	16	20
PCB	7	0	10	10
Pesticide	7	0	10	10
Herbicide	6	0	9	9
Dioxins and Furans	2	0	5	5
Industrial Area EU				
Radionuclide	723	394	610	1,004
Metal	1,695	417	2,065	2,482
VOC	2,088	584	2,612	3,196
SVOC	1,972	254	2,610	2,864
PCB	466	143	518	661
Pesticide	712	177	705	882
Herbicide	705	176	696	872
Dioxins and Furans	9	0	17	17

Table A3.56
Subsurface Soil/Subsurface Sediment Data Summary

Exposure Unit	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
West Area EU				
Radionuclide	2	7	0	7
Metal	2	7	0	7
VOC	1	5	0	5
SVOC	1	5	0	5
PCB	0	0	0	0
Pesticide	1	5	0	5
Herbicide	1	5	0	5
Dioxins and Furans	0	0	0	0
Inter-Drainage EU				
Radionuclide	18	66	4	70
Metal	19	66	6	72
VOC	17	59	6	65
SVOC	14	55	6	61
PCB	0	0	0	0
Pesticide	9	45	0	45
Herbicide	11	55	0	55
Dioxins and Furans	0	0	0	0
Lower Walnut Drainage EU				
Radionuclide	12	14	3	17
Metal	18	11	9	20
VOC	17	13	8	21
SVOC	13	5	8	13
PCB	5	5	0	5
Pesticide	5	5	0	5
Herbicide	5	5	0	5
Dioxins and Furans	0	0	0	0
Rock Creek Drainage EU				
Radionuclide	7	9	2	11
Metal	7	9	2	11
VOC	7	13	2	15
SVOC	2	0	2	2
PCB	0	0	0	0
Pesticide	2	0	2	2
Herbicide	2	0	2	2
Dioxins and Furans	0	0	0	0
Southwest Buffer Zone Area EU				
Radionuclide	1	0	1	1
Metal	2	0	3	3
VOC	1	0	1	1
SVOC	1	0	1	1
PCB	0	0	0	0
Pesticide	0	0	0	0
Herbicide	0	0	0	0
Dioxins and Furans	0	0	0	0

Table A3.56
Subsurface Soil/Subsurface Sediment Data Summary

Exposure Unit	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
Southeast Buffer Zone Area EU				
Radionuclide	5	8	1	9
Metal	4	6	1	7
VOC	3	7	0	7
SVOC	1	3	0	3
PCB	0	0	0	0
Pesticide	1	3	0	3
Herbicide	1	3	0	3
Dioxins and Furans	0	0	0	0
Wind Blown Area EU				
Radionuclide	286	280	137	417
Metal	161	148	162	310
VOC	256	326	252	578
SVOC	225	165	252	417
PCB	73	76	113	189
Pesticide	117	125	131	256
Herbicide	116	123	131	254
Dioxins and Furans	0	0	0	0
No Name Gulch Drainage EU				
Radionuclide	171	262	2	264
Metal	189	271	22	293
VOC	66	176	4	180
SVOC	32	58	4	62
PCB	26	51	0	51
Pesticide	12	38	0	38
Herbicide	12	39	0	39
Dioxins and Furans	1	1	0	1
Lower Woman Drainage EU				
Radionuclide	19	26	5	31
Metal	48	20	35	55
VOC	18	29	3	32
SVOC	12	11	3	14
PCB	9	7	2	9
Pesticide	11	9	3	12
Herbicide	11	9	3	12
Dioxins and Furans	1	0	3	3
Upper Woman Drainage EU				
Radionuclide	112	249	3	252
Metal	120	245	13	258
VOC	80	290	8	298
SVOC	63	104	8	112
PCB	54	100	0	100
Pesticide	59	104	4	108
Herbicide	57	101	4	105
Dioxins and Furans	1	0	1	1

Table A3.56
Subsurface Soil/Subsurface Sediment Data Summary

Exposure Unit	Total Number of Sampling Locations	Number of Samples 1991-2000	Number of Samples 2001 to Present	Total Number of Samples
Upper Walnut Drainage EU				
Radionuclide	121	121	53	174
Metal	103	119	39	158
VOC	108	161	31	192
SVOC	58	43	31	74
PCB	51	40	25	65
Pesticide	51	40	25	65
Herbicide	49	40	23	63
Dioxins and Furans	2	0	8	8
Industrial Area EU				
Radionuclide	731	401	612	1,013
Metal	1,703	424	2,067	2,491
VOC	2,101	597	2,619	3,216
SVOC	1,985	261	2,617	2,878
PCB	478	150	524	674
Pesticide	724	184	711	895
Herbicide	717	183	702	885
Dioxins and Furans	9	0	17	17

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FIGURES

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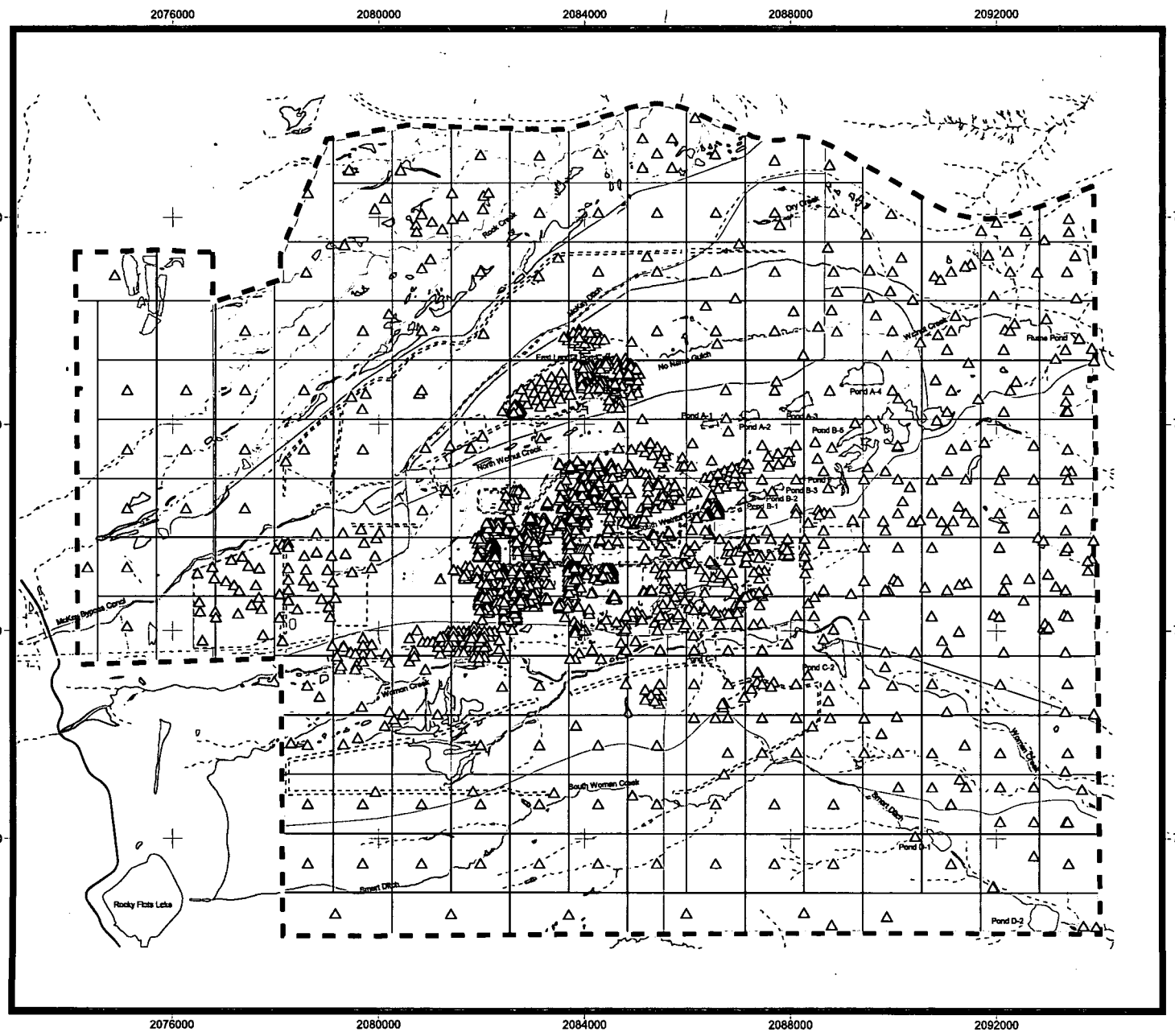

Figure A3.1

Surface Soil Sampling Locations for Radionuclides

KEY

Sample location
- >= ESL
- < ESL
- Nondetect
- Detected, no ESL
- Nondetect, no ESL
- Historical IHSS/PAC
- Seep
- 30-acre grid

Exposure Unit
- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

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Colorado Central Zone
Datum: NAD 27

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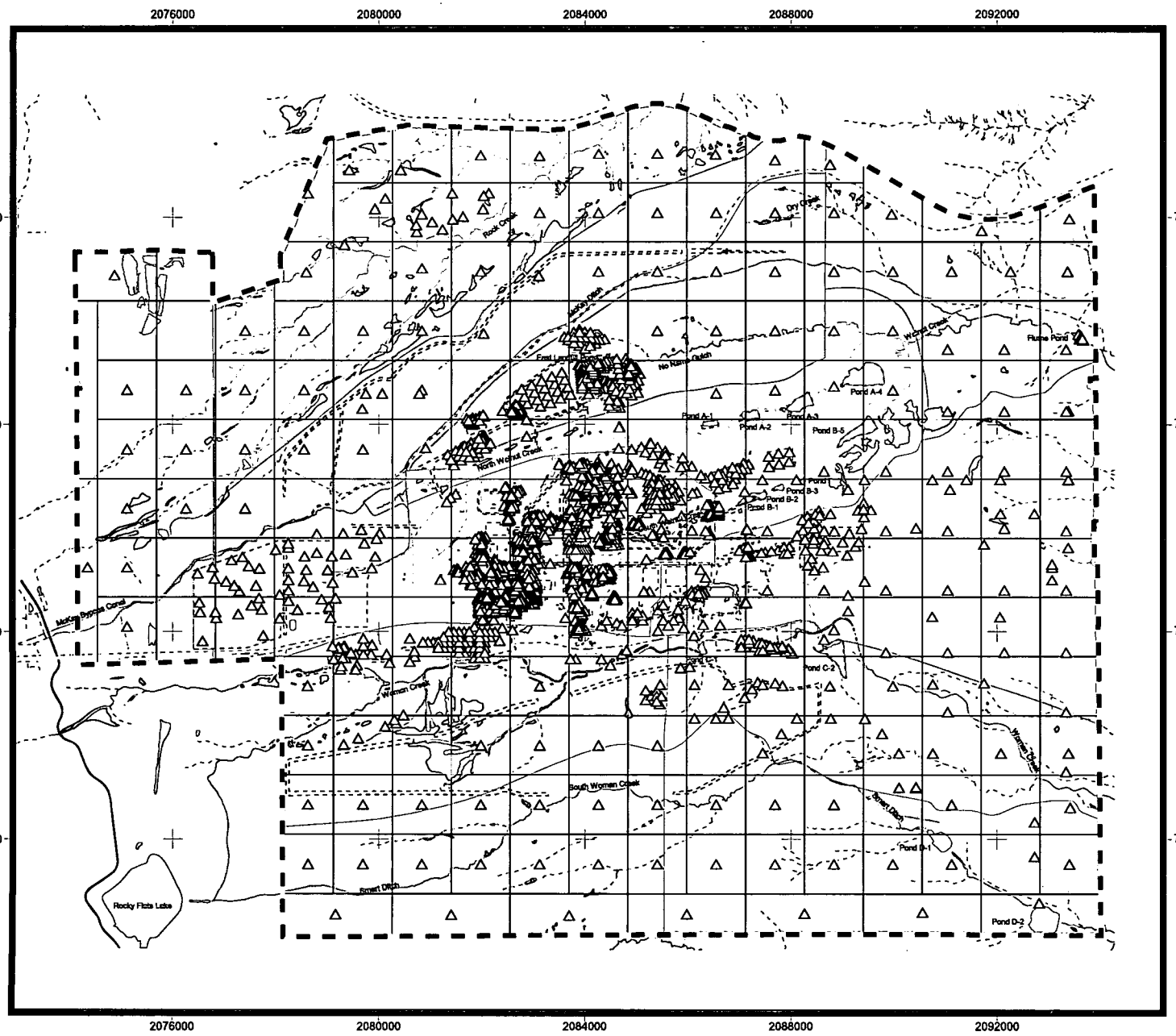

Figure A3.2

Surface Soil Sampling Locations for Metals

KEY

Sample location
- >= ESL
- < ESL
- Nondetect
- Detected, no ESL
- Nondetect, no ESL
- Historical IHSS/PAC
- Seep
- 30-acre grid

Exposure Unit
- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

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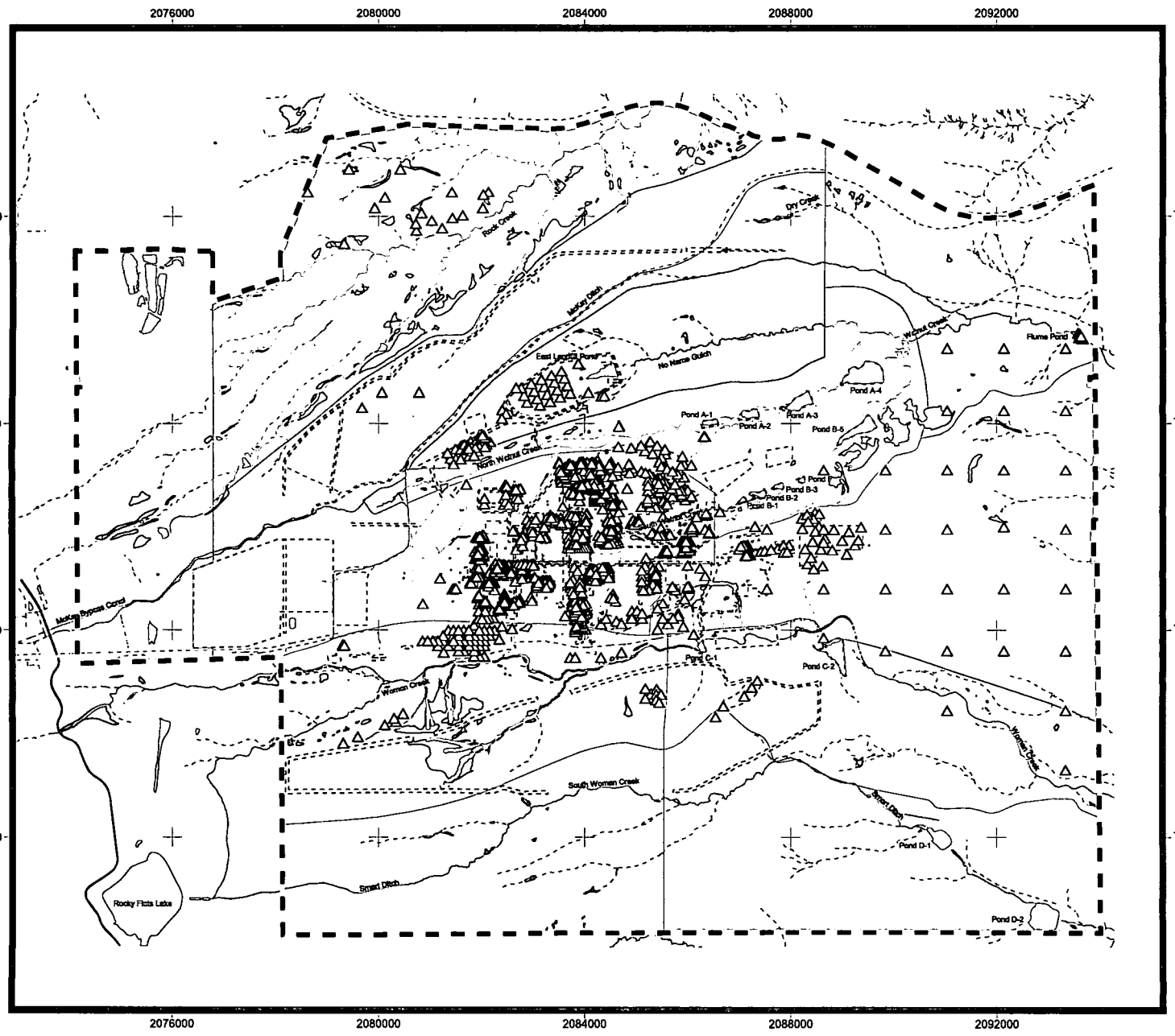

Figure A3.3
Surface Soil Sampling Locations for VOCs (Acetone and Methylene Chloride not included)

KEY

Sample location
- >= ESL
- < ESL
- Nondetect
- Detected, no ESL
- Nondetect, no ESL
- Historical IHSS/PAC
- Seep

Exposure Unit
- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

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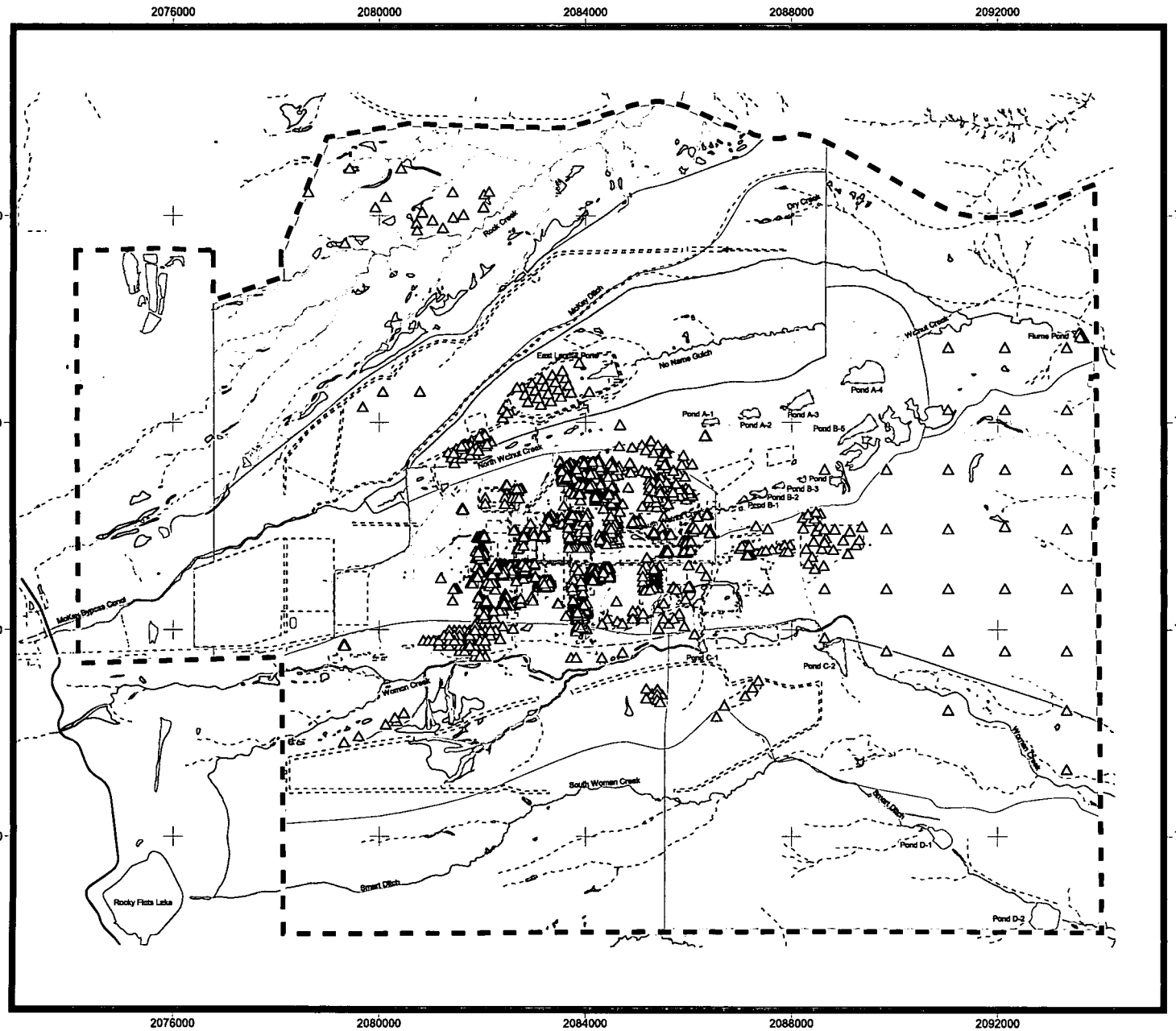

Figure A3.4a

Surface Soil Sampling Locations for SVOCs (PAHs not included)

KEY

Sample location
- >= ESL
- < ESL
- Nondetect
- Detected, no ESL
- Nondetect, no ESL
- Historical IHSS/PAC
- Seep

Exposure Unit
- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

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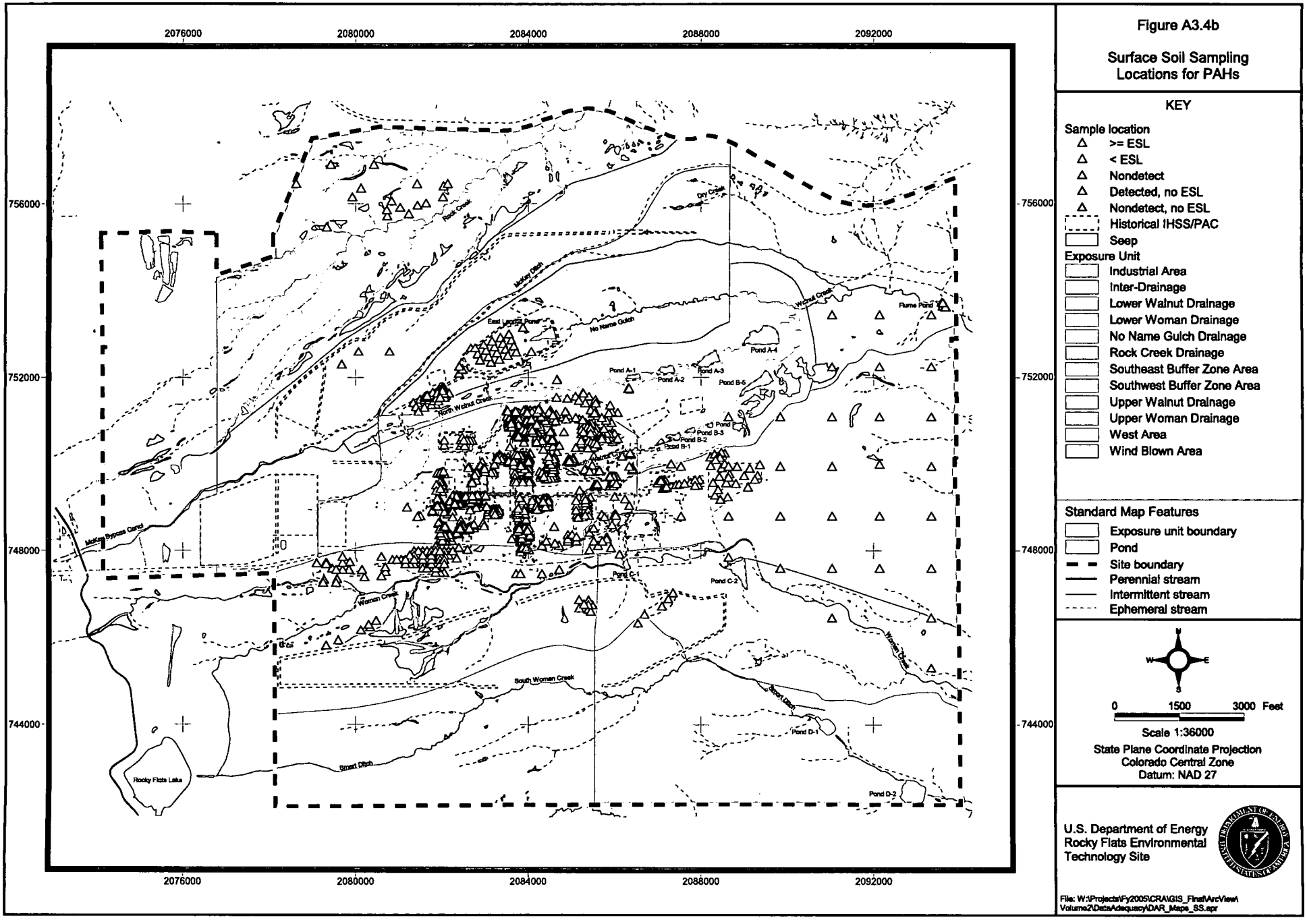

Figure A3.4b

Surface Soil Sampling Locations for PAHs

KEY

Sample location
- >= ESL
- < ESL
- Nondetect
- Detected, no ESL
- Nondetect, no ESL
- Historical IHSS/PAC
- Seep

Exposure Unit
- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

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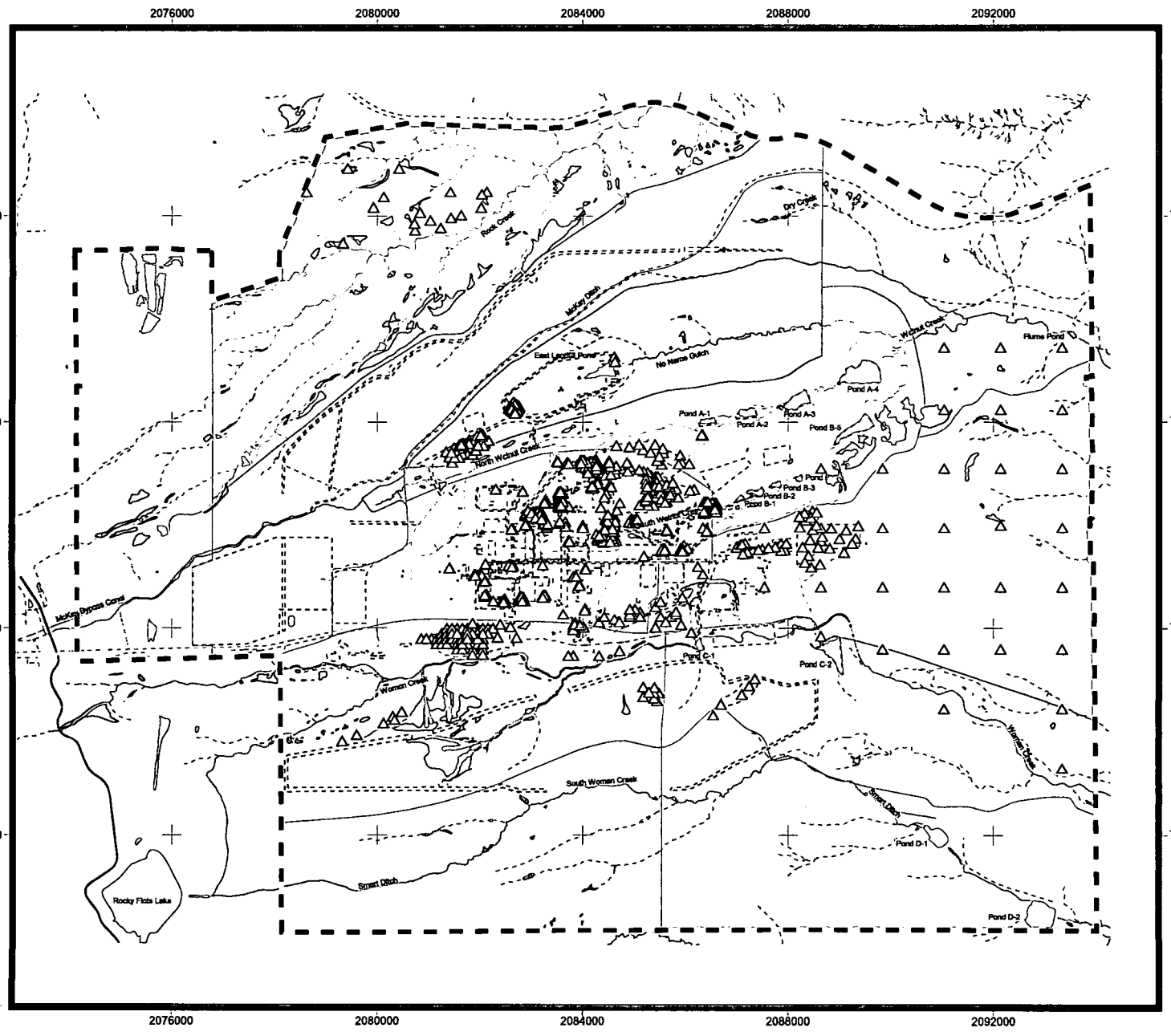

Figure A3.5

Surface Soil Sampling Locations for PCBs

KEY

Sample location
- >= ESL
- < ESL
- Nondetect
- Detected, no ESL
- Nondetect, no ESL
- Historical IHSS/PAC
- Seep

Exposure Unit
- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

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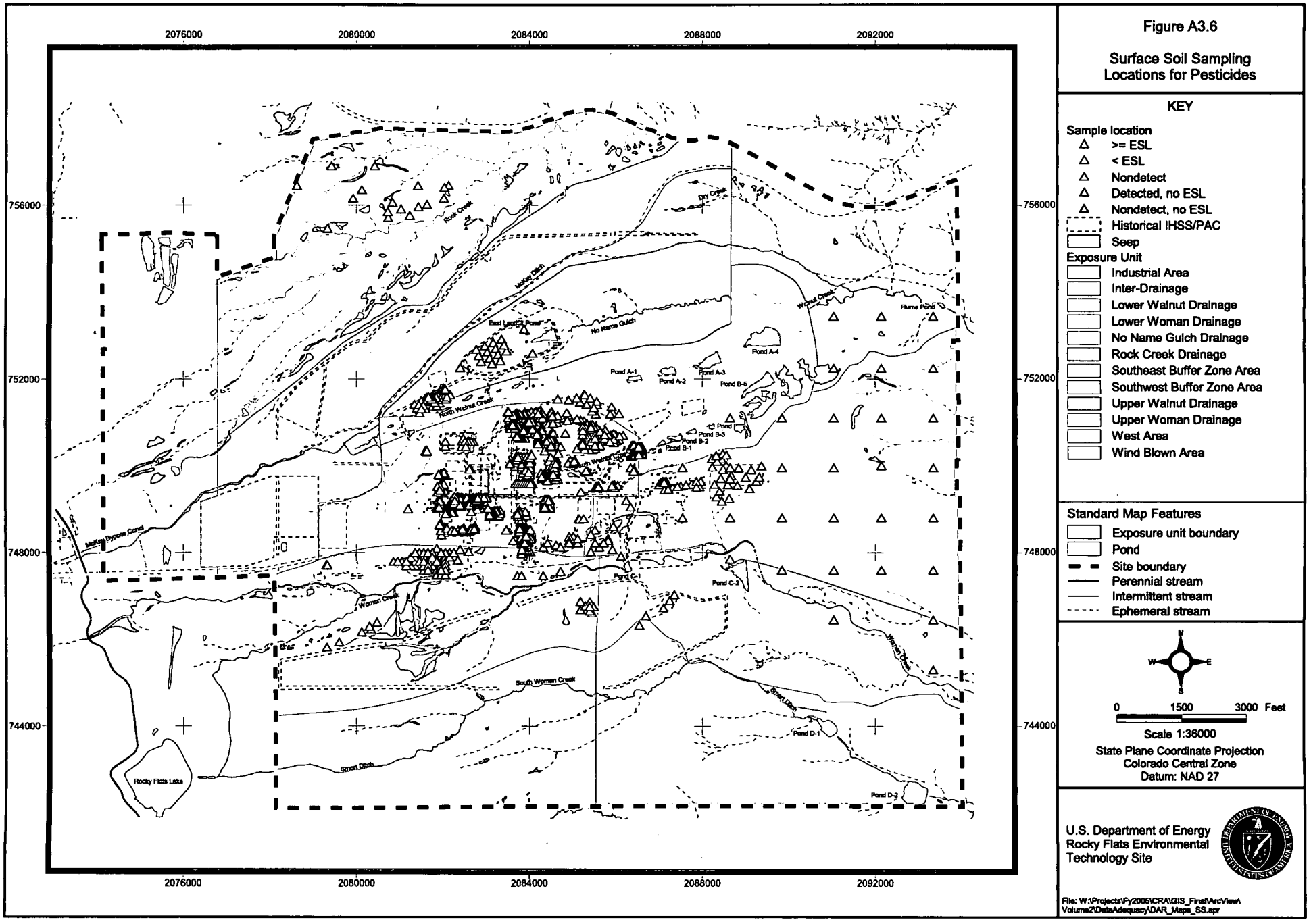

Figure A3.6

Surface Soil Sampling Locations for Pesticides

KEY

Sample location
- >= ESL
- < ESL
- Nondetect
- Detected, no ESL
- Nondetect, no ESL
- Historical IHSS/PAC
- Seep

Exposure Unit
- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

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Colorado Central Zone
Datum: NAD 27

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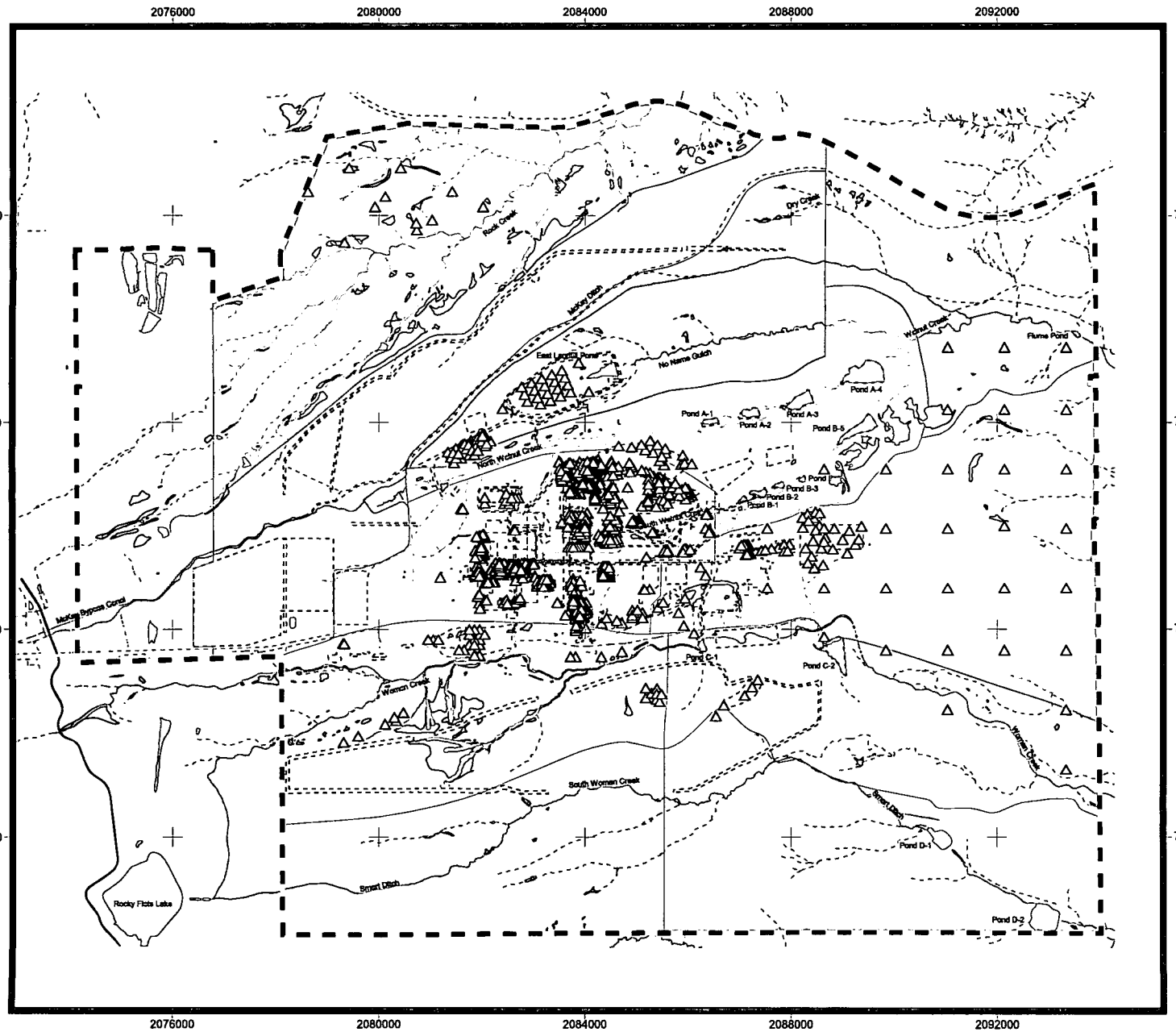

Figure A3.7

Surface Soil Sampling Locations for Herbicides

KEY

Sample location
- >= ESL
- < ESL
- Nondetect
- Detected, no ESL
- Nondetect, no ESL
- Historical IHSS/PAC
- Seep

Exposure Unit
- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

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Colorado Central Zone
Datum: NAD 27

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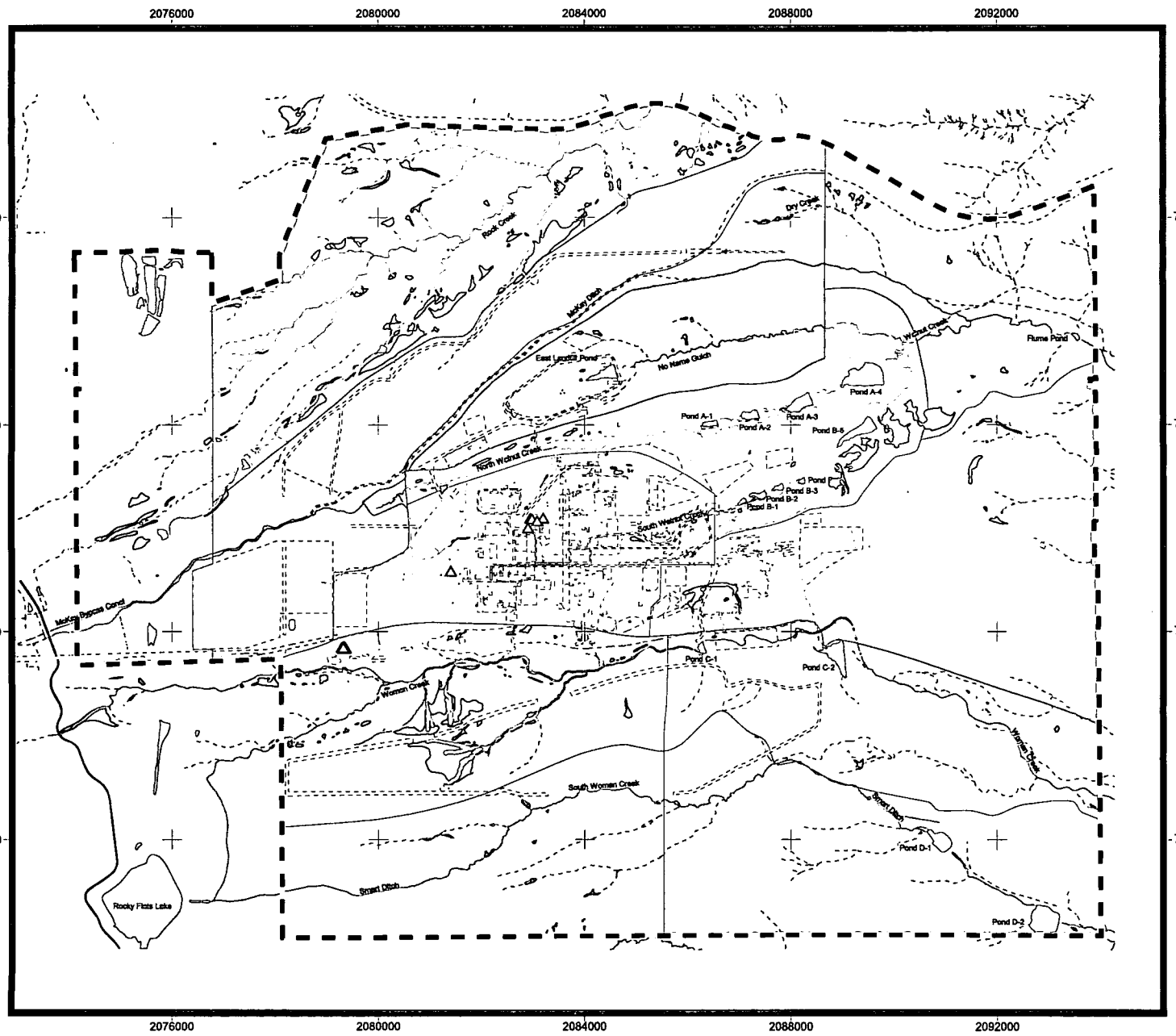

Figure A3.8

Surface Soil Sampling Locations for Dioxins and Furans

KEY

Sample location
- >= ESL
- < ESL
- Nondetect
- Detected, no ESL
- Nondetect, no ESL
- Historical IHSS/PAC
- Seep

Exposure Unit
- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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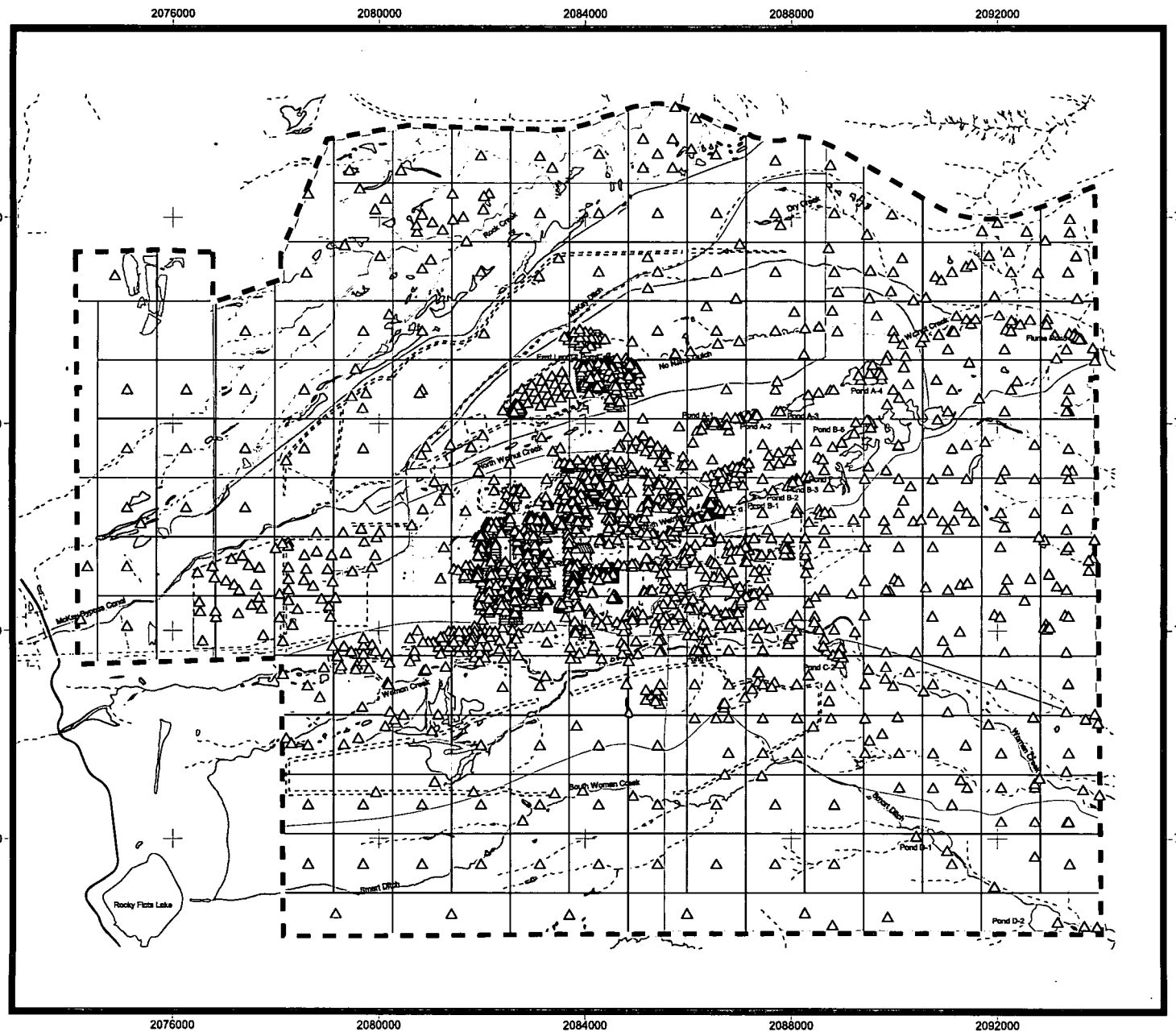

Figure A3.9

Surface Soil and Surface Sediment Sampling Locations for Radionuclides

KEY

Sample location
- >= PRG
- < PRG
- Nondetect
- Detected, no PRG
- Nondetect, no PRG
- Historical IHSS/PAC
- Seep
- 30-acre grid

Exposure Unit
- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

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Colorado Central Zone
Datum: NAD 27

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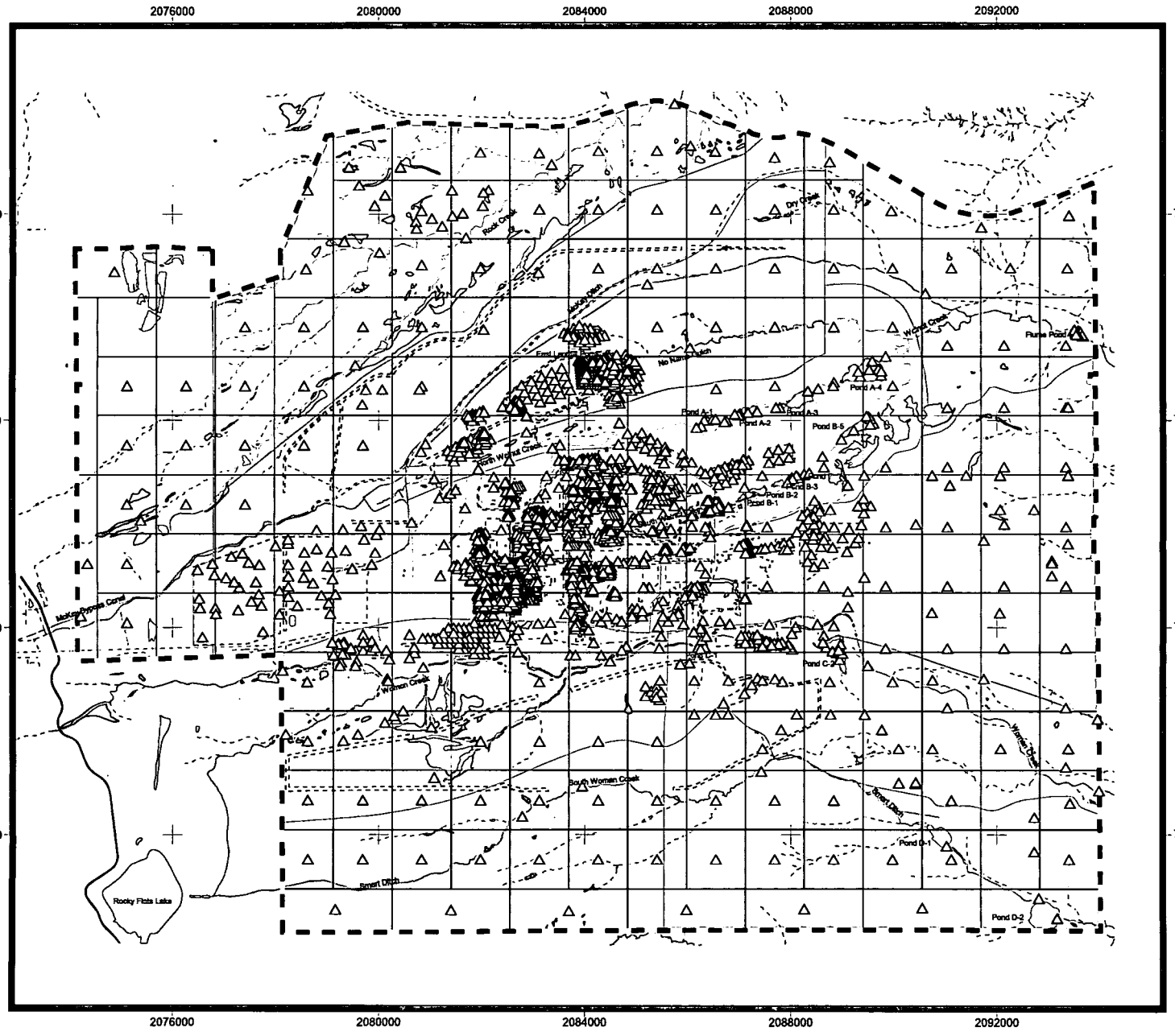

Figure A3.10

Surface Soil and Surface Sediment Sampling Locations for Metals

KEY

Sample location
- >= PRG
- < PRG
- Nondetect
- Detected, no PRG
- Nondetect, no PRG
- Historical IHSS/PAC
- Seep
- 30-acre grid

Exposure Unit
- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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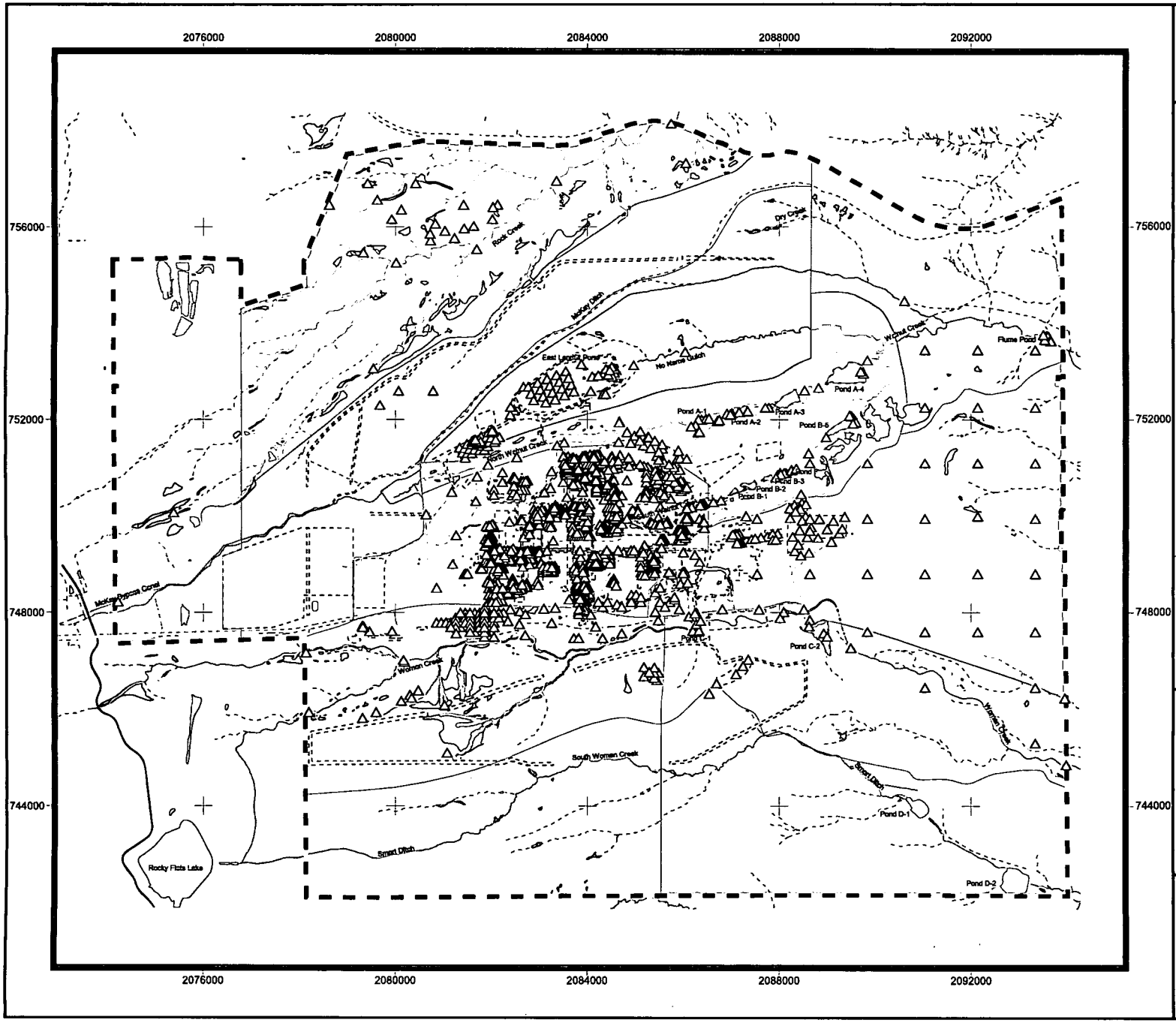

Figure A3.11
Surface Soil and Surface Sediment Sampling Locations for VOCs (Acetone and Methylene Chloride not included)

KEY

Sample location
- >= PRG
- < PRG
- Nondetect
- Detected, no PRG
- Nondetect, no PRG
- Historical IHSS/PAC
- Seep

Exposure Unit
- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
W E
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0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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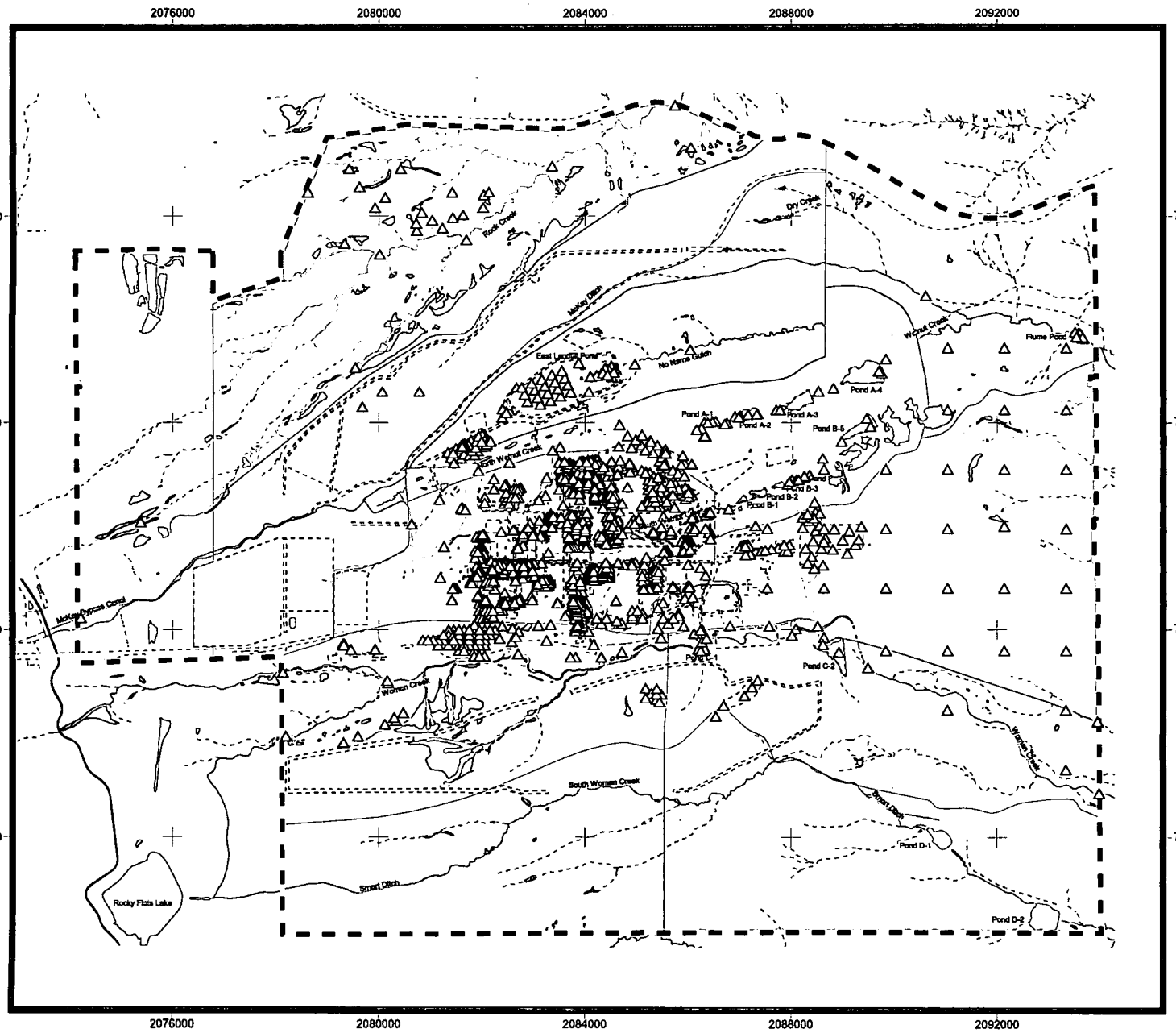

Figure A3.12a

Surface Soil and Surface Sediment Sampling Locations for SVOCs (PAHs not included)

KEY

Sample location
- >= PRG
- < PRG
- Nondetect
- Detected, no PRG
- Nondetect, no PRG
- Historical IHSS/PAC
- Seep

Exposure Unit
- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

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Datum: NAD 27

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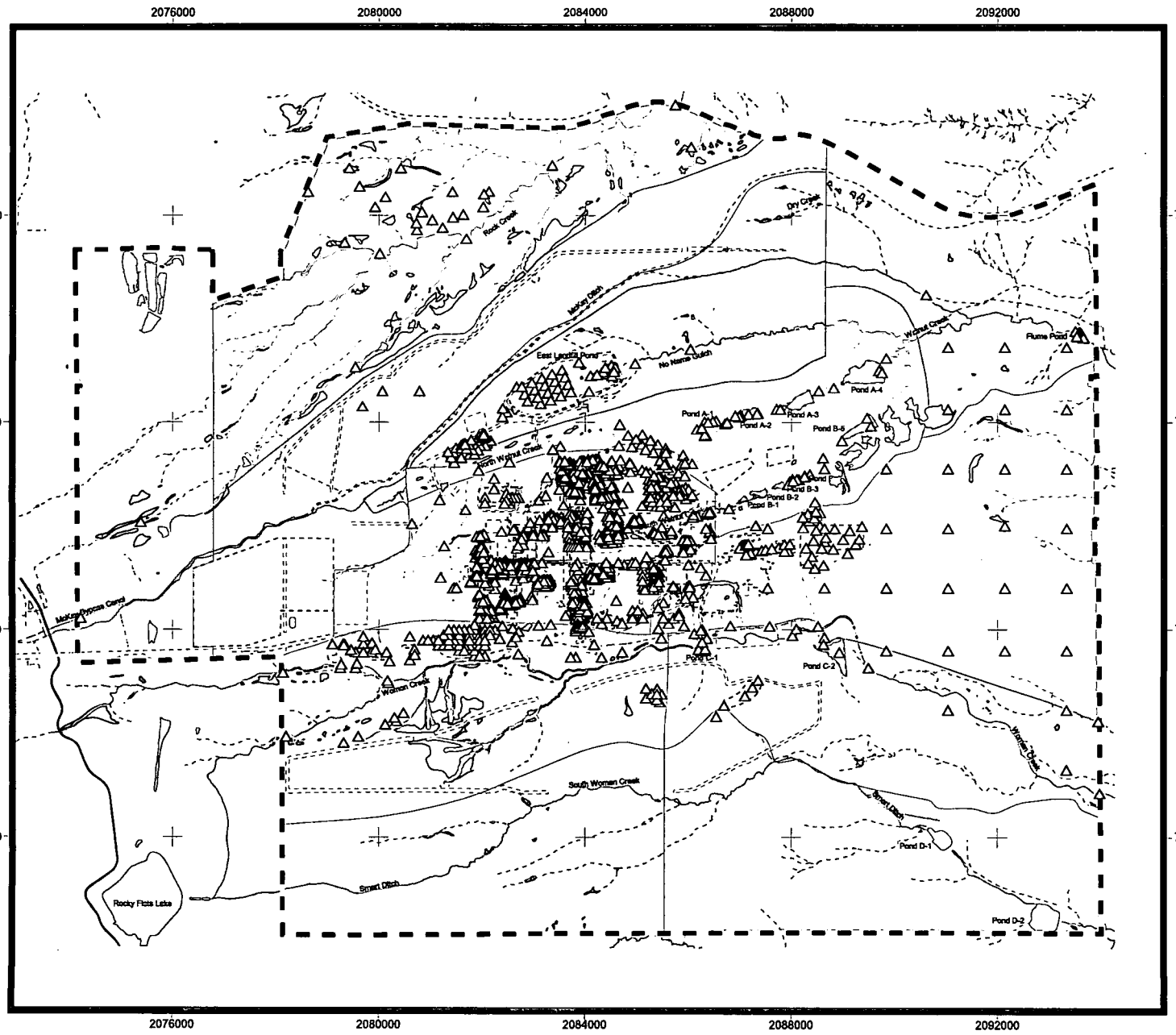

Figure A3.12b

Surface Soil and Surface Sediment Sampling Locations for PAHs

KEY

Sample location
- >= PRG
- < PRG
- Nondetect
- Detected, no PRG
- Nondetect, no PRG
- Historical IHSS/PAC
- Seep

Exposure Unit
- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

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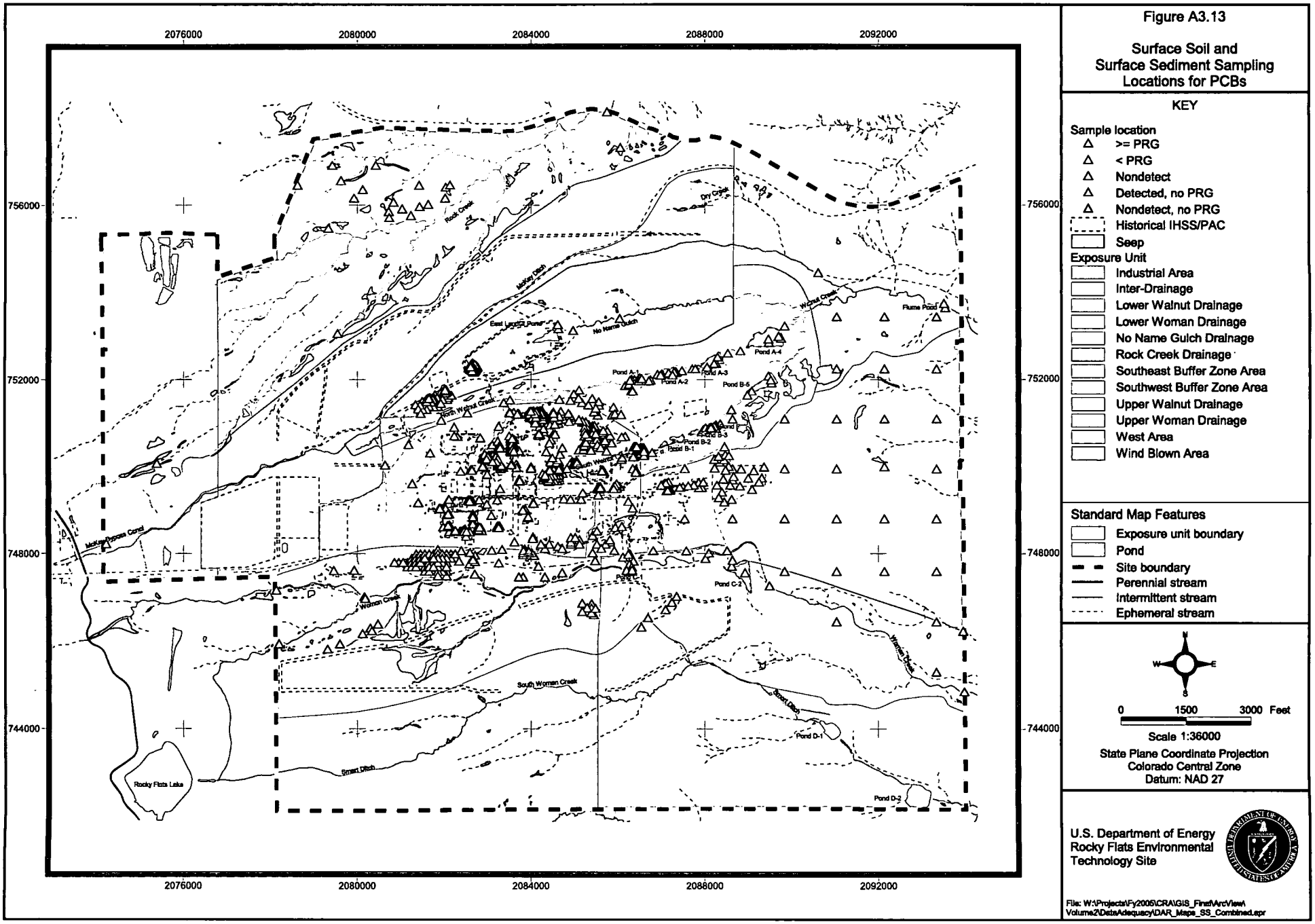
2076000
2080000
2084000
2088000
2092000
756000
752000
748000
744000
Rock Creek
Dry Creek
McKay Ditch
East Walnut Pond
No Name Gulch
Walnut Creek
Plume Pond
Pond A-4
Pond A-1
Pond A-2
Pond A-3
Pond B-5
North Walnut Creek
Pond B-3
Pond B-2
Pond B-1
South Walnut Creek
McKay Possible Cond
Pond C-1
Pond C-2
Woman Creek
South Woman Creek
Woman Tributary
Boulder Ditch
Pond D-1
Smart Ditch
Rocky Flats Lake
Pond D-2
Figure A3.13
Surface Soil and
Surface Sediment Sampling
Locations for PCBs
KEY
Sample location
>= PRG
< PRG
Nondetect
Detected, no PRG
Nondetect, no PRG
Historical IHSS/PAC
Seep
Exposure Unit
Industrial Area
Inter-Drainage
Lower Walnut Drainage
Lower Woman Drainage
No Name Gulch Drainage
Rock Creek Drainage
Southeast Buffer Zone Area
Southwest Buffer Zone Area
Upper Walnut Drainage
Upper Woman Drainage
West Area
Wind Blown Area
Standard Map Features
Exposure unit boundary
Pond
Site boundary
Perennial stream
Intermittent stream
Ephemeral stream
N
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1500
3000 Feet
Scale 1:36000
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27
U.S. Department of Energy
Rocky Flats Environmental
Technology Site
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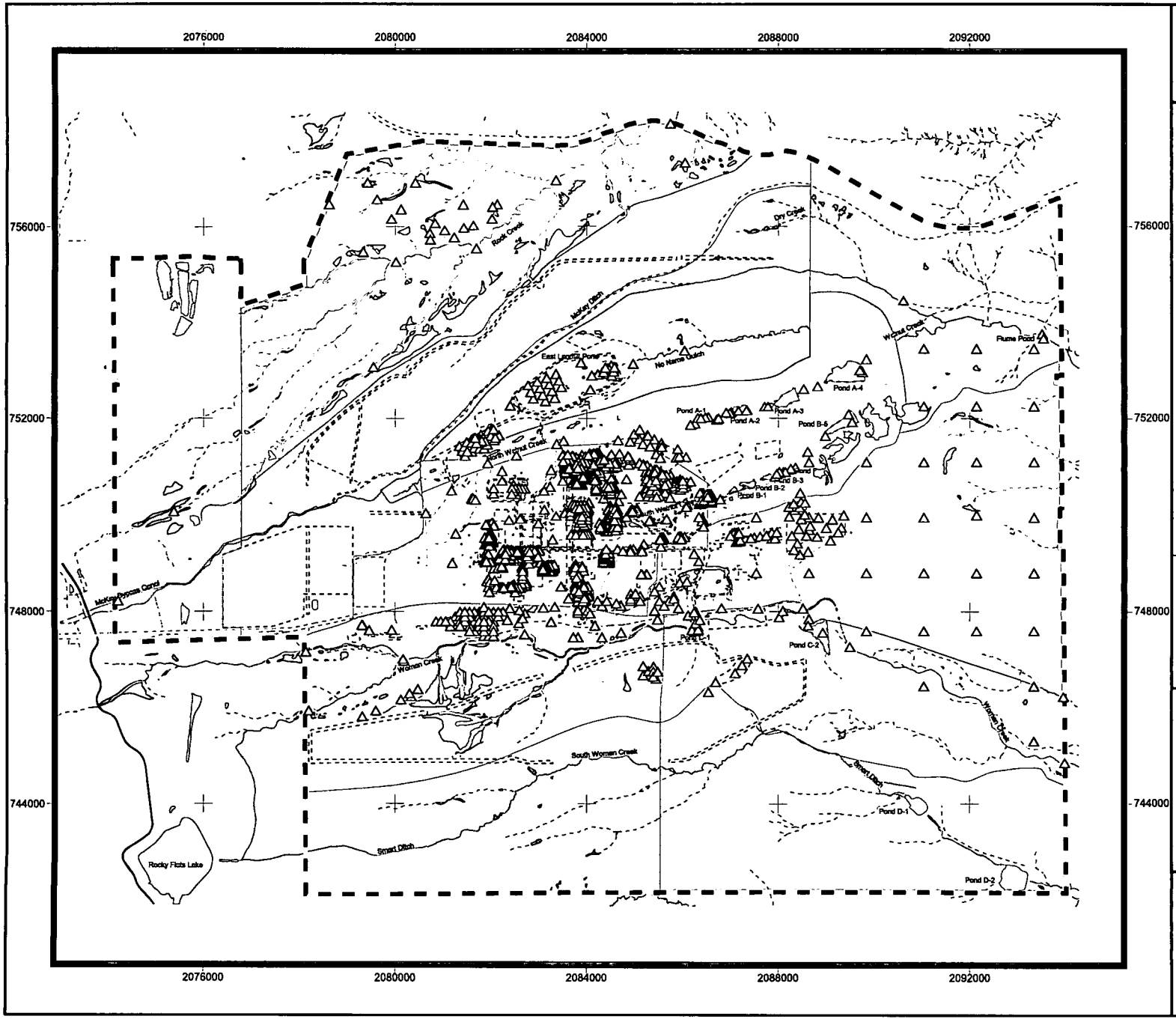

Figure A3.14

Surface Soil and Surface Sediment Sampling Locations for Pesticides

KEY

Sample location
- >= PRG
- < PRG
- Nondetect
- Detected, no PRG
- Nondetect, no PRG
- Historical IHSS/PAC
- Seep

Exposure Unit
- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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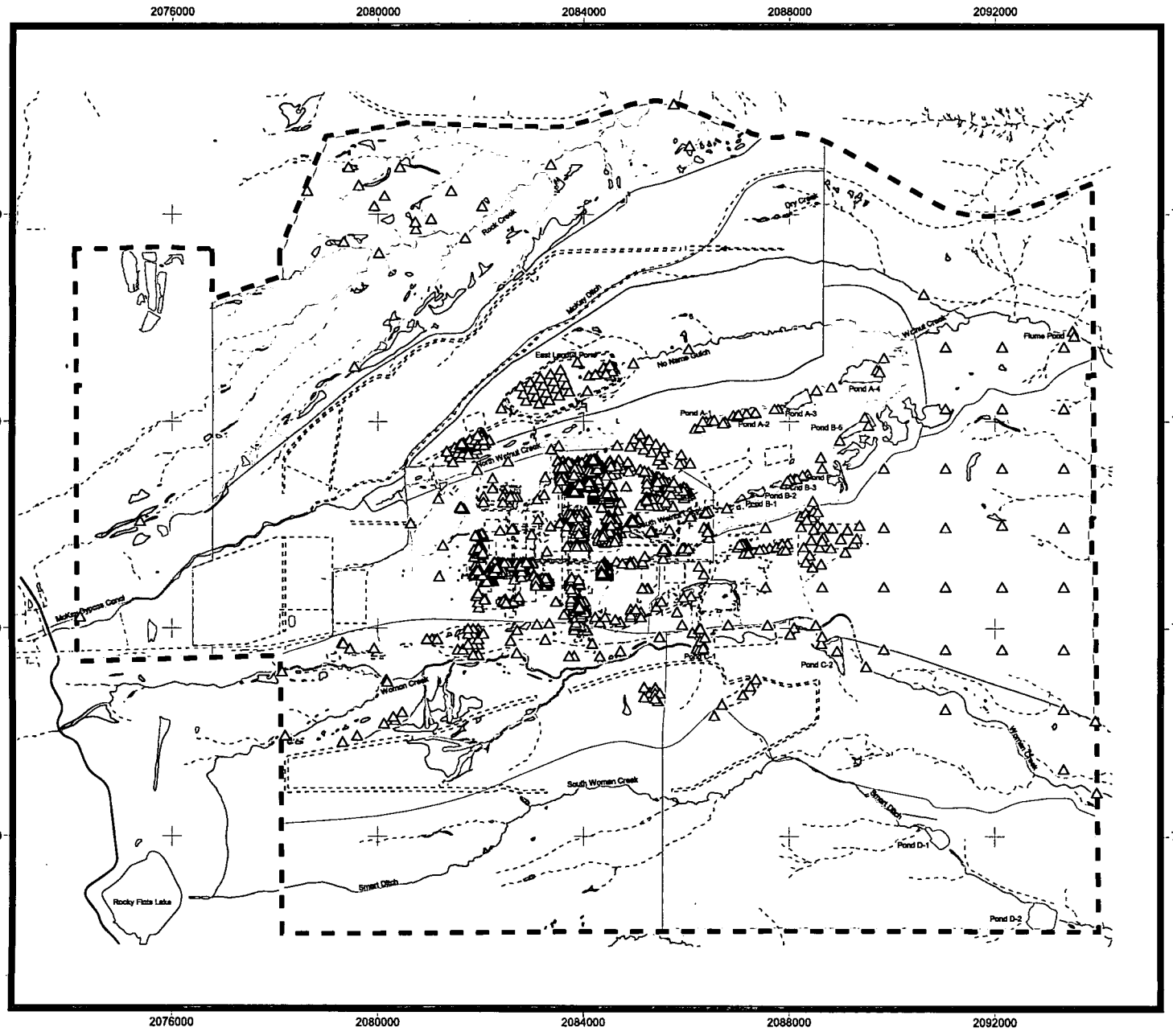

Figure A3.15

Surface Soil and Surface Sediment Sampling Locations for Herbicides

KEY

Sample location
- >= PRG
- < PRG
- Nondetect
- Detected, no PRG
- Nondetect, no PRG
- Historical IHSS/PAC
- Seep

Exposure Unit
- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
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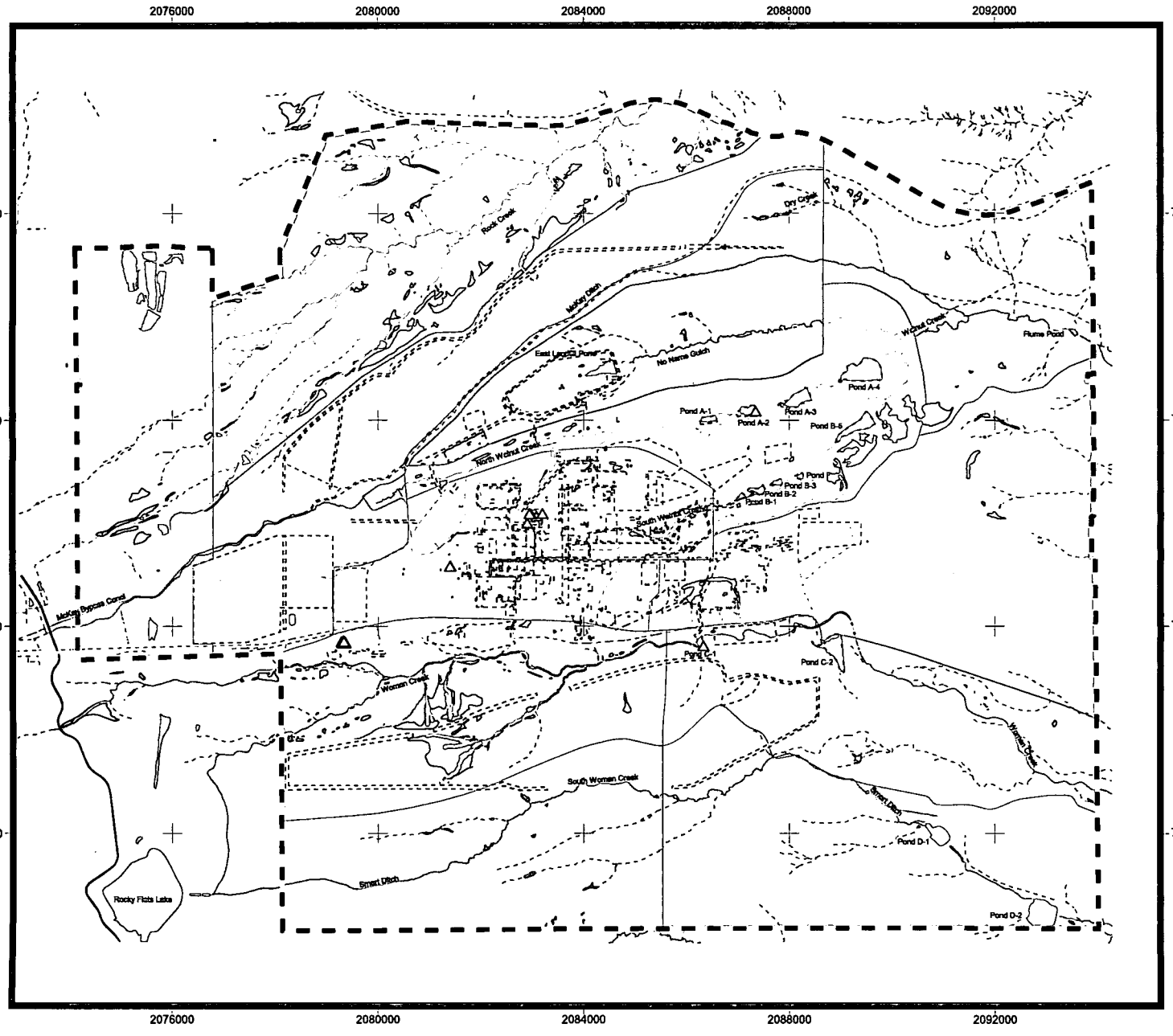

Figure A3.16

Surface Soil and Surface Sediment Sampling Locations for Dioxins and Furans

KEY

Sample location
- >= PRG
- < PRG
- Nondetect
- Detected, no PRG
- Nondetect, no PRG
- Historical IHSS/PAC
- Seep

Exposure Unit
- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
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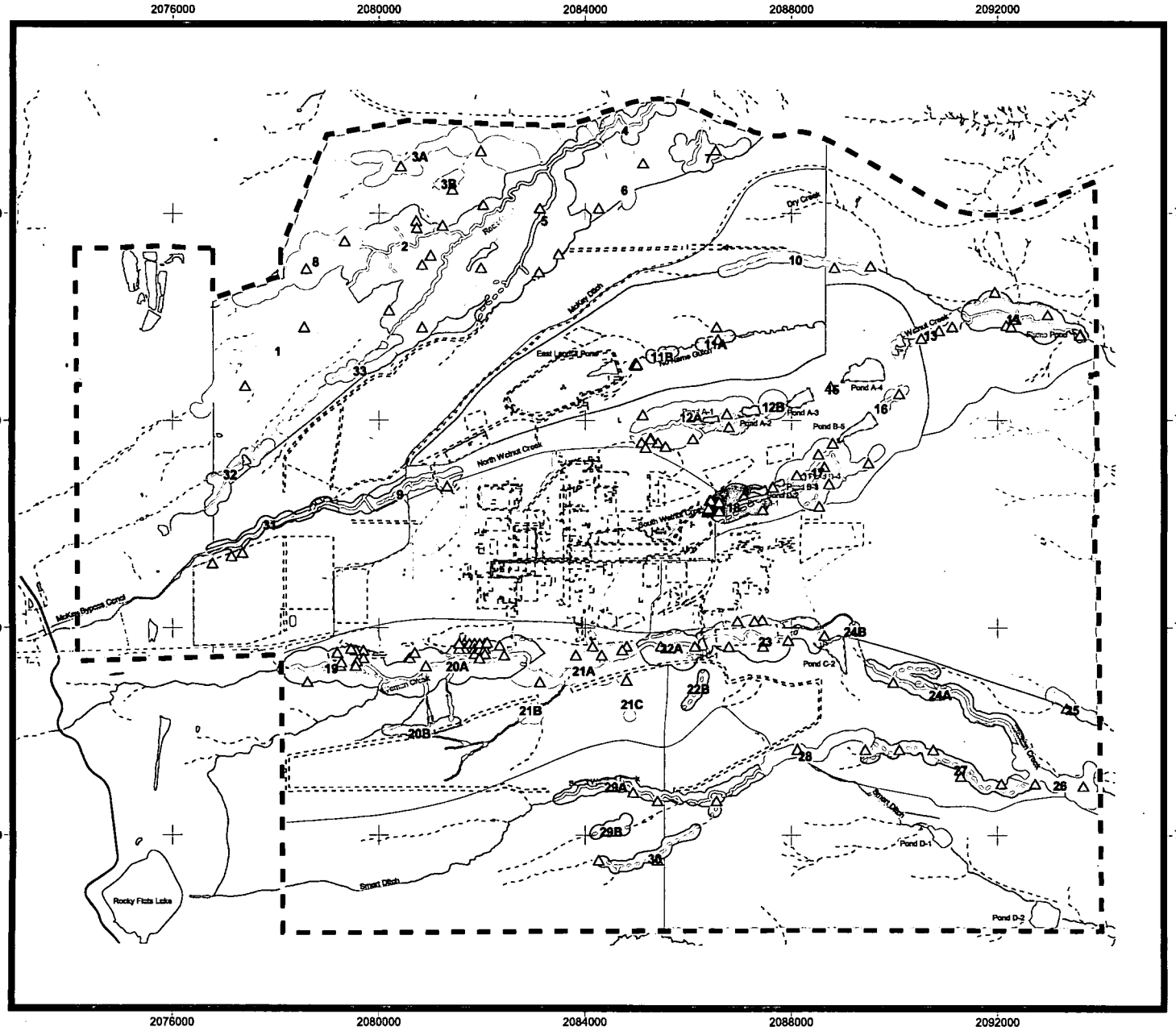

Figure A3.17

Surface Soil Sampling Locations in PMJM Habitat Patches for Radionuclides

KEY

Sample location
- >= ESL
- < ESL
- Nondetect
- Detected, no ESL
- Nondetect, no ESL
- Historical IHSS/PAC
- PMJM habitat patch
- 1 PMJM habitat patch ID

Exposure Unit
- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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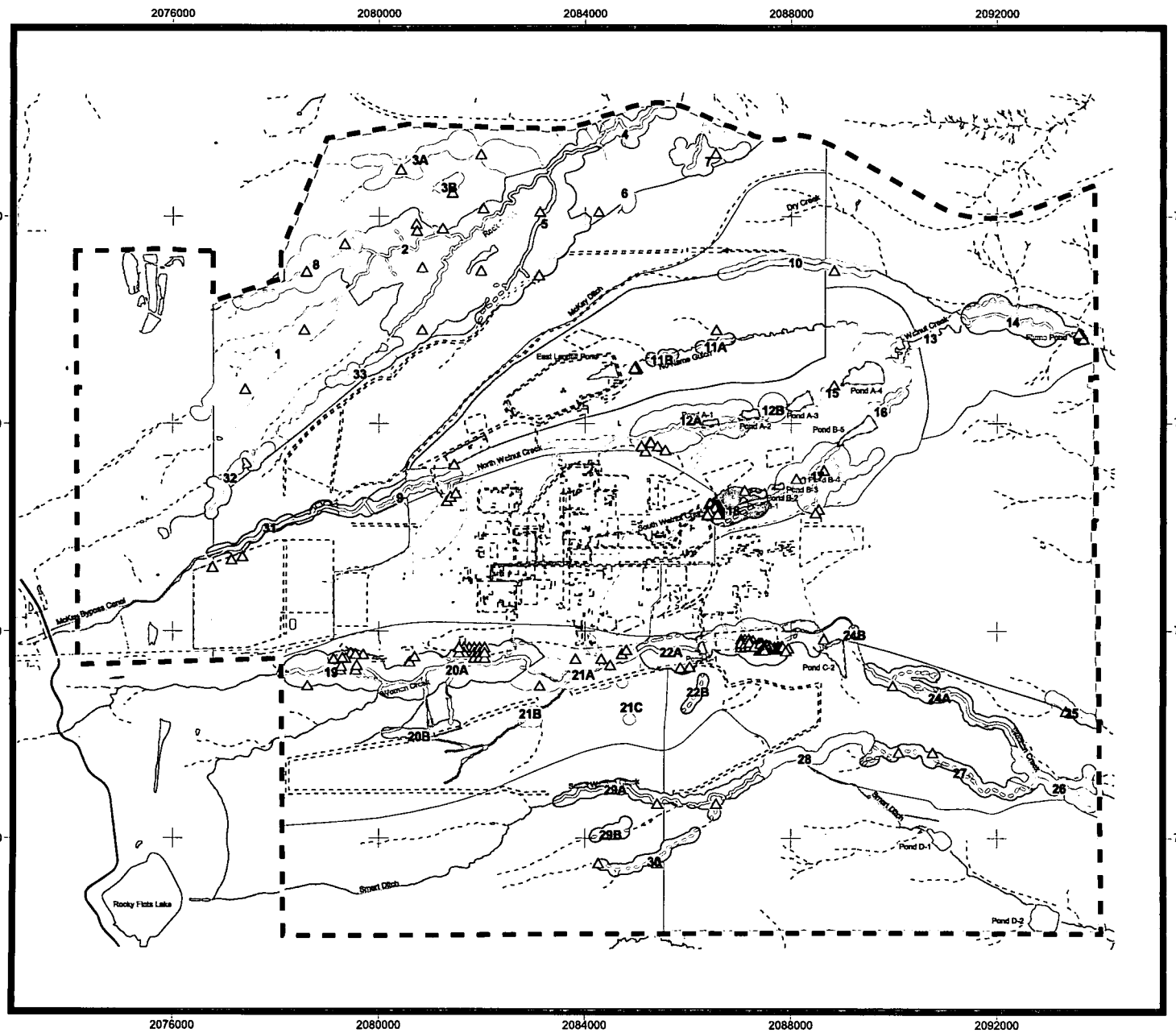

Figure A3.18

Surface Soil Sampling Locations in PMJM Habitat Patches for Metals

KEY

Sample location
- >= ESL
- < ESL
- Nondetect
- Detected, no ESL
- Nondetect, no ESL
- Historical IHSS/PAC
- PMJM habitat patch
- 1 PMJM habitat patch ID

Exposure Unit
- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

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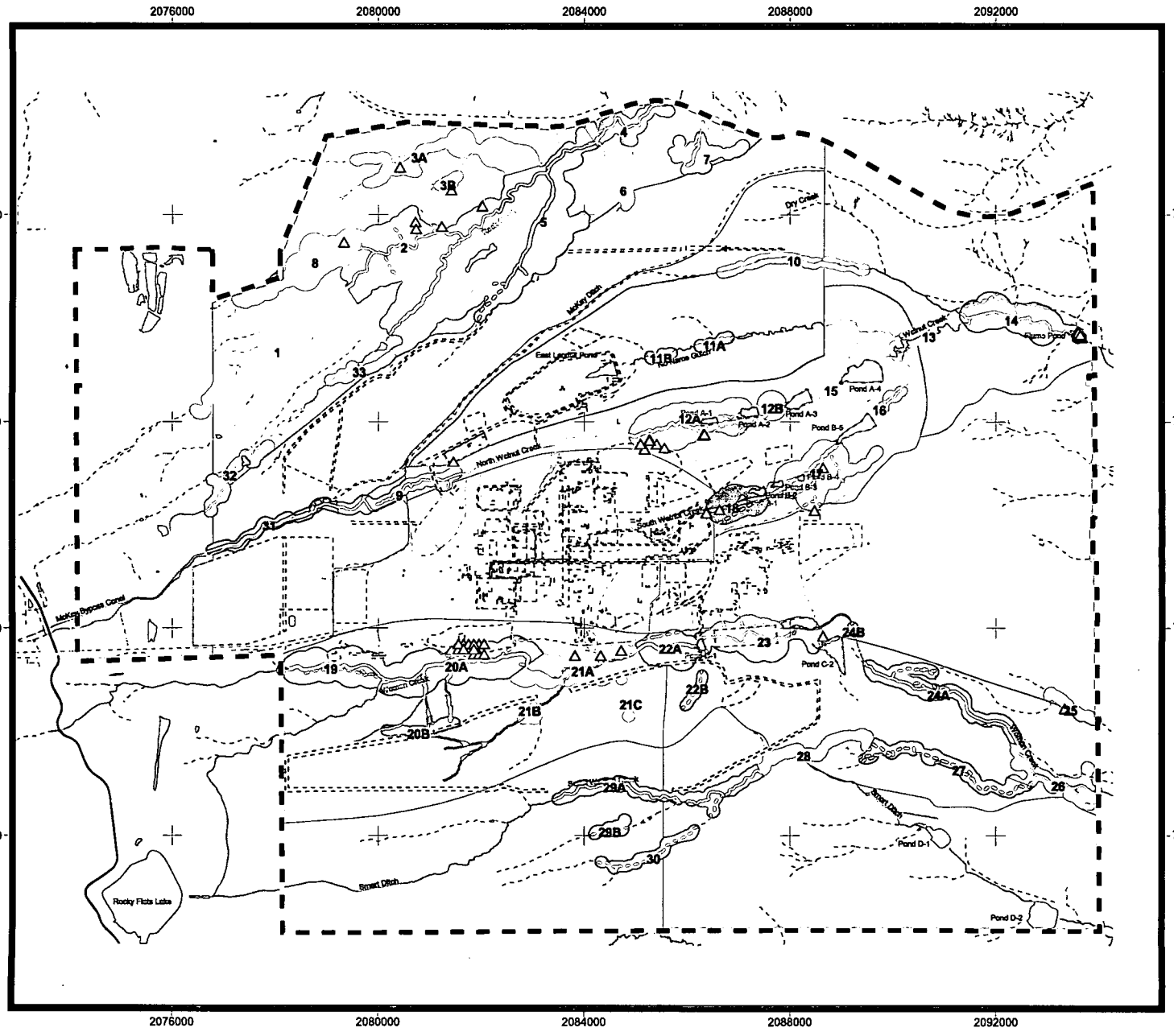

Figure A3.19

Surface Soil Sampling Locations in PMJM Habitat Patches for VOCs

KEY

Sample location
- >= ESL
- < ESL
- Nondetect
- Detected, no ESL
- Nondetect, no ESL
- Historical IHSS/PAC
- PMJM habitat patch
- 1 PMJM habitat patch ID

Exposure Unit
- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

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Datum: NAD 27

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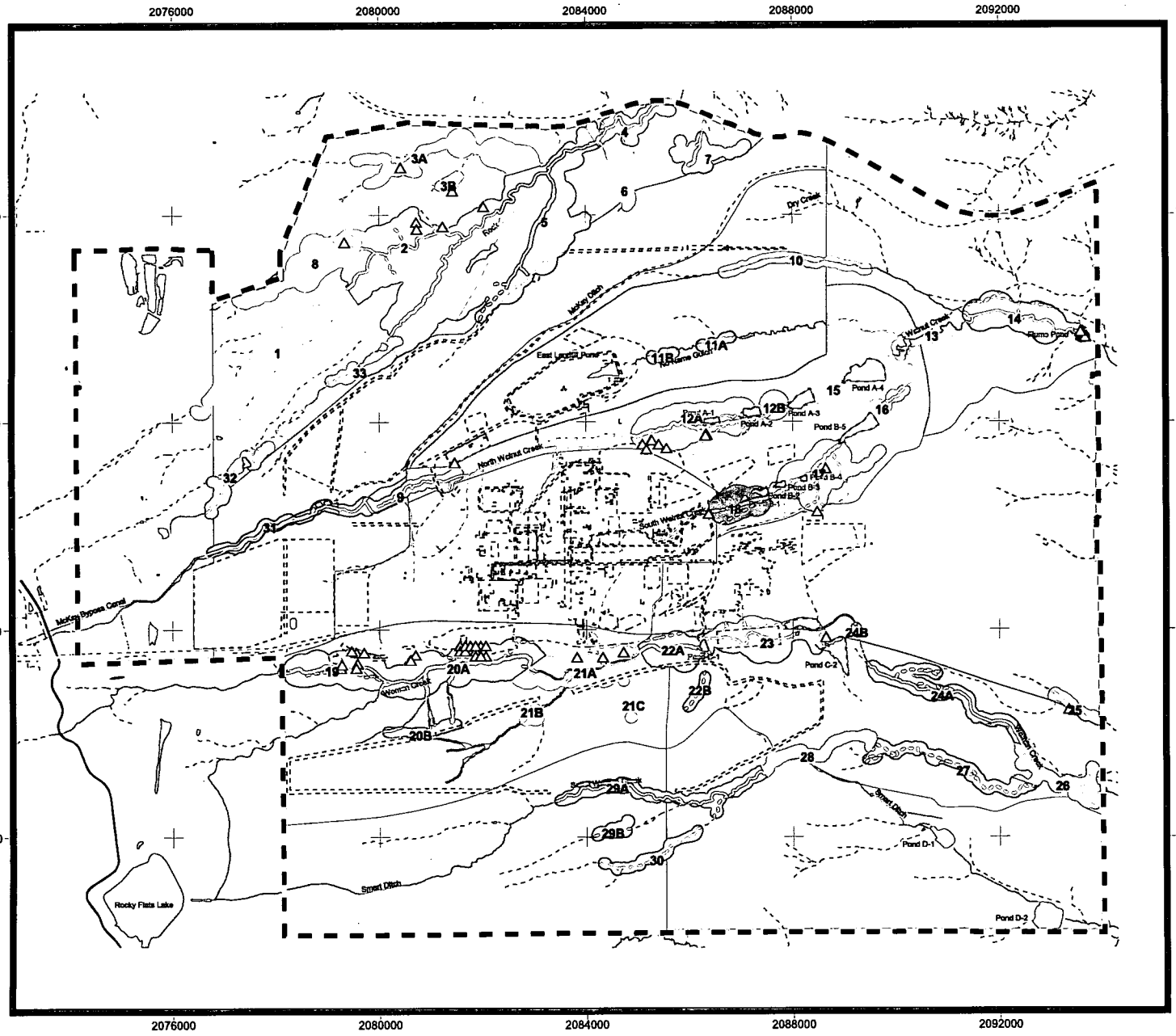

Figure A3.20

Surface Soil Sampling Locations in PMJM Habitat Patches for SVOCs

KEY

Sample location
- >= ESL
- < ESL
- Nondetect
- Detected, no ESL
- Nondetect, no ESL
- Historical IHSS/PAC
- PMJM habitat patch
- 1 PMJM habitat patch ID

Exposure Unit
- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

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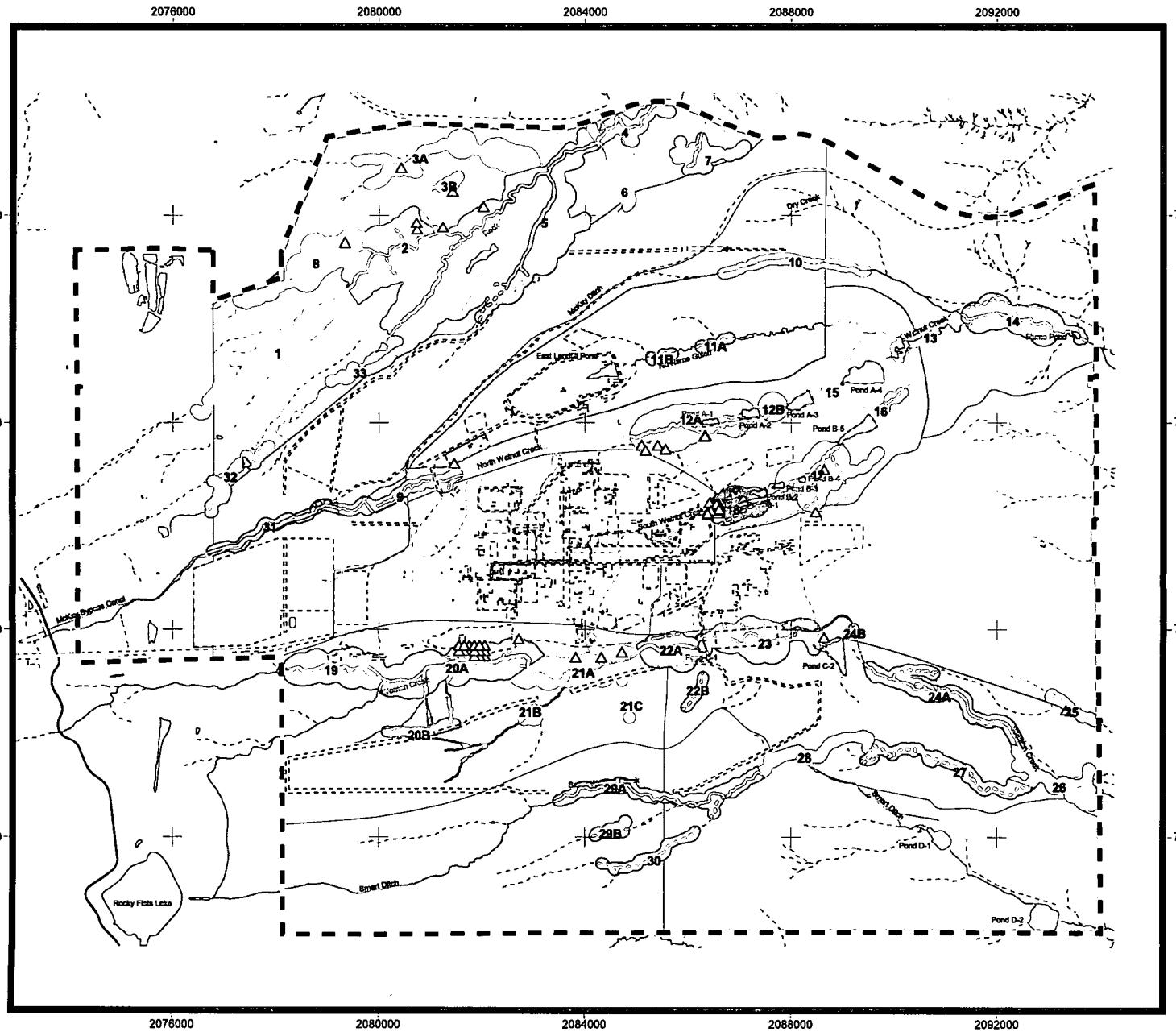

Figure A3.21

Surface Soil Sampling Locations in PMJM Habitat Patches for PCBs

KEY

Sample location
- >= ESL
- < ESL
- Nondetect
- Detected, no ESL
- Nondetect, no ESL
- Historical IHSS/PAC
- PMJM habitat patch
- 1 PMJM habitat patch ID

Exposure Unit
- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

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Datum: NAD 27

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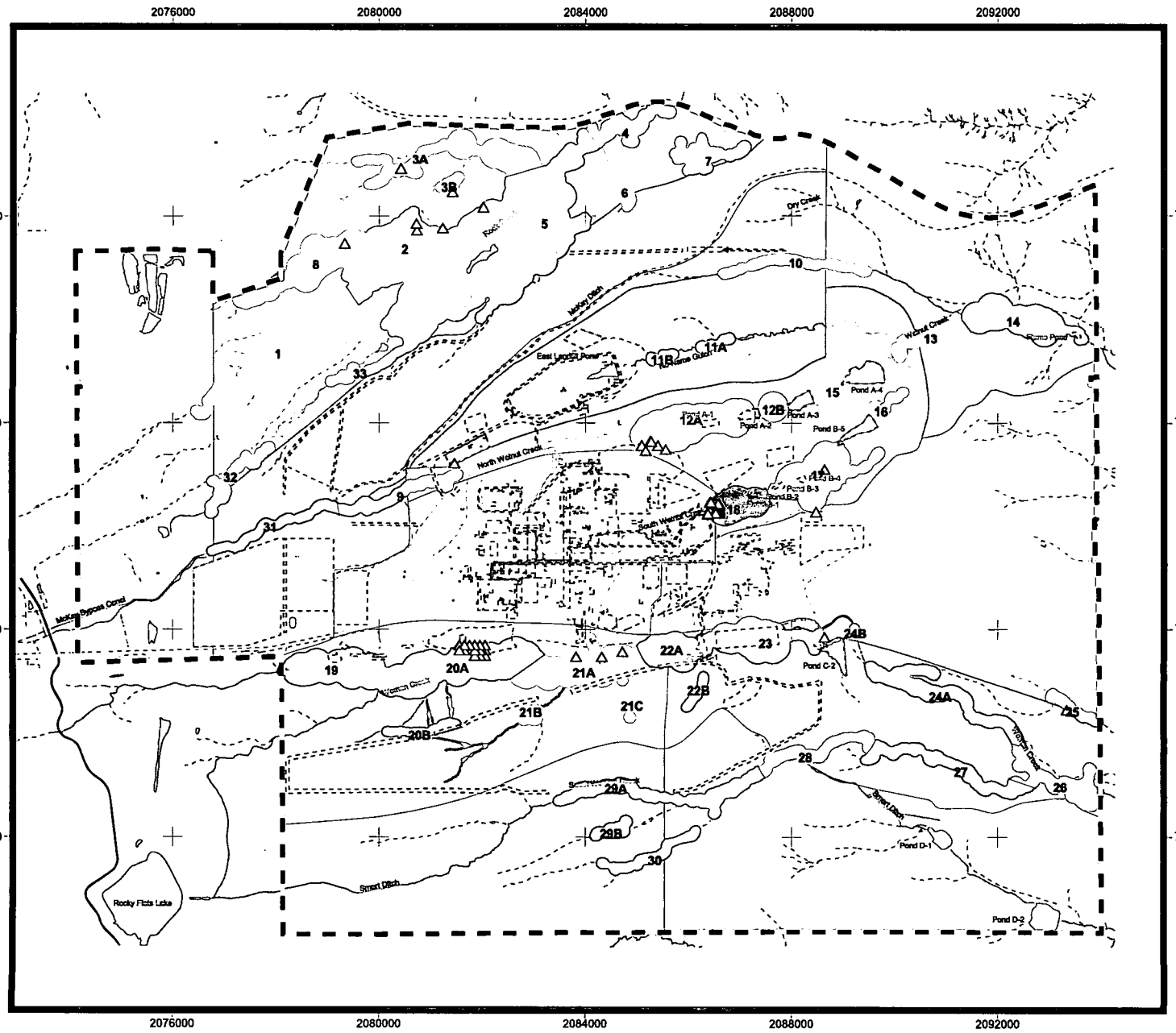

Figure A3.22

Surface Soil Sampling Locations in PMJM Habitat Patches for Pesticides

KEY

Sample location
- >= ESL
- < ESL
- Nondetect
- Detected, no ESL
- Nondetect, no ESL
- Historical IHSS/PAC
- PMJM habitat patch
- 1 PMJM habitat patch ID

Exposure Unit
- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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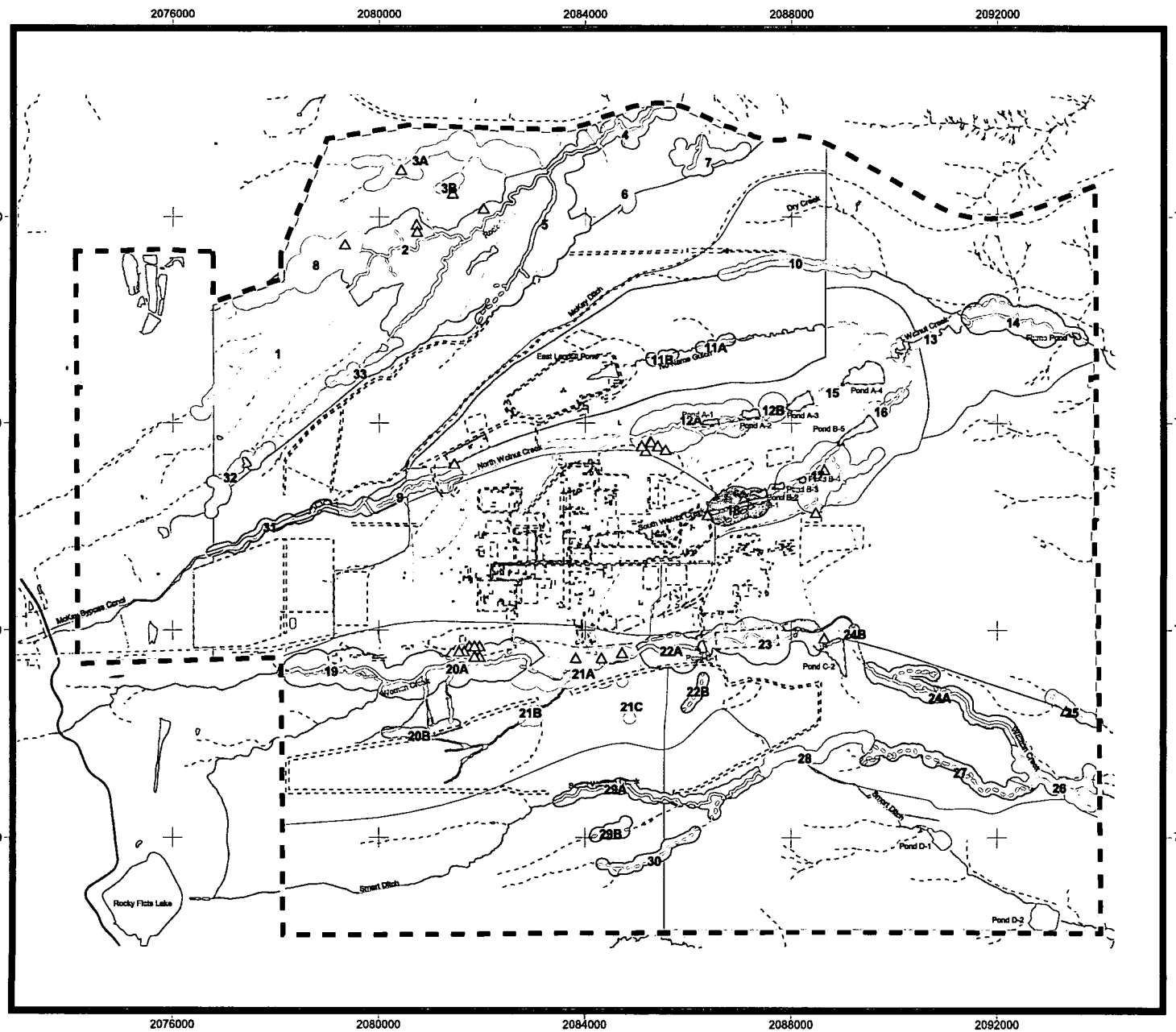

Figure A3.23

Surface Soil Sampling Locations in PMJM Habitat Patches for Herbicides

KEY

Sample location
- >= ESL
- < ESL
- Nondetect
- Detected, no ESL
- Nondetect, no ESL
- Historical IHSS/PAC
- PMJM habitat patch
- 1 PMJM habitat patch ID

Exposure Unit
- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
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0 1500 3000 Feet

Scale 1:36000

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Colorado Central Zone
Datum: NAD 27

