LA-UR-07-6077
September 2007
EP2007-0559

Sandia Canyon Biota Investigation Work Plan

Los Alamos
NATIONAL LABORATORY
EST. 1943

Prepared by the Environmental Programs Directorate

LA-UR-07-6077
EP2007-0559

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EXECUTIVE SUMMARY

Comparison of concentrations of chemicals of potential concern in Sandia Canyon sediment and surface water samples to ecological screening levels (ESLs) supported the development of a biota investigation work plan. The biota plan is based largely on assessment endpoints (AEs) and associated ecological measures developed for the "Pajarito Canyon Biota Investigation Work Plan," which has been approved by the New Mexico Environment Department.

The plan provides a summary of the soil, sediment, and surface-water ecological screening for Sandia Canyon data. Sediment data are presented in a separate report, "Summary of Sandia Canyon Phase 1 Sediment Investigations," and are screened against sediment and soil ESLs. Surface water data from three monitoring stations in Sandia Canyon are screened against water ESLs.

The seven AEs adopted for the Sandia Canyon biota investigation are as follows:

- AE1: Survival and reproduction of the Mexican spotted owl
- AE2: Health and reproductive success of avian ground invertevore feeding guild species (e.g., American robin)
- AE3: Survival of mammalian invertevore and omnivore feeding guild species (e.g., shrews and deer mice)
- AE4: Survival and growth of detritivore species (earthworms)
- AE5: Survival and growth of native plant species
- AE6: Survival and reproduction of the southwestern willow flycatcher
- AE7: Abundance and survival of the aquatic community in the Sandia Canyon reaches that retain surface water long enough to support aquatic communities

The proposed studies represent the measures of exposure and/or effect for these endpoints and include

- collection and chemical analysis of soil, sediment, and water samples;
- cavity-nesting bird monitoring and chemical analysis of eggs;
- small mammal trapping and chemical analysis of whole organisms;
- earthworm bioaccumulation testing—measures of growth and survival and chemical analysis of whole organisms;
- seedling germination testing;
- spatial modeling using ECORSK.9;
- chironomid toxicity testing; and
- rapid bioassessment protocol (habitat evaluation and macroinvertebrate sampling).

Table ES-1 is a summary of the ecological measures proposed for Sandia Canyon investigation reaches.

Table ES-1
Proposed Biota Investigation in Sandia Canyon

Reach	Number of Samples or Reaches for Each Ecological Measure													Notes on Ecological Measures and Locations
	Nest Box Monitoring	Soil (discrete sample)	Soil (composite sample)	Sediment Sample	Water Sample	Eggs	Small Mammals	Earthworm Growth and Survival Test	Earthworm Bioaccumulation	Seedling Germination Test	Chironomid Toxicity Test	Rapid Bioassessment Protocol	ECORSK.9 Model	
S-2	1	4	3	3	2	14	TBD[a]	4	4	4	6	2	1	Large wetland and highest chromium and polychlorinated biphenyl; concentrations; sample locations will capture maximum Phase 1 chromium concentrations; shrews are expected in this area and pitfall trapping will be attempted; water samples will be collected at upstream and downstream ends of the reach to evaluate possible chemical changes through the wetland; eggs represent previously collected and stored samples; moderate habitat potential for threatened and endangered (T&E) species (Mexican spotted owl and southwestern willow flycatcher)
S-3W	—[b]	2	—	3	—	—	—	2	2	2	6	—	1	Region of typically persistent surface water; moderate chromium concentrations in sediment; soil samples will target highest chromium concentrations in this reach; high habitat potential for T&E species (Mexican spotted owl)
Between S-3W and S-3E	—	—	—	—	1	—	—	—	—	—	—	1	1	Region of typically persistent surface water; hexavalent chromium at concentrations near the water ecological screening level; samples from this location will be used for chironomid bioassay; high habitat potential for T&E species (Mexican spotted owl)
S-3E	—	—	—	1	1	—	—	—	—	—	2	1	1	Near downstream end of region of typically persistent surface water flow; moderate chromium concentrations in sediment; high habitat potential for T&E species (Mexican spotted owl)

Table ES-1 (continued)

Reach	Number of Samples or Reaches for Each Ecological Measure													Notes on Ecological Measures and Locations
	Nest Box Monitoring	Soil (discrete sample)	Soil (composite sample)	Sediment Sample	Water Sample	Eggs	Small Mammals	Earthworm Growth and Survival Test	Earthworm Bioaccumulation	Seedling Germination Test	Chironomid Toxicity Test	Rapid Bioassessment Protocol	ECORSK.9 Model	
S-4W	1	2	—	1	—	—	—	2	2	2	2	—	1	Chromium concentrations are above background levels in this reach, but lower than in upcanyon reaches; represents lower end of concentration gradient; moderate habitat potential for T&E species (Mexican spotted owl)
S-4E	—	—	3	—	—	—	TBD	—	—	—	—	—	—	Good habitat for cavity-nesting birds and small mammals; chromium concentrations are above background levels in this reach; reach contains extensive thick historic sediment deposits
S-5E	1	1	3	1	—	—	TBD	1	1	1	2	—	—	Good habitat for cavity-nesting birds and small mammals; chromium concentrations are relatively low but locally above background levels in this reach
PA-0	—	1	—	1	—	—	—	1	1	1	2	—	—	Reference site location for bioassays in upper Pajarito Canyon; post-fire deposits will be avoided in collecting samples
Cañada del Buey, Guaje Canyon, and/or Los Alamos Golf Course	—	—	—	—	—	6	—	—	—	—	—	—	—	Reference site locations for eggs—distant from Laboratory contaminant sources

[a] TBD = To be determined; one sample per species.

[b] — = No analyses proposed for suite in reach.

CONTENTS

Tables

Attachment

1.0 INTRODUCTION

This biota investigation work plan for Sandia Canyon at Los Alamos National Laboratory (LANL, or the Laboratory) constitutes an addendum to the "Work Plan for Sandia Canyon and Cañada del Buey" (the work plan) (LANL 1999, 064617), which was approved by the New Mexico Environment Department (NMED) after modifications (LANL 2003, 081597; LANL 2005, 091542; NMED 2005, 091689). This biota plan was prepared following currently accepted approaches for evaluating ecological risks, including the U.S. Environmental Protection Agency's (EPA's) Ecological Risk Assessment Guidance for Superfund (ERAGS) (EPA 1997, 059370) and the Laboratory's screening level ecological risk assessment (SLERA) process (LANL 2004, 087630). It also follows the general process used to evaluate potential ecological risks in Los Alamos and Pueblo Canyons that was developed in consultation with NMED and the U.S. Department of Energy (DOE), as documented in a record of communication (Katzman 2002, 073667), and the process used in the "Mortandad Canyon Biota Investigation Work Plan" (LANL 2005, 089308) and the "Pajarito Canyon Biota Investigation Work Plan" (LANL 2006, 093553), which were approved by NMED (NMED 2005, 092084; NMED 2007, 096332).

Due to the nature of the primary contamination in Sandia Canyon (metals and polychlorinated biphenyls [PCBs]) and the ecological setting (including an expansive wetland area in reach S-2), this plan is based largely on assessment endpoints (AEs) and associated ecological measures developed for the "Pajarito Canyon Biota Investigation Work Plan" (LANL 2006, 093553). The appropriate studies to evaluate ecological measures of exposure and effects, which were used in the Pajarito Canyon investigation and adopted here, include

- collection of soil and sediment samples,
- cavity-nesting bird-monitoring data,
- earthworm bioaccumulation testing,
- seedling germination testing,
- spatial modeling using the ECORSK.9 model,
- chironomid toxicity testing, and
- rapid bioassessment protocol.

To address the potential for ecological effects of metals on small mammal communities and the potential for exposure through the food chain, this plan also proposes to collect small mammals for analysis. Small mammal data, previously obtained in Los Alamos, Pueblo, and Mortandad Canyons, are proposed for Sandia Canyon in addition to the measures evaluated in Pajarito Canyon that are listed above.

This plan addresses ecological screening of sediment samples collected in Sandia Canyon from 1998 to 2007 and surface water samples collected from 2002 to 2007. Analytical data from these sediment and water samples are included as Attachment 1, Sample Locations and Analytical Results, on the compact disk (CD) that accompanies this plan. Ecological scoping will be documented in the Sandia Canyon Investigation Report along with the other information required for ERAGS Steps 1 through 7. Information on radioactive materials and radionuclides, including the results of sampling and analysis of radioactive constituents, is voluntarily provided to NMED in accordance with DOE policy.

2.0 BACKGROUND

This section briefly outlines key features of the Sandia Canyon watershed. Additional background information for Sandia Canyon, including locational information, historic and prehistoric site uses, potential sources of contamination, the biological setting, and relevant monitoring programs are described further in the work plan (LANL 1999, 064617).

2.1 Historical Site Uses

Key Laboratory operations within or in proximity to Sandia Canyon have included discharge of cooling-water from a power plant and other liquid wastes, operation of a small-charge implosion and initiator experiment site, operation of a security-force firing range, and waste storage (LANL 1999, 064617). Effluent discharges, primarily from power plant blowdown, support perennial flow conditions along a 3-km (2-mi) stretch of canyon below Technical Area (TA) 03. Treated effluents from the TA-46 Sanitary Wastewater Systems (SWWS) plant are also discharged into Sandia Canyon.