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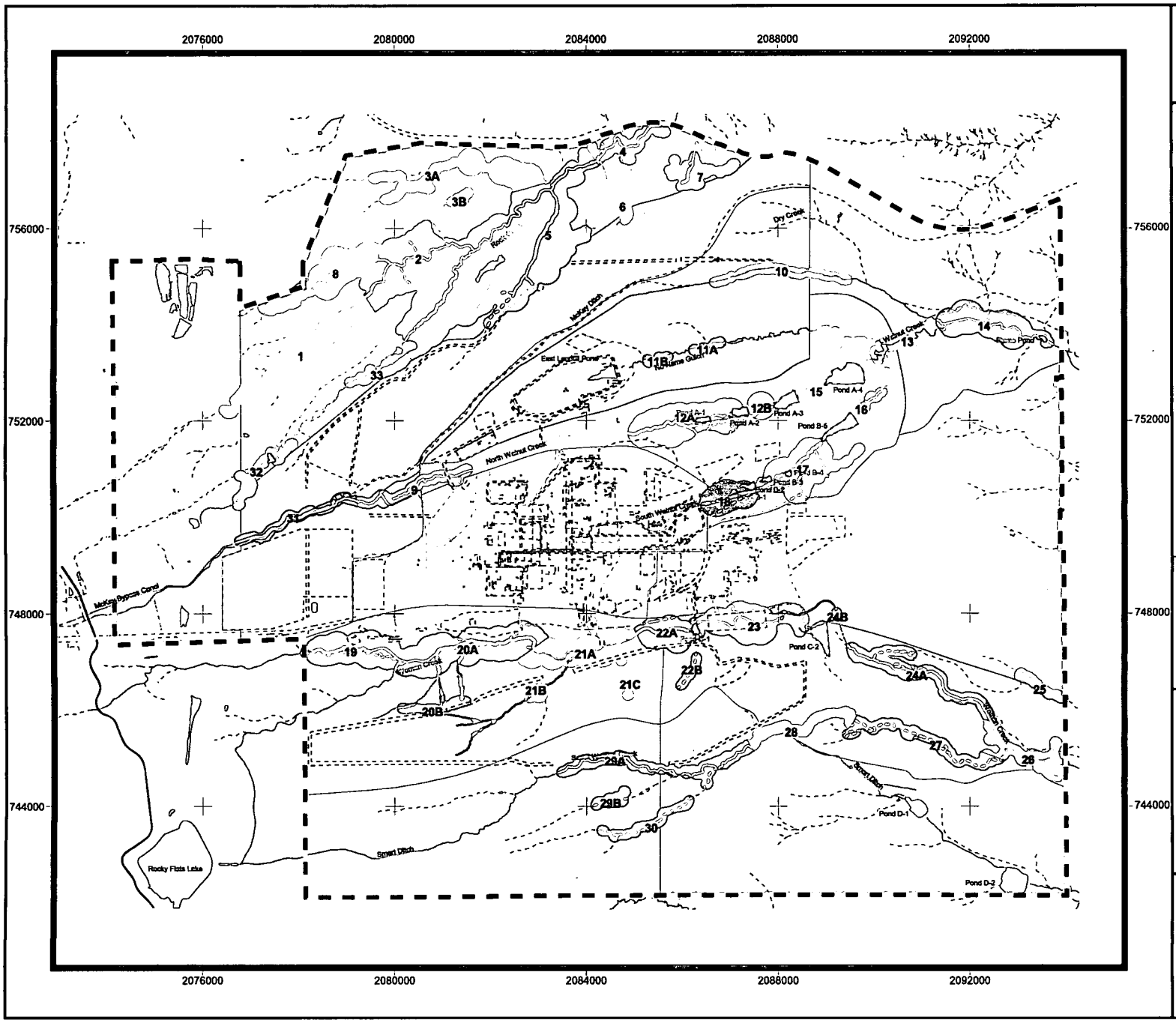

Figure A3.24

Surface Soil Sampling Locations in PMJM Habitat Patches for Dioxins and Furans

KEY

Sample location
- △ >= ESL
- △ < ESL
- △ Nondetect
- △ Detected, no ESL
- △ Nondetect, no ESL
- Historical IHSS/PAC
- PMJM habitat patch
- 1 PMJM habitat patch ID

Exposure Unit
- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
Colorado Central Zone
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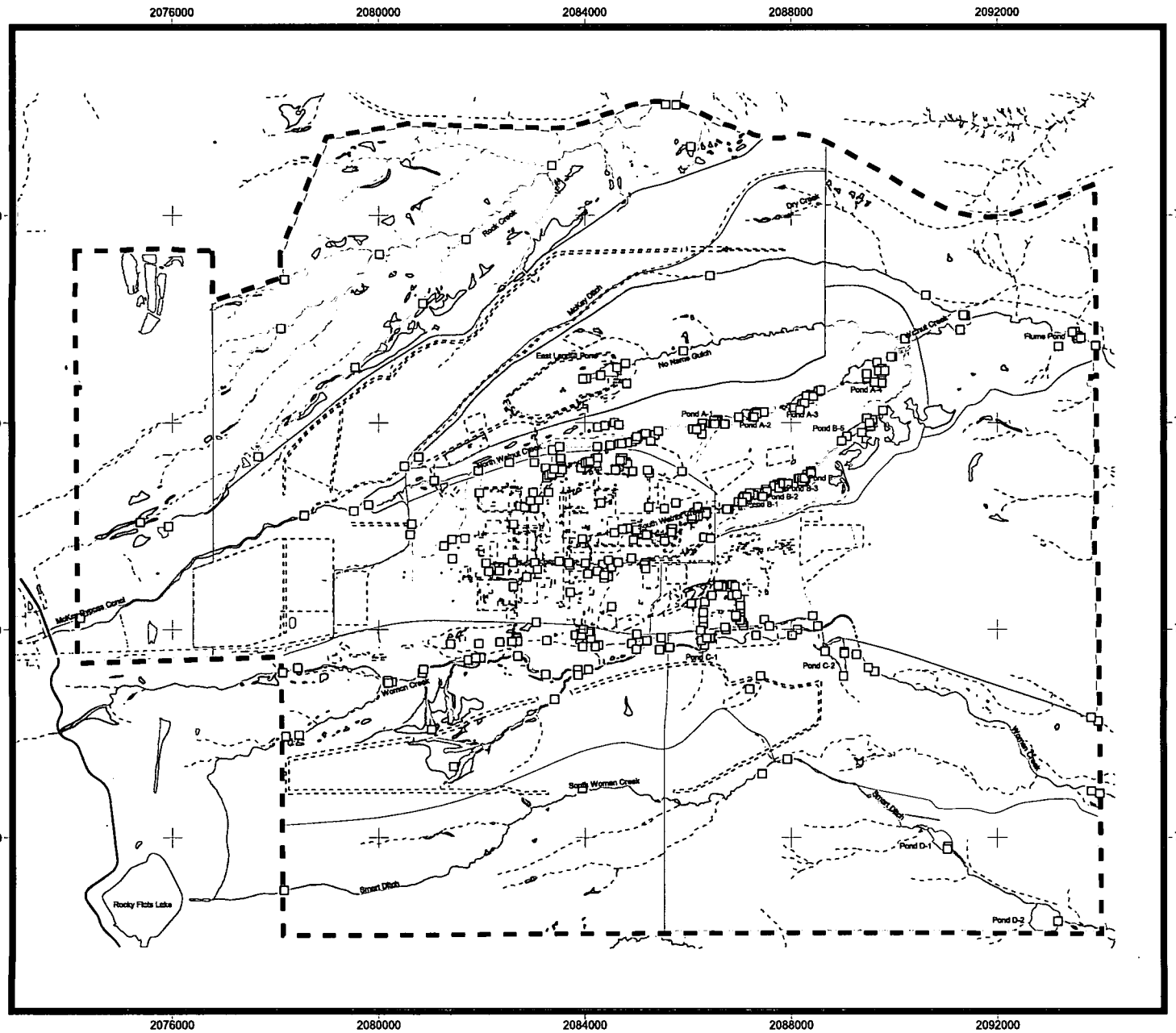

Figure A3.25

Surface Water Sampling Locations for Radionuclides

KEY

Sample location
- >= PRG
- < PRG
- Nondetect
- Detected, no PRG
- Nondetect, no PRG
- Historical IHSS/PAC
- Seep

Exposure Unit
- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
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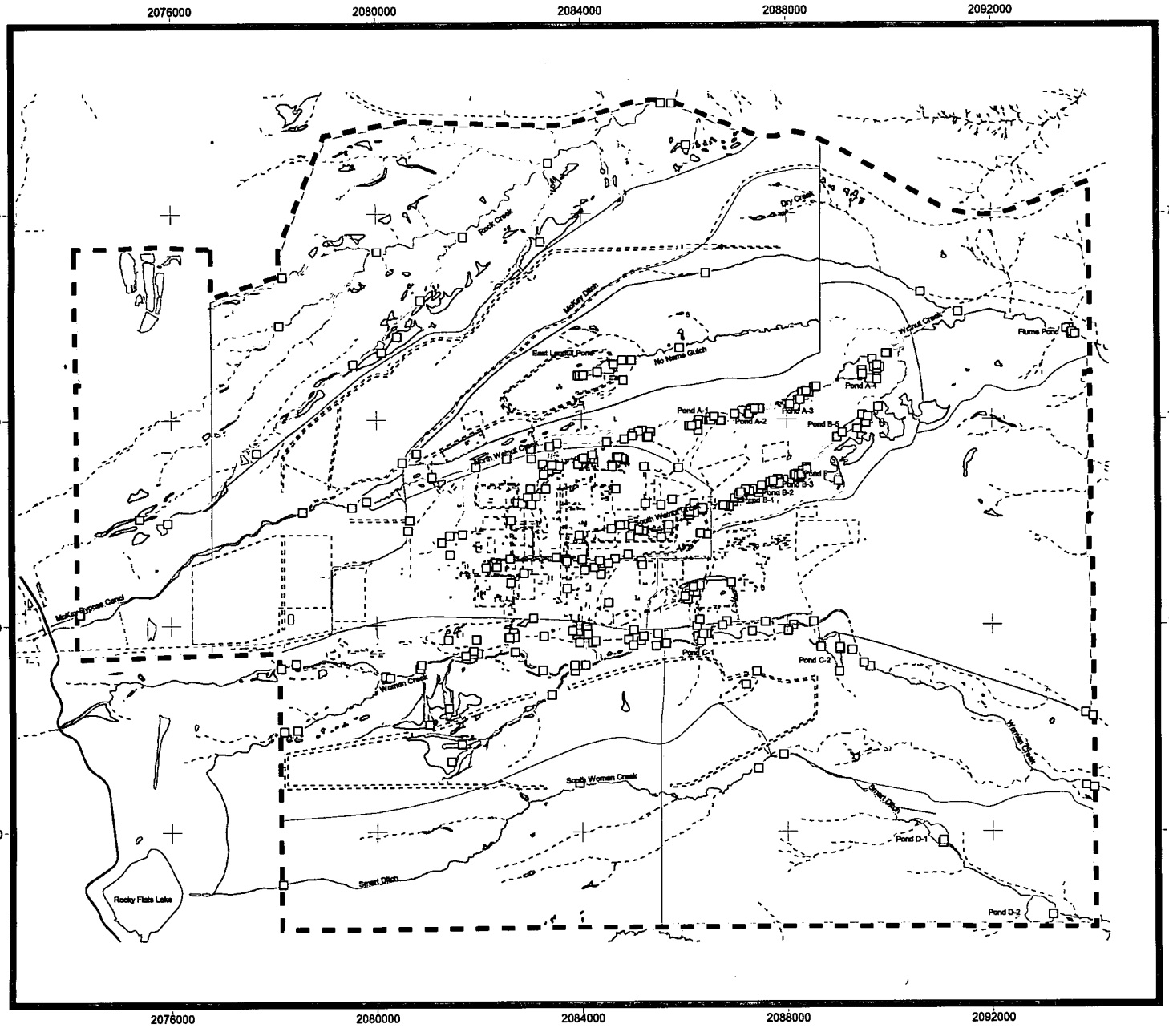

Figure A3.26

Surface Water Sampling Locations for Metals

KEY

Sample location
- >= PRG
- < PRG
- Nondetect
- Detected, no PRG
- Nondetect, no PRG
- Historical IHSS/PAC
- Seep

Exposure Unit
- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental
Technology Site

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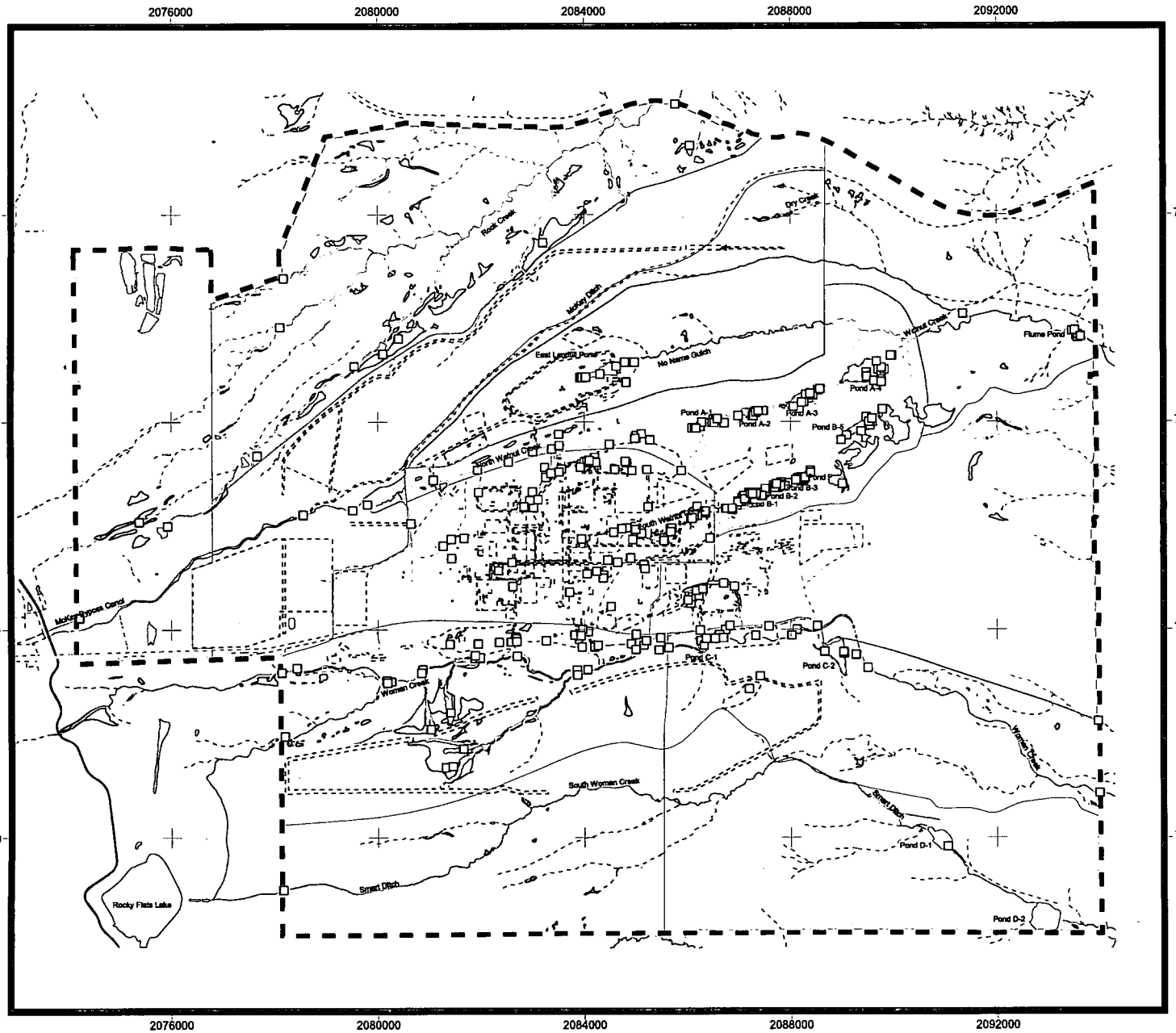

Figure A3.27

Surface Water Sampling Locations for VOCs

KEY

Sample location
- >= PRG
- < PRG
- Nondetect
- Detected, no PRG
- Nondetect, no PRG
- Historical IHSS/PAC
- Seep

Exposure Unit
- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

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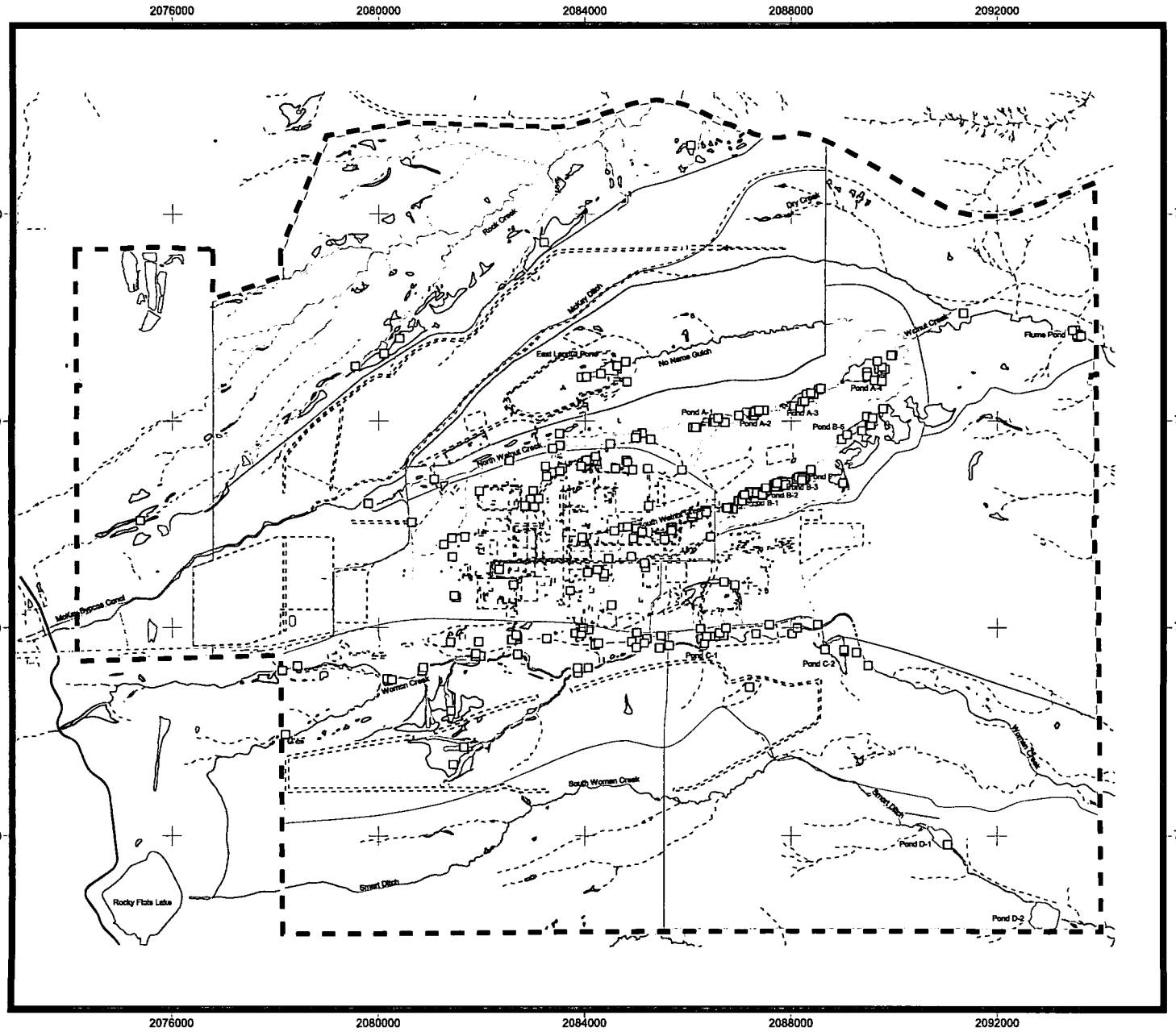

Figure A3.28

Surface Water Sampling Locations for SVOCs

KEY

Sample location
- >= PRG
- < PRG
- Nondetect
- Detected, no PRG
- Nondetect, no PRG
- Historical IHSS/PAC
- Seep

Exposure Unit
- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
W E
S

0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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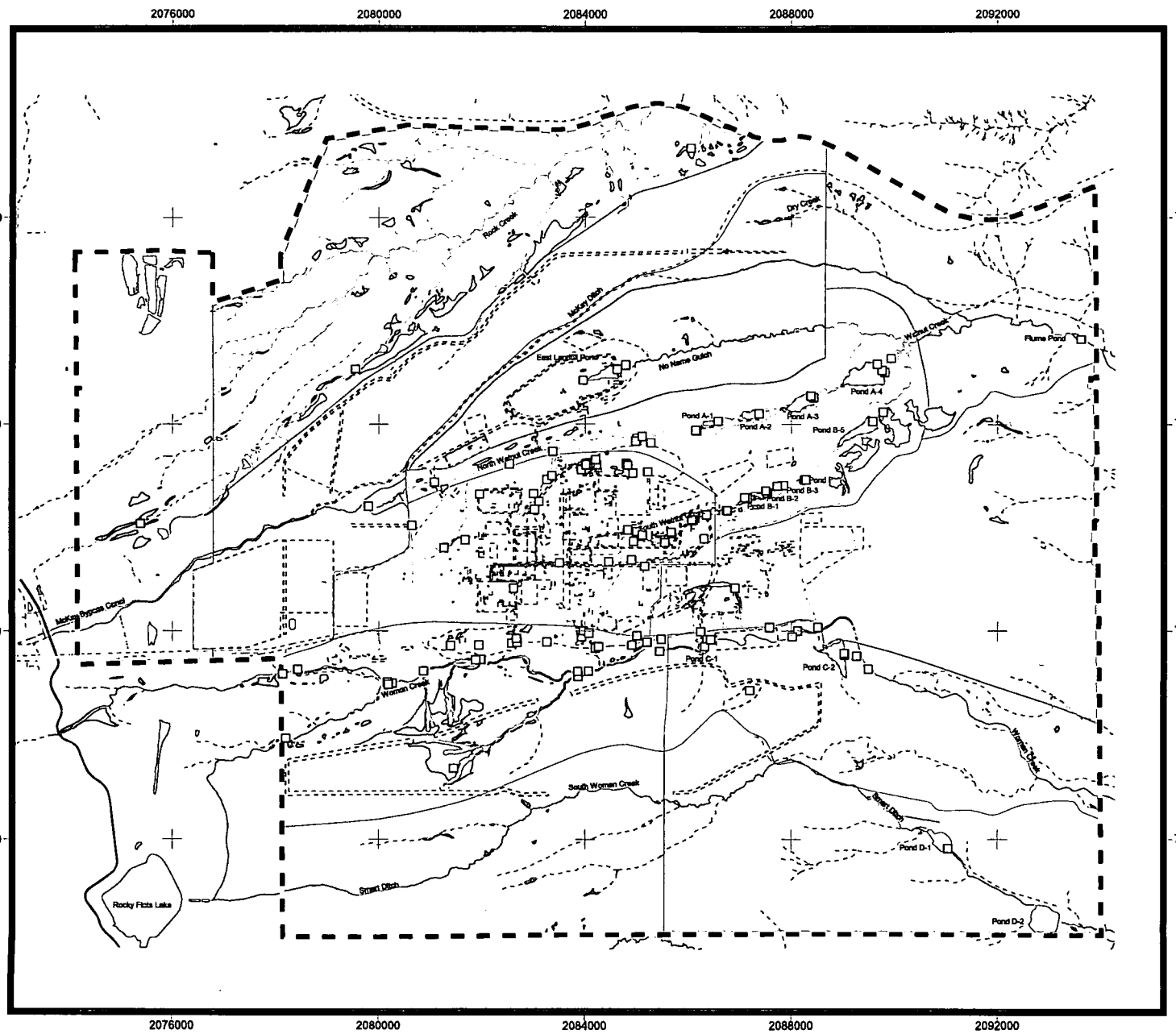

Figure A3.29

Surface Water Sampling Locations for PCBs

KEY

Sample location
- >= PRG
- < PRG
- Nondetect
- Detected, no PRG
- Nondetect, no PRG
- Historical IHSS/PAC
- Seep

Exposure Unit
- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

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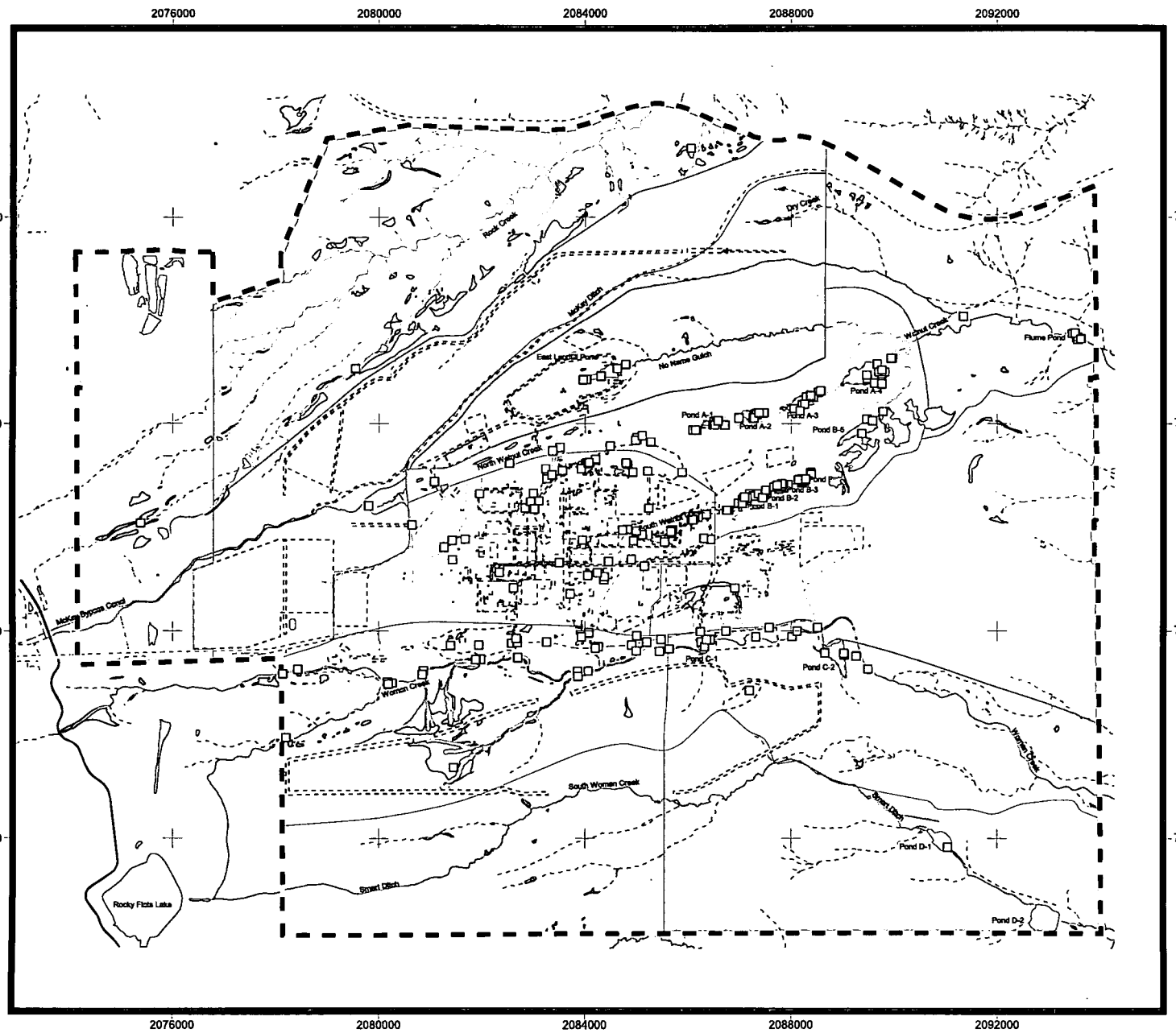

Figure A3.30

Surface Water Sampling Locations for Pesticides

KEY

Sample location
- >= PRG
- < PRG
- Nondetect
- Detected, no PRG
- Nondetect, no PRG
- Historical IHSS/PAC
- Seep

Exposure Unit
- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental
Technology Site

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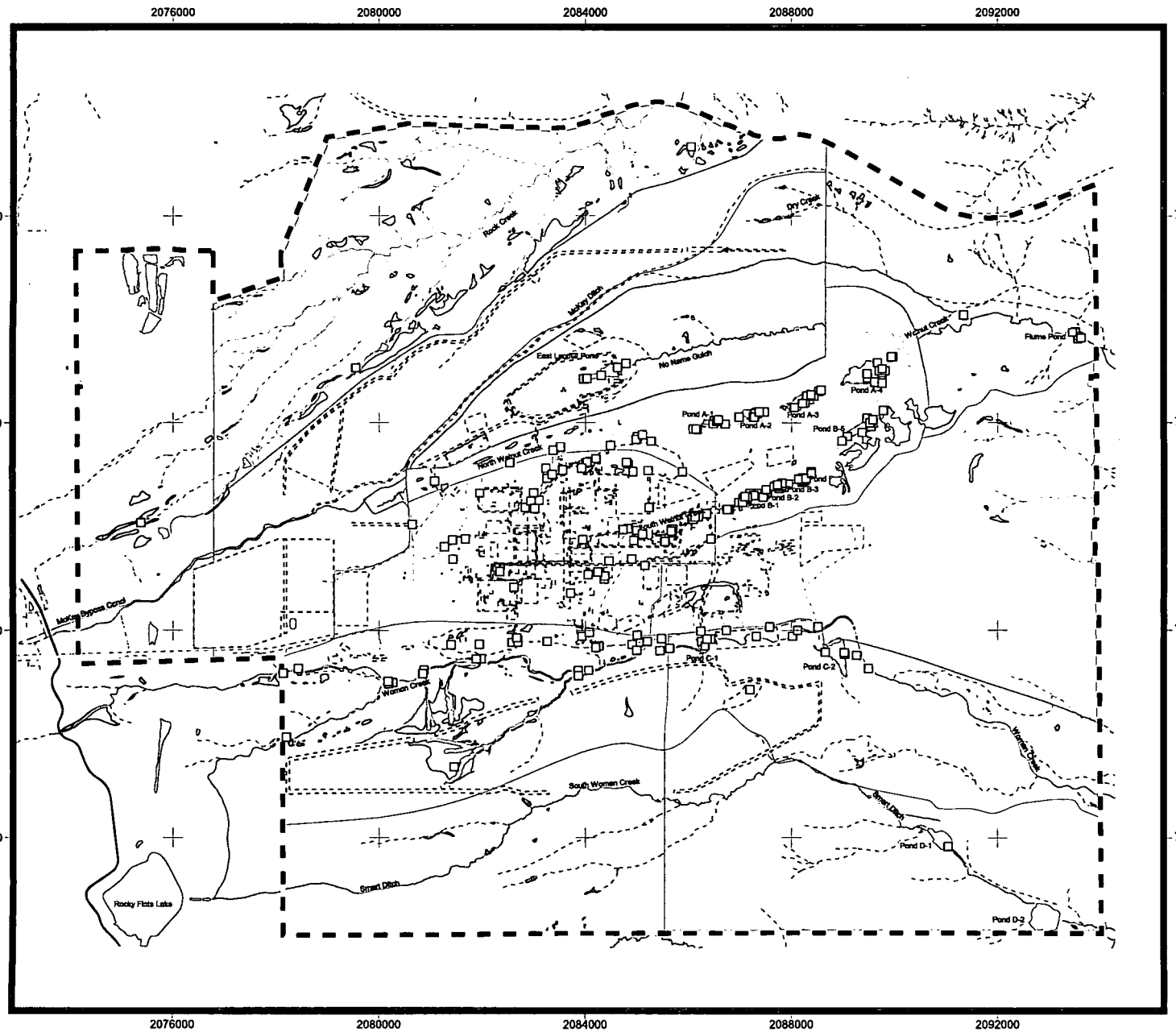

Figure A3.31

Surface Water Sampling Locations for Herbicides

KEY

Sample location
- >= PRG
- < PRG
- Nondetect
- Detected, no PRG
- Nondetect, no PRG
- Historical IHSS/PAC
- Seep

Exposure Unit
- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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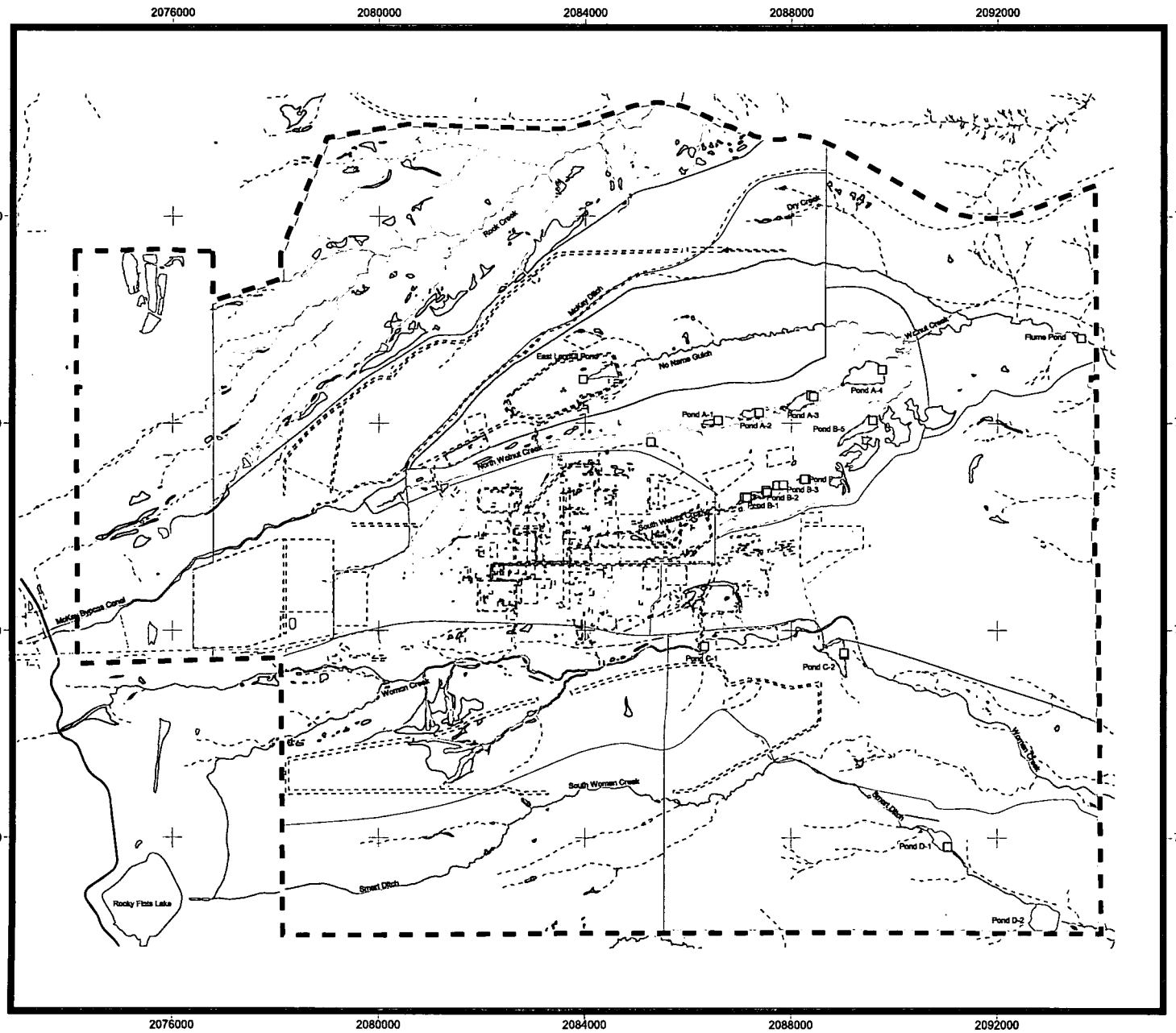

Figure A3.32

Surface Water Sampling Locations for Dioxins and Furans

KEY

Sample location
- >= PRG
- < PRG
- Nondetect
- Detected, no PRG
- Nondetect, no PRG
- Historical IHSS/PAC
- Seep

Exposure Unit
- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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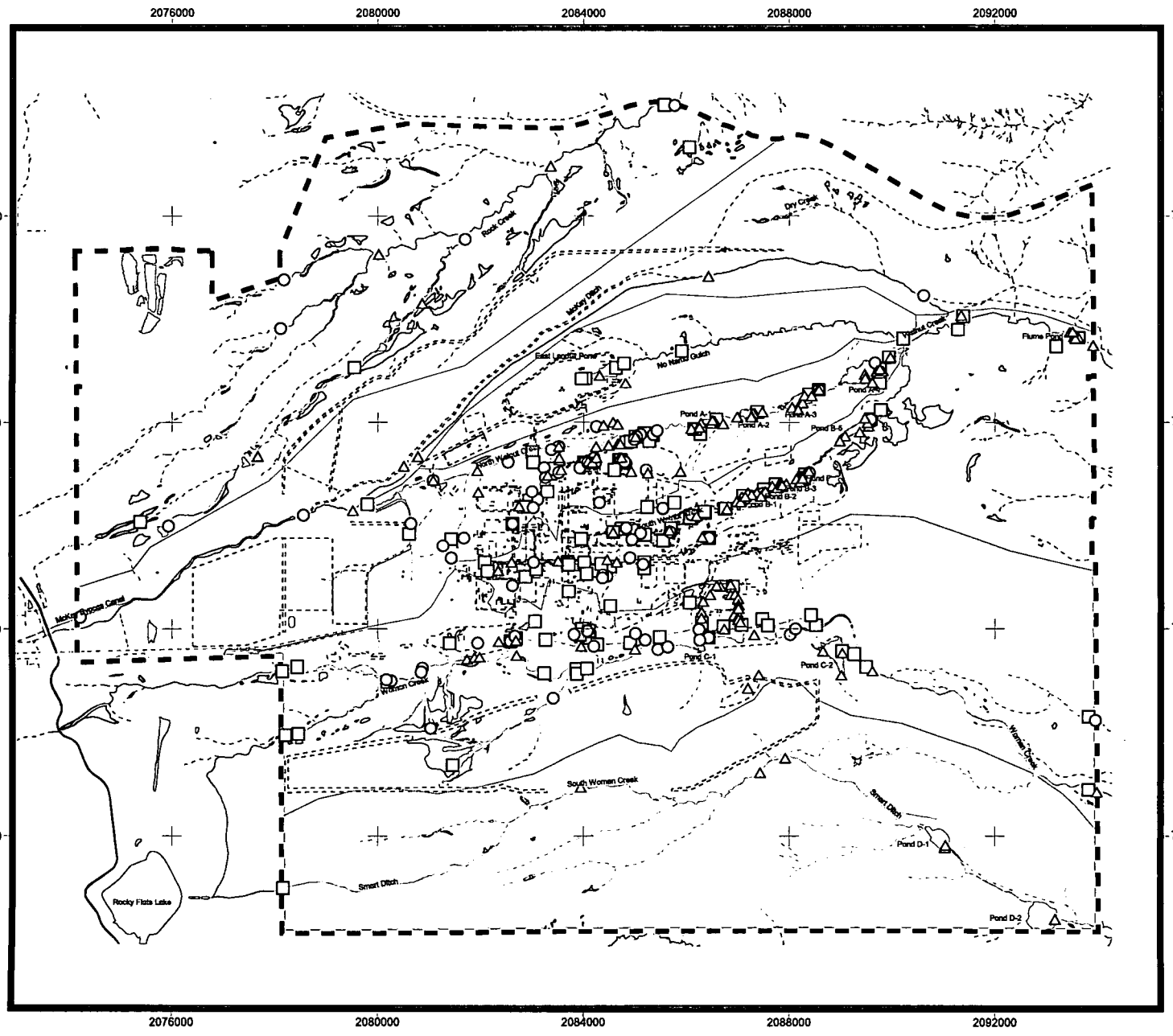

Figure A3.33

Surface Water Sampling Frequency for Radionuclides

KEY

Sample location
- Sampling frequency = 1
- Sampling frequency = 2-4
- Sampling frequency = >4
- Historical IHSS/PAC
- Seep

Aquatic Exposure Unit
- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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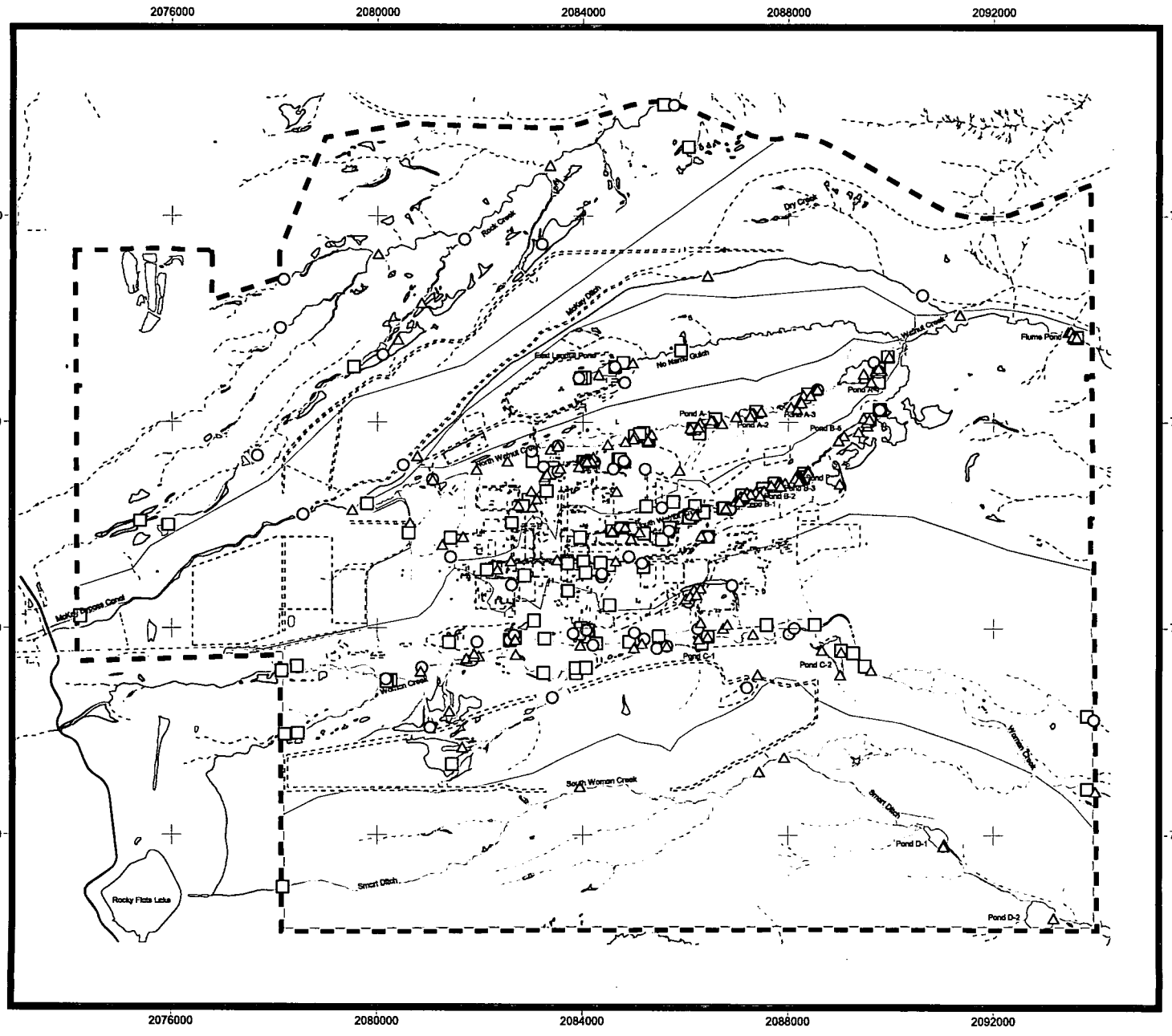

Figure A3.34

Surface Water Sampling Frequency for Metals

KEY

Sample location
- Sampling frequency = 1
- Sampling frequency = 2-4
- Sampling frequency = >4
- Historical IHSS/PAC
- Seep

Aquatic Exposure Unit
- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

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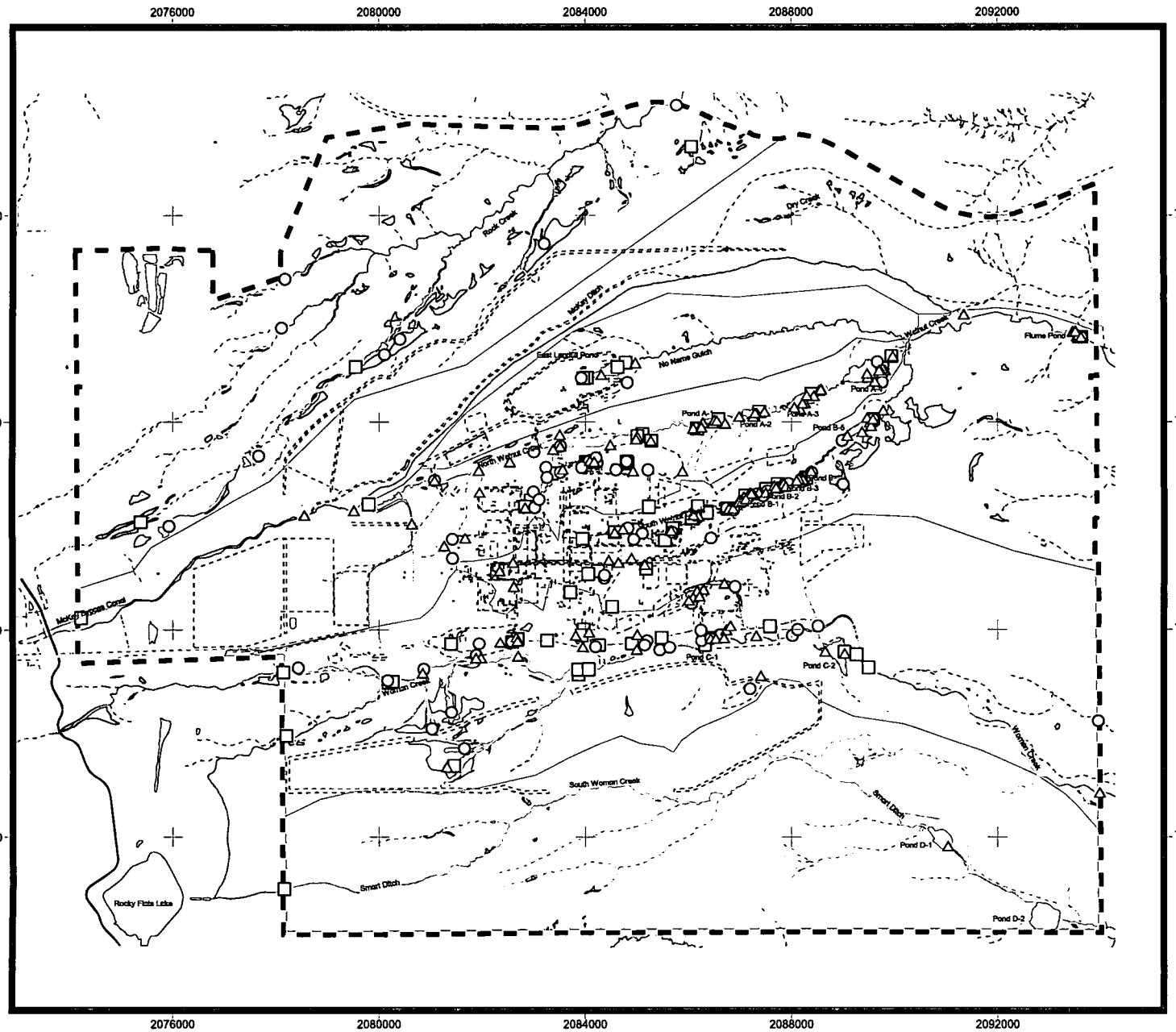

Figure A3.35

Surface Water Sampling Frequency for VOCs

KEY

Sample location
- △ Sampling frequency = 1
- ○ Sampling frequency = 2-4
- □ Sampling frequency = >4
- Historical IHSS/PAC
- Seep

Aquatic Exposure Unit
- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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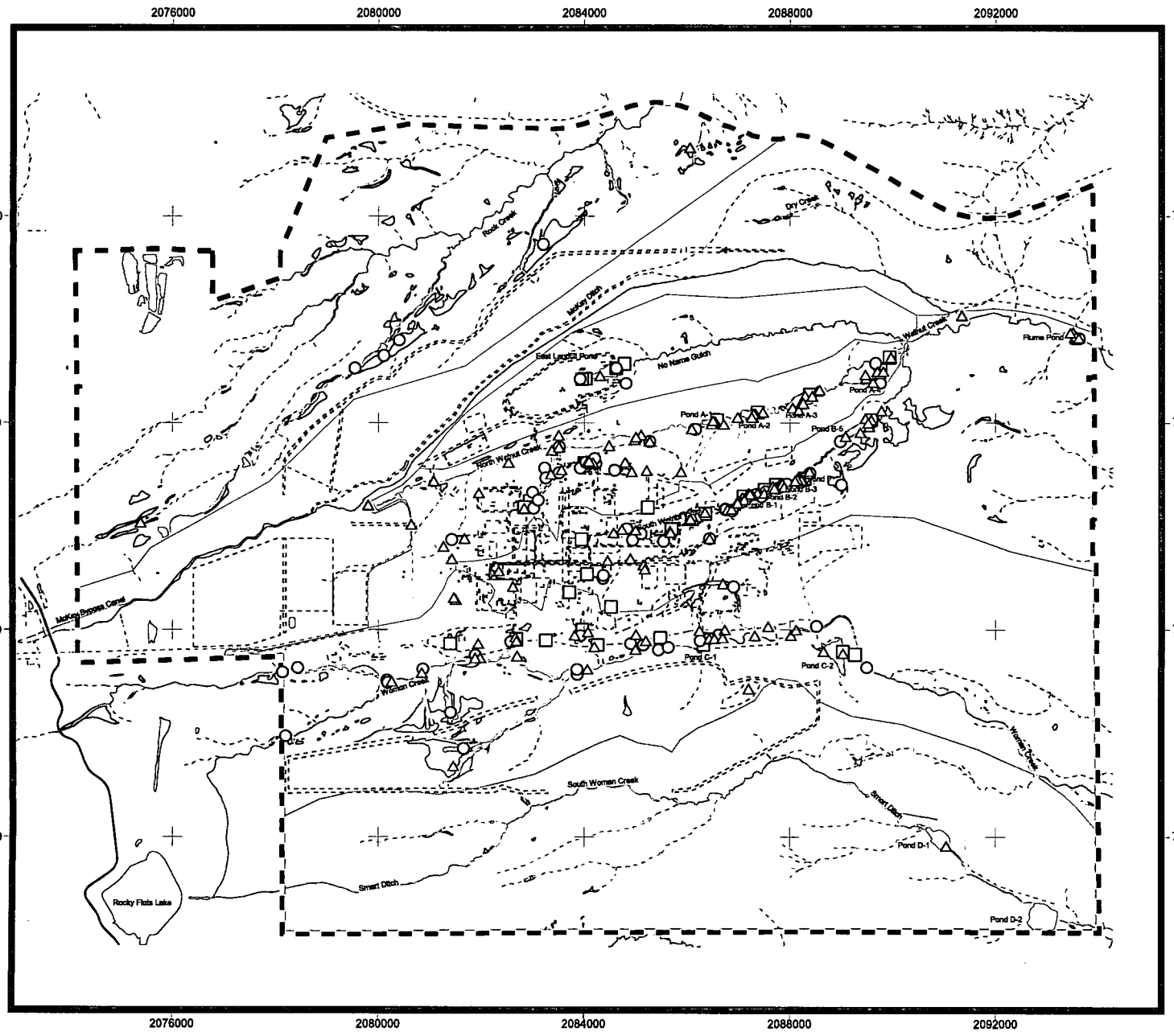

Figure A3.36

Surface Water Sampling Frequency for SVOCs

KEY

Sample location
- Sampling frequency = 1
- Sampling frequency = 2-4
- Sampling frequency = >4
- Historical IHSS/PAC
- Seep

Aquatic Exposure Unit
- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
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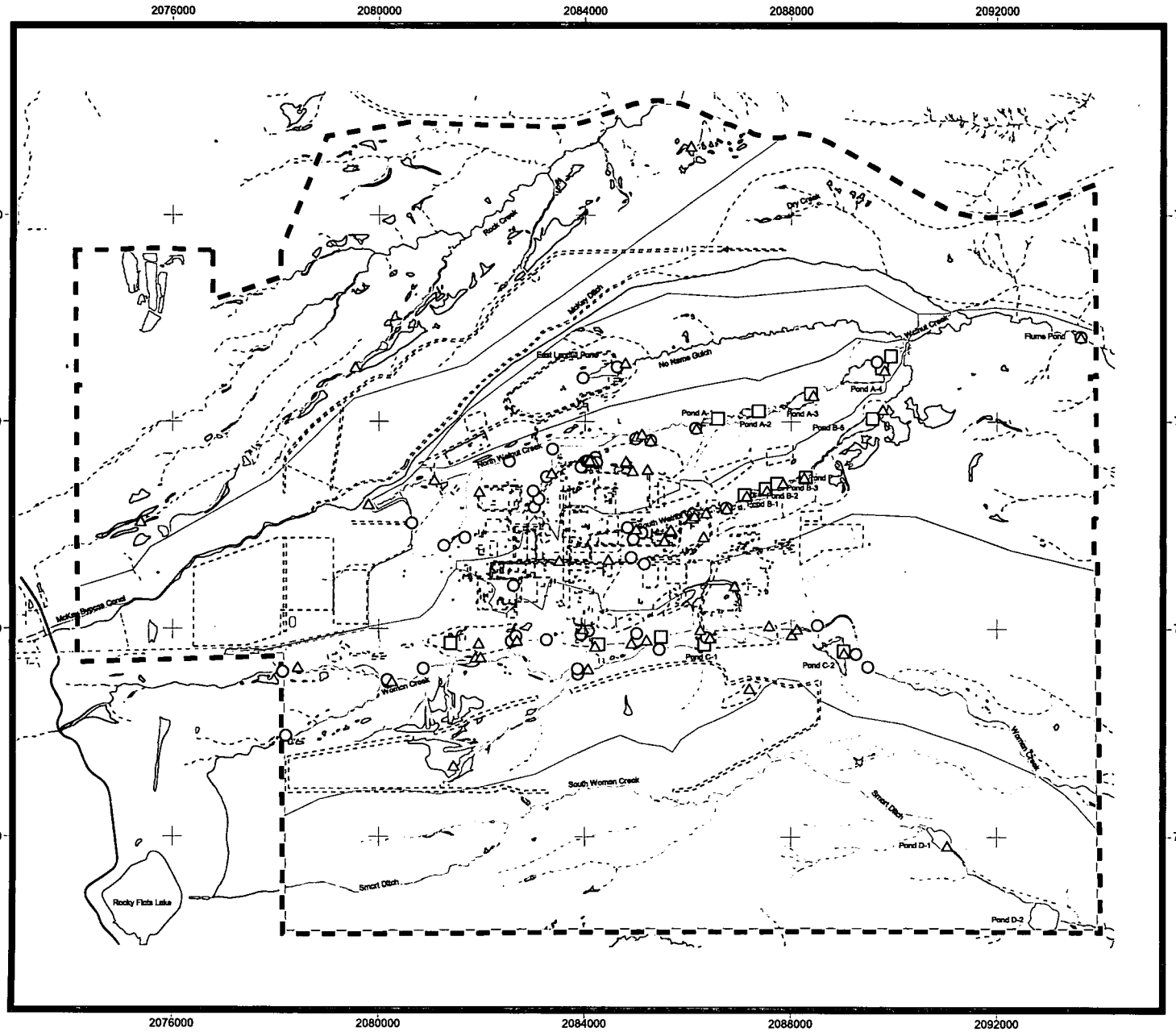

Figure A3.37

Surface Water Sampling Frequency for PCBs

KEY

Sample location
- Sampling frequency = 1
- Sampling frequency = 2-4
- Sampling frequency = >4
- Historical IHSS/PAC
- Seep

Aquatic Exposure Unit
- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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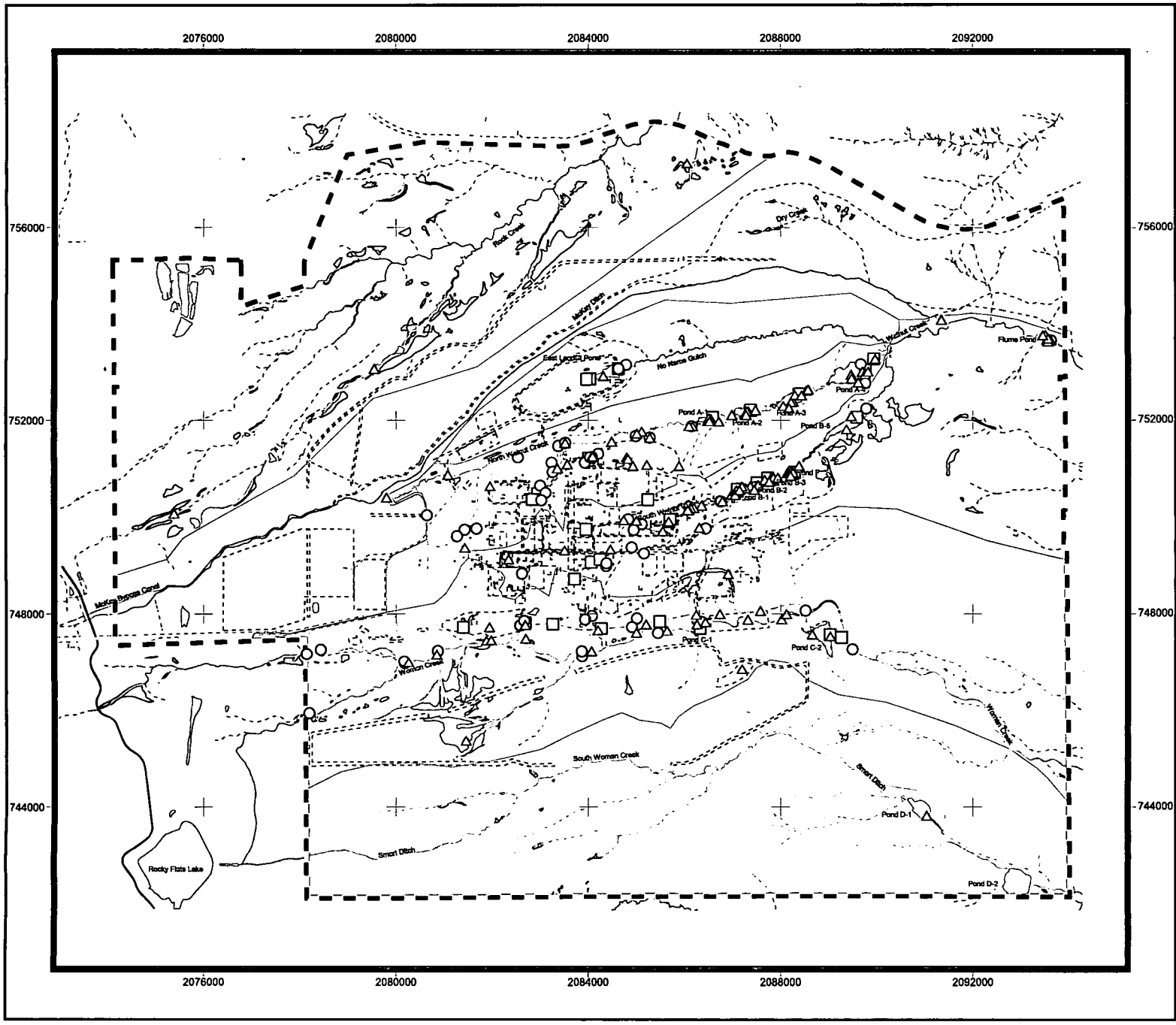

Figure A3.38

Surface Water Sampling Frequency for Pesticides

KEY

Sample location
- Sampling frequency = 1
- Sampling frequency = 2-4
- Sampling frequency = >4
- Historical IHSS/PAC
- Seep

Aquatic Exposure Unit
- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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Rocky Flats Environmental Technology Site

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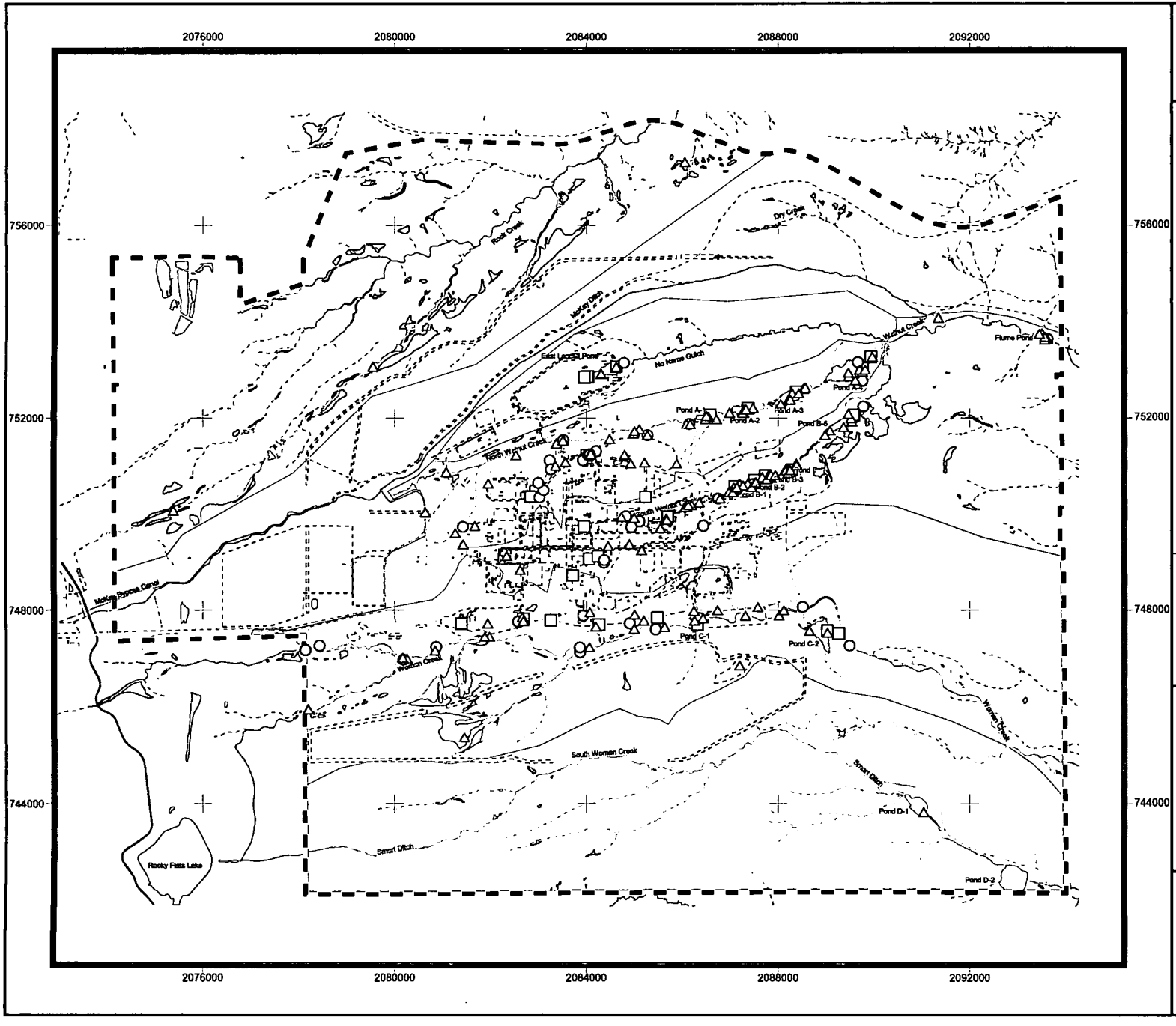

Figure A3.39

Surface Water Sampling Frequency for Herbicides

KEY

Sample location
- Sampling frequency = 1
- Sampling frequency = 2-4
- Sampling frequency = >4
- Historical IHSS/PAC
- Seep

Aquatic Exposure Unit
- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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Rocky Flats Environmental Technology Site

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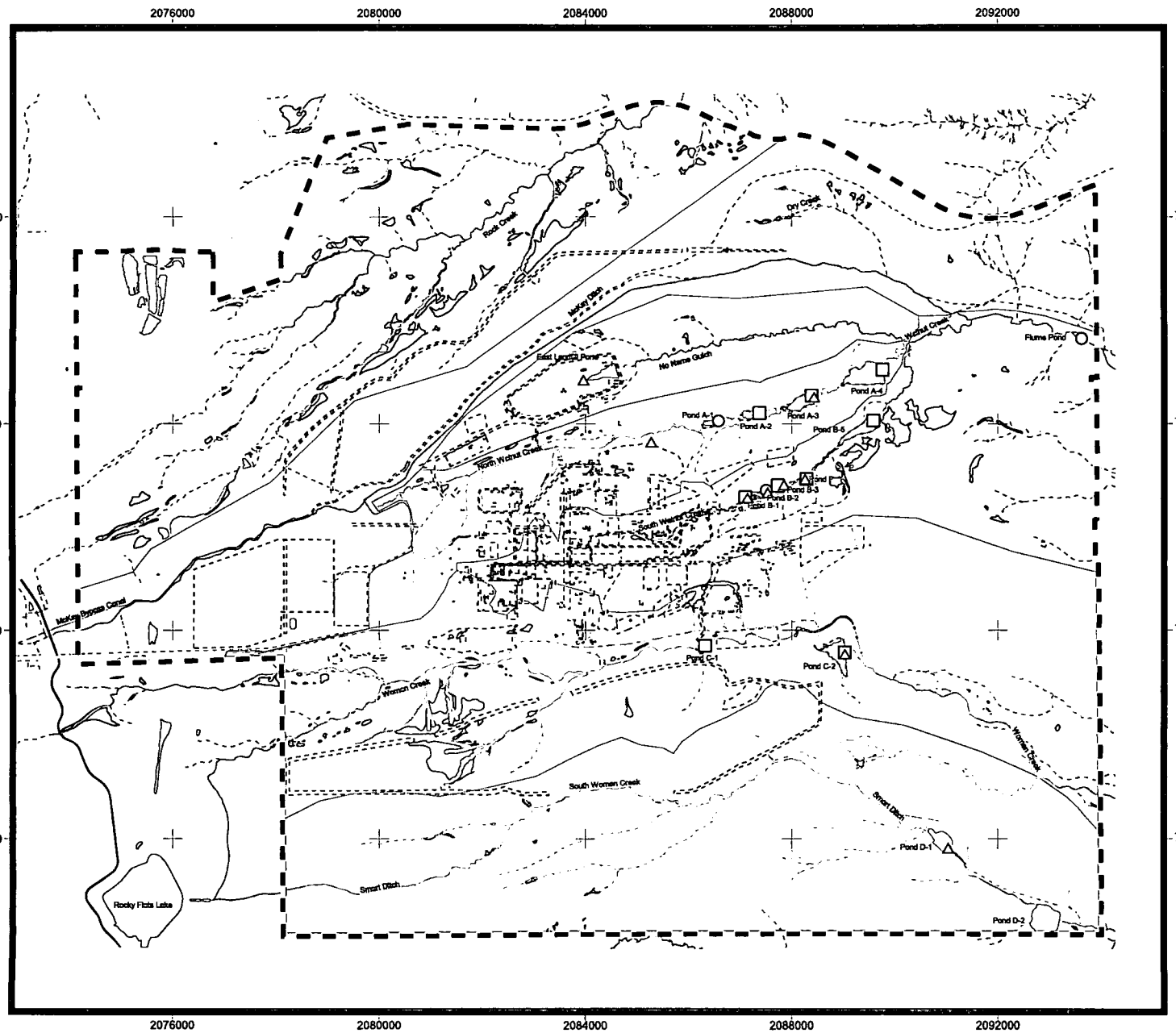

Figure A3.40

Surface Water Sampling Frequency for Dioxins and Furans

KEY

Sample location
- Sampling frequency = 1
- Sampling frequency = 2-4
- Sampling frequency = >4
- Historical IHSS/PAC
- Seep

Aquatic Exposure Unit
- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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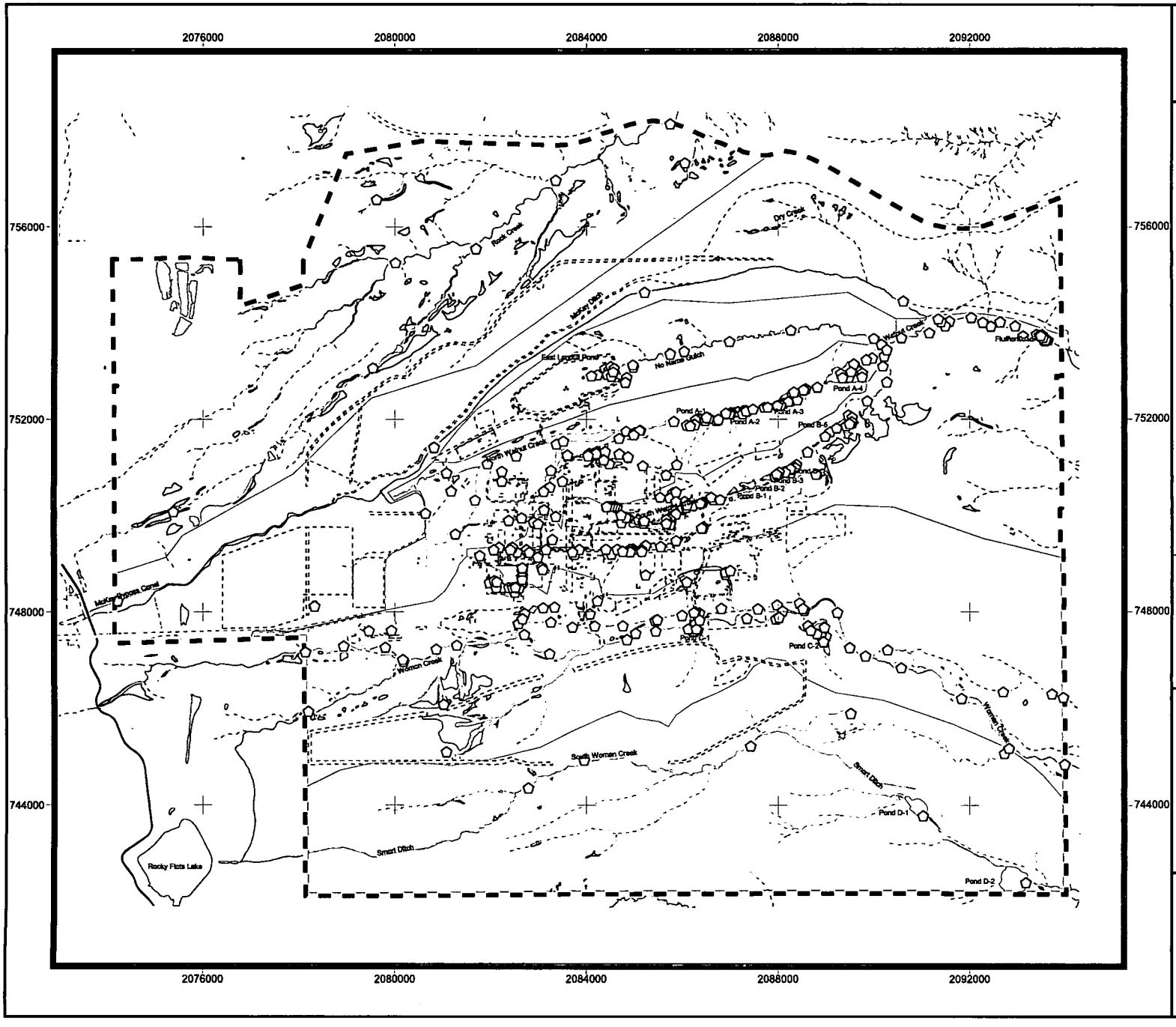

Figure A3.41

Sediment Sampling Locations for Radionuclides

KEY

Sample location
- >= ESL
- < ESL
- Nondetect
- Detected, no ESL
- Nondetect, no ESL
- Historical IHSS/PAC
- Seep

Aquatic Exposure Unit
- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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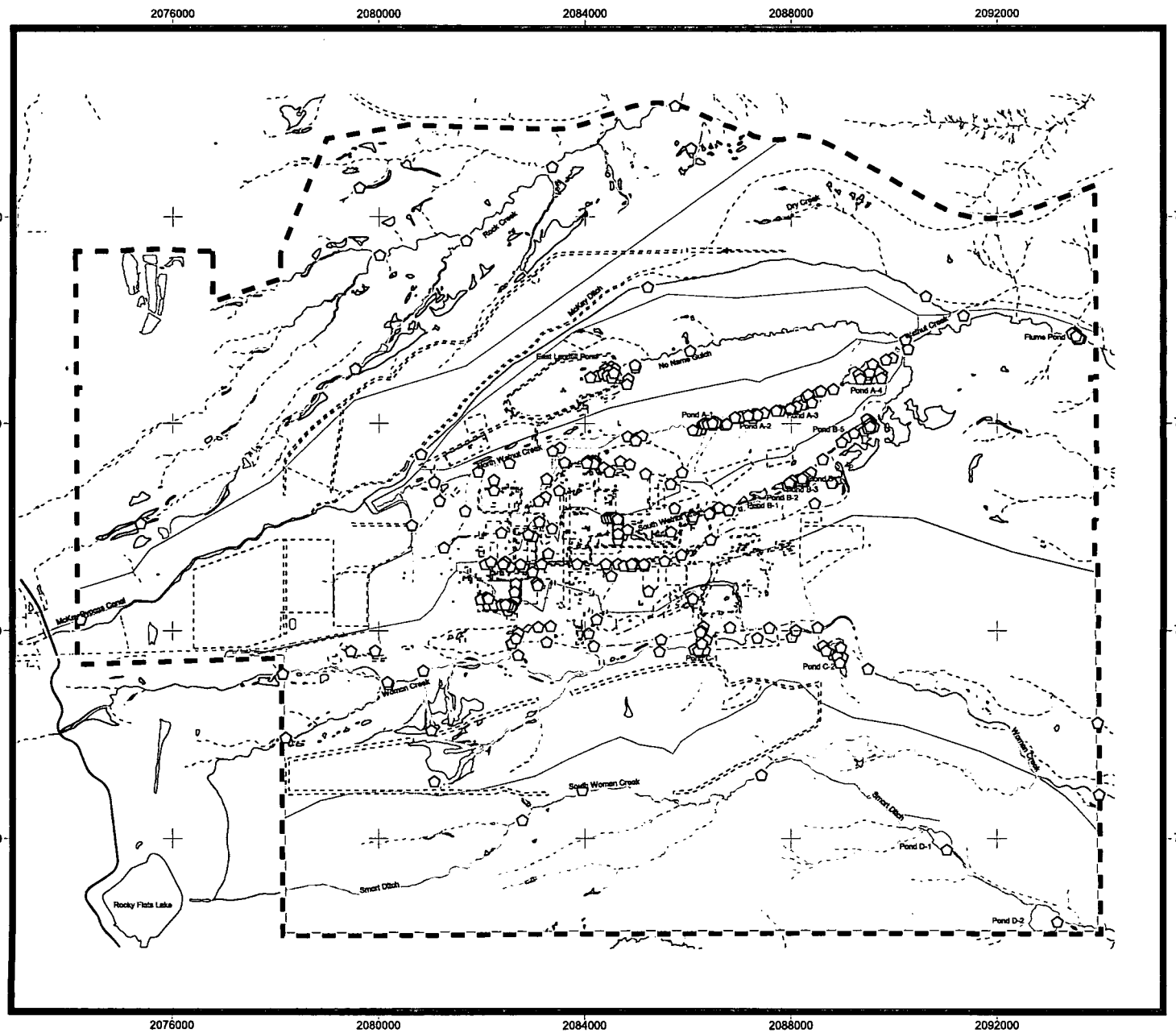

Figure A3.42

Sediment Sampling Locations for Metals

KEY

Sample location
- >= ESL
- < ESL
- Nondetect
- Detected, no ESL
- Nondetect, no ESL
- Historical IHSS/PAC
- Seep

Aquatic Exposure Unit
- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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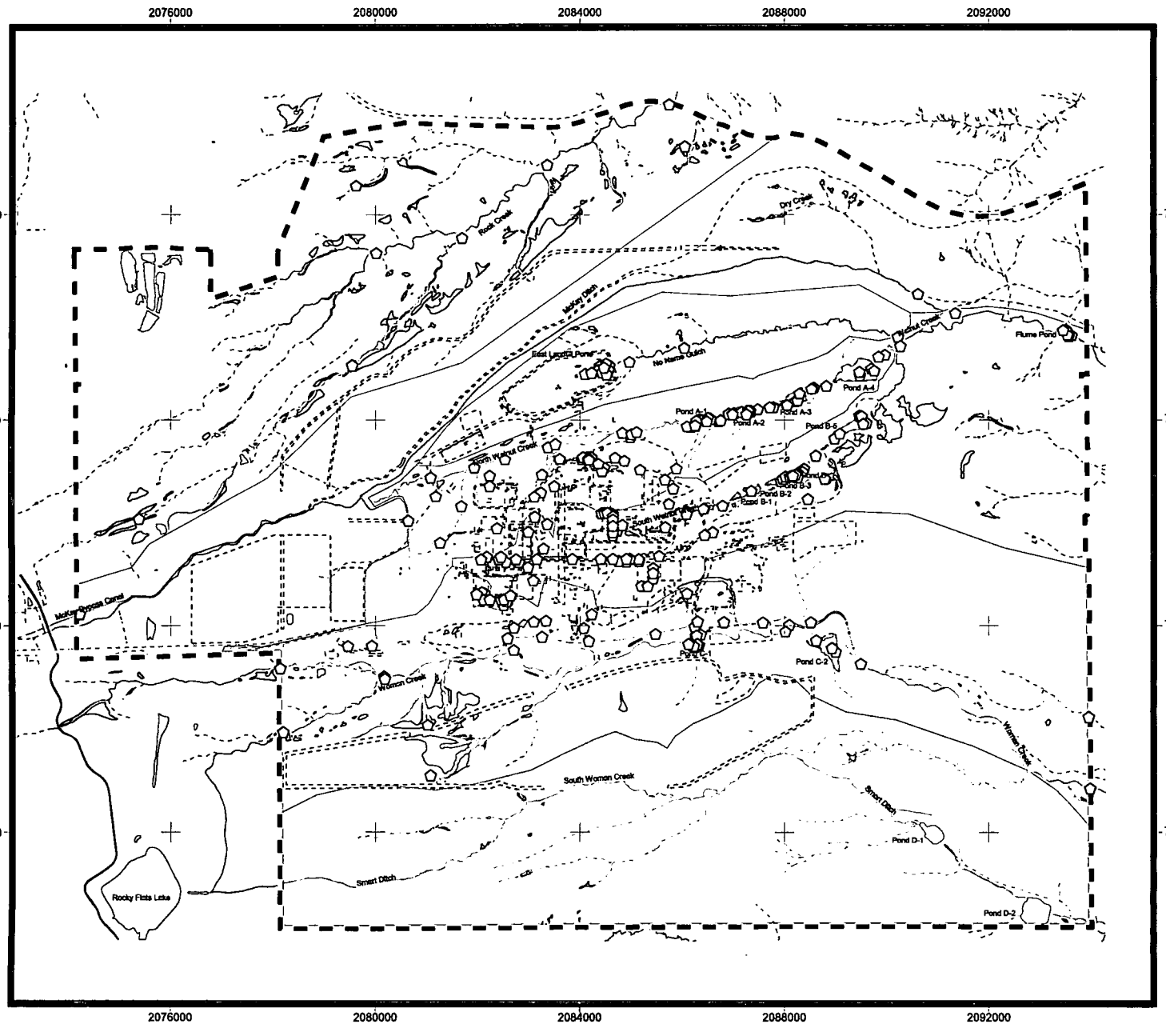

Figure A3.43

Sediment Sampling Locations for VOCs

KEY

Sample location
- >= ESL
- < ESL
- Nondetect
- Detected, no ESL
- Nondetect, no ESL
- Historical IHSS/PAC
- Seep

Aquatic Exposure Unit
- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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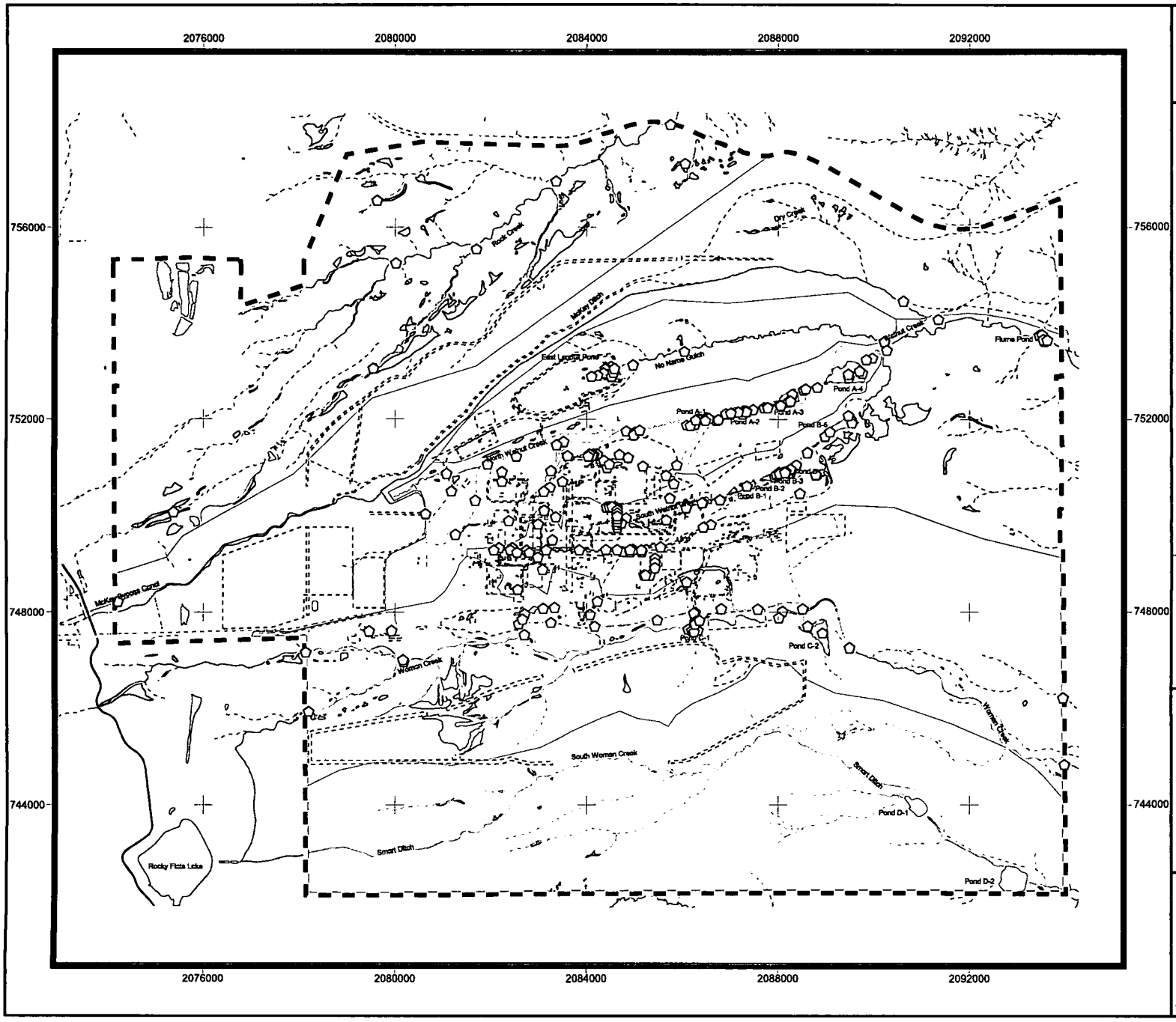

Figure A3.44

Sediment Sampling Locations for SVOCs

KEY

Sample location
- >= ESL
- < ESL
- Nondetect
- Detected, no ESL
- Nondetect, no ESL
- Historical IHSS/PAC
- Seep

Aquatic Exposure Unit
- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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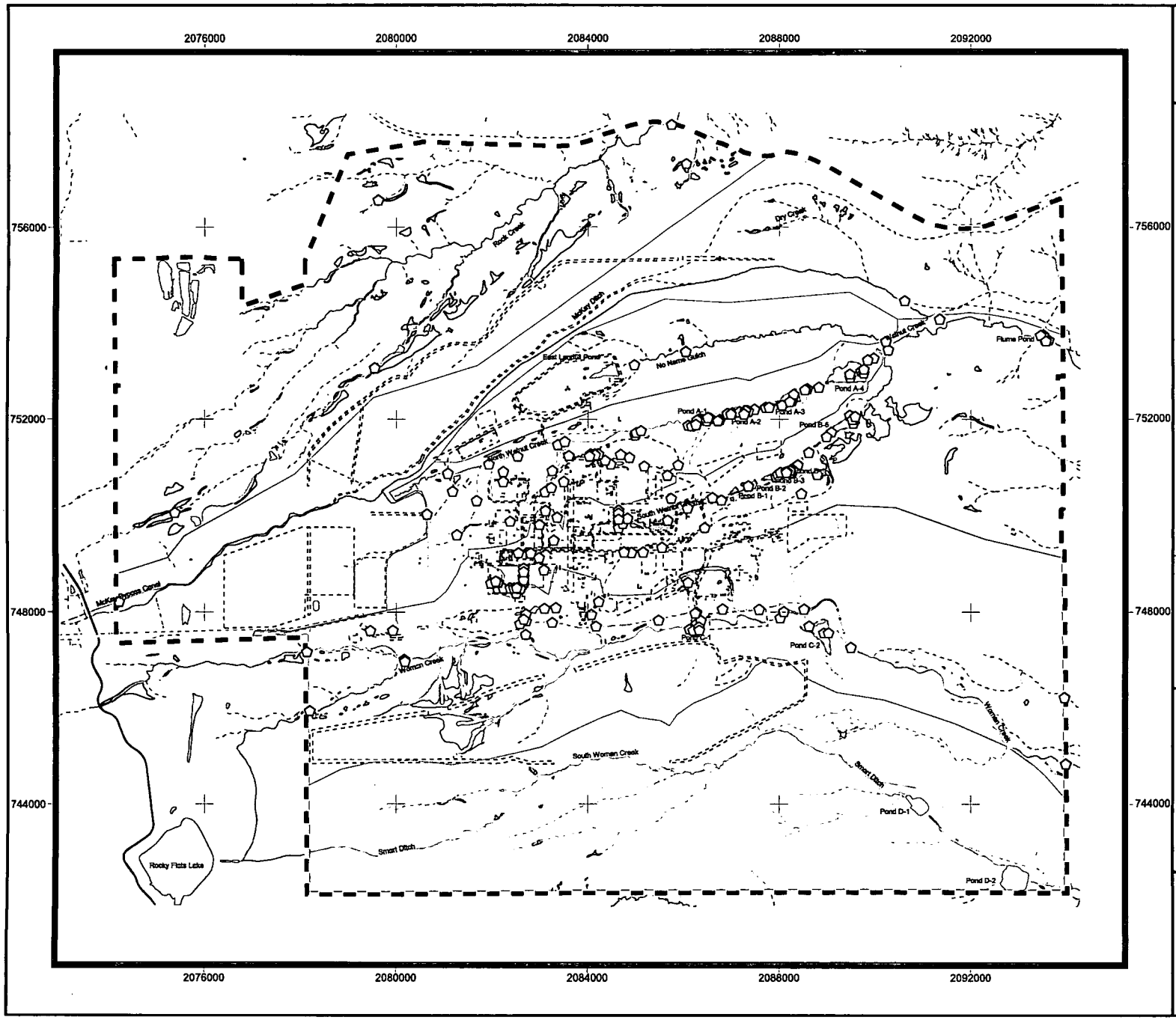

Figure A3.45

Sediment Sampling Locations for PCBs

KEY

Sample location
- >= ESL
- < ESL
- Nondetect
- Detected, no ESL
- Nondetect, no ESL
- Historical IHSS/PAC
- Seep

Aquatic Exposure Unit
- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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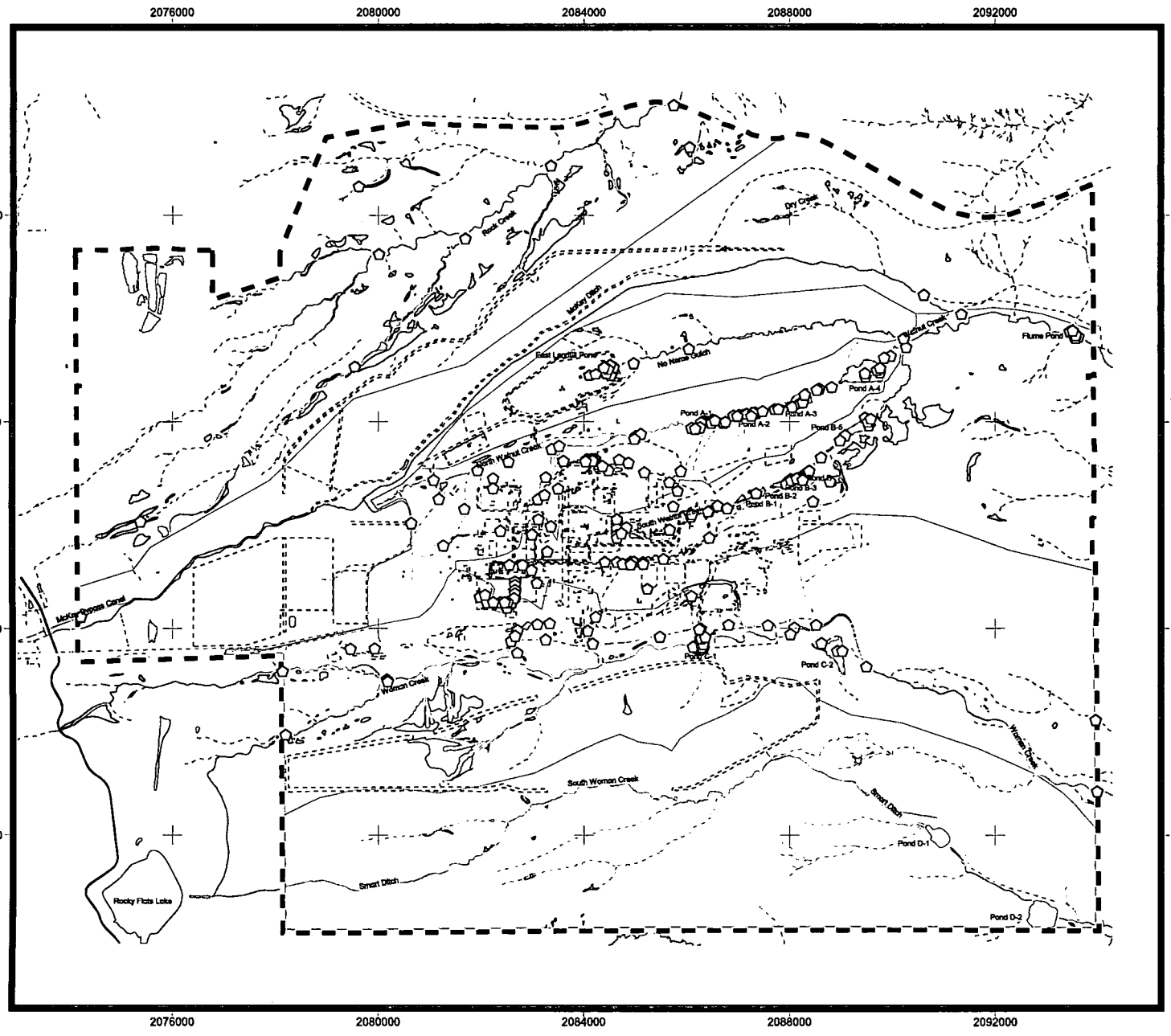

Figure A3.46

Sediment Sampling Locations for Pesticides

KEY

Sample location
- >= ESL
- < ESL
- Nondetect
- Detected, no ESL
- Nondetect, no ESL
- Historical IHSS/PAC
- Seep

Aquatic Exposure Unit
- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
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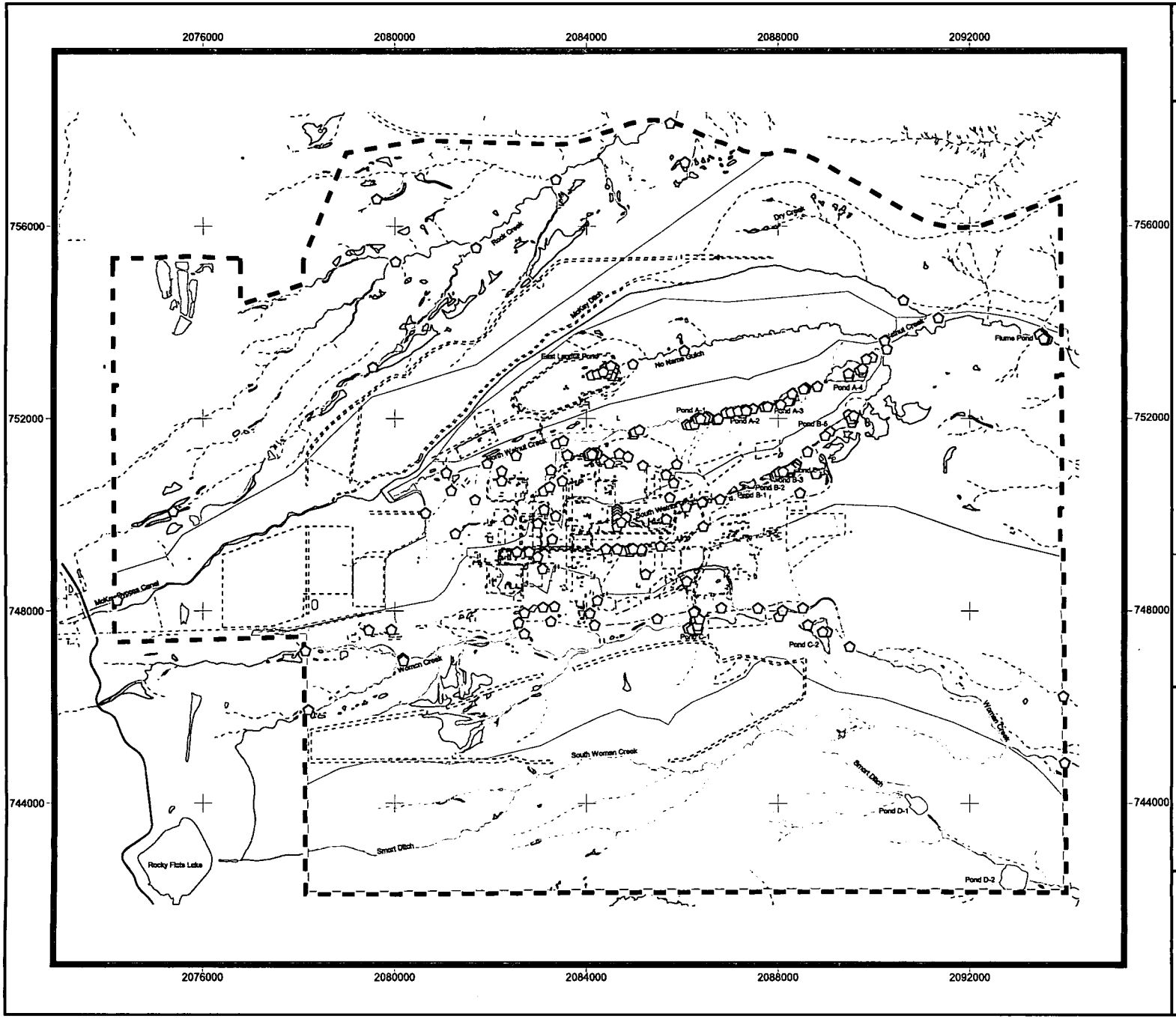

Figure A3.47

Sediment Sampling Locations for Herbicides

KEY

Sample location
- >= ESL
- < ESL
- Nondetect
- Detected, no ESL
- Nondetect, no ESL
- Historical IHSS/PAC
- Seep

Aquatic Exposure Unit
- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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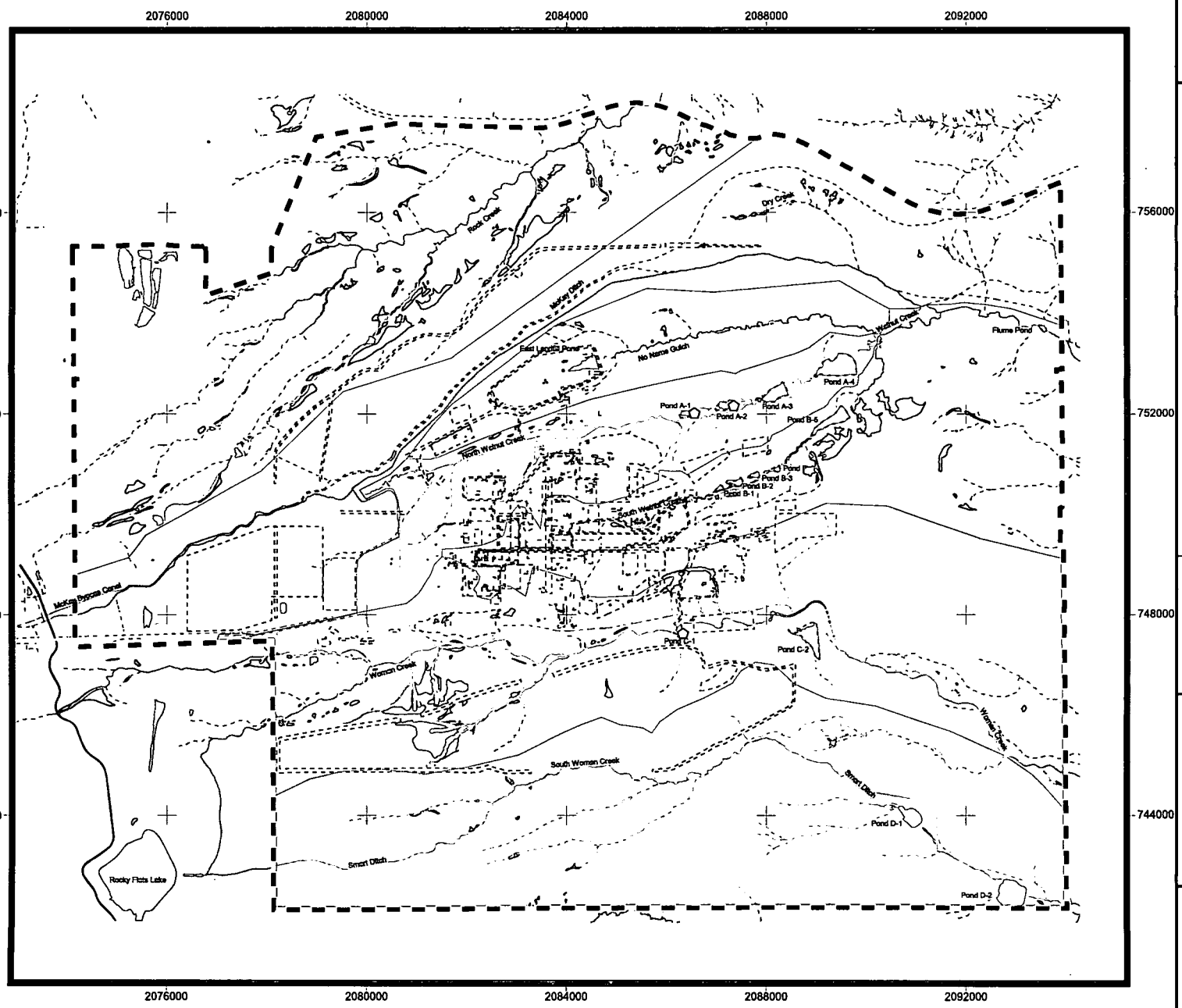

Figure A3.48

Sediment Sampling Locations for Dioxins and Furans

KEY

Sample location
- >= ESL
- < ESL
- Nondetect
- Detected, no ESL
- Nondetect, no ESL
- Historical IHSS/PAC
- Seep

Aquatic Exposure Unit
- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

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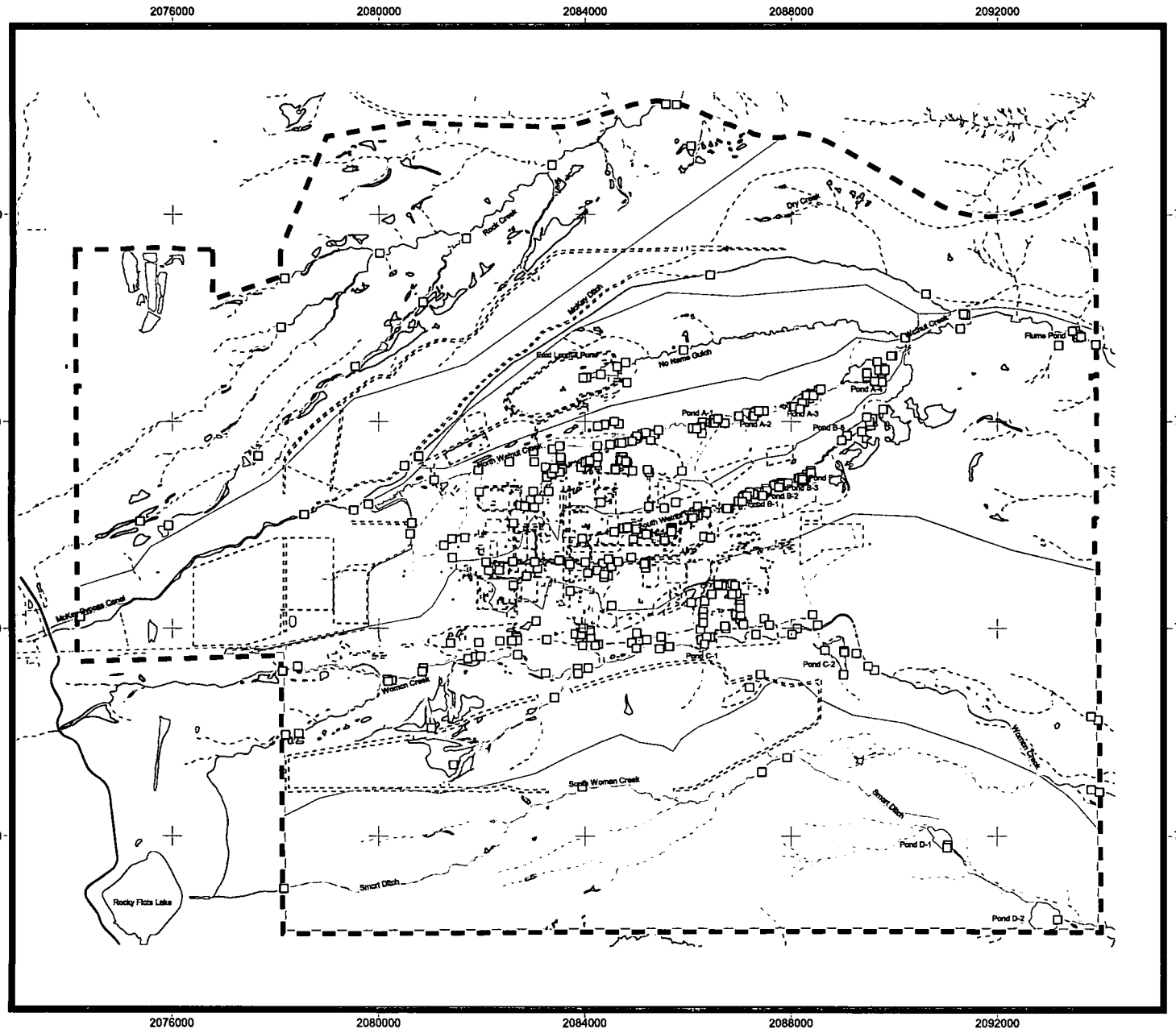

Figure A3.49

Surface Water Sampling Locations for Radionuclides

KEY

Sample location
- >= ESL
- < ESL
- Nondetect
- Detected, no ESL
- Nondetect, no ESL
- Historical IHSS/PAC
- Seep

Aquatic Exposure Unit
- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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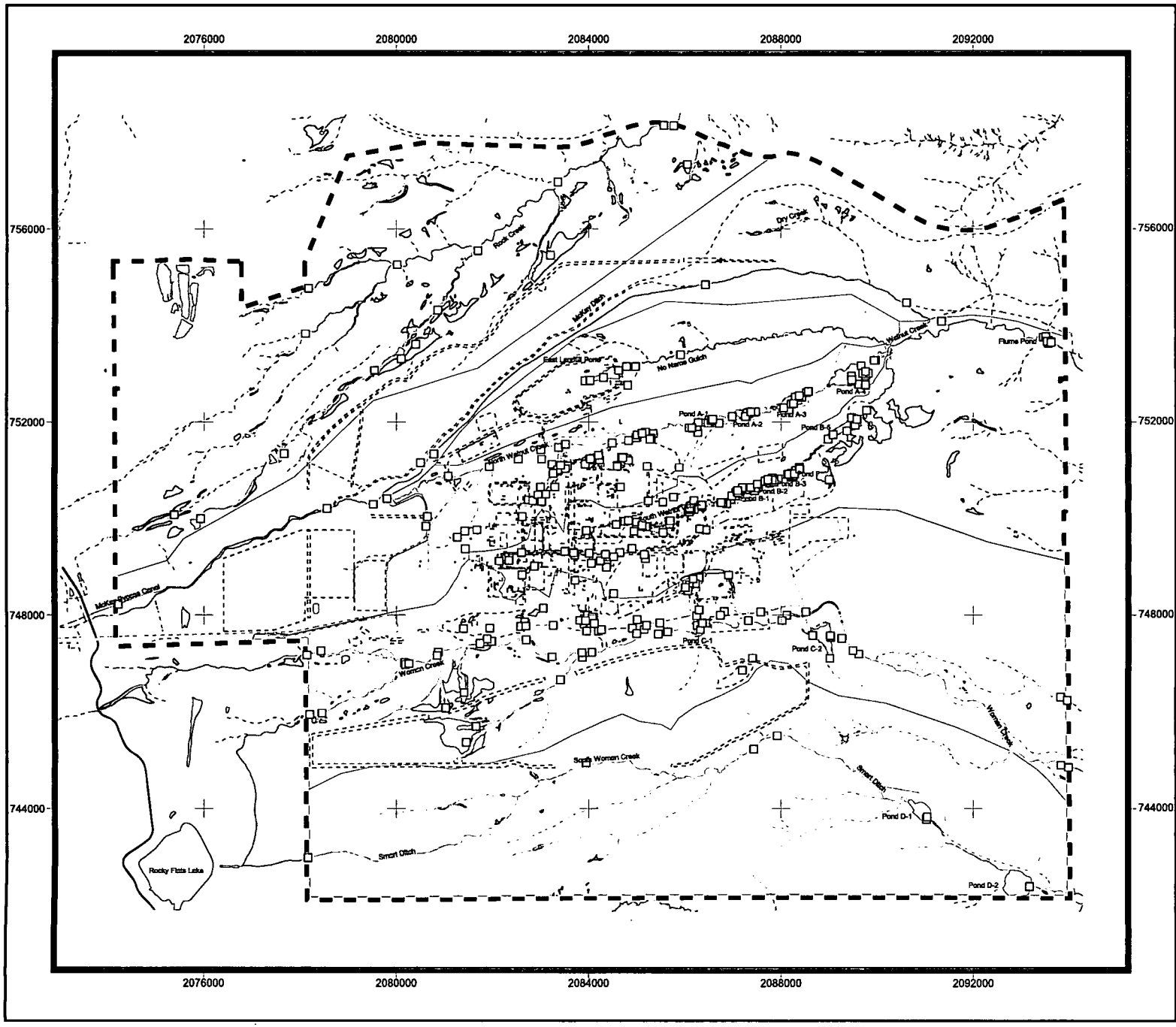

Figure A3.50

Surface Water Sampling Locations for Metals

KEY

Sample location
- >= ESL
- < ESL
- Nondetect
- Detected, no ESL
- Nondetect, no ESL
- Historical IHSS/PAC
- Seep