2.2 Ecological Receptors

Several terrestrial habitats exist within Sandia Canyon, including mixed conifer forests, ponderosa pine woodlands, riparian areas, piñon-juniper woodlands, and grass and shrub areas (McKown et al. 2003, 087150). All of these habitats are included in the development of the terrestrial food web for the Laboratory (LANL 2004, 087630, p. 24). The receptor species represent the major feeding guilds that may be exposed to contamination. The terrestrial receptors include plants, the earthworm, the desert cottontail, the deer mouse, the montane shrew, the American robin (modeled to represent herbivorous, omnivorous, and insectivorous birds), the American kestrel (representing both an intermediate carnivore and a top carnivore), and the red fox. In addition to representing an overall feeding guild, the kestrel modeled as a top carnivore serves as a surrogate for the Mexican spotted owl, a threatened and endangered (T&E) species for which potential habitat exists within a portion of Sandia Canyon (Keller 2007, 098042).

Aquatic habitats, including wetlands and perennial, intermittent, and ephemeral reaches of flowing water and pools, also exist within Sandia Canyon. Persistent surface water exists in the active channel in the upper canyon, fed by discharges from outfalls. All active channel deposits are potentially subject to persistent flow under different climatic conditions and, therefore, could harbor aquatic receptors, namely organisms dependent on water such as algae or insects (LANL 2004, 087630, p. 69). The U.S. Army Corps of Engineers (ACE) identified 2.96 acres of wetland within Sandia Canyon in 2005, documenting observations of hydrophytic vegetation, wetland hydrology, and hydric soil indicators (ACE 2005, 092220). Outfalls and impoundments in Sandia Canyon have been the subjects of biological assessments and monitoring studies and are described in the work plan (LANL 1999, 064617, pp. 3-76 to 3-79). There was also a detailed evaluation of the Sandia Canyon wetland that covered several topics including wetland importance, historical information on the wetlands, 1990 to 2000 photographic comparison, and a wetland functional assessment (Bennett et al. 2001, 098200). This report also evaluated the wetlands under various stream flow scenarios.

Aquatic areas provide potential habitat for aquatic community organisms and two species of aerial insectivores, the little brown myotis bat and the violet-green swallow, that may be exposed to sediment contaminants through ingestion of sediment-dwelling insects. In addition to representing the feeding guild of insectivorous birds, the violet-green swallow serves as a surrogate for the southwestern willow flycatcher, a T&E species for which habitat exists within Sandia Canyon (Keller 2007, 098042).

2.3 Summary of Contamination and Comparison to Ecological Screening Levels

For the purpose of this biota investigation, chemicals of potential concern (COPCs) are being evaluated for their potential ecological impacts. Sections 2.0 through 4.0 of the "Summary of Sandia Canyon Phase 1 Sediment Investigations" (LANL 2007, 098127) describe the field investigations and resulting data used to identify and describe the nature and extent of COPCs in Sandia Canyon sediment deposits.

Phase 1 sediment investigations in Sandia Canyon identified COPCs in each sampled reach, based on comparisons to sediment background values (BVs) or detection status. Tables 2.3-1 through 2.3-6 compare maximum detected concentrations for these COPCs to ecological screening levels (ESLs) for soil and sediment. The distinction between soil and sediment as used here is that samples from active channel geomorphic units (c1 units) are screened versus sediment ESLs and all sediment data are screened versus soil ESLs. COPCs whose maximum detected concentrations exceed ESLs are considered chemicals of potential ecological concern (COPECs) and include 16 inorganic chemicals and 10 organic chemicals. No radionuclides exceed ESLs in soil or sediment.

Data from surface-water samples collected from three locations in Sandia Canyon from 2002 to 2007 were compared with water ESLs, as shown in Tables 2.3-7 through 2.3-9. Based on this screening, nine inorganic chemicals, one organic chemical, and no radionuclides in surface water are considered COPECs.

Tables 2.3-10, 2.3-11, and 2.3-12 provide summaries of the soil, sediment, and surface-water ecological screening for Sandia Canyon data. Study design COPECs are COPCs with a hazard quotient (HQ) greater than 3 and a maximum detected concentration in Sandia Canyon greater than in the Pajarito Canyon watershed. Study design COPECs include metals, PCBs, and pesticides. Some semivolatile organic chemicals (SVOCs) also meet these criteria, but concentrations of polycyclic aromatic hydrocarbons (PAHs) are only marginally greater in Sandia Canyon than in Pajarito Canyon and have been detected at similar or greater concentrations in other canyons (e.g., LANL 2004, 087390). They are therefore eliminated as study design COPECs for this study. Phthalates also meet these criteria, but concentrations of these SVOCs are similar in Sandia Canyon and Pajarito Canyon, and phthalates were assessed in the NMED-approved Mortandad Canyon Investigation Report (LANL 2006, 094161; LANL 2007, 098279; NMED 2007, 096394). Thus, additional ecological risk assessment of phthalates is not needed.

2.4 Summary of Previous Biota Studies in Sandia Canyon

Previous biota studies, including biological assessments, T&E and sensitive species surveys, and contaminant uptake studies in Sandia Canyon are discussed in Section 3.4.6 of the work plan (LANL 1999, 064617). Section 3.4.6.4.5 of the work plan summarizes significant information about the biological setting from previous studies. Summaries of several biota studies published for Sandia Canyon are also presented in the "Annotated Bibliography of Environmental Studies on the Pajarito Plateau, Revision 1" (Ferenbaugh 2000, 097875, pp. 196-208).

Studies of Sandia Canyon biota have included population and diversity studies of aquatic macroinvertebrates and small mammals, contaminant uptake studies related to water quality, and special investigations related to effects of unplanned releases in the watershed. Field data were collected throughout the 1990s to establish baseline water-quality and aquatic macroinvertebrate community data. The studies were designed to determine the effects of routine discharges of industrial and sanitary wastewater into Sandia Canyon. These water-quality studies identified differences in water-quality parameters and aquatic macroinvertebrate diversity between Sandia Canyon sampling stations and natural streams, suggesting degraded water quality resulting from effluent discharges. The studies concluded that degradation in water quality was variable by sampling location throughout the watershed and that biotic diversity and density were also influenced by physical disturbances such as erosion, scour, and substrate limitations (Cross 1994, 057544; Cross 1995, 057543; Cross and Nottelman 1996, 057540).

In the late 1990s, small mammal studies were conducted in Sandia Canyon to establish baseline conditions for populations in three habitats receiving effluent from multiple Laboratory sources. Parameters assessed in one study included species diversity, species composition, small mammal density, biomass, physical characteristics, body mass, and other physical attributes (Bennett and Biggs 1996, 057541). This study concluded that the highest species diversity occurred in cattail-dominated marshes with ponderosa pine overstory and that animal density and biomass declined as one moved downstream. Another similar study compared small mammal diversity near outfalls, streams, and dry locations (Raymer and Biggs 1994, 056038). This study showed that diversity and abundance were related to the quantity of water regardless of whether that amount of water was from natural sources or a Laboratory outfall. In 1999, archived adipose tissue and internal organs of voles, harvest mice, shrews, and deer mice were analyzed for PCBs (Bennett et al. 1999, 082652). Select Aroclors were detected in mammal tissues from Sandia Canyon but were not detected in reference site tissues. Detected concentrations approached levels for which effects have been noted (Bennett et al. 1999, 082652).

An avian nest box monitoring network was established at the Laboratory to evaluate the health and condition of cavity-nesting birds potentially affected by contaminant releases. In 2001, three nesting species—western bluebird, house wren, and violet-green swallow—were observed in Sandia Canyon nest boxes. Eggs were submitted for metal and organic residue analyses. PAHs and chlorinated insecticides were detected in western bluebird egg samples (Fair and Sommer 2002, 098047; Fair and Colestock 2003, 098046). In 2003, 33 nest boxes were established in the Sandia wetland and in lower Sandia Canyon. All Sandia Canyon nest boxes were unoccupied in 2003 (Fair and Colestock 2003, 098046). In 2004, nest box data from 1997 to 2003 were compiled and evaluated for sites throughout the monitoring network, including Sandia Canyon (Fair et al. 2004, 085524). In addition to analyses for inorganic and organic chemicals and radionuclides, eggshell thickness was investigated. A notable result of the assessment was the significant decrease in eggshell thickness and egg size from the Sandia Canyon wetland location relative to other locations. Both PCBs and pesticides were detected in eggs from Sandia Canyon at concentrations higher than other sampling locations (Fair et al. 2004, 085524, p. 13). No significant differences were noticed in the concentrations or detection of inorganic chemicals or radionuclides.

Avian uptake and toxicity studies relevant to Sandia Canyon have included evaluations of reproductive success and characterization of immune and growth response in western bluebirds and ash-throated flycatchers (Fair and Myers 2002, 082655; Fair et al. 2003, 082660) and uptake of nitrogen and PCBs from treated sanitary effluent in the Sandia wetland (Fair and Heikoop 2006, 098045). Measurements of reproductive success included eggshell quality, clutch size, sex ratio, and hatching success for cavity-nesting birds potentially exposed to heavy metals, chemicals, insecticides, PCBs, organochlorine pesticides, and radionuclides in the Sandia wetland (Fair and Myers 2002, 082655). This work concluded that decreased hatching success and eggshell thinning were prevalent in the Sandia wetland, whereas clutch size and sex ratio did not differ significantly between the wetland and distant locations. Another study concluded that survivorship of receptor bird species was a function of nest box distance from the source of contaminant release (i.e., higher survivorship was observed at nest boxes further from contaminant sources) (Fair et al. 2003, 082660). Growth response in bluebirds and flycatchers was variable by location and between species but showed similar response patterns from year to year.

Between 2000 and 2002, wetland media, including cattail leaves and roots, pore water, and sediment, were sampled for PCBs in the Sandia wetland (unpublished Laboratory data), These analyses indicated that cattail roots had higher concentrations of PCBs than leaves, and that PCB concentrations in cattail tissue were higher than those of adjacent pore-water samples. A key observation relative to toxicity of PCBs in Sandia Canyon was that the PCBs may be undergoing processes in the wetland that are decreasing toxicity through dechlorination of PCB molecules.

Field surveys have indicated the presence of multiple amphibian and reptile species in the Sandia wetland (unpublished Laboratory data). Habitat analyses were performed in Sandia Canyon in 2001 to support a study of the morphology of the many-lined skink (Gonzales et al. 2002, 098255). Habitat attributes of Sandia Canyon, including canopy cover, vegetation stand composition, and habitat modifiers, were recorded along two transects where skinks were collected and examined for morphological anomalies. Attributes of skink morphology included physical measurements of length and mass, gender, missing appendages (digits, limb segments, joints, claws, and toes), skin scars, and incidence of ectoparasites. Results were compared with those of skinks from off-site locations. The study revealed there was insufficient evidence to conclude that localized soil and sediment contamination was associated with morphological anomalies, and observed anomalies were not distinguishable from those attributed to natural variation.

3.0 SITE CONDITIONS

Sandia Canyon heads on the Pajarito Plateau within TA-03 and has a total drainage area of approximately 5.5 mi^2. The canyon extends east-southeast from TA-03 to the Rio Grande for a distance of approximately 10 mi (16 km). The upper canyon contains a perennial stream that is supplied from effluent discharges from the SWWS plant and from cooling tower discharges, and a large wetland in the upper canyon is documented in ACE (2005, 092220). The stream in the middle and lower parts of the canyon is mainly ephemeral, flowing in response to precipitation events. Section 3.1.1 of the work plan (LANL 1999, 064617, pp. 3-2 to 3-3) describes the location, topography, surface drainage, and other attributes of Sandia Canyon, and surface water hydrology and hydrogeology are discussed in Sections 3.4.3 and 3.4.4 of the work plan (LANL 1999, 064617, pp. 3-37 to 3-72). The headwaters of Sandia Canyon are highly developed and include large areas of pavement and buildings, enhancing stormwater runoff. Part of the Sandia Canyon watershed was burned in the May 2000 Cerro Grande fire, although burn severity was relatively low (BAER 2000, 072659), and no significant hydrologic effects of the fire have been noted here.

4.0 SCOPE OF ACTIVITIES

Proposed investigation activities for Sandia Canyon were based on the AEs and associated measures developed for biota investigations in other Laboratory canyons. Given the similarity in contaminants and the ecological setting of Sandia Canyon and Pajarito Canyon, this plan is largely based on the AEs and measures developed for Pajarito Canyon (LANL 2006, 093553).

AEs and associated ecological measures were identified by applying the EPA ERAGS process (EPA 1997, 059370) to COPECs in soil, sediment, and persistent surface water in the canyon bottoms (LANL 2006, 093553). The seven AEs adopted for the Sandia Canyon biota investigation are as follows:

- AE1: Survival and reproduction of the Mexican spotted owl
- AE2: Health and reproductive success of avian ground invertevore feeding guild species (e.g., American robin)
- AE3: Survival of mammalian invertevore and omnivore feeding guild species (e.g., shrews and deer mice)

- AE4: Survival and growth of detritivore species (earthworms)
- AE5: Survival and growth of native plant species
- AE6: Survival and reproduction of the southwestern willow flycatcher
- AE7: Abundance and survival of the aquatic community in the Sandia Canyon reaches that retain surface water long enough to support aquatic communities

The studies presented in this plan represent the proposed measures of exposure and/or effect for these endpoints. Locations of proposed study reaches and existing sediment sample locations are shown in Plates 1 through 4 of LANL (2007, 098127).

4.1 Overview of Terrestrial Biota Studies

Six measures (or lines of evidence) are proposed for the terrestrial ecological effects evaluation. These measures are identical to those considered in LANL (2006, 093553) with the addition of a small mammal field study. Adding a small mammal study is warranted in Sandia Canyon because of the higher concentrations of COPECs relative to Pajarito Canyon, the prior detection of PCBs in small mammal organs, the absence of whole body analyses for organic COPECs, and the absence of data for inorganic COPECs.

The relationship between these measures and the AEs listed in Section 4.0 is depicted in Table 4.1-1. Section 5 presents additional information on the study design and investigation methods for each study.

Sample locations for terrestrial measures were selected based on concentrations of total chromium; specifically the highest concentration location in reach S-2 and other locations with intermediate and low concentrations were selected to provide a gradient in COPEC concentration. A similar logic was applied to the selection of reaches for small mammal trapping and cavity-nesting bird monitoring.

(1) Soil Characterization

Soil samples are proposed to provide exposure concentrations for small mammal studies, earthworm bioaccumulation, and seedling germination tests. Sample collection is discussed in Section 5.1, and the earthworm and seedling tests are discussed in Sections 5.3 and 5.4, respectively. Samples for soil characterization will be collected at the same time and location as samples for the small mammal field studies, earthworm bioaccumulation, and seedling germination tests.

(2) Cavity-Nesting Bird-Monitoring Study

Continuation and expansion of the existing cavity-nesting bird-monitoring study are proposed to collect measures of effect (nest success, eggshell thickness, and sex ratio) and of exposure (egg concentrations and insect concentrations) for avian ground invertevores. The spatial coverage, network design, and sampling design are discussed in Section 5.2.

Exploratory data analysis (EDA) tools are proposed to evaluate the avian-monitoring network data for differences in nest success and eggshell thickness between reaches. The EDA will include scatter plots to evaluate trends in nest success and eggshell thickness along gradients in elevation or COPEC concentrations. The EDA will also include correlation analysis using parametric and nonparametric statistical methods. To evaluate potential effects on abundance, information from burned areas will be compared with unburned areas across the nest box network using box plots and statistical analyses. Information from the scientific literature and other studies at the Laboratory will be used as secondary information to support the interpretation of results.

The primary tool for risk characterization of potential effects on abundance is trend analysis versus predicted HQ for COPECs (e.g., PCBs and inorganic chemicals). Concentrations in eggs will be used to generate central tendency estimates (estimates of averages) of COPECs in eggs. Concentrations in eggs will be related to soil and sediment concentrations by location to estimate uptake of chemicals from sediment and soil. To further support the assessment of the avian invertevore feeding guild, data from the existing network outside Sandia Canyon will be compared with data from new boxes added to the existing cavity-nesting bird-monitoring network in 2007 or 2008.

(3) Small Mammal Field Study

A small mammal field study is proposed to provide a measure of exposure (whole animal concentrations) and a measure of effect (measure of abundance in each reach relative to the other reaches as food abundance) for the Mexican spotted owl; a measure of effect (abundance in each reach relative to the other reaches, reproductive status, and sex ratio) for the mammalian invertevore feeding guild, as represented by the montane shrew, and the mammalian omnivore, as represented by the deer mouse; and a measure of exposure (whole animal concentrations) for the mammalian invertevore and the mammalian omnivore. The spatial coverage and sampling design are discussed in Section 5.3.

Elevation and presence of flowing water, in addition to COPEC concentration, are expected to affect mammal populations and therefore be confounding factors in risk characterization. EDA will be conducted to evaluate the importance of these factors before evaluating trends in small mammal abundance and diversity over these reaches. The EDA will include scatter plots to evaluate trends in relative abundance or whole animal concentrations along gradients in COPEC concentrations. The EDA will also include correlation analysis using parametric and nonparametric statistical methods. Information from the scientific literature and other studies at the Laboratory will be used to support the interpretation of results. The primary tool for characterization of potential effects on abundance and diversity is trend analysis versus predicted HQ for COPECs (e.g., inorganic chemicals and PCBs).

The central tendency of whole animal concentrations will be estimated for COPECs. A model relating whole animal concentrations to soil and sediment concentrations by location will also be developed.

(4) Earthworm Bioaccumulation Test

Earthworm bioaccumulation and mortality tests are proposed as a measure of effect (survival and growth) and exposure (whole body concentrations) for detritivores. The spatial coverage as well as the sampling and analysis design are discussed in Section 5.4. Evidence for effects will be based on statistically significant differences (using Dunnett's t-test) in mortality and growth for the soils tested versus the reference site results. Effects will also be evaluated by plotting the data to determine if there are trends in mortality and growth versus COPEC concentrations. COPEC concentrations from soil and worm samples will also be analyzed using linear regression analysis to determine if COPECs bioaccumulate in earthworms. An estimate of central tendency of COPEC concentrations will be used to develop a model relating depurated whole animal concentrations to soil concentrations.

(5) Seedling Germination Test

Seedling germination tests are proposed as a measure of effect (germination and growth) for primary producers. The spatial coverage as well as the sampling and analysis design are discussed in Section 5.5. Evidence for effects will be based on statistically significant differences (using Dunnett's t-test) in germination and growth measures for the soils tested versus the reference site results. Effects will also be evaluated by plotting the data to determine if there are trends in germination measures versus COPEC concentrations, nutrients, and/or organic matter.

(6) ECORSK.9 Model

The ECORSK.9 model (Gonzales et al. 2004, 085207) is proposed as a measure of effect (hazard index [HI]) for the terrestrial avian wildlife receptor that is also a T&E species (the Mexican spotted owl). A summary of the model and its application to Sandia Canyon is discussed in Section 5.6.

4.2 Overview of Aquatic Biota Studies

Five measures (or lines of evidence) are proposed for the aquatic biota ecological effects evaluation. The relationship between these measures and the AEs is depicted in Table 4.2-1. Evaluation of potential effects on the southwestern willow flycatcher, a T&E species, is included because this species is assumed to feed primarily on insects that are associated with aquatic communities.

Sample locations for aquatic measures were selected based on concentrations of total chromium; specifically, the highest concentration location (in reach S-2) and other locations with intermediate and low concentrations were selected to provide a gradient in COPEC concentration. A similar logic was applied to the selection of reaches for small mammal trapping and cavity-nesting bird monitoring.