Aquatic Exposure Unit
- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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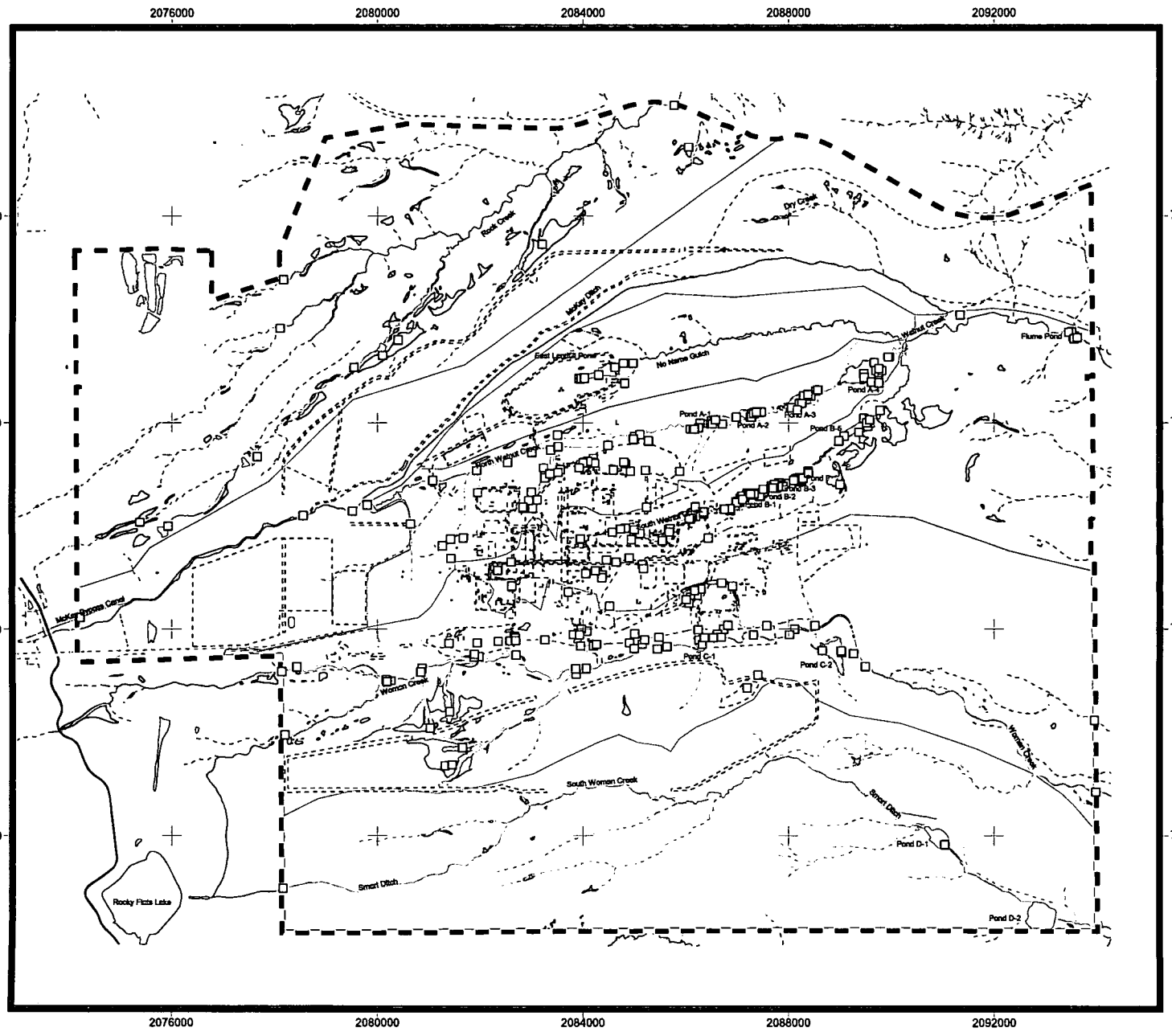

Figure A3.51

Surface Water Sampling Locations for VOCs

KEY

Sample location
- >= ESL
- < ESL
- Nondetect
- Detected, no ESL
- Nondetect, no ESL
- Historical IHSS/PAC
- Seep

Aquatic Exposure Unit
- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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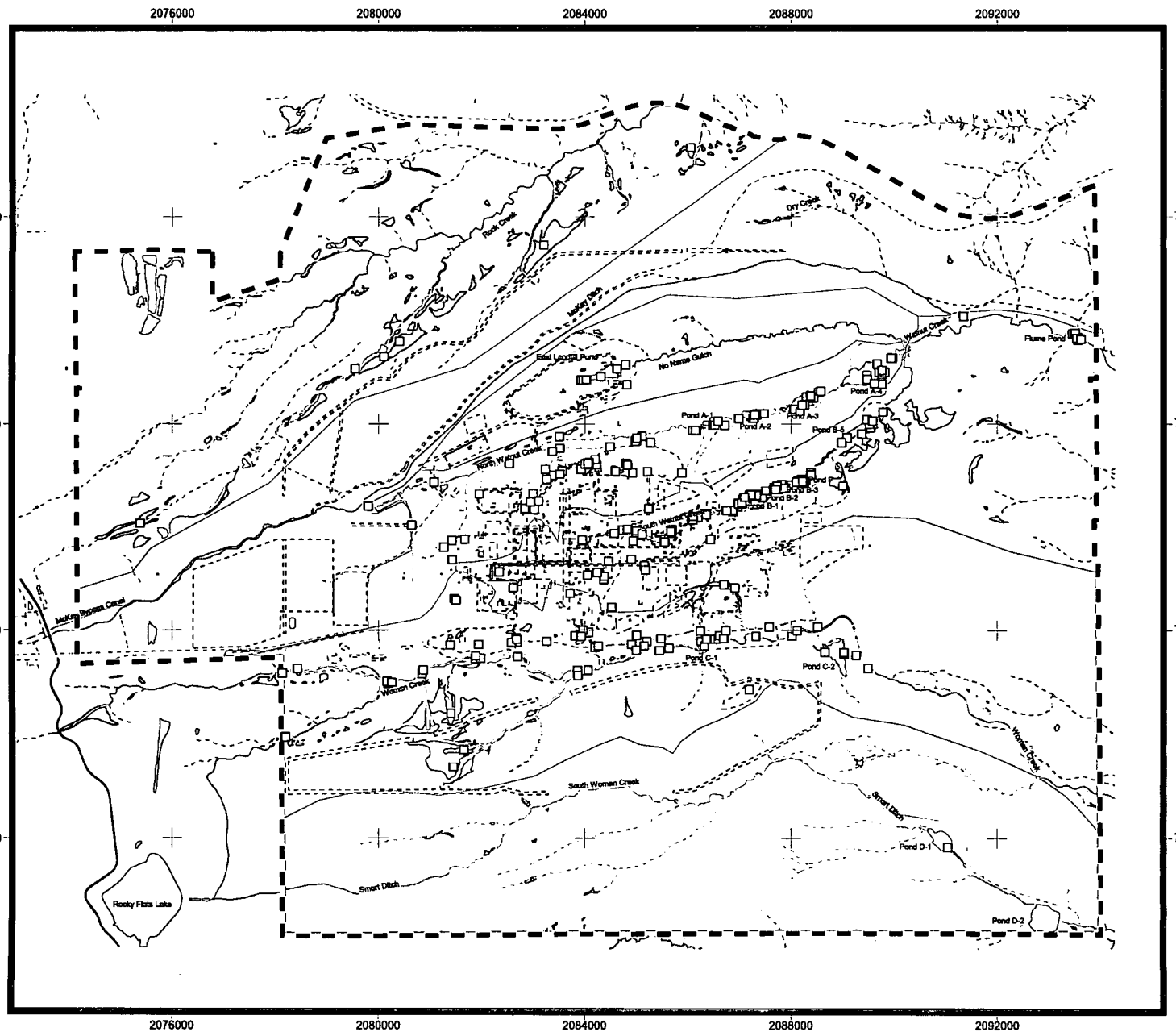

Figure A3.52

Surface Water Sampling Locations for SVOCs

KEY

Sample location
- >= ESL
- < ESL
- Nondetect
- Detected, no ESL
- Nondetect, no ESL
- Historical IHSS/PAC
- Seep

Aquatic Exposure Unit
- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

File: W:\Projects\Fy2005\CRA\GIS_Final\ArcView\Volume2\DataAdequacy\DAR_Maps_SW_vs_ESL.apr

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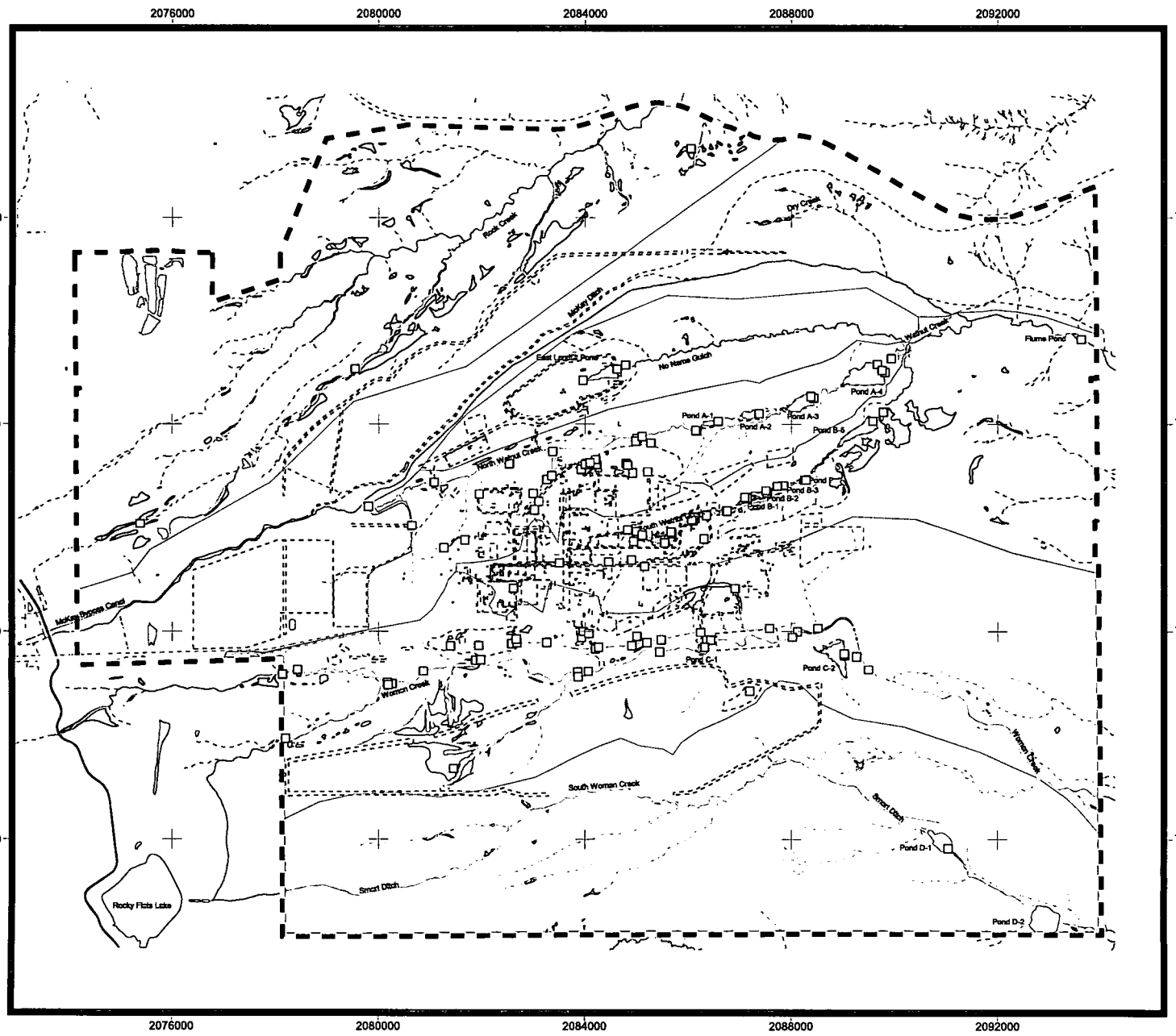

Figure A3.53

Surface Water Sampling Locations for PCBs

KEY

Sample location
- >= ESL
- < ESL
- Nondetect
- Detected, no ESL
- Nondetect, no ESL
- Historical IHSS/PAC
- Seep

Aquatic Exposure Unit
- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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File: W:\Projects\Fy2005\CRA\GIS_Final\ArcView\Volume2\DataAdequacy\DAR_Maps_SW_vs_ESL.apr

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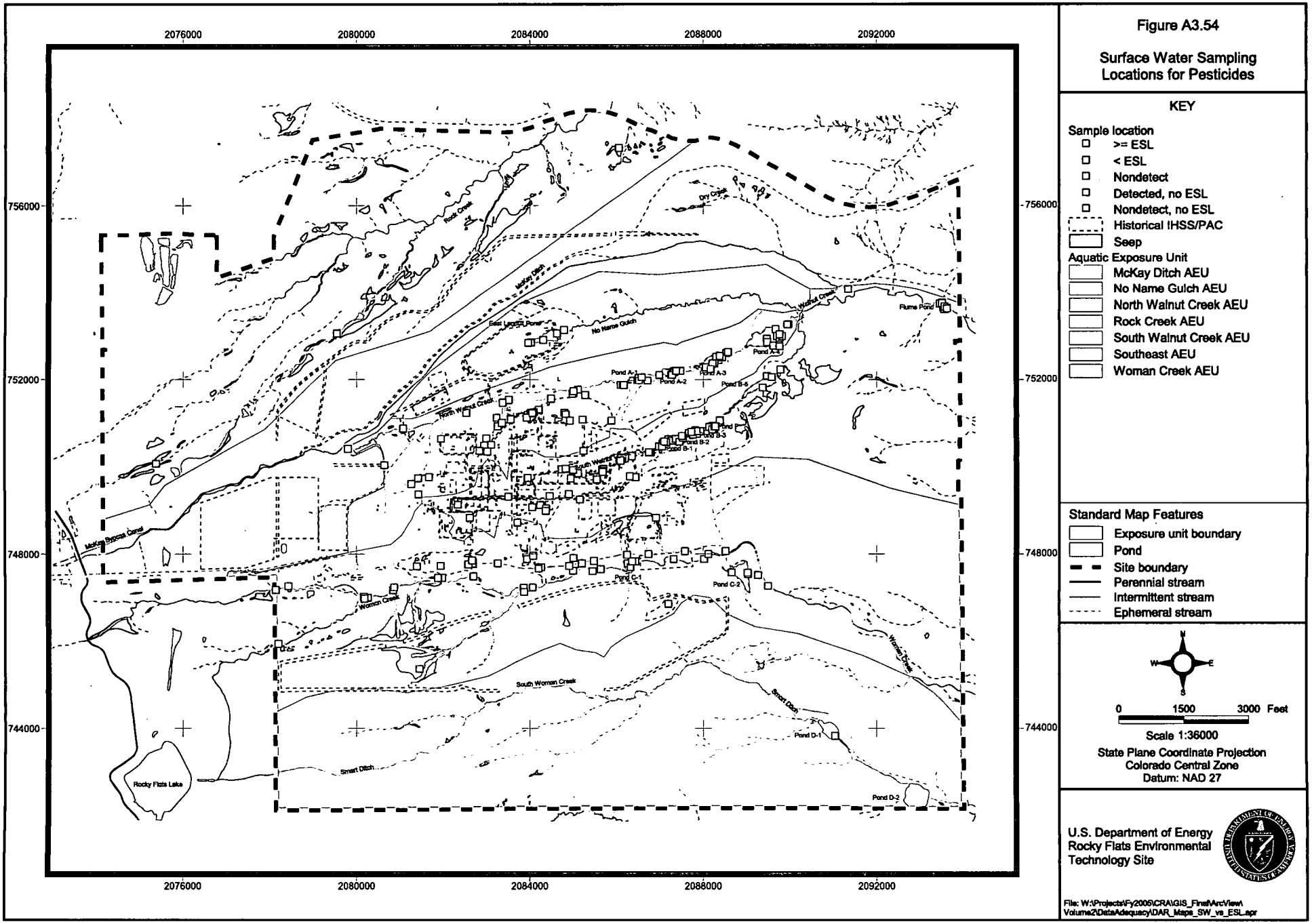
2076000
2080000
2084000
2088000
2092000
756000
752000
748000
744000
Rock Creek
Dry Creek
McKay Ditch
East Walnut Pond
No Name Gulch
Walnut Creek
Flume Pond
Pond A-4
Pond A-2
Pond A-3
Pond A-5
Pond B-5
North Walnut Creek
Pond B-3
Pond B-2
Pond B-1
South Walnut Creek
McKay Bypass Canal
Pond C-1
Pond C-2
Woman Creek
South Woman Creek
Smart Ditch
Pond D-1
Pond D-2
Rocky Flats Lake
Figure A3.54
Surface Water Sampling Locations for Pesticides
KEY
Sample location
>= ESL
< ESL
Nondetect
Detected, no ESL
Nondetect, no ESL
Historical IHSS/PAC
Seep
Aquatic Exposure Unit
McKay Ditch AEU
No Name Gulch AEU
North Walnut Creek AEU
Rock Creek AEU
South Walnut Creek AEU
Southeast AEU
Woman Creek AEU
Standard Map Features
Exposure unit boundary
Pond
Site boundary
Perennial stream
Intermittent stream
Ephemeral stream
N
W
E
S
0
1500
3000 Feet
Scale 1:36000
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27
U.S. Department of Energy
Rocky Flats Environmental Technology Site
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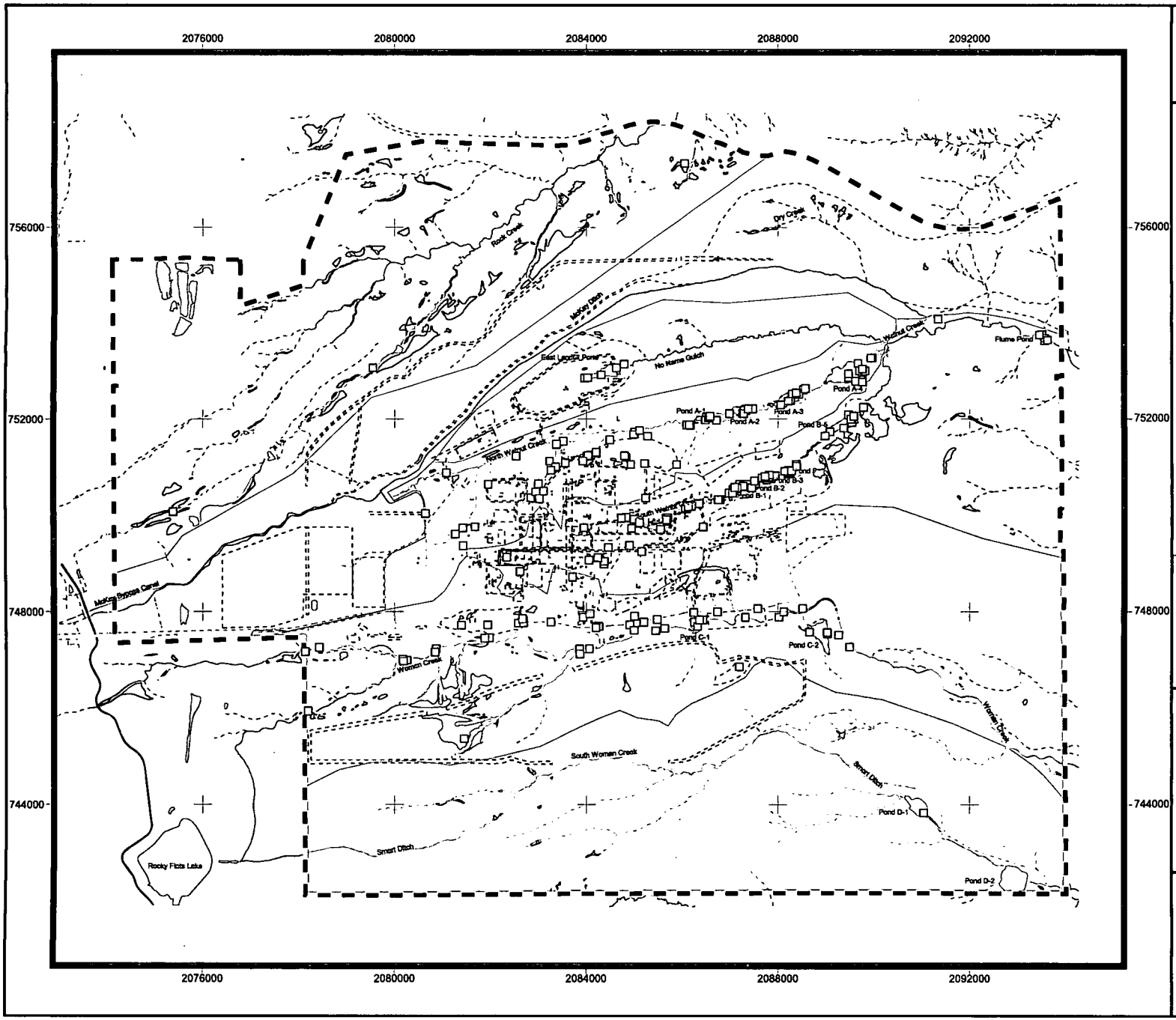

Figure A3.55

Surface Water Sampling Locations for Herbicides

KEY

Sample location
- >= ESL
- < ESL
- Nondetect
- Detected, no ESL
- Nondetect, no ESL
- Historical IHSS/PAC
- Seep

Aquatic Exposure Unit
- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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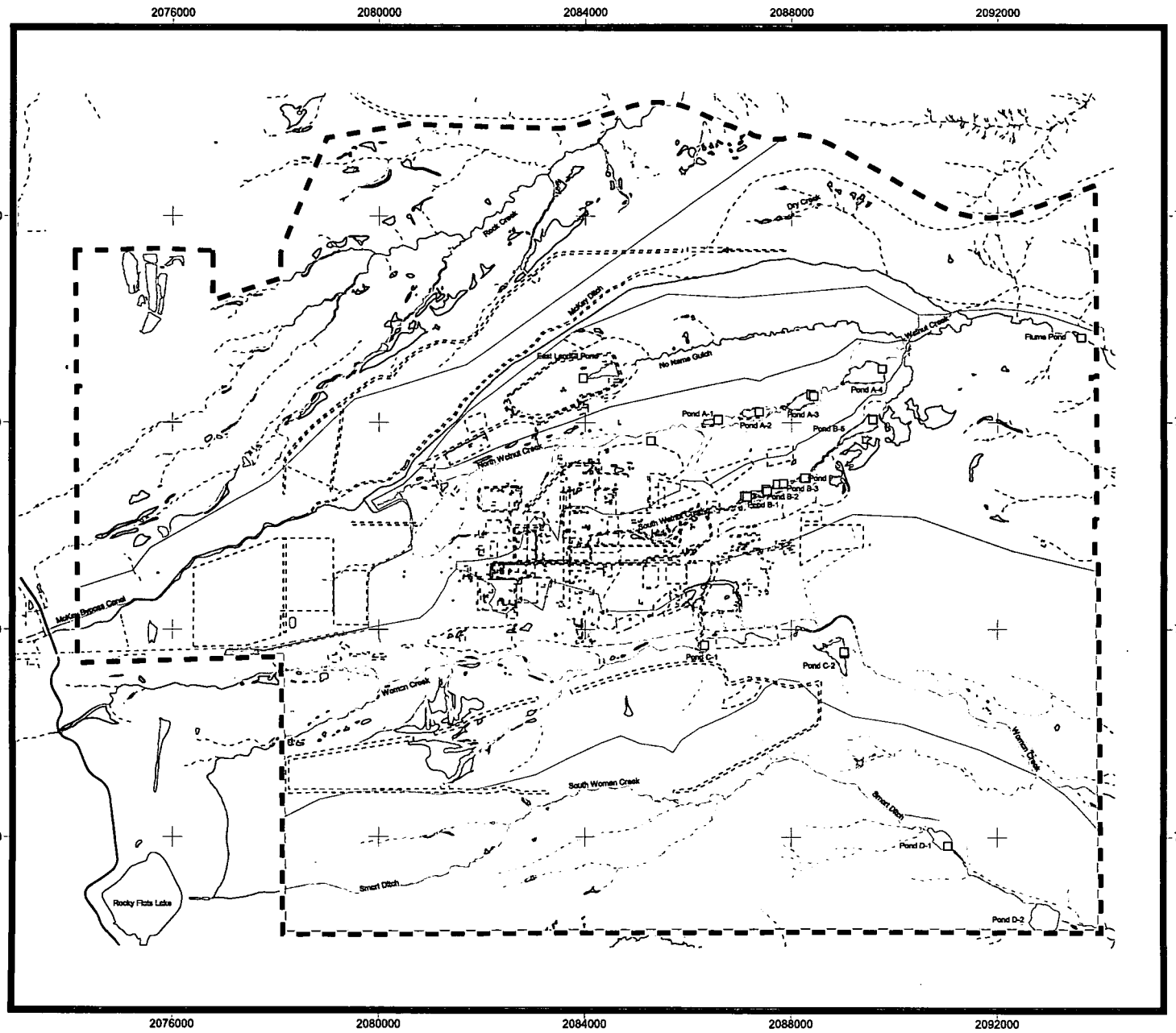

Figure A3.56

Surface Water Sampling Locations for Dioxins and Furans

KEY

Sample location
- >= ESL
- < ESL
- Nondetect
- Detected, no ESL
- Nondetect, no ESL
- Historical IHSS/PAC
- Seep

Aquatic Exposure Unit
- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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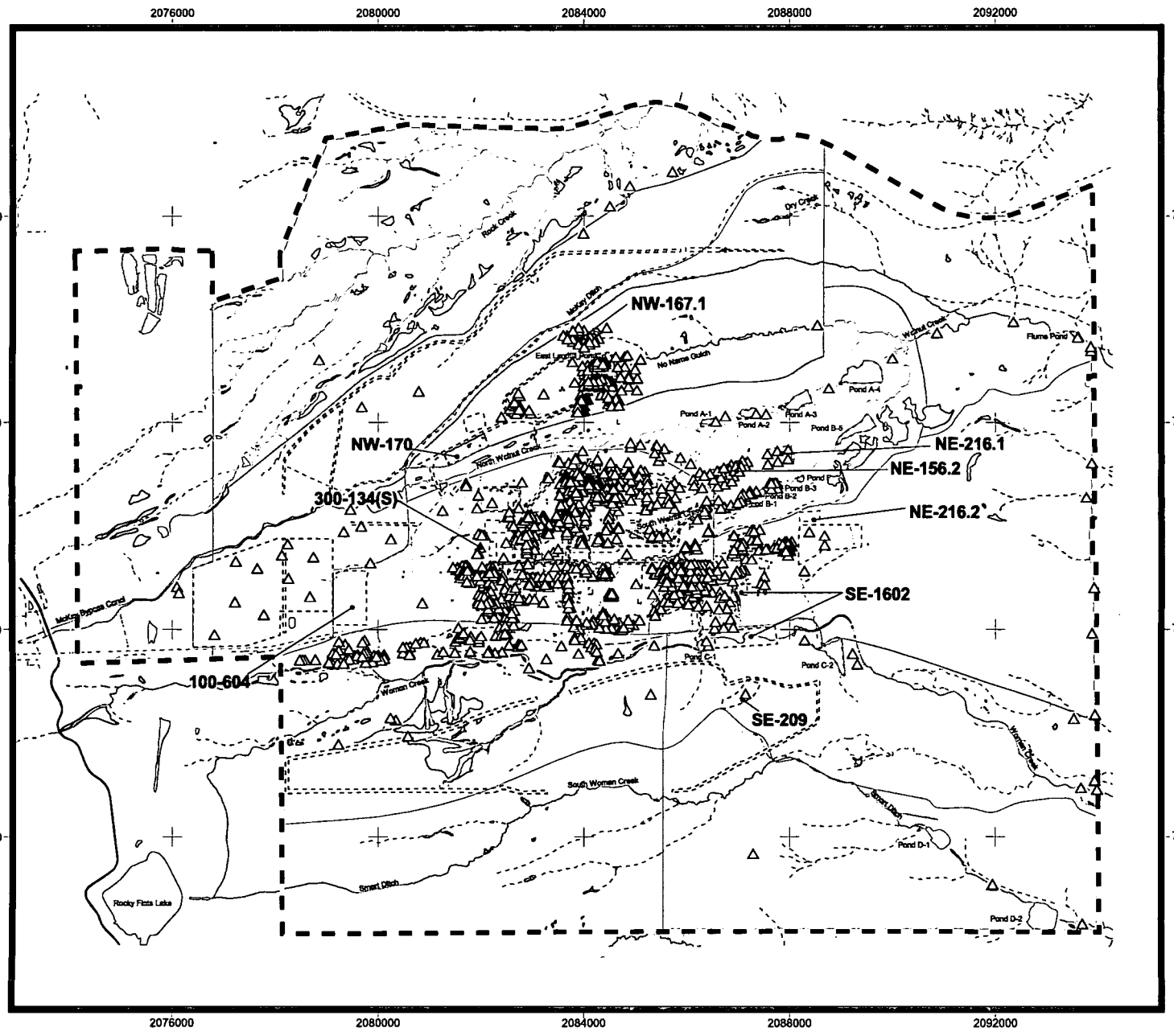

Figure A3.57

Subsurface Soil Sampling Locations for Radionuclides

KEY

Sample location
- >= ESL
- < ESL
- Nondetect
- Detected, no ESL
- Nondetect, no ESL
- Historical IHSS/PAC
- Seep

Exposure Unit
- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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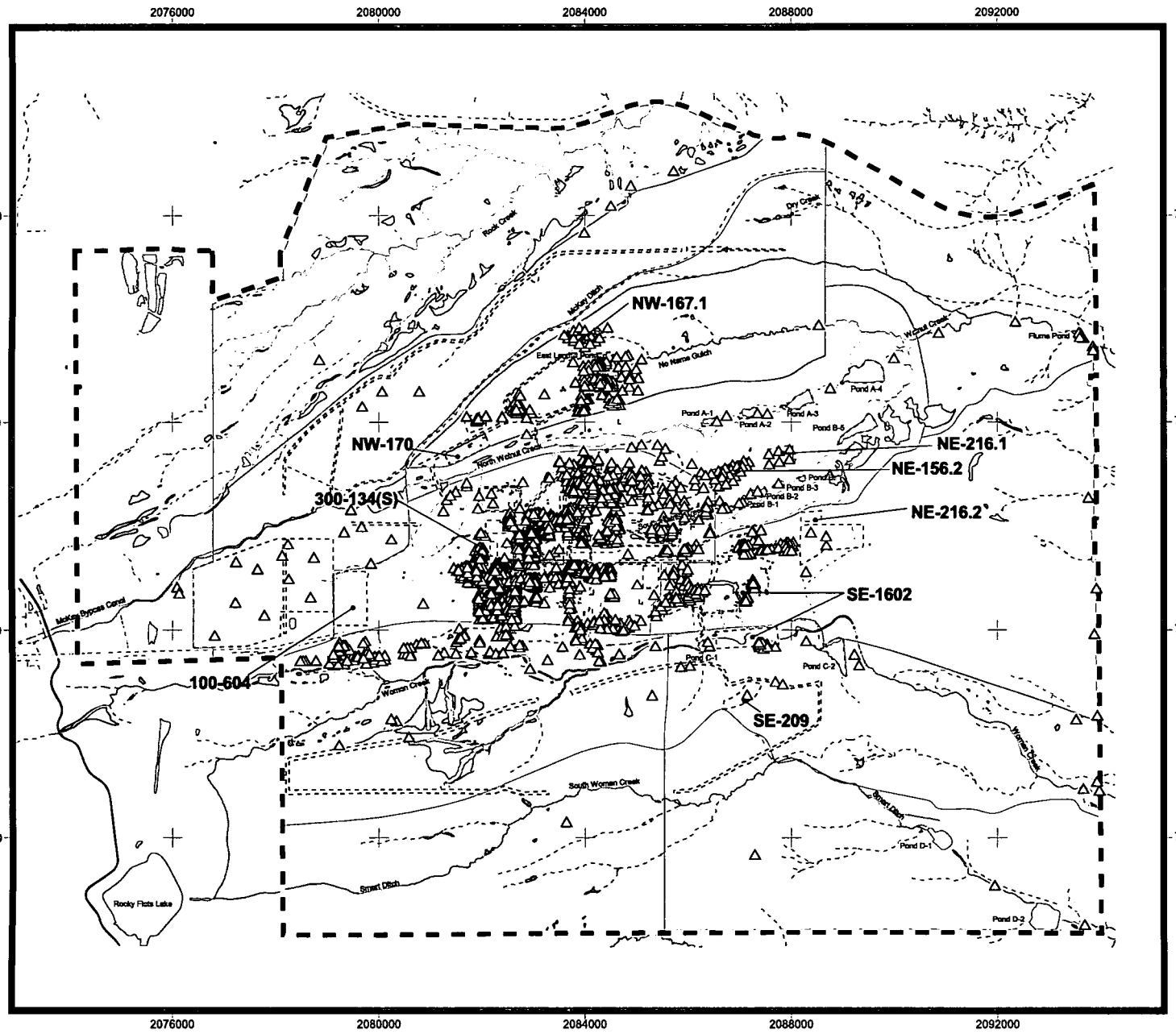

Figure A3.58

Subsurface Soil Sampling Locations for Metals

KEY

Sample location
- >= ESL
- < ESL
- Nondetect
- Detected, no ESL
- Nondetect, no ESL
- Historical IHSS/PAC
- Seep

Exposure Unit
- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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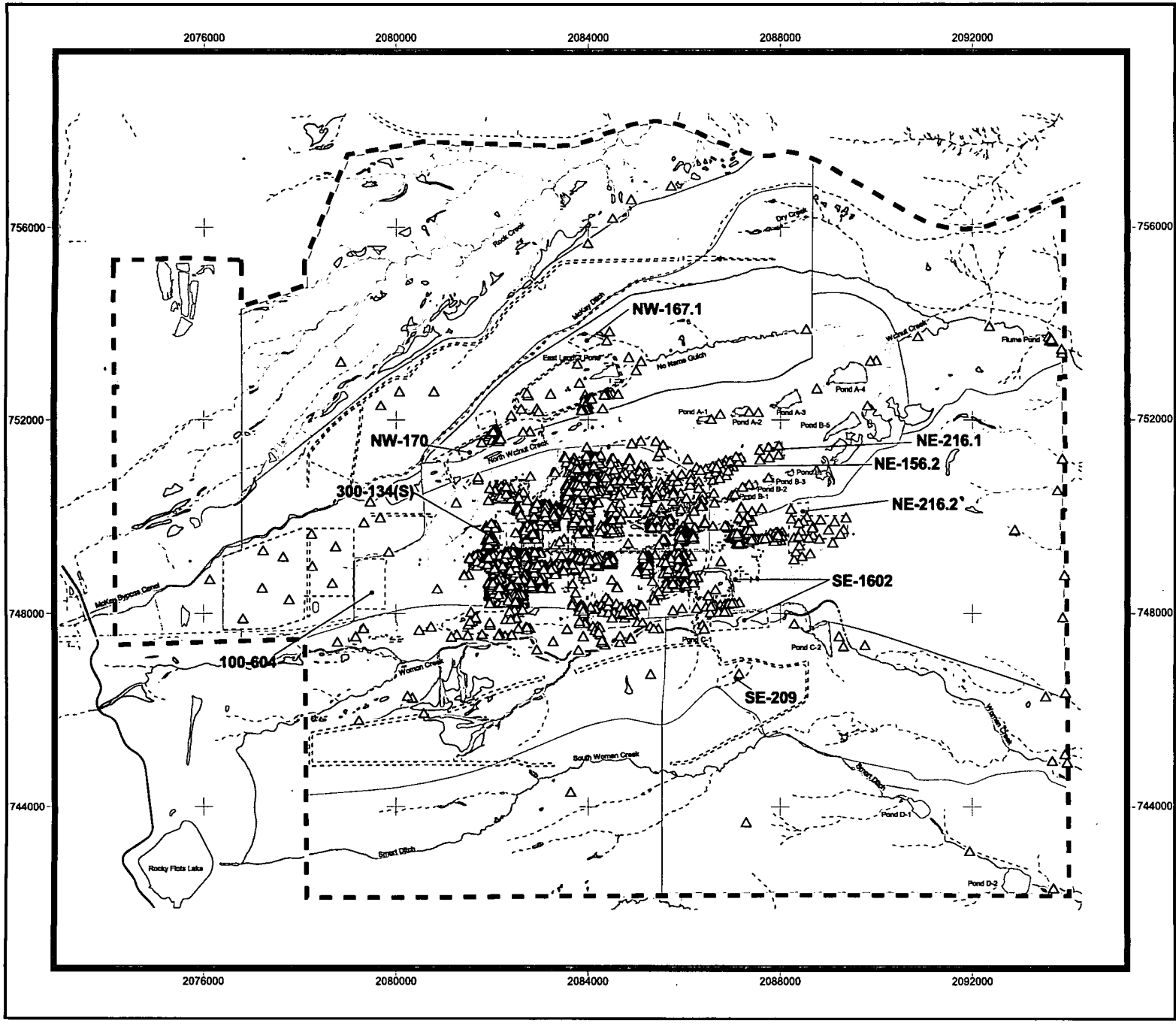

Figure A3.59
Subsurface Soil Sampling Locations for VOCs (Acetone and Methylene Chloride not included)

KEY

Sample location
- >= ESL
- < ESL
- Nondetect
- Detected, no ESL
- Nondetect, no ESL
- Historical IHSS/PAC
- Seep

Exposure Unit
- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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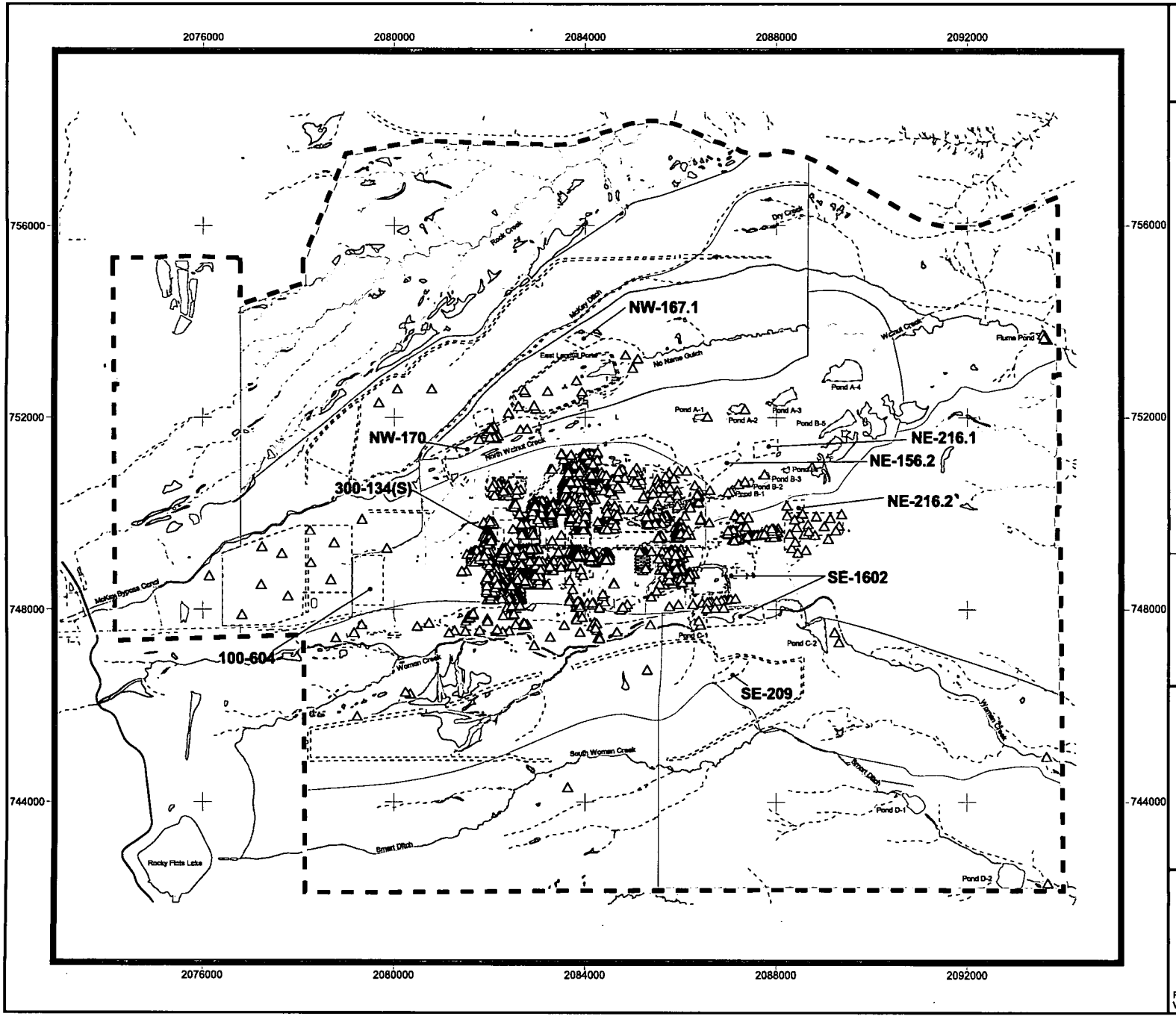

Figure A3.60a

Subsurface Soil Sampling Locations for SVOCs (PAHs not included)

KEY

Sample location
- >= ESL
- < ESL
- Nondetect
- Detected, no ESL
- Nondetect, no ESL
- Historical IHSS/PAC
- Seep

Exposure Unit
- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
Colorado Central Zone
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329

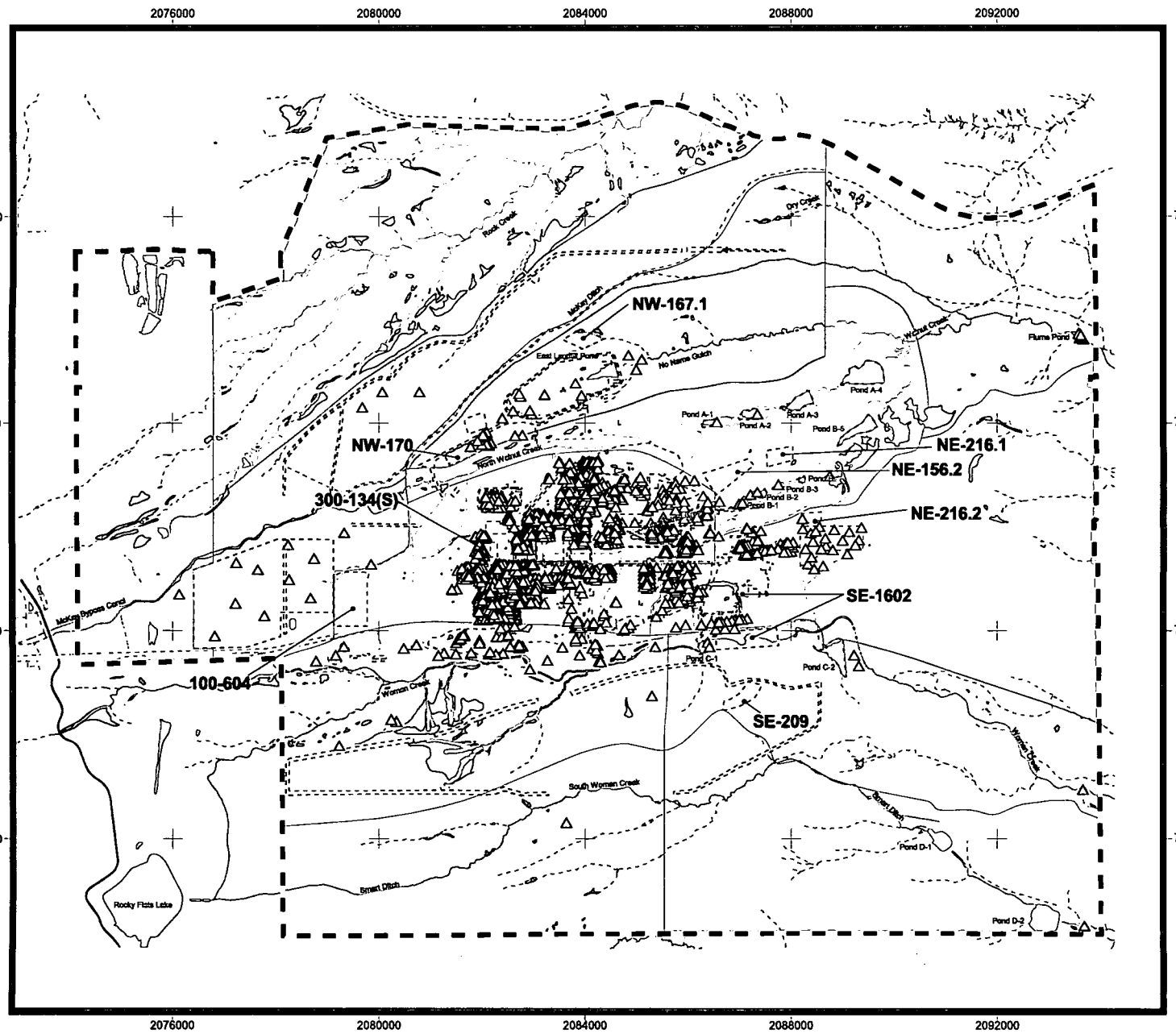

Figure A3.60b

Subsurface Soil Sampling Locations for PAHs

KEY

Sample location
- >= ESL
- < ESL
- Nondetect
- Detected, no ESL
- Nondetect, no ESL
- Historical IHSS/PAC
- Seep

Exposure Unit
- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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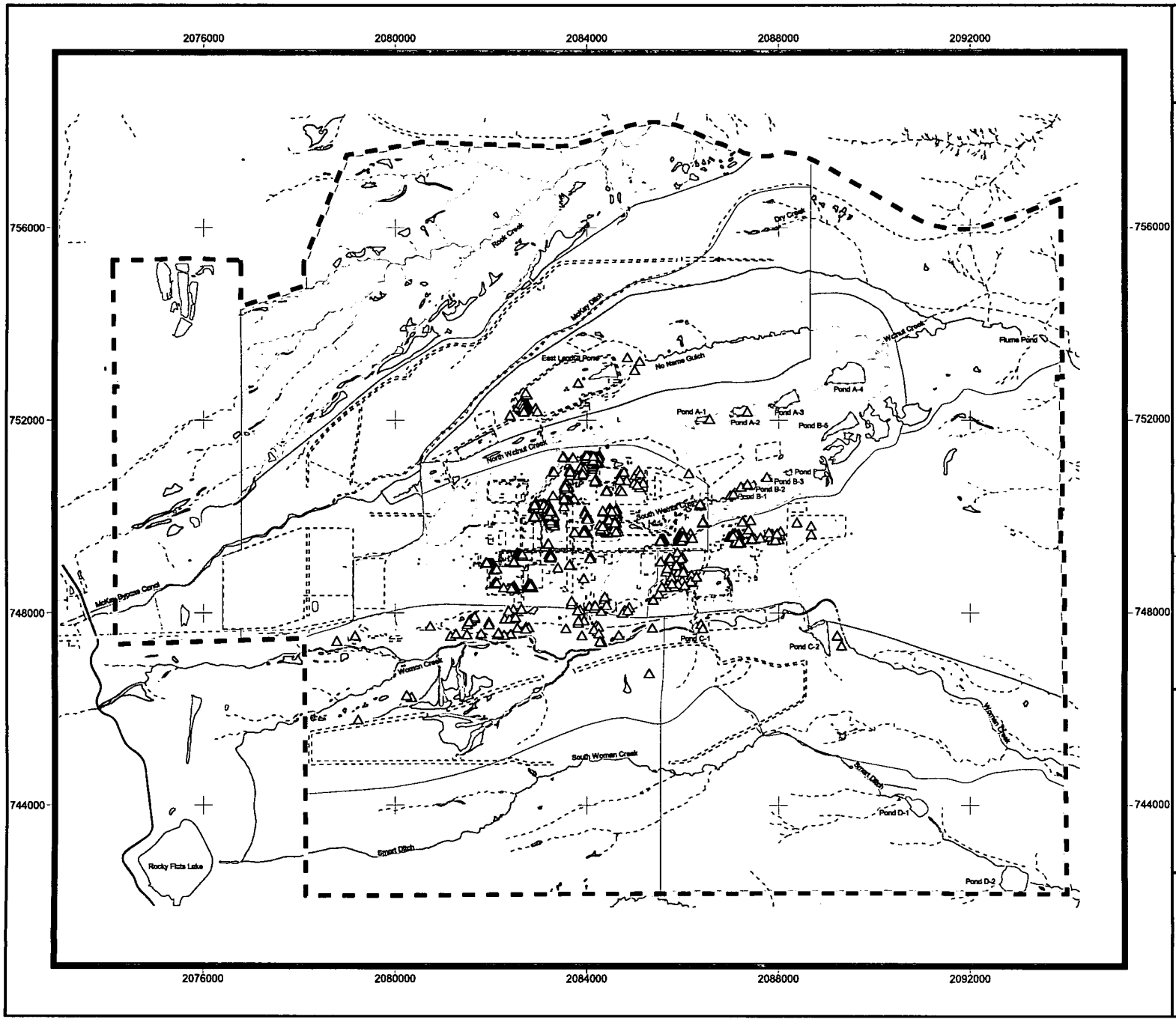

Figure A3.61

Subsurface Soil Sampling Locations for PCBs

KEY

Sample location
- >= ESL
- < ESL
- Nondetect
- Detected, no ESL
- Nondetect, no ESL
- Historical IHSS/PAC
- Seep

Exposure Unit
- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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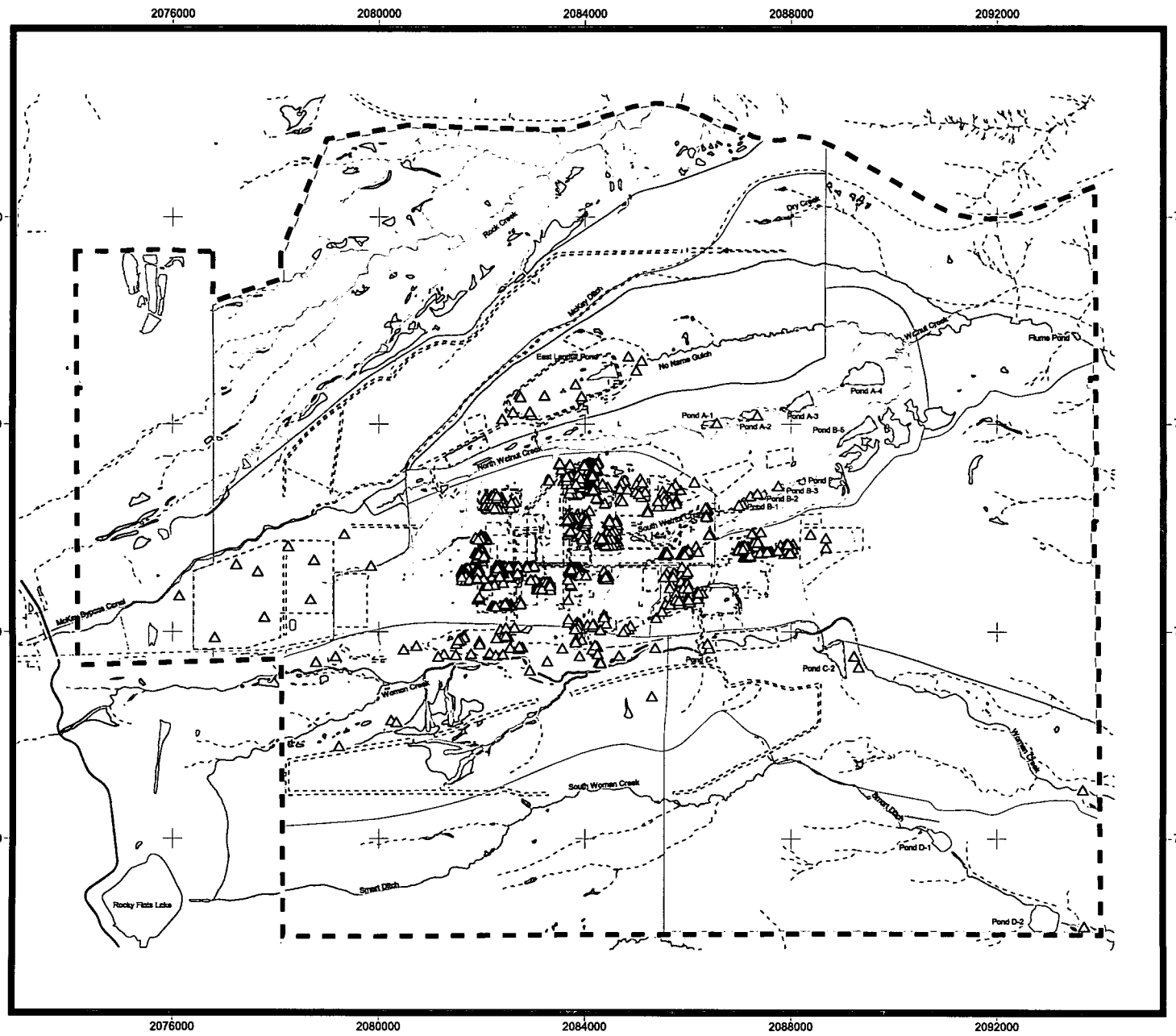

Figure A3.62

Subsurface Soil Sampling Locations for Pesticides

KEY

Sample location
- >= ESL
- < ESL
- Nondetect
- Detected, no ESL
- Nondetect, no ESL
- Historical IHSS/PAC
- Seep

Exposure Unit
- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

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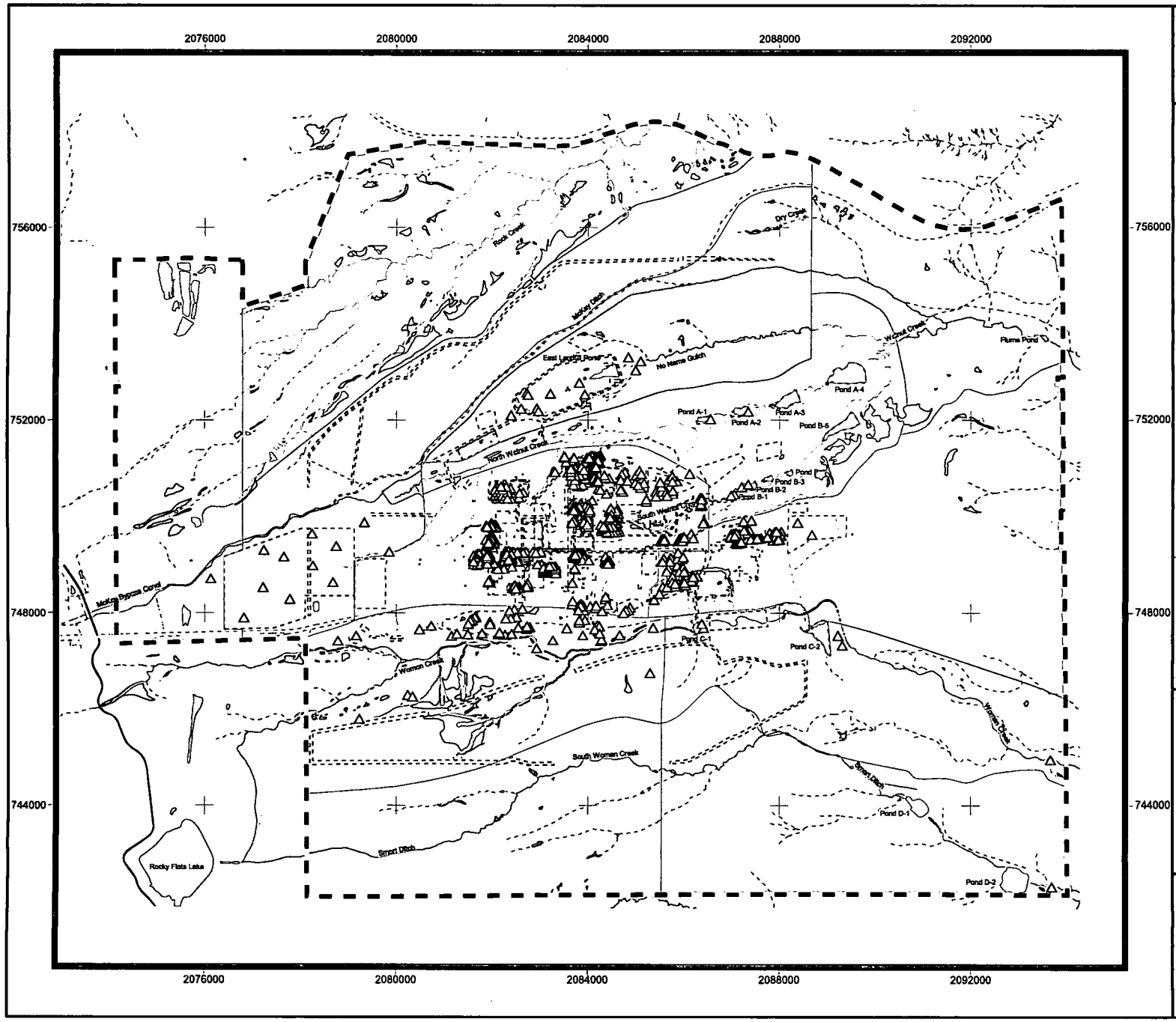

Figure A3.63

Subsurface Soil Sampling Locations for Herbicides

KEY

Sample location
- >= ESL
- < ESL
- Nondetect
- Detected, no ESL
- Nondetect, no ESL
- Historical IHSS/PAC
- Seep

Exposure Unit
- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
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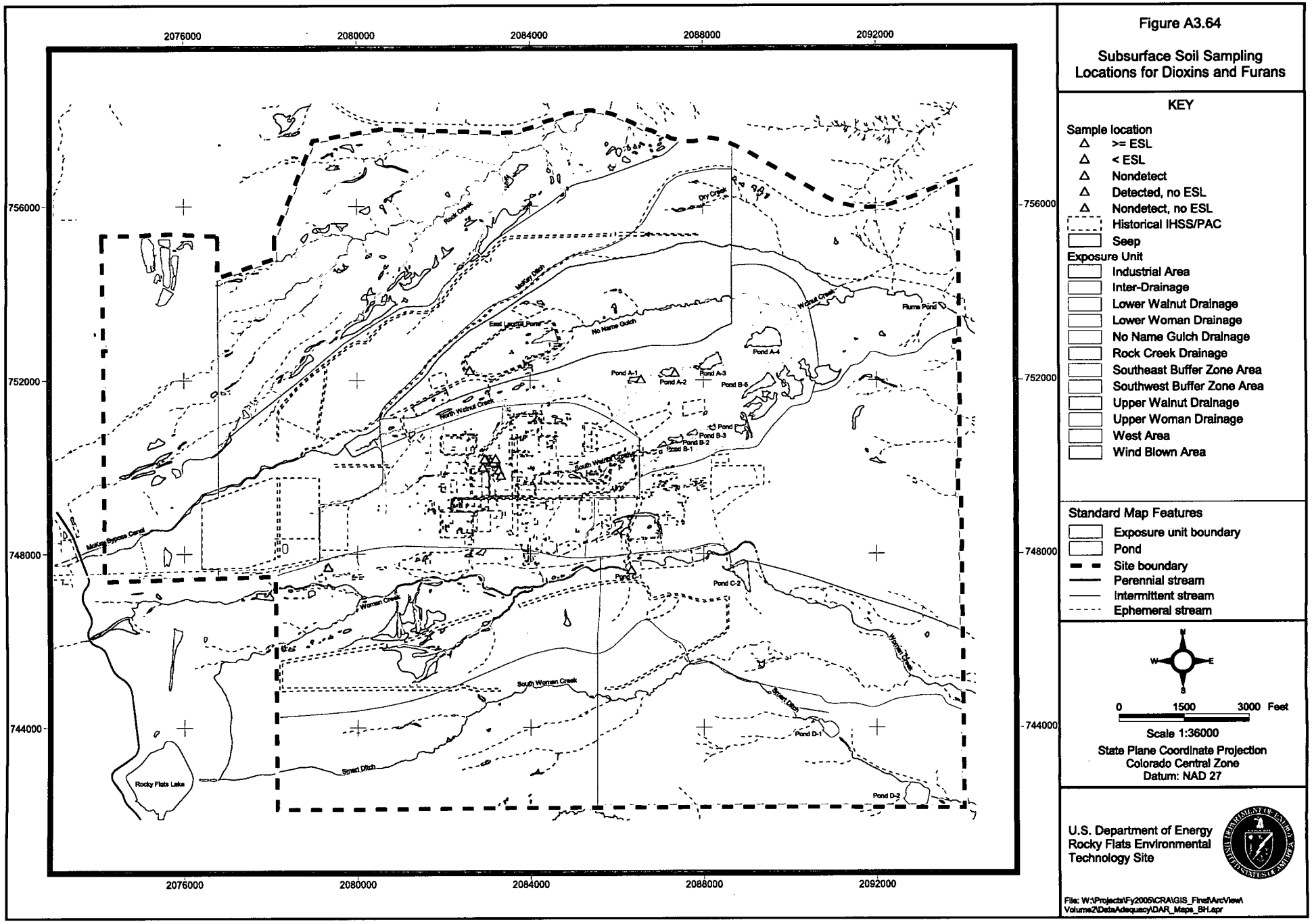

Figure A3.64

Subsurface Soil Sampling Locations for Dioxins and Furans

KEY

Sample location
- >= ESL
- < ESL
- Nondetect
- Detected, no ESL
- Nondetect, no ESL
- Historical IHSS/PAC
- Seep

Exposure Unit
- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
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Datum: NAD 27

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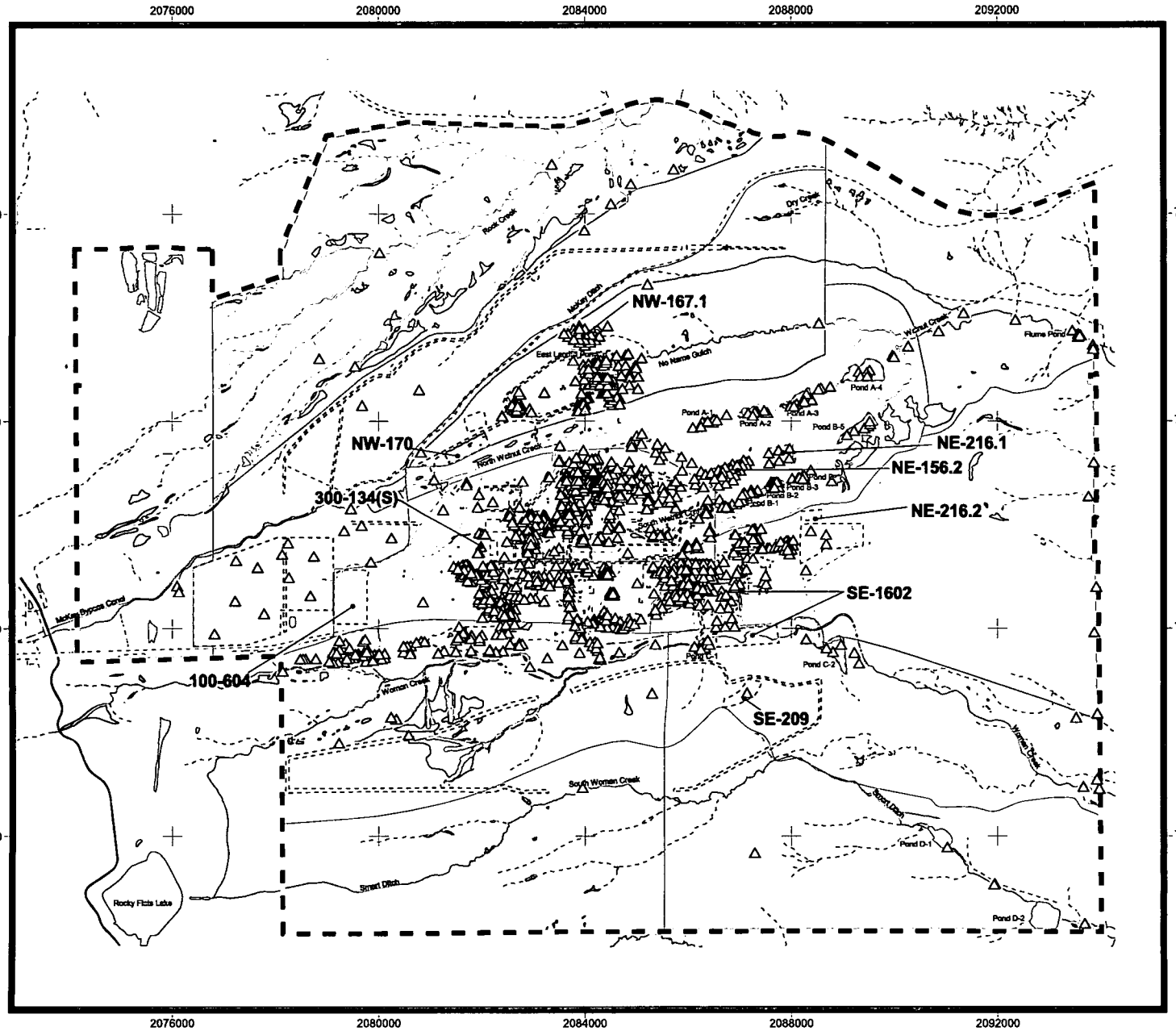

Figure A3.65

Subsurface Soil and Subsurface Sediment Sampling Locations for Radionuclides

KEY

Sample location
- >= PRG
- < PRG
- Nondetect
- Detected, no PRG
- Nondetect, no PRG
- Historical IHSS/PAC
- Seep

Exposure Unit
- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

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Datum: NAD 27

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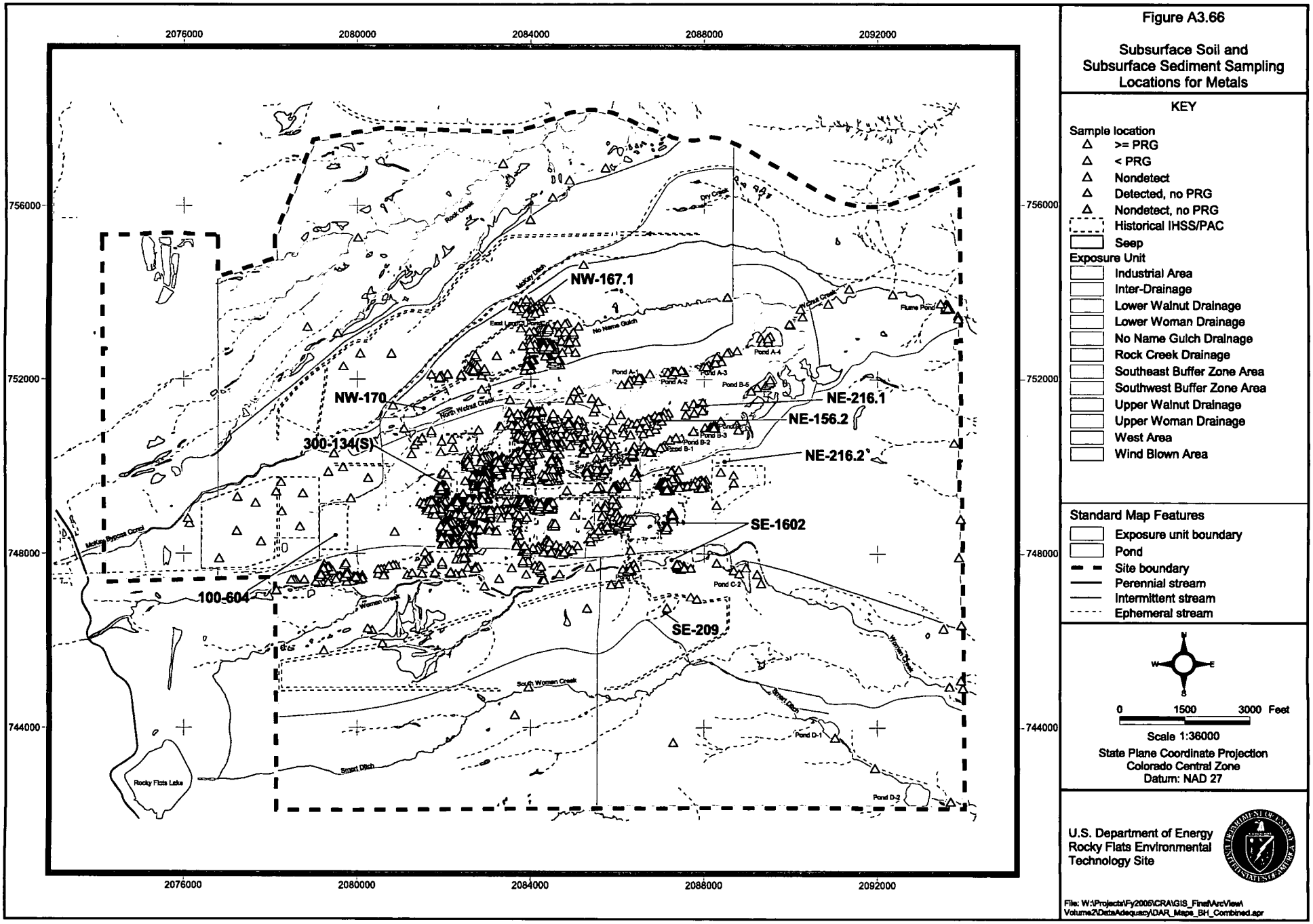
2076000
2080000
2084000
2088000
2092000
756000
752000
748000
744000
NW-167.1
NW-170
300-134(S)
NE-216.1
NE-156.2
NE-216.2
SE-1602
100-604
SE-209
Rock Creek
Dry Creek
McKay Ditch
East Walnut Creek
No Name Gulch
North Walnut Creek
Walnut Creek
Flume Pond
Pond A-1
Pond A-2
Pond A-3
Pond A-4
Pond B-5
Pond B-3
Pond B-2
Pond B-1
Pond C-2
Pond D-1
Pond D-2
McKay Bypass Canal
Woman Creek
South Woman Creek
Smart Ditch
Woman Creek
Rocky Flats Lake
Figure A3.66
Subsurface Soil and Subsurface Sediment Sampling Locations for Metals
KEY
Sample location
>= PRG
< PRG
Nondetect
Detected, no PRG
Nondetect, no PRG
Historical IHSS/PAC
Seep
Exposure Unit
Industrial Area
Inter-Drainage
Lower Walnut Drainage
Lower Woman Drainage
No Name Gulch Drainage
Rock Creek Drainage
Southeast Buffer Zone Area
Southwest Buffer Zone Area
Upper Walnut Drainage
Upper Woman Drainage
West Area
Wind Blown Area
Standard Map Features
Exposure unit boundary
Pond
Site boundary
Perennial stream
Intermittent stream
Ephemeral stream
N
W
E
S
0
1500
3000 Feet
Scale 1:36000
State Plane Coordinate Projection
Colorado Central Zone
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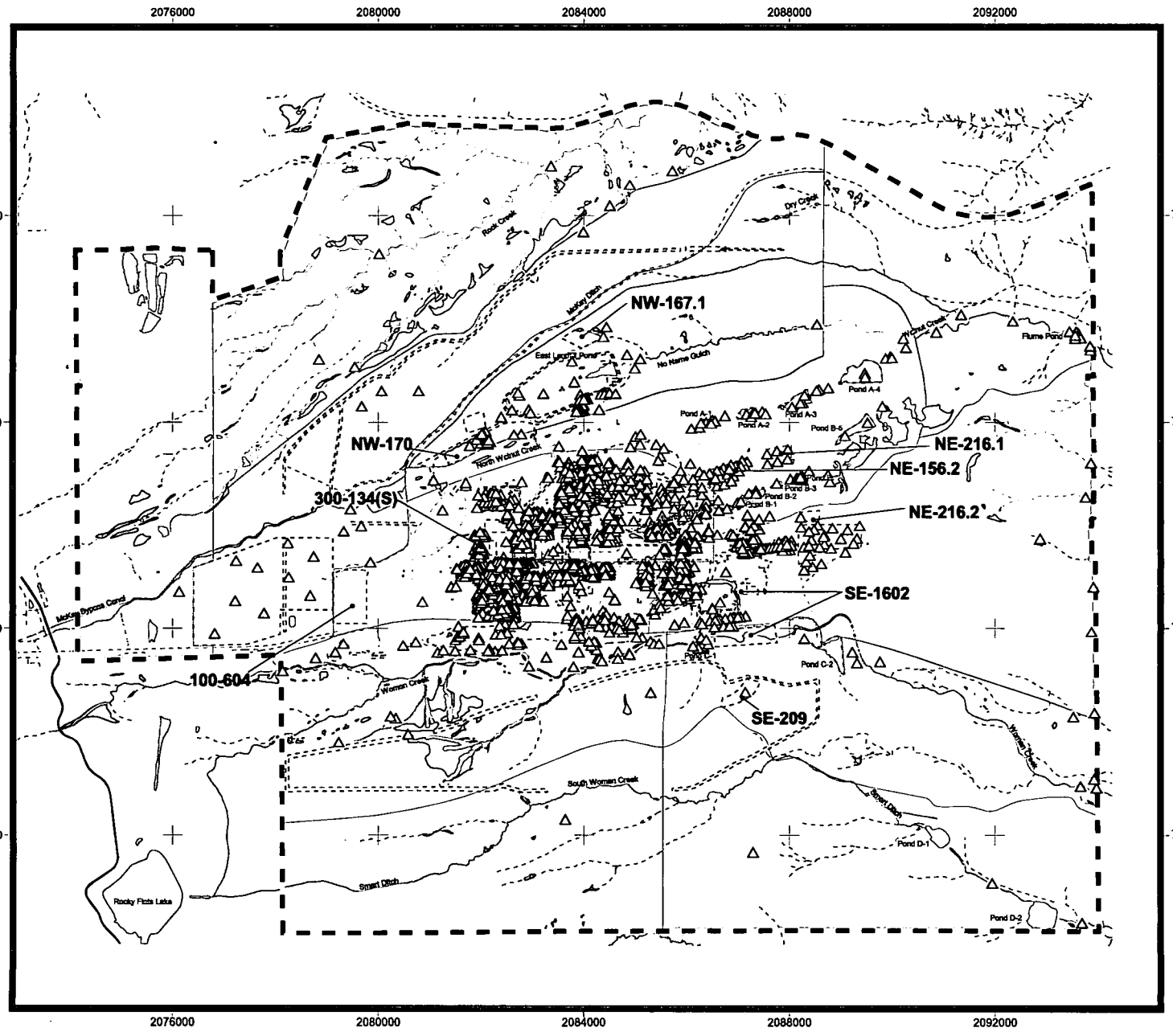

Figure A3.67
Subsurface Soil and Subsurface Sediment Sampling Locations for VOCs (Acetone and Methylene Chloride not included)

KEY

Sample location
- >= PRG
- < PRG
- Nondetect
- Detected, no PRG
- Nondetect, no PRG
- Historical IHSS/PAC
- Seep

Exposure Unit
- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

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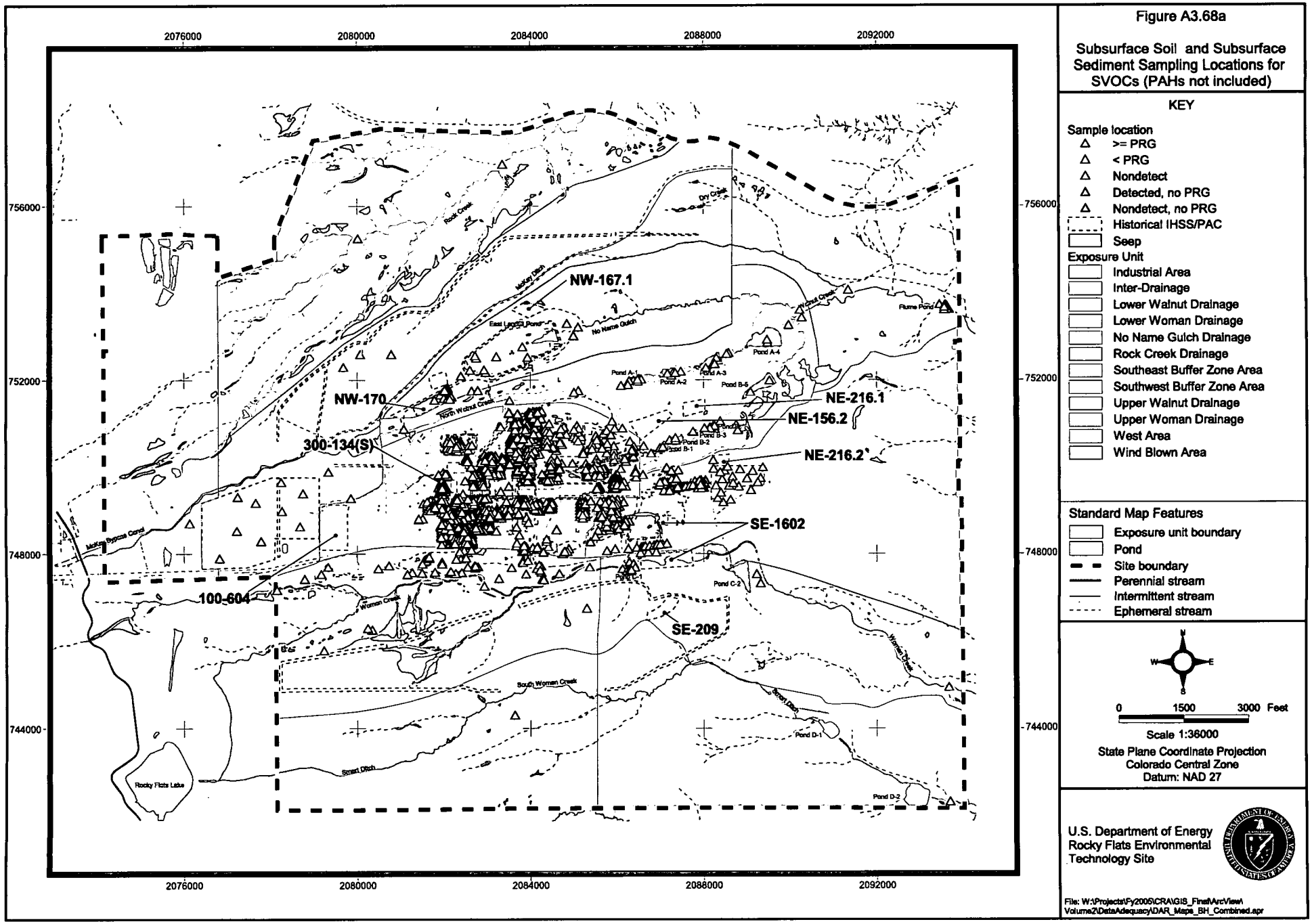
Figure A3.68a
Subsurface Soil and Subsurface Sediment Sampling Locations for SVOCs (PAHs not included)
KEY
Sample location
>= PRG
< PRG
Nondetect
Detected, no PRG
Nondetect, no PRG
Historical IHSS/PAC
Seep
Exposure Unit
Industrial Area
Inter-Drainage
Lower Walnut Drainage
Lower Woman Drainage
No Name Gulch Drainage
Rock Creek Drainage
Southeast Buffer Zone Area
Southwest Buffer Zone Area
Upper Walnut Drainage
Upper Woman Drainage
West Area
Wind Blown Area
Standard Map Features
Exposure unit boundary
Pond
Site boundary
Perennial stream
Intermittent stream
Ephemeral stream
0 1500 3000 Feet
Scale 1:36000
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27
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2076000
2080000
2084000
2088000
2092000
756000
752000
748000
744000
NW-167.1
NW-170
300-134(S)
100-604
NE-216.1
NE-156.2
NE-216.2
SE-1602
SE-209
Rock Creek
Dry Creek
Walnut Creek
Flume Pond
Mower Ditch
East Landfill Pond
No Name Gulch
Pond A-1
Pond A-2
Pond A-3
Pond A-4
Pond B-1
Pond B-2
Pond B-3
Pond B-5
North Walnut Creek
Mower Bypass Canal
Woman Creek
South Woman Creek
Smart Ditch
Pond C-1
Pond C-2
Pond D-1
Pond D-2
Rocky Flats Lake

338.

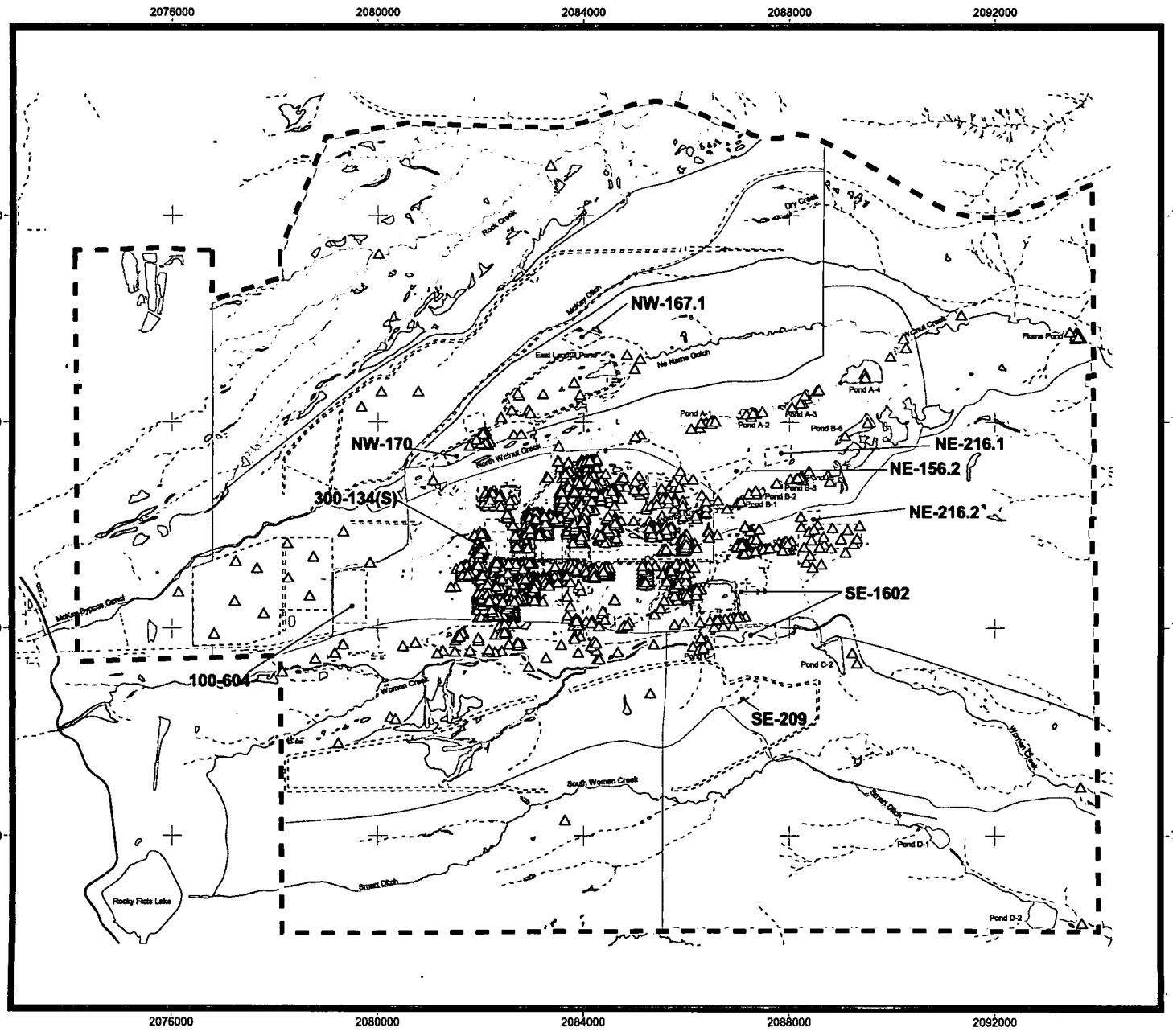

Figure A3.68b

Subsurface Soil and Subsurface Sediment Sampling Locations for PAHs

KEY

Sample location
- >= PRG
- < PRG
- Nondetect
- Detected, no PRG
- Nondetect, no PRG
- Historical IHSS/PAC
- Seep

Exposure Unit
- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
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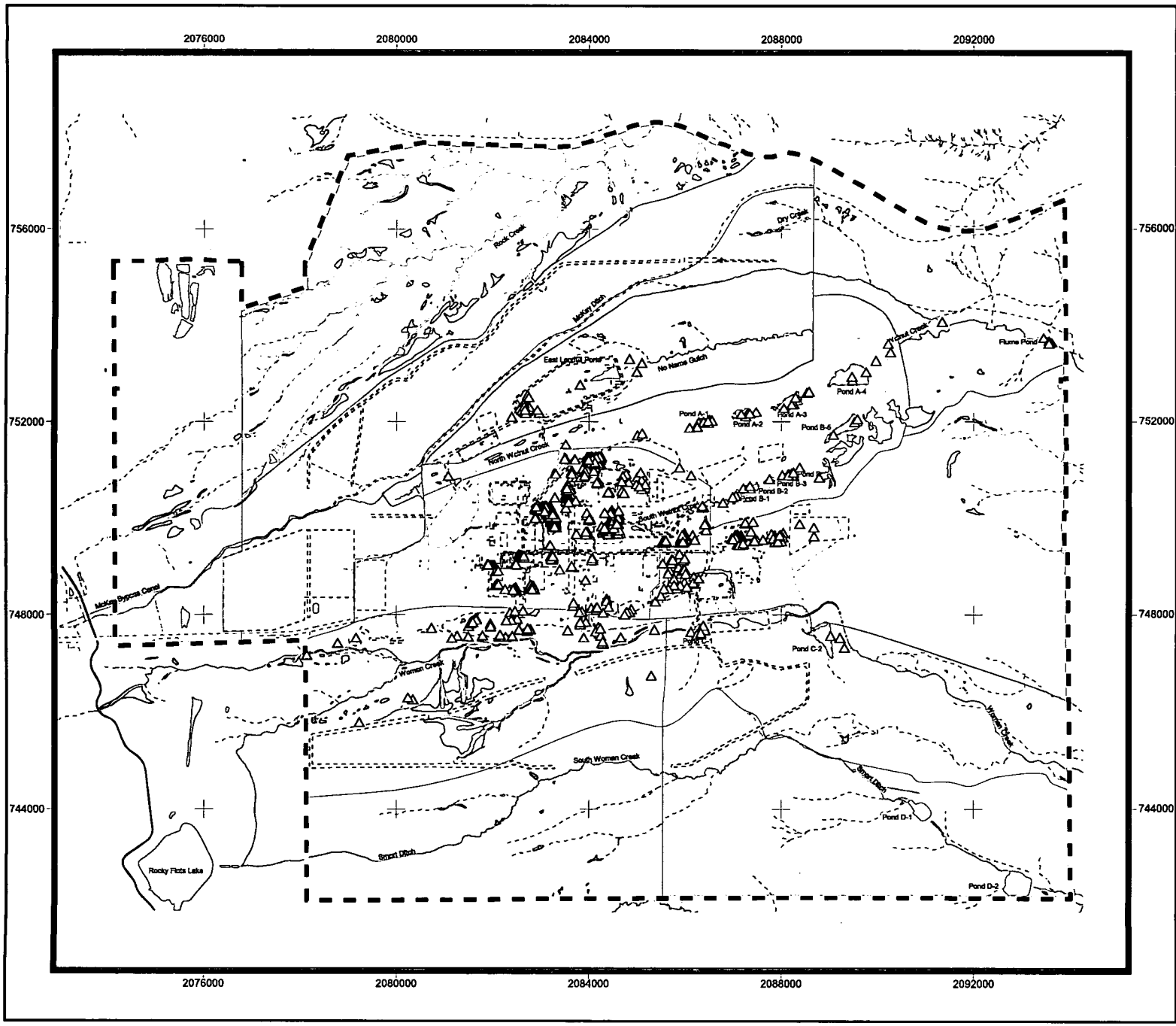

Figure A3.69

Subsurface Soil and Subsurface Sediment Sampling Locations for PCBs

KEY

Sample location
- >= PRG
- < PRG
- Nondetect
- Detected, no PRG
- Nondetect, no PRG
- Historical IHSS/PAC
- Seep

Exposure Unit
- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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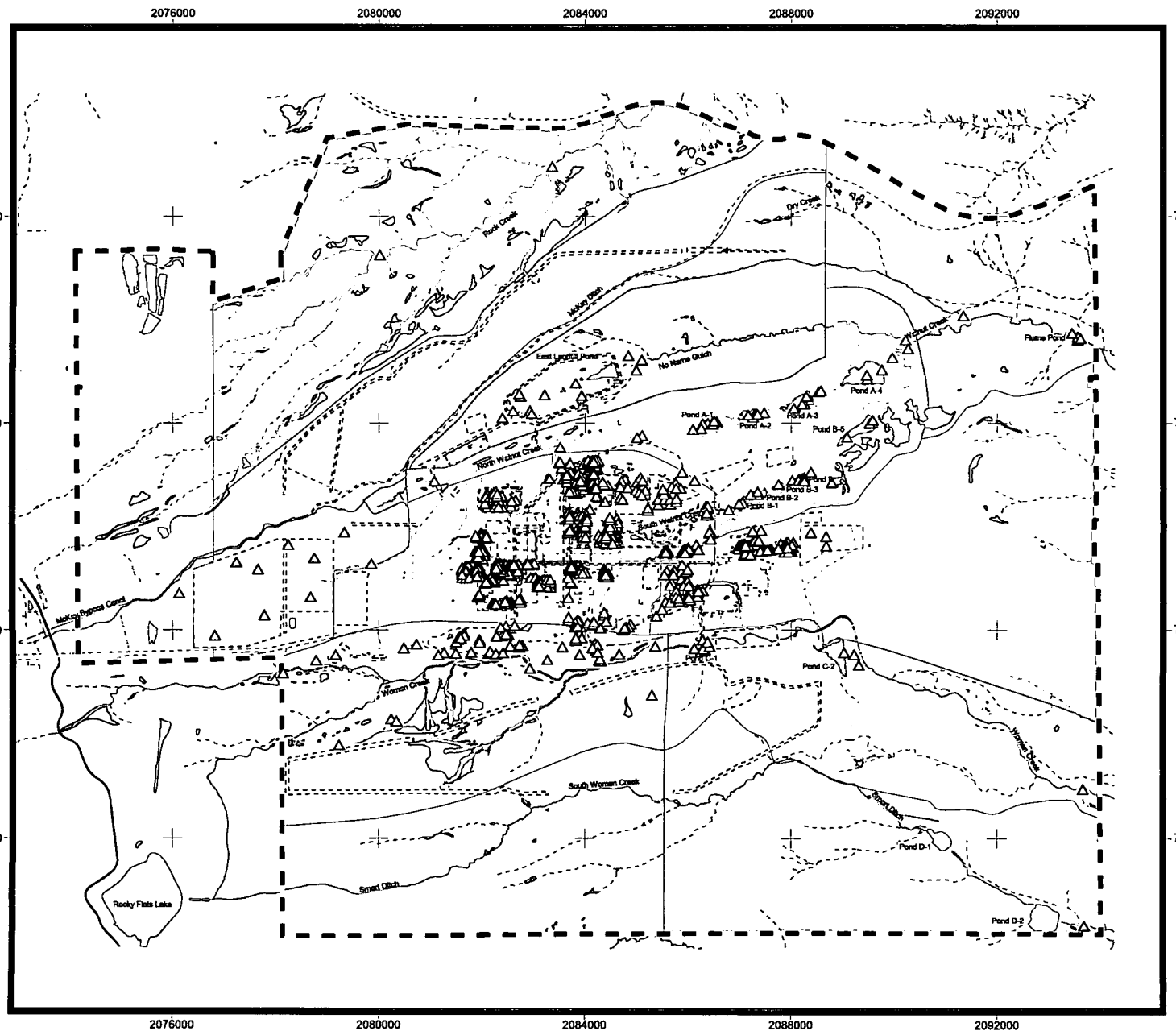

Figure A3.70

Subsurface Soil and Subsurface Sediment Sampling Locations for Pesticides

KEY

Sample location
- >= PRG
- < PRG
- Nondetect
- Detected, no PRG
- Nondetect, no PRG
- Historical IHSS/PAC
- Seep

Exposure Unit
- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
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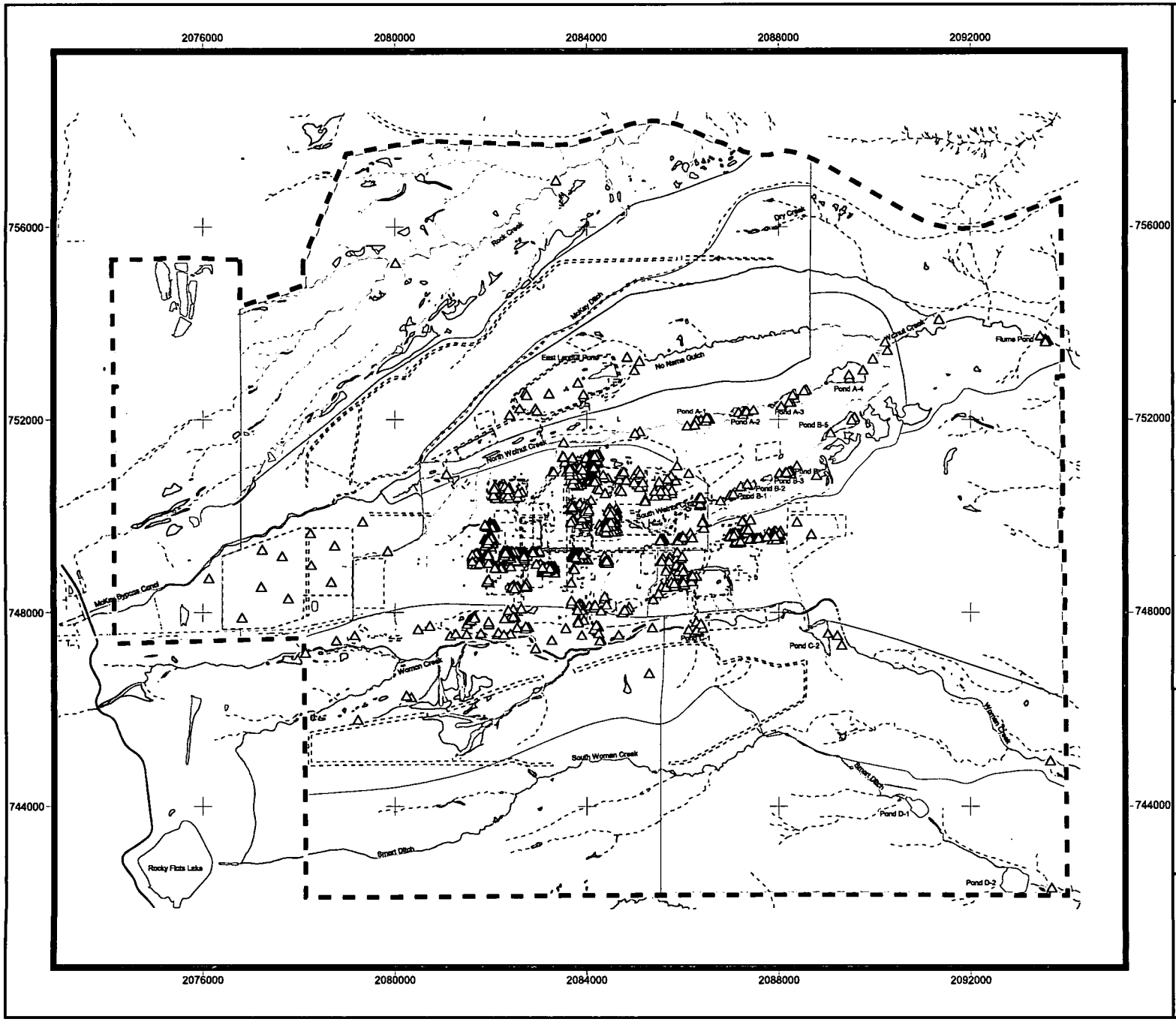

Figure A3.71

Subsurface Soil and Subsurface Sediment Sampling Locations for Herbicides

KEY

Sample location
- >= PRG
- < PRG
- Nondetect
- Detected, no PRG
- Nondetect, no PRG
- Historical IHSS/PAC
- Seep

Exposure Unit
- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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Rocky Flats Environmental Technology Site

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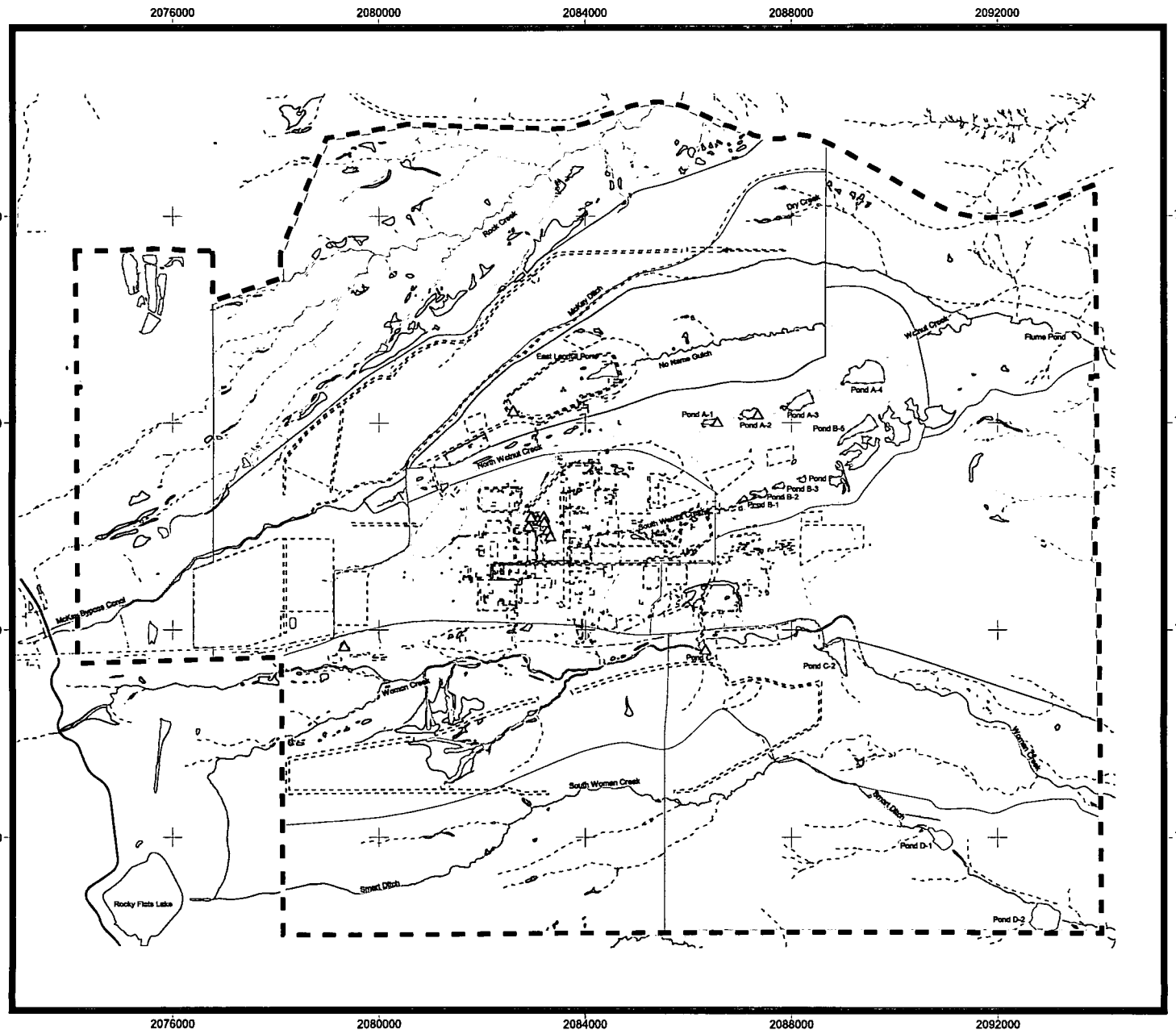

Figure A3.72

Subsurface Soil and Subsurface Sediment Sampling Locations for Dioxins and Furans

KEY

Sample location
- >= PRG
- < PRG
- Nondetect
- Detected, no PRG
- Nondetect, no PRG
- Historical IHSS/PAC
- Seep

Exposure Unit
- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1500 3000 Feet

Scale 1:36000

State Plane Coordinate Projection
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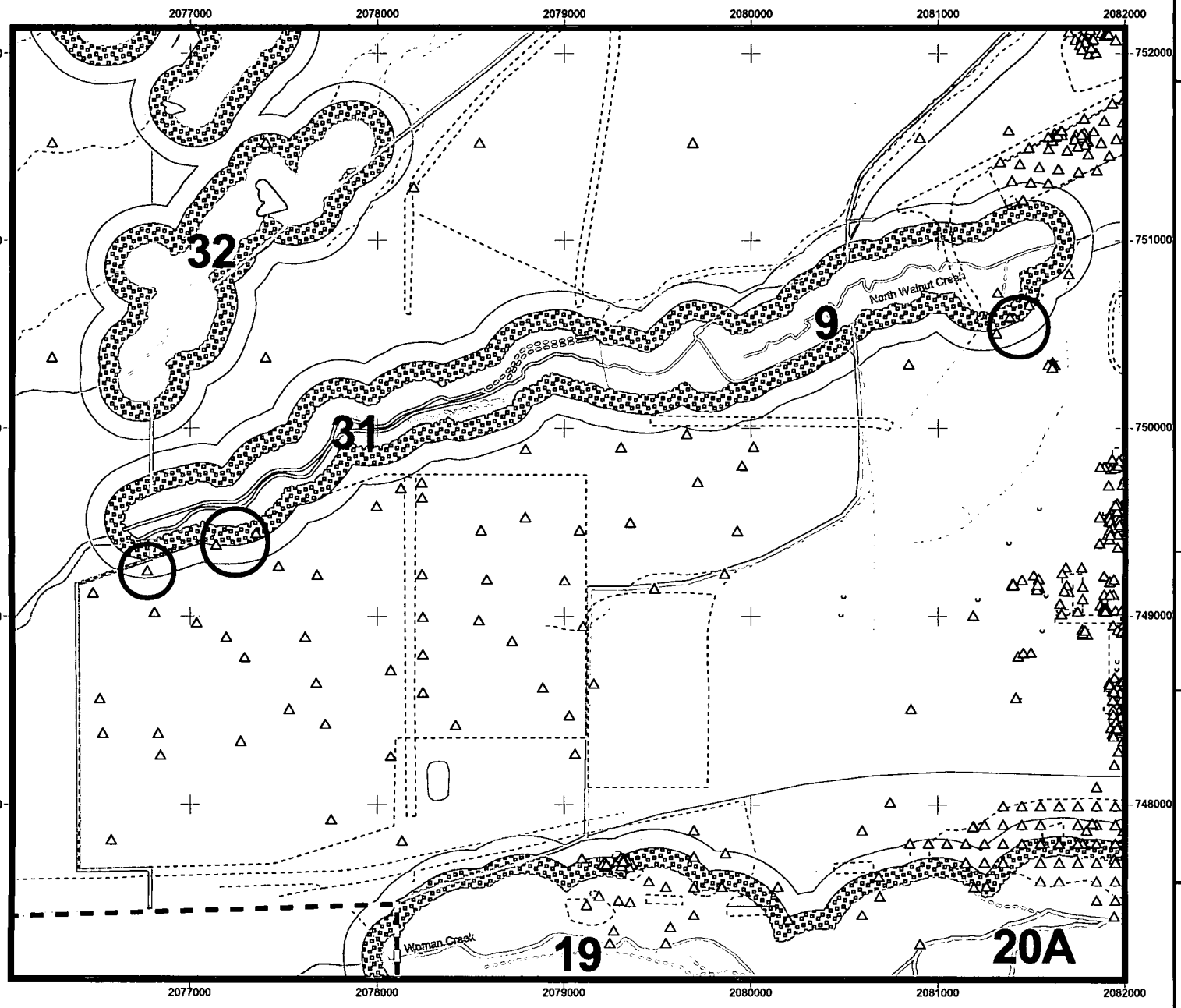

Figure A3.73

Surface Soil Sample Locations Within and Near PMJM Habitat in the Inter-Drainage Exposure Unit

KEY

Sample location
- Within PMJM Habitat
- Near PMJM habitat
- Samples used in PMJM evaluation
- Inter-Drainage EU
- Historical IHSS/PAC
- PMJM habitat patch
- 1 PMJM habitat patch ID
- 100 foot habitat buffer
- 200 foot habitat buffer

Exposure Unit
- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 400 800 Feet

Scale 1:9600

State Plane Coordinate Projection
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Datum: NAD 27

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344

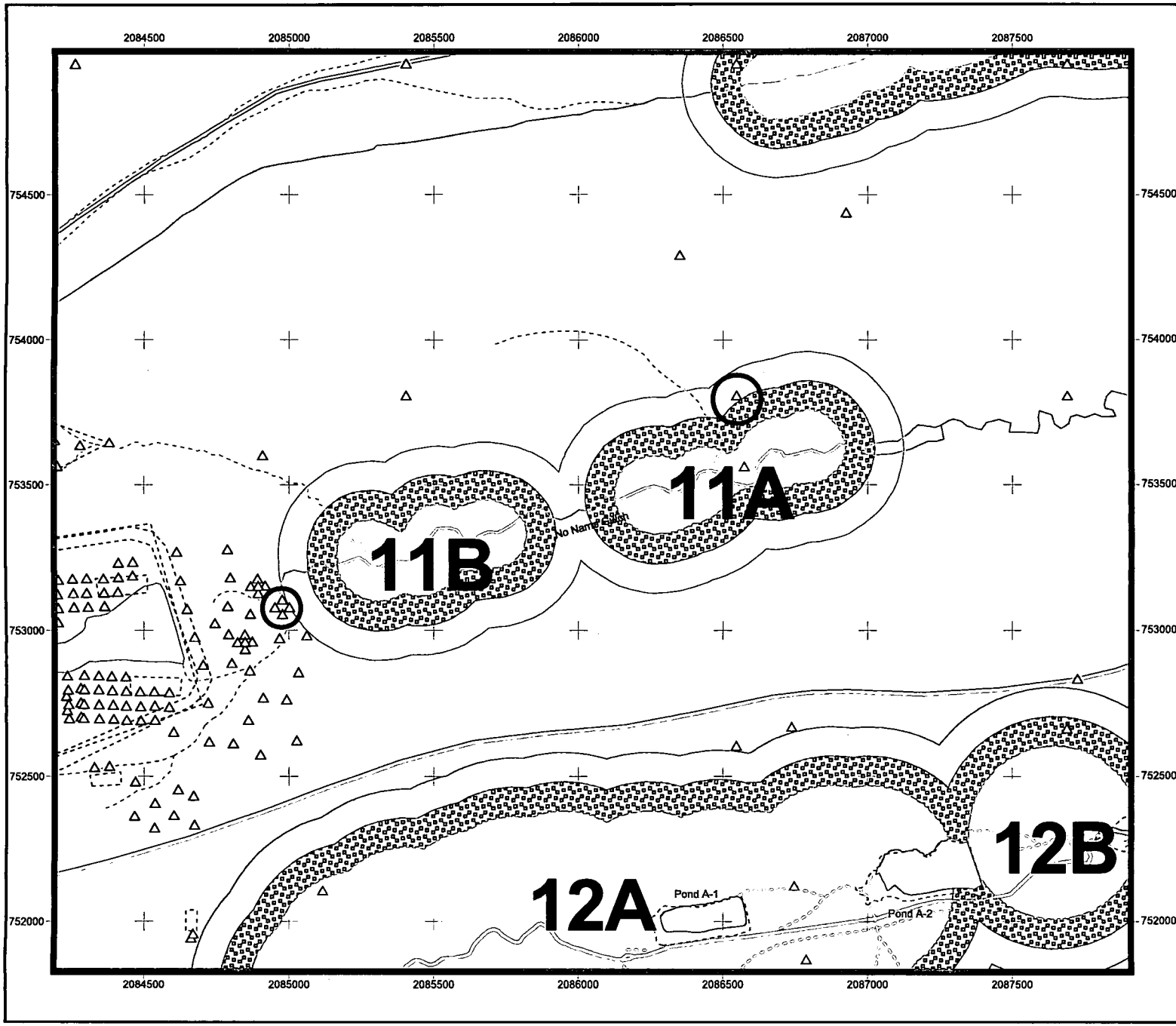

Figure A3.74
Surface Soil Sample Locations Within and Near PMHM Habitat in the No Name Gulch Drainage Exposure Unit

KEY

Sample location
- Within PMJM Habitat
- Near PMJM habitat
- Samples used in PMJM evaluation
- Inter-Drainage EU
- Historical IHSS/PAC
- PMJM habitat patch
- 1 PMJM habitat patch ID
- 100 foot habitat buffer
- 200 foot habitat buffer

Exposure Unit
- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 250 500 Feet

Scale 1:6000

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Rocky Flats Environmental Technology Site

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COMPREHENSIVE RISK ASSESSMENT

COMPREHENSIVE RISK ASSESSMENT METHODOLOGY AND DATA DESCRIPTION

VOLUME 2: ATTACHMENT 4

Evaluation of Insignificant Pathways

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Figure A4.13 Groundwater Sample Locations where Volatilization PRGs were Exceeded

ACRONYMS AND ABBREVIATIONS

AL	Action Level
AOI	Analyte Of Interest
ATSDR	Agency For Toxic Substances And Disease Registry
BDL	Below Detection Limit
CDPHE	Colorado Department Of Public Health And Environment
CRA	Comprehensive Risk Assessment
DOE	U.S. Department Of Energy
EPA	U.S. Environmental Protection Agency
EU	Exposure Unit
FS	Feasibility Study
IAEU	Industrial Area Exposure Unit
IDEU	Inter-Drainage Exposure Unit
KG	Kilogram
KG/YR	Kilograms Per Year
MDC	Maximum Detected Concentration
PCE	Perchloroethene Or Tetrachloroethene
PCI/G	Picocuries Per Gram
PCOC	Potential Contaminant Of Concern
PRG	Preliminary Remediation Goal
RESRAD	Residual Radioactivity Model
RFCA	Rocky Flats Cleanup Agreement
RFETS	Rocky Flats Environmental Technology Site
RI	Remedial Investigation

TCE	Trichloroethene
UCL	Upper Confidence Limit
USFWS	U.S. Fish And Wildlife Service
UWNEU	Upper Walnut Drainage Exposure Unit
UWOEU	Upper Woman Drainage Exposure Unit
VOC	Volatile Organic Compound
WBEU	Wind Blown Exposure Unit
WRV	Wildlife Refuge Visitor
WRW	Wildlife Refuge Worker

1.0 INTRODUCTION

Several exposure pathways were identified in the Final CRA Work Plan and Methodology, Revision 1 (DOE 2005), hereafter referred to as the CRA Methodology, as potentially complete but unlikely to contribute significantly to site risks for the Wildlife Refuge Worker (WRW) and Wildlife Refuge Visitor (WRV) at the Rocky Flats Environmental Technology Site (RFETS). Complete and significant pathways are evaluated in the risk assessments for the individual Exposure Units (EUs). Exposure pathways that are considered potentially complete but insignificant are evaluated on a sitewide basis in this attachment. The following pathways were identified as complete but insignificant for WRW and WRV in the CRA Methodology:

- Ingestion of and dermal exposure to surface water;
- Ingestion of and dermal exposure to groundwater that daylights at seeps or streams;
- Inhalation of volatile organic compounds (VOCs) released from subsurface soil or groundwater to ambient and indoor air; and
- Ingestion of deer meat.