(1) Sediment and Water Characterization

Collection of sediment and water samples is proposed to measure exposure for aquatic invertebrates and for aerial insectivores. Sediment and water collection is discussed in Section 5.1. Sediment and water samples will be collected at the same time and location as sample collection for the *Chironomus tentans* toxicity tests.

(2) *Chironomus tentans* Toxicity Tests

Toxicity testing using the aquatic midge *Chironomus tentans* is proposed in select locations as a measure of effect (survival and growth) for the aquatic community that can be related to potential impacts on abundance and diversity of the aquatic community in parts of Sandia Canyon with perennial or intermittent water. The spatial coverage as well as the sampling and analysis design is discussed in Section 5.7. Statistical comparisons of survival and growth will be conducted between reaches with COPECs, a background reach, and laboratory controls.

(3) Rapid Bioassessment Characterization

Habitat assessments and aquatic macroinvertebrate sampling are proposed in three reaches in Sandia Canyon in which surface water flow volume and persistence are sufficient to support aquatic invertebrate communities. The rapid bioassessment will provide information about the quality of the physical habitat and the structure of the aquatic macroinvertebrate community at these locations. The spatial coverage as well as the sampling and analysis design is discussed in Section 5.8. Aquatic invertebrates will be identified by a qualified taxonomist, and macroinvertebrate metrics will be calculated for samples collected with a Hess sampler that contain at least 100 individuals.

(4) Cavity-Nesting Bird-Monitoring Study

The cavity-nesting bird-monitoring study mentioned in Section 4.1 is also proposed as surrogate measures of effect (nest success, eggshell thickness, and sex ratio) for an avian insectivore T&E species (southwestern willow flycatcher). Species inhabiting the nest boxes are not exposed solely to sediment, but information from the nest box studies can be used to qualitatively evaluate effect and exposure to the avian insectivore. Insects collected from the boxes within the avian monitoring network provide a measure of exposure for the western bluebird and ash-throated flycatcher, which are surrogates for the selected avian aerial insectivores, the violet green swallow and the southwestern willow flycatcher. The spatial coverage, network design, and sampling design are discussed in Section 5.2.

(5) ECORSK.9 Model

The ECORSK.9 model (Gonzales et al. 2004, 085207) is proposed as a measure of effect (HI) for the southwestern willow flycatcher based on sediment ingestion and consumption of sediment-dwelling insects. A summary of the model and its application to Sandia Canyon is discussed in Section 5.6.

4.3 Health and Safety Requirements

The field investigations described in this work plan will comply with all applicable requirements pertaining to worker health and safety. Prior to conducting fieldwork, approval will be obtained for an integrated work document (IWD) following the process described in the Laboratory's Implementation Procedure IMP 300-00-00.1, Integrated Work Management for Work Activities.

4.4 Waste Management

The investigation activities described in this work plan will generate a variety of types of investigation-derived waste (IDW) that will be managed in accordance with applicable federal, state, DOE, and Laboratory requirements. The applicable IDW management plan will follow Appendix E of LANL (2006, 093553).

5.0 INVESTIGATION METHODS (STUDY DESIGN)

The investigation methods and general study design are the same as those described in Section 5 of LANL (2006, 093553), unless otherwise noted.

5.1 Collection of Soil, Sediment, and Water Samples

Procedures for the collection of soil and sediment samples in Sandia Canyon will follow those listed in Section 5.1 of LANL (2006, 093553, pp. 11-12). Water collection procedures will follow those described in the "Mortandad Canyon Biota Investigation Work Plan" (LANL 2005, 089308). Locations and analytical suites for soil, sediment, and water samples are listed in Tables 5.1-1a, 5.1-1b, and 5.1-1c, respectively. Target detection limits for soil, sediment, and water are listed in Tables 5.1-2, 5.1-3, and 5.1-4, respectively. The target detection limits for abiotic media are the media-specific ESLs. The COPECs in Table 5.1-1a are the soil study design COPECs (Table 2.3-10); the sediment and water COPECs in Tables 5.1-1b and 5.1-1c are based on the combined lists of sediment and water study design COPECs (Table 2.3-11 and 2.3-12).

5.2 Cavity-Nesting Bird Monitoring

The purpose and procedures for monitoring cavity-nesting birds in Sandia Canyon are identical to those described in LANL (2006, 093553). The existing monitoring network, which includes nest boxes in reach S-2, will be expanded to add boxes in reaches S-4E and S-5E. Eggs and insects will be collected from nest boxes for chemical analysis. Procedures for sample collection are described in Section 5.2 of LANL

(2006, 093553, p. 12). Analytical suites and detection limits for eggs are listed in Tables 5.2-1 and 5.2-2, respectively. The detection limits for eggs are based on the toxicity reference value (TRV) for the COPEC and the food ingestion rate for potential avian predators. Prioritization of analytical suites, in case sample mass is insufficient to obtain all proposed analyses, is presented in Table 5.2-3.

5.3 Small Mammal Trapping and Animal Collection

Small mammal trapping in Sandia Canyon is designed to collect data to support evaluation of relative abundance, population parameters, and bioaccumulation. Procedures for small mammal trapping, including descriptions of target genera, and additional considerations are described in LANL (2005, 089308, pp. 14-15). Animals will be composited by species. As an exception from the Mortandad Canyon biota plan, pelts will not be removed. This will make the Sandia Canyon data consistent with most of the small mammal contaminant data collected for the Laboratory. Trapping in reach S-2 is proposed to include pitfall traps for shrews because of the presence of suitable habitat. Locations and analytical suites for small mammal samples are listed in Table 5.3-1. Detection limits for small mammal samples are listed in Table 5.2-2. Prioritization of analytical suites, in case sample mass is insufficient to obtain all proposed analyses, is presented in Table 5.2-3.

5.4 Earthworm Bioaccumulation Testing

The purpose and procedures for earthworm bioaccumulation testing in Sandia Canyon follow those described in LANL (2006, 093553, pp. 12-13). Analytical suites and target detection limits for earthworm tissues are listed in Tables 5.4-1 and 5.4-2, respectively. Prioritization of analytical suites, in case sample mass is insufficient to obtain all proposed analyses, is presented in Table 5.2-3.

5.5 Seedling Germination Testing

Seedling germination testing for Sandia Canyon will be performed following procedures and methods described in LANL (2006, 093553, p. 13).

5.6 Spatial Modeling Using ECORSK.9

The purpose and procedure for spatial modeling using ECORSK.9 for Sandia Canyon follow that described in LANL (2006, 093553, pp. 13-14). Modeling of potential nest box sites will be restricted to areas with high or moderate potential for T&E species (Mexican spotted owl or southwestern willow flycatcher), which includes reaches S-2, S-3W, S-3E, and S-4W.

5.7 Chironomid Toxicity Testing

Toxicity testing in Sandia Canyon using the aquatic midge *Chironomus tentans* will be generally performed as described in LANL (2006, 093553, p. 14). One difference is that toxicity testing will be conducted in two sets, one using analytical laboratory water and the other using field-collected water. All of the field water will be from a single location, gaging station D123.8, which is located downstream of reach S-3E. Sandia Canyon sampling locations and chemical analyses for sediment and water are presented in Tables 5.1-1b and 5.1-1c, respectively. Water samples from the field water set of treatments will be submitted for hexavalent chromium analysis at the beginning, midpoint, and completion of the test (day 1, day 5, day 10) to evaluate potential changes in concentration over the duration of the test. Other analytes in sediment and water will be analyzed at the beginning of the test only.

5.8 Rapid Bioassessment Protocol (Habitat Evaluation and Macroinvertebrate Sampling)

Rapid bioassessment characterization sampling for macroinvertebrates will be conducted at locations in Sandia Canyon with sufficient water to potentially support an aquatic community. Procedures for the rapid bioassessment characterization will follow those described in LANL (LANL 2006, 093553, pp. 14-15). Target reaches for rapid bioassessment are listed in Table 5.1-1c.(LANL 2006, 093553)

5.9 Equipment Decontamination

After sampling activities, all equipment will be decontaminated in accordance with Standard Operating Procedure 1.08, Field Decontamination of Sampling Equipment. Residual material adhering to equipment will be removed using paper towels and Fantastik cleaner.

6.0 MONITORING AND SAMPLING PROGRAM

Ongoing environmental monitoring in Sandia Canyon includes sampling and analysis of surface water and groundwater. Additional information on the monitoring program can be found in the annual environmental surveillance reports (e.g., LANL 2006, 093925).

7.0 SCHEDULE

The majority of the fieldwork proposed in this biota investigation plan is currently scheduled to be implemented in fall 2007, with the remainder of the work to be completed in spring or summer 2008. The results of the biota investigations will be presented in the Sandia Canyon Investigation Report that is scheduled for submission to NMED by December 15, 2008.

8.0 REFERENCES

The following list includes all documents cited in this plan. Parenthetical information following each reference provides the author, publication date, and ER ID number. This information is also included in text citations. ER ID numbers are assigned by the Environmental Programs Directorate's Records Processing Facility (RPF) and are used to locate the document at the RPF and, where applicable, in the master reference set.

Copies of the master reference set are maintained at the NMED Hazardous Waste Bureau; the U.S. Department of Energy–Los Alamos Site Office; the U.S. Environmental Protection Agency, Region 6; and the Directorate. The set was developed to ensure that the administrative authority has all material needed to review this document, and it is updated with every document submitted to the administrative authority. Documents previously submitted to the administrative authority are not included.

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Table 2.3-1
Comparison of Maximum Concentrations for Inorganic COPCs in Sandia Canyon Sediment Samples with Soil ESLs

Reach	Aluminum	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chloride	Chromium	Chromium Hexavalent Ion	Cobalt	Copper	Cyanide (Total)	Fluoride	Iron	Lead	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Nitrate	Perchlorate	Potassium	Selenium	Silver	Sulfate	Thallium	Vanadium	Zinc
Sediment BV	**15400**	**3.98**	**127**	**1.31**	**0.4**	**4420**	**17.1**	**10.5**	**na[a]**	**4.73**	**11.2**	**0.82**	**na**	**13800**	**19.7**	**2370**	**543**	**0.1**	**na**	**9.38**	**na**	**na**	**2690**	**0.3**	**1**	**58.2**	**0.73**	**19.7**	**60.2**
Soil ESL	**na**	**6.8**	**110**	**2.5**	**0.27**	**na**	**na**	**2.3**	**0.34**	**13**	**10**	**0.1**	**31**	**na**	**14**	**na**	**50**	**0.013**	**na**	**20**	**na**	**na**	**na**	**0.1**	**0.05**	**na**	**0.03**	**0.03**	**10**
S-1S	—[b]	—	—	—	0.6 (U)	—	—	160 (J-)	—	—	48 (J-)	—	—	—	77 (J-)	—	—	1.2	—	—	—	—	—	0.6 (U)	14 (J-)	—	—	—	110 (J-)
S-1N	—	4	—	—	0.63 (U)	—	—	—	—	—	—	—	—	—	690	—	—	0.13 (U)	—	11	—	—	—	0.63 (U)	2.5 (U)	—	—	—	—
S-2	20000	15.6	297	3.97	8.69	6080	66 (J-)	3740	2.01 (J+)	8.2	223	11.6	3.31 (J-)	21000	74.4	2800	582	5.57	44.4	69.3 (J+)	13 (J-)	0.000997 (J)	3500	4.43 (U)	87.3 (J+)	1340 (J-)	1.06	40	1140
S-3W	—	4.77	128 (J-)	—	0.79	—	—	217 (J-)	0.548 (J+)	—	28.7	—	—	—	24.4 (J)	—	996	0.26	3.4	10.2	1.43	—	—	1.7 (U)	6.35	—	—	—	—
S-3E	—	—	—	1.6	0.64 (U)	—	79.4	439	1.96	—	26	0.86 (U)	4.87 (J-)	—	34	—	—	0.17 (U)	1.6	—	3.75	0.00141 (J)	—	1.92 (U)	4.2	59.5	—	—	100
S-4W	—	—	—	—	0.665 (U)	—	43.6 (J-)	112	—	—	16.2	—	1.88 (J-)	—	30.1	—	636	—	1.12	—	4.72 (J-)	0.00123 (J)	—	1.99 (U)	2.29	—	—	—	158
S-4E	—	—	—	—	0.559 (U)	—	—	113	2.53	5.24	18.4	—	4.56 (J-)	13900 (J+)	28.5	—	629	0.239	1.6	—	5.87 (J-)	0.00101 (J)	—	1.68 (U)	3	—	—	—	102
S-5C	—	—	—	—	0.55 (U)	—	—	73.9	—	—	15.2	—	1.89 (J-)	14600	63.2	—	597	0.106	1.54	—	1.65 (J-)	0.00221 (J-)	—	1.76	2.4	—	—	—	89.9
S-5E	—	—	—	—	0.535 (U)	—	—	22.5	0.587 (J)	—	—	—	2.44 (J-)	—	25.1	—	—	—	0.394	—	1.37 (J-)	0.00113 (J)	—	1.6 (U)	—	—	—	—	—

Notes: Units are mg/kg. Qualifiers are shown in ( ). Results shown are only for analytes that are COPCs in a reach. Values highlighted in gray exceed the soil ESL.

[a] na = Not available.

[b] — = Not a COPC in reach.

Table 2.3-2
Comparison of Maximum Detected Concentrations for Organic COPCs in Sandia Canyon Sediment Samples with Soil ESLs

Reach	Acenaphthene	Acenaphthylene	Acetone	Anthracene	Aroclor-1016	Aroclor-1242	Aroclor-1248	Aroclor-1254	Aroclor-1260	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Benzoic Acid	Bis(2-ethylhexyl)phthalate	Butanone[2-]	Butylbenzene[n-]	Butylbenzene[sec-]
Soil ESL	**0.25**	**120**	**1.2**	**210**	**1**	**0.041**	**0.007**	**0.041**	**0.14**	**3**	**9.6**	**18**	**24**	**62**	**1**	**0.02**	**360**	**na[a]**	**na**
S-1S	—[b]	—	—	1.9 (J)	—	—	—	—	11	3.6	3.3	3	—	2.8	—	—	—	—	—
S-1N	—	—	—	—	—	—	0.076	—	0.045	—	—	—	—	—	—	—	—	—	—
S-2	1.39	0.0608 (J)	0.207 (J+)	2.04	0.024	0.366	—	2.53	2.08	3.3	2.36 (J)	3.54 (J)	0.914 (J)	1.57 (J)	0.466 (J)	1.35	0.0339 (J+)	0.000847 (J)	0.000877 (J)
S-3W	—	—	—	—	—	—	—	0.258	0.282	—	—	—	—	—	—	—	—	—	—
S-3E	—	—	—	—	—	—	—	0.06	0.3 (J-)	0.0286 (J)	—	0.225 (J)	—	0.0146 (J)	—	0.111 (J)	—	—	—
S-4W	—	0.0631	—	—	—	—	—	0.112	0.12	0.0565	—	0.0792	—	—	—	—	—	—	—
S-4E	0.279	—	—	0.00888 (J)	—	—	—	0.17	0.219	0.0473	0.0981	0.132	0.0174 (J)	0.052 (J)	—	—	—	—	—
S-5C	0.0777	—	—	—	—	0.043	—	0.0979	0.157	0.0524	0.0438	0.0575	—	0.0146 (J)	—	—	—	—	—
S-5E	0.0252 (J)	—	—	0.00731 (J)	—	0.0414	—	0.0259	0.0527	—	—	—	—	—	—	0.0932 (J)	—	—	—

Table 2.3-2 (continued)

Reach	Carbon Disulfide	Chlordane[gamma-]	Chloroaniline[4-]	Chloroform	Chrysene	DDD[4,4'-]	Dibenzofuran	Dieldrin	Di-n-butylphthalate	Ethylbenzene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Isopropyltoluene[4-]	Methylnaphthalene[2-]	Naphthalene	Phenanthrene	Pyrene	Toluene	Total Petroleum Hydrocarbons Diesel Range Organics
Soil ESL	**na**	**2.2**	**na**	**8**	**2.4**	**na**	**6.1**	**0.0045**	**0.011**	**na**	**22**	**4.1**	**62**	**na**	**2.5**	**0.34**	**10**	**18**	**23**	**na**
S-1S	—	—	—	—	3.7	—	—	—	—	—	9	—	1.2 (J)	—	—	—	6.8	6.3	—	69
S-1N	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S-2	0.012 (J+)	0.047	0.342 (J)	0.000383 (J)	3.3	0.036	1.22	0.037	0.106 (J)	0.001 (J)	13	1.88	1.03 (J)	0.0798	0.456	0.854	16	9.78	0.00651	470 (J)
S-3W	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S-3E	—	—	—	0.0003 (J)	0.0279 (J)	—	—	—	—	—	0.046	—	—	—	—	—	0.0277 (J)	0.0557	—	81.9
S-4W	—	—	—	0.000344 (J)	0.0512	—	—	—	—	—	0.164	—	—	—	—	—	0.0515	0.108	—	28.8 (J)
S-4E	—	—	—	—	0.067	—	—	—	—	—	0.105	0.00976 (J)	0.0639 (J)	0.00543	—	—	0.0486	0.0909	0.00613	52.5
S-5C	—	—	—	—	0.0394	—	—	—	—	—	0.0851	—	—	—	—	—	0.0387	0.0833	0.00223 (J+)	120 (J)
S-5E	—	—	—	0.00024 (J)	0.00861	—	—	0.00274	—	—	0.0133	—	—	—	—	—	0.00791 (J)	0.0129	0.000887 (J)	69.6

Notes: Units are mg/kg. Qualifiers are shown in ( ). Results shown are only for analytes that are COPCs in a reach. Values highlighted in gray exceed the soil ESL.

[a] na = Not available.

[b] — = Not a COPC in reach.

Table 2.3-3
Comparison of Maximum Detected Concentrations for Radionuclide COPCs in Sandia Canyon Sediment Samples with Soil ESLs

Reach	Americium-241	Cesium-137	Plutonium-238	Plutonium-239/Plutonium-240	Strontium-90	Thorium-228	Thorium-232	Tritium	Uranium-234	Uranium-235	Uranium-238
Sediment BV	**0.04**	**0.9**	**0.006**	**0.068**	**1**	**2.28**	**2.33**	**0.093**	**2.59**	**0.2**	**2.29**
Soil ESL	**44**	**680**	**44**	**47**	**560**	**43**	**6.2**	**36000**	**51**	**55**	**55**
S-2	0.05	1.1	0.125	0.391	1.9	—*	—	4.46	4.29	0.228	4.04
S-4W	—	—	0.0251	—	—	2.47	2.37	—	—	—	—
S-4E	—	—	—	1.72	—	—	—	—	—	—	—
S-5C	—	0.96	—	—	—	—	—	—	—	—	—
S-5E	0.0431	—	—	—	—	2.35	—	—	—	—	—

Notes: Units are pCi/g. No values exceed the soil ESL.
*— = Not a COPC in reach.