The surface water ingestion and dermal exposure pathways are theoretically complete for both WRW and WRV (DOE 2005) because Potential Contaminants of Concern (PCOCs) have been detected in various surface water bodies on the site, and the WRW could theoretically be exposed to surface water while working near streams and seeps, and the WRV while recreating on the site. However, because the anticipated WRW work activities do no routinely involve contact with surface water, and because most of the proposed trail system is located at some distance from the onsite water bodies, exposure is expected to be limited, and therefore, to be insignificant. Since contact with surface water is expected to be limited, contact with groundwater released at seeps is also expected to be insignificant. Exposure to surface water and groundwater is evaluated in Section 4.0.

Volatilization of PCOCs from subsurface soil, subsurface sediment and/or groundwater into the atmosphere, and subsequent inhalation by the WRW and WRV is not considered significant for several reasons. Inhalation of VOCs in ambient air is not a significant pathway because VOCs released from the subsurface will rapidly dissipate outdoors. Release of VOCs present in the subsurface, and inhalation of VOCs in indoor air can be a significant exposure pathway due to the limited air exchange indoors as compared to dilution effects outdoors. The indoor air inhalation pathway is assumed to be insignificant. The analysis presented in Section 4.0 of this volume evaluates the validity of this assumption.

Ingestion of animal tissue is incomplete for the WRW, but is considered potentially complete but insignificant for the WRV due to possible limited hunting that the WRV may engage in. The Fish and Wildlife Service's preferred alternative for the Wildlife Refuge includes development of a limited public hunting program (USFWS 2004). Currently, this envisions a limited hunting program for youth and disabled people. Even if the program was to be expanded to include the general population in the future, the per-person hunting quota is expected to be small, due to the limited deer population on the site. This pathway is further evaluated in Section 4.0.

2.0 SURFACE WATER AND GROUNDWATER PRG SCREEN

2.1 Evaluation of the Surface Water Exposure Pathway

The surface water exposure pathway is evaluated by comparing the detected concentrations of analytes in surface water to the surface water preliminary remediation goals (PRGs) developed in the CRA Methodology. Total and dissolved surface water concentrations were compared to the surface water PRGs. However, PRG exceedances only occurred for total concentrations. Table A4.1 shows summary statistics for the analytes that exceed the surface water PRGs. As shown in this table, exceedances of the surface water PRG occurred in three EUs; the Industrial Area (IAEU), Upper Walnut Drainage (UWNEU), and Upper Woman Drainage (UWOEU). Concentrations of arsenic, nitrate, thallium, tetrachloroethene, trichloroethene, uranium-233, 234, and uranium-238 exceeded their surface water PRG. The locations where the surface water PRGs were exceeded[1] (and were not exceeded) are shown on Figure A4.1. Except for thallium and uranium isotopes, the Nature and Extent of Surface Water and Sediment Contamination also identifies these constituents as Analytes of Interest (AOIs) in surface water based on the screening of data collected since 2000 against surface water standards (see Section 5 of the Remedial Investigation/Feasibility Study (RI/FS) Report).

Arsenic exceedances occurred in the IAEU and UWOEU and maximum detected concentrations (MDCs) are less than three times the surface water PRG (TableA4.1). PRG exceedances are only 0.38 % of the total number of samples collected in the IAEU and only 1.73 % of those collected in the UWOEU. Because the number of arsenic exceedances and the number of locations with arsenic exceedances are comparable, arsenic exceedances at any one location are infrequent. Because arsenic concentrations in surface water exceed the PRG very infrequently, and the MDCs in the IAEU and UWOEU are of the same order of magnitude as the surface water PRG, human exposure to arsenic in surface water is not a significant pathway.

There was only one exceedance of the lead PRG, and it occurred in the UWOEU at station GS05 (see Figure A4.1). The MDC is less than six times the surface water PRG (TableA4.1). The PRG exceedance is only 0.24 % of the total number of samples collected in the UWOEU. Because lead concentrations in surface water exceed the PRG very infrequently, and the MDC in the UWOEU is the same order of magnitude as the surface water PRG, human exposure to lead in surface water is not a significant pathway.

Thallium had a detection frequency of less than five percent in the IAEU, a PRG exceedance frequency of only 0.16 %, and a MDC that is only slightly above the PRG (Table A4.1). Because the number of thallium exceedances and the number of locations with thallium exceedances are comparable, thallium exceedances at any one location are also infrequent. The low PRG exceedance frequencies and a MDC near the surface water PRG indicate human exposure to thallium in surface water is not a significant pathway.

Tetrachloroethene (PCE), trichloroethene (TCE), uranium-233, 234, uranium-238, and nitrate are known site-related contaminants. The locations where the PRGs were exceeded are shown on

[1] A location is classified as a PRG exceedance if any analyte has been at a concentration exceeding the PRG since June 28, 1991. This date is when Inter-Agency Agreement Work Plans were first implemented, and data collected previous to this date are not included in the CRA dataset.

Figures A4.2 through A4.5 (a map for uranium-238 is not shown; however, the single exceedance is at the uranium-233,234 exceedance location downstream of Pond A-4 [see Figure A4.4]).

PCE PRG exceedances occurred in the IAEU and UWNEU, and MDCs were less than two times the PRG (Table A4.1 and Figure A4.2). PRG exceedances were extremely rare, representing only 0.15 % of the total samples collected in the IAEU and 0.25 % of the total number of samples collected in the UWNEU. In the IAEU, there were exceedances at two sampling locations (Figures A4.2). In both locations, the sole exceedance was for a sample collected in 1991 or 1992, and more recent sampling has resulted in concentrations that are well below the PRG (Figures A4.6a and A4.6b) (see Figure A4.1 for sample locations). In the UWNEU, there was only one exceedance of the PRG (collected in 1998). No other samples were collected from this sampling location; however, data for the other sample locations shown on Figure A4.2 in the UWNEU indicate concentrations are well below the surface water PRG (see Section A4.2.2). Because PCE concentrations exceed the PRG very infrequently, and available data indicate a downward concentration trend where PRGs exceedances have occurred (or data for neighboring surface water monitoring stations show very low concentrations relative to the PRG), human exposure to PCE in surface water is not a significant pathway.

TCE concentrations exceeded the PRG at four locations in the UWNEU (Table A4.1 and Figure A4.3). These exceedances are very rare, accounting for less than one percent of the total number of samples collected from the UWNEU. Because the number of TCE exceedances and the number of locations with TCE exceedances are the same, the TCE exceedances are also isolated occurrences. Consequently, human exposure to TCE in surface water is not a significant pathway.

Uranium-233, 234 concentrations exceeded the PRG in the IAEU and UWNEU (Figure A4.4), and uranium-238 concentrations exceeded the PRG in the UWNEU (same location as the uranium-233, 234 exceedance). These three exceedances account for only 0.06 % of the total number of samples collected from each EU, and MDCs are less than twice the PRG. In the UWNEU, samples collected before and after these exceedances from the same sampling locations were at very low concentrations relative to the PRG (Figure A4.6c and A4.6d) (see Figure A4.1 for sample location). In the IAEU, no samples were collected subsequent to the sample with the exceedance; however, the sample with the exceedance is from many years ago (1991) and current monitoring data for uranium indicates concentrations are significantly lower such that uranium isotopes are not categorized as AOIs (see Section 5 of the RI/FS report). Consequently, human exposure to uranium isotopes in surface water is not a significant pathway.

Nitrate concentrations exceeded the PRG twice in the IAEU (Table A4.1 and Figure A4.5). Nitrate exceedances accounted for only 0.08 % of the total number of samples collected (Table A1.1). The two exceedances were less than three times the PRG. Consequently, human exposure to nitrate in surface water is not a significant pathway.

In conclusion, for analytes with concentrations that exceeded the PRG, the frequency of exceedances was less than two percent for any given analyte and EU, and exceedances were no more than six times the PRG. In most cases, the exceedances occurred many years ago and more

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recent sampling has confirmed that concentrations are well below the PRG. Therefore, human exposure to these analytes in surface water is not a significant pathway.

2.2 Evaluation of the Groundwater-to-Surface Water Exposure Pathway

The potential for the WRW or WRV to be exposed to groundwater is evaluated in areas where groundwater can potentially be released into surface water (i.e., at seeps). The groundwater data used in this evaluation are for wells that are within 100 ft of a seep, and are shown in Figure A4.7. The groundwater-to-surface water exposure pathway is evaluated by comparing detected groundwater concentrations at these locations to the surface water PRGs. Total and dissolved groundwater concentrations were compared to the PRG; however, exceedances only occurred for total concentrations. Table A4.2 provides summary statistics for the groundwater analytes that exceed the surface water PRG.

As shown in Figure A4.7 and Table A4.2, groundwater concentrations exceeded the surface water PRG in four EUs (IAEU, UWOEU, UWNEU, and Wind Blown Area [WBEU]). Groundwater concentrations for antimony, iron, lead, nitrate, carbon tetrachloride, tetrachloroethene, trichloroethene, and vinyl chloride exceeded their PRGs.

Antimony, iron, carbon tetrachloride, and vinyl chloride were not detected above the PRG in surface water, indicating that these groundwater contaminants were not released into surface water at concentrations that pose a risk to human health for the WRW and WRV. The single exceedance of the lead surface water PRG in groundwater occurred in the UWOEU (Figure A4.7). The location is remote from the isolated lead PRG exceedance in surface water in the UWOEU, which occurred upstream at station GS05 (see Figure A3.1). Therefore, the lead in groundwater near the seep was not released into surface water at a concentration that poses a risk to the WRW and WRV. The assessment for PCE, TCE, and nitrate is provided below. The locations where these analytes exceeded the surface water PRG in groundwater are shown on Figures A4.8, A4.9, and A4.10, respectively.

PCE concentrations in groundwater near seeps exceeded the surface water PRG in the IAEU, UWNEU, and WBEU (Figure A4.8). However, the surface water PRG exceedance frequencies for samples collected in these EUs were relatively low - 2.6%, 5.1%, and 11.8%, respectively (Table A4.2). In the UWNEU, several of the PCE PRG exceedance locations in groundwater and surface water are in close proximity to each other (Figure A4.2 and A4.8) suggesting groundwater discharged to surface water at these locations. However, the PCE exceedances last occurred in 1998, and more recent sampling data for all of the UWNEU surface water stations and wells shown on Figures A4.2 and A4.8 indicate that concentrations are well below the surface water PRGs in both groundwater and surface water at these locations (Figure A4.11a). Therefore, human exposure to PCE in groundwater potentially emerging as seeps is not a significant pathway.

TCE concentrations in groundwater near seeps exceeded the surface water PRG in the IAEU, UWNEU, and WBEU (Figure A4.9). The surface water PRG exceedance frequencies for samples collected in these EUs were 3.7%, 2.6%, and 32.3%, respectively (Table A4.2). In UWNEU, several of the locations of TCE exceedances in groundwater and surface water are in close proximity to each other (Figure A4.3 and A4.9) suggesting groundwater discharged to

surface water at these locations. However, the TCE exceedances last occurred in 1998, and more recent sampling data for all of the UWNEU surface water stations and wells shown on Figures A4.3 and A4.9 show that concentrations are well below the surface water PRGs in both groundwater and surface water at these locations (Figure A4.11b). In the WBEU, where the frequency of PRG exceedances in groundwater was the highest, there were no PRG exceedances for surface water in the area (Figure A4.3). Therefore, human exposure to TCE in groundwater potentially emerging as seeps is not a significant pathway.

As mentioned, there have been no exceedances of the surface water PRGs for PCE and TCE in recent years, and exceedances are not expected in the future. Two passive groundwater collection and treatment systems were installed to protect surface water in this area. The Mound Site Plume Treatment System, located south of SW059 captures and redirects contaminated groundwater to treatment cells containing zero valence iron. The zero valence iron, contained in two buried treatment cells, is used to remediate volatile organic compound (VOC) contaminated groundwater by reductive dehalogenation of the VOCs. After treatment, the water is discharged back to groundwater on the downgradient side of the treatment system through a French drain. The system installation was completed in 1998. The East Trenches Plume Treatment System also consists of a passive subsurface groundwater collection system coupled with a zero-valence iron treatment system. The downgradient capture system was installed along and near the upper reach of South Walnut Creek to capture the contaminated groundwater to the maximum extent practicable. The treated water discharges to groundwater through an infiltration gallery. The system installation was completed in 1999.

Nitrate concentrations in groundwater near seeps exceeded the surface water PRG in the IAEU (Figure A4.10). The frequency of the PRG exceedances was less than 1%. The nitrate exceedances in groundwater and surface water were located in close proximity to each other (Figure A4.5 and A4.10). However, the nitrate exceedances last occurred in 1994, and more recent IAEU sampling data for all of the surface water stations and groundwater wells shown on Figures A4.5 and A4.10 show that concentrations are well below the surface water PRGs in both groundwater and surface water at these locations (Figure A4.11c). Therefore, human exposure to nitrate in groundwater potentially emerging as seeps is not a significant pathway.

Like TCE and PCE, there have been no exceedances of the surface water PRGs for nitrate in recent years, and exceedances are not expected in the future. The Solar Pond Plume Treatment System consists of a 1,100-foot long collection system located south of North Walnut Creek near the former Solar Evaporation Ponds. The collection system routes groundwater to a passive treatment cell containing zero valence iron and wood chips, and was completed in 1999. The wood chips provide the substrate for the removal of nitrate by denitrification.

In addition to the passive collection and treatment systems addressing the East Trenches and Solar Pond plumes, phytoremediation systems have been installed downgradient of these collection systems. The phytoremediation systems are willow trees (family *Salicaceae*) planted in areas showing evidence of shallow groundwater flow, i.e., wetter areas or areas showing increased plant growth. The willow trees are capable of removing VOCs and nitrate. The phytoremediation will further ensure PRGs in surface water are not exceeded in these areas.

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In conclusion, several analytes in groundwater near seeps have exceeded the surface water PRG. However, many of these same analytes in surface water have never exceeded the PRG. Additionally, many of the exceedances in groundwater occurred a number of years ago and more recent sampling has confirmed that concentrations are below the PRG. Therefore, human exposure to these analytes in groundwater potentially emerging at seeps is not a significant pathway.

3.0 SUBSURFACE SOIL AND GROUNDWATER VOLATILIZATION PRG SCREEN

The indoor air inhalation pathway evaluation is performed by comparing the detected concentrations of VOCs in subsurface soil/subsurface sediment and groundwater to volatilization PRGs. The volatilization PRGs were developed in the CRA Methodology using the Johnson and Ettinger Model (Johnson and Ettinger 1991). Site-specific input parameters included WRW exposure assumptions and average soil characteristics for RFETS. Input parameters into the Johnson and Ettinger Model are shown in Table A4.3. Additional information regarding development of the volatilization PRGs is presented in the CRA Methodology.

3.1 Volatilization Analysis for Subsurface Soil/Subsurface Sediment

Summary statistics for analytes with MDCs that exceeded their volatilization PRGs in subsurface soil/subsurface sediment are presented in Table A4.4. PRGs were exceeded in the following EUs: the Industrial Area (IA), the Inter-Drainage (IDEU), the No Name Gulch Drainage (NNEU), the Upper Walnut Drainage (UWAEU), the Upper Woman Drainage, (UWOEU) and the Windblown Area (WBEU). Fourteen analytes exceeded their volatilization PRGs in the IAEU, and a maximum of four analytes exceeded their volatilization PRGs in the other EUs. Carbon tetrachloride, chloroform, tetrachloroethene and trichloroethene were the most common analytes with exceedances in the different EUs. Tetrachloroethene exceeded its PRG in the highest number of samples and the greatest number of locations in each EU.

Locations at which at least one analyte in subsurface soil/subsurface sediment exceeded its volatilization PRG are shown in Figure A4.12. The figure also shows subsurface soil/subsurface sediment sampling locations at which none of the analytes exceeded the volatilization PRGs. As is evident from Figure A4.12, the vast majority of subsurface soil/subsurface sediment sampling locations had no PRG exceedances. Almost all of the locations with exceedances are located in the IAEU and adjacent EUs to the north, south, and east. At some of these locations, MDCs exceeded the PRGs by two to three orders of magnitude (see Table A4.4). In these areas, the indoor air inhalation pathway is potentially significant if buildings were constructed. Outside these areas, the indoor air inhalation pathway is insignificant, including the area in the IDEU where PRGs were exceeded, as explained below.

Two sampling locations west of the IAEU (in the IDEU) have volatilization PRG exceedances; borehole 46392 (chloroform PRG exceedance) and 51494 (mercury PRG exceedance). Borehole 46392 is the exceedance location further to the north on Figure A4.12. The MDCs for chloroform at borehole 46392 and mercury at borehole 51494 are the same order of magnitude as the volatilization PRGs. The maximum concentrations for chloroform and mercury are 96 ug/kg and 25.4 mg/kg, whereas the PRGs are 47.1 ug/kg and 9.47 mg/kg, respectively (Table A.4.4). In both cases, all other detections were below the PRG.

There is uncertainty regarding the data for the IDEU sample where chloroform exceeded the volatilization PRG. The subsurface soil sample was collected from an unusually large depth interval (0-60 foot), and almost all of the analytical data for the sample were either rejected ("R" qualified) or estimated ("J"qualified). Thirty-two of the results were rejected ("R" qualified) and two were designated as estimated. Chloroform was one of the two J-qualified analytical results. Because of this uncertainty, and considering chloroform is at a concentration that is only slightly higher than the PRG, volatilization risks from chloroform in the IDEU are considered negligible.

For the borehole with the mercury PRG exceedance, the mercury concentration in the one sample that exceeded the PRG is approximately twice the PRG. Since the PRG for mercury is based on a hazard quotient (HQ) of 0.1, the HQ estimate for mercury would be approximately 0.2. An HQ of 1 is considered to be protective of human populations, including sensitive subgroups. Therefore, volatilization risks from mercury in the IDEU are considered negligible.

3.2 Volatilization Analysis for Groundwater

Summary statistics for analytes with MDCs exceeding their volatilization PRGs in groundwater are presented in Table A4.5. PRGs for groundwater were exceeded in the following EUs: the IA, the NNEU, the UWNEU, and the WBEU (Figure A4.13). Nine analytes exceeded their volatilization PRGs in the IA, one in the NNEU, four in the UWAEU, and 11 in the WBEU. 1,1-dichloroethene, carbon tetrachloride, chloroform, and trichloroethene exceeded their PRGs in all of the above EUs, except for the NNEU, where only carbon tetrachloride exceeded its PRG. Carbon tetrachloride exceeded its PRG in the highest number of samples and the greatest number of locations.

Except for one well, all groundwater wells with PRG exceedances are located within or near the IAEU. At some of these locations, MDCs exceeded the PRGs by several orders of magnitude (see Table A4.5). In these areas, the indoor air inhalation pathway is potentially significant if buildings were constructed. Outside these areas, the indoor air inhalation pathway is insignificant, including the one area in the NNEU where PRGs were exceeded, as explained below.

One well located in the NNEU had a VOC concentration that exceeded the PRG. The MDC of carbon tetrachloride at this well was 75 ug/L, which is slightly above the PRG of 62.3 ug/L. Except for the 75 ug/L detection, all measured carbon tetrachloride concentrations at this well are below the PRG. The measured concentration in 1993 was 4 ug/l and those in 1995 were 1.2, and 10 ug/L. The detected concentrations in nearby wells are also low, ranging from 0.2 to 4 ug/L. This analysis suggests that 75 ug/L is not representative of carbon tetrachloride concentrations in groundwater in this area, and the indoor air pathway is insignificant.

3.3 Summary

A screening-level evaluation was performed to assess potential indoor air impacts at RFETS. The evaluation was performed by comparing concentrations of volatile analytes in subsurface soil/subsurface sediment and groundwater to volatilization PRGs that were developed in the CRA Methodology. In general, all sampling locations with PRG exceedances were located within or near the IAEU. In these areas, the indoor air inhalation pathway is potentially

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significant if buildings were constructed. If these areas are encompassed by the ICA, the indoor air pathway will be incomplete. Outside of these areas, the indoor air pathway is insignificant, and quantitative risk evaluation of this pathway in the CRA is not warranted.

4.0 ASSESSMENT OF RISK FROM INGESTION OF DEER AND GRAZING ANIMALS

In the Rocky Flats National Wildlife Refuge Final Comprehensive Conservation Plan and Environmental Impact Statement (USFWS 2004), four alternatives for future use of the site are described. Two of the alternatives, which include the preferred alternative, have a limited public hunting program at the site. The hunting program is described as a controlled youth and/or disabled person's deer and/or elk hunting program a few weekends per year. The hunting program may be modified in the future to include able-bodied hunters if appropriate for wildlife management (USFWS 2004).

In addition to a controlled hunting program, other animals (for example, cattle or goats) may be used on site for grassland management and/or weed control. Both of these uses of animals are described as short term. For grassland management, the grazing would be limited to short duration with high animal numbers (flash grazing for an average of 2 weeks) (USFWS 2004).

Although deer, elk, and other grazing animals may be on site in the future, the risk associated with ingesting meat from these animals is expected to be insignificant for the WRV receptor (as defined in the CRA Methodology). By insignificant, it is meant that the contribution from the meat ingestion pathway to the overall risk from all exposure pathways is expected to be less than 10 percent. EPA defines this percentage as insignificant for the dermal exposure pathway when this pathway contributes less than 10 percent of the total risk (EPA 2004). The deer ingestion pathway is expected to be an insignificant contributor to risk due to very low soil-to-plant actinide transfer rates, and low gastrointestinal absorption rates for actinides (Todd and Sattelberg 2004). In general, terrestrial animal assimilation of actinides from the gastrointestinal tract is assumed to be less than 0.01 percent (Todd and Sattelberg 2004).

A quantitative assessment was conducted to evaluate the contribution to the overall potential risk for the WRV from consumption of meat from deer, and to provide documentation that the pathway designation of complete and insignificant is appropriate. Because of the limited amount of time that domestic grazing animals (cattle or goats) would be on site, and the wide distribution of meat from these animals to many consumers, it was assumed that risk calculations based on uptake of radionuclides by deer would be conservative for grazing animals because deer are assumed to reside on site and the meat from one deer may be eaten by a single individual (for example, a hunter).

This section of Attachment 4 includes a description of the approach, methods, and results for this assessment. A brief review of the USFWS report (Todd and Sattelberg 2004) on Rocky Flats deer meat tissue analyses is also provided.

4.1 Methodology

The potential contribution to overall risks from soil exposure pathways of the deer meat ingestion pathway was assessed using the Residual Radioactivity Model (RESRAD Version 6.22).[2] Input parameters for the soil exposure pathways in the RESRAD model were left as default values or adjusted to site-specific values as specified in the Task 3 Report and Appendices: Calculation of Surface Radionuclide Soil Action Levels for Plutonium, Americium, and Uranium (Task 3 Report) (EPA et al. 2002). All RESRAD calculations were run using the Federal Guidance Report No.13 (EPA 1999) Morbidity Dose Factor Library. Parameters in RESRAD associated with deer meat consumption were adjusted based on default values for beef consumption.

The assumptions used in these calculations are summarized as follows:

- The WRV scenario presented in the CRA Methodology, which is based on the Adult Open Space User scenario presented in the Task 3 Report, is assumed to be representative of the hunter. This should be conservative because only youth and/or disabled persons are expected to participate in the hunting program a few weekends per year.
- The meat ingestion pathway was added to the WRV exposure scenario to simulate the ingestion of muscle and liver from game animals. An adult exposure scenario was chosen to maximize the intake of game animal meat.
- RESRAD parameters for the meat consumption pathway were developed based on cattle. Even though cattle have an average body weight 8 to 9 times greater than deer, the default fodder and soil intakes for cattle were used for the RESRAD calculations. This assumption will overestimate the amount of radionuclides that accumulate in edible tissue in deer.
- The deer are assumed to stay on the Rocky Flats property for the duration of their lives, and it is assumed deer will be exposed to radionuclide concentrations evenly across the entire Rocky Flats property.
- RESRAD was run using input parameters specified in the Task 3 Report for the adult open space exposure scenario (which approximates the WRV exposure scenario) with the meat ingestion pathway added. All exposure parameter values specified in Table D-1 of the Task 3 Report were retained for this assessment except where noted.
- The default meat consumption rate was adjusted from a default beef ingestion rate of 68 kilograms per year (kg/yr) to a game ingestion rate of 2.4 kg/yr. The game ingestion rate is the 99th percentile ingestion rate for game in the U.S. (EPA 1997). In the RESRAD calculations, it is also assumed that all meat ingested is from deer taken from Rocky Flats.

First, the relationship between the modeled meat concentrations and the concentrations of radionuclides found in deer meat samples from Rocky Flats deer (Todd and Sattelberg 2004)

[2] RESRAD was used for this assessment of the deer meat ingestion pathway because the RESRAD model includes all relevant pathways, and the objective was to evaluate relative risk associated with this pathway. In the CRA human health risk assessment, RESRAD is only used for dose estimation, and potential risks associated with radionuclides exposure are evaluated using cancer slope factors and EPA risk assessment equations.

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were assessed. Because the deer in the study were exposed to historical levels of radionuclides in the environment, the average radionuclide concentration across all of Rocky Flats was used to assess this relationship.

The relative importance of each exposure pathway was then assessed to see whether deer meat ingestion is a significant exposure pathway. For this exposure pathway analysis, the average concentration across all of Rocky Flats is used; however, all radionuclide concentrations above the action levels (ALs) prescribed in the Rocky Flats Cleanup Agreement (RFCA) were reduced to the AL concentrations. This is appropriate because deer present at Rocky Flats in the future will be exposed to lower post-accelerated action concentrations of radionuclides in soil.

The RESRAD results for the meat ingestion pathway were first reviewed to determine whether the modeled meat concentrations were similar to the concentrations of radionuclides found in deer meat samples from Rocky Flats deer (Todd and Sattelberg 2004). This analysis considers both deer muscle and deer liver meat. The results of this analysis are presented in Table A4.6, and show that the RESRAD model tends to overestimate muscle and liver meat concentrations for americium-241 and plutonium-239 while underestimating concentrations for uranium-234, uranium-235 and uranium-238. Modeled deer meat concentrations could be overestimated or underestimated based on the following considerations:

- Concentrations for five radionuclides (americium-241, plutonium-239, uranium-234, uranium-235, and uranium-238) were used in the model. The concentrations used to calculate pathway risks were the 95 percent upper confidence limits on the mean (95UCLs) from site-specific data across the entire Rocky Flats property on February 10, 2005.
- The fodder and soil intake in RESRAD is based upon cattle. Deer will intake much less fodder and soil than cattle due to large weight differences.
- There was only one control deer to assess the reported concentrations of radionuclides in deer. This one deer showed no radionuclide concentrations above the detection limit for deer muscle. This deer also showed one detection each for americium-241 and uranium-235 in the liver. A more robust set of radionuclide concentrations for the control deer population may show detections of radionuclides in the muscle and liver meat. This larger data set would also be a better data set for a background comparison. (See discussion below for USFWS Study.)
- Out of 26 deer assessed at Rocky Flats, the deer muscle showed 1) plutonium-239 and uranium-235 were detected in none of the deer, 2) uranium-234 and uranium-238 were detected in only 1 of the deer and 3) americium-241 was detected in 4 of the deer. Therefore, the mean muscle concentrations are being computed based on a very limited number of radionuclide detections. (See discussion below for USFWS Study.)
- Out of 26 deer assessed at Rocky Flats, the deer liver showed 1) americium-241, plutonium-239 and uranium-238 were detected in none of the deer, 2) uranium-235 was detected in only 1 of the deer, and 3) uranium-234 was detected in 3 of the deer. Therefore, the mean liver concentrations are being computed based on a very limited number of radionuclide detections. (See discussion below for USFWS Study.)

- Uranium-234, uranium-235 and uranium-238 are found naturally in soil and biota in the Rocky Flats region. Natural levels of these radionuclides would be expected in deer muscle and liver meat.

4.2 Results

Hunters will be allowed to take game at Rocky Flats only after the site has been released as a wildlife refuge. Because remediation efforts at Rocky Flats will be complete at that point, risks were calculated using a modified data set to represent post-remediation conditions. For the modified data set, all reported radionuclide concentrations at Rocky Flats above the ALs prescribed in the RFCA were reduced to the AL concentrations. The 95UCL concentrations were then calculated using the modified data set. These 95UCL concentrations were used to calculate potential cancer risks for the WRV exposure scenario.

Table A4.7 outlines the potential cancer risks associated with each radionuclide. The individual risks by exposure pathway and the total risks are lower than EPA's acceptable risk range of 1E-04 to 1E-06.

Table A4.8 outlines the relative contribution of each exposure pathway to the overall risk. The meat ingestion pathway shows a relative contribution to the overall risk of less than 10 percent for all radionuclides of concern.

USFWS Study

USFWS evaluated the potential cancer risk associated with the consumption of tissue from on-site deer (Todd and Sattelberg 2004). The intention of the study, which is based on actual radionuclide concentrations in deer tissue, was to provide a very conservative estimate of human health risk from consumption of the tissue. The study is summarized here to show that soil-to-plant actinide transfer rates and gastrointestinal absorption rates for actinides are very low, and to further demonstrate that the deer meat consumption pathway is a minor exposure pathway for the WRV.

Deer tissue samples were collected from 26 deer at RFETS in 2002 and stored in a secured freezer until July 2004. Lung, liver, kidney, muscle, and bone tissue sub-samples were analyzed. Control samples from one deer at the Rocky Mountain Arsenal National Wildlife Refuge site were also analyzed. Twenty-seven liver and muscle sample (26 from Rocky Flats and 1 control), 14 randomly selected lung and associated bone samples, and 6 composite kidney samples were analyzed for americium-241, plutonium-238, plutonium-239/240, uranium-233/234, uranium-235/236, and uranium-238. (The bone samples were only analyzed for plutonium-238 and plutonium-239/240). A total of 454 isotopic analyses were run. Based on the results from these analyses, the potential risk from the consumption of 30.3 kilograms (kg) of Rocky Flats deer meat was calculated using a 1-year exposure duration.

As shown in Table A4.9, of the 454 isotopic analyses run on Rocky Flats deer samples, only 17 had results above the laboratory detection limits. Also, the results for all samples (including those below the laboratory detection limit) varied by only approximately one order of magnitude, and there was little difference between the sample results and the control results.

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Historical studies of radionuclide levels in deer tissues at Rocky Flats indicate similar results to the 2002 deer tissue samples. Plutonium analyses for tissue samples from eight Rocky Flats deer from 1977 showed plutonium concentrations near or below detection limits (Hiat 1977). In 1992, 12 tissue samples from Rocky Flats deer were analyzed for plutonium isotopes and all samples had concentrations below the detection limits (Symonds and Alldredge 1992). The extremely low levels of radionuclides present in deer tissues at RFETS are likely the result of the low levels in surface soil across the site, very low soil to plant actinide transfer rates (EPA 1979) (Hinton and Pinder 2001), and low gastrointestinal adsorption rates (ATSDR 1990). Though actinide-specific, terrestrial animal assimilation of actinides from the gastrointestinal tract is assumed to be less than 0.01% (Whicker and Schlutz 1982).

4.3 Conclusions

This evaluation was conducted to assess the relative contribution of potential risks associated with the deer meat ingestion pathway to the total potential risk for the Rocky Flats WRV. Risks were calculated for the soil exposure pathways using the RESRAD computer model. The results from RESRAD indicate that the relative contribution of deer meat consumption to the total risk from soil exposure is low (less than 10 percent in all cases) and, consequently, the deer meat consumption pathway may be considered insignificant relative to the other soil exposure pathways. It is important to note that these results are based on the conservative assumption that one individual consumes deer meat from a deer taken from Rocky Flats every year for 30 years. Based on the limiting hunting proposed for Rocky Flats in the future, it is likely that the assumptions used in this evaluation overestimate potential future exposure.

The risk levels presented by USFWS for deer muscle and liver consumption range from 2E-09 to 7E-08 for a 1-year exposure duration. These risks are very conservative because they are based on detected radionuclide concentrations only, without consideration for the large percentage of nondetections. Also, according to USFWS (Todd and Sattelberg 2004), the risk levels associated with the deer tissue samples were developed using very conservative assumptions (that is, one individual consumes the liver and muscle tissue from one entire deer every year) and, therefore, calculations likely overestimate the risk associated with deer tissue consumption.

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TABLES

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Table A4.1
Summary Statistics for Analytes in Surface Water that Exceed the Surface Water PRG

Exposure Unit	Analyte	Units*	Number of Samples Collected	Number of Sampling Locations	Number of Detects	Detection Frequency (%)	MDC	PRG	Number of PRG Exceedances	PRG Exceedance Frequency (%)	Number of Exceedances 1-10 x PRG	Number of Exceedances 10-100 x PRG	Number of Exceedances >100 x PRG	Number of Locations with PRG Exceedances
IndustrialArea	Arsenic	mg/L	1824	94	912	50.0	0.139	0.051	7	0.38	7		0	6
IndustrialArea	Nitrate	mg/L	2651	65	2642	99.7	8,820	3,244	2	0.08	2		0	2
IndustrialArea	Tetrachloroethene	ug/L	1299	75	410	31.6	150	141	2	0.15	2		0	2
IndustrialArea	Thallium	mg/L	1823	96	88	4.8	0.176	0.142	3	0.16	3		0	2
IndustrialArea	Uranium-233/234	pCi/L	1743	82	1743	100.0	710	600	1	0.06	1		0	1
UpperWalnutDrainage	Tetrachloroethene	ug/L	406	123	53	13.1	280	141	1	0.25	1		0	1
UpperWalnutDrainage	Trichloroethene	ug/L	409	123	74	18.1	970	190	4	0.98	4		0	4
UpperWalnutDrainage	Uranium-233/234	pCi/L	1741	123	1741	100.0	1,161	600	1	0.06	1		0	1
UpperWalnutDrainage	Uranium-238	pCi/L	1741	123	1741	100.0	1,214	663	1	0.06	1		0	1
UpperWomanDrainage	Arsenic	mg/L	405	47	166	41.0	0.147	0.051	7	1.73	7		0	3
UpperWomanDrainage	Lead	mg/L	411	47	250	60.8	5.90	1.00	1	0.24	1		0	1

*Total Concentration

Table A4.2
Summary Statistics for Analytes in Groundwater Near Seeps that Exceed the Surface Water PRG

Exposure Unit	Analyte	Units*	Number of Samples Collected	Number of Sampling Locations	Number of Detects	Detection Frequency (%)	MDC	PRG	Number of PRG Exceedances	PRG Exceedance Frequency (%)	Number of Exceedances 1-10 x PRG	Number of Exceedances 10-100 x PRG	Number of Exceedances >100 x PRG	Number of Locations with PRG Exceedances
IndustrialArea	Nitrate	mg/L	390	41	279	71.5	16700	3244.444444	3	0.77	3			2
IndustrialArea	Tetrachloroethene	ug/L	462	59	195	42.2	930	141	12	2.60	12			3
IndustrialArea	Trichloroethene	ug/L	461	58	202	43.8	2,300	190	17	3.69	15	2		6
IndustrialArea	Vinyl Chloride	ug/L	460	59	90	19.6	720	50.6	24	5.22	22	2		2
UpperWalnutDrainage	Tetrachloroethene	ug/L	157	34	103	65.6	730	141	8	5.10	8			8
UpperWalnutDrainage	Trichloroethene	ug/L	157	34	84	53.5	6,800	190	4	2.55	2	2		4
UpperWomanDrainag	Lead	mg/L	53	14	29	54.7	2.86	1.00	1	1.89	1			1
WindBlownArea	Antimony	mg/L	49	10	3	6.1	2.06	0.811	1	2.04	1			1
WindBlownArea	Carbon Tetrachloride	ug/L	168	29	141	83.9	2,300	584	34	20.24	34			7
WindBlownArea	Iron	mg/L	50	10	44	88.0	2,020	608	2	4.00	2			1
WindBlownArea	Tetrachloroethene	ug/L	170	29	154	90.6	1,100	141	20	11.76	20			5
WindBlownArea	Trichloroethene	ug/L	170	29	165	97.1	8,200	190	55	32.35	17	38		6

*Total Concentration

Table A4.3
Parameters for Subsurface Volatilization Screening Model

Screening Model User-Entered Parameter	Value	Source
Target hazard quotient for non-carcinogens	0.1	
Target risk for carcinogens	1.00E-06	
Averaging time for non-carcinogens	18.7 years	EPA et al. 2002
Averaging time for carcinogens	70 years	EPA 1991
Exposure frequency	250 days/year	EPA et al. 2002
Exposure duration	18.7 years	EPA et al. 2002
Vadose zone soil dry bulk density	1.59 g/cm^3	Site Average
Vadose zone soil total porosity	0.35 unitless	Site Average
Vadose zone soil water-filled porosity	0.2399 cm^3/cm^3	Site Average
Vadose zone soil organic carbon fraction	0.007 unitless	Site Average
Depth below grade to bottom of enclosed space floor	200 cm	Johnson and Ettinger 1991
Depth below grade to top of contamination	400 cm	Johnson and Ettinger 1991
Vadose zone SCS soil type	Sandy-Clay-Loam	Johnson and Ettinger 1991
Average soil and ground water temperature	10 °C	Johnson and Ettinger 1991
Average vapor flow rate into building	calculated	Johnson and Ettinger 1991

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Table A4.4
Summary Statistics for Analytes in Subsurface Soil that Exceed the Subsurface Soil Volatilization PRGs

Exposure Unit	Analyte	Units	Number of Samples Collected	Number of Sampling Locations	Number of Detects	Detection Frequency (%)	MDC	PRG	Number of PRG Exceedances	PRG Exceedance Frequency (%)	Number of Locations with PRG Exceedances
IndustrialArea	1,1,2,2-Tetrachloroethane	ug/kg	6054	2057	6	0.1	1,000	492	1	0.02	1
IndustrialArea	1,2,4-Trimethylbenzene	ug/kg	5294	1860	254	4.8	72,300	3,610	2	0.04	2
IndustrialArea	1,3,5-Trimethylbenzene	ug/kg	5294	1860	132	2.5	20,600	3,780	2	0.04	2
IndustrialArea	Benzene	ug/kg	6070	2060	40	0.7	240	130	1	0.02	1
IndustrialArea	Bromomethane	ug/kg	5982	2041	2	0.0	7,450	41.2	1	0.02	1
IndustrialArea	Carbon Tetrachloride	ug/kg	6066	2061	90	1.5	370	24.5	2	0.03	2
IndustrialArea	Chloroform	ug/kg	6068	2061	92	1.5	670	47.1	5	0.08	5
IndustrialArea	Isopropylbenzene	ug/kg	5300	1862	42	0.8	2,500	676	1	0.02	1
IndustrialArea	Mercury	mg/kg	4840	1656	3800	78.5	16.0	9.47	1	0.02	1
IndustrialArea	Naphthalene	ug/kg	5738	1976	1032	18.0	350,000	36,700	1	0.02	1
IndustrialArea	Tetrachloroethene	ug/kg	6068	2061	514	8.5	197,000	265	28	0.46	23
IndustrialArea	Trichloroethene	ug/kg	6064	2060	260	4.3	11,600	1,260	7	0.12	6
IndustrialArea	Xylene	ug/kg	6036	2047	350	5.8	115,000	16,800	1	0.02	1
InterDrainage	Chloroform	ug/kg	108	17	2	1.9	96.0	47.1	1	0.93	1
InterDrainage	Mercury	mg/kg	144	19	28	19.4	25.4	9.47	1	0.69	1
NoNameGulchDrainage	Tetrachloroethene	ug/kg	350	66	12	3.4	750	265	2	0.57	2
UpperWalnutDrainage	Carbon Tetrachloride	ug/kg	344	101	6	1.7	110	24.5	1	0.29	1
UpperWalnutDrainage	Chloroform	ug/kg	354	101	36	10.2	84.0	47.1	1	0.28	1
UpperWalnutDrainage	Trichloroethene	ug/kg	354	101	66	18.6	3,500	1,260	1	0.28	1
UpperWalnutDrainage	Vinyl Chloride	ug/kg	352	101	2	0.6	16.8	10.2	1	0.28	1
UpperWomanDrainage	Naphthalene	ug/kg	224	62	18	8.0	61,000	36,700	1	0.45	1
UpperWomanDrainage	Tetrachloroethene	ug/kg	398	76	40	10.1	920	265	5	1.26	3
WindBlownArea	Carbon Tetrachloride	ug/kg	992	254	34	3.4	6,200	24.5	6	0.60	4
WindBlownArea	Chloroform	ug/kg	984	249	70	7.1	130	47.1	4	0.41	3
WindBlownArea	cis-1,2-Dichloroethene	ug/kg	560	149	42	7.5	4,400	911	3	0.54	2
WindBlownArea	Tetrachloroethene	ug/kg	992	254	246	24.8	72,000	265	16	1.61	12
WindBlownArea	Trichloroethene	ug/kg	992	254	102	10.3	1,900	1,260	3	0.30	2

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Table A4.5
Summary Statistics for Analytes in Groundwater that Exceed the Groundwater Volatilization PRGs

Exposure Unit	Analyte	Units	Number of Samples Collected	Number of Sampling Locations	Number of Detects	Detection Frequency (%)	MDC	PRG	Number of PRG Exceedances	PRG Exceedance Frequency (%)	Number of Locations with PRG Exceedances
IndustrialArea	1,1-Dichloroethene	ug/L	3122	403	685	21.9	18000	139	73	2.34	14
IndustrialArea	1,2-Dichloroethane	ug/L	3080	403	206	6.7	1,100	419	1	0.03	1
IndustrialArea	Carbon Tetrachloride	ug/L	3114	403	585	18.8	6.90E+08	62.3	240	7.71	51
IndustrialArea	Chloroform	ug/L	3112	403	973	31.3	9.90E+06	146	116	3.73	31
IndustrialArea	cis-1,2-Dichloroethene	ug/L	2537	362	866	34.1	9,730	2,960	2	0.08	2
IndustrialArea	Hexachlorobutadiene	ug/L	2619	392	26	1.0	320,000	63.6	1	0.04	1
IndustrialArea	Methylene Chloride	ug/L	3105	403	597	19.2	6.20E+07	10,000	8	0.26	6
IndustrialArea	Tetrachloroethene	ug/L	3116	403	1357	43.5	420,000	21,400	9	0.29	4.
IndustrialArea	Trichloroethene	ug/L	3120	402	1359	43.6	84,800	1,830	56	1.79	10
IndustrialArea	Vinyl Chloride	ug/L	3110	403	215	6.9	4,190	97.5	32	1.03	6
NoNameGulchDrainage	Carbon Tetrachloride	ug/L	1009	88	110	10.9	75.0	62.3	1	0.10	1
UpperWalnutDrainage	1,1-Dichloroethene	ug/L	949	126	135	14.2	200	139	1	0.11	1
UpperWalnutDrainage	Carbon Tetrachloride	ug/L	949	126	312	32.9	1,100	62.3	136	14.33	17
UpperWalnutDrainage	Chloroform	ug/L	948	126	305	32.2	150	146	1	0.11	1
UpperWalnutDrainage	Trichloroethene	ug/L	949	126	396	41.7	6,800	1,830	29	3.06	3
WindBlownArea	1,1-Dichloroethene	ug/L	1440	148	283	19.7	5,000	139	10	0.69	2
WindBlownArea	Benzene	ug/L	1448	148	41	2.8	950	341	1	0.07	1
WindBlownArea	Carbon Tetrachloride	ug/L	1440	148	883	61.3	100,000	62.3	487	33.82	54
WindBlownArea	Chloroform	ug/L	1440	148	845	58.7	64,000	146	111	7.71	15
WindBlownArea	Chloromethane	ug/L	1433	148	17	1.2	18,000	1,970	1	0.07	1
WindBlownArea	cis-1,3-Dichloropropene	ug/L	1349	148	9	0.7	1,600	374	1	0.07	1
WindBlownArea	Dichlorodifluoromethane	ug/L	1174	138	10	0.9	5,000	1,760	1	0.09	1
WindBlownArea	Hexachlorobutadiene	ug/L	1200	139	18	1.5	520	63.6	1	0.08	1
WindBlownArea	Methylene Chloride	ug/L	1437	148	292	20.3	43,000	10,000	11	0.77	4
WindBlownArea	Tetrachloroethene	ug/L	1444	148	933	64.6	27,000	21,400	1	0.07	1
WindBlownArea	Trichloroethene	ug/L	1444	148	883	61.1	220,000	1,830	114	7.89	9

Table A4.6
Deer Meat Concentration Assessment

Radionuclide	Sitewide Mean Surface Soil Concentration (pCi/g)	Meat Concentration RESRAD Calculated (pCi/g)[a]	Mean Muscle Concentration USFWS (pCi/g)	Mean Liver Concentration USFWS (pCi/g)
Americium-241	24	6.82E-04	3.07E-04	BDL (1E-03)
Plutonium-239	54	3.07E-03	BDL (2E-03)	BDL (2E-03)
Uranium-234	3.6	8.21E-04	3.30E-03	6.73E-03
Uranium-235	0.3	6.84E-05	BDL (2E-02)	2.18E-03
Uranium-238	13	3.01E-03	4.09E-03	BDL (2E-02)

[a] It is assumed that an individual ingests 2.4 kg/yr of game meat.
BDL – below detection limit with detection limit in parentheses
Source □ Todd and Sattelberg 2004

Table A4.7
RESRAD Risk Results for Radionuclides of Concern

Radionuclide	Surface Soil 95% UCL Concentration (pCi/g)[a]	Soil Ingestion Risk[b]	Soil Inhalation Risk[b]	External Radiation Risk[b]	Meat Consumption Risk[b]	Total Risk[b]
Americium-241	3.5	7.10E-08	2.11E-08	8.41E-08	9.22E-10	1.77E-07
Plutonium-239	14.5	3.92E-07	1.31E-07	2.52E-09	1.02E-08	3.92E-07
Uranium-234	2	2.21E-09	6.79E-10	3.44E-11	2.37E-10	3.16E-09
Uranium-235	0.13	1.46E-10	3.98E-11	4.53E-09	1.61E-11	4.73E-09
Uranium-238	1.9	2.63E-09	5.47E-10	9.95E-09	2.83E-10	1.34E-08

[a] Based on RFETS Sitewide data compiled on February 10, 2005; representative of post-remediation conditions.
[b] Based on 30-year exposure duration.

Table A4.8
RESRAD Exposure Pathway Contribution for Radionuclides of Concern

Radionuclide	Surface Soil 95% UCL Concentration (pCi/g)[a]	Ingestion Pathway (%)[b]	Soil Inhalation Pathway (%)[b]	External Radiation Pathway (%)[b]	Meat Consumption Pathway (%)[b]	Total (%)[b]
Americium-241	3.5	40.1	11.9	47.5	0.5	100
Plutonium-239	14.5	73.1	24.5	0.5	1.9	100
Uranium-234	2	69.9	21.5	1.1	7.5	100
Uranium-235	0.13	3.1	0.9	95.7	0.3	100
Uranium-238	1.9	19.6	4.1	74.2	2.1	100

[a] Based on RFETS Sitewide data compiled on February 10, 2005; representative of post-remediation conditions.
[b] Based on 30-year exposure duration.

Table A4.9
Radionuclide Detections in Deer Tissue

Tissue	Liver	Muscle	Lung	Bone	Kidney
Rocky Flats Deer Tissue[a]					
No. of samples	26	26	14	14	6
No. of plutonium-238 detections	0	0	0	2	0
No. of plutonium-239,240 detections	0	0	0	2	0
No. of americium-241 detections	0	4	2	NA	1
No. of uranium-233, 234 detections	3	1	0	NA	0
No. of uranium-235, 236 detections	1	0	0	NA	0
No. of uranium-238 detections	0	1	0	NA	0
Control Deer Tissue[a]					
No. of samples	1	1	1	1	1
No. of plutonium-238 detections	0	0	0	0	0
No. of plutonium-239, 240 detections	0	0	0	0	0
No. of americium-241 detections	1	0	0	NA	1
No. of uranium-233, 234 detections	0	0	0	NA	0
No. of uranium-235, 236 detections	1	0	0	NA	0
No. of uranium-238 detections	0	0	0	NA	0

[a] Source - Todd and Sattelberg 2004

FIGURES

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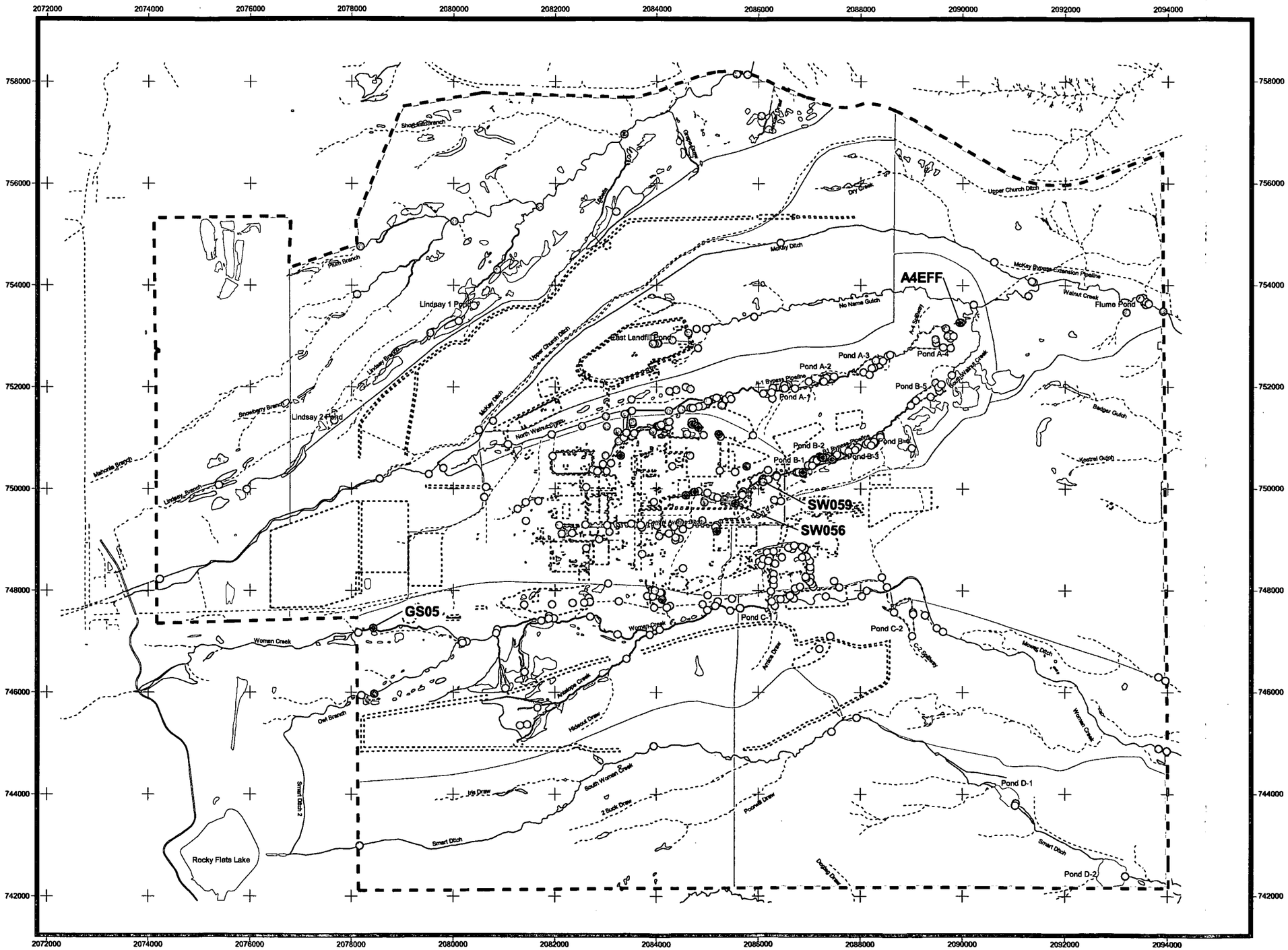

Figure A4.1

Surface Water Sample Locations Where Wildlife Refuge Worker PRGs Were Exceeded

KEY

Exceeded Surface Water PRG

- Yes
- No

A location is classified as a PRG exceedance if any analyte was detected at a concentration exceeding it's PRG since June 28, 1991.

Standard Map Features

- Perennial seep *
- Ephemeral seep *
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

Exposure Units

- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

* Seep designation Ebasco 1995

N W E S

0 1000 2000 Feet

Scale 1:24,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

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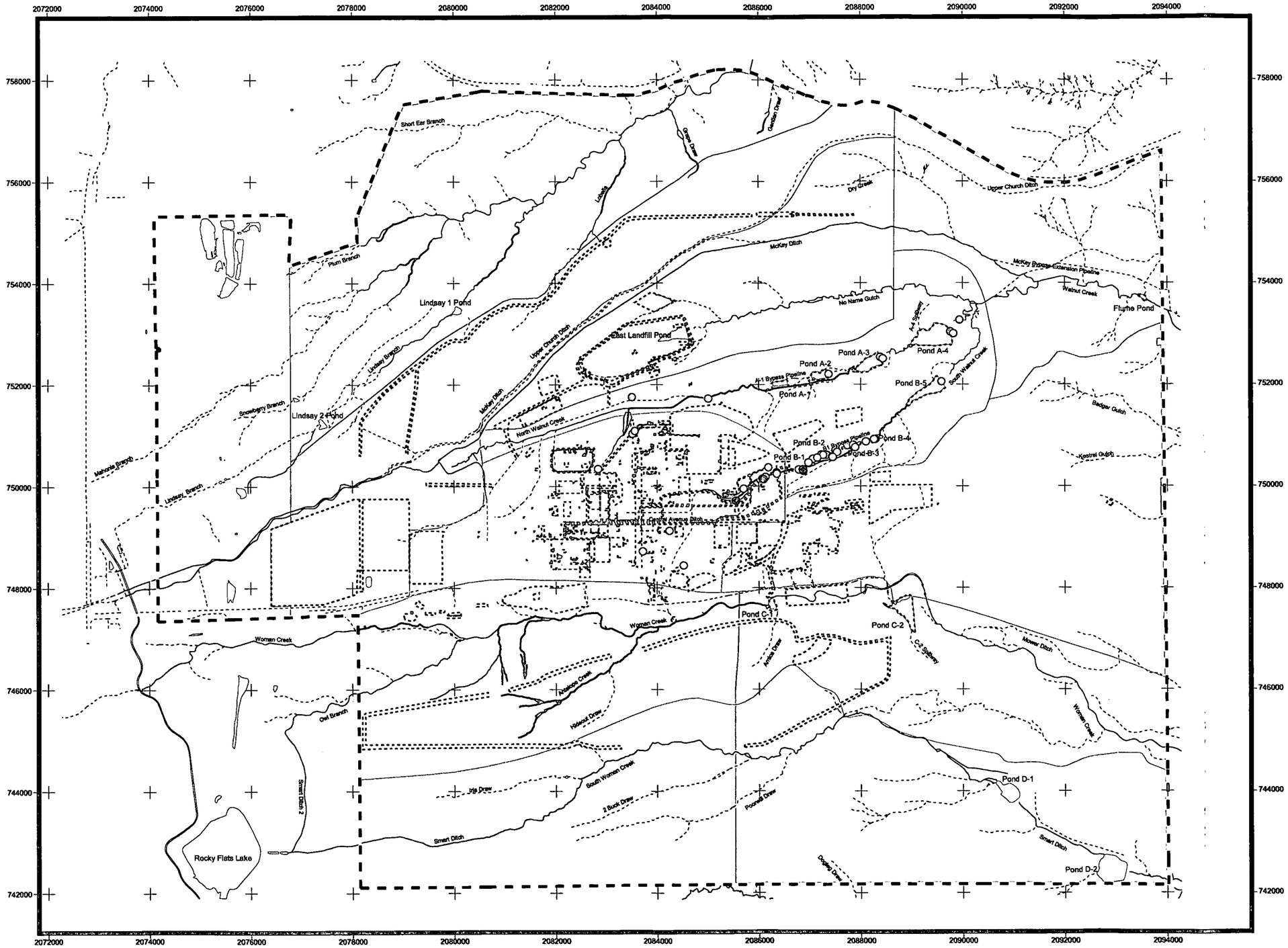

Figure A4.2

Surface Water Sample Locations Where Wildlife Refuge Refuge Worker PCE PRG Was Exceeded

KEY

Exceeded Surface Water PRG

- Yes
- No

A location is classified as a PRG exceedance if any analyte was detected at a concentration exceeding it's PRG since June 28, 1991.

Standard Map Features

- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

Exposure Units

- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

N W E S

0 1000 2000 Feet

Scale 1:24,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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Rocky Flats Environmental
Technology Site

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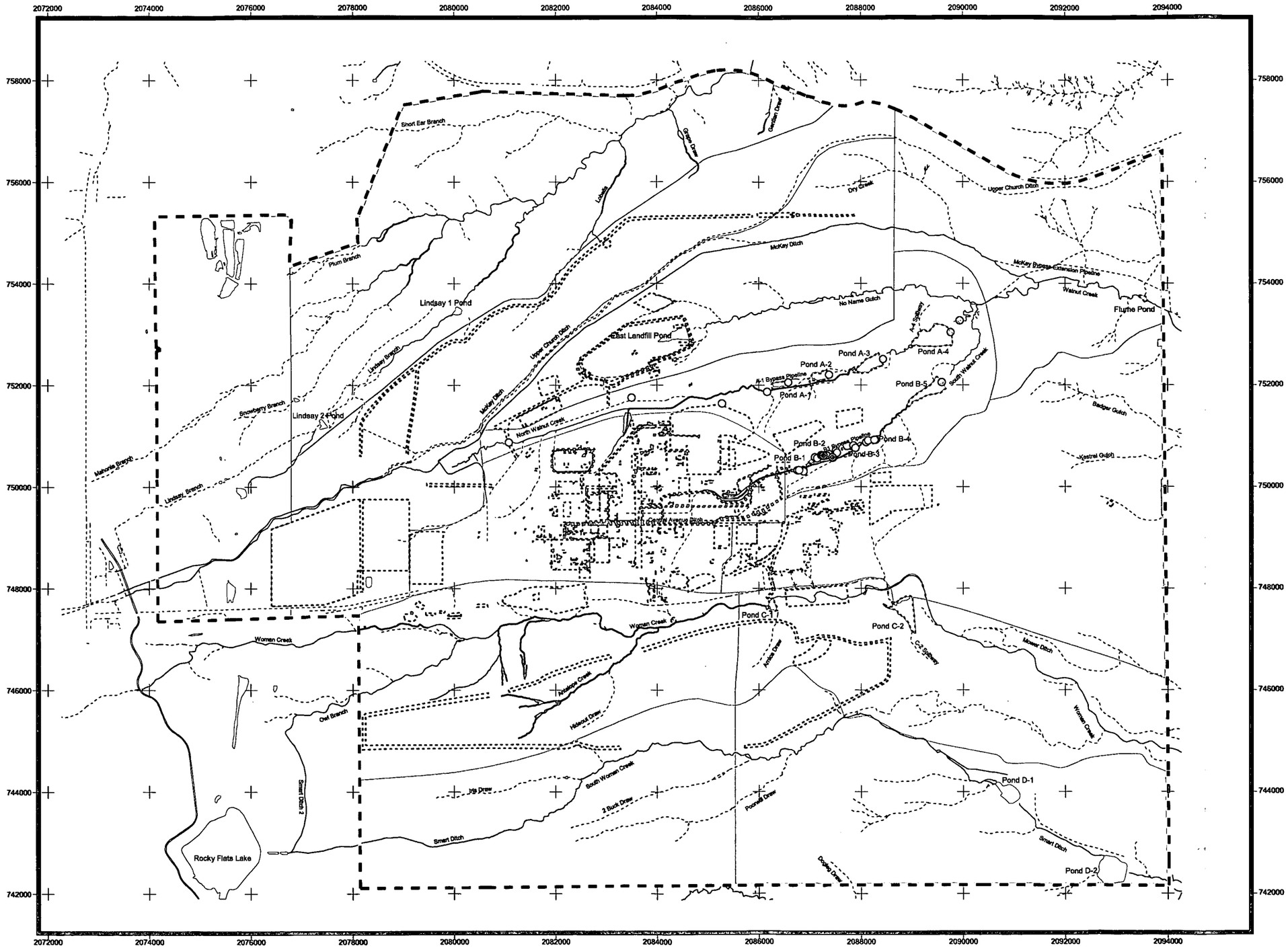

Figure A4.3

Surface Water Sample Locations Where Wildlife Refuge Refuge Worker TCE PRG Was Exceeded

KEY

Exceeded Surface Water PRG

- Yes
- No

A location is classified as a PRG exceedance if any analyte was detected at a concentration exceeding it's PRG since June 28, 1991.

Standard Map Features

- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

Exposure Units

- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

N W E S

0 1000 2000 Feet

Scale 1:24,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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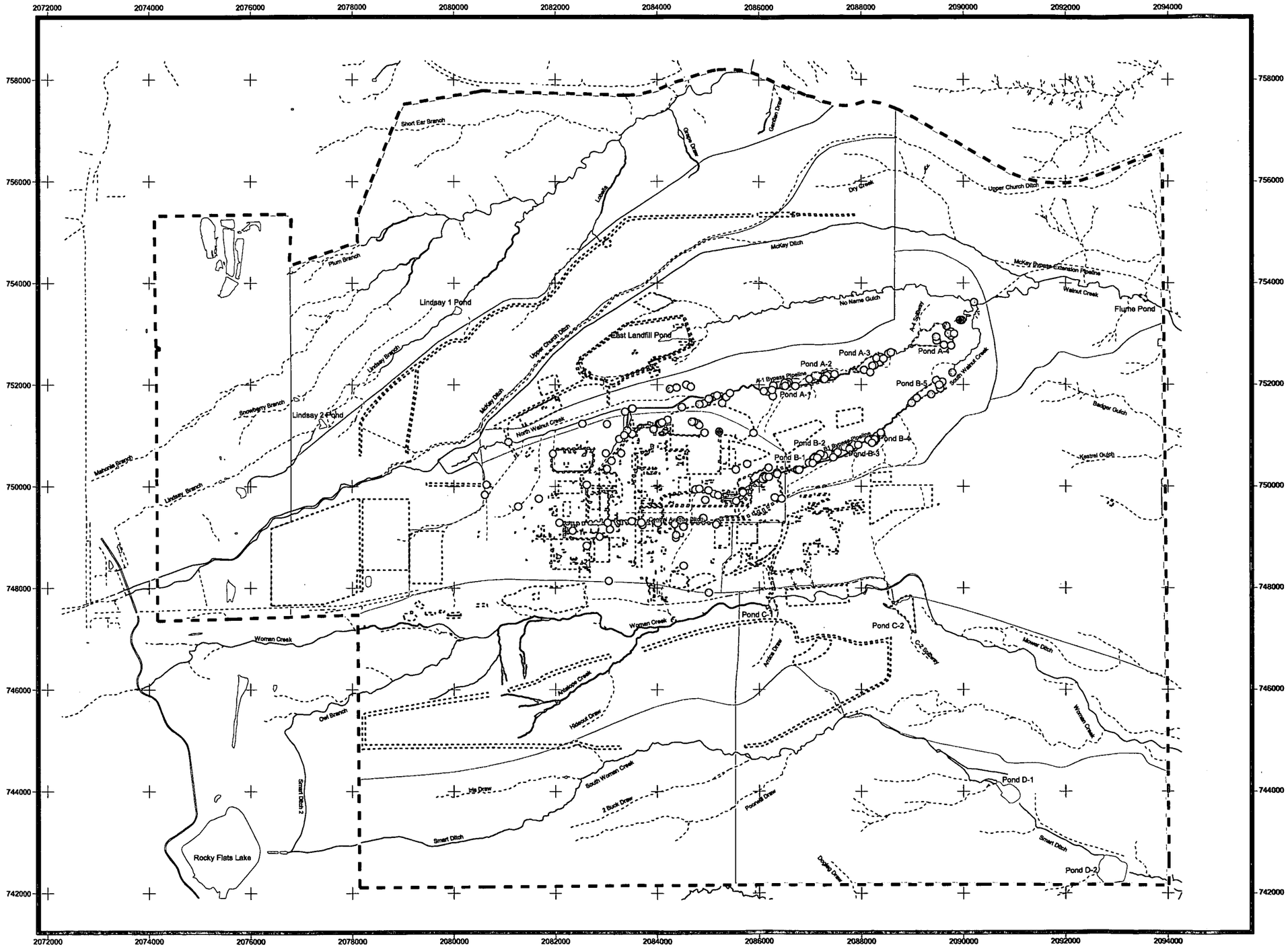

Figure A4.4

Surface Water Sample Locations Where Wildlife Refuge Refuge Worker Uranium-233, 234 PRG Was Exceeded

KEY

Exceeded Surface Water PRG

- Yes
- No

A location is classified as a PRG exceedance if any analyte was detected at a concentration exceeding it's PRG since June 28, 1991.

Standard Map Features

- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

Exposure Units

- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

N W E S

0 1000 2000 Feet

Scale 1:24,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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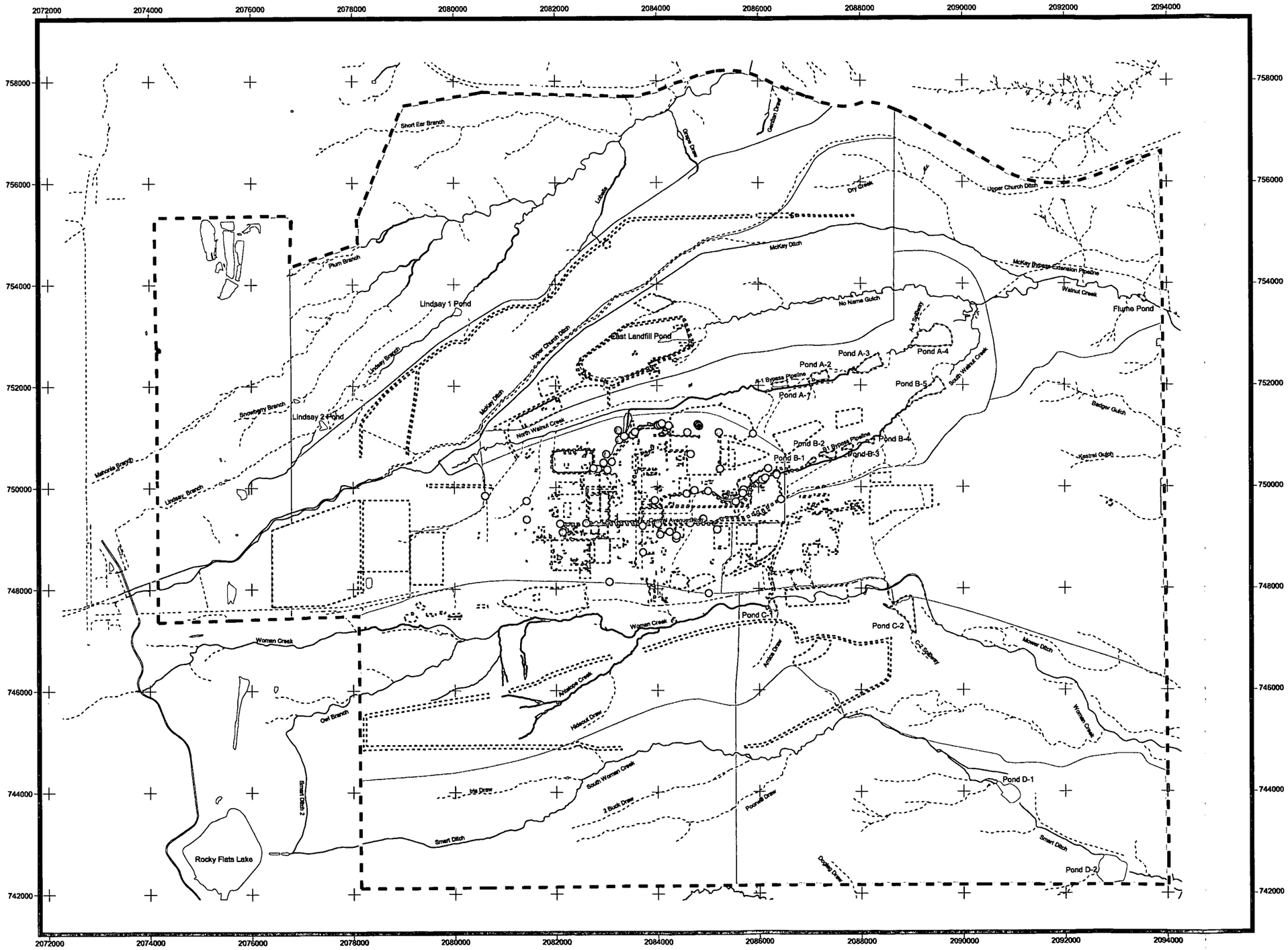

Figure A4.5

Surface Water Sample Locations Where Wildlife Refuge Refuge Worker Nitrate PRG Was Exceeded

KEY

Exceeded Surface Water PRG

- Yes
- No

A location is classified as a PRG exceedance if any analyte was detected at a concentration exceeding it's PRG since June 28, 1991.

Standard Map Features

- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

Exposure Units

- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

N W E S

0 1000 2000 Feet

Scale 1:24,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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Figure A4.6a
Tetrachloroethene Surface Water Concentrations at SW056 in the IAEU

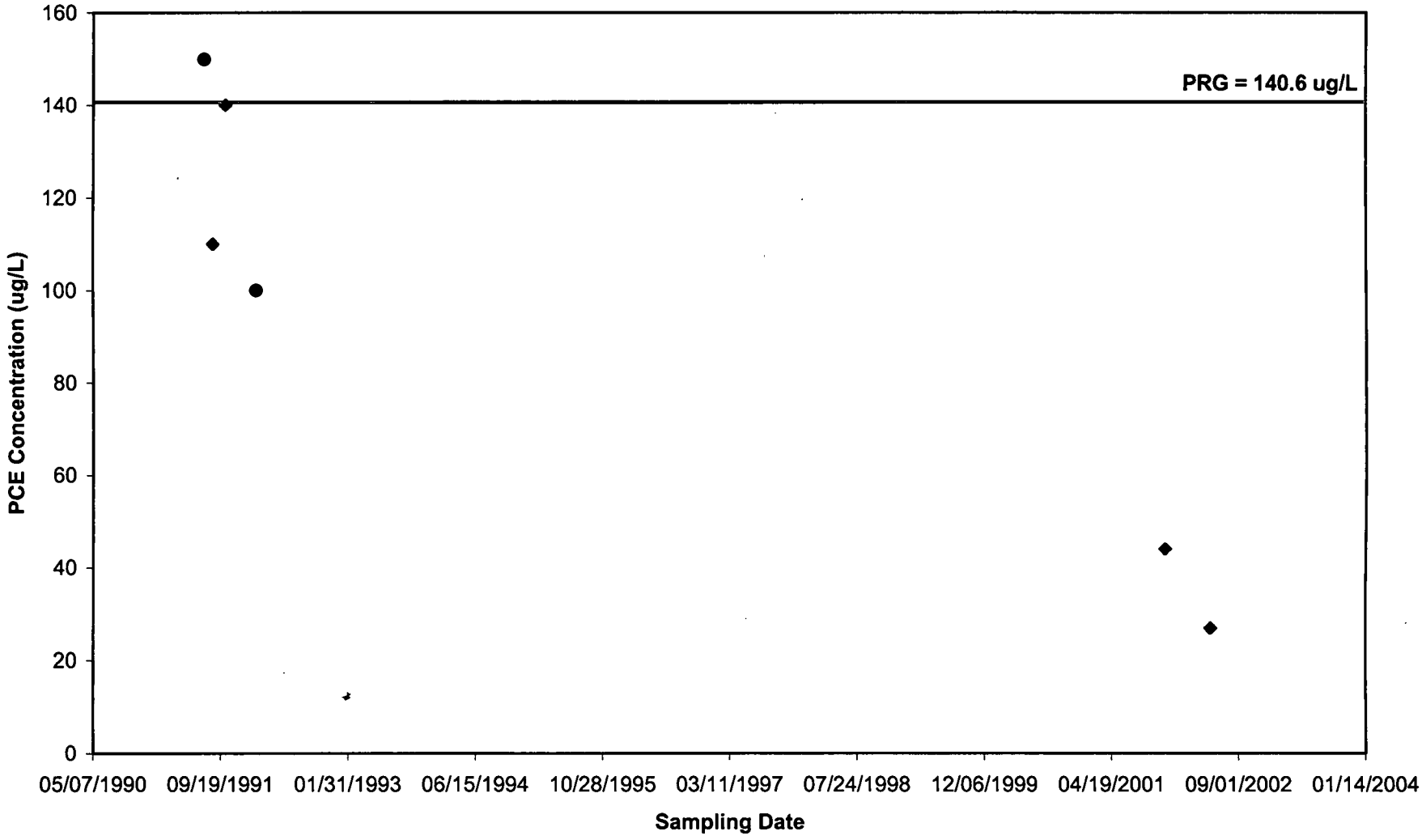

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Figure A4.6b
Tetrachloroethene Surface Water Concentrations at SW059 in the IAEU

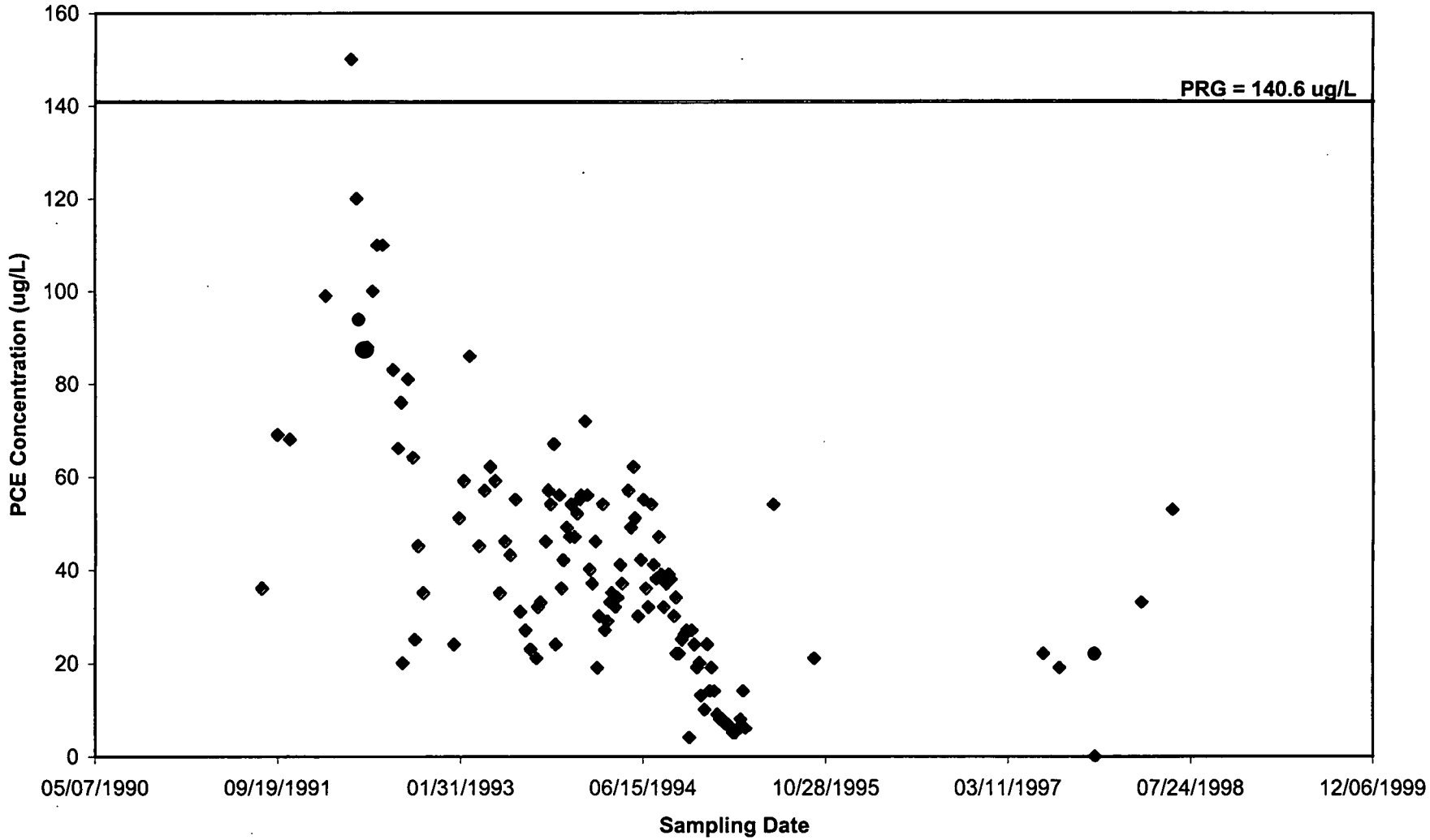

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Figure A4.6c
Uranium-233, 234 Surface Water Concentrations at A4EFF in the UWNEU

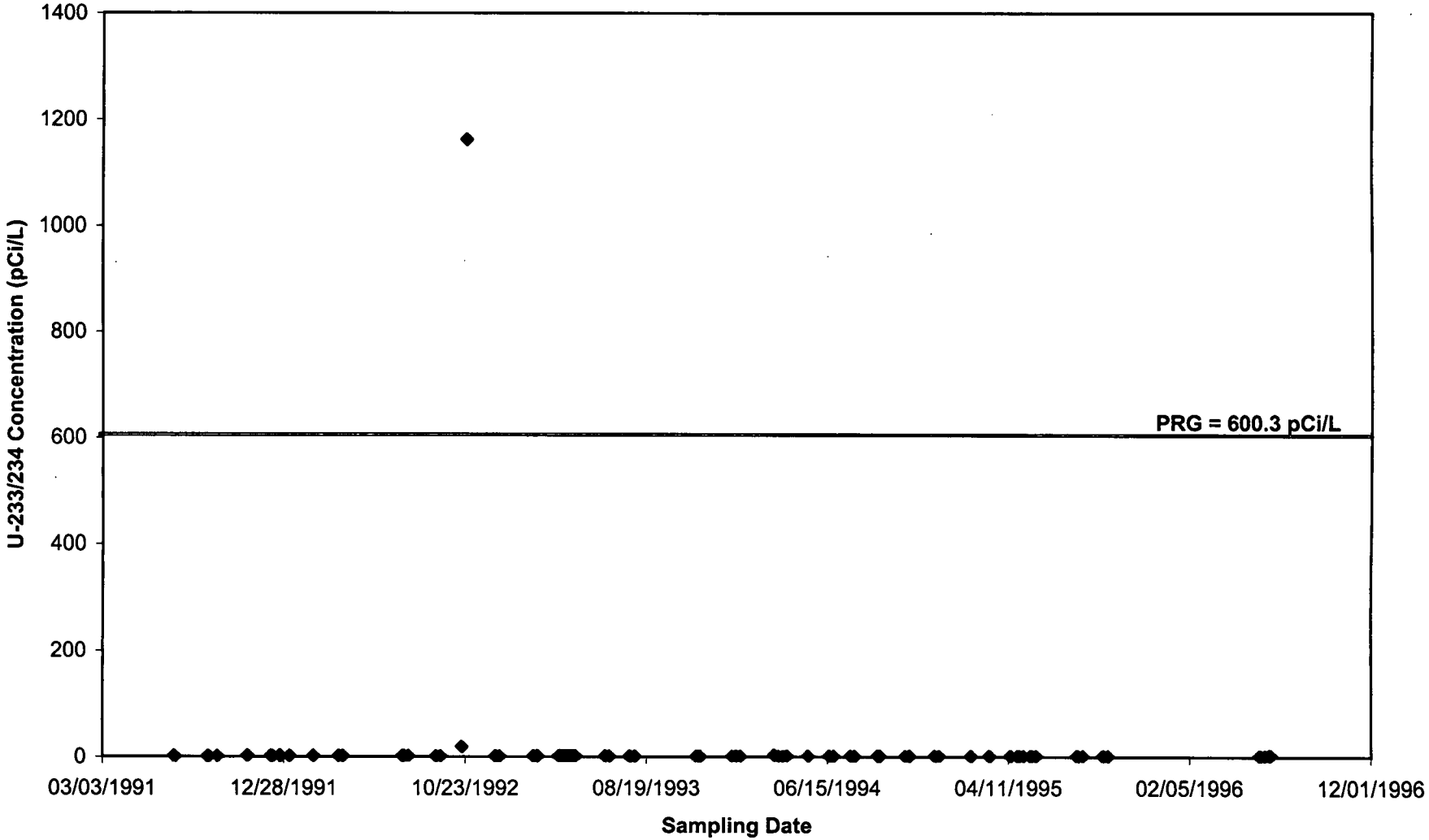

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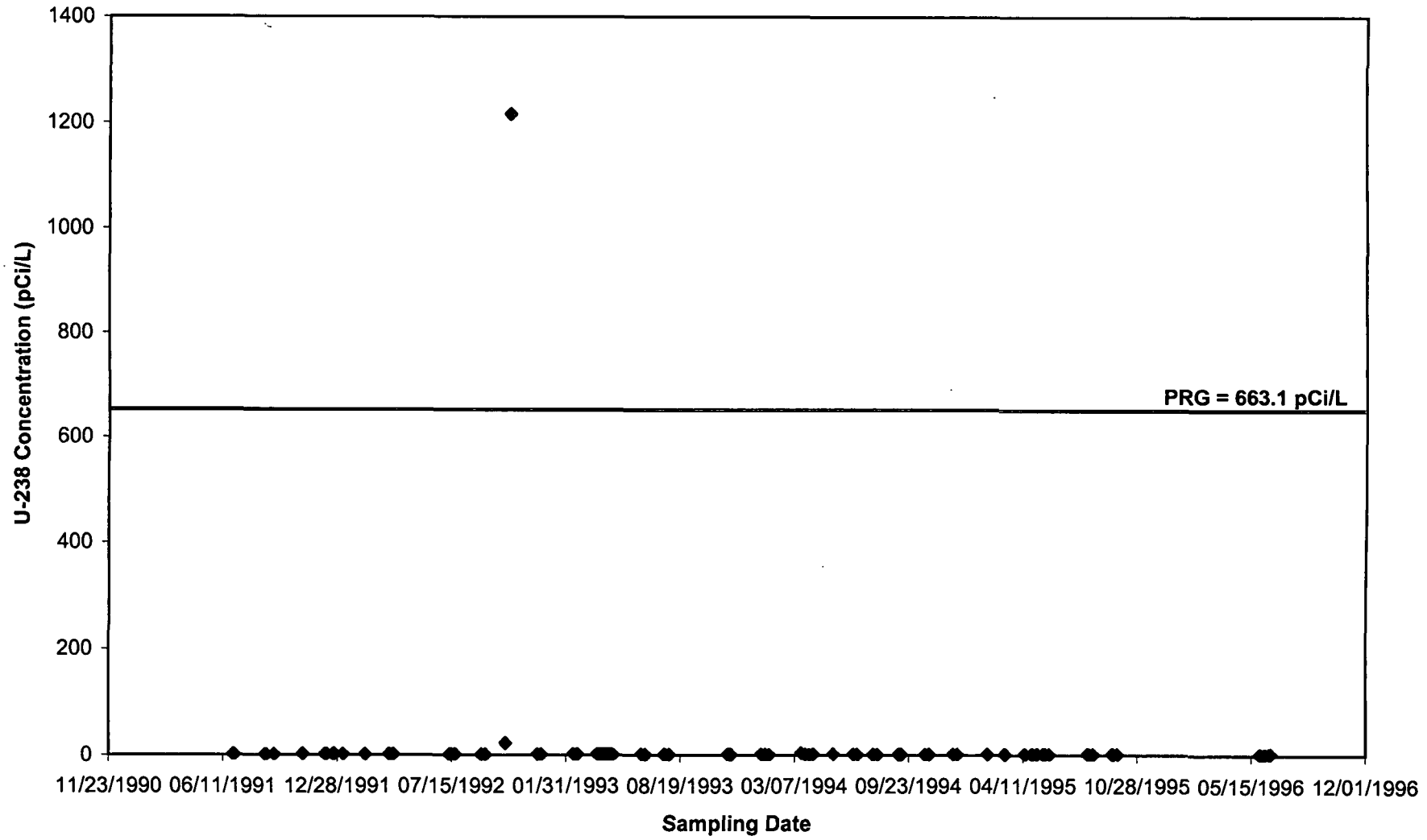
Figure A4.6d
Uranium-238 Surface Water Concentrations at A4EFF in the UWNEU



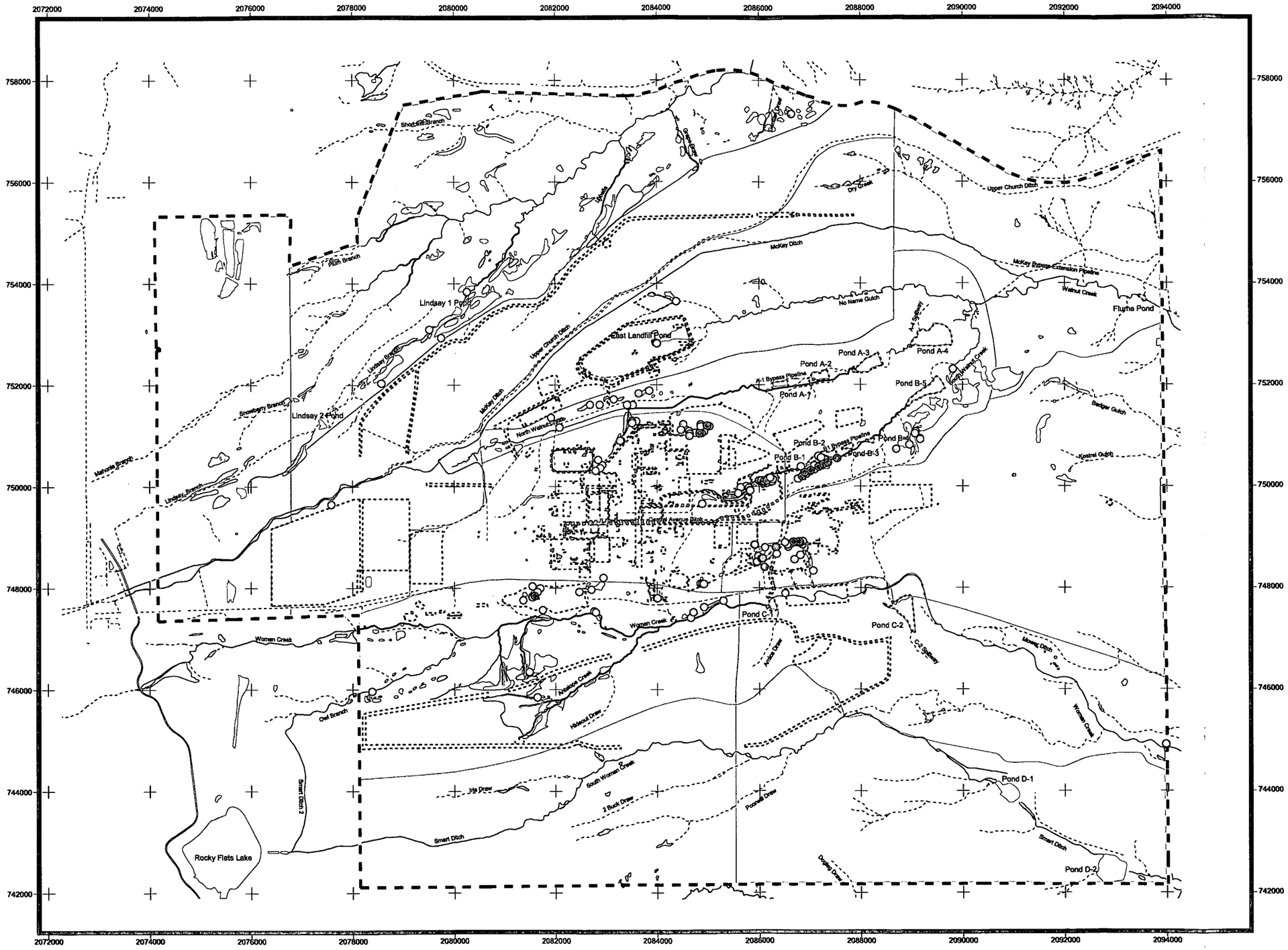


Figure A4.7

Groundwater Sample Locations at Seeps Where Wildlife Refuge Worker PRGs Were Exceeded

KEY

Exceeded Surface Water PRG

- Yes
- No

A location is classified as a PRG exceedance if any analyte was detected at a concentration exceeding it's PRG since June 28, 1991.

Standard Map Features

- Perennial seep *
- Ephemeral seep *
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

Exposure Units

- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

* Seep designation Ebasco 1995

N W E S

0 1000 2000 Feet

Scale 1:24,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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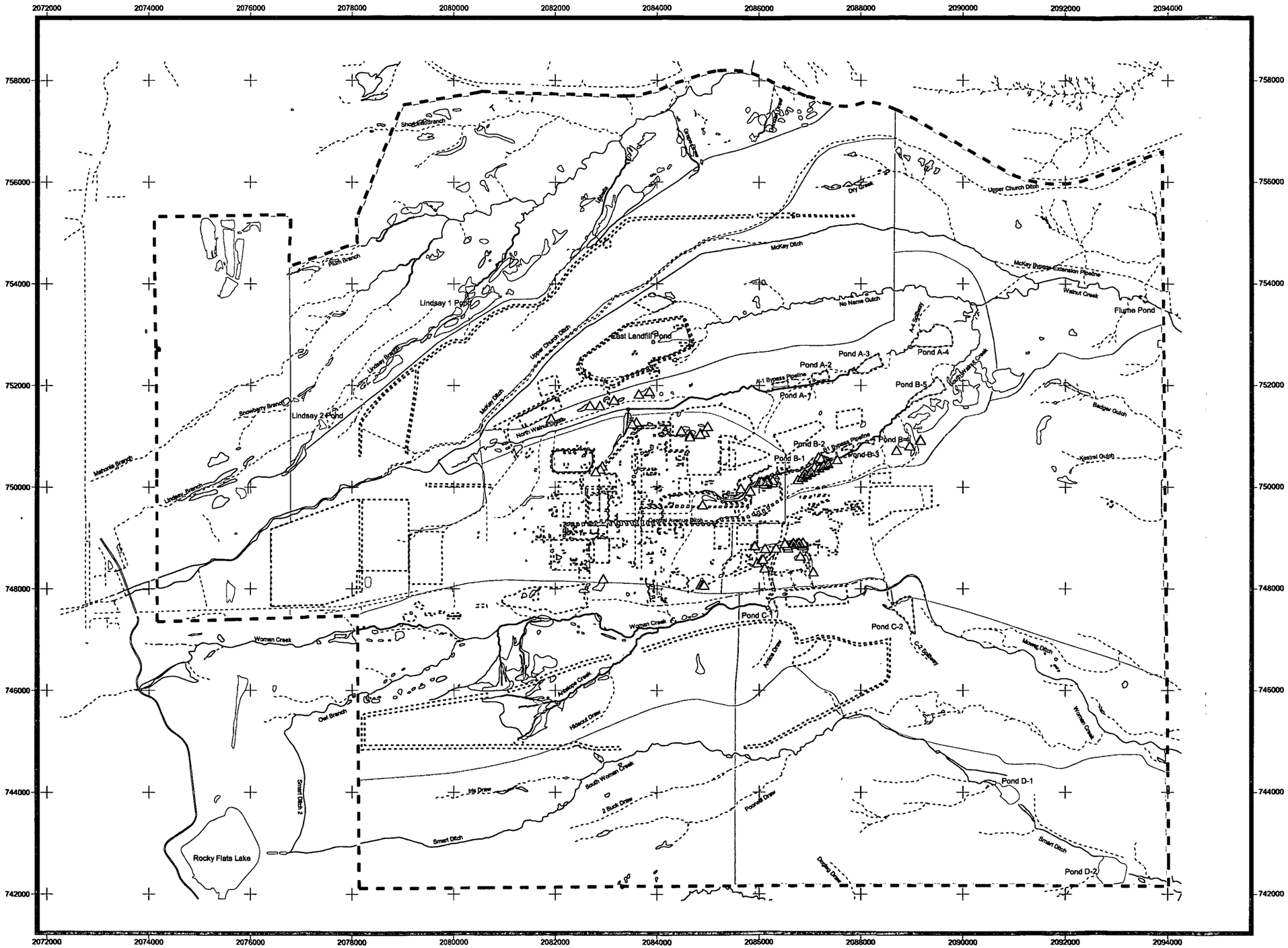

Figure A4.8

Groundwater Sample Locations At Seeps Where Wildlife Refuge Worker PCE PRG Was Exceeded

KEY

Exceeded Ground Water PRG

- ▲ Yes
- △ No

A location is classified as a PRG exceedance if any analyte was detected at a concentration exceeding it's PRG since June 28, 1991.

Standard Map Features

- Perennial seep *
- Ephemeral seep *
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

Exposure Units

- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

* Seep designation Ebasco 1995

N W E S

0 1000 2000 Feet

Scale 1:24,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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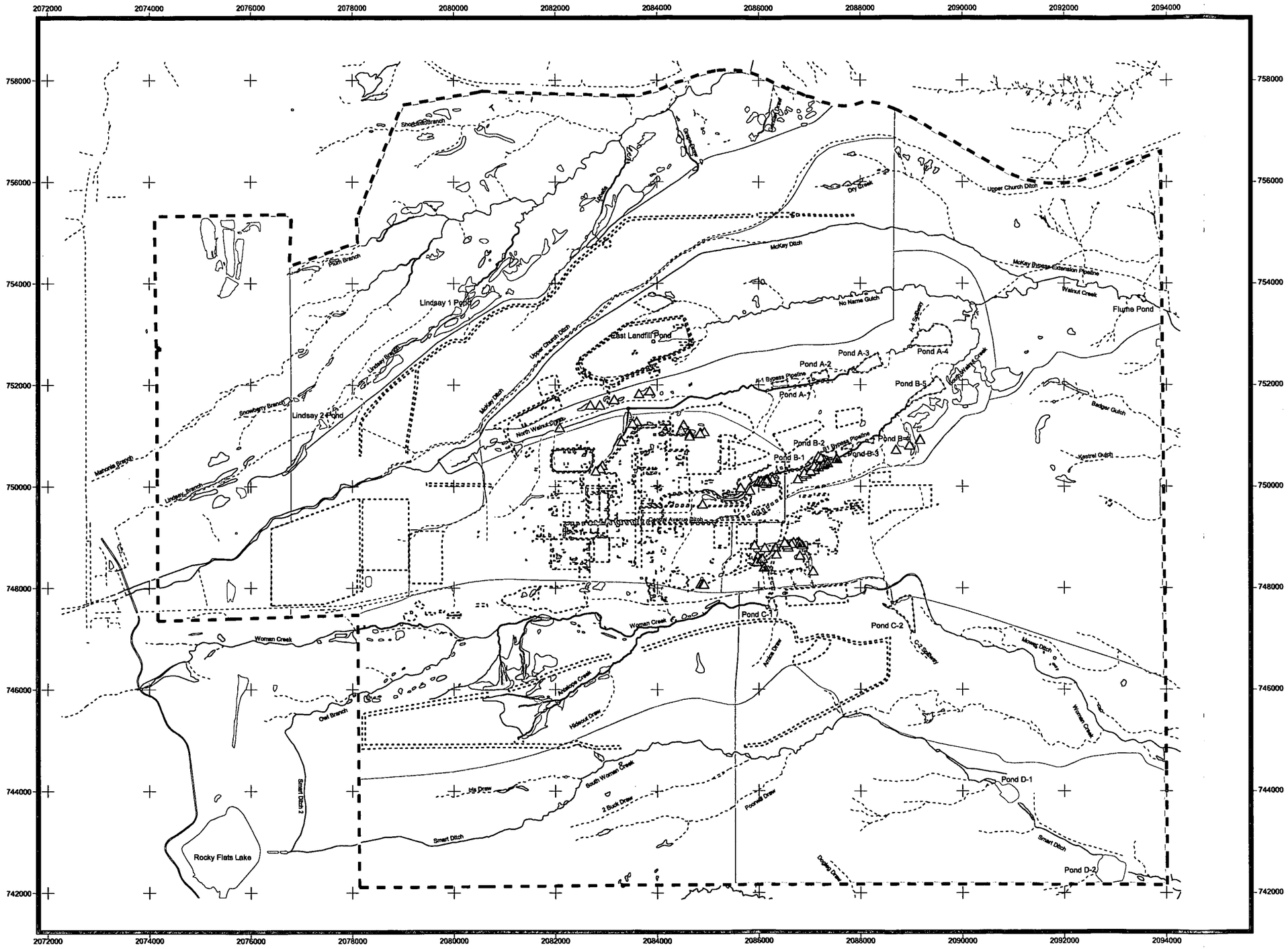

Figure A4.9

Groundwater Sample Locations At Seeps Where Wildlife Refuge Worker TCE PRG Was Exceeded

KEY

Exceeded Ground Water PRG

- ▲ Yes
- △ No

A location is classified as a PRG exceedance if any analyte was detected at a concentration exceeding it's PRG since June 28, 1991.

Standard Map Features

- Perennial seep *
- Ephemeral seep *
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

Exposure Units

- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

* Seep designation Ebasco 1995

N W E S

0 1000 2000 Feet

Scale 1:24,000

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Colorado Central Zone
Datum: NAD 27

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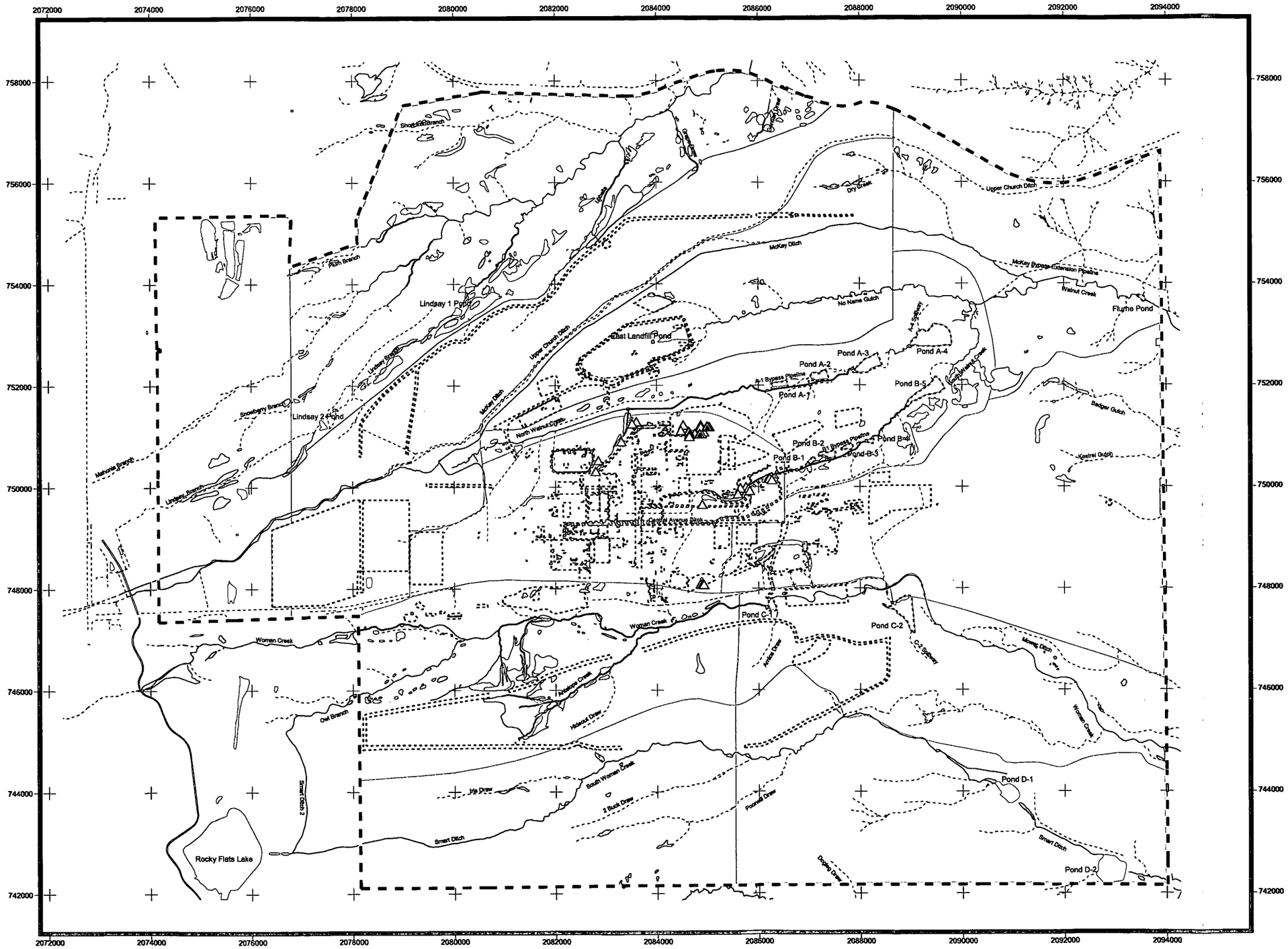

Figure A4.10

Groundwater Sample Locations At Seeps Where Wildlife Refuge Worker Nitrate PRG Was Exceeded

KEY

Exceeded Ground Water PRG

- ▲ Yes
- △ No

A location is classified as a PRG exceedance if any analyte was detected at a concentration exceeding it's PRG since June 28, 1991.