Table 2.3-4
Comparison of Maximum Concentrations for Inorganic COPCs in Sandia Canyon Sediment Samples with Sediment ESLs

Reach	Aluminum	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chloride	Chromium	Chromium Hexavalent Ion	Cobalt	Copper	Cyanide (Total)	Fluoride	Iron	Lead	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Nitrate	Perchlorate	Potassium	Selenium	Silver	Sulfate	Thallium	Vanadium	Zinc
Sediment BV	**15400**	**3.98**	**127**	**1.31**	**0.4**	**4420**	**17.1**	**10.5**	**na**[a]	**4.7**	**11.2**	**0.82**	**na**	**13800**	**19.7**	**2370**	**543**	**0.1**	**na**	**9.38**	**na**	**na**	**2690**	**0.3**	**1**	**58.2**	**0.73**	**20**	**60.2**
Sediment ESL	**280**	**12**	**48**	**73**	**0.33**	**na**	**na**	**56**	**8**	**230**	**17**	**0.1**	**45**	**20**	**27**	**na**	**720**	**0.018**	**na**	**39**	**na**	**na**	**na**	**1**	**1**	**na**	**0.04**	**30**	**37**
S-1S	—[b]	—	—	—	0.6 (U)	—	—	15 (J-)	—	—	15 (U)	—	—	—	22	—	—	0.13 (U)	—	—	—	—	—	0.6 (U)	2.4 (U)	—	—	—	—
S-2	18000	15.6	297	3.97	8.69	5300	66 (J-)	3580	2.01 (J+)	8.2	223	8.77	3.31 (J-)	21000	74.4	2700	582	5.57	22.3	69.3 (J+)	1.65 (J-)	0.000997 (J)	3500	4.43 (U)	87.3 (J+)	1340 (J-)	1.06	40	1140
S-3W	—	—	—	—	0.565 (U)	—	—	46 (J-)	—	—	12.4	—	—	—	—	—	—	—	0.428	—	—	—	—	1.7 (U)	—	—	—	—	—
S-3E	—	—	—	—	0.64 (U)	—	—	—	0.316	—	—	—	—	—	—	—	—	—	0.634	—	—	—	—	1.92 (U)	—	—	—	—	63.6 (J+)
S-4W	—	—	—	—	0.528 (U)	—	—	—	—	—	—	—	0.771 (J-)	—	—	—	—	—	0.333	—	—	—	—	1.58 (U)	—	—	—	—	—
S-4E	—	—	—	—	0.502 (U)	—	—	—	0.115	—	—	—	—	—	—	—	—	—	0.485	—	—	—	—	1.51 (U)	—	—	—	—	—
S-5C	—	—	—	—	0.51 (U)	—	—	26 (J-)	—	—	—	—	—	—	23	—	—	—	0.555	—	—	—	—	1.53 (U)	2.4	—	—	—	—
S-5E	—	—	—	—	0.53 (U)	—	—	—	—	—	—	—	—	—	—	—	—	—	0.376	—	—	—	—	1.59 (U)	—	—	—	—	—

Notes: Units are mg/kg. Qualifiers are shown in ( ). Results shown are only for analytes that are COPCs in a reach. Values highlighted in gray exceed the sediment ESL.

[a] na = Not available.

[b] — = Not a COPC in reach.

Table 2.3-5
Comparison of Maximum Detected Concentrations for Organic COPCs in Sandia Canyon Sediment Samples with Sediment ESLs

Reach	Acetone	Anthracene	Aroclor-1242	Aroclor-1254	Aroclor-1260	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Bis(2-ethylhexyl)phthalate	Butanone[2-]	Carbon Disulfide	Chloroform	Chrysene	Ethylbenzene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Isopropyltoluene[4-]	Phenanthrene	Pyrene	Toluene	Total Petroleum Hydrocarbons Diesel Range Organics
Sediment ESL	**0.065**	**0.00039**	**0.031**	**0.031**	**0.031**	**0.11**	**0.35**	**0.24**	**0.29**	**0.24**	**0.026**	**3300**	**na**[a]	**10**	**0.5**	**na**	**2.9**	**0.54**	**0.078**	**na**	**0.85**	**0.57**	**0.67**	**na**
S-1S	—[b]	—	—	—	0.1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	33
S-1N	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S-2	0.207 (J+)	0.0557 (J)	0.366	2.3	1.78	0.193	0.19	0.261	0.574 (J)	0.112 (J)	1.03 (J)	0.0339 (J+)	0.012 (J+)	0.000383 (J)	0.218	0.001 (J)	0.45 (J)	0.0232	0.449 (J)	0.0798	0.239	0.4	0.00651	134
S-3E	—	—	—	—	—	—	—	—	—	—	0.111 (J)	—	—	—	—	—	—	—	—	—	—	—	—	21 (J)
S-4E	—	—	—	0.007	0.0106	—	—	—	—	—	—	—	—	—	—	—	0.00343	—	—	—	—	0.00366	—	2.52 (J)
S-5C	—	—	0.043	0.0248 (J)	0.073 (J)	0.00954	0.0125	—	—	—	—	—	—	—	0.00886	—	0.0123	—	—	—	0.00696 (J)	0.0123	—	—
S-5E	—	—	—	—	0.0034 (J)	—	—	—	—	—	0.0932 (J)	—	—	—	—	—	—	—	—	—	—	—	—	11.9

Notes: Units are mg/kg. Qualifiers are shown in ( ). Results shown are only for analytes that are COPCs in a reach. Values highlighted in gray exceed the sediment ESL.

[a] na = Not available.

[b] — = Not a COPC in reach.

Table 2.3-6
Comparison of Maximum Detected Concentrations for Radionuclide COPCs in Sandia Canyon Sediment Samples with Sediment ESLs

Reach	Plutonium-238	Plutonium-239/Plutonium-240	Uranium-234	Uranium-235	Uranium-238
Sediment BV	**0.006**	**0.068**	**2.59**	**0.2**	**2.29**
Sediment ESL	**110**	**110**	**620**	**670**	**690**
S-2	0.0308	0.294	4.29	0.212	4.04
S-3E	0.0169	—*	—	—	—
S-4W	0.00611	—	—	—	—
S-4E	0.02	—	—	—	—
S-5C	0.009	—	—	—	—

Note: Units are pCi/kg. No values exceed the sediment ESL.
*— = Not a COPC in reach.

Table 2.3-7
Comparison of Maximum Detected Concentrations for Inorganic COPCs in Sandia Canyon Surface Water Samples with Water ESLs

Location Name	Location Synonym	Aluminum	Ammonia as Nitrogen	Antimony	Arsenic	Barium	Boron	Bromide	Cadmium	Calcium	Chloride	Chromium	Cobalt	Copper	Cyanide (Total)	Fluoride	Iron	Lead	Magnesium	Manganese
Water ESL		**87**	**na**[a]	**100**	**150**	**3.8**	**540**	**na**	**0.15**	**na**	**230000**	**77**	**3**	**5**	**5.2**	**1600**	**1000**	**1.2**	**na**	**80**
Sandia right fork at Power Plant	E121	171	15 (JN-)	0.371	—[b]	36	102	502	—	25400	95500	7.18	5.04	5.5	5.41	601	206	0.65	8350	123
SCS-2	W2CS	354	—	0.277	1.68 (JN-)	39	114	662	0.1	25700	88700	12.5	8.58	6.99	—	674	462	1	7380	16.2
Sandia below Wetlands	E123	760	79	0.275	8.9	56	115	1060	0.12	24400	146000	40.4	7.4	9.4	5.53 (J)	910	1230	4.7	6920	271

Table 2.3-7 (continued)

Location Name	Location Synonym	Mercury	Molybdenum	Nickel	Nitrate-Nitrite as N	Perchlorate	Potassium	Selenium	Silicon Dioxide	Silver	Sodium	Strontium	Sulfate	Thallium	Total Kjeldahl Nitrogen	Total Phosphate as Phosphorus	Uranium	Vanadium	Zinc
Water ESL		**0.77**	**na**	**28**	**na**	**35000**	**na**	**5**	**na**	**0.36**	**na**	**620**	**na**	**18**	**na**	**na**	**1.8**	**19**	**66**
Sandia right fork at Power Plant	E121	—	10.1	1.8	2500	18.5	23800	—	124000	—	104000	72.5	130000	0.311	591	5460	0.32	13.4	390
SCS-2	W2CS	—	19.3	2.4	990	0.385	21000	—	108000	0.34	135000	122	100000	—	475	4340	0.48	12.7	47.3
Sandia below Wetlands	E123	0.09	15.8	3.1	2620	0.721 (J)	27900	2.51	121000	1.5	145000	120	161000	0.158	895	4750	0.46	14.4	99

Notes: Units are µg/L. Qualifiers are shown in (). Results shown are only for analytes that are COPCs in a reach. Values highlighted in gray exceed the water ESL.

[a] na = Not available.

[b] — = Not a COPC in reach.

Table 2.3-8
Comparison of Maximum Detected Concentrations for Organic COPCs in Sandia Canyon Surface Water Samples with Water ESLs

Location Name	Location Synonym	Acetone	Aroclor-1254	Aroclor-1260	Bromodichloromethane	Bromoform	Chlorodibromomethane	Chloroform
Water ESL		**11000**	**0.02**	**10**	**na**[a]	**na**	**na**	**180**
Sandia right fork at Power Plant	E121	—[b]	—	—	7.8	2.8	18.5	1.9
SCS-2	W2CS	—	—	—	—	—	—	—
Sandia below Wetlands	E123	5.7	0.11	0.1	0.458	1	0.68	0.278

Notes: Units are µg/L. Results shown are only for analytes that are COPCs at a location. Value highlighted in gray exceeds the water ESL.

[a] na = Not available.

[b] — = Not a COPC in reach.

Table 2.3-9
Comparison of Maximum Detected Concentrations for Radionuclide COPCs in Sandia Canyon Surface Water Samples with Water ESLs

Location Name	Location Synonym	Potassium-40	Strontium-90	Tritium	Uranium-234	Uranium-238
Water ESL		**na**[a]	**570**	**160000000**	**22**	**24**
Sandia right fork at Power Plant	E121	63.9 (J)	—[b]	—	0.253 (J)	0.138 (J)
SCS-2	W2CS	—	—	—	0.193 (J)	0.153
Sandia below Wetlands	E123	—	0.223 (J)	29.6949	0.311	0.232

Notes: Units are pCi/L. Qualifiers are shown in ( ). Results shown are only for analytes that are COPCs in a reach. No values exceed the water ESL.

[a] na = Not available.

[b] — = Not a COPC in reach.

Table 2.3-10
Summary of Soil COPECs with HQs Greater Than 3

Analyte	Sediment BV (mg/kg)	Soil ESL (mg/kg)	Sandia Max (mg/kg)	Pajarito Max (mg/kg)	Sandia HQ	Sandia HQ >3?	Sandia Max > Pajarito Max?	Proposed Sandia Study Design COPEC?	Receptors	Pajarito Study Design COPEC
Cadmium	0.4	0.27	8.69	4.74	32.2	Yes	Yes	Yes	Bird, mammal	Yes
Chromium	10.5	2.3	3740	24	1626	Yes	Yes	Yes	Plant, worm, bird, mammal	No
Chromium hexavalent ion	n/a*	0.34	2.53	n/a	7.4	Yes	n/a	Yes	Plant, worm	No
Copper	11.2	10	223	90	22.3	Yes	Yes	Yes	Plant, worm, bird	Yes
Cyanide (Total)	0.82	0.1	11.6	2.5	116.0	Yes	Yes	Yes	Bird	Yes
Lead	19.7	14	690	84.6	49.3	Yes	Yes	Yes	Plant, bird, mammal	Yes
Mercury	0.1	0.013	5.57	0.717	428.5	Yes	Yes	Yes	Plant, bird, mammal	Yes
Perchlorate	n/a	n/a	0	0.00276	n/a	n/a	n/a	Yes	Not identified (no ESL)	Yes
Selenium	0.3	0.1	1.76	1.45	17.6	Yes	Yes	Yes	Plant	No
Zinc	60.2	10	1140	131	114.0	Yes	Yes	Yes	Plant, worm, bird, mammal	Yes
Aroclor-1242	n/a	0.041	0.366	n/a	8.9	Yes	n/a	Yes	Bird, mammal	No
Aroclor-1254	n/a	0.041	2.53	0.184	61.7	Yes	Yes	Yes	Bird, mammal	Yes
Aroclor-1260	n/a	0.14	11	0.163	78.6	Yes	Yes	Yes	Bird, mammal	No
Bis(2-ethylhexyl)phthalate	n/a	0.02	1.35	1.27	67.5	Yes	Yes	No	Bird	Yes
Dieldrin	n/a	0.0045	0.037	0.00157	8.2	Yes	Yes	Yes	Mammal	No
Di-n-butylphthalate	n/a	0.011	0.106	0.104	9.6	Yes	Yes	No	Bird	Yes

*n/a = Not applicable.

Table 2.3-11
Summary of Sediment COPECs with HQs Greater Than 3

Analyte	Sediment BV (mg/kg)	Sediment ESL (mg/kg)	Sandia Max (mg/kg)	Pajarito Max (mg/kg)	Sandia HQ	Sandia HQ >3?	Sandia > Pajarito	Proposed Sandia Study Design COPEC?	Receptors	Pajarito Study Design COPEC
Cadmium	0.4	0.33	8.69	1.02	26.3	Yes	Yes	Yes	Aquatic community, bird, mammal	Yes
Chromium	10.5	56	3580	19.8	63.9	Yes	Yes	Yes	Aquatic community	No
Chromium hexavalent ion	na*	8	2.01	na	0.3	na	na	Yes	Aquatic community	No
Copper	11.2	17	223	37.7	13.1	Yes	Yes	Yes	Aquatic community, bird, mammal	No
Cyanide (Total)	0.82	0.1	8.77	2.3	87.7	Yes	Yes	Yes	Aquatic community, bird	Yes
Mercury	0.1	0.018	5.57	0	309.4	Yes	Yes	Yes	Aquatic community, bird	No
Perchlorate	na	na	0.000997	0.000774	na	na	Yes	Yes	Not identified (no ESL)	Yes
Silver	1	1	87.3	14.2	87.3	Yes	Yes	Yes	Aquatic community, bird	No
Thallium	0.73	0.044	1.06	0	24.1	Yes	Yes	Yes	Mammal	No
Zinc	60.2	37	1140	126	30.8	Yes	Yes	Yes	Aquatic community, bird, mammal	No
Acetone	na	0.065	0.207	0.0385	3.2	Yes	Yes	No	Aquatic community	No
Aroclor-1242	na	0.031	0.366	na	11.8	Yes	na	Yes	Aquatic community, bird	No
Aroclor-1254	na	0.031	2.3	0.184	74.2	Yes	Yes	Yes	Aquatic community, bird, mammal	No
Aroclor-1260	na	0.031	1.78	0.163	57.4	Yes	Yes	Yes	Aquatic community	No
Bis(2-ethylhexyl)phthalate	na	0.026	1.03	0.181	39.6	Yes	Yes	No	Bird	Yes
Indeno(1,2,3-cd)pyrene	na	0.078	0.449	0.429	5.8	Yes	Yes	No	Aquatic community	No

*na = Not available.

Table 2.3-12
Summary of Water COPECs with HQs Greater Than 3

Analyte	Water ESL (µg/L)	Sandia Max (µg/L)	Pajarito Max (µg/L)	Sandia HQ	Sandia HQ>3?	Sandia > Pajarito?	Proposed Sandia Study Design COPEC?	Receptors	Pajarito Study Design COPEC
Aroclor-1254	0.02	0.11	na*	5.5	Yes	na	Yes	Aquatic community	No
Lead	1.2	4.7	2.9	3.9	Yes	Yes	Yes	Aquatic community	No
Silver	0.36	1.5	0.69	4.2	Yes	Yes	Yes	Aquatic community	No
Zinc	66	390	31	5.9	Yes	Yes	Yes	Aquatic community	No

*na = Not available.

Table 4.1-1
Crosswalk of Terrestrial Measures and Assessment Endpoint Receptors

Measures	Assessment Endpoint Receptor Species				
	T&E Species (Mexican spotted owl)	**Avian Ground Invertevore Feeding Guild (robin, bluebird)**	**Mammalian Invertevore Feeding Guild (shrew, deer mouse)**	**Detritivores (earthworm)**	**Primary Producers (plants)**
COPEC Concentrations in Soil	Exposure	Exposure	Exposure	Exposure	Exposure
Small Mammal Field Survey	Effect: tissue concentrations Effect: food availability based on existing data	n/a*	Effect–relative abundance	n/a	n/a
Nest Box Field Survey	n/a*	Effect: nest success, eggshell thickness Exposure: egg and insect concentrations	n/a	n/a	n/a
Earthworm Bioaccumulation Test	Worm concentrations used to model concentration in shrews and mice for refined estimate of dose to Mexican spotted owl	Effect based on tissue concentration and TRV	Effect based on tissue concentration and TRV	Effect: mortality and growth Exposure	n/a
Seedling Germination Test	n/a	n/a	n/a	n/a	Effect: regeneration
ECORSK.9 Modeling	Effect: comparison to TRVs	n/a	n/a	n/a	n/a

*n/a = Not applicable.

Table 4.2-1
Crosswalk of Aquatic Measures and Assessment Endpoint Receptors

Measures	Assessment Endpoint Receptor Species	
	T&E Species (southwestern willow flycatcher)	Aquatic Community (macroinvertebrates)
COPEC Concentrations in Sediment and Water	Exposure Effects based on comparison to ESLs	Exposure Effects based on comparison to ESLs
Nest Box Field Survey	Effect: nest success, eggshell thickness Exposure: egg concentrations	n/a*
Rapid Bioassessment Protocol	n/a	Effect: abundance and diversity
Survival and Growth Using *Chironomus tentans*	n/a	Effect based on survival and growth
ECORSK.9 Modeling	Effect: comparison to TRVs	n/a

*n/a = Not applicable.

Table 5.1-1a
Proposed Sample Locations and Analytical Suites for Soil Samples and Toxicity Tests

Location ID	Reach	Depth (cm)	Cyanide	TAL[a] Metals (6010B)	Hexavalent Chromium	Perchlorate	PCBs (8082)	Pesticides (8081)	pH, Organic Matter, Particle Size	Toxicity Tests	
										Earthworm	Plant
SA-600113	S-2	0–30	X	X	X	X	X	X	X	X	X
SA-600115	S-2	0–30	X	X	X	X	X	X	X	X	X
SA-600115	S-2	0–30	X	X	X	X	X	X	X	X	X
Composite (new)[b]	S-2	0–30	X	X	X	X	X	X	X	X	X
SA-600368	S-3W	0–30	X	X	X	X	X	X	X	X	X
SA-600376	S-3W	0–30	X	X	X	X	X	X	X	X	X
SA-600782	S-4W	0–30	X	X	X	X	X	X	X	X	X
SA-600773	S-4W	0–30	X	X	X	X	X	X	X	X	X
SA-600830	S-5E	0–30	X	X	X	X	X	X	X	X	X
Composite over small mammal trapping array	S-2	0–15	X	X	X	X	X	X	X	—[c]	—
Composite over small mammal trapping array	S-4E	0–15	X	X	X	X	X	X	X	—	—
Composite over small mammal trapping array	S-5E	0–15	X	X	X	X	X	X	X	—	—
New	PA-0	0–30	X	X	X	X	X	X	X	X	X

[a] TAL = Target analyte list.
[b] Composite sample is a mixture of soil from SA-600113 and a new location in the active channel adjacent to SA-600113.
[c] — = No test proposed in reach.