Standard Map Features

- Perennial seep *
- Ephemeral seep *
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

Exposure Units

- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

* Seep designation Ebasco 1995

N W E S

0 1000 2000 Feet

Scale 1:24,000

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Figure A4.11a
Tetrachloroethene Surface Water and Groundwater Concentrations in the UWNEU

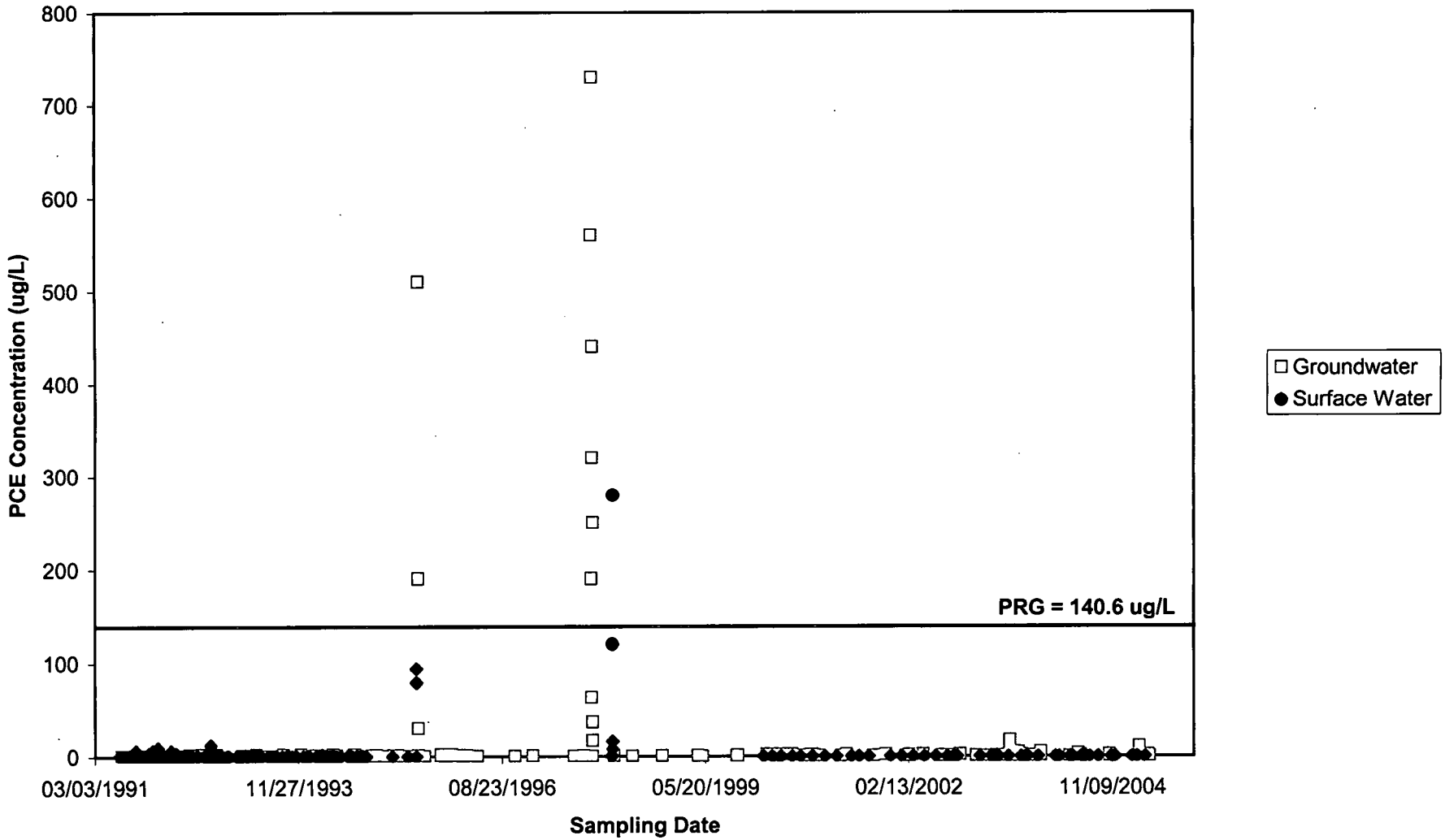

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Figure A4.11b
Trichloroethene Surface Water and Groundwater Concentrations in the UWNEU

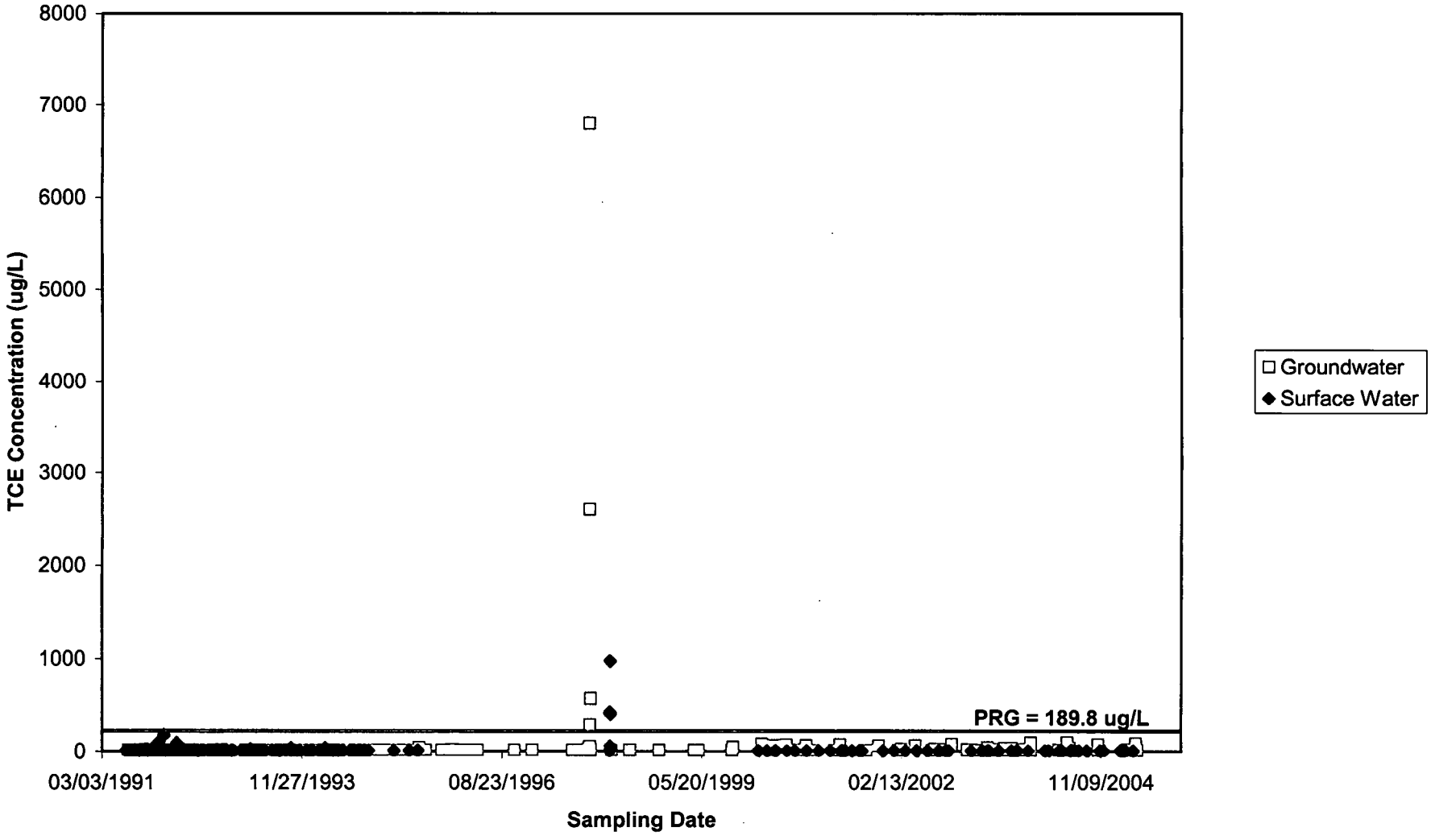

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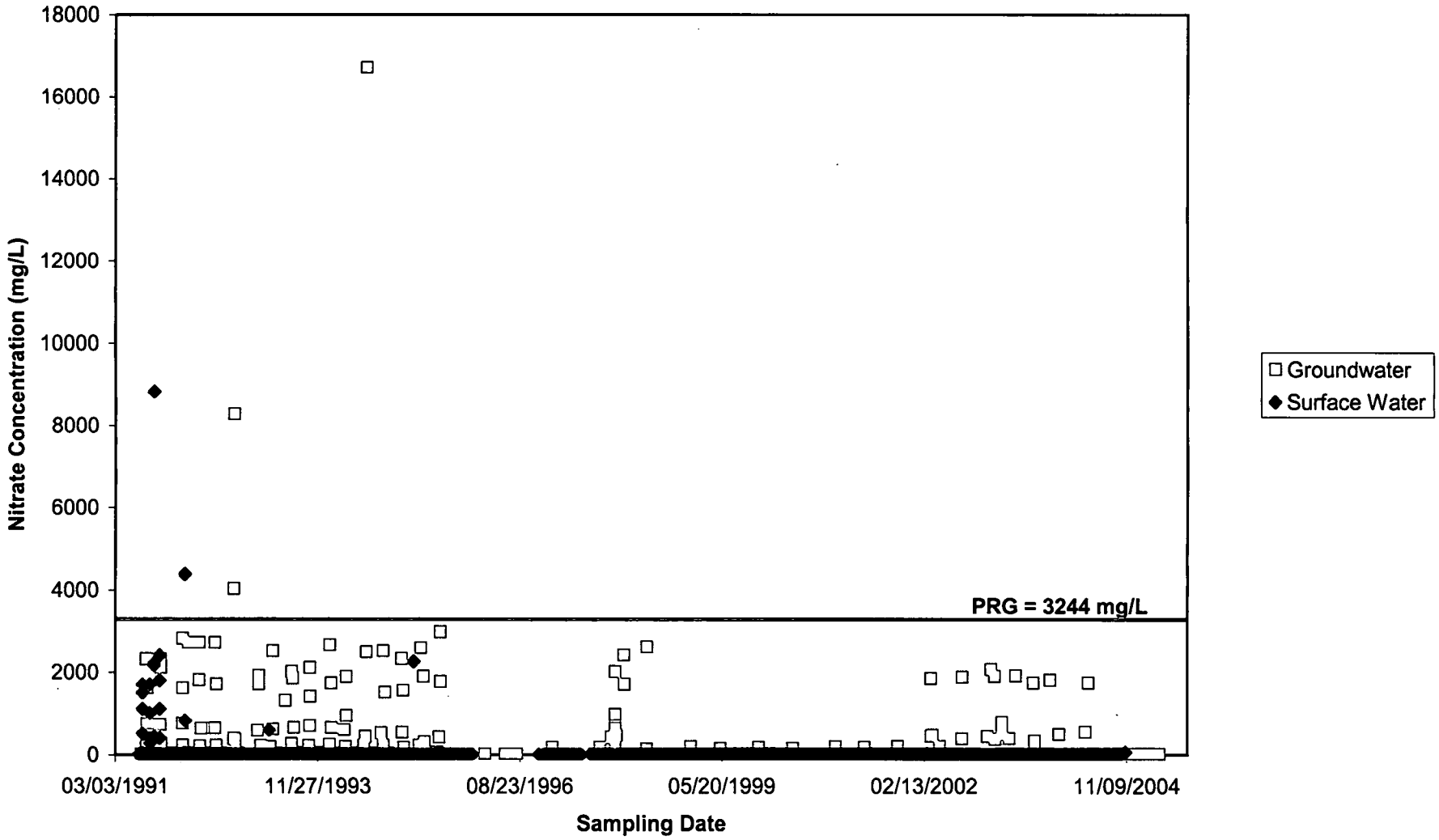
Figure A4.11c
Nitrate Surface Water and Groundwater Concentrations in the IAEU



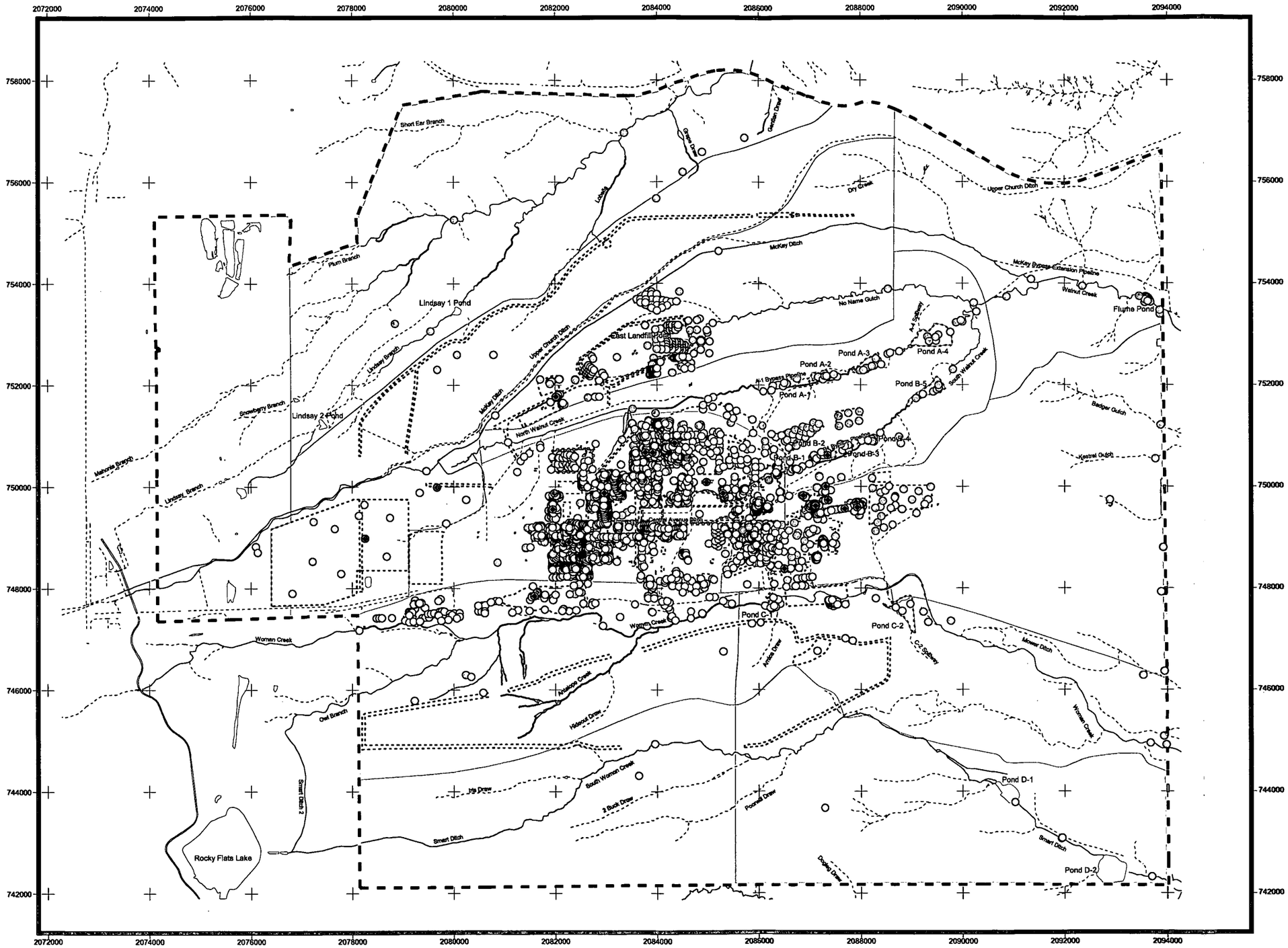


Figure A4.12

Subsurface Soil Sample Locations Where Volatilization PRGs Were Exceeded

KEY

Exceeded Volatilization PRG

- Yes
- No

A location is classified as a PRG exceedance if any analyte was detected at a concentration exceeding it's PRG since June 28, 1991.

Standard Map Features

- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

Exposure Units

- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

N W E S

0 1000 2000 Feet

Scale 1:24,000

State Plane Coordinate Projection
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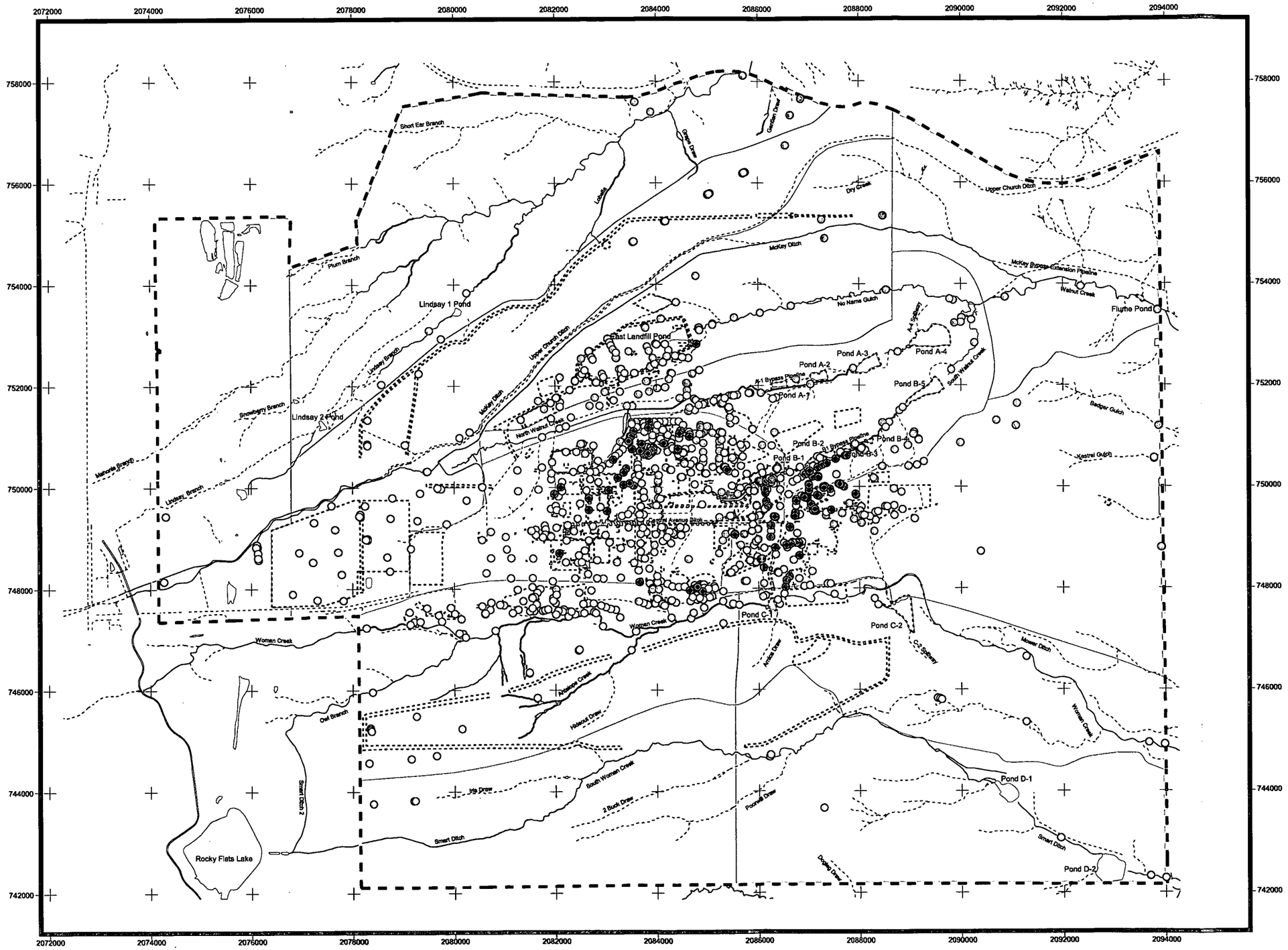

Figure A4.13

Groundwater Sample Locations Where Volatilization PRGs Were Exceeded

KEY

Exceeded Volatilization PRG

- ● Yes
- ○ No

A location is classified as a PRG exceedance if any analyte was detected at a concentration exceeding it's PRG since June 28, 1991.

Standard Map Features

- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

Exposure Units

- Industrial Area
- Inter-Drainage
- Lower Walnut Drainage
- Lower Woman Drainage
- No Name Gulch Drainage
- Rock Creek Drainage
- Southeast Buffer Zone Area
- Southwest Buffer Zone Area
- Upper Walnut Drainage
- Upper Woman Drainage
- West Area
- Wind Blown Area

N W E S

0 1000 2000 Feet

Scale 1:24,000

State Plane Coordinate Projection
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COMPREHENSIVE RISK ASSESSMENT

COMPREHENSIVE RISK ASSESSMENT METHODOLOGY AND DATA DESCRIPTION

VOLUME 2: ATTACHMENT 5

Background Data Summary Tables

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Table A5.2 Sitewide Surface Soil and Surface Sediment Background Data Summary

Table A5.3 Sitewide Sitewide Subsurface Soil Background Data Summary

Table A5.4 Sitewide Subsurface Soil and Subsurface Sediment Background Data Summary

Table A5.5 Sitewide Sediment Background Data Summary

Table A5.6 Sitewide Surface Water Background Data Summary (Total Concentrations)

Table A5.7 Sitewide Surface Water Background Data Summary (Dissolved Concentrations)

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ACRONYMS AND ABBREVIATIONS

mg/kg	milligrams per kilogram
mg/L	milligrams per liter
pCi/g	picocuries per gram
pCi/L	picocuries per liter
StDev	standard deviation
UCL	upper confidence limit

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Table A5.1
Sitewide Surface Soil Background Data Summary

Analyte	Unit	No. of Samples	No. of Detects	%D	Maximum Concentration Detected	Minimum Concentration Detected	Mean Concentration	StDev	Mean+2St Dev	Distribution Recommended by ProUCL	UCL Recommended by ProUCL	UCL Value
Aluminum	mg/kg	20	20	100%	17,100	4,050	10,203	3,256	16,715	NORMAL	95% Student's-t UCL	11,461
Americium-241	pCi/g	50	50	100%	0.025	1.00E-03	0.010	0.006	0.022	NORMAL	95% Student's-t UCL	0.012
Ammonia	mg/kg	20	13	65%	7.00	1.00	2.03	1.90	5.83	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	3.88
Antimony	mg/kg	20					0.279	0.078	0.436	NON-PARAMETRIC	95% Student's-t UCL	0.309
Arsenic	mg/kg	20	20	100%	9.60	2.30	6.09	2.00	10.1	NORMAL	95% Student's-t UCL	6.86
Barium	mg/kg	20	20	100%	134	45.7	102	19.4	141	NORMAL	95% Student's-t UCL	110
Beryllium	mg/kg	20	20	100%	0.900	0.240	0.660	0.152	0.964	NORMAL	95% Student's-t UCL	0.719
Cadmium	mg/kg	20	13	65%	2.30	0.670	0.708	0.455	1.62	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	1.15
Calcium	mg/kg	20	20	100%	4,550	1,450	2,965	750	4,464	NORMAL	95% Student's-t UCL	3,255
Cesium	mg/kg	20					6.54	0.224	6.99	NORMAL	95% Student's-t UCL	6.62
Cesium-134	pCi/g	70	70	100%	0.300	0.050	0.148	0.059	0.266	NON-PARAMETRIC	95% Student's-t UCL	0.160
Cesium-137	pCi/g	70	70	100%	1.80	0.070	0.911	0.391	1.69	NORMAL	95% Student's-t UCL	0.989
Chromium	mg/kg	20	20	100%	16.9	5.50	11.2	2.78	16.8	NORMAL	95% Student's-t UCL	12.3
Cobalt	mg/kg	20	20	100%	11.2	3.40	7.27	1.79	10.9	NORMAL	95% Student's-t UCL	7.96
Copper	mg/kg	20	20	100%	16.0	5.20	13.0	2.58	18.1	NON-PARAMETRIC	95% Student's-t UCL	14.0
Iron	mg/kg	20	20	100%	16,100	7,390	12,409	2,596	17,601	NORMAL	95% Student's-t UCL	13,412
Lead	mg/kg	20	20	100%	53.3	8.60	33.5	10.5	54.6	NORMAL	95% Student's-t UCL	37.6
Lithium	mg/kg	20	20	100%	11.6	4.80	7.66	1.89	11.4	NORMAL	95% Student's-t UCL	8.39
Magnesium	mg/kg	20	20	100%	2,800	1,310	1,909	463	2,834	NORMAL	95% Student's-t UCL	2,087
Manganese	mg/kg	20	20	100%	357	129	237	63.9	365	NORMAL	95% Student's-t UCL	262
Mercury	mg/kg	20	8	40%	0.120	0.090	0.072	0.031	0.133	NON-PARAMETRIC	95% Student's-t UCL	0.083
Molybdenum	mg/kg	20					0.573	0.184	0.941	NORMAL	95% Student's-t UCL	0.644
Nickel	mg/kg	20	20	100%	14.0	3.80	9.60	2.59	14.8	NORMAL	95% Student's-t UCL	10.6
Nitrate	mg/kg	20	20	100%	7.00	2.00	4.00	1.69	7.37	NON-PARAMETRIC	95% Student's-t UCL	4.65
Plutonium-239/240	pCi/g	50	50	100%	0.350	0.017	0.045	0.047	0.138	NON-PARAMETRIC	95% Student's-t UCL	0.056
Potassium	mg/kg	20	20	100%	2,830	1,110	2,055	449	2,952	NORMAL	95% Student's-t UCL	2,228
Radium-226	pCi/g	20	20	100%	0.870	0.100	0.620	0.156	0.932	NON-PARAMETRIC	95% Student's-t UCL	0.680
Radium-228	pCi/g	20	20	100%	2.30	0.200	1.35	0.480	2.31	NORMAL	95% Student's-t UCL	1.54
Selenium	mg/kg	20	12	60%	1.40	0.680	0.628	0.305	1.24	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.925
Silica	mg/kg	20	20	100%	1,650	934	1,385	178	1,741	NORMAL	95% Student's-t UCL	1,454
Silver	mg/kg	20					0.207	0.007	0.221	NORMAL	95% Student's-t UCL	0.210
Sodium	mg/kg	20	20	100%	105	43.8	63.6	15.7	95.0	NORMAL	95% Student's-t UCL	69.7
Strontium	mg/kg	20	20	100%	45.2	9.60	28.4	10.2	48.8	NORMAL	95% Student's-t UCL	32.4
Strontium-89/90	pCi/g	50	50	100%	0.610	0.063	0.251	0.128	0.508	GAMMA	95% Approximate Gamma UCL	0.285
Thallium	mg/kg	14					0.414	0.015	0.443	NORMAL	95% Student's-t UCL	0.421
Tin	mg/kg	20					2.06	0.410	2.88	NORMAL	95% Student's-t UCL	2.22
Uranium-233/234	pCi/g	20	20	100%	3.10	0.660	1.10	0.578	2.25	NON-PARAMETRIC	95% Student's-t UCL	1.32
Uranium-235	pCi/g	20	20	100%	0.110	0.033	0.054	0.020	0.095	GAMMA	95% Approximate Gamma UCL	0.062
Uranium-238	pCi/g	20	20	100%	2.60	0.740	1.09	0.456	2.00	NON-PARAMETRIC	95% Student's-t UCL	1.27
Vanadium	mg/kg	20	20	100%	45.8	10.8	27.7	7.68	43.1	NORMAL	95% Student's-t UCL	30.7
Zinc	mg/kg	20	20	100%	75.9	21.1	49.8	12.2	74.2	NORMAL	95% Student's-t UCL	54.5

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Table A5.2
Sitewide Surface Soil and Surface Sediment Background Data Summary

Analyte	Unit	No. of Samples	No. of Detects	%D	Maximum Concentration Detected	Minimum Concentration Detected	Mean Concentration	StDev	Mean+2St Dev	Distribution Recommended by ProUCL	UCL Recommended by ProUCL	UCL Value
Aluminum	mg/kg	73	73	100%	25,200	811	7,712	5,349	18,410	NORMAL	95% Student's-t UCL	8,755
Americium-241	pCi/g	90	90	100%	0.087	-0.040	0.009	0.013	0.035	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.015
Ammonia	mg/kg	20	13	65%	7.00	1.00	2.03	1.90	5.83	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	3.88
Antimony	mg/kg	66	5	8%	12.4	1.00	2.64	3.12	8.87	NON-PARAMETRIC	97.5% Chebyshev (Mean, Sd) UCL	5.03
Arsenic	mg/kg	73	67	92%	9.60	0.270	3.42	2.55	8.51	GAMMA	95% Approximate Gamma UCL	4.03
Barium	mg/kg	72	72	100%	260	10.6	84.6	52.2	189	NORMAL	95% Student's-t UCL	94.8
Beryllium	mg/kg	71	45	63%	2.30	0.150	0.554	0.422	1.40	GAMMA	95% Approximate Gamma UCL	0.641
Cadmium	mg/kg	67	18	27%	2.30	0.410	0.578	0.389	1.36	LOGNORMAL	95% H-UCL	0.651
Calcium	mg/kg	73	73	100%	13,000	392	2,565	1,987	6,538	GAMMA	95% Approximate Gamma UCL	2,948
Cesium	mg/kg	69	6	9%	157	0.560	52.7	72.4	198	NON-PARAMETRIC	97.5% Chebyshev (Mean, Sd) UCL	107
Cesium-134	pCi/g	77	77	100%	0.300	1.00E-03	0.141	0.066	0.272	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.173
Cesium-137	pCi/g	105	105	100%	1.80	-0.027	0.692	0.492	1.68	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.901
Chloride	mg/kg	1	1	100%	10.0	10.0	10.0			0	Too Few Observations To Calculate UCLs	N/A
Chromium	mg/kg	73	65	89%	30.4	1.50	9.21	6.69	22.6	NORMAL	95% Student's-t UCL	10.5
Cobalt	mg/kg	72	61	85%	15.3	1.80	5.82	3.18	12.2	NORMAL	95% Student's-t UCL	6.44
Copper	mg/kg	73	63	86%	36.7	2.20	11.4	7.47	26.4	GAMMA	95% Approximate Gamma UCL	13.2
Cyanide	mg/kg	1					0.105			0	Too Few Observations To Calculate UCLs	N/A
Gross Alpha	pCi/g	44	44	100%	72.0	3.79	25.1	19.3	63.8	GAMMA	95% Approximate Gamma UCL	30.7
Gross Beta	pCi/g	44	44	100%	59.0	14.7	36.1	9.89	55.9	NORMAL	95% Student's-t UCL	38.6
Iron	mg/kg	73	73	100%	31,400	1,040	10,433	6,064	22,560	NORMAL	95% Student's-t UCL	11,615
Lead	mg/kg	73	73	100%	68.8	2.60	18.6	15.0	48.6	GAMMA	95% Approximate Gamma UCL	22.0
Lithium	mg/kg	71	60	85%	20.3	1.50	7.81	5.47	18.8	GAMMA	95% Approximate Gamma UCL	8.91
Magnesium	mg/kg	73	70	96%	5,850	197	1,636	1,122	3,879	GAMMA	95% Approximate Gamma UCL	1,883
Manganese	mg/kg	73	73	100%	1,280	9.00	241	189	618	GAMMA	95% Approximate Gamma UCL	277
Mercury	mg/kg	65	10	15%	0.120	0.034	0.075	0.054	0.184	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.105
Molybdenum	mg/kg	71	14	20%	14.0	0.790	3.31	5.57	14.5	NON-PARAMETRIC	97.5% Chebyshev (Mean, Sd) UCL	7.44
Nickel	mg/kg	72	57	79%	25.6	1.20	7.65	4.89	17.4	NORMAL	95% Student's-t UCL	8.61
Nitrate	mg/kg	67	49	73%	76.0	0.300	6.29	13.4	33.1	NON-PARAMETRIC	97.5% Chebyshev (Mean, Sd) UCL	16.5
Nitrite	mg/kg	9	1	11%	0.300	0.300	0.211	0.096	0.403	NORMAL	95% Student's-t UCL	0.271
Plutonium-238	pCi/g	3	3	100%	0.00E+00	-1.03E-04	-3.43E-05	5.95E-05	8.46E-05	0	Too Few Observations To Calculate UCLs	N/A
Plutonium-239/240	pCi/g	94	94	100%	0.350	-0.010	0.032	0.039	0.109	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.049
Potassium	mg/kg	73	62	85%	3,770	215	1,246	874	2,993	GAMMA	95% Approximate Gamma UCL	1,456
Radium-226	pCi/g	39	39	100%	1.80	0.100	0.747	0.337	1.42	NON-PARAMETRIC	95% Student's-t UCL	0.838
Radium-228	pCi/g	40	40	100%	4.10	0.200	1.60	0.799	3.20	GAMMA	95% Approximate Gamma UCL	1.84
Selenium	mg/kg	72	25	35%	3.20	0.100	0.485	0.562	1.61	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.774
Silica	mg/kg	38	38	100%	1,650	96.8	895	579	2,053	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	1,304
Silver	mg/kg	67	3	4%	3.40	1.40	0.583	0.604	1.79	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.904
Sodium	mg/kg	73	66	90%	559	36.6	143	126	395	LOGNORMAL	95% H-UCL	165
Strontium	mg/kg	73	66	90%	421	3.00	31.0	51.9	135	LOGNORMAL	95% H-UCL	36.2
Strontium-89/90	pCi/g	87	87	100%	0.793	-0.200	0.230	0.160	0.550	NORMAL	95% Student's-t UCL	0.258
Sulfate	mg/kg	1	1	100%	60.0	60.0	60.0			0	Too Few Observations To Calculate UCLs	N/A
Thallium	mg/kg	60	3	5%	0.740	0.340	0.335	0.228	0.791	GAMMA	95% Approximate Gamma UCL	0.382
Tin	mg/kg	69	14	20%	27.1	3.60	9.13	25.5	60.1	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	22.5
Uranium-233/234	pCi/g	65	65	100%	4.78	0.136	1.49	0.982	3.45	LOGNORMAL	95% H-UCL	1.82
Uranium-235	pCi/g	64	64	100%	0.191	0.00E+00	0.058	0.041	0.140	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.080
Uranium-238	pCi/g	65	65	100%	3.82	0.127	1.36	0.825	3.01	GAMMA	95% Approximate Gamma UCL	1.55
Vanadium	mg/kg	72	69	96%	73.0	3.40	22.6	14.1	50.8	NORMAL	95% Student's-t UCL	25.4
Zinc	mg/kg	73	72	99%	720	6.50	66.6	112	291	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	124

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Table A5.3
Sitewide Subsurface Soil Background Data Summary

Analyte	Unit	No. of Samples	No. of Detects	%D	Maximum Concentration Detected	Minimum Concentration Detected	Mean Concentration	StDev	Mean+2St Dev	Distribution Recommended by ProUCL	UCL Recommended by ProUCL	UCL Value
Aluminum	mg/kg	44	44	100%	40,700	4,300	14,160	8,116	30,392	GAMMA	95% Approximate Gamma UCL	16,278
Americium-241	pCi/g	13	13	100%	0.010	-0.010	-0.002	0.006	0.010	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.005
Antimony	mg/kg	28	2	7%	8.20	2.90	4.21	2.78	9.78	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	6.50
Arsenic	mg/kg	45	42	93%	41.8	1.70	5.48	6.02	17.5	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	9.39
Barium	mg/kg	45	40	89%	491	36.8	114	88.6	291	GAMMA	95% Approximate Gamma UCL	137
Beryllium	mg/kg	45	43	96%	22.4	1.00	5.76	5.01	15.8	GAMMA	95% Approximate Gamma UCL	7.10
Cadmium	mg/kg	37	2	5%	1.50	1.40	0.569	0.254	1.08	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.751
Calcium	mg/kg	45	45	100%	157,000	1,130	10,426	23,141	56,708	LOGNORMAL	95% H-UCL	11,866
Cesium	mg/kg	43	1	2%	274	274	118	27.2	172	NON-PARAMETRIC	95% Student's-t UCL	125
Cesium-137	pCi/g	45	45	100%	0.200	0.00E+00	0.027	0.058	0.143	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.064
Chromium	mg/kg	45	45	100%	69.6	5.80	18.4	11.9	42.2	GAMMA	95% Approximate Gamma UCL	21.2
Cobalt	mg/kg	45	12	27%	20.5	4.50	5.99	4.71	15.4	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	9.06
Copper	mg/kg	45	43	96%	31.6	2.20	11.6	6.09	23.8	NORMAL	95% Student's-t UCL	13.1
Gross Alpha	pCi/g	45	45	100%	46.0	3.00	26.2	8.95	44.1	NORMAL	95% Student's-t UCL	28.5
Gross Beta	pCi/g	45	45	100%	41.0	6.00	24.0	7.00	38.0	NORMAL	95% Student's-t UCL	25.7
Iron	mg/kg	45	45	100%	35,900	5,750	15,046	6,707	28,459	GAMMA	95% Approximate Gamma UCL	16,782
Lead	mg/kg	45	45	100%	25.8	4.20	13.9	6.31	26.5	GAMMA	95% Approximate Gamma UCL	15.8
Lithium	mg/kg	45	25	56%	31.3	3.30	9.83	5.32	20.5	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	13.3
Magnesium	mg/kg	45	42	93%	5,580	1,290	2,803	1,362	5,526	NORMAL	95% Student's-t UCL	3,144
Manganese	mg/kg	45	45	100%	747	16.0	171	158	487	GAMMA	95% Approximate Gamma UCL	211
Mercury	mg/kg	41	12	29%	0.640	0.190	0.155	0.166	0.488	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.269
Molybdenum	mg/kg	45	30	67%	41.0	3.50	13.5	7.80	29.1	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	18.6
Nickel	mg/kg	44	44	100%	54.2	4.30	20.9	11.1	43.0	GAMMA	95% Approximate Gamma UCL	23.9
Nitrate	mg/kg	44	27	61%	7.08	1.10	1.57	1.38	4.33	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	2.47
Plutonium-239/240	pCi/g	45	45	100%	0.030	-0.002	0.006	0.008	0.022	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.011
Potassium	mg/kg	44	29	66%	3,830	698	1,351	938	3,227	GAMMA	95% Approximate Gamma UCL	1,637
Radium-226	pCi/g	31	31	100%	1.30	0.400	0.784	0.279	1.34	NON-PARAMETRIC	95% Student's-t UCL	0.869
Radium-228	pCi/g	31	31	100%	2.10	1.00	1.45	0.320	2.09	GAMMA	95% Approximate Gamma UCL	1.55
Selenium	mg/kg	38					0.592	0.543	1.68	LOGNORMAL	95% H-UCL	0.741
Silver	mg/kg	37	18	49%	40.9	1.50	6.39	10.1	26.6	NON-PARAMETRIC	99% Chebyshev (Mean, Sd) UCL	22.9
Sodium	mg/kg	45	10	22%	3,680	194	349	551	1,450	GAMMA	95% Approximate Gamma UCL	456
Strontium	mg/kg	45	27	60%	226	25.1	50.3	42.6	136	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	78.0
Strontium-89/90	pCi/g	45	45	100%	0.800	-0.600	-0.038	0.304	0.570	NORMAL	95% Student's-t UCL	0.038
Sulfide	mg/kg	41	16	39%	7.20	2.00	2.20	1.48	5.16	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	3.21
Thallium	mg/kg	35	2	6%	0.400	0.220	0.476	0.472	1.42	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.824
Tin	mg/kg	41	15	37%	441	25.7	86.0	134	354	NON-PARAMETRIC	99% Chebyshev (Mean, Sd) UCL	294
Uranium-233/234	pCi/g	45	45	100%	3.40	0.200	0.829	0.625	2.08	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	1.24
Uranium-235	pCi/g	45	45	100%	0.300	0.00E+00	0.036	0.063	0.162	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.077
Uranium-238	pCi/g	45	45	100%	3.20	0.200	0.792	0.491	1.77	NON-PARAMETRIC	95% Student's-t UCL	0.915
Vanadium	mg/kg	45	44	98%	70.0	11.4	33.8	14.8	63.3	NORMAL	95% Student's-t UCL	37.5
Zinc	mg/kg	44	44	100%	79.8	0.520	36.2	21.0	78.3	NORMAL	95% Student's-t UCL	41.5

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Table A5.4
Sitewide Subsurface Soil and Subsurface Sediment Background Data Summary

Analyte	Unit	No. of Samples	No. of Detects	%D	Maximum Concentration Detected	Minimum Concentration Detected	Mean Concentration	StDev	Mean+2St Dev	Distribution Recommended by ProUCL	UCL Recommended by ProUCL	UCL Value
Aluminum	mg/kg	46	46	100%	40,700	4,300	13,862	8,069	29,999	GAMMA	95% Approximate Gamma UCL	15,902
Americium-241	pCi/g	15	15	100%	0.010	-0.010	-0.001	0.006	0.011	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.005
Antimony	mg/kg	29	2	7%	8.20	2.90	4.16	2.75	9.65	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	6.38
Arsenic	mg/kg	47	44	94%	41.8	1.70	5.37	5.91	17.2	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	9.13
Barium	mg/kg	47	42	89%	491	36.8	114	87.1	288	GAMMA	95% Approximate Gamma UCL	136
Beryllium	mg/kg	46	43	93%	22.4	1.00	5.64	5.02	15.7	GAMMA	95% Approximate Gamma UCL	7.03
Cadmium	mg/kg	38	2	5%	1.50	1.40	0.570	0.251	1.07	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.747
Calcium	mg/kg	47	47	100%	157,000	1,130	10,230	22,664	55,558	LOGNORMAL	95% H-UCL	11,551
Cesium	mg/kg	45	2	4%	274	2.90	115	31.6	178	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	135
Cesium-137	pCi/g	47	47	100%	0.370	0.00E+00	0.037	0.078	0.194	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.087
Chromium	mg/kg	47	47	100%	69.6	5.80	18.4	11.9	42.1	GAMMA	95% Approximate Gamma UCL	21.1
Cobalt	mg/kg	47	14	30%	20.5	4.50	6.15	4.77	15.7	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	9.19
Copper	mg/kg	47	44	94%	31.6	2.20	11.5	5.98	23.5	NORMAL	95% Student's-t UCL	13.0
Gross Alpha	pCi/g	46	46	100%	46.0	3.00	26.0	8.97	44.0	NORMAL	95% Student's-t UCL	28.2
Gross Beta	pCi/g	47	47	100%	49.7	6.00	24.6	7.81	40.2	NORMAL	95% Student's-t UCL	26.5
Iron	mg/kg	47	47	100%	35,900	5,750	14,880	6,667	28,214	GAMMA	95% Approximate Gamma UCL	16,566
Lead	mg/kg	47	47	100%	30.3	4.20	14.3	6.66	27.6	GAMMA	95% Approximate Gamma UCL	16.3
Lithium	mg/kg	46	26	57%	31.3	3.30	9.75	5.28	20.3	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	13.1
Magnesium	mg/kg	47	44	94%	5,580	1,290	2,772	1,344	5,460	GAMMA	95% Approximate Gamma UCL	3,187
Manganese	mg/kg	47	47	100%	747	16.0	168	155	479	GAMMA	95% Approximate Gamma UCL	206
Mercury	mg/kg	42	12	29%	0.640	0.190	0.154	0.165	0.483	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.264
Molybdenum	mg/kg	46	31	67%	41.0	3.50	13.3	7.84	29.0	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	18.3
Nickel	mg/kg	45	45	100%	54.2	4.30	20.7	11.1	42.8	GAMMA	95% Approximate Gamma UCL	23.6
Nitrate	mg/kg	46	27	59%	7.08	1.10	1.77	1.98	5.74	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	3.05
Plutonium-239/240	pCi/g	47	47	100%	0.030	-0.002	0.006	0.008	0.022	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.011
Potassium	mg/kg	45	30	67%	3,830	698	1,342	929	3,200	GAMMA	95% Approximate Gamma UCL	1,620
Radium-226	pCi/g	31	31	100%	1.30	0.400	0.784	0.279	1.34	NON-PARAMETRIC	95% Student's-t UCL	0.869
Radium-228	pCi/g	31	31	100%	2.10	1.00	1.45	0.320	2.09	GAMMA	95% Approximate Gamma UCL	1.55
Selenium	mg/kg	40	2	5%	1.50	0.810	0.621	0.549	1.72	LOGNORMAL	95% H-UCL	0.780
Silica	mg/kg	1	1	100%	157	157	157			0	Too Few Observations To Calculate UCLs	N/A
Silver	mg/kg	38	18	47%	40.9	1.50	6.23	10.0	26.3	NON-PARAMETRIC	99% Chebyshev (Mean, Sd) UCL	22.4
Sodium	mg/kg	47	11	23%	3,680	131	343	539	1,422	GAMMA	95% Approximate Gamma UCL	444
Strontium	mg/kg	47	29	62%	226	15.9	49.6	42.0	134	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	76.3
Strontium-89/90	pCi/g	47	47	100%	0.800	-0.600	-0.034	0.298	0.563	NORMAL	95% Student's-t UCL	0.039
Sulfide	mg/kg	41	16	39%	7.20	2.00	2.20	1.48	5.16	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	3.21
Thallium	mg/kg	36	2	6%	0.400	0.220	0.475	0.466	1.41	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.813
Tin	mg/kg	42	15	36%	441	25.7	84.0	133	350	NON-PARAMETRIC	99% Chebyshev (Mean, Sd) UCL	288
Uranium-233/234	pCi/g	47	47	100%	3.98	0.200	0.905	0.766	2.44	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	1.39
Uranium-235	pCi/g	47	47	100%	0.300	0.00E+00	0.037	0.062	0.161	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.076
Uranium-238	pCi/g	47	47	100%	3.20	0.200	0.851	0.592	2.03	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	1.23
Vanadium	mg/kg	47	46	98%	70.0	11.4	33.3	14.8	62.8	NORMAL	95% Student's-t UCL	36.9
Zinc	mg/kg	46	46	100%	79.8	0.520	36.9	20.9	78.7	NORMAL	95% Student's-t UCL	42.1

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Table A5.5
Sitewide Sediment Background Data Summary

Analyte	Unit	No. of Samples	No. of Detects	%D	Maximum Concentration Detected	Minimum Concentration Detected	Mean Concentration	StDev	Mean+2St Dev	Distribution Recommended by ProUCL	UCL Recommended by ProUCL	UCL Value
Aluminum	mg/kg	55	55	100%	25,200	811	6,791	5,603	17,996	GAMMA	95% Approximate Gamma UCL	8,246
Americium-241	pCi/g	42	42	100%	0.087	-0.040	0.008	0.018	0.043	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.019
Antimony	mg/kg	47	5	11%	12.4	1.00	3.64	3.21	10.1	LOGNORMAL	95% H-UCL	4.50
Arsenic	mg/kg	55	49	89%	8.70	0.270	2.43	1.92	6.26	GAMMA	95% Approximate Gamma UCL	2.93
Barium	mg/kg	54	54	100%	260	10.6	78.9	58.8	197	GAMMA	95% Approximate Gamma UCL	94.1
Beryllium	mg/kg	52	25	48%	2.30	0.150	0.505	0.481	1.47	LOGNORMAL	95% H-UCL	0.646
Cadmium	mg/kg	48	5	10%	1.30	0.410	0.525	0.345	1.21	LOGNORMAL	95% H-UCL	0.601
Calcium	mg/kg	55	55	100%	13,000	392	2,537	2,421	7,380	GAMMA	95% Approximate Gamma UCL	3,064
Cesium	mg/kg	51	7	14%	157	0.560	70.8	77.8	226	NON-PARAMETRIC	97.5% Chebyshev (Mean, Sd) UCL	139
Cesium-134	pCi/g	7	7	100%	0.260	1.00E-03	0.070	0.092	0.254	GAMMA	95% Adjusted Gamma UCL	0.494
Cesium-137	pCi/g	37	37	100%	1.50	-0.027	0.253	0.353	0.960	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.506
Chloride	mg/kg	1	1	100%	10.0	10.0	10.0			0	Too Few Observations To Calculate UCLs	N/A
Chromium	mg/kg	55	47	85%	30.4	1.50	8.78	7.87	24.5	GAMMA	95% Approximate Gamma UCL	10.9
Cobalt	mg/kg	54	43	80%	15.3	1.80	5.42	3.58	12.6	NORMAL	95% Student's-t UCL	6.24
Copper	mg/kg	55	44	80%	36.7	2.20	10.8	8.43	27.6	GAMMA	95% Approximate Gamma UCL	13.0
Cyanide	mg/kg	1					0.105			0	Too Few Observations To Calculate UCLs	N/A
Gross Alpha	pCi/g	45	45	100%	72.0	3.79	24.9	19.2	63.2	GAMMA	95% Approximate Gamma UCL	30.3
Gross Beta	pCi/g	46	46	100%	59.0	14.7	36.2	9.98	56.2	NORMAL	95% Student's-t UCL	38.7
Iron	mg/kg	55	55	100%	31,400	1,040	9,740	6,739	23,217	GAMMA	95% Approximate Gamma UCL	11,404
Lead	mg/kg	55	55	100%	68.8	2.60	13.3	12.4	38.1	LOGNORMAL	95% H-UCL	17.1
Lithium	mg/kg	52	41	79%	20.3	1.50	7.84	6.31	20.5	GAMMA	95% Approximate Gamma UCL	9.36
Magnesium	mg/kg	55	52	95%	5,850	197	1,553	1,259	4,071	GAMMA	95% Approximate Gamma UCL	1,868
Manganese	mg/kg	55	55	100%	1,280	9.00	238	216	669	GAMMA	95% Approximate Gamma UCL	286
Mercury	mg/kg	46	2	4%	0.050	0.034	0.077	0.061	0.200	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.117
Molybdenum	mg/kg	52	15	29%	14.0	0.790	4.37	6.21	16.8	NON-PARAMETRIC	97.5% Chebyshev (Mean, Sd) UCL	9.75
Nickel	mg/kg	53	38	72%	25.6	1.20	6.93	5.32	17.6	GAMMA	95% Approximate Gamma UCL	8.34
Nitrate	mg/kg	49	29	59%	76.0	0.300	7.23	15.6	38.4	LOGNORMAL	95% Chebyshev (MVUE) UCL	14.1
Nitrite	mg/kg	9	1	11%	0.300	0.300	0.211	0.096	0.403	NORMAL	95% Student's-t UCL	0.271
Plutonium-238	pCi/g	3	3	100%	0.00E+00	-1.03E-04	-3.43E-05	5.95E-05	8.46E-05	0	Too Few Observations To Calculate UCLs	N/A
Plutonium-239/240	pCi/g	46	46	100%	0.072	-0.010	0.016	0.017	0.051	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.027
Potassium	mg/kg	54	43	80%	3,770	215	941	791	2,522	GAMMA	95% Approximate Gamma UCL	1,135
Radium-226	pCi/g	19	19	100%	1.80	0.390	0.881	0.421	1.72	NORMAL	95% Student's-t UCL	1.05
Radium-228	pCi/g	20	20	100%	4.10	0.520	1.86	0.971	3.80	NORMAL	95% Student's-t UCL	2.23
Selenium	mg/kg	54	15	28%	3.20	0.100	0.458	0.634	1.73	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.834
Silica	mg/kg	19	19	100%	1,180	96.8	341	308	957	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	649
Silver	mg/kg	48	3	6%	3.40	1.40	0.737	0.654	2.04	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	1.15
Sodium	mg/kg	55	47	85%	559	36.6	175	135	445	GAMMA	95% Approximate Gamma UCL	205
Strontium	mg/kg	55	48	87%	421	3.00	32.1	59.6	151	LOGNORMAL	95% H-UCL	39.0
Strontium-89/90	pCi/g	39	39	100%	0.793	-0.200	0.194	0.191	0.576	NORMAL	95% Student's-t UCL	0.245
Sulfate	mg/kg	1	1	100%	60.0	60.0	60.0			0	Too Few Observations To Calculate UCLs	N/A
Thallium	mg/kg	47	3	6%	0.740	0.340	0.314	0.254	0.821	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.475
Tin	mg/kg	50	14	28%	27.1	3.60	11.8	29.5	70.9	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	30.0
Uranium-233/234	pCi/g	47	47	100%	4.78	0.136	1.70	1.11	3.92	GAMMA	95% Approximate Gamma UCL	2.03
Uranium-235	pCi/g	46	46	100%	0.191	0.00E+00	0.059	0.047	0.152	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.089
Uranium-238	pCi/g	47	47	100%	3.82	0.127	1.51	0.937	3.38	GAMMA	95% Approximate Gamma UCL	1.79
Vanadium	mg/kg	54	51	94%	73.0	3.40	20.7	15.3	51.3	GAMMA	95% Approximate Gamma UCL	24.7
Zinc	mg/kg	55	54	98%	720	6.50	72.2	129	330	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	148

Table A5.6

Sitewide Surface Water Background Data Summary (Total Concentrations)

Analyte	Unit	No. of Samples	No. of Detects	%D	Maximum Concentration Detected	Minimum Concentration Detected	Mean Concentration	StDev	Mean+2St Dev	Distribution Recommended by ProUCL	UCL Recommended by ProUCL	UCL Value
Aluminum	mg/L	166	136	82%	129	0.026	3.39	12.5	28.4	NON-PARAMETRIC	97.5% Chebyshev (Mean, Sd) UCL	9.46
Americium-241	pCi/L	101	101	100%	0.060	-0.010	0.005	0.009	0.023	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.009
Ammonia	mg/L	1					0.050			0	Too Few Observations To Calculate UCLs	N/A
Antimony	mg/L	169	17	10%	0.055	4.10E-04	0.015	0.028	0.071	NON-PARAMETRIC	97.5% Chebyshev (Mean, Sd) UCL	0.029
Arsenic	mg/L	161	37	23%	0.017	1.00E-03	0.002	0.005	0.012	NON-PARAMETRIC	97.5% Chebyshev (Mean, Sd) UCL	0.005
Barium	mg/L	172	134	78%	0.630	0.009	0.079	0.079	0.236	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.105
Beryllium	mg/L	167	21	13%	0.004	4.00E-05	8.01E-04	8.44E-04	0.002	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.001
Cadmium	mg/L	165	8	5%	0.004	7.00E-05	0.001	8.84E-04	0.003	NON-PARAMETRIC	97.5% Chebyshev (Mean, Sd) UCL	0.002
Calcium	mg/L	172	172	100%	147	0.012	21.7	12.1	45.9	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	25.7
Cesium	mg/L	137	9	7%	0.400	0.006	0.276	0.241	0.758	NON-PARAMETRIC	97.5% Chebyshev (Mean, Sd) UCL	0.404
Cesium-137	pCi/L	79	79	100%	1.70	-0.558	0.161	0.359	0.880	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.337
Chloride	mg/L	165	157	95%	88.2	1.20	15.9	14.5	44.9	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	20.8
Chromium	mg/L	167	49	29%	0.247	5.10E-04	0.008	0.024	0.056	NON-PARAMETRIC	97.5% Chebyshev (Mean, Sd) UCL	0.020
Chromium VI	mg/L	3					3.50	2.60	8.70	0	Too Few Observations To Calculate UCLs	N/A
Cobalt	mg/L	171	29	17%	0.019	2.90E-04	0.005	0.008	0.021	NON-PARAMETRIC	97.5% Chebyshev (Mean, Sd) UCL	0.009
Copper	mg/L	164	76	46%	0.048	0.002	0.007	0.008	0.022	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.010
Cyanide	mg/L	128	7	5%	0.040	0.002	0.048	0.443	0.935	NON-PARAMETRIC	97.5% Chebyshev (Mean, Sd) UCL	0.293
Fluoride	mg/L	118	112	95%	1.00	0.100	0.335	0.125	0.586	NON-PARAMETRIC	95% Student's-t UCL	0.354
Gross Alpha	pCi/L	87	87	100%	45.0	-2.00	2.87	7.71	18.3	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	6.47
Gross Beta	pCi/L	87	87	100%	35.0	-0.500	4.32	5.34	15.0	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	6.81
Iron	mg/L	172	166	97%	88.6	0.032	3.04	10.2	23.5	NON-PARAMETRIC	97.5% Chebyshev (Mean, Sd) UCL	7.90
Lead	mg/L	166	75	45%	0.051	1.20E-04	0.003	0.007	0.018	NON-PARAMETRIC	97.5% Chebyshev (Mean, Sd) UCL	0.007
Lithium	mg/L	166	82	49%	0.154	0.001	0.015	0.022	0.059	NON-PARAMETRIC	97.5% Chebyshev (Mean, Sd) UCL	0.026
Magnesium	mg/L	172	148	86%	32.7	1.25	5.05	2.94	10.9	NON-PARAMETRIC	95% Student's-t UCL	5.42
Manganese	mg/L	171	156	91%	4.06	0.002	0.090	0.334	0.758	LOGNORMAL	95% H-UCL	0.104
Mercury	mg/L	162	18	11%	6.30E-04	3.50E-05	1.13E-04	7.89E-05	2.71E-04	NON-PARAMETRIC	95% Student's-t UCL	1.23E-04
Molybdenum	mg/L	167	36	22%	0.020	9.50E-04	0.017	0.032	0.081	NON-PARAMETRIC	97.5% Chebyshev (Mean, Sd) UCL	0.032
Nickel	mg/L	167	44	26%	0.120	0.002	0.009	0.013	0.036	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.014
Nitrate	mg/L	129	79	61%	8.37	0.030	0.644	1.42	3.48	NON-PARAMETRIC	97.5% Chebyshev (Mean, Sd) UCL	1.43
Nitrite	mg/L	77	2	3%	0.058	0.020	0.016	0.010	0.036	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.021
Ortho-phosphate	mg/L	42	3	7%	0.580	0.052	0.040	0.086	0.213	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.098
Phosphate	mg/L	80	42	53%	0.420	0.010	0.052	0.072	0.197	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.087
Plutonium-238	pCi/L	4	4	100%	0.013	-6.07E-04	0.003	0.007	0.017	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.018
Plutonium-239/240	pCi/L	107	107	100%	0.047	-0.020	0.003	0.008	0.019	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.007
Potassium	mg/L	167	123	74%	15.4	0.370	2.11	1.68	5.48	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	2.68
Radium-226	pCi/L	5	5	100%	4.90	-0.100	1.76	2.06	5.88	NORMAL	95% Student's-t UCL	3.72
Selenium	mg/L	162	23	14%	0.019	6.50E-04	0.002	0.003	0.007	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.003
Silica	mg/L	90	88	98%	6,500	1.09	80.9	685	1,450	NON-PARAMETRIC	97.5% Chebyshev (Mean, Sd) UCL	532
Silicon	mg/L	1	1	100%	4.34	4.34	4.34			0	Too Few Observations To Calculate UCLs	N/A
Silver	mg/L	170	11	6%	0.007	6.00E-05	0.002	0.002	0.006	NON-PARAMETRIC	97.5% Chebyshev (Mean, Sd) UCL	0.003
Sodium	mg/L	172	171	99%	66.3	1.92	16.5	8.31	33.2	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	19.3
Strontium	mg/L	168	135	80%	0.955	0.028	0.199	0.159	0.517	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.252
Strontium-89/90	pCi/L	53	53	100%	3.20	-0.200	0.611	0.577	1.77	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.957
Strontium-90	pCi/L	18	18	100%	1.20	0.022	0.537	0.350	1.24	NORMAL	95% Student's-t UCL	0.680
Sulfate	mg/L	165	159	96%	66.0	4.00	21.4	10.7	42.7	GAMMA	95% Approximate Gamma UCL	23.0
Sulfide	mg/L	67	6	9%	4.00	1.00	0.828	1.01	2.84	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	1.36
Thallium	mg/L	166	10	6%	0.007	2.40E-04	0.003	0.012	0.027	NON-PARAMETRIC	97.5% Chebyshev (Mean, Sd) UCL	0.009
Tin	mg/L	161	19	12%	0.180	9.90E-04	0.027	0.058	0.143	NON-PARAMETRIC	97.5% Chebyshev (Mean, Sd) UCL	0.055
Tritium	pCi/L	96	96	100%	751	-800	85.1	177	439	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	164
Uranium	mg/L	9	2	22%	0.004	0.003	0.003	0.004	0.012	GAMMA	95% Approximate Gamma UCL	0.006
Uranium-233/234	pCi/L	77	77	100%	5.10	-0.056	0.479	0.747	1.97	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.850
Uranium-235	pCi/L	74	74	100%	0.290	-0.021	0.047	0.066	0.178	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.080
Uranium-238	pCi/L	77	77	100%	4.90	-0.013	0.397	0.721	1.84	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.756
Vanadium	mg/L	171	58	34%	0.132	0.002	0.011	0.019	0.049	NON-PARAMETRIC	97.5% Chebyshev (Mean, Sd) UCL	0.020
Zinc	mg/L	170	125	74%	3.11	0.002	0.055	0.245	0.544	LOGNORMAL	95% H-UCL	0.051

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Table A5.7
Sitewide Surface Water Background Data Summary (Dissolved Concentrations)

Analyte	Unit	No. of Samples	No. of Detects	%D	Maximum Concentration Detected	Minimum Concentration Detected	Mean Concentration	StDev	Mean+2St Dev	Distribution Recommended by ProUCL	UCL Recommended by ProUCL	UCL Value
Aluminum	mg/L	138	64	46%	1.05	0.013	0.101	0.164	0.430	NON-PARAMETRIC	97.5% Chebyshev (Mean, Sd) UCL	0.189
Americium-241	pCi/L	22	22	100%	0.500	-0.010	0.086	0.140	0.366	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.216
Antimony	mg/L	137	21	15%	0.037	0.005	0.023	0.041	0.104	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.038
Arsenic	mg/L	129	7	5%	0.005	1.00E-03	0.002	0.005	0.012	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.004
Barium	mg/L	140	95	68%	0.586	8.50E-04	0.058	0.059	0.177	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.080
Beryllium	mg/L	134	4	3%	0.059	7.00E-04	0.001	0.005	0.012	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.003
Cadmium	mg/L	136	10	7%	0.017	1.00E-03	0.002	0.001	0.005	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.002
Calcium	mg/L	141	141	100%	143	2.90	20.6	12.3	45.3	NON-PARAMETRIC	95% Student's-t UCL	22.4
Cesium	mg/L	137	18	13%	0.340	7.06E-04	0.276	0.239	0.754	NON-PARAMETRIC	97.5% Chebyshev (Mean, Sd) UCL	0.404
Cesium-137	pCi/L	31	31	100%	0.850	-0.437	0.257	0.393	1.04	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.564
Chloride	mg/L	1	1	100%	33.0	33.0	33.0			0	Too Few Observations To Calculate UCLs	N/A
Chromium	mg/L	136	7	5%	0.015	0.002	0.003	0.002	0.008	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.004
Cobalt	mg/L	139	5	4%	0.005	2.80E-04	0.006	0.009	0.024	NON-PARAMETRIC	97.5% Chebyshev (Mean, Sd) UCL	0.011
Copper	mg/L	138	46	33%	0.026	0.001	0.006	0.005	0.017	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.008
Fluoride	mg/L	1	1	100%	0.200	0.200	0.200			0	Too Few Observations To Calculate UCLs	N/A
Gross Alpha	pCi/L	44	44	100%	69.2	-1.38	2.49	10.4	23.2	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	9.29
Gross Beta	pCi/L	49	49	100%	18.5	0.00E+00	3.86	3.16	10.2	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	5.82
Iron	mg/L	137	109	80%	72.8	0.010	0.724	6.21	13.1	LOGNORMAL	95% H-UCL	0.327
Lead	mg/L	133	32	24%	0.013	1.20E-04	0.002	0.003	0.008	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.003
Lithium	mg/L	134	46	34%	0.035	0.001	0.015	0.021	0.056	NON-PARAMETRIC	97.5% Chebyshev (Mean, Sd) UCL	0.026
Magnesium	mg/L	141	116	82%	32.4	1.10	4.60	2.86	10.3	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	5.65
Manganese	mg/L	139	112	81%	1.45	1.00E-03	0.052	0.163	0.378	LOGNORMAL	95% H-UCL	0.064
Mercury	mg/L	135	10	7%	0.005	2.20E-04	1.48E-04	4.06E-04	9.59E-04	NON-PARAMETRIC	95% Student's-t UCL	2.06E-04
Molybdenum	mg/L	139	20	14%	0.680	0.002	0.030	0.077	0.184	NON-PARAMETRIC	97.5% Chebyshev (Mean, Sd) UCL	0.071
Neptunium-237	pCi/L	17	17	100%	1.00	-0.150	0.731	0.359	1.45	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	1.11
Nickel	mg/L	134	9	7%	0.082	0.001	0.009	0.010	0.028	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.012
Plutonium-239/240	pCi/L	23	23	100%	76.0	0.00E+00	3.46	15.8	35.1	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	17.8
Potassium	mg/L	134	89	66%	6.80	0.390	1.76	0.979	3.72	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	2.13
Radium-226	pCi/L	6	6	100%	0.342	-0.050	0.164	0.148	0.460	NORMAL	95% Student's-t UCL	0.285
Radium-228	pCi/L	4	4	100%	1.40	0.700	0.925	0.330	1.59	NORMAL	95% Student's-t UCL	1.31
Selenium	mg/L	133	10	8%	0.009	9.00E-04	0.002	0.002	0.006	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.002
Silica	mg/L	36	36	100%	13.4	0.613	4.89	2.78	10.4	NORMAL	95% Student's-t UCL	5.67
Silicon	mg/L	38	38	100%	10.3	1.58	5.16	2.47	10.1	GAMMA	95% Approximate Gamma UCL	5.90
Silver	mg/L	141	8	6%	0.022	0.002	0.003	0.003	0.009	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.004
Sodium	mg/L	141	140	99%	66.4	4.00	17.4	8.61	34.6	NON-PARAMETRIC	95% Student's-t UCL	18.6
Strontium	mg/L	139	105	76%	0.944	0.040	0.202	0.173	0.547	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.265
Strontium-89	pCi/L	20	20	100%	1.00	-0.200	0.617	0.434	1.48	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	1.04
Strontium-89/90	pCi/L	28	28	100%	2.59	-0.200	0.692	0.673	2.04	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	1.25
Strontium-90	pCi/L	20	20	100%	3.00	-0.034	0.575	0.637	1.85	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	1.20
Sulfate	mg/L	1	1	100%	10.0	10.0	10.0			0	Too Few Observations To Calculate UCLs	N/A
Sulfide	mg/L	1					0.500			0	Too Few Observations To Calculate UCLs	N/A
Thallium	mg/L	134	4	3%	0.006	4.30E-04	0.003	0.014	0.031	NON-PARAMETRIC	97.5% Chebyshev (Mean, Sd) UCL	0.011
Tin	mg/L	133	10	8%	0.030	0.011	0.030	0.062	0.153	NON-PARAMETRIC	97.5% Chebyshev (Mean, Sd) UCL	0.063
Uranium-233/234	pCi/L	27	27	100%	31.8	-0.016	1.44	6.06	13.6	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	6.52
Uranium-234	pCi/L	9	9	100%	5.00	0.190	1.25	1.75	4.75	LOGNORMAL	95% Chebyshev (MVUE) UCL	3.04
Uranium-235	pCi/L	35	35	100%	5.00	-0.018	0.244	0.856	1.96	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.874
Uranium-238	pCi/L	36	36	100%	24.5	-0.061	1.03	4.10	9.22	NON-PARAMETRIC	95% Chebyshev (Mean, Sd) UCL	4.00
Vanadium	mg/L	139	13	9%	1.20	4.08E-04	0.018	0.108	0.234	NON-PARAMETRIC	97.5% Chebyshev (Mean, Sd) UCL	0.075
Zinc	mg/L	138	78	57%	2.30	0.002	0.033	0.197	0.428	NON-PARAMETRIC	97.5% Chebyshev (Mean, Sd) UCL	0.138

COMPREHENSIVE RISK ASSESSMENT

COMPREHENSIVE RISK ASSESSMENT METHODOLOGY AND DATA DESCRIPTION

VOLUME 2: ATTACHMENT 6

Tier 2 Exposure Point Concentration Calculation Methodology

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ACRONYMS AND ABBREVIATIONS

CRA	Comprehensive Risk Assessment
EPC	exposure point concentration
IHSS	Individual Hazardous Substance Site
UCL	upper confidence limit
UTL	upper tolerance limit

1.0 INTRODUCTION

In accordance with the Final CRA Work Plan and Methodology, Revision 1 (DOE 2005), a two-tiered approach is used to calculate surface soil/surface sediment and surface soil exposure point concentrations (EPCs) for the human health and ecological risk assessments for each exposure unit (EU) to reduce the uncertainty associated with non-random sampling data that may be biased toward historical potential source areas (i.e., Individual Hazardous Substance Sites [IHSSs]). The upper confidence limits (UCLs) recommended by ProUCL (Singh et. al.2004) are used for the Tier 1 EPCs, and an area-weighted method is used to calculate the Tier 2 EPCs to address potential bias.

For the Tier 1 EPCs, UCLs are estimated using ProUCL, which computes parametric UCLs based on normal, lognormal, or gamma distributions, and nonparametric UCLs using one of several nonparametric methods. ProUCL recommends the UCLs based on the data distribution and the associated skewness. The UCL chosen by ProUCL is used as the EPC unless the UCL exceeds the maximum detected concentration (MDC), in which case the MDC is used as the EPC. Because the EPC is a conservative estimate of the average (mean) concentration to which receptors would be exposed over time in an EU, if most samples are collected in areas of contamination, and these areas represent only a small portion of the EU, the UCL will overestimate the actual EPC.

In computing the Tier 2 EPC, a 30-acre grid was randomly placed over RFETS, and the data for sample locations within each 30-acre grid cell were used to compute average concentrations for each grid cell (Figure A6.1). The grid cell average concentrations were then used to calculate the best estimate of the area-weighted average concentration for the EU. The UCL_{95} (95% upper confidence limit on the mean) and the UTL_{95} (the UCL_{95} of the 90th percentile ($UCL_{95/90}$) otherwise referred to as the upper tolerance limit) of the area-weighted average concentration for the EU are used as the Tier 2 EPCs. A normal distribution is assumed in the calculation of the UCL_{95} and UTL_{95}.

2.0 TIER 2 UCL_{95} ON THE MEAN

The UCL_{95} on the mean is calculated by using the average values in each of the 30-acre grid cells that fall inside the EU. If any portion of the 30-acre grid falls within the EU boundary, then sample data in the 30-acre grid will be used, even if the sample locations are outside the EU. Data will be averaged to derive a single value for the 30-acre cell. Once each 30-acre grid cell has an average value, the 30-acre grid cells will be multiplied by the percentage of the area that each grid cell contributes to the total EU. These values will then be summed to determine the EU average. Then, the weighted standard deviation will be calculated. Finally, a UCL_{95} will be calculated using the mean, standard deviation, and appropriate Student's t value from statistical tables.

Procedure

<u>Compute the Tier 2 Mean Concentration</u>

1) Identify all 30-acre grid cells that have any portion of their areas inside the EU.
2) Extract data for all samples that fall in the 30-acre grids cells.

3) Calculate an arithmetic average of the sample concentrations within the 30-acre grid cell.
4) If only one sample is available, use the concentration of that sample as the average for the grid cell. This applies to any grid cell, whole or partial.
5) If no sample occurs in a grid cell, then that cell is not used in the calculation and its area is taken out of the total area of the EU for the area weighting of average concentration.
6) Multiply the percentage each sampled grid cell (whole or partial) contributes to the total EU area (EU fraction) by the average value for the EU.
7) Sum the results of these products to obtain the mean concentration for the EU.

Compute the Tier 2 Standard Deviation

8) Subtract each 30-acre grid cell average from the EU mean concentration and square the resultant value.
9) Multiply this resultant value by the EU fraction.
10) Sum the results of these products.
11) Divide by the number of 30-acre grid cells in the EU. Use this number as the variance of the 30-acre grid cells.
12) Calculate the standard deviation of the 30-acre grid cells by taking the square root of the variance.

Compute the Tier 2 UCL_{95}

13) Determine the appropriate Student's *t* value based on the number of 30-acre grid cells.
14) Calculate the UCL_{95} by using the following formula.

$$UCL_{95} = \bar{x} + \frac{\sigma t_{\alpha}}{\sqrt{n}}$$

where

$\bar{x}$ = the mean concentration for the EU
σ = the standard deviation for the EU
t_{α} = the Student's t value at a 95% level of confidence
n = number of 30-acre grid cells in the EU

3.0 TIER 2 UTL_{95}

The UTL_{95} calculation will follow the same steps as the calculation of the UCL_{95}, up to the point where the Student's *t* value is determined.

Instead of identifying the Student's *t* value, identify the k value for a one-sided UTL from a tabulation of k values for a given sample number, percentile, and level of confidence.

Procedure

1) Determine the appropriate UTL_{95} *k* value for 95 percent confidence on the 90 percentile of the distribution from a statistical table for the *n* samples.
2) Calculate the UTL_{95} by using the following formula.

$$UTL_{95} = \bar{x} + \sigma k_n$$

where

$\bar{x}$ = the mean concentration for the EU
σ = the standard deviation for the EU
k_α = the *k* value at a 95% level of confidence on the 90th percentile
n = number of samples

4.0 REFERENCES

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Singh, A., A.K. Singh, and R.W. Maichle, 2004, ProUCL Version 3.0 Users Guide, Las Vegas, Nevada, April.

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COMPREHENSIVE RISK ASSESSMENT

COMPREHENSIVE RISK ASSESSMENT METHODOLOGY AND DATA DESCRIPTION

VOLUME 2: ATTACHMENT 7

Uncertainties Associated with the Ecological Risk Assessment Applicable to All Exposure Units

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ACRONYMS AND ABBREVIATIONS

BAF	bioaccumulation factor
CRA	Comprehensive Risk Assessment
DOE	U.S. Department of Energy
DQA	Data Quality Assessment
DQO	data quality objective
ECOI	ecological contaminant of interest
ECOPC	ecological contaminant of potential concern
EPC	exposure point concentration
ERA	Ecological Risk Assessment
ESL	ecological screening level
EU	Exposure Unit
HQ	hazard quotient
IHSS	Individual Hazardous Substance Site
LOAEL	lowest observed adverse effect level
MDC	maximum detected concentration
NOAEL	no observed adverse effect level
RFETS	Rocky Flats Environmental Technology Site
SAP	Sampling and Analysis Plan
UCL	upper confidence limit
WRV	wildlife refuge visitor
WRW	wildlife refuge worker

1.0 GENERAL UNCERTAINTY ANALYSIS

Quantitative evaluation of ecological risks is limited by uncertainties regarding the assumptions used to predict risk and the data available for quantifying risk. The following sections summarize the various sources of uncertainty in the ecological risk assessment (ERA), along with a qualitative estimate of the direction and magnitude of the likely errors attributable to the uncertainty.

1.1 Uncertainties Associated With Data Quality and Adequacy

There are approximately 2 million data records for use in the CRA. The data used in the CRA are the result of implementation of regulatory agency-approved Sampling and Analysis Plans (SAPs) that were prepared to characterize background and site conditions for soil, sediment, groundwater, and surface water. Consistent with the Final CRA Work Plan and Methodology, Revision 1 (DOE 2005), hereafter referred to as the CRA Methodology, data quality was assessed using a standard precision, accuracy, representativeness, completeness, and comparability (PARCC) parameter analysis. The Data Quality Assessment (DQA) presented in Attachment 2 of this CRA volume is based on evaluation of field and laboratory control samples, and was performed on a site-wide basis. DQAs were also performed on an Exposure Unit (EU) and Aquatic Exposure Unit (AEU) basis, and are presented in each of the EU and AEU risk assessments. The DQA indicates data used in the CRA meet the data quality objectives for the CRA.

Sufficient samples must also be collected in each medium to adequately estimate the long-term average exposure of receptors to contaminants in an EU. The CRA Methodology requires that all decision criteria, sampling decisions, and supporting data be included in a data adequacy report (DAR) for the CRA. The DAR is provided in Attachment 3 of this CRA volume. Through the consultative process with EPA and CDPHE, specific data adequacy guidelines were identified for use in the DAR. The guidelines address the number of samples, and the spatial and temporal representativeness of the data. The adequacy of the data was assessed on an EU and AEU basis. The DAR concludes that the data are considered adequate for the purposes of the CRA.

1.2 Uncertainties Associated with the Ecological Contaminants of Potential Concern Identification Process

The ecological contaminant of potential concern (ECOPC) identification process was designed to eliminate chemicals that are not likely to be of ecological concern within each EU. This process includes a comparison of maximum detected concentrations (MDCs) to No Observed Adverse Effect Level (NOAEL)-based Ecological Screening Levels (ESLs); a frequency of detection evaluation; a comparison to background; a comparison of upper-bound exposure point concentrations (EPCs) to threshold ESLs (tESLs); and a weight-of-evidence professional judgment evaluation. Use of the ECOPC identification process ensures that ecological contaminants of interest (ECOIs) related to historic site operations and those of toxicological significance, with the potential to be

transported from historical sources to the individual EUs, are retained for additional quantitative evaluation. For many EUs, ECOPCs were retained even if a specific source within the EU was not identified but exceedances were located near historical Individual Hazardous Substance Sites (IHSSs). Therefore, potential risks for site-related chemicals may be overestimated to a limited degree.

1.3 Uncertainties Associated with the Selection of Representative Receptors

ESLs were developed for several receptors that represent the various groups of species or feeding guilds potentially inhabiting the Rocky Flats Environmental Technology Site (RFETS). There are uncertainties associated with the selection of the representative receptors from the group of species identified at RFETS based on field observations. The receptors were selected based on several criteria, including their potential to be found in the various habitats present within each EU, their potential to come into contact with ECOIs, and the amount of life history and behavioral information available. The use of these criteria decreases the uncertainty associated with receptor selection; however, the direction and magnitude of the effects of this uncertainty are unknown.

1.4 Uncertainties Associated with Exposure Calculations

Exposure was also quantified using life history and behavioral parameters for each receptor. These parameters were used to estimate the amount of contact a receptor may have with contaminated media by various exposure routes. The following parameters were used in the exposure models in the CRA and in the ESL calculation procedures presented in the CRA Methodology:

- Ingestion rates of food, soil, and surface water;
- Body weight;
- Dietary proportions of each prey type; and
- Feeding habits.

Most of the exposure parameters used in this ERA are based on published values presented in the Wildlife Exposure Factors Handbook (handbook) (EPA 1993) or other literature sources. However, some of the exposure factors used in the ERA are based on mathematical models, allometric equations, and professional judgment assumptions.

The use of exposure parameters derived from studies conducted in habitats and climates different from that of the RFETS adds uncertainty to the CRA because they may not reflect actual site-related conditions. For example, ingestion rates cited in the handbook typically are based on eating habits of laboratory animals with access to an abundant food supply. In a wild setting such as that present at the site, it is unlikely that the same animals would have access to such an abundant food supply, resulting in a lower actual ingestion rate than cited in the handbook. In this case, use of the published values would tend to bias the CRA toward an overestimation of risk, although underestimation is also possible. The magnitude of overestimation or underestimation of risk is unknown.

While the models used in the analysis of exposure and derivation of ESLs are scientifically defensible and based on recognized ERA techniques, they are still essentially simplistic approximations of complex natural systems. As a result, there is uncertainty inherent in the use of models to describe the interactions that occur in a natural system. Additional uncertainty is introduced into the modeling procedure because no species-specific studies were conducted to determine site-specific values for each exposure parameter for each receptor. Instead, literature values were used to estimate each parameter, and each receptor was assumed to spend 100 percent of its life cycle within the EU being evaluated. Therefore, there is uncertainty involved with estimating exposure to ECOPCs by using modeling techniques that could overestimate or underestimate the actual risk to the receptors to an unknown degree. One exception is in the sitewide risk assessment (CRA Volume 15A) which evaluates sitewide exposure and risks to wide-ranging receptors. Risks to these receptors due to the assumption that the wide-ranging receptors spend 100 of their time within RFETS boundaries are not likely to cause overestimation of risks.

Uncertainties associated with exposure modeling are introduced into the CRA in several other locations. First, the pathways selected for use in the exposure models included only the ingestion of ECOPCs in food items, incidentally ingested soils, and drinking water. These three exposure pathways make up the majority of the potential exposure to wildlife receptors; however, exposure also likely occurs to lesser degrees through inhalation of ECOPCs either in vapor form or adhered to particulate matter. Exposure can also occur through dermal absorption. These latter two pathways may be significant for some ECOPCs, but scientific data suitable for the quantification of these pathways are lacking. The overall effect of not quantitatively evaluating exposure due to inhalation and dermal absorption is unknown but likely underestimates risk to a low degree, but should be taken into consideration when reviewing the uncertainties related to exposure assessment.

Second, as discussed for each ECOPC, ESLs and exposure calculations rely heavily on literature-derived bioaccumulation factors and models as opposed to directly measured food item tissue concentrations. The factors and models used in the CRA are generally conservative and likely overestimate tissue concentrations to an unknown degree but underestimation is possible. There is also considerable uncertainty inherent in the use of data not directly related to the conditions at the RFETS. For ECOIs with no bioaccumulation factor (BAF) or BAF models available, BAFs were set at a default value of 1. This may be a source of overestimation of risk since the ECOIs using a default BAF of 1 are not known to be bioaccumulative in nature.

Finally, the relative bioavailability of ECOPCs contacted through ingested soils or food items can create uncertainty in the risk characterization process. Such uncertainty can affect the EPCs used to estimate bioavailable forms (for example, dissolved metals in solution) as well as the toxicity endpoints used to derive toxicity reference values (TRVs). TRVs, for example, are generally based on observed dose-response relationships when the chemical is dissolved in water or some other readily soluble form. Thus, where ECOIs are not readily dissolved in the gastrointestinal tract of a receptor, potential risks to organisms associated with intake of the ECOI will be overestimated.

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Bioavailability and ecotoxicity of environmental contaminants are integrally linked to their environmental concentrations and chemical forms (EPA 1999). The toxicity of a contaminant is controlled by:

- Its environmental concentration;
- Its site-specific chemistry (especially its ionic solubility and speciation if a metal or metalloid);
- The physical matrix in which the contaminant is found; and
- The uptake pathway(s) into a target organism from its physical matrix.

All of these factors help to determine the exposure matrix for organisms in the field. Because the interplay of these factors determines the site-specific bioavailability and, thus, the potential expression of ecologically relevant effects, predictions of toxicity based solely on total concentrations in various environmental media have questionable scientific validity (EPA 1999). Therefore, assessment of ecological risks and the potential adverse effects of a contaminant require an understanding of the exposure matrix that may lead to actual uptake by a receptor species. For inorganic ECOIs, the assumption of complete bioavailability in the soil ingestion pathways likely overestimates risk to a moderate degree. For inorganic ECOIs ingested through the food ingestion pathway and organic ECOIs ingested through the food or soil pathways, there is may be some overestimation of risk but to a lower degree than inorganics in the soil ingestion pathway. The overall effect of the uncertainties related to unknown bioavailabilities may overestimate or underestimate the calculated risks. However, because bioavailability was assumed to be equal to 100 percent for each exposure pathway in this assessment, the underestimation of risks due to the estimation of bioavailability is limited.

1.5 Uncertainties Associated with Development of No Observed Adverse Effect Level Ecological Screening Levels

Uncertainties related to each ECOPC are discussed in the previous sections. General uncertainties related to ESLs are discussed in this section. ESLs are typically based on information gained from laboratory and other carefully controlled experimental exposures described in the literature. This information is then used to extrapolate conditions likely to exist in the natural environment. The laboratory information often does not provide adequate background for these extrapolations. Consequently, assessment factors are often used to compensate for the many uncertainties inherent in the extrapolation from laboratory effects data to effects in natural ecosystems (Warren-Hicks et al. 1998). Uncertainties can arise (Calabrese and Baldwin 1993) when extrapolations are made from:

- Acute to chronic endpoints;
- One life stage to an entire life cycle;
- Individual effects to effects at the population level or higher;
- One species to many species;
- Laboratory to field conditions;

- One to all exposure routes;
- Direct to indirect effects;
- One ecosystem to all ecosystems; and/or
- One location or time to others.

The net effect of these uncertainties may result in either an overestimate or underestimate of risk to an unknown degree depending on RFETS-specific conditions, types of receptors included in the evaluation, and the particular ECOIs.

The CRA Methodology presents a strict set of rules for applying toxicity data to develop ESLs for the ECOIs and to minimize uncertainty related to the extrapolations listed above. In all cases, the minimum Lowest Observed Adverse Effect Level (LOAEL) value that met data quality criteria was selected. While no procedures for the identification of toxicity data and eventual development of ESLs can eliminate the uncertainty inherent in the overall development process for ESLs a consistently conservative bias brought about by selecting the lowest applicable LOAEL helps to ensure that risks are not underestimated.

1.6 Uncertainties Associated with the Lack of Toxicity Data for Ecological Contaminant of Interest

Several ECOIs detected in each EU do not have adequate toxicity data for the derivation of ESLs (CRA Methodology). These ECOIs are identified in Volumes 3 through 15 with a "UT" designation ("unknown toxicity"). Appendix B of the CRA Methodology outlined a detailed search process for toxicological information for the ECOIs that was intended to provide high-quality data for a large proportion of the chemicals detected at RFETS. While the toxicity of those ECOIs that do not have ESLs calculated due to a lack of identified toxicity data is uncertain, the overall effect on the risk assessment is small because the primary chemicals historically used at RFETS have adequate toxicity data for use in the CRA. Therefore, while the potential for risk from these ECOPCs is uncertain and will tend to underestimate the overall risk calculated, the magnitude of underestimation is likely to be low. Uncertainties related to ECOIs with uncertain toxicity specific to each EU are discussed in the ERA for that EU.

1.7 Uncertainties Associated With Eliminating Ecological Contaminants of Interest Based on Professional Judgment

In many EUs, analytes in surface soil and subsurface soil were eliminated as ECOIs based on professional judgment. The professional judgment evaluation is intended to identify those ECOIs that have a limited potential for contamination in the EU. The weight-of-evidence approach attempts to identify potential sources of contamination or patterns of release within or adjacent to the EUs. Since natural variation of inorganic ECOIs may be significant, the professional judgment assessment attempts to identify those ECOIs that are unrelated to RFETS activities and remove them from further analysis in the CRA. The professional judgment evaluation has little effect on the overall risk calculations because the ECOIs eliminated from further consideration are not related

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to site-activities in the EU and have very low potential to be transported from historical sources to the EU. EU-specific discussions of this uncertainty are presented in Volumes 3 through 15 of the CRA.

2.0 SUMMARY OF SIGNIFICANT SOURCES OF UNCERTAINTY

The preceding discussion outlined the significant sources of uncertainty in the CRA process for assessing ecological risk. While some of the sources of uncertainty discussed tend to underestimate risk, several of the uncertainties are somewhat biased toward the overestimation of risk to a generally unknown degree. The uncertain and somewhat conservative nature of the risk estimations should be taken into consideration when reviewing the conclusions of the risk assessment during the risk management process.

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COMPREHENSIVE RISK ASSESSMENT

COMPREHENSIVE RISK ASSESSMENT METHODOLOGY AND DATA DESCRIPTION

VOLUME 2: ATTACHMENT 8

Sitewide Professional Judgment Evaluation for Metals

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ACRONYMS AND ABBREVIATIONS

AEU	Aquatic Exposure Unit
AL	action level
BZ	Buffer Zone
CAD/ROD	Corrective Action Decision/Record of Decision
CDPHE	Colorado Department of Public Health and Environment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CHWA	Colorado Hazardous Waste Act
COC	contaminant of concern
CRA	Comprehensive Risk Assessment
DAR	Data Adequacy Report
DOE	U.S. Department of Energy
DQO	data quality objectives
ECOI	ecological contaminant of interest
ECOPC	ecological contaminant of potential concern
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
ESL	ecological screening level
EU	Exposure Unit
FS	Feasibility Study
ft	foot
HEPA	high-efficiency particulate air
HRR	Historical Release Report
IA	Industrial Area

IAEU	Industrial Area Exposure Unit
IAG	Interagency Agreement
IDEU	Inter-Drainage Exposure Unit
IHSS	Individual Hazardous Substance Site
IMP	Integrated Monitoring Plan
LRA	Lead Regulatory Agency
LWNEU	Lower Walnut Drainage Exposure Unit
LWOEU	Lower Woman Drainage Exposure Unit
MDC	maximum detected concentration
NFA	No Further Action
NNEU	No Name Gulch Drainage Exposure Unit
NPL	National Priorities List
OU	Operable Unit
PAC	Potential Area of Concern
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCOC	potential contaminant of concern
PDSR	Pre-Demolition Survey Report
PMJM	Preble's meadow jumping mouse
PRG	preliminary remediation goal
QA	quality assurance
QAPjP	Quality Assurance Project Plan
QC	quality control
RCEU	Rock Creek Drainage Exposure Unit
RCRA	Resource Conservation and Recovery Act

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RFCA	Rocky Flats Cleanup Agreement
RFETS	Rocky Flats Environmental Technology Site
RFI	RCRA Facility Investigation
RI	Remedial Investigations
RLCR	Reconnaissance-Level Characterization Report
SAP	Sampling and Analysis Plan
SEEU	Southeast Buffer Zone Area Exposure Unit
SEP	Solar Evaporation Ponds
SVOC	semivolatile organic compound
SWEU	Southwest Buffer Zone Area Exposure Unit
SWMU	Solid Waste Management Unit
tESL	threshold ESL
UBC	Under Building Contamination
UCL	upper confidence limit
UTL	upper tolerance limit
UWOEU	Upper Woman Drainage Exposure Unit
UWNEU	Upper Walnut Drainage Exposure Unit
VOC	volatile organic compound
WAEU	West Area Exposure Unit
WBEU	Wind Blown Area Exposure Unit
WRW	wildlife refuge worker

1.0 INTRODUCTION

Unlike most organic contaminants, metal potential contaminants of concern (PCOCs) and ecological contaminants of interest (ECOIs) in soil are also naturally occurring. In all of the Exposure Units (EUs) at the Rocky Flats Environmental Technology Site (RFETS), numerous metals occur at concentrations statistically greater than site-specific background concentrations. However, when elevated metal concentrations are seen in areas away and upgradient from historical Individual Hazardous Substance Sites (IHSSs), these concentrations should be indicative of naturally occurring levels even though concentrations for the entire EU are statistically greater than site-specific background concentrations. Conversely, when elevated metal concentrations are seen within or near historical IHSSs, these concentrations may be reflective of contamination depending on the concentration of the metal and information regarding the potential historical release of the metal to the environment. Therefore, as part of the professional judgment step of the contaminant of concern (COC)/ecological contaminant of potential concern (ECOPC) selection process, metals have been evaluated on a sitewide basis in this attachment.

COCs/ECOPCs are identified for each medium in each EU. Selection of COCs/ECOPCs is a screening process that eliminates PCOCs/ECOIs that:

- Have maximum detected concentrations (MDCs) or exposure point concentrations (EPCs)[1] for the EU that do not exceed wildlife refuge worker (WRW) preliminary remediation goals (PRGs) or the limiting threshold ecological screening levels (tESLs);
- Are infrequently detected (less than 5 percent detection);
- Are at concentrations not significantly different from background levels; or
- Are not present in the environment as a result of historical site-related activities based on professional judgment.

Professional judgment is the final step used to identify COCs/ECOPCs. The professional judgment evaluation takes into account the following factors in a weight-of-evidence approach:

- Process Knowledge – An evaluation of historical RFETS-related operations that may have resulted in a release of the constituent.
- Spatial Trends – An evaluation of EU-specific and sitewide concentrations to discern the presence of concentration trends that may indicate the PCOC/ECOI is a result of historical site-related activities.
- Pattern Recognition – An evaluation of EU-specific data for the presence of two data populations (or distributions) using probability plots, which may be an indicator of a historical site-related release.

[1]As described in more detail in Volume 2, Section 2.0, EPCs are upper confidence limits on the mean (UCLs), upper tolerance limits (UTLs) (95 percent upper confidence limit on the mean of the 90th percentile), or MDCs if the UCL or UTL exceeds the MDC.

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- Comparison to Regional Background – Comparison of EU data to a regional background data set for Colorado and the bordering states.
- Risk Potential – Evaluation of the magnitude of PCOC/ECOI concentrations in relation to the PRGs/ESLs and background concentrations.

Process knowledge and spatial trends are discussed in Sections 2.0 and 3.0, respectively, as part of the professional judgment evaluation. Table A8.1 identifies the metals by medium in each EU that were carried forward into the professional judgment step of the COC/ECOPC screening process (based on the criteria noted above as presented in Attachment 3, Volumes 3 through 14 of the CRA). For each of the metals carried forward into professional judgment, Attachment 8 provides a discussion of process knowledge (Section 2.0) followed by a sitewide spatial trend evaluation (Section 3.0) for the relevant media. If the spatial trend evaluation suggests the metal concentrations in a specific medium reflect variations in the naturally occurring element, the metal is further evaluated by the other professional judgment lines of evidence in Attachment 3, Volumes 3 through 14 of the CRA. If the spatial trend evaluation indicates clustering of elevated metal concentrations near historical IHSSs, this line of evidence is considered significant enough for the metal to be considered a COC/ECOPC regardless of process knowledge or other lines of evidence, and is further evaluated in the risk characterization for the EU to be conservative.

For reference, sitewide summary statistics for metals in surface soil, surface soil within Preble's meadow jumping mouse (PMJM) habitat, surface soil/surface sediment, and subsurface soil are provided in Tables A8.3 through A8.6, respectively.

2.0 PROCESS KNOWLEDGE

This section presents the process knowledge line of evidence for those metals that were carried forward into the professional judgment step of the COC/ECOPC identification process in each of the EU risk assessments.

The process knowledge discussion makes reference to Table A8.2, which identifies historical metal inventories at RFETS. For Task 1 of the ChemRisk Dose Reconstruction Project, inventories of chemicals and radionuclides used at RFETS were identified (CDH 1991). ChemRisk conducted an independent, 2-year investigation of the off-site health risks associated with the operations of RFETS. Table A8.2 shows the inventories in 1974 (a production year) and 1988 (near the end of production) of Priority 1 metals (those that should be subjected to further evaluation to identify compounds of concern). Table A8.2 also shows whether the metal was only used as a laboratory standard and the number of buildings identifying the metal as a waste constituent. Shaded entries are metals that are unlikely to be contaminants at RFETS based on low metal inventories, use as a laboratory standard only, and/or limited identification as a constituent in wastes generated at RFETS. The table is based in part on a White Paper (DOE 2005) that identifies where metals were 1) used in buildings; 2) identified as constituents of wastes generated at buildings; 3) identified as constituents in Under Building Contamination (UBC) or in spills at buildings; and 4) identified as above a Rocky Flats Cleanup Agreement (RFCA) action level (AL) requiring an accelerated action.

2.1 Aluminum

As shown in Table A8.2, aluminum was used in relatively large quantities at RFETS and was identified as a constituent of waste generated in four buildings. Aluminum compounds were used in Buildings 444, 707, 771, 779, 865, and 883 (DOE 2005). However, because radiological operations were performed in these buildings, each of the facilities contained high-efficiency particulate air (HEPA) filtration systems that extensively filtered all of the air leaving the buildings. Any particulates or fines from machining aluminum metals would have been collected on these filters prior to release from the buildings. Additionally, there is no record of spills involving aluminum based on a review of Reconnaissance-Level Characterization Reports (RLCRs) and Pre-Demolition Survey Reports (PDSRs) for these buildings (DOE 2005), and no historical IHSSs that are potential sources for aluminum contamination at RFETS. However, because there was a large inventory of aluminum and it was present in waste generated during former RFETS operations, aluminum may be present in RFETS soil as a result of historical site-related activities.

2.2 Antimony

As shown in Table A8.2, antimony was used in very small quantities at RFETS and only as laboratory standards. Antimony was not identified or discussed in building process information and has not been found associated with UBC sites (DOE 2005). However, antimony is a constituent in bullets and there were two firing ranges at RFETS: the East Firing Range (IHSS SE-1602 in the Wind Blown Area EU [WBEU] and Lower Woman Drainage EU [LWOEU]) and the North Firing Range (IHSS NW-1505 in the No Name Gulch Drainage EU [NNEU]). Although both historical IHSSs were addressed through an accelerated action, antimony may be present at concentrations above background, albeit at concentrations below the RFCA AL. Based on process knowledge, antimony is unlikely to be present in RFETS soil as a result of historical site-related activities except in the WBEU, LWOEU, and NNEU.

2.3 Arsenic

As shown in Table A8.2, arsenic was used in small quantities at RFETS. Arsenic was not identified or discussed in building process information and has not been found associated with UBC sites (DOE 2005). Arsenic waste has been generated from both laboratory and process buildings. However, there is no record of spills involving arsenic based on a review of RLCRs and PDSRs for these buildings. The ChemRisk Task 1 Report concluded that arsenic releases to the environment were estimated to be minimal or there was no release (CDH 1991). Arsenic was identified to be present in soil above the RFCA AL, requiring an accelerated action in only a few isolated historical IHSSs for specific arsenic uses. Specifically, this includes the Building 712/713 cooling towers (IHSS 700-137 in the Industrial Area EU [IAEU]), where arsenic may have been a component of the rust inhibitors used in the towers; outside of Building 707 (IHSS Group 700-2 in the IAEU), where arsenic may have been associated with pressure-treated wood or rat poison; and at the East Firing Range (IHSS SE-1602 in the WBEU and LWOEU) and North Firing Range (IHSS NW-1505 in the NNEU), where arsenic is a component in lead shot. Based on process knowledge, arsenic is unlikely to present in RFETS soil as a result of historical site-related activities except in the NNEU, IAEU, WBEU, and LWOEU.

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2.4 Barium

Barium was used in small quantities at RFETS (Table A8.2). Barium was not identified or discussed in building process information and has not been found to be associated with UBC building processes (DOE 2005). However, barium waste has been generated from both laboratory and process buildings. Barium was initially identified in the ChemRisk Report, but was not carried forward as a material of concern (CDH 1991). Barium was not identified above a RFCA AL requiring an accelerated action for any historical IHSS, Potential Area of Concern (PAC), or UBC site based on Closeout Reports. Based on process knowledge, barium is unlikely to be present in RFETS soil as a result of historical site-related activities.

2.5 Boron

Boron was used in relatively small quantities at RFETS (Table A8.2). There are no documented historical source areas present at RFETS and no documented operations or activities that occurred involving the use of boron. Based on process knowledge, boron is unlikely to be present in RFETS soil as a result of historical site-related activities.

2.6 Chromium

As shown in Table A8.2, chromium was used in moderate quantities at RFETS and was identified as a constituent of waste generated in 13 buildings. Chromium compounds were used in Buildings 371, 374, 444, 460, 559, 561, 712/713, 774, 776/777, 779 (DOE 2005). Chromium waste has been generated from these facilities, and spills involving chromium did occur based on a review of RLCRs and PDSRs for these buildings. Chromium compounds were carried forward as a material of concern for the ChemRisk Reports, but were deemed to not warrant further quantitative evaluation as potential off-site impacts (CDH 1992). Chromium was identified to be present in soil above the RFCA AL, requiring an accelerated action based on the Closeout Report for IHSS 500-158, near Building 551. Based on process knowledge, chromium may be present in RFETS soil as a result of historical site-related activities.

2.7 Copper

As shown in Table A8.2, copper was used in relatively small quantities at RFETS and was identified as a constituent of waste generated in only two buildings. Copper was primarily used in metallurgical operations involving the development of alloys within Buildings 865, 881, and 883 (DOE 2005). All of these buildings involved radiological operations and included extensive HEPA filtration systems. Any particulates or fines from machining copper metals would have been collected on these filters prior to release from the buildings. Copper was identified in the ChemRisk Task 1 Report (CDH 1991). Copper was not carried forward as a material of concern for the ChemRisk process, indicating an insufficient quantity existed at RFETS to pose a potential off-site health hazard (CDH 1991). Copper waste was generated from Building 559 and 881. An elevated concentration of copper greater than the RFCA AL was identified at the East Firing Range (IHSS SE-1602 in the LWOEU) and was removed. Based on process knowledge, copper may be present in the LWOEU soil as a result of historical site-related activities.

2.8 Lead

As shown in Table A8.2, lead was used in relatively large quantities at RFETS and was identified as a constituent of waste generated in 13 buildings. Lead was chiefly used for radiation shielding for plutonium operations in the 300 and 700 area buildings, and Building 559 (DOE 2005). Other buildings that used lead are 460, 771 and 865. Lead compounds were carried forward as a material of concern for the ChemRisk Reports. However, the Tasks 3 and 4 Reports indicate that, based on the nature of their use, they did not warrant further quantitative evaluation of potential off-site impacts. In addition, lead was one of five metals (cadmium, chromium, lead, mercury, and nickel) included in a group of 13 chemicals that underwent extensive investigation by ChemRisk (CDH 1992). Results indicated that uses of these materials at RFETS had been extremely limited in scope or duration, associated with insignificant quantities of the material, or involved processes or forms of the materials that were not expected to have significant off-site releases. These materials, therefore, did not warrant further quantitative evaluation as potential off-site impacts in the ChemRisk process. Spills involving process wastes (containing cadmium, chromium, and lead) did occur within certain buildings, based on a review of RLCRs and PDSRs for these facilities. Lead waste has been generated from both laboratory and process buildings. Lead was also identified to be present in soil above the RFCA AL, requiring an accelerated action most specifically at an underground storage tank associated with Building 441 (IHSS 400-128); at UBC 123; and at both the East Firing Range (IHSS SE-1602) and North Firing Range (IHSS NW-1505). Based on process knowledge, lead may be present in RFETS soil as a result of historical site-related activities.

2.9 Lithium

Lithium was used in moderate quantities and was identified as a constituent of waste generated in seven buildings (Table A8.2). Lithium compounds were used in Buildings 559, 707, 776/777, and 881, but there is no record of spills involving lithium within these facilities based on a review of RLCRs and PDSRs (DOE 2005). Based on process knowledge, lithium was present in the metals inventory and lithium may be present in RFETS soil as a result of historical site-related activities.

2.10 Manganese

As shown in Table A8.2, manganese was used in moderate quantities at RFETS but was not identified as a constituent of waste generated in any buildings. Manganese was not identified or discussed in building process information and has not been found associated with UBC sites (DOE 2005). Manganese was identified in the ChemRisk Task 1 Report but was not carried forward as a material of concern (CDH 1991). Manganese was not identified above a RFCA AL requiring an accelerated action for any IHSS, PAC, or UBC site, based on Closeout Reports. Based on process knowledge, manganese is unlikely to be present in RFETS soil as a result of historical site-related activities.

2.11 Mercury

As shown in Table A8.2, mercury was used in relatively small quantities at RFETS and was identified as a constituent of waste generated in 13 buildings. For the most part, mercury used at RFETS was limited to the metallic mercury contained in instruments

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such as barometers, manometers, and thermometers; plant machinery; mercury switches; and experimental apparatus (CDH 1992). Mercury was used in Buildings 559, 561, 777, and 881, and was identified in a spill within Building 774. Mercury compounds were carried forward as materials of concern for the ChemRisk Reports (CDH 1992). However, the Tasks 3 and 4 Reports indicated that, based on the nature of their use, they did not warrant further quantitative evaluation of potential off-site impacts. In addition, mercury was one of five metals (cadmium, chromium lead, mercury, and nickel) included in a group of 13 chemicals that underwent extensive investigation by ChemRisk (CDH 1992). Results indicated uses of these materials at RFETS had been extremely limited in scope or duration, associated with insignificant quantities of the material, or involved processes or forms of the materials that were not expected to have significant off-site releases. These materials, therefore, did not warrant further quantitative evaluation as potential off-site impacts in the ChemRisk process. Mercury was not identified above a RFCA AL requiring an accelerated action based on Sampling and Analysis Plans (SAPs), SAP Addenda, or Closeout Reports for IHSSs and UBC sites. Based on process knowledge, mercury may be present in RFETS soil as a result of historical site-related activities.

2.12 Molybdenum

As shown in Table A8.2, molybdenum was used in relatively small quantities at RFETS and was identified as a constituent of waste generated in only one building. Molybdenum compounds were used in Buildings 444, 771, 776/777, and 865 (CDH 1992), but each of these buildings contained HEPA filtration systems that extensively filtered all of the air leaving the facilities. Molybdenum was identified in the ChemRisk Report, but was not carried forward as a material of concern for the ChemRisk process (CDH 1991). Molybdenum was not identified above a RFCA AL requiring an accelerated action for any IHSS, PAC, or UBC site based on Closeout Reports. Based on process knowledge, molybdenum is unlikely to be present in RFETS soil as a result of historical site-related activities.

2.13 Nickel

As shown in Table A8.2, nickel was used in moderate quantities at RFETS and was identified as a constituent of waste generated in 12 buildings. Nickel waste has been generated from both laboratory and process buildings. Nickel carbonyl plating was conducted in Buildings 771, 777, and 779 from the early 1950s until as late as the early 1970s. Prior to the Resource Conservation and Recovery Act (RCRA), plating wastes were treated in Building 774, and dilute rinsing solutions were sent to Building 374. Before the existence of Building 374, the solar ponds were used to treat wastewater (CDH 1992). Nickel was found to be associated with anion exchange resins in Building 371. However, the buildings identified above involved radiological operations and included extensive HEPA filtration systems. Any emissions from machining or plating nickel would have been collected on these filters prior to release from the buildings. In addition, there is no record of spills involving nickel compounds within these buildings based on a review of RLCRs and PDSRs for these facilities. Nickel compounds were carried forward as a material of concern for the ChemRisk Reports. However, based on the nature of its use and storage, nickel did not warrant further quantitative evaluation of potential off-site impacts (CDH 1992). Nickel was not identified above a RFCA AL

requiring an accelerated action for any IHSS, PAC, or UBC site based on Closeout Reports. Based on process knowledge, nickel may be present in RFETS soil as a result of historical site-related activities.

2.14 Selenium

Selenium was used in relatively small quantities at RFETS (Table A8.2). Selenium was initially identified in the ChemRisk Reports, but was not carried forward as a material of concern (CDH 1991). Based on process knowledge, selenium is unlikely to be present in RFETS soil as a result of historical site-related activities.

2.15 Silver

Silver was used in relatively moderate quantities at RFETS (Table A8.2). Silver was initially identified in the ChemRisk Task 1 Report as a chemical in inventory at RFETS (although no specific building was identified). Silver was not carried forward as a material of concern for the ChemRisk process, indicating an insufficient quantity existed at RFETS to pose a potential off-site health hazard (CDH 1991). Silver waste was generated from both laboratory and process buildings. There is no record of spills involving silver within these buildings based on a review of RLCRs, PDSRs, and Closeout Reports for these facilities. Silver was not identified above a RFCA AL requiring an accelerated action based on SAPs, SAP Addenda, or Closeout Reports for historical IHSSs and UBC sites. Because silver was present in moderate quantities in the historical metals inventory at RFETS, silver may be present in RFETS soil as a result of historical site-related activities.

2.16 Thallium

Thallium was used in very small quantities at RFETS (Table A8.2). Thallium was not identified in building process information and has not been found associated with UBC building processes (CDH 1992). Thallium waste has been generated from both laboratory and process buildings, and thallium compounds were identified in the ChemRisk Reports but were not carried forward as a material of concern (CDH 1991). Thallium was not identified above a RFCA AL requiring an accelerated action based on Closeout Reports for IHSSs and UBCs. Based on process knowledge, thallium is unlikely to be present in RFETS soil as a result of historical site-related activities.

2.17 Tin

Tin was used in moderate quantities at RFETS (Table A8.2) but was not identified as a waste constituent for any buildings. Tin was initially identified in the ChemRisk Reports, but was not carried forward as a material of concern (CDH 1991). Because tin was present in moderate quantities in the historical metals inventory at RFETS, tin may be present in RFETS soil as a result of historical site-related activities.

2.18 Uranium

Uranium has been reported in Buildings 331, 334, 371, 374, 444, 447, 559, 707, 771, 776/777, 865, 881, 883, and 886 based on the ChemRisk Tasks 3 and 4 Reports. The ChemRisk Task 1 and Task 2 Reports stated that uranium was handled in kilogram quantities and is also a radionuclide of concern at RFETS (CDH 1991). Uranium was also identified to be present in soil above the RFCA AL, requiring an accelerated action

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at the Original Landfill (IHSS 115). Based on process knowledge, uranium may be present in RFETS soil as a result of historical site-related activities.

2.19 Vanadium

As shown in Table A8.2, vanadium was used in small quantities at RFETS and was identified as a constituent of waste generated in only 2 buildings. Vanadium compounds were used in radiological operations in Buildings 707, 865, and 444 (DOE 2005), all of which contained extensive HEPA filtration systems. Any emissions from machining vanadium would have been collected on these filters prior to release from the buildings. Vanadium was identified in the ChemRisk Report and was not carried forward as a material of concern (CDH 1991). Vanadium was identified above a RFCA AL in the PU&D Yard (IHSS 170). The vanadium hot spot was removed on August 22, 2005. Based on process knowledge, vanadium may be present in NNEU soil as a result of historical site-related activities.

2.20 Zinc

Zinc was used in moderate quantities at RFETS (Table A8.2). However, zinc was not identified or discussed in building process information, and has not been found associated with UBC building processes (DOE 2005). Because zinc was present in moderate quantities in the historical metals inventory at RFETS, zinc may be present in RFETS soil as a result of historical site-related activities.

3.0 SPATIAL TREND EVALUATION

This section presents the spatial trend line of evidence for those metals that were carried forward into the professional judgment step of the COC/ECOPC identification process in each of the EU risk assessments. (The EUs at RFETS are shown in Figure 2.1 of this CRA volume.) As described previously, if the spatial trend evaluation suggests the metal concentrations in a specific medium reflect variations in the naturally occurring element, the metal is further evaluated by the other professional judgment lines of evidence in Attachment 3, Volumes 3 through 14 of the CRA. If the spatial trend evaluation indicates clustering of elevated metal concentrations near historical IHSSs, this line of evidence is considered significant enough for the metal to be considered a COC/ECOPC regardless of process knowledge or other lines of evidence, and is further evaluated in the risk characterization for the EU to be conservative. For those EUs where a metal is evaluated in the risk characterization, an "x" is shown in bold on Table A8.1 (or the "N/A" is shown bold; see Notes on Table A8.1).

The maps presented in this attachment that support the spatial trend analysis identify the concentrations of the metals relative to the PRGs/ESLs, and the RFETS background MDCs where available. EUs where a metal is at concentrations statistically greater than background often, but not always, have locations with metal concentrations greater than the background MDC. In addition, EUs where a metal is not at concentrations statistically greater than background can have locations with metal concentrations greater than the background MDC. This can occur because the statistical comparison of the EU and background data sets is a central tendency test, i.e., a comparison of the means or medians of the two data sets. Table A8.1 identifies which EUs have metal concentrations that are greater than background levels based on this statistical comparison.

3.1 Aluminum

Surface Soil (Non-PMJM)

Aluminum in surface soil is at concentrations statistically above background for all EUs except NNEU, IAEU, and Upper Woman Drainage EU (UWOEU) (Table A8.1). As shown on Figure A8.1, aluminum concentrations across the entire site are above the minimum non-PMJM ESL and often above the background MDC. Although there are more locations where aluminum concentrations are above the background MDC in and near historical IHSSs, this appears to reflect the higher sampling density in these areas, i.e., there are also numerous neighboring sample locations where aluminum concentrations are not above the background MDC. Thus, a spatial concentration trend for aluminum in surface soil at RFETS is not suggested. Aluminum concentrations in surface soil for all EUs reflect variations in naturally occurring aluminum, and aluminum is further evaluated as a possible ECOPC by the other professional judgment lines of evidence for EUs where aluminum is statistically greater than background as identified in Table A8.1.

3.2 Antimony

Surface Soil (Non-PMJM)

For surface soil, statistical comparisons to background could not be performed for any EU because antimony results for the background data set are nondetects (Table A8.1). Because the antimony EPCs for the Inter-Drainage EU (IDEU), NNEU, UWOEU, LWOEU, UWNEU, Lower Walnut Drainage EU (LWNEU), and IAEU are greater than the tESL, antimony was carried forward into the professional judgment evaluation step of the ECOPC identification process for these EUs. As shown on Figure A8.2, antimony concentrations across most of the site are below the ESL and the regional background MDC[2]. However, antimony concentrations exceeding three times the regional background MDC largely occur at historical IHSSs within the NNEU, UWNEU, IAEU, and UWOEU. At the IDEU, there are also several locations where antimony concentrations are greater than the ESL and background MDC that are near a historical IHSS. Therefore, antimony in surface soil cannot be eliminated as an ECOPC for the IDEU, NNEU, UWNEU, IAEU, and UWOEU and is further evaluated in the risk characterization for these EUs to be conservative. However, antimony concentrations in surface soil for the IDEU, LWNEU, and LWOEU reflect variations in naturally occurring antimony, and antimony is further evaluated as a possible ECOPC by the other professional judgment lines of evidence in Attachment 3 of Volumes 5, 8, and 11 of the CRA.

Surface Soil (PMJM)

For surface soil within PMJM habitat, statistical comparisons to background could not be performed for any EU because antimony results for the background data set are nondetects (Table A8.1). Therefore, antimony was carried forward into the professional

[2] Where RFETS background data consist of non detects or is otherwise unavailable, regional background MDCs are used. The regional background data set for Colorado and the bordering states was extracted from data for the western United States (Shacklette and Boerngen 1984), and is composed of data from Colorado as well as Arizona, Kansas, Nebraska, New Mexico, Oklahoma, Utah, and Wyoming.

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judgment evaluation step for the UWOEU and UWNEU, the only EUs where antimony MDC exceeds the PMJM ESL. As shown on Figure A8.3, antimony concentrations in PMJM habitat surface soil across most of the site are below the ESL and the background MDC. However, antimony concentrations exceeding three times the regional background MDC occur in PMJM habitat within the UWNEU and UWOEU. These locations are also near historical IHSSs. As discussed for surface soil (non-PMJM), antimony concentrations exceeding three times the regional background MDC largely occur at historical IHSSs. Based on this line of evidence, antimony cannot be eliminated as a PMJM ECOPC for the UWNEU and UWOEU, and antimony is further evaluated in the risk characterization for these EUs as a conservative measure.

Subsurface Soil (Non-PMJM)

The antimony EPC in the LWOEU is greater than the minimum tESL. Statistical comparisons to background for antimony in subsurface soil could not be performed for the LWOEU because antimony was detected in less than 20 percent of background samples (Table A8.1). Therefore, antimony was carried forward into the professional judgment step of the ECOPC identification process for this EU. As shown in Figure A8.4, antimony concentrations across most of the site are below the ESL and the background MDC. However, antimony concentrations exceeding the background MDC and three times the ESL occur near historical IHSSs within the WBEU and UWOEU. Although this may be indicative of contamination, the antimony EPCs for the WBEU and UWOEU are less than the ESL. Therefore, antimony in subsurface soil was eliminated as a subsurface soil ECPOC for these EUs. In the LWOEU, antimony concentrations across most of the EU are below the ESL and the background MDC, and the highest concentrations (above the background MDC and/or ESL) are mostly at the eastern property line, remote from any historical IHSSs. Thus, a spatial concentration trend for antimony in subsurface soil for the LWOEU is not suggested. Therefore, based on this line of evidence, antimony concentrations in subsurface soil for the LWOEU reflect variations in naturally occurring antimony, and antimony is further evaluated as a possible ECOPC by the other professional judgment lines of evidence in Attachment 3, Volume 11 of the CRA.

3.3 Arsenic

Surface Soil/Surface Sediment

In all the EUs, concentrations of arsenic in surface soil/surface sediment statistically exceed background levels (Table A8.1). Concentrations of arsenic sitewide that are greater than the background MDC are generally not located near historical IHSSs and do not indicate a release pattern (Figure A8.5). In the West Area EU (WAEU), Rock Creek Drainage EU (RCEU), IDEU, NNEU, UWNEU, LWNEU, Southwest Drainage EU (SWEU), Southeast Drainage EU (SEEU), UWOEU, and LWOEU, arsenic is detected at concentrations greater than the WRW PRG but less than the background MDC at most locations. In each of these EUs, with the exception of LWNEU and SWEU, there is one to several locations where the arsenic concentration is greater than the background MDC but less than three times the background MDC. However, these locations are not near historical IHSSs, which suggest these concentrations are naturally occurring. In contrast, in the IAEU, there are several locations near historical IHSSs where arsenic exceeds three

times the background MDC. In addition, in the WBEU, there are two locations near historical IHSSs, including the East Firing Range (IHSS SE-1602) where arsenic is greater than the background MDC but less than three times the background MDC. Although the concentrations in the WBEU are lower than in the IAEU, arsenic is a component of lead shot, and therefore, a potential contaminant. Therefore, arsenic in surface soil/surface sediment cannot be eliminated as a COC for the IAEU and WBEU, and will be evaluated in the risk characterization for both EUs. However, arsenic concentrations in surface soil/surface sediment for the other EUs reflect variations in naturally occurring arsenic, and arsenic is further evaluated as a possible COC by the other professional judgment lines of evidence for the EUs where arsenic is statistically greater than background as identified in Table A8.1.

Surface Soil (Non-PMJM)

In the WAEU and IDEU, concentrations of arsenic in surface soil statistically exceed background and EPCs are greater than the minimum tESL. Arsenic concentrations are mostly detected at levels above the ESL but below the background MDC (Figure A8.6). In the WAEU, there is one location where arsenic concentrations are greater than the background MDC but less than three times the background MDC. The sample is not located near an historical IHSS. In the IDEU, there are several locations where arsenic is greater than the background MDC but less than three times the background MDC. These locations are not near historical IHSSs where arsenic was used as part of the process. Thus, a spatial concentration trend for arsenic in surface soil at RFETS is not suggested. Therefore, based on this line of evidence, arsenic concentrations in soil for the WAEU and IDEU reflect variations in naturally occurring arsenic, and arsenic is further evaluated as a possible ECOPC by the other professional judgment lines of evidence in Attachment 3 of the applicable EU volumes of the CRA.

Subsurface Soil

In the RCEU, LWNEU, and SEEU, concentrations of arsenic in subsurface soil are statistically greater than background and the EPCs are greater than the tESL. Arsenic concentrations in subsurface soil (Figure A8.7) in these EUs are greater than the ESL at one or more locations but are less than the background MDC. Considering there are more locations in the IAEU, WBEU, and NNEU where arsenic is at similar concentrations, but the EU-wide concentrations are not statistically greater than background levels, a spatial concentration trend for arsenic in subsurface soil at RFETS is not suggested. Therefore, based on this line of evidence, arsenic concentrations in subsurface soil for the RCEU, LWNEU, and SEEU reflect variations in naturally occurring arsenic, and arsenic is further evaluated as a possible ECOPC by the other professional judgment lines of evidence in Attachment 3 of the applicable EU volume of the CRA.

3.4 Barium

Surface Soil (Non-PMJM)

In the RCEU, WBEU, NNEU, and UWOEU, barium concentrations are statistically greater than background with EPCs greater than the minimum tESL (Table A8.1). In these EUs, barium is detected at concentrations greater than the minimum ESL but less than three times the ESL at locations across the site that are not near historical IHSSs

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(Figure A8.8). In the NNEU and IAEU, there are locations near historical IHSSs that exceed three times the minimum ESL. Barium in surface soil is considered an ECOPC for the NNEU as a conservative measure for the risk characterization because concentrations above background are located near historical IHSSs. For the IAEU, barium concentrations are not statistically greater than background and, therefore, barium is not an ECOPC. Barium concentrations in surface soil for the other EUs reflect variations in naturally occurring barium, and barium is further evaluated as a possible ECOPC by the other professional judgment lines of evidence in Attachment 3 of the applicable EU volumes of the CRA.

3.5 Boron

Surface Soil (Non-PMJM)

Statistical comparisons to background for boron were not performed because there are no site-specific background data for boron. As seen in Figure A8.9, boron was detected at nearly every location across the site at concentrations greater than the ESL. There are no concentrations of boron greater than the regional background MDC. Boron concentrations are uniform across the site. Thus, a spatial concentration trend for boron in surface soil at RFETS is not suggested. Therefore, based on this line of evidence, boron concentrations in surface soil reflect variations in naturally occurring boron, and boron is further evaluated as a possible ECOPC by the other professional judgment lines of evidence in Attachment 3, Volumes 3 through 14 of the CRA.

3.6 Chromium

Surface Soil (Non-PMJM)

Chromium was statistically above background for all EUs except the NNEU, UWOEU, and UWNEU (Table A8.1). As seen in Figure A8.10, concentrations of chromium in surface soil in the WAEU, RCEU, LWNEU, SWEU, and SEEU are detected at levels generally greater than the minimum ESL but less than the background MDC. There are several locations in these EUs that are at concentrations greater than the background MDC but less than three times the background MDC. These locations are not near historical IHSSs, which suggest the concentrations are naturally occurring. Concentrations of chromium are three times the background MDC at several locations in the IAEU, UWOEU, and WBEU that are near historical IHSSs, which suggest the presence of chromium is from historical site-related activities. However, for the UWOEU, chromium concentrations are not statistically above background. In the LWOEU, there are several locations that exceed the background MDC and these are largely near an historical IHSS. Therefore, based on this line of evidence, chromium cannot be eliminated as a non-PMJM ECOPC for the IAEU, WBEU, and LWOEU, and will be evaluated in the risk characterization for the specific EU. In the WAEU, IDEU, LWNEU, RCEU, SWEU, and SEEU, chromium appears to be naturally occurring, and chromium is further evaluated as a possible ECOPC by the other professional judgment lines of evidence in Attachment 3 of the applicable EU volumes of the CRA.

Surface Soil (PMJM)

Chromium was statistically above background for PMJM habitats in the UWOEU, LWOEU, RCEU, and LWNEU (Table A8.1). As seen on Figure A8.11, concentrations of

chromium in PMJM habitat in the LWNEU are detected at concentrations less than the ESL but greater than the background MDC. There is one location in the LWNEU where chromium was detected at a concentration greater than the ESL but less than three times the ESL.In the RCEU, there is one location on PMJM habitat where chromium concentrations exceed the ESL.The locations are not near an historical IHSS and, therefore, chromium in surface soil within PMJM habitat in these EUs appears to be naturally occurring. At the UWOEU and LWOEU, there are concentrations of chromium that are greater than the background MDC and the ESL but less than three times the ESL located near historical IHSSs. Therefore, based on this line of evidence, chromium cannot be eliminated as a PMJM ECOPC for the UWOEU and LWOEU, and will be evaluated in the risk characterization for the specific EU. However, chromium concentrations in PMJM habitat surface soil for the other EUs reflect variations in naturally occurring chromium, and chromium is further evaluated as a possible ECOPC by the other professional judgment lines of evidence in Attachment 3 of the applicable EU volumes of the CRA.

3.7 Copper

Surface Soil (Non-PMJM)

Copper in surface soil (non-PMJM) was statistically above background for the SEEU, NNEU, UWOEU, LWOEU, UWNEU, and the IAEU (Table A8.1). In the SEEU, there are several locations with concentrations of copper greater than the background MDC but less than three times background. These locations are not near an historical IHSS. Copper was detected above three times background in the NNEU, UWNEU, UWOEU, LWOEU, and IAEU at locations near historical IHSSs as seen in Figure A8.12. Therefore, based on this line of evidence, copper in surface soil cannot be eliminated as an ECOPC for the NNEU, UWNEU, UWOEU, LWOEU, and IAEU, and will be evaluated in the risk characterization for the specific EU. However, copper concentrations in surface soil in the SEEU reflect variations in naturally occurring copper, and copper is further evaluated as a possible ECOPC by the other professional judgment lines of evidence in Attachment 3 of Volume 13 of the CRA.

Surface Soil (PMJM)

Copper was above background for PMJM habitat in the UWOEU and LWOEU (Table A8.1). As seen in Figure A8.13, in the LWOEU, copper concentrations are detected at levels greater than the background MDC but less than the ESL throughout the PMJM habitat, and there is only one location in the LWOEU that is greater than the ESL. However, this single exceedance in the LWOEU is in an historical IHSS and, to be conservative, it will be retained as an ECOPC. In UWOEU, there is one location in the PMJM habitat associated with an historical IHSS that is three times the ESL for copper. Therefore, based on this line of evidence, copper cannot be eliminated as a PMJM ECOPC for the UWOEU and will be evaluated in the risk characterization for the specific EU. However, copper concentrations in PMJM habitat surface soil for the UWNEU reflect variations in naturally occurring copper, and copper is further evaluated as a possible ECOPC by the other professional judgment lines of evidence in Attachment 3 of Volume 7 of the CRA.

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3.8 Lead

Surface Soil (Non-PMJM)

Lead was statistically above background in only the IDEU (Table A8.1). Lead does occur at concentrations three times the background MDC in historical IHSSs in other EUs, which suggest lead is present in the soil from historical site-related activities. However, lead is not at concentrations statistically above background in these EUs. Lead concentrations in surface soil in the IDEU are greater than the minimum ESL but less than the background MDC at most locations as seen on Figure A8.14. There are several locations near an historical IHSS that are greater than the background MDC but less than three times the background MDC. Based on this line of evidence, lead cannot be eliminated as an ECOPC for the IDEU and will be evaluated in the risk characterization.

3.9 Lithium

Surface Soil (Non-PMJM)

Lithium concentrations were statistically above background in all the EUs except the NNEU, UWOEU, UWNEU, and the IAEU (Table A8.1). As seen on Figure A8.15, lithium concentrations across the entire site are above the minimum ESL, and often above the background MDC. Although there are more locations where lithium concentrations are above the background MDC in and near historical IHSSs, this appears to reflect the higher sampling density in these areas, i.e., there are also numerous neighboring sample locations where lithium concentrations are not above the background MDC. Thus, a spatial concentration trend for lithium in surface soil at RFETS is not suggested. Therefore, based on this line of evidence, lithium concentrations in surface soil reflect variations in naturally occurring lithium, and lithium is further evaluated as a possible ECOPC by the other professional judgment lines of evidence in Attachment 3 of the applicable EU volumes of the CRA.

3.10 Manganese

Surface Soil/Surface Sediment

Manganese concentrations in surface soil/surface sediment are statistically greater than background at the RCEU, LWOEU, and SEEU (Table A8.1). As seen on Figure A8.16, manganese concentrations in these EUs and across the site are mostly below the PRG, and there are several locations where concentrations are greater than the PRG but less than the background MDC. There are only a few locations where concentrations exceed the background MDC, but these locations are generally not near historical IHSSs. Thus, a spatial concentration trend for manganese in surface soil/surface sediment at RFETS is not suggested. Therefore, based on this line of evidence, manganese concentrations in surface soil/surface sediment reflect variations in naturally occurring manganese, and manganese is further evaluated as a possible COC by the other professional judgment lines of evidence in Attachment 3 of the applicable EU volumes of the CRA.

Surface Soil (Non-PMJM)

Manganese in surface soil statistically exceeded background, with EPCs greater than the minimum ESL at the RCEU, WBEU, LWOEU, and SEEU (Table A8.1). As seen in Figure A8.17, concentrations of manganese in surface soil are detected at concentrations

below the background MDC at most locations within these EUs and across the site. There are several locations in these EUs and across the site where manganese is detected above the background MDC but less than the minimum ESL. In the RCEU and SEEU, there are also several locations where concentrations of manganese are greater than the minimum ESL but less than three times the minimum ESL. These locations are not near an historical IHSS. In the NNEU, IAEU, WBEU, and LWOEU, there are several locations where manganese exceeds the ESL and background but are at concentrations less than three times the minimum ESL. Several of these locations are near historical IHSSs. Therefore, based on this line of evidence, manganese in surface soil cannot be eliminated as an ECOPC for the WBEU and LWOEU and will be evaluated in the risk characterization. Manganese is not at concentrations statistically greater than background for the NNEU and IAEU. On this basis, manganese can be eliminated as an ECOPC in these two EUs. Manganese concentrations in surface soil for the other EUs reflect variations in naturally occurring manganese, and manganese is further evaluated as a possible ECOPC by the other professional judgment lines of evidence for the RCEU and SEEU in Attachment 3 of Volume 4 and 13 of the CRA.

Surface Soil (PMJM)

Manganese is at concentrations that are statistically greater than background for surface soil in the PMJM habitats in the RCEU, UWOEU and LWOEU (Table A8.1). As seen on Figure A8.18, there are several locations on PMJM habitat with elevated concentrations of manganese but there are not located near historical IHSSs. There are several locations where manganese exceeds the ESL in habitat patches located in UWOEU and LWOEU. These locations are near historical IHSSs. Also, there are two locations in the LWOEU where concentrations are three times greater than the ESL and are near an historical IHSS. Therefore, based on this line of evidence, manganese cannot be eliminated as a PMJM ECOPC for the UWOEU and LWOEU, and as a conservative measure, is evaluated for the risk characterization.

3.11 Mercury

Surface Soil (Non-PMJM)

In all EUs except the NNEU, the mercury MDCs are either less than the minimum ESLs or mercury is not at concentrations statistically greater than background (Table A8.1). In the NNEU, a background comparison could not be performed because mercury was detected in less than 20 percent of the EU samples; however, the EPC is greater than the minimum tESL. As seen on Figure A8.19, mercury is greater than the three times the background MDC at locations near historical IHSSs in the IAEU, UWOEU, and LWOEU. Although this suggest that mercury is present in the soil as a result of historical site-related activities, as mentioned, mercury, was eliminated as an ECOPC in these EUs because mercury MDCs are less than the minimum ESL or mercury is not at concentrations statistically greater than background. In the NNEU, mercury is mostly not detected, and infrequently is at concentrations greater than the ESL and greater than the background MDC. The locations where mercury is at concentrations greater than the ESL and background MDC are generally within an historical IHSS. Therefore, based on this line of evidence, mercury in surface soil cannot be eliminated as an ECOPC for the NNEU and will be evaluated in the risk characterization for the specific EU.

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3.12 Molybdenum

Surface Soil (Non-PMJM)

Background comparisons could not be performed for molybdenum because it was not detected in the background data set (Table A8.1). For the RCEU, WBEU, NNEU, UWOEU, SEEU, and the IAEU, EPCs were greater than the tESLs and molybdenum was carried into the professional judgment step of the ECOPC screening process. As seen in Figure A8.20, molybdenum is mostly below detection limits or detected at a concentration less than the ESL across the site. The NNEU and IAEU are the only two EUs where molybdenum was detected above the regional background MDC. These locations are also near an historical IHSS. In the UWNEU, there is one sample on the border of the NNEU and UWNEU that is near an historical IHSS. Therefore, based on this line of evidence, molybdenum in surface soil cannot be eliminated as an ECOPC for the NNEU, UWNEU, and IAEU, and will be evaluated in the risk characterization for the specific EU. However, molybdenum concentrations in surface soil for the other EUs reflect variations in naturally occurring molybdenum, and molybdenum is further evaluated as a possible ECOPC by the other professional judgment lines of evidence in Attachment 3 of the applicable EU volumes of the CRA.

Surface Soil (PMJM)

For surface soil in PMJM habitat, the molybdenum MDCs were less the ESL for all EUs except the UWOEU (background comparisons could not be performed as explained above) (Table A8.1). There are several locations in PMJM habitat where molybdenum concentrations are greater than the ESL but less than the regional background MDC (Figure A8.21). These locations are near historical IHSSs. Therefore, based on this line of evidence, molybdenum cannot be eliminated as a PMJM ECOPC for the UWOEU and will be evaluated in the risk characterization for this EU.

3.13 Nickel

Surface Soil (Non-PMJM)

Nickel concentrations are statistically greater than background in all EUs except the WAEU, IDEU, and IAEU (Table A8.1). As seen on Figure A8.22, in the RCEU, LWNEU, SEEU, and SWEU, there are many locations where nickel is detected at concentrations greater than the background MDC but less than three times the background MDC. These locations are not near historical IHSSs, and therefore, these concentrations appear to be naturally occurring. In the UWNEU and LWOEU, there are several locations near historical IHSSs where concentrations were detected greater than background but less than three times background. In the IAEU, UWOEU, NNEU, and WBEU, there are one or more locations near historical IHSSs where background is exceeded by greater than three times. Therefore, based on this line of evidence, nickel in surface soil cannot be eliminated as an ECOPC for the UWNEU, UWOEU, LWOEU, NNEU, and WBEU, and will be evaluated in the risk characterization for the specific EU. Nickel concentrations were not statistically greater than background in the IAEU and, therefore, nickel was eliminated as an ECOPC in this EU. Nickel concentrations in surface soil for the other EUs reflect variations in naturally occurring nickel, and nickel is

further evaluated as a possible ECOPC by the other professional judgment lines of evidence in Attachment 3 of the applicable EU volumes of the CRA.

Surface Soil (PMJM)

Nickel concentrations are statistically greater than background for surface soil in PMJM habitat at the UWNEU, LWNEU, RCEU, SWEU, NNEU, UWOEU, and LWOEU (Table A8.1). Nickel concentrations across these EUs were detected at concentrations above the ESL but less than the background MDC at most locations, as seen on Figure A8.23. There are several locations within the PMJM habitat in the NNEU, UWNEU, UWOEU, and LWOEU near historical IHSSs where concentrations exceed the background MDC but not three times the background MDC. In the UWOEU, there is one location where concentrations of nickel are three times the background MDC. Therefore, based on this line of evidence, nickel in surface soil cannot be eliminated as an ECOPC for the UWOEU, LWOEU, NNEU, and UWNEU, and will be evaluated in the risk characterization for the specific EU. However, nickel concentrations in surface soil for the RCEU, LWNEU, and SWEU reflect variations in naturally occurring nickel, and nickel is further evaluated as a possible ECOPC by the other professional judgment lines of evidence in Attachment 3 of Volumes 4, 8, and 12 of the CRA.

3.14 Selenium

Surface Soil (Non PMJM)

In all EUs except the IAEU, UWNEU and LWNEU, selenium in surface soil was either at concentrations that are not statistically greater than background or the EPCs are less than the minimum tESL (Table A8.1). In the LWNEU and IAEU, a background comparison could not be performed because selenium was detected in less than 20 percent of the EU samples. For the IAEU, the EPC is less than the minimum ESL, and for the LWNEU, the EPC is greater than the minimum ESL. For the UWNEU, selenium concentrations are statistically greater than background but the EPC is less than the minimum ESL. As shown on Figure A8.24, selenium concentrations across the entire site are generally less than the minimum ESL or nondetected, with only a few locations where selenium concentrations exceed the ESL and background MDC. Although there are more locations where selenium concentrations are above the ESL and background MDC in and near historical IHSSs, this appears to reflect the higher sampling density in these areas, i.e., there are also numerous neighboring sample locations where selenium concentrations are less than the ESL or nondetected. Thus, a spatial concentration trend for selenium in surface soil at RFETS is not suggested. Therefore, based on this line of evidence, selenium concentrations in surface soil in the UWNEU, LWNEU, and IAEU reflect variations in naturally occurring selenium, and selenium is further evaluated as a possible ECOPC by the other professional judgment lines of evidence in Attachment 3 of Volumes 7, 8, and 14 of the CRA.

Surface Soil (PMJM)

In all EUs except the UWNEU and LWOEU, selenium in surface soil in PMJM habitat was either at concentrations that are not statistically greater than background or the MDCs are less than the ESL (Table A8.1). In the UWNEU and LWOEU, a background comparison could not be performed because selenium was detected in less than 20

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percent of the EU samples; however, the EPC is greater than the PMJM ESL. Selenium concentrations for samples located within PMJM habitat in the UWNEU are generally below detection limits with only a few locations where selenium is greater than the ESL (Figure A8.25). In the LWOEU, there is one sample located in PMJM habitat near an historical IHSS with concentrations greater than the background MDC and ESL. Therefore, based on this line of evidence, selenium in surface soil cannot be eliminated as an ECOPC for the LWOEU and is evaluated in the risk characterization. However, selenium concentrations in surface soil in the UWNEU reflect variations in naturally occurring selenium and selenium is further evaluated as a possible ECOPC by the other professional judgment lines of evidence in Attachment 3 of Volume 7 of the CRA.

3.15 Silver

Surface Soil (Non-PMJM)

In all EUs, statistical comparisons to background for surface soil could not be performed because silver is nondetected in the background data set. However, in the WBEU, UWNEU, and UWOEU the EPCs are greater than the minimum tESL (Table 8.1). As seen in Figure A8.26, these EUs each have concentrations of silver greater than the minimum ESL and the regional background MDC that are located near historical IHSSs. Therefore, based on this line of evidence, silver in surface soil cannot be eliminated as an ECOPC for the WBEU, UWNEU, and UWOEU, and will be evaluated in the risk characterization.

3.16 Thallium

Surface Soil (Non-PMJM)

In all EUs, statistical comparisons to background for surface soil could not be performed because thallium is nondetected in the background data set. However, in the WAEU, WBEU, and LWOEU the EPCs are greater than the minimum tESL (Table A8.1). As seen in Figure A8.27, with the exception of the WAEU, these EUs have concentrations of thallium greater than the minimum ESL that are located near historical IHSSs. This trend applies to the IAEU, but the thallium EPC is less than the minimum ESL for this EU. Therefore, based on this line of evidence, thallium in surface soil cannot be eliminated as an ECOPC for the WBEU and LWOEU EU and, as a conservative measure, will be evaluated in the risk characterization because concentrations above background were located near historical IHSSs. However, thallium concentrations in surface soil for the WAEU reflect variations in naturally occurring thallium, and thallium is further evaluated as possible ECOPC by the other professional judgment lines of evidence in Attachment 3 of Volume 3of the CRA.

3.17 Tin

Surface Soil (Non-PMJM)

In all EUs, statistical comparisons to background for surface soil could not be performed because tin is nondetected in the background data set (Table A8.1). The EPCs exceed the minimum tESL for the IDEU, LWNEU, RCEU, WBEU, NNEU, LWOEU, UWOEU, UWNEU, and IAEU. In the IDEU, there are several locations where tin was detected at concentrations greater than the minimum ESL but less than the regional background MDC (Figure A8.28). In the RCEU and LWNEU, there are one or more locations where

tin was detected at concentrations greater than three times the regional background MDC. However, none of these locations are near historical IHSSs. In the other EUs where the tin EPCs exceed the minimum ESL, there are also several samples near historical IHSSs with concentrations of tin greater than three times the regional background MDC. Therefore, based on this line of evidence, tin in surface soil cannot be eliminated as an ECOPC for the NNEU, WBEU, UWOEU, UWNEU, LWOEU, and IAEU. However, tin concentrations in surface soil for the RCEU, IDEU, and LWNEU reflect variations in naturally occurring tin, and tine is further evaluated as a possible ECOPC by the other professional judgment lines of evidence in Attachment 3 of Volumes 4, 5, and 8 of the CRA.

Surface Soil (PMJM)

Statistical comparisons to background for surface soil in PMJM habitat could not be performed because tin is nondetected in the background data set (Table A8.1). The MDCs exceed the ESL for the LWOEU, UWOEU, and UWNEU. In the LWOEU, tin is either not detected or detected at concentrations less than the ESL in the PMJM habitat associated with these EUs as seen on Figure A8.29. There are several locations on PMJM habitat near an historical IHSS where tin is detected greater than three times background in the UWNEU and UWOEU. Thus, a spatial concentration trend for tin in surface soil in PMJM habitat is apparent. Therefore, based on this line of evidence, tin in surface soil cannot be eliminated as an ECOPC for the PMJM for the UWOEU and UWNEU, and will be evaluated in the risk characterization for the specific EU. However, tin concentrations in surface soil for the LWOEU and SWEU reflect variations in naturally occurring tin, and tin is further evaluated as a possible ECOPC by the other professional judgment lines of evidence in Attachment 3 of Volumes 11 and 12 of the CRA.

3.18 Uranium

Surface Soil (Non PMJM)

Statistical comparisons to background for surface soil could not be performed because there is no uranium background data set (Table A8.1). The EPCs exceed the minimum ESL for the WBEU, UWOEU, and IAEU. As seen on Figure A8.30, uranium in the WBEU is generally either below detection limits or detected at concentrations less the minimum ESL. There is one sample where the uranium concentration is greater than the regional background MDC but less than three times background. In the UWOEU, there are two locations near an historical IHSS where concentrations are three times greater than background. Therefore, based on this line of evidence, uranium in surface soil cannot be eliminated as an ECOPC for the UWOEU and will be evaluated in the risk characterization. However, uranium concentrations in surface soil for the WBEU and IAEU reflect variations in naturally occurring uranium, and uranium is further evaluated as a possible ECOPC by the other professional judgment lines of evidence in Attachment 3, Volumes 9 and 14 of the CRA.

3.19 Vanadium

Surface Soil/Surface Sediment

Vanadium concentrations in surface soil/surface sediment are statistically greater than background in the NNEU. In the NNEU, there is one sample greater than three times the

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WRW PRG and one sample greater than background MDC but less than the WRW PRG, both of which are located near an historical IHSS (Figure A8.31). Therefore, based on this line of evidence, vanadium in surface soil/surface sediment cannot be eliminated as a COC for the NNEU and will be evaluated in the risk characterization.

Surface Soil (Non-PMJM)

Vanadium concentrations in surface soil are statistically greater than background for the LWNEU, RCEU, SEEU, SWEU, LWOEU, UWOEU, and UWNEU. In the RCEU, SWEU, LWNEU, and SEEU, there are several locations not located near an historical IHSS where vanadium was detected at concentrations greater than the background MDC, which suggest the vanadium is naturally occurring (Figure A8.32). In the UWOEU, LWOEU, and UWNEU, there are several locations near an historical IHSS with vanadium concentrations greater than the background MDC but less than three times background. This pattern is also seen for the NNEU and IAEU, but vanadium concentrations are not statistically greater than background. Therefore, based on this line of evidence, vanadium in surface soil cannot be eliminated as an ECOPC for the UWOEU, LWOEU, and UWNEU, and will be evaluated in the risk characterization. However, vanadium concentrations in surface soil for the other EUs reflect variations in naturally occurring vanadium, and vanadium is further evaluated as a possible ECOPC by the other professional judgment lines of evidence in Attachment 3 of the applicable EU volumes of the CRA.

Surface Soil (PMJM)

Vanadium concentrations are statistically greater than background in surface soil in PMJM habitat for the RCEU, SWEU, NNEU, LWOEU, UWOEU, and UWNEU. As seen on Figure A8.33, concentrations of vanadium in PMJM habitat located in the RCEU and SWEU are greater than the ESL but less than the background MDC. These locations are not near historical IHSSs. In the UWOEU, LWOEU, NNEU, and UWNEU, there are several locations where vanadium exceeds the background MDC in PMJM habitat that are near historical IHSSs. Therefore, based on this line of evidence, vanadium in surface soil cannot be eliminated as an ECOPC for PMJM for the NNEU, UWNEU, UWOEU, and LWOEU, and will be evaluated in the risk characterization. However, vanadium concentrations in surface soil for the SWEU reflect variations in naturally occurring vanadium, and vanadium is further evaluated as a possible ECOPC by the other professional judgment lines of evidence in Attachment 3 of Volume 12 of the CRA.

3.20 Zinc

Surface Soil (Non-PMJM)

Zinc concentrations in surface soil are statistically above background in the LWNEU, RCEU, SEEU, LWOEU, and UWNEU (Table A8.1). As seen in Figure A8.34, zinc concentrations in these EUs are generally greater than the ESL but less than the background MDC. There are several locations not near historical IHSSs where zinc is detected greater than the background MDC. There is one sample located near an historical IHSS along the western border of the UWNEU where concentrations of zinc were three times greater than background. Therefore, based on this line of evidence, zinc in surface soil cannot be eliminated as an ECOPC for the UWNEU and will be evaluated

in the risk characterization. However, zinc concentrations in surface soil for the other EUs reflect variations in naturally occurring zinc, and zinc is further evaluated as a possible ECOPC by the other professional judgment lines of evidence in Attachment 3 of the applicable EU volumes of the CRA.

Surface Soil (PMJM)

Zinc concentrations in surface soil in PMJM habitat are statistically above background in the NNEU, LWOEU, UWOEU, and UWNEU (Table A8.1). Zinc concentrations in these EUs in PMJM habitat are generally greater than the ESL but less than the background MDC, as seen in Figure A8.35. There are several locations near historical IHSSs where zinc is detected greater than background. Therefore, based on this line of evidence, zinc in surface soil cannot be eliminated as a PMJM ECOPC for the NNEU, LWOEU, UWOEU, and UWNEU, and will be evaluated in the risk characterization.

4.0 REFERENCES

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Table A8.1
Summary of COC/ECOPC Selection Process for Metals

Analyte	Figure	Medium	WAEU Volume 3	RCEU Volume 4	IDEU Volume 5	NNEU Volume 6	UWNEU Volume 7	LWNEU Volume 8	WBEU Volume 9	UWOEU Volume 10	LWOEU Volume 11	SWEU Volume 12	SEEU Volume 13	IAEU Volume 14
Aluminum	A8.1	SS-Non PMJM	>B	>B	>B		>B	>B	>B		>B	>B	>B	
Antimony	A8.2	SS-Non PMJM			N/A	N/A	N/A	N/A		N/A	N/A			N/A
Antimony	A8.3	SS-PMJM					N/A			N/A				
Antimony	A8.4	SB				N/A*			N/A*	N/A*	N/A			N/A*
Arsenic	A8.5	SS/SD	>B	>B	>B	>B	>B	>B	>B	>B	>B	>B	>B	>B
Arsenic	A8.6	SS-Non PMJM	>B		>B							>B*		
Arsenic	A8.7	SB		>B				>B			>B*		>B	
Barium	A8.8	SS-Non PMJM		>B	>B*	>B	>B*	>B*	>B	>B	>B*	>B*	>B*	
Boron	A8.9	SS-Non PMJM	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Chromium	A8.10	SS-Non PMJM	>B	>B	>B			>B	>B		>B	>B	>B	>B
Chromium	A8.11	SS-PMJM		>B				>B		>B	>B	>B		
Copper	A8.12	SS-Non PMJM				>B	>B			>B	>B		>B	>B
Copper	A8.13	SS-PMJM								>B	>B			
Lead	A8.14	SS-Non PMJM			>B									
Lithium	A8.15	SS-Non PMJM	>B	>B	>B			>B	>B		>B	>B	>B	
Manganese	A8.16	SS/SD		>B									>B	
Manganese	A8.17	SS-Non PMJM		>B	>B*				>B		>B		>B	
Manganese	A8.18	SS-PMJM		>B						>B	>B			
Mercury	A8.19	SS-Non PMJM				N/A								
Molybdenum	A8.20	SS-Non PMJM		N/A	N/A*	N/A	N/A	N/A	N/A	N/A		N/A	N/A	N/A
Molybdenum	A8.21	SS-PMJM		>B						N/A				
Nickel	A8.22	SS-Non PMJM		>B		>B	>B	>B	>B	>B	>B	>B	>B	
Nickel	A8.23	SS-PMJM		>B		>B	>B	>B		>B	>B	>B		
Selenium	A8.24	SS-Non PMJM					>B*	N/A						N/A*
Selenium	A8.25	SS-PMJM					>B				N/A			
Silver	A8.26	SS-Non PMJM				N/A*	N/A		N/A	N/A				N/A*
Thallium	A8.27	SS-Non PMJM	N/A			N/A*	N/A*		N/A		N/A			N/A*
Tin	A8.28	SS-Non PMJM		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A			N/A
Tin	A8.29	SS-PMJM		N/A			N/A			N/A	N/A	N/A		
Uranium	A8.30	SS-Non PMJM							N/A	N/A				N/A*
Vanadium	A8.31	SS/SD				>B								
Vanadium	A8.32	SS-Non PMJM		>B			>B	>B		>B	>B	>B	>B	
Vanadium	A8.33	SS-PMJM		>B		>B	>B			>B	>B	>B		
Zinc	A8.34	SS-Non PMJM		>B			>B	>B			>B		>B	
Zinc	A8.35	SS-PMJM				>B	>B			>B	>B			

>B	Indicates metal is statistically above background at a significance level of 0.1.
N/A	Background comparison not performed. Metal detected in less than 20 percent of the samples in the background dataset or the EU dataset, or background dataset is not available.
*	EPC does not exceed the limiting ESL; therefore, the metal is eliminated as an ECOPC and is not carried into the professional judgment evaluation.
Bold and Shaded	**Bold and shaded entries indicate analyte for that EU is a COC/ECOPC and will be evaluated in the EU-specific risk characterization.**
Note:	
	All metals designated >B or NA, and without an asterisk, were carried into the professional judgment evaluation step of the COC/ECOPC selection process. A blank entry indicates that the MDC (or EPC in the case of surface soil/surface sediment) is less than the corresponding PRG/ESL, or the metal is not at concentrations that are statistically greater than background.
SS-Non PMJM	Surface soil data evaluated against non-PMJM ESLs.
SS-PMJM	Surface soil data in PMJM habitat evaluated against PMJM ESL.
SS/SD	Combined surface soil/surface sediment data evaluated against PRG.
SB	Subsurface soil data evaluated against the prairie dog ESL.

Table A8.2

Metal Use and Disposal at RFETS

Metal*	Priority 1 Metal Inventory (KG)**		Lab Chemical Only (Y/N)***	# of Buildings Identifying Metal as a Waste Constituent***
	1974	1988		
Aluminum	1,470	7,700	No	4
Antimony[a]	3	8	Yes	1
Arsenic	3	3	Yes	12
Barium	35	32	Yes	12
Beryllium	9,100	<1	No	No data
Boron	27	6	No	No data
Cadmium	100	44	No	13
Chromium	<1	730	No	13
Cobalt	700	11	Yes	0
Copper	22	125	No	2
Iron	480	980	No	0
Lead[a]	50,400	136	No	13
Lithium	30	300	No	7
Manganese	2,580	7	No	0
Mercury	420	4	No	13
Molybdenum	27	12	No	1
Nickel	160	105	No	12
Selenium	<1	1	Yes	12
Silver	26	790	No	No data
Strontium	4	7	Yes	0
Thallium	<1	<1	Yes	5
Tin	55	11		No data
Vanadium	12	4	No	2
Zinc	161	84	No	1

*Element and all compounds.

**Ref. CDH 1991a.

*** Ref. DOE 2005.

Shaded entries are metals that are unlikely to be contaminants at RFETS based on low metal inventories, use as a laboratory standard only, and/or limited identification as a constituent in wastes generated at RFETS.

[a] Metals are components of bullets and therefore expected contaminants at the firing ranges.

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Table A8.3
Summary of Detected Metals in Surface Soil

[illegible]	Range of Reported Detection Limits			[illegible] Results	[illegible]	[illegible] (mg/kg)	Maximum Detected Concentration (mg/kg)	Arithmetic Mean Concentration (mg/kg)	Standard Deviation (mg/kg)
Aluminum	0.0014	-	200	2,622	99.9	1,450	61,000	11,270.1	6,308.1
Antimony	0.00036	-	60	2,482	20.0	0.27	348	2.2	7.9
Arsenic	0.00022	-	10	2,613	99.0	0.29	56.2	4.8	3.0
Barium	0.00071	-	200	2,624	99.9	0.64	1,500	99.6	67.3
Beryllium	0.000029	-	5	2,623	81.7	0.071	26.8	0.6	0.7
Boron	0.0036	-	1.7	1,303	85.7	0.35	28	3.8	2.8
Cadmium	0.000025	-	5	2,603	36.1	0.06	270	0.7	5.7
Calcium	0.031	-	5,000	2,622	100.0	270	210,000	9,022.6	15,873.1
Cesium	9.1	-	1,000	1,029	26.3	0.69	18.8	11.8	19.6
Chromium	0.0001	-	10	2,624	99.2	1.2	210	15.4	13.2
Chromium VI	0.53	-	10	17	5.9	0.85	0.85	0.4	0.2
Cobalt	0.00029	-	50	2,622	98.1	1.1	137	6.6	5.2
Copper	0.00036	-	25	2,621	98.2	1.7	1,860	21.9	54.5
Iron	0.012	-	100	2,622	100.0	2,610	130,000	13,671.3	5,895.6
Lead	0.000029	-	17.2	2,618	100.0	0.87	814	25.1	39.2
Lithium	0.00095	-	100	2,433	94.5	0.99	50	8.9	4.3
Magnesium	0.016	-	5,000	2,633	100.0	180	30,000	2,656.4	1,652.1
Manganese	0.00022	-	15	2,617	99.9	15	2,220	227.3	139.5
Mercury	0	-	0.3	2,541	48.8	0.0014	48	0.1	1.0
Molybdenum	0.00099	-	200	2,421	47.0	0.14	19.1	1.0	1.1
Nickel	0.00034	-	40	2,620	97.5	1.9	280	12.3	10.7
Potassium	0.029	-	5,000	2,621	99.5	270	8,310	2,001.6	865.6
Selenium	0.00054	-	5	2,590	13.3	0.22	2.2	0.4	0.2
Silver	0.0000094	-	10	2,589	28.4	0.058	364	1.0	8.3
Sodium	0.033	-	5,000	2,622	56.1	22.6	6,600	236.7	432.6
Strontium	0.00072	-	200	2,423	100.0	2.4	413	32.5	29.9
Thallium	0.00016	-	10	2,597	14.1	0.1	5.8	0.4	0.4
Tin	0.00078	-	200	2,423	10.0	0.289	161	3.4	8.1
Titanium	0.00022	-	0.25	1,303	100.0	28	1,730	257.1	170.5
Uranium	0.00063	-	16.8	1,296	8.8	0.43	370	1.8	12.7
Vanadium	0.00063	-	50	2,622	100.0	4.4	5,300	36.5	143.4
Zinc	0.00056	-	20	2,622	99.8	4.2	11,900	75.5	256.6

Table A8.4
Summary of Detected Metals in Surface Soil within PMJM Habitat

Analyte	Range of Reported Detection Limits (mg/kg)	Number of Results	Frequency of Detection (%)	Minimum Detected Concentration (mg/kg)	Maximum Detected Concentration (mg/kg)	Arithmetic Mean Concentration (mg/kg)	Standard Deviation
Aluminum	1.07 - 200	173	100.0	1,950	28,000	13,138.9	5,098.8
Antimony	0.19 - 60	157	31.8	0.29	49.8	4.8	7.0
Arsenic	0.23 - 10	173	100.0	1.8	9.9	5.7	1.6
Barium	0.02 - 200	173	100.0	40.1	470	145.0	45.3
Beryllium	0.003 - 5	174	74.1	0.18	1.7	0.7	0.3
Boron	0.38 - 1.3	71	97.2	2.3	9.9	6.3	1.8
Cadmium	0.02 - 5	170	50.6	0.15	4.1	0.6	0.5
Calcium	1.1 - 5,000	173	100.0	1,300	161,000	7,836.6	13,121.5
Cesium	200 - 1,000	89	50.6	1.7	16.4	11.6	20.0
Chromium	0.064 - 10	173	100.0	2.2	28	14.7	5.3
Cobalt	0.07 - 50	173	96.0	2.4	24	8.1	2.8
Copper	0.045 - 25	172	100.0	2.2	170	20.4	17.9
Iron	0.251 - 100	173	100.0	3,680	38,000	16,325.5	4,952.2
Lead	0.17 - 3	174	100.0	3.9	210	35.6	31.1
Lithium	0.003 - 100	168	83.9	2.4	20	10.0	4.3
Magnesium	0.27 - 5,000	173	100.0	663	11,400	3,034.5	1,354.5
Manganese	0.02 - 15	173	100.0	67	2,220	328.3	213.2
Mercury	0.0013 - 0.3	167	53.3	0.013	0.37	0.1	0.1
Molybdenum	0.12 - 200	169	45.0	0.202	4.4	1.1	0.7
Nickel	0.11 - 40	172	97.7	5.7	45.2	14.8	4.7
Potassium	2.03 - 5,000	173	100.0	690	5,310	2,545.1	904.8
Selenium	0.391 - 5	172	18.6	0.22	2	0.4	0.4
Silicon	0 - 100	19	100.0	90.5	4,570	1,330.4	1,186.4
Silver	0.069 - 10	169	18.9	0.11	52.7	1.0	4.2
Sodium	0.4 - 5,000	173	54.9	26.9	1,650	147.3	191.6
Strontium	0.01 - 200	170	100.0	14	151	42.7	18.9
Thallium	0.34 - 10	171	36.3	0.21	5.7	0.5	0.7
Tin	0.217 - 200	170	25.3	0.289	66.9	6.6	9.9
Titanium	0.025 - 0.11	71	100.0	54.5	410	186.7	82.1
Uranium	1.4 - 6	77	2.6	9	26	1.4	3.0
Vanadium	0.054 - 50	173	100.0	9.9	75.9	35.7	10.7
Zinc	0.05 - 20	173	100.0	15	650	69.1	54.3

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Table A8.5
Summary of Detected Metals in Surface Soil/Surface Sediment

Analyte	Range of Reported Detection Limits (mg/kg)	Total Number of Results	Detection Frequency (%)	Minimum Detected Concentration (mg/kg)	Maximum Detected Concentration (mg/kg)	Arithmetic Mean Concentration (mg/kg)	Standard Deviation
Aluminum	0.0014 - 200	2,911	99.9	763	61,000	11,186.9	6,353.2
Antimony	0.00036 - 60	2,758	19.4	0.27	348	2.4	7.8
Arsenic	0.00022 - 10	2,901	98.7	0.29	56.2	4.8	3.0
Barium	0.00071 - 200	2,913	99.9	0.64	1,500	101.4	68.1
Beryllium	0.000029 - 5	2,907	80.9	0.071	26.8	0.6	0.7
Boron	0.0036 - 5.2	1,370	86.2	0.35	30	4.0	3.0
Cadmium	0.000025 - 5	2,885	36.3	0.036	270	0.7	5.4
Calcium	0.031 - 5,000	2,911	100.0	270	210,000	9,231.0	15,718.9
Cesium	2 - 1,000	1,214	24.3	0.68	18.8	14.5	25.9
Chromium	0.0001 - 10	2,913	98.9	1.2	210	15.2	12.8
Chromium VI	0.005 - 10	59	25.4	0.005	0.85	0.1	0.2
Cobalt	0.00029 - 50	2,909	97.5	1.1	137	6.6	5.0
Copper	0.00036 - 25	2,910	98.0	1.7	1,860	21.7	52.4
Iron	0.012 - 100	2,911	100.0	1,680	130,000	13,718.9	5,981.4
Lead	0.000029 - 17.2	2,907	100.0	0.87	814	25.1	37.9
Lithium	0.00095 - 100	2,717	93.5	0.99	50	8.8	4.4
Magnesium	0.016 - 5,000	2,922	100.0	180	30,000	2,660.8	1,666.1
Manganese	0.00022 - 15	2,906	99.9	15	2,500	232.8	156.8
Mercury	0 - 0.62	2,803	47.0	0.0014	48	0.1	0.9
Molybdenum	0.00099 - 200	2,705	45.7	0.14	19.1	1.1	1.1
Nickel	0.00034 - 40	2,909	96.9	1.4	280	12.4	11.0
Potassium	0.029 - 5,000	2,909	99.1	270	8,310	1,961.3	876.5
Selenium	0.00054 - 5	2,871	14.6	0.22	3.8	0.4	0.3
Silver	0.0000094 - 10	2,865	27.2	0.058	364	1.0	7.9
Sodium	0.033 - 5,000	2,909	59.3	22.6	6,600	248.0	427.7
Strontium	0.00072 - 400	2,710	99.9	2.4	526	34.5	33.1
Thallium	0.00016 - 10	2,878	14.3	0.1	10	0.4	0.5
Tin	0.00078 - 200	2,705	11.0	0.289	161	3.7	8.3
Titanium	0.00022 - 0.75	1,370	100.0	28	1,730	251.2	168.8
Uranium	0.00063 - 39	1,387	8.7	0.43	370	1.9	12.3
Vanadium	0.00063 - 50	2,911	99.7	2.3	5,300	35.6	136.1
Zinc	0.00056 - 20	2,911	99.8	4.2	11,900	82.6	252.4

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Table A8.6
Summary of Detected Metals in Subsurface Soil

Analyte	Range of Reported Detection Limits (mg/kg)			Total Number of Results	Detection Frequency (%)	Minimum Detected Concentration (mg/kg)	Maximum Detected Concentration (mg/kg)	Arithmetic Mean Concentration (mg/kg)	Standard Deviation
Aluminum	0.0014	-	200	3,575	100.0	463	110,000	14,927.4	9,685.2
Ammonia	0.3	-	0.3	65	21.5	0.353	1.44	0.3	0.3
Antimony	0.00036	-	60	3,399	19.4	0.18	350	2.1	8.7
Arsenic	0.00022	-	10	3,576	98.9	0.46	69.7	5.5	4.0
Barium	0.00071	-	200	3,576	99.9	8.6	2970	100.7	99.8
Beryllium	0.000029	-	5	3,559	82.3	0.052	446	1.0	7.9
Boron	0.0036	-	9.7	2,252	76.8	0.42	33	3.3	2.7
Cadmium	0.000025	-	19	3,514	28.5	0.04	547	1.2	15.2
Calcium	0.031	-	5,000	3,575	99.9	180	412,000	16,492.0	34,593.9
Cesium	5	-	1,000	1,087	21.3	0.64	29.6	17.4	23.1
Chromium	0.0001	-	10	3,576	99.5	1.2	11,000	24.5	243.3
Chromium VI	0.52	-	0.52	1	100.0	0.59	0.59	0.6	
Cobalt	0.00029	-	50	3,576	98.1	0.47	701	6.7	12.8
Copper	0.00036	-	25	3,575	99.0	0.7	8850	25.4	208.5
Iron	0.012	-	100	3,575	100.0	1,060	290,000	14,501.1	9,130.0
Lead	0.000029	-	20	3,586	99.9	0.49	8,500	21.6	177.6
Lithium	0.00095	-	100	3,530	92.1	0.4	79.9	10.2	6.6
Magnesium	0.016	-	5,000	3,575	99.9	135	17,000	2,641.5	1,419.8
Manganese	0.00022	-	15	3,575	99.9	8.2	3,140	187.4	182.2
Mercury	0	-	0.67	3,487	65.7	0.0015	25.4	0.1	0.6
Molybdenum	0.00099	-	200	3,561	51.7	0.14	4,100	3.1	76.8
Nickel	0.00034	-	40	3,576	96.8	0.72	4,750	17.5	84.6
Potassium	0.029	-	5,000	3,572	96.1	139	21,100	1,643.1	1,087.7
Selenium	0.00054	-	49.08	3,554	12.2	0.06	80.8	0.4	1.4
Silver	0.0000094	-	25	3,544	20.6	0.062	311	1.0	9.8
Sodium	0.033	-	5,000	3,573	52.1	19.5	11,000	277.5	603.6
Strontium	0.00072	-	400	3,574	99.7	2.3	506	42.3	46.4
Tantalum	66.5	-	66.5	2	50.0	15.7	15.7	11.9	5.4
Thallium	0.00016	-	29.45	3,556	17.2	0.1	10.8	0.5	0.6
Tin	0.00078	-	200	3,544	12.0	0.47	579	3.9	14.1
Titanium	0.00022	-	0.5	2,261	100.0	14	1,420	190.5	125.5
Uranium	0.00063	-	31	2,307	12.1	0.54	1,600	2.6	35.4
Vanadium	0.00063	-	50	3,576	99.8	2.1	740	32.0	19.9
Zinc	0.00056	-	20	3,573	99.4	2.2	6,920	46.8	153.3

FIGURES

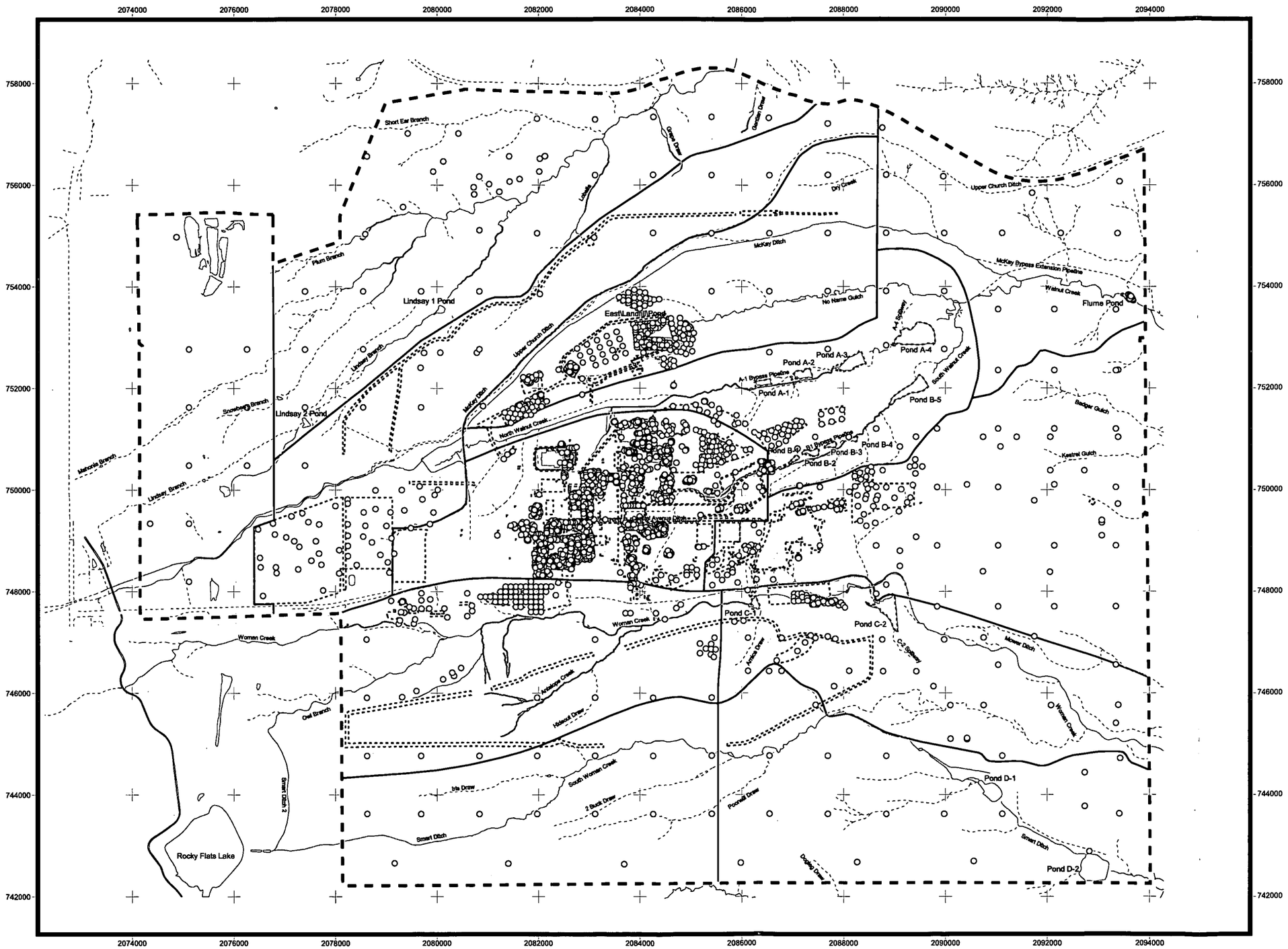

Figure A8.1

Aluminum Concentrations in Sitewide Surface Soil (Non-PMJM)

KEY

- Concentration > 3x Background MDC
- Concentration > Background MDC and <= 3x Background MDC
- Concentration > ESL and <= Background MDC
- Concentration <= ESL
- Nondetect (ND)

Min. Non-PMJM ESL = 50 mg/kg
Background MDC = 17,100 mg/kg
3 x Background MDC = 51,300 mg/kg

Standard Map Features

- Exposure Unit boundary
- Former building where analyte was used or generated as waste
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N W E S

0 1000 2000 Feet

Scale 1:24,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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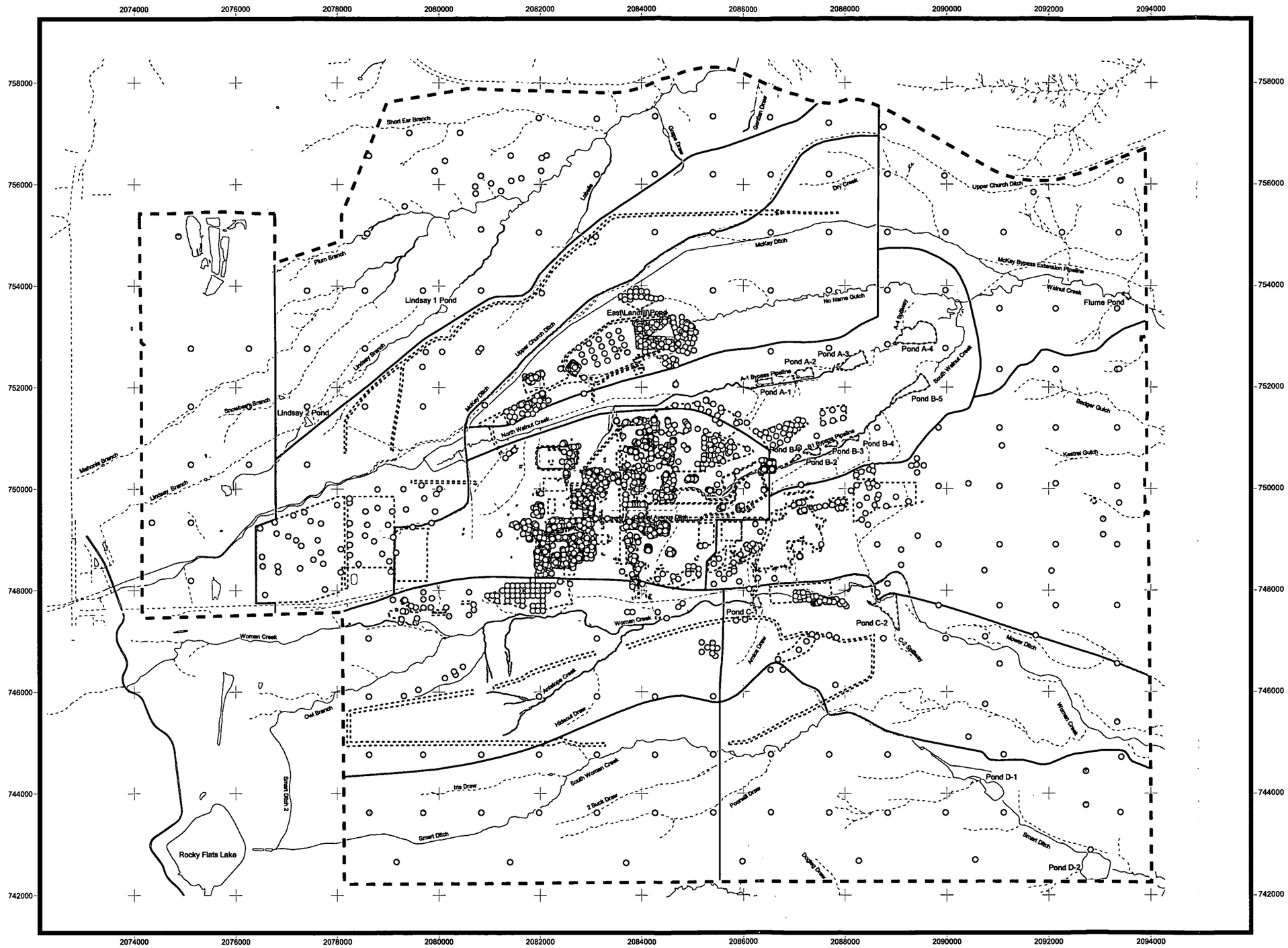

Figure A8.2

Antimony Concentrations in Sitewide Surface Soil (Non-PMJM)

KEY

- Concentration > 3x Background MDC
- Concentration > Background MDC and <= 3x Background MDC
- Concentration > ESL and <= Background MDC
- Concentration <= ESL
- Nondetect (ND)

Min. Non-PMJM ESL = 0.905 mg/kg
MDC* = 2.53 mg/kg
3 x MDC* = 7.59 mg/kg

* Maximum detected concentration of the surface soil background data set for Colorado, Arizona, Kansas, Nebraska, New Mexico, Oklahoma, Utah, and Wyoming from Shacklette and Boerngen (1984).

Standard Map Features

- Exposure Unit boundary
- Former building where analyte was used or generated as waste
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N W E S

0 1000 2000 Feet

Scale 1:24,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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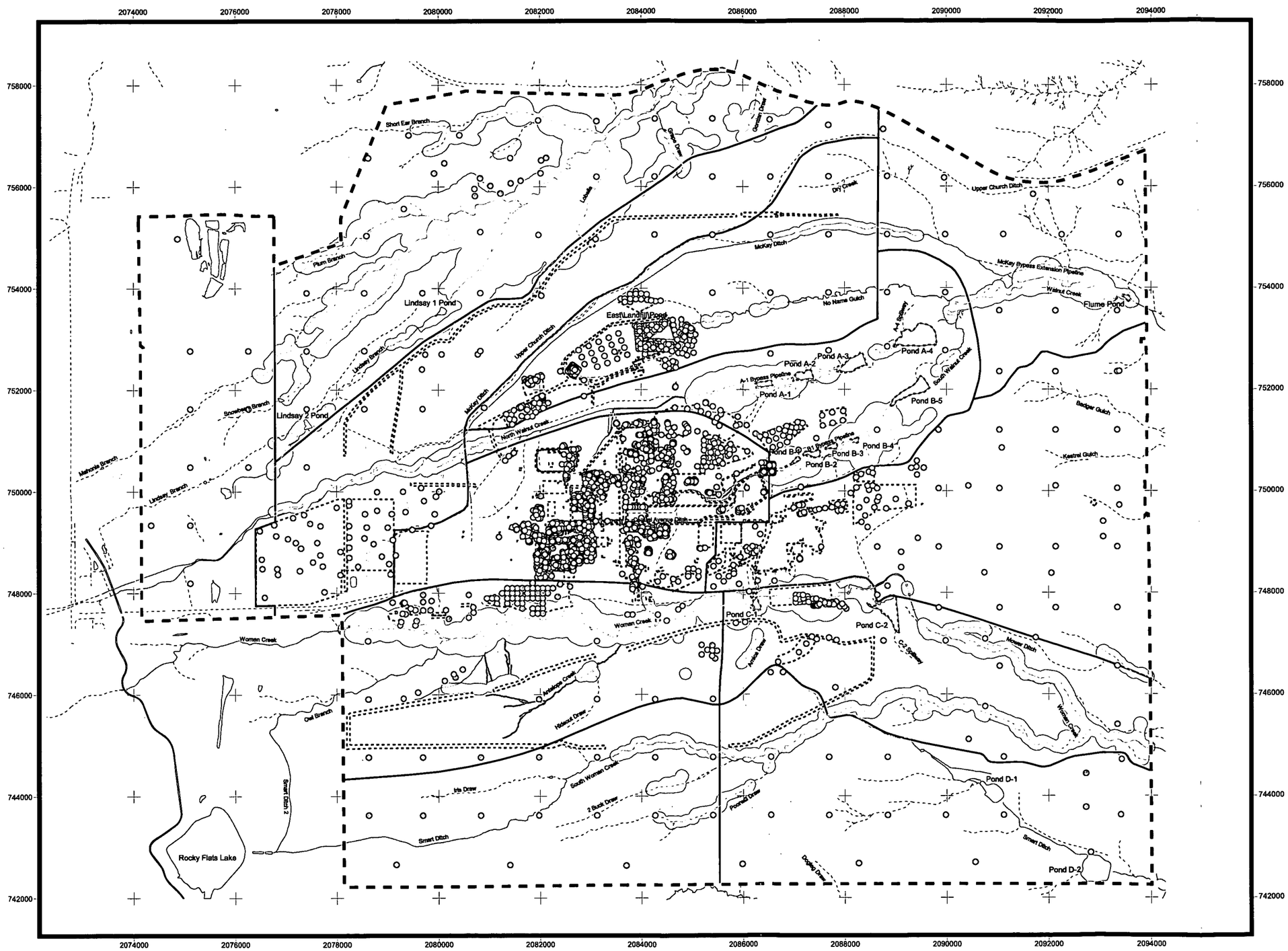

Figure A8.3

Antimony Concentrations in Sitewide Surface Soil (PMJM)

KEY

- Concentration > 3x Background MDC
- Concentration > Background MDC and <= 3x Background MDC
- Concentration > ESL and <= Background MDC
- Concentration <= ESL
- Nondetect (ND)

PMJM ESL = 1 mg/kg
MDC* = 2.53 mg/kg
3 x MDC* = 7.59 mg/kg

* Maximum detected concentration of the surface soil background data set for Colorado, Arizona, Kansas, Nebraska, New Mexico, Oklahoma, Utah, and Wyoming from Shacklette and Boerngen (1984).

Standard Map Features

- Exposure Unit boundary
- Former building where analyte was used or generated as waste
- PMJM habitat patch
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N W E S

0 1000 2000 Feet

Scale 1:24,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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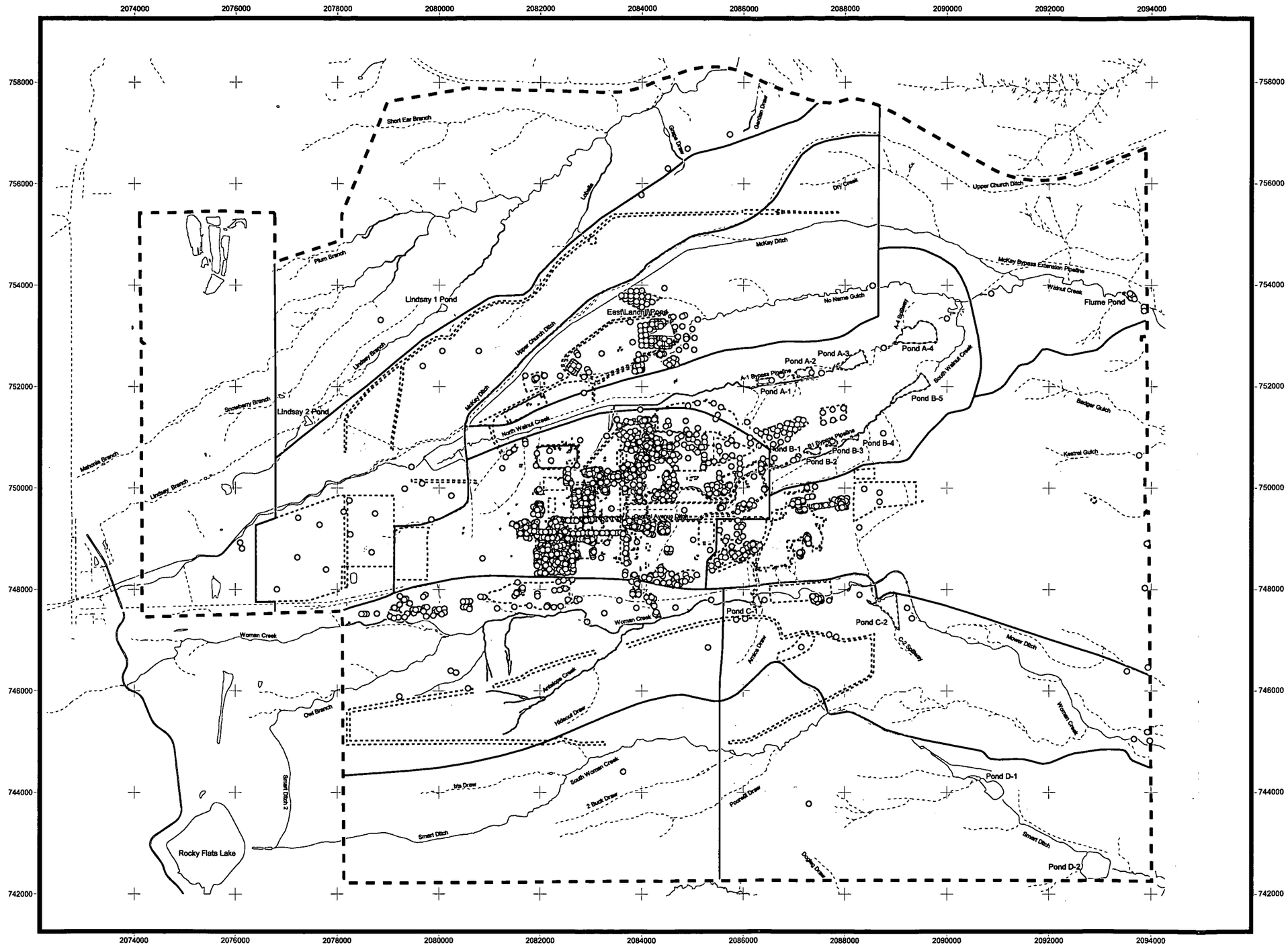

Figure A8.4

Antimony Concentrations in Sitewide Subsurface Soil

KEY

- Concentration > 3x ESL
- Concentration > ESL and <= 3x ESL
- Concentration > Background MDC and <= ESL
- Concentration <= Background MDC
- Nondetect (ND)

Background MDC = 8.20 mg/kg
Pdog_N ESL = 18.7 mg/kg
3 x Pdog_N ESL = 56.2 mg/kg

Standard Map Features

- Exposure Unit boundary
- Former building where analyte was used or generated as waste
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N W E S

0 1000 2000 Feet

Scale 1:24,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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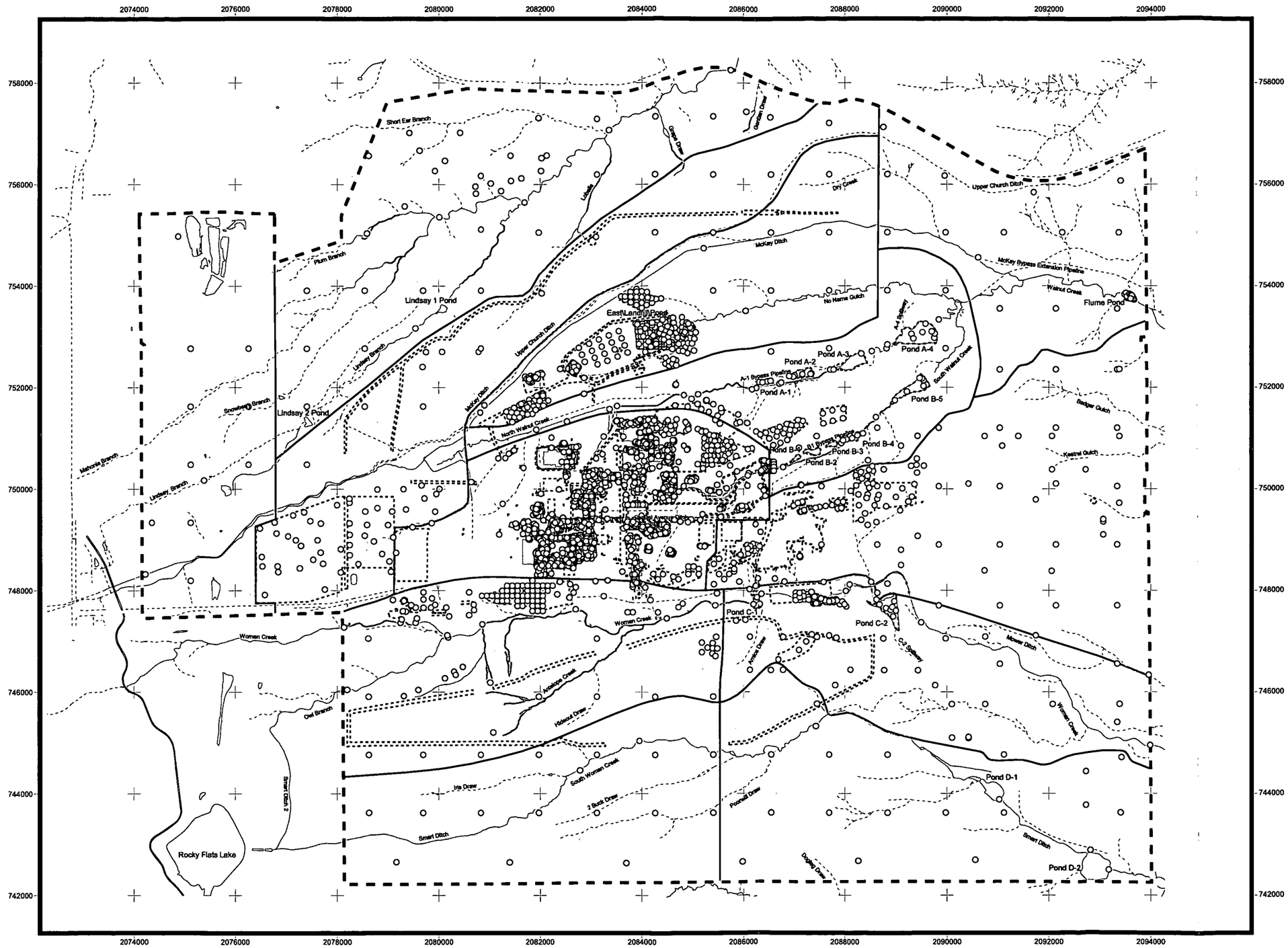

Figure A8.5

Arsenic Concentrations in Sitewide Surface Soil/Surface Sediment

KEY

- Concentration > 3x Background MDC
- Concentration > Background MDC and <= 3x Background MDC
- Concentration > WRW PRG and <= Background MDC
- Concentration <= WRW PRG
- Nondetect (ND)

WRW PRG = 2.41 mg/kg
Background MDC = 9.60 mg/kg
3 x Background MDC = 28.8 mg/kg

Standard Map Features

- Exposure Unit boundary
- Former building where analyte was used or generated as waste
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N W E S

0 1000 2000 Feet

Scale 1:24,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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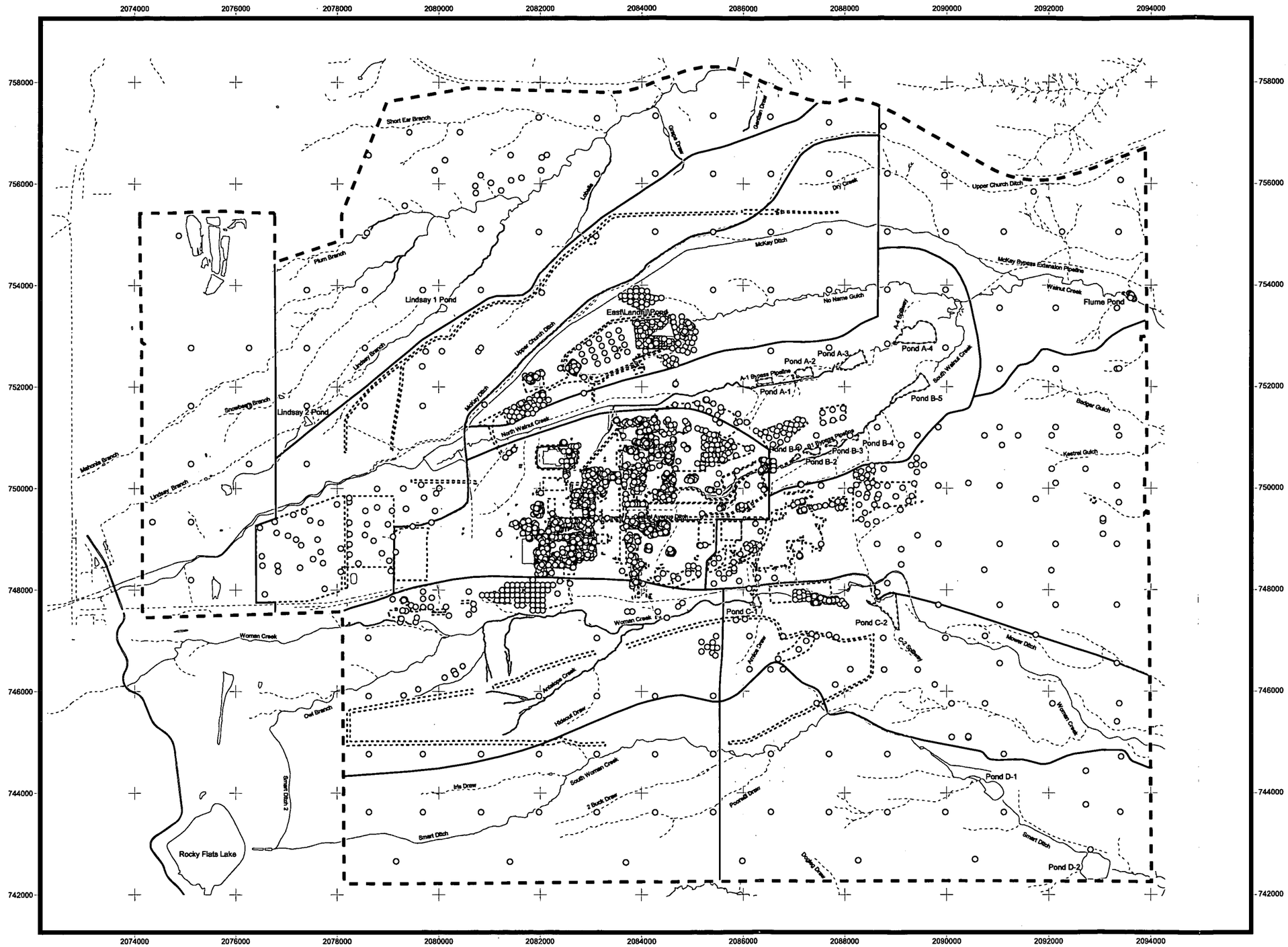

Figure A8.6

Arsenic Concentrations in Sitewide Surface Soil (Non-PMJM)

KEY

- Concentration > 3x Background MDC
- Concentration > Background MDC and <= 3x Background MDC
- Concentration > ESL and <= Background MDC
- Concentration <= ESL
- Nondetect (ND)

Min. Non-PMJM ESL = 2.57 mg/kg
Background MDC = 9.60 mg/kg
3 x Background MDC = 28.8 mg/kg

Standard Map Features

- Exposure Unit boundary
- Former building where analyte was used or generated as waste
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N W E S

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Scale 1:24,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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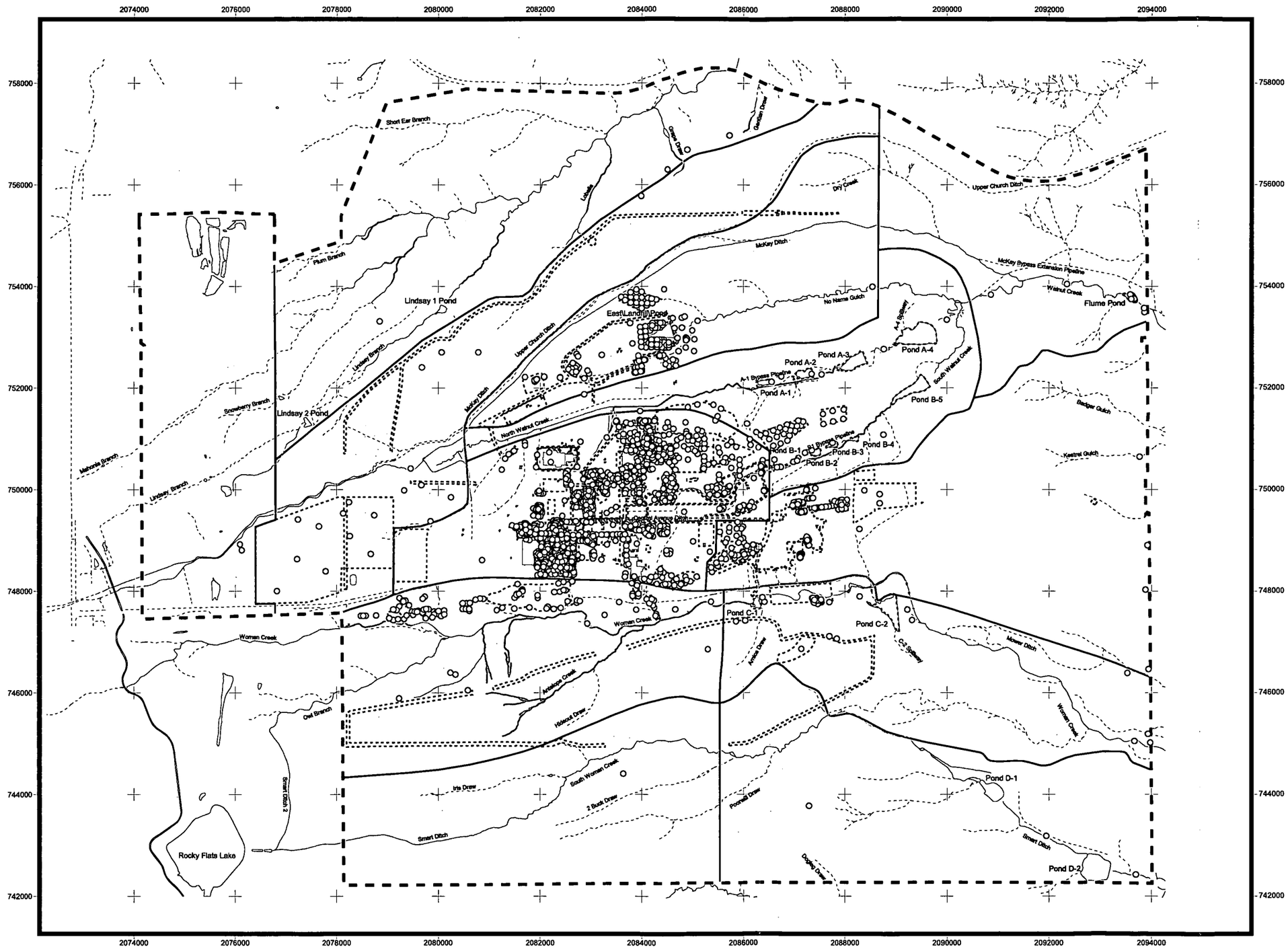

Figure A8.7

Arsenic Concentrations in Sitewide Subsurface Soil

KEY

- Concentration > 3x Background MDC
- Concentration > Background MDC and <= 3x Background MDC
- Concentration > ESL and <= Background MDC
- Concentration <= ESL
- Nondetect (ND)

Pdog_N ESL = 9.35 mg/kg
Background MDC = 41.8 mg/kg
3 x Background MDC = 125 mg/kg

Standard Map Features

- Exposure Unit boundary
- Former building where analyte was used or generated as waste
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

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State Plane Coordinate Projection
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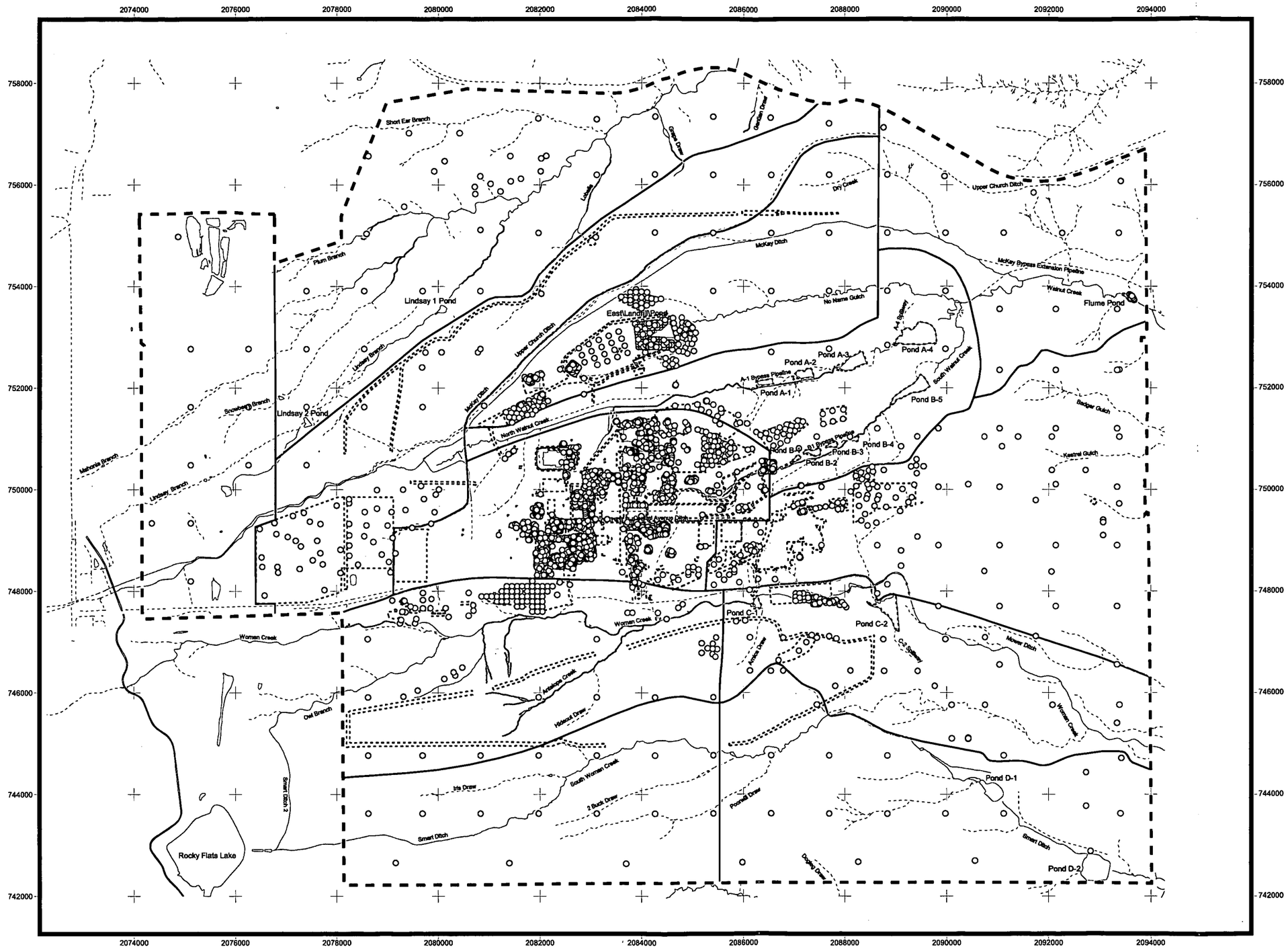

Figure A8.8

Barium Concentrations in Sitewide Surface Soil (Non-PMJM)

KEY

- Concentration > 3x ESL
- Concentration > ESL and <= 3x ESL
- Concentration > Background MDC and <= ESL
- Concentration <= Background MDC
- Nondetect (ND)

Background MDC = 134 mg/kg
Min. Non-PMJM ESL = 159 mg/kg
3 x Min. Non-PMJM ESL = 476 mg/kg

Standard Map Features

- Exposure Unit boundary
- Former building where analyte was used or generated as waste
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

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Scale 1:24,000

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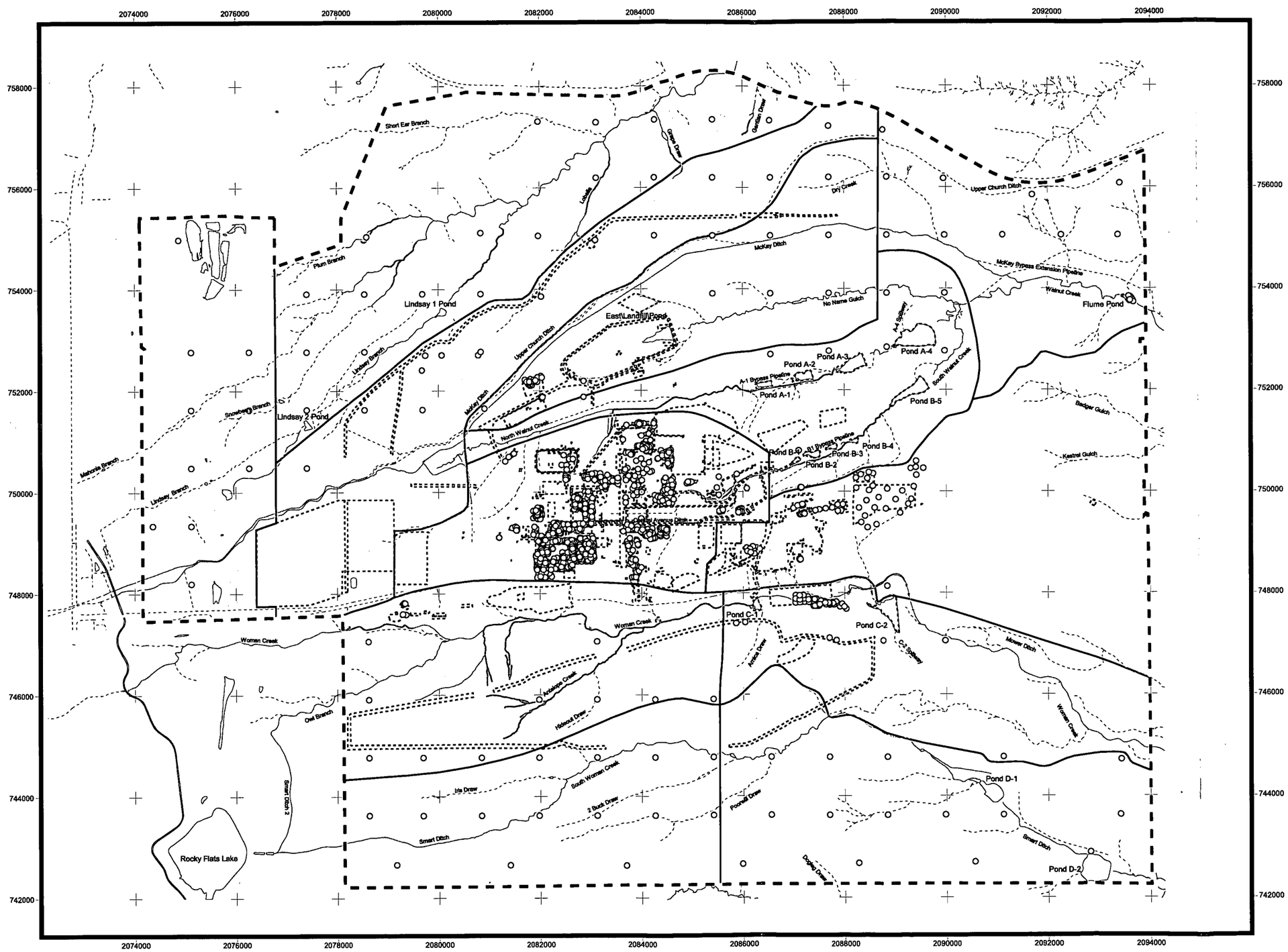

Figure A8.9

Boron Concentrations in Sitewide Surface Soil (Non-PMJM)

KEY

- Concentration > 3x Background MDC
- Concentration > Background MDC and <= 3x Background MDC
- Concentration > ESL and <= Background MDC
- Concentration <= ESL
- Nondetect (ND)

Min. Non-PMJM ESL = 0.500 mg/kg
MDC* = 150 mg/kg
3 x MDC* = 450 mg/kg

* Maximum detected concentration of the surface soil background data set for Colorado, Arizona, Kansas, Nebraska, New Mexico, Oklahoma, Utah, and Wyoming from Shacklette and Boerngen (1984).

Standard Map Features

- Exposure Unit boundary
- Former building where analyte was used or generated as waste
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

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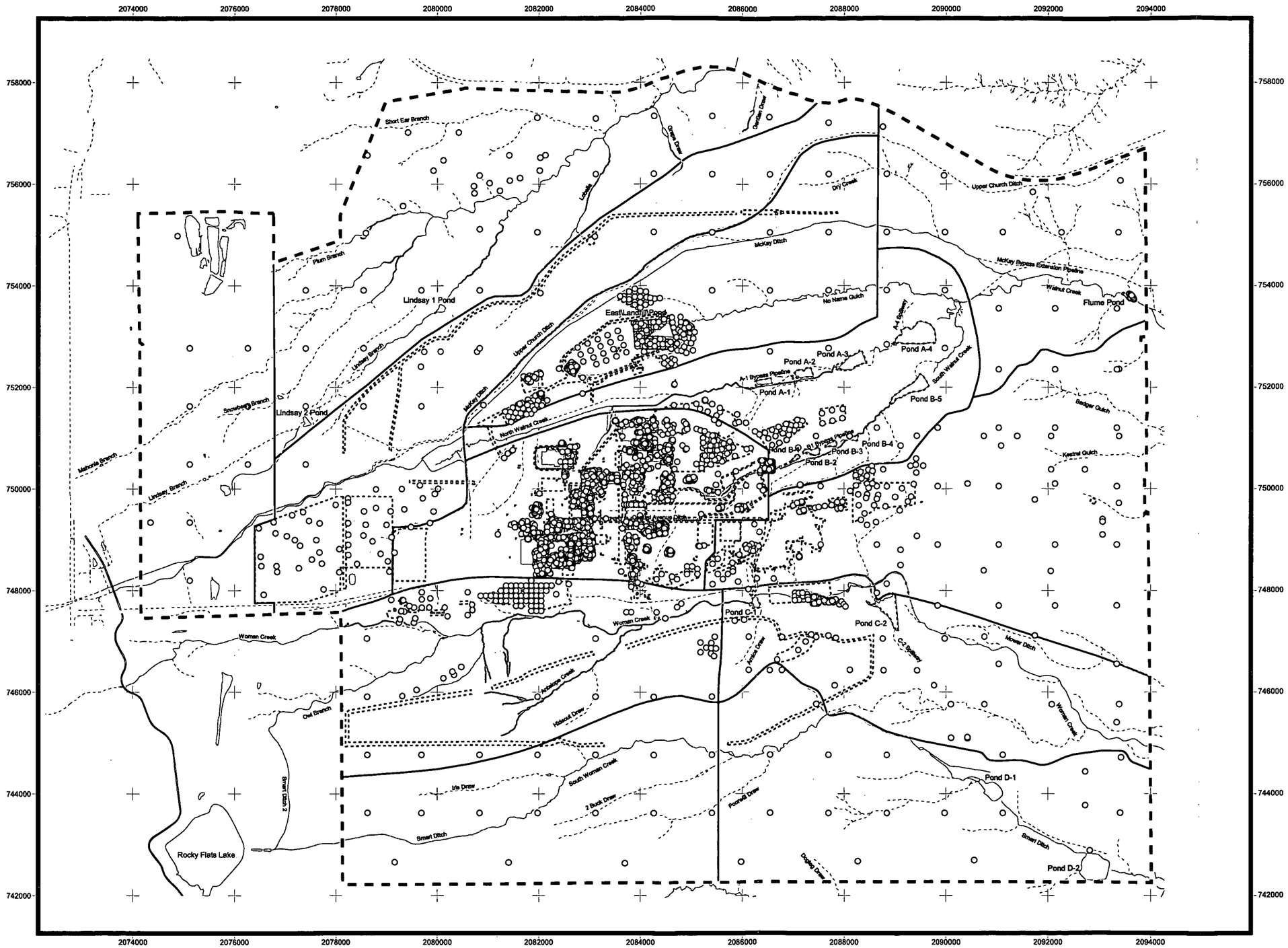

Figure A8.10

Chromium Concentrations in Sitewide Surface Soil (Non-PMJM)

KEY

- Concentration > 3x Background MDC
- Concentration > Background MDC and <= 3x Background MDC
- Concentration > ESL and <= Background MDC
- Concentration <= ESL
- Nondetect (ND)

Min. Non-PMJM ESL = 0.400 mg/kg
Background MDC = 16.9 mg/kg
3 x Background MDC = 50.7 mg/kg

Standard Map Features

- Exposure Unit boundary
- Former building where analyte was used or generated as waste
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

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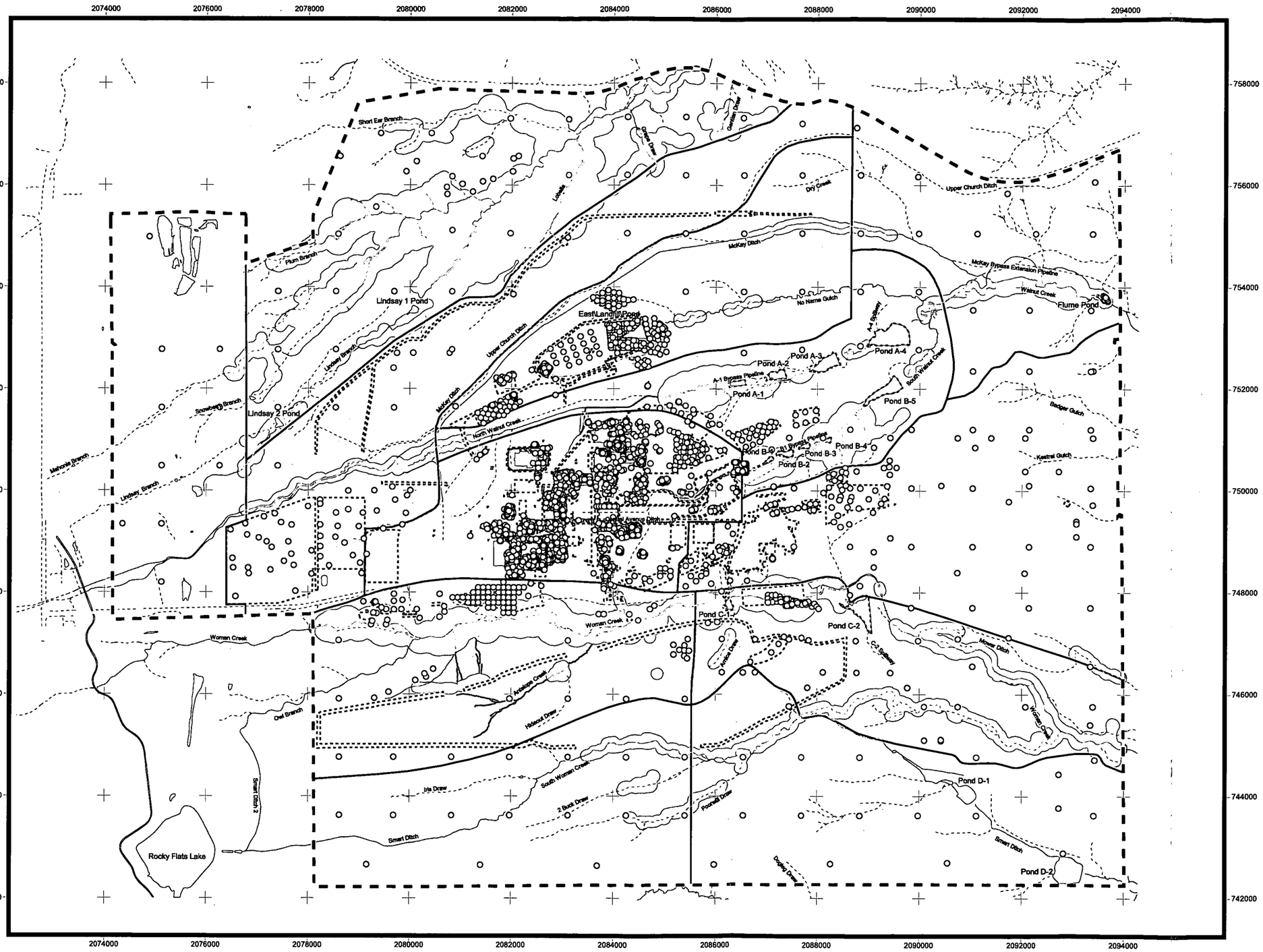

Figure A8.11

Chromium Concentrations in Sitewide Surface Soil (PMJM)

KEY

- Concentration > 3x ESL
- Concentration > ESL and <= 3x ESL
- Concentration > Background MDC and <= ESL
- Concentration <= Background MDC
- Nondetect (ND)

Background MDC = 16.9 mg/kg
PMJM ESL = 19.3 mg/kg
3 x PMJM ESL = 57.9 mg/kg

Standard Map Features

- Exposure Unit boundary
- Former building where analyte was used or generated as waste
- PMJM habitat patch
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

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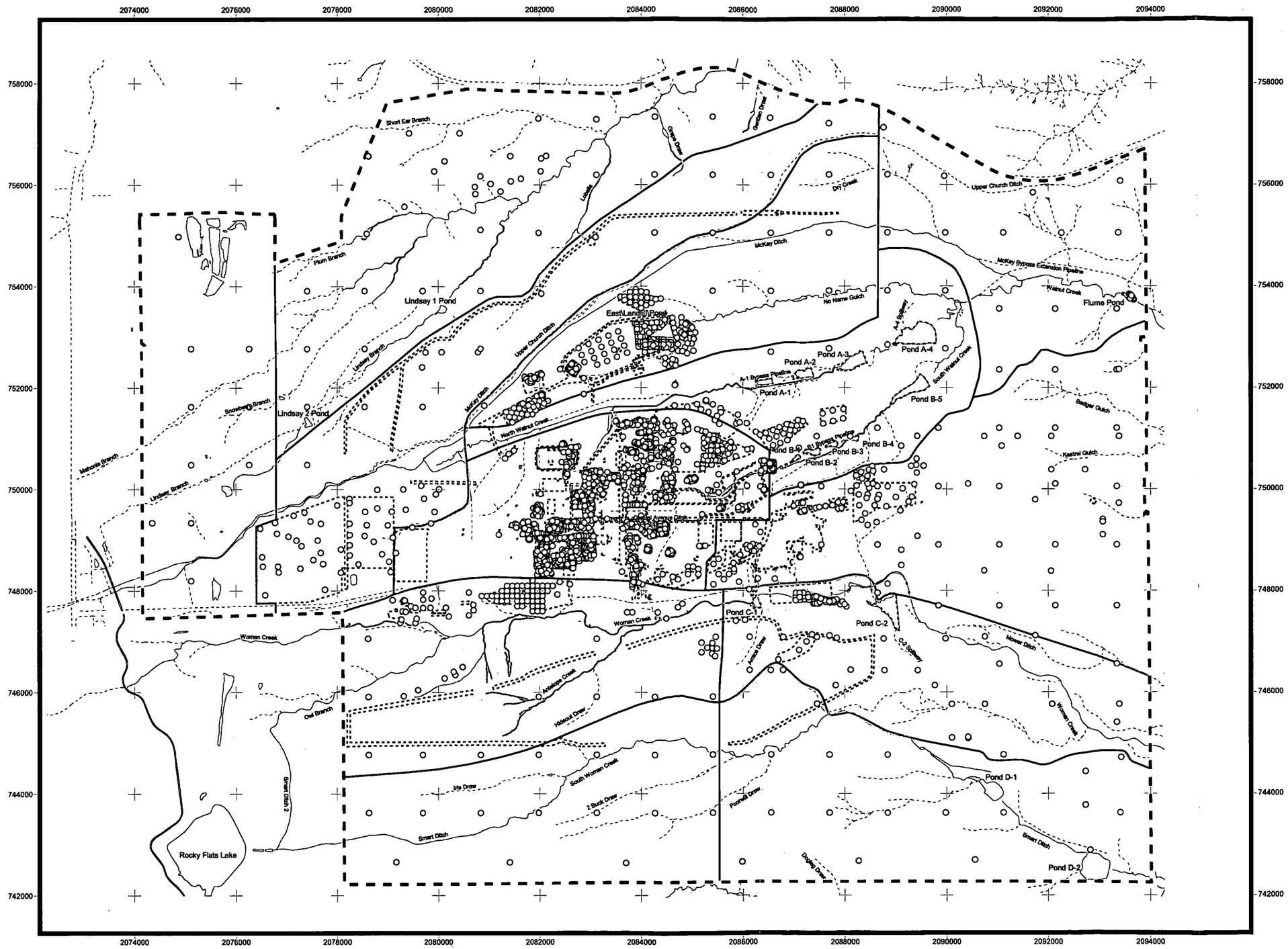

Figure A8.12

Copper Concentrations in Sitewide Surface Soil (Non-PMJM)

KEY

- Concentration > 3x Background MDC
- Concentration > Background MDC and <= 3x Background MDC
- Concentration > ESL and <= Background MDC
- Concentration <= ESL
- Nondetect (ND)

Min. Non-PMJM ESL = 8.25 mg/kg
Background MDC = 16 mg/kg
3 x Background MDC = 48 mg/kg

Standard Map Features

- Exposure Unit boundary
- Former building where analyte was used or generated as waste
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N W E S

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Scale 1:24,000

State Plane Coordinate Projection
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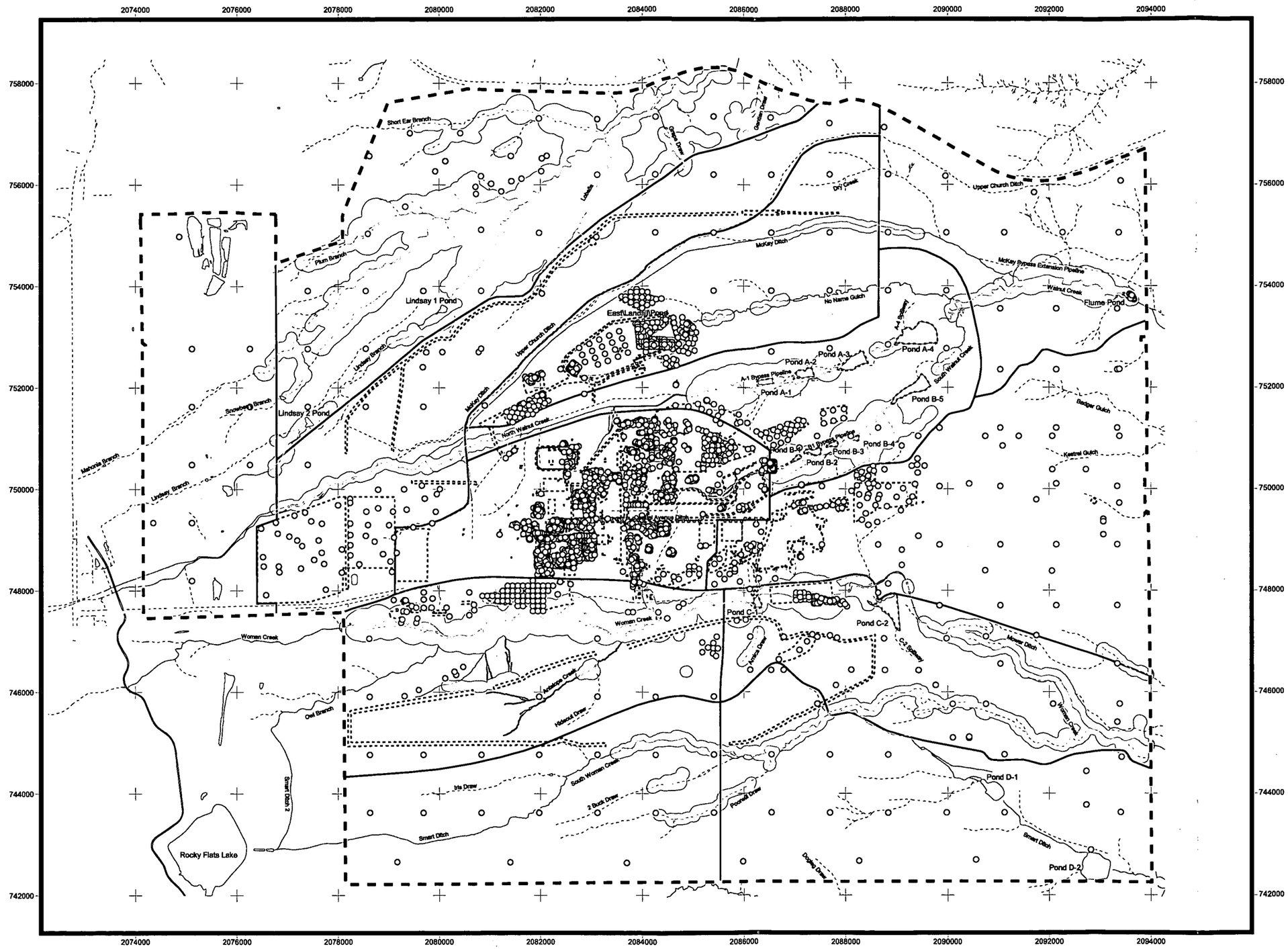

Figure A8.13

Copper Concentrations in Sitewide Surface Soil (PMJM)

KEY

- Concentration > 3x ESL
- Concentration > ESL and <= 3x ESL
- Concentration > Background MDC and <= ESL
- Concentration <= Background MDC
- Nondetect (ND)

Background MDC = 16 mg/kg
PMJM ESL = 95 mg/kg
3 x PMJM ESL = 285 mg/kg

Standard Map Features

- Exposure Unit boundary
- Former building where analyte was used or generated as waste
- PMJM habitat patch
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N W E S

0 1000 2000 Feet

Scale 1:24,000

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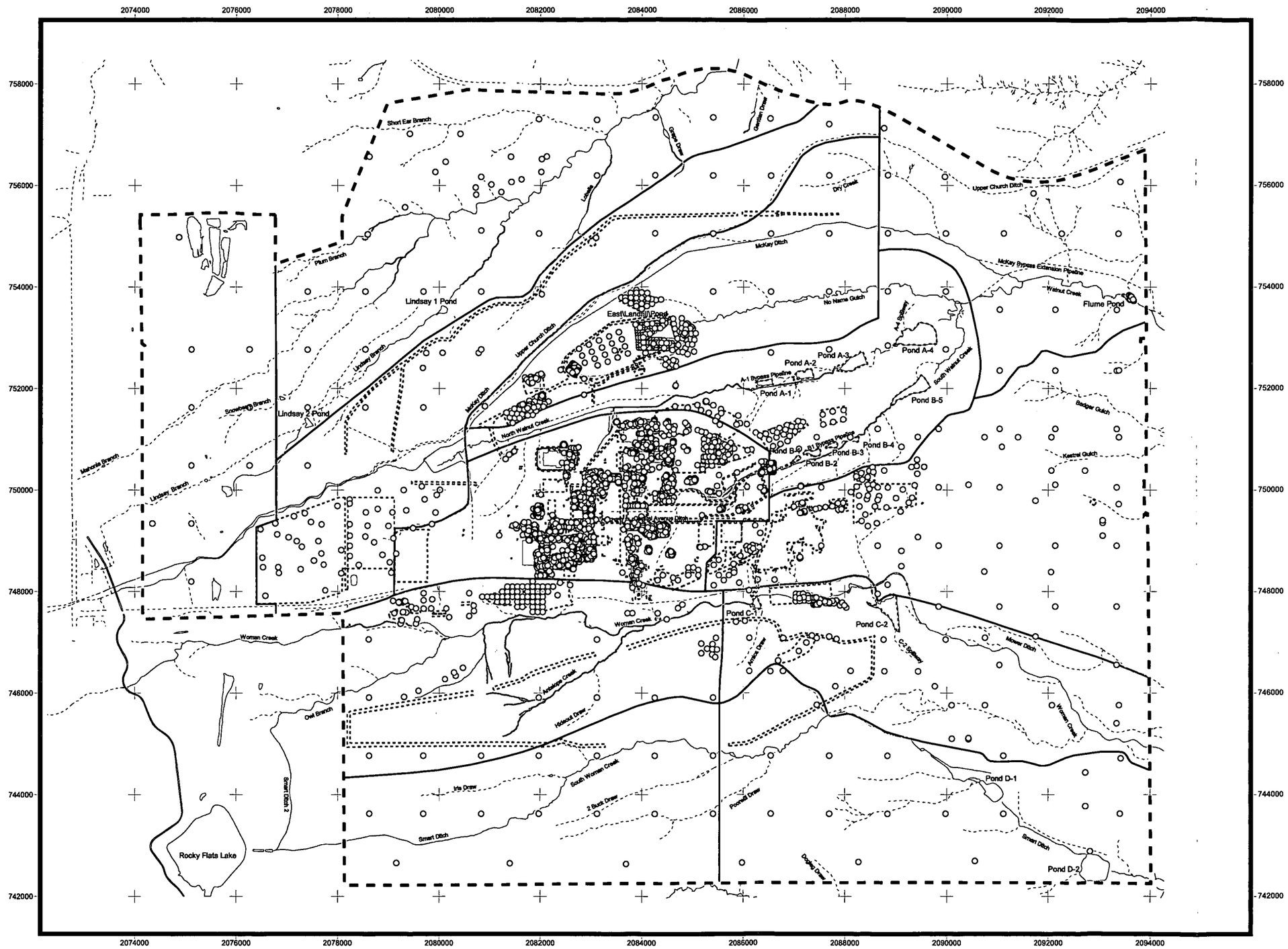