Table 5.1-1b
Locations and Analytical Suites for Sediment Samples and Chironomid Toxicity Tests

Location ID	Reach	Depth (cm)	TAL[a] Metals (6010B)	Hexavalent Chromium	PCBs (8082)	Pesticides (8081)	Cyanide	Perchlorate	Particle Size, Organic Matter, pH	Chironomid Toxicity Tests
SA-600113	S-2	10–25	X	X	X	X	X	X	X	X
Composite (new)[b]	S-2	0–15 and 10–25	X	X	X	X	X	X	X	X
SA-600907	S-2	0–15	X	X	X	X	X	X	X	X
SA-600426	S-3E	0–15	X	X	X	X	X	X	X	X
SA-600374	S-3W	0–15	X	X	X	X	X	X	X	X
SA-600779	S-4W	0–15	X	X	X	X	X	X	X	X
SA-600821	S-5E	0–15	X	X	X	X	X	X	X	X
New	PA-0	0–15	X	X	X	X	X	X	X	X

[a] TAL = Target analyte list.

[b] Composite sample is a mixture of soil from SA-600113 (10–25-cm depth) and a new location in the active channel adjacent to SA-600113 (0–15-cm depth).

Table 5.1-1c
Proposed Locations and Analytical Suites for Water Samples and Chironomid Toxicity Tests

Location	Reach	TAL[a] Metals (6010B)	Hexavalent Chromium	PCBs (8082)	General Water Parameters	Rapid Bioassessment Protocol	Chironomid Toxicity Tests[b]
SA-00007	S-2	X	X	X	X	X	—[d]
E123	S-2	X	X	X	X	X	—
D123.8[c]	[c]	X	X	X	X	X	X
SA-600427	S-3E	X	X	X	X	X	—

[a] TAL = Target analyte list.

[b] Toxicity testing will be conducted in two sets—one using analytical laboratory water and the other using field-collected water from station E-123.8.

[c] D123.8 is a temporary gaging station between reaches S-3E and S-4W, which was formerly named E123.5.

[d] — = No test proposed in reach.

Table 5.1-2
Target Detection Limits for Soil

Suite for Soil	COPEC	Chemical Abstract Service (CAS) ID	Analytical Method	Target Minimum Quantitation Limit (mg/kg)
Anion	Perchlorate	14797-73-0	EPA Method 314.1	na*
Metal	Cadmium	7440-43-9	EPA Method 6010A	0.27
Metal	Chromium	7440-47-3	EPA Method 6010A	2.30
Metal	Hexavalent chromium	18540-29-9	EPA Method 7199	0.34
Metal	Copper	7440-50-8	EPA Method 6010A	10
Metal	Cyanide (total)	57-12-5	EPA Method 9010	0.10
Metal	Lead	7439-92-1	EPA Method 6010A	14
Metal	Mercury	7439-97-6	EPA Method 7471	0.013
Metal	Selenium	7782049-2	EPA Method 6010A	0.1
Metal	Zinc	7440-66-6	EPA Method 6010A	10
PCB	Aroclor-1242	53469-21-9	EPA Method 8082	0.0072
PCB	Aroclor-1254	11097-69-1	EPA Method 8082	0.041
PCB	Aroclor-1260	11096-82-5	EPA Method 8082	0.140
PEST	Dieldrin	60-57-1	EPA Method 8081	0.0045

*na = Not available because there is no soil ESL.

Table 5.1-3
Target Detection Limits in Sediment

Suite for Sediment	COPEC	Chemical Abstract Service (CAS) ID	Analytical Method	Target Minimum Quantitation Limit (mg/kg)
Anion	Perchlorate	14797-73-0	EPA Method 314.1	na*
Metal	Cadmium	7440-43-9	EPA Method 6010A	0.33
Metal	Chromium	7440-47-3	EPA Method 6010A	56
Metal	Hexavalent chromium	18540-29-9	EPA Method 7199	8
Metal	Copper	7440-50-8	EPA Method 6010A	17
Metal	Cyanide (total)	57-12-5	EPA Method 9010	0.1
Metal	Lead	7439-92-1	EPA Method 6010A	27
Metal	Mercury	7439-97-6	EPA Method 7471	0.018
Metal	Silver	7440-22-4	EPA Method 6010A	1
Metal	Thallium	7440-28-0	EPA Method 6010A	0.044
Metal	Zinc	7440-66-6	EPA Method 6010A	37
PCB	Aroclor-1242	53469-21-9	EPA Method 8082	0.031
PCB	Aroclor-1254	11097-69-1	EPA Method 8082	0.031
PCB	Aroclor-1260	11096-82-5	EPA Method 8082	0.031

*na = Not available because there is no soil ESL.

Table 5.1-4
Target Detection Limits in Water

Suite for Water	COPEC	Chemical Abstract Service (CAS) ID	Analytical Method	Target Minimum Quantitation Limit (µg/L)
Anion	Perchlorate	14797-73-0	EPA Method 314.1	35000
Metal	Cadmium	7440-43-9	EPA Method 6010A	0.15
Metal	Chromium	7440-47-3	EPA Method 6010A	77
Metal	Hexavalent chromium	18540-29-9	EPA Method 7199	11
Metal	Copper	7440-50-8	EPA Method 6010A	5
Metal	Cyanide (total)	57-12-5	EPA Method 9010	5.2
Metal	Lead	7439-92-1	EPA Method 6010A	1.2
Metal	Mercury	7439-97-6	EPA Method 7471	0.77
Metal	Silver	7440-22-4	EPA Method 6010A	0.36
Metal	Thallium	7440-28-0	EPA Method 6010A	18
Metal	Zinc	7440-66-6	EPA Method 6010A	66
PCB	Aroclor-1242	53469-21-9	EPA Method 8082	0.06
PCB	Aroclor-1254	11097-69-1	EPA Method 8082	0.02
PCB	Aroclor-1260	11096-82-5	EPA Method 8082	10

Table 5.2-1
Locations and Analytical Suites for Eggs

Reach	TAL* Metals (610B)	Perchlorate	PCBs (8082)	Pesticides (8081)
S-2	X	X	X	X
S-4E	X	X	X	X
S-5E	X	X	X	X

*TAL = Target analyte list.

Table 5.2-2
Target Detection Limits for Eggs and Small Mammals

Analytical Suite	COPEC	Chemical Abstract Service (CAS) ID	Analytical Method	Target Minimum Quantitation Limit (mg/kg)
Anion	Perchlorate	14797-73-0	EPA Method 314.1	na*
Metal	Cadmium	7440-43-9	EPA Method 6010A	4.73
Metal	Chromium	7440-47-3	EPA Method 6010A	248
Metal	Copper	7440-50-8	EPA Method 6010A	9.59
Metal	Lead	7439-92-1	EPA Method 6010A	5.25
Metal	Mercury	7439-97-6	EPA Method 7471	0.06
Metal	Selenium	7782049-2	EPA Method 6010A	1.42
Metal	Zinc	7440-66-6	EPA Method 6010A	121
PCB	Aroclor-1242	53469-21-9	EPA Method 8082	0.22
PCB	Aroclor-1254	11097-69-1	EPA Method 8082	0.22
PCB	Aroclor-1260	11096-82-5	EPA Method 8082	6.92
PEST	Dieldrin	60-57-1	EPA Method 8081	0.109

*na = Not available because there are no avian or mammalian toxicity reference values.

Table 5.2-3
Prioritization of Analytical Suites for Biota Samples

Biota Sample	TAL[a] Metal	PCBs	Pesticides	Perchlorate
Earthworms	1	2	3	4
Eggs	1	2	3	NA[b]
Small mammals	1	2	3	NA

[a] TAL = Target analyte list.

[b] NA = Not analyzed for this suite.

Table 5.3-1
Locations and Analytical Suites for Small Mammals

Reach	TAL* Metals (6010B)	Perchlorate	PCBs (8082)	Pesticides (8081)
S-2	X	X	X	X
S-4E	X	X	X	X
S-5E	X	X	X	X

Notes: Samples will be composited by species. The number of samples submitted for analysis will be dependent upon the number of species captured.

*TAL = Target analyte list.

Table 5.4-1
Analytical Suites for Earthworm Bioaccumulation Testing

Media	TAL* Metals (6010B)	Perchlorate	PCBs (8082)	Pesticides (8081)
Earthworm from toxicity test; see Table 5.1-1a for list of locations.	X	X	X	X

*TAL = Target analyte list.

Table 5.4-2
Target Detection Limits for Earthworm Analysis

Analytical Suite	COPEC	Chemical Abstract Service (CAS) ID	Analytical Method	Target Minimum Quantitation Limit (mg/kg)
Anion	Perchlorate	14797-73-0	EPA Method 314.1	na[a]
Metal	Cadmium	7440-43-9	EPA Method 6010A	0.97
Metal	Chromium	7440-47-3	EPA Method 6010A	50.7
Metal	Hexavalent chromium	18540-29-9	EPA Method 7199	—[b]
Metal	Copper	7440-50-8	EPA Method 6010A	1.96
Metal	Cyanide (total)	57-12-5	EPA Method 9010	—
Metal	Lead	7439-92-1	EPA Method 6010A	1.07
Metal	Mercury	7439-97-6	EPA Method 7471	0.013
Metal	Selenium	7782049-2	EPA Method 6010A	0.29
Metal	Zinc	7440-66-6	EPA Method 6010A	24.8
PCB	Aroclor-1242	53469-21-9	EPA Method 8082	0.066
PCB	Aroclor-1254	11097-69-1	EPA Method 8082	0.066
PCB	Aroclor-1260	11096-82-5	EPA Method 8082	1.41
PEST	Dieldrin	60-57-1	EPA Method 8081	0.0245

[a] na = Not available because there are no avian or mammalian TRVs.

[b] — = No analyses are planned for this COPEC in tissues.

Attachment 1

Sample Locations and Analytical Results
(on CD included with this document)