Figure A8.14

Lead Concentrations in Sitewide Surface Soil (Non-PMJM)

KEY

- Concentration > 3x Background MDC
- Concentration > Background MDC and <= 3x Background MDC
- Concentration > ESL and <= Background MDC
- Concentration <= ESL
- Nondetect (ND)

Min. Non-PMJM ESL = 12.1 mg/kg
Background MDC = 53.3 mg/kg
3 x Background MDC = 160 mg/kg

Standard Map Features

- Exposure Unit boundary
- Former building where analyte was used or generated as waste
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

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Scale 1:24,000

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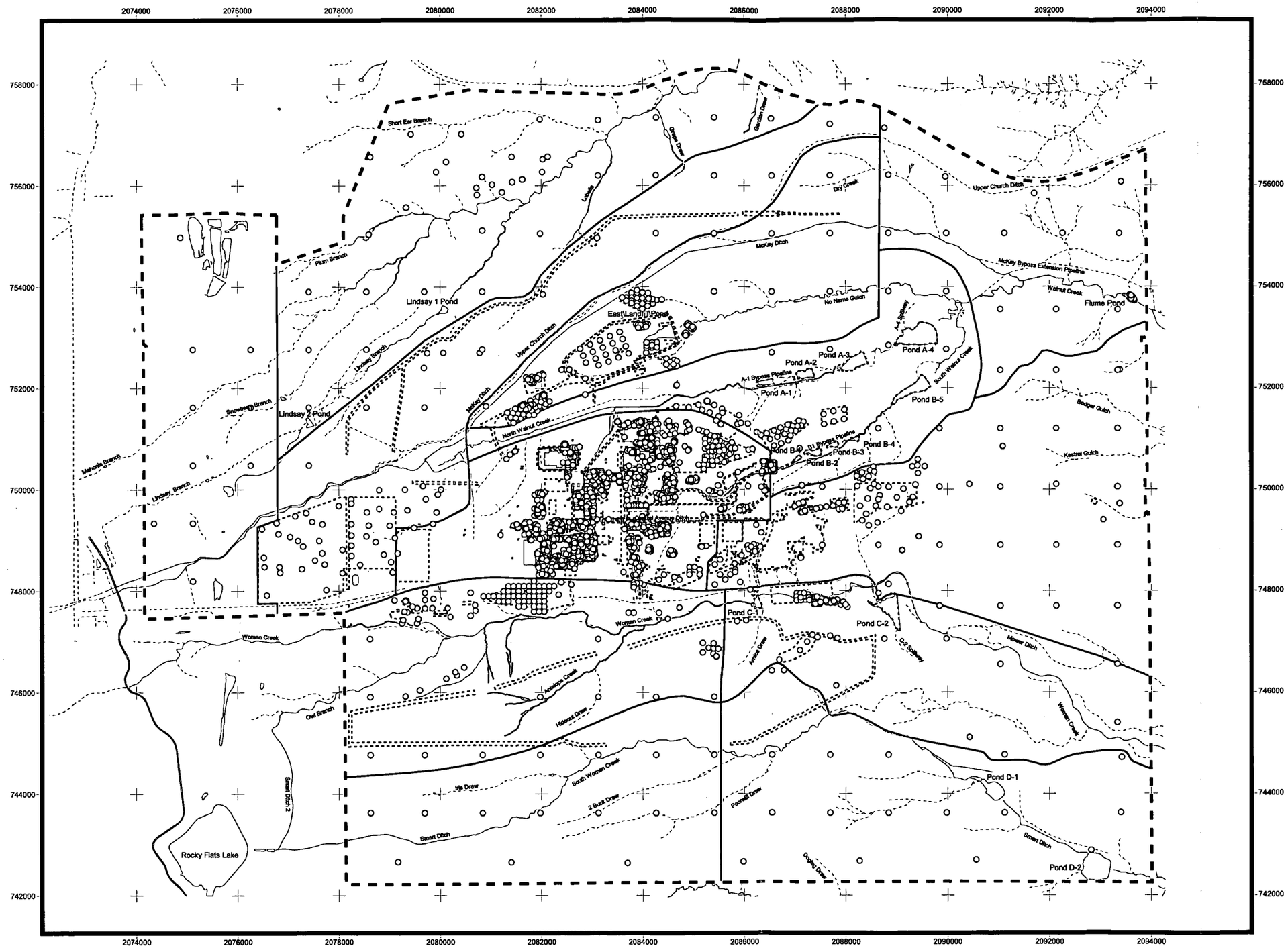

Figure A8.15

Lithium Concentrations in Sitewide Surface Soil (Non-PMJM)

KEY

- Concentration > 3x Background MDC
- Concentration > Background MDC and <= 3x Background MDC
- Concentration > ESL and <= Background MDC
- Concentration <= ESL
- Nondetect (ND)

Min. Non-PMJM ESL = 2 mg/kg
Background MDC = 11.6 mg/kg
3 x Background MDC = 34.8 mg/kg

Standard Map Features

- Exposure Unit boundary
- Former building where analyte was used or generated as waste
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

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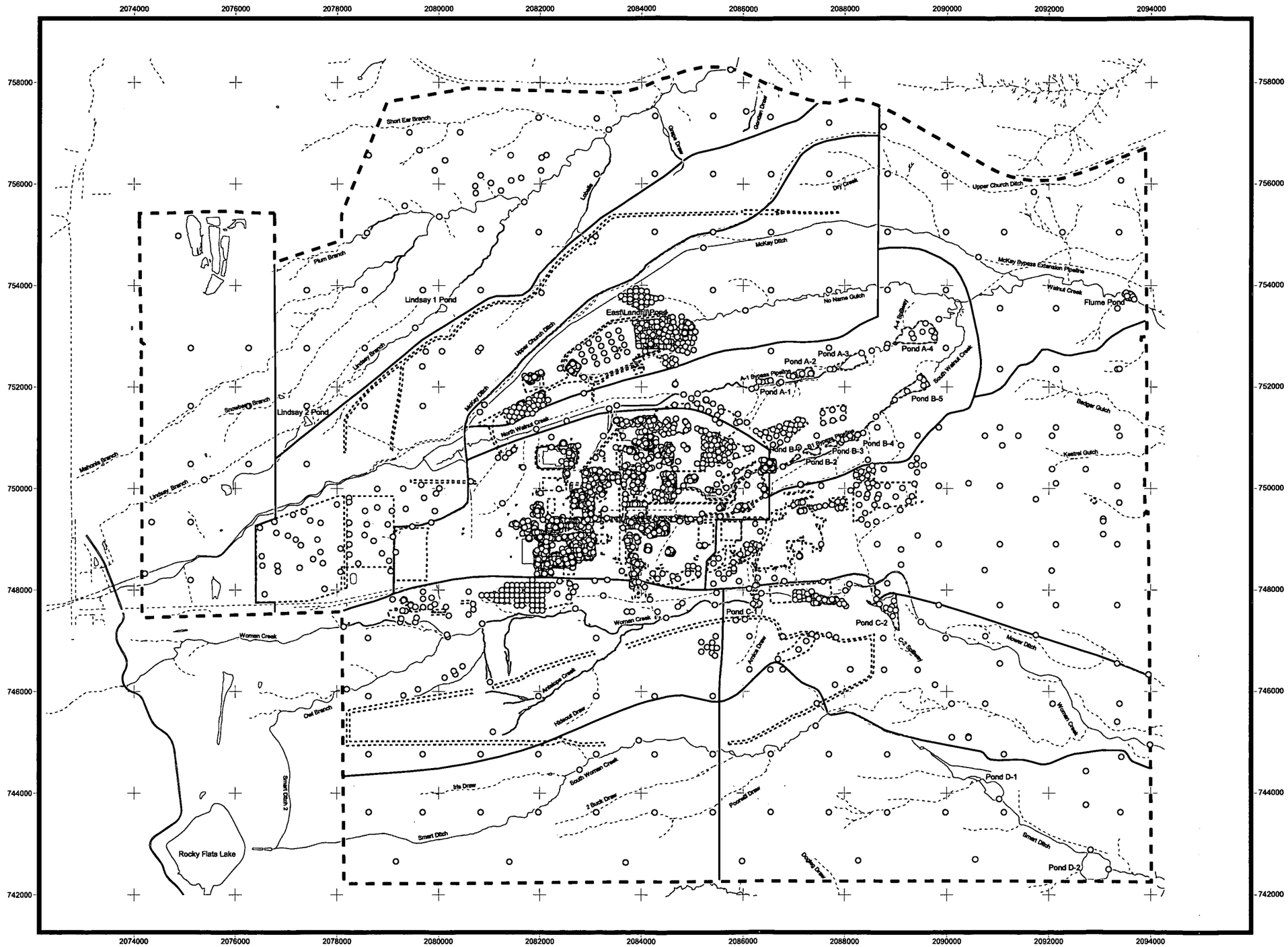

Figure A8.16

Manganese Concentrations in Sitewide Surface Soil/Surface Sediment

KEY

- Concentration > 3x Background MDC
- Concentration > Background MDC and <= 3x Background MDC
- Concentration > WRW PRG and <= Background MDC
- Concentration <= WRW PRG
- Nondetect (ND)

WRW PRG = 419 mg/kg
Background MDC = 1,280 mg/kg
3 x Background MDC = 3,840 mg/kg

Standard Map Features

- Exposure Unit boundary
- Former building where analyte was used or generated as waste
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N W E S

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Scale 1:24,000

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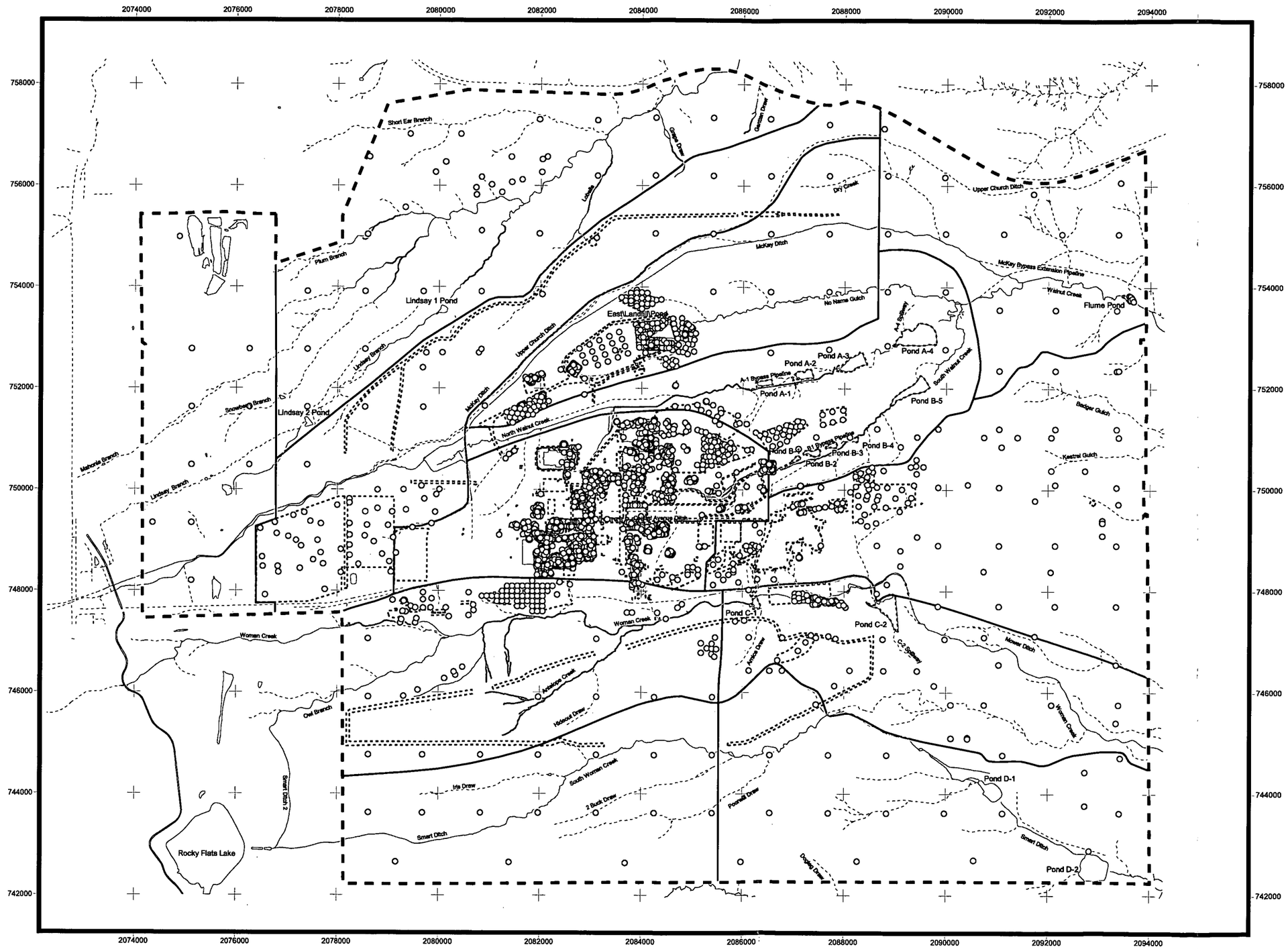

Figure A8.17

Manganese Concentrations in Sitewide Surface Soil (Non-PMJM)

KEY

- Concentration > 3x ESL
- Concentration > ESL and <= 3x ESL
- Concentration > Background MDC and <= ESL
- Concentration <= Background MDC
- Nondetect (ND)

Background MDC = 357 mg/kg
Min. Non-PMJM ESL = 486 mg/kg
3 x Min. Non-PMJM ESL = 1,458 mg/kg

Standard Map Features

- Exposure Unit boundary
- Former building where analyte was used or generated as waste
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N W E S

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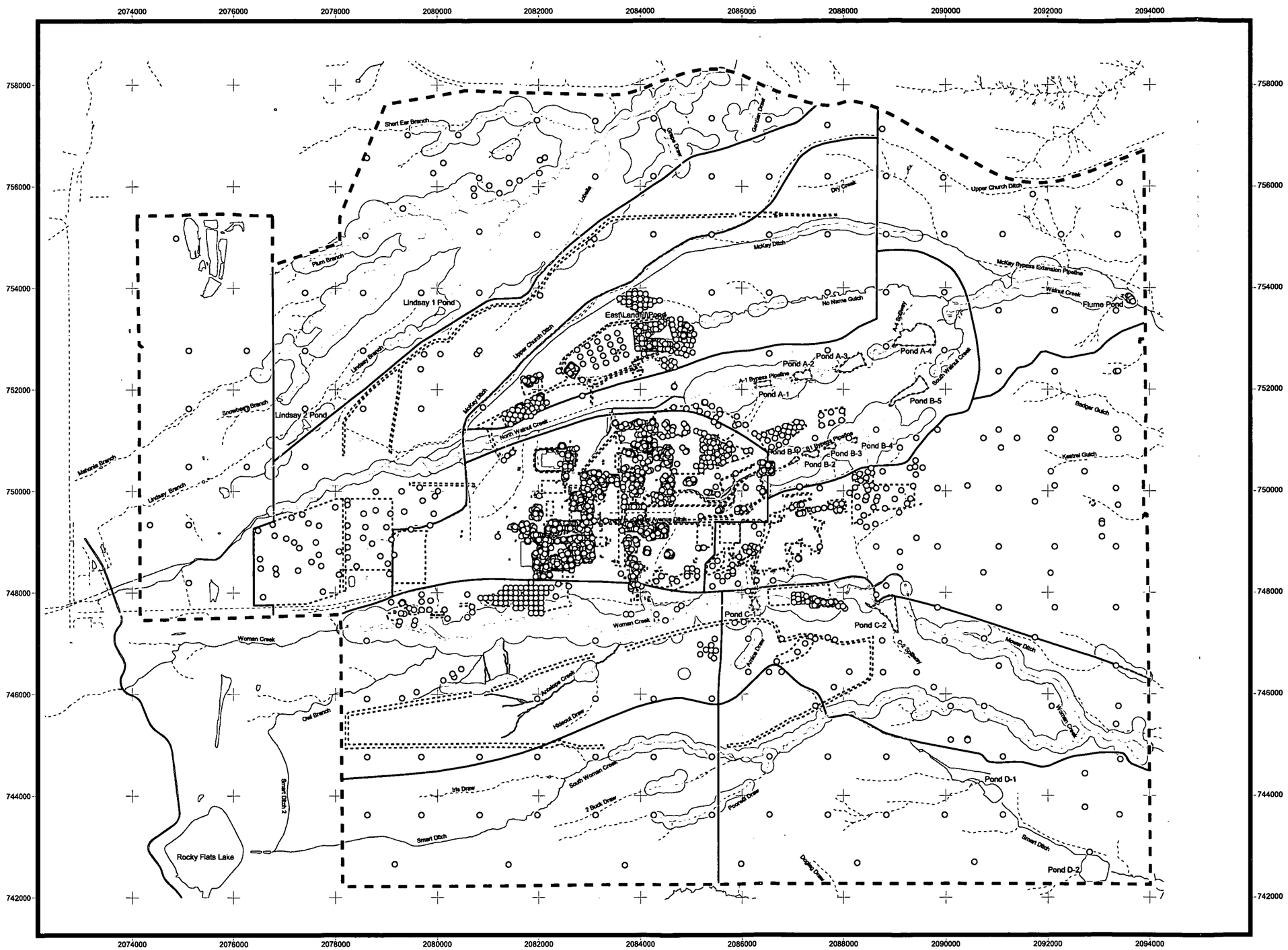

Figure A8.18

Manganese Concentrations in Sitewide Surface Soil (PMJM)

KEY

- Concentration > 3x ESL
- Concentration > ESL and <= 3x ESL
- Concentration > Background MDC and <= ESL
- Concentration <= Background MDC
- Nondetect (ND)

Background MDC = 357 mg/kg
PMJM ESL = 388 mg/kg
3 x PMJM ESL = 1,164 mg/kg

Standard Map Features

- Exposure Unit boundary
- Former building where analyte was used or generated as waste
- PMJM habitat patch
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

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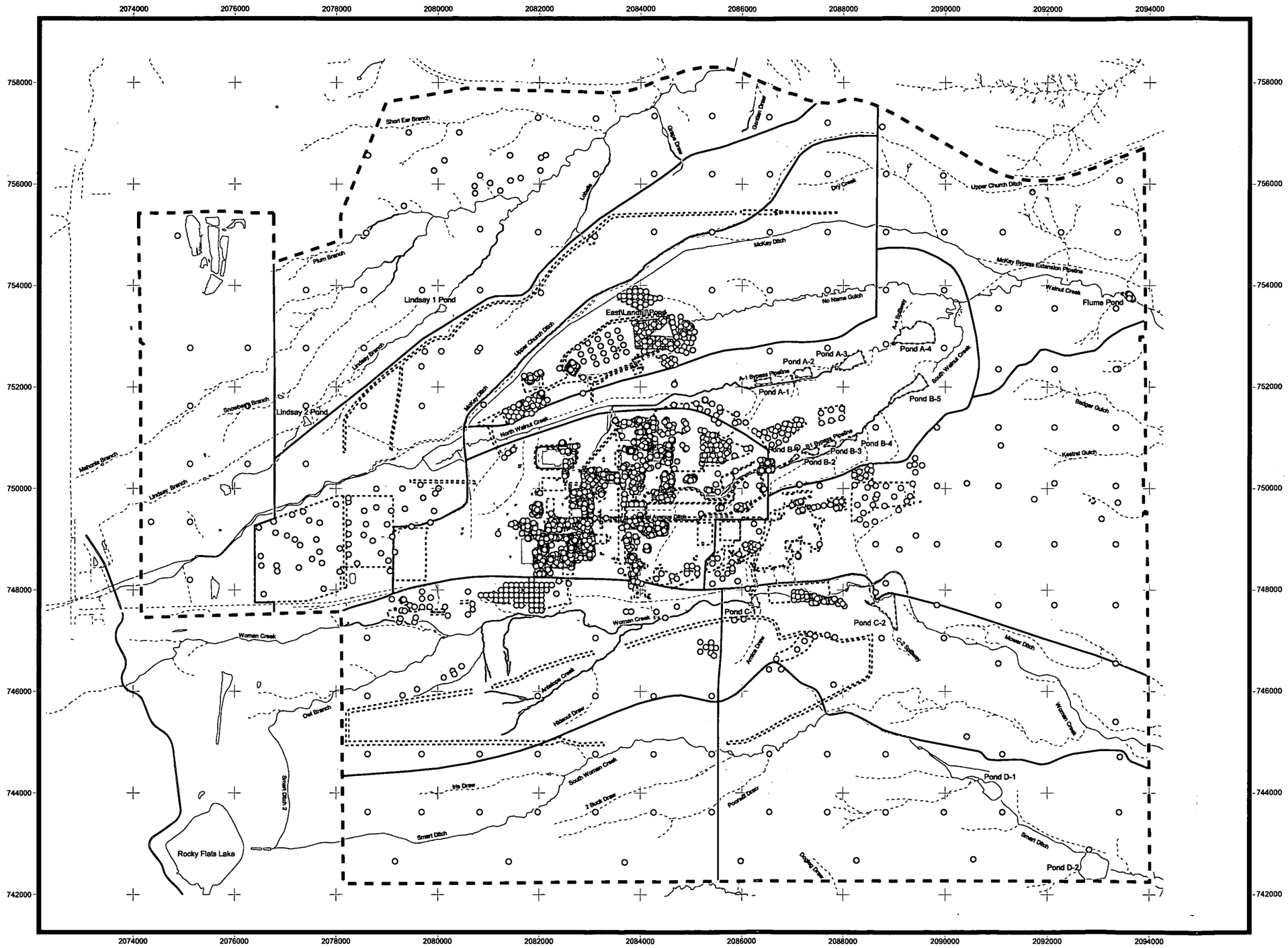

Figure A8.19

Mercury Concentrations in Sitewide Surface Soil (Non-PMJM)

KEY

- Concentration > 3x Background MDC
- Concentration > Background MDC and <= 3x Background MDC
- Concentration > ESL and <= Background MDC
- Concentration <= ESL
- Nondetect (ND)

Min. Non-PMJM ESL = 1.00E-04 mg/kg
Background MDC = 0.120 mg/kg
3 x Background MDC = 0.360 mg/kg

Standard Map Features

- Exposure Unit boundary
- Former building where analyte was used or generated as waste
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

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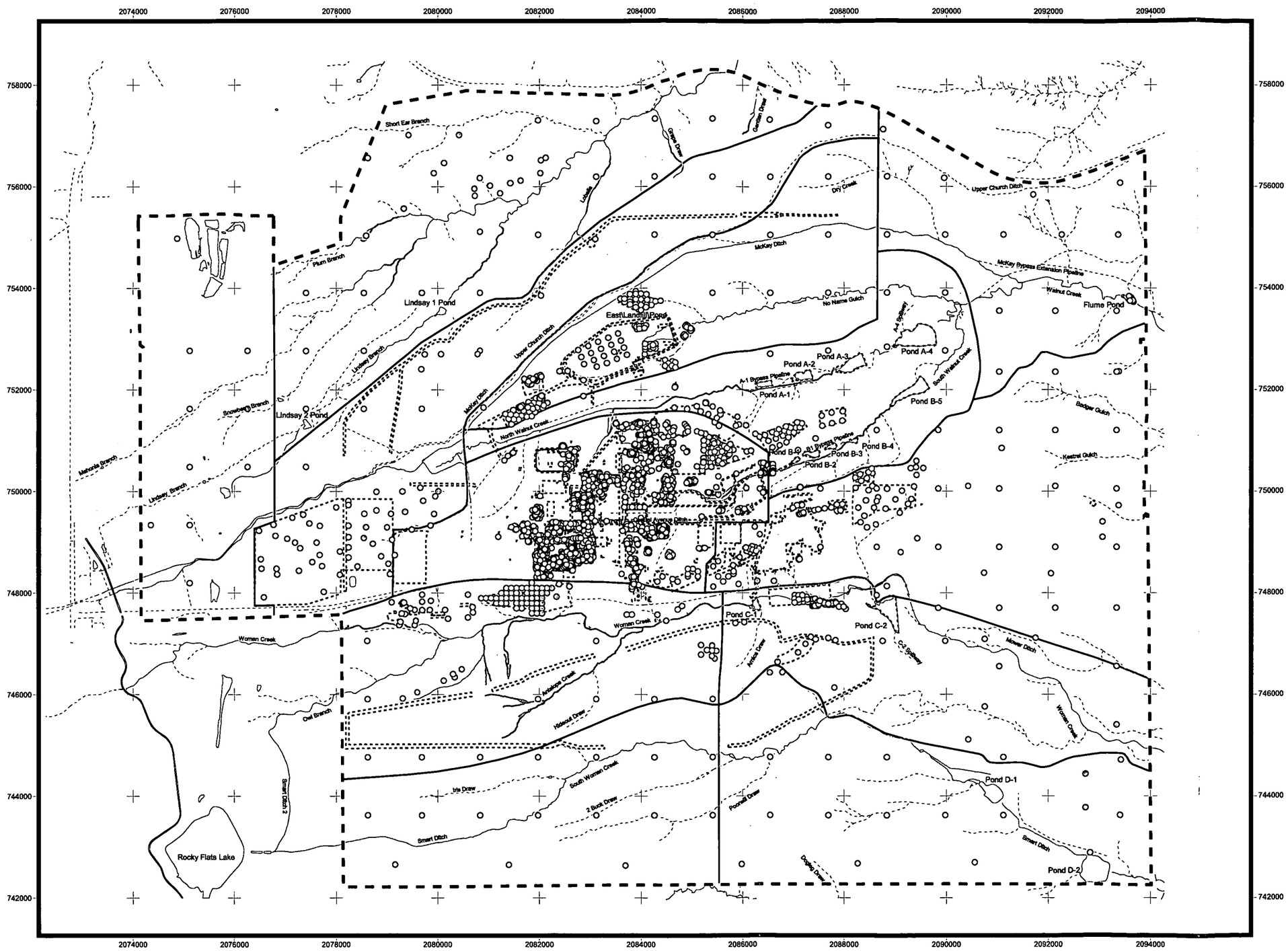

Figure A8.20

Molybdenum Concentrations in Sitewide Surface Soil (Non-PMJM)

KEY

- Concentration > 3x Background MDC
- Concentration > Background MDC and <= 3x Background MDC
- Concentration > ESL and <= Background MDC
- Concentration <= ESL
- Nondetect (ND)

Min. Non-PMJM ESL = 1.90 mg/kg
MDC* = 7 mg/kg
3 x MDC* = 21 mg/kg

* Maximum detected concentration of the surface soil background data set for Colorado, Arizona, Kansas, Nebraska, New Mexico, Oklahoma, Utah, and Wyoming from Shacklette and Boerngen (1984).

Standard Map Features

- Exposure Unit boundary
- Former building where analyte was used or generated as waste
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

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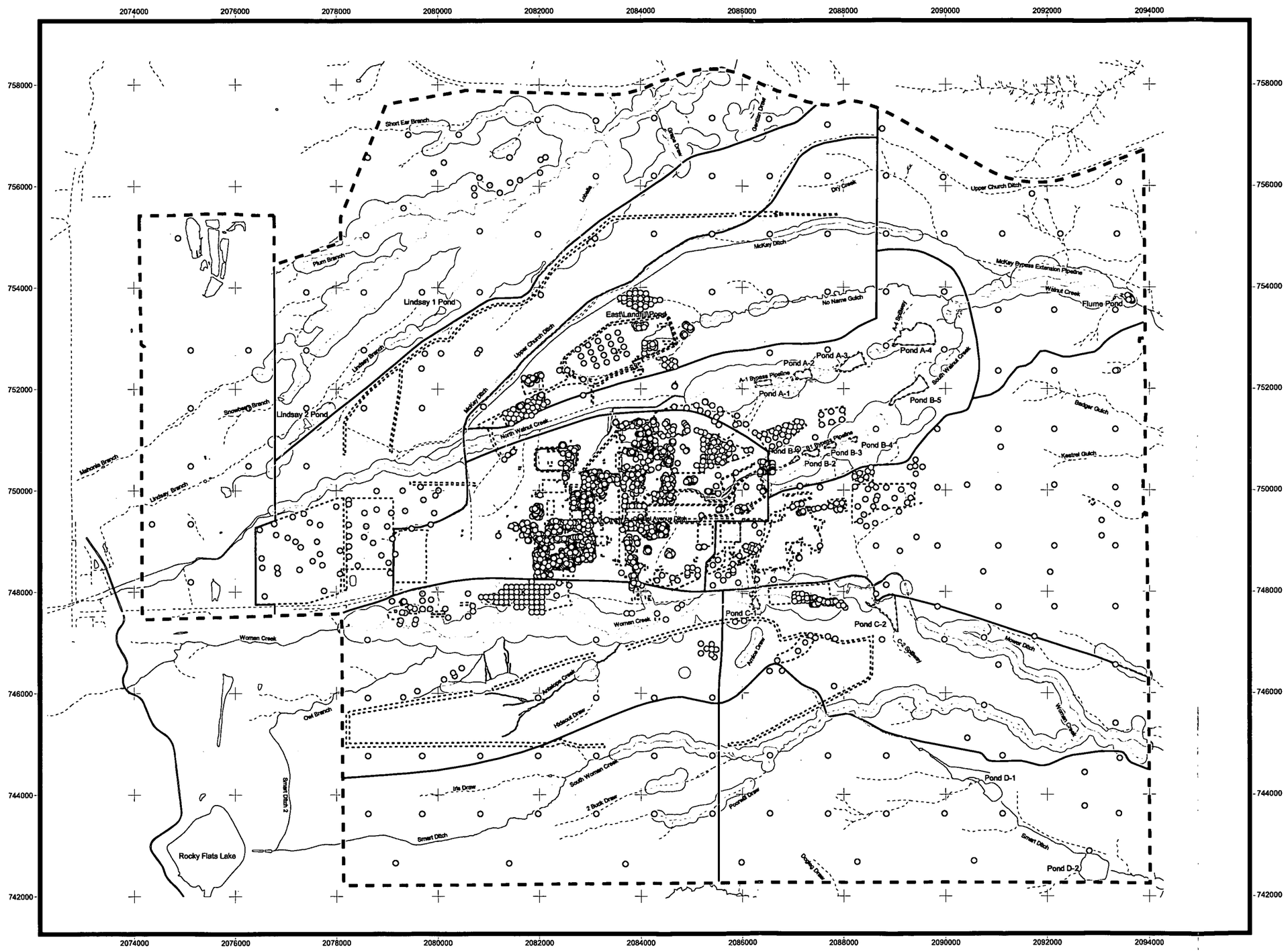

Figure A8.21

Molybdenum Concentrations in Sitewide Surface Soil (PMJM)

KEY

- Concentration > 3x Background MDC
- Concentration > Background MDC and <= 3x Background MDC
- Concentration > ESL and <= Background MDC
- Concentration <= ESL
- Nondetect (ND)

PMJM ESL = 1.84 mg/kg
MDC* = 7 mg/kg
3 x MDC* = 21 mg/kg

* Maximum detected concentration of the surface soil background data set for Colorado, Arizona, Kansas, Nebraska, New Mexico, Oklahoma, Utah, and Wyoming from Shacklette and Boerngen (1984).

Standard Map Features

- Exposure Unit boundary
- Former building where analyte was used or generated as waste
- PMJM habitat patch
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

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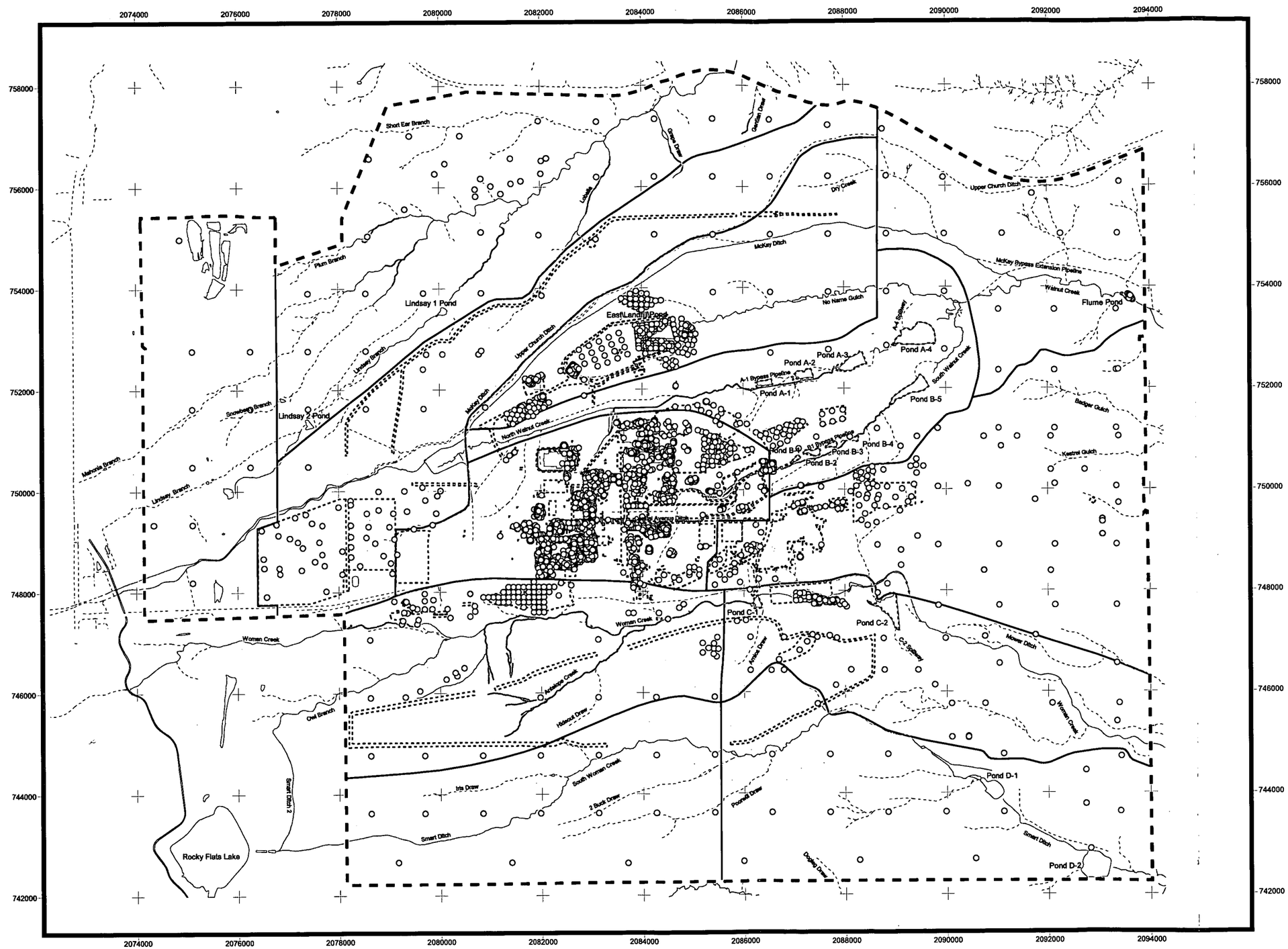

Figure A8.22

Nickel Concentrations in Sitewide Surface Soil (Non-PMJM)

KEY

- Concentration > 3x Background MDC
- Concentration > Background MDC and <= 3x Background MDC
- Concentration > ESL and <= Background MDC
- Concentration <= ESL
- Nondetect (ND)

Min. Non-PMJM ESL = 0.431 mg/kg
Background MDC = 14 mg/kg
3 x Background MDC = 42 mg/kg

Standard Map Features

- Exposure Unit boundary
- Former building where analyte was used or generated as waste
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

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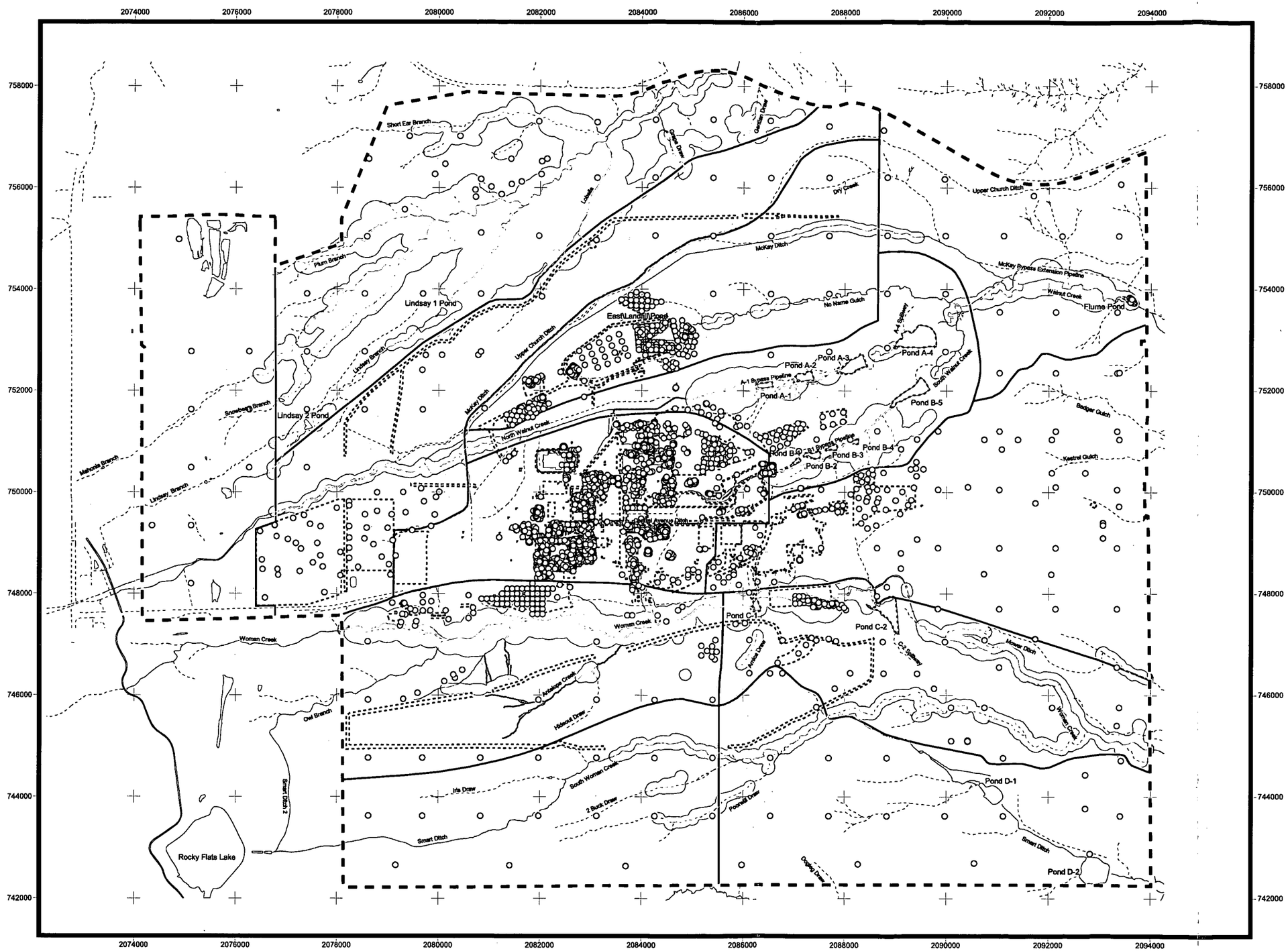

Figure A8.23

Nickel Concentrations in Sitewide Surface Soil (PMJM)

KEY

- Concentration > 3x Background MDC
- Concentration > Background MDC and <= 3x Background MDC
- Concentration > ESL and <= Background MDC
- Concentration <= ESL
- Nondetect (ND)

PMJM ESL = 0.510 mg/kg
Background MDC = 14 mg/kg
3 x Background MDC = 42 mg/kg

Standard Map Features

- Exposure Unit boundary
- Former building where analyte was used or generated as waste
- PMJM habitat patch
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N W E S

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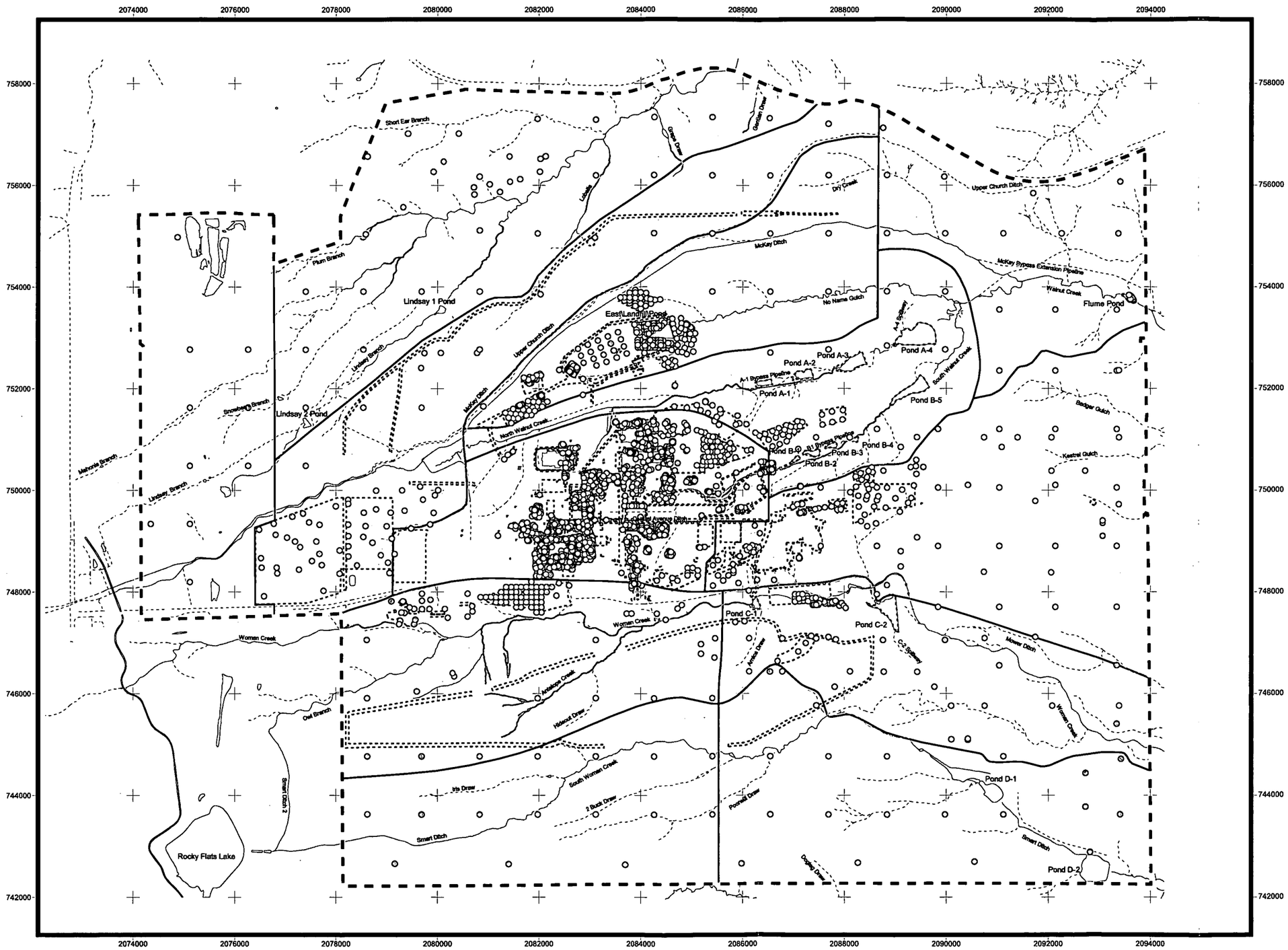

Figure A8.24

Selenium Concentrations in Sitewide Surface Soil (Non-PMJM)

KEY

- Concentration > 3x Background MDC
- Concentration > Background MDC and <= 3x Background MDC
- Concentration > ESL and <= Background MDC
- Concentration <= ESL
- Nondetect (ND)

Min. Non-PMJM ESL = 0.754 mg/kg
Background MDC = 1.40 mg/kg
3 x Background MDC = 4.20 mg/kg

Standard Map Features

- Exposure Unit boundary
- Former building where analyte was used or generated as waste
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N W E S

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Scale 1:24,000

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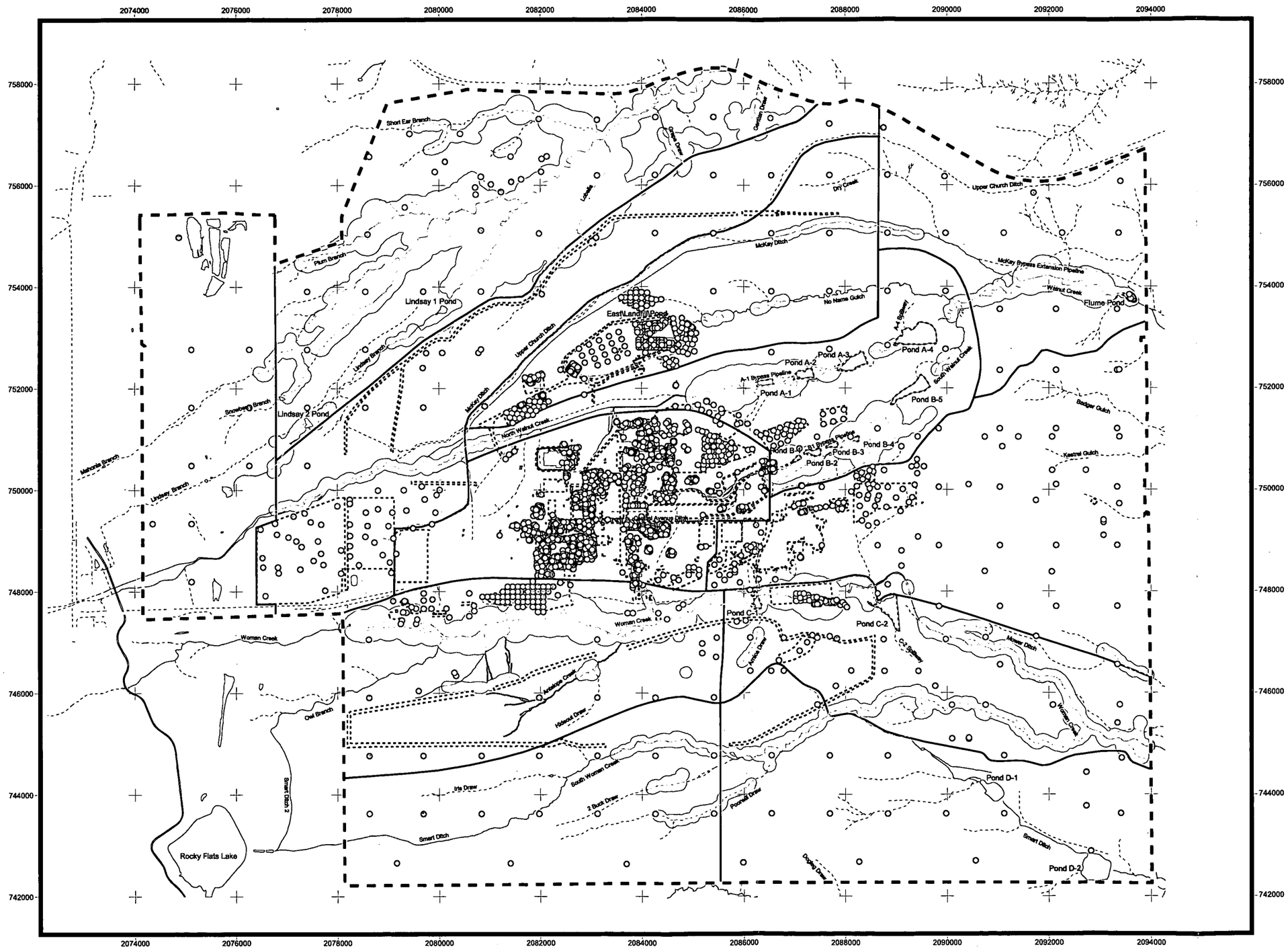

Figure A8.25

Selenium Concentrations in Sitewide Surface Soil (PMJM)

KEY

- Concentration > 3x Background MDC
- Concentration > Background MDC and <= 3x Background MDC
- Concentration > ESL and <= Background MDC
- Concentration <= ESL
- Nondetect (ND)

PMJM ESL = 0.421 mg/kg
Background MDC = 1.40 mg/kg
3 x Background MDC = 4.20 mg/kg

Standard Map Features

- Exposure Unit boundary
- Former building where analyte was used or generated as waste
- PMJM habitat patch
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N W E S

0 1000 2000 Feet

Scale 1:24,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
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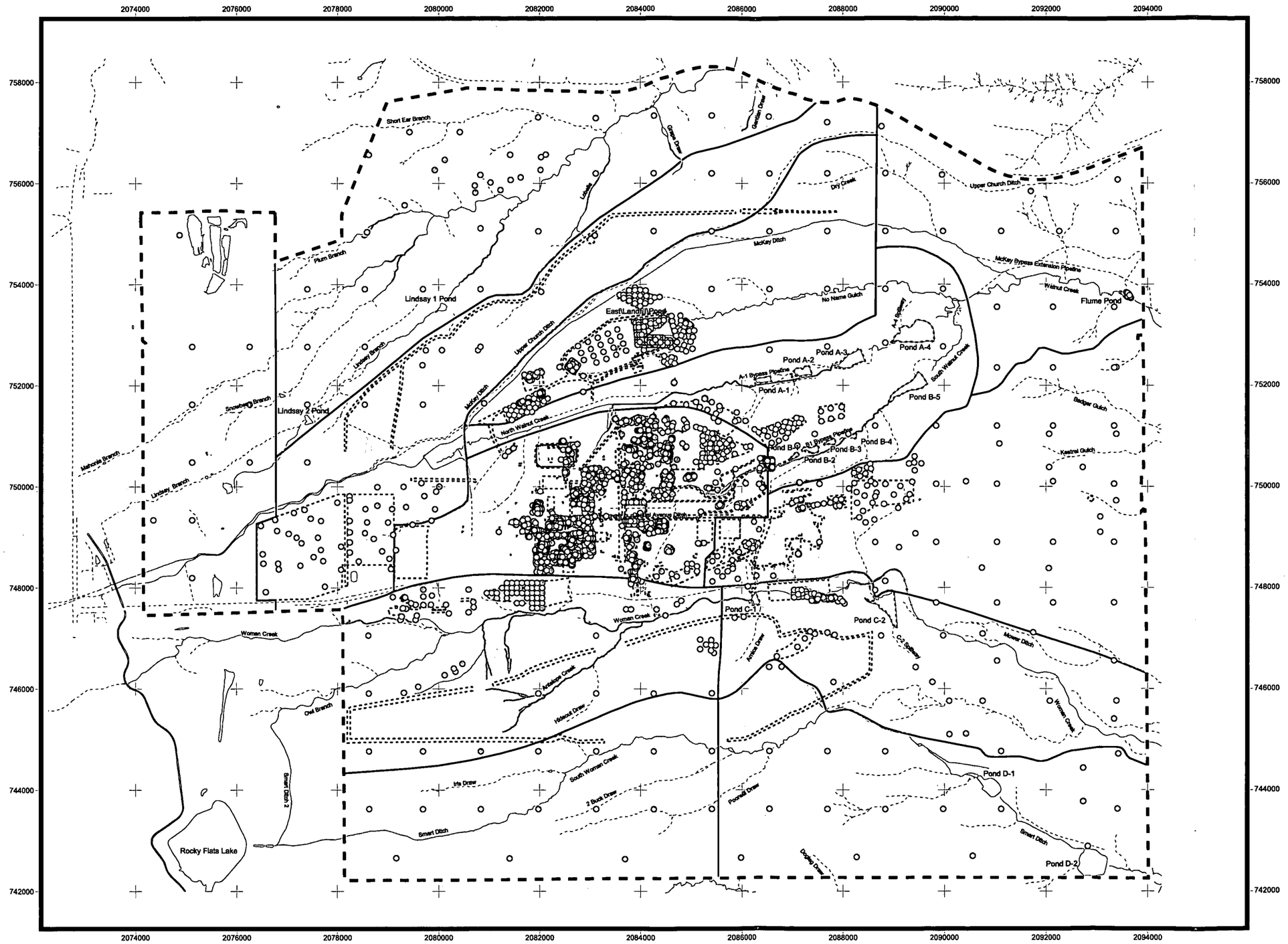

Figure A8.26

Silver Concentrations in Sitewide Surface Soil (Non-PMJM)

KEY

- Concentration > 3x Background MDC
- Concentration > Background MDC and <= 3x Background MDC
- Concentration > ESL and <= Background MDC
- Concentration <= ESL
- Nondetect (ND)

Min. Non-PMJM ESL = 2 mg/kg
N/A = 1000000 mg/kg
3 x N/A = 3.00E+06 mg/kg

Standard Map Features

- Exposure Unit boundary
- Former building where analyte was used or generated as waste
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N W E S

0 1000 2000 Feet

Scale 1:24,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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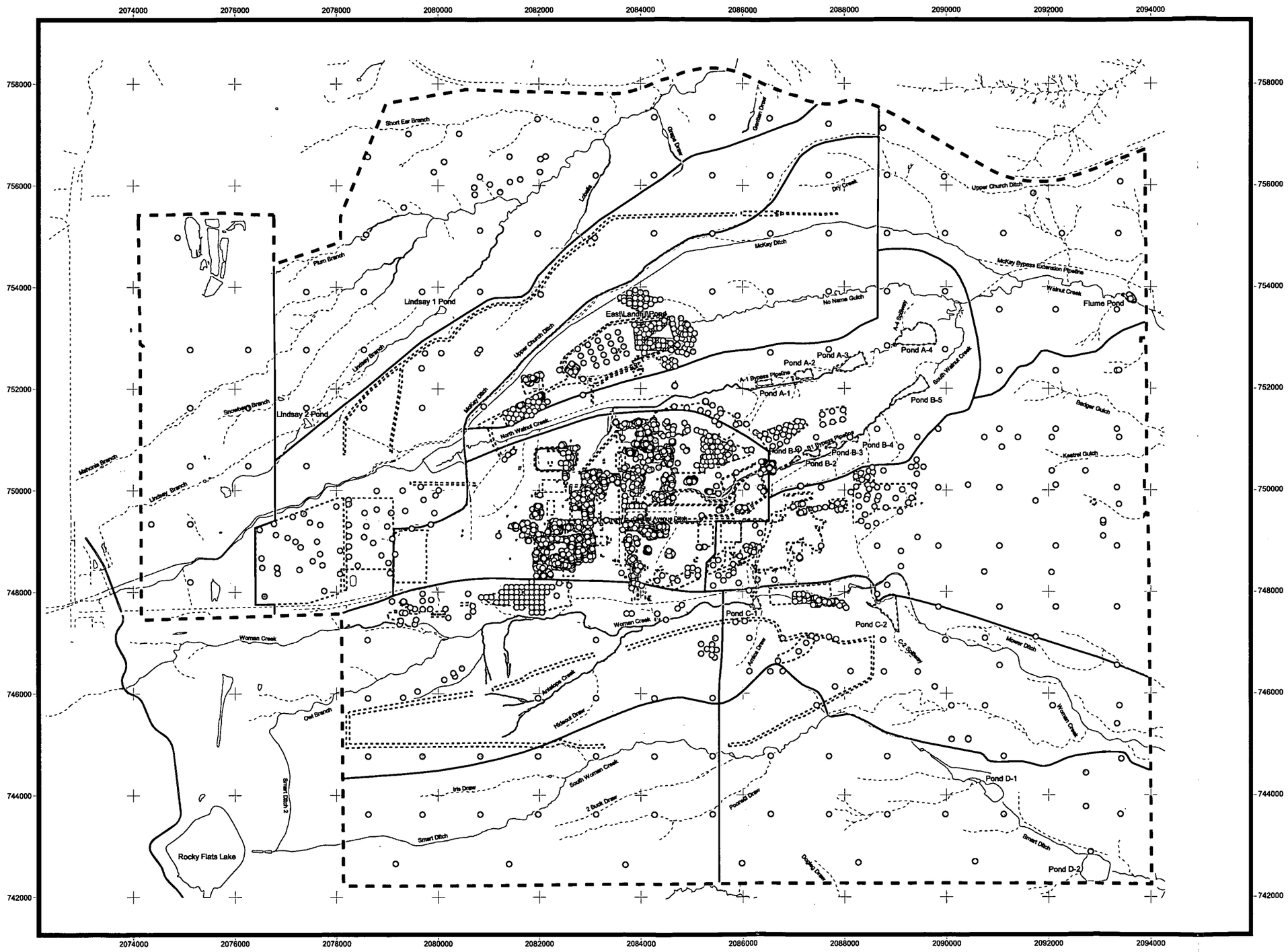

Figure A8.27

Thallium Concentrations in Sitewide Surface Soil (Non-PMJM)

KEY

- Concentration > 3x Background MDC
- Concentration > Background MDC and <= 3x Background MDC
- Concentration > ESL and <= Background MDC
- Concentration <= ESL
- Nondetect (ND)

Min. Non-PMJM ESL = 1 mg/kg
MDC* = 20.8 mg/kg
3 x MDC* = 62.4 mg/kg

* Maximum detected concentration of the surface soil background data set for Colorado, Arizona, Kansas, Nebraska, New Mexico, Oklahoma, Utah, and Wyoming from Shacklette and Boerngen (1984).

Standard Map Features

- Exposure Unit boundary
- Former building where analyte was used or generated as waste
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N W E S

0 1000 2000 Feet

Scale 1:24,000

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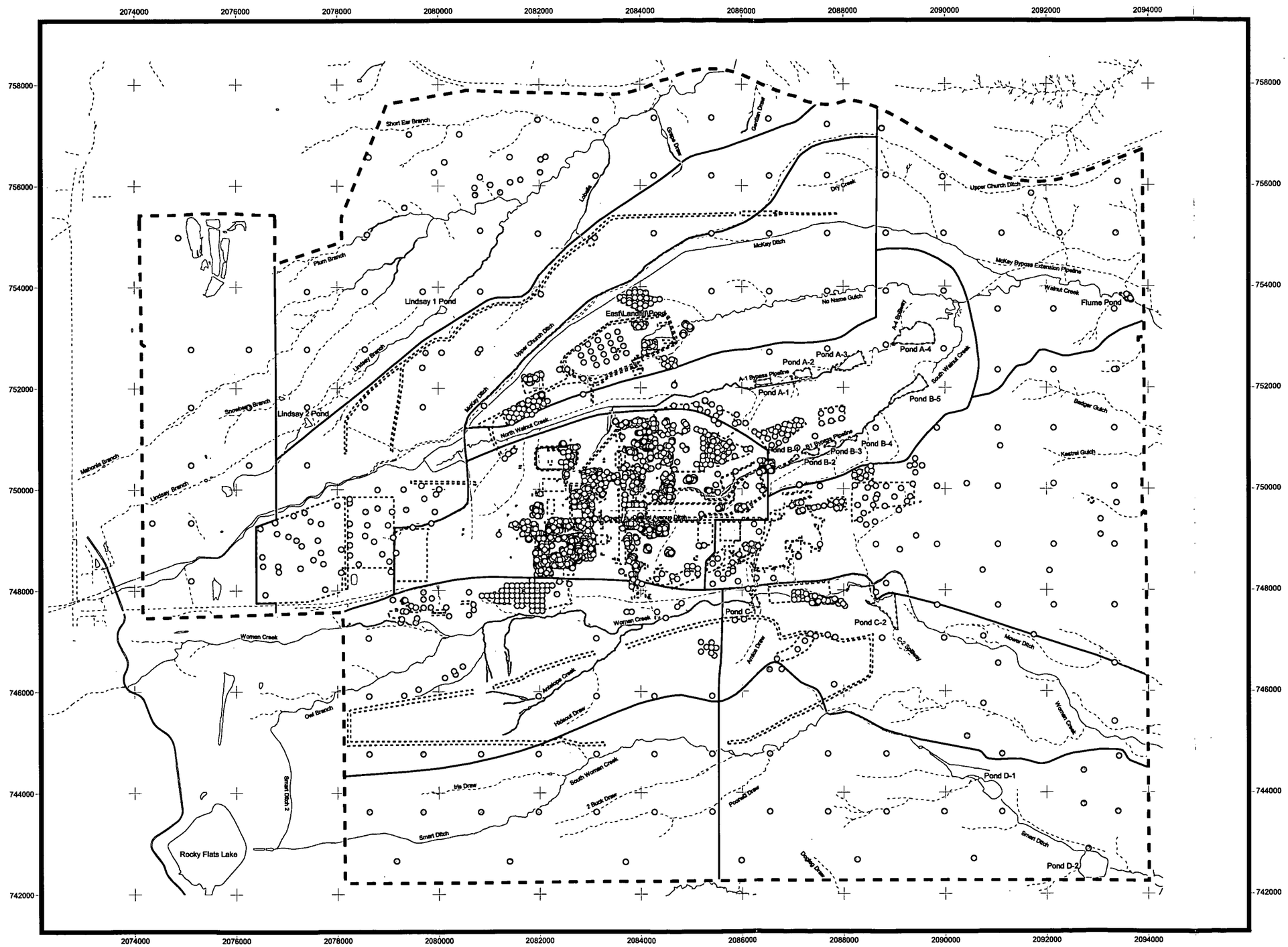

Figure A8.28

Tin Concentrations in Sitewide Surface Soil (Non-PMJM)

KEY

- Concentration > 3x Background MDC
- Concentration > Background MDC and <= 3x Background MDC
- Concentration > ESL and <= Background MDC
- Concentration <= ESL
- Nondetect (ND)

Min. Non-PMJM ESL = 2.90 mg/kg
MDC* = 5 mg/kg
3 x MDC* = 15 mg/kg

* Maximum detected concentration of the surface soil background data set for Colorado, Arizona, Kansas, Nebraska, New Mexico, Oklahoma, Utah, and Wyoming from Shacklette and Boerngen (1984).

Standard Map Features

- Exposure Unit boundary
- Former building where analyte was used or generated as waste
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N W E S

0 1000 2000 Feet

Scale 1:24,000

State Plane Coordinate Projection
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Datum: NAD 27

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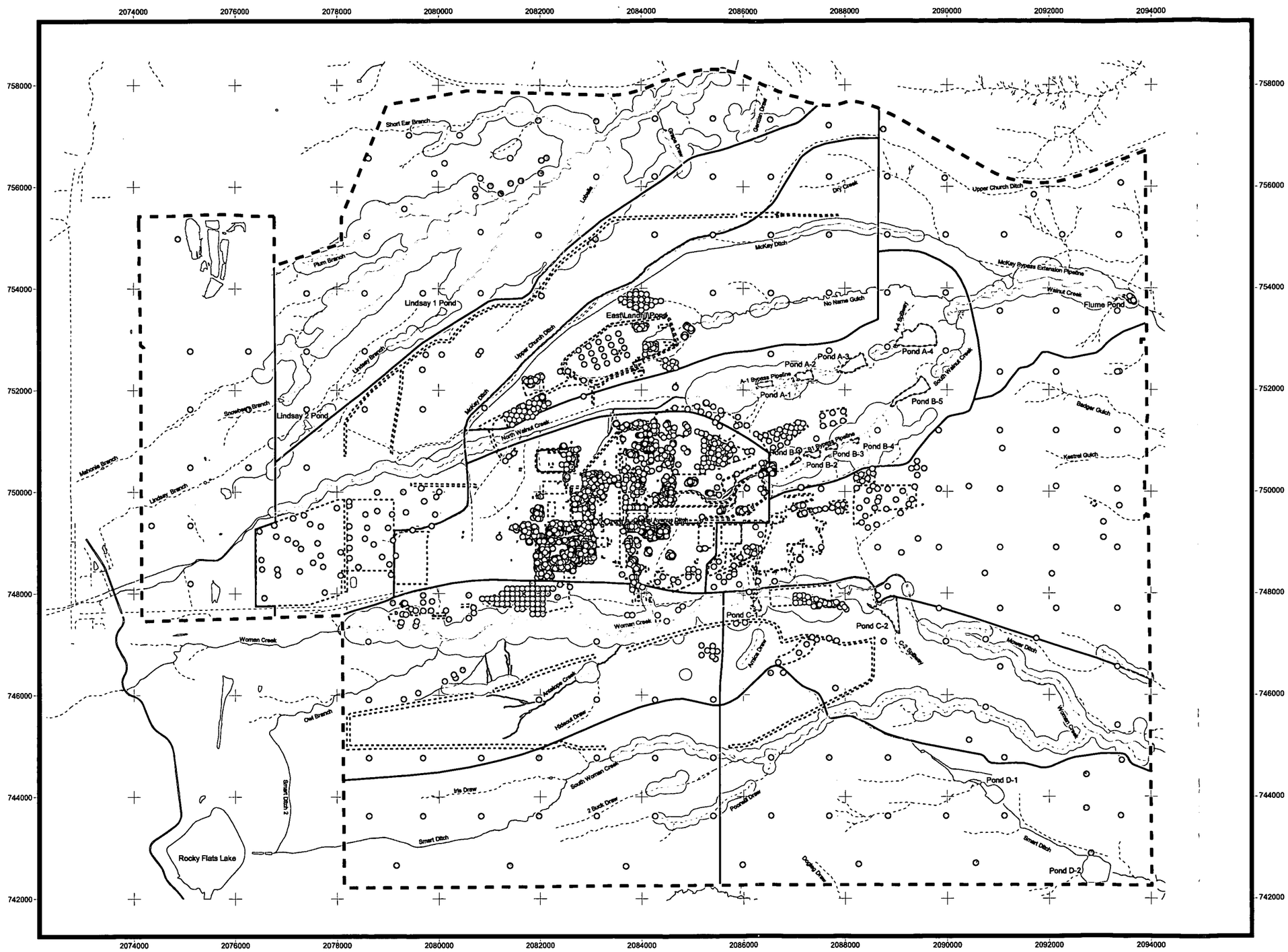

Figure A8.29

Tin Concentrations in Sitewide Surface Soil (PMJM)

KEY

- Concentration > 3x Background MDC
- Concentration > Background MDC and <= 3x Background MDC
- Concentration > ESL and <= Background MDC
- Concentration <= ESL
- Nondetect (ND)

PMJM ESL = 4.22 mg/kg
MDC* = 5 mg/kg
3 x MDC* = 15 mg/kg

* Maximum detected concentration of the surface soil background data set for Colorado, Arizona, Kansas, Nebraska, New Mexico, Oklahoma, Utah, and Wyoming from Shacklette and Boerngen (1984).

Standard Map Features

- Exposure Unit boundary
- Former building where analyte was used or generated as waste
- PMJM habitat patch
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N W E S

0 1000 2000 Feet

Scale 1:24,000

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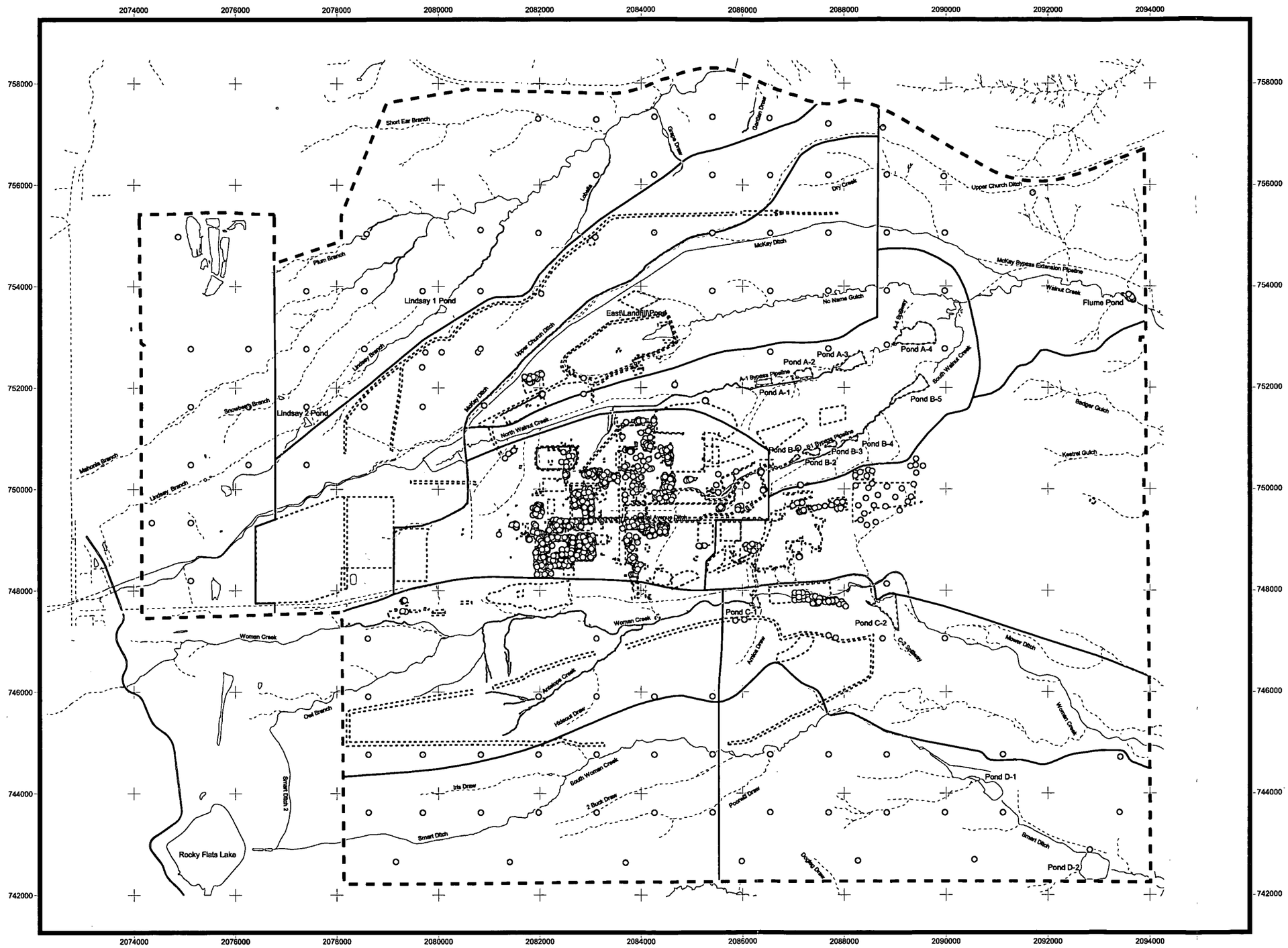

Figure A8.30

Uranium Concentrations in Sitewide Surface Soil (Non-PMJM)

KEY

- Concentration > 3x Background MDC
- Concentration > Background MDC and <= 3x Background MDC
- Concentration > ESL and <= Background MDC
- Concentration <= ESL
- Nondetect (ND)

Min. Non-PMJM ESL = 5 mg/kg
MDC* = 5.98 mg/kg
3 x MDC* = 17.9 mg/kg

* Maximum detected concentration of the surface soil background data set for Colorado, Arizona, Kansas, Nebraska, New Mexico, Oklahoma, Utah, and Wyoming from Shacklette and Boerngen (1984).

Standard Map Features

- Exposure Unit boundary
- Former building where analyte was used or generated as waste
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N W E S

0 1000 2000 Feet

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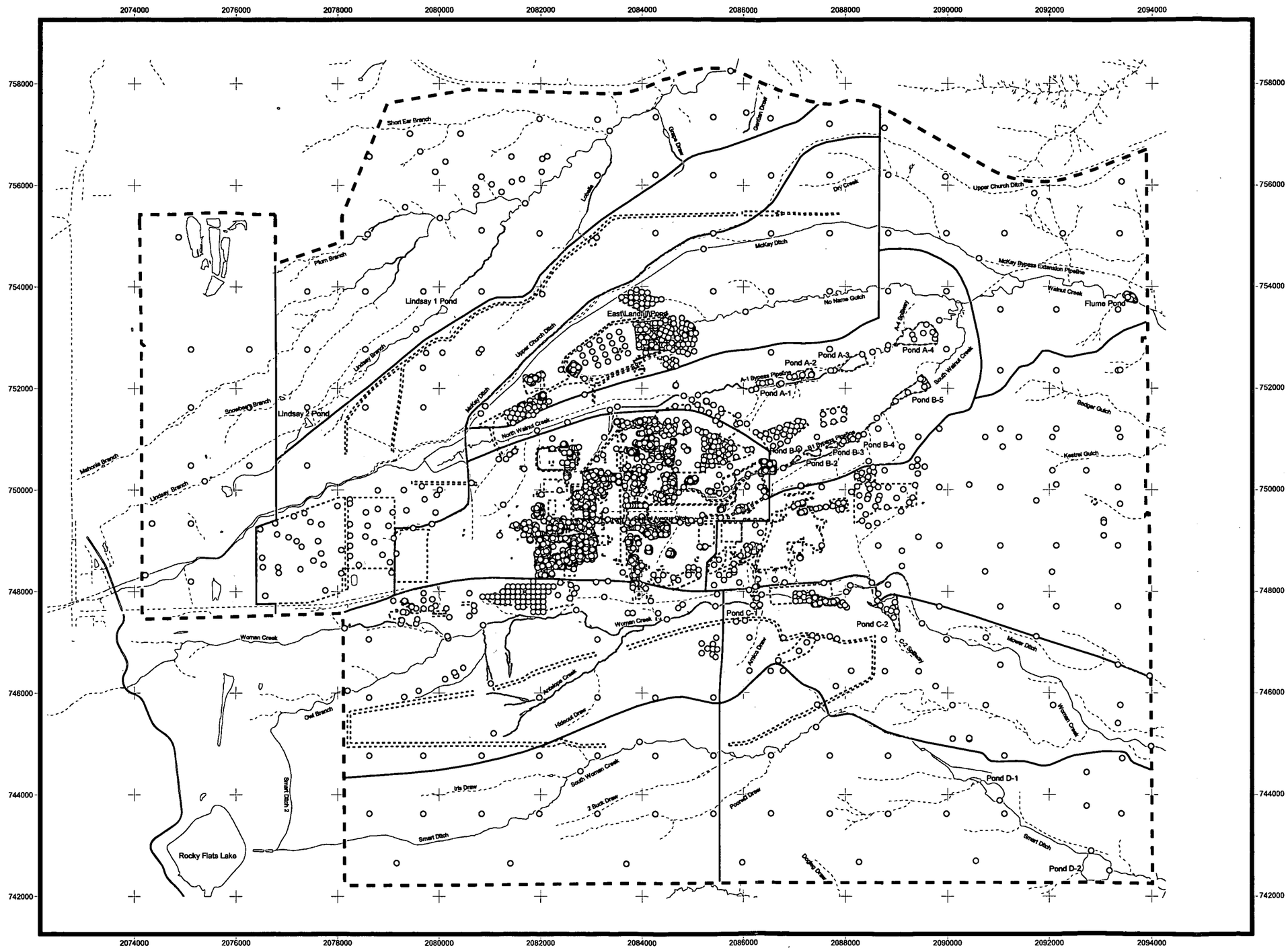

Figure A8.31

Vanadium Concentrations in Sitewide Surface Soil/Surface Sediment

KEY

- Concentration > 3x WRW PRG
- Concentration > WRW PRG and <= 3x WRW PRG
- Concentration > Background MDC and <= WRW PRG
- Concentration <= Background MDC
- Nondetect (ND)

Background MDC = 73 mg/kg
WRW PRG = 111 mg/kg
3 x WRW PRG = 333 mg/kg

Standard Map Features

- Exposure Unit boundary
- Former building where analyte was used or generated as waste
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N W E S

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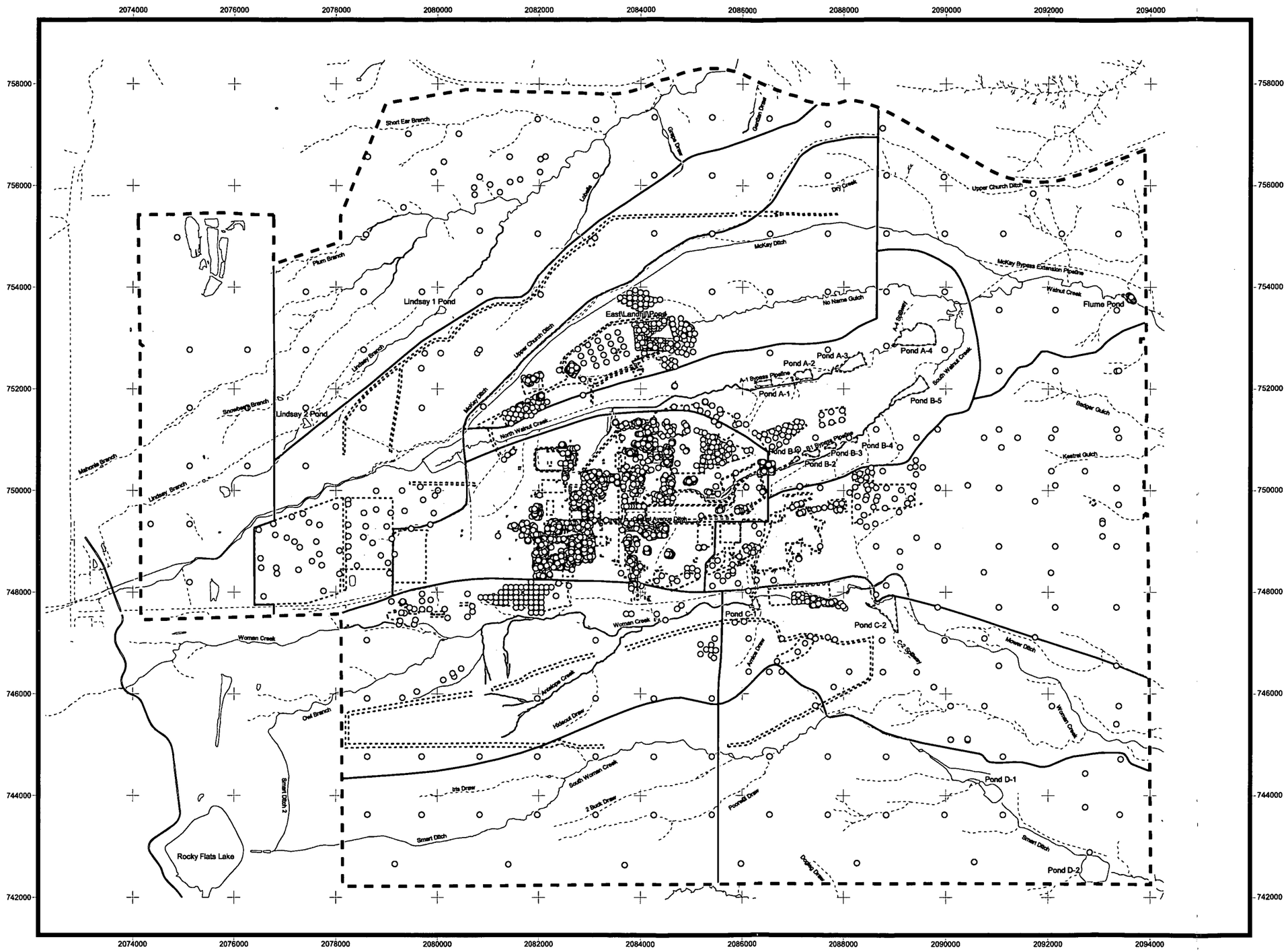

Figure A8.32

Vanadium Concentrations in Sitewide Surface Soil (Non-PMJM)

KEY

- Concentration > 3x Background MDC
- Concentration > Background MDC and <= 3x Background MDC
- Concentration > ESL and <= Background MDC
- Concentration <= ESL
- Nondetect (ND)

Min. Non-PMJM ESL = 2 mg/kg
Background MDC = 45.8 mg/kg
3 x Background MDC = 137 mg/kg

Standard Map Features

- Exposure Unit boundary
- Former building where analyte was used or generated as waste
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N W E S

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Scale 1:24,000

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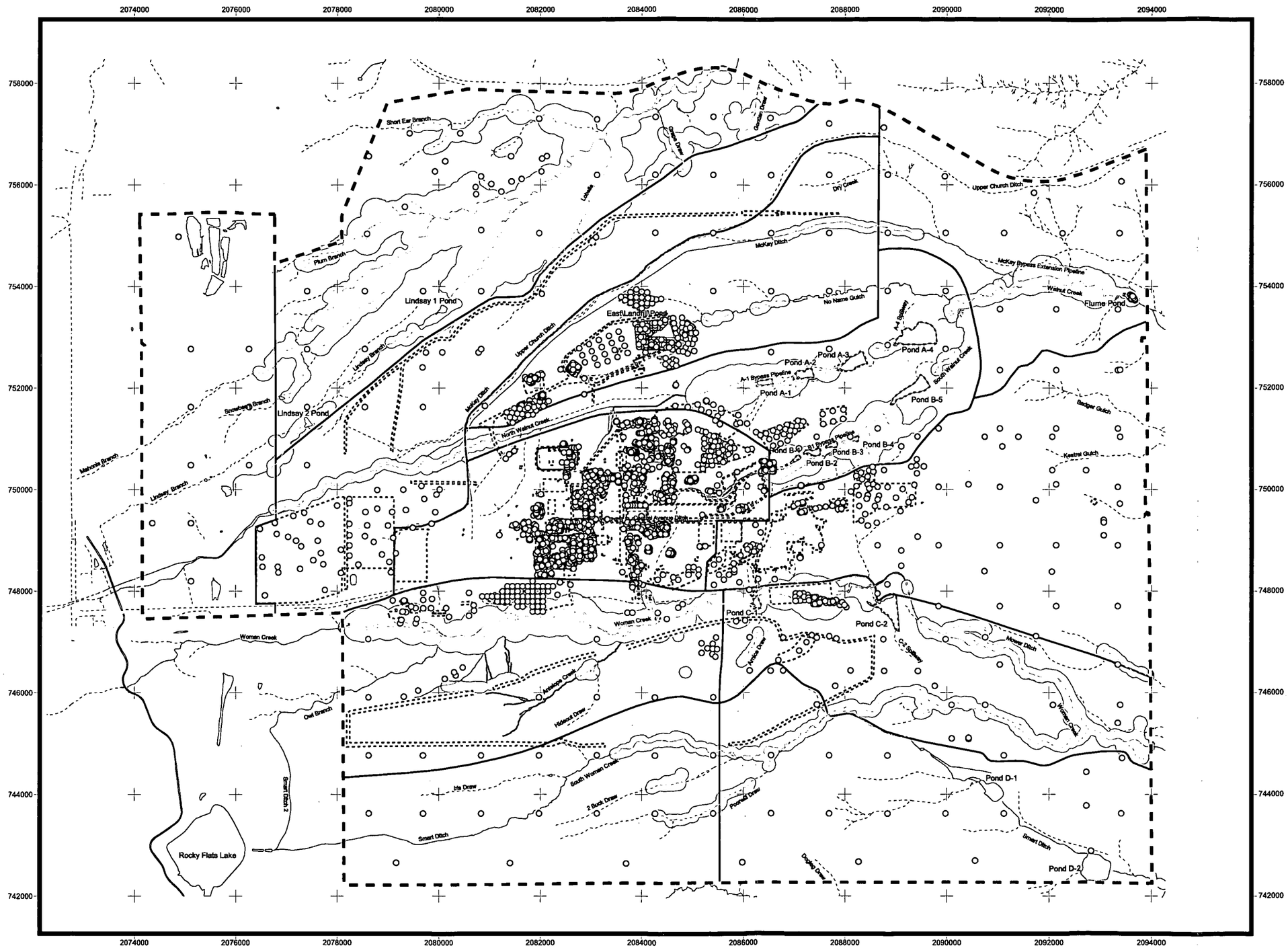

Figure A8.33

Vanadium Concentrations in Sitewide Surface Soil (PMJM)

KEY

- Concentration > 3x Background MDC
- Concentration > Background MDC and <= 3x Background MDC
- Concentration > ESL and <= Background MDC
- Concentration <= ESL
- Nondetect (ND)

PMJM ESL = 21.6 mg/kg
Background MDC = 45.8 mg/kg
3 x Background MDC = 137 mg/kg

Standard Map Features

- Exposure Unit boundary
- Former building where analyte was used or generated as waste
- PMJM habitat patch
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N W E S

0 1000 2000 Feet

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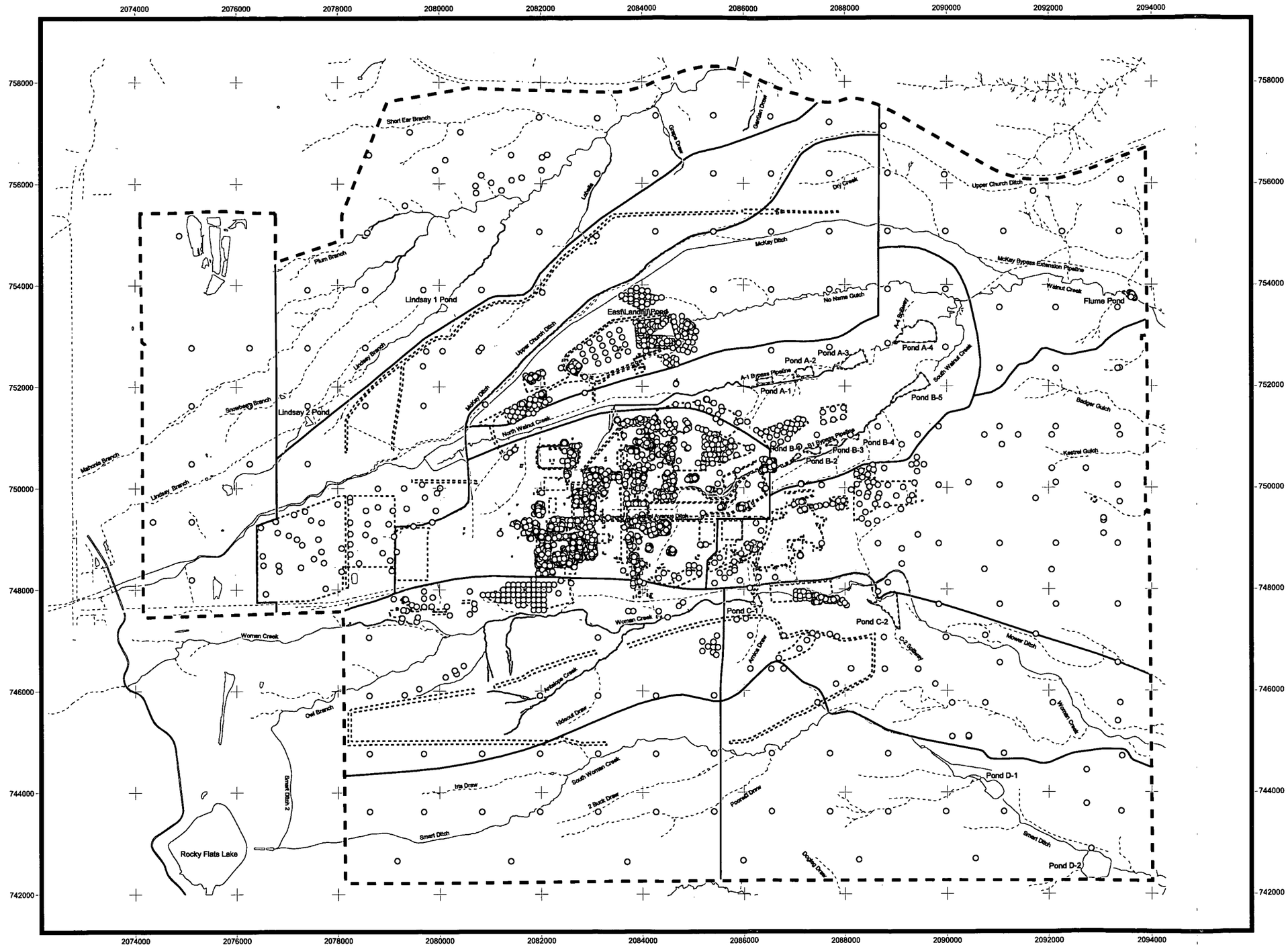

Figure A8.34

Zinc Concentrations in Sitewide Surface Soil (Non-PMJM)

KEY

- Concentration > 3x Background MDC
- Concentration > Background MDC and <= 3x Background MDC
- Concentration > ESL and <= Background MDC
- Concentration <= ESL
- Nondetect (ND)

Min. Non-PMJM ESL = 0.646 mg/kg
Background MDC = 75.9 mg/kg
3 x Background MDC = 228 mg/kg

Standard Map Features

- Exposure Unit boundary
- Former building where analyte was used or generated as waste
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N W E S

0 1000 2000 Feet

Scale 1:24,000

State Plane Coordinate Projection
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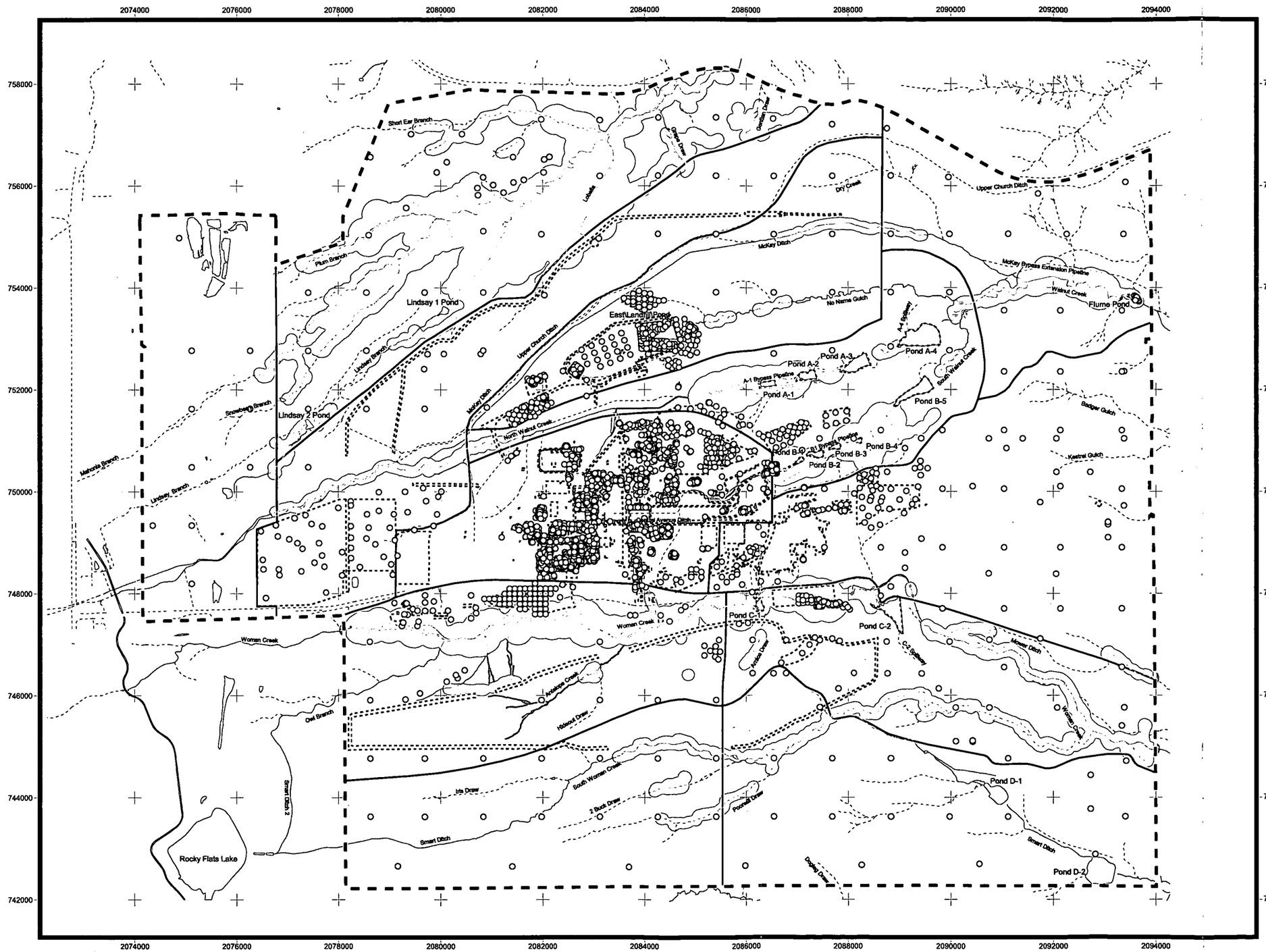

Figure A8.35

Zinc Concentrations in Sitewide Surface Soil (PMJM)

KEY

- Concentration > 3x Background MDC
- Concentration > Background MDC and <= 3x Background MDC
- Concentration > ESL and <= Background MDC
- Concentration <= ESL
- Nondetect (ND)

PMJM ESL = 6.41 mg/kg
Background MDC = 75.9 mg/kg
3 x Background MDC = 228 mg/kg

Standard Map Features

- Exposure Unit boundary
- Former building where analyte was used or generated as waste
- PMJM habitat patch
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N W E S

0 1000 2000 Feet

Scale 1:24,000

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COMPREHENSIVE RISK ASSESSMENT

COMPREHENSIVE RISK ASSESSMENT METHODOLOGY AND DATA DESCRIPTION

VOLUME 2: ATTACHMENT 9

Background Risk Characterization

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ACRONYMS AND ABBREVIATIONS

ABS	dermal absorption fraction
BAF	bioaccumulation factor
BW	body weight
CAS	chemical abstract service
COC	contaminant of concern
CNS	central nervous system
CRA	Comprehensive Risk Assessment
CSF	cancer slope factor
DOE	U.S. Department of Energy
DRI	dietary reference intake
ECOI	ecological contaminant of interest
ECOPC	ecological contaminant of potential concern
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
ERA	Ecological Risk Assessment
ESL	ecological screening level
EU	Exposure Unit
ft	foot or feet
HHRA	Human Health Risk Assessment
HQ	hazard quotient
L/day	liters per day
MDC	maximum detected concentration
mg	milligram
mg/day	milligrams per day
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mL/day	milliliters per day
N/A	not applicable
NC	not calculated
NOAEL	no observed adverse effect level

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pCi/g	picocuries per gram
pCi/L	picocuries per liter
PCOC	potential contaminant of concern
PMJM	Preble's meadow jumping mouse
PRG	preliminary remediation goal
RfD	reference dose
RFETS	Rocky Flats Environmental Technology Site
tESL	threshold ecological screening level
TRV	toxicity reference value
UCL	upper confidence limit
µg/kg	micrograms per kilogram (may be found as ug/kg)
µg/L	micrograms per liter (may be found as ug/L)
UL	upper limit daily intake
UT	uncertain toxicity
WRV	wildlife refuge visitor
WRW	wildlife refuge worker

1.0 INTRODUCTION

Through the screening process described in Volume 2, Section 2, some metals have been identified as human health Contaminants of Concern (COCs) and Ecological Contaminants of Potential Concern (ECOPCs), and have been carried forward into the human health and ecological risk characterizations, respectively, for the exposure units (EUs) at the Rocky Flats Environmental Technology Site (RFETS). These COCs/ECOPCs typically occur at concentrations statistically greater than site-specific background concentrations, and are detected in more than 5% of the samples. In order to provide perspective on the magnitude of the risks calculated for the EUs, this attachment provides the human health and ecological risks associated with exposure to background levels of these naturally occurring metals.

The Comprehensive Risk Assessment (CRA) quantifies risks based on concentrations of COC/ECOPCs in the EU soil. Because these concentrations include a background component, the CRA estimated risk also includes a background component. The background risk characterization described in this attachment provides one means to compare CRA risk results with the risk contribution from the background concentrations alone.

The risks from exposure to background concentrations alone are estimated using the same assumptions and models applied to COCs and ECOPCs as outlined in the Final CRA Work Plan and Methodology, Revision 1 (DOE 2005), hereafter referred to as the CRA Methodology. For the EUs where risks were not calculated because COCs and ECOPCs were not identified, the background risks estimated in this attachment provide a measure of the non site-related risks associated with the EUs. In addition, for the ecological risk assessment, if risks associated with ECOPCs are only slightly higher than those estimated for background concentrations, this may be an indicator of the conservative nature of the risk estimation models (see Attachment 7 of this CRA volume).

The background human health risk characterization was conducted for all metals with toxicity criteria. In the EU-specific human health risk assessments, the risk estimates for carcinogens are assumed to be additive and a total potential cancer risk is calculated. As a conservative assumption for non-carcinogens, the hazard quotients estimated for each analyte are also assumed to be additive, and therefore, are summed to arrive at a Hazard Index (HI). The background human health risk characterization was similarly performed to determine the total potential cancer risk and HI for background conditions.

The background ecological risk characterization was only performed for metals that have been identified as ECOPCs in the individual EU risk assessments. The background risk characterizations were conducted for the individual ECOPC/ecological receptor pairs.

2.0 DATA DESCRIPTION

The human health and ecological background risk characterizations are based on background data for combined surface soil/surface sediment (human health risk characterization) and surface soil (ecological risk characterization). COCs were not identified for subsurface soil/subsurface sediment, and ECOPCs were not identified for

subsurface soil. Therefore, background risk characterizations for these media were not performed.

The background sample collection program for RFETS is described in Volume 2, Section 2, and background data summary statistics are presented in Attachment 5 of this CRA volume. The background data summary statistics identify the number of samples, percent detections, maximum detected concentration (MDC), minimum detected concentration, average of the detections, mean, standard deviation, data distributions, as well as the 95% upper confidence limit on the mean (UCL) and the upper tolerance limit (UTL)(95% upper confidence limit on the mean of the 90th percentile). The UCLs are used as exposure point concentrations (EPCs) for the human health risk assessment (unless the UCL is greater than the MDC, then the MDC is used as the EPC). The UCL and UTL are used to estimate the EPCs for the background ecological risk characterizations. As with the human health risk characterization, the MDC is used when the UCL or UTL exceeds the MDC. The methods used to calculate these statistics are described in Section 2 of this CRA volume.

3.0 HUMAN HEALTH BACKGROUND RISK CHARACTERIZATION

The human health risk characterization provides the estimated potential cancer risk and non-cancer hazards to the Wildlife Refuge Worker (WRW) and Wildlife Refuge Visitor (WRV) from exposure to background concentrations of metals in surface soil/surface sediment. Chemical intakes were estimated using the EPCs calculated according to the Tier 1 approach described in Section 2 of this CRA volume. Table A9.1 presents the MDCs, UCLs, and EPCs for metals in the background dataset.

Using the EPCs, intakes are quantified to estimate background risks to the WRW and WRV. The oral and inhalation exposure pathways are evaluated using the exposure factors listed in Tables A9.2 and A9.3 for the WRW and WRV, respectively. The dermal absorption pathway is not included for metals in accordance with the CRA Methodology. Additional information on the estimation of chemical intakes is presented in Section 2 of this CRA volume.

Tables A9.4 and A9.5 present the toxicity criteria (cancer slope factors [CSFs] and reference doses [RfDs]) for metals that are used in the risk calculations. Toxicity criteria are presented for the oral and inhalation exposure pathways. Background risks are only calculated for metals with toxicity information. Essential nutrients (calcium, magnesium, potassium, and sodium) and cesium and silica are excluded from background risk calculations because no toxicity information is available. Lead is typically evaluated using blood-lead models and does not have toxicity factors; therefore, background risks are not calculated for lead.

The exposure factors and toxicity criteria are used to characterize background risk to the WRW and WRV receptors.

3.1 Wildlife Refuge Worker (WRW)

Potential risks to the WRW were evaluated for exposure to background metals in surface soil/surface sediment through ingestion and inhalation. The risk calculations are

presented in Table A9.6, and the estimated cancer risks and noncancer hazards are presented in Table A9.7.

The total potential cancer risk estimate for the WRW exposure to background metal concentrations in surface soil/surface sediment is 2 x 10^{-6} (Table A9.7). Sixty-eight percent of the risk is from arsenic, 28 percent is from chromium-VI, and the remainder is from cobalt, beryllium, and cadmium. Exposure to background concentrations of arsenic poses a potential risk in excess of 1 x 10^{-6}. The total cancer risk is predominantly from the ingestion exposure route (Table A9.6).

The noncancer HI for the WRW exposure to background metal concentrations in surface soil/surface sediment is 0.3 (Table A9.7). The largest contributors to the HI were manganese (39%), aluminum (21%), iron (13%), and vanadium (9%). The inhalation exposure route contributes slightly more to the HI than the ingestion exposure route (Table A9.6).

3.2 Wildlife Refuge Visitor (WRV)

Risks to the WRV receptor are evaluated for potential exposure to background metals in surface soil/surface sediment by inhalation and ingestion. The risk calculations are presented in Table A9.8, and the estimated cancer risks and noncancer hazard estimates are presented in Table A9.9.

The total potential cancer risk estimate for the WRV exposure to background metal concentrations in surface soil/surface sediment is 2 x 10^{-6} (Table A9.9). Seventy-four percent of the risk is from arsenic, 22 percent is from chromium VI, and the remainder is from cobalt, beryllium, and cadmium. Exposure to background concentrations of arsenic poses a potential risk in excess of 1 x 10^{-6}. The total cancer risk is predominantly from the ingestion exposure route (Table A9.8).

The noncancer HI for the WRV exposure to background metal concentrations in surface soil/surface sediment is 0.1 (Table A9.9). The largest contributors to the HI were manganese (35%), aluminum (19%), iron (16%), and vanadium (10%). The inhalation exposure route contributes slightly more to the HI than the ingestion exposure route (Table A9.8).

3.3 Human Health Background Risk Characterization Summary

Risks associated with exposure to background metals in surface soil/surface sediment at RFETS were evaluated. A summary of the cancer risks and noncancer hazards is presented in Table A9.10.

The results of the risk characterizations indicate that estimated risks are 2 x 10^{-6}, which is at the lower end of the EPA acceptable risk range (Table A9.10). Exposure to background concentrations of arsenic poses a risk that exceeds 1 x 10^{-6}, indicating that some EU-specific concentrations are likely to exceed the PRG, even in the absence of site-related contamination. Background risks should, therefore, be carefully considered when viewing total risks calculated for each EU.

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The total HI estimates for background metals are below one, indicating that no significant noncarcinogenic health effects are expected for the WRW or the WRV from exposure to background concentrations of metals in RFETS (Table A9.10).

4.0 ECOLOGICAL RISK CHARACTERIZATION

Risks to the Preble's meadow jumping mouse (PMJM) and non-PMJM receptors from exposure to background metal concentrations are assessed in the following sections for the ECOPCs identified in the EU-specific risk assessments.

Table A9.11 shows the ECOIs for which background data are available and the receptors for which each chemical was identified as an ECOPC in at least one EU. Those ECOIs that were never identified as an ECOPC in any EU are not assessed further in this attachment.

For those ECOPCs marked with an "X" in Table A9.11, background risks are calculated for each ECOPC/Receptor pair. Risks were calculated using the EPCs shown in Table A9.12.

Food tissue concentrations were estimated from soil EPCs using the same bioaccumulation models applied to ECOPCs in each EU risk assessment. The surface water ingestion pathway was evaluated by calculating the EPCs using background stream surface water data (refer to Attachment 5 of this CRA volume for the Surface Water Summary Statistics) corresponding to the statistic used for soil EPCs. Only total concentration surface water data were used in the EPC calculations. No surface water ECOPCs were identified for terrestrial receptors. Surface water EPCs were only used to complete the exposure calculations for the ECOPCs in surface soil.

The EPCs, bioaccumulation factors (BAFs) and receptor parameters used in the exposure calculations are presented on Tables A9.13 through A9.23. HQs were calculated by dividing the estimated intakes based on the EPCs by the toxicity reference values (TRVs) shown in Table A.9.24. The BAFs, receptor parameters, and TRVs are for the default scenario per the CRA Methodology. HQs were calculated using both the no-observable-adverse-effects-level (NOAEL) and the lowest-observable-adverse-effects-level (LOAEL) TRVs. Where they were provided in the CRA Methodology, threshold TRVs were also used to calculate background risks. Threshold TRVs were calculated in the CRA Methodology for a subset of ECOIs that had toxicity data meeting strict data quality guidelines. The threshold TRVs represent intake rates at a hypothetical threshold point between the NOAEL and LOAEL TRVs. Threshold TRVs were calculated by taking the geometric mean of the NOAEL and LOAEL TRVs.

Background HQs are presented for surface soil as follows:

- Barium – Table A9.25
- Cadmium – Table A9.26
- Chromium – Table A9.27 (terrestrial plants and invertebrates) and Table A9.28 (vertebrate receptors)
- Copper – Table A9.29

- Lead – Table A9.30
- Manganese – Table A9.31 (terrestrial plants) and Table A9.32 (vertebrate receptors)
- Mercury – Table A9.33
- Nickel – Table A9.34
- Selenium – Table A9.35
- Vanadium – Table A9.36 (terrestrial plants) and Table A9.37 (vertebrate receptors)
- Zinc – Table A9.38 (terrestrial plants) and Table A9.39 (vertebrate receptors)

4.1 Background Ecological Risk Summary

LOAEL HQs calculated using the UTLs are presented below for metals in background surface soil. When the LOAEL ESL was not available the NOAEL HQ is listed. HQs are greater than one for the following Receptor/ECOPC pairs, which indicates that risks may be predicted even in the absence of site-related contamination:

- Cadmium/Deer Mouse Insectivore (LOAEL HQ = 2).
- Chromium/Terrestrial Plant (NOAEL HQ = 17). No LOAEL ESL was available so the NOAEL ESL was used.
- Chromium/Terrestrial Invertebrate (NOAEL HQ = 42). No LOAEL ESL was available so the NOAEL ESL was used.
- Chromium/Mourning Dove Insectivore (LOAEL HQ = 3).
- Lead/Mourning Dove Insectivore (LOAEL HQ = 3).
- Nickel/PMJM (LOAEL HQ = 3).
- Nickel/Deer Mouse Insectivore (LOAEL HQ = 3).
- Nickel/Mourning Dove Insectivore (Threshold HQ = 2).
- Vanadium/Terrestrial Plant (NOAEL HQ = 23). No LOAEL ESL was available so the NOAEL ESL was used.
- Zinc/Terrestrial Plant (NOAEL HQ = 2). No LOAEL ESL was available so the NOAEL ESL was used.

Risks calculated for these receptor/ECOPC pairs in each EU risk assessment should be viewed in light of these results. The background risk characterization suggests that the models used to estimate risks for these ECOPC/receptor pairs are conservative and risk managers should take these factors into consideration when making risk management decisions.

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5.0 REFERENCES

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Jefferson County, 1996, Data provided by Jefferson County Department of Open Space from surveys performed in 1996, Jefferson County, Colorado.

TABLES

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Table A9.1
Background Exposure Point Concentrations

Analyte	Unit	MDC[a]	UCL Value[b]	UCL Type[c]	Distribution[d]	EPC[e]
Tier 1						
Surface Soil/Surface Sediment						
Aluminum	mg/kg	25,200	8,755	95% Student's-t UCL	NORMAL	8,755
Antimony	mg/kg	12.4	5.03	97.5% Chebyshev (Mean, Sd) UCL	NONPARAMETRIC	5.03
Arsenic	mg/kg	9.60	4.03	95% Approximate Gamma UCL	GAMMA	4.03
Barium	mg/kg	260	94.8	95% Student's-t UCL	NORMAL	94.8
Beryllium	mg/kg	2.30	0.641	95% Approximate Gamma UCL	GAMMA	0.641
Cadmium	mg/kg	2.30	0.651	95% H-UCL	LOGNORMAL	0.651
Chromium VI	mg/kg	30.4	10.5	95% Student's-t UCL	NORMAL	10.5
Cobalt	mg/kg	15.3	6.44	95% Student's-t UCL	NORMAL	6.44
Copper	mg/kg	36.7	13.2	95% Approximate Gamma UCL	GAMMA	13.2
Iron	mg/kg	31,400	11,615	95% Student's-t UCL	NORMAL	11,615
Lithium	mg/kg	20.3	8.91	95% Approximate Gamma UCL	GAMMA	8.91
Manganese	mg/kg	1,280	277	95% Approximate Gamma UCL	GAMMA	277
Mercury	mg/kg	0.120	0.105	95% Chebyshev (Mean, Sd) UCL	NONPARAMETRIC	0.105
Molybdenum	mg/kg	14.0	7.44	97.5% Chebyshev (Mean, Sd) UCL	NONPARAMETRIC	7.44
Nickel	mg/kg	25.6	8.61	95% Student's-t UCL	NORMAL	8.61
Selenium	mg/kg	3.20	0.774	95% Chebyshev (Mean, Sd) UCL	NONPARAMETRIC	0.774
Silver	mg/kg	3.40	0.904	95% Chebyshev (Mean, Sd) UCL	NONPARAMETRIC	0.904
Strontium	mg/kg	421	36.2	95% H-UCL	LOGNORMAL	36.2
Thallium	mg/kg	0.740	0.382	95% Approximate Gamma UCL	GAMMA	0.382
Tin	mg/kg	27.1	22.5	95% Chebyshev (Mean, Sd) UCL	NONPARAMETRIC	22.5
Vanadium	mg/kg	73.0	25.4	95% Student's-t UCL	NORMAL	25.4
Zinc	mg/kg	720	124	95% Chebyshev (Mean, Sd) UCL	NONPARAMETRIC	124

[a] The MDC for Tier 1 is the maximum detected concentration of all background samples sitewide.

[b] UCL = upper confidence limit.

[c] The Tier 1 UCL type is recommended by ProUCL.

[d] The Tier 1 distribution is recommended by ProUCL.

[e] The UCL is used as the EPC, unless the UCL exceeds the MDC, then the MDC is used for the EPC.

Table A9.2
Exposure Factors Used in Background Surface Soil/Surface Sediment Intake Calculations for the Wildlife Refuge Worker

Exposure Route/Exposure Factor	Abbreviation	Value	Units	Source
Ingestion				
CI = (Cs x IRwss x EFwss x EDw x CF_3) / (BW x [ATc_wss or ATn_wss]b)				
Chemical Intake	CI	chemical-specific	mg/kg-day	calculated
Chemical concentration in soil	Cs	chemical-specific	mg/kg	Tier 1 EPC
Ingestion Rate of soil/sediment	IRwss	100	mg/day	EPA et al. 2002
Exposure Frequency	EFwss	230	days/year	EPA et al. 2002
Exposure Duration	EDw	18.7	yr	EPA et al. 2002
Conversion Factor	CF_3	1.00E-06	kg/mg	1 kg = 1.0E6 mg
Adult Body Weight	BW	70	kg	EPA 1991
Averaging Time-Carcinogenic	ATc_wss	25,550	day	calculated
Averaging Time-Noncarcinogenic	ATnc_wss	6,826	day	calculated
Outdoor Inhalation of Suspended Particulates				
CI = (Cs x IRawss x EFwss x EDw x ETwss x ETFo x MLF) / (BW x [ATc_wss or ATn_wss][b])				
Chemical Intake	CI	chemical-specific	mg/kg-day	calculated
Chemical concentration in soil	Cs	chemical-specific	mg/kg	Tier 1 EPC
Inhalation Rate	IRawss	1.3	m^3/hr	EPA et al. 2002
Exposure Frequency	EFwss	230	days/year	EPA et al. 2002
Exposure Duration	EDw	18.7	yr	EPA et al. 2002
Exposure Time	ETwss	8	hr/day	EPA et al. 2002
Exposure Time Fraction, outdoor	ETFo	0.5	--	EPA et al. 2002
Mass loading, (PM 10) for inhalation[a]	MLF	6.70E-08	kg/m^3	EPA et al. 2002
Adult Body Weight	BW	70	kg	EPA 1991
Averaging Time-Carcinogenic	ATc_wss	25,550	day	calculated
Averaging Time-Noncarcinogenic	ATnc_wss	6,826	day	calculated
Indoor Inhalation of Suspended Particulates				
CI = (Cs x IRawss x EFwss x EDw x ETwss x ETFi x DFi x MLF) / (BW x [ATc_wss or ATn_wss][b])				
Chemical Intake	CI	chemical-specific	mg/kg-day	calculated
Chemical concentration in soil	Cs	chemical-specific	mg/kg	Tier 1 EPC
Inhalation Rate	IRawss	1.3	m^3/hr	EPA et al. 2002
Exposure Frequency	EFwss	230	days/year	EPA et al. 2002
Exposure Duration	EDw	18.7	yr	EPA et al. 2002
Exposure Time	ETwss	8	hr/day	EPA et al. 2002
Exposure Time Fraction, indoor	ETFi	0.5	--	EPA et al. 2002
Dilution Factor, indoor inhalation	DFi	0.7	--	EPA et al. 2002
Mass Loading, (PM 10) for inhalation	MLF	6.70E-08	kg/m^3	EPA et al. 2002[a]
Adult Body Weight	BW	70	kg/m3	EPA 1991
Averaging Time-Carcinogenic	ATc_wss	25,550	day	calculated
Averaging Time-Noncarcinogenic	ATnc_wss	6,826	day	calculated

[a] The mass loading value is the 95th percentile of the estimated mass loading distribution estimated in the RSALs Task 3 Report (EPA et al. 2002).

[b] Carcinogenic or noncarcinogenic averaging times (Atc and Atnc, respectively) are used in equations, depending on whether carcinogenic or noncarcinogenic intakes are being calculated.

Table A9.3
Exposure Factors Used in Background Surface Soil/Surface Sediment Intake Calculations for the Wildlife Refuge Visitor

Exposure Route/Exposure Factor	Abbreviation	Value	Units	Source
Ingestion				
CI = (Cs x IRagevss x EFvss x CF_3) / [Atc_vss or Atnc][a]				
where, IRageav = ((IRvss x EDav) / BW) + ((IRcvss x EDcv) / BWc)				
Chemical Intake	CI	chemical-specific	mg/kg-day	calculated
Chemical concentration in soil	Cs	chemical-specific	mg/kg	Tier 1 EPC
Age-adjusted Soil Ingestion Rate for chemicals	IRagevss	57	mg-yr/kg-day	calculated
Exposure Frequency	EFvss	100	days/year	EPA et al. 2002[b]
Exposure Duration - adult	EDav	24	yr	EPA et al. 2002
Exposure Duration - child	EDcv	6	yr	EPA et al. 2002
Conversion Factor	CF_3	1.00E-06	kg/mg	1 kg = 1.0E6 mg
Soil Ingestion Rate - adult	IRvss	50	mg/day	EPA et al. 2002
Soil Ingestion Rate - child	IRcvss	100	mg/day	EPA et al. 2002
Adult Body Weight	BW	70	kg	EPA 1991
Child Body Weight	BWc	15	kg	EPA 1991
Averaging Time-Carcinogenic	ATc_vss	25,550	day	calculated
Averaging Time-Noncarcinogenic	ATn_vss	8,760	day	calculated
Averaging Time-Noncarcinogenic (child)	ATn_c_vss	2,190	day	calculated
Averaging Time-Noncarcinogenic (child+adult)	ATnc	10,950	day	calculated
Outdoor Inhalation of Suspended Particulates				
CI = (Cs x IRa_agevss x EFvss x MLF) / [Atc_vss or Atnc][a]				
where, IRa_agevss = (((Ira_vss x EDav) / BW) + ((IRa_cvss x EDcv) / BWc)) x ET				
Chemical Intake	NRI	chemical-specific	mg/kg-day	calculated
Chemical concentration in soil	Cs	chemical-specific	mg/kg	Tier 1 EPC
Age-averaged Inhalation Rate for chemicals	IRa_agevss	3.7	m^3-yr/kg-day	EPA et al. 2002[b]
Exposure Frequency	EFvss	100	days/year	EPA et al. 2002[b]
Mass loading, (PM 10) for inhalation	MLF	6.70E-08	kg/m^3	EPA et al. 2002[c]
Exposure Duration - adult	EDav	24	yr	EPA et al. 2002
Exposure Duration - child	EDcv	6	yr	EPA et al. 2002
Adult Body Weight	BW	70	kg	EPA 1991
Child Body Weight	BWc	15	kg	EPA 1991
Air Inhalation Rate - adult	IRavss	2.4	m^3/hr	EPA et al. 2002
Air Inhalation Rate - child	IRa_cvss	1.6	m^3/hr	EPA et al. 2002
Exposure Time	ET	2.5	hr/day	EPA et al. 2002[b]
Averaging Time-Carcinogenic	ATc_vss	25,550	day	calculated
Averaging Time-Noncarcinogenic	ATn_vss	8,760	day	calculated
Averaging Time-Noncarcinogenic (child)	ATn_c_vss	2,190	day	calculated
Averaging Time-Noncarcinogenic (child+adult)	ATnc	10,950	day	calculated

[a] Carcinogenic or noncarcinogenic averaging times (Atc and Atnc, respectively) are used in equations, depending on whether carcinogenic

[b] Value is 95th percentile of visitation frequency for open space users (Jefferson County 1996).

[c] The mass loading value is the 95th percentile of the estimated mass loadding distribution estimated in the RSALs Task 3 Report (EPA et al. 2002).

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Table A9.4
Cancer Slope Factors, Weight of Evidence, and Target Organs for Background Metals

Analyte	CAS Number	Oral Slope Factor $(mg/kg\text{-}day)^{-1}$	Source	Dermal Slope Factor $(mg/kg\text{-}day)^{-1}$	Source	Inhalation Slope Factor $(mg/kg\text{-}day)^{-1}$	Source	Weight of Evidence[a]	Dermal Absorption Fraction[b]	Target Organ/Cancer	Source
Aluminum	7429-90-5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Antimony	7440-36-0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Arsenic	7440-38-2	1.50E+00	I	N/A	N/A	1.50E+01	I	A	3.00E-02	Skin, lungs	I
Barium	7440-39-3	N/A	N/A	N/A	N/A	N/A	N/A	D	N/A	NC	I
Beryllium	7440-41-7	N/A	N/A	N/A	N/A	8.40E+00	I	B1	N/A	Lungs	I
Cadmium	7440-43-9	N/A	N/A	N/A	N/A	6.30E+00	I	B1	N/A	Lung, trachea, bronchus	I
Chromium VI	18540-29-9	N/A	N/A	N/A	N/A	4.20E+01	I	Ai, Do	N/A	Lung	I
Cobalt	7440-48-4	N/A	N/A	N/A	N/A	9.80E+00	P	B2	N/A	Induction of tumors	R
Copper	7440-50-8	N/A	N/A	N/A	N/A	N/A	N/A	D	N/A	NC	I
Iron	7439-89-6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Lithium	7439-93-2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Manganese	7439-96-5	N/A	N/A	N/A	N/A	N/A	N/A	D	N/A	NC	I
Mercury	7439-97-6	N/A	N/A	N/A	N/A	N/A	N/A	D	N/A	NC	I
Molybdenum	7439-98-7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Nickel	7440-02-0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Selenium	7782-49-2	N/A	N/A	N/A	N/A	N/A	N/A	D	N/A	NC	I
Silver	7440-22-4	N/A	N/A	N/A	N/A	N/A	N/A	D	N/A	NC	I
Strontium	7440-24-6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Thallium	7440-28-0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tin	7440-31-5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Vanadium	7440-62-2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Zinc	7440-66-6	N/A	N/A	N/A	N/A	N/A	N/A	D	N/A	NC	I

[a] See Table 5.1 in the CRA Methodology for definitions of Weight of Evidence classifications.
[b] Dermal ABS from EPA 2001.
I = IRIS (EPA 2004).
P = EPA-NCEA provisional value (EPA 2004)
R = International Agency for the Research of Cancer (IARC) Monographs Database, http://monographs.iarc.fr.
NC = Effects not classifiable.
N/A = Not available or not applicable.

Table A9.5
Non-Cancer Reference Doses, Target Organs, and Effects for Background Metals

Analyte	CAS Number	Oral RfD (mg/kg-day)	Source	Dermal RfD (mg/kg-day)	Source	Inhalation RfD (mg/kg-day)	Source	Dermal Absorption Fraction[a]	Target Organ/Effect	Source
Aluminum	7429-90-5	1.00E+00	P	N/A	N/A	1.00E-03	P	N/A	Bone	A
Antimony	7440-36-0	4.00E-04	I	N/A	N/A	N/A	N/A	N/A	Longevity, blood glucose, and cholesterol	I
Arsenic	7440-38-2	3.00E-04	I	N/A	N/A	N/A	N/A	3.00E-02	Hyperpigmentation, keratosis and vascular complications	I
Barium	7440-39-3	7.00E-02	I	N/A	N/A	1.43E-04	A	N/A	Increased kidney weight.	I
Beryllium	7440-41-7	2.00E-03	I	N/A	N/A	5.71E-06	I	N/A	Small intestines, lungs	I
Cadmium	7440-43-9	1.00E-03	I	N/A	N/A	5.70E-05	P	1.00E-03	Proteinuria	I
Chromium VI	18540-29-9	3.00E-03	I	N/A	N/A	2.86E-05	I	N/A	Nasal septum atrophy	I
Cobalt	7440-48-4	2.00E-02	P	N/A	N/A	5.70E-06	P	N/A	Lung and heart effects	A
Copper	7440-50-8	4.00E-02	H	N/A	N/A	N/A	N/A	N/A	Liver and kidney damage	A
Iron	7439-89-6	3.00E-01	P	N/A	N/A	N/A	N/A	1.00E-01	N/A	N/A
Lithium	7439-93-2	2.00E-02	P	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Manganese	7439-96-5	1.40E-01	I	N/A	N/A	1.43E-05	I	N/A	CNS effects	I
Mercury	7439-97-6	3.00E-03	I	N/A	N/A	8.57E-05	I	N/A	CNS effects	I
Molybdenum	7439-98-7	5.00E-03	I	N/A	N/A	N/A	N/A	1.00E-01	Increased uric acid levels	I
Nickel	7440-02-0	2.00E-02	I	N/A	N/A	N/A	N/A	1.00E-01	Decreased body and organ weights	I
Selenium	7782-49-2	5.00E-03	I	N/A	N/A	N/A	N/A	N/A	Selenosis	I
Silver	7440-22-4	5.00E-03	I	N/A	N/A	N/A	N/A	N/A	Argyria	I
Strontium	7440-24-6	6.00E-01	I	N/A	N/A	N/A	N/A	N/A	Rachitic bone	I
Thallium	7440-28-0	7.00E-05	I	N/A	N/A	N/A	N/A	N/A	Nervous system effects	A
Tin	7440-31-5	6.00E-01	H	N/A	N/A	N/A	N/A	N/A	Liver lesions	OR
Vanadium	7440-62-2	1.00E-03	P	N/A	N/A	N/A	N/A	N/A	Decreased hair cystine	OR
Zinc	7440-66-6	3.00E-01	I	N/A	N/A	N/A	N/A	N/A	Decrease in ESOD concentration	I

[a] Dermal ABS from EPA 2001.
A = HEAST Alternate.
H = HEAST (EPA 1997)
I = IRIS (EPA 2004).
P = EPA-NCEA provisional value (EPA 2003).
OR = Oakridge National Laboratory, Toxicity Metadata, http://rais.ornl.gov/tox/metadata.shtml
N/A - Not available or not applicable.

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Table

Calculation of Background Cancer Risks and Non[illegible]r Hazards for the Wildlife Refuge Worker

Exposure Route	Analyte	Tier 1 EPC (mg/kg)	Cancer Risk Calculations: Intake/Exposure Concentration (mg/kg/day)	CSF (mg/kg/day)$^{-1}$	Cancer Risk		Non-Cancer Hazard Calculations: Intake/Exposure Concentration (mg/kg/day)	RfD (mg/kg/day)	Hazard Quotient
Tier 1									
Surface Soil/Surface Sediment									
Ingestion	Aluminum	8,755	0.00211	N/A	NC		0.00788	1.00	0.00788
	Antimony	5.03	1.21E-06	N/A	NC		4.53E-06	4.00E-04	0.0113
	Arsenic	4.03	9.69E-07	1.50	1.45E-06		3.63E-06	3.00E-04	0.0121
	Barium	94.8	2.28E-05	N/A	NC		8.54E-05	0.0700	0.00122
	Beryllium	0.641	1.54E-07	N/A	NC		5.77E-07	0.00200	2.88E-04
	Cadmium	0.651	1.57E-07	N/A	NC		5.86E-07	0.00100	5.86E-04
	Chromium VI	10.5	2.53E-06	N/A	NC		9.47E-06	0.00300	0.00316
	Cobalt	6.44	1.55E-06	N/A	NC		5.80E-06	0.0200	2.90E-04
	Copper	13.2	3.17E-06	N/A	NC		1.19E-05	0.0400	2.97E-04
	Iron	11,615	0.00279	N/A	NC		0.0105	0.300	0.0349
	Lithium	8.91	2.14E-06	N/A	NC		8.02E-06	0.0200	4.01E-04
	Manganese	277	6.66E-05	N/A	NC		2.49E-04	0.140	0.00178
	Mercury	0.105	2.52E-08	N/A	NC		9.42E-08	0.00300	3.14E-05
	Molybdenum	7.44	1.79E-06	N/A	NC		6.70E-06	0.00500	0.00134
	Nickel	8.61	2.07E-06	N/A	NC		7.75E-06	0.0200	3.87E-04
	Selenium	0.774	1.86E-07	N/A	NC		6.97E-07	0.00500	1.39E-04
	Silver	0.904	2.17E-07	N/A	NC		8.14E-07	0.00500	1.63E-04
	Strontium	36.2	8.71E-06	N/A	NC		3.26E-05	0.600	5.43E-05
	Thallium	0.382	9.20E-08	N/A	NC		3.44E-07	7.00E-05	0.00492
	Tin	22.5	5.41E-06	N/A	NC		2.02E-05	0.600	3.37E-05
	Vanadium	25.4	6.10E-06	N/A	NC		2.28E-05	0.00100	0.0228
	Zinc	124	2.98E-05	N/A	NC		1.11E-04	0.300	3.72E-04
				Ingestion Total:	**1.45E-06**			**Ingestion Total:**	**0.104**
Inhalation - (indoor + outdoor)	Aluminum	8,755	1.25E-05	N/A	NC		4.67E-05	0.00100	0.0467
	Antimony	5.03	7.17E-09	N/A	NC		2.68E-08	N/A	NC
	Arsenic	4.03	5.74E-09	15.0	8.61E-08		2.15E-08	N/A	NC
	Barium	94.8	1.35E-07	N/A	NC		5.06E-07	1.43E-04	0.00354
	Beryllium	0.641	9.12E-10	8.40	7.66E-09		3.41E-09	5.71E-06	5.98E-04
	Cadmium	0.651	9.28E-10	6.30	5.84E-09		3.47E-09	5.70E-05	6.09E-05
	Chromium VI	10.5	1.50E-08	42.0	6.29E-07		5.61E-08	2.86E-05	0.00196
	Cobalt	6.44	9.17E-09	9.80	8.99E-08		3.43E-08	5.70E-06	0.00602
	Copper	13.2	1.88E-08	N/A	NC		7.03E-08	N/A	NC
	Iron	11,615	1.65E-05	N/A	NC		6.19E-05	N/A	NC
	Lithium	8.91	1.27E-08	N/A	NC		4.75E-08	N/A	NC
	Manganese	277	3.94E-07	N/A	NC		1.48E-06	1.43E-05	0.103
	Mercury	0.105	1.49E-10	N/A	NC		5.58E-10	8.57E-05	6.51E-06
	Molybdenum	7.44	1.06E-08	N/A	NC		3.97E-08	N/A	NC
	Nickel	8.61	1.23E-08	N/A	NC		4.59E-08	N/A	NC
	Selenium	0.774	1.10E-09	N/A	NC		4.13E-09	N/A	NC
	Silver	0.904	1.29E-09	N/A	NC		4.82E-09	N/A	NC
	Strontium	36.2	5.16E-08	N/A	NC		1.93E-07	N/A	NC
	Thallium	0.382	5.45E-10	N/A	NC		2.04E-09	N/A	NC
	Tin	22.5	3.20E-08	N/A	NC		1.20E-07	N/A	NC
	Vanadium	25.4	3.61E-08	N/A	NC		1.35E-07	N/A	NC
	Zinc	124	1.76E-07	N/A	NC		6.60E-07	N/A	NC
				Inhalation Total:	**8.19E-07**			**Inhalation Total:**	**0.162**
				Surface Soil/Surface Sediment Total:	**2.27E-06**			**Surface Soil/Surface Sediment Total:**	**0.267**
				WRW Total:	**2.27E-06**			**WRW Total:**	**0.267**

N/A : Not Applicable or Not Available

NC : Not Calculated; Toxicity Factor (CSF or RfD) not available.

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Table A9.7
Summary of Background Cancer Risks and Non-Cancer Hazards for the Wildlife Refuge Worker

EPC/Medium/ Analyte	Cancer Risk					Non-Cancer Hazard Quotient				
	Ingestion	Inhalation	Dermal	Exposure Routes Total	Percent Contribution to Risk	Ingestion	Inhalation	Dermal	Exposure Routes Total	Percent Contribution to Hazard Index
Tier 1										
Surface Soil/Surface Sediment										
Aluminum	NC	NC	NC	NC	--	0.00788	0.0467	NC	0.0546	20.5%
Antimony	NC	NC	NC	NC	--	0.0113	NC	NC	0.0113	4.25%
Arsenic	1.45E-06	8.61E-08	NC	1.54E-06	67.8%	0.0121	NC	NC	0.0121	4.54%
Barium	NC	NC	NC	NC	--	0.00122	0.00354	NC	0.00476	1.78%
Beryllium	NC	7.66E-09	NC	7.66E-09	0.337%	2.88E-04	5.98E-04	NC	8.86E-04	0.333%
Cadmium	NC	5.84E-09	NC	5.84E-09	0.257%	5.86E-04	6.09E-05	NC	6.47E-04	0.243%
Chromium VI	NC	6.29E-07	NC	6.29E-07	27.7%	0.00316	0.00196	NC	0.00512	1.92%
Cobalt	NC	8.99E-08	NC	8.99E-08	3.96%	2.90E-04	0.00602	NC	0.00631	2.37%
Copper	NC	NC	NC	NC	--	2.97E-04	NC	NC	2.97E-04	0.111%
Iron	NC	NC	NC	NC	--	0.0349	NC	NC	0.0349	13.1%
Lithium	NC	NC	NC	NC	--	4.01E-04	NC	NC	4.01E-04	0.150%
Manganese	NC	NC	NC	NC	--	0.00178	0.103	NC	0.105	39.4%
Mercury	NC	NC	NC	NC	--	3.14E-05	6.51E-06	NC	3.79E-05	0.0142%
Molybdenum	NC	NC	NC	NC	--	0.00134	NC	NC	0.00134	0.503%
Nickel	NC	NC	NC	NC	--	3.87E-04	NC	NC	3.87E-04	0.145%
Selenium	NC	NC	NC	NC	--	1.39E-04	NC	NC	1.39E-04	0.0523%
Silver	NC	NC	NC	NC	--	1.63E-04	NC	NC	1.63E-04	0.0611%
Strontium	NC	NC	NC	NC	--	5.43E-05	NC	NC	5.43E-05	0.0204%
Thallium	NC	NC	NC	NC	--	0.00492	NC	NC	0.00492	1.85%
Tin	NC	NC	NC	NC	--	3.37E-05	NC	NC	3.37E-05	0.0127%
Vanadium	NC	NC	NC	NC	--	0.0228	NC	NC	0.0228	8.56%
Zinc	NC	NC	NC	NC	--	3.72E-04	NC	NC	3.72E-04	0.139%
Surface Soil/Surface Sediment Total:				**2.27E-06**	**100%**				**0.267**	**100%**
Tier 1 WRW Total:				**2.E-06**					**0.3**	

NC : Not Calculated because toxicity information was not available or dermal pathway was only evaluated for organics.
-- : Risk was not calculated.

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Table

Calculation of Background Cancer Risks and Non-Cancer Hazards for the Wildlife Refuge Visitor

Exposure Route	Analyte	Tier 1 EPC (mg/kg)	Cancer Risk Calculations: Intake/Exposure Concentration (mg/kg/day)	CSF (mg/kg/day)	Cancer Risk		Non-Cancer Hazard Calculations: Intake/Exposure Concentration (mg/kg/day)	RfD (mg/kg/day)	Hazard Quotient
Tier 1									
Surface Soil/Surface Sediment									
Ingestion	Aluminum	8,755	0.00196	N/A	NC		0.00457	1.00	0.00457
	Antimony	5.03	1.13E-06	N/A	NC		2.63E-06	4.00E-04	0.00657
	Arsenic	4.03	9.02E-07	1.50	1.35E-06		2.10E-06	3.00E-04	0.00701
	Barium	94.8	2.12E-05	N/A	NC		4.95E-05	0.0700	7.07E-04
	Beryllium	0.641	1.43E-07	N/A	NC		3.34E-07	0.00200	1.67E-04
	Cadmium	0.651	1.46E-07	N/A	NC		3.40E-07	0.00100	3.40E-04
	Chromium VI	10.5	2.35E-06	N/A	NC		5.49E-06	0.00300	0.00183
	Cobalt	6.44	1.44E-06	N/A	NC		3.36E-06	0.0200	1.68E-04
	Copper	13.2	2.95E-06	N/A	NC		6.88E-06	0.0400	1.72E-04
	Iron	11,615	0.00260	N/A	NC		0.00606	0.300	0.0202
	Lithium	8.91	1.99E-06	N/A	NC		4.65E-06	0.0200	2.32E-04
	Manganese	277	6.19E-05	N/A	NC		1.44E-04	0.140	0.00103
	Mercury	0.105	2.34E-08	N/A	NC		5.46E-08	0.00300	1.82E-05
	Molybdenum	7.44	1.66E-06	N/A	NC		3.88E-06	0.00500	7.77E-04
	Nickel	8.61	1.93E-06	N/A	NC		4.49E-06	0.0200	2.25E-04
	Selenium	0.774	1.73E-07	N/A	NC		4.04E-07	0.00500	8.08E-05
	Silver	0.904	2.02E-07	N/A	NC		4.72E-07	0.00500	9.44E-05
	Strontium	36.2	8.10E-06	N/A	NC		1.89E-05	0.600	3.15E-05
	Thallium	0.382	8.55E-08	N/A	NC		2.00E-07	7.00E-05	0.00285
	Tin	22.5	5.03E-06	N/A	NC		1.17E-05	0.600	1.96E-05
	Vanadium	25.4	5.67E-06	N/A	NC		1.32E-05	0.00100	0.0132
	Zinc	124	2.77E-05	N/A	NC		6.46E-05	0.300	2.15E-04
				Ingestion Total:	**1.35E-06**			**Ingestion Total:**	**0.0605**
Inhalation - (outdoor)	Aluminum	8,755	8.40E-06	N/A	NC		1.96E-05	0.00100	0.0196
	Antimony	5.03	4.83E-09	N/A	NC		1.13E-08	N/A	NC
	Arsenic	4.03	3.87E-09	15.0	5.80E-08		9.02E-09	N/A	NC
	Barium	94.8	9.10E-08	N/A	NC		2.12E-07	1.43E-04	0.00148
	Beryllium	0.641	6.14E-10	8.40	5.16E-09		1.43E-09	5.71E-06	2.51E-04
	Cadmium	0.651	6.25E-10	6.30	3.93E-09		1.46E-09	5.70E-05	2.56E-05
	Chromium VI	10.5	1.01E-08	42.0	4.24E-07		2.35E-08	2.86E-05	8.23E-04
	Cobalt	6.44	6.18E-09	9.80	6.05E-08		1.44E-08	5.70E-06	0.00253
	Copper	13.2	1.26E-08	N/A	NC		2.95E-08	N/A	NC
	Iron	11,615	1.11E-05	N/A	NC		2.60E-05	N/A	NC
	Lithium	8.91	8.54E-09	N/A	NC		1.99E-08	N/A	NC
	Manganese	277	2.65E-07	N/A	NC		6.19E-07	1.43E-05	0.0433
	Mercury	0.105	1.00E-10	N/A	NC		2.34E-10	8.57E-05	2.73E-06
	Molybdenum	7.44	7.14E-09	N/A	NC		1.67E-08	N/A	NC
	Nickel	8.61	8.26E-09	N/A	NC		1.93E-08	N/A	NC
	Selenium	0.774	7.42E-10	N/A	NC		1.73E-09	N/A	NC
	Silver	0.904	8.67E-10	N/A	NC		2.02E-09	N/A	NC
	Strontium	36.2	3.47E-08	N/A	NC		8.11E-08	N/A	NC
	Thallium	0.382	3.67E-10	N/A	NC		8.56E-10	N/A	NC
	Tin	22.5	2.16E-08	N/A	NC		5.03E-08	N/A	NC
	Vanadium	25.4	2.43E-08	N/A	NC		5.67E-08	N/A	NC
	Zinc	124	1.19E-07	N/A	NC		2.77E-07	N/A	NC
				Inhalation Total:	**5.51E-07**			**Inhalation Total:**	**0.0680**
				Surface Soil/Surface Sediment Total:	**1.9E-06**			**Surface Soil/Surface Sediment Total:**	**0.129**
				WRV Total:	**2.E-06**			**WRV Total:**	**0.1**

N/A : Not Applicable or Not Available

NC : Not Calculated; Toxicity Factor (CSF or RfD) not available.

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Table A9.9

Summary of Background Cancer Risks and Non-Cancer Hazards for the Wildlife Refuge Visitor

EPC/Medium/ Analyte	Cancer Risk					Non-Cancer Hazard Quotient				
	Ingestion	Inhalation	Dermal	Exposure Routes Total	Percent Contribution to Risk	Ingestion	Inhalation	Dermal	Exposure Routes Total	Percent Contribution to Hazard Index
Tier 1										
Surface Soil/Surface Sediment										
Aluminum	NC	NC	NC	NC	--	0.00457	0.0196	NC	0.0242	18.8%
Antimony	NC	NC	NC	NC	--	0.00657	NC	NC	0.00657	5.11%
Arsenic	1.35E-06	5.80E-08	NC	1.41E-06	74.1%	0.00701	NC	NC	0.00701	5.45%
Barium	NC	NC	NC	NC	--	7.07E-04	0.00148	NC	0.00219	1.70%
Beryllium	NC	5.16E-09	NC	5.16E-09	0.271%	1.67E-04	2.51E-04	NC	4.18E-04	0.325%
Cadmium	NC	3.93E-09	NC	3.93E-09	0.207%	3.40E-04	2.56E-05	NC	3.65E-04	0.284%
Chromium VI	NC	4.24E-07	NC	4.24E-07	22.3%	0.00183	8.23E-04	NC	0.00265	2.06%
Cobalt	NC	6.05E-08	NC	6.05E-08	3.18%	1.68E-04	0.00253	NC	0.00270	2.10%
Copper	NC	NC	NC	NC	--	1.72E-04	NC	NC	1.72E-04	0.134%
Iron	NC	NC	NC	NC	--	0.0202	NC	NC	0.0202	15.7%
Lithium	NC	NC	NC	NC	--	2.32E-04	NC	NC	2.32E-04	0.181%
Manganese	NC	NC	NC	NC	--	0.00103	0.0433	NC	0.0443	34.5%
Mercury	NC	NC	NC	NC	--	1.82E-05	2.73E-06	NC	2.09E-05	0.0163%
Molybdenum	NC	NC	NC	NC	--	7.77E-04	NC	NC	7.77E-04	0.604%
Nickel	NC	NC	NC	NC	--	2.25E-04	NC	NC	2.25E-04	0.175%
Selenium	NC	NC	NC	NC	--	8.08E-05	NC	NC	8.08E-05	0.0628%
Silver	NC	NC	NC	NC	--	9.44E-05	NC	NC	9.44E-05	0.0734%
Strontium	NC	NC	NC	NC	--	3.15E-05	NC	NC	3.15E-05	0.0245%
Thallium	NC	NC	NC	NC	--	0.00285	NC	NC	0.00285	2.22%
Tin	NC	NC	NC	NC	--	1.96E-05	NC	NC	1.96E-05	0.0152%
Vanadium	NC	NC	NC	NC	--	0.0132	NC	NC	0.0132	10.3%
Zinc	NC	NC	NC	NC	--	2.15E-04	NC	NC	2.15E-04	0.168%
Surface Soil/Surface Sediment Total:				**1.90E-06**	**100%**				**0.129**	**100%**
Tier 1 WRV Total:				**2.E-06**					**0.13**	

NC : Not Calculated because toxicity information was not available or dermal pathway was only evaluated for organics.

-- : Risk was not calculated.

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Table A9.10
Summary of Background Risk Characterization Results

Exposure Scenario/EPC/Medium	Estimated Excess Lifetime Cancer Risk	Major Contributors to Background Cancer Risk	Estimated Non-Cancer Hazard Index	Major Contributors to Background Hazard Index
Wildlife Refuge Worker (WRW)				
Tier 1 EPC				
Surface Soil/Surface Sediment	2.E-06	Arsenic (68%), Chromium VI (28%)	0.27	Manganese (39%), Aluminum (21%), Iron (13%), Vanadium (9%)
Wildlife Refuge Visitor (WRV)				
Tier 1 EPC				
Surface Soil/Surface Sediment	2.E-06	Arsenic (74%), Chromium VI (22%)	0.13	Manganese (35%), Aluminum (19%), Iron (16%), Vanadium (10%)

Table A9.11

ECOPCs for the RFETS CRA

ECOI	Terrestrial Plants	Terrestrial Invertebrates	Mourning Dove Insectivore	Mourning Dove Herbivore	American Kestrel	Deer Mouse Insectivore	Deer Mouse Herbivore	Prairie Dog	Mule Deer	Coyote Generalist	Coyote Insectivore	Coyote Carnivore	PMJM
Inorganics													
Aluminum	Not an ECOPC												
Ammonia	Not an ECOPC												
Antimony	Not detected in background surface soil samples. No background risks are calculated.												
Arsenic	Not an ECOPC												
Barium				X									
Beryllium	Not an ECOPC												
Cadmium													X
Calcium	Not an ECOPC												
Cesium	Not an ECOPC												
Chromium	X	X	X	X	X	X							X
Cobalt	Not an ECOPC												
Copper			X	X									X
Iron	Not an ECOPC												
Lead			X	X	X	X	X						
Lithium	Not an ECOPC												
Magnesium	Not an ECOPC												
Manganese	X			X			X						X
Mercury			X										X
Molybdenum	Not detected in background surface soil samples. No background risks are calculated.												
Nickel			X		X	X	X			X	X		X
Nitrate	Not an ECOPC												
Potassium	Not an ECOPC												
Selenium													X
Silica	Not an ECOPC												
Silver	Not detected in background surface soil samples. No background risks are calculated.												
Sodium	Not an ECOPC												
Strontium	Not an ECOPC												
Thallium	Not detected in background surface soil samples. No background risks are calculated.												
Tin	Not detected in background surface soil samples. No background risks are calculated.												
Vanadium	X		X			X	X						X
Zinc	X		X	X	X	X							X
Radionuclides													
Americium-241	Not an ECOPC												
Cesium-134	Not an ECOPC												
Cesium-137	Not an ECOPC												
Plutonium-239/240	Not an ECOPC												
Radium-226	Not an ECOPC												
Radium-228	Not an ECOPC												
Strontium-89/90	Not an ECOPC												
Uranium-233/234	Not an ECOPC												
Uranium-235	Not an ECOPC												
Uranium-238	Not an ECOPC												

X = Chemical was identified as an ECOPC for the receptor in at least 1 EU. Background risks for all receptors are calculated.

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Table A9.12

Statistics Used to Estimate Exposure Point Concentrations

Analyte	Unit	Appropriate Distribution	Recommended UCL	UCL	UTL	MDC
Barium	mg/kg	NORMAL	95% Student's-t UCL	109.8	139.7	134
Cadmium	mg/kg	NONPARAMETRIC	95% Chebyshev (Mean, Sd) UCL	1.2	2.3	2.3
Chromium	mg/kg	NORMAL	95% Student's-t UCL	12.3	16.6	16.9
Copper	mg/kg	NONPARAMETRIC	95% Student's-t UCL	14.0	16.0	16
Lead	mg/kg	NORMAL	95% Student's-t UCL	37.6	53.8	53.3
Manganese	mg/kg	NORMAL	95% Student's-t UCL	261.8	360.2	357
Mercury	mg/kg	NONPARAMETRIC	95% Student's-t UCL	0.08	0.12	0.12
Nickel	mg/kg	NORMAL	95% Student's-t UCL	10.6	14.6	14
Selenium	mg/kg	NONPARAMETRIC	95% Chebyshev (Mean, Sd) UCL	0.92	1.4	1.4
Vanadium	mg/kg	NORMAL	95% Student's-t UCL	30.7	42.5	45.8
Zinc	mg/kg	NORMAL	95% Student's-t UCL	54.5	73.3	75.9

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Table A9.13
Background Surface Soil Exposure Calculations for Barium

Bioaccumulation Factors						
Soil to Plant	Soil to Invertebrate	Soil to Small Mammal				
0.447	0.16	0.1121				
Media Concentrations (mg/kg)						
Soil Concentration	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**	
134	MDC	59.90	21.4	15.02	0.6	
110	UCL	49.17	17.6	12.33	0.105	
Intake Parameters						
	$IR_{(food)}$ (kg/kg BW day)	$IR_{(water)}$ (kg/kg BW day)	$IR_{(soil)}$ (kg/kg BW day)	P_{plant}	P_{invert}	P_{mammal}
Mourning Dove - Herbivore	0.23	0.12	0.021	1	0	0
Mourning Dove - Insectivore	0.23	0.12	0.021	0	1	0
American Kestrel	0.092	0.12	0.005	0	0.2	0.8
Deer Mouse - Herbivore	0.111	0.19	0.002	1	0	0
Deer Mouse - Insectivore	0.065	0.19	0.001	0	1	0
Prairie Dog	0.029	0.098	0.002	1	0	0
Mule Deer	0.022	0.065	0.0004	1	0	0
Coyote - Generalist	0.015	0.08	0.001	0	0.25	0.75
Coyote - Insectivore	0.015	0.08	0.0004	0	1	0
Coyote - Carnivore	0.015	0.08	0.000	0	0	1
Intake Estimates (mg/kg BW day)						
	Plant Tissue	Invertebrate Tissue	Mammal Tissue	Soil	Surface Water	Total
Mourning Dove - Herbivore						
MDC	1.38E+01	N/A	N/A	2.87E+00	7.20E-02	1.67E+01
UCL	1.13E+01	N/A	N/A	2.35E+00	1.26E-02	1.37E+01
Mourning Dove - Insectivore						
MDC	N/A	4.93E+00	N/A	2.87E+00	7.20E-02	7.87E+00
UCL	N/A	4.05E+00	N/A	2.35E+00	1.26E-02	6.41E+00
American Kestrel						
MDC	N/A	3.94E-01	1.11E+00	6.16E-01	7.20E-02	2.19E+00
UCL	N/A	3.24E-01	9.08E-01	5.06E-01	1.26E-02	1.75E+00
Deer Mouse - Herbivore						
MDC	6.65E+00	N/A	N/A	2.97E-01	1.14E-01	7.06E+00
UCL	5.46E+00	N/A	N/A	2.44E-01	2.00E-02	5.72E+00
Deer Mouse - Insectivore						
MDC	N/A	1.39E+00	N/A	1.74E-01	1.14E-01	1.68E+00
UCL	N/A	1.14E+00	N/A	1.43E-01	2.00E-02	1.31E+00
Prairie Dog						
MDC	1.74E+00	N/A	N/A	2.99E-01	5.88E-02	2.10E+00
UCL	1.43E+00	N/A	N/A	2.46E-01	1.03E-02	1.68E+00
Mule Deer						
MDC	1.32E+00	N/A	N/A	5.01E-02	3.90E-02	1.41E+00
UCL	1.08E+00	N/A	N/A	4.11E-02	6.83E-03	1.13E+00
Coyote - Generalist						
MDC	N/A	8.04E-02	1.69E-01	1.01E-01	4.80E-02	3.98E-01
UCL	N/A	6.60E-02	1.39E-01	8.25E-02	8.40E-03	2.96E-01
Coyote - Insectivore						
MDC	N/A	3.22E-01	N/A	5.63E-02	4.80E-02	4.26E-01
UCL	N/A	2.64E-01	N/A	4.62E-02	8.40E-03	3.19E-01
Coyote - Carnivore						
MDC	N/A	N/A	2.25E-01	5.36E-02	4.80E-02	3.27E-01
UCL	N/A	N/A	1.85E-01	4.40E-02	8.40E-03	2.37E-01

N/A = Not applicable.

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Table A9.14

Background Surface Soil Exposure Calculations for Cadmium

Bioaccumulation Factors						
Soil to Plant	Soil to Invertebrate	Soil to Small Mammal				
lnCp = 0.476 + 0.546 (ln Cs)	lnCi = 2.114 + 0.795 (ln Cs)	lnCsm = 1.5383 + 0.566 (ln Cs)				
Media Concentrations (mg/kg)						
Soil Concentration	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**	
2.3	UTL	2.54	16.06	7.46	0.004	
1.15	UCL	1.74	9.25	5.04	0.002	
Intake Parameters						
	$IR_{(food)}$ (kg/kg BW day)	$IR_{(water)}$ (kg/kg BW day)	$IR_{(soil)}$ (kg/kg BW day)	P_{plant}	P_{invert}	P_{mammal}
PMJM	0.17	0.15	0.004	0.7	0.3	0
Mourning Dove - Herbivore	0.23	0.12	0.021	1	0	0
Mourning Dove - Insectivore	0.23	0.12	0.021	0	1	0
American Kestrel	0.092	0.12	0.005	0	0.2	0.8
Deer Mouse - Herbivore	0.111	0.19	0.002	1	0	0
Deer Mouse - Insectivore	0.065	0.19	0.001	0	1	0
Prairie Dog	0.029	0.098	0.002	1	0	0
Mule Deer	0.022	0.065	0.0004	1	0	0
Coyote - Generalist	0.015	0.08	0.001	0	0.25	0.75
Coyote - Insectivore	0.015	0.08	0.0004	0	1	0
Coyote - Carnivore	0.015	0.08	0.000	0	0	1
Intake Estimates (mg/kg BW day)						
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
PMJM						
UTL	3.02E-01	8.19E-01	N/A	9.38E-03	6.00E-04	1.13E+00
UCL	2.07E-01	4.72E-01	N/A	4.69E-03	3.00E-04	6.84E-01
Mourning Dove - Herbivore						
UTL	5.83E-01	N/A	N/A	4.92E-02	4.80E-04	6.33E-01
UCL	4.00E-01	N/A	N/A	2.46E-02	2.40E-04	4.24E-01
Mourning Dove - Insectivore						
UTL	N/A	3.69E+00	N/A	4.92E-02	4.80E-04	3.74E+00
UCL	N/A	2.13E+00	N/A	2.46E-02	2.40E-04	2.15E+00
American Kestrel						
UTL	N/A	2.95E-01	5.49E-01	1.06E-02	4.80E-04	8.56E-01
UCL	N/A	1.70E-01	3.71E-01	5.29E-03	2.40E-04	5.47E-01
Deer Mouse - Herbivore						
UTL	2.82E-01	N/A	N/A	5.11E-03	7.60E-04	2.87E-01
UCL	1.93E-01	N/A	N/A	2.55E-03	3.80E-04	1.96E-01
Deer Mouse - Insectivore						
UTL	N/A	1.04E+00	N/A	2.99E-03	7.60E-04	1.05E+00
UCL	N/A	6.02E-01	N/A	1.50E-03	3.80E-04	6.03E-01
Prairie Dog						
UTL	7.36E-02	N/A	N/A	5.14E-03	3.92E-04	7.91E-02
UCL	5.04E-02	N/A	N/A	2.57E-03	1.96E-04	5.31E-02
Mule Deer						
UTL	5.58E-02	N/A	N/A	8.60E-04	2.60E-04	5.69E-02
UCL	3.82E-02	N/A	N/A	4.30E-04	1.30E-04	3.88E-02
Coyote - Generalist						
UTL	N/A	6.02E-02	8.39E-02	1.73E-03	3.20E-04	1.46E-01
UCL	N/A	3.47E-02	5.67E-02	8.63E-04	1.60E-04	9.24E-02
Coyote - Insectivore						
UTL	N/A	2.41E-01	N/A	9.66E-04	3.20E-04	2.42E-01
UCL	N/A	1.39E-01	N/A	4.83E-04	1.60E-04	1.39E-01
Coyote - Carnivore						
UTL	N/A	N/A	1.12E-01	9.20E-04	3.20E-04	1.13E-01
UCL	N/A	N/A	7.56E-02	4.60E-04	1.60E-04	7.62E-02

N/A = Not applicable.

Table A9.15

Background Surface Soil Exposure Calculations for Chromium

Bioaccumulation Factors						
Soil to Plant	Soil to Invertebrate	Soil to Small Mammal				
0.084	3.162	lnCm = -1.495 + 0.7326(lnCs)				
Media Concentrations (mg/kg)						
Soil Concentration	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**	
16.9	UTL	1.42	53.4	1.78	0.247	
12.3	UCL	1.03	38.9	1.41	0.02	
Intake Parameters						
	IR_{plant} (kg/kg BW day)	IR_{invert} (kg/kg BW day)	IR_{mammal} (kg/kg BW day)	P_{plant}	P_{invert}	P_{mammal}
PMJM	0.17	0.15	0.004	0.7	0.3	0
Mourning Dove - Herbivore	0.23	0.12	0.021	1	0	0
Mourning Dove - Insectivore	0.23	0.12	0.021	0	1	0
American Kestrel	0.092	0.12	0.005	0	0.2	0.8
Deer Mouse - Herbivore	0.111	0.19	0.002	1	0	0
Deer Mouse - Insectivore	0.065	0.19	0.001	0	1	0
Prairie Dog	0.029	0.098	0.002	1	0	0
Mule Deer	0.022	0.065	0.0004	1	0	0
Coyote - Generalist	0.015	0.08	0.001	0	0.25	0.75
Coyote - Insectivore	0.015	0.08	0.0004	0	1	0
Coyote - Carnivore	0.015	0.08	0.000	0	0	1
Intake Estimates (mg/kg BW day)						
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
PMJM						
UTL	1.69E-01	2.73E+00	N/A	6.90E-02	3.71E-02	3.00E+00
UCL	1.23E-01	1.98E+00	N/A	5.02E-02	3.00E-03	2.16E+00
Mourning Dove - Herbivore						
UTL	3.27E-01	N/A	N/A	3.61E-01	2.96E-02	7.18E-01
UCL	2.38E-01	N/A	N/A	2.63E-01	2.40E-03	5.03E-01
Mourning Dove - Insectivore						
UTL	N/A	1.23E+01	N/A	3.61E-01	2.96E-02	1.27E+01
UCL	N/A	8.95E+00	N/A	2.63E-01	2.40E-03	9.21E+00
American Kestrel						
UTL	N/A	9.83E-01	1.31E-01	7.77E-02	2.96E-02	1.22E+00
UCL	N/A	7.16E-01	1.04E-01	5.66E-02	2.40E-03	8.78E-01
Deer Mouse - Herbivore						
UTL	1.58E-01	N/A	N/A	3.75E-02	4.69E-02	2.42E-01
UCL	1.15E-01	N/A	N/A	2.73E-02	3.80E-03	1.46E-01
Deer Mouse - Insectivore						
UTL	N/A	3.47E+00	N/A	2.20E-02	4.69E-02	3.54E+00
UCL	N/A	2.53E+00	N/A	1.60E-02	3.80E-03	2.55E+00
Prairie Dog						
UTL	4.12E-02	N/A	N/A	3.77E-02	2.42E-02	1.03E-01
UCL	3.00E-02	N/A	N/A	2.75E-02	1.96E-03	5.94E-02
Mule Deer						
UTL	3.12E-02	N/A	N/A	6.32E-03	1.61E-02	5.36E-02
UCL	2.27E-02	N/A	N/A	4.60E-03	1.30E-03	2.86E-02
Coyote - Generalist						
UTL	N/A	2.00E-01	2.00E-02	1.27E-02	1.98E-02	2.53E-01
UCL	N/A	1.46E-01	1.59E-02	9.23E-03	1.60E-03	1.73E-01
Coyote - Insectivore						
UTL	N/A	8.02E-01	N/A	7.10E-03	1.98E-02	8.28E-01
UCL	N/A	5.83E-01	N/A	5.17E-03	1.60E-03	5.90E-01
Coyote - Carnivore						
UTL	N/A	N/A	2.67E-02	6.76E-03	1.98E-02	5.32E-02
UCL	N/A	N/A	2.11E-02	4.92E-03	1.60E-03	2.77E-02

N/A = Not applicable.

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Table A9.16
Background Surface Soil Exposure Calculations for Copper

Bioaccumulation Factors						
Soil to Plant	Soil to Invertebrate	Soil to Small Mammal				
lnCp = 0.669 + 0.394(lnCs)	lnCi = 1.675 + 0.264(lnCs)	lnCsm = 2.042 + .1444(lnCs)				
Media Concentrations (mg/kg)						
Soil Concentration	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**	
16	UTL	5.82	11.10	11.50	0.048	
14	UCL	5.52	10.72	11.28	0.01	
Intake Parameters						
	$IR_{(food)}$ (kg/kg BW/day)	$IR_{(water)}$ (kg/kg BW/day)	$IR_{(soil)}$ (kg/kg BW/day)	P_{plant}	P_{invert}	P_{mammal}
PMJM	0.17	0.15	0.004	0.7	0.3	0
Mourning Dove - Herbivore	0.23	0.12	0.021	1	0	0
Mourning Dove - Insectivore	0.23	0.12	0.021	0	1	0
American Kestrel	0.092	0.12	0.005	0	0.2	0.8
Deer Mouse - Herbivore	0.111	0.19	0.002	1	0	0
Deer Mouse - Insectivore	0.065	0.19	0.001	0	1	0
Prairie Dog	0.029	0.098	0.002	1	0	0
Mule Deer	0.022	0.065	0.0004	1	0	0
Coyote - Generalist	0.015	0.08	0.001	0	0.25	0.75
Coyote - Insectivore	0.015	0.08	0.0004	0	1	0
Coyote - Carnivore	0.015	0.08	0.000	0	0	1
Intake Estimates (mg/kg BW/day)						
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
PMJM						
UTL	6.93E-01	5.66E-01	N/A	6.53E-02	7.20E-03	1.33E+00
UCL	6.57E-01	5.47E-01	N/A	5.71E-02	1.50E-03	1.26E+00
Mourning Dove - Herbivore						
UTL	1.34E+00	N/A	N/A	3.42E-01	5.76E-03	1.69E+00
UCL	1.27E+00	N/A	N/A	2.99E-01	1.20E-03	1.57E+00
Mourning Dove - Insectivore						
UTL	N/A	2.55E+00	N/A	3.42E-01	5.76E-03	2.90E+00
UCL	N/A	2.46E+00	N/A	2.99E-01	1.20E-03	2.77E+00
American Kestrel						
UTL	N/A	2.04E-01	8.46E-01	7.36E-02	5.76E-03	1.13E+00
UCL	N/A	1.97E-01	8.30E-01	6.44E-02	1.20E-03	1.09E+00
Deer Mouse - Herbivore						
UTL	6.46E-01	N/A	N/A	3.55E-02	9.12E-03	6.91E-01
UCL	6.13E-01	N/A	N/A	3.11E-02	1.90E-03	6.46E-01
Deer Mouse - Insectivore						
UTL	N/A	7.22E-01	N/A	2.08E-02	9.12E-03	7.51E-01
UCL	N/A	6.97E-01	N/A	1.82E-02	1.90E-03	7.17E-01
Prairie Dog						
UTL	1.69E-01	N/A	N/A	3.57E-02	4.70E-03	2.09E-01
UCL	1.60E-01	N/A	N/A	3.13E-02	9.80E-04	1.92E-01
Mule Deer						
UTL	1.28E-01	N/A	N/A	5.98E-03	3.12E-03	1.37E-01
UCL	1.21E-01	N/A	N/A	5.24E-03	6.50E-04	1.27E-01
Coyote - Generalist						
UTL	N/A	4.16E-02	1.29E-01	1.20E-02	3.84E-03	1.87E-01
UCL	N/A	4.02E-02	1.27E-01	1.05E-02	8.00E-04	1.78E-01
Coyote - Insectivore						
UTL	N/A	1.67E-01	N/A	6.72E-03	3.84E-03	1.77E-01
UCL	N/A	1.61E-01	N/A	5.88E-03	8.00E-04	1.67E-01
Coyote - Carnivore						
UTL	N/A	N/A	1.73E-01	6.40E-03	3.84E-03	1.83E-01
UCL	N/A	N/A	1.69E-01	5.60E-03	8.00E-04	1.76E-01

N/A = Not applicable.

Table A9.17
Background Surface Soil Exposure Calculations for Lead

Bioaccumulation Factors						
Soil to Plant	Soil to Invertebrate	Soil to Small Mammal				
lnCp = -1.328 + 0.561 (ln Cs)	lnCi = -.218 + 0.807 (ln Cs)	lnCsm = 0.0761 + 0.4422 (ln Cs)				
Media Concentrations (mg/kg)						
Soil Concentration	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**	
53.3	UTL	2.47	19.90	6.26	0.051	
37.6	UCL	2.03	15.01	5.37	0.007	
Intake Parameters						
	$IR_{(food)}$ (kg/kg BW day)	$IR_{(water)}$ (kg/kg BW day)	$IR_{(soil)}$ (kg/kg BW day)	P_{plant}	P_{invert}	P_{mammal}
Mourning Dove - Herbivore	0.23	0.12	0.021	1	0	0
Mourning Dove - Insectivore	0.23	0.12	0.021	0	1	0
American Kestrel	0.092	0.12	0.005	0	0.2	0.8
Deer Mouse - Herbivore	0.111	0.19	0.002	1	0	0
Deer Mouse - Insectivore	0.065	0.19	0.001	0	1	0
Prairie Dog	0.029	0.098	0.002	1	0	0
Mule Deer	0.022	0.065	0.0004	1	0	0
Coyote - Generalist	0.015	0.08	0.001	0	0.25	0.75
Coyote - Insectivore	0.015	0.08	0.0004	0	1	0
Coyote - Carnivore	0.015	0.08	0.000	0	0	1
Intake Estimates (mg/kg BW day)						
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Mourning Dove - Herbivore						
UTL	5.67E-01	N/A	N/A	1.14E+00	6.12E-03	1.71E+00
UCL	4.66E-01	N/A	N/A	8.04E-01	8.40E-04	1.27E+00
Mourning Dove - Insectivore						
UTL	N/A	4.58E+00	N/A	1.14E+00	6.12E-03	5.72E+00
UCL	N/A	3.45E+00	N/A	8.04E-01	8.40E-04	4.26E+00
American Kestrel						
UTL	N/A	3.66E-01	4.61E-01	2.45E-01	6.12E-03	1.08E+00
UCL	N/A	2.76E-01	3.95E-01	1.73E-01	8.40E-04	8.45E-01
Deer Mouse - Herbivore						
UTL	2.74E-01	N/A	N/A	1.18E-01	9.69E-03	4.02E-01
UCL	2.25E-01	N/A	N/A	8.35E-02	1.33E-03	3.10E-01
Deer Mouse - Insectivore						
UTL	N/A	1.29E+00	N/A	6.93E-02	9.69E-03	1.37E+00
UCL	N/A	9.76E-01	N/A	4.89E-02	1.33E-03	1.03E+00
Prairie Dog						
UTL	7.15E-02	N/A	N/A	1.19E-01	5.00E-03	1.96E-01
UCL	5.88E-02	N/A	N/A	8.40E-02	6.86E-04	1.43E-01
Mule Deer						
UTL	5.42E-02	N/A	N/A	1.99E-02	3.32E-03	7.75E-02
UCL	4.46E-02	N/A	N/A	1.41E-02	4.55E-04	5.91E-02
Coyote - Generalist						
UTL	N/A	7.46E-02	7.04E-02	4.00E-02	4.08E-03	1.89E-01
UCL	N/A	5.63E-02	6.04E-02	2.82E-02	5.60E-04	1.45E-01
Coyote - Insectivore						
UTL	N/A	2.98E-01	N/A	2.24E-02	4.08E-03	3.25E-01
UCL	N/A	2.25E-01	N/A	1.58E-02	5.60E-04	2.42E-01
Coyote - Carnivore						
UTL	N/A	N/A	9.39E-02	2.13E-02	4.08E-03	1.19E-01
UCL	N/A	N/A	8.05E-02	1.50E-02	5.60E-04	9.61E-02

N/A = Not applicable.

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Table A9.18
Background Surface Soil Exposure Calculations for Manganese

Bioaccumulation Factors						
Soil to Plant	Soil to Invertebrate	Soil to Small Mammal				
0.234	lnCi = 0.809 + 0.682(lnCs)	0.037				
Media Concentrations (mg/kg)						
Soil Concentration	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**	
357	UTL	83.54	123.7	13.21	4.06	
262	UCL	61.31	100.1	9.69	0.104	
Intake Parameters						
	$IR_{(food)}$ (kg/kg BW day)	$IR_{(water)}$ (kg/kg BW day)	$IR_{(soil)}$ (kg/kg BW day)	P_{plant}	P_{invert}	P_{mammal}
PMJM	0.17	0.15	0.004	0.7	0.3	0
Mourning Dove - Herbivore	0.23	0.12	0.021	1	0	0
Mourning Dove - Insectivore	0.23	0.12	0.021	0	1	0
American Kestrel	0.092	0.12	0.005	0	0.2	0.8
Deer Mouse - Herbivore	0.111	0.19	0.002	1	0	0
Deer Mouse - Insectivore	0.065	0.19	0.001	0	1	0
Prairie Dog	0.029	0.098	0.002	1	0	0
Mule Deer	0.022	0.065	0.0004	1	0	0
Coyote - Generalist	0.015	0.08	0.001	0	0.25	0.75
Coyote - Insectivore	0.015	0.08	0.0004	0	1	0
Coyote - Carnivore	0.015	0.08	0.000	0	0	1
Intake Estimates (mg/kg BW day)						
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
PMJM						
UTL	9.94E+00	6.31E+00	N/A	1.46E+00	6.09E-01	1.83E+01
UCL	7.30E+00	5.11E+00	N/A	1.07E+00	1.56E-02	1.35E+01
Mourning Dove - Herbivore						
UTL	1.92E+01	N/A	N/A	7.64E+00	4.87E-01	2.73E+01
UCL	1.41E+01	N/A	N/A	5.60E+00	1.25E-02	1.97E+01
Mourning Dove - Insectivore						
UTL	N/A	2.84E+01	N/A	7.64E+00	4.87E-01	3.66E+01
UCL	N/A	2.30E+01	N/A	5.60E+00	1.25E-02	2.86E+01
American Kestrel						
UTL	N/A	2.28E+00	9.72E-01	1.64E+00	4.87E-01	5.38E+00
UCL	N/A	1.84E+00	7.13E-01	1.21E+00	1.25E-02	3.77E+00
Deer Mouse - Herbivore						
UTL	9.27E+00	N/A	N/A	7.93E-01	7.71E-01	1.08E+01
UCL	6.81E+00	N/A	N/A	5.82E-01	1.98E-02	7.41E+00
Deer Mouse - Insectivore						
UTL	N/A	8.04E+00	N/A	4.64E-01	7.71E-01	9.27E+00
UCL	N/A	6.51E+00	N/A	3.41E-01	1.98E-02	6.87E+00
Prairie Dog						
UTL	2.42E+00	N/A	N/A	7.97E-01	3.98E-01	3.62E+00
UCL	1.78E+00	N/A	N/A	5.85E-01	1.02E-02	2.37E+00
Mule Deer						
UTL	1.84E+00	N/A	N/A	1.34E-01	2.64E-01	2.24E+00
UCL	1.35E+00	N/A	N/A	9.80E-02	6.76E-03	1.45E+00
Coyote - Generalist						
UTL	N/A	4.64E-01	1.49E-01	2.68E-01	3.25E-01	1.20E+00
UCL	N/A	3.76E-01	1.09E-01	1.97E-01	8.32E-03	6.89E-01
Coyote - Insectivore						
UTL	N/A	1.86E+00	N/A	1.50E-01	3.25E-01	2.33E+00
UCL	N/A	1.50E+00	N/A	1.10E-01	8.32E-03	1.62E+00
Coyote - Carnivore						
UTL	N/A	N/A	1.98E-01	1.43E-01	3.25E-01	6.66E-01
UCL	N/A	N/A	1.45E-01	1.05E-01	8.32E-03	2.59E-01

N/A = Not applicable.

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Table A9.19
Background Surface Soil Exposure Calculations for Mercury

Soil to Plant	Soil to Invertebrate	Soil to Small Mammal				
lnCp = -0.966 + 0.54 (ln Cs)	lnCi = -0.68 + 0.12 (ln Cs)	0.192				
Media Concentrations (mg/kg)						
Soil Concentration	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**	
0.12	UTL	0.12	0.39	0.02	0.00062	
0.083	UCL	0.10	0.38	0.02	0.000123	
Intake Parameters						
	IR(food) (kg/kg BW day)	**IR(water) (kg/kg BW day)**	**IR(soil) (kg/kg BW day)**	**Pplant**	**Pinvert**	**Pmammal**
PMJM	0.17	0.15	0.004	0.7	0.3	0
Mourning Dove - Insectivore	0.23	0.12	0.021	0	1	0
Intake Estimates (mg/kg BW day)						
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
PMJM						
UTL	1.44E-02	2.00E-02	N/A	4.90E-04	9.30E-05	3.50E-02
UCL	1.18E-02	1.92E-02	N/A	3.39E-04	1.85E-05	3.13E-02
Mourning Dove - Insectivore						
UTL	0.00E+00	9.03E-02	0.00E+00	2.57E-03	7.44E-05	9.30E-02
UCL	0.00E+00	8.64E-02	0.00E+00	1.78E-03	1.48E-05	8.82E-02

N/A = Not applicable

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Table A9.20

Background Surface Soil Exposure Calculations for Nickel

Bioaccumulation Factors						
Soil to Plant	Soil to Invertebrate	Soil to Small Mammal				
lnCp = -2.224+0.748(lnCs)	4.73	lnCm = -0.2462 + 0.4658(lnCs)				
Media Concentrations (mg/kg)						
Soil Concentration	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**	
14	UTL	0.78	66.2	2.67	0.12	
10.6	UCL	0.63	50.1	2.35	0.014	
Intake Parameters						
	$IR_{(plant)}$ (kg/kg BW day)	$IR_{(invert)}$ (kg/kg BW day)	$IR_{(soil)}$ (kg/kg BW day)	P_{plant}	P_{invert}	P_{mammal}
PMJM	0.17	0.15	0.004	0.7	0.3	0
Mourning Dove - Herbivore	0.23	0.12	0.021	1	0	0
Mourning Dove - Insectivore	0.23	0.12	0.021	0	1	0
American Kestrel	0.092	0.12	0.005	0	0.2	0.8
Deer Mouse - Herbivore	0.111	0.19	0.002	1	0	0
Deer Mouse - Insectivore	0.065	0.19	0.001	0	1	0
Prairie Dog	0.029	0.098	0.002	1	0	0
Mule Deer	0.022	0.065	0.0004	1	0	0
Coyote - Generalist	0.015	0.08	0.001	0	0.25	0.75
Coyote - Insectivore	0.015	0.08	0.0004	0	1	0
Coyote - Carnivore	0.015	0.08	0.000	0	0	1
Intake Estimates (mg/kg BW day)						
	Plant Tissue	Invertebrate Tissue	Mammal Tissue	Soil	Surface Water	Total
PMJM						
UTL	9.27E-02	3.38E+00	N/A	5.71E-02	1.80E-02	3.55E+00
UCL	7.53E-02	2.56E+00	N/A	4.32E-02	2.10E-03	2.68E+00
Mourning Dove - Herbivore						
UTL	1.79E-01	N/A	N/A	2.99E-01	1.44E-02	4.93E-01
UCL	1.45E-01	N/A	N/A	2.27E-01	1.68E-03	3.74E-01
Mourning Dove - Insectivore						
UTL	N/A	1.52E+01	N/A	2.99E-01	1.44E-02	1.55E+01
UCL	N/A	1.15E+01	N/A	2.27E-01	1.68E-03	1.18E+01
American Kestrel						
UTL	N/A	1.22E+00	1.97E-01	6.44E-02	1.44E-02	1.49E+00
UCL	N/A	9.23E-01	1.73E-01	4.88E-02	1.68E-03	1.15E+00
Deer Mouse - Herbivore						
UTL	8.64E-02	N/A	N/A	3.11E-02	2.28E-02	1.40E-01
UCL	7.02E-02	N/A	N/A	2.35E-02	2.66E-03	9.64E-02
Deer Mouse - Insectivore						
UTL	N/A	4.30E+00	N/A	1.82E-02	2.28E-02	4.35E+00
UCL	N/A	3.26E+00	N/A	1.38E-02	2.66E-03	3.28E+00
Prairie Dog						
UTL	2.26E-02	N/A	N/A	3.13E-02	1.18E-02	6.56E-02
UCL	1.83E-02	N/A	N/A	2.37E-02	1.37E-03	4.34E-02
Mule Deer						
UTL	1.71E-02	N/A	N/A	5.24E-03	7.80E-03	3.02E-02
UCL	1.39E-02	N/A	N/A	3.96E-03	9.10E-04	1.88E-02
Coyote - Generalist						
UTL	N/A	2.48E-01	3.01E-02	1.05E-02	9.60E-03	2.98E-01
UCL	N/A	1.88E-01	2.64E-02	7.95E-03	1.12E-03	2.24E-01
Coyote - Insectivore						
UTL	N/A	9.93E-01	N/A	5.88E-03	9.60E-03	1.01E+00
UCL	N/A	7.52E-01	N/A	4.45E-03	1.12E-03	7.58E-01
Coyote - Carnivore						
UTL	N/A	N/A	4.01E-02	5.60E-03	9.60E-03	5.53E-02
UCL	N/A	N/A	3.52E-02	4.24E-03	1.12E-03	4.06E-02

N/A = Not applicable.

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Table A9.21

PMJM Intake Estimates for Selenium - Default Expsosure Scenario

Bioaccumulation Factors						
Soil to Plant	Soil to Invertebrate	Soil to Small Mammal				
lnCp = -0.678 + 1.104 (ln Cs)	lnCi = -0.075 + 0.733 (ln Cs)	lnCsm = -0.4158 + 0.3764 (ln Cs)				
Media Concentrations (mg/kg)						
Soil Concentration	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**	
0.12	UTL	0.05	0.20	0.30	0.00062	
0.083	UCL	0.03	0.15	0.26	0.000123	
Intake Parameters						
	$IR_{(food)}$ (kg/kg BW day)	$IR_{(water)}$ (kg/kg BW day)	$IR_{(soil)}$ (kg/kg BW day)	P_{plant}	P_{invert}	P_{mammal}
PMJM	0.17	0.15	0.004	0.7	0.3	0
Intake Estimates (mg/kg BW day)						
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
PMJM						
UTL	5.81E-03	1.00E-02	N/A	4.90E-04	9.30E-05	1.64E-02
UCL	3.87E-03	7.63E-03	N/A	3.39E-04	1.85E-05	1.19E-02

N/A = Not applicable or not available.

Table A9.22

Background Surface Soil Exposure Calculations for Vanadium

Bioaccumulation Factors						
Soil to Plant	Soil to Invertebrate	Soil to Small Mammal				
0.0097	0.088	0.0131				
Media Concentrations (mg/kg)						
Soil Concentration	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**	
45.8	UTL	0.44	4.0	0.60	0.132	
30.7	UCL	0.30	2.7	0.40	0.02	
Intake Parameters						
	IR_{plant} (kg/kg BW day)	IR_{invert} (kg/kg BW day)	IR_{mam} (kg/kg BW day)	P_{plant}	P_{invert}	P_{mammal}
PMJM	0.17	0.15	0.004	0.7	0.3	0
Mourning Dove - Herbivore	0.23	0.12	0.021	1	0	0
Mourning Dove - Insectivore	0.23	0.12	0.021	0	1	0
American Kestrel	0.092	0.12	0.005	0	0.2	0.8
Deer Mouse - Herbivore	0.111	0.19	0.002	1	0	0
Deer Mouse - Insectivore	0.065	0.19	0.001	0	1	0
Prairie Dog	0.029	0.098	0.002	1	0	0
Mule Deer	0.022	0.065	0.0004	1	0	0
Coyote - Generalist	0.015	0.08	0.001	0	0.25	0.75
Coyote - Insectivore	0.015	0.08	0.0004	0	1	0
Coyote - Carnivore	0.015	0.08	0.000	0	0	1
Intake Estimates (mg/kg BW day)						
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
PMJM						
UTL	5.29E-02	2.06E-01	N/A	1.87E-01	1.98E-02	4.65E-01
UCL	3.54E-02	1.38E-01	N/A	1.25E-01	3.00E-03	3.01E-01
Mourning Dove - Herbivore						
UTL	1.02E-01	N/A	N/A	9.80E-01	1.58E-02	1.10E+00
UCL	6.85E-02	N/A	N/A	6.57E-01	2.40E-03	7.28E-01
Mourning Dove - Insectivore						
UTL	N/A	9.27E-01	N/A	9.80E-01	1.58E-02	1.92E+00
UCL	N/A	6.21E-01	N/A	6.57E-01	2.40E-03	1.28E+00
American Kestrel						
UTL	N/A	7.42E-02	4.42E-02	2.11E-01	1.58E-02	3.45E-01
UCL	N/A	4.97E-02	2.96E-02	1.41E-01	2.40E-03	2.23E-01
Deer Mouse - Herbivore						
UTL	4.93E-02	N/A	N/A	1.02E-01	2.51E-02	1.76E-01
UCL	3.31E-02	N/A	N/A	6.82E-02	3.80E-03	1.05E-01
Deer Mouse - Insectivore						
UTL	N/A	2.62E-01	N/A	5.95E-02	2.51E-02	3.47E-01
UCL	N/A	1.76E-01	N/A	3.99E-02	3.80E-03	2.19E-01
Prairie Dog						
UTL	1.29E-02	N/A	N/A	1.02E-01	1.29E-02	1.28E-01
UCL	8.64E-03	N/A	N/A	6.86E-02	1.96E-03	7.91E-02
Mule Deer						
UTL	9.77E-03	N/A	N/A	1.71E-02	8.58E-03	3.55E-02
UCL	6.55E-03	N/A	N/A	1.15E-02	1.30E-03	1.93E-02
Coyote - Generalist						
UTL	N/A	1.51E-02	6.75E-03	3.44E-02	1.06E-02	6.68E-02
UCL	N/A	1.01E-02	4.52E-03	2.30E-02	1.60E-03	3.93E-02
Coyote - Insectivore						
UTL	N/A	6.05E-02	N/A	1.92E-02	1.06E-02	9.03E-02
UCL	N/A	4.05E-02	N/A	1.29E-02	1.60E-03	5.50E-02
Coyote - Carnivore						
UTL	N/A	N/A	9.00E-03	1.83E-02	1.06E-02	3.79E-02
UCL	N/A	N/A	6.03E-03	1.23E-02	1.60E-03	1.99E-02

N/A = Not applicable.

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Table A9.23

Background Surface Soil Exposure Calculations for Zinc

Bioaccumulation Factors						
Soil to Plant	Soil to Invertebrate	Soil to Small Mammal				
lnCp = 1.575 + 0.554 (ln Cs)	lnCi = 4.449 + 0.328 (ln Cs)	lnCsm = 1.4987 + 0.0745 (ln Cs)				
Media Concentrations (mg/kg)						
Soil Concentration	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**	
75.9	UTL	53.17	353.91	6.18	3.11	
54.5	UCL	44.26	317.48	6.03	0.051	
Intake Parameters						
	$IR_{(food)}$ (kg/kg BW day)	$IR_{(water)}$ (kg/kg BW day)	$IR_{(soil)}$ (kg/kg BW day)	P_{plant}	P_{invert}	P_{mammal}
PMJM	0.17	0.15	0.004	0.7	0.3	0
Mourning Dove - Herbivore	0.23	0.12	0.021	1	0	0
Mourning Dove - Insectivore	0.23	0.12	0.021	0	1	0
American Kestrel	0.092	0.12	0.005	0	0.2	0.8
Deer Mouse - Herbivore	0.111	0.19	0.002	1	0	0
Deer Mouse - Insectivore	0.065	0.19	0.001	0	1	0
Prairie Dog	0.029	0.098	0.002	1	0	0
Mule Deer	0.022	0.065	0.0004	1	0	0
Coyote - Generalist	0.015	0.08	0.001	0	0.25	0.75
Coyote - Insectivore	0.015	0.08	0.0004	0	1	0
Coyote - Carnivore	0.015	0.08	0.000	0	0	1
Intake Estimates (mg/kg BW day)						
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
PMJM						
UTL	6.33E+00	1.80E+01	N/A	3.10E-01	4.67E-01	2.52E+01
UCL	5.27E+00	1.62E+01	N/A	2.22E-01	7.65E-03	2.17E+01
Mourning Dove - Herbivore						
UTL	1.22E+01	N/A	N/A	1.62E+00	3.73E-01	1.42E+01
UCL	1.02E+01	N/A	N/A	1.17E+00	6.12E-03	1.14E+01
Mourning Dove - Insectivore						
UTL	N/A	8.14E+01	N/A	1.62E+00	3.73E-01	8.34E+01
UCL	N/A	7.30E+01	N/A	1.17E+00	6.12E-03	7.42E+01
American Kestrel						
UTL	N/A	6.51E+00	4.55E-01	3.49E-01	3.73E-01	7.69E+00
UCL	N/A	5.84E+00	4.44E-01	2.51E-01	6.12E-03	6.54E+00
Deer Mouse - Herbivore						
UTL	5.90E+00	N/A	N/A	1.68E-01	5.91E-01	6.66E+00
UCL	4.91E+00	N/A	N/A	1.21E-01	9.69E-03	5.04E+00
Deer Mouse - Insectivore						
UTL	N/A	2.30E+01	N/A	9.87E-02	5.91E-01	2.37E+01
UCL	N/A	2.06E+01	N/A	7.09E-02	9.69E-03	2.07E+01
Prairie Dog						
UTL	1.54E+00	N/A	N/A	1.69E-01	3.05E-01	2.02E+00
UCL	1.28E+00	N/A	N/A	1.22E-01	5.00E-03	1.41E+00
Mule Deer						
UTL	1.17E+00	N/A	N/A	2.84E-02	2.02E-01	1.40E+00
UCL	9.74E-01	N/A	N/A	2.04E-02	3.32E-03	9.97E-01
Coyote - Generalist						
UTL	N/A	1.33E+00	6.95E-02	5.69E-02	2.49E-01	1.70E+00
UCL	N/A	1.19E+00	6.78E-02	4.09E-02	4.08E-03	1.30E+00
Coyote - Insectivore						
UTL	N/A	5.31E+00	N/A	3.19E-02	2.49E-01	5.59E+00
UCL	N/A	4.76E+00	N/A	2.29E-02	4.08E-03	4.79E+00
Coyote - Carnivore						
UTL	N/A	N/A	9.27E-02	3.04E-02	2.49E-01	3.72E-01
UCL	N/A	N/A	9.04E-02	2.18E-02	4.08E-03	1.16E-01

N/A = Not applicable.

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Table A9.24
Toxicity Reference Values

ECOI	NOAEL (mg/kg day)	NOAEL Endpoint	Lowest Bounded LOAEL (mg/kg day)	LOAEL Endpoint	TRV Source	Uncertainty Factor	Final NOAEL (mg/kg day)	Threshold (mg/kg day)	Rationale For Calculation	TRV Confidence	Confidence Notes
Mammal											
Barium	51.8	Mean value	121	Decrease in rat growth and reproduction	USEPA (2003)	1	51.8	N/A	No threshold value calculated due to multiple endpoints affected at the LOAEL	Very High	
Cadmium	0.77	No change in rat growth	0.91	Decrease in sheep growth	USEPA (2003)	1	0.77	N/A	The original paper was not reviewed. Not enough information was available to calculate the threshold	Very High	
Chromium III	2737	No effects on rat reproduction and life span	N/A	No effects at the highest study dose	Sample et al. (1996)	1	2737	N/A	No LOAEL was presented.	High	
Chromium VI	3.28	No effects on rat body weight or food	13.14	Increased mortality in rats	Sample et al. (1996)	1	3.28	N/A	No LOAEL was presented.	High	
Copper	2.67	No immune response effects	631.58	Increased mortality and decreased body weight in	PRC (1994)	1	2.67	N/A	Not enough data available for calculation of threshold	High	
Lead	4.7	No change in rat growth	5	Decrease in rat progeny weight and growth	USEPA (2003)	1	4.7	N/A	The original paper was not reviewed. Not enough information was available to calculate the threshold	Very High	
Manganese	13.7	No change in mouse testicle weight	159.1	Decrease in mouse testicle weight	PRC (1994)	1	13.7	N/A	The original paper was not reviewed. Not enough information was available to calculate the threshold	High	
Mercury	0.027	NOAEL was estimated from LOAEL	0.27	Increase in mortality	PRC (1994)	1	0.027	N/A	NOAEL was estimated from LOAEL	High	
Nickel	0.133	NOAEL was estimated from LOAEL	1.33	Increase in pup mortality in rats	PRC (1994)	1	0.133	N/A	NOAEL was estimated from LOAEL	High	
Selenium	0.05	No increase in liver lesions in mice	1.21	Decrease in mouse reproductive success	PRC (1994)	1	0.05	N/A	The effects were noted to be in the mid-range, therefore, no threshold was calculated	High	
Vanadium	0.21	NOAEL estimated from LOAEL	2.1	Significant reproductive effects in rats	Sample et al. (1996)	1	0.21	N/A	NOAEL was estimated from the LOAEL.	High	
Zinc	9.61	NOAEL was estimated from LOAEL	411.4	Increase in fetal developmental effects in	PRC (1994)	1	9.61	N/A	NOAEL was estimated from LOAEL	High	
Bird											
Barium	20.8	No mortality noted in chicks	41.7	5% mortality in chicks	Sample et al. (1996)	1	20.8	29.45	The magnitude of the response was small. Thus, the data satisfy the requirements described in the text for calculating a threshold.	High	
Cadmium	1.47	Mean value	2.37	Decrease in chicken reproduction	USEPA (2003)	1	1.47	N/A	No threshold value calculated because the study was not reviewed and effect levels are unknown.	Very High	
Chromium III	1	No effect on black duckling survival	5	Reduction in black duckling survival	Sample et al. (1996)	1	1	N/A	Original study was not reviewed and not enough information is presented in Sample et al (1996) to meet threshold criteria calculation.	High	
Chromium VI	***No Values Available***									N/A	No data

Table A9.24
Toxicity Reference Values

ECOI	NOAEL (mg/kg day)	NOAEL Endpoint	Lowest Bounded LOAEL (mg/kg day)	LOAEL Endpoint	TRV Source	Uncertainty Factor	Final NOAEL (mg/kg day)	Threshold (mg/kg day)	Rationale For Calculation	TRV Confidence	Confidence Notes
Copper	2.3	No effects noted	52.3	Increase in chicken gizzard erosion	PRC (1994)	1	2.3	11.0	The nature of the effect is not likely to cause a significant effect on growth, reproduction or survival. Thus, the data satisfy the requirements described in the text for calculating a threshold.	High	
Lead	1.63	No change in chicken reproduction	1.94	Decrease in Japanese quail reproduction	USEPA (2003)	1	1.63	N/A	No threshold value calculated because the study was not reviewed and effect levels are unknown.	Very High	
Manganese[1]	77.6	NOAEL was estimated from LOAEL	776	Decrease in Japanese quail motor skills development and increase in aggressive behavior	PRC (1994)	1	77.6	N/A	NOAEL was estimated from LOAEL	High	
Mercury	0.039	NOAEL was estimated from LOAEL	0.18	Increase in mortality in mallards	PRC (1994)	1	0.039	N/A	NOAEL was estimated from LOAEL	High	
Nickel	1.38	No increase in tremors or toe and leg joint edema	55.26	Increase in tremors and toe and knee joint edema in mallard	PRC (1994)	1	1.38	8.7	The nature of the effect is not likely to cause a significant effect on growth, reproduction or survival. Thus, the data satisfy the requirements described in the text for calculating a threshold.	High	
Selenium	0.23	No reproductive effects in mallards	0.93	Decrease in hatchling success	PRC (1994)	1	0.23	N/A		High	
Vanadium	11.4	No effects on mallard mortality, body weight, or blood chemistry	N/A	No effects at highest study dose	Sample et al. (1996)	1	11.4	N/A	No LOAEL was presented.	High	
Zinc	17.2	NOAEL was estimated from LOAEL	172	Decrease in mallard body weight	PRC (1994)	1	17.2	N/A	NOAEL was estimated from LOAEL	High	

NOTES:
[1] The nature of the effect is not likely to cause a significant effect on growth, reproduction, or survival.
Threshold TRVs were independently calculated using the procedures outline in the CRA Methodology
The LOAEL TRVs for Butyltin (birds) and nickel (mammals) represent more conservative TRVs than those published in PRC (1994) as High-TRVs. A more conservative TRV was selected as the LOAEL from that document to remain consistent with the Site-specific TRV selection process.
The support data for the TRVs from the Attachment Table 3 source is provided in Attachment Table 3.

1. NA – No TRV has been identified or the TRV has been deemed unacceptable for use in ECOPC selection.
2. Low – TRVs that have data for only one species looking at one endpoint (non-mortality) and from one primary literature source.
3. Moderate – TRVs that have multiple primary literature sources looking at one endpoint (non-mortality or mortality) but with only one species evaluated.
4. Good – For TRVs that have either multiple species with one endpoint from multiple studies or those TRVs with multiple species and multiple endpoints from only one study.
5. High –For TRVs that have multiple study sources looking at multiple endpoints and more than one species.
6. Very High – All EcoSSLs (EPA 2003a) will be assigned this level of confidence by default.

Table A9.25

Surface Soil Background Hazard Quotients for Barium

	Total Intake (mg/kg BW day)	TRV (mg/kg BW day)		Hazard Quotients	
		NOAEL	LOAEL	NOAEL	LOAEL
Barium					
Mourning Dove - Herbivore					
MDC	1.67E+01	2.08E+01	4.17E+01	1	0.4
UCL	1.37E+01	2.08E+01	4.17E+01	1	0.3
Mourning Dove - Insectivore					
MDC	7.87E+00	2.08E+01	4.17E+01	0.4	0.2
UCL	6.41E+00	2.08E+01	4.17E+01	0.3	0.2
American Kestrel					
MDC	2.19E+00	2.08E+01	4.17E+01	0.1	0.05
UCL	1.75E+00	2.08E+01	4.17E+01	0.1	0.04
Deer Mouse - Herbivore					
MDC	7.06E+00	5.18E+01	1.21E+02	0.1	0.06
UCL	5.72E+00	5.18E+01	1.21E+02	0.1	0.05
Deer Mouse - Insectivore					
MDC	1.68E+00	5.18E+01	1.21E+02	0.03	0.01
UCL	1.31E+00	5.18E+01	1.21E+02	0.03	0.01
Prairie Dog					
MDC	2.10E+00	5.18E+01	1.21E+02	0.04	0.02
UCL	1.68E+00	5.18E+01	1.21E+02	0.03	0.01
Mule Deer					
MDC	1.41E+00	5.18E+01	1.21E+02	0.03	0.01
UCL	1.13E+00	5.18E+01	1.21E+02	0.02	0.01
Coyote - Generalist					
MDC	3.98E-01	5.18E+01	1.21E+02	0.01	0.003
UCL	2.96E-01	5.18E+01	1.21E+02	0.006	0.002
Coyote - Insectivore					
MDC	4.26E-01	5.18E+01	1.21E+02	0.01	0.004
UCL	3.19E-01	5.18E+01	1.21E+02	0.006	0.003
Coyote - Carnivore					
MDC	3.27E-01	5.18E+01	1.21E+02	0.006	0.003
UCL	2.37E-01	5.18E+01	1.21E+02	0.005	0.002

N/A = Not applicable.

Bold = Hazard quotients>1.

Table A9.26

Surface Soil Background Hazard Quotients for Cadmium

		TRV (mg/kg BW day)		Hazard Quotients	
	Total Intake (mg/kg BW day)	NOAEL	LOAEL	NOAEL	LOAEL
Cadmium					
PMJM					
UTL	1.13E+00	7.70E-01	9.10E-01	1	1
UCL	6.84E-01	7.70E-01	9.10E-01	0.9	0.8
Mourning Dove - Herbivore					
UTL	6.33E-01	1.47E+00	2.37E+00	0.4	0.3
UCL	4.24E-01	1.47E+00	2.37E+00	0.3	0.2
Mourning Dove - Insectivore					
UTL	3.74E+00	1.47E+00	2.37E+00	**3**	**2**
UCL	2.15E+00	1.47E+00	2.37E+00	1	0.9
American Kestrel					
UTL	8.56E-01	1.47E+00	2.37E+00	0.6	0.4
UCL	5.47E-01	1.47E+00	2.37E+00	0.4	0.2
Deer Mouse - Herbivore					
UTL	2.87E-01	7.70E-01	9.10E-01	0.4	0.3
UCL	1.96E-01	7.70E-01	9.10E-01	0.3	0.2
Deer Mouse - Insectivore					
UTL	1.05E+00	7.70E-01	9.10E-01	1	1
UCL	6.03E-01	7.70E-01	9.10E-01	0.8	0.7
Prairie Dog					
UTL	7.91E-02	7.70E-01	9.10E-01	0.1	0.1
UCL	5.31E-02	7.70E-01	9.10E-01	0.1	0.1
Mule Deer					
UTL	5.69E-02	7.70E-01	9.10E-01	0.1	0.1
UCL	3.88E-02	7.70E-01	9.10E-01	0.1	0.04
Coyote - Generalist					
UTL	1.46E-01	7.70E-01	9.10E-01	0.2	0.2
UCL	9.24E-02	7.70E-01	9.10E-01	0.1	0.1
Coyote - Insectivore					
UTL	2.42E-01	7.70E-01	9.10E-01	0.3	0.3
UCL	1.39E-01	7.70E-01	9.10E-01	0.2	0.2
Coyote - Carnivore					
UTL	1.13E-01	7.70E-01	9.10E-01	0.1	0.1
UCL	7.62E-02	7.70E-01	9.10E-01	0.1	0.1

N/A = Not applicable.
Bold = Hazard quotients>1.

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Table A9.27

Terrestrial Plant Hazard Quotients for Background Surface Soils - Chromium

EPC Statistic	Concentration (mg/kg)	TRV (mg/kg) Screening ESL	Hazard Quotient Screening ESL
Terrestrial Plant			
UTL	16.9	1.00E+00	**17**
UCL	12.3	1.00E+00	**12**
Terrestrial Invertebrate			
UTL	16.9	4.00E-01	**42**
UCL	12.3	4.00E-01	**31**

N/A = Not applicable.

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Table A9.28

Surface Soil Background Hazard Quotients for Chromium

		TRV (mg/kg BW day)				Hazard Quotients			
	Total Intake (mg/kg BW day)	Chromium VI NOAEL	Chromium VI LOAEL	Chromium III NOAEL	Chromium III LOAEL	Chromium VI NOAEL	Chromium VI LOAEL	Chromium III NOAEL	Chromium III LOAEL
Chromium									
PMJM									
UTL	3.00E+00	3.28E+00	1.31E+01	2.74E+03	N/A	0.9	0.23	0.0011	N/A
UCL	2.16E+00	3.28E+00	1.31E+01	2.74E+03	N/A	0.66	0.16	0.0008	N/A
Mourning Dove - Herbivore									
UTL	7.18E-01	N/A	N/A	1.00E+00	5.00E+00	N/A	N/A	0.7	0.1
UCL	5.03E-01	N/A	N/A	1.00E+00	5.00E+00	N/A	N/A	0.5	0.1
Mourning Dove - Insectivore									
UTL	1.27E+01	N/A	N/A	1.00E+00	5.00E+00	N/A	N/A	**13**	**3**
UCL	9.21E+00	N/A	N/A	1.00E+00	5.00E+00	N/A	N/A	**9**	**2**
American Kestrel									
UTL	1.22E+00	N/A	N/A	1.00E+00	5.00E+00	N/A	N/A	1	0.2
UCL	8.78E-01	N/A	N/A	1.00E+00	5.00E+00	N/A	N/A	0.9	0.2
Deer Mouse - Herbivore									
UTL	2.42E-01	3.28E+00	1.31E+01	2.74E+03	N/A	0.1	0.02	0.0001	N/A
UCL	1.46E-01	3.28E+00	1.31E+01	2.74E+03	N/A	0.04	0.01	0.0001	N/A
Deer Mouse - Insectivore									
UTL	3.54E+00	3.28E+00	1.31E+01	2.74E+03	N/A	1	0.3	0.001	N/A
UCL	2.55E+00	3.28E+00	1.31E+01	2.74E+03	N/A	0.8	0.2	0.001	N/A
Prairie Dog									
UTL	1.03E-01	3.28E+00	1.31E+01	2.74E+03	N/A	0.03	0.01	0.00004	N/A
UCL	5.94E-02	3.28E+00	1.31E+01	2.74E+03	N/A	0.02	0.005	0.00002	N/A
Mule Deer									
UTL	5.36E-02	3.28E+00	1.31E+01	2.74E+03	N/A	0.02	0.004	0.00002	N/A
UCL	2.86E-02	3.28E+00	1.31E+01	2.74E+03	N/A	0.01	0.002	0.00001	N/A
Coyote - Generalist									
UTL	2.53E-01	3.28E+00	1.31E+01	2.74E+03	N/A	0.1	0.02	0.0001	N/A
UCL	1.73E-01	3.28E+00	1.31E+01	2.74E+03	N/A	0.1	0.01	0.0001	N/A
Coyote - Insectivore									
UTL	8.28E-01	3.28E+00	1.31E+01	2.74E+03	N/A	0.3	0.1	0.0003	N/A
UCL	5.90E-01	3.28E+00	1.31E+01	2.74E+03	N/A	0.2	0.04	0.0002	N/A
Coyote - Carnivore									
UTL	5.32E-02	3.28E+00	1.31E+01	2.74E+03	N/A	0.02	0.004	0.00002	N/A
UCL	2.77E-02	3.28E+00	1.31E+01	2.74E+03	N/A	0.01	0.002	0.00001	N/A

N/A = Not applicable.

Bold = Hazard quotients>1.

Table A9.29

Surface Soil Background Hazard Quotients for Copper

		TRV (mg/kg BW day)			Hazard Quotients		
	Total Intake (mg/kg BW day)	NOAEL	Threshold	LOAEL	NOAEL	Threshold	LOAEL
Copper							
PMJM							
UTL	1.33E+00	2.67E+00	N/A	6.32E+02	0.5	N/A	0.002
UCL	1.26E+00	2.67E+00	N/A	6.32E+02	0.5	N/A	0.002
Mourning Dove - Herbivore							
UTL	1.69E+00	2.30E+00	1.10E+01	5.23E+01	0.7	0.2	0.03
UCL	1.57E+00	2.30E+00	1.10E+01	5.23E+01	0.7	0.1	0.03
Mourning Dove - Insectivore							
UTL	2.90E+00	2.30E+00	1.10E+01	5.23E+01	1	0.3	0.1
UCL	2.77E+00	2.30E+00	1.10E+01	5.23E+01	1	0.3	0.1
American Kestrel							
UTL	1.13E+00	2.30E+00	1.10E+01	5.23E+01	0.5	0.1	0.02
UCL	1.09E+00	2.30E+00	1.10E+01	5.23E+01	0.5	0.1	0.02
Deer Mouse - Herbivore							
UTL	6.91E-01	2.67E+00	N/A	6.32E+02	0.3	N/A	0.001
UCL	6.46E-01	2.67E+00	N/A	6.32E+02	0.2	N/A	0.001
Deer Mouse - Insectivore							
UTL	7.51E-01	2.67E+00	N/A	6.32E+02	0.3	N/A	0.001
UCL	7.17E-01	2.67E+00	N/A	6.32E+02	0.3	N/A	0.001
Prairie Dog							
UTL	2.09E-01	2.67E+00	N/A	6.32E+02	0.1	N/A	0.0003
UCL	1.92E-01	2.67E+00	N/A	6.32E+02	0.1	N/A	0.0003
Mule Deer							
UTL	1.37E-01	2.67E+00	N/A	6.32E+02	0.1	N/A	0.0002
UCL	1.27E-01	2.67E+00	N/A	6.32E+02	0.05	N/A	0.0002
Coyote - Generalist							
UTL	1.87E-01	2.67E+00	N/A	6.32E+02	0.1	N/A	0.0003
UCL	1.78E-01	2.67E+00	N/A	6.32E+02	0.1	N/A	0.0003
Coyote - Insectivore							
UTL	1.77E-01	2.67E+00	N/A	6.32E+02	0.1	N/A	0.0003
UCL	1.67E-01	2.67E+00	N/A	6.32E+02	0.1	N/A	0.0003
Coyote - Carnivore							
UTL	1.83E-01	2.67E+00	N/A	6.32E+02	0.1	N/A	0.0003
UCL	1.76E-01	2.67E+00	N/A	6.32E+02	0.1	N/A	0.0003

N/A = Not applicable.
Bold = Hazard quotients>1.

Table A9.30

Surface Soil Background Hazard Quotients for Lead

		TRV (mg/kg BW day)		Hazard Quotients	
	Total Intake (mg/kg BW day)	NOAEL	LOAEL	NOAEL	LOAEL
Lead					
Mourning Dove - Herbivore					
UTL	1.71E+00	1.63E+00	1.94E+00	1	0.9
UCL	1.27E+00	1.63E+00	1.94E+00	1	0.7
Mourning Dove - Insectivore					
UTL	5.72E+00	1.63E+00	1.94E+00	**4**	**3**
UCL	4.26E+00	1.63E+00	1.94E+00	**3**	**2**
American Kestrel					
UTL	1.08E+00	1.63E+00	1.94E+00	0.7	0.6
UCL	8.45E-01	1.63E+00	1.94E+00	0.5	0.4
Deer Mouse - Herbivore					
UTL	4.02E-01	4.70E+00	5.00E+00	0.1	0.1
UCL	3.10E-01	4.70E+00	5.00E+00	0.1	0.1
Deer Mouse - Insectivore					
UTL	1.37E+00	4.70E+00	5.00E+00	0.3	0.3
UCL	1.03E+00	4.70E+00	5.00E+00	0.2	0.2
Prairie Dog					
UTL	1.96E-01	4.70E+00	5.00E+00	0.04	0.04
UCL	1.43E-01	4.70E+00	5.00E+00	0.03	0.03
Mule Deer					
UTL	7.75E-02	4.70E+00	5.00E+00	0.02	0.02
UCL	5.91E-02	4.70E+00	5.00E+00	0.01	0.01
Coyote - Generalist					
UTL	1.89E-01	4.70E+00	5.00E+00	0.04	0.04
UCL	1.45E-01	4.70E+00	5.00E+00	0.03	0.03
Coyote - Insectivore					
UTL	3.25E-01	4.70E+00	5.00E+00	0.1	0.1
UCL	2.42E-01	4.70E+00	5.00E+00	0.1	0.05
Coyote - Carnivore					
UTL	1.19E-01	4.70E+00	5.00E+00	0.03	0.02
UCL	9.61E-02	4.70E+00	5.00E+00	0.02	0.02

N/A = Not applicable.

Bold = Hazard quotients>1.

Table A9.31

Terrestrial Plant Hazard Quotients for Background Surface Soils - Manganese

EPC Statistic	Concentration (mg/kg)	TRV (mg/kg) Screening ESL	Hazard Quotient Screening ESL
Terrestrial Plant			
UTL	357	5.00E+02	0.7
UCL	262	5.00E+02	0.5

N/A = Not applicable.

Table A9.32

Surface Soil Background Hazard Quotients for Manganese

	Total Intake (mg/kg BW day)	TRV (mg/kg BW day)		Hazard Quotients	
		NOAEL	LOAEL	NOAEL	LOAEL
Manganese					
PMJM					
UTL	1.83E+01	1.37E+01	1.59E+02	1	0.1
UCL	1.35E+01	1.37E+01	1.59E+02	1	0.1
Mourning Dove - Herbivore					
UTL	2.73E+01	7.76E+01	7.76E+02	**0**	0.0
UCL	1.97E+01	7.76E+01	7.76E+02	**0**	0.0
Mourning Dove - Insectivore					
UTL	3.66E+01	7.76E+01	7.76E+02	**0**	0.0
UCL	2.86E+01	7.76E+01	7.76E+02	**0**	0.0
American Kestrel					
UTL	5.38E+00	7.76E+01	7.76E+02	0.1	0.0
UCL	3.77E+00	7.76E+01	7.76E+02	0.0	0.00
Deer Mouse - Herbivore					
UTL	1.08E+01	1.37E+01	1.59E+02	0.8	0.1
UCL	7.41E+00	1.37E+01	1.59E+02	0.5	0.05
Deer Mouse - Insectivore					
UTL	9.27E+00	1.37E+01	1.59E+02	0.7	0.1
UCL	6.87E+00	1.37E+01	1.59E+02	0.5	0.04
Prairie Dog					
UTL	3.62E+00	1.37E+01	1.59E+02	0.3	0.02
UCL	2.37E+00	1.37E+01	1.59E+02	0.2	0.01
Mule Deer					
UTL	2.24E+00	1.37E+01	1.59E+02	0.2	0.01
UCL	1.45E+00	1.37E+01	1.59E+02	0.1	0.01
Coyote - Generalist					
UTL	1.20E+00	1.37E+01	1.59E+02	0.1	0.01
UCL	6.89E-01	1.37E+01	1.59E+02	0.1	0.004
Coyote - Insectivore					
UTL	2.33E+00	1.37E+01	1.59E+02	0.2	0.01
UCL	1.62E+00	1.37E+01	1.59E+02	0.1	0.01
Coyote - Carnivore					
UTL	6.66E-01	1.37E+01	1.59E+02	0.0	0.004
UCL	2.59E-01	1.37E+01	1.59E+02	0.02	0.002

N/A = Not applicable.
Bold = Hazard quotients>1.

Table A9.33
Surface Soil Background Hazard Quotients for Mercury

Patch/ EPC Statistic	Total Intake (mg/kg BW day)	TRV (mg/kg BW day)		Hazard Quotients	
		NOAEL	LOAEL	NOAEL	LOAEL
Selenium					
PMJM					
UTL	3.50E-02	2.70E-02	2.70E-01	1	0.1
UCL	3.50E-02	2.70E-02	2.70E-01	1	0.1
Mourning Dove - Insectivore					
UTL	9.30E-02	3.90E-02	1.80E-01	2	0.5
UCL	8.82E-02	3.90E-02	1.80E-01	2	0.5

N/A = Not applicable
Bold = Hazard quotients>1.

Table A9.34

Surface Soil Background Hazard Quotients for Nickel

		TRV (mg/kg BW day)			Hazard Quotients		
	Total Intake (mg/kg BW day)	NOAEL	Threshold	LOAEL	NOAEL	Threshold	LOAEL
Nickel							
PMJM							
UTL	3.55E+00	1.33E-01	N/A	1.33E+00	**27**	N/A	**3**
UCL	2.68E+00	1.33E-01	N/A	1.33E+00	**20**	N/A	**2**
Mourning Dove - Herbivore							
UTL	4.93E-01	1.38E+00	8.70E+00	5.53E+01	0.4	0.1	0.01
UCL	3.74E-01	1.38E+00	8.70E+00	5.53E+01	0.3	0.04	0.01
Mourning Dove - Insectivore							
UTL	1.55E+01	1.38E+00	8.70E+00	5.53E+01	**11**	**2**	0.3
UCL	1.18E+01	1.38E+00	8.70E+00	5.53E+01	**9**	1	0.2
American Kestrel							
UTL	1.49E+00	1.38E+00	8.70E+00	5.53E+01	1	0.2	0.03
UCL	1.15E+00	1.38E+00	8.70E+00	5.53E+01	0.8	0.1	0.02
Deer Mouse - Herbivore							
UTL	1.40E-01	1.33E-01	N/A	1.33E+00	1	N/A	0.1
UCL	9.64E-02	1.33E-01	N/A	1.33E+00	0.7	N/A	0.1
Deer Mouse - Insectivore							
UTL	4.35E+00	1.33E-01	N/A	1.33E+00	**33**	N/A	**3**
UCL	3.28E+00	1.33E-01	N/A	1.33E+00	**25**	N/A	**2**
Prairie Dog							
UTL	6.56E-02	1.33E-01	N/A	1.33E+00	0.5	N/A	0.05
UCL	4.34E-02	1.33E-01	N/A	1.33E+00	0.3	N/A	0.03
Mule Deer							
UTL	3.02E-02	1.33E-01	N/A	1.33E+00	0.2	N/A	0.02
UCL	1.88E-02	1.33E-01	N/A	1.33E+00	0.1	N/A	0.01
Coyote - Generalist							
UTL	2.98E-01	1.33E-01	N/A	1.33E+00	**2**	N/A	0.2
UCL	2.24E-01	1.33E-01	N/A	1.33E+00	**2**	N/A	0.2
Coyote - Insectivore							
UTL	1.01E+00	1.33E-01	N/A	1.33E+00	**8**	N/A	0.8
UCL	7.58E-01	1.33E-01	N/A	1.33E+00	**6**	N/A	0.6
Coyote - Carnivore							
UTL	5.53E-02	1.33E-01	N/A	1.33E+00	0.4	N/A	0.04
UCL	4.06E-02	1.33E-01	N/A	1.33E+00	0.3	N/A	0.03

N/A = Not applicable.

Bold = Hazard quotients>1.

Table A9.35
Surface Soil Background Hazard Quotients for Selenium

Patch/ EPC Statistic	Total Intake (mg/kg BW day)	TRV (mg/kg BW day)		Hazard Quotients	
		NOAEL	LOAEL	NOAEL	LOAEL
Selenium					
PMJM					
UTL	1.64E-02	5.00E-02	1.21E+00	0.3	0.01
UCL	1.19E-02	5.00E-02	1.21E+00	0.2	0.01

N/A = Not applicable.
Bold = Hazard quotients>1.

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Table A9.36

Terrestrial Plant Hazard Quotients for Background Surface Soils - Vanadium

EPC Statistic	Concentration (mg/kg)	TRV (mg/kg) Screening ESL	Hazard Quotients Screening ESL
Terrestrial Plant			
UTL	45.8	2.00E+00	**23**
UCL	30.7	2.00E+00	**15**

N/A = Not applicable.

Bold = Hazard quotients>1.

Table A9.37

Surface Soil Background Hazard Quotients for Vanadium

		TRV (mg/kg BW day)		Hazard Quotients	
	Total Intake (mg/kg BW day)	NOAEL	LOAEL	NOAEL	LOAEL
Vanadium					
PMJM					
UTL	4.65E-01	2.10E-01	2.10E+00	**2**	0.2
UCL	3.01E-01	2.10E-01	2.10E+00	1	0.1
Mourning Dove - Herbivore					
UTL	1.10E+00	1.14E+01	N/A	0.1	N/A
UCL	7.28E-01	1.14E+01	N/A	0.1	N/A
Mourning Dove - Insectivore					
UTL	1.92E+00	1.14E+01	N/A	0.2	N/A
UCL	1.28E+00	1.14E+01	N/A	0.1	N/A
American Kestrel					
UTL	3.45E-01	1.14E+01	N/A	0.03	N/A
UCL	2.23E-01	1.14E+01	N/A	0.02	N/A
Deer Mouse - Herbivore					
UTL	1.76E-01	2.10E-01	2.10E+00	0.8	0.1
UCL	1.05E-01	2.10E-01	2.10E+00	0.5	0.1
Deer Mouse - Insectivore					
UTL	3.47E-01	2.10E-01	2.10E+00	**2**	0.2
UCL	2.19E-01	2.10E-01	2.10E+00	1	0.1
Prairie Dog					
UTL	1.28E-01	2.10E-01	2.10E+00	0.6	0.1
UCL	7.91E-02	2.10E-01	2.10E+00	0.4	0.04
Mule Deer					
UTL	3.55E-02	2.10E-01	2.10E+00	0.2	0.02
UCL	1.93E-02	2.10E-01	2.10E+00	0.1	0.01
Coyote - Generalist					
UTL	6.68E-02	2.10E-01	2.10E+00	0.3	0.03
UCL	3.93E-02	2.10E-01	2.10E+00	0.2	0.02
Coyote - Insectivore					
UTL	9.03E-02	2.10E-01	2.10E+00	0.4	0.04
UCL	5.50E-02	2.10E-01	2.10E+00	0.3	0.03
Coyote - Carnivore					
UTL	3.79E-02	2.10E-01	2.10E+00	0.2	0.02
UCL	1.99E-02	2.10E-01	2.10E+00	0.1	0.01

N/A = Not applicable.

Bold = Hazard quotients>1.

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Table A9.38

Terrestrial Plant Hazard Quotients for Background Surface Soils - Zinc

EPC Statistic	Concentration (mg/kg)	TRV (mg/kg) Screening ESL	Hazard Quotients Screening ESL
Terrestrial Plant			
UTL	75.9	5.00E+01	**2**
UCL	54.5	5.00E+01	**1**

N/A = Not applicable.
Bold = Hazard quotients>1.

Table A9.39

Surface Soil Background Hazard Quotients for Zinc

		TRV (mg/kg BW day)		Hazard Quotients	
	Total Intake (mg/kg BW day)	NOAEL	LOAEL	NOAEL	LOAEL
Zinc					
Deer Mouse - Herbivore					
UTL	2.52E+01	9.61E+00	4.11E+02	**3**	0.1
UCL	2.17E+01	9.61E+00	4.11E+02	**2**	0.1
Mourning Dove - Herbivore					
UTL	1.42E+01	1.72E+01	1.72E+02	0.8	0.1
UCL	1.14E+01	1.72E+01	1.72E+02	0.7	0.1
Mourning Dove - Insectivore					
UTL	8.34E+01	1.72E+01	1.72E+02	**5**	0.5
UCL	7.42E+01	1.72E+01	1.72E+02	**4**	0.4
American Kestrel					
UTL	7.69E+00	1.72E+01	1.72E+02	0.45	0.04
UCL	6.54E+00	1.72E+01	1.72E+02	0.38	0.04
Deer Mouse - Herbivore					
UTL	6.66E+00	9.61E+00	4.11E+02	0.7	0.02
UCL	5.04E+00	9.61E+00	4.11E+02	0.5	0.01
Deer Mouse - Insectivore					
UTL	2.37E+01	9.61E+00	4.11E+02	**2**	0.1
UCL	2.07E+01	9.61E+00	4.11E+02	**2**	0.1
Prairie Dog					
UTL	2.02E+00	9.61E+00	4.11E+02	0.2	0.005
UCL	1.41E+00	9.61E+00	4.11E+02	0.1	0.003
Mule Deer					
UTL	1.40E+00	9.61E+00	4.11E+02	0.1	0.003
UCL	9.97E-01	9.61E+00	4.11E+02	0.1	0.002
Coyote - Generalist					
UTL	1.70E+00	9.61E+00	4.11E+02	0.2	0.004
UCL	1.30E+00	9.61E+00	4.11E+02	0.1	0.003
Coyote - Insectivore					
UTL	5.59E+00	9.61E+00	4.11E+02	0.6	0.01
UCL	4.79E+00	9.61E+00	4.11E+02	0.5	0.01
Coyote - Carnivore					
UTL	3.72E-01	9.61E+00	4.11E+02	0.04	0.001
UCL	1.16E-01	9.61E+00	4.11E+02	0.01	0.0003

N/A = Not applicable.
Bold = Hazard quotients>1